APPENDIX D

Water Quality

"The following technical report reflects the findings and data available at the time the report was prepared and may not represent the current conclusions and steps forward in the main text of the HAMP, which has been updated after the completion of these reports. These more detailed technical reports provided in the appendices represent the foundation for the overall approach to the HAMP, but are not "living" documents that reflect updated steps forward, costing, quantities, etc. presented in the main text of the HAMP. The main text of the HAMP represents more current information and recommendations based on updated information, new studies, changes in conditions, new funding sources, and/or new regulations."

HARBOR AREA MANAGEMENT PLAN

Strategic BMP Implementation Plan

Technical Report

Prepared For:

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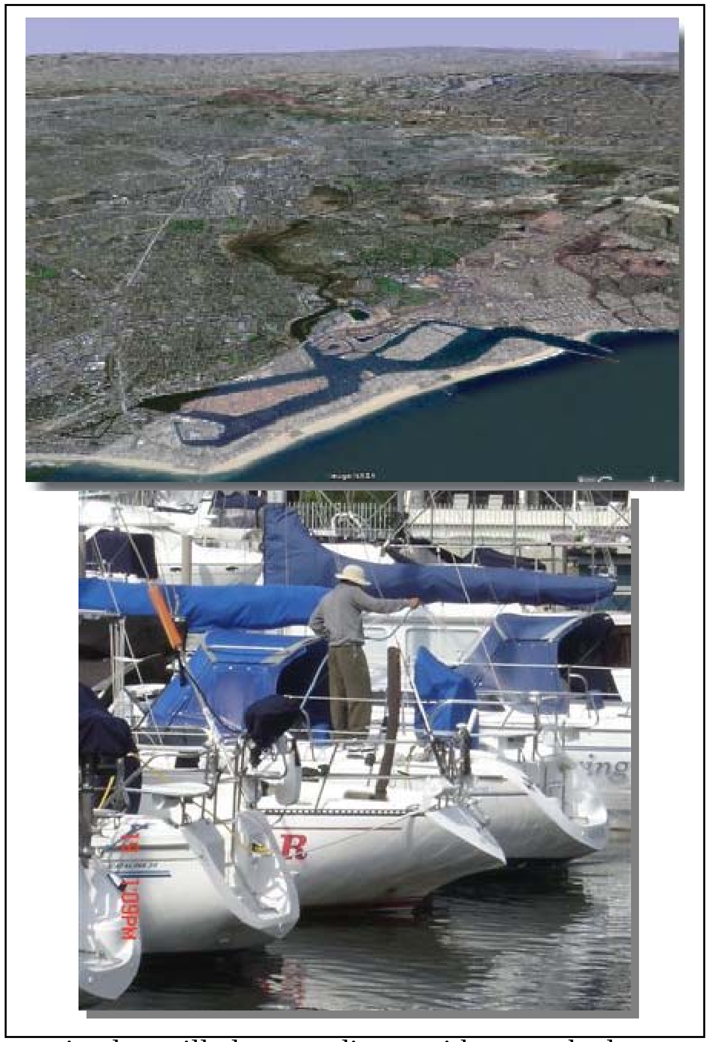
1.0 INTRODUCTION

1.1 Introduction



The City of Newport Beach (City) is committed to achieving a sustainable Newport Harbor Area (Harbor Area) through protection and improvement of water quality. Water quality is a key link in addressing community needs, regulatory requirements, and the health and diversity of the surrounding ecosystems to the Harbor Area. The City's strategy toward achieving this vision begins with an evaluation of the current health and water quality of the Harbor Area and identifying the sources of impacts to it. Based on this understanding, strategies will be developed to protect water quality in the Harbor Area through the implementation of best management practices (BMP) supplemented by coordination with other regional water quality protection measures, community outreach, and education. The end goal is to create a Strategic BMP Implementation Plan (Strategic BMP Plan) to strategically implement water quality BMP that is coordinated with Harbor Area beneficial uses and addresses current and future pollutants entering and discharging from the Upper and Lower Newport Bay. The strategic plan will also coordinate with watershed, Upper Newport Bay and coastal plans and projects to create a sustainable water quality improvement plan maintained through iterative effectiveness assessment of the implanted water quality protection, preservation, and improvement measures.

1.2 Purpose of the Strategic BMP Plan

The purpose of the Strategic BMP Plan is to first identify the priority water quality issues and the management measures to address them. Based on the applicable management measures developed in this plan, the strategy for the implementation of these measures is then presented. Therefore, this Strategic BMP Plan provides the City with a management tool to identify the BMP to be implemented to address the water quality issues of the Newport Harbor.

These BMP will be implemented in coordination with the other components of the HAMP to achieve the following overall goals:

- Maintaining the beneficial uses of the Upper and Lower Newport Bay and economic value of the Bay;
- Providing a practical framework to meet regulatory requirements in the current and anticipated municipal discharge permits, sediment management permits, total maximum daily loads (TMDL), and other regulatory programs for Newport Bay; and,
- Supporting a sustainable estuary ecosystem to integrated with upstream sustainable watersheds and adjacent coastal area systems.

This Strategic BMP Plan focuses on addressing the water quality issues of the Newport Bay. BMP recommended for implementation in this Plan are to be coordinated with the management measures and priorities presented in the following management plans for the upper watershed and the coastal canyon watersheds:

- Central Orange County Integrated Regional and Coastal Watershed Management Plan (County of Orange Resources and Development Management Department, Watershed and Coastal Resource Division, August 2007)

- City of Newport Beach Coastal Watershed Management Plan (Weston, November 2007)

Each of these plans presents the goals, challenges and recommended solutions for the respective watersheds. Solutions that address water quality issues are linked to measures recommended in this plan by the connectivity of the upper watershed and coastal areas to the Harbor. Several of the projects presented in these plans are included in the BMP presented in this plan where there directly address water quality in the Harbor.

1.3 Plan Outline and Contents

The Strategic BMP Plan first presents in Section 2 an evaluation of the water quality issues of the Harbor Area based on available data. The outcome of the evaluation is the identification of priority constituents of concern (COC). These priority COC are then used to develop the key questions and coordination with other program presented in Section 3. The identification of applicable BMP to address the priority COC and prioritization strategy for the implementation of the BMP are presented in Section 4. The recommend implementation strategy is an integrated, tiered and phased BMP implementation approach. Recommended prioritized BMP are then presented in Section 5.

2.0 EVALUATION OF WATER QUALITY ISSUES IN THE HARBOR AREA

2.1 Overview of Water Quality Issues and Regulatory Drivers

Upper Newport Bay is approximately 1,000 acres in size and 2 miles long. The Upper Newport Bay State Ecological Reserve is one of only a few remaining estuaries in Southern California and is the home to numerous species of mammals, fish, invertebrates, and native plants, including several endangered species (Newport Bay Naturalists and Friends, 2007). The lower portion of the Upper Newport Bay includes the Upper Newport Bay State Marine Park. Lower Newport is approximately 752 acres in size, and consists of Newport Harbor and recreational and navigational channels.

The primary tributary to Newport Bay is San Diego Creek. This sub-watershed covers approximately 122 square miles and includes numerous tributary drainages such as Peters Canyon Wash, Serrano Creek, Borrego Canyon Wash, Bee Canyon Wash, El Modena-Irvine Channel, and Sand Canyon Wash. The Santa Ana-Delhi Channel is the second major tributary, draining approximately 17 square miles of densely developed area within the City of Santa Ana.

The Newport Harbor Area faces water quality challenges as identified through regulatory action and a number of special studies recently undertaken by the City of Newport Beach and other watershed stakeholders. The Harbor Area, located in the Lower Newport Bay, is the nexus between the highly urbanized San Diego Creek and Santa Ana-Delhi Channel upstream sub-watersheds, the ecologically sensitive Upper Newport Bay and the receiving waters of the Pacific Ocean (Figure 2-1). The Harbor Area is also functioning small boat harbor surrounded by small businesses, private residences, and municipal facilities. The Lower Bay has over 9000 boats berthed in its marinas and private boat slips. The Lower Bay also serves as a major Southern California recreational destination, attracting both visitors and locals to take advantage of a variety of water-related activities.

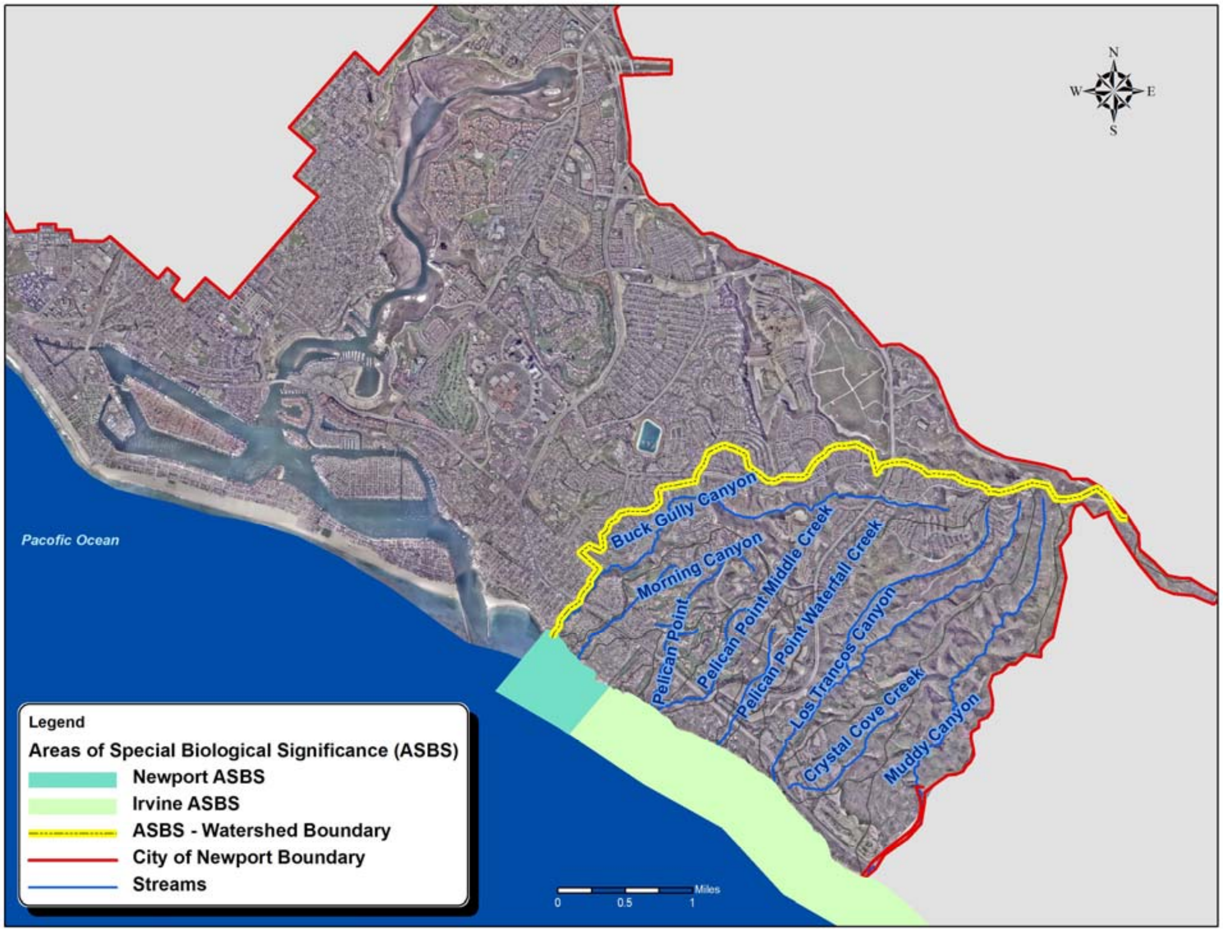


Figure 2-1: Newport Beach Coastal Watershed

Key water quality challenges in the Harbor Area include: understanding constituent loadings from regional upstream sources in the San Diego Creek Watershed, contributions of constituents from local sources within the Harbor Area, potential cross-contamination from sources outside of the Bay, and Bay discharges of degraded water quality to sensitive marine areas outside of the harbor. The Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) lists Newport Bay as tributary to the Pacific Ocean and also serves as the receiving waters for San Diego Creek. Located just outside the Harbor are two areas designated by the State as Areas of Special Biological Significance (ASBS) that are subject to special protections under the California Ocean Plan (COP). Table 2-1 summarizes the Basin Plan beneficial uses for the waters in and adjacent to the Harbor Area.

Table 2-1. Beneficial Uses for Waters in the Newport Harbor Area.

	Agricultural Supply	Groundwater	Water Contact Recreation	Non-water contact recreation	Commercial and Sportfishing	Warm Freshwater Habitat	Limited Warm Freshwater Habitat	Biological Habitats of Special Significance	Wildlife Habitat	Rare, Threatened, or Endangered Species	Spawning, Reproduction, and Development	Marine Habitat	Shellfish Harvesting	Estuarine Habitat
Bays, Estuaries, and Tidal Prisms														
Lower Newport Bay			●	●	●				●	●	●	●	●	
Upper Newport Bay			●	●	●			●	●	●	●	●	●	●
Channels Discharging to Coastal or Bay Waters			●	●	●				●			●		
Ocean Waters														
SWQPA (formerly ASBS)			●	●				●				●		
Newport Bay			●	●	●								●	
Inland Surface Streams														
Buck Gully	●	●				●	●							
Morning Canyon						●	●							
San Diego Creek														
Reach 1 - Below Jeffries Road			●	●					●					

* Beneficial use definitions can be found in the Santa Ana Basin Plan (RWQCB, 2000)

Based on the Basin Plan beneficial use designations and the COP, water bodies within and near the Harbor Area are subject to regulatory action from the USEPA, the State Water Resources Control Board (SWRCB) and the Santa Ana Regional Water Quality Control Board (RWQCB). The EPA and the RWQCB have implemented Total Maximum Daily Loads (TMDL) for various constituents in San Diego Creek and the Upper and Lower Newport Bay. Buck Gully Creek, the Upper and Lower Newport Bay, Rhine Channel, and San Diego Creek all are listed on the EPA's 303(d) list as impaired (Table 2-2).

Table 2-2. Impaired Water Bodies and Pollutants of Concern in the Newport Harbor Area.

	Buck Gully Creek	Lower Newport Bay	Upper Newport Bay	Rhine Channel	San Diego Creek - Reach 1
TMDLs					
Nutrients		●	●		●
Pathogens		●	●		
Pesticides		●	●		●
Sedimentation			●		●
303(d) Listings					
Chlordane		●	●		
Copper		●	●	●	
DDT		●	●		
Fecal Coliform	●				●
Lead				●	
Mercury				●	
Metals			●		
PCBs		●	●	●	
Sediment Toxicity		●	●	●	
Selenium					●
Total Coliform	●				
Toxaphene					●
Zinc				●	

The development of a cost-effective strategy to implement BMP to meet current and anticipated TMDL, other regulatory drivers, and existing City planning documents and ordinances is a key component in effectively addressing water quality issues in the Upper and Lower Bay.

2.2 Newport Bay Watershed History and Water Quality Issues (IRWMP, County of Orange, 2007)

Newport Bay Watershed History and Water Quality Issues

"The resources of Newport Bay have been long and extensively studied. Gilbert (in 1889) described the main channel of the Bay as muddy, soft in places—quote: '. . . but with many banks of native oysters, which reach a large size'. He also noted a small but constant flow of freshwater from springs at the head of the Bay. Another early contribution (MacGinitie, 1939) documented freshwater storm flows as causing high mortality among benthic organisms in Newport Bay. Historical changes in Bay ecology that reflect the shifting course of the Santa Ana River (and later the San Diego Creek) have also been documented (Stevenson and Emery, 1958; Macdonald, 1991).

Central Orange County Integrated Regional and Coastal Watershed Management Plan
August 2007 2-40

After the eastward extension of Balboa Peninsula in the 1860s, the Upper Bay was protected from direct ocean waves providing a quiet environment subject only to tidal action and local runoff. The result was the accretion of silt over the previously sandy platform. By the 1950s, silt was 18 to 50 inches deep throughout the Bay (Stevenson and Emery, 1958).

As the Bay became shallower, marsh vegetation spread and further enhanced deposition. Major sources for the initial 18-50 inches of silt were the roughly 32 square miles of natural local drainage area surrounding Newport Bay and, until 1920 when the Santa Ana River was re-routed directly to the sea, fine sediments from floods could be brought into the Bay through that source. Sediment from the larger drainage of San Diego Creek was not a factor until that stream was gradually routed into Upper Newport Bay in this century.

San Diego Creek did not have integrated drainage nor regular drainage to the sea at the time of European settlement. Sediment-laden streams from both Loma Ridge and the San Joaquin Hills flowed through steep valleys to the Tustin plain where the slope suddenly decreased. The resulting decrease in stream velocity plus rapid infiltration of water caused the deposition of the coarser sediment creating alluvial fans at the base of the hills. The flow of water moved about on these fans causing them to spread laterally and coalesce along the foot of the hills.

The higher stormflows were ponded in an ephemeral lake located between Upper Newport Bay and the present site of the Santa Ana River. The ephemeral lake bed and the area to its north and east was usually swampy and marshy and was known as the "Swamp of the Frogs" (Cienega de las Ranas). The swamp extended to areas near the 100 feet elevation mark and included areas with slopes up to perhaps 1.5 percent.

To improve agricultural drainage for those areas on either side of Peters Canyon Wash, a channel was dug towards Upper Newport Bay and the ridge which had historically dammed water in the Tustin Basin was breached (1901 and 1915). However, the water was only being conducted to the 600 or so acres of peat and swampland lying one to three miles above the Bay, where it was simply allowed to spread into that wetland and make its way to the Bay the best it could (Trimble, 1998).

To contain increasing flood flows and sediment loads, and to protect a salt works, the Irvine Company in 1946 built a 3,000 acre-feet floodwater retention pond upstream of present University Avenue. Finally, the wide, efficient San Diego Creek channel was built in the 1960s so that peak floods and sediment could be efficiently routed to the Bay itself.

The uppermost portion of Upper Newport Bay contained salt evaporation ponds and was separated from the rest of the Bay by an earthen dike. Heavy storm runoff destroyed the salt ponds and breached the dike in 1969. Subsequent storm season sedimentation events in 1978 and 1980 caused shallowing of the Upper Bay; while intertidal saltmarsh vegetation became established and expanded rapidly (ACOE, 1993).

In 1985, 85 acres of the Upper Bay were dredged out to create the Unit I Sediment Control Basin (depths –3 to –7 feet MSL). A second dredging project in 1988 created the 37-acre Unit II Sediment Control Basin, just south of the Main Dike (depth –14 feet MSL). Both basins have worked well, collecting large volumes of coarser grained sediment from periodic flood runoff, principally down San Diego Creek. These then require extensive maintenance dredging, as is on-going at present.

Open water estuary/marine aquatic habitats still predominate in Newport Bay. The present shoreline includes scattered bare and disturbed areas, extensive intertidal saltmarsh with cordgrass, less common pickleweed, rare eelgrass, and small fringing areas of willow/mulefat scrub wetland. Algae and other forms of plankton are seasonally dominant.

Studies of physical conditions in Upper Newport Bay confirm a picture of significant tidal, seasonal, and annual variability. During peak storms the upper part of Upper Newport Bay was characterized by a well mixed, freshwater column. In lesser flows, salinity stratification is noted in the lower part of Upper Newport Bay, with freshwater overlying slightly diluted seawater." (California Coastal Conservancy, 1998)

Changes in land use from ranching and grazing to farmland resulted in the discharge of pesticides and nutrients into San Diego Creek and Upper Newport Bay. Since the 1960s, commercial, residential, and light industrial development has replaced open space and agricultural lands. Development and the related increase in impervious surfaces have increased runoff and altered drainage patterns. Several drainages were channelized for flood control as the amount of runoff necessitated increasing the size and number of channels that drain into San Diego Creek and Upper Newport Bay. As a result, basins were constructed to control sedimentation (ACOE 1999). Additional erosion control structures were installed in the channels. Channel erosion is most evident along Serrano Creek, where recent estimates of flow velocities are about 30 feet per second (Watershed and Coastal Resources Division 2007).

These changes in land use and the location of the former military bases within the San Diego Creek subwatershed have resulted in the discharge of toxic substances, including metals and pesticides, into San Diego Creek and Upper Newport Bay.

Lower Newport Bay, which includes Newport Harbor, has additional water quality issues associated with metals used in boat paints. Rhine Channel, located in the western end of Lower Newport Bay, has been surrounded by industrial uses such as canneries, metal plating companies, and shipyards since the 1920s (Anchor Environmental 2006). Rhine Channel is a dead-end channel in which toxic pollutants have accumulated in the sediment. Sediment accumulation in the bay due to erosion from San Diego Creek and its tributaries has created adverse effects on habitat in the bay and on use of the Lower Newport Bay channels for navigation.

San Diego Creek, Peters Canyon Channel, Upper and Lower Newport Bay, and the Rhine Channel are listed on the EPA's 303(d) list (SWRCB, 2006) as impaired with fecal coliform, organochlorine pesticides, polychlorinated biphenyls (PCBs), metals, and sediment toxicity. The EPA and the Santa Ana RWQCB have implemented TMDLs for the San Diego Creek and Newport Bay for toxicity (including pesticides and metals), sediment, and nutrients. Additionally, a TMDL for fecal coliform has been established for Newport Bay. The TMDLs have been established to restore the beneficial uses of and improve water quality in the Newport Bay Watershed, including Upper Newport Bay State Ecological Reserve.

Surface Water

The two main tributaries to Newport Bay are San Diego Creek and the Santa Ana-Delhi Channel (*See Figure 2.1*). San Diego Creek accounts for approximately 80 percent of freshwater flows into Upper Newport Bay, and the Santa Ana-Delhi Channel accounts for approximately 15 percent of the freshwater flows (ACOE 2000). Newport Bay also receives flows from Santa Isabel Channel, Bonita Creek, Costa Mesa Channel, Big Canyon Wash and smaller storm drains (EPA 1998).

Two important tributaries to San Diego Creek are Serrano Creek and Borrego Wash. These tributaries have experienced significant erosion and have created a life and property hazard for nearby residents. Unfortunately, neither of these tributaries are gauged, so no historical flow data is available.

San Diego Creek extends approximately 14 miles from the Newport Bay to its headwaters and is differentiated into two reaches for the purpose of defining specific beneficial uses and corresponding water quality objectives. Reach 1 extends from the mouth of San Diego Creek at Upper Newport Bay to Jeffrey Road. Reach 2 is upstream of Reach 1 and extends from Jeffrey Road to the headwaters of San Diego Creek. Stream flow in Reach 2 is intermittent (Basin Plan).

Mean daily flow rates in Reach 1 of the San Diego Creek (at Campus Drive) from July 2003 to June 2004 varied from a low of 6.51 cubic feet per second (cfs) in July 2003 to a high of 167 cfs in February 2004 (County of Orange 2004). The average daily flow rates from San Diego Creek at Campus Drive are presented in *Table 2.3, Stream Flow for San Diego Creek Reach 1 – Mouth of San Diego Creek at Upper Newport Bay to Jeffrey Road.*

Stream-flow data for San Diego Creek at Campus Drive were also obtained from the U.S. Geological Survey for the years 1977 through 1984 (there is no data for October 1979 to September 1982). Average monthly flow rates for that time period are also presented in *Table 2.3*. Average monthly flow rates for San Diego Creek Reach 2 are presented in *Table 2.4, Stream Flow for San Diego Creek Reach 2 – Jeffrey Road to Headwaters*.

Table 2.3
Stream Flow for San Diego Creek Reach 1 –Mouth of San Diego Creek at Upper Newport Bay to Jeffrey Road(measured at Campus Drive)

AVG Q (cfs)	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
2003-2004	6.51	8.76	7.45	7.52	14.4	29.0	13.7	167	27.1	19.7	7.47	7.37
1977-1984	26.5	27.5	32.1	31.9	53.9	57.1	110.7	106.9	184.5	45.5	28.2	26.6

Source: County of Orange, RDMD, Hydrologic Data Report, 2003-2004 Season, Station 226; USGS Water Resources Historical Data for San Diego Creek at Campus Drive.

AVG Q = Average Daily Flow Rate
cfs = cubic feet per second

Table 2.4
Stream Flow for San Diego Creek Reach 2 – At Culver Drive and Jeffrey Road to Headwaters (measured at Lane Road)

AVG Q (cfs)	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
2003-2004	2.4	1.3	1.1	1.4	2.3	10.8	4.3	76.0	12.8	5.3	1.0	0.8
1972-1977	15.3	15.5	13.3	12.3	20.3	17.7	32.4	30.9	31.2	19.7	12.5	13.3

Source: County of Orange, RDMD, Hydrologic Data Report, 2003-2004 Season, Station 231, USGS Water Resources.

AVG Q = Average Daily Flow Rate
cfs = cubic feet per second

The Santa Ana Delhi Channel contributes about 15 percent of the total flow into Newport Bay. During water year 2003-2004 the momentary peak flow from the channel was about 2,000 cfs with an average daily flow of about 5.1 cfs. Average daily flow rates for 2003-2004 are shown in *Table 2.5, Stream Flow for Santa Ana-Delhi Channel at Irvine Avenue*

Table 2.5
Stream Flow for Santa Ana Delhi Channel at Irvine Avenue

Avg Q (cfs)	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
2003-2004	2.36	1.09	1.88	1.10	4.09	7.09	3.63	29.6	3.80	4.07	1.57	2.08

Source: County of Orange, RDMD, Hydrologic Data Report, 2003-2004 Season, Station 220

Avg Q = Average Daily Flow Rate
cfs = cubic feet per second

Peters Canyon Wash originates in Peters Canyon Regional Park and drains into San Diego Creek approximately 14 miles upstream from the Newport Bay. Average monthly flow rates for Peters Canyon Wash are presented in *Table 2.6, Stream Flow for Peters Canyon Wash.*

Table 2.6
Stream Flow for Peters Canyon Wash
(at Barranca Parkway)

AVG Q (cfs)	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
2003-2004	7.54	5.22	4.44	3.36	3.78	7.94	4.79	64.0	8.83	6.66	4.20	3.98
1982-1985	17.8	17.0	20.5	22.0	33.6	27.5	26.0	33.1	59.0	24.1	17.9	18.2

Source: County of Orange, RDMD, Hydrologic Data Report, 2003-2004 Season, Station 230, USGS Water Resources.

AVG Q = Average Daily Flow Rate
cfs = cubic feet per second

Beneficial uses for surface waters have been designated within the Newport Bay Watershed by the Santa Ana RWQCB (see *Table 2.1*). At this time, native surface waters from the Newport Bay Watershed are not used as a potable water supply.

Surface Water Quality

San Diego Creek, Peters Canyon Channel, Upper and Lower Newport Bay, and the Rhine Channel are listed on the 303(d) list as impaired with fecal coliform, organochlorine pesticides, PCBs, metals, and sediment toxicity. The EPA and the Santa Ana RWQCB have implemented TMDLs for the San Diego Creek and Newport Bay for toxicity (including pesticides and metals), sediment, and nutrients. Additionally, a TMDL for fecal coliform has been established for Newport Bay. Monitoring locations are shown in *Figure 2.10, Newport Bay Monitoring Locations*.

Coliform

Bacterial contamination of the waters of Newport Bay can directly affect two designated beneficial uses: water-contact recreation and shellfish harvesting. The Orange County Health Care Agency (OCHCA) conducts routine bacteriological monitoring and more detailed sanitary surveys as necessary, and is responsible for closure of areas to recreational and shellfish harvesting uses if warranted by the results.

Because of consistently high levels of total coliform bacteria, the upper portion of Upper Newport Bay (Upper Bay) has been closed to these uses since 1974. In 1978, the shellfish harvesting prohibition area was expanded to include all of the Upper Bay, and the OCHCA

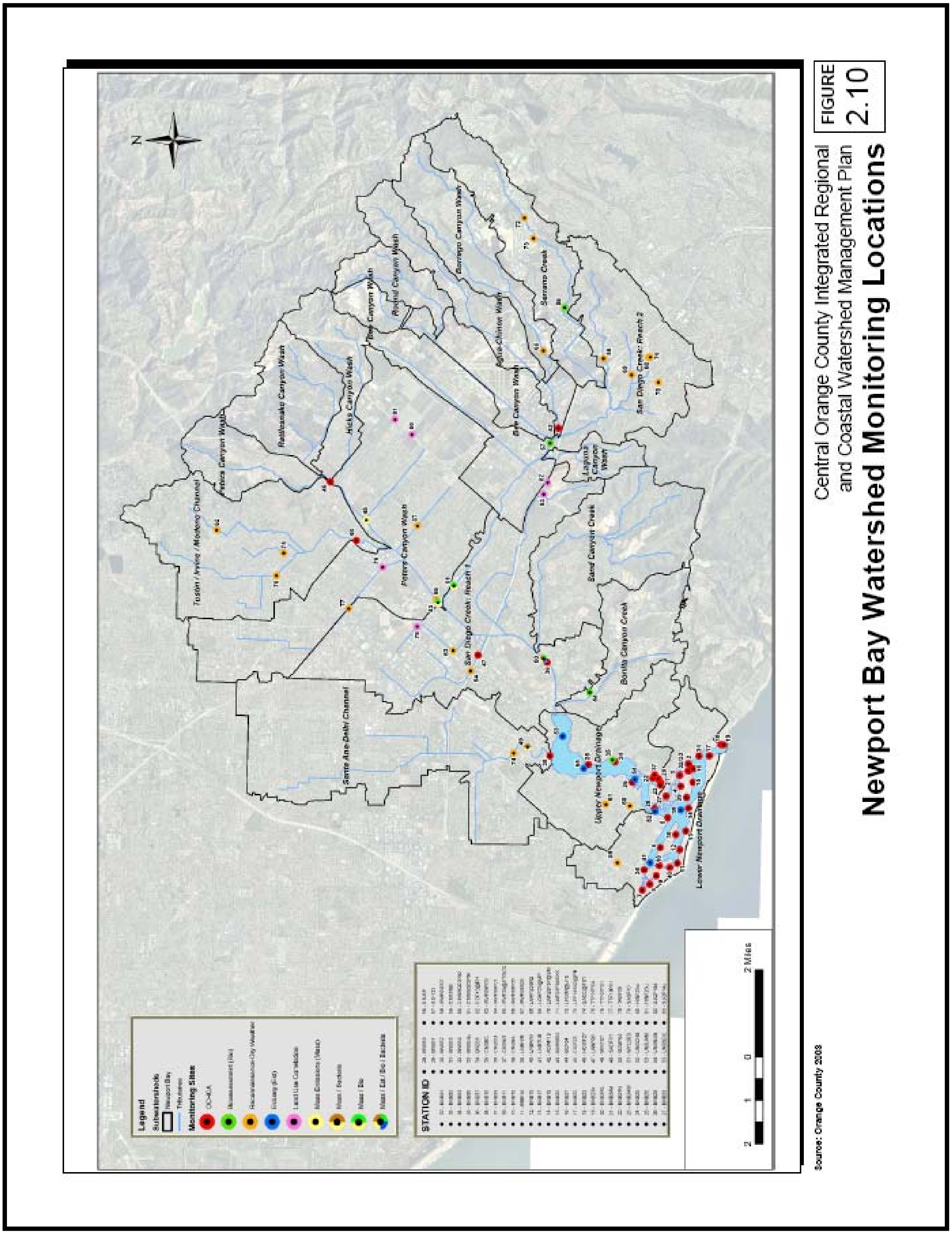


FIGURE
2.10
Central Orange County Integrated Regional
and Coastal Watershed Management Plan
Newport Bay Watershed Monitoring Locations
Source: Orange County 2008
Legend
Monitoring Sites
STATION ID
2 Miles

generally advises against the consumption of shellfish harvested anywhere in the Bay. Bacterial objectives established to protect shellfish harvesting activities are rarely met in the Bay. Certain areas in the lower parts of the Upper Bay and in Lower Newport Bay (Lower Bay) are also closed to water-contact recreation on a temporary basis, generally in response to storms. In these areas, there is generally good compliance with water-contact recreation bacterial objectives in the summer.

Data collected by the OCHCA demonstrate that tributary inflows, composed of urban and agricultural runoff, including stormwater, are the principal sources of coliform input to the Bay. As expected, there are more violations of bacterial standards in the Bay during wet weather, when tributary flows are higher, than in dry weather. There are few data on the exact sources of the coliform in this runoff. Coliform has diverse origins, including: manure fertilizers which may be applied to agricultural crops and to commercial and residential landscaping; the fecal wastes of humans, household pets and wildlife; and other sources.

Another source of bacterial input to the Bay is the discharge of vessel sanitary wastes. Newport Bay has been designated a no-discharge harbor for vessel sanitary wastes since 1976. Despite this prohibition, discharges of these wastes have continued to occur. Since these wastes are of human origin, they pose a potentially significant public health threat.

As noted, the fecal waste of wildlife, including waterfowl that inhabit the Bay and its environs, is a source of coliform input. The fecal coliform from these natural sources may contribute to the violations of water quality objectives and the loss of beneficial uses, but it is currently unknown to what extent these natural sources contribute to, or cause, the violations of bacterial quality objectives in Newport Bay.

Implementation of the TMDL is expected to address these bacterial quality problems and to assure attainment of water quality standards, that is, compliance with water quality objectives and protection of beneficial uses.

Sediment

Sediment control has been a key water quality issue for decades. Increased surface water flow due to urbanization and channelization has increased the quantity of sediment transported through the watershed to Upper Newport Bay. For example, an estimated 400,000 cubic yards of sediment were deposited in Upper Newport Bay during the 1969 storm season (ACOE 1998). Issues related to increased surface water flow and sedimentation are: increased stream erosion, which has threatened homes, utilities, and other structures; impacts to estuarine species and habitats in Upper Newport Bay; and loss of navigation channels in Newport Bay (ACOE 1998).

Stream erosion has recently been most notable in Serrano Creek, upstream of Serrano Creek Community Park. In Serrano Creek, stream erosion threatens to undercut homes, has damaged and threatened a Los Alisos Water District sewer line and a Southern California Edison utility pole, and has cut hundreds of thousands of cubic yards of channel banks in a storm season, which has resulted in the loss of riparian habitat (ACOE 1998). In addition, Borrego Wash has also shown severe erosion. Historically, there are other channels that have had erosion issues.

Sedimentation in Upper Newport Bay has altered the depth of the bay, which in turn has altered tidal exchange and the type and availability of aquatic and wildlife habitat (ACOE 1998). These conditions are of concern to natural resource groups and regulatory agencies as Upper Newport Bay is one of only a few remaining estuaries in Southern California, is one of the only remaining coastal Mediterranean habitats and is used as a stopover point on the Pacific flyway, and is the home to numerous species of mammals, fish, invertebrates, and native plants, including several endangered species (Newport Bay Naturalists and Friends 2007).

The implementation of BMPs (i.e. foothill retarding basins, in-channel and in-bay sediment trapping basins, etc.) and the TMDL have improved these conditions of concern; however, tens of thousands of tons of sediment are still being deposited in the bay each year, as shown in *Table 2.7, Sediment Discharge from San Diego Creek to Newport Bay*.

Table 2.7
Sediment Discharge from San Diego Creek to Newport Bay as Measured at the San Diego Creek at Campus Drive Station

Year	Annual Flow in Acre-Feet	Annual Sediment Discharge in Tons
1983	58,952	534,035
1984	29,425	64,455
1985	26,987	32,236
1986	29,746	37,760
1987	21,423	20,060
1988	22,089	34,186
1989	17,359	19,810
1990	19,154	24,855
1991	28,935	83,924
1992	37,186	173,212
1993	62,510	355,208
1994	20,000	33,027
1995	61,182	347,579
1996	23,501	49,438
1997	33,946	92,181
1998	92,345	618,006
1999	17,334	16,439
2000	17,780	28,864
2001	27,320	75,686
2002	10,610	5,640
2003	30,090	64,740

Table 2.7
Sediment Discharge from San Diego Creek to Newport Bay as Measured at the San Diego Creek at Campus Drive Station

Year	Annual Flow in Acre-Feet	Annual Sediment Discharge in Tons
2004	18,690	30,464
2005	75,860	165,810
2006	20,150	9,291

Source: URS 2003 and County of Orange, RDMD Upper Newport Bay/ San Diego Creek Watershed Sediment TMDL Annual Reports

The Sediment TMDL monitoring program includes a monitoring element for Newport Bay. The Newport Bay monitoring element includes bathymetric surveys, vegetation surveys, and sediment removal.

Nutrients

Changes in land use from ranching and grazing to farmland in the watershed resulted in the discharge of nutrients into San Diego Creek and Upper Newport Bay. Nutrients are also discharged from landscaped areas of residential and commercial developments. The increased nutrient loading to the San Diego Creek and Upper Newport Bay has resulted in algal growth. Algal blooms in Newport Bay have been responsible for aesthetic nuisances and interfered with recreational activities, and decomposing algae has resulted in fish kills due to the creation of anoxic conditions (EPA 1998). Additionally, the nutrient impairment has resulted in non-compliance with the narrative water quality objectives of the Santa Ana River Basin Plan regarding algae and dissolved oxygen (EPA 1998).

Nutrient loading from San Diego Creek to Upper Newport Bay peaked in the mid-1980s at 7 million pounds of nitrate in the 1985-1986 seasons (EPA 1998). Nutrient loading decreased in the 1990s due to increased controls and BMPs; however, total inorganic nitrogen (TIN) data continued to be greater than the water quality goals in the 1990s, and algal blooms continued in Upper Newport Bay (EPA 1998).

San Diego Creek and Newport Bay were placed on the EPA Section 303(d) list of impaired waters. Based on that listing, TMDLs of nutrients entering waters of the creek and bay were established. In accordance with the nutrient TMDL, a Regional Monitoring Program was initiated in 2000.

Data from the Quarterly Data Report, Newport Bay Watershed, Nutrient TMDL, October - December 2006 are presented in *Table 2.8, Summary of Second Quarter 2006-2007 Concentrations in San Diego Creek at Campus Drive* and *Table 2.9, Summary of Second Quarter 2006-2007, Concentrations in Santa Ana-Delhi Channel at Irvine Avenue.*

Table 2.8
Summary of Second Quarter 2006-2007
Concentrations in San Diego Creek at Campus Drive

	NH3	NO3 + NO2 as N	TKN	TIN	TP as PO4	TP	OrthoPO4 as P	TSS	VSS	TN
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Max	0.8	8.8	9.6	9.0	1.71	0.56	0.23	40	14	1776.82
Min	0.1	2.6	4.2	3.2	0.25	0.08	<0.02	14	2	89.57
Median	0.2	4.9	6.4	5.1	0.59	0.19	0.08	27	7	281.61
Mean	0.3	5.0	6.6	5.2	0.71	0.23	0.08	27	7	400.40
St Dev	0.2	1.6	1.4	1.6	0.37	0.12	0.07	8	3	390.10

Source: Quarterly Data Report, Newport Bay Watershed, Nutrient TMDL, October - December 2006

Table 2.9
Summary of Second Quarter 2006-2007
Concentrations in Santa Ana-Delhi Channel at Irvine Ave

	NH3	NO3 + NO2 as N	TKN	TN	TIN	TP as PO4	TP	OrthoPO4 as P	TSS	VSS
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Max	1.9	8.7	8.4	12.3	8.8	5.85	1.91	0.14	630	180
Min	<0.1	3.4	0.6	5.9	4.0	0.11	0.04	< 0.02	<5	< 1
Median	0.2	6.6	1.1	8.4	6.7	0.48	0.16	0.07	19	5
Mean	0.4	6.3	2.4	8.7	6.7	1.26	0.41	0.06	116	32
St Dev	0.5	1.9	2.8	2.0	1.6	1.76	0.58	0.04	204	56

Source: Quarterly Data Report, Newport Bay Watershed, Nutrient TMDL, October - December 2006

A Nitrogen and Selenium Management Program (NSMP) was created in 2005 in response to a general NPDES permit (Order No. R8-2004-0021) issued for the Newport Bay watershed. The NSMP is a collaborative effort of 18 stakeholders, including various State, county, and local agencies, water districts, and private entities with the goal of developing management strategies and treatment technologies for groundwater dewatering discharges of both selenium and nitrogen for the watershed. A work plan has been developed by the NSMP and approved by the Santa Ana Regional Water Quality Control Board. The work plan will focus on the development of treatment technologies, BMPs, and an offset, trading or mitigation program. Additionally, if necessary, the NSMP will develop and recommend a site specific objective for selenium. The County of Orange is the Chair of the NSMP, providing program leadership and ensuring implementation of the work plan and compliance with the terms of the permit.

The key elements of the work plan include, (1) collecting additional data to fill knowledge gaps regarding the movement and impacts and selenium and nitrogen in the watershed, (2) examining Best Management

Practices (BMPs) and treatment technologies that can reasonably and effectively be applied in the watershed, (3) developing an offset, trading, or mitigation program for both selenium and nitrogen, (4) using the increased knowledge and treatment opportunities developed in previous tasks to evaluate the Nutrient TMDL, and (5) if appropriate, develop a site specific objective for selenium.

Toxic Pollutants

Changes in land use from ranching, grazing, and farming to residential and industrial development result in the discharge of metals (cadmium, cooper, lead, selenium, and zinc) and organic compounds into San Diego Creek, Upper Newport Bay, and Lower Newport Bay. Historical farming, military bases, and urban development all introduce sources of toxic substances into the watersheds. Land use activities that cause erosion increase the delivery of toxic substances to the watersheds.

On June 14, 2002, the U.S. Environmental Protection Agency (EPA) established the Toxics TMDL for San Diego Creek/Newport Bay. The EPA promulgated TMDL covers 14 different constituents – chlorpyrifos and diazinon (organophosphate pesticides); chlordane, dieldrin, DDT, PCBs, and toxaphene (organochlorinated compounds); cadmium, copper, lead and zinc (metals); selenium; chromium and mercury (metals, specific to Rhine Channel only).

Table 2.10 Waterbodies and Pollutants below lists the pollutants and the geographical areas to which the TMDL applies within the San Diego Creek/Newport Bay watersheds:

Table 2.10
Waterbodies and Pollutants

Waterbody	Element/Metal	Organic Compounds						
San Diego Creek (freshwater)	Cd, Cu, Pb, Se, Zn	Chlorpyrifos	Diazinon	Chlordane	Dieldrin	DDT	PCBs	Toxaphene
Upper Newport Bay (saltwater)	Cd, Cu, Pb, Se, Zn	Chlorpyrifos		Chlordane		DDT	PCBs	
Lower Newport Bay (saltwater)	Cu, Pb, Se, Zn			Chlordane	Dieldrin	DDT	PCBs	
Rhine Channel (saltwater)	Cd, Cu, Pb, Se, Zn, Cr, Hg			Chlordane	Dieldrin	DDT	PCBs	

The Santa Ana Regional Water Quality Control Board is in the process of reviewing the EPA promulgated Toxics TMDL and has decided to break it down into five separate constituent and geographically specific TMDLs. The five resulting TMDLs include:

1. Organophosphate Pesticides (diazinon and chlorpyrifos);
2. Selenium;
3. Organochlorinated Compounds (chlordane, dieldrin, DDT, PCBs, toxaphene);
4. Metals (cadmium, copper, lead, zinc); and
5. Rhine Channel (copper, lead, selenium, zinc, chromium, mercury).

The organophosphate pesticides TMDL has been amended into the Basin Plan. The other individual TMDLs must proceed through the full State approval process before they are officially adopted.

An investigation of stormwater runoff in tributaries to Newport Bay in 1992 and 1993 demonstrated the existence of aquatic life toxicity. A toxicity identification evaluation (TIE) performed on several of the samples collected during the study, indicated that one or more pesticides were responsible for the observed toxicity, and that diazinon was likely one of these pesticides. Separate sampling programs, the Toxic Substances Monitoring Program (TSMP), and the State Mussel Watch (SMW), demonstrated that chlorpyrifos and diazinon were present in fish and mussel tissue. The TSMP and SMW were conducted in upper and lower Newport Bay as well as in the drainage channels in the Newport Bay watershed, with diazinon and chlorpyrifos data available from 1983 onwards.

As a result of these investigations, upper and lower Newport Bay and Reach 1 of San Diego Creek were included on California's 1998 Clean Water Act Section 303d list for pesticides. Reach 2 of San Diego Creek was listed for unknown toxicity. Supplemental studies to determine the sources of the toxicity observed during the 1992-93 investigation were carried out from 1996 to 2000. These studies further documented the occurrence of aquatic life toxicity in the Newport Bay watershed, and concluded that diazinon and chlorpyrifos were causing a large portion of the observed toxicity in San Diego Creek. An investigation of Upper Newport Bay indicated the presence of toxicity attributable to chlorpyrifos in stormwater runoff entering the upper bay from San Diego Creek. No samples were collected from lower Newport Bay. Based on these findings, TMDL development for diazinon and chlorpyrifos in San Diego Creek, and chlorpyrifos in upper Newport Bay was initiated (Santa Ana Regional Water Quality Control Board [SARWQCB] 2001). Diazinon and chlorpyrifos are widely used organophosphate pesticides, and are among the pesticides detected most frequently in urban waterways.

Selenium, a primary metal of concern in the watershed, is discharged into the San Diego Creek and eventually to Newport Bay through erosion, runoff, and discharges of shallow groundwater from dewatering activities and pump-and-treat groundwater remediation activities (EPA 2002).

Hibbs and Lee (2000) investigated sources of selenium in the Newport Bay/San Diego Creek watershed. The study presents convincing evidence that groundwater is a significant source of selenium to San Diego Creek and Newport Bay. At the watershed scale, the study shows that selenium concentrations exceed the numeric target in most of the surface and groundwater samples collected, and that they exhibit spatial heterogeneity. Concentrations in groundwater range from below 4 µg/L (method detection limit) to 478 µg/L. A statistical analysis shows that selenium concentrations in groundwater samples were generally found to be higher within the boundaries of a historical marsh ("Swamp of the Frogs" or "La Cienega de las Ranas") than in other areas. Radioisotope analysis on the water samples suggest that high selenium concentrations in groundwater result from oxidation and leaching of subsurface soils in the saturated zone underlying the old marsh area. Monitoring of nursery discharge shows selenium concentrations in most runoff samples (6 out of 7) were below detection limits (*i.e.*, < 4 µg/L). One sample was detected at 7 µg/L from Bordiers Nursery. Surface water monitoring shows that discharges containing less than 10 µg/L selenium were mostly urban and agricultural runoff. Surface channels and drains with particularly high concentrations coincide with areas where high selenium groundwater samples were collected. Those channels include Como Channel (38 to 42 µg/L), Valencia Drain at Moffett Drive (25 to 40 µg/L), Warner Drain (24 to 33 µg/L), and the circular drains at Irvine Center Drive (141 to 162 µg/L) and at Barranca Parkway (107 µg/L). Channel inspection and chemical composition analysis indicate that those drainage channels collect considerable amounts of groundwater

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In November 2006, the Santa Ana RWQCB presented a staff report for TMDLs for organochlorine pesticides and PCBs. The RWQCB TMDLs report summarizes the information presented in the EPA TMDL and presents some new information and modifications to reflect the 2006 proposed 303(d) list and revised loading information.

Lower Newport Bay has additional water quality issues associated with metals used in boat paints. Rhine Channel, located in the western end of Lower Newport Bay, has been surrounded by industrial uses, such as canneries, metal plating companies, and shipyards, since the 1920s (Anchor Environmental 2006). Rhine Channel is a dead-end channel in which toxic pollutants have accumulated in the sediment. Consequently, the Santa Ana Regional Board has designated Rhine Channel as toxic hotspot. The land use history in the area immediately adjacent to Rhine Channel suggests that local pollutant source may be significantly different from the pollutant sources that have discharged to the rest of the watershed. Given the different levels of sediment contamination observed in Rhine Channel as compared to other areas of Newport Bay and the likely association of toxic hotspots in Rhine Channel with local pollutant sources, EPA has determined that is appropriate to develop separate TMDLs for that specific reach of Lower Newport Bay.

Table 2.11, Toxic Pollutant TMDLs and Newport Bay Concentrations, presents the TMDLs and the concentrations of pesticides and metals contained in samples collected from San Diego Creek, Upper and Lower Newport Bay, and the Rhine Channel.

Table 2.11
Toxic Pollutant TMDLs and Newport Bay Watershed Concentrations

			Criteria			2002 Concentrations			
Pollutant	Type of Compound	Location	Status	Fresh-water (ug/l)	Saltwater (ug/l)	San Diego Creek (ug/l)	Upper Newport Bay (ug/l)	Lower Newport Bay (ug/l)	Rhine Channel (ug/l)
Diazinon	Organophosphate Pesticide	San Diego Creek	Chronic	0.05		0.2	0.202		
			Acute	0.08					
Chlorphyrifos	Organophosphate Pesticide	San Diego Creek	Chronic	0.014	0.009	0.111	0.0433		
			Acute	0.02	0.02				
Selenium	Metal	San Diego Creek	Chronic	5		22.1			
			Acute	20	71 (dissolved)				
Cadmium	Metal	San Diego Creek	Acute	8.9 to 19.1 for large flows to baseflows	42	0.13-0.27	0.095-0.22	-	-

Table 2.11
Toxic Pollutant TMDLs and Newport Bay Watershed Concentrations

			Criteria			2002 Concentrations			
Pollutant	Type of Compound	Location	Status	Fresh-water (ug/l)	Saltwater (ug/l)	San Diego Creek (ug/l)	Upper Newport Bay (ug/l)	Lower Newport Bay (ug/l)	Rhine Channel (ug/l)
			Chronic	4.2 to 6.2 for medium flows to baseflows	9.3				
Copper	Metal	San Diego Creek	Acute	25.5 to 50 for large flows to baseflows	4.8	2.4-5.5	3.4-29.0	8.2-26.3	-
			Chronic	18.7 to 29.3 for medium flows to baseflows	3.1				
Lead	Metal	San Diego Creek	Acute	134 to 281 for large flows to baseflows	210	0.05-0.35	0.023-0.96	0.03-0.89	-
			Chronic	6.3 to 10.9 for medium flows to baseflows	8.1				
Zinc	Metal	San Diego Creek	Acute	208 to 379 for large flows to baseflows	90	2.6-23.1	10-100	2.5-11.5	-
			Chronic	244 to 382 for medium flows to baseflows	81				
PCBs	Organochlorine Pesticides	San Diego Creek	Chronic	0.014		ND			ND
DDT	Organochlorine Pesticides	San Diego Creek	Acute	1.1		ND			ND
			Chronic	0.001					
Chlordane	Organochlorine Pesticides	San Diego Creek	Acute	2.4		ND			ND
			Chronic	0.0043					
Dieldrin	Organochlorine Pesticides	San Diego Creek	Acute	0.24		ND			ND
			Chronic	0.056					

Table 2.11
Toxic Pollutant TMDLs and Newport Bay Watershed Concentrations

			Criteria			2002 Concentrations			
Pollutant	Type of Compound	Location	Status	Fresh-water (ug/l)	Saltwater (ug/l)	San Diego Creek (ug/l)	Upper Newport Bay (ug/l)	Lower Newport Bay (ug/l)	Rhine Channel (ug/l)
Toxaphene	Organochlorine Pesticides	San Diego Creek	Acute	0.73		ND			ND
			Chronic	0.0002					

Notes
Source: EPA 2002;metal data from Newport Bay Toxics TMDL Part E.
NA – not analyzed, DNQ – detected but not quantified, ND – not detected

Water Quality Projects

Major efforts being conducted within the Newport Bay Watershed to reduce non-point source releases and improve water quality as identified in the June 2006 *State of the CCAs Report for Upper Newport Bay* are listed in *Table 2.12, Water Quality Projects Defined in the State of the CCAs Report*.

Table 2.12
Water Quality Projects Defined in the State of the CCAs Report

1	Serrano Creek Stabilization and Restoration Project	Restore about 1.2 miles of Serrano Creek in the City of Lake Forest through installation of several creek stabilization features coupled with riparian restoration; designed to balance flood management, habitat, and recreation objectives. http://www.willdan.com/Services_Flood.asp?ProjectID=41
2	Newport Bay Watershed Management Plan	Framework for how to achieve effective watershed management, leading to a sustainable urban environment; includes wetland protection, education, water conservation, regulation, ad stormwater management, economics. http://www.ocwatersheds.com/watersheds/pdfs/Newport_Bay_Watershed_Plan_04-12-15.pdf
3	Special Area Management Plan for San Diego Creek Watershed	Plan will describe an approach and set of actions to preserve, enhance, and restore aquatic resources, while allowing reasonable economic development and construction and maintenance of public infrastructure facilities. http://www.spl.usace.army.mil/samp/sandiegocreeksamp.htm
4	Selenium Removal Pilot Project	Tested an anoxic biofiltration process using laboratory cylinders and "mesocosms" to remove selenium from surface water in San Diego Creek; now constructing a full-scale in situ version to treat water from Peters Canyon Wash. http://www.irwd.com/
5	Upper Newport Bay Ecosystem Restoration Project	The project will deepen two sediment basins in the upper bay; includes an ongoing maintenance-dredging program and enhancements to several existing wetlands and tidal channels and the creation of a least tern nesting island.

Table 2.12
Water Quality Projects Defined in the State of the CCAs Report

		http://www.spl.usace.army.mil/newportbay/uppernewportbay.htm
6	Newport Bay Naturalists and Friends	Mission is to restore and preserve the native habitat of the bay and surroundings; educate the public about the ecological value of the bay; achieve good water quality, healthy native flora and fauna, and compatible public use. www.newportbay.org
7	Orange County CoastKeepers	Mission is to protect and preserve Orange County's marine habitats and watersheds through education, advocacy, restoration, and enforcement. www.coastkeeper.org
8	Dry Weather Diversions, Storm Drain Inlet Modifications, and Circulation Study	Clean Beaches Initiative grant study at Newport Bay to divert or treat urban runoff. http://www.city.newport-beach.ca.us/Pubworks/pwmain.htm
9	Divert Urban Runoff at Newport Bay Beaches an Newport Beach and Ocean Beach	Grant for storm drain to sewer diversions. http://www.city.newport-beach.ca.us/Pubworks/pwmain.htm
10	Working At the Watershed Level Science & Stewardship Program & ERF High School Clubs	Modules on understanding importance of a healthy watershed, urban refuse collection, data collection, source identification, and bioassessment. Program enhances the teachers' opportunity to involve students in science. http://earthresource.org/
11	Big Canyon Creek Restoration Project	Improving the water quality of Big Canyon Creek as it enters Upper Newport Bay; remove exotic species and replace with native, non-invasive species; create effective riparian, wetlands, coastal sage scrub, and other habitat. http://www.city.newport-beach.ca.us/Pubworks/pwmain.htm
12	Newport Bay Fecal Coliform Source Identification and Management Plan	Activities to determine extent that urban and natural sources of fecal coliform contribute to bacterial quality problems throughout the bay; and development of a source management plan to address source inputs. http://www.ocwatersheds.com/
13	Newport Bay Nutrient Total Maximum Daily Load (TMDL) Dissolved Oxygen and Algae Distribution Study	Two investigations of the Newport Bay Nutrient TMDL Regional Monitoring Program: (1) monitor dissolved oxygen levels continuously; and (2) collect remote sensing data of bay to document extent of algae growth. http://www.ocwatersheds.com/
14	Assessment of Food Web Transfer of Organochlorine Compounds and Metals in Fishes Newport Bay, California	Identify fish species that could be used as surrogates for assessing ambient water quality relative to wildlife protection and human health concerns; examine food-web interactions of DDTs, PCBs, and trace metals in fish. http://www.sccwrp.org/
15	Storm Drain Inlet Modifications and Implement Circulation Measures	Source abatement at Newport Bay. http://www.city.newport-beach.ca.us/Pubworks/pwmain.htm

Groundwater Supply

The Orange County Groundwater Basin (the Basin) is located throughout the majority of the San Diego Creek subwatershed (see *Figure 2.2*). Resolution No. R8-2004-0001, which was adopted by the Santa Ana RWQCB and amended the Water Quality Control Plan, contains several revisions that affect waters within the region. Specifically, the Irvine Forebay I, Irvine Forebay II, and Irvine Pressure groundwater basins were amalgamated into one groundwater management zone called the Irvine Management Zone for groundwater quality purposes. Within OCWD's Groundwater Management Plan, the area is called the Irvine Subbasin.

The Irvine Subbasin is bounded by the San Joaquin Hills to the south and the foothills of the Santa Ana Mountains to the northeast (Wildermuth 2000). The boundary with the Main Basin is approximately aligned along Interstate Highway 55 and Newport Boulevard. The Irvine Subbasin and Main Basin, while hydraulically continuous, are distinct in that they have separate recharge zones; the thickness of the water-bearing alluvium increases substantially from Irvine to the central portion of the main basin; and the permeability of the water-bearing alluvium increases substantially from Irvine to the central portion of the main basin. The percentage of clay and silt is much higher in the Irvine Subbasin than in the main basin (USGS 2002).

Groundwater in the Irvine Subbasin flows westward from the forebay areas into the pressure area. The pressure area, in a general sense, is defined as the area where surface waters and near-surface groundwater are impeded from percolating in large quantities into the major productive aquifers by clay and silt layers at shallow depths (upper 50 feet). Most of the central and coastal portions of the basin fall within the pressure area (OCWD 2004). Groundwater flow direction can vary locally due to variations in climate and groundwater production patterns; however, the prevailing flow direction remains westward (Wildermuth 2000). The depth to groundwater in the basin is known to vary based on the permeability characteristics of the subsurface soils, irrigation, groundwater pumping, and groundwater recharge.

The Irvine Subbasin is divided into three groundwater aquifers referred to as the shallow, principal, and deep aquifers (OCWD 2004). The shallow aquifer is unconfined, is of poor quality, and is generally not used for municipal supply. Details regarding each of these aquifers are presented in *Table 2.13, Irvine Groundwater Aquifers*.

Table 2.13
Irvine Groundwater Aquifers

Aquifer	Description	Thickness
Shallow	System of unconfined semi-perched aquifers in Pleistocene marine terrace deposits that is generally not used for domestic or agricultural supply. Consists mostly of fine sands, silts, and clays. In the vicinity of the Upper Newport Bay, the shallow aquifer discharges to Upper Newport Bay.	1 to 180 feet
Principal	The principal aquifer is where the majority of the water is produced. It includes an alluvial sequence of interbedded sands and gravels with silts and clays.	400 to 1,000 feet
Deep	The deep aquifer consists of fine- to coarse-grained sands. It is rarely used for supply due to economical constraints and slight brownish tint. IRWD began pumping and treating approximately 7,400 acre-feet per year in 2002. Water in the deep aquifer contains fewer minerals than in other areas of the basin.	1,000 to 3,000 feet

Source: USGS 2005.

Table 2.12 is an overall generalization of a fairly complex aquifer system, and the depths of the three aquifer units described above vary based on location. For instance, the units thin and converge at the basin margins, and the principal aquifer is located at much shallower depths in these areas.

Based on the studies and modeling conducted by OCWD, the Orange County Groundwater Basin stores approximately 66 million acre-feet of water, although only a fraction can be removed without causing physical damage, such as seawater intrusion or land subsidence (OCWD 2004). The Basin is not operated on an annual safe-yield basis, and it has historically been overdrafted. OCWD has developed a hydrologic budget (with inflows and outflows balanced) to evaluate Basin production capacity and recharge requirements. The budget factors in recharge, groundwater production, and flows along the coast and across the Los Angeles/Orange County line. The budget shown in *Table 2.14, Representative Basin Water Budget,* is based on the following assumptions: (1) average precipitation; (2) accumulated overdraft (400,000 acre-feet from full); (3) recharge at Forebay facilities equal to current maximum capacity of 250,000 acre-feet per year; and (4) adjusted groundwater production to balance inflows and outflows (OCWD 2004).

Table 2.14
Representative Basin Water Budget

INFLOW	Acre Feet
Measured Recharge	
1. Forebay spreading facilities, current maximum, including imported water	250,000
2. Talbert Barrier injection, current maximum	12,000
3. Alamitos Barrier injection, Orange County only	2,500
Unmeasured Recharge (average precipitation)	
1. Inflow from La Habra Basin	3,000
2. Santa Ana Mountain recharge into Irvine subbasin	13,500
3. San Joaquin Hills recharge into Irvine subbasin	500
4. A real recharge from rainfall/irrigation (Forebay area)	13,000
5. A real recharge from rainfall/irrigation (Pressure area)	4,500
6. Chino Hills recharge into Yorba Linda subbasin	6,000
7. Subsurface inflow at Imperial Highway beneath SAR	4,000
8. SAR recharge between Imperial Highway and Rubber Dam	4,000
9. Subsurface inflow beneath Santiago Creek	10,000
10. Peralta Hills recharge into Anaheim/Orange	4,000
11. Tustin Hills recharge into City of Tustin	6,000
12. Seawater inflow through coastal gaps	2,000
Subtotal:	*70,500*
TOTAL INFLOW	335,000
OUTFLOW	
1. Groundwater Production	327,000
2. Flow across Orange/Los Angeles County line, est. at 400,000 acre-feet accumulated overdraft	8,000
TOTAL OUTFLOW	335,000
CHANGE IN STORAGE: 0	0

Note: The representative water budget has equal (balanced) total inflow and total outflow and does not represent data for any given year.

Source: OCWD 2004.

OCWD replenishes the Basin through the use of recharge basins located outside of the study area for this IRCWM Plan. In November 2007, the Groundwater Replenishment System will begin operating, which will use advance treated wastewater from OCSD's reclamation plant for groundwater recharge and seawater barrier. The first phase of the Groundwater Replenishment System will provide an estimated 70,000 acre-feet per year for recharge, with a maximum project size of 110,000 acre-feet year. One of the key factors for future phases is the availability of sufficient secondary treated wastewater flows from OCSD.

Recharge to the Irvine Subbasin occurs through infiltration of flow within the unlined stream channels, underflow from the saturated alluvium and fractures within the bordering bedrock, and from precipitation and irrigation (Wildermuth 2000). As groundwater production increases in the subbasin to where it exceeds recharge, groundwater will flow from the main basin into the subbasin. As noted in *Table 2.13*, unmeasured recharge to the Irvine Subbasin based on average precipitation is approximately 20,000 acre-feet per year.

There are approximately 500 active wells within OCWD's boundaries, with an estimated 300 wells producing less than 25 acre-feet per year (OCWD 2004). All large-capacity wells are metered, and individual well production is documented monthly. OCWD manages groundwater production from the groundwater basin through setting an annual basin pumping percentage (BPP) based on net water available for pumping divided by net total water demands from the previous year. The BPP is directly related to hydrologic conditions and recent groundwater production. Water available for future basin pumping is estimated at approximately 357,000 acre-feet in 2007-2008, increasing to 367,104 acre-feet in 2010-2011 (OCWD 2006). Producers pay a Replenishment Assessment for groundwater production up to the BPP; production that exceeds the BPP is assessed an additional higher-cost Basin Equity Assessment charge to cover the cost of replenishing that groundwater. Through this methodology, OCWD is able to manage the basin resources and provide financial incentive for producers to work cooperatively in reducing any overdraft.

Groundwater production has doubled since 1954, and increasing use is anticipated as agencies seek to reduce dependence on imported water. OCWD has developed a draft Long-Term Facilities Plan that identifies and evaluates projects that could increase the sustainable yield of the basin in a cost-effective manner to the highest possible amount. The Plan also identifies projects to protect and enhance groundwater quality and protect the coastal portion of the basin.

Groundwater Quality

The Orange County Groundwater Basin is currently recharged by streambed percolation, recycling programs, and imported water purchases. OCWD monitors the quality of the Groundwater Basin extensively, testing for over 190 constituents, including nitrate, salts, selenium, trichloroethylene, volatile organic compounds, and radon to ensure potable quality. OCWD and OCSD are also implementing the new Groundwater Replenishment System, scheduled to be on-line in 2007, which will take highly treated wastewater from the OCSD Water Reclamation Plant and purify it using micro-filtration, reverse osmosis, and ultraviolet light and hydrogen peroxide before percolating it into the basin. Water produced by this system is expected to be so pure it will actually help to reduce the growing mineral content in the basin and will exceed all state and federal drinking water standards (OCWD 2005).

Individual water districts, such as IRWD, also test their domestic groundwater sources. IRWD, which serves the majority of the planning area, obtains domestic groundwater from two sources: the Irvine Subbasin, which is located within the Orange County Groundwater Basin, and Lake Forest, which does not overlie the Orange County Groundwater Basin. The Irvine Subbasin is mainly used for non-potable water, as the groundwater is high in TDS, nitrates, and has color. Additionally, the groundwater obtained from the six Lake Forest wells have poor quality and are used as non-potable water to supplement IRWD's recycled water production. Water quality for groundwater from these two areas is presented in *Table 2.15, Select Groundwater Concentrations in 2005*.

Table 2.15
Select Groundwater Concentrations in 2005

Analyte	Dyer Road Well Field (Irvine Subbasin)		Lake Forest Wells		
	Concentration Range	Average Concentration	Concentration Range	Average Concentration	Concentration Limit (MCL)
Nitrate and Nitrite as Nitrogen	ND-1.9 mg/l	<0.4 mg/l	ND-1.3 mg/l	0.6 mg/l	10 mg/l
Nitrate as Nitrate	ND-8.2 mg/l	<2 mg/l	ND-5.7 mg/l	2.6 mg/l	45 mg/l
Arsenic	ND-9.0 ug/l	<2 ug/l	3.3-5.7 ug/l	4.3 ug/l	0.004 ug/l
PCE	ND-0.9 ug/l	<0.5 ug/l	ND	<5 ug/l	5 ug/l
Color	ND-500	41	5-10	8	15
Iron	ND-172 ug/l	<100 ug/l	170-490 ug/l	300 ug/l	300 mg/l
Manganese	ND-22 ug/l	<20 ug/l	ND-75 ug/l	44 ug/l	50 ug/l
TDS	208-394 mg/l	263 mg/l	450-850 mg/l	670 mg/l	1,000 mg/l
Perchlorate	ND-6.1 ug/l	<4 ug/l	ND	<4 mg/l	N/A

Source: IRWD 2006 Water Quality Annual Report, Dyer Road Wellfield Data.

As shown in *Table 2.15*, color is a water quality issue in portions of the Groundwater Basin, including areas where groundwater is produced for the City of Costa Mesa. Colored water is generally a problem in the deeper aquifer.

High TDS in portions of the Irvine Subbasin present a water quality issue. High TDS in other areas of the Groundwater Basin are due to seawater intrusion.

Nitrogen concentrations in the study area groundwater, especially shallow groundwater, have been high. Several studies have indicated that the high nitrogen concentrations are a result of the historical agricultural practices in the area.

Selenium is an issue in shallow groundwater throughout the watershed High selenium concentrations are mainly found in the Peters Canyon Wash sub-watershed; however, high concentrations are also found in the vicinity of MCAS–Tustin. Selenium concentrations in groundwater sources in the main subbasins of the San Diego Creek Watershed from 1999-2005 are presented in *Table 2.16, Selenium Concentrations in Groundwater Sources*.

Table 2.16
Selenium Concentrations in Groundwater Sources

Sub-watershed	Range of Selenium Concentrations (ug/l)	Concentration Limits (ug/l)
San Diego Creek, Reach 1	3.15-187	2-5
San Diego Creek, Reach 2	1.87-12.8	2-5
Peters Canyon Wash	2.6-270	2-5
Santa Ana-Delhi Channel	7.69-106	2-5

Source: Sources and Loads and Identification of Data Gaps for Selenium – Nitrogen and Selenium Management Program.

OCWD and local water districts have implemented water quality projects in the study area to treat the groundwater. These projects include the Irvine desalter project to remove nitrates, TDS, and volatile organic compounds (VOCs); the Tustin desalter and nitrate projects to remove TDS and nitrates; the IRWD Deep Aquifer Treatment to remove color and organics; and the MCWD colored water program.

The Irvine desalter program focuses on groundwater in central Irvine, specifically in the vicinity of the former MCAS–El Toro facility. In addition to high TDS and nitrate concentrations, groundwater in this area was found to contain concentrations of VOCs due to former use and disposal of solvents related to aerospace use. A 1 mile-by-3 mile plume of VOC contamination extends off of the former MCAS–El Toro. The Tustin desalter program is a similar program located in the northern portion of Tustin.

2.5.2 Newport Coast Watershed

The Newport Coast Watershed is shared by several jurisdictions. Most of this watershed was annexed by the City of Newport Beach in 2002, although the southernmost portion, beginning at Morro Canyon, is within the County of Orange's jurisdiction. The northern portion of the watershed is within the Santa Ana RWQCB boundary, and the southern portion is within the San

Diego region. Only the portion of the watershed within the jurisdiction of the Santa Ana RWQCB is included in this IRCWM Plan.

Surface Water

Eight coastal canyon drainage areas, defined by their canyon creeks, are included in the Newport Coast Watershed for this IRCWM Plan, including:

- Buck Gully: Reaches 1, 2, and 3
- Morning Canyon: Reaches 1 and 2
- Pelican Point, Pelican Point Middle Creek, Pelican Point Waterfall Creek
- Los Trancos Creek (and Crystal Cove Creek)
- Muddy Creek
- Morro Creek.

Most of the canyon creeks in the upper portions of the drainage areas are steep natural channels. Several are developed in both the upper and lower portions and contain concrete storm drain outlets. Unpaved access roadways and hiking trails exist in several canyons but are generally not maintained. The lower portions of the steep canyon creek channels have been subject to erosion impacts caused by increased and longer sustained peak flows. These flows are a result of increased impervious surfaces, introduction of invasive/exotic species of vegetation, and greater number of channelized/piped flows into the canyons. Flow data from the Newport Coast Flow and Water Quality Assessment study completed in 2006 are shown in *Table 2.17, Wet Weather Flow Data*, and *Table 2.18, Dry Weather Flows Per Unit Area* (Weston 2006).

Table 2.17
Wet Weather Flow Data

Station ID	Unit Modeled Flow (cfs)
Buck Gully	
BG1	1.18
BG2	1.08
BG3	1.03
BG4	0.89
BG5	0.69
BG6	0.46
BG7	0.29
Morning Canyon	
MCD	0.36
Pelican Point	
PP1	0.02
PPM	0.22
PPW	0.13

Table 2.17
Wet Weather Flow Data

Station ID	Unit Modeled Flow (cfs)
Los Trancos Canyon	
LTD*	1.10
Muddy Canyon	
MCC	0.93
El Morro Canyon	
EMD*	2.00

*Dry weather flows are diverted at these sites

Table 2.18
Dry Weather Flows Per Unit Area

Station ID	Unit Modeled Flow (cfs)
Buck Gully	
BG1	0.43
BG2	0.39
BG3	0.37
BG4	0.32
BG5	0.25
BG6	0.17
BG7	0.10
Morning Canyon	
MCD	0.13
Pelican Point	
PP1	0.01
PPM	0.08
PPW	DRY
Los Trancos Canyon	
LTD*	
Muddy Canyon	
MCC*	
El Morro Canyon	
EMD	0.72

*Dry weather flows are diverted at these sites

Surface Water Quality

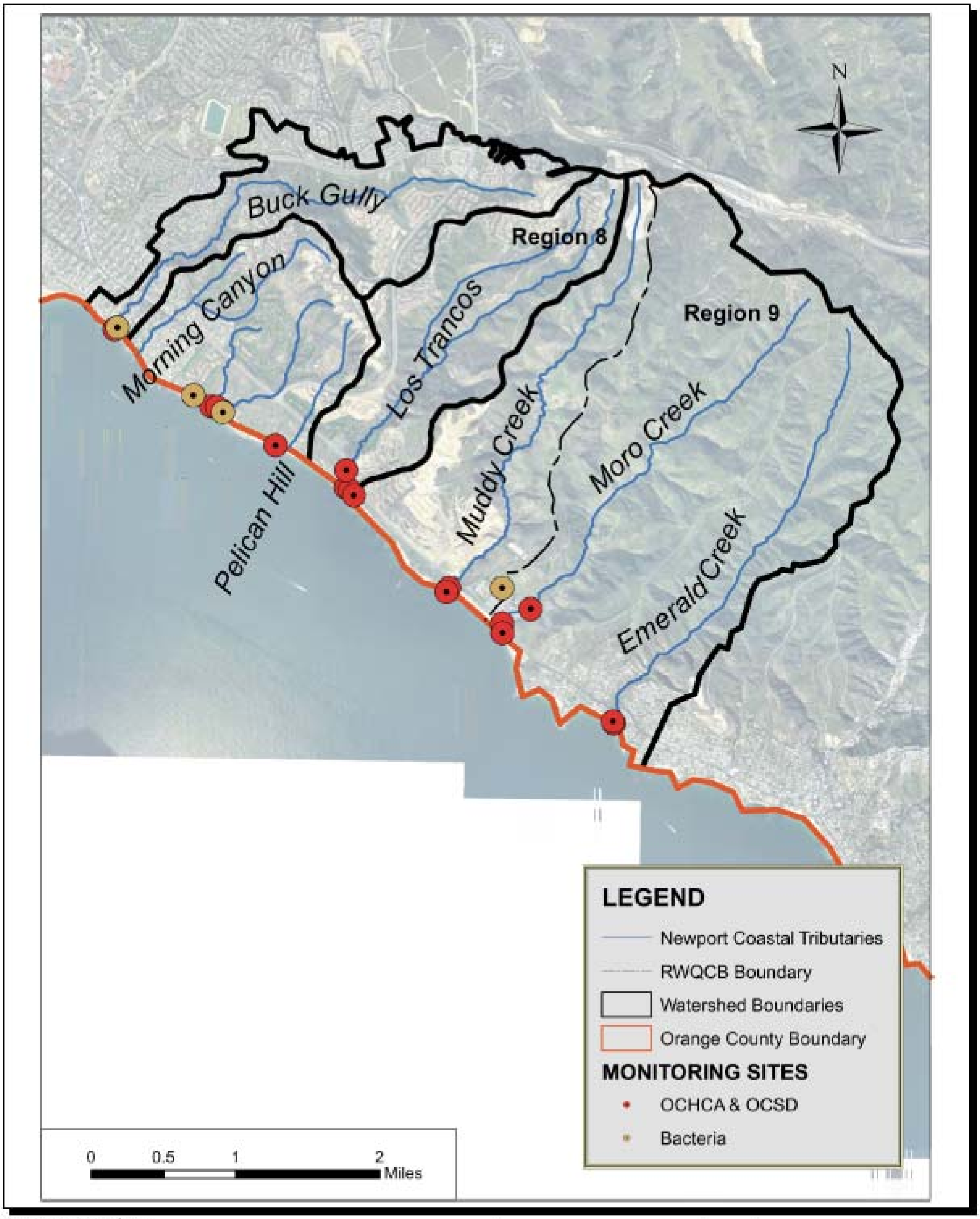
In recent years, the Newport Coast Watershed, like much of Orange County, has faced watershed problems involving streambed instability as exhibited by head-cutting and slope failures, the arrival of invasive plant species, and the loss of native wetland and riparian habitat. Seven of the canyon streams now flow year-round due to over-irrigation in the upstream developments. It is suspected that the dry-weather flows carry bacteria, fertilizer, and pesticides through the canyon reaches and into the ocean. These problems have become progressively worse and pose a threat to residences, the two ASBSs, Crystal Cove State Park, and the ecological function of the riparian corridors within the watershed. A piecemeal approach to dealing with these problems has been ineffective due to the technical, jurisdictional, and financial hurdles that must be simultaneously addressed.

Over the past 40 years, the Orange County Health Care Agency has been testing the coastal waters in Orange County for bacteria. As of 1999, new requirements for frequent testing of surf zone waters and stringent criteria for beach water closures went into effect as part of Assembly Bill 411. Samples from the watershed are collected weekly by the Health Care Agency from 10 ocean, bay, and drainage locations (County of Orange 2003*)*. The Irvine Company, IRWD, Surfrider Foundation, and Orange County Coastkeeper have performed limited water quality sampling as well. The results of these sampling programs are currently being reviewed. Monitoring programs are specifically geared toward providing information that can be used to develop programs to protect the two ASBSs (Newport Coast Watershed Program 2004*)*. Monitoring locations are shown in *Figure 2.11, Newport Coastal Watershed Monitoring Stations*.

In accordance with the Clean Water Act, the Santa Ana Regional Board in 2006 placed Buck Gully Creek and Los Trancos Creek on the draft 303(d) list for total coliform and fecal coliform (see *Figure 2.1*). The Orange County coastline, which runs along over 5 miles of the Newport Coast Watershed, is also listed on the draft 303(d) list for trash.

A confluence of separate investigations and projects are being carried out in the Newport Coast Watershed by the City of Newport Beach, the Irvine Company, the County of Orange, IRWD, Orange County Coastkeeper, and the Surfrider Foundation. In order to address the destabilization and degradation of the watershed's coastal canyons in a systematic and effective manner, the City of Newport Beach is developing a watershed program for the Newport Coast as an organizing tool for future activities in the watershed.

As part of this program, a flow and water quality assessment has been performed for the watershed to assess the extent and magnitude of the current or potential problems in the eight Newport Coast canyons and the two ASBSs where these creeks flow into. The most frequently exceeded and widely detected exceedances of the water quality objectives were observed for bacteriological indicators, followed by dissolved cadmium. Specific finding include:



Source: Orange County 2003

Central Orange County Integrated Regional and Coastal Watershed Management Plan

FIGURE 2.11

Newport Coastal Watershed Monitoring Stations

- The exceedances for fecal indicator bacteria were observed for all coastal canyons for multiple storm events (see *Exhibit 2.E*). Comparison of the observed Enterococcus and total coliform concentrations to water quality objectives for ocean samples for indicate exceedances in the mixing zone samples at Buck Gully and El Morro (Enterococcus only).

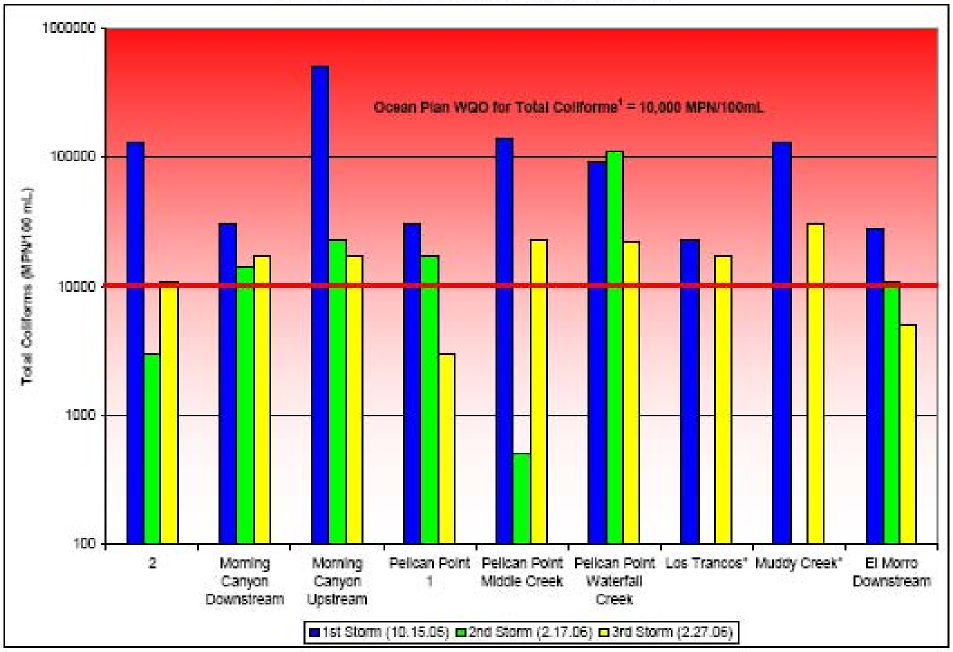
- Exceedances of water quality objectives for fecal coliform bacteria concentrations were limited to dry weather samples to Pelican Point, Upper Los Trancos and Muddy Creek. Of these, Los Trancos and Muddy Creek are diverted to the sewer system during weather.

- The findings from the development of load duration curves for Buck Gully indicate that predicted exceedances of the fecal indicator bacteria load allocation for Buck Gully would occur during wet weather events in the absence of measures to reduce the overall current loads. Dry weather flows would not exceed the load allocation.

- In addition to bacteriological indicators, dissolved cadmium concentrations exceeded water quality objectives in wet and dry weather flows in Pelican Point Middle Creek and Morning Canyon Downstream (see *Table 2.19*). The highest concentrations for wet weather events were Pelican Point Waterfall Creek and Morning Canyon (see *Exhibit 2.F*), and for dry weather samples at Pelican Point Middle Creek, which was an order of magnitude greater than the concentration detected at Buck Gully. An evaluation of total loads for dissolved cadmium using modeled annual flows showed the highest annual loads from Morning Canyon and Pelican Point Middle Creek, even though these are much smaller watersheds.

- Exceedances of dissolved copper concentrations were found in two canyons during storm flows (see *Exhibit 2.G*)

Exhibit 2.E
Total Coliform Results during Wet Weather



* Los Trancos and Muddy Creek sites were not sampled during the second wet weather event. The data from the third storm event was collected by the Irvine Company.

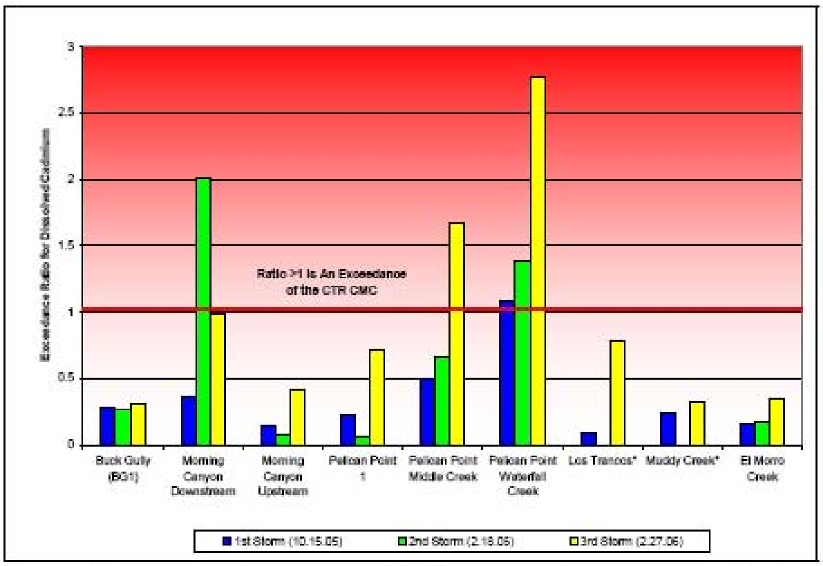
[1] The Ocean Plan WQO is applicable to ocean samples only and is presented as a reference.

The relative urban runoff contribution to the problems in the eight coastal canyons and the ASBSs are assessed as follows.

1. Dry weather flows deliver the preponderance heavy metal loads to the ocean that exceed water quality objectives.
2. An opposite conclusion was found for dissolved metals where the largest loadings are due to storm flows.
3. The results of the analysis of contributions to the total estimated annual load for bacteriological indicators found that wet weather flows contribute the greatest portion of total load.
4. The bacterial load contribution from wet weather flows was an order of magnitude higher than those from the dry weather flows for both fecal coliform and Enterococcus.
5. Substantial nitrate and phosphate concentrations found in the canyon watershed.

Based on the Groundwater Seepage Study prepared by Todd Engineers (2006), the use of imported water for irrigation has resulted in a groundwater mound in the Buck Gully, Morning Canyon and Pelican Point watersheds. The Groundwater Seepage Study also suggested that the quality of the dry weather flows is significantly influenced by the quality of the infiltration waters and the groundwater seeps. Analysis of groundwater seeps by Todd Engineers for chloride and sulfate indicated higher concentrations of these constituents downgradient of potential sources compared to upstream samples. The Draft Groundwater Seepage Report indicated that the golf course at Pelican Point may increase concentrations of these constituents through the use of soil amendments and provide a migration pathway through irrigation.

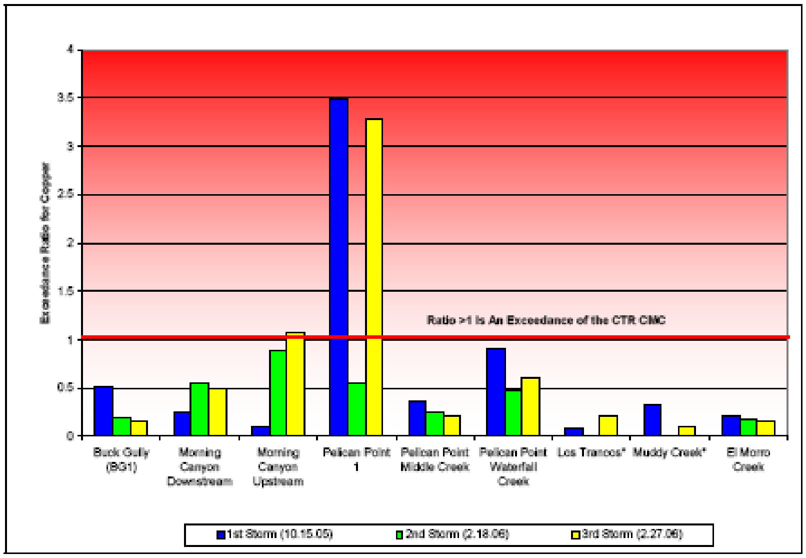
Exhibit 2.F
Exceedance Ratio for Wet Weather Dissolved Cadmium Results



* Los Trancos and Muddy Creek sites were not sampled during the second wet weather event. The data from the third storm event was collected by the Irvine Company.

Exhibit 2.G

Exceedance Ratio for Wet Weather Dissolved Copper Results



* Los Trancos and Muddy Creek sites were not sampled during the second wet weather event. The data from the third storm event was collected by the Irvine Company.

Table 2.19
Newport Coast Dry Weather Exceedances

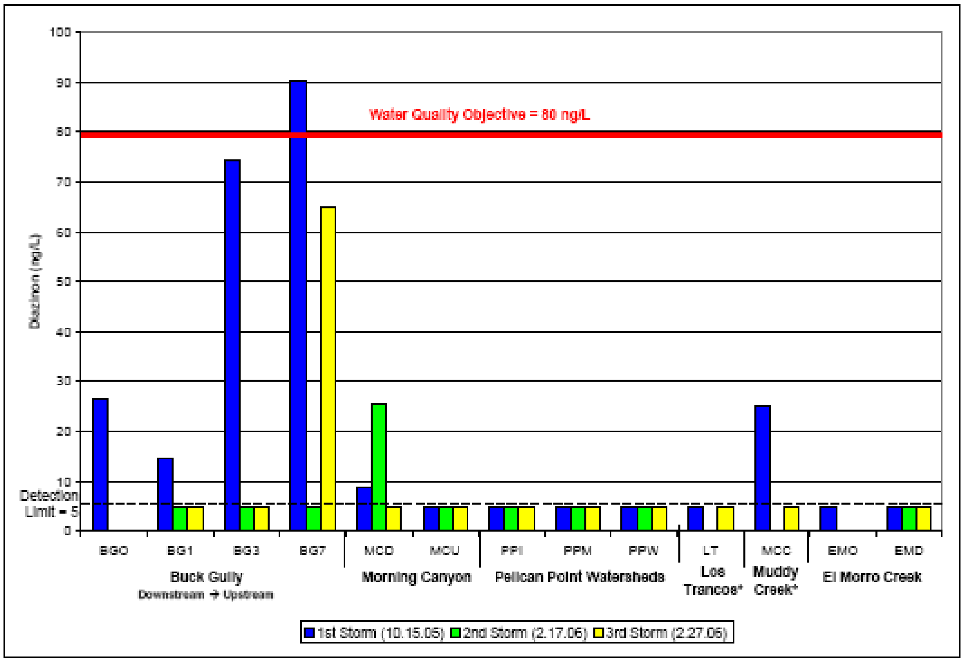
Constituent		Copper Dissolved	Copper Total	Cadmium Dissolved	Cadmium Total	Total Coliforms	Fecal Coliforms	Enterococcus
Units		µg/L	µg/L	µg/L	µg/L	MPN/100mL	MPN/100mL	MPN/100mL
WQO		29.28	12 / 30.5	6.22	4 / 7.31	10,000	400	105
WQO Source		CTR CCC[1] (Hardness > 400)	Ocean Plan Daily Max / CTR CCC[1] (Hardness > 400)	CTR CCC[1] (Hardness>400)	Ocean Plan Daily Max / CTR CCC[1] (Hardness>400)	Ocean Plan[2]	Ocean Plan[2]/ Basin Plan[3]	Ocean Plan[2]
BGO	(9.27.05)	0.754	2.85	<0.005	4.58	300	<20	228
BG1	(9.27.05)	9.06	1.09	1.12	3.36	3000	230	213
	(2.13.06)	11.1	11	6.39	9.01	170	40	121
EMO	(9.27.05)	0.475	1.54	<0.005	0.045	<20	<20	<10
EMD	(9.27.05)	5.26	0.199	0.87	1.48	500	300	<10
	(2.13.06)	6.08	5.64	2.67	3.34	500	40	30
BG2	(9.27.05)	8.91	9.52	2.07	3.58	5000	210	327
BG3	(9.27.05)	8.5	9.48	2.13	3.92	1700	220	121
	(2.13.06)	11	11.4	6.23	7.96	500	40	52
BG4	(9.27.05)	7.75	7.47	2.52	5.47	800	130	52
	(2.13.06)	9.4	10.5	4.85	8.01	220	20	20
BG5	(9.27.05)	3.97	5.69	0.95	0.96	500	40	20
BG6	(9.27.05)	2.09	3.41	0.48	0.34	1700	300	63
BG7	(9.27.05)	2.9	3.62	0.51	0.61	800	130	84
	(2.13.06)	5.14	3.59	3.04	3.35	170	70	63
MCD	(9.27.05)	15	17.2	26.2	36.7	2300	40	480
MCU	(9.27.05)	6.7	7.6	2.26	2.44	1700	300	279
PP1	(9.27.05)	6.55	9.58	2.82	3.75	30000	1400	798
PPM	(9.27.05)	35.1	12.8	100	105	270	<20	73
LTU	(9.27.05)	10.3	11.8	3.51	12.3	3000	2300	613
MCC	(9.27.05)	7.16	5.88	1.11	1.34	5000	800	132

[1] CTR CCC = The California Toxic's Rule Criterion Continuous Concentration (chronic criterion) defined as a four-day average concentration limit (EPA 65 FR 31682).
[2] The Ocean Plan WQOs for total coliforms, fecal coliforms, and Enterococcus are single sample objectives for samples collected in the ocean and do not apply to freshwater samples.
[3] The Basin Plan WQO for fecal coliforms states, "the log mean [must be] less than 200MPN/100mL based on five or more samples/30 day period, and not more than 10% of the samples exceed 400 MPN/100mL for any 30-day period." Therefore, as a conservative approach, the WQO presented here assumes that one samples would equal 10% of the monthly samples, and a result greater than 400MPN/100mL would exceed the WQO.

A monitoring program will specify biological indicators and metrics to assess and monitor ecosystem health relative to watershed function. Examples of applicable indicators include biomass of native riparian wetland vegetation, habitat use by declining or sensitive species, attached fresh-water algae, aquatic macro-invertebrate diversity and distribution, and the health and diversity of intertidal and subtidal communities in the marine life refuges. Additional indicators will be selected in consultation with the Santa Ana RWQCB and the County of Orange. In addition, the watershed program will include a program for mapping the areas of *Arundo* and instituting a removal program.

Diazinon was found in several stormwater samples in Buck Gully and Morning Canyon (see *Exhibit 2.H*).

Exhibit 2.H
Diazinon Results During Wet Weather Events



* Los Trancos and Muddy Creek sites were not sampled during the second wet weather event. The data from the third storm event was collected by The Irvine Company.

Six objectives have been put forth by the Newport Coast Watershed Program (Newport Coast Watershed Program 2004), several of which are already being implemented:

- Complete the technical studies and prepare the watershed assessment report for the watershed management area (this has been completed);
- Implement a monitoring program for baseline data and ongoing monitoring to track changes in the watershed (in process);
- Prepare a Watershed Management Plan that provides specific restoration recommendations for each of the coastal streams with attendant ecological benefits for the intertidal and subtidal communities in the ASBSs (an internal draft has been prepared);
- Implement specific stabilization and restoration projects in Buck Gully and Morning Canyon within the framework of the Watershed Management Plan;
- Provide educational opportunities for city staff, community members, and stakeholders in watershed science and management skills and enlist community support in monitoring and restoring the health of the watersheds and marine life refuges (in process); and
- Expand the scope of the watershed management program, including researching funding opportunities for subsequent restoration projects as outlined by the Watershed Management Plan.

Major efforts being conducted within the watershed to reduce non-point source releases and improve water quality as identified in the June 2006 *State of the CCAs Report for Upper Newport Bay* include:

1	**Working At the Watershed Level Science & Stewardship Program & Earth Resources Foundation High School Clubs**	Modules on understanding importance of a healthy watershed, urban refuse collection, data collection, source identification, and bioassessment. Program enhances the teachers' opportunity to involve students in science. http://earthresource.org/
2	**Newport Coast Watershed Program: Assessment, Management and Restoration**	Complete watershed assessments (survey, hydrologic/hydraulic, biological/ecological, water quality, and sedimentation), prepare restoration recommendations, and implement stabilization and restoration projects. http://www.city.newport-beach.ca.us/Pubworks/pwmain.htm
3	**Orange County CoastKeeper**	Mission is to protect and preserve Orange County's marine habitats and watersheds through education, advocacy, restoration, and enforcement. www.coastkeeper.org

Streamflow and surface water quality data are lacking due to limited dry weather flows in the past. A program has been developed by the City of Newport Beach to monitor dry weather flows and water quality in Buck Gully (City of Newport Beach 2007). Additionally, a program is being developed by the City of Newport Beach to evaluate pollutant loads in the drainages in the Newport Coast Watershed.

Groundwater

While a groundwater basin has not been identified in the Santa Ana RWQCB Basin Plan for the Newport Coast Watershed, groundwater is present in the watershed (City of Newport Beach 2007). According to the City of Newport Beach, groundwater seepage occurs in Buck Gully and Crystal Cove State Park, located at the exit of Los Trancos Creek at the Pacific Ocean. A pumping experiment in Buck Gully in 1999 indicated that groundwater exfiltration provides a significant amount of water to dry-weather flows in the canyon. A groundwater seepage study is now underway to begin to identify sources, quantities, and quality.

2.3 Priority Constituent of Concern for Harbor Area

Based on the existing water and sediment quality data, 303d listings and TMDL discussed in the previous subsections, the priority constituents of concern (COC) for the harbor area are identified in Table 2-3. The priority constituents are considered in BMP development and implementation. As discussed further in Section 3, an integrated approach is recommended for BMP implementation. An integrated approach considers both current and future priority constituents to insure a long-term cost effective water quality program. An integrated approach is more cost effective as it addresses potential future BMP retrofits in order to address additional constituents in the future.

The priority constituents listed in Table 2-3 have been identified for consideration in the development and prioritization of BMP. As will be discussed in Section 3, BMP implementation is to be conducted in a tiered and phased approach. Initial phases will include further investigations of the impact to the beneficial uses and the sources of constituents. These activities shall be conducted for priority constituents before a second phase of BMP are implemented.

Table 2-3. Priority Constituents of Concern Lower Newport Bay

Priority Constituent of Concern	Reason for Listing	Potential Sources	Further Data Needs
Nutrients	TMDL	Upper Watershed runoff from agricultural areas and runoff from residential area upstream and within the Harbor Area. Groundwater seepage into the San Diego Creek also is a source of nitrates. Air Deposition of nitrogen compounds	Source Identification Studies and Modeling of the contributions from upstream and local sources. Investigations of the impact of the nutrients in the Lower Bay
Pathogens – Bacteria Indicators – Fecal Coliform	TMDL	Non-point anthropogenic and natural sources from the upstream watershed and drainage areas within the Harbor. Sources within the Harbor may include boat washing and prohibited vessel sanitary waste discharges, water fowl, sea lions, sewer leaks, pet wastes, dry weather flows that provide transport mechanism for bacteria, and commercial poor house keeping, poor solid waste management, improper washing, and illicit discharges.	Source Identification Study in the Harbor Area to assess the primary and largest bacteria loading and contribution from natural sources (birds, sea lions, etc.)
Chlordane and Dieldrin	Toxics TMDL	Chlordane and Dieldrin have been phased out due to these pesticides' toxicity to aquatic organisms. Licensed businesses no longer use these pesticides, but small quantities may still be used by residences. Additional chlordane and dieldrin loading may be from impacted sediment in the upper watershed and	Continued monitoring of the storm flows and water quality in the Lower Bay to asses the long-term trend.

Table 2-3. Priority Constituents of Concern Lower Newport Bay

Priority Constituent of Concern	Reason for Listing	Potential Sources	Further Data Needs
		Upper Newport Bay that is transported during significant storm events.	
Synthetic Pyrethroids	These pesticides have replaced the chlorinated pesticides and only recently have been shown to result in toxic effect to aquatic organisms. Sediment toxicity testing of sediments in the Harbor have indicated that these pesticides may be the primary cause of the toxicity observed.	Synthetic pyrethroids are regulated pesticides that are used by licensed commercial pest control businesses and also sold for public use to control household pests such as ants.	Further toxicity testing and extent and nature of these constituents to define the issue
DDT	TMDL	This is a legacy constituent that is transported to the Lower Bay via impacted sediments and soils from the upper watershed and Upper Bay during storm events.	Continued monitoring of the storm flows and water quality in the Lower Bay to asses the long-term trend
PCBs	303d listing	This is a legacy constituent that is transported to the Lower Bay via impacted sediments and soils from the upper watershed and Upper Bay during storm events.	Continued monitoring of the storm flows and water quality in the Lower Bay to asses the long-term trend
Sediment	TMDL for Upper Bay – although Lower Bay not listed, the Harbor receives significant sediment loading that has impact sediments (sediment toxicity) and navigation channels	Sediment is transported from the upper watershed due to erosion of channels due to hydro-modification and agricultural activities. The sediment basins in the Upper Bay function to remove much of the coarse grained sediments. Fine-grained sediments that may consist of clay and organic matter are carried to the Lower Bay. These particles have a greater affinity to attract and absorbed pollutants that have results in toxicity of sediments in areas of the Harbor. Dredging of the basins and channels of the Lower Bay will remove impacted sediments.	Sediment transport modeling to assess the loading contribution to the Lower Bay and the associated loading of legacy constituents such as PCB, DDT, and chlordane.
Copper	Toxics TMDL	Copper based boat paints – studies have shown that both maintenance and leaching are source of copper. Air Deposition – Studies in Los Angeles and San Diego have indicated that air deposition from traffic can contribute a significant portion of the load of copper to storm water in urban areas.	Evaluation and possible further study of the contribution of leaching compared to maintenance and assessment of the effectiveness of better maintenance practices. Air deposition studies
Lead Zinc	Toxics TMDL	Air Deposition – Studies in Los Angeles and San Diego have indicated that air deposition from traffic can contribute to the load of lead and zinc to storm water in urban areas.	Source Identification Studies

Table 2-3. Priority Constituents of Concern Lower Newport Bay

Priority Constituent of Concern	Reason for Listing	Potential Sources	Further Data Needs
		Lead and zinc may also be transported from industrial areas of former DOD facilities in the watershed.	
Selenium	Toxics TMDL	Natural sources of selenium have been identified in the watershed. The mobilization of Se to groundwater has occurred due to the changes in land use in the watershed. Impacted groundwater then discharges into the San Diego Creek and Bay.	Water quality and source studies to identify additional natural sources of Se that have been mobilized by land use changes in the drainage areas/canyon surrounding the Harbor

The Rhine Channel is part of the Lower Newport Bay, but is considered a separate unit based on its designation. Rhine Channel is a dead-end channel in which toxic pollutants have accumulated in the sediments. Consequently, the Santa Ana Regional Board has designated Rhine Channel as a toxic hotspot. Due to the different historical land uses, sources of pollutants and level of contamination in the sediment, EPA has determined that a separate TMDL is appropriate for this specific reach of Lower Newport Bay. Water quality issues will therefore be address through the source control and sediment management activities under this regulatory program for Rhine Channel. The priority constituents of concern for Rhine Channel are consistent with those listed in Table 2-3 for the Lower Newport Bay with the exception of addition of the metals Cadmium, Chromium, and Mercury.

3.0 LINKAGES WITH OTHER PROGRAMS

The BMP Plan has been developed in this HAMP to coordinate with existing planning documents for watershed and coastal areas. Specifically, the Phase I projects developed in the BMP Plan are consistent with projects proposed in the Integrated Regional Watershed Management Plan (IRWMP) for the Newport Bay Watershed for the Lower Newport Bay. These Lower Newport Bay projects are linked to water quality issues in the watershed and coastal areas that include the ASBS. Preliminary pollutant transport modeling has indicated a likely connection between the Lower Newport Bay and the ASBS. Therefore, projects that improve the water quality of the Lower Bay will benefit the coastal habitats. These projects are further coordinated with the Phase I projects developed in the Integrated Coastal Watershed Management Plan (Weston, 2007) for the seven coastal watersheds along the Newport Coast and the Upper Bay Restoration Planning. For example, the City is planning to expand the runoff reduction program to all the watersheds within its jurisdiction in order to reduce urban flows and associated pollutant loads into the Upper and Lower Newport Bay, and to the ASBS. Metals reductions projects in the Coastal Watersheds will be implemented on similar schedules to the copper reduction programs in the Lower Newport Bay.

As presented in the BMP plan, water quality improvement efforts will also need to coordinated with the sediment control and dredge management projects. Siltation issues in the watershed and Upper Newport Bay have resulted in the migration of fine sediments and associated metals and pesticide pollutant loading to the Lower Newport Bay. Siltation can also impact vital eel grass beds and impact the quality of sediments and benthic communities. These issues can only be successfully addressed through an integrated program that reduces the siltation loading from the watershed, maintenance of inline basins in the Upper Bay and removal of impacted sediments in the Lower Bay. Projects planned and underway in the watershed to reduce siltation include channel stabilization, agricultural BMPs, construction site BMPs, sediment monitoring, natural treatment basins and inline channel basins in San Diego Creek. The inline basins in the Upper Newport Bay are undergoing maintenance to provide additional sediment removal. As discussed in the Upper Newport Bay Sediment Control section, the effectiveness of these basins to remove the fine-grained materials requires further assessment.

The Big Canyon Restoration project includes water quality ponds for sediment and other constituent reduction before discharge into the Upper Bay. These projects along with the implementation of BMPs during dredging activities and bulkhead maintenance and upgrades will reduce the siltation to meet overall TMDL goals.

As outlined in the following section of this Plan, a tiered and phased approach is recommended to meet water quality improvement and TMDL goals. The BMP proposed in the first phase of the Lower Newport Bay program focus on source control and pollution prevention and runoff reduction while also collecting effectiveness assessment data that may also be used to identify additional water quality improvement program opportunities. This is consistent with the coastal watershed strategy as presented in the Integrated Coastal Watershed Management Plan (Weston, 2007).

Water quality is a key component to bring together diverse water resource and land use agencies, environmental groups, and other stakeholders within the region to develop management strategies. The objective of the Strategic BMP Plan is to coordinate regional and local water quality protection and improvement efforts to meet both Harbor Area beneficial use criteria as well as regulatory drivers within and outside the Lower Bay. Many of the issues in the Harbor Area involve aquatic resources and/or the presence or transport of pollutants in water and water quality protection and improvement is a key link to successful Harbor Area Management. The water quality BMP implementation strategy will include ongoing effectiveness assessment to evaluate the performance of water quality improvement programs in meeting the water quality goals and integration with watershed, Bay and coastal plans and BMP projects.

Regionally, the Central Orange County Integrated Regional and Coastal Watershed Management Plan (IRCWM Plan) addresses overall water resources management needs for the Newport Bay and Newport Coast Watersheds (County of Orange, 2007). The IRCWM Plan has been submitted to the SWRCB to qualify for Proposition 50 funding to support numerous projects to improve water quality within and adjacent to the Harbor Area. Other water quality-related programs under the jurisdiction of the US Army Corps of Engineers, RWQCB, County of Orange Watershed & Coastal Resources Division, and local environmental and restoration groups are currently being conducted in Newport Bay and the San Diego Creek and Coastal Watersheds. Harbor Area stakeholder coordination with these groups is key to the success of water quality improvement projects in the Newport Bay.

Within the Harbor Area, the City and other stakeholders have already implemented some programs that align with other city-wide water quality improvement goals such as residential and construction BMP and numerous clean water outreach efforts. However, water quality improvement efforts in the Lower Bay require special consideration given the sensitive habitats of the Upper and Lower Bay, current and future harbor maintenance requirements, and federal, state and local regulatory actions.

4.0 HARBOR AREA WQ BMP PRIORITIZATION

The Strategic BMP Implementation Plan provides guidance for water quality BMP efforts within the Harbor Area for issues specific to harbor stakeholders. This plan establishes an iterative activity prioritization process and implementation strategy for the identification of priority pollutants in the Harbor Area. The prioritization strategy for BMP implementation considers current and future water quality issues such that BMP are designed to accommodate future reduction requirements without expensive retrofits. The strategy also implements BMP in a phased approach in order to both assess the effectiveness of the projects as they are implemented and to continually refine the prioritization process using all available data. The BMP Plan provides a road map for BMP implementation within the Harbor Area that coordinates with the regional watershed plan (IRCWM) and the coastal watershed and ASBS plan (ICWMP).

This section describes the approach to BMP identification and planning based on the assessment of water quality issues and regulatory drivers. BMP are identified in this section that area applicable to prevent, control, or treat constituents in urban runoff and discharges from recreational activities in the Lower Bay in order to lessen overall water quality degradation and environmental impacts.

Project Identification Process

Reduction of pollutant loads to receiving waters can be accomplished using three main project types, non-structural BMP, structural BMP and treatment systems. A non-structural BMP approach can include source control, runoff reduction and pollution prevention measures that can be used to reduce pollutant sources and prevent pollutant pathways to receiving waters. Source control can be accomplished through activities such as legislative restrictions on the manufacture and use of potential pollutants and education of community stakeholders to become aware of, and change behaviors that potentially lead to pollution. This may include the use of copper-based boat paints or modifications to boat maintenance practices. Runoff reduction non-structural BMPs include activities that reduce the runoff volumes and peak flows for both dry and wet weather flows such as education of responsible irrigation practices. It may also include reduction of discharges from boat washing practices and sanitary discharges. Together, non-structural source control and runoff reduction are accomplished through public participation efforts such as outreach, education and enforcement programs that all aim to educate Harbor stakeholders and users to practice techniques to prevent pollutants from entering the Bay. This approach has the added benefit of integrating water management strategies, such as responsible boat maintenance practices, water conservation and water quality protections and improvement.

A phased implementation of non-structural and structural BMPs in the Lower Newport Bay is recommended to establish the actual effectiveness in reducing constituent concentrations to the Bay. This phased approach will allow the effectiveness of non-structural and lower-impact BMPs implemented in early phases to be assessed as well as allow design parameters required to implement more complex treatment systems to be measured. Effectiveness assessment activities of the early phases of the BMP implementation program will therefore accomplish two objectives: assess the effectiveness of lower impact BMPs in reducing pollutant loads and assess the runoff volume and volume of storm water requiring more complex treatment to be developed.

Published data indicates that the effectiveness of non-structural source control and runoff reduction measures can range widely from 30-70% pollutant reduction. The effectiveness of these non-structural BMP will vary depending on the level of implementation and enforcement, drainage area hydrological characteristics, and constituent type. However, the effectiveness of non-structural BMP in a particular watershed can not be accurately assessed without effectiveness data that compares drainage areas in which these measures are fully implemented compared to a drainage-area where little or no measures are established. In addition, initial pilot studies are recommended for innovative approaches such as use of non-copper based boat paint in order to assess the effectiveness of measures to reduce pollutant loads and to develop community and stakeholder support before implementing the BMP on a broader scale.

Source control and pollution prevention measures can be more effective when targeted at sources and activities that have the greatest loading potential for the constituents of concern. Therefore assessment of individual projects and assessment of the overall impact of project implementation on the water quality of the Lower Bay are integral components of the strategy of this Plan.

Nonstructural BMP techniques can be combined with structural BMP to both control sources and reduce runoff volume to prevent pollution. Structural BMP include source control and runoff reduction strategies that require infrastructure for implementation. Examples of structural BMP include street sweeping, Low Impact Development (LID) structures, infiltration basins, and other techniques (Figure 4-1). Published data indicates that the effectiveness of structural BMP in reducing pollutants varies from 50-90%. The effectiveness of different structural BMP also varies depending on the level of implementation and enforcement, drainage area hydrological characteristics, and constituent type. Effectiveness assessment of structural BMP in the context of local conditions is imperative to evaluating individual project pollutant reduction efforts.

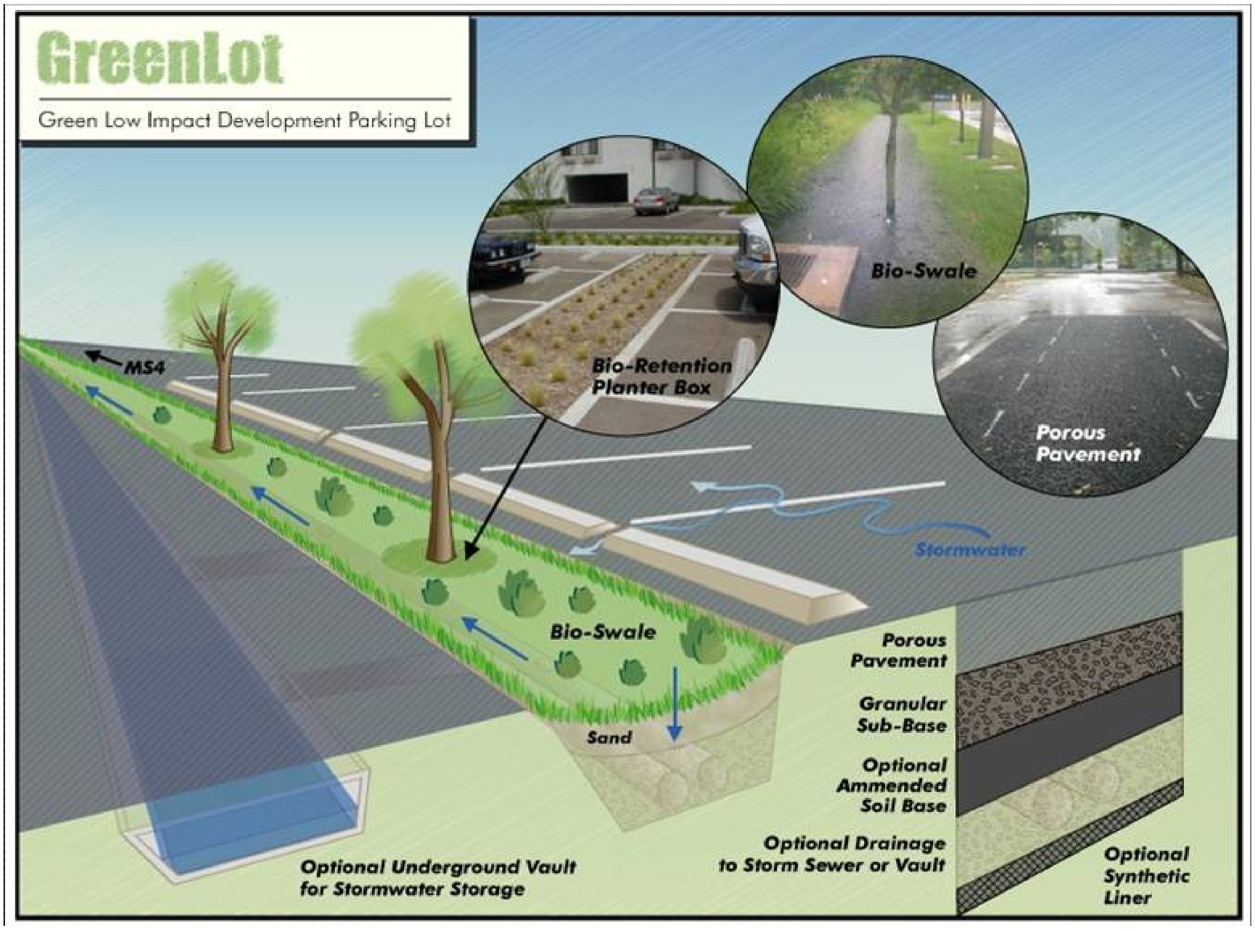


Figure 4-1. Example LID- Green Lot BMP schematic

A final method of pollutant load reduction can be accomplished through treatment BMP technologies that treat constituent concentrations. Published data indicates that pollutant reduction effectiveness of treatment BMPs can vary from 50-90+%. The effectiveness of treatment BMPs have been evaluated based on information presented in the Treatment BMP Technology Report (Caltrans, April 2006), USACE/USEPA BMP Database (USACE, 2006), and other technical publications. Based on the data presented in these referenced studies, it is likely that relatively complex treatment systems ("treatment trains") are required to collect and treat the complete design storm events to meet the required water quality objectives and load allocations for the multiple pollutants that have been identified as priority constituents of concern for the Lower Bay. These treatment train technologies often require relatively large areas and capital expenditure to design and install depending on the design storm volume required to meet pollutant reduction goals. Therefore, a phased approach, discussed in the following section, is recommended that implements source control pollution prevention and runoff reduction BMP in the first phase (Phase I). Reductions in runoff volume from infiltration BMP and pollution reductions through source control and pollution prevention measures may significantly reduce the need for more infrastructure-intensive treatment train BMP.

BMP Integrated and Tiered Approach

The development of management measures to address the goals of the HAMP and this BMP Implementation Plan is based on an integrated and tiered approach. The integrated approach addresses all priority constituents in the BMP development. A tiered project selection process then addresses constituents with the greatest impacts to beneficial uses through the effective use of resources and is then used to rank potential BMP. In the integrated and tiered process, each BMP is then classified according to the relative efficiency of constituent removal from the system, level of infrastructure required for implementation, and cost.

Three tiers of BMP classifications are defined. Tier I BMP focus on non-structural source control and pollution prevention measures that are designed to reduce the amount and understand the effect of pollutants entering runoff though education, enforcement and behavioral modification programs.

Tier I – Non-structural BMP and Activities
- Product Substitution through Education/Pilot Program or through Legislation
- Source Control Measures and Pollution Prevention BMP
- Effectiveness Monitoring of BMP
- Integrate Efforts through Information Management
- Public Participation and Community Involvement through a Bay Protection Program that includes safe and green boating practices

Tier II includes structural BMP such as smart irrigation controllers, infiltration basins, bioretention and LID techniques to reduce wet and dry weather runoff volumes (including water conservation efforts) and further reduce pollutant entry into the Lower Bay. Additionally, Tier II includes source identification and design studies that will fill data gaps and aid in the further identification of pollutant sources and provide design parameters for construction of effective in-line treatment systems as part of Tier III.

Tier II – Structural BMP and Activities
- Hydrologic Studies, Source Studies and Determination of Design Storm
- Aggressive Pollutant Source Control in Targeted Areas (e.g. Street Sweeping)
- Implementation of Urban Runoff Reduction Techniques (irrigation controllers, progressive water rates, LID)
- Dry weather Flow Diversions
- Effectiveness Monitoring of BMP

Tier III BMPs are infrastructure-intensive structural pollution reduction treatment measures that typically require significant capital investment and/or have impacts on surrounding communities.

Tier III – Treatment BMP and Activities
- Pilot Treatment Projects to Assess Effectiveness
- Property Acquisition and Easements (where necessary)
- Implementation of Treatment BMP in Targeted Areas where Tier I and Tier II BMP have been shown not to meet full reduction goals
- Effectiveness Monitoring of BMP

Effectiveness assessment, monitoring, and data incorporation into the overall information management program are components common to all three tiers. Within each tier, the effectiveness of each BMP program must be monitored in order to assess whether the program is meeting pollution reduction goals. A secondary benefit of effectiveness monitoring is that oftentimes BMP techniques can be modified or pollutant sources can be identified in order to further reduce pollutant loads as time series data becomes available.

Project Prioritization Process

The development of an implementation strategy to reduce pollution within the Lower Newport Bay and impacts to the beneficial uses of the Harbor requires that potential management measures be prioritized. Criteria for the prioritization process include:

- Meets the Plan objectives
- Meets multiple regulatory objectives
- Integrates water management strategies
- Reduces priority COC inputs to the Bay
- Follows the tiered approach to urban runoff management
- Leads to understanding of Bay ecosystem impacts
- Fills critical data gaps
- Contributes to Newport Watershed and ASBS information management
- Increases Harbor Protection stewardship and Safe and Green Boating Practices
- Implements the most feasible and cost effective measures first
- Assesses management measure effectiveness

The prioritization process begins with current knowledge of water quality issues that was summarized in the previous sections. A three-phased implementation approach is then developed based on the prioritization criteria listed above. Central to the prioritization process is the iterative nature of the process where priority management actions concurrently address identified project goals, priority pollutants and identify emergent issues. This process occurs in parallel with ongoing source identification, water quality and BMP assessment projects and the development of an overall assessment data management strategy that integrates specific pollutant reductions with beneficial use goals. This process allows for effective management decisions for BMP implementation to be coordinated with long-term assessment of ASBS performance. The overall goal of the phased and integrated approach is to address individual constituents of concern, address multiple water management strategies, and meet pollution reduction goals in a prioritized cost-efficient manner.

Management Measures: Short-term Implementation Program- Phase I

The prioritization process implements management measures defined by the tier system in a phased approach. Phase I of this approach consists of implementing a range of Tier I and II, and pilot Tier III projects, including pollution prevention and source control measures to address priority constituents of concern and loading identified in the water quality issues discussion. Several of the Phase I projects are designed to fill data gaps needed for more effective design of future projects. In Phase I, Tier III projects will only be implemented on a pilot basis where a specific pollutant source and treatment system has been identified and the implementation of a Tier III BMP will provide a clear benefit to overall pollutant reduction. These pilot BMPs are also located in small isolated drainage areas where the storage volume required is limited and the effectiveness of the BMP can be readily assessed. Specific Tier I and II source control and pollution prevention projects included as part of Phase I include public outreach and education, increased inspection of identified sources, increased targeted street sweeping, and runoff reduction and diversion programs that best meet the prioritization criteria presented above.

Phase I also incorporates effectiveness assessment to measure the performance of specific BMP. Specific BMP effectiveness assessments verify the efficiency of implemented BMP by measuring load reductions and/or water quality improvements and determine whether Tier I and Tier II BMP need to be modified or can be expanded to other areas of the Harbor.

Overall, Phase I aims to implement a range of BMP projects designed to address identified priority constituents of concern from a range of community, structural and ecosystem-level activities. Phase I is also designed to understand the efficiency of specific pollutant reduction efforts and to identify existing pollutant source or BMP design data gaps through the integration of data into an information management system. The goal is to maximize the effectiveness of Tier I and II projects in Phase I to address pollutant reduction goals and guide the BMP priority rankings and implementation strategies in Phases II and III. Figure 4-2 shows the emphasis on Tier I and II projects during Phase I and also shows the planned timing for implementation.

Management Measures: Long-term BMP Implementation- Phase II

Information gathered during Phase I will then used to prioritize management measures in Phase II. The information management system developed as part of this Plan will combine effectiveness assessment data of programs conducted in Phase I, specific health of the Harbor studies, and other data to prioritize specific pollutant reduction BMPs in Phase II, characterize design parameters for Phase II structural BMPs, and re-evaluate or verify constituents of concern and data gaps. Phase II will consist of continued implementation of a range of Tier I and II projects, and some pilot Tier III projects, including pollution prevention and source control measures to address high priority pollutant and loading areas originally identified in the water quality assessment and modified as a result of effectiveness assessments conducted in Phase I. Some Tier I and Tier II projects may also be modified or expanded through this analysis process. Since Tier III BMPs are often infrastructure-intensive and costly, this integrated and tiered strategy has the potential to reduce overall project costs and community impacts and will focus Tier III efforts on pollutants with the highest impact to beneficial uses and in locations where pollutants can be most effectively reduced.

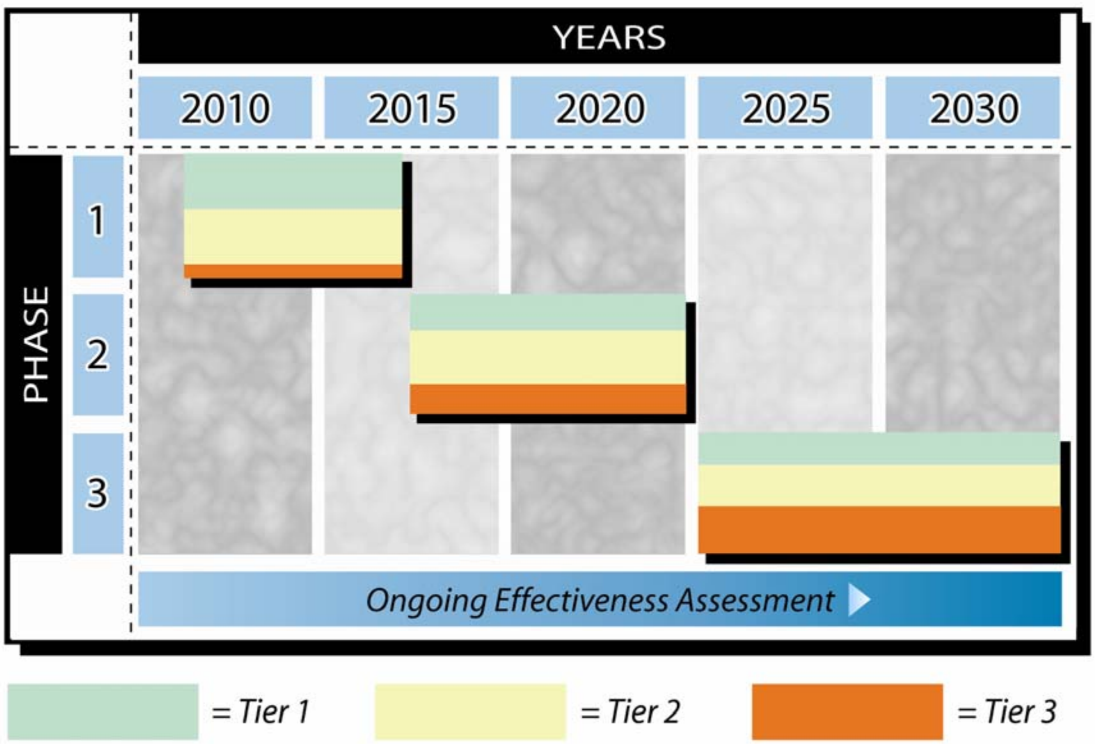


Figure 4-2. BMP Phased Approach.

Management Measures: Long-term BMP Implementation- Phase III

Information gathered during Phases I and II will then used to prioritize management measures in Phase III. Similar to Phase II, Phase III will incorporate data and knowledge acquired as part of previous phases to prioritize specific pollutant reduction BMP, characterize design parameters for structural BMP, and identify emergent constituents of concern and data gaps. Although Phase III will continue the implementation of a range of Tier I and II, and some Tier III, pollution prevention and source control measures to address high priority pollutant and loading areas, it is assumed that Phase III may prioritize a larger proportion of specific Tier III BMP to be implemented through the analysis of Phase I and II efforts. As in Phase II, some Tier I and Tier II programs may also be modified or expanded through this analysis process.

As a result of the iterative process and the nature of the phased BMP approach, specific projects to be included in Phase III of the BMP approach are not well defined. As defined above, specific management decisions and allocation of projects in subsequent phases will be driven by an integrated information analysis of identified priority pollutants, BMP effectiveness assessments, and public participation and Bay Protection Program activities.

Adaptive Management Strategy

As the Phased BMP Implementation process proceeds, data gathered from Phase I activities will be integrated into the information management system and used to evaluate the prioritization and implementation schedule for Phase II and III. Accordingly, Phase I contains the most well defined set of Tier I, II and III projects. As new pollutants emerge or strategies to address pollutants are developed, results of effectiveness assessments of Phase I activities become available, assessment data is gathered from special studies, and more funding sources become available, the list of projects in Phases II and III will increase. Inherent in this strategy, therefore, is the need to continuously assess and manage each phase of the project implementation. This iterative process is depicted in Figure 4-3.

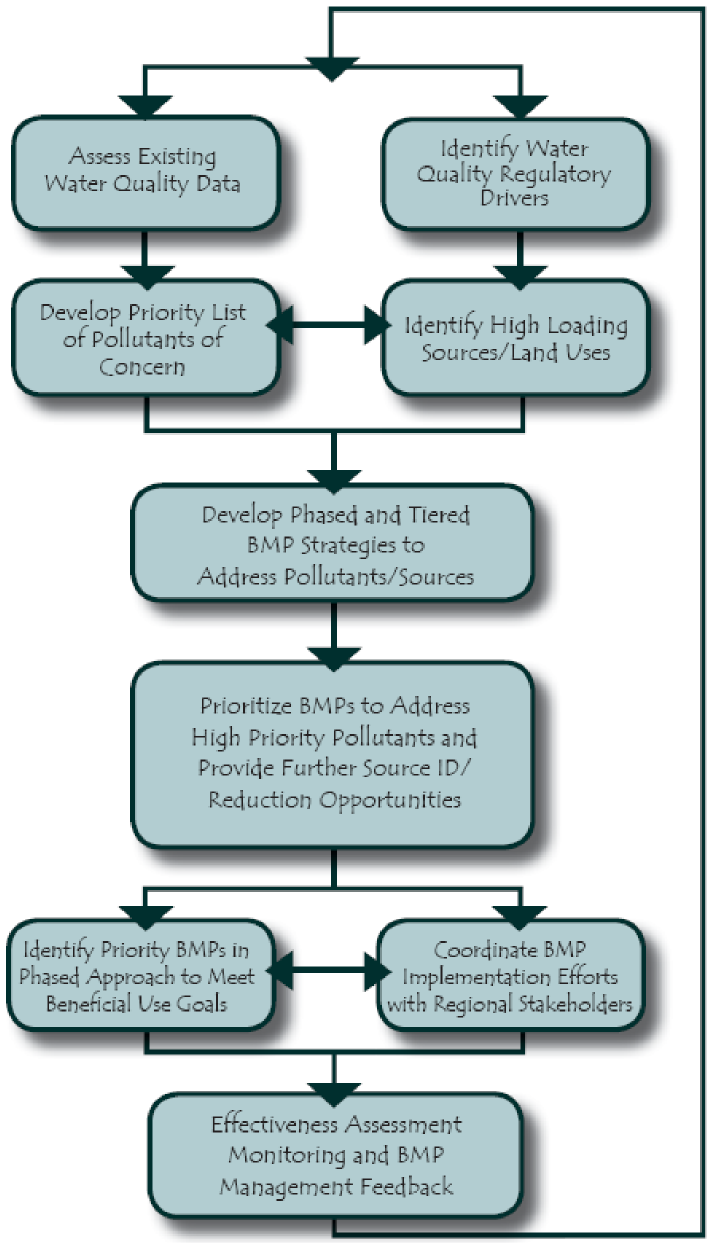


Figure 4-3. Adaptive management strategy for pollutant reduction process.

Public Participation and Bay Protection Program

In order to effectively implement the Strategic BMP Implementation Plan, public participation and education is critical. Failure to implement public outreach and promote a program of Bay protection will prevent the success of source control BMPs and run-off reduction. Public participation and Outreach must continue and expand. Phase I of the Plan includes implementation of education and outreach programs to reduce copper loading through the use of alternative paints and boat maintenance practices, boat washing and proper disposal of sanitary boat waste. A behavior-based approach to outreach programs should be used to engage the public and create positive behaviors that impact pollution prevention. This approach involves: identifying barriers to a sustainable behavior, designing a strategy that utilizes behavior change tools, piloting the strategy with a small segment of a community, and finally, evaluating the impact of the program once it has been implemented across a community. This approach is similar to the iterative approach of the BMP implementation strategy presented above. Education and outreach activities should be coordinated with local stakeholder groups such as Coastkeeper and Surf Rider. 4

Implementation Schedule

The implementation schedule for management measures within the Lower Newport Bay is based on results of the water quality issue assessment and the integrated and tiered process. Figure 4-2 illustrates the general implementation schedule and estimated maximum pollutant reduction goals for recommended projects in the La Jolla Shores Coastal Watershed. In general, Phase I projects are to be implemented within the first 3 – 5 years of the Program. Several of these projects have been initiated such as the copper-based boat paints outreach program and the runoff reduction program in the watershed. Phase II projects are to be implemented in 5 – 10 years and Phase III beyond 10 years. Recommended Phase I BMP projects are presented in Section 4.

BMP Effectiveness Monitoring

In conjunction with BMP implementation efforts, effectiveness assessment and monitoring efforts will be conducted in order to further refine identified or emerging pollutants and/or sources, BMP effectiveness, and address any data gaps. Effectiveness monitoring is vital for accurate adaptive management and will be tailored to specific BMPs. For instance, effectiveness monitoring of outreach activities should include surveys, community dialogue and polls. Structural BMP effectiveness should include assessments of baseline conditions, calculated flows, assessment of concentrations of contaminants of concern and assessment of overall efficacy.

The effectiveness of each BMP program must be monitored in order to assess whether the program is meeting pollution reduction goals. Effectiveness assessment activities can sometimes be combined to allow multiple BMP efforts to be assessed concurrently A secondary benefit of effectiveness monitoring is that oftentimes BMP techniques can be modified or pollutant sources can be identified in order to further reduce pollutant loads as time series data becomes available.

5.0 BMP PRIORITY (PHASE I) PROJECTS AND IMPLEMENTATION

The purpose of the BMP Plan is to develop a comprehensive Harbor Area activity strategy that addresses current and anticipated pollutants and associated regulatory drivers, community needs, and ecosystem health and sustainability. The iterative prioritization and implementation strategy developed for the Harbor Area provides the framework for stakeholder participation and coordination in the protection and improvement of water quality in Newport Bay. Ongoing effectiveness assessment of implemented strategies will assure coordinated and efficient use of available resources in achieving a sustainable Harbor Area plan to protect and improve water quality.

Based on the process outlined in the previous sections, the following are the recommended Phase I water quality improvement projects for the Lower Newport Bay:

Pollution Prevention/Runoff Reduction- Copper Reduction Program

Several COCs are listed in the Toxics TMDL for lower Newport Bay, including lead, zinc, selenium, and copper. There are several potential on-point sources of these contaminants in Newport Bay. Copper-based anti-fouling boat paints have been shown to be a significant source of copper in harbor environments, including Lower Newport Bay. Other sources, such as break pad wear introduced to the receiving waters via urban runoff are also a concern. Preliminary cross contamination study results have identified a connection between Lower Newport Bay and the Newport ASBS. Because of this association, bioaccumulation studies are being conducted to determine the extent to which copper may be influencing ASBS biota.

To address these concerns, a primary focus of the copper reduction program in Lower Newport Bay will address the use of alternatives to copper-based boat paints. An important constituent of the study will be to implement a BMP pilot project for boat maintenance to address potential cross-contamination impacts to the ASBS from Newport Harbor. The program will also implement an outreach program to further educate the boating community regarding the environmental effects of using copper-based antifouling paints.

Other regional programs will be incorporated into the copper reduction program. For instance, the City of Newport Beach in conjunction with Orange County Coastkeeper (a local NGO) and Trace Marine Services is conducting a 3-year public campaign to encourage boaters to switch from copper-based boat paints to less toxic alternatives. The goal of the study is to reduce dissolved copper levels in a designated area of Lower Newport Bay (the Balboa Yacht Basin Marina) to below California Toxics Rule (CTR) criteria. In addition to reducing copper levels in the receiving waters, it is hoped that the study will elevate the use of non-toxic bottom paints to the preferred application for boaters in the harbor area.

The Shelter Island Yacht Basin TMDL for dissolved copper will also be used as an important resource for the Lower Newport Bay copper reduction program. Because of the similarities between Shelter Island and Upper Newport Bay with respect to sources of copper, harbor configuration, and abatement alternatives, the implementation plan for the Shelter Island TMDL provides meaningful alternatives to a copper reduction plan in Newport Bay. In addition to a transition to non-toxic hull coatings, other recommendations from the Shelter Island TMDL for reducing copper levels in the harbor receiving waters include management practices designed to reduce the effects of copper-based paints, financial incentives to boat owners and marinas, effective fate and transport modeling, and other alternative anti-fouling strategies. Assessing the most effective reduction measures from other studies conducted in the region will allow for the most of efficient management plan for reducing copper levels in Lower Newport Bay.

Pollution Prevention/Runoff Reduction- Water Quality Enforcement Cross Training Program

The primary path through which nearly all of the priority COC listed for Newport Bay enter the receiving waters is through non-point sources. These COC are common to urbanized environments, but source identification and abatement is often complicated by numerous inputs, intermittent sources, and the co-mingling of COC, particularly in a complicated harbor environment. A focused, efficient program is required to address these issues.

The Water Quality Enforcement Cross Training Program is a Municipal inter-departmental coordination initiative designed to control non-point source discharges to the Lower Bay. The Program will train Harbor Area oversight departments (Harbor Patrol, Lifeguards, Coast Guard, Cal Fish and Game) in identifying potential sources of water quality degradation. In addition, the Program will increase communication among these Departments and City Code Enforcement officers to report potential violations.

These efforts will be conducted in conjunction with Sea Grant projects related to the Coastal Zone Management Act that are being conducted in the region. The Nonpoint Source Pollution Program is an education and outreach program for boaters, marinas, and the marine industry on pollution prevention, non-point pollution, marine debris, and other related topics. The program provides education for recreational boaters on ways they can prevent water pollution and help protect marine species and habitats.

Pollution Prevention/Runoff Reduction- Boating Activities

Nutrients and bacteria are listed as priority COCs for Upper Newport Bay. In addition to natural sources, there are numerous non-point anthropogenic sources of these constituents that can impact water quality in the Bay, including animal waste, groundwater seepage, a diffuse storm drain network. In harbor areas, source identification studies of these constituents are complicated by the presence of numerous boats and boating activities, such as illicit discharge of holding tanks, dock maintenance, and boat washing.

To address these latter concerns a Water Quality Education Program has been designed to provide brochures and posters for Harbor Area boat users to reduce pollutants entering the Bay as a result of boat and dock washing activities. The Program is designed to mesh with the Boating Clean and Green Campaign, a statewide boater education assistance program conducted by the California Department of Boating and Waterways and the California Coastal Commission. The Campaign promotes environmentally sound boating practices to marine businesses and boaters throughout California. The Campaign focuses on boater education in promoting environmentally friendly boating practices while assisting marinas and local governments in identifying and installing pollution prevention services for boaters.

In addition, other programs have been initiated to education boat owners about the environmental impacts of certain boating activities. The Water Quality Education Program for Short-term Slip Rentals is a Municipal, inter-departmental coordination initiative designed to educate Harbor users and visitors of the importance of water quality protection. The Program will provide literature to help short-term slip tenants identify and reduce potential sources of water quality pollution from their vessels. Similarly, the City could implement inspection process linked to slip transfers so that Harbor users are educated and potentially polluting vessels are identified prior to the slip transfer process.

Pollution Prevention/Runoff Reduction- Nutrient Load – Cross Contamination Study

Nutrients are listed as a Priority COC for Lower Newport Bay and there is currently a Nutrient TMDL for the water body. Excessive nutrients in an urbanized water body, particularly in a semi-enclosed harbor area, can lead to limited circulation and a nutrient build-up that can result in algal blooms. Assessing the sources of these nutrients and their fate and transport in the Harbor and surrounding area are important factors for maintaining water quality in the Bay as well as the adjacent Newport ASBS. The transport of nutrients and algae from Newport Bay to the area is determined by coastal circulation and volume of the water outflow from the Newport Bay. Because of the large tidal exchange in the Bay, it has been hypothesized that nutrients and algae originating in the Bay may have a larger impact on the adjacent Newport Coast ASBS than runoff from its local watershed.

The Cross-Contamination Project is designed to reduced fertilizer and pesticide use that impact the Bay the Bay via urban runoff and assess nutrient loads in urban runoff and their potential for causing algal blooms. Community outreach will be targeted towards chemical suppliers (such as garden centers, etc.), commercial landscaping operations, and residents. In addition, the project will incorporate the Newport Bay outlet plume modeling project to understand the impact of nutrient loading and algal blooms on the Newport Coast ASBS.

Pollution Prevention/Runoff Reduction- Municipal Low Impact Development (LID) Assessments

As part of the Phase I BMP projects, Tier II runoff reduction BMP are recommended that will address multiple pollutant loading to the Lower Bay. This first phase of Tier II project includes a pilot assessment program to incorporate additional LID designs into municipal facilities within the Harbor Area and the Marina Park Conceptual Plan. Currently, the Marina Park Conceptual Plan indicates a Bio-Swale Filtration Area adjacent to the Community Center. Additional LID techniques as shown on Figure 5-1 and Figure 5-2 may be incorporated into the Marina Park projects and well as other municipal projects schedule in the next 5-years. This pilot assessment program include first identifying the municipal projects where LID techniques can be incorporated into the design. The City will then coordinate with the team's that are designing and implementing the project to incorporate infiltration and runoff disconnect features as part of the project. The LID features will then we assessed for their effectiveness in reducing runoff and pollutant loadings. The results of this Phase I will be used to expand on this program where effective and feasible.

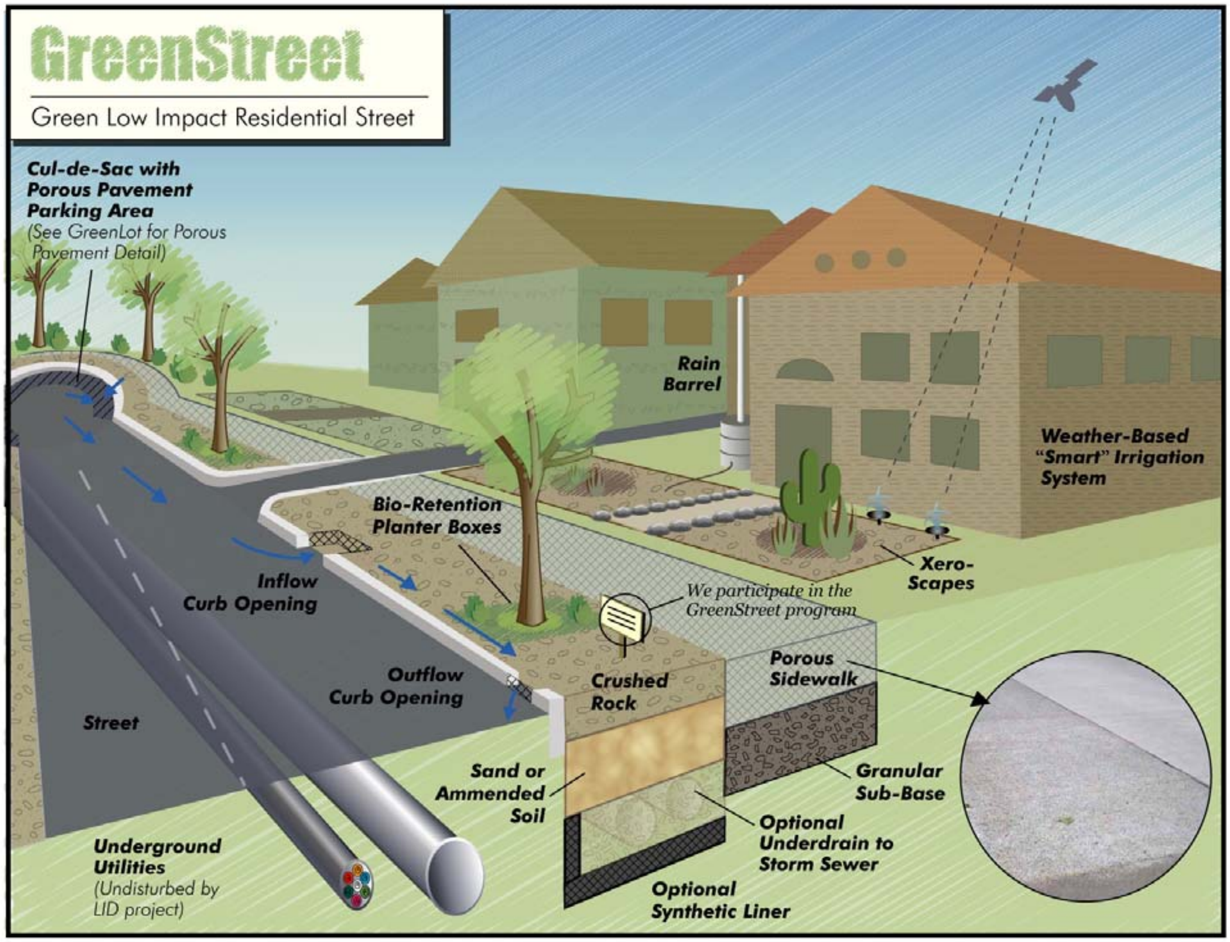


Figure 5-1. GreenStreet

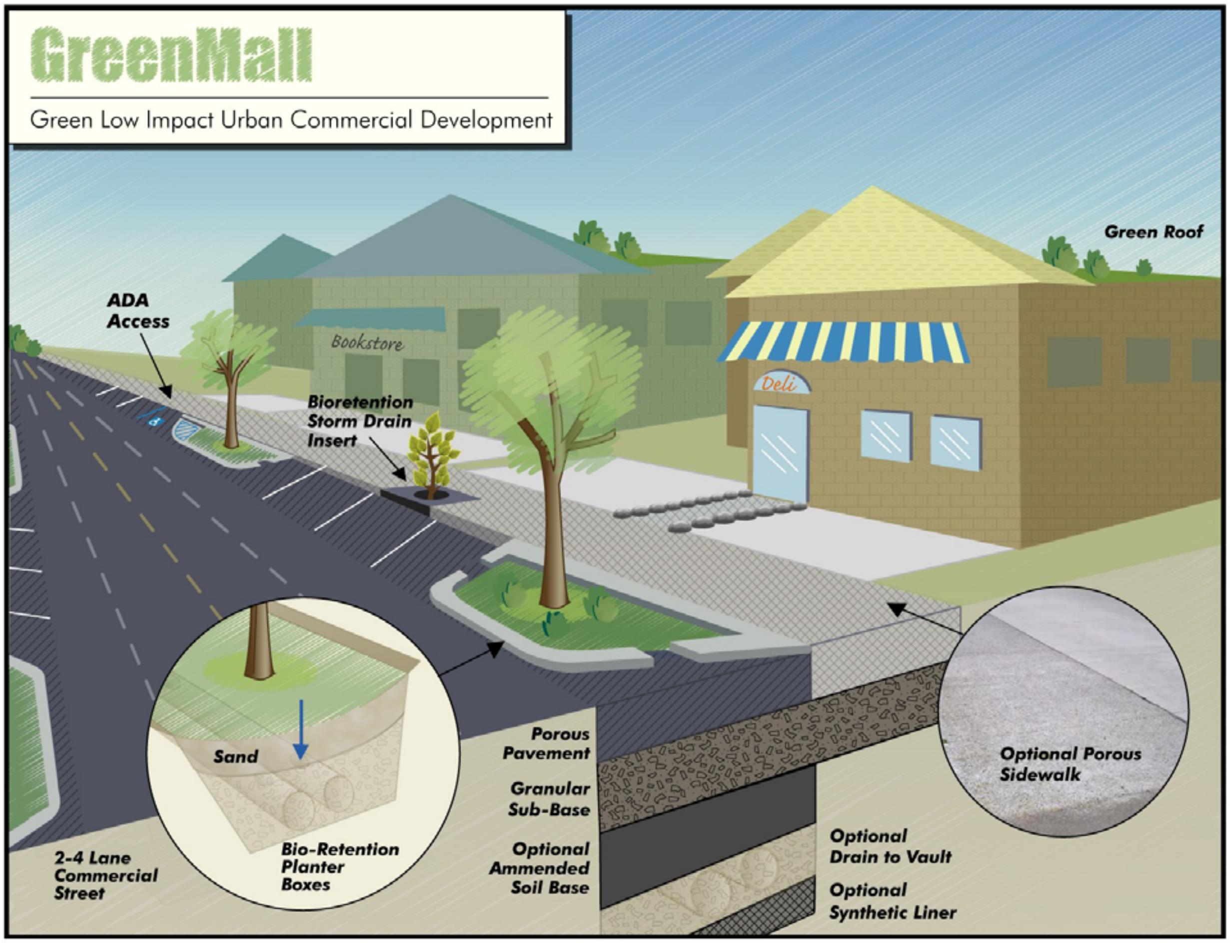


Figure 5-2. GreenMall