California Regional Water Quality Control Board
San Diego Region

Sediment TMDL for Los Peñasquitos Lagoon

DRAFT
STAFF REPORT
April 22, 2011

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Sediment TMDL
Los Peñasquitos Lagoon

Draft
Staff Report

Adopted by the
California Regional Water Quality Control Board
San Diego Region
on _______________, 201x

Approved by the
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on _______________, 201x
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STATE OF CALIFORNIA

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Table of Contents

Figures:

Tables:

Abbreviations:

BAT:	Best Available Technology
BMP:	Best Management Practice
CWA:	Clean Water Act
CFR:	Code of Federal Regulations
EFDC:	Environmental Fluids Dynamic Code
EMC:	Event Mean Concentration
USEPA:	United States Environmental Protection Agency
LA:	Load Allocation
LSPC:	Loading Simulation Program in C++
MLS:	Mass Loading Station
MOS:	Margin of Safety
MS4:	Municipal Separate Storm Sewer System
NPS:	Non-point Source Pollution
NPDES:	National Pollutant Discharge Elimination System
SANDAG:	San Diego Association of Governments
TBELs:	Technology Based Effluent Limitations
TMDL:	Total Maximum Daily Load
TSS:	Total Suspended Solids
TWAS:	Temporary Watershed Assessment Stations
USGS:	Unites States Geological Survey
WQOs:	Water Quality Objectives
WLA:	Wasteload Allocation
WDRs:	Waste Discharge Requirements
WQBELs:	Water Quality Based Effluent Limitations (WQBELs)

Acknowledgements

Many dedicated professionals contributed to this Staff Report through their service on the Stakeholder Advisory Group (SAG) for this Total Maximum Daily Load project. The SAG provided insightful technical comments on early drafts of this report, suggested issues for technical peer review, raised important policy issues, and assisted with drafting the Implementation Plan. The California Regional Water Quality Control Board, San Diego Region, would like to thank the individuals who served on the SAG for their significant contributions to this project.

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Executive Summary

This staff report supports tentative Resolution No. R9-2011-0021, which will amend the *Water Quality Control Plan for the San Diego Basin (9)* (Basin Plan) to incorporate the sediment Total Maximum Daily Load (TMDL) for Los Peñasquitos Lagoon (Lagoon). The Basin Plan amendment will incorporate the TMDL, associated waste load allocations, and required load reductions into the Basin Plan. This TMDL should result in attainment of water quality objective for sediment in Lagoon and address the Clean Water Act section 303(d) sediment impairment for the Lagoon.

Los Peñasquitos Lagoon is one of the few remaining and irreplaceable coastal lagoons in southern California providing valuable estuarine habitat as well as numerous other important beneficial uses. Over the course of the 20th century, the Lagoon has incurred a number of important anthropogenic disturbances which, cumulatively, have resulted in excessive sedimentation and the gradual degradation and loss of the estuarine habitat.

Restoration of the Lagoon is a high priority for the San Diego Water Board. Acknowledging the environmental and political complexities, as well as the time and financial resources needed to restore a coastal lagoon, the San Diego Water Board has established a three-step Waterbody Goal for Los Peñasquitos Lagoon in the Basin Plan amendment. Although we do not expect a return to pristine conditions, we do expect that a holistic watershed restoration effort will eventually result in the attainment of all applicable water quality standards in Los Peñasquitos Lagoon as well as in each of its three tributary creeks.

Accordingly, the Sediment TMDL for Los Peñasquitos Lagoon should (1) result in reduction in the current watershed sediment loading rate to the early-1970s watershed sediment loading rate, and (2) initiate long-term Lagoon monitoring to assess Lagoon's response to decreasing sediment loads and overall health.

<u>Water Quality Impairment of Los Peñasquitos Lagoon</u>

As required by section 303(d) of the Clean Water Act, the Los Peñasquitos Lagoon (Lagoon) was placed on the 1996 List of Water Quality Limited Segments due to sedimentation and siltation loads that exceeded water quality objectives. The beneficial use that is most sensitive to increased sedimentation is estuarine habitat. Beneficial uses of the Lagoon may include preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (such as marine mammals or shorebirds). Other beneficial uses listed in the Basin Plan for the Lagoon include contact water recreation; non-contact water recreation; preservation of biological habitats of special significance; wildlife habitat; rare, threatened or endangered species; marine habitat; migration of aquatic organisms; spawning, reproduction and/or early development; and shellfish harvesting.

Impacts associated with increased and rapid sedimentation include: reduced tidal mixing within Lagoon channels, degraded and (in some cases) net loss of riparian and salt marsh vegetation, increased vulnerability to flooding for surrounding urban and industrial developments, increased turbidity associated with siltation in Lagoon channels, and constricted wildlife corridor.

Numeric Target

The water quality objective for sediment is contained in the Basin Plan. The Basin Plan states, "The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses." Because the sediment water quality objective is narrative, a numeric target is needed to evaluate attainment of the narrative water quality objective for sediment. Consideration of various lines of evidence indicates that the Lagoon was likely achieving the water quality standard for sediment before the mid-1970s. A historic coverage for the Los Peñasquitos watershed was developed for this period using US Geological Survey topographic maps from the 1970s (primarily the La Jolla quadrangle-dated 1975). This historic land use distribution was used to calculate the numeric target using the LSPC watershed model (see Attachment 2). This historic sediment load of 12,360 tons per critical wet period (58.6 tons per day) represents the sediment TMDL numeric target.

Sources and Responsible Parties

Watershed Point and Non-point Sediment Sources

There are two broad categories of sediment sources to the Lagoon: 1) "collective watershed sources"; and 2) the Pacific Ocean. The "collective watershed sources" consist of all of point and non-point sources of sediment in the watershed tributary to Los Peñasquitos Lagoon.

Point sources: The primary point sources in the watershed include the four National Pollutant Discharge Elimination System "Phase I" MS4 copermittees, namely the San Diego County, City of San Diego, City of Del Mar, and City of Poway. Other point sources include Caltrans infrastructure, all Phase II MS4s, and all individual industrial facilities and construction sites located within the watershed. All point sources are considered "controllable" anthropogenic sources.

Non-point sources: In this project, the "collective watershed sources" also include all the *non-point sources located in the watershed* such as agriculture (1 percent of current land use area) and open space (43 percent of current land use area).

This is the case because virtually the entire Los Peñasqutios watershed is drained through the Phase I MS4 collection systems and therefore these sources, although nonpoint in origin, are considered by the Water Board to be “controllable” point sources. For this reason the Phase I MS4s can be thought of as the primary and ultimate point sources of sediment to the Lagoon.

Ocean Non-point Sediment Sources

The Pacific Ocean is a significant non-point source of sediment to the Lagoon that the Water Board considers to be an uncontrollable natural background source. Sediment loads from the ocean are primarily a function of littoral forces and other factors that are largely separate from the sedimentation problem originating from the watershed. Although important to understanding the entire picture for management purposes, the ocean sources are outside the scope of this initial project.

Responsible Parties

The “responsible parties” are defined as the owners and operators of the “collective watershed sources”. Hence, the responsible parties were assigned a collective waste load allocation and are jointly responsible for meeting the waste load reductions required in this TMDL project. Owners and operators of the collective watershed sources are the only responsible parties in this project and include the following: Phase I MS4s copermittees (the County of San Diego, City of San Diego, City of Del Mar, and City of Poway), Phase II MS4s permittees, Caltrans, and the General Construction and General Industrial Storm Water permittees.

<u>Linkage Analysis</u>
Available data were used to configure, calibrate, and validate a customized modeling framework developed to support sediment TMDL development. The modeling framework consists of a watershed model (based on the Loading Simulation Program in C++, LSPC) and a receiving water model (based on the Environmental Fluids Dynamic Code, EFDC). The watershed model was used to calculate existing and historical sediment loading to the Lagoon from the Los Peñasquitos watershed, while the Lagoon receiving water model was used to simulate hydrodynamics and sediment transport characteristics for this tidally-influenced waterbody.

<u>TMDL and Allocations</u>
TMDL = 12,360 tons per year

The maximum load of sediment that Los Peñasquitos Lagoon can receive from all sources and still meet the sediment water quality objective is estimated at 12,360 tons per year, the early 1970s loading rate.

Wasteload Allocations to Watershed = 2,580 tons/year

As the primary controllable point source to the Lagoon, a wasteload allocation (WLA) of 2,580 tons/year was assigned to the “collective watershed sources” (WLA equal to full historic load). Wasteload reductions are required of the watershed sources collectively.

Load Allocations to Ocean = 9,780 tons/year

The ocean was the most significant nonpoint source of sediment to the Lagoon and was assigned at load allocation (LA) of 9,780 tons/year (LA equal to full historic load). Because the ocean is considered an “uncontrollable” natural background source, load reductions are not required of the ocean.

Allocations and Load Reductions

The TMDL results are summarized in the tables below. The overall WLA is represented by the watershed contribution in Tables ES-1 and ES-2. The ocean boundary (LA) includes sediment loads from storm surge, wave action, and tidal exchange. The historical load represents the estimated load contribution from the mid-1970s time period (reference condition).

Table ES-1. TMDL summary

Source	Critical Wet Period Load (tons)	Daily Load (tons)
TMDL	12,360	58.6
Watershed contribution (WLA)	2,580	12.2
Ocean boundary (LA)	9,780	46.4
MOS	Implicit	Implicit

Table ES-2. Current vs. historical loads and percent reduction

Source	Current Load (tons)	Historical Load (tons)	Load Reduction (tons)	Percent Reduction Required
Watershed contribution (WLA)	7,719	2,580	5,139	**67%**
Ocean boundary (LA)	5,944	9,780	+3,836 (increase)	+39% (increase)
Total	13,663	12,360	1,303	10%

Implementation of TMDL

Because the Phase I MS4s are located at the base of the watersheds and have been identified as the most significant controllable source of sediment discharging to the Lagoon, this TMDL will most likely be implemented primarily through the revision of the National Pollutant Discharge Elimination System (NPDES) discharge requirements regulating discharges from the Phase I MS4s. The Caltrans NPDES requirements will also be revised. Federal regulations require that NPDES requirements incorporate water quality based effluent limitations (WQBELs) that are consistent with the requirements and assumptions of any available WLAs.[1] WQBELs may be expressed as numeric effluent limitations, when feasible, and/or as a program of expanded or better-tailored Best Management Program.[2] The WQBELs will likely need to include a BMP program to achieve the load reductions required to attain the TMDL in the receiving waters.

The Phase I MS4s and Caltrans will be required to submit a Comprehensive Load Reduction Plan outlining a proposed BMP program that will be capable of achieving the necessary load reductions required to attain the TMDL in the Lagoon. Phase II MS4s will be required to comply with existing requirements upon designation and enrollment under the Statewide Phase II MS4 general NPDES permit[3] or other individual Phase II MS4 permit issued by the San Diego Water Board. Industrial and construction storm water permittees will also be required to comply with existing requirements under their respective permits[4]. In addition, Phase II MS4s and Construction and Industrial Storm Water Permit holders may be required to submit Sediment Load Reduction Plans outlining a proposed BMP program that will be capable of achieving the necessary load reductions required to attain the TMDL in the Lagoon. The Phase I MS4s, Phase II MS4s, Caltrans, and Construction and Industrial Storm Water Permit holders will be responsible for reducing their sediment loads and/or demonstrating that their discharges are not causing exceedances of the WQOs.

TMDL Compliance Monitoring

Compliance monitoring is required of the responsible parties to assess their BMP effectiveness and progress towards achieving the required interim milestones and final load reductions in accordance with the compliance schedule. The responsible parties are required to design and carry-out a compliance monitoring program that is capable of demonstrating that the responsible parties' have reduced their collective watershed sediment loading to the Lagoon to the early 1970s watershed loading rate.

Compliance Determination

Final compliance with this project will be reached when the responsible parties have demonstrated that they have reduced their collective watershed sediment load to Los Penasquitos Lagoon to the early 1970s watershed sediment load in accordance with the appropriate compliance schedule.

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[1] Code of Federal Regulations Title 40 section 122.44(d)(1)(vii)(B)
[2] Code of Federal Regulations Title 40 section 122.44(k)(2)&(3)
[3] Order No. 2003-0005-DWQ, *National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000004, Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems (General Permit)*
[4] Construction projects are covered under Order No. 2009-0009-DWQ, *National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, CAS000002*. Industrial sites are covered under

Similarly, interim milestone compliance will be based on the responsible parties' ability to demonstrate that each interim milestone load reduction has been achieved in accordance with the appropriate compliance schedule.

Compliance Schedule

Full implementation of the TMDL for sediment shall be completed within 10 years from the effective date of the Basin Plan amendment. As an incentive to take a more comprehensive pollution reduction approach, an alternative 20-year schedule is provided which requires responsible parties to plan for, and demonstrate required load reductions of bacteria and other pollutants, in addition to the sediment load reductions required by this project.

1 Introduction

The California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) is the California state agency responsible for water quality protection in the southwest portion of the state of California. It is one of nine Regional Water Boards in California, each generally separated by hydrological boundaries. Each Regional Water Board consists of nine governor-appointed members who serve four-year terms. The San Diego Water Board, under its federally designated authority, administers the Clean Water Act (CWA) within the San Diego Region.

In accordance with the CWA, the San Diego Water Board has adopted the *Water Quality Control Plan for the San Diego Region (9)* (Basin Plan) that specifies water quality standards for waters in the San Diego Region and implementation measures to enforce those standards. Section 305(b) of the CWA mandates biennial assessment of the nation's water resources to identify and list waters not meeting their water quality standards. These waters are listed in accordance with CWA section 303(d) and the list is commonly referred to as the 303(d) list. The CWA requires states to establish a priority ranking for impaired waters and to develop and implement Total Maximum Daily Loads (TMDLs) to address the impairments.

A TMDL is a written, quantitative assessment of water quality problems and contributing pollutant sources. It identifies one or more numeric targets for restoring beneficial uses based on applicable water quality standards, specifies the maximum pollutant load that can be discharged and still meet water quality standards, allocates pollutant loads among sources in the watershed and provides a basis for taking actions needed to meet the numeric target(s) and water quality standards.

The Los Peñasquitos Lagoon (Lagoon) is currently listed on the 303(d) list for impairment due to sedimentation/siltation. Sedimentation within the Lagoon restricts the tidal prism, or exchange between the ocean and the Lagoon, and degrades critical salt marsh habitats through various processes. Because the Lagoon is not meeting the sediment narrative water quality objective, numerous beneficial uses are impaired, primarily those associated with protection of aquatic life (e.g., Estuarine, Marine Life Habitat, and Preservation of Biological Habitats of Special Significance, etc.).

The San Diego Water Board proposes to amend its Basin Plan to incorporate a TMDL and implementation plan to address sedimentation problems adversely affecting water quality in the Lagoon. This TMDL staff report describes the scientific and technical basis for confirming sediment impacts, developing numeric targets, determining sediment sources, and establishing watershed loading capacity. When all discharges from controllable sources meet their assigned WLAs and the numeric targets are also met in the Lagoon, compliance with the TMDL will be achieved. Compliance with the

TMDL will be assessed by monitoring the Lagoon and contributing creeks, and then comparing the results to the numeric target. At the end of the TMDL compliance schedule, the annual sediment load must not exceed the numeric target.

This TMDL was developed through close collaboration between the municipalities within the Los Peñasquitos watershed (City of San Diego, San Diego County, City of Del Mar, and City of Poway), the California Department of Transportation (Caltrans), San Diego Coastkeeper, California State Parks, the Los Peñasquitos Lagoon Foundation, and representatives from the San Diego Water Board. This third party TMDL effort was led by the City of San Diego and included detailed modeling of the Lagoon and its contributing watershed.

For the technical portion of this TMDL, the San Diego Water Board relied on the report prepared by Tetra Tech entitled, *Los Peñasquitos Lagoon Sediment/Siltation TMDL* (Technical Support Document).

2 Problem Statement

Under section 303(d) of the Clean Water Act (CWA), states are required to identify waters whose beneficial uses have been impaired due to specific constituents. Los Peñasquitos Lagoon was placed on the Section 303(d) list of Water Quality Limited Segments in 1996 for sedimentation and siltation with an estimated 469 acres affected. The Lagoon is subject to the development of a total maximum daily load (TMDL) (USEPA, 2009).

The Lagoon is an estuarine system that is part of the Torrey Pines State Natural Reserve. In addition to its marine influence, the Lagoon receives freshwater inputs from an approximately 60,000-acre watershed comprised of three major canyons (Carroll Canyon, Los Peñasquitos Canyon, and Carmel Canyon). Given the status of “Natural Preserve” by the California State Parks, the Lagoon is one of the few remaining native salt marsh lagoons in southern California, providing a home to several endangered species. (California State Parks, 2009) The Lagoon is ecologically diverse, supporting a variety of plant species, and providing habitat for numerous bird, fish, and small mammal populations. The Lagoon also serves as a stopover for the Pacific Flyway, offering migratory birds a safe place to rest and feed, as well as providing refuge for coastal marine species that use the Lagoon to feed and hide from predators.

The San Diego Basin Plan states, “The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.” Beneficial uses listed in the Basin Plan for the Lagoon include contact water recreation; non-contact water recreation (although access is not permitted in some areas per California State Parks); preservation of biological habitats of special significance; estuarine habitat; wildlife habitat; rare, threatened or endangered species; marine habitat; migration of aquatic organisms; spawning, reproduction and/or early development; and shellfish harvesting. The beneficial use that is most sensitive to increased sedimentation is estuarine habitat. Estuarine uses may include preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (such as marine mammals or shorebirds).

Impacts associated with increased and rapid sedimentation include: reduced tidal mixing within Lagoon channels, degraded and (in some cases) net loss of riparian and salt marsh vegetation, increased vulnerability to flooding for surrounding urban and industrial developments, increased turbidity associated with siltation in Lagoon channels, and constricted wildlife corridors. The Los Peñasquitos Lagoon Enhancement Plan and Program (1985), San Diego Basin Plan (1994), and Clean Water Act section 303(d) highlight sedimentation as a significant impact associated with urban development and a leading cause in the rapid loss of salt marsh habitat in the Lagoon, making sediment reduction a management priority.

According to California State Parks, the Lagoon consists of approximately 510 acres of wetland habitats including coastal salt marsh (this includes salt panne, tidal channels, and mudflats), brackish marsh, riparian woodland and scrub, and freshwater marsh. The Lagoon’s 510 acres include approximately 210 acres of unimpaired tidal salt marsh and 120 acres of unimpaired freshwater wetlands (California State Parks 2010). The remaining 180 acres of salt marsh and brackish marsh vegetation are impaired by excessive sedimentation, which converted the coastal salt marsh to freshwater or upland habitats. The environmental processes that support wetland habitats in the Lagoon have been altered by urban development in three ways:

1) Increase in the volume and frequency of freshwater input
2) Increase in sediment deposition
3) Decrease in the tidal prism

These factors have led to decreases in saltwater and brackish marsh habitats and increases in freshwater habitats as well as increases in the abundance of non-native species.

The Sediment TMDL for Los Peñasquitos Lagoon should (1) result in reduction in the current watershed sediment loading rate to the early-1970s watershed sediment loading rate, and (2) initiate long-term Lagoon monitoring to assess Lagoon’s response to decreasing sediment loads and overall health.

3 Background Information

This section describes the Los Peñasquitos watershed and Lagoon, applicable water quality standards (including beneficial uses and WQOs), and provides background information on the impairment.

3.1 Los Peñasquitos Watershed Description

The Los Peñasquitos watershed is located in central San Diego County (Figure 1). Both the watershed and Lagoon are included in the Los Peñasquitos Hydrologic Unit (906), which also includes Mission Bay and several coastal tributaries. This 93 square mile (approximately 60,000 acres) coastal watershed includes portions of the City of San Diego, City of Poway, City of Del Mar, and San Diego County (Figure 2). There are also several major road corridors that are maintained by Caltrans within the watershed.

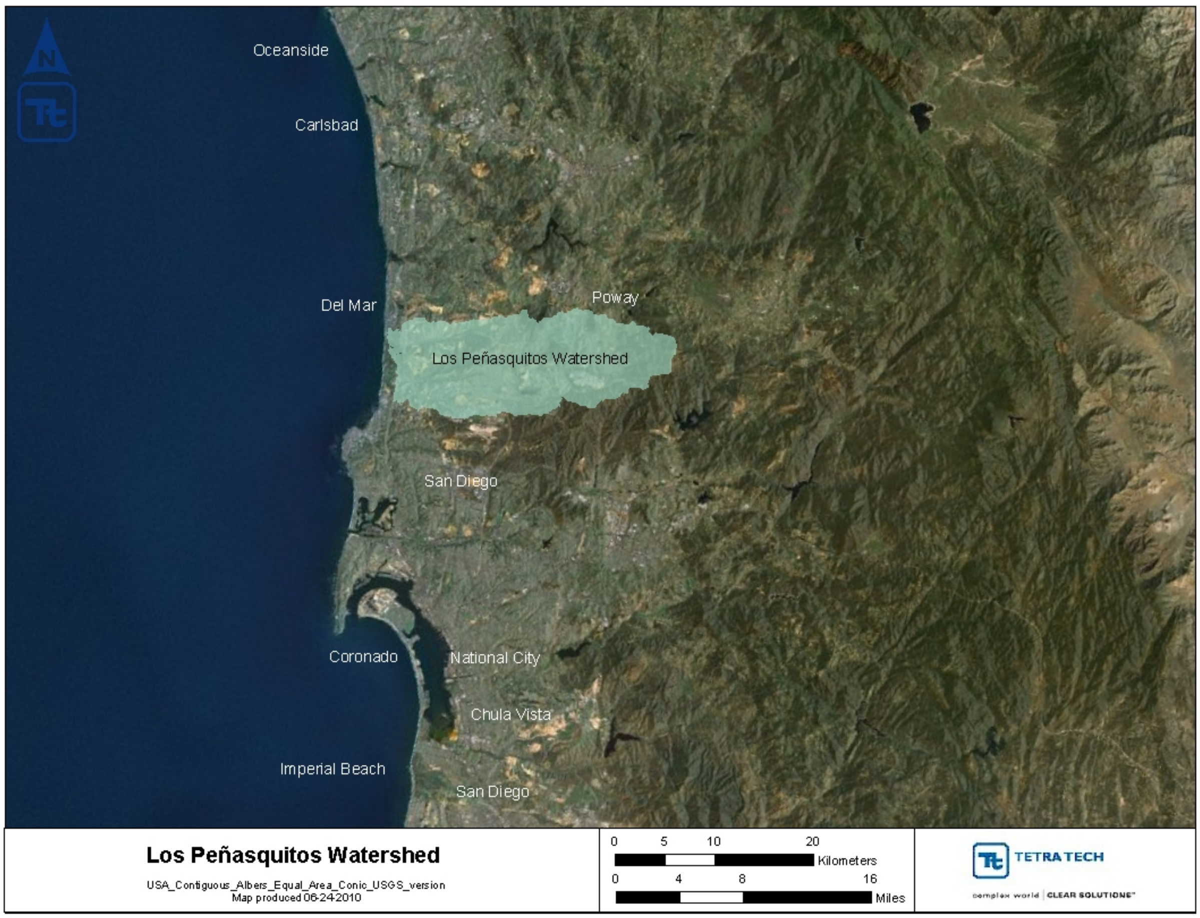

Figure 1. Location of the Los Peñasquitos watershed

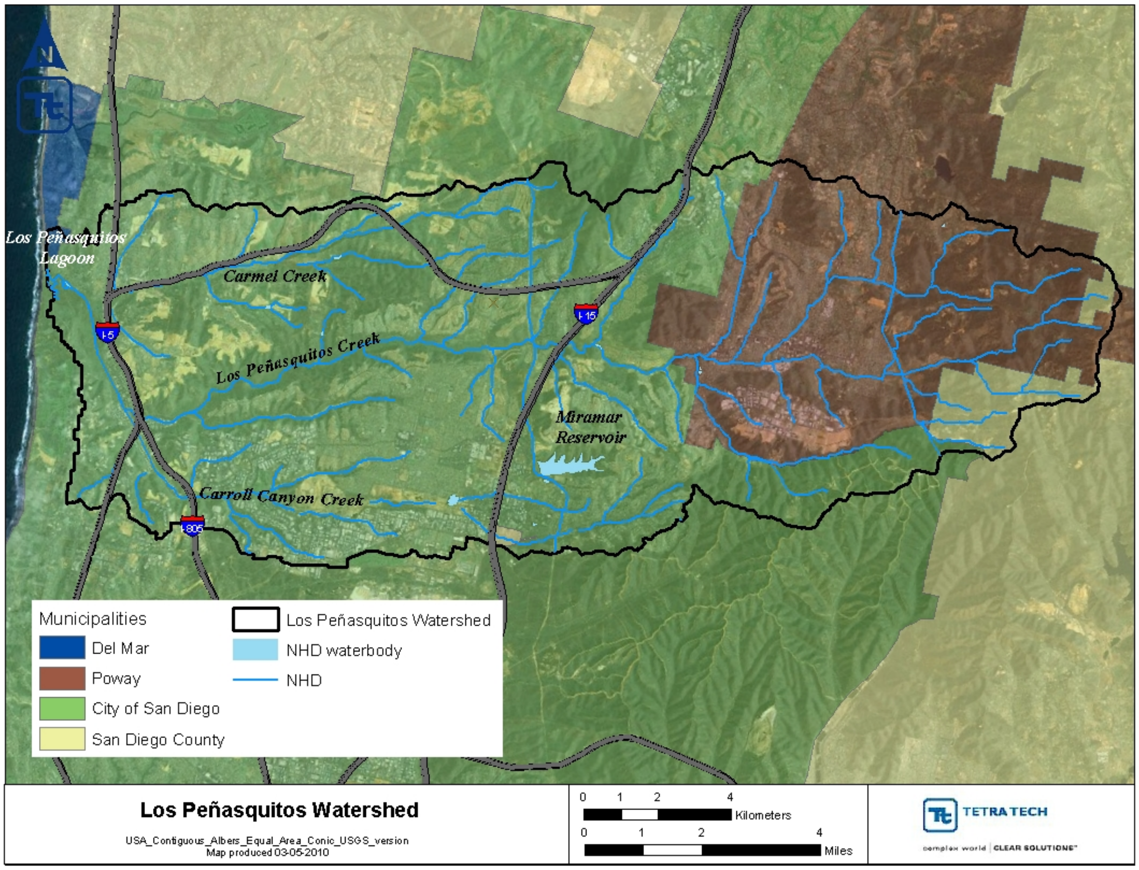

Figure 2. Municipalities within the Los Peñasquitos watershed

The climate in the Region is generally mild with annual temperatures averaging around 65°F near the coastal areas. Average annual rainfall ranges from nine to eleven inches along the coast. There are three distinct seasons in the Region. The summer dry season occurs from late April to mid-October. The winter season occurs from mid-October through early April and has two types of weather; 1) winter dry weather when rain has not fallen for the preceding 72 hours, and 2) wet weather consisting of storms of 0.2 inches of rainfall (or greater) and the following 72 hours. The winter season accounts for 85 to 90 percent of the annual rainfall .

Three major streams drain the watershed and flow into the Lagoon (Figure 2). Los Peñasquitos Creek is the largest catchment, located in the central portion of the watershed, draining 59 square miles (approximately 37,760 acres). Carroll Canyon Creek is the second largest catchment, located in the southern portion of the watershed, draining 18 square miles (approximately 11,520 acres). Carmel Creek is the smallest of the three catchments, located in the northern, coastal area, draining the remaining 16 square miles (approximately 10,240 acres). Los Peñasquitos Creek and Carroll

Canyon Creek converge prior to entering the Lagoon. There is one major dam in the Carroll Canyon Creek watershed, which drains approximately 1 square mile (approximately 640 acres) and forms Miramar Reservoir (retains imported drinking water; does not discharge downstream). Watershed elevation rises from sea level to 2,600 ft in the headwaters.

Data detailing land use in the Los Peñasquitos watershed is available through the San Diego Association of Governments 2000 land use coverage[5] and is presented in Figure 3. Approximately 54 percent of the watershed has been developed, with 46 percent of that area classified as impervious. The largest single land use type in the Los Peñasquitos watershed is open space (approximately 25,500 acres), followed by low density residential development (approximately 14,250 acres) and industrial/transportation (approximately 11,660 acres). The percent distribution of all land uses in the watershed is presented in Figure 4. Additional key watershed characteristics that were used for model configuration are described in the Modeling Report. (Attachment 2)

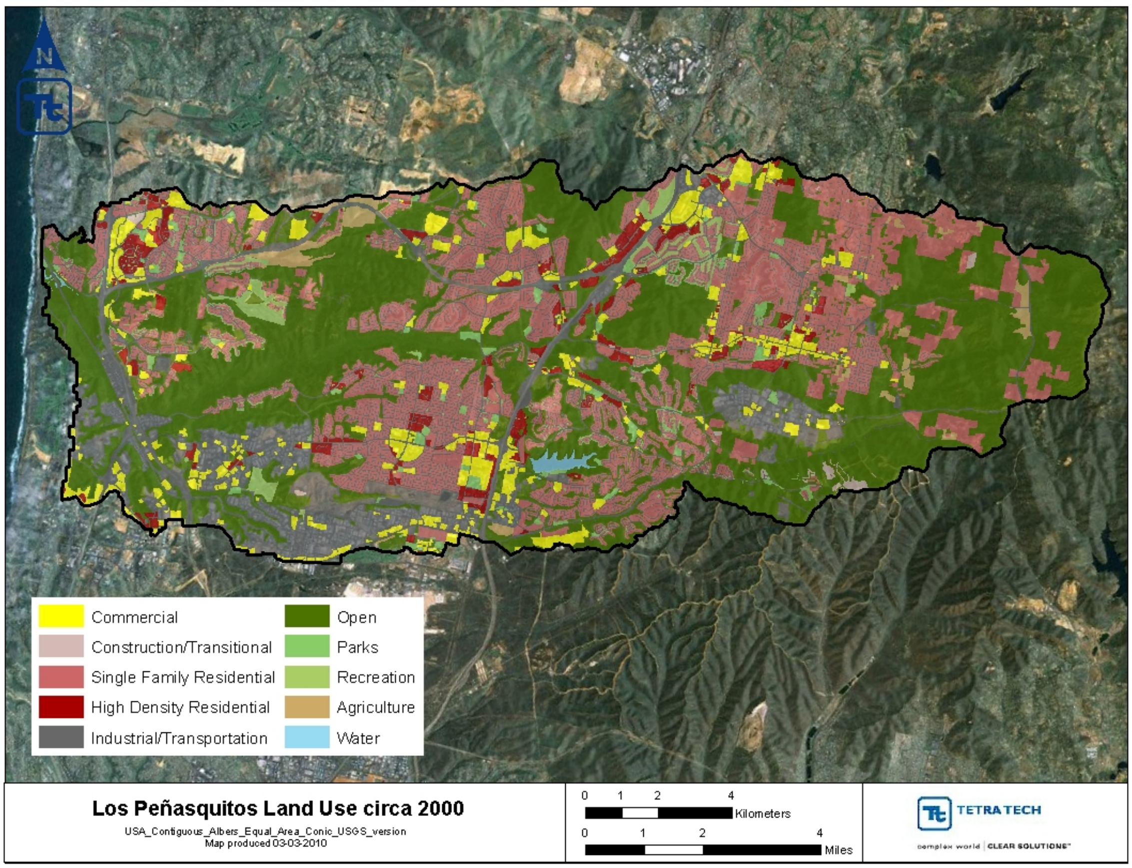

Figure 3. Land uses in the Los Peñasquitos watershed

5 http://www.sandag.org/resources/maps_and_gis/gis_downloads/downloads/zip/Land/CurrentLand/lu.zip

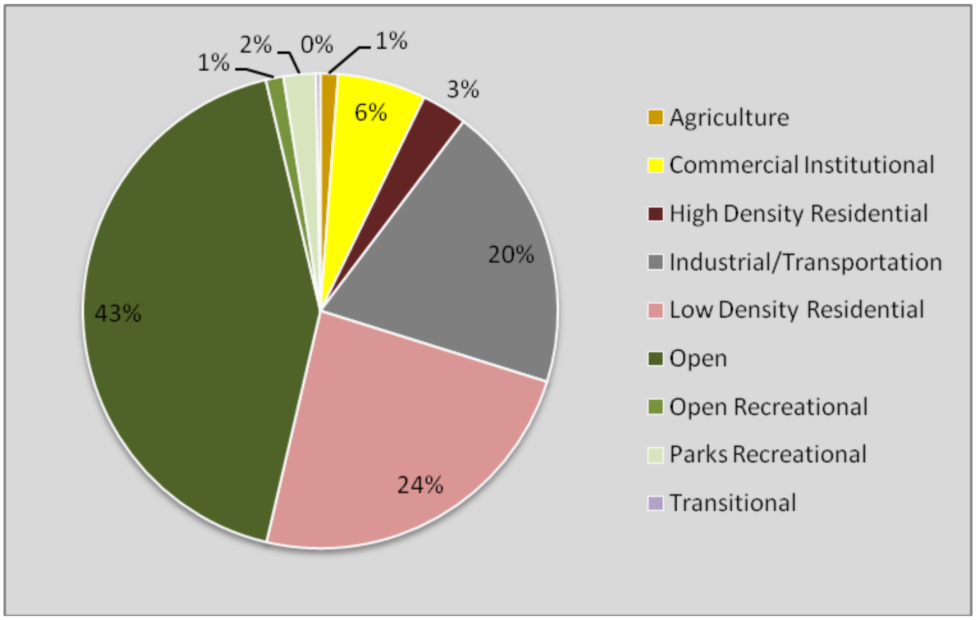

Figure 4. Land use distribution in the Los Peñasquitos watershed

3.2 Los Peñasquitos Lagoon Description

The Lagoon is a relatively small estuarine system that is part of the Torrey Pines State Natural Reserve (Figure 5). Given the status of "Natural Preserve" by the California State Parks, the Lagoon is one of the few remaining native salt marsh lagoons in southern California. The Lagoon is ecologically diverse, supporting a variety of plant species, and providing habitat for numerous bird, fish, and small mammal populations. The Lagoon also serves as a stopover for migratory birds and provides habitat for coastal marine and salt marsh species.

Figure 5. Photograph of Los Peñasquitos Lagoon

Tidal flows enter the Lagoon during periods when the Lagoon mouth is open to the ocean. Currently, the Lagoon mouth is open throughout most of the year. Mouth closures are typically caused by coastal processes (deposition of sand and cobble due to storms surges and wave action) and structures, such as the U.S. Highway 101 abutments. Mechanical dredging is used, when needed, to eliminate blockages and allow for tidal flow into the Lagoon to improve water quality conditions and support salt marsh species.

Most of the freshwater input flows through Los Peñasquitos Canyon into the Lagoon. Carroll Canyon Creek to the south and Carmel Creek to the north also contribute freshwater to the Lagoon. Historically, Los Peñasquitos Creek was the only tributary that flowed year-round, while Carroll Canyon and Carmel Creeks only flowed during significant rainfall events. Beginning in the 1990s, Carroll Canyon and Carmel Creeks also began flowing year-round due to increased urban development within the watershed.

The railroad track berm acts as a barrier between the eastern and western portions of the Lagoon. The railroad trestle along the Lagoon's northern portion provides the main connection between the eastern and western portions of the lagoon. The Lagoon channel that receives flow from Carmel Creek crosses through this area (Figure 6). There are also two smaller bridges located in the southern portion of the Lagoon which allow flow from Carroll Canyon Creek to pass through to the eastern side of the Lagoon during high flow events (Figure 7).

Figure 6. Photograph of Carmel Creek entering Los Peñasquitos Lagoon

Figure 7. Photograph of Carroll Canyon Creek entering Los Peñasquitos Lagoon

3.3 Applicable Water Quality Standards

The narrative sediment WQO, as set forth in the Water Quality Control Plan for the San Diego Basin (Basin Plan) states, "*The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses"* (San Diego Water Board, 1994). The Basin Plan identifies the beneficial uses that are designated for Los Peñasquitos Lagoon (Table 1) (San Diego Water Board, 1994). Compliance with WQOs must be assessed and maintained throughout the waterbody to protect all beneficial uses. The narrative sediment WQO is applied to all beneficial uses.

Table 1. Beneficial uses designated for Los Peñasquitos Lagoon

Beneficial Use	Beneficial Use Description
REC 1	Includes uses of water for recreation activities involving body contact with water, where ingestion of water is reasonable possible. These uses include, but are not limited to, swimming, wadding, water skiing, skin and SCUBA diving, surfing, white water activities, fishing, or use of natural hot springs. *Note that access to some areas is not permitted per California State Parks
REC 2	Includes the use of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonable possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beach combing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities. *Note that access to some areas is not permitted per California State Parks
BIOL	Includes uses of water that support designated area or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.
EST	Includes uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds)
WILD	Includes uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.
RARE	Includes uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.
MAR	Includes uses of water that support marine ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.
MIGR	Includes uses of water that support habitats necessary for migration, acclimatization, between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.
SPWN	Includes uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish. This use is applicable only for the protection of anadromous fish.
SHELL	Includes uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters and mussels) for human consumption, commercial, or sport purposes.

3.4 Impairment Description

The Lagoon is listed as impaired on the 303(d) list due to sedimentation/siltation impacts. This impairment impacts several beneficial uses; however, the estuarine habitat use is the most sensitive to increased sedimentation. The Lagoon's wetland habitats consist of estuarine and riparian habitats, including coastal salt marsh habitat and wetland/upland buffer areas. The 303(d) listing indicated that the entire Lagoon was not supporting beneficial uses and was impaired by sediment. Recent surveys by California State Parks indicate that the Lagoon consists of more than 510 acres include approximately 210 acres of unimpaired tidal salt marsh and 120 acres of unimpaired freshwater wetlands (California State Parks 2010). The remaining 180 acres of salt marsh and brackish marsh vegetation are impaired by excessive sedimentation (Figure 8) (California State Parks, 2009; California State Parks, 2010).

Impacts associated with increased and rapid sedimentation include: reduced tidal mixing within Lagoon channels, degraded and net loss of riparian and salt marsh vegetation, increased vulnerability to flooding for surrounding urban and industrial developments, increased turbidity associated with siltation in Lagoon channels, and constricted wildlife corridors. There are many potential sources that have influenced the accumulation of sediment within the Lagoon. Sources include erosion of canyon banks and bluffs, scouring stream banks, and tidal influx. Some of these processes are exacerbated by anthropogenic disturbances, such as urban development within the watershed. Urban development transforms the natural landscape and results in increased runoff due to hydromodification resulting in scouring of sediment, primarily below storm water outfalls that discharge into canyon areas. Sediment loads are transported downstream to the Lagoon during storm events causing deposits on the salt flats and in Lagoon channels. These sediment deposits have gradually built-up over the years due to increased sediment loading and inadequate flushing, which directly and indirectly affects lagoon functions and salt marsh characteristics.

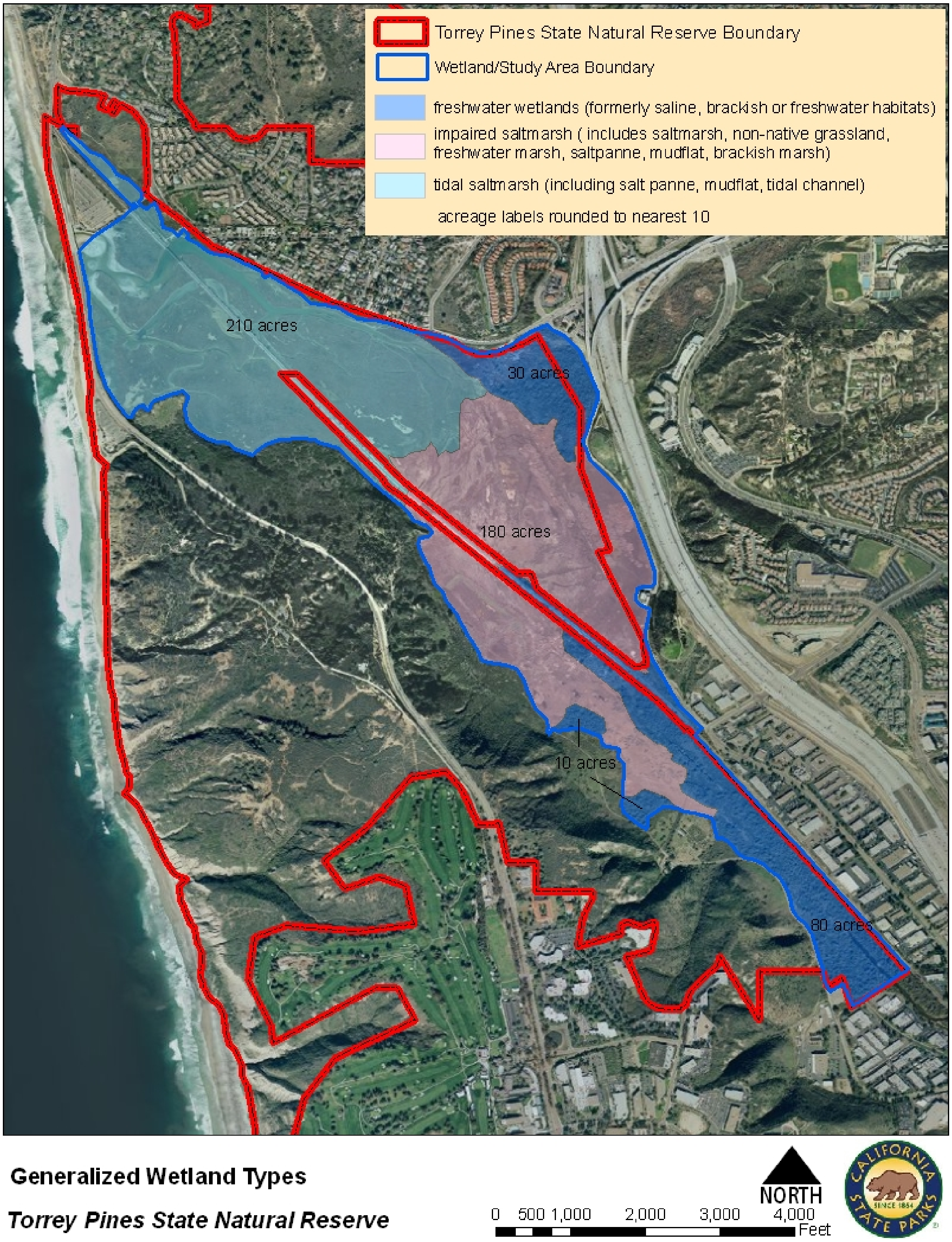

Figure 8. Wetland habitats within Los Peñasquitos Lagoon (California State Parks, 2010)

4 Numeric Targets

When calculating TMDLs, numeric targets are selected to meet WQOs for a waterbody and subsequently ensure the restoration and/or protection of beneficial uses. The WQO set forth in the Basin Plan that is associated with sediment was presented in section 3.3. This WQO was interpreted using multiple lines of evidence to determine the numeric target for this TMDL.

A narrative WQO applies to sediment loading to the Lagoon (see section 3.3). The minimum protective target would be to reduce loads to natural levels. The reduction in sediment loads to obtain natural levels was calculated using a model to simulate sediment loading under the land use distribution that existed during a historic state of the watershed, when water quality standards were once met. Available literature and past accounts of sedimentation impacts within the Lagoon were reviewed in the Technical Support Document (Attachment 1). This information provides the understanding of how watershed sedimentation results in impacts to the Lagoon's beneficial uses. Furthermore, this information was used in a weight of evidence approach (see section 1.3) to select the historic period that represents a time when water quality standards were being obtained.

4.1 Watershed Sedimentation

Several studies have documented the influx of sediment originating in the watershed to the Lagoon. Mudie and Byrne (1980) estimate that sedimentation rates have increased to 50 cm/100 years since European settlement of the area. Between 1968 and 1985, sediment from Carmel Valley has raised the elevation of the northeast corner of the Lagoon by 6.1 feet, converting salt marsh vegetation into riparian and cattail marsh which contributes to sediment retention (LPL Foundation and State Coastal Conservancy, 1985). The main depositional areas in the Lagoon are just downstream of the I-5 Carmel Valley Creek culverts and at the southern end of the Lagoon near Sorrento Valley. Gradual sediment accumulation in the lagoon has created areas of higher elevation which tidal water no longer reaches.

A 1974 report by the California Department of Fish and Game expressed concerns associated with a significant increase in flow of urban runoff draining into the eastern channel. It was determined that the runoff was the result of intensive residential development of the mesas northeast of the Lagoon. During the fall of 1973, this runoff volume amounted to approximately 1,500 gal/day (Mudie et al.,1974).
Prestegaard (1978) concluded that unmitigated urbanization could double the annual sediment load within 30 years. More recently, the City of San Diego identified

increasing urban development, resulting in alterations in hydrology and modified geomorphic conditions within the three main tributaries of the Lagoon's watershed, as a source of sedimentation (City of San Diego, 2005).

4.2 Sedimentation Impacts on Beneficial Uses

Continued sedimentation and freshwater inputs, both resulting from urbanization, have resulted in significant alterations to habitat (White and Greer, 2002; Greer and Stowe, 2003; CE, 2003; Mudie et al, 1974; LPL Foundation and State Coastal Conservancy, 1985). In 1985, the Los Peñasquitos Lagoon Enhancement Plan estimated that sedimentation had removed 25 acres from the coastal salt marsh inventory. The encroachment of freshwater wetlands and reduction of saltwater marsh is evident in the National Wetland Inventory (NWI) maps from 1985 and 2009 (Figures 9 and 10). The location of different wetland types is also shown in maps that were included in the Los Peñasquitos Lagoon Enhancement Plan (1985) and in the Mudie et al. 1974 report (Figures 11 and 12). Although there are differences in the depiction of wetland areas from each study and time period, these maps show an encroachment of riparian, freshwater, and upland vegetation types in the eastern portion of the lagoon that is likely related to sediment accumulation and impediments to tidal flow. As discussed in Section 3, California State Parks determined that coastal salt marsh has been impaired by sedimentation, converting coastal salt marsh to more riparian habitat.

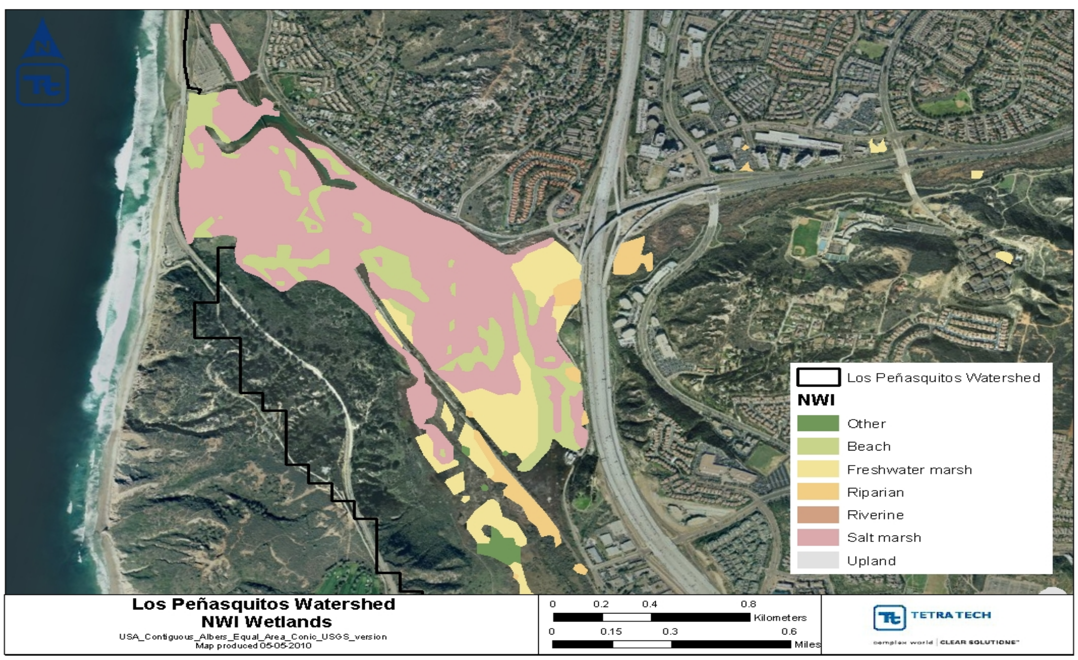

Figure 9. National Wetland Inventory (NWI) - 1985

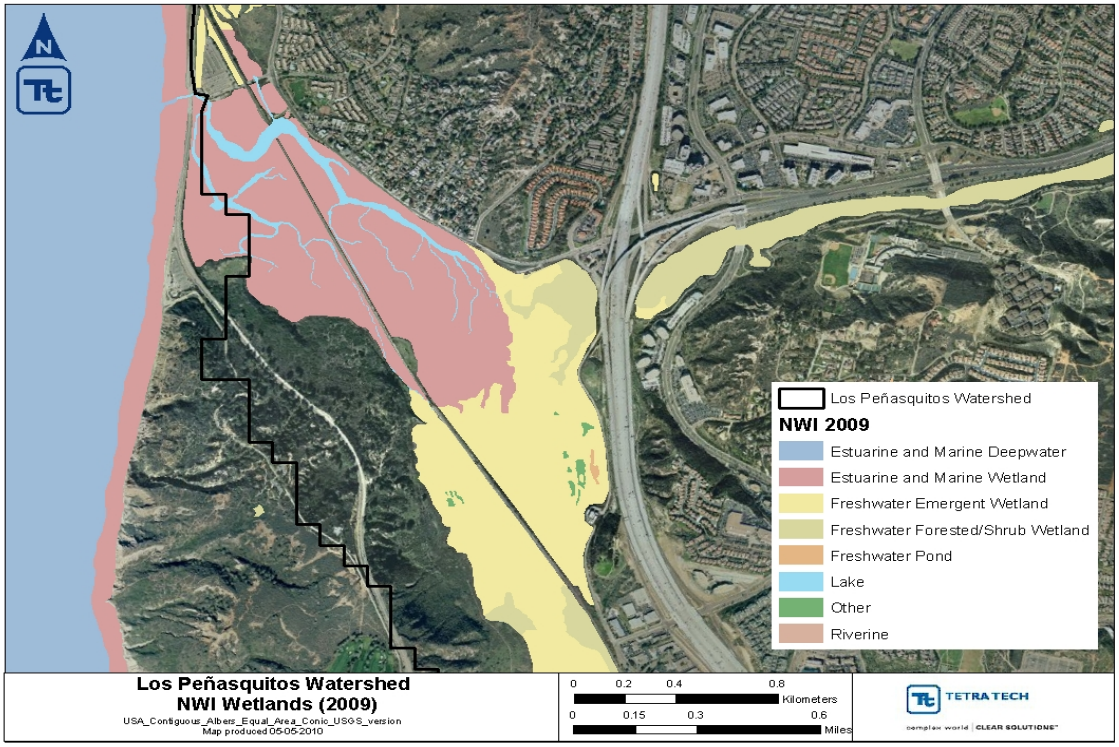

Figure 10. National Wetland Inventory (NWI) - 2009

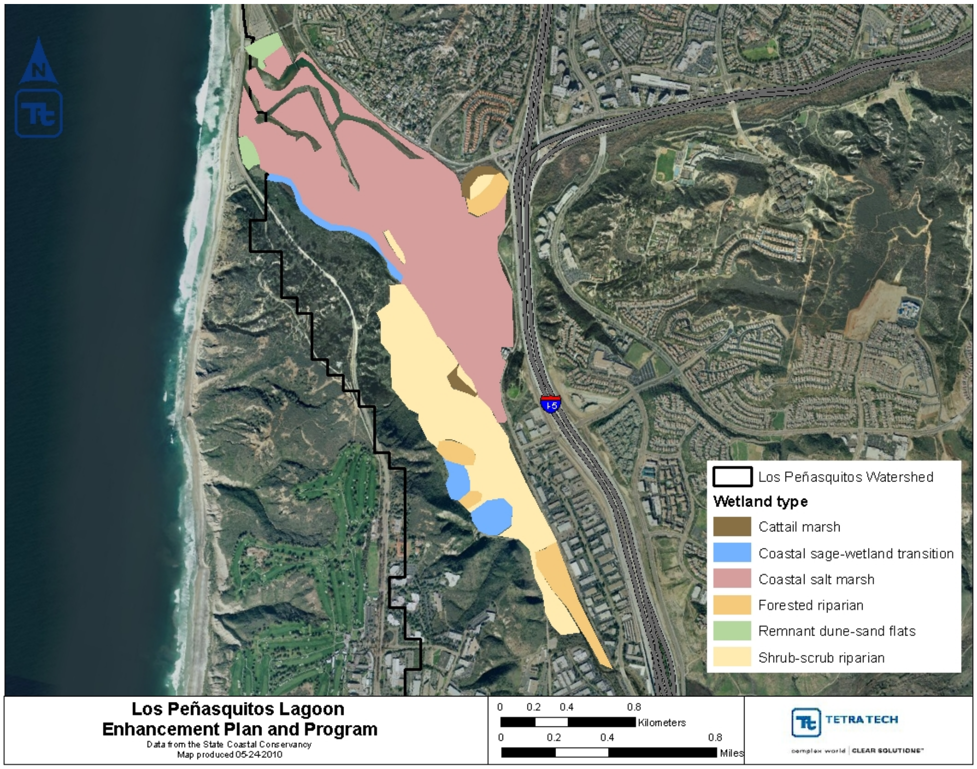

Figure 11. LPL Enhancement Plan – 1985 wetland types

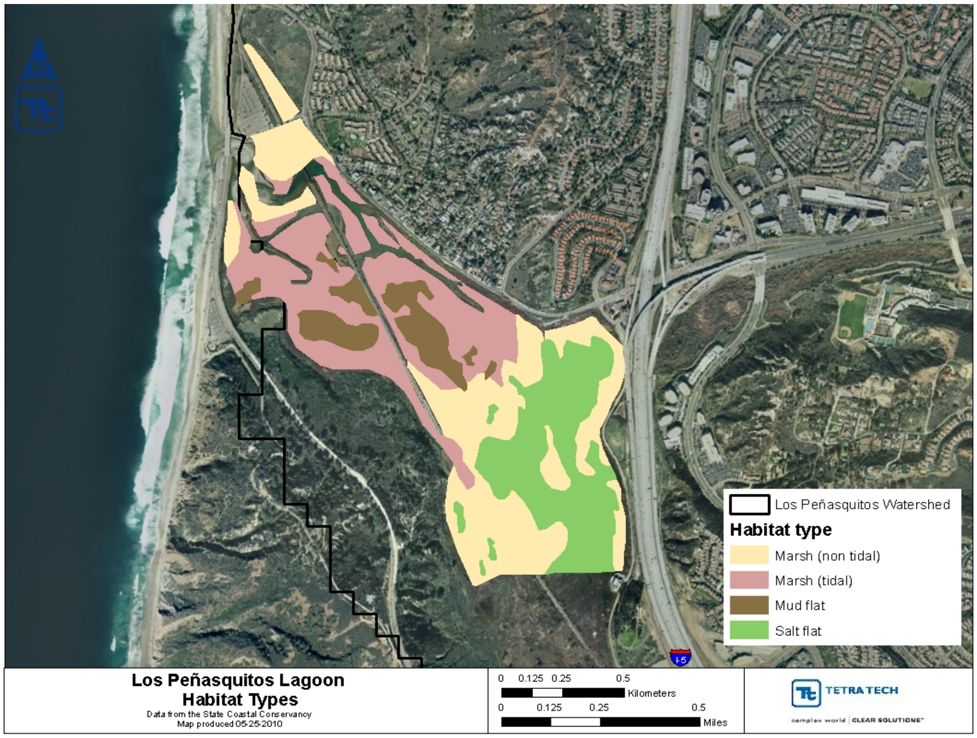

Figure 12. Historical lagoon wetland types (Mudie et al. 1974)

4.3 Selection of TMDL Numeric Target

The timeline of significant events and literature references (Figures 13 and 14) summarizes the important changes in the Lagoon over time in relation to changes in land use (urbanization in particular) and other impacts. This information is utilized to inform a weight of evidence approach to select the historic time period during which the WQS was in attainment.

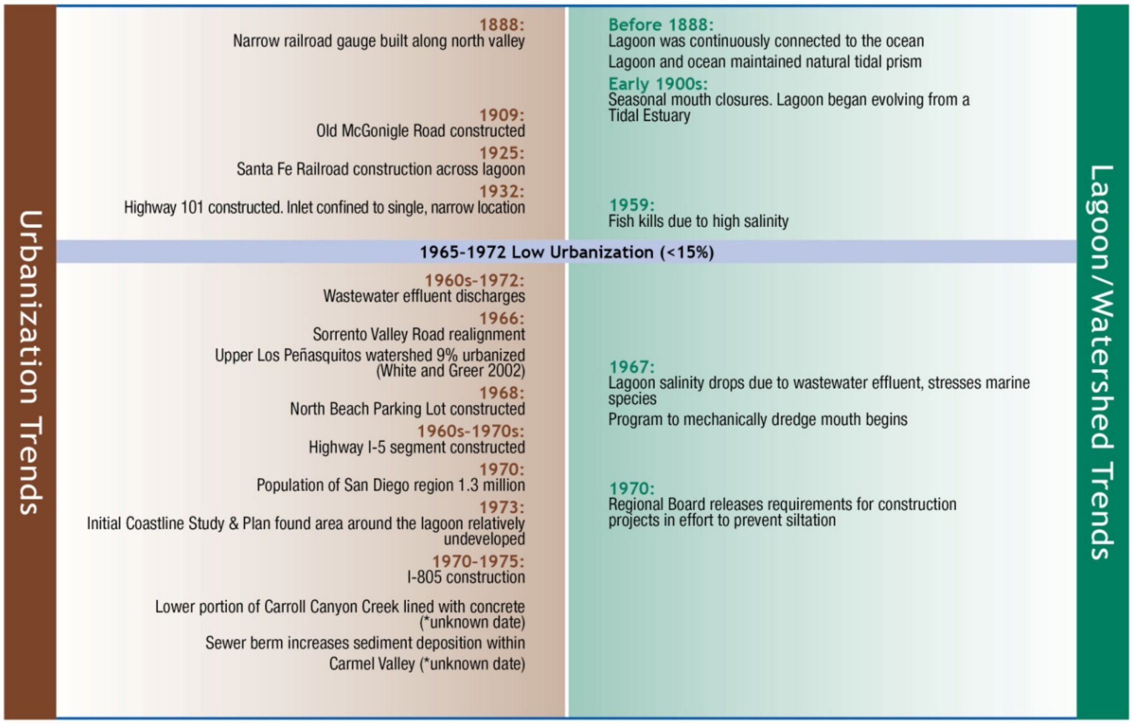

Figure 13. Timeline of urbanization and lagoon trends (1800s through early 1970s)

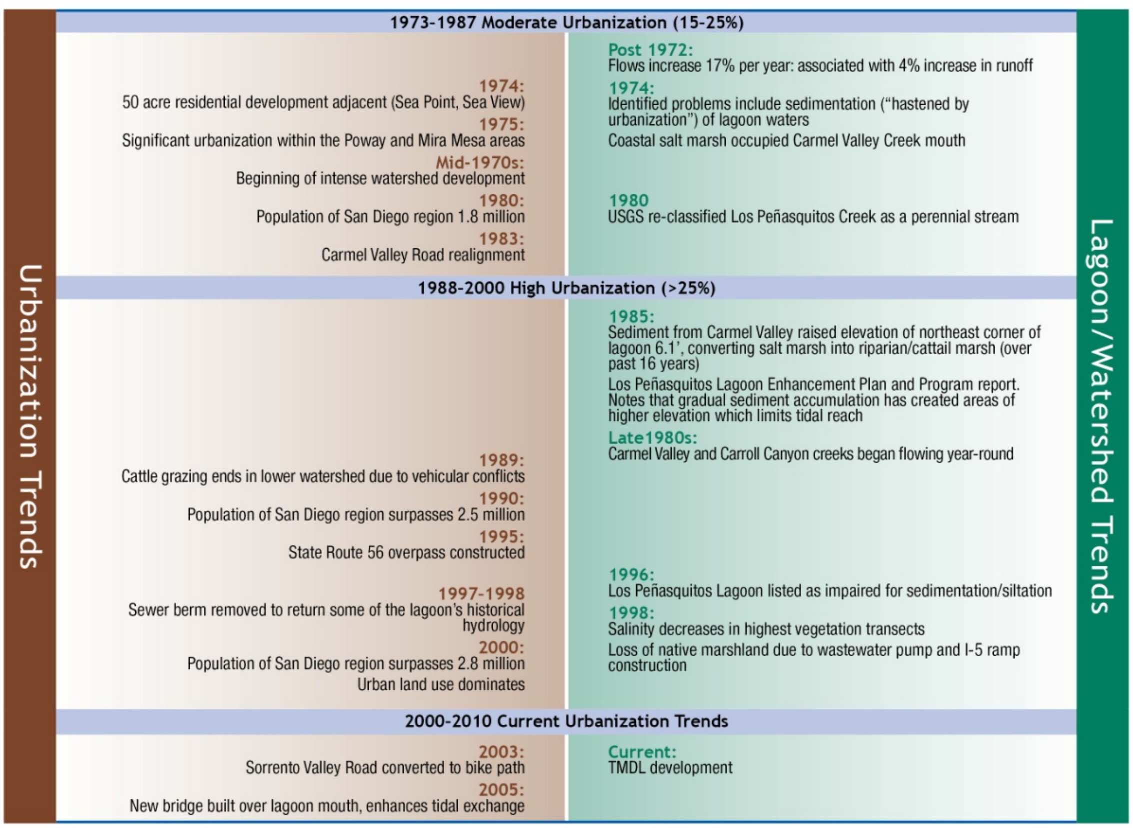

Figure 14. Timeline of urbanization and lagoon trends (mid 1970s through current)

Several lines of evidence were considered to determine which land use and Lagoon conditions supported water quality standards. This time period defines the reference condition upon which the numeric sediment target load was calculated. The identified time period provides the link to the narrative WQO for sediment and defines the conditions that will result in the attainment of WQS for the Lagoon. The lines of evidence considered include:

- **Urbanization trends**: A review of historical literature indicates that intensive development in the Los Peñasquitos watershed began in the in the mid-1970s. Land use data shows a nearly 37 percent decrease in open space in the watershed beginning in the mid 1970s.
- **Population data**: Trend analysis of population data indicates that the population of the San Diego region has been steadily increasing since 1970.
- **Flow data**: Review of historical streamflow data from the USGS gage on Los Peñasquitos Creek and the conclusions drawn by White and Greer (2002) indicate that flow has increased substantially since the 1970s. White and Greer (2002) associated these flow increases with urbanization trends in the watershed.
- **Evaluation of Lagoon conditions:** As described above, Lagoon conditions have been influenced by several factors, which can be separated into watershed impacts and problems associated with the lagoon mouth. Watershed impacts to the Lagoon include sediment delivery associated with urban development, which increased substantially in the mid-1970s. The wastewater treatment plants impacted water quality in the Lagoon until 1972 when the area was connected to the city sewer system, making it difficult to differentiate between the wastewater impacts and development-associated impacts during this time period (pre-1972). Available literature indicates that sediment deposition from the watershed is not adequately flushed out of the system due to problems at the lagoon mouth caused by the railroad berm (and other physical alterations) and sediment build-up at the ocean inlet. Note that the Highway 101 bridge abutments were recently replaced and have resulted in improved tidal exchange through the area. As discussed above, reductions in the tidal prism have resulted in increased sediment build-up at the ocean inlet. Sediment impacts at the ocean inlet are primarily a function of littoral forces (Elwany, 2008) and other factors that are largely separate from the sedimentation problems that originate from the watershed. These factors are important to understand in order to effectively manage and improve conditions within the Lagoon, but are outside the scope of the sediment TMDL analysis.

Consideration of these various lines of evidence indicates that the Lagoon was likely achieving the water quality standard for sediment before the mid-1970s. A historic coverage for the Los Peñasquitos watershed was developed for this period using US Geological Survey topographic maps from the 1970s (primarily the La Jolla quadrangle-dated 1975). This historic land use distribution was used to calculate the numeric target using the LSPC watershed model (see Attachment 2). This historic sediment load of 12,360 tons per critical wet period (58.6 tons per day) represents the sediment TMDL numeric target.

5 Source Assessment

The purpose of the source assessment is to identify and quantify the sources of sediment to the Los Peñasquitos Lagoon. Sediment can enter surface waters from both point and non-point sources. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels from, for example, municipal wastewater treatment plants or municipal separate storm sewer systems (MS4s). These discharges are regulated through waste discharge requirements (WDRs) that implement federal NPDES regulations issued by the State Water Board or the San Diego Water Board through various orders. Non-point sources are diffuse sources that have multiple routes of entry into surface waters. Some non-point sources, such as agricultural and livestock operations, are regulated under the Basin Plan's waste discharge requirement waiver policy. The source assessment quantification is measured as an annual or daily load, which is then used to separate the load allocations or wasteload allocations for the TMDL. The following sections discuss the sediment sources that contribute to Los Peñasquitos Lagoon.

5.1 Land Use/Sediment Source Correlation

Sources of sediment are generally the same under both wet weather and dry weather conditions; however, storm events can cause significant erosion and transport of sediment downstream (especially from canyon areas below storm water outfalls). Dry weather loading is dominated by nuisance flows from urban land use activities such as car washing, sidewalk washing, and lawn over-irrigation, which pick up and transport sediment into receiving waters. Wet weather loading is dominated by episodic storm flows that wash off built up sediment on land surfaces, erode canyon areas below storm water outfalls, and scour stream banks. Some of these processes are exacerbated by anthropogenic disturbances, such as urban development within the watershed. Urban development transforms the natural landscape and results in increased runoff due to hydromodification resulting in scouring of sediment, primarily below storm water outfalls that discharge into canyon areas. Sediment loads are transported downstream to the Lagoon during storm events causing deposits on the salt flats and in Lagoon channels. Due to the higher runoff potential associated with wet weather conditions, emphasis was placed on characterizing wet weather watershed loading.

Sediment sources were quantified by land use group since sediment loading can be highly correlated with land use practices. Since several land use types share hydrologic or pollutant loading characteristics, many were grouped into similar classifications, resulting in a subset of nine categories for modeling. Selection of these land use categories was based on the availability of monitoring data and literature values that could be used to characterize individual land use contributions and critical sediment-contributing practices associated with different land uses. For example, multiple urban categories were represented independently (e.g., high density residential, low density residential, and commercial/institutional), whereas other natural categories were grouped. The three major land use sources in the watershed are open space, low density residential, and industrial/transportation.

The sediment load contributed by each land use type was calculated using the LSPC model. Modeling parameters varied by land use to provide the correlation between sediment loading and land use type. The amount of runoff and associated sediment concentrations are highly dependent on land use.

5.2 Watershed Point and Non-Point Sediment Sources

There are two broad categories of sediment sources to the Lagoon: 1) "collective watershed sources"; and 2) the Pacific Ocean. The "collective watershed sources" consist of all of point and non-point sources of sediment in the watershed tributary to Los Peñasquitos Lagoon.

5.2.1 Watershed Point Sources

Storm water runoff is regulated through the following NPDES permits: the San Diego County Phase I municipal separate storm sewer system (MS4) permit, the Phase II MS4 permit for small municipal responsible parties, the statewide storm water permit issued to Caltrans, the statewide Construction Activities Storm water General Permit, and the statewide Industrial Activities Storm water General Permit. The permitting process defines these discharges as point sources because storm water is discharged from the end of a storm water conveyance system. Since the industrial and construction storm water discharges are governed under NPDES permits, these discharges are treated as point sources in the TMDL analysis. These permit types are described below.

Phase I Municipal Separate Storm Sewer System (MS4)

Twenty one entities are identified in San Diego Water Board Order R9-2007-0001 (NPDES No. CAS0108758) and are responsible for addressing water quality concerns for the MS4 (San Diego Water Board, 2007). Responsible Municipal Responsible parties within the Los Peñasquitos watershed are San Diego County, the City of San Diego, the City of Del Mar, and the City of Poway.

All land uses were classified as generating point source loads because, although the sediment sources on these land use types may be diffuse in origin, the pollutant loading is transported and discharged to receiving waters through the MS4. Sediment loads that are attributed to point sources are discharged via the MS4 from all land uses. Note that several construction and industrial sites regulated under the General Statewide Storm Water Permit program are located within the Phase 1 MS4 permitted area.

During wet weather events, significant erosion can occur along canyon walls below storm water outfalls. Sediment also builds up on the land surface from various sources and associated management practices and is then washed off the surface during rainfall events. Runoff from urbanized areas into the MS4 can be characterized as “hungry” flows capable of exacerbating the natural erosion and scouring processes of the creek.

The amount of runoff and associated concentrations are, therefore, highly dependent on the nearby land management practices. Note that the redistribution of sediment to other areas of the Lagoon can be caused by both anthropogenic and natural processes; however, most of the sediment is contributed by point sources in the watershed so this resuspension is associated with and quantified in the MS4 load calculations.

Phase II Municipal Separate Storm Sewer System (MS4)

Entities that enroll in the General Permit for the Discharge of Storm Water from Small MS4s, Water Quality Order No. 2003-0005-DWQ are responsible for addressing water quality concerns from their small MS4s. In general, these are storm water systems serving public campuses (including universities, community colleges, primary schools, and other publicly owned learning institutions with campuses), military bases, and prison and hospital complexes within or adjacent to other regulated MS4s, or which pose significant water quality threats. In the San Diego Region, there are no small MS4s currently enrolled under Order No. 2003-0005-DWQ.

As with Phase I MS4s, pollutants build up on land surfaces within small MS4s and are then washed off during rainfall events. In addition, urbanized areas within the Phase II MS4s also generate “hungry” flows that exacerbate the natural erosion and scouring processes of the creek. The amount of runoff and associated concentrations are highly dependent on the nearby land uses and management practices.

Caltrans MS4s

Caltrans is regulated by a statewide storm water discharge permit that covers all municipal storm water activities and construction activities (State Board Order No. 99-06-DWQ; CAS000003). The Caltrans storm water permit authorizes storm water discharges from Caltrans properties such as the state highway system, park and ride facilities, and maintenance yards. The storm water discharges from most of these Caltrans properties and facilities eventually ends up in either a city or county storm drain system.

General Statewide Storm Water Permits

On April 17, 1997, the State Water Board issued a statewide general NPDES permit for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities Permit (Order No. 97-03-DWQ; CAS000002). This Order regulates storm water discharges and authorized non-storm water discharges from ten specific categories of industrial facilities, including but not limited to manufacturing facilities, oil and gas mining facilities, landfills, and transportation facilities. There are currently 76 permittees enrolled under the general industrial storm water permit in the watersheds draining to the Lagoon, resulting in 1,304 facility acres (Figure 21). Potential pollutants from an industrial site will depend on the type of facility and operations that take place at that facility.

During wet weather, runoff from industrial sites has the potential to contribute pollutant loadings. During dry weather, the potential contribution of pollutant loadings from industrial storm water is low because non-storm water discharges are prohibited or authorized by the permit only under the following circumstances: when they do not contain significant quantities of pollutants, where Best Management Practices (BMPs) are in place to minimize contact with significant materials and reduce flow, and when they are in compliance with Regional Board and local agency requirements.

On August 19th, 1999, the State Water Board issued a statewide general NPDES permit for Discharges of Storm Water Runoff Associated with Construction Activities (Order No. 2009-0009 DWQ; CAS000002). There are currently 23 permittees enrolled under the general construction storm water permit in the watersheds draining to the Lagoon, resulting in 442 acres of disturbed area (Figure 15). Particularly during wet weather, runoff from construction sites has the potential to contribute sediment loadings to the Lagoon. Under Order No. 99-08-DWQ, during dry weather discharges of non-storm water are authorized only where they do not cause or contribute to an exceedance of any water quality standard and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants.

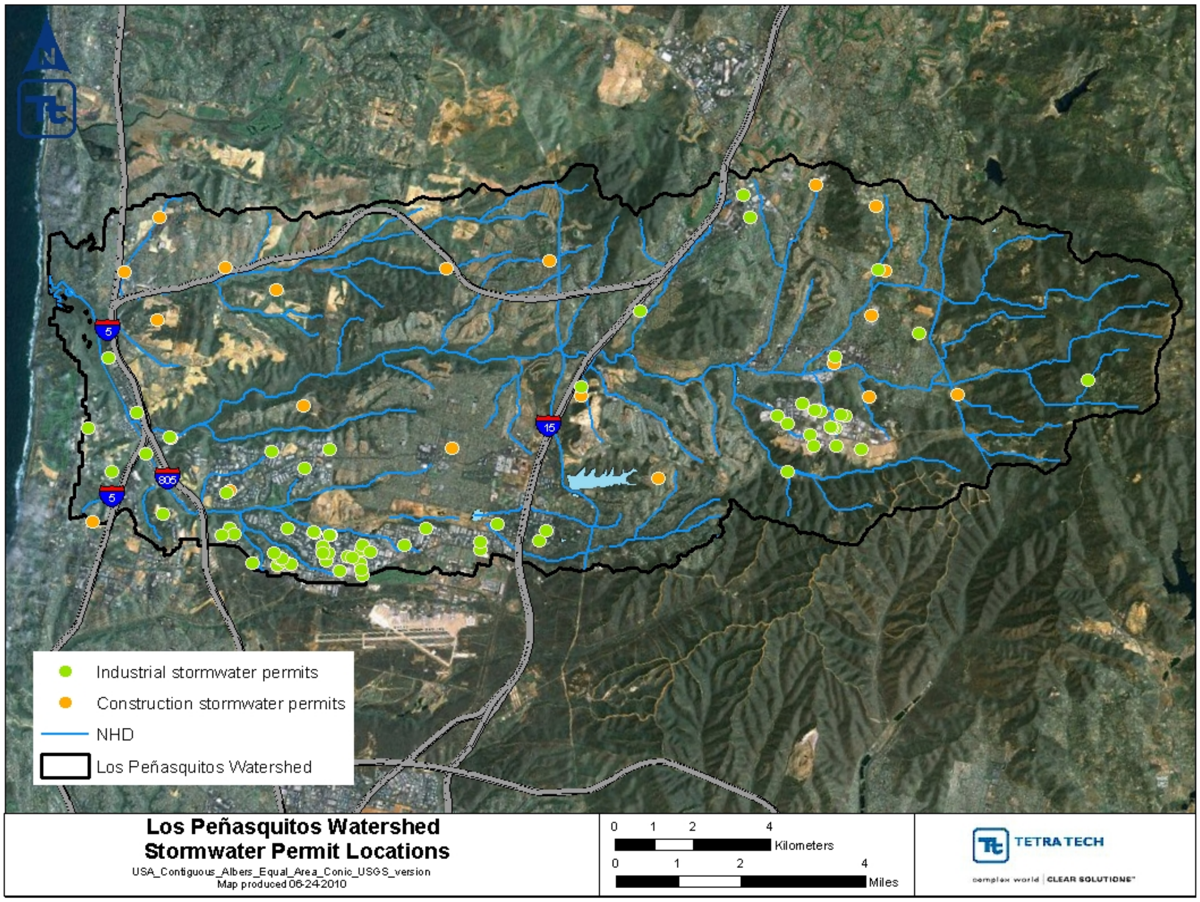

Figure 15. NPDES construction and industrial storm water permits

5.2.2 Watershed Non-Point Sources

In this TMDL, the "collective watershed sources" also include all the *non-point sources located in the watershed* such as agriculture (1 percent of current land use area) and open space (43 percent of current land use area).

This is the case because virtually the entire Los Peñasquitos watershed is drained through the Phase I MS4 collection systems and therefore these sources, although non-point in origin, are considered by the Water Board to be "controllable" point sources. For this reason the Phase I MS4s can be thought of as the primary and ultimate point sources of sediment to the Lagoon.

5.3 Ocean Non-point Sediment Sources

Storm surges and ocean tides can be a source of sediment to the mouth of the Lagoon as evidenced by a recent study found that accumulated sediment at the Lagoon's ocean inlet was similar to beach sediment and tidal sources (Elwany, 2008). The Pacific Ocean is a significant non-point source of sediment to the Lagoon that the San Diego

Water Board considers to be an uncontrollable natural background source. Sediment loads from the ocean are primarily a function of littoral forces and other factors that are largely separate from the sedimentation problem originating from the watershed. Although important to understanding the entire picture for management purposes, the ocean sources are outside the scope of this initial project.

6 Linkage Analysis

The technical analysis of the relationship between pollutant loading from identified sources and the response of the waterbody to this loading is referred to as the linkage analysis. The purpose of the linkage analysis is to quantify the maximum allowable sediment loading that can be received by an impaired waterbody and still attain the WQOs of the applicable beneficial uses. This numeric value is represented by the TMDL.

The linkage analysis for this TMDL is based on computer models that were developed to represent the physical processes within the impaired receiving waterbody and the associated watershed. The models provide estimation of sediment loadings from the watersheds based on rainfall events and simulation of the response of the receiving water to these loadings. The following sections provide more detailed discussion regarding model selection and linkage analyses.

6.1 Date Inventory and Analysis

Multiple data sources were used to characterize the watershed and Lagoon, in particular stream flow and water quality conditions. Much of this information was recently collected by watershed stakeholders to assist with TMDL model development. Data describing the watershed's topography, land use, soil characteristics, meteorological data, and irrigation needs along with available bathymetric survey information and data sondes analyzing pressure and salinity were used to calibrate the watershed and Lagoon models. The Technical Support Document (Attachment 1) summarizes stream flow and total suspended sediment data.

6.2 Model Selection Criteria

In selecting an appropriate approach for TMDL calculation, technical and regulatory criteria were considered.

6.2.1 Technical Criteria

Technical criteria include the physical domain, source contributions, critical conditions, and constituents to be addressed. The physical domain is the one of the most important considerations in model selection and accounts for watershed or receiving water characteristics and processes

6.2.2 Regulatory Criteria

Regulatory criteria include water quality objectives or procedural protocol. The modeling framework must enable direct comparison of model results to the selected numeric target and allow for the analysis of the duration of watershed and receiving water conditions. For the watershed loading analysis and implementation of required reductions, it is also important that the modeling framework allow for the examination of gross land use loading.

6.3 Model Selection and Overview

A properly designed and applied model provides the source-response linkage component of the TMDL and enables accurate assessment of assimilative capacity and allocation distribution. The receiving water's assimilative capacity is determined by assuming adherence to WQOs. For all waters in the San Diego Region, the Basin Plan establishes the beneficial uses for each waterbody to be protected and the WQOs that protect those uses. In the case of narrative objectives, interpretation is required to develop a numeric target for TMDL development (refer to Section 4). Establishing the relationship between the receiving water quality target and source loading is a critical component of TMDL development. This allows for the evaluation of management options that will help achieve the desired source load reductions. This can be established through a number of techniques, ranging from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses to flow and loading conditions. The objective of this section is to present the approach taken to develop the linkage between sources and receiving water responses for TMDL development in the Lagoon.

The modeling system was divided into two components representative of the processes essential for accurately modeling hydrology, hydrodynamics, and water quality. The first component of the modeling system, the Loading Simulation Program in C++ (LSPC) model, is a watershed model that predicts runoff and external pollutant loading as a result of rainfall events. The second component, the Environmental Fluids Dynamic Code (EFDC) model, is a hydrodynamic and water quality model that simulates the complex water circulation and pollutant transport patterns in the Lagoon.

6.3.1 Watershed Model: Loading Simulation Program in C++ (LSPC)

LSPC was selected for simulation of land-use based sources of sediment and the hydrologic and hydraulic processes that affect delivery (Shen et al., 2004; Tetra Tech and USEPA, 2002; USEPA, 2003). LSPC was specifically used to simulate watershed hydrology and transport of sediments in the streams and storm drains flowing to the impaired Lagoon. LSPC is a watershed modeling system that includes streamlined Hydrologic Simulation Program Fortran (HSPF) (Bicknell et al., 1997) algorithms for simulating hydrology, sediment, and general water quality on land, as well as a simplified stream fate and transport model. Since its original public release, the LSPC model has been expanded to include additional GQUAL components for sorption/desorption of selected water quality constituents with sediment, enhanced temperature simulation, and the HSPF RQUAL module for simulating dissolved oxygen, nutrients, and algae.

The hydrologic (water budget) process is complex and interconnected within LSPC. Rain falls and lands on various constructed landscapes, vegetation, and bare soil areas within a watershed. Varying soil types allow the water to infiltrate at different rates while evaporation and plant matter exert a demand on this rainfall. Water flows overland and through the soil matrix. There may also be point source discharge and water withdrawals/intakes. The land representation in the LSPC model environment considers three flowpaths; surface, interflow, and groundwater outflow. The sediment routine in LSPC represents the general detachment of sediment due to rainfall, overland and instream transport, attachment when there is no rainfall, and scour.

The model can simulate sediment loadings from specific source areas (i.e., subwatershed or land use areas). This is important in terms of TMDL development and allocation analysis. For this TMDL, the LSPC model was used to calculate both historic and existing conditions within the watershed to establish the TMDL numeric target and required load reductions from existing conditions. The LSPC model output was incorporated as an input to the receiving water model for the Lagoon, as described below.

6.3.2 Lagoon Model: Environmental Fluid Dynamics Code (EFDC)

The Los Peñasquitos Lagoon was simulated using the EFDC model. The LSPC watershed model was linked to EFDC and provided all freshwater flows and loadings as model input. EFDC is a public domain, general purpose modeling package for simulating one-dimensional (1-D), two-dimensional (2-D), and three-dimensional (3-D) flow, sediment transport, and biogeochemical processes in surface water systems including rivers, lakes, estuaries, reservoirs, wetlands, and coastal regions. The EFDC model was originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications (Hamrick, 1992). This model is now being supported by the USEPA and has been used extensively to support TMDL development throughout the country. In addition to hydrodynamic, salinity, and temperature transport simulation capabilities, EFDC is capable of simulating cohesive and noncohesive sediment transport, near-field and far-field discharge dilution from multiple sources, eutrophication processes, the transport and fate of toxic contaminants in the water and sediment phases, and the transport and fate of various life stages of finfish and shellfish. The EFDC model has been extensively tested, documented, and applied to environmental studies worldwide by universities, governmental agencies, and other entities.

The EFDC model includes four primary modules: (1) a hydrodynamic model, (2) a water quality model, (3) a sediment transport model, and (4) a toxics model. The hydrodynamic model predicts water depth, velocities, and water temperature. The water quality portion of the model uses the results from the hydrodynamic model to compute the transport of the water quality variables. The water quality model then computes the fate of up to 22 water quality parameters including dissolved oxygen, phytoplankton (three groups), benthic algae, various components of carbon, nitrogen, phosphorus and silica cycles, and fecal coliform bacteria (Cerco and Cole 1994). The sediment transport and toxics modules use the hydrodynamic model results to calculate the settling of suspended sediment and toxics, resuspension of bottom sediments and toxics, and bed load movement of noncohesive sediments and associated toxics. For this project, the hydrodynamics and sediment transport models were used. The hydrodynamics model simulated the circulation, water temperature, and salinity in the lagoon driven by ocean tides and watershed inflows. The sediment transport model simulated the transport of sand, silt as non-cohesive sediments, and clay as cohesive sediment. Details of the EFDC model's hydrodynamic and eutrophication components are provided in Hamrick (1992) and Tetra Tech (2002, 2006a, 2006b, 2006c, 2006d).

The EFDC model was configured to simulate hydrodynamics and sediment transport in the Los Peñasquitos Lagoon for both existing and historic conditions. Specifically, water temperature and salinity were both modeled for hydrodynamics. Sediment fractions considered in the model include sand, silt, and clay. Sand and silt were modeled using the non-cohesive sediment module and clay was modeled using the cohesive sediment module in EFDC.

6.4 Model Application

A complete discussion, including model configuration, hydrologic and hydrodynamic calibration and validation, and water quality calibration and validation of the LSPC and EFDC models is provided in the Modeling Report (Attachment 2).

The models were initially calibrated to observed hydrologic and water quality data to characterize existing conditions in the watershed and Lagoon (required load reductions are based on these existing loads). In addition, the models were used to establish a TMDL numeric target for sediment. As described in Section 4, a historical review of available literature regarding urbanization trends and Lagoon impacts was used to identify an appropriate time period (mid 1970s) for calculating the numeric target that represents the sediment WQO. Conditions present at this time were associated with loads that met WQOs and did not adversely impact the Lagoon. To characterize this historical period, historic land use coverage for the watershed was developed and model simulations were performed. The resulting historical net annual sediment load was identified as the TMDL numeric target and represents the loading (assimilative) capacity for the lagoon (i.e. the TMDL). Percent reductions were calculated based on the difference between the TMDL load and the sediment load that corresponds with existing conditions.

7 Identification of Load Allocations and Reductions

The calibrated models were used to simulate historical and existing sediment loads to the Los Peñasquitos Lagoon from which numeric targets and load reductions were established. Point sources were then assigned a wasteload allocation (WLA) while non-point sources were assigned a load allocation (LA). This section discusses the methodology used for TMDL development and the results in terms of loading capacities and required load reductions for the Los Peñasquitos Lagoon. Other TMDL components are also discussed including the margin of safety (MOS), seasonality and critical conditions, and a daily load expression.

7.1 Loading Analysis

Existing sediment loads to the Lagoon were estimated using the calibrated LSPC model and receiving water conditions were simulated using the EFDC model (see Attachment 2). Using the EFDC model, the assimilative capacity of the Lagoon was assessed and compared to the historical numeric target for evaluation of sediment quality.

7.2 Application of Numeric Targets

As discussed in Section 4, the narrative WQO for sediment was interpreted using a weight of evidence approach to determine a reference condition to define the TMDL numeric target (i.e., a historical period when the Lagoon was not impaired for sedimentation). Several lines of evidence used to establish a numeric sediment target include: urbanization trends, population data, flow data, and evaluation of Lagoon conditions over time.

7.3 Load Estimation

Estimation of current watershed loading to the impaired Lagoon required use of the LSPC model to predict flows and pollutant concentrations. The dynamic model-simulated watershed processes, based on observed rainfall data as model input, provided temporally variable load estimates for the critical period. These load estimates were simulated using calibrated, land use-specific processes associated with hydrology and sediment transport (see Attachment 2).

7.4 Identification of Critical Conditions

Due to the higher transport potential of sediment during wet weather, the 1993 El Nino time period was selected as the critical period for assessment. The wet season that includes the 1993 El Nino storm events (10/1/92 – 4/30/93) is one of the wettest periods on record over the past several decades. Statistically, 1993 corresponds with the 93rd percentile of annual rainfall for the past 15 years measured at the San Diego Airport (Lindbergh Field). Selection of this year was also consistent with studies performed by the Southern California Coastal Water Research Project (SCCWRP). An analysis of rainfall data for the Los Angeles Airport from 1947 to 2000 shows that 1993 was the 90th percentile year; meaning 90 percent of the years between 1947 and 2000 had less annual rainfall than 1993. (Los Angeles Water Board, 2002)

7.5 Critical Locations for TMDL Calculation

Due to the variability and dynamic nature of conditions within the Lagoon (e.g., mouth closures, tidal fluctuations, sediment fate and transport, etc.), the entire modeled Lagoon area was assessed as the critical location. Load reductions for sediment were based on achieving the numeric TMDL target across the Lagoon.

7.6 Calculation of TMDL and Allocation of Loads

A TMDL was established for the Lagoon using the methodology described above (Section 6). Conceptually, a TMDL definition is represented by the equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The wasteload allocation (WLA) portion of this equation is the total loading assigned to point sources. The load allocation (LA) portion is the loading assigned to non-point sources. The margin of safety (MOS) is the portion of loading reserved to account for any uncertainty in the data and computational methodology, as described in Section 8. An implicit MOS was incorporated for this TMDL.

Load calculations for sediment were developed using land use-based generation rates and meteorological conditions from the critical wet period (10/1/92 – 4/30/93).

7.7 Wasteload Allocations

The point sources identified in the Los Peñasquitos watershed are Phase I MS4 co-permittees (San Diego County and the cities of San Diego, Poway, and Del Mar), Phase II MS4s, Caltrans, and construction and industrial storm water permit holders. The existing loads estimated were solely the result of watershed runoff (land-use based) and streambank erosion and not other types of point sources. The total sediment contribution from all responsible parties in the watershed is presented as the WLA.

7.8 Load Allocations

According to federal regulations (40 CFR 130.2(g)), load allocations are best estimates of the non-point source or background loading. For the Los Peñasquitos watershed, land use contributions to MS4 systems are included in the WLAs described above, including contributions due to hydromodification and accelerated erosion. A LA was assigned to sediment contributions from storm surges and wave action along the ocean boundary (ocean sediment contributions).

7.9 Summary of TMDL Results

The overall TMDL and its component loads are presented in Table 2. Daily loads are established by dividing the modeled loads by the number of days within the critical wet period (211 days). Current loads, historical loads, and required reductions are presented in Table 3. Existing loads were estimated based on modeling of current land use conditions (from the SANDAG 2000 land use coverage) and meteorological conditions from the critical wet period (10/1/92 – 4/30/93). As described in Section 4, the numeric target was calculated based on modeling of historical (mid-1970s) land use conditions and the same meteorological data in order to accurately compare the watershed and Lagoon response to the same weather conditions. Historic loads define the allowable load; therefore, required load reductions represent the difference between current sediment loads and historic (allowable) loads.

Note that sediment dynamics within the Lagoon are dependent on a number of factors, including runoff volumes and the amount of sediment that is transported to the lagoon from the watershed. These factors are important components in determining the timing and magnitude of erosion and depositional processes within the Lagoon. The Lagoon model shows that a reduction in watershed sediment loading affects the amount of sediment that can deposit throughout the Lagoon from oceanic inputs (considering the input of sediment from the ocean boundary under current and historical conditions is constant). The model analysis for historical conditions indicates that a greater proportion of sediment that deposits in the Lagoon originates from tidal inputs during lower watershed loading periods; therefore, the TMDL results show that a net increase in oceanic loads occurs during the critical wet period under historical land use conditions. To meet the TMDL, the total load reduction required from the watershed is approximately 67 percent. Tidal input from the ocean boundary represents natural background loads; therefore, no reduction is required for this source category.

Table 2. TMDL summary

Source	Critical Wet Period Load (tons)	Daily Load (tons)
TMDL	12,360	58.6
Watershed contribution (WLA)	2,580	12.2
Ocean boundary (LA)	9,780	46.4
MOS	Implicit	Implicit

Table 3. Current vs. historical loads and percent reduction

Source	Current Load (tons)	Historical Load (tons)	Load Reduction (tons)	Percent Reduction Required
Watershed contribution (WLA)	7,719	2,580	5,139	**67%**
Ocean boundary (LA)	5,944	9,780	+3,836 (increase)	+39% (increase)
Total	13,663	12,360	1,303	10%

7.10 Daily Load Expression

Load allocations are expressed in terms of net sediment load for the critical period (tons) because sediment delivery to streams is highly variable on a daily and annual basis. Loads were also divided by the number of days in the critical period (211) to derive daily loading rates (tons/mi^2/day). The USEPA expects the load allocations to be evaluated using a long-term rolling average period (e.g. 15-year), because of the natural variability in sediment delivery rates. In addition, USEPA does not expect each square mile within a particular source category throughout the watershed to necessarily meet the load allocation; rather, USEPA expects the watershed average for the entire source category to meet the load allocation for that category.

7.11 Margin of Safety

A margin of safety (MOS) is incorporated into a TMDL to account for uncertainty in developing the relationship between pollutant discharges and water quality impacts (USEPA, 1991). For this TMDL, an implicit MOS was included through the application of conservative assumptions throughout TMDL development. The following list describes several key assumptions that were used.

- **Critical condition** - The wet season that includes the 1993 El Nino storm events (10/1/92 – 4/30/93) was selected as the critical condition time period for TMDL development. This is one of the wettest periods on record over the past several decades. Because of the large amount of rainfall, sediment loads were significantly higher during this period than in other years with less rainfall.

- **Soil composition** - Soils that are more easily transported typically have higher proportions of smaller particles sizes (silt and clay fractions), as compared to local parent soils, because of differences in settling rates and other sediment transport characteristics. To account for these differences in the model, soils transported by surface runoff were assumed to be composed of 5 percent sand, twice as much clay as the percentage of clay within each hydrologic soil group, and the remainder assigned to the silt fraction.

- **Numeric target** - The historical analysis involved an extensive literature search and technical analysis in order to identify an appropriate time period for development of the numeric sediment target. This comprehensive ‘weight of evidence’ analysis considered all available information regarding urbanization and lagoon impacts over time in order to identify a conservative reference condition.

7.12 Seasonality

The federal regulations at 40 CFR 130.7 require that TMDLs include seasonal variations. Sources of sediment are similar for both dry and wet weather seasons (the two general seasons in the San Diego region). Despite the similarity of wet/dry sources, transport mechanisms can vary between the two seasons. Throughout the TMDL monitoring period, the greatest transport of sediment occurred during rainfall events. It is recognized that dry weather will contribute a deminimus discharge of sediment; however, model calibration and TMDL development focused on wet weather conditions as sediment transport is dramatically higher during wet weather. Model simulation was completed for the 10/1/92–4/30/93 wet period to account for the much greater sediment loading and associated impacts to the Lagoon during this time period.

8 Implementation Plan

Restoration of the Lagoon is a high priority for the San Diego Water Board. Acknowledging the environmental and political complexities, as well as the time and financial resources needed to restore a coastal lagoon, the San Diego Water Board has established the following three-step Waterbody Goal for Los Peñasquitos Lagoon. Accordingly, this Implementation Plan describes both the program of implementation and the adaptive management approach necessary for achieving step 1, the Intermediate-term goal.

Step 1: Intermediate-term Goal

Attain water quality objective for sediment in Los Peñasquitos Lagoon and address current Clean Water Act section 303(d) sediment impairment.

> Overall Strategy
> Reduce current watershed sediment load to early 1970s watershed sediment load. Initiate long-term Lagoon monitoring to assess Lagoon's response to decreasing sediment loads and overall health.
> Regulatory Action
> Adopt and implement sediment TMDL.

Step 2: Long-term Goal

Stop degradation and loss of Los Peñasquitos Lagoon's salt marsh habitat. Restore to condition of early 1970s salt marsh in terms of extent and quality.

> Overall Strategy
> To monitor, assess, and implement appropriate regulatory mechanism.
> Regulatory Action
> To be determined based on results of required Lagoon Monitoring.

Step 3: Final Goal

Attain all water quality objectives and protect all beneficial uses. Restore Lagoon to functional healthy estuarine ecosystem.

> Overall Strategy
> To monitor, assess, and implement appropriate regulatory mechanism.
> Regulatory Action
> To be determined based on results of required Lagoon Monitoring.

8.1 Implementation Actions

There are two types of implementation actions described below: (1) actions that the Water Board may take; and (2) actions that the responsible parties must take. The first type involves actions which the San Diego Water Board may take to compel the responsible parties to comply with this TMDL.

8.1.1 San Diego Water Board Actions

The San Diego Water Board may exercise any of its authorities under the Water Code to compel responsible parties to comply with the total wasteload allocation to reduce "collective watershed sources." These regulatory authorities are spelled out in the Environmental Analysis and Checklist, Attachment 3.

8.1.2 Responsible Party Identification

The responsible parties must undertake actions that will reduce watershed sediment loads in accordance with the appropriate compliance schedule in section 8.3. In this TMDL project, the term "responsible parties" is defined as the owners and operators of the collective watershed sources. The term "collective watershed sources" is defined as any point or non-point source of sediment discharging from the watershed to Los Peñasquitos Lagoon. Responsible parties include: Phase I MS4s copermittees (the County of San Diego, City of San Diego, City of Del Mar, and City of Poway), Phase II MS4s permittees, Caltrans, and the General Construction and General Industrial Storm Water permittees.

Under this TMDL, the responsible parties were collectively assigned a single waste load allocation, which they are collectively responsible for meeting. To meet their collective waste load allocation, the responsible parties must take actions to reduce their collective sediment loads to the watershed. To reduce their collective sediment loads, the owners and operators of each individual point and non-point source must individually reduce their own sediment load attributable to their discharge. Furthermore, owners and operators of point and non-point sources are collectively responsible for reducing the collective sediment discharge from the watershed to the Lagoon.

The San Diego Water Board expects cooperation among all the responsible parties. While it is the collective responsibility of all the responsible parties in the Los Peñasquitos watershed to reduce their collective sediment load, the Phase I MS4 systems collect and drain virtually the entire watershed. As such, the Phase I MS4 copermittees become the ultimate point source conveyor of sediment to the Los Peñasquitos Lagoon. Therefore, it is the expectation and responsibility of the Phase I MS4 copermittees to assume the lead role in coordinating and carrying out the responsible party actions, compliance monitoring, and adaptive management required under this TMDL project.

Furthermore, individual industrial facilities and construction sites are subject to regulation on two levels: (1) The San Diego Water Board is responsible for enforcing its MS4 permits (for violations of the MS4 permit by the MS4 copermittees); and (2) each local municipality is responsible, under the MS4 storm water permit, for enforcing its own ordinances and permits (for violations of its ordinances/permits by an individual industrial facility or construction site within its jurisdiction). The San Diego Water Board is also responsible for enforcing the statewide General Industrial and Construction Storm Water Permits within its jurisdiction. The San Diego Water Board relies upon the municipality to enforce its ordinances/permits and then work with the municipality to coordinate information and actions to compel compliance.

8.1.3 Develop and Submit a Load Reduction Plan

The Phase I MS4 owners (City of San Diego, City of Del Mar, City of Poway, and County of San Diego) and Caltrans are required to jointly prepare and submit for San Diego Water Board review, comment, and revision, a Sediment Load Reduction Plan (SLRP) that demonstrates how they will comply with the required wasteload reductions in this TMDL. If the Phase I MS4s and Caltrans choose to address impairments due to loads from multiple pollutants, in addition to sediment, then they will be required to jointly prepare and submit a Comprehensive Load Reduction Plan in lieu of a SLRP.

If the Phase I MS4s and Caltrans choose to submit a SLRP that addresses only sediment, compliance must be achieved as soon as possible, but no later than 10 years from this TMDL effective date. If the decision is made to address multiple pollutants in a CLRP, compliance must be achieved as soon as possible, but no later than 20 years from this TMDL effective date.

The detailed SLRP and CLRP must be submitted to the San Diego Water Board for review and comment within 18 months after the effective date of this TMDL.[6]

SLRP Requirements

The SLRP shall contain, at a minimum, the following components:

1) A plan to identify the BMPs/water quality projects that are planned for implementation and provide an implementation schedule for each BMP/water quality project. The SLRP must demonstrate how the BMPs/water quality projects will result in the required sediment load reductions in accordance with the 10 year compliance schedule. This plan, at a minimum, should include scheduling for the following:

[6] The effective date is the date the Office of Administrative Law approves this Basin Plan amendment.

A. Initial BMP Analysis - Watershed and site data should be analyzed to identify effective BMPs for implementation.

B. Scheduled BMP Implementation - The above analysis should be used to identify BMPs that will be implemented and to develop an aggressive BMP implementation schedule. The SLRP should include a construction schedule and provide a discussion on adjustments to staff scheduling and resources to meet new BMP demands. Schedules should be realistic and justifiable.

C. Scheduled Periodic BMP Assessment and Optimizing Adjustments - As the BMPs are being implemented, a scheduled in-depth assessment of the BMPs' performance should follow. BMPs that are found to be ineffective should be modified to incorporate optimizing adjustments to improve performance or be replaced by other effective BMPs. The results from this assessment should also be used to determine additional BMP selection and the schedule for additional BMP implementation. The SLRP should include periodic, in-depth BMP assessment and adjustment.

D. Scheduled Continuous Budget and Funding Efforts- Securing budget and funding for BMP staffing and equipment should be scheduled early and continue until the sediment TMDL is met. The SLRP should include a schedule for staff time, including position and job description, authorized for securing funding for non-structural BMP implementation and maintenance.

2) A coordinated monitoring and reporting program that is consistent with the compliance monitoring requirements in section 8.2 and the Lagoon monitoring requirements in section 8.5.1.

3) Details of the special studies required pursuant to section 8.5.2, including delivery dates for those studies.

4) Data sufficient to complete the side-by-side comparison of historic conditions (early 1970s) and current conditions (2000-current) (see section 8.3) to inform the lines of evidence necessary to determine compliance.

5) Each SLRP should be reviewed periodically to identify needed modifications and improvements. The responsible parties should develop and implement a plan and schedule to address the identified modifications and improvements. All updates to the SLRP should be documented in the SLRP, and submitted to the San Diego Water Board.

6) Individual responsible parties should also review and modify their jurisdictional ordinances, permits, and activities as necessary so that they are consistent with the requirements of the SLRP.

CLRP Requirements

The CLRP shall contain, at a minimum, the following components:

1) The SLRP components required above; and

2) A comprehensive watershed and multi-pollutant load reduction approach that includes the following information:

   A. Identify the Lead Watershed Contact for the CLRP. The Lead Watershed Contact should serve as liaison between all other common watershed responsible parties and the San Diego Water Board, where appropriate.

   B. Describe a program for encouraging collaborative, watershed-based, land-use planning in their jurisdictional planning departments.

   C. Develop and periodically update a map of the CLRP watershed, to facilitate planning, assessment, and collaborative decision-making. As appropriate, the map should include features such as receiving waters (including the Pacific Ocean); Clean Water Act section 303(d) impaired receiving waters; water quality projects; land uses; MS4s; major highways; jurisdictional boundaries; and inventoried commercial, industrial, and municipal sites.

   D. Periodically assess the water quality of all water body/pollutant combinations within the Peñasquitos watershed in the CLRP to identify all water quality problems. This assessment should use applicable water quality data, reports, and analysis generated in accordance with the requirements of the applicable NPDES MS4 monitoring and reporting programs, as well as applicable information available from other public and private organizations.

   E. Identified water quality problems in the Lagoon, Los Peñasquitos Creek, Carmel Creek, and Carroll Canyon Creek including, in addition to sediment, all CWA section 303(d) listings, persistent violations of water quality standards, toxicity, impacts to beneficial uses, water quality conditions for which water quality improvement projects are currently being implemented, and any other pertinent conditions. All pollutants in all impaired waters within the Peñasquitos watershed shall be included.

   F. Develop and implement a collective watershed CLRP strategy to meet the sediment TMDL and all other receiving water quality standards for all other pollutants being addressed in the CLRP. The strategy should guide responsible parties in BMP planning and scheduling.

G. Collaborate to develop and implement the CLRP. The CLRP should include a proposal for frequent regularly scheduled meetings among the responsible parties in the impaired watershed.

8.1.4 Implement Load Reduction Plan

The SLRP or CLRP must be implemented immediately upon receipt of Water Board comments and recommendation, but in any event, no later than 60 days after submittal to the San Diego Water Board.

8.1.5 Reasonably Foreseeable Methods of Compliance

The responsible parties must design and implement a range of structural and non-structural best management practices (BMPs), which will prevent or reduce watershed sediment loads to the Lagoon.

Emphasis should be placed on BMPs that prevent and control sources of sediment and/or the intensity and duration of storm water runoff, and on maintenance of those BMPs. The following list of BMPs contains reasonably foreseeable methods the responsible parties may undertake to comply with the wasteload reductions:

- Plant native vegetation on canyon bluffs to prevent erosion, installing irrigation systems as required to support establishment.
- Revise existing local permits and ordinances for consistency with these load reduction requirements, as needed; or adopt new ordinances/issue new permits as needed.
- Enforce all local ordinances and permits as needed for consistency with these load reduction requirements.
- Install basins to retain sediment.
- Install dissipaters to slow discharge velocity to canyons.
- Install bio-swales to infiltrate runoff.
- Install and vegetate buffers to protect erosion channels.
- Repair and/or replace storm drainage infrastructure.
- Take actions to restore streams and the Lagoon by removing accumulated sediments, stabilizing banks, restoring natural channels, and revegetating.
- Stabilize slopes above erosion channels.
- Require low impact development controls designed to reduce runoff for new construction.
- Install sand filters where appropriate.
- Educate watershed residents and businesses about the sediment problem in Los Peñasquitos Lagoon and what actions they need to take to reduce the problem.

8.2 Compliance Monitoring

Compliance monitoring is required of the responsible parties to assess their BMP effectiveness and progress towards achieving the required interim milestones and final load reductions in accordance with the compliance schedule in Section 8.4. The responsible parties are required to design and carry-out a compliance monitoring program that is capable of demonstrating that the responsible parties' have reduced their collective watershed sediment loading to the Lagoon to the early 1970s watershed loading rate. The proposed Compliance Monitoring Program should be included in the Load Reduction Plan submitted to the San Diego Water Board for review.

The compliance monitoring program should be developed in coordination with other monitoring programs. The compliance monitoring program must establish the following elements:

1) Specification of the constituents, sample locations and frequency of monitoring;
2) The types of monitoring techniques to be used;
3) The standard operating procedures and appropriate quality assurance protocols;
4) Analytical techniques and objectives for the interpretation and analysis of information gathered;
5) A process for refining and modifying the monitoring design in response to changing objectives and improved information; and
6) A designated laboratory with sufficient capacity and appropriate levels of certification.

8.3 Compliance Determination

The Step 1 intermediate-term waterbody goal and the objective of this TMDL project is to "attain the water quality objective for sediment in Los Peñasquitos Lagoon and address the current Clean Water Act section 303(d) sediment impairment." Final compliance with this TMDL will be reached when the responsible parties have demonstrated that they have reduced their collective watershed sediment load to Los Peñasquitos Lagoon to the early 1970s watershed sediment load in accordance with the appropriate compliance schedule.

Similarly, interim milestone compliance will be based on the responsible parties' ability to demonstrate that each interim milestone load reduction has been achieved in accordance with the appropriate compliance schedule.

Because of the uncertainty in the data collected to model sediment loads and the difficulty to accurately quantify sediment loads in the field, responsible parties must demonstrate compliance through a weight of evidence approach. Furthermore, the compliance demonstration must be based, to the extent possible, on actual measurements collected in the field.

8.3.1 Weight of Evidence Approach

Attainment of the 1970s loading rate will be demonstrated by measuring and reporting on any combination of the following individual lines of evidence that are sufficient to demonstrate reductions:

Sediment Delivery to Lagoon / Sediment Accretion in Lagoon

- Total estimated sediment loading rate
- Total estimated accretion rate

Lagoon Conditions

- Saltwater Marsh Acreage
- Freshwater Wetlands acreage
- Saltwater Marsh Condition (qualitative evaluation)
- Percent imperviousness of watershed
- Index of Biotic Integrity Score
- CRAM Score

Creek Conditions

- Elevation of Lagoon Bottom Sediment Near Creek Mouth:
- Average Width and Depth of Creek Channel at Mouth:
- Decrease in Flow Regime at Creek Mouth:
- Creek Index of Biotic Integrity Score:
- Riparian and Streambank Indicators
- Hillslope Erosion Features

Each line of evidence must establish the early 1970s condition and the existing condition in the SLRP or CLRP, such that progress can be quantified as a percent. In addition, all lines of evidence must be weighted.

The responsible parties may also propose other equivalent lines of evidence in their SLRP or CLRP, which can effectively measure and report sediment load reductions. For example, computer modeling results of the management scenarios actually implemented may be used as a supporting line of evidence to be considered along with field measurements, but may not be used alone.

8.4 TMDL Compliance Schedule and Implementation Milestones

8.4.1 Compliance Schedule

Responsible parties must demonstrate compliance with each interim milestone load reduction specified in the Compliance Schedule as shown in Table 5. **Ultimate**

compliance must be achieved as soon as possible, but no later than 10 years from the effective date of the TMDL.

Table 5*. 10-Year Compliance Schedule*

Item	Implementation Action	Entity	Date
1	Meet Interim Milestone Reduction #1 30% required reduction in sediment loading to achieve 1970s loading rate	Responsible parties	Within 4 years of effective date of TMDL[a]
2	Meet Interim Milestone Reduction #2 60% required reduction in sediment loading to achieve 1970s loading rate	Responsible parties	Within 6 years of effective date of TMDL[a]
3	Attain Final 100% Reduction in sediment loading to achieve 1970s loading rate (100% of required load reduction is equivalent to 67% reduction from current loading rate)	Responsible parties	Within 10 years of effective date of TMDL[a]

[a] Effective date is the date of approval by OAL.

8.4.2 Alternative Compliance Schedule

As an incentive to take a more comprehensive pollution reduction approach, an alternative 20-year schedule is provided which requires responsible parties to plan for, and demonstrate required load reductions of bacteria and other pollutants, in addition to the sediment load reductions required by this project.

Under the Alternate Compliance Schedule, responsible parties must develop, submit, and implement a Comprehensive Load Reduction Plan (CLRP). Responsible parties must demonstrate compliance with all interim milestone sediment load reductions specified in Table 6 during the 20-year life of this project in addition to other pollutant load reduction schedules as mutually agreed upon in advance by the responsible parties and the San Diego Water Board Executive Officer**. Ultimate compliance must be achieved as soon as possible, but no later than 20 years** from the effective date of this TMDL, as shown in Table 6, below.

Table 6*.* Alternate 20-Year Compliance Schedule

Item	Implementation Action	Entity	Date
1	Meet Interim Milestone #1 of 20% required reduction in sediment loading to achieve 1970s loading rate	Responsible Parties	Within 5 years of effective date of TMDL[a]
2	Meet Interim Milestone #2 of 40% required reduction in sediment loading	Responsible Parties	Within 9 years of effective date of TMDL[a]

Item	Implementation Action	Entity	Date
	to achieve 1970s loading rate		
3	Meet Interim Milestone #3 of 60% required reduction in sediment loading to achieve 1970s loading rate	Responsible Parties	Within 13 years of effective date of TMDL[a]
4	Meet Interim Milestone #4 of 80% required reduction in sediment loading to achieve 1970s loading rate	Responsible Parties	Within 15 years of effective date of TMDL[a]
5	Attain final 100% reduction in sediment loading to achieve 1970s loading rate (100% of required load reduction is equivalent to 67% reduction from current loading rate)	Responsible Parties	Within 20 years of effective date of TMDL[a]

[a] Effective date is the date of approval by OAL.

Responsible parties may also propose additional interim milestone and final compliance schedules for San Diego Water Board consideration and acceptance.

8.5 Adaptive Management

Adaptive management entails applying the scientific method to the TMDL. A National Research Council review of U.S. EPA's TMDL program strongly suggests that the key to improving the application of science in the TMDL program is to apply the scientific method to TMDL implementation (NRC 2001). For a TMDL, applying the scientific method involves 1) taking immediate actions commensurate with available information, 2) defining and implementing a program for refining the information on which the immediate actions are based, and 3) modifying actions as necessary based on new information. This approach allows the Lagoon to make progress toward attaining water quality standards while regulators and stakeholders improve the understanding of the system through research and by observing how it responds to the immediate actions.

8.5.1 Required Lagoon Monitoring

Long-term Lagoon monitoring is required of the responsible parties to measure and assess the Lagoon's response to the sediment load reductions required under this TMDL over time. The specific purpose of the Lagoon monitoring results will be to serve as a "trigger" to indicate the need for, and timing of, further follow-up regulatory actions by the San Diego Water Board and further restorative actions by the responsible parties. In other words, the Lagoon Monitoring Program results will be used to signal when, and if there is a need for, the San Diego Water Board to proceed to Steps 2 and 3 of the Waterbody Goals, as described in the beginning of this section. If, for example, the monitoring results show little improvement in the Lagoon's health over time in response to load reductions, then the San Diego Water Board will have the information needed to support moving the restoration process forward to Step 2 in the Three-Step Waterbody Goals. To the contrary, if the Lagoon shows a marked improvement in response to the sediment reductions required under this project (Step 1 for the Three-Step Waterbody Goals), then no further regulatory or restorative actions may be warranted at this time.

For this reason, the long-term Lagoon Monitoring Program is an essential component of adaptive management for this TMDL project and is critical to the cost effective restoration of the Lagoon. The responsible parties will be required to design and carry-out a long-term Lagoon Monitoring Program that will, at a minimum, include tracking the areal extent of the salt marsh habitat, and will be capable of answering the following questions:

- What is the ecological health of the Lagoon?
- How is the Lagoon's health changing with time?
- What is the progress toward ultimate restoration of the Lagoon?
- What additional regulatory and implementation actions are needed to restore the Lagoon?

The long-term Lagoon Monitoring Program must include the same elements as the Compliance Monitoring program, see section 8.2. The elements must be established in the SLRP or CLRP. In addition, the Lagoon Monitoring Program should be developed in coordination with other related monitoring programs, and will likely be incorporated directly into (and will augment) the existing monitoring requirements under the MS4 permit. One of the San Diego Water Board's priorities is to eventually create (1) a seamless incorporation of all TMDL requirements into the applicable existing MS4 permits; and (2) a seamless implementation of TMDL requirements by the copermittees as part of implementing their MS4 requirements.

8.5.2 Required Special Study on Lagoon Stressors

Because sediment is not the only stressor to Lagoon health and this TMDL is likely only a first step toward achieving the Three-Step Waterbody Goal, the responsible parties are required to quantify the magnitude and extent of impacts caused by **all** stressors to Lagoon health. In the SLRP and CLRP, the responsible parties must design a study to answer the following questions:

- What is the extent of salt marsh habitat and why is it being converted to freshwater habitat?
- What factors are affecting the Lagoon's health?
- What are the watershed sources of these factors?
- What impacts do dry weather flows have on the Lagoon and bacteria sources?

The study should be developed in coordination with other monitoring programs. Any monitoring program developed as part of this study must include the same elements identified is section 8.2, Compliance Monitoring. The Special Study on Lagoon Stressors must be proposed in the SLRP or CLRP.

8.5.3 Adaptive Management Schedule

The above adaptive management reports are summarized in Table 7.

Table 7. *Adaptive Management Schedule*

Item	Action	Entity	Date
1	Develop Special Studies in SLRP or CLRP	Responsible parties	Within 18 months of OAL approval
2	Carry-out Special Studies	Responsible parties	Within 4 years of OAL approval
3	Submit report to San Diego Water Board on Required Special Studies	Responsible parties	Within 5 years of OAL approval
4	Make management decisions based on results of Special Studies	Responsible parties and San Diego Water Board	Within 1 year of submittal of report from item 3

9 Environmental Analysis, Environmental Checklist, and Economic Factors

The San Diego Water Board must comply with the California Environmental Quality Act (CEQA) when amending the Basin Plan as proposed in this project to adopt this TMDL for sedimentation in the Lagoon. Under the CEQA, the San Diego Water Board is the Lead Agency for evaluating the environmental impacts of the reasonably foreseeable methods of compliance with the proposed TMDLs.

The following section summarizes the environmental analysis conducted to fulfill the CEQA requirements. The complete environmental analysis, including the environmental checklist and discussion of economic factors, are discussed in detail in Attachment 5.

9.1 California Environmental Quality Act Requirements

The CEQA authorizes the Secretary of the Resources Agency to certify state regulatory programs, designed to meet the goals of the CEQA, as exempt from its requirements to prepare an Environmental Impact Report (EIR), Negative Declaration, or Initial Study. The State Water Board's and San Diego Water Board's Basin Plan amendment process is a certified regulatory program and is therefore exempt from the CEQA's requirements to prepare such documents.

The State Water Board's CEQA implementation regulations describe the environmental documents required for Basin Plan amendment actions. These documents consist of a written report that includes a description of the proposed activity, alternatives to the proposed activity to lesson or eliminate potentially significant environmental impacts, and identification of mitigation measures to minimize any significant adverse impacts.

The CEQA and CEQA Guidelines limit the scope to an environmental analysis of the reasonably foreseeable methods of compliance with the WLAs and LAs. The State Water Board CEQA Implementation Regulations for Certified Regulatory Programs require the environmental analysis to include at least the following:

1. A brief description of the proposed activity. In this case, the proposed activity is the TMDL Basin Plan amendment.

2. Reasonable alternatives to the proposed activity.

3. Mitigation measures to minimize any significant adverse environmental impacts of the proposed activity.

Additionally, the CEQA and CEQA Guidelines require the following components, some of which are repetitive of the list above:

1. An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.
2. An analysis of the reasonably foreseeable feasible mitigation measures relating to those impacts.
3. An analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate the identified impacts.

Additionally, the CEQA Guidelines require the environmental analysis take into account a reasonable range of:

1. Environmental factors,
2. Economic factors,
3. Technical factors,
4. Population,
5. Geographic areas, and
6. Specific sites.

9.2 Analysis of Reasonably Foreseeable Methods of Compliance

The analysis of potential environmental impacts is based on the numerous alternative means of compliance available for controlling excessive stormwater flows from urbanized areas and excessive sediment loading to the creeks within the Los Peñasquitos HU. Attainment of the WLAs will be achieved through responsible party implementation of structural and non-structural Best Management Practices (BMPs) for point sources. The BMP control strategies should be designed to reduce sediment loading in urban and stormwater runoff and reduce duration and intensity of stormwater runoff.

The controls evaluated in Attachment 5 include the following non-structural and structural BMPs:

1) Sedimentation Basins
2) Buffer Strips and Vegetated Swales
3) Stream Restoration
4) Lagoon Restoration
5) BMP Inspection and Maintenance

6) Slope stabilization
7) Enhanced vegetation
8) Enforcement of permits and local ordinances
9) LID-new and existing developments
10) Public outreach and education
11) Culvert cleaning
12) Storm drain repair and replacement
13) Sand filters

Structural and non-structural control strategies can be based on specific land uses, sources, or periods of a storm event. In order to comply with this TMDL, emphasis should be placed on BMPs that control the sources of sediment, on BMPs that control the intensity and duration of storm water runoff, and on the maintenance of those BMPs.

9.3 Possible Environmental Impacts

The CEQA and CEQA Guidelines require an analysis of the reasonably foreseeable environmental impacts of the methods of compliance with the TMDL Basin Plan amendment. The environmental checklist contained in Attachment 5 identifies the potential environmental impacts associated with these methods with respect to aesthetics, biological resources, greenhouse gas emissions, land use/planning, population/housing, transportation/traffic, agriculture and forestry, cultural resources, hazards and hazardous materials, mineral resources, public services, utilities/service systems, air quality, geology/soils, hydrology/water quality, noise, recreation, and mandatory findings of significance.

In addition to the potential impacts mentioned above, mandatory finding of significance regarding short-term, long-term, cumulative, and substantial impacts were evaluated. Based on this review, the San Diego Water Board concluded that the potentially significant cumulative impacts can be mitigated to less than significant levels as discussed in Attachment 5.

9.4 Alternative Means of Compliance

The CEQA requires an analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate the identified impacts. The responsible parties can use the structural and non-structural BMPs described in Attachment 5 or other structural and non-structural BMPs, to control and prevent pollution, and meet the TMDL's required load reductions. The alternative means of compliance with the TMDL consists of the different combinations of structural and non-structural BMPs that the responsible parties might use. Since most of the adverse environmental effects are associated with the construction and installation of large scale structural BMPs, to avoid or eliminate impacts, compliance alternatives should minimize structural BMPs; maximize non-structural BMPs; and site, size, and design structural BMPs in ways to minimize environmental effects.

9.5 Reasonably Foreseeable Methods of Compliance at Specific Sites

The San Diego Water Board analyzed various reasonably foreseeable methods of compliance at specific sites within the subject watersheds. The specific sites analysis was focused on reviewing potential compliance methods within various land uses. The land uses analyzed roughly correspond to the land uses that were utilized for watershed model development.

In addition to land use, BMP selection includes considering site-specific geographical factors such as average rainfall; soil type; amount of impervious surfaces; and non-geographical factors, such as available funding. Such factors vary between project sites. The most suitable BMP(s) for a particular site must be determined by the responsible parties in a detailed, project-specific environmental analysis.

In order to meet TMDL requirements, responsible parties will determine and implement the actual compliance method(s) after a thorough analysis of the specific sites suitable for BMP implementation within each watershed. In most cases, the San Diego Water Board anticipates a potential strategy to be the use of management measures, or other non-structural BMPs as a first step in controlling sediment discharges to the Lagoon, followed by structural BMP installation if necessary.

9.6 Economic Factors

The environmental analysis required by the CEQA must take into account a reasonable range of economic factors. This section contains estimates of the costs of implementing the reasonably foreseeable methods of compliance with the TMDL Basin Plan amendment. Specifically, this analysis estimates the costs of implementing the structural and non-structural BMPs, which the responsible parties could use to reduce sediment loading to the Lagoon.

While not all potential BMPs are analyzed for cost, sufficient estimates of high-cost and low-cost BMPs were calculated to provide a cost range for compliance with this TMDL. As discussed in section 6 in Attachment 5, the cost estimates ranged from $1,750 for household surveys to $100 million for Lagoon restoration. Yearly maintenance costs add additional costs. Implementation of this TMDL will also entail water quality monitoring which has associated costs. Assuming that a two-person sampling team can collect samples at 5 sites per day, the total cost for one day of sampling would be $2,851.

The specific BMPs to be implemented will be chosen by the responsible parties after adoption of this TMDL. All costs are preliminary estimates since particular elements of a BMP, such as type; size; and location, would need to be developed to provide a basis for more accurate cost estimations.

9.7 Reasonable Alternatives to the Proposed Activity

The environmental analysis must include an analysis of reasonable alternatives to the proposed activity. The proposed activity is a Basin Plan Amendment to incorporate a sediment TMDL for Los Peñasquitos Lagoon. The purpose of this analysis is to determine if there is an alternative that would feasibly attain the basic objective of the rule or regulation (the proposed activity), but would lessen; avoid; or eliminate any identified impacts. The alternatives analyzed include taking no action and modifying water quality standards. These alternative actions are discussed in section 7 of Attachment 5. Because these alternatives are not expected to attain the basic objective of the proposed activity at this point in time, the preferred alternative is the proposed activity itself, which is the Basin Plan amendment incorporating the sediment TMDL.

10 Necessity of Regulatory Provisions

The Office of Administrative Law (OAL) is responsible for reviewing administrative regulations proposed by State agencies for compliance with standards set forth in California's Administrative Procedure Act, Government Code section 11340 *et seq*., for transmitting these regulations to the Secretary of State and for publishing regulations in the California Code of Regulations. Following State Water Board approval of this Basin Plan amendment establishing a TMDL, any regulatory portions of the amendment must be approved by the OAL per Government Code section 11352. The State Water Board must include in its submittal to the OAL a summary of the necessity[7] for the regulatory provision.

This Basin Plan amendment for sediment impairment of the Los Peñasquitos Lagoon meets the “necessity standard” of Government Code section 11353(b). Amendment of the Basin Plan to establish and implement the sediment TMDL for the Los Peñasquitos Lagoon is necessary because the existing water quality does not meet the applicable narrative sediment WQOs. Applicable State and federal laws require the adoption of this Basin Plan amendment and regulations as provided below.

The State Water Board and Regional Water Boards are delegated the responsibility for implementing the California Water Code and the federal CWA. Pursuant to relevant provisions of both of these acts the State Water Board and Regional Water Boards establish water quality standards, including designated (beneficial) uses and criteria or objectives to protect those uses.

Section 303(d) of the CWA [33 USC section 1313(d)] requires the states to identify certain waters within its borders that are not attaining water quality standards and to establish TMDLs for the pollutants impairing those waters. USEPA regulations [40 CFR 130.2] provide that a TMDL is a numerical calculation of the amount of a pollutant that a water body can assimilate and still meet standards. A TMDL includes one or more numeric targets that represent attainment of the applicable standard, considering seasonal variations, a margin of safety, and load allocations. TMDLs established for impaired waters must be submitted to the USEPA for approval.

[7] "Necessity" means the record of the rulemaking proceeding demonstrates by substantial evidence the need for a regulation to effectuate the purpose of the statute, court decision, provision of law that the regulation implements, interprets, or makes, taking into account the totality of the record. For purposes of this standard, evidence includes, but is not limited to, facts, studies, and expert opinion. [Government Code section 11349(a)]

CWA section 303(e) requires that TMDLs, upon USEPA approval, be incorporated into the state's Water Quality Management Plans, along with adequate measures to implement all aspects of the TMDL. In California, these are the basin plans for the nine regions. Water Code sections 13050(j) and 13242 require that basin plans have a program of implementation to achieve WQOs. The implementation program must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the objectives. California law requires that a TMDL project include an implementation plan because TMDLs normally are, in essence, interpretations or refinements of existing WQOs. The TMDLs have to be incorporated into the region's basin plan [CWA section 303(e)] because the TMDLs supplement, interpret, or refine existing objectives.

11 Public Participation

Public participation is an important component of TMDL development. Federal regulations [40 CFR 130.7] require that TMDL projects be subject to public review. All public hearings and public meetings have been conducted as stipulated in the regulations [40 CFR 25.5 and 25.6], for all programs under the CWA. Public participation was provided through one public workshop, and through the formation and participation of the Stakeholder Advisory Group. In addition, staff contact information was provided on the San Diego Water Board's website, along with periodically updated drafts of the TMDL project documents. Public participation also took place through the San Diego Water Board's Basin Plan amendment process, which included an additional public workshop, a hearing, and a formal public comment period. A chronology of public participation and major milestones is provided in Table 8.

Table 8. Public participation milestones

Date	Event
February 15, 2011	Public Workshop and CEQA Scoping Meeting
tbd	Draft Documents released for public review
tbd	Public Hearing and Adoption

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