Total Maximum Daily Loads for Nutrients
San Diego Creek and Newport Bay, California

U.S. Environmental Protection Agency
Region 9

Approved:

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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 impaired waters and establish Total Maximum Daily Loads (TMDLs) for such waters. As part of the 1996 303(d) list submittal, the State identified the Newport Bay watershed (including San Diego Creek) as a high priority for TMDL development and began work on the TMDL in 1996.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in U.S. Environmental Protection Agency guidance (U.S. 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. A TMDL is also required to be developed with seasonal variations and 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 to be used to directly implement the plan elements, including TMDLs.

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

The Newport Bay/San Diego Creek TMDLs in this document incorporate elements which address the statutory and regulatory requirements for a TMDL along with documentation of the basis for the TMDL.

On October 31, 1997, the United States Environmental Protection Agency, Region 9 (EPA) entered into a consent decree (decree), Defend the Bay, Inc. v. Marcus, (N.D. Cal. No. C-97-3997 MMC), which established a schedule for development of TMDLs in San Diego Creek and Newport Bay. The decree required development of nutrient and sediment TMDLs by January 15, 1998. The decree stipulated that the EPA would establish the required TMDLs within ninety (90) days, if the State failed to establish an approved TMDL by the deadline.

The Santa Ana Regional Water Quality Control Board (Regional Board) considered taking action on the staff proposed nutrient TMDLs at a January 23, 1998 hearing. The Regional Board continued the hearing and considered additional testimony on March 6, 1998. It will consider adoption of the TMDLs at the April 17, 1998 Regional Board meeting. Should the Regional Board adopt the draft nutrient TMDLs, which would be in the form of a Basin Plan Amendment, the State Water Resources Control Board and the State's Office of Administrative

Law would have to approve the Basin Plan Amendment prior to submittal of the nutrient TMDLs to EPA. The additional approvals would take from four to nine months. The EPA has, therefore, acted to establish the nutrient TMDLs for Newport Bay and San Diego Creek described below (Section 2).

The State is required to incorporate the TMDLs into the State Water Quality Management Plan (40 CFR 130.6(c)(1), 130.7). The Regional Board Basin Plan, and applicable state-wide plans, serve as the State Water Quality Management Plan governing the Newport Bay watershed. If the State subsequently adopts and submits for EPA approval a TMDL (or TMDLs) which is(are) different from the TMDL(s) established by EPA, EPA will review the submittal to determine if it meets all TMDL requirements. If EPA approves the State TMDL(s), EPA expects the State-established TMDL(s) would be applicable for the Newport Bay watershed.

The Regional Board is considering the adoption of an implementation, monitoring, and review plan for the Newport Bay/San Diego Creek nutrient TMDLs (California Regional Water Quality Control Board, Santa Ana Region, 1998a, 1998c). EPA endorses the approach that the Regional Board is considering to control nutrient sources in the Newport Bay watershed. The proposed development of a Regional Monitoring Program and a specific schedule for review of the nutrient TMDLs is consistent with guidance on “phased” TMDLs (US EPA, 1991) and should provide the necessary information to refine, as necessary, the TMDLs and allocations. When the State completes its administrative approval process and forwards the implementation plan to EPA, EPA will review the implementation plan being considered by the Regional Board.

Section 2. EPA Established Nutrient TMDLs for the Newport Bay Watershed

Table 1. Total Nitrogen (TN) TMDL for Newport Bay (expressed as allowable discharge to Newport Bay)

		Annual (lbs TN)	October 1-March 31 (lbs TN) Non-Storm Discharges[1]	April 1-September 30 (lbs TN)
TMDL (loading capacity)		**298,225**	**144,364**	**153,861**
Waste Load Allocation				
	Urban Runoff	72,070	55,442	16,628
	Other NPDES Discharges	39,311	13,640	25,671
Total WLA		**111,381**	**69,082**	**42,299**
Load Allocation				
	Nurseries[2]	85,646	23,060	62,586
	Agricultural Discharges	49,764	38,283	11,481
	Undefined Sources	51,434	13,939	37,495
Total LA		**186,844**	**75,282**	**111,562**

[1] The load limits do not apply on days on which the mean daily flow rate in San Diego Creek at Campus Drive exceeds 50 cubic feet per second (cfs) as a result of precipitation events.

[2] Includes nurseries currently regulated by the Regional Board and nurseries currently not regulated by the Regional Board.

Table 2. Total Nitrogen (TN) TMDL for San Diego Creek, Reach 2 during non-storm conditions[3] (expressed as allowable discharge to San Diego Creek, Reach 2)

TMDL	14 lbs/day (TN)
Waste Load Allocation (NPDES Discharge - urban runoff)	5.5 lbs/day (TN)
Load Allocation (Nurseries, Agriculture, Open Space)	8.5 lbs/day (TN)

Table 3. Total Phosphorous (TP) TMDL for Newport Bay (expressed as allowable discharge to Newport Bay)

		Annual (lbs TP)
TMDL (loading capacity)		**62,080**
Waste Load Allocation		
	Urban Areas	2,960
	Construction Sites	12,810
Total WLA		**15,770**
Load Allocation		
	Agricultural	18,720
	Open Space	27,590
Total LA		**46,310**

[3] The load limits do not apply on days on which the mean daily flow rate in San Diego Creek at Culver Drive exceeds 25 cubic feet per second (cfs) as a result of precipitation events.

Section 3. Supporting Documentation

Section 3.1 Problem Statement

An assessment of the water quality problems is necessary to clearly identify the water quality standards being violated or threatened and to identify the pollutant(s) for which the TMDL is being developed. The description below is taken largely from the document written by the California Regional Water Quality Control Board, Santa Ana Region; *Staff Report on the Nutrient Total Maximum Daily Load for Newport Bay/ San Diego Creek, August 29, 1997*. Additional descriptions of actual or potential beneficial use impacts, along with observed water quality problems in San Diego Creek, are also presented.

Section 3.1.1. The Newport Bay Watershed

The Newport Bay watershed is located in central Orange County, California. 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 number of smaller tributaries which drain to the Lower Newport Bay.

The watershed has gradually been developed from the rural agricultural system of the early 1900's to the largely urban development of today. In 1983, agriculture accounted for 22% and urban uses for 48% of the area of the Newport Bay watershed. In 1993, agricultural uses accounted for 12% and urban uses 64% of the area. Agricultural activities in the watershed include row crops (primarily strawberries), avocados, lemons, and commercial nurseries. The commercial nurseries drain to Peters Canyon Wash via the Central Irvine Channel and San Diego Creek via Marshburn Channel and Serrano Creek.

Section 3.1.2 Beneficial Uses and Water Quality Objectives

The beneficial uses of San Diego Creek and Newport Bay as identified in the 1995 Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) are listed in Table 4. The Basin Plan also contains two applicable narrative water quality objectives for enclosed bays and estuaries that relate to nutrient impairment in Newport Bay:

<u>Algae</u>
"Waste discharges shall not contribute to excessive algal growth in receiving

waters."

and

Dissolved Oxygen
"The dissolved oxygen content of enclosed bays and estuaries shall not be depressed to levels that adversely affect beneficial uses as a result of controllable water quality factors."

Narrative water quality objectives for inland surface waters that apply to San Diego Creek and its tributaries and relate to nutrient impairment are:

Algae
"Waste discharges shall not contribute to excessive algal growth in inland surface receiving waters."

and

Dissolved Oxygen
"The dissolved oxygen content of surface waters shall not be depressed below 5 mg/L for waters designated **WARM**, or 6 mg/L for waters designated **COLD**, as a result of controllable water quality factors. In addition, waste discharges shall not cause the median dissolved oxygen concentration to fall below 85% of saturation or the 95th percentile concentration to fall below 75% of saturation within a 30-day period."

Table 4. Beneficial Uses of San Diego Creek and Newport Bay.[a]

	GWR	NAV	REC1	REC2	COMM	WARM	BIOL	WILD	RARE	SPWN	MAR	SHELL	EST
San Diego Creek, Reach 1[b]			X	X		X		X					
San Diego Creek, Reach 2	|		|	|		|		|					
Tributaries to San Diego Creek [C]	|		|	|		|		|					
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	

[a] X denotes a present or potential beneficial use, | denotes an intermittent beneficial use.
[b] Reach 1 is from Jeffrey Road to Newport Bay, Reach 2 is from Jeffrey Road to the headwaters.
[C] Sand Canyon has a **RARE** beneficial use.

Beneficial Uses:

Groundwater Recharge (**GWR**)
Navigation (**NAV**)
Water Contact Recreation (**REC1**)
Non-contact Water Recreation (**REC2**)
Commercial and Sportfishing (**COMM**)
Warm Freshwater Habitat (**WARM**)
Preservation of Biological Habitats of Special Significance (**BIOL**)
Wildlife Habitat (**WILD**)
Rare, Threatened or Endangered Species (**RARE**)
Spawning, Reproduction, and Development (**SPWN**)
Marine Habitat (**MAR**)
Shellfish Harvesting (**SHEL**)
Estuarine Habitat (**EST**)

The nutrients which are responsible for algae growth include nitrogen and phosphorus (Blodgett, 1989; Fong, 1998; Horne, 1998a). The Basin Plan contains numeric water quality objectives for San Diego Creek. Reach 1 (Jeffrey Road to Newport Bay) has a 13 mg/L total inorganic nitrogen (TIN)[4] objective, and Reach 2 (Jeffrey Road to the headwaters) has a 5 mg/L TIN objective[5]. There are no numeric objectives for phosphorus for San Diego Creek.

Section 3.1.3. History of Nutrient Problems

Newport Bay

The description below is taken from the California Regional Water Quality Control Board, Santa Ana Region; *Staff Report on the Nutrient Total Maximum Daily Load for Newport Bay/ San Diego Creek, August 29, 1997.* The Regional Board conducted a thorough review of existing information on nutrient problems in Newport Bay and their summary of that review is described below.

Newport Bay has exhibited signs of nutrient enrichment for over 25 years. This enrichment and the resulting algae growth is the reason that Newport Bay is listed as water quality limited for nutrients pursuant to Section 303(d) of the Clean Water Act.

The cycling of nutrients between land, the water column, groundwater, the atmosphere, and sediments is a complex process. The different forms of nitrogen, ammonia, nitrate, nitrite, and organic nitrogen, are constantly changing and converting in the estuarine environment. Phosphorus undergoes a less complex cycle. Particulate phosphorus is typically bound with sediment that is transported into the estuarine environment by erosion. The particulate material then settles into the sediments or is dissolved into organic or inorganic components.

The inorganic forms of nitrogen, nitrate, nitrite, and especially ammonia, are the preferred 'food' for marine plants, including phytoplankton and green algae. When these nutrients are present with the right amount of light, inorganic carbon, phosphorus, and silica, photosynthesis and growth can occur. Usually, the concentration of one or more of these substances is present at less than an optimal level, and are thereby a limiting factor in the rate of algae growth.

Large mats of the green algae *Ulva*, *Enteromorpha,* and *Cladophora* (e.g. macrophytes or

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[4] TIN is sum of nitrate, nitrite, and ammonia forms of nitrogen.

[5] The 5 mg/L objective was originally proposed for both reaches of San Diego Creek during the development of the 1983 Basin Plan. However, the 5 mg/L objective for Reach 1 was not adopted because of economic reasons. The Regional Board directed staff to reexamine the objective. Staff then averaged the low-flow concentrations from the Orange County monitoring station for San Diego Creek at Campus Drive to derive the 13 mg/L TIN objective (California Regional Water Quality Control Board, Santa Ana Region. 1997a)

seaweeds) have been commonplace in Newport Bay, with a peak bloom occurring in 1985-86. These seaweeds, also known as macrophytes due to their large size, grow in sandy, intertidal mudflats and shallow subtidal areas. The macrophytes attach to the substrate and float in the water column due to internal oxygen storage. When their length exceeds the height of the water column, the macrophytes will form mats on the water surface. These mats can completely fill the water column, shading out other plants and creating a monoculture that does not support the habitat beneficial uses of Newport Bay. The mats can also become detached from the substrate and float around the estuary, usually being deposited on sandy beaches or entangled in boat propellers. This also impairs the recreational beneficial uses of Newport Bay.

The Santa Ana Watershed Planning Agency (now the Santa Ana Watershed Project Authority or SAWPA) retained Water Resource Engineers, Inc., to prepare a water quality management plan for Newport Bay as part of the 1975 Basin Planning Process (Water Resource Engineers, 1973). The project report specifically reports on the high levels of nitrates in both San Diego Creek and Santa-Ana Delhi Channel and generally describes algal blooms and mats occurring in the Upper Bay.

Dixon and Marsh (1973) noted that considerable algal growth was increasingly detected around storm drains and channels in the Upper Bay. Orange County Human Services Agency (1978) reported that nuisance mats of *Ulva* and *Enteromorpha* formed in the Upper Bay between May and October.

MBC and SCCWRP (1980) used both *Ulva* and *Enteromorpha* as primary producers in their food web biomagnification study of the Irvine Ranch Water District's (IRWD) Stream Augmentation project. The algae was used as food by other higher level consumers in the food web (i.e. crabs, topsmelt, mullet). The study examined the environmental effects of the discharge of reclaimed water from Sand Canyon Reservoir into San Diego Creek during the wet season. Algae samples were collected along Back Bay Drive north of Shellmaker Island. Both species are described as forming extensive algal mats in shallow intertidal areas of the Bay. Blodgett (1989) cursorily describes the seasonal algal blooms that peaked in severity in 1985.

During the period between 1980 and 1996, no studies were conducted on the extent of macrophytes in Newport Bay. The shift in algal species in the Bay during this time is only anecdotally known. Dr. Jack Skinner, of Newport Beach, has closely observed the conditions of the Bay for many years. He observed a decrease in the abundance of phytoplankton starting in 1983 through 1985. This improvement in water clarity was easily seen by visual observation (Dr. Jack Skinner, personal communications). In 1985, the decline in phytoplankton was replaced by a bloom of green algae, primarily *Enteromorpha*, that grew around the sandy beaches of Lido Island, the Balboa Peninsula, Newport Island, Balboa Coves, and the North side of Balboa Island. This bloom caused a considerable aesthetic nuisance and interfered with boating and recreation activities. The bloom persisted through the winter of 1985 into the summer of 1986. In May of 1986, there was a fish kill in the Newport Island area due to anoxic conditions (dissolved oxygen at 0 mg/L) that was attributed to the decomposing algae. It is unknown how far the bloom extended into the Upper Bay.

Several things were occurring in the bay and watershed at that time that probably contributed to this extensive bloom. The annual nitrate loading to the Bay from the San Diego Creek watershed reached a peak of 7 million pounds (1.6 million pounds as nitrate-nitrogen) during the 1985-86 season (Blodgett, 1989). In 1985 there was also a large scale dredging project (898,000 cubic yards) to build the Unit I Sedimentation Basin just below Jamboree Road that probably released a large flux of sediment nutrients back into the water column. These two factors probably provided the largest load of nutrients to Newport Bay in the past thirty years.

Following the bloom of 1985-86 and implementation of nutrient control activities, the extent of algal blooms in the Lower Bay steadily decreased. During this period, 1986-1990, there was a shift in the distribution of green algae from the Lower Bay to the Upper Bay. During the 1990's, the green algae distribution has been limited mainly to the Upper Bay, with blooms sometimes occurring through the winter months. Photographs from the late fall of 1994 provide some indication of the persistence of these algal blooms (Natural Heritage Institute, 1998). Currently, the distribution of macrophytes is concentrated in the Upper Bay above the Pacific Coast Highway bridge (Alex Horne Associates, 1997). The highest biomass during 1996 was found from Shellmaker Island to the Narrows.

The Total Inorganic Nitrogen (TIN) concentrations have steadily decreased at the Upper Newport Bay monitoring station (UNBSDC) since the start of systematic sampling in the winter of 1976. Values have ranged from a high of 19.75 mg/L TIN in the summer of 1985 to a low of 0.1 mg/L TIN in the summer of 1997. The decrease in the variability of concentrations is evident following the implementation of nursery controls in 1990. The concentrations observed in 1996-1997 are still in the lower eutrophic range of between 2.5 to 5 mg/L.

The Lower Newport Bay monitoring station (LNBHIR) is located just north of Bay Island in the Lower Bay. The TIN concentrations have ranged from a high of 6.2 mg/L TIN in the winter of 1986 to a low of 0.2 mg/L that was observed during 1997. The Lower Bay is generally not exhibiting the extensive signs of nutrient enrichment it did during the 1985-86 season.

Since July 1996, the Irvine Ranch Water District (IRWD) has conducted a comprehensive monitoring program for water column physical parameters and nutrients, algal biomass, fish populations, and vegetation change in Upper Newport Bay as required by the NPDES permit for the Wetlands Water Supply Project (WWSP).

EPA has reviewed recent information from these studies (Alex Horne Associates, 1998a) which indicate dissolved oxygen (DO) levels in Upper Newport Bay are periodically depressed to levels that could impact beneficial uses (< 3 mg/L). The DO sags correspond to a period of time when there is a combination of low tide (a small pool of DO) , algal respiration (nighttime), and proximity of areas of high algal biomass.

San Diego Creek

Nitrogen data for San Diego Creek (SDC) is extensive for the nurseries and three in-stream monitoring stations (SDC @ Culver, SDC @ Campus, and Peters Canyon Wash @ Barranca), but is limited for other areas in the watershed (California Regional Water Quality Control Board, Santa Ana Region, 1998b). Since nitrate control has been the focus of past nutrient control efforts, less phosphorous data is available for the watershed. The discussion below is based on the data provided by the Regional Board.

In a survey conducted by the Regional Board in April, 1997 (California Regional Water Quality Control Board, Santa Ana Region, 1997b), Peters Canyon Wash and its tributaries had generally high concentrations of TIN (> 13 mg/L Nitrate-Nitrogen). San Diego Creek, Reach 2 and its tributaries had generally low concentrations of TIN (< 5 mg/L), except for the Marshburn Channel. Other tributaries to Newport Bay, as well as Bonita Creek (which enters San Diego Creek below the Campus monitoring station), had TIN concentrations below 5 mg/L.

The historical record for San Diego Creek, Reach 1, indicates consistently elevated concentrations of TIN, especially during non-storm events. TIN data were evaluated for 1990-1997 (after waste discharge requirements on the nurseries were in place) and average and median concentrations were calculated for the wet season and dry season (Table 5). As can be seen from the table, the mean concentration by season is relatively consistent, with higher variation during the wet season (October-March) than in the dry season (April-September). A plot of the TIN concentration versus flow for all seasons (Figure 1) shows that the observed values greater than 13 mg/L TIN generally occur at flow rates below 50 cfs (i.e. non-storm flows). The few samples that showed TIN concentrations above 13 mg/L during storm flows (i.e. above 50 cfs) could be related to the time at which the sample was taken. If the sample was taken prior to the rise in flow rate associated with the storm event, than the sample may actually have been more representative of base flow conditions.

Table 5. San Diego Creek at Campus. Summary Data for 1990-1997

	October-March	April-September
Average	14.1 mg/L TIN	14.8 mg/L TIN
Standard Deviation	6.1	3.8
Median	16.0 mg/L TIN	14.0 mg/L TIN
# Samples	105	71

The data set for San Diego Creek, Reach 2 is very limited. The San Diego Creek at Culver station, which has a fair data set, is likely to be representative of conditions just upstream at Jeffrey Road. There are no major inputs between Jeffrey and Culver (Scott Dawson, personal communication). In general, there is more variability in TIN concentration between seasons and within seasons for San Diego Creek, Reach 2 than in Reach 1. Where both flow and TIN data are available, the 5 mg/L TIN is generally met when flow rates are above 25 cfs, but often exceeded when flow rates fall below 25 cfs (Figure 2).

Table 6. San Diego Creek at Culver. Summary Data for 1990-1997.

	October-March	April-September
Average	9.5 mg/L TIN	15.4 mg/L TIN
Standard Deviation	7.9	6.5
Median	7.3 mg/L TIN	15.1 mg/L TIN
# Samples	76	37

In contrast to Newport Bay, no data exists to relate the presence of attached algae to beneficial use impacts in San Diego Creek (Scott Dawson, Regional Board, personal communication). Additionally, the Regional Board has not established a water quality objective for phosphorous in San Diego Creek.

Section 3.2. Numeric Targets

<u>Newport Bay</u>

Section 303(d)(1)(C) states that TMDLs "shall be established at a level necessary to implement the applicable water quality standards...." Numeric targets help to interpret the narrative water quality standards for Newport Bay and establish the linkage between attainment of the standards and the TMDL.

EPA's nutrient TMDLs for Newport Bay, which are identical to the current proposed Regional Board TMDLs, are based on trying to reduce nutrient loading to approximately the same level as was observed in the early 1970's. The nutrient TMDL for Newport Bay will reduce non-storm discharge of total nitrogen to 298,225 lbs. Historical data from 1973-74 (Blodgett, 1989) indicates that total nitrate loading from San Diego Creek during low flow conditions was approximately 383,000 lbs (total nitrogen would be about 12% higher or approximately 428,000 lbs). Qualitative observations indicate that there was limited presence of macrophytes at that time and, therefore, presumably limited impact due to nutrient enrichment (California Regional

Water Quality Control Board, Santa Ana Region, 1998b). During the mid-1980's when nitrate loading peaked, macrophytes were ubiquitous in Newport Bay and affected navigation and recreation. Currently macrophytes are absent in lower Newport Bay (Alex Horne Associates, 1998b) and the navigation and recreation uses in the lower Bay are no longer impacted. So one indicator of nutrient enrichment and non-attainment of narrative water quality standards is excessive presence of macrophytes. Stated another way, the absence of large mats of macrophytes may indicate attainment of the narrative water quality standard.

In his recent reports, Alex Horne suggests a number of indicators that could be used to relate presence of macrophytes to beneficial use impacts (Alex Horne Associates, 1998a). Horne has suggested that aquatic life beneficial uses are likely impacted when dissolved oxygen levels are depressed below 3 mg/L. These DO depressions are associated with high biomass density (i.e. macrophyte density) in Newport Bay. Monitoring stations that are in close proximity to algal biomass densities between 2.2 - 2.5 kg/m2 show periodic DO depression. Monitoring stations that are in close proximity to a lower algal biomass density (1.5 kg/m2) do not show the same DO depression. These observations suggest two indicators: 1) algal biomass density should be 1.5 kg/m2 or less; and 2) dissolved oxygen levels should always exceed 3.0 mg/L in order to protect aquatic life beneficial uses in Newport Bay. There currently is some disagreement as to whether there is a clear relationship established between algal density and DO depression (Fong, 1998).

The primary target is to reduce nutrient loading to levels below those observed prior to widespread presence of macrophytes (as is also proposed with in the Regional Board nutrient TMDL). The targets suggested by Horne should be refined and used to establish the relationship between nutrient inputs, macrophyte growth, and dissolved oxygen levels.

San Diego Creek

In contrast to Newport Bay, numeric water quality standards do exist for San Diego Creek. Water quality standards for total inorganic nitrogen (TIN) have been established for San Diego Creek, Reach 1 and Reach 2, respectively. Additionally the Regional Board has adopted a numeric DO standard for inland surface waters. These standards are also indicators of stream health.

A narrative standard for nuisance algae also applies to San Diego Creek. Although there is a great deal of attached algae present in San Diego Creek, little data is available to relate the presence of that algae with beneficial use impacts. No indicator has been suggested by the Regional Board or others to suggest an appropriate level of attached algae in San Diego Creek. Since no relationship between attached algae and beneficial use impacts has been established, a violation of the narrative standard has not been established, and a TMDL for the San Diego Creek narrative standard for nuisance algae is not required at this time.

Section 3.3. Source Analysis

The purpose of the source analysis is to demonstrate that all pollutant sources have been considered, and significant sources estimated, in order to help determine the degree of pollutant reductions needed to meet numeric targets and allocation of pollutant allowances among sources. 40 CFR 130.2 defines a TMDL as the sum of individual wasteload allocations, load allocations and natural background. In order to develop individual allocations, existing and potential sources must be first be characterized. The description of sources is taken largely from the document from the California Regional Water Quality Control Board, Santa Ana Region, *Staff Report on the Nutrient Total Maximum Daily Load for Newport Bay/ San Diego Creek, August 29, 1997*. The discussion of loading from various sources is based on the Tetra Tech loading assessment (Tetra Tech, 1998a).

Total Nitrogen

Several studies have been undertaken both independently and cooperatively by the Regional Board and Orange County to investigate the sources of nutrients in the Newport Bay watershed (Orange County Environmental Management Agency 1980, 1986, 1994, Smythe 1990). The studies determined that approximately 80% of the nitrate-nitrogen loading to Newport Bay was from the Peters Canyon Wash. Peters Canyon Wash is the main tributary to San Diego. Regional Board investigations during April 1997 found that nitrogen loading from Peters Canyon Wash accounted for 60% of the load to Newport Bay (California Regional Water Quality Control Board, Santa Ana Region, 1997b). The three large commercial nurseries and other agricultural sources located in the Peters Canyon Wash watershed were identified as the major sources of nutrients entering Newport Bay.

The sources of nutrients in the watershed and Bay are known although the magnitude of some of their individual contributions is less certain. A number of sources have waste discharge requirements that include specific effluent limits for nitrogen compounds. The countywide urban stormwater permit does not have any specific numeric criteria or effluent limits for nutrients. Other potential and existing point sources include the proposed discharge of dewatered groundwater by Silverado Constructors from the Eastern Transportation Corridor project to Peters Canyon Wash and the numerous small nurseries that are not currently under permit for any discharge to surface waters.

The nonpoint sources (NPS) in the watershed are mainly agricultural operations. These include avocados and lemons grown in the foothills and a wide variety of row crops grown in Irvine and Tustin. Open space areas also contribute a nutrient load, especially during storm events, as does direct atmospheric deposition to Newport Bay .

Other NPS of nutrients and their contribution to the nutrients in Newport Bay are largely unknown. Smaller nurseries which are currently unregulated likely contribute to the nutrient loading. Shallow rising groundwater contributes to the base flows in storm channels and may exchange with saltwater in Newport Bay. These relationships need further monitoring to determine if there is a net loading of nutrients from these sources. Another unknown is the amount of nutrients that are stored in plant biomass and Bay sediments which can be resuspended into the water column.

Tetra Tech performed an analysis of annual total nitrogen loading from various discharge sectors and land uses in the San Diego Creek watershed (Tetra Tech, 1998a). Unit loading rates from various land uses were derived from literature values. Tetra Tech found that the largest variation in unit loading was from agricultural sources. Based on this finding, two loading assessment scenarios were performed. Unit loadings from urban sources were set based on the average of the literature values and the maximum values. Unit loading of agricultural sources was varied so that the total loading based on the assessment would equal the observed loading based on the last eight years of monitoring data. Therefore, when higher unit loading values are used for the urban sources, the estimated unit loading from the agricultural sources goes down.

In the Tetra Tech analysis, the nurseries are considered point sources, since the nurseries operate under waste discharge requirements. The San Diego Creek at Campus watershed is considered to include all land that drains to San Diego Creek at Campus minus the land area draining into San Diego Creek at Culver and Peters Canyon at Barranca. The results of that analysis are given below.

Table 7. Nitrogen Loading in pounds in the SDC Watershed using Average & (Maximum) Literature Values* (from Tables 7 & 8, Tetra Tech, 1998a)

Land Use/Source	**Peters Canyon**	**SDC at Culver**	**SDC at Campus**	**Total Loads**	**Percent of Total Load**
Residential	55,451 (76,687)	17,432 (24,108)	15,294 (21,151)	88,177 (121,947)	9.6 (13.3)
Parks and Recreation	2,412 (4,108)	1,561 (2,659)	2,072 (3,528)	6,045 (10,294)	0.7 (1.1)
Other Urban	46,154 (83,613)	74,513 (134,988)	42,090 (76,250)	162,757 (294,850)	17.7 (32.1)
Total Urban	104,017 (164,408)	93,506 (161,755)	59,456 (100,929)	256,979 (427,090)	28.0 (46.5)
Cropland and Improved Pasture	62,050 (41,201)	114,850 (76,260)	29,750 (19,754)	206,650 (137,216)	22.5 (14.9)
Orchards and Vineyards	191,250 (126,990)	108,100 (71,778)	N/A	299,350 (198,768)	32.6 (21.6)
Total Agriculture	253,300 (168,191)	222,950 (148,038)	29,750 (19,754)	506,000 (335,984)	55.1 (36.5)
Open Space	3,782	5,275	1,851	10,907	1.2
Point Sources	114,610	30,660	N/A	145,270	15.8
Total	475,709 (450,990)	352,391 (345,728)	91,057 (122,534)	919,156 (919,253)	100
8-Year Average**	557,265	217,122	145,107	919,494	

* Total Loading from "Other Agriculture" land use classification is considered negligible. Nurseries are considered point sources only.

** Regional Board loading estimate

As described in the Tetra Tech report, the primary objective of the loading assessment was to determine the relative magnitude of nitrogen sources. The Regional Board used the Tetra Tech analysis as a baseline for determining appropriate allocations for urban and agricultural sources (Scott Dawson, personal communication, 1998).

The Tetra Tech report provides the best available estimate of nitrogen sources. Direct atmospheric deposition to Newport Bay will be minor compared to deposition throughout the whole watershed (deposition in other parts of the watershed would already be “counted” under the land use categories described above). In-bay sources are currently not quantified, but would likely be reduced over time if overall nutrient loading to the Bay is reduced. Shallow groundwater may well contribute a significant (although currently undefined) nutrient load. No estimate of shallow groundwater nitrogen contribution is currently available.

Total Phosphorous

The Regional Board also evaluated current sources of total phosphorous (California Regional Water Quality Control Board, Santa Ana Region, 1997a; 1997b). The overwhelming majority of the total phosphorous load in the San Diego Creek watershed comes from Peters Canyon Wash (62%) and San Diego Creek above Culver Drive (27%). Additionally, most of the loading observed in San Diego Creek at Campus Drive occurs during storm events (approximately 90%). A comparison of San Diego Creek total phosphorous loading to other tributaries to Newport Bay, also shows that San Diego Creek contributes the vast majority (80%) of total phosphorous load to Newport Bay (California Regional Water Quality Control Board, Santa Ana Region, 1997a). The Regional Board estimated that 124,160 lbs of total phosphorous is delivered to Newport Bay annually. A plot of total suspended solids versus total phosphorous (Figure 3) indicates that increases in particulate levels and total phosphorous levels are closely related (i.e. phosphorous and sediment delivery to Newport Bay are linked).

Section 3.4. Loading Capacity and Allocation of Loads

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the Clean Water Act, as well as in various guidance documents. A TMDL is defined as the sum of the individual waste load allocations for point sources, load allocations for nonpoint sources and natural background pollutants. 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 explained. In addition, 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.”

Newport Bay - Loading Capacity

The total phosphorous TMDL (Table 3) is based on a 50% reduction in current phosphorous loading to Newport Bay. The total nitrogen TMDL (Tables 1) is based on a 50% reduction in current "low-flow" loading of total nitrogen to Newport Bay. This reduction should result in total nitrogen "low-flow" loading rates less than those observed in 1973, when algae growth was less prevalent in the Upper Newport Bay (see discussion in Section 3.2.). A significant increase (two to three times) in nitrate loading was observed from the mid-1970's to late 1970's (Blodgett, 1989). This increase corresponded to reports of extensive mats of macropyhtes in Newport Bay. The concurrence of increased nitrogen loading and increased presence of macrophytes in the late 1970's would indicate that the loading capacity of Newport Bay was exceeded at that time. A reduction to loading levels observed prior to the increase should result in decreased presence of macrophytes to a level that results in attainment of the narrative water quality objective.

Phosphorous is essential to plant growth. Currently, there is no consensus as to whether nitrogen or phosphorous is limiting (also see discussion in Section 3.1.3.) in Newport Bay (Fong, 1998; Alex Horne Associates, 1998a); therefore, it is important to limit phosphorous as well as nitrogen loading to Newport Bay. Since phosphorous is generally associated with clay and silt sediment particles, control of erosion and sedimentation will also control phosphorous loading.

Sedimentation in Newport Bay increased significantly in the mid-1960's when the channels in the San Diego Creek watershed were modified (U.S. Army Corps of Engineers, 1993). In 1982, Boyle Engineering (Boyle Engineering Corp., 1982) estimated that the annual amount of sediment delivered to upper Newport Bay was 86,000 tons per year and that under ultimate conditions (i.e. land use conversion from agricultural and open space to urban) the sediment delivery would decrease to 65,000 tons per year. Boyle also predicted a change in particle size distribution in sediment delivered to Newport Bay from sediment dominated by clay and silt (82%) to a distribution with less clay and silt (62%). Trimble (Trimble, 1993) calculated a sediment budget for San Diego Creek and Upper Newport Bay based on 1986-1993 data, but included estimates for sediment delivery from channel erosion. Trimble estimated that approximately 115,000 tons of sediment were delivered to Newport Bay. The Regional Board has amended its Basin Plan to require a 50% reduction in sediment loading to Newport Bay (California Regional Water Quality Control Board, 1997c). The EPA is currently proposing a sediment TMDL for Newport Bay and San Diego Creek that mirrors the Regional Board plan, with adjustments for current land use (US EPA, 1998a).

Based on the anticipated shift in particle size distribution and the Regional Board's proposed reduction in overall sediment loading, it is likely that implementation of sediment controls will also reduce phosphorous loading to upper Newport Bay by at least 50%, since phosphorous is generally bound to sediment (also see Figure 3). Although many of the sedimentation controls (upland and in-channel sedimentation basins) will likely capture larger size particles, conversion of land use from agriculture and open space to urban will tend to reduce erosion of smaller size particles. Additionally erosion controls for construction activities are required and the Regional Board may also encourage the implementation of erosion control BMPs on agricultural land. The erosion control measures would reduce sediment delivery of fine particles (clay and silt).

In addition to the nutrient reductions, the loading capacity of Newport Bay will be increased with implementation of proposed dredging of sedimentation basins in upper Newport Bay (California Regional Water Quality Control Board, 1997c). The maintenance of the sediment holding capacity proposed by the Regional Board will result in increased tidal flushing of the upper Newport Bay over current conditions. This increased tidal flushing will effectively dilute the nutrient inputs from the San Diego Creek watershed and other tributaries. The combination of decreased nutrient loads and increased tidal flushing should result in a significant reduction in ambient levels of TIN in the water column of upper Newport Bay.

Control of both the total nitrogen and total phosphorous loads throughout the year should result in a gradual reduction in the "pool" of available nutrients in the Bay sediments. Although the analysis of Horne (Horne, 1998a) suggests that simply reducing dry season loading of nitrate may be sufficient to reduce macrophyte density, year round control of both phosphorous and nitrogen inputs to the Bay provides the necessary assurance that nutrient inputs are not available during periods of significant macrophyte growth.

Newport Bay - Allocations

The Regional Board has proposed implementing the phosphorous TMDL through implementation of the sediment TMDL. The Regional Board allocations for the sediment TMDL have been modified in the EPA sediment TMDL to account for land use changes (US EPA, 1998a). Therefore, the phosphorous allocations are allocated in a similar manner to the sediment allocations contained in the EPA sediment TMDL. The phosphorous TMDL is allocated using the same discharge sectors that are used for the EPA sediment TMDL and in the same proportions. As can be seen in Table 3, the sum of the phosphorous allocations equals the phosphorous TMDL.

The EPA total nitrogen allocations for Newport Bay are identical to those proposed by the Regional Board (California Regional Water Quality Control Board, Santa Ana Region, 1998a). Notable differences between the TMDL allocations and the current total nitrogen contributions include the addition of NPDES (non-stormwater) discharges. The Regional Board has recently adopted an NPDES permit for the Eastern Transportation Corridor ground water dewatering project and in the future will consider adoption of an NPDES permit for the permanent discharge from the Irvine Ranch Water District's Wetland Water Supply Project. The EPA TMDL contains waste load allocations for two discharge categories: Urban Runoff and Other NPDES Dischargers. While EPA would normally establish individual waste load allocations for each

NPDES discharger, we are not doing so in this case because the Regional Board is scheduled to adopt specific waste load allocations for individual NPDES dischargers on April 17, 1998 (including waste load allocations for the newly issued permit and the anticipated future permanent wetland water supply discharge). The total waste load allocations for NPDES discharges established by EPA and proposed by the Regional Board are identical.

Additionally, the EPA's TMDL and the Regional Board's proposed TMDL allocate part of the TMDL to "Undefined" sources, since ground water total nitrogen contributions a re currently unknown. It should be noted that the EPA and the Regional Board are not specifically accounting for total nitrogen loads from open space although the Tetra Tech report (Tetra Tech, 1998a) does make an estimate of total nitrogen loads from open space. The Tetra Tech report considered total nitrogen loading during both storm and non-storm events. Since loading from open space generally occurs during storm events and the TMDLs only apply during non-storm events during the wet season, the total nitrogen loading from open space is likely to be insignificant. As can be seen in Table 1, the sum of the total nitrogen allocations equals the total nitrogen TMDL.

San Diego Creek, Reach 1

San Diego Creek, Reach 1 has a water quality standard of 13 mg/L TIN. Tetra Tech evaluated the changes in water quality in San Diego Creek based on the Regional Board's proposed reductions in loading to Newport Bay (Tetra Tech, 1998b). Based on the modeling performed by Tetra Tech, the loading reductions proposed by the Regional Board during the dry season should result in attainment of the water quality standard.

A simple analysis of the recent historical seasonal concentration information for San Diego Creek, Reach 1 will also provide some indication of the effect of a 50% reduction in total nitrogen loading. As can be seen in Table 5, during the dry season TIN concentrations are slightly above the objective on average. As long as flow rates in San Diego Creek remain similar to historical flow rates, a 50% reduction in total nitrogen loading should result in average concentrations of approximately 7 mg/L TIN[6]. The combination of average concentrations 30-40% below the standard and the small variance in observed TIN in the dry season should result in consistent attainment of the water quality standard. Table 5 also indicates that the average concentration in the wet season is above 13 mg/L TIN, with an average concentration of 14.1 mg/L and a median concentration of 16.0 mg/L TIN. Again a simple analysis indicates that as long as flow rates in San Diego Creek remain similar to historical flow rates, a 50% reduction in total nitrogen loading should result in average and median concentrations of 7-8 mg/L TIN. Although the variance during the wet season is greater than the dry season, it is still expected that a 50% reduction in total nitrogen loading should significantly lower both the average

[6] It should be noted that historical data indicates that most (about 90%) of the total nitrogen measured in San Diego Creek is in the form of inorganic nitrogen.

concentration and the variance. Therefore, the 13 mg/L TIN standard should be met during the wet season with the implementation of the total nitrogen TMDL for the Newport Bay Watershed.

A separate TMDL for San Diego Creek, Reach 1 is not established, since the total nitrogen TMDL applicable to the entire Newport Bay watershed should result in attainment of the water quality standard in San Diego Creek, Reach 1. Table 8 describes the allocations for discharges to San Diego Creek, Reach 1 that would result with implementation of the total nitrogen TMDL for Newport Bay. The urban and agricultural allocations are slightly lower for San Diego Creek, Reach 1 than they are for Newport Bay. The urban allocations are 82% of the total allocation for Newport Bay and the agricultural allocations are 97% of the total allocation for Newport Bay. These adjustments were made since there are agricultural and urban areas that drain to Newport Bay, but are not within the San Diego Creek watershed.

Table 8. Total Nitrogen (TN) Allocations that would result in San Diego Creek, Reach 1 with Implementation of Newport Bay Total Nitrogen TMDL (see Table 1)

		Annual (lbs TN)	October 1-March 31 (lbs TN)	April 1-September 30 (lbs TN)
Loading Capacity		265,482	128,286	137,196
	Urban Runoff	59,097	45,462	13,635
	Other NPDES Discharges	39,311	13,640	25,671
Total WLA		98,408	59,102	39,306
	Nurseries	83,734	22,545	61,189
	Agricultural Discharges	48,271	37,135	11,136
	Undefined Sources	35,069	9,504	25,565
Total LA		167,074	69,184	97,890

San Diego Creek, Reach 2

San Diego Creek, Reach 2 has a 5 mg/L TIN objective. Tables 9(a) - 9(c) present a number of possible options for determining the allocations and TMDL for San Diego Creek, Reach 2. An evaluation of historical flow records at San Diego Creek at Culver (just downstream of Jeffrey Road - the lower boundary of Reach 2) indicates that there is generally very little flow and therefore little assimilative capacity in Reach 2. The concentration data available for San Diego Creek at Culver indicate that San Diego Creek, Reach 2 TIN concentrations average 9.5 mg/L (median 7.3 mg/L) in the October-March time period and average 15.4 mg/L (median 15.1 mg/L) in the April-September time period. Even with a 50% reduction in total nitrogen loading (as established by the Newport Bay total nitrogen TMDL), it is likely that average concentrations in Reach 2 would remain close to or above 5 mg/L.

Table 9(a). Option A

Total Inorganic Nitrogen (TIN) TMDL for San Diego Creek, Reach 2 during non-storm conditions (expressed as allowable discharge to San Diego Creek, Reach 2)	
TMDL	5 mg/L (TIN)
Waste Load Allocation	5 mg/L (TIN)
Load Allocation	5 mg/L (TIN)

Table 9(b) . Option B

Total Inorganic Nitrogen (TN) TMDL for San Diego Creek, Reach 2 during non-storm conditions- based on 10th Percentile flow of approx. 0.5 CFS (expressed as allowable discharge to San Diego Creek, Reach 2)	
TMDL	13 lbs/day (TIN) or 14 lbs/day (TN)
Waste Load Allocation (NPDES Discharge - urban runoff - 37% of TMDL)	5 lbs/day (TIN) or 5.5 lbs/day (TN)
Load Allocation (Nurseries, Agriculture, Open Space - 63% of TMDL)	8 lbs/day (TIN) or 8.5 lbs/day (TN)

Table 9(c). Option C

Total Nitrogen (TN) Load allowed for San Diego Creek, Reach 2 based on seasonal allocations in Table 8(adjusted for land use distribution in Reach 2 and Bordiers Nursery discharge)		
	October 1- March 31	April 1-September 30
TMDL	224 lbs/day (TN)	175 lbs/day (TN)
Waste Load Allocation (NPDES Discharge - urban runoff)	84 lbs/day (TN)	25 lbs/day (TN)
Load Allocation (Nurseries, Agriculture, Undefined)	140 lbs/day (TN)	150 lbs/day (TN)

Table 9(a) presents a TMDL and allocations that are set equal to the numeric water quality objective. EPA's proposed TMDL (US EPA, 1998b) had proposed adoption of "Option

A" as the TIN TMDL for San Diego Creek, Reach 2. Options B and C were also presented in EPA's proposed TMDL. The Regional Board (California Regional Water Quality Control Board, Santa Ana Region, 1998d) commented that "Option A" would be more difficult to implement than "Option B" and is not consistent with the approach taken for the total nitrogen TMDL for the rest of the Newport Bay watershed. EPA agrees with the Regional Board that the lack of consistency between "Option A" (which is concentration based) and the total nitrogen TMDL for the entire Newport Bay watershed (which is load based) will make implementation of the San Diego Creek, Reach 2 TMDL more difficult, and, therefore, make standards less likely to be attained. Based on the relative ease of implementation of "Option B" over "Option A", EPA is establishing the "Option B" total nitrogen load limits as the TMDL for San Diego Creek, Reach 2.

Table 9(b) (Option B) presents a TMDL based on the 10th percentile flow rate at the Culver station during non-storm events[7]. The flow rate is multiplied by the standard to find a total allowable load. The "Option B" TMDL is expressed both as total nitrogen and as total inorganic nitrogen. The EPA TMDL for San Diego Creek, Reach 2 is expressed as total nitrogen for consistency with the total nitrogen TMDL for the rest of the Newport Bay watershed, although it is designed to meet the total inorganic nitrogen objective for San Diego Creek, Reach 2 (i.e. 5 mg/L TIN). If historical flow patterns during non-storm events are mirrored in the future, one would expect that 90% of the observed mean daily flows would be greater than the 10th percentile flow rate and 10% would be less. If the dischargers do not exceed their allowable load, than the standard would be exceeded 10% or less of the time.

Table 9(c) (Option C) would require no further adjustments to the load and waste load allocations than those already required by the Newport Bay total nitrogen TMDLs. A comparison of tables 9(b) and 9(c) shows that the 5 mg/L objective in Reach 2 would continue to be exceeded. Thus "Option C" is not an acceptable option.

Section 3.5. 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 into conservative assumptions used to develop the TMDL or added as a separate component of the TMDL (US EPA, 1991). A number of conservative assumptions are included in the nutrient TMDLs.

Newport Bay

[7] The load limits do not apply on days on which the mean daily flow rate in San Diego Creek at Culver Drive exceeds 25 cubic feet per second (cfs) as a result of precipitation events.

Limiting Nutrient — In general, it has been assumed that nitrogen is the limiting nutrient for macrophyte growth in Newport Bay. Horne (Horne, 1998a) presents data that indicates that although water column phosphate concentrations in upper and lower Newport Bay are similar, the nitrate concentrations and macrophyte density in upper Newport Bay are significantly greater. Horne infers that nitrate is therefore the nutrient controlling macrophyte growth. Horne also presents data that indicates that phosphorous is at very low levels in the macrophytes, which would indicate that phosphorous is limiting. Since there is conflicting information regarding the limiting nutrient and some disagreement among experts (Fong, 1998), nutrient TMDLs are established for both nitrogen and phosphorous.

Seasonal Availability — Horne has described the growing season for macrophytes as generally being in the spring-summer time period (Horne, 1998b). It has been argued that it is not necessary to control nutrient inputs during other times of the year. This argument is based on the assumption that TIN is limiting and that since TIN is generally only used by macrophytes during the spring-summer time period, it is not necessary to limit it at other times of the year. There is disagreement on this point as well, since particulate nitrogen and phosphorous that is delivered to the Bay during periods of limited macrophyte growth may be available during periods of significant macrophyte growth (Fong, 1998; Josselyn, 1998). Additionally, there is photographic and anecdotal evidence that macrophyte growth has occurred year round in Newport Bay (Natural Heritage Institute, 1998). In other words, spring and summer may be the favored growth period, but not the only growth period. Therefore, the nutrient TMDLs include limits for the whole year.

Nutrient Form — Another area of uncertainty is what chemical configuration (or form) of nutrients can become bioavailable for use by the macrophytes. This is especially true of forms of nitrogen, where it has been argued by some that only the inorganic forms can be used by the macrophytes, whereas others contend that organic forms of nitrogen can be transformed and be used. In the absence of conclusive data to support either assertion, the nutrient TMDLs assume that all forms of phosphorous and nitrogen must be controlled.

Tidal Flushing — The greater volume of the sedimentation basins in upper Newport Bay will result in greater tidal interchange. The Regional Board’s adopted Basin Plan Amendment requires maintenance dredging every time the volume of sediment in the basins exceeds 50% of the design capacity. The increased dilution from tidal interchange in upper Newport Bay will likely be a long term change. The sedimentation basins were not present in the early 1970's, so the combination of decreased nutrient loading to less than the 1970's level and greater dilution will result in ambient nutrient levels in upper Newport Bay that are much lower than those observed in the early 1970's. The increased tidal flushing was not explicitly accounted for in setting the nutrient reduction level. The benefit of increased tidal flushing provides a margin of safety that accounts for uncertainty regarding the appropriateness of the early 1970's nutrient loads as a target level.

<u>San Diego Creek, Reach 1</u>

Since a specific numeric water quality standard for TIN exists for San Diego Creek, Reach 1, there is less uncertainty in the relationship between the TMDL and attainment of this standard. The Newport Bay TMDL adequately addresses the load reductions necessary to meet the water quality standard, so no additional margin of safety for San Diego Creek, Reach 1 is necessary. As discussed in section 3.4, the 50% reduction in total nitrogen loading should result in average ambient TIN levels in San Diego Creek, Reach 1 that are 30%-40% below the water quality standard. Even accounting for the variation in water quality, the reductions required by the Newport Bay total nitrogen TMDL should result in attainment of the water quality standard.

<u>San Diego Creek, Reach 2</u>

The EPA TMDL for San Diego Creek, Reach 2 (Table 2) accounts for uncertainty in the available assimilative capacity by basing the TMDL on low flow conditions in San Diego Creek, Reach 2. The TMDL is expressed as total nitrogen, so uptake of inorganic forms of nitrogen is not explicitly accounted for in the San Diego Creek, Reach 2 TMDL. Basing the Reach 2 TMDL on low flow conditions and ignoring uptake in the calculation of assimilative capacity provides a margin of safety to ensure that the numeric water quality objective for total inorganic nitrogen will be met.

Section 3.6. Seasonal Variation

The TMDL for discharge of total nitrogen to Newport Bay explicitly considers discharge during the wet season (October-March: non-storm discharges) and dry season (April-September).

<u>Newport Bay - Total Nitrogen</u>

In both the public workshops and nutrient TMDL work group meetings, there has been much discussion as to whether total nitrogen loading limits should be imposed during the wet season. According to Horne, the wet season corresponds to a period of no or little algae growth (Horne, 1998a) and the dry season corresponds to the time period of substantial algae growth and periodic dissolved oxygen sags (Horne, 1998a). Although there is general agreement on the time period during which consistent beneficial use impacts are observed, conflicting views have been presented as to whether the total nitrogen load that is discharged to Newport Bay during the wet season is bioavailable during the period of greatest algae growth. Until the issues of bioavailability of seasonal discharges of total nitrogen and macrophyte presence during fall and winter are clarified, it is appropriate to maintain total nitrogen load limits for both the wet and dry seasons.

Newport Bay - Total Phosphorous

Phosphorous is generally associated with sediment in the Newport Bay watershed. Although sediment transport and deposition in Newport Bay generally occurs in the wet season, the phosphorous associated with the sediment is available to support algae growth during the dry season (Fong, 1998, California Regional Water Quality Control Board, Santa Ana Region, 1997a). Therefore, control of annual loads of total phosphorous is of primary concern since the availability of phosphorous for use by the algae is not dependent on the timing of discharge.

San Diego Creek , Reach 1

As shown in Table 5, average TIN levels are similar for all seasons, although the variation in concentration is greater in the wet season, than the dry season. Since TIN levels are similar and elevated throughout the year, the TMDL establishes allocations that apply both to the wet season and dry season. Wet season allocations only apply during non-storm events, since exceedances of the standard are not observed when flow rates are above 50 cfs.

San Diego Creek, Reach 2

As shown in Table 6, average TIN levels are well above the objective during all seasons. The San Diego Creek, Reach 2 TMDL (Table 2), therefore, limits discharge during all seasons. No limits are established during storm events (above 25 cfs), since the historical data indicates that the standard is generally met in San Diego, Reach 2 during storm events.

Section 3.7. 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. Sections 3.5-3.6 contain extensive discussion on critical conditions and how they were accounted for in the nutrient TMDLs.

During the Regional Board workshops and hearings, there was discussion as to whether storm loading of nutrients to Newport Bay needed to be controlled. There was general agreement that during storm events, the fresh water from Newport Bay's tributaries would be stratified in the saline environment of the Bay (due to density differences) and would form a fresh water "lens" that would go directly to the ocean.

In the absence of data to indicate when sufficient stratification occurs, the EPA is relying on the "storm flow" definition that applies to the analysis used for San Diego Creek, Reach 1 (i.e. >50 cfs). The Regional Board and others (Irvine Ranch Water District, 1998) agree with this approach, but some have suggested that the definition of the "storm flow" cut-off must be higher to be protective of Newport Bay (Natural Heritage Institute, 1998; Limno-Tech, 1998). It should be noted that the "storm flow" cut-off as defined in Table 1, only applies to total nitrogen loading and does not apply to total phosphorous loading.

The record available to the EPA indicates that non-storm or low flow loading of total nitrogen as defined in Table 1 is the critical flow and loading condition for Newport Bay. As noted above (sections 3.1 and 3.2), lower Newport Bay is not showing signs of nutrient enrichment. The nutrient controls that have been put in place by the Regional Board (principally effluent limits on nursery discharges) have been effective in minimizing impacts in lower Newport Bay. These controls have had the greatest effect in reducing low-flow loading of nutrients. Storm flow discharges of total nitrogen to lower Newport Bay are likely similar to what they were prior to imposition of the nursery controls. Therefore, it does not appear necessary to control total nitrogen storm flow discharges to upper Newport Bay at this time to ensure attainment of water quality standards. The EPA will suggest to the Regional Board that it further investigate the issue of stratification of freshwater flows in Newport Bay as part of its Regional Monitoring Plan and evaluate what effect, if any, storm flows (as defined in Table 1) have on macrophyte growth in upper Newport Bay.

Section 4. Public Participation

40 CFR 130.7 requires that TMDLs be subject to public review. The State and EPA have provided for public participation through several mechanisms. The Regional Board has conducted numerous informal technical workshops on the nutrient TMDLs which have been open to the public (monthly meetings since June, 1997). Additionally, the Regional Board has held two public workshops as part of their regular meetings to discuss the staff proposals (September 12, 1997; December 5, 1997). On December 9, 1997, the Regional Board and EPA jointly noticed the availability of the Regional Board's proposed Basin Plan Amendment which would adopt the nutrient TMDL. The Regional Board considered comments on the proposed nutrient TMDL at their January 23, 1998 and March 6, 1998 meetings. EPA reviewed both the comment letters to the Regional Board and the Regional Board staff's response to comments as part of the development of EPA's proposed and final TMDLs. These comments and the Regional Board's response are incorporated into EPA's administrative record. As a general matter, EPA concurs with the Regional Board's responses to its comments. As to some issues raised, EPA has supplemented the Regional Board's discussion in EPA's responses to comments and in EPA's TMDL document.

EPA noticed the availability of the proposed nutrient TMDLs and report on February 27, 1998 and gave the public until March 31, 1998 to provide written comments. A summary of the comments received and the EPA's responses are provided in a separate document. The EPA notice of availability was posted in the Orange County Register on February 27, 1998 and the notice was mailed to the Basin Plan distribution list provided by the Regional Board. Additionally, the EPA faxed the proposed nutrient TMDL to the Regional Board's Nutrient TMDL Workgroup for Newport Bay on February 27, 1998 and the Regional Board made 25 copies of the proposed nutrient TMDL available at its March 6, 1998 Regional Board meeting.

Section 5. Implementation and Monitoring

Federal regulations require the State to identify measures needed to implement TMDLs in the state water quality management plan (40 CFR 130.6). EPA has recently established new policies which address implementation of TMDLs (memo from Robert Perciasepe, Assistant Administrator for Water, to EPA Regional Division Directors, August 8, 1997). EPA expects the State to promptly develop and ensure the implementation of source control measures which are adequate to achieve the goals of the TMDLs.

The Regional Board's TMDL and associated Basin Plan provisions dated December 9, 1997, along with subsequent modifications dated January 23, 1998 and March 6, 1998 describe an implementation plan which includes:

- issuance of waste discharge requirements to currently unregulated nurseries greater than 5 acres and with discharges that contain greater than 1 mg/l of total inorganic nitrogen;

- revision of existing waste discharge requirements for currently regulated nursery operations;

- revision of existing NPDES permits for which discharges of nutrients exceed 1 mg/l of total inorganic nitrogen;

- requiring the development of nutrient management plans for all agricultural operations not regulated by waste discharge requirements;

- requiring the co-permittees of the stormwater permit to submit an analysis of Best Management Practices that will be implemented to achieve the urban runoff targets;

EPA guidance concerning the development of TMDLs through the phased approach emphasizes the importance of establishing rigorous monitoring and evaluation plans and associated schedules which will guide the review and potential revision of the TMDLs and implementation activities (EPA, 1991). The Regional Board's TMDL and Basin Plan provisions establish a comprehensive approach to monitoring and evaluation which identifies parties responsible for implementation and timeframes for Regional Board review of monitoring results. This monitoring and review plan provides a workable framework consistent with the direction of EPA guidance on phased approach TMDLs.

EPA commends the Regional Board for its efforts to identify appropriate implementation measures and recommends that the Regional Board pursue an aggressive timeframe for ensuring attainment of the TMDL. EPA looks forward to the State's submission of both the final TMDLs and the associated implementation measures.

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