Multipollutant TMDL Implementation Plan for the County of Los Angeles Unincorporated Area of the Machado Lake Watershed

Submitted to:

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Executive Summary

This report documents the results of the County of Los Angeles (County) effort to address impairments in the unincorporated area of the Machado Lake watershed with a comprehensive, phased approach of best management practice (BMP) implementation. The goal of the multi-pollutant implementation plan is to address Nutrients and Toxics Total Maximum Daily Loads (TMDLs) established for waters within Machado Lake watershed. The Nutrient TMDL was developed to address nutrient-related beneficial use impairments including the following Section 303(d) listings: eutrophication, algae, ammonia, and odor. The Los Angeles Regional Water Quality Control Board adopted the Machado Lake Toxics Total Maximum Daily Load (Toxics TMDL) on September 2, 2010 (LARWQCB, 2010) and is currently awaiting approval by the State Water Quality Control Board and the US Environmental Protection Agency (USEPA). With respect to the Toxics TMDL, toxics include organochlorine (OC) pesticides and polychlorinated biphenyls (PCBs).

This implementation plan describes management options that are limited to unincorporated County areas. Although the implementation plan is limited to unincorporated County areas (also known as County Islands), opportunities for partnerships with incorporated cities and other responsible agencies will be explored, especially in cases where projects have a regional benefit and drainage areas that cross multiple jurisdictional boundaries.

The Nutrients TMDL includes allocations for stormwater in terms of Total Nitrogen and Total phosphorus concentrations, but allows for mass-based allocations through a special study. The County conducted the required Special Study to determine appropriate mass-based allocations. Prior to the completion of the Special Study, the Regional Board Executive Officer assigned mass-based waste load allocations (WLAs) specific to the unincorporated County islands through a letter dated May 13, 2010.

To develop this implementation plan, BMPs to treat stormwater and dry weather flows to reduce nutrients and toxics were identified and selected. As part of this process, benefits of management activities were estimated, in terms of pollutant load reductions or improvement in water quality, to meet waste load allocations (WLAs) defined by approved TMDLs. The process of BMP selection included considering cost-effectiveness to provide assurance that the plan is practical and implementable. The plan also includes integrated water resources approaches that consider BMPs that can address multiple pollutants cost-effectively, while considering parallel water resources planning strategies for the watershed.

The Machado Lake TMDLs include schedules for attaining the associated WLAs. The phases are considered as interim goals for developing strategies to address TMDL implementation. A summary of the Machado Lake WLAs and associated compliance schedules are summarized in **Table ES-1**.

Table ES-1: Implementation Schedule for the Multipollutant Approach for the Machado Lake TMDLs.

TMDL	Milestone	Date
Nutrients	Effective Date	March 11, 2009
	Submit Implementation Plan	September 12, 2011
	Begin Monitoring and Implementation	60-days from approval
	Information Item to Regional Board on Implementation Progress	March 11, 2013
	Interim Limits Apply	March 11, 2014
	LARWQCB to Reconsider TMDL	September 11, 2016
	Final WLA applicable	September 11, 2018
Toxics	Effective Date	Not Currently Effective
	Draft Implementation Plan to attain WLA's	6 months from completion of Phase 1 Monitoring
	Final Implementation Plan to attain WLA's	1 year from completion of Phase 1 Monitoring
	Begin Implementation Plan	60-days from Regional Board approval of Implementation Plan
	Achieve WLAs for Toxics	September 30, 2019

To meet the phased TMDL implementation schedules, a combination of structural and nonstructural BMPs were identified. **Table ES-2** lists the new nonstructural BMPs, enhancements to existing nonstructural BMPs, and the targeted TMDL pollutants addressed.

Table ES-2: Summary of Nonstructural Solutions to Support TMDL Implementation

Nonstructural Solution	New/ Existing Enhanced Program	Targeted Pollutant
Add stencils and re-stencil storm drains, as needed	Enhanced: Public Agency Activities Program	Nutrients and toxics
Catch basin clean outs	Enhanced: Public Agency Activities Program	Nutrients and toxics
Catch basin inserts[1]	Enhanced: TMDL Implementation	Nutrients and toxics
Downspout disconnection program	New	Nutrients and toxics
Fats, oils, and grease outreach	Enhanced: PIPP	Nutrients
Green waste outreach	New	Nutrients
Horse manure outreach	New	Nutrients
Illicit connection removal	Enhanced: ID/IC Program	Nutrients and toxics
Industrial/ Commercial Facilities Control Program	Enhanced: Industrial Commercial Facilities Program	Nutrients and toxics
Landscape and recreational facilities management	Enhanced: Public Agency Activities Program	Nutrients and toxics
Materials storage facilities/ corporation yards management	Enhanced: Public Agency Activities Program	Nutrients and toxics
Oil well ESC outreach	New	Nutrients and toxics
Pet waste outreach	Enhanced: PIPP	Nutrients
Post construction requirements for new development and redevelopment	Existing: Development Planning Program	Nutrients and toxics
Sewer system maintenance, overflow, and spill prevention	Enhanced: Public Agency Activities Program	Nutrients
Smart Gardening Program	Enhanced: Public Agency Activities Program	Nutrients and toxics
Street and parking lot sweeping	Enhanced: Public Agency Activities Program	Nutrients and toxics

1: Although normally considered structural BMPs, for the purposes of the model, catch basin inserts were accounted for as a non-structural BMP.

Structural BMPs opportunities were identified through several mechanisms. First, a field reconnaissance identified several conceptual retrofit opportunities on existing parcels. Then it was assumed that future redevelopment would implement Low Impact Development (LID) where none previously existed. And finally, additional structural BMPs were identified by the County's Watershed Management Modeling System (WMMS) to meet WLA. The structural BMPs identified for TMDL implementation are summarized in **Table ES-3**.

Table ES-3: Structural BMPs to Support TMDL Implementation

Site/ BMP	Land Use
Identified Retrofit Concepts	
South Coast Botanical Gardens	
Vegetated Swale	Institutional
Porous Pavement	Institutional
Centralized Treatment Retrofit(1)	
Bioretention Area	Residential & Industrial
Commercial Parking Lot Retrofit – Option 1(1)	
Bioretention	Commercial
Commercial Parking Lot Retrofit – Option 2(1)	
Bioretention	Commercial
Perimeter Sand Filter	Commercial
Commercial Parking Lot Retrofit – Option 3(1)	
Bioretention	Commercial
Island 1 Additional Retrofit Opportunities	
Bioretention Cul-de-sac Retrofits in Island 1	Residential
Filterra Tree Box Units	Residential
Catch Basin Inserts	Institutional
Island 3 Additional Retrofit Opportunities	
Bioretention Cul-de-sac Retrofits in Island 3	Residential
Filterra Tree Box Units	Residential & Commercial
Catch Basin Inserts	Residential & Industrial
Recommended BMPs for Redevelopment and Remaining Area(1)	
Rain Barrel	Residential
Bioretention	Residential & Commercial
Porous Pavement	Commercial
Centralized BMPs	Residential, Commercial and Industrial

1 May require Public-Private partnerships

Once the nonstructural BMPs were identified the WMMS was leveraged to determine the pollutant loading from the unincorporated County Islands within the Machado Lake watershed, and to quantify the additional structural BMPs to attain the TMDL WLAs. The WMMS is a regional modeling approach that has been used to support development of numerous TMDLs throughout the County. The proposed nonstructural solutions were evaluated using the Watershed Treatment Model (WTM) to estimate the reductions in pollutant loading. This information was incorporated into the BMP analysis component of the WMMS to generate the requirements for structural BMPs necessary for the remaining load reductions. The WMMS determined the cost effective suite of structural BMPs proposed in the Implementation Plan.

The following conclusions were drawn from the analysis:

- Total Phosphorus is the most limiting pollutant. Actions required to meet the final WLA for Total Phosphorus are sufficient to ensure the Total Nitrogen and Toxics loads attain their respective WLAs.
- Nonstructural BMPs and catch basin inserts are effective at reducing pollutant loads before or as they enter the storm drain system and are recommended for implementation.
- Implementing structural BMPs are effective at reducing Total Phosphorus pollutant loads. However the limited availability of doing so on public lands may mean that structural BMPs on private land may be necessary to achieve the Total Phosphorus TMDL reduction target.
- While public centralized BMPs are generally the most cost-effective implementation option, opportunities do not exist in the Machado Lake watershed for centralized BMPs due to limited public land within the County Islands.
- Public distributed BMPs are the second cost-effective options; however, given the limited public distributed BMP opportunities, it may be necessary to implement centralized BMPs on private land to achieve TMDL reduction targets.

The quantification analysis provided the foundation for BMP strategies recommended for phasing of TMDL implementation. This TMDL Implementation Plan provides the timing and planning-level costs for BMPs in the unincorporated County areas of the Machado Lake watershed. **Tables ES-4 and 5** summarize the cost of BMP strategies to meet WLAs. The estimated combined total cost for implementation is approximately 62 million dollars. However, due to the low levels of County owned land, there is a high degree of public-private partnerships required. The estimated costs do not account for negotiations, leases, or acquision of private land for the installation of structural BMPs. Currently, none of the BMP strategies identified in this plan are funded, and the implementation of these strategies is subject to the availability of adequate funding. The implementation schedule for non-structural and structural projects is summarized in **Table ES-6**. The timing for establishing the large number of Public-private partnerships is not included in the schedule, requiring the overall schedule to remain flexible.

Table ES-4: Cost Estimates Associated with the Implementation of Non-Structural BMPs

Program	Present Worth (2011 dollars)[1]
Storm Drain Stenciling Program	60,000
Catch Basin Cleanouts	1,100,000
Catch Basin Inserts[2]	2,000,000
Downspout Disconnection Program	150,000
Fats, Oils and Grease Outreach	60,000
Green Waste Outreach	60,000
Horse Manure Outreach	30,000
Illicit Connection Removal	140,000
Industrial/ Commercial Facilities Control Program	70,000
Landscape and Recreational Facilities Management	130,000
Storage Facilities	50,000
Oil Well ESC Outreach	80,000
Pet Waste Outreach	300,000
Post Construction Requirements	25,000
Sewer System Maintenance	110,000
Smart Gardening Program	550,000
Street and Parking Lot Sweeping	1,100,000
Total	6,015,000

1 Costs through 2018 using 3% rate of inflation.
2 Although normally considered structural BMPs, for the purposes of the model, catch basin inserts were accounted for as a non-structural BMP.

Table ES-5: Cost Estimates Associated with the Implementation of Structural BMPs

Structural Best Management Practice	Present Worth (2011 Dollars)[1]
Conceptual Projects	
South Coast Botanical Gardens	595,000[2]
Centralized Treatment Retrofit	4,570,000[2]
Commercial Parking Lot Retrofit – Option 1	145,000[2]
Commercial Parking Lot Retrofit – Option 2	1,280,000[2]
Commercial Parking Lot Retrofit – Option 3	125,000[2]
Redevelopment	0[3]
Additional County Projects	4,900,000[4]
Projects on Leased/Private Parcels	45,000,000[5]
Total	56,605,000[6]

1 Costs through 2018 using 3% rate of inflation.
65Includes construction, engineering design, permitting, and O&M over 10-years; does not include land acquisition
3 Redevelopment subject to the LID Ordinance and SUSMP requirements to be implemented at developer's expense
4 County projects largely bioretention for secondary roadways, may require additional flow management to direct runoff to center median area.
5 Estimates subject to specific site variability and may require additional funds. Does not consider cost of land acquisition.
6 Cost estimate presented as simple summation.

Table ES-6: Proposed Implementation Schedule

Project	Structural or Non-Structural
By end of 2012	
Focus on Island 1 Storm Drain Stencils	Non-Structural
Purchase Advanced Cleaning Technology (i.e., steam cleaning), as needed for the catch basin cleaning program	Non-Structural
Focus Catch Basin Cleaning in Islands 1 and 3	Non-Structural
Nutrients and Toxics Specific Training for Industrial/Commercial Inspection Staff	Non-Structural
Specialized Fertilizer/Plant Selection Training for Landscape & Rec Facilities Staff	Non-Structural
Specialized Nutrient, Toxics & Runoff Reduction Training for Post-Construction Staff	Non-Structural
Upgrade/Purchase More Effective Street Sweepers, as needed	Non-Structural
Conduct Residential Outreach related to Street Sweeping	Non-Structural
By end of 2013	
Plan for Downspout Disconnection Program	Non-Structural
Nutrients and Toxics Specific Training for Corp Yard Mgt Staff	Non-Structural
Plan for Oil Well ESC Outreach	Non-Structural
Plan for Pet Waste Outreach	Non-Structural
Plan for Smart Gardening Program	Non-Structural
Design, Engineering, and Planning of South Coast Botanical Parking Lot Retrofit	Structural
By end of 2014	
Implement Downspout Disconnection Program	Non-Structural
Assessment of Lawn Conversion by Landscape & Rec Facilities Staff	Non-Structural
Survey Storm Drain System for Illicit Connections in County Islands	Non-Structural
Outreach to Industrial/Commercial Facilities to Improve Source Control Activities	Non-Structural
Design, Engineering, and Planning of Existing Open Space Retrofit	Structural
Design, Engineering, and Planning of Commercial Parking Lot Option 1 Retrofit	Structural
By end of 2015	
Plan for Horse Manure Outreach	Non-Structural
Implement Pet Waste Bag Dispenser Stations in County Islands	Non-Structural
Specialized Training for Sewer System Maintenance Staff	Non-Structural
Design, Engineering, and Planning of Commercial Parking Lot Option 2 Retrofit	Structural
Design, Engineering, and Planning of Commercial Parking Lot Option 3 Retrofit	Structural
By end of 2016	
Plan for Green Waste Outreach	Non-Structural
Implement Horse Manure Outreach	Non-Structural
Conversion of Lawn to Native Landscaping	Non-Structural
Focus Pet Waste Outreach in County Islands	Non-Structural
Focus Maintenance of Sewer System in County Islands	Non-Structural

Continued

Table ES-6: Continued.

Project	Structural or Non-Structural
By end of 2017	
Focus FOG Outreach on Residents in County Islands	Non-Structural
Implement Green Waste Outreach	Non-Structural
Implement Illicit Connection Removal	Non-Structural
By end of 2018	
Complete Construction of South Coast Botanical Garden Retrofit	Structural
Complete Construction of Centralized Treatment Retrofit	Structural
Complete Construction of Commercial Parking Lot Retrofit - Option 1	Structural
Complete Construction of Commercial Parking Lot Retrofit - Option 2	Structural
Complete Construction of Commercial Parking Lot Retrofit - Option 3	Structural
Ongoing	
Continuation of Existing Stenciling Program	Non-Structural
Increase Frequency of Catch Basin Cleanouts	Non-Structural
Continuation of Existing FOG Outreach	Non-Structural
Continuation of Existing I/C Facilities Program	Non-Structural
Fertilizer Reductions	Non-Structural
Continuation of Existing Landscape and Recreational Facilities Mgt Program	Non-Structural
Continuation of Existing Storage Facilities/Corp Yard Mgt Program	Non-Structural
Implementation of Oil Well ESC Outreach	Non-Structural
Continuation of Existing Pet Waste Outreach	Non-Structural
Implementation of Smart Gardening Program	Non-Structural
Increase Frequency of Sweeping	Non-Structural
Require Implementation of BMPs for Redevelopment Projects in County Islands	Structural
Retrofit of Public ROW	Structural
Retrofit Private Property by Land Owner	Structural
Retrofit on Leased Property	Structural

The time frame for implementation of management actions that can be used for attainment of Total Phosphorus load reduction is summarized in **Figure ES-1**. The schedules for nonstructural, structural, redevelopment, and leased property projects were used to distribute the implementation costs over time, ending in 2018, the attainment point established in the Nutrients TMDL. As the adaptive management and reevaluation of the Nutrient TMDL progresses, the required levels of pollutant loading and the implementation timeline may change. The actual costs and timing of implementation will depend on the specific site characteristics, special studies, and actual effectiveness of installed BMPs.

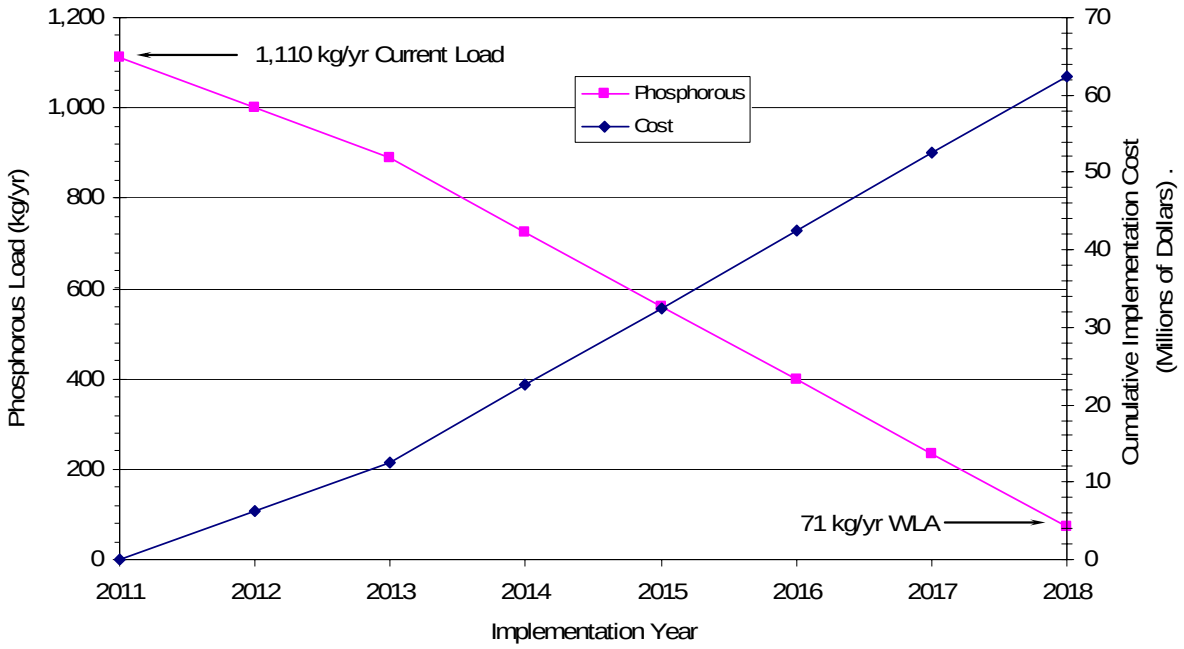

Figure ES-1: Load Reduction for Cumulative Spending to Attain Phosphorus Waste Load Allocation at the County Unincorporated Areas.

This TMDL Implementation Plan is meant to be iterative and adaptive to allow for modifications and improvements informed by ongoing monitoring of the drainage system, source investigations, emergence of new technologies and methodologies for dry and wet weather treatment, and quantified benefits of BMPs through performance monitoring.

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1 Introduction

Machado Lake has a total drainage area of approximately 23 square miles, and is located within the Dominguez Channel Watershed Management Area, although it is not tributary to the Dominguez Channel. The lake itself is under the jurisdiction of the City of Los Angeles, while the drainage area is within the jurisdiction of several cities and unincorporated Los Angeles County (County). The lake is located in the Ken Malloy Harbor Regional Park (KMHRP), which is a 231 acre Los Angeles City Park serving the Wilmington and Harbor City areas. The lake was originally created for inclusion into Harbor Regional Park in 1971, and intended for boating and fishing.

A map of the Machado Lake watershed and the different jurisdictions located within the drainage area is shown in **Figure 1**. The Figure includes the boundary of the Machado Lake watershed. Communities within the watershed include: the Cities of Los Angeles, Torrance, Carson, Lomita, Rolling Hills, Rolling Hills Estates, Rancho Palos Verdes, Redondo Beach, and Palos Verdes Estates; and unincorporated Los Angeles County. Within the watershed, there are three unincorporated County areas (County Islands) that account for 8.4% of the total Machado Lake drainage area. Additionally, the major Storm Drains are called out in **Figure 1**.

Within the County Islands, the dominant land use is single family and high density single family housing. Machado Lake is a receiving body of urban and stormwater runoff from a network of storm drains throughout the watershed. Approximately 88% of the Machado Lake Watershed area flows through the Wilmington Drain into Machado Lake. The land uses in the County Islands are listed in **Table 1**. High and medium residential uses account for nearly 64% of the area in the County Islands.

Table 1: Land Use within the County Islands of Machado Lake Watershed

Land Use	Acreage	Percent County Land	Average Percent Impervious Cover	Acreage of Impervious Cover
High Density Residential(1)	178.03	14.20%	89%	157.85
Medium Density Residential(1)	622.34	49.65%	42%	263.86
Commercial(1)	92.18	7.35%	95%	87.44
Industrial(1)	128.58	10.26%	89%	113.99
Institutional(1)	41.29	3.29%	81%	33.42
Open Space	191.15	15.25%	8%	15.93
Total	1253.57	---	---	672.49

1 Includes transportation

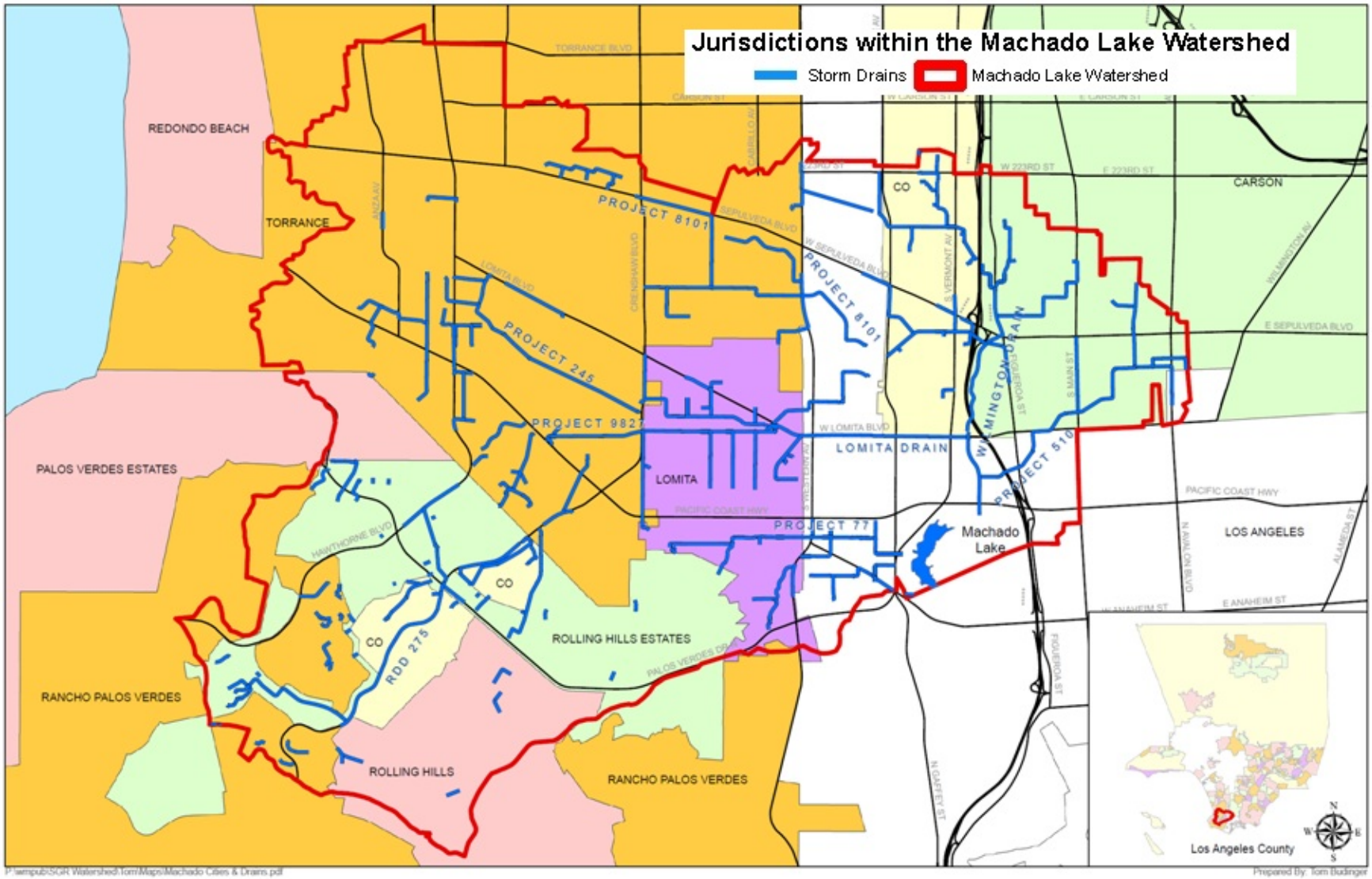


Figure 1: Machado Lake Watershed and Jurisdictions within the Watershed

Section 303(d) of the Clean Water Act (CWA) requires each State to identify waterbodies with impaired water quality. The CWA also requires states to establish a priority ranking for 303(d) listed impaired waters and establish TMDLs for such waters. In California, the State Water Resources Control Board and the nine Regional Water Quality Control Boards are responsible for preparing 303(d) lists of impaired water bodies, subject to USEPA approval. This Implementation Plan addresses the Nutrients and Toxics TMDLs established for the Machado Lake watershed, and gives consideration to potential future TMDLs. The Nutrients and Toxics TMDLs are the primary focus of this Implementation Plan.

1.1 IMPLEMENTATION PLAN OBJECTIVES AND APPROACH

This Implementation Plan outlines the management actions that may be necessary to ultimately attain compliance with the Machado Lake Nutrient TMDL (LARWQCB, 2009) and the Machado Lake Toxics TMDL (LARWQCB, 2010), within the unincorporated County areas of the Machado Lake watershed. The Implementation Plan calls for an integrated, adaptive management approach to utilize available resources effectively and efficiently. As new information becomes accessible through the continued study of drainage patterns, diagnosis of problem sources, and new technologies for dry and wet weather treatment, the plan may be modified as necessary. Implementation of the management actions depend described by the plan depends on feasibility, available funding, site specific conditions, and various other factors.

1.2 MACHADO LAKE RESPONSIBLE AGENCIES

The Machado Lake watershed encompasses approximately 23 square miles and includes the Cities of Carson, Lomita, Los Angeles, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates, and Torrance, as well as unincorporated areas of Los Angeles County.

1.3 WATER QUALITY AND IMPAIRMENTS

1.3.1 Designated Beneficial Uses

The existing beneficial uses of Machado Lake, as defined by the Los Angeles Regional Water Quality Control Board (LARWQCB) in the Basin Plan, include recreation (REC 1 and REC 2) and aquatic life support (WARM, WILD, RARE, and WET). The Basin Plan applies the municipal supply (MUN) beneficial use designation to Machado Lake, qualified by an asterisk, as a potential future use. Conditional designations are not recognized under federal law and are not water quality standards requiring TMDL development at this time.

1.3.2 2010 Section 303(d) List

Section 303(d) of the Clean Water Act (CWA) requires that "Each State shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters." The CWA also requires states to establish a priority ranking for 303(d) listed impaired waters and establish TMDLs for such waters. A TMDL is defined as the "sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loadings (the Loading Capacity) is not

exceeded. TMDLs are required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis.

Nutrient enrichment to Machado Lake has resulted in high algal productivity; algal blooms have been observed in the lake during summer months. High nutrient concentrations also contribute to excessive and nuisance macrophyte growth. Algae respiration and decay remove oxygen from the water column, leaving insufficient oxygen for fish and other organisms to breathe. The decay of algal blooms and other eutrophic related impairments can also create offensive odors. EutrophicationThis nutrient enrichment, or eutrification of the ecosystem, causes impaired Warm Freshwater Habitat (WARM), Water Contact Recreation (REC 1), and Non-contact Water Recreation (REC 2) beneficial uses in Machado Lake. Because of the high nutrient concentrations, algal blooms, odors and eutrophic conditions, Machado Lake was placed on the Clean Water Act 303(d) list of impaired waterbodies in 1998, 2002, and 2006. A schedule for developing TMDLs in the Los Angeles Region was established in a consent decree (Heal the Bay Inc., et al. v. Browner C 98-4825 SBA) approved on March 22, 1999. The consent decree combined waterbody-pollutant combinations in the Los Angeles Region into ninety-two (92) TMDL analytical units. In accordance with the consent decree, the Nutrient TMDL addresses nitrogen and phosphorus compounds and related effects for Machado Lake (analytical unit #76).

Machado Lake is listed in the 1998, 2002, 2006, and 2008 Clean Water Act 303(d) lists of impaired water bodies as impaired due to chlordane, DDT, Dieldrin, Chem A, and PCBs in tissue. In addition to these approved 303(d) listings, there are sufficient data to document chlordane, DDT, and PCB impairments in sediment. The impairments were addressed in the Toxics TMDL. Chem A chemicals are bioaccumulative pesticides, which include chlordane and Dieldrin, and were addressed specifically through chlordane and Dieldrin. Clean Water Act 303(d) listing for Machado Lake and Wilmington Drain are presented in **Table 2**. Total maximum daily loads (TMDLs) have been completed for nutrients, toxics, and trash. The TMDLs are discussed below.

Table 2: 2010 Clean Water Act 303(d) Listings for Machado Lake and Wilmington Drain.

Water Body	Impairments
Machado Lake	Algae
	Ammonia
	Eutrophication
	Odor
	ChemA
	Chlordane
	DDT
	Dieldrin
	PCBs
	Trash
Wilmington Drain	Coliform Bacteria
	Copper
	Lead

1.3.3 Machado Lake Nutrient Total Maximum Daily Load

The Machado Lake Nutrient Total Maximum Daily Load (Nutrient TMDL) was developed by the Los Angeles Regional Water Quality Control Board (LARWQCB) in 2009. The U.S. Environmental Protection Agency (USEPA) approved the Nutrient TMDL on March 11, 2009, and the approval letter was posted on April 8, 2009. The Nutrient TMDL was developed to address nutrient-related beneficial use impairments including the following Section 303(d) listings: eutrophication, algae, ammonia, and odor.

The Nutrient TMDL Basin Plan Amendment (BPA), included as Appendix A, set waste load allocations (WLAs) for municipal separate storm sewer system (MS4) permittees as monthly average concentrations of 0.1 mg/L total Phosphorus (TP) and 1 mg/L total nitrogen (TN). The TMDL also allows a mass-based WLA option for point sources to be established through a special study, defined in the BPA as Optional Special Study #3. The County submitted a Draft Work Plan for Optional Special Study #3 on March 11, 2010. In response to the approaches suggested in the Draft Work Plan for Optional Special Study #3, the Regional Board Executive Officer presented the following approach for calculating mass-based WLAs. This approach was deemed adequate to fulfill the requirements of the Nutrient TMDL:

> The Machado Lake Nutrient TMDL allows for the establishment of annual mass-based WLAs for total phosphorus (TP) and total nitrogen (TN) equivalent to monthly average concentrations of 0.1 mg/L TP and 1.0 mg/L TN, based on approved flow conditions. When the concentration based WLA are met under the approved flow condition of 8.45 hm^3(cubic hectometers or million cubic meters/year), the annual mass of the TP discharged to the lake will be 845 kg and the annual mass of TN discharged to the lake will be 8450 kg. The Los Angeles County mass-based WLA should be proportional to the County owned area in the sub-watershed. The unincorporated County area accounts for 8.4% of the Machado Lake sub-watershed.

Interim and final WLAs based on the County area are listed in **Table 3**.

Table 3: Los Angeles County Nutrient TMDL Mass-based Waste Load Allocations

Years after Effective TMDL Date	TMDL Attainment Date[1]	Total Nitrogen (kg/yr)	Total Phosphorus (kg/yr)
5 (Interim Limits)	March 11, 2014	1739	887
9.5 (Final Limits)	September 11, 2018	710	71

1 Effective date of the nutrient TMDL is March 11, 2009.

1.3.4 Machado Lake Toxics Total Maximum Daily Load

Machado Lake is listed as impaired for chlordane, Chem-A, DDT, Dieldrin, PCBs. The Los Angeles Regional Water Quality Control Board adopted the Machado Lake Toxics Total Maximum Daily Load (Toxics TMDL) on September 2, 2010 (LARWQCB, 2010) and is currently awaiting approval by the State Water Quality Control Board and the USEPA. The BPA adopted by the LARWQCB is included as Appendix B. The pollutants listed within the Toxics TMDL include organochlorine (OC) pesticides and polychlorinated biphenyls (PCBs). These pollutants are associated with suspended sediments, therefore the WLAs were calculated based on the fraction of suspended solids loading produced by each stormwater discharger, and assigned for both dry and wet weather. Compliance is measured either at the storm drain outfall of the permittee's drainage area, at representative storm drain outfalls representing the combined discharge of cooperating parties (if a coordinated compliance option is chosen by multiple permittees), or at an alternative compliance point approved by the Regional Board Executive Officer.

The WLAs assigned to MS4 permittees in the Toxicity TMDL BPA are concentration-based allocations (equal to the sediment numeric targets), and are listed in **Table 4**. The Toxics TMDL requires compliance with these WLAs by September 30, 2019.

Table 4: MS4 Permittees Toxics TMDL Waste Load Allocations

	Numeric Target for Sediment	Waste Load Allocation for Suspended Sediment-Associated Contaminants[1]	
Parameter of Concern	Concentration (µg/kg dry weight)	Concentration (µg/kg dry weight)	Compliance Averaging Period
Total PCBs	59.8	59.8	3-year average
DDT (all congeners)	4.16	4.16	3-year average
DDE (all congeners)	3.16	3.16	3-year average
DDD (all congeners)	4.88	4.88	3-year average
Total DDT	5.28	5.28	3-year average
Chlordane	3.24	3.24	3-year average
Dieldrin	1.9	1.9	3-year average

1 The WLA applies to all MS4 Permittees including the County, Caltrans, General Construction and, Industrial Stormwater Permittees, and other non-stormwater NPDES Permittees.

1.3.5 Machado Lake Trash Total Maximum Daily Load

The Machado Lake Trash TMDL became effective in March 2008. The trash monitoring and reporting plan (TMRP) was submitted to the LARWQCB in September 2008, and conditionally approved in December 2008. This Implementation Plan does not specifically address the Trash TMDL.

1.3.6 Scheduled Total Maximum Daily Loads

Wilmington Drain, to which all of the County areas drain (see **Figure 1**), is listed in the 303(d) list as impaired for metals (copper and lead) and bacteria. The additional pollutants of concern listed in Machado Lake are scheduled for TMDL development in 2014 or 2019. This Implementation Plan does not directly address metals or bacteria impairments in Wilmington Drain.

2 Machado Lake Watershed

The Machado Lake watershed is situated within the Dominguez Channel Watershed Management Area. Machado Lake is separate from Dominguez Channel and discharges, under storm conditions, to the LA Harbor. Unincorporated County land accounts for 8.4% of the Machado Lake watershed.

2.1 COUNTY ISLANDS WITHIN THE WATERSHED

There are three islands of unincorporated County land within the Machado Lake watershed, comprising 1,254 acres, combined. The major land use in the combined County area is residential (63%), including high density single family (HDSF) use, multi-family residential (MFR) use, and mobile homes. The next most prevalent land uses are open space (15%) and commercial uses (6%). For purposes of the Implementation Plan, the County Islands are numbered 1, 2, and 3 from west to east, as displayed and labeled in **Figure 2**. The subwatersheds within the County's Watershed Management Modeling System (WMMS) model and the general flow direction of stormwater are also presented in the figure.

Land use in County Island 1 is listed in **Table 5**. County Island 1 is predominately comprised of residential and open space, together totaling over 90% of the land area. Approximately 37% of the land area is impervious cover. The remaining area is used by the Chadwick Academy.

Land uses in County Island 2 are listed in **Table 6**. County Island 2 is nearly covered by the South Coast Botanical Gardens. Slightly more than 27% of the area is impervious.

Land uses in County Island 3 are listed in **Table 7**. County Island 3 is largely residential, with significant commercial and industrial components. Island 3 is relatively urbanized, with 64% of the land area corresponding to impervious cover.

Table 5: Land Use in County Island 1

Land Use	Acreage	% County Land	Average Percent Impervious Cover	Acreage of Impervious Cover
Medium Density Residential[(1)]	235.21	70.11%	42	98.79
Commercial[(1)]	0.62	0.18%	91	0.56
Institutional[(1)]	28.18	8.40%	82	23.11
Open Space	71.46	21.30%	1	0.71
Total	335.48		37	123.18

1 Includes transportation.

Table 6: Land Use in County Island 2

Land Use	Acreage	% County Land	Average Percent Impervious Cover	Acreage of Impervious Cover
High Density Residential[(1)]	17.07	16.19	86	14.68
Industrial[(1)]	0.78	0.74	66	0.52
Institutional[(1)]	0.35	0.33	82	0.29
Open Space	87.24	82.73	15	13.08
Total	105.45		27	28.57

1 Includes transportation.

Table 7: Land Use in County Island 3

Land Use	Acreage	% County Land	Average Percent Impervious Cover	Acreage of Impervious Cover
High Density Residential[(1)]	160.95	19.81	89	143.17
Medium Density Residential[(1)]	387.13	47.64	43	165.07
Commercial[(1)]	91.56	11.27	95	86.88
Industrial[(1)]	127.79	15.73	89	113.47
Institutional[(1)]	12.76	1.57	78	10.02
Open Space	32.45	3.99	6	2.13
Total	812.64		64	520.74

1 Includes transportation.

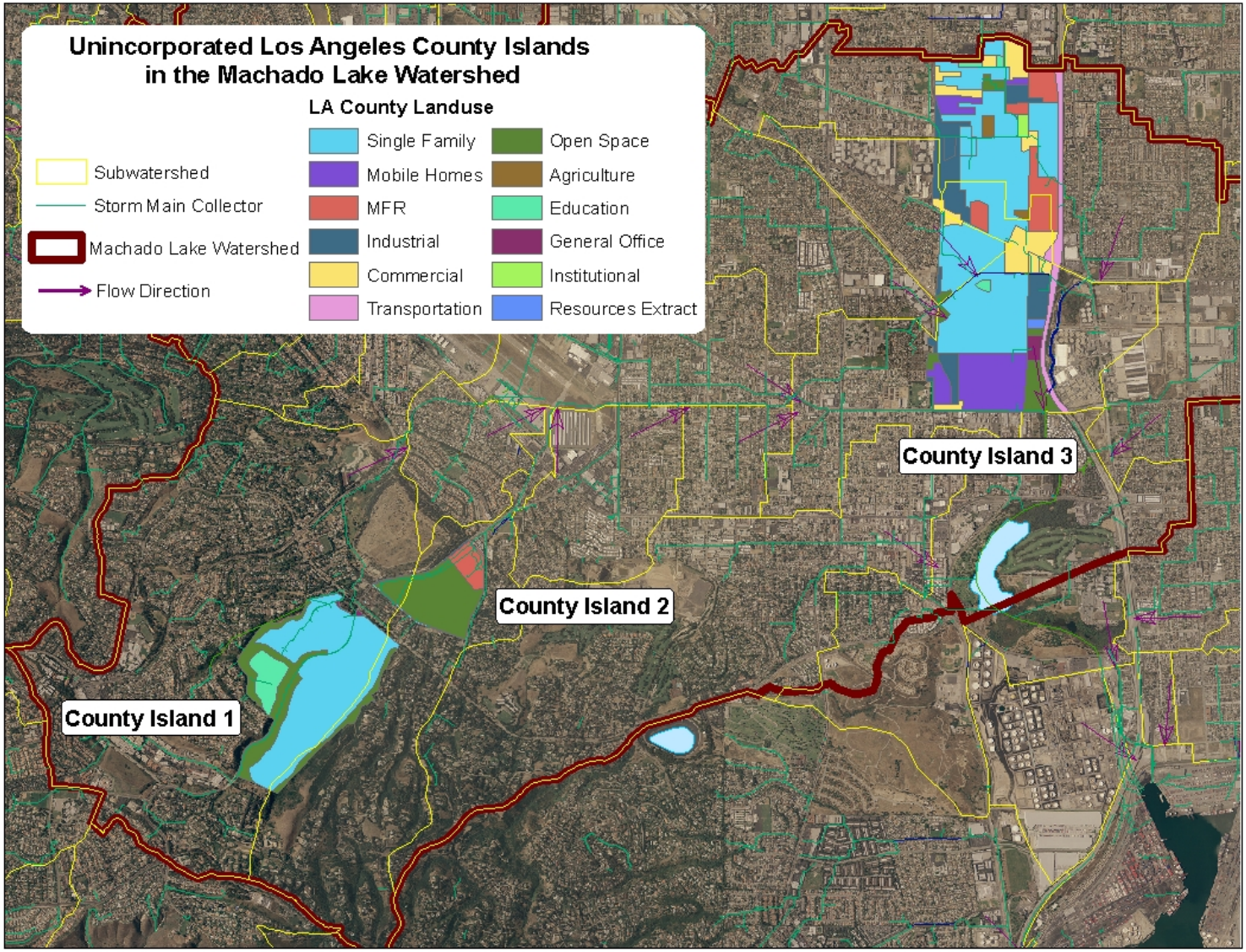


Figure 2: Overview of County Islands and Land Uses

2.2 GEOLOGICAL SETTING AND SOIL

The soils found within the Machado Lake watershed are predominantly loam and clay. The most common soil type is Ramona Loam, which was observed in all three County Islands, including the entirety of County Island 2 and more than 99% of County Island 3, as well as the area underneath the lake. Ramona Loam is a compact soil with a large runoff coefficient at high rates of precipitation. Areas such as the Rolling Hills Estates and the lands along Highway 1 are composed of several different classifications of clay and loam. Diablo Clay Loam and Montezuma Clay Adobe, two soil types which are also compact with high runoff coefficients, make up a majority of the soils seen on County Island 1. Oakley Fine Sand, a loose soil with a relatively low runoff coefficient, comprises a significant percentage of the Machado Lake watershed as a whole, but less than one percent of the unincorporated county land. Oakley Fine Sand was observed in the northern areas of the watershed around Torrance.

The predominant soil types found in the unincorporated County Islands are listed by their percentage in **Table 8**. The soil types found across the Machado Lake watershed are displayed in **Figure 3**.

Table 8: Soil Types and Prevalence in the Unincorporated areas of the Machado Lake Watershed

Soil Classification[1]	Percentage of Soil within County Islands
Ramona Loam	78%
Montezuma Clay Adobe	15%
Diablo Clay Loam	5.9%
Oakley Fine Sand	0.3%

1 LACDPW 2006 Hydrology Manual

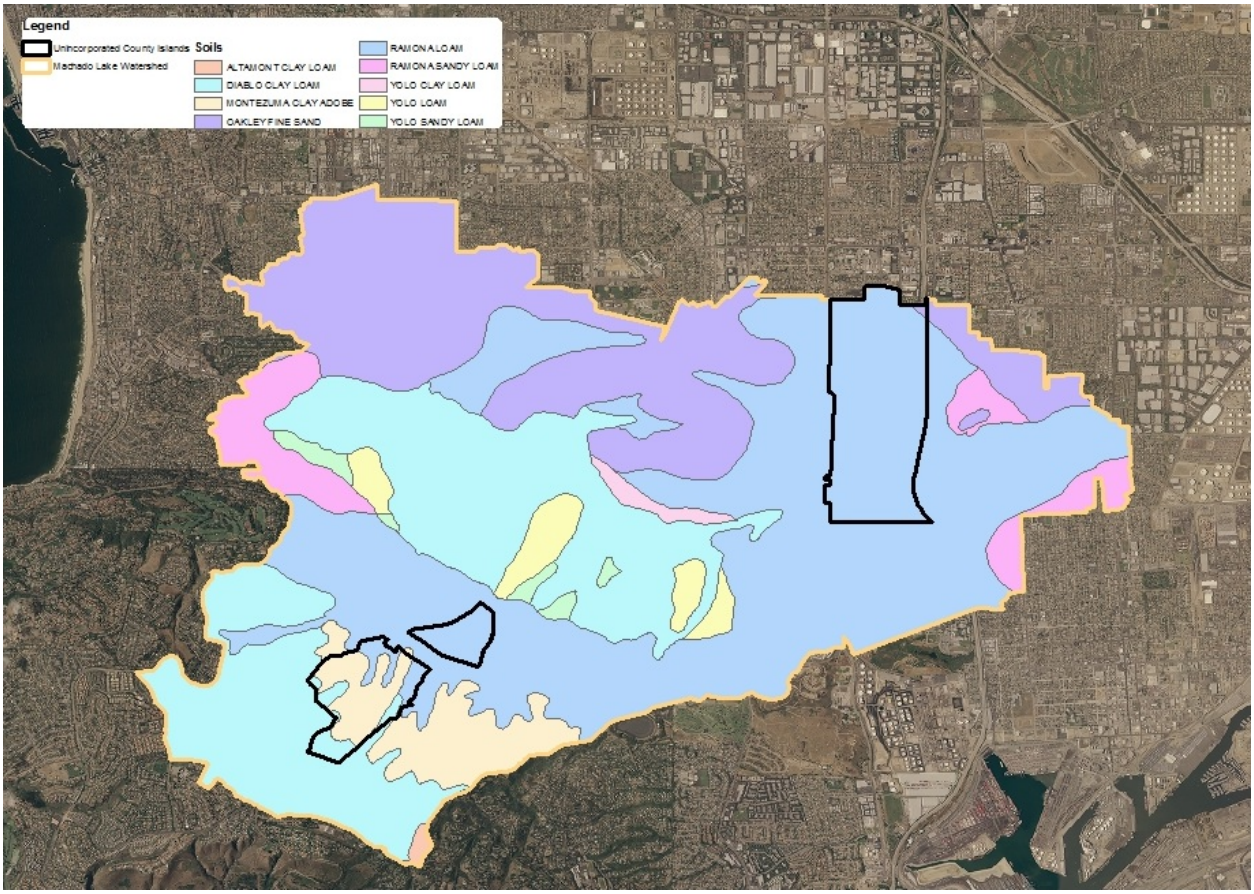


Figure 3: Soils Map for the Machado Lake Watershed (LA County Department of Public Works).

2.3 WATERSHED HYDROLOGY

2.3.1 Precipitation

Rainfall data was collected from gauges managed by the Los Angeles County Department of Public Works Water Resources Division. Precipitation estimates for unincorporated County Islands 1 and 2 were based on precipitation records from the Rolling Hills Fire Station, located approximately 1 mile south of the County Islands and on the lee-side of the hills. Estimates for County Island 3 precipitation were based on records from the Dominguez Water Company station located about 4 miles east of the Island and similarly inland from the Pacific Ocean. Precipitation data from the nearby stations Redondo Yards and Point Vicente Lighthouse were also reviewed for verification of data from the selected sites.

Seasonal precipitation for the areas surrounding the Machado Lake watershed averages between 12 and 14 inches per year. Areas of higher elevation, such as Rolling Hills and Palos Verdes, tend to receive a higher average rainfall than low-lying areas such as Lomita and Torrance. County Islands 1 and 2 can expect an average of 14 inches per year, while Island 3 can expect an average of 12 inches per year. There has been a wide variation of annual precipitation historically, with an observed minimum of 3 inches per year and an observed maximum of 31 inches per year. All unincorporated County Islands can expect to observe such variation in

annual precipitation rates. The stations representing the County Islands have, on average, recorded higher precipitation than stations in areas surrounding the Machado Lake watershed, but their numbers do not significantly deviate from regional averages. Summary information for precipitation gauges in the vicinity of the Machado Lake watershed is presented in **Table 9**.

Table 9: Summary of Precipitation Gauges in the Vicinity of Machado Lake Watershed

Station Name	Representative County Islands	Record Span	Rainfall (in/year)		
			Minimum	Average	Maximum
Rolling Hills Fire Station	Island 1, Island 2	1947 - 2010	3.82	14.03	30.96
Dominguez Water Company	Island 3	1955 - 2010	2.68	12.09	28.44
Redondo Yard	watershed	2005 - 2010	2.76	8.67	13.19
Point Vicente Lighthouse	watershed	1925 - 2010	2.50	10.80	25.32

[1] Records considered incomplete if more than a month of data are unavailable.

2.3.2 Groundwater

County Island 3 is within the West Coast Groundwater Basin. The West Coast Groundwater Basin is composed of the Gage, Lynwood, Silverado, and Sunnyside Aquifers. Depth to the Gage Aquifer, the shallowest aquifer in the basin, is about 200 feet below ground. The Silverado Aquifer, which provides 80 to 90 percent of the groundwater extractions within the basin, ranges from about 300 to 700 feet below ground. The West Coast Groundwater Basin is bound by the Palos Verdes Hills, the Newport-Inglewood Uplift, and the Ballona Escarpment. All aquifers within the basin are confined. In the areas surrounding County Island 3, groundwater flows from west to east.[1] County Islands 1 and 2 are within the Palos Verdes Hills, which is not within a designated groundwater basin. Shallower, perched groundwater not currently used as drinking water is likely in the watershed.

2.4 MONITORING

2.4.1 Special Study

The Machado Lake Nutrient TMDL provides the option for responsible agencies to comply with mass-based WLAs developed through a special study instead of end-of-pipe concentration limits. The County chose the mass-based compliance option and was assigned mass-based WLAs by the LARWQCB. Pursuant to the TMDL, a special study was conducted between spring 2010 and summer 2011 to determine pollutant loading estimates for the water quality constituents associated with the Machado Lake Nutrients TMDL. The study was comprised of six water quality sampling events and continuous flow rate measurements at six sites. The Special Study is detailed further in Section 3.1.1.

1 Groundwater Basin Report: Los Angeles Coastal Plain Basins - West Coast Basin, Metropolitan Water District, September 2007

2.4.2 Monitoring and Reporting Program

The Nutrient TMDL and the Toxics TMDL require the development of monitoring and reporting programs (MRPs). The County has developed a MRP in parallel with the Implementation Plan to address the Nutrient TMDL and Toxics TMDL requirements. Nutrient sampling will be performed during wet and dry weather, and toxics sampling will be performed only during wet weather. Water quality monitoring will be performed at three sites, one on each of the County Islands. Flow rate measurements will continue to be collected at the six sites monitored during the Special Study plus wet weather flow at the South Coast Botanical Gardens. The water quality and flow monitoring sites are called out in **Figure 4**. Nutrient and toxic pollutant loads from the County Islands will be calculated from the water quality (concentration) sampling data and continuous flow rate information. The load data can then be compared with the TMDL waste load allocations. The MRP includes specification of annual reporting of results to the LARWQCB.

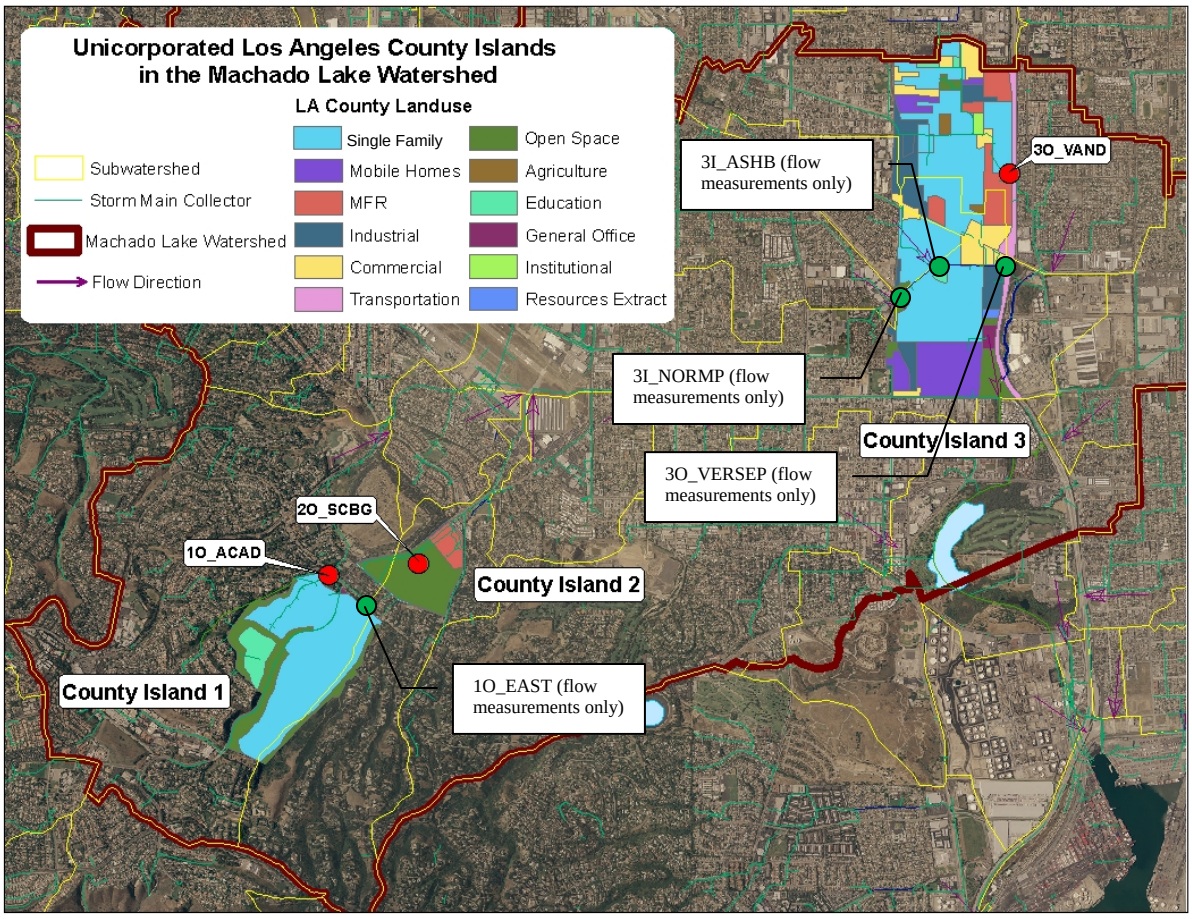


Figure 4: Water Quality and Flow Monitoring Sites Proposed in the Monitoring and Reporting Program.

Nutrient Sampling Approach

Analysis of the dry weather sampling conducted during the Special Study showed that each distribution of water quality constituent was similar for County Islands 1 and 3 (there was no observed dry weather runoff from County Island 2). As all sites were found to be statistically similar, estimations of dry weather loading from the County Islands may be determined in the future without sampling all six of the monitoring locations identified in the Special Study. Three of the outlet monitoring locations in County Islands 1 and 3 shall be sampled for both dry and wet weather. As County Island 2 had no observed dry weather runoff, samples shall only be collected at those locations during wet weather events; however, site visits shall continue to be conducted during each dry weather event to ensure that no dry weather flows can be observed. Flow measurements shall continue to be taken at all the sites from the Special Study plus a site at the South Coast Botanical Gardens following the protocols developed in the Special Study.

Toxics Sampling Approach

Toxics TMDL monitoring shall be conducted in two phases of wet weather monitoring. An estimated 60 liters of sample volume containing suspended sediment from the water column is necessary for analyzing pollutants in bulk sediments. Phase 1 monitoring will be conducted for a two year period, during which samples shall be collected during three wet weather events per year[2], including the first large storm event of the season. Phase 2 monitoring will commence once Phase 1 monitoring has been completed. During Phase 2 monitoring, samples will be collected during one wet weather event every other year up through the fifth year of the program. At the end of Phase 2, the County will review the monitoring results to assess whether the proposed approach should be modified.

Additional Parameters Approach

Metals and bacteria samples will be collected in conjunction with Nutrient TMDL and Toxics TMDL sampling, and will follow the protocols and frequencies of the nutrient sampling. Metals and bacteria data will be helpful during the future development and compliance assessment of TMDLs for those respective constituents.

A summary of the proposed MRP monitoring program, including frequency, location, and monitored parameters, is shown in **Table 10.** After each monitoring year, the County will review the monitoring results to assess whether modifications to the monitoring program should be made. In addition, at the end of year 4, the County will evaluate the monitoring data top determine whether changes should be made to the monitoring program. This review also coincides with the Regional Board effort to revisit the Nutrients TMDL scheduled for September 2016. The results and findings from the monitoring program should be incorporated into the Regional Board revisit of the Nutrients TMDL.

[2] The Department of Water Resources classifies water year based on the time period from October 1 through September 30. For the purposes of this document it is recommended using October 1 as the starting date for the wet season and that the DWR classification be used for annual monitoring reporting. Thus 3 wet weather events per year will be interpreted to be 3 storm events per water year (October-September).

Table 10: Summary of Multipollutant TMDL MRP Monitoring Events.

		Year 1		Year 2		Year 3		Year 4		Year 5	
Site ID	Constituents	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
1O_ACAD	Nutrients	3	4	3	4	3	4	1	4	-	-
	Toxics	3	-	3	-	1	-	-	-	1	-
	Metals	3	4	3	4	3	4	1	4	-	-
	Bacteria	3	4	3	4	3	4	1	4	-	-
2O_SCBG	Nutrients	3	-	3	-	3	-	1	-	-	-
	Toxics	3	-	3	-	1	-	-	-	1	-
	Metals	3	-	3	-	3	-	1	-	-	-
	Bacteria	3	-	3	-	3	-	1	-	-	-
3O_VAND	Nutrients	3	4	3	4	3	4	1	4	-	-
	Toxics	3	-	3	-	1	-	-	-	1	-
	Metals	3	4	3	4	3	4	1	4	-	-
	Bacteria	3	4	3	4	3	4	1	4	-	-

3 Pollutant Source Characterization

3.1 POLLUTANT LOADING ANALYSIS

The Special Study conducted by the County involved dry weather monitoring to estimate the dry weather loading from County Islands. For purposes of the analysis, the dry weather load is the annual non-wet weather load from the County Islands. The Sediment Characterization Report was utilized to estimate the amount of chlorinated pesticides and PCBs associated with the total suspended solids in the runoff from the County Islands. The Watershed Management Modeling System (WMMS) was used to quantify the average annual pollutant loading of nutrients and toxics from the County Islands.

3.1.1 Special Study

To meet the Nutrient TMDL's Optional Study #3 requirements and the aforementioned objectives, the Work Plan outlined an approach that utilized previously existing information to develop mass-based WLAs, and used a combination of water quality sampling and modeling to characterize current wet and dry weather loading from the unincorporated County areas. Water quality samples were collected bimonthly during six dry weather events at each monitoring location. During the wet season, dry weather sampling events were scheduled seven days after measurable precipitation, or after flow rates had returned to base levels typical of the season, whichever period was shorter.

A total of six monitoring sites were selected for the Special Study. The monitoring sites are presented in **Table 11**. The site identifications are in the form of #X_AAAA, where:

- *#* indicates the County Island number in which the site is located,
- *X* identifies whether the site is an inlet (I) or an outlet (O),
- *AAAA* indicates the cross street, where available, such as ACAD for Academy Drive.

The area drained by each monitoring site and the majority land use on the portion of the County Island drained by each site are presented in **Table 12**. Drainage areas were determined using GIS layers, provided by the County, of storm drains and the flow paths of Wilmington Drain. Land use calculations were determined using a GIS layer, compiled of data from the year 2000. Calculations for the Special Study report use a more recent GIS layer, compiled of data from the year 2005. The two inlet sites (3I_ASHB and 3I_NORMB) drain land upstream of the County Islands; however, due to complex drainage patterns, a small area of County land is also captured in the drainage area of the inlet sites. The four outlet sites (1O_ACAD, 1O_EAST, 3O_VAND, and 3O_VERSEP) drain the County Islands and any additional portion of the drainage area upstream of the County Islands. County Island 2 does not discharge under dry weather conditions, so it was not monitored in the Special Study.

Table 11: Monitoring Sites for the Special Study

SiteID	County Island	Type	Nearest Intersection	Latitude	Longitude	Rationale
1O_ACAD	1	Island Outlet (storm drain manhole)	Academy Dr./ Palos Verdes Dr.	33.7831	-118.3537	Representative of County Island outlet and potentially residential land use. This site will be used to characterize loading from the County Island and low to medium residential land uses.
1O_EAST	1	Island Outlet (storm drain manhole)	Eastvale Rd./ Palos Verdes Dr.	33.7809	-118.3506	Representative of County Island outlet and residential land use. This site will be used to characterize loading from the County Island and low to medium residential land uses.
3I_NORMP	3	Island Inlet (concrete-lined channel)	Normandie Ave./ Pasatiempo Ln.	33.8058	-118.2989	Large drain into County Island. Associated Vermont/Sepulveda outlet drains large portion of County Island. This site will be used to characterize loading to the County Island and evaluate loadings to other portions of the County without an associated inlet site.
3I_ASHB	3	Island Inlet Proxy (concrete-lined channel)	Ashbridge Dr./ Pasatiempo Ln.	33.8082	-118.2954	Drains the combination of two other small Island inlets to the associated Vermont/Sepulveda Island outlet. This site will be used to characterize loading to the County Island.
3O_VERSEP	3	Island Outlet (concrete-lined channel)	Vermont Ave./ Sepulveda Blvd.	33.8083	-118.2883	Drains large section of County Island. This site will be used to characterize loading from the County Island and evaluate loadings from other portions of the County without an associated outlet site.
3O_VAND	3	Island Outlet (concrete-lined channel)	Van Deene Ave./ 228th St.	33.8158	-118.2878	Drains large section of County Island. This site will be used to characterize loading from the County Island and evaluate loadings from other portions of the County without an associated outlet site.

Table 12: Monitoring Site Drainage Areas and Majority Land Use

SiteID	Type	Drainage Area (acres)			% of Total Drainage Area Draining County Land	Majority County Land Use Drained
		County	Upstream of County	Total		
1O_ACAD	Outlet	61	0	61	100%	Residential - 65% [SFR - 65%]
1O_EAST	Outlet	54	0	54	100%	Residential - 99% [SFR - 99%]
3I_NORMP[1]	Inlet	45	1,330	1,375	NA[2]	NA
3I_ASHB[1]	Inlet Proxy	48	197	244	NA[2]	NA
3O_VERSEP	Outlet	291	1,527	1,818	16%	Residential - 70% [SFR - 61% MFR - 5% Mobile Homes - 4%]
3O_VAND	Outlet	339	326	665	51%	Residential - 69% [SFR - 51% MFR - 14% Mobile Homes - 4%]

1 Complex drainage pattern causes small area of County land to drain to site.
2 Not Applicable - Inlet sites are not intended to measure County inputs.

Monitoring for nitrogen constituents, phosphorus constituents, metals, chlorinated pesticides, and PCBs was performed during the Special Study. To ensure robust measurements were being collected, a QA/QC program was an essential component of the study. The monitoring results for Total Nitrogen, Total Phosphorus, Total Suspended Solids, and flow rate are displayed in **Figures 5** through **8**.

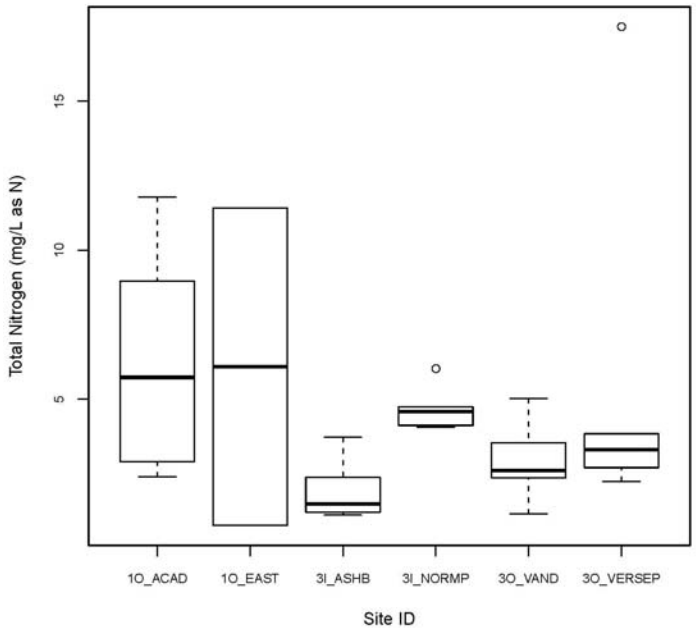


Figure 5: Special Study Total Nitrogen Concentrations.

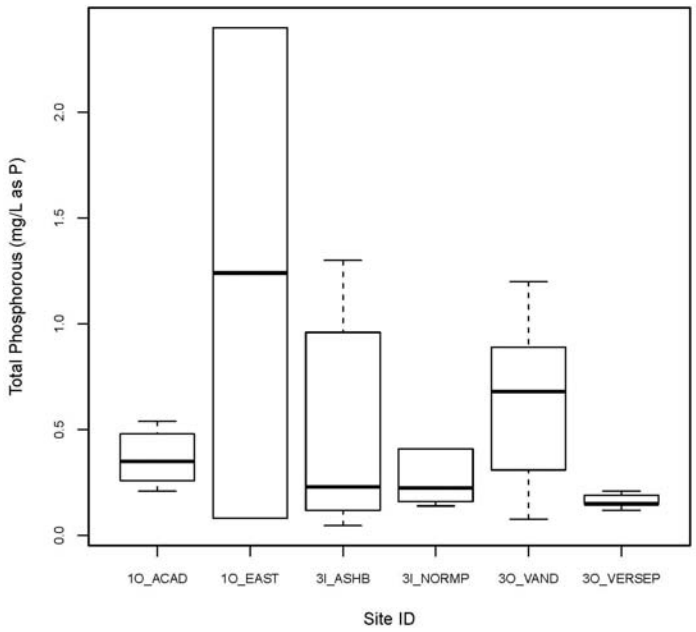


Figure 6: Special Study Total Phosphorus Concentrations.

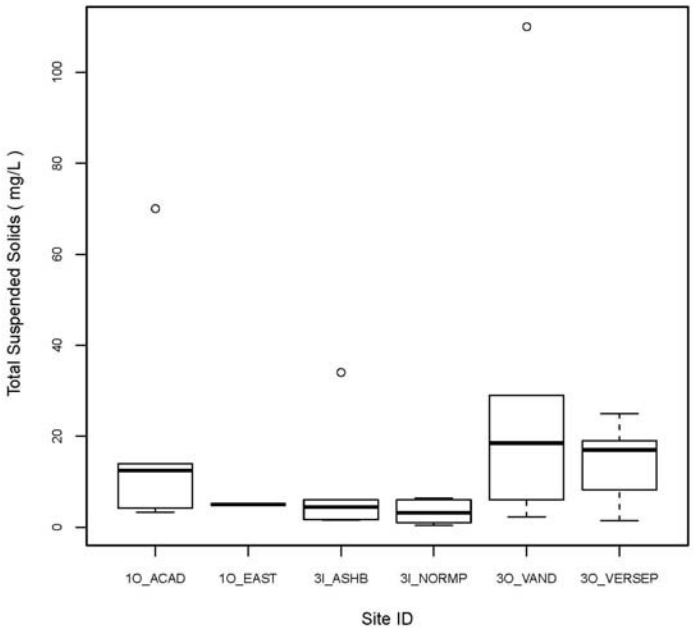


Figure 7: Special Study Total Suspended Solids Concentrations.

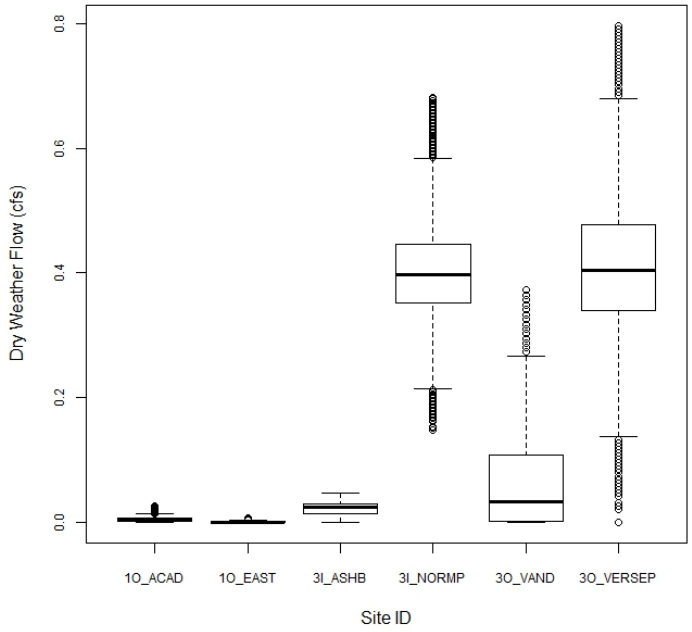


Figure 8: Special Study Dry-Weather Flow Rates.

The water quality sampling data were reviewed to identify whether site location or the timing of events affected the concentrations observed. The data set was reviewed in this way by constituent group, constituent, and, as necessary, constituent fraction (e.g. total and dissolved phosphorus). An analysis of sample variance showed that neither the site location nor event timing had any significant affect on the concentrations of the constituents measured during the study. Because no consistent pattern of differences arose through the analysis of location and event date, the measurement of each constituent can be considered a part of a distribution applicable to all County Islands. This was the case for individual constituents (e.g., all constituents with concentrations greater at 1O_ACAD than at other sites) or groups of constituents (e.g., all nutrients with concentrations greater at 1O_ACAD than at other sites). Therefore, the distribution of constituent concentration is not dependent on location within the watershed, season, or date of sampling.

Mass loadings were calculated using the appropriate estimation of dry weather flow rates and an appropriate distribution of dry weather concentrations for constituents of concern. The dry weather concentrations were developed by sampling from the developed distributions as a Monte Carlo simulation of the conditions. The flow and concentration data sets were used to calculate the loading rates at each location. The mass-based loading estimates from County-owned lands to Machado Lake in kilograms per year (kg/year) are presented in **Table 13**.

Table 13: Mass-Based County Land Dry Weather Loading Estimates of Water Quality Constituents

Water Quality Constituent	Units	Mass-Based Loading Estimate
Total Suspended Solids (TSS)	kg/yr	2,000
Total Nitrogen	kg/yr	560
Total Kjeldahl Nitrogen (TKN)	kg/yr	230
Nitrate as Nitrogen (NO3-N)	kg/yr	320
Nitrite as Nitrogen (NO2-N)	kg/yr	8.4
Ammonia as Nitrogen (NH3-N)	kg/yr	22
Total Phosphorus	kg/yr	56
Dissolved Phosphorus	kg/yr	45
Total Ortho-phosphate (PO4)	kg/yr	34

Over the course of the Special Study, only 10 of the 310 analyses preformed resulted in detectable levels of chlorinated pesticides and PCBs. The detection level for the chlorinated pesticides was 1 ng/L and the detection level for PCBs was 10 ng/L. Because the chlorinated pesticides and PCBs were essentially all non-detect in the samples collected in the Special Study, therefore applicable loadings estimates could not be calculated and therefore are not provided.

3.1.2 Sediment Characterization Report

In 2010, the City of Los Angeles prepared a Sediment Characterization Report (SCR) in support of its proposed dredging and excavation activities within Ken Malloy Harbor Regional Park,

Machado Lake, and Wilmington Drain Channel[3]. The SCR described the results of 124 sediment core samples taken across 53 sampling sites within the areas surrounding Machado Lake. Of the sites sampled, 24 were within Machado Lake, seven were within the Wilmington Drain delta, 17 were within the freshwater marsh, and five were within the riparian woodland. Site locations and identifiers were different from those used in the previous sediment studies performed in the Wilmington Drain and Machado Lake areas. Initial sediment sampling was performed over a seven-week period ending October 9, 2009, then twelve additional samples were collected from the freshwater marsh and riparian woodland on March 5 and March 8, 2010. Samples were collected across several depths, dependent upon the site area, and analyzed for OC pesticides and PCBs, among other constituents.

In the study, PCBs were measured as Aroclors, with approximately 5% of the samples additionally analyzed for PCB congeners. The value of Total PCBs was calculated as the summation of the detected Aroclors or the largest MDL of Aroclor samples (if the sample was non-detect). To calculate the particle associated toxics, this Total PCB value is used in the calculation of the fraction metrics. The OC pesticide congeners DDD, DDE, and DDT were calculated where sufficient data were available. Total DDT congeners were calculated as either the sum of detected values or the largest detection limit (if all individual concentrations were non-detect). All samples were included in the calculations, regardless of location or depth.

The calculated results of the sediment data in the Sediment Characterization Report are summarized in **Table 14**. The majority of samples were found to be non-detect for PCBs, though PCBs were sporadically detected across all four sampling areas.

[3] "Sediment Characterization Report: Machado Lake Ecosystem Rehabilitation Project and Wilmington Drain Multi-Use Project" CDM in association with Parsons Corporation, April 22, 2010

Table 14: Toxic Constituent Fractions Measured from Sediments in 2010 Machado Lake Sediment Characterization Report

Constituent	Range of Values (µg/kg)	Median Concentration (µg/kg)	Average Concentration (µg/kg)
Chlordane-alpha	1.2- 130	2.3	6.8
Chlordane-gamma	1.1 - 160	3.2	16
Total Chlordanes	2 - 1100	20	35
Dieldrin	1.3 - 30	4.9	4.8
2,4-DDD	1.2 - 18	2.0	4.6
2,4-DDE	1.2 - 39	4.4	8.2
2,4-DDT	1.0 - 2.4	2.0	1.9
4,4-DDD	1.0 - 150	4.1	15
4,4-DDE	0.99 - 200	4.2	19
4,4-DDT	0.88 - 870	3.9	15
DDD (all congeners)	1.0 - 170	4.2	16
DDE (all congeners)	0.99 - 240	5.1	20
DDT (all congeners)	0.88 - 870	4.0	16
Total DDTs	0.88 - 910	5.8	43
Total PCBs	4.8 - 240	58	61

3.1.3 Watershed Management Modeling System

The annual average loadings generated by the Watershed Management Modeling System (WMMS) for each County Island are presented in **Table 15**. The loads calculated by the model from the various land uses in each of the County Islands are enumerated in **Table 16**. The data used in the model represent general observations in the Los Angeles Harbor/Dominguez Channel Watershed, which includes the Machado Lake subwatershed, not specific monitoring data from the unincorporated areas of this study. Monitoring conducted as per the TMDL requirements will be used to refine the WMMS modeling results in the Machado Lake watershed, as appropriate.

Table 15: Watershed Management Modeling System Annual Average Loads from Each County Island

County Island	Area[(1)] (acre)	TSS (kg/yr)	TN (kg/yr)	TP (kg/yr)
1	334.91	2,990	271	200
2	106.26	1,070	37.5	24.3
3	813.09	34,300	1,060	888
Total	1254.26	38,400	1370	1110

1 Areas from WMMS

Table 16: Watershed Management Modeling System Annual Average Loads from Each County Island by Land Use

County Island #1	Area[(1)] (acre)	TSS (kg/yr)	TN (kg/yr)	TP (kg/yr)
Transportation	45.33	1,930	53.9	26.9
Residential	197.10	181	113	108
Ind. Inst. & Comm.	44.46	236	95.2	60.8
Vacant/Agriculture	48.01	644	8.95	4.47
Total	334.90	2,990	271	200

County Island #2	Area[(1)] (acre)	TSS (kg/yr)	TN (kg/yr)	TP (kg/yr)
Transportation	7.46	363	10.2	5.11
Residential	98.40	689	26.7	18.8
Ind. Inst. & Comm.	0.38	18.1	0.55	0.35
Vacant/Agriculture	0.02	0	0	0
Total	106.26	1,070	37.5	24.3

County Island #3	Area[(1)] (acre)	TSS (kg/yr)	TN (kg/yr)	TP (kg/yr)
Transportation	196.34	10,800	283	142
Residential	435.61	12,499	464	441
Ind. Inst. & Comm.	153.53	11,000	307	304
Vacant/Agriculture	27.58	36.3	1.54	0.77
Total	813.07	34,300	1,060	888

1 Areas from WMMS

3.2 SUMMARY OF SOURCES

The information about pollutant loading from the County Islands in the Machado Lake watershed can be compared with the TMDL allocations. A summary of the pollutant loading from the unincorporated County Islands, the Final TMDL allocations and ultimate required reductions are presented in **Table 17**. The annual loading from the County Islands currently complies with the interim limit of total nitrogen, 1,739 kg/yr. However, the current total phosphorus loading from the County Islands, 1,100 kg/yr, should be reduced by approximately 20% to comply with the March 11, 2014 interim limitation of 887 kg/yr for total phosphorus. Final nutrient WLAs are supposed to be attained by September 11, 2018. The toxics WLAs are supposed to be attained by September 30, 2019.

Table 17: Calculated Annual Loading Rates to Machado Lake from County-owned Lands

Constituent	Annual Loading	Final Allocation	Required Reduction (%)
Total Nitrogen (kg/yr)	1,370	710	48%
Total Phosphorus (kg/yr)	1,100	71	94%
Total Suspended Solids (kg/yr)	38,400	NA	NA
Chlordane (g/yr)	0.77[1]	0.12[2]	84%[3]
DDT (all congeners) (g/yr)	0.15[1]	0.16[2]	0%
DDE (all congeners) (g/yr)	0.20[1]	0.12[2]	38%[3]
DDD (all congeners) (g/yr)	0.16[1]	0.19[2]	0%
Total DDT (g/yr)	0.22[1]	0.20[2]	9%[3]
Dieldrin (g/yr)	0.19[1]	0.073[2]	62%[3]
Total PCBs (g/yr)	2.2[1]	2.3[2]	0%

1. Based on annual TSS load of 38,400 kg/yr loading and median solids associated fractions as listed in Table 14.
2. Based on annual TSS load of 38,400 kg/yr loading and median solids associated fractions as listed in Table 4.
3. Would be realized through a reduction in TSS load.

4 Nonstructural BMP Opportunities

The Implementation Plan uses an integrated approach to address multiple pollutants, using both structural and nonstructural solutions. The following are the proposed nonstructural BMP opportunities to control the contribution of pollutants to the maximum extent practicable.

4.1 NONSTRUCTURAL SOLUTIONS

In general, nonstructural solutions include pollution prevention actions and source control activities that prevent or minimize the amount of pollution entering urban runoff. Pollution prevention actions seek to control constituents of concern before their release to the environment. Typical pollution prevention actions include conservation and reuse activities. Source control activities target pollutants from specific sources to reduce or eliminate the concentrations of those pollutants entering the MS4 system. Typical source control activities include the issuance of local ordinances, street sweeping, or product bans by either the State or Federal government. A detailed description of the nonstructural solutions is contained in Appendix C.

For pollution prevention and source control measures to be effective, the parties involved need to be educated about the measures, incentives should be provided to use the measures, and enforcement should be available to ensure the measures are implemented. Both pollution prevention and source control measures are proposed as complementary components of nonstructural solutions which may provide more effective treatment at a lower cost than many structural solutions.

4.1.1 Existing Nonstructural BMPs

The following provides a summary of existing nonstructural BMPs that were evaluated to determine if enhancements can be made to specifically support TMDL implementation. **A** summary of the County's existing nonstructural BMPs relevant to nutrients and sediment reduction and flow reductions are presented in **Table 18**. The description provides an overview of relevant programs that could directly support stormwater pollution control.

Enhancements to the existing nonstructural BMPs and additional nonstructural BMPs can be considered and are discussed in the following section.

Table 18: Ongoing Nonstructural Solutions Conducted by Los Angeles County

Nonstructural Solution	BMP Type	Description
Public Information and Participation Program	Education	Encompasses several outreach campaigns. Those that most directly address nutrients are the Smart Gardening Program, pet waste outreach, and fats, oils and grease outreach, as discussed in the public outreach section.
Industrial/Commercial Facilities Control Program	Enforcement	Tracks, inspects, and ensures compliance with permits for industrial and commercial facilities. Controls pollutant transport.
Development Planning	Source Control	Focuses on mitigating the long-term hydrologic and pollutant effects of the built environment and changes in land use. Includes establishing requirements for post-construction BMPs, reviewing plans to ensure that proposed drainage plans meet water quality and hydrologic performance standards, and ensuring long-term operation and maintenance of post-construction BMPs.
Development Construction Program	Enforcement	Addresses runoff from public and private construction projects through the use of stormwater pollution prevention plans (SWPPPs), training of staff engaged in construction activities, and compliance inspections. Through runoff prevention, controls the transport of nutrients and toxics.
Public Agency Activities Program	Source Control	Applies BMPs to infrastructure and facility operation and maintenance activities of Public Agencies to reduce pollutant sources. This includes sewer system maintenance, corporation yard and recreational facility management.
Illicit Connections/Illicit Discharge Program	Enforcement	IC/ID removal prevents the discharge of a variety of pollutants including nutrients and toxics from entering the storm drain system.
Catch Basin Clean Out	Source Control	Catch basins are cleaned at least annually, with higher priority catch basins cleaned semi-annually or quarterly.
Catch Basin Inserts[(1)]	Source Control	In an effort to reduce trash as part of the Machado Lake Trash TMDL, catch basin inserts will be installed in portions of County Island 3.
Street Sweeping	Source Control	Curbed streets are swept weekly with vacuum sweepers in Islands 1 and 2, and Island 3 South of Sepulveda. Mechanical broom sweepers used in the northern portion of County Island 3.
County Ordinance No. 2008-00052U	Enforcement	Prohibits wash down of paved surfaces, irrigation runoff, and requires car washing BMPs.
County Ordinance Title 10 Animals, Chapter 10.40.060, B.	Enforcement	Requires pet owners to pick up and properly dispose of their pet's waste.

1 Although normally considered structural BMPs, for the purposes of the model, catch basin inserts were accounted for as a nonstructural BMP.

4.1.2 Potential Nonstructural BMPs

Potential nonstructural BMPs may include new nonstructural solutions and enhancements of existing nonstructural solutions. Specific sources of nutrients and toxics and their associated nonstructural solutions are listed in **Table 19**.

Table 19: Pollutant Sources and Associated Potential Nonstructural Solution.

Pollutant Source	Associated Potential Nonstructural Solution(s)
Irrigation overflow	• Smart Gardening Program, with evapotranspiration controller irrigation enhancement • Public Agency Activities Program – landscape and recreational facilities management focus
Landscape fertilizer	• Smart Gardening Program • Public Agency Activities Program – landscape and recreational facilities management focus • Development Planning – post construction BMPs
Catch basins[1]	• Catch basin clean outs – increased frequency • Catch basin inserts – install inserts where other structural BMP retrofits options are infeasible due to ownership/space constraints. Inserts should be selected that are capable of removing nutrients.
Streets and parking lots	• Street and parking lot sweeping – more efficient sweepers and increased frequency
IC/ID	• More aggressive identification and removal of illicit connections • Add stencils and re-stencil storm drains, as needed
Sewage	• Public Agency Activities Program – sewer systems maintenance, overflow, and spill prevention focus • Public Information and Participation Program – fats, oils, and grease outreach • Recreation Vehicle Sewage Disposal Sites – Public Information
Horse manure	• Public outreach
Pet waste	• Public outreach
Green waste	• Public outreach
Sediment	• Industrial/Commercial Facilities Control Program • Development Planning • Public Agency Activities Program – materials storage facilities/corporation yards management focus

1 Although normally considered structural BMPs, for the purposes of the model, catch basin inserts were accounted for as a nonstructural BMP.

The nonstructural solutions listed in **Table 19** are detailed in **Table 20**. Sanitary sewer maintenance is covered in other areas of the Implementation Plan. Note that the costs presented in **Table 20** are per year, and total implementation costs include an estimated rate of inflation of 3% over the life of the program

Table 20: Proposed New and Enhanced Non-Structural BMP Descriptions.

Nonstructural Solution	Description	New/ Existing Enhanced Program	Targeted Pollutant	Cost
Add stencils and re-stencil storm drains, as needed	Audit storm drains to determine where stencils are not present or are faded. Efforts should initially be focused in Island 1 where field investigations noted faded or missing storm drain labels	Enhanced: Public Agency Activities Program	Nutrients and toxics	$5K per year
Catch basin clean outs	Modify program to use more aggressive techniques and increase frequency to clean 60% of catch basins monthly and 40% of catch basins semi-annually. Field work investigations identified a particular need for storm drain cleaning in Island 3 industrial areas and the Chadwick School in Island 1	Enhanced: Public Agency Activities Program	Nutrients and toxics	$100K per year
Catch basin inserts[1]	Expand installation of trash catch basin inserts to cover more area in Island 3; catch basin inserts should be capable of removing trash, nutrients and toxics. As an example, Kristar's FloGard Perk Filter has been approved by Washington Dept of Ecology's TAPE program[5] as "basic treatment" meaning that third party monitoring data has validated its ability to remove at least 80% TSS and 50% TP. Regular maintenance is necessary to retain pollutant removal performance.	Enhanced: TMDL Implementation	Nutrients and toxics	$20K (includes yearly O&M)
Downspout disconnection program	Establish a downspout disconnection program to incentivize the disconnection of residential rooftop downspouts. See Section on Integrated Water Resource Considerations for additional information, page 36	New	Nutrients and toxics	$50K/ year
Fats, oils, and grease outreach	Target restaurants and residents in the TMDL Implementation Area for additional FOG outreach to educate them about the potential of sewage overflows caused by FOG blockages	Enhanced: PIPP	Nutrients	$5K/ year
Green waste outreach	Target residents and institutional land uses in TMDL Implementation Area for additional proper management of green waste. Field investigations identified the Chadwick School in Island 1 as an areas where proper green waste mgt is needed	New	Nutrients	$5K/ year

Continued

Table 20: Continued.

Nonstructural Solution	Description	New/ Existing Enhanced Program	Targeted Pollutant	Cost
Horse manure outreach	Target residents for outreach about horse manure management. Field investigations identified this nonstructural BMP as a need for Island 1	New	Nutrients	$5K/ year
Illicit connection removal	Enhance program so that 40% of the system is surveyed and 20% of identified IC is removed	Enhanced: ID/IC Program	Nutrients and toxics	$75K $2,500/illicit connection removal[2]
Industrial/ Commercial Facilities Control Program	Enhancement may include more in-depth training for inspectors and staff that addresses nutrient and toxics specific BMPs. Strengthening partnerships with enforcing agencies may also improve enforcement escalation procedures	Enhanced: Industrial Commercial Facilities Program	Nutrients and toxics	$5K/ year
Landscape and recreational facilities management	Enhancements are similar to the Smart Gardening Program, with application to landscape and recreational facilities managed by the County. The enhancements include switching to non-phosphorus organic fertilizers or using no fertilizer, adding soil amendments to lawns, converting a goal of 25% of lawn to native vegetation and using ET controllers. Outreach may include trainings for County staff that manage or maintain landscape and recreational facilities	Enhanced: Public Agency Activities Program	Nutrients and toxics	$10K/ year
Materials storage facilities/ corporation yards management	Training for County staff in charge of materials storage facilities and corporation yards with focus on activities and materials that may contribute to nutrient and toxic pollution to storm drain	Enhanced: Public Agency Activities Program	Nutrients and toxics	$5K/ year
Oil pump ESC outreach	Work with oil pump parcels located throughout the TMDL Implementation Area to ensure that sediment does not leave the site during the wet season. Field investigation results indicate that initial efforts should be focused in Island 3	New	Nutrients and toxics	$10K/ year

Continued

Table 20: Continued.

Nonstructural Solution	Description	New/ Existing Enhanced Program	Targeted Pollutant	Cost
Pet waste outreach	Target residents, pet stores, and animal shelters in TMDL Implementation Area for additional pet waste outreach	Enhanced: PIPP	Nutrients	$50K/ year
Post construction requirements for new development and redevelopment	This program may be enhanced with additional training for Development Planning Staff. The focus would be education in planning for and maintaining post-construction BMPs that are effective in reducing nutrients toxics, and runoff	Existing: Development Planning Program	Nutrients and toxics	$25K
Sewer system maintenance, overflow, and spill prevention	Enhance sewer system maintenance and target staff working in the TMDL Implementation Area for SSO response and spill prevention training.	Enhanced: Public Agency Activities Program	Nutrients	$20K • $1,700/mi to clean sewer pipe[3]
Smart Gardening Program	This program includes outreach to reduce inputs (fertilizers, pesticides, water, etc.) to landscape, controlling nutrient sources and irrigation runoff. Field investigations showed evidence of lawn irrigation runoff in the majority of residential neighborhoods in all three Islands. This program should aggressively target the population within the TMDL Implementation areas. This program may be additionally enhanced to include evapotranspiration (ET) controllers to further reduce irrigation runoff. It may also encourage residents to change to non-phosphorus organic fertilizers or use no fertilizer, add soil amendments to lawns, and convert lawn to natural vegetation.	Enhanced: Public Agency Activities Program	Nutrients and toxics	$60K/ year
Street and parking lot sweeping	Increase frequency of sweeping to 2x/weekly	Enhanced: Public Agency Activities Program	Nutrients and toxics	$80K/ year[4]

1. Although normally considered structural BMPs, for the purposes of the model, catch basin inserts were accounted for as a nonstructural BMP.
2. Source: Marcoux, 2004 and Brown et al., 2004
3. Source: WERF, 1997
4. Source: Modified from Ramsey-Washington Metro Watershed District, 2005.
5. Source: Washington State Department of Ecology's Technology Assessment Protocol - Ecology (TAPE) program reviews performance evaluation reports on new stormwater treatment technologies and determines whether or not the technologies meet Ecology's performance standards. http://www.ecy.wa.gov/programs/wq/stormwater/newtech/

4.2 PUBLIC INFORMATION AND PARTICIPATION PROGRAM

The County of Los Angeles Department of Public Works' Countywide Stormwater/Urban Runoff Public Education, Used Motor Oil and Used Oil Filter Recycling, Household Hazardous Waste/Electronic Waste Collection, and SmartGardening programs help achieve the Public Information and Participation Program (PIPP) public outreach mandates and address nutrients and toxics pollution. Public community events, paid media campaigns, media relations efforts, and distribution of collateral materials are part of the standard public outreach practices for the above-mentioned environmental education programs. Visit www.CleanLA.com for information about these programs.

The SmartGardening Program consists of learning centers and workshops that educate homeowners about conservation (of fertilizers, pesticides, water, etc.) when gardening and landscaping, which reduces the amount nutrients and toxics in the environment. The SmartGardening Program could be enhanced to help facilitate TMDL implementation by identifying learning centers and/or holding workshops in County TMDL Implementation Areas. Tip cards with SmartGardening Program information could be tailored to address specific concerns (discontinuing irrigation overspray as a pollutant transport mechanism, controlling excess nutrients from fertilizer, pesticide alternatives, etc.) and sent to residences within TMDL Implementation Areas.

5 Structural BMP Opportunities

The structural BMP opportunities include a list of projects which, if constructed (and used in combination with the nonstructural activities), are intended to reduce County stormwater discharges to levels within the TMDL WLAs. The process described below will be refined and improved through the iterative and adaptive approach to TMDL implementation, as new information becomes available and decision support systems evolve.

5.1 SUMMARY OF STRUCTURAL SOLUTIONS

A phased approach is necessary for implementing structural solutions. The first priority will be given to approaches that do not require obtaining land tenure, which may be projects within publicly owned right-of-ways or programs that encourage private owners to implement structural BMPs within their own properties. The next phase will involve public acquisition of property on which structural solutions can be implemented. The creation of public-private partnerships to implement structural solutions will also be considered. A summary of the pollutant removal mechanisms and capabilities of structural BMPs is provided in **Table 21.**

Table 21: Pollutant removal mechanisms and capabilities of structural BMPs (modified from International BMP Database, 2010)

		Pollutant Removal Capabilities			
Structural BMP	Pollutant Removal Mechanism	Total Nitrogen	Total Phosphorus	Pesticides[1]	PCBs[1]
Infiltration Basin	Infiltration	H	H	H	H
Detention Basin	Settling	M	M	M	M
Constructed Wetland	Biological Uptake, Settling	M	H	H	H
Catch Basin Insert	Settling, Filtration	L	M	M	M
Bioretention[2, 3]	Adsorption, Settling, Biological Uptake, Infiltration	M	H	H	H
Porous Pavement	Infiltration	M	H	H	H

H: high; M: medium; L: low

1. Performance data is not widely available for this pollutant class; assumed that removal efficiency would be similar to sediments since these pollutants are largely associated particulates
2. Phosphorus index of fill soils in bioretention areas will cause a high total phosphorus outflow; high TP removal efficiency is dependent on the fill soils having a low P-index
3. Nitrogen removal by bioretention areas can be increased using a design variation that creates an anaerobic zone below the drain pipe.

5.1.1 Rainwater Harvesting

Rainwater harvesting captures rainwater such that runoff and any potential pollutants it may carry does not enter the drainage system. Captured rainwater can reduce the demand for potable water by supplementing non-potable uses. Most typically, roof runoff is captured for landscape

irrigation, although indoor non-potable uses such as toilet flushing are possible. Rainwater harvesting can be implemented in high-density urban environments (CASQA, 2011).

Public health considerations place constraints on the implementation of rainwater harvesting. Large-scale rainwater harvesting systems that integrate below-grade pipelines, pumps and large capacity holding tanks are subject to requirements issued by the Los Angeles County Department of Public Health (LACDPH, 2009). The use of harvested rainwater from large-scale systems is limited to subsurface irrigation (i.e., no misting or spraying) unless treated to Title 22 tertiary recycled water standards (LACDPH, 2009). Indoor reuse of harvested rainwater requires disinfection (Geosyntec, 2009).

Los Angeles County Department of Public Works Watershed Management Division's Cistern Document (Geosyntec, 2009) established standards for the design and use of large-scale cisterns (described in the next section). This document was reviewed in detail in the March 22, 2011 *Draft Multi-Pollutant TMDL Implementation Plan for the Unincorporated Area of Marina del Rey Harbor Back Basins* (Marina del Rey Implementation Plan) (County of Los Angeles, 2011). The rainwater harvesting system identified in the Marina del Rey Implementation Plan may be feasible for similar land uses within the Machado Lake watershed. The Cistern Document modeled various landscape areas to drainage area ratios to estimate the amount of rainwater that could potentially be captured and reused. High-density, low-landscape areas showed a diminishing return at a cistern volume of approximately 300 gallons per 1,000 square-feet of drainage area. Low-density, high-landscape areas showed a diminishing return at a cistern volume of approximately 700 gallons per 1,000 square-feet of drainage area. Meanwhile, the cost-benefit analysis indicated that the most cost effective design was a cistern volume of 100 gallons per 1,000 square-feet of drainage area. Implementing the most cost effective design would therefore capture a small percentage of the potential rainwater that could be harvested.

Small rainwater harvesting systems may provide incremental benefits to improve water quality in the County Islands and may provide a feasible option in areas with limited available area for retrofits. High density residential development comprises the largest percentage (~56%) of land use within the County Islands. The average impervious cover within the high density residential land use is approximately 49%, which suggests that landscaping is present where harvested rainwater could be reused. An assessment of the available drainage area/landscape area ratio and soil types would be required to confirm the feasibility of harvesting rainwater at specific sites.

Larger scale harvesting may be feasible at education facilities, where larger areas of land may be dedicated to landscaping or to green play fields.

Rainwater harvesting provides an ancillary public outreach benefit that supports nonstructural efforts. Rain barrels directly involve the public in the hydrology of their watershed and water conservation efforts.

5.1.2 Rain Barrel Program for the County Islands

Rain barrels and cisterns are containers that collect and store rainwater from rooftop drainage systems that would otherwise be lost to runoff and diverted to storm drains. Rain barrels are placed above ground beneath a shortened downspout next to a home or building, and typically range in size from 50 to 180 gallons. Cisterns are larger storage tanks that may be sited above or below ground and are sufficient to collect rainwater from larger rooftops such as apartments or

office buildings. Stored rainwater is typically used for landscape irrigation, but can be used for washing or toilet flushing (with pretreatment).

Information on rain barrel installation will be provided to residences. A homeowner incentive program will be necessary to achieve the level of implementation indicated in the model. Examples of incentive programs include:

- City of Los Angeles provided free assistance to 600 homeowners willing to install rain barrels in targeted areas in 2009. The program was funded by the Safe Neighborhood Parks, Clean Water, Clean Air and Coastal Protection Bond Act of 2000 (Prop 12) through the Santa Monica Bay Restoration Commission and the California Coastal Conservancy. www.larainwaterharvesting.org
- Burbank Water and Power partnered with the California Energy Commission to provide homeowners with a $100 rebate for the purchase and installation of a rain barrel. www.burbankwaterandpower.com/incentives-for-residents/rain-barrel-rebates
- City of Palo Alto, CA has a Stormwater Rebate Program to encourage the use of innovative stormwater treatment control measures, including rain barrels. Homeowners can receive $50 for the purchase and installation of a rain barrel. www.cityofpaloalto.org/depts/pwd/flood_storm/stormwater_rebates/rain_barrels.asp
- Kansas City, MO created the 10,000 Rain Gardens program that encourages the voluntary establishment of rain gardens and/or rain barrels. www.rainkc.com/

Installation of rain barrels is an important component of the residential BMP solution. Implementation of a program to encourage of rain barrel installation in the County Islands is important for the success of the residential BMP program.

5.2 LOW IMPACT DEVELOPMENT

The County of Los Angeles adopted a low impact development (LID) ordinance on January 1, 2009 which directly influences the selection and use of structural BMPs. New development and future redevelopment within the County Islands are subject to LID requirements. The requirements are intended to result in runoff quantities and quality that mimic the runoff from undeveloped areas, up to and including runoff from a 50-year capital design storm event. Development projects with four or fewer residential units are required to implement two LID BMP alternatives as specified in the County LID Standards Manual. LID BMP alternatives include disconnecting impervious areas, installing porous pavement, dry wells, conforming to landscaping and irrigation requirements, and installing green roofs. Developments with five or more units or nonresidential developments are required to provide infiltration for excess runoff volume. Runoff from these developments that mimics the natural hydrograph must meet treatment requirements. Redevelopment projects where at least 50% of the impervious surfaces are altered must mitigate the entire project area. Redevelopment projects that alter less than 50% of the impervious area only need to mitigate the alteration.

Implementation of LID BMPs within the County Islands provides an opportunity to reduce the loading of pollutants by reducing concentrations of pollutants in runoff and reducing the volume of runoff. Both development and redevelopment are largely driven by the strength of the economy. Currently, the rate of development is near a historic low and as a result, estimates for gains and the schedule for those gains are difficult to quantify. As part of the adaptive management implementation, the effects of implementing LID BMPs through development and

redevelopment will be tracked though the monitoring and reporting program. Increased levels of development or redevelopment should result in decreases in pollutant loading from the County Islands, reducing the need for additional structural controls. Stagnation of development in the County Island may lead to an extended schedule or require additional structural controls to attain TMDL WLA levels.

5.3 INTEGRATED WATER RESOURCES SOLUTIONS

An integrated water resource approach incorporates multiple water resource goals, including water supply, groundwater recharge, and storage and reuse opportunities. Water quantity (i.e., structural) BMPs that infiltrate or store rainwater for reuse are also referred to as rainwater harvesting systems. Water resource projects tend to be implemented on a regional level, while rainwater harvesting systems are implemented at a lot or site level.

Water quantity BMPs and water resource projects could contribute to the implementation of the Machado Lake Nutrients and Machado Lake Toxics TMDLs while enhancing water resources. The water resource projects applicable to the Machado Lake watershed were identified through the review of *The Greater Los Angeles County Integrated Regional Water Management Plan* (IRWMP) (Leadership Committee of Greater Los Angeles County Integrated Regional Water Management Plan, 2006) as well as the IRWMP Projects database found on the Greater Los Angeles County Region IRWMP website[4] (Greater Los Angeles Region, 2006).

5.3.1 Water Resource Projects

Water resource projects provide multiple benefits including flood protection, groundwater recharge, water supply, ecosystem restoration, and water quality improvements. The water resource projects identified in the Implementation Plan include projects planned by other agencies in the Machado Lake watershed. While these projects do not directly benefit the County, these projects will contribute to water quality improvement in Machado Lake. A list of potential water resource projects within the jurisdiction of other local agencies in the Machado Lake watershed is presented in **Table 22**.

[4] http://www.ladpw.org/wmd/irwmp/index.cfm [4] http://www.ladpw.org/wmd/irwmp/index.cfm

Table 22: Planned Water Resource Projects by Agencies within the Machado Lake Watershed.[1]

Agency or Agencies	Project Title	Project Description	Project Type(s)
City of Lomita, WRD[2], WBMWD[3]	Lomita Integrated Storm to Vadose to Water Supply – Lomita Park Subdivision	Utilize BMPs to treat stormwater and provide for water supply.	WS
City of Lomita, WRD, WBMWD	Lomita Integrated Storm to Vadose to Water Supply – Walnut Street	Utilize BMPs to treat stormwater and provide for water supply.	WS
City of Lomita, WRD, WBMWD, Egmond Assoc., Ltd.	Lomita Integrated Storm to Vadose to Water Supply – Robin Lane	Utilize BMPs to treat stormwater and provide for water supply.	WS
LADPW[4], LADRP[5]	Machado Lake Ecosystem Rehabilitation Project	Aquascaping along the lake's shore and near shore areas, construction of two vegetated detention basins, installation of pervious paving material, installation of bioswales, and installation of a smart irrigation system.	WQ, HB
City of Rolling Hills Estates	Model Equestrian Center	planned renovation and expansion of the center will provide the opportunity to incorporate stormwater BMPs, including low impact development techniques, and interpretive signage into the project to provide a model equestrian center for public education	
City of Torrance	Reduction of Harmful Nutrients in the water at the Madrona Marsh Preserve	Reduce or remove phosphates, nitrates, and other pollutants through filtration from stormwater and dry weather urban runoff.	WQ
City of Torrance	237th Street Sump Conversion Project	Installation of a diversion structure that would allow the City to maximize the use of the 237th Street Sump for stormwater runoff retention and infiltration	WQ
City of Torrance	Walnut Avenue Sump Conversion Project	Diversion structure to divert stormwater runoff back into the Walnut Avenue Sump utilizing retention and infiltration to meet TMDL compliance requirements	WQ
CSU[6] Dominguez Hills Dept. of Biology and Madrona Marsh Preserve	Swales for Schools Demonstration Project	A demonstration swale will be constructed at a local elementary school to show removal of pollutants such as toxics or nutrients.	WQ, WS

Continued

Table 22: Continued.

Agency or Agencies	Project Title	Project Description	Project Type(s)
LACSD[7]	Joint Water Pollution Control Plant Marshland Enhancement Project	Restoration of the 17 acre freshwater JWPCP marshland, which provides stormwater treatment and flood control.	WQ, HB
LADRP	Harbor Park Golf Course BMPs	Installation of dry swale drainage systems to replace existing concrete drainage channels; installation of new water treatment and recycling system to capture, treat and reuse mechanical equipment wash water.	WQ, WS
SCWRP[8]	Ocean Avenue Retention Basin	Enhance native vegetation in the Ocean Ave Retention Basin to improve habitat and increase pollutant removal capabilities.	WQ, HB
SCWRP	Del Amo Boulevard Detention Basin	Enhance native vegetation in the Del Amo Blvd Basin to improve habitat and increase pollutant removal capabilities.	WQ, HB
LACFCD[9], LADPW[4]	Wilmington Drain Multi-Use Project	Includes native vegetation enhancements, trash capture devices, a passive park, and removal of approximately 30,000 cubic yards of sediment from the soft-bottom channel invert of Wilmington Drain	WQ, HB

Notes:
WS = Water Supply
WQ = Water Quality
HB = Habitat Improvement
1. Source: Greater Los Angeles County IRWMP and IRWMP database (2006)
2. Water Replenishment District of Southern California
3. West Basin Municipal Water District
4. City of Los Angeles Department of Public Works
5. City of Los Angeles Department of Recreation and Parks
6. California State University
7. Los Angeles County Sanitation Districts
8. Southern California Wetlands Recovery Project
9. Los Angeles County Flood Control District

5.3.2 Future Retrofit and Reuse Opportunities

Future funding may be available for BMPs which provide flood protection and other benefits such as groundwater recharge, water quality improvements, and ecosystem restoration, through Planning and Implementation Grants under Proposition 84 and Stormwater Flood Management Grants under Proposition 1E. Flood control projects utilizing infiltration-based BMPs located in County Island 3 could provide groundwater recharge,[5] as County Island 3 is situated above the West Coast Basin of the Los Angeles County Coastal Plain Basin (County of Los Angeles,

[5] Groundwater recharge opportunities will depend on many environmental variables including soil infiltration rates and the nature of the underlying aquifers. Therefore, detailed analyses and ground-truthing will be required to ensure the feasibility of groundwater recharge.

2010), and therefore could be eligible for funding under Proposition 1E. Funding opportunities are contingent on the State budget and are therefore constantly changing.

Retrofitting large impervious surfaces such as parking lots and commercial rooftops may be a relatively efficient use of restoration funds, but are contingent on land availability and execution of agreements with other entities. Vacant lands or underutilized open space offer an opportunity to construct an infiltration basin or underground infiltration gallery to treat upstream drainage areas. Within the County Islands, there is little County-owned property, most of which is relegated to secondary streets and the South Coast Botanical Gardens. A zoning map of the County Islands is presented in **Figure 9**. Retrofit opportunities that may exist within the County Islands are described in Section 5.4.

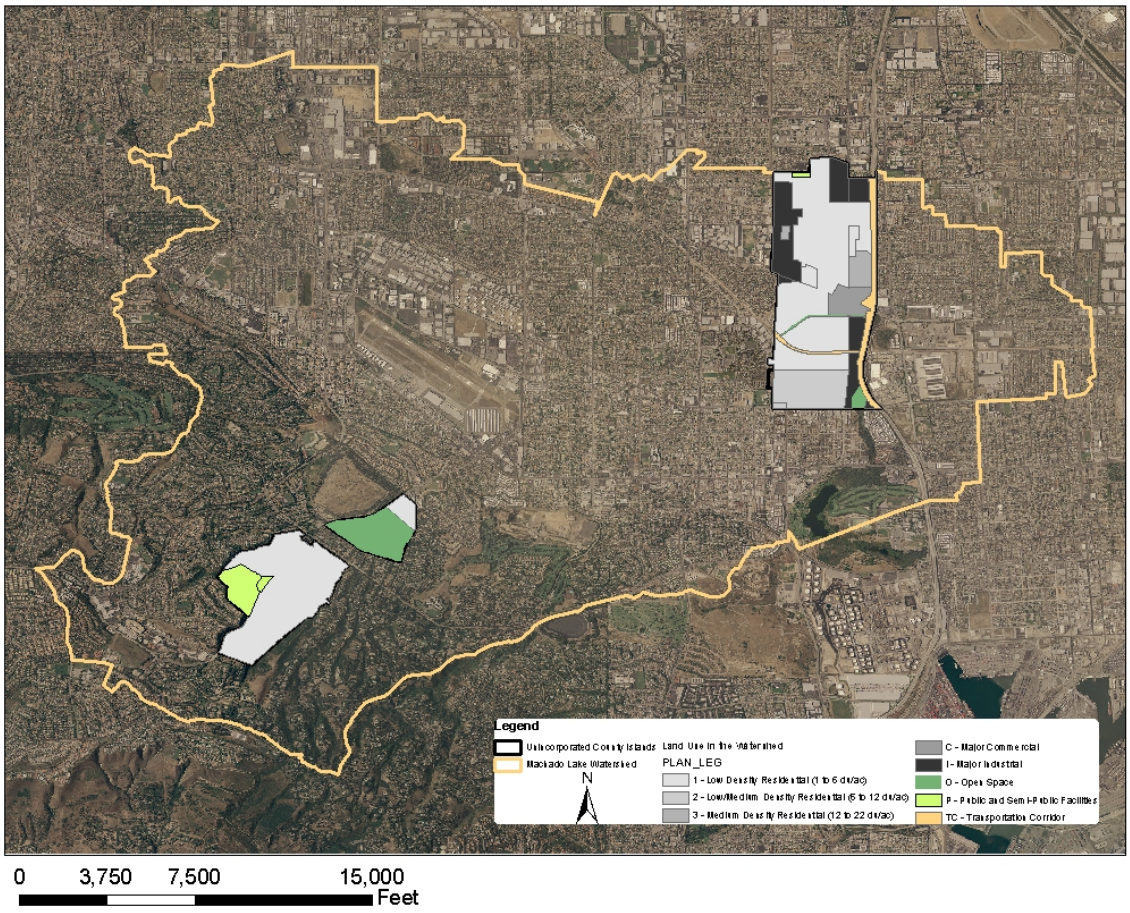


Figure 9: Zoning of County Islands in Machado Lake Watershed.

As noted, potential future projects are contingent upon the availability of funding. The availability of Planning and Implementation Grants and Stormwater Flood Management Grants administered by DWR through Proposition 84 and Proposition 1E offers the possibility of future funding for projects that provide multiple water resource benefits. These grants are intended for projects that are ready or nearly ready to be implemented.

Projects intended to meet TMDL requirements that also provide water supply, groundwater recharge, and storage and reuse capability may be eligible for Proposition 84 Implementation

Grants. IRWMP projects must assist agencies in meeting the long-term water needs of the State, including the delivery of safe drinking water and the protection of water quality and the environment.

Projects designed to manage stormwater runoff to reduce flooding may be eligible for Stormwater Flood Management Grants under Proposition 1E. In addition to flood control, such projects may yield additional benefits such as groundwater recharge, water quality improvements, ecosystem restoration, and reduction of in-stream erosion and sedimentation.

5.3.3 Structural BMPs on Private Land

Although centralized BMP projects are useful in reducing pollutant loads, it is not likely that doing such projects in public lands only will be sufficient to provide the full pollutant load reductions necessary to meet the WLAs for the entire County TMDL Implementation Area. According to the available modeling estimates, there is currently not enough suitable public land available to build centralized BMPs to treat the drainage area required. As a result, strategic acquisition of private land may be necessary to provide the space needed to site the BMPs. Acquisition is a difficult process limited by available funding, sellers willing to negotiate reasonable prices, logistically acceptable locations, site conditions that do not have pre-existing conditions or other environmental limitations (i.e. soil contamination), land zoning that allow for such projects, and communities accepting of having such a project in their neighborhood.

Accordingly, this TMDL Implementation Plan does not specify which privately owned parcels may be targeted for acquisition. The necessary capacity of centralized BMPs on private land within the County TMDL Implementation Area was determined by evaluating structural and nonstructural BMPs and estimating associated pollutant load reductions and costs. BMPs were assumed to represent a combination of multiple infiltration basins and dry detention basins. As funding and private properties become available, a strategic land acquisition program may be developed and implemented to assist in achieving phased load reductions to meet WLAs. Descriptions of treatment processes for infiltration basins and dry detention basins were provided in the discussions for the centralized BMPs.

5.4 SITE OPPORTUNITIES FOR STRUCTURAL SOLUTIONS

A field reconnaissance of the County Islands was conducted in August 2011. The purpose of this reconnaissance was to identify stormwater retrofit opportunities that can provide stormwater quality treatment where none currently exists. Numerous sites were visited and considered for structural BMPs. This list was narrowed down to a subset of top opportunities based on feasibility and the amount of drainage area treated. Conceptual designs are provided below, along with construction cost estimates. Given the hypothetical nature of this analysis, the intention is not to identify the exact solution, but to provide examples of potential solutions for meeting TMDL WLAs. The conceptual designs utilize the 0.75-inch storm event as the water quality design storm. This is consistent with allowable design storm options as outlined in the LA County MS4 Permit (Order No. 01-182) and SUSMP Manual (LACDPW, 2002). The sites containing top opportunities are:

- South Coast Botanical Gardens Parking Lot
- Existing Open Space
- Commercial Parking Lots

5.4.1 Conceptual Design of the South Coast Botanical Gardens

5.4.1.1 Botanical Gardens Site Overview

The South Coast Botanical Gardens is publicly-owned land that is located at 26300 Crenshaw Boulevard in County Island 2. The Botanical Garden makes up approximately 78% of County Island 2. The Gardens are also the largest available publicly-owned area within the County Islands.

The South Coast Botanical Gardens occupy parcel APN 7548-010-907. The property includes a parking lot, visitor's center, and landscaped grounds. Two views of the parking lot are presented in **Figure 10**. Limited storm drain and topographic information makes determining an exact drainage area difficult, but an estimated 1.33 acres of the parking lot could be retrofitted with vegetated swales and porous pavement. The parking lot for the South Coast Botanical Gardens is displayed in **Figure 11**.

Figure 10: Parking Lot at the South Coast Botanical Gardens

Figure 11: Site Overview Map with South Coast Botanical Gardens Botanical Gardens Conceptual Design.

This subsection presents the conceptual design of the BMPs best suited for implementation at the South Coast Botanical Gardens. A vegetated swale and the installation of porous pavement are well suited to the site conditions and are the recommended BMPs for several reasons:

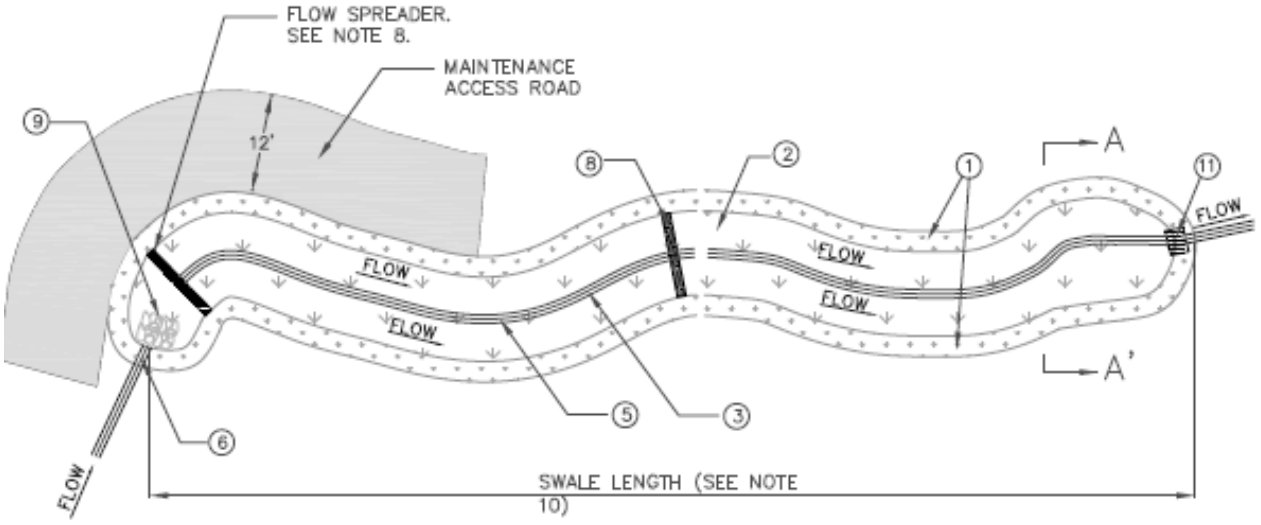
- Vegetated swales and porous pavement are effective at removing nutrients and toxics.
- Though infiltration basins and constructed wetlands are also effective at removing nutrients and toxics, the clayey soils located within County Island 3 are not suitable for infiltration BMPs. Space is not available to accommodate a constructed wetland.
- With proper plant selection, vegetated swales can also enhance site aesthetics and have relatively low maintenance requirements.

- Vegetated swales are typically long linear BMPs that provide both conveyance and water quality treatment. This BMP would be well suited to capture runoff along the edge of the parking lot.
- Porous pavement provides parking spaces and stormwater treatment in the same area (i.e., it takes up no additional space).

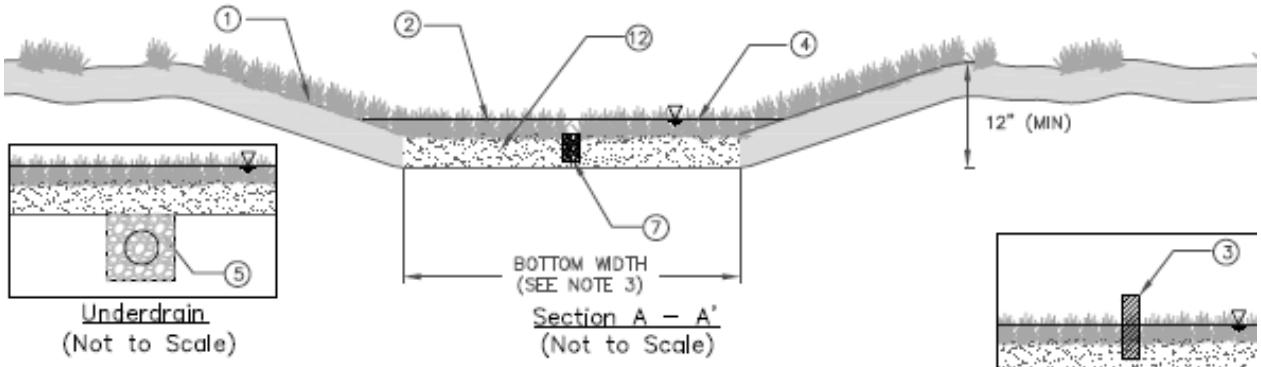
The majority of the parking lot drains to the edge of a steep slope where runoff is collected by three concrete slope drains which convey it down the slope to a concrete channel. There is room along the edge of the parking lot to construct a vegetated swale to intercept and treat runoff prior to being discharged to this channel. Some of the existing landscaping will need to be removed to accommodate the swale. The vegetated swale should be landscaped to complement and enhance existing onsite landscaping. Curbing can be installed on the parking lot side of the swale to prevent (automotive) tire damage, with strategic curb cuts to allow stormwater runoff to sheet-flow into the swale. To prevent short-circuiting, curb cuts should not be placed directly across from storm drain inlets. Due to the low infiltration rate of native soils, the swale should be installed with an underdrain (**Figure 12**). The vegetated swale dimensions are approximately 15' x 45'. The design specifications of the vegetated swale should adhere to the guidance provided within the County's *Stormwater Best Management Practice Design and Maintenance Manual for Publicly Maintained Storm Drain Systems*. See **Table 23** for additional design information.

The western side of the parking lot appears to be primarily used for overflow parking and drains to the northern end of the property. The asphalt could be replaced with porous pavement which would provide treatment for this portion of the parking lot without taking up space. Due to the low infiltration rate of native soils, the porous pavement should be installed with an underdrain (**Figure 13**). As the parking lot is located on a former landfill, a geotechnical investigation and further analysis will be required to assess the suitability of this BMP. The treatment capacity of porous pavement is in a 1:1 ratio (by area) of the impervious area treated, so the area is equal to the western portion of the parking lot (an estimated 0.33 acres). Guidance on the design of porous pavement can be found in the County of Los Angeles' *Low Impact Development Standards Manual* (2009). See **Table 23** for additional design information.

Harvesting and use of rainwater from the visitor center is also an option that will be explored.



Plan View
(Not to Scale)



Underdrain
(Not to Scale)

Section A – A'
(Not to Scale)

Swale Divider
(Not to Scale)

NOTES:

1. VEGETATED SIDE SLOPES AT 2H:1V MAXIMUM SLOPE. MOWED TURF SWALES AT 3H:1V MAXIMUM.
2. GRASS HEIGHT SHALL BE 4" – 6" HIGH.
3. SWALE DIVIDER REQUIRED FOR BOTTOM WIDTHS > 10'. MINIMUM REQUIRED BOTTOM WIDTH IS 2' EXCLUDING WIDTH OF LOW FLOW CHANNEL. MAXIMUM BOTTOM WIDTH WITH DIVIDER IS 16'.
4. DEPTH OF FLOW FOR WATER QUALITY TREATMENT MUST NOT EXCEED TWO–THIRDS OF THE GRASS HEIGHT AND NOT GREATER THAN 4" (INFREQUENTLY MOWED) OR 2" (FREQUENTLY MOWED).
5. 6" PERFORATED UNDERDRAIN IN 9" DEEP COARSE AGGREGATE BED CONNECTED TO STORM DRAIN. REQUIRED FOR SLOPES < 1.5% OR AS NEEDED.
6. INLET PIPE WITH INLET PROTECTION.
7. IF NO UNDERDRAIN, LOW FLOW DRAIN SHALL EXTEND ENTIRE LENGTH OF SWALE AND SHALL HAVE A DEPTH OF 6" MINIMUM AND WIDTH NO MORE THAN 5% SWALE BOTTOM WIDTH. ANCHORED PLATE FLOW SPREADER IF USED, SHALL HAVE V–NOTCHES (MAX TOP WIDTH = 5% OF SWALE WIDTH) OR HOLES TO ALLOW PREFERENTIAL EXIT OF LOW FLOWS.
8. INSTALL CHECK DAMS OR GRADE CONTROL STRUCTURES FOR SLOPES > 6% AT 50' MAXIMUM SPACING TO ACHIEVE A MAXIMUM EFFECTIVE LONGITUDINAL SLOPE OF 6%. FLOW SPREADERS SHALL BE PROVIDED AT INLET AND AT THE BASE OF EACH CHECK DAM SEE FIGURE 3–2.
9. INSTALL ENERGY DISSIPATOR AT THE INLET OF VEGETATED SWALE.
10. SWALE LENGTH SHALL BE 100' OR LENGTH REQUIRED TO PROVIDE 10 MINUTES RESIDENCE TIME, WHICH EVER IS GREATER.
11. INSTALL APPROPRIATE OUTLET STRUCTURE. ACCOMODATE LOW FLOW CHANNEL AND/OR UNDERDRAIN (IF PRESENT).
12. AMEND SOILS WITH 2" OF COMPOST TILLED INTO 6" OF NATIVE SOIL UNLESS NATIVE SOIL ORGANIC CONTENT > 10%

Figure 12: Vegetated Swale Schematic (Source: LA County DPW, 2009)

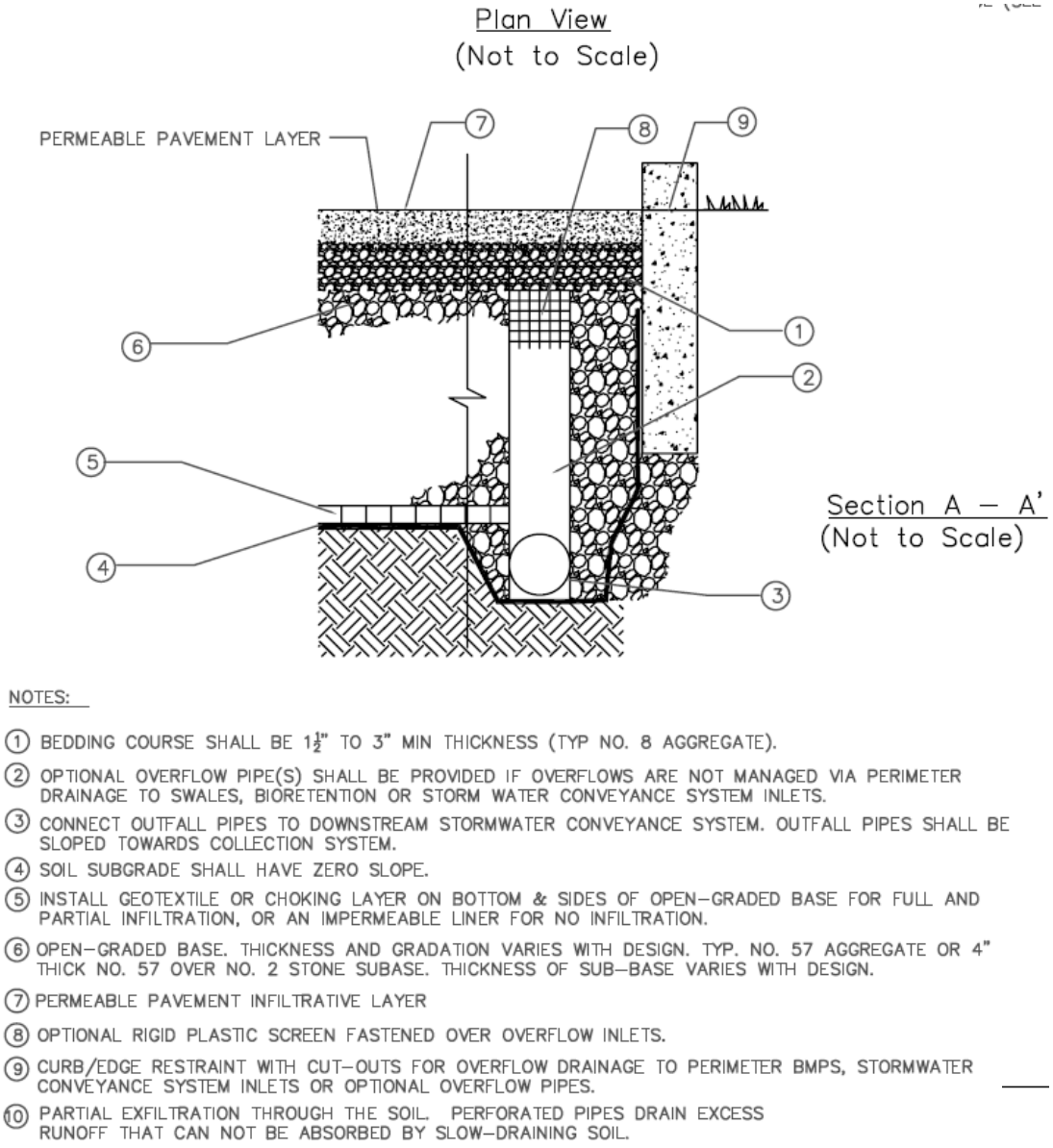


Figure 13: Porous Pavement Schematic (Source: Ventura 2011 TGM)

Table 23: Estimated Design Information for the South Coast Botanical Gardens

Design Information	Vegetated Swale Amount	Porous Pavement Amount
Drainage Area	1 ac	0.33 ac
Proposed BMP Surface Area	0.04 ac	0.33 ac
Water Quality Volume	0.06 ac-ft	0.02 ac-ft
Volume Provided	0.06 ac-ft	0.02 ac-ft

5.4.1.2 Botanical Gardens Implementation Cost

The cost of implementing the proposed vegetated swale and porous pavement for the South Coast Botanical Gardens is $595,000 (includes construction, design, engineering, permitting, and O&M costs for 10 years) (Source CWP, 2006; updated to 2011 dollars using ENR Cost Construction Index).

5.4.2 Conceptual Design for Existing Open Space

5.4.2.1 Open Space Site Overview

Existing open spaces provide potential opportunities for implementing structural solutions. A typical open space area might consist of approximately 1.5 acres of an undeveloped area. Although utility conflicts, grading, drainage area served, and size would be site specific, an ideal retrofit scenario would be to divert flow from an adjacent existing storm drain system to the site. It is estimated that runoff from approximately 28 acres of County Island 3 could be treated by retrofitting 1.5 acres of existing open space.

Figure 14: Retrofit Opportunity at an Open Space Area in County Island 3

5.4.2.2 Open Space Conceptual Design

This subsection presents the conceptual design of the recommended BMP, bioretention. Bioretention is best suited for existing open space areas for several reasons:

- Bioretention is effective at removing nutrients, suspended solids, and the associated toxics.
- Though infiltration basins and constructed wetlands are also effective at removing nutrients and toxics, the clayey soils located within County Island 3 are not suitable for infiltration BMPs. Constructed wetlands may not be well suited to dense residential areas due to homeowner safety concerns about standing water and mosquitoes.
- With proper plant selection, bioretention areas can also enhance site aesthetics and have relatively low maintenance requirements.

A diversion pipe will have to be constructed to divert stormwater flows from existing storm drain infrastructure to the site. Further investigation is needed to determine whether or not a pump station would be necessary. The bioretention area could be constructed to fill the lot, in order to provide as much treatment as possible. The inlet to the bioretention area should be stabilized to ensure that incoming flows do not create erosion problems within the BMP. Filtered runoff will be collected by an underdrain system and returned to the storm drain system. Flow-through bioretention areas consist of a shallow ponding area, mulch cover, engineered soil media, and gravel with an embedded, perforated underdrain pipe (**Figure 15**). The dimensions of the bioretention area are estimated to be 185' x 250'.

To enhance the nutrient removal effectiveness of bioretention areas, two design features are recommended:

- To prevent the export of phosphorus, select an engineered soil media with a low P-index (a P-index between 10 – 30 is recommended).
- To enhance nitrogen removal, elevate the underdrain from the bottom of the facility to 6 inches within the gravel blanket, to create a fluctuating anaerobic/aerobic zone below the drain pipe.

The design specifications of the bioretention area should adhere to the guidance provided within the County's *Stormwater Best Management Practice Design and Maintenance Manual for Publicly Maintained Storm Drain Systems*. See **Table 24** for additional design information.

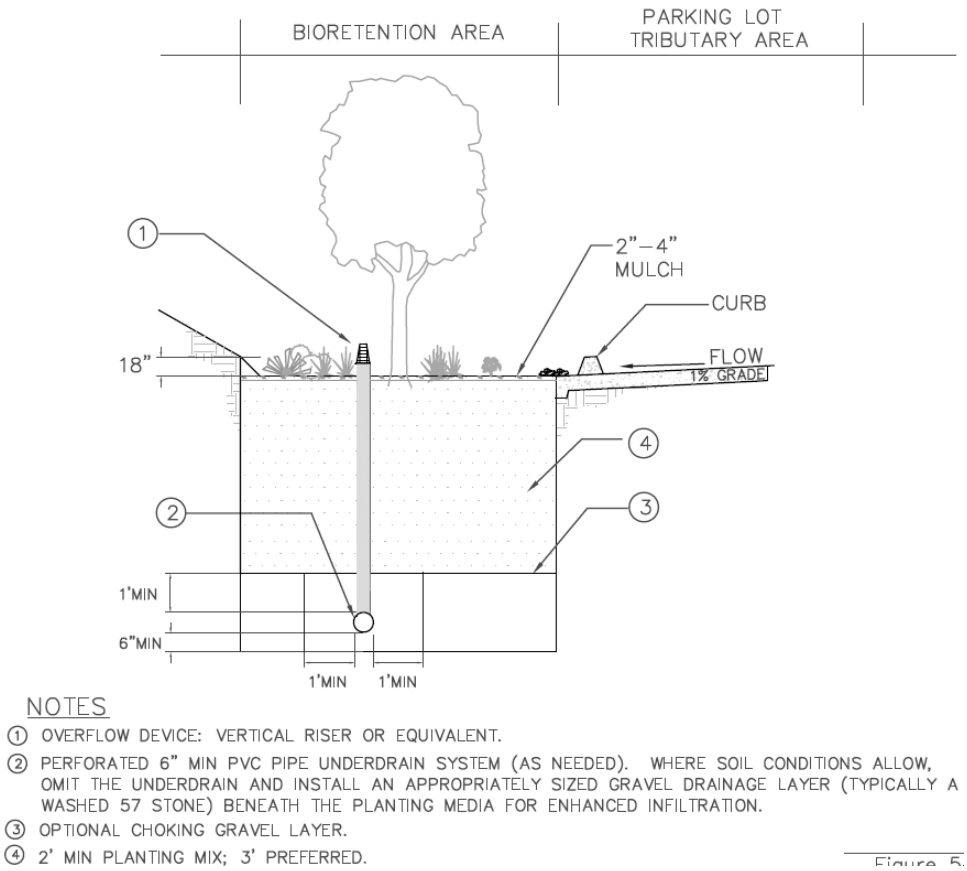


Figure 15: Bioretention Schematic (Source: LA County DPW, 2009)

Table 24: Bioretention Area Estimated Design Information for an Existing Open Space Area

Design Information	Amount
Drainage Area	28 ac
Proposed BMP Surface Area	1.06 ac
Water Quality Volume	1.43 ac-ft
Volume Provided	1.59 ac-ft

5.4.2.3 Open Space Implementation Cost

The base construction cost of implementing a proposed bioretention area in an existing open space is $4,570,000 (includes construction, O&M for 10 years and design, engineering and permitting costs; does not include pump station or land acquisition-related expenses) (Source CWP, 2006; updated to 2011 dollars using ENR Cost Construction Index).

5.4.3 Conceptual Design for a Commercial Parking Lot Retrofit – Option 1

5.4.3.1 Commercial Option 1 Site Overview

County Island 3 includes commercial areas characterized by heavy traffic due to the volume of cars handled by Vermont Avenue, Sepulveda Road, and the 110 Freeway. Large parking lots are prevalent and present opportunities for retrofit. A typical site might be around 8 acres in size, including a commercial building rooftop and surrounding parking lot (**Figure 16**). Onsite storm drains connecting to the public storm drains in the adjacent streets are not uncommon (**Figure 17**). A recycling center, including dumpsters and trash bins, may be present, and activities at the center may be a source of pollutants to the storm drain. Limited storm drain and topographic information makes determining an exact drainage area difficult, but an estimated 2 acres of property could be treated through the installation of two bioretention areas that tie in with the two aforementioned storm drains.

Figure 16: Typical Retrofit Opportunity at a Commercial Area in County Island 3

Figure 17: Typical On-site Storm Drains Located on a Commercial Property

5.4.3.2 Commercial Option 1 Conceptual Design

This subsection presents the conceptual design of the recommended BMP, bioretention. Bioretention is best suited for commercial areas for several reasons:

- Bioretention is effective at removing nutrients and toxics.
- Though infiltration basins and constructed wetlands are also effective at removing nutrients and toxics, the clayey soils located within County Island 3 are not suitable for infiltration BMPs. Constructed wetlands may not be compatible with surrounding land uses.
- Porous pavement is an option for parking lots, but may not be appropriate for all commercial areas due to high traffic volumes and customer use during weekdays (i.e., the BMP should not disrupt customer access to stores). Porous pavement should be seriously considered if the site is redeveloped or if significant physical improvements are planned for the site.
- With proper plant selection, bioretention areas can also enhance site aesthetics and have relatively low maintenance requirements.

The bioretention areas can be constructed to tie in with the existing storm drain, which would be provided with raised storm drain inlets to facilitate ponding within the facility and convey overflow. The bioretention area in the southern portion of the lot will take up some of the existing travel lane space. A typical site might implement two bioretention areas in under-utilized areas of the parking lot with dimensions around 7’ x 100’ and 19’ x 40’, respectively.

To enhance the nutrient removal effectiveness of bioretention areas two design features are recommended:

- To prevent the export of phosphorus, select an engineered soil media with a low P-index (a P-index between 10 – 30 is recommended).

- To enhance nitrogen removal, elevate the underdrain from the bottom of the facility to 6 inches within the gravel blanket to create a fluctuating anaerobic/aerobic zone below the drain pipe.

Due to the low infiltration rate of native soils, bioretention areas should be installed with underdrains. Underdrains should tie in with the existing onsite storm drain infrastructure. The design specifications of the bioretention area should adhere to the guidance provided within the County's *Stormwater Best Management Practice Design and Maintenance Manual for Publicly Maintained Storm Drain Systems*. See **Table 25** for additional design information.

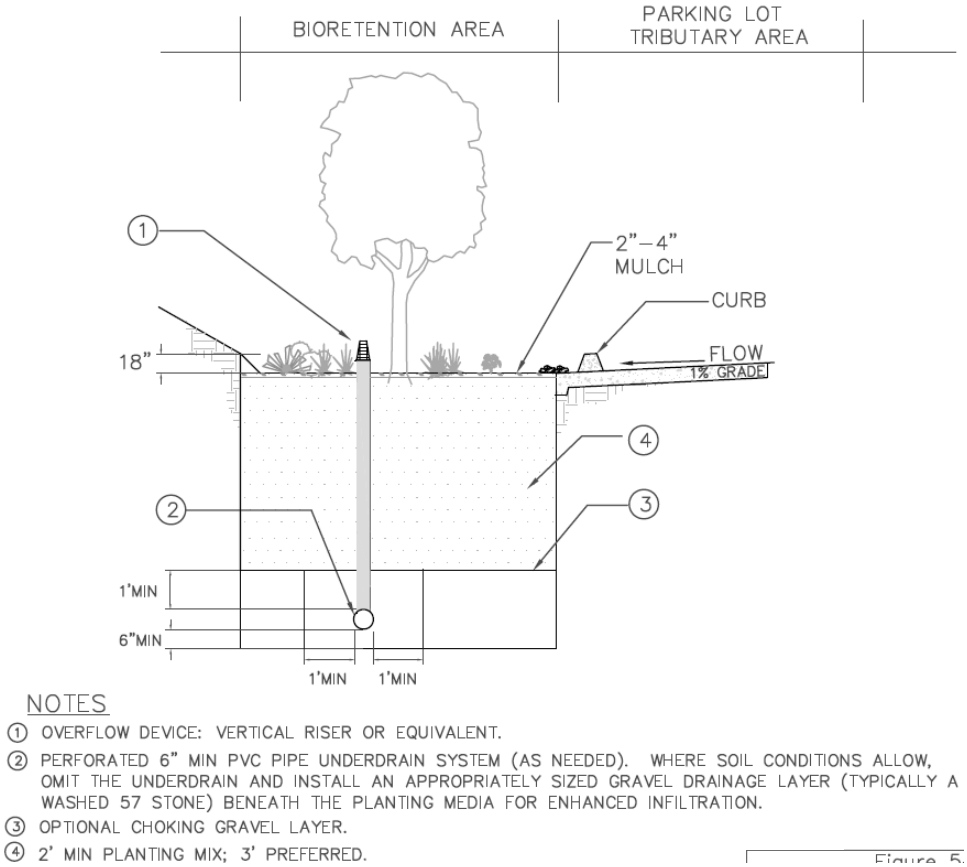


Figure 18: Bioretention Schematic (Source: LA County DPW, 2009)

Table 25: Bioretention Area Estimated Design Information for a Commercial Parking an existing open space area Retrofit

Design Information	Bioretention 1 Area Amount	Bioretention 2 Area Amount
Drainage Area	0.9 ac	0.72 ac
Proposed BMP Surface Area	0.02 ac	0.02 ac
Water Quality Volume	0.05 ac-ft	0.04 ac-ft
Volume Provided	0.02 ac-ft	0.03 ac-ft

5.4.3.3 Implementation Cost

The base construction cost of implementing the a proposed bioretention areas for commercial parking lots in an existing open space area is $145,000 (includes O&M, and design, engineering and permitting costs; does not include land acquisition expenses) (Source CWP, 2006; updated to 2011 dollars using ENR Cost Construction Index).

5.4.4 Conceptual Design for a Commercial Parking Lot Retrofit – Option 2

5.4.4.1 Commercial Option 2 Site Overview

A typical commercial site in County Island 3 may cover around 8 acres and is commonly dominated by retail store rooftops and a surrounding parking lot. Existing grading and site conditions can significantly limit reasonable onsite retrofit opportunities. Significant alterations to the current parking lot layouts may be needed to create space for a substantial amount of water quality treatment and would probably require the removal of a significant number of parking spaces. The opportunities presented here were selected to present minimal disruption to current site layout and conditions. An estimated 0.75 acres of typical commercial property could be treated through the installation of bioretention areas in landscaped islands and a perimeter sand filter (**Figure 19).** Conversion of other landscaped islands may be feasible depending on the current grading of the parking lot (i.e., grading would not necessarily lead stormwater runoff to the location of all existing landscaped islands).

Figure 19: Retrofit Opportunity in Commercial Parking Lot within County Island 3

5.4.4.2 Commercial Option 2 Conceptual Design

This subsection presents the conceptual design of the BMPs best suited for implementation at a County Island 3 commercial area. Bioretention areas and a perimeter sand filter (also known as underground sand filter or Delaware linear sand filter) are the recommended BMPs for several reasons:

- Bioretention areas and sand filters are moderately to highly effective at removing nutrients and toxics.
- Though infiltration basin and constructed wetlands are also effective at removing nutrients and toxics, the clayey soils located within County Island 3 are not suitable for infiltration BMPs. Constructed wetlands may not be compatible with surrounding land uses.
- Porous pavement is an option for parking lots, but it was not selected due to the fairly high traffic volumes and customer use during weekdays (i.e., the BMP should not disrupt customer access to stores). Porous pavement should be seriously considered if the site is redeveloped or if significant physical improvements are planned for the site.
- With proper plant selection, bioretention areas can also enhance site aesthetics and have relatively low maintenance requirements.
- Perimeter sand filters are built underground and thus can be implemented in areas with space constraints and traffic accommodation needs.

Existing landscaped islands in parking lots can be modified as bioretention areas designed to accept runoff from up-slope parking spaces. For example, four existing landscape islands, each with a dimension of 10'x35', could be converted for stormwater quality treatment. Depending on

topography, drainage and grading, the conversion of additional landscaped islands may be feasible.

To enhance the nutrient removal effectiveness of bioretention areas, two design features are recommended:

- To prevent the export of phosphorus, select an engineered soil media with a low P-index (a P-index between 10 – 30 is recommended).
- To enhance nitrogen removal, elevate the underdrain from the bottom of the facility to 6 inches within the gravel blanket to create a fluctuating anaerobic/aerobic zone below the drain pipe.

In areas with limited space, a perimeter sand filter can be constructed to tie in with the existing storm drain and provide treatment for parking lot and rooftop runoff while maintaining the integrity of the parking areas. The dimensions of a perimeter sand filter in a typical commercial area are estimated to be 13' x 140'.

Perimeter sand filters generally consist of two underground chambers. The first chamber promotes settling while the second is a filter bed that usually consists of sand or an organic filtering media. Flow enters the first chamber through grates that are usually located at the edge of a parking lot. Once stormwater runoff filters through the second chamber it is collected in an underdrain and returned back to the storm drain system A schematic of the system is presented in **Figure 20**.

Due to the low infiltration rate of native soils, the bioretention areas and the perimeter sand filter should be installed with underdrains. The design specifications of the bioretention area should adhere to the guidance provided within the County's *Stormwater Best Management Practice Design and Maintenance Manual for Publicly Maintained Storm Drain Systems*. See **Table 26** for additional design information.

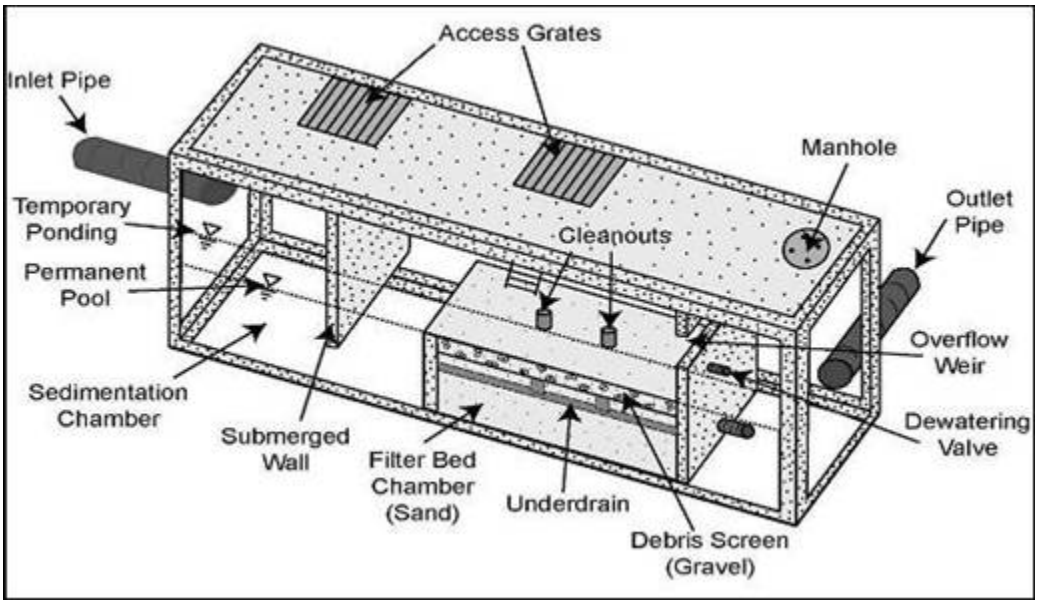


Figure 20: Perimeter Sand Filter Schematic (Source: CWP, 2006)

Table 26: BMP Estimated Design Information for a Commercial Center

Design Information	Bioretention Areas	Perimeter Sand Filter
Drainage Area	0.51 ac	0.27 ac
Proposed BMP Surface Area	0.03 ac	0.04 ac
Water Quality Volume	0.03 ac-ft	0.02 ac-ft
Volume Provided	0.04 ac-ft	0.09 ac-ft

5.4.4.3 Commercial Option 2 Implementation Cost

The base construction cost of implementing the proposed bioretention areas and perimeter sand filter for this concept is $1,280,000 (includes O&M, and design, engineering and permitting costs; does not reflect land acquisition expenses) (Source CWP, 2006; updated to 2011 dollars using ENR Cost Construction Index).

5.4.5 Conceptual Design for a Commercial Parking Lot Retrofit – Option 3

5.4.5.1 Commercial Option 3 Site Overview

Option 3 illustrates a retrofit concept in a commercial/office park setting that treats approximately 3.5 acres. This concept includes a typical multi-story office setting in County Island 3. The office building roof drains are either directed to landscaping or to the parking lot, as called out in **Figure 21**. Roof drains currently directed to the parking lot would be redirected to adjacent landscaped areas (**Figure 22**).

Limited storm drain and topographic information makes determining an exact drainage area difficult, but an estimated 0.8 acres of property could be treated through the conversion of a parking lot landscape island into a bioretention area.

Figure 21: Retrofit Opportunity at Office Park

Figure 22: Roof drains drain directed to parking lot (right); drain directed to landscaping (left)

5.4.5.2 Commercial Option 3 Conceptual Design

This subsection presents the conceptual design of the recommended BMP, bioretention. Bioretention is best suited for the office park setting for several reasons:

- Bioretention is effective at removing nutrients and toxics.
- Though infiltration basin and constructed wetlands are also effective at removing nutrients and toxics, the clayey soils located within County Island 3 are not suitable for infiltration BMPs. Constructed wetlands may not be compatible with surrounding land uses.
- Porous pavement is an option for parking lots, but it was not selected due to the fairly high traffic volumes and customer use during weekdays (i.e., the BMP should not disrupt customer access to stores). Porous pavement should be seriously considered if the site is redeveloped or if significant physical improvements are planned for the site.
- With proper plant selection, bioretention areas can also enhance site aesthetics and have relatively low maintenance requirements.

Large landscaped islands can be converted into bioretention areas designed to accept runoff. A few parking spaces may need to be removed to maximize the water quality treatment benefits of the bioretention area. The bioretention concept is proposed as a "T" shape, with the top dimensions approximately 15' x 45' and longer portion approximately 10' x 100'.

To enhance the nutrient removal effectiveness of the bioretention area, two design features are recommended:

- To prevent the export of phosphorus, select an engineered soil media with a low P-index (a P-index between 10 – 30 is recommended).
- To enhance nitrogen removal, elevate the underdrain from the bottom of the facility to 6 inches within the gravel blanket to create a fluctuating anaerobic/aerobic zone below the drain pipe.

Due to the low infiltration rate of native soils, the bioretention area should be installed with an underdrain. The design specifications of the bioretention area should adhere to the guidance provided within the County's *Stormwater Best Management Practice Design and Maintenance Manual for Publicly Maintained Storm Drain Systems*. See **Table 27** for additional design information.

Table 27: Bioretention Areas Estimated Design Information

Design Information	Amount
Drainage Area	0.8 ac
Proposed BMP Surface Area	0.04 ac
Water Quality Volume	0.04 ac-ft
Volume Provided	0.04 ac-ft

5.4.5.3 Commercial Option 3 Implementation Cost

The base construction cost of implementing the proposed bioretention area is $125,000 (includes O&M and design, engineering and permitting costs; does not include land acquisition expenses) (Source CWP, 2006; updated to 2011 dollars using ENR Cost Construction Index).

5.4.6 Additional Retrofit Opportunities

Additional, smaller retrofit opportunities exist throughout the County Islands. These opportunities include retrofitting cul-de-sacs with bioretention center islands, Filterra Tree Box units (or similar product) next to storm drain inlets, and catch basin inserts where space constraints prevent the use of other types of BMPs. These opportunities are summarized below and in **Table 28** and **Figure 23**.

- Cul-de-Sac Retrofits: large cul-de-sac bulbs can be retrofitted to receive and treat stormwater runoff via bioretention areas in newly created center islands.
- Filterra Tree Box Units: Many of the storm drain inlets located throughout the County Islands are located next to grassy areas (primarily in residential areas) where a Filterra Tree Box unit could be installed to intercept a portion of the runoff before it enters the storm drain system.
- Catch Basin Inserts: Due to the highly compact and urban nature of County Island 3, limited space is available for the installation of BMPs. Catch Basin inserts should be utilized to provide some level of water quality treatment if no other options exist.

The locations of additional BMPs may be based on the five proposed conceptual designs discussed above, with additional consideration of the monitoring data collected and reevaluation of the Nutrient TMDL. Available funding will determine the ultimate location, type, and timing of BMP installation in the County Islands. The Quantification Analysis provides details about the types and quantities of additional structural BMPs that may be implemented in the County Islands, provided funding is available to do so.

Table 28: Estimated Design Information for Additional Retrofit Opportunities

Retrofit Opportunity	Drainage Area (ac)	Proposed BMP Surface Area (ac)	Water Quality Volume (ac-ft)	Volume Provided (ac-ft)
County Island 1				
Cul-de-Sac Retrofits	0.1	0.01	0.004	0.008
Filterra Tree Box Units	0.2	0.001	0.01	0.001
Catch Basin Inserts	0.5	n/a	n/a	n/a
County Island 3				
Cul-de-Sac Retrofits	0.2	0.016	0.01	0.02
Filterra Tree Box Units	2.2	0.018	0.11	0.03
Catch Basin Inserts	3	n/a	n/a	n/a

Figure 23: Additional Retrofit Opportunities (Clockwise from top left: a) large cul-de-sacs; b) space constrained scenarios where catch basin inserts may be appropriate; c) space for Filterra units next to storm drain inlets

5.5 REGULATORY REQUIREMENTS AND ENVIRONMENTAL PERMITS

Consultation with regulatory agencies and the acquisition of permits is required before project components can be constructed. The following sections summarize regulatory permits and approvals relevant to the implementation of the Water Quality Enhancement Projects in the Machado Lake watershed.

5.5.1 Environmental Assessment

In accordance with the California Environmental Quality Act (CEQA), local agencies are required to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. Every development project that requires discretionary governmental approval will require at least some environmental review pursuant to CEQA, unless an exemption applies. The Water Quality Enhancement Projects discussed in the previous section will likely require the preparation of a Negative Declaration.

5.5.2 U.S. Army Corps of Engineers

Section 404 of the Federal Clean Water Act regulates the discharge of dredged, excavated, or fill material in wetlands, streams, rivers, and other waters of the United States. The U.S. Army Corps of Engineers (USACE) is the federal agency authorized to enforce Section 404 and issue permits for certain authorized activities conducted in these waters. Based on the proposed area for the projects, it is unlikely that a Section 404 permit will be required. If required and jurisdictional, Section 404 permitting could potentially be completed under the nationwide permit program. Coverage under the nationwide program can be authorized within three to four months from the time the permit application is deemed complete.

5.5.3 U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS), Department of the Interior, is responsible for administering the Federal Endangered Species Act, which prohibits activities affecting threatened and endangered species unless authorized by a permit from the USFWS. The Endangered Species Program is charged with issuing permits for activities that could potentially affect native endangered or threatened species, including Incidental Take Permits associated with Habitat Conservation plans. The USACE will consult with USFWS regarding endangered species issues as part of the Section 404 process. A biological resources report for the project site may be required as part of the permit application package to the USACE.

5.5.4 California Department of Fish and Game

The regulatory functions of the California Department of Fish and Game (CDFG) include the review of CEQA documents as a responsible agency. In addition, CDFG issues streambed or lakebed alteration agreements for projects with impacts to waters of the State, issues permits for take of threatened and endangered species for authorized activities, approves and permits the take of birds, mammals, reptiles, amphibians, non-game fish, and plants for scientific or educational purposes, and the take of threatened, endangered, or candidate species for management purposes. The Water Quality Enhancement Projects may require a CDFG Code Section 1602 Streambed Alteration Agreement.

5.5.5 State Water Resources Control Board

Construction activities disturbing one or more acres must obtain coverage under the NPDES General Permit for Discharges of Stormwater Associated with Construction Activity Water Quality Order No. 2009-0009-DWQ (Construction General Permit, or CGP). Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling or excavation. To obtain coverage under the CGP, the County will designate a Legally Responsible Person to electronically file Permit Registration Documents (PRDs) with the SWRCB. PRDs include a Notice of Intent, Risk Assessment, Site Map, Stormwater Pollution Prevention Plan (SWPPP), annual fee, and certification. A project-specific SWPPP will need to be developed and implemented to reduce polluted discharges from entering the storm drain system and local receiving waters during construction activities. The CGP requires all permitted dischargers to develop and implement a SWPPP that:

- Identifies all pollutant sources including sources of sediment that may affect the quality of stormwater discharges associated with construction activity from the construction site.

- Identifies and eliminates non-stormwater discharges.
- Specifies BMPs to reduce or eliminate pollutants in stormwater and authorized non-stormwater discharges from the site during construction.
- Incorporates BMP inspection and maintenance routines.
- Identifies a sampling and analysis strategy and sampling schedule for discharges that have been discovered through visual monitoring to be potentially contaminated by pollutants not visually detectable in runoff.

The County or construction contractor will need a Qualified SWPPP Developer (QSD) to prepare the SWPPP, and then a Qualified SWPPP Practitioner (QSP) will need to implement the plan during construction. The SWPPP must address the use of appropriately selected, correctly installed, and properly maintained pollution control BMPs.

5.5.6 Regional Water Quality Control Board, Los Angeles Region

Under Section 401 of the Clean Water Act, applicants for Section 404 Permits must first obtain a Water Quality Certification documenting that the proposed activity will comply with state water quality standards. If the project is determined to be under USACE jurisdiction, a Section 401 Water Quality Certification will be required for the project.

If the project is not under USACE jurisdiction, the Regional Water Quality Control Board for the Los Angeles Region (LARWQCB) may require coverage under Waste Discharge Requirements instead. Protection of beneficial uses during construction and operation are key issues. Construction dewatering may be necessary because of high groundwater. Dewatering activities will require coverage under the General NPDES Permit and Waste Discharge Requirements of Discharges from Construction and Project Dewatering to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties. To obtain permit coverage, a Report of Waste Discharge and application must be filed with LARWCQB at least 30 days prior to discharge.

Even though the installation of Water Quality Enhancement Projects is generally encouraged by the LARWQCB, concerns may be raised with the potential of projects using on-site infiltration of stormwater to affect the water quality of the underlying groundwater. Prior to implementing projects such as infiltration basins/trenches, flow through planters, porous pavement, etc., the County would need to conduct a technical analysis evaluating the possibility of groundwater impacts. The analysis will determine the depth to groundwater, its designated beneficial uses, and the historical uses of the site. There are cases where projects may be infeasible – if the depth to groundwater is less than 5 feet from the surface, if drinking water wells are present within 100 feet of the proposed infiltration site, or if the site is a brownfield with potential pollutant mobilization through the soil, etc. Consultation with LARWQCB staff is recommended.

5.5.7 South Coast Air Quality Management District

Construction activities in the South Coast Air Basin are subject to South Coast Air Quality Management District's (SCAQMD) Rule 403. Rule 403 sets requirements to reasonably regulate operations that periodically may cause fugitive dust emissions into the atmosphere by requiring actions to prevent, reduce, or mitigate fugitive dust emissions. The construction contractor will need to implement dust control measures during project construction.

6 Quantification Analysis

The quantification analysis for the Nutrient and Toxics TMDLs uses an integrated approach, considering reductions for both classes of pollutants.

The quantification analysis uses the identified suite of structural and nonstructural projects discussed in Sections 4 and 5 to determine the set of actions that will most likely be implemented in an effort to achieve the TMDL requirements. The analysis is a demonstration of how the identified projects may achieve the compliance. As the implementation is an adaptive management process, the precise suite of actions and the timing may be changed to use resources more cost effectively. The adaptive management approach will allow changes in the type and quantity of structural and nonstructural BMPs to ensure cost effective measures are being implemented. Flexibility in the schedule and makeup of the Implementation Plan are key to adaptive management.

The quantification analysis is based on the reductions from both nonstructural and structural BMPs that work together to reduce the concentration and load of constituents. Generally nonstructural BMPs consist of pollution prevention activities and source control activities that reduce the amount of the constituent entering the MS4 system, ultimately reducing the concentration in stormwater. Nonstructural activities also encourage the effective use of water, aiming to reduce dry-weather flows. In this way, nonstructural activities reduce the constituent load entering structural BMPs located downstream of the sources.

6.1 WATERSHED MANAGEMENT MODELING SYSTEM

6.1.1 Watershed modeling and Optimized BMP selection approach

Watershed modeling tools linked to a BMP simulation and optimization system were used to evaluate and optimize quantitative load reduction scenarios to address TMDL implementation efforts in the unincorporated County areas of the Machado Lake watershed. The watershed model is based on existing Loading Simulation Program in C++ (LSPC) models linked with innovative BMP optimization system. Brief descriptions of the watershed model and BMP optimization model are provided below.

6.1.1.1 LSPC - Hydrologic modeling using a continuous simulation model

The LSPC watershed modeling system utilizes a regional modeling approach that has been used to support numerous TMDL developments throughout the County. The LSPC model is a continuous simulation model and generates runoff characteristics based on rainfall, soil characteristics and infiltration rates, evapo-transpiration, antecedent conditions, and land use-specific pollutant loading characteristics. Meteorological data from 1997 to 2006 were used to calibrate the model. Existing meteorological data, hydraulic data, land use information, and monitoring data were used to calibrate each sub-watershed to most accurately simulate the runoff and pollutant load.

The LSPC model simulates hydrology, sediment, and general water quality on land and is combined with a stream fate and transport model. Wet-weather loading estimates are developed using the modeled constituents including Total Nitrogen (TN), Total Phosphorus (TP), and total suspended solids (TSS). For the other organic pollutants (chlordane, DDE, DDT, PCBs, and Dieldrin), loading estimates are developed as a function of runoff volume or TSS load.

Based on the model results from 1997 to 2006, a daily or average annual load was calculated for TSS, TN, and TP. Annual load results were compared with the TMDL waste load allocations (WLAs) to calculate the load reduction needed to meet those WLAs.

6.1.1.2 Optimization BMP Design Approach

The optimization BMP design approach uses GIS information and time-series data for watershed runoff flows and pollutant concentrations (generated by the watershed model), integrates a process-based BMP simulation, and applies optimization techniques for the most cost-effective BMP planning and selection.

6.1.1.3 BMP Simulation Process

The BMP simulation system uses process-based simulation for BMP function and removal efficiency and accepts flow and water quality time-series data generated by LSPC models as input data. Process-based simulation of BMPs provides a technique that is sensitive to local climate and rainfall patterns. BMP effectiveness can be evaluated and estimated over a wide range of storm conditions, site designs, and flow routing configurations.

For BMP selection purposes, various land uses were sub-grouped into four general land use categories (residential, commercial/industrial/institutional, transportation, and untreated open space). For each land use category, assumptions were made regarding the percent of impervious area and characteristics of impervious and pervious areas contributing to runoff flow and quality.

For each urban land use category, a unique combination of specific storage/infiltration BMPs was evaluated to provide an analysis of the benefits versus costs of each practice. The storage/infiltration BMPs used in the study included bioretention, porous pavements, and rain barrels/cisterns. The primary benefits of these BMPs are storage and infiltration which enable runoff volume and rate reduction. These type BMPs also provide water quality benefits via filtration, settling of sediment, and pollutant decay.

6.1.1.4 Optimization Process

The optimization process employs the latest optimization techniques to identify the most cost-efficient BMP selection and placement strategies. The function of the optimization engine is to determine the locations, types, and design configurations of the BMPs that best satisfy the management objectives, such as water quality, water quantity, or maximized benefits for a fixed budget.

The BMP optimization system was formulated on the basis of a dynamic watershed simulation model. It can provide assessment of both distributed (i.e., LID-type) and centralized BMPs in combination for a TMDL implementation plan and can support selection of the optimum plan that maximizes benefits and leads to significant cost savings.

The system adopted the Guided Optimal Adaptive decision-making approach within a Risk Explicit Interval Linear Programming modeling framework. This approach provides an ideal mechanism to prioritize implementation options based on the risk and return tradeoff.

It should be noted that the there are significant differences in the BMP selection approach used in this study compared with the traditional BMP selection approach. The traditional approach, such as SUSMP BMP design, typically involves using a preselected design storm instead of actual historical storm events to determine BMP sizes and does not directly consider TMDL attainment

in determining which BMPs are needed. The continuous simulation and optimization BMP design approach used in this study is uniquely different. In this approach, every possible set of BMPs has a unique associated treatment capacity. The BMP optimization process results in the specific combination of BMPs that is required to attain TMDL WLAs at the target location of a watershed.

6.1.2 Loading Analysis Using Watershed Management Modeling System

The Watershed Management Modeling System (WMMS) was used to estimate the average annual load of TN, TP, and TSS from the County Islands. The model-calculated annual loadings for these constituents are presented in **Table 29**. Additionally, the final WLA and the resulting required reduction for nutrients are included in **Table 29**. The model's estimates for current annual loading of nitrogen are within the interim WLA, but would require a 48% reduction to meet the final WLA. The current loading of phosphorus estimated by the WMMS is greater than the interim WLA, requiring a 20% reduction in average phosphorus loading by 2014. To attain the final WLA for phosphorus, the annual average loading will require a 94% reduction in loading from the County Islands. Load reductions of total suspended solids (TSS) are not specifically required in the TMDLs under consideration. However, TSS reductions will be used as the mechanism to attain toxics allocations.

Table 29: Model Calculated Average Annual Loading, Final Waste Load Allocation, and resulting Required Reduction for the Unincorporated County Islands in the Machado Lake Watershed

Parameter of Concern	Current Annual Loading (kg/yr)	Interim Waste Load Allocation (kg/yr)	Final Waste Load Allocation (kg/yr)	Required Reduction (%)
Total Nitrogen	1,370	1,739	710	48%
Total Phosphorus	1,100	887	71	94%
Total Suspended Solids	38,400	NA	NA	NA

To determine the loading of the toxic compounds, multipliers representing the fraction of toxic compound per unit mass of suspended solid are used with the modeled annual load of TSS. The current estimate of toxics loadings from County Islands were calculated using the fraction multipliers determined through the Sediment Characterization Report (CDM 2010). The sediment quality in Machado Lake and the surrounding area were evaluated in CDM 2010 to determine the amount of toxics associated with the sediments. A list of the toxics fractions is included in **Table 30**. The values from CDM 2010 were selected for use to translate WMMS sediment loads to toxics loads because the study measured sediments originating from the Machado Lake watershed and analyzed for the suite of toxics evaluated in the Toxics TMDL. Annual average loading of toxics are determined by multiplying the annual average load of suspended solids by the toxics fractions.

Toxics WLAs are listed in the TMDL as toxics fractions in sediment. Derivation of estimates for the toxics fractions are discussed in Appendix D. A final allocation loading is calculated in **Table 30**, where the WLA is multiplied by the current average annual sediment loading, resulting in the final allocation loading. The required reductions for the toxics are determined by comparing the calculated annual average loading and the final allocation loading. Annual

average calculated current toxics loadings are presented in **Table 30**. The TSS load reductions necessary to reach the final allocation loading are also listed in **Table 30**. Based on the current conditions, the loading from the County Islands are in compliance with the WLA for Total PCBs, DDT (all congeners), and DDD (all congeners). DDE (all congeners), Total DDT, chlordane, and Dieldrin loading from the County Islands require up to a 84% reduction in TSS loading to achieve the final allocation loading.

Table 30: Modeled Average Annual Loading of Toxics from the Unincorporated County Islands, the Fraction of Toxics on Sediments, Waste Load Allocations of Toxics, and the Required Load Reduction in TSS

Parameter of Concern	County Island Sediment[1] (µg/kg dry weight)	Calculated Annual Loading (g/yr)	Waste Load Allocation for Sediment (µg/kg dry weight)	Final Allocation Loading (g/yr)	Required TSS Load Reduction[2] (%)
Total PCBs	58	2.2[3]	59.8	2.3[2]	0%
DDT (all congeners)	4.0	0.15[3]	4.16	0.16[2]	0%
DDE (all congeners)	5.1	0.20[3]	3.16	0.12[2]	38%[4]
DDD (all congeners)	4.2	0.16[3]	4.88	0.19[2]	0%
Total DDT	5.8	0.22[3]	5.28	0.20[2]	9%[4]
Chlordane	20	0.77[3]	3.24	0.12[2]	84%[4]
Dieldrin	4.9	0.19[3]	1.9	0.073[2]	62%[4]

1 Toxics fractions estimated from the Sediment Characterization Report (CDM 2010).
2 Percent load reduction from current annual loading to final allocation loading.
3 Based on an annual TSS load of 38,400 kg/yr.
4 Required TSS load reduction to generate an equivalent load of Toxics.

Based on loading reduction presented in **Table 29** and **Table 30**, phosphorus reduction is the key to determine the best management practices. The following sections will present the quantification of lad reduction by nonstructural and structural BMPs.

6.2 NONSTRUCTURAL QUANTIFICATION ANALYSIS

The Watershed Treatment Model (WTM)[6] is used to assess the effectiveness of nonstructural BMPs on the dry weather and annual loading of nutrients and suspended solids from the County Islands. The WTM was developed by the Center for Watershed Protection with funding by the USEPA in June 2010. The WTM is a spreadsheet-based model that calculates annual pollutant loads and runoff volumes and accounts for the benefits of a full suite of stormwater treatment practices to determine reductions in pollutant loads. It is currently a beta model. The WTM is used for the County Islands in the Machado Lake watershed to determine the accumulated effectiveness of implementing dry weather BMPs for the control of nutrients and suspended solids. A detailed discussion of the nonstructural quantification is included in Appendix C.

The WTM uses both environmental inputs (e.g., area of land use types, soil types, etc.) and inputs about BMPs. Environmental inputs are used to determine current loads and inputs about BMPs determine the percent reduction in loads.

[6] www.cwp.org/Resource_Library/Center_Docs/Desktop/ELC_WTM.pdf

6.2.1.1 Illicit Connection Removal

Illicit connections to storm drains are sources of a variety of pollutants including nutrients. This source control is applicable to residential and commercial areas in the County Islands. However, the success of this program is dependent on the presence of illicit connections in the County Islands. The costs of a field investigation, water sample analysis and illicit connections trace or to confirm reconnection to the sewer system (via dye, video, or smoke testing) can be highly variable and depend on the extent and nature of the problem. Literature review indicates that the cost of removal of one illicit connection and its reconnection to the sewer system is $2,500 (Marcoux, 2004 and Brown et al., 2004), which makes this is an expensive option. However, the County's NPDES Permit already requires inspection of the storm drain system for illicit connections and removal of the connections,[7] and increased effort to identify illicit connections would enhance the County's illicit connection program.

For the purposes of this evaluation, it was assumed that:

- 1% of residents have illicit connections,
- 10% of businesses have illicit connections,
- 40% of the sanitary sewer is surveyed for illicit connections,
- 20% of illicit connections are corrected.

Assumptions were based on best professional judgment because the number of illicit connections varies depending on local habits, municipal outreach, and enforcement. The number of illicit connections identified and corrected would be dependent on the resources the County can allocate to this program.

6.2.1.2 Catch Basin Cleanout

Regular catch basin cleanout prevents pollutants from flowing through and into the storm drain system. Sediment, debris, and gross particulate matter are the targeted pollutants with the cleanout of catch basins, but removal of particulate-bound pollutants, including nutrients and toxics, occurs through the physical removal of sediments.

The County's Annual Report indicates that the County prioritizes catch basin cleanouts as follows:

- Priority A: These catch basins are cleaned quarterly.
- Priority B: These catch basins are cleaned semi-annually.
- Priority C: These catch basins are cleaned annually.

Review of the Annual Report showed that most catch basins were Priority C. However, the model only allows input of semi-annual or monthly cleanouts. Therefore, semi-annual cleanouts were selected. Other inputs were based on best professional judgment. The assumption of semi-annual cleanouts may overestimate current load removal and therefore underestimate the percent reduction in loads that could be achieved from increased cleanout frequency.

For the purposes of this evaluation it was assumed that:

[7] NPDES Permit Order # 01-182 Part 4 (G) http://63.199.216.6/larwqcb_new/permits/docs/6948_01-182_WDR.pdf

- The impervious area drains to the catch basins,
- Catch basins are currently cleaned semi-annually,
- In the future, 60% of catch basins will be cleaned monthly,
- In the future, 40% of catch basins will be cleaned semi-annually,

6.2.1.3 Street Sweeping

Street sweeping uses mechanical pavement cleaning practices to minimize pollutant transport to receiving water bodies. Sediment, debris, and gross particulate matter are the targeted pollutants, but removal of other particulate-bound pollutants can be accomplished as well, such as nutrients and toxics.

The County's Permit requires that the County prioritize street sweeping as follows:

- Priority A: These streets and/or street segments shall be swept at least two times per month.
- Priority B: Each street and/or street segments is swept at least once per month.
- Priority C: These streets and/or street segments shall be swept as necessary but in no case less than once per year.

In the County's document "Streets and Roads Maintenance Guidance" the County states that curbed streets must be swept monthly and that priority A and B curbed streets must be swept more frequently. The County defines these and A and B priority streets as the following:

- High vehicle (ADT above 20,000) or pedestrian traffic areas,
- Construction areas,
- Industrial areas.

For the purposes of this evaluation, it was assumed that:

- Publicly-owned roads and parking lots are currently swept weekly.
- All roads in County Islands 1 and 2 and roads in County Island 3 south of Sepulveda are currently swept with vacuum sweepers. The remaining roads are currently swept with mechanical (broom) sweepers.
- In the future, residential roads and parking lots will be swept twice weekly, other roads will be swept weekly.
- The future program will use vacuum sweepers.

County roads are currently being swept weekly. The County uses both mechanical and the more effective vacuum sweepers, with mechanical sweepers employed in County Island 3 north of Sepulveda Avenue, and vacuum sweepers utilized on the remaining unincorporated County area within the watershed. The street sweeping cost (including O&M) of vacuum street sweepers is $290/curb mile based on a monthly sweeping frequency (in 2005 dollars) (Shilling, 2005).

6.2.1.4 Residential Irrigation and Fertilizer Reduction

Over irrigation may lead to runoff, increasing flows within the stormwater system. Additioanlly, urban irrigation runoff can be high in TSS and nutrients. The nutrients in urban irrigation runoff

are typically from fertilizers, which are often overused. Effective outreach can teach residents not to overwater and to test the soil to determine the appropriate amount of fertilizer to apply. In addition, evapotranspiration (ET) controllers have been successfully used to reduce irrigation runoff. The cost of this outreach is highly dependent on the approach, which could vary from internet outreach sites to homeowner incentives to educational displays at retail stores.

For the purposes of this evaluation, it was assumed that:

- Half of runoff from the County Islands is dry weather flow.[8]
- An irrigation reduction program would reduce irrigation flows by 20%.[9]
- Enhanced outreach of television and radio spots would be necessary to reach and convey the message of controlling irrigation and using proper amounts of fertilizer.

6.2.2 Results of Watershed Treatment Model

The results of the above combined inputs to the WTM are listed in **Table 31**. The reductions are based on percent of dry weather load and the percent of annual runoff load (e.g., street sweeping has benefits in both wet and dry weather). These reductions are considered rough estimates due to the environmental characterization assumptions made for the model and the assumptions listed in the previous sections.

Table 31: Reductions in Nutrient and Total Suspended Solids Loads in Stormwater Given by Watershed Treatment Model

Percent Reduction	Total Nitrogen	Total Phosphorus	Total Suspended Solids
Dry Weather Runoff	20%	14%	32%
Annual Runoff	22%	10%	26%

As explained in Section 6.2, the WTM is currently a beta model. It requires a number of inputs to assess current conditions and the effectiveness of specific source controls. However, the WTM is still the best available tool for modeling and estimating reductions because there is very little reliable literature about load reduction in stormwater through implementation of nonstructural BMPs. WTM results will be compared with and used in conjunction with stormwater quality and quantity data to evaluate the effectiveness of the nonstructural BMPs.

The use of nonstructural BMPs is estimated to reduce Total Phosphorus loading by 10%. Therefore the remaining 84% of the required 94% reduction will need be through the use of structural BMPs.

[8]Nearly half the annual MS4 flow volume in Sacramento, California could not be attributed to precipitation. (Montoya, 1987) It is assumed that irrigation flows would be similar to if not higher than Sacramento's in the County, because of less precipitation in the County.

[9]Runoff reduction ranged from 49% to 71% with the installation of ET controllers. (Diamond, 2003). Best professional judgment was used to lower this number as ET controllers use would not be installed on all turf.

6.3 STRUCTURAL QUANTIFICATION ANALYSIS

The WMMS calculates the distribution of structural BMPs to provide the required load reductions at the optimal cost. In setting the load reductions levels for structural BMPs in the WMMS, the anticipated reductions through implementation of non-structural BMPs are subtracted from the total load reductions necessary to achieve the TMDL WLAs. Structural BMPs considered in the WMMS include rainwater capture and reuse, bioretention, porous pavement, and centralized treatment. The initial recommendations for structural BMPs optimized by the WMMS are presented in **Table 32**. The final mix of BMPs will depend on funding available for installation and the measured gains in nutrients and toxics reductions as projects are implemented. Refinements to the model based on Machado Lake watershed water quality and quantity monitoring may change the amounts and relative distributions of BMPs in future reconsideration of the Nutrients TMDL.

Table 32: Watershed Management Modeling System Optimized Best Management Practices

Land Use	Total Area[1] (acre)	Impervious Area (acre)	Rain Barrel[2] (acre-ft)	Bioretention[2] (acre-ft)	Porous Pavement[2] (acre-ft)	Centralized BMP (acre-ft)	Total BMP Treatment Capacity (acre-ft)
Residential	731.11	275.23	4.49	28.31	---	---	32.80
Commercial, Industrial, & Institutional	198.37	150.19	---	5.97	10.30	---	16.27
Transportation	249.13	103.76	---	10.32	---	---	10.32
Open Space	75.61	0	---	---	---	---	0
Centralized BMP	---	0	---	---	---	2.64	2.64
Total	1,254.22	529.18	4.49	44.60	10.30	2.64	62.03

1 Area from WMMS.
2 Distributed BMPs assumed to be located uniformly across land-use.

The optimized BMPs from the WMMS together with the non-structural BMPs are a method of achieving compliance with WLAs from both the Nutrients and Toxics TMDLs. The adaptive management implementation will consider the results of monitoring to evaluate the progress of achieving the WLAs. The final realized distribution of structural and non-structural BMPs may be different than proposed through the Implementation Plan as necessary to achieve the highest level of reduction within the funding available to the County.

The County may need to implement BMPs on County and private properties. The land parcels within County Islands in the Machado Lake watershed are largely privately held, with the secondary roads, and the South Coast Botanical Gardens the most notable exceptions. Each of the County Islands include at least one secondary road suitable for retrofit with road-side or median bioretention. However, Vermont Avenue, on the eastern portion of County Island 3 may not be suitable for median retrofit as the road bed overlays abandoned railroad tracks including 1 to 2 feet of concrete. The treatment capacity for BMP retrofits on the County Lands are listed in **Table 33**. Vermont Avenue was not considered in the available area to install bioretention. The BMPs specified for the County Land retrofits follow the ratios of treatment types determined by

the WMMS, as they are the cost efficient blend of treatment given the current information available. Specific site information and opportunities may result in modification to the BMP type and sizing. The South Coast Botanical Garden retrofit opportunity is one of the sites selected as a conceptual design and is included below in **Table 34**.

Table 33: County Property and Public Right of Way Best Management Practices.

Land Use	Total Area[(1)] (acre)	County Land Area (acre)	Rain Barrel[1] (acre-ft)	Bioretention (acre-ft)	Porous Pavement (acre-ft)	Centralized BMP (acre-ft)	Total BMP Treatment Capacity (acre-ft)
Residential	731.11	0	---	---	---	---	0
Commercial, Industrial, & Institutional	198.37	0	---	---	---	---	0
Transportation	249.13	103.76 [(2)]	---	5.67	---	---	
Open Space	75.61	0	---	---	---	---	0
Total	1,254.22	103.76	0	5.67	0	0	5.67

1 Area from WMMS.
2 Secondary Roads

6.3.1 Retrofit Opportunities at Commercial Parcels

Cumulatively, the identified retrofit opportunities evaluated in Section 5 could provide treatment for up to approximately 37 acres through the implementation of a variety of BMPs including bioretention areas, perimeter sand filters, vegetated swales, and catch basin inserts. A summary of the structural BMP retrofit options is presented in **Table 34**. Note that each of the opportunities listed in **Table 34** are subject to available funding and ability to secure agreement between the County and landowner on access and maintenance of the BMPs.

Table 34: Summary of Structural BMP Retrofit Options

Site/ BMP	Land Use	Drainage Area (ac)	Recommended BMP Capacity (ac-ft)
Conceptual Centralized Treatment Retrofit[1]			
Bioretention Area	Residential	15.2	0.86
	Industrial	12.9	0.73
Commercial Parking Lot Potenital Retrofit Option 1			
Bioretention	Commercial	1.62	0.05
Commercial Parking Lot Retrofit Option 2			
Bioretention	Commercial	0.51	0.04
Perimeter Sand Filter	Commercial	0.27	0.09
Commercial Parking Lot Retrofit Option 3			
Bioretention	Commercial	0.78	0.04
South Coast Botanical Gardens			
Vegetated Swale	Institutional	1.00	0.06
Porous Pavement	Institutional	0.33	0.02
Island 1 Additional Retrofit Opportunities			
Bioretention Cul-de-sac Retrofits[2] in Island 1	Residential	0.1	0.02
Filterra Tree Box Units[3]	Residential	0.2	0.001
Catch Basin Inserts	Institutional	0.5	n/a
Island 3 Additional Retrofit Opportunities			
Bioretention Cul-de-sac Retrofits[2] in Island 3	Residential	0.2	0.024
Filterra Tree Box Units[3]	Residential	1.98	0.024
	Commercial	0.22	0.003
Catch Basin Inserts	Residential	2.1	n/a
	Industrial	0.9	n/a
TOTAL		**36.59**	**3.83**

1 The conceptual centralized treatment retrofit provides 1.59 acre-ft of centralized treatment for County Island 3.
2 Current funding and staffing levels would not support cul-de-sac retrofits and the associated maintenance.
3 Current funding and staffing levels would not support installation of Filter type tree box units and the associated maintenance.

6.3.2 Retrofit Through Redevelopment

Additionally, the County has adopted an ordinance requiring low impact development (LID) components when greater than 50% of the impervious area is modified. Residential areas within the County Islands are generally established with low levels of redevelopment. The commercial and industrial areas of County Island 3 may experience a moderate rate of redevelopment and would be subject to the County LID ordinance. Of the 91.56 acres commercial, industrial, and institutional area in County Island 3, it is assumed that 15% will experience redevelopment over the course of the Implementation Plan. The rate of redevelopment, 2.5% per year between 2012 and 2018, is based on the levels experienced in the County Islands over the past 20 years and is

expected to be similar in the Machado Lake watershed over the life of the Implementation Plan. The BMP installation through redevelopment are summarized in **Table 35**. Future rates of redevelopment are largely a function of the economic health of the region as a whole and is outside the control of the County. In the future, if the levels of LID through redevelopment becomes more significant, there would be less required structural BMPs to be built in the County Islands.

Table 35: Installation of Best Management Practices through Redevelopment.

Land Use	Total Area (acre)	Redevelopment Area (acre)	Rain Barrel[1] (acre-ft)	Bioretention (acre-ft)	Porous Pavement (acre-ft)	Centralized BMP (acre-ft)	Total BMP Treatment Capacity (acre-ft)
Residential	731.11	0	---	---	---	---	
Commercial, Industrial, & Institutional	198.37	13.7[1]	---	0.30	0.54	---	0.84
Transportation	249.13	0	---	---	---	---	
Open Space	75.61	0	---	---	---	---	
Total	1,254.22	13.7	---	0.30	0.54	---	0.84

1 Redevelopment rate of 15% applied to commercial, industrial areas of County Island 3.

6.4 QUANTIFICATION ANALYSIS RESULTS

A summary of the required BMP capacity volumes and identified volumes though County projects, redevelopment, and identified opportunities is presented in **Table 36**. The remaining BMP capacity (ie the BMP capacity not identified through retrofit of County lands, conceptual opportunities, or redevelopment) may be provided through private installation of BMPs or the installation of structural BMPs within leased properties or acquisition of land within the County Islands. Leasing land area will require negotiation with lessees on properties where leases will expire during the implementation period. Private installation of BMPs may occur through incentive programs, or ordinances. Stormwater fees may be developed to provide a funding mechanism for future BMPs and fund (not oversee) the programs discussed in the Implementation Plan. To attain the WLAs it may be necessary for the County to acquire land within the watershed to implement BMPs. Successful implementation of the programs to attain WLAs will require the multi-departmental detailed planning which is beyond the scope of the Implementation Plan. The Implementation Plan is rooted in an adaptive management approach, allowing the County to assess the true effectiveness of non-structural BMPs, and monitoring to better refine the annual average load of the pollutants of concern. Of the 62.03 acre-feet of BMP capacity determined by the WMMS to attain the WLAs, 8.4 acre-feet have been identified. As listed in **Table 36** 53.64 acre-feet of BMP capacity remains to be distributed throughout the County Islands.

Table 36: Summary of Best Management Practices in Unincorporated County Islands.

Land Use	Total Area (acre)	WMMS Optimized Treatment Capacity (acre-ft)	Identified Opportunities[1]				Remaining BMP Treatment Capacity (acre-ft)
			Rain Barrel[1] (acre-ft)	Bioretention (acre-ft)	Porous Pavement (acre-ft)	Centralized BMP (acre-ft)	
Residential	731.11	32.80	---	---	---	---	32.80
Commercial, Industrial, & Institutional	198.37	16.27	---	0.58	0.56	---	15.14
Transportation	249.13	10.32	---	5.67	---	---	4.65
Open Space	75.61	0	---	---	---	---	---
Centralized BMP		2.64				1.59	1.05
Total	1,254.22	62.03	---	6.25	0.56	1.59	53.64

1 Identified opportunities include projects on County lands, redevelopment, and opportunities identified in Section 5.

The land area not draining to an identified BMP is used to distribute the remaining BMP capacity uniformly through the County Islands. The land uses and areas tributary to BMPs are summarized in **Table 37**. By accounting for the land area served by the BMPs discussed above, the land area not being served by an identified BMP can be determined and is listed in **Table 37**. Based on the WMMS results, BMPs should be distributed uniformly through the unincorporated areas of the watershed. At a planning level, BMPs can be recommended for the remaining areas listed in **Table 37** through the use of ratios comparing the remaining area to the total area. The capacity is assigned using the developed ratios and the treatment capacity calculated by the WMMS. The remaining areas are matched to BMP capacity in **Table 38**. The distribution of BMP capacity by land use is a method to attain the levels of structural BMPs determined through the WMMS and calculated effectiveness of the nonstructural BMPs. The ultimate combination of distributed BMPs and centralized BMPs and the total treatment volume required to attain the WLAs in the Nutrients and Toxics TMDLs will ultimately be determined through the adaptive management process where the actions in the watershed are evaluated by the results from the monitoring program.

Table 37: Land Area in County Islands Tributary to Best Management Practices and Remaining Land Area.

Land Use	Total Area (acre)	Tributary Area County Projects (acre)	Tributary Area Identified Projects (acre)	Tributary Area Redevelopment (acre)	Tributary Area Remaining (acre)
Residential	731.11	0	0	0	731.11
Commercial, Industrial, & Institutional	198.37	1.33(1)	3.18	13.7	180.16
Transportation	249.13	57.03(2)	0	0	192.1
Open Space	75.61	0	0	0	75.61
Total	1,254.22	66.86	3.18	13.7	1,170.48
Centralized BMP Treatment Capacity	2.64 (acre-ft)	0	1.59 (acre-ft)	0	1.05 (acre-ft)

1 Area represents the South Coast Botanical Garden
2 Area of secondary roads amenable to bioretention

Table 38: Recommended Typical Best Management Practices on Remaining Area in Unincorporated County Islands in the Machado Lake Watershed.

Land Use	Total Area (acre)	Tributary Area Remaining (acre)	Rain Barrel[1] (acre-ft)	Bioretention[1] (acre-ft)	Porous Pavement[1] (acre-ft)	Centralized BMP (acre-ft)	Total BMP Treatment Capacity (acre-ft)
Residential	731.11	731.11	4.49	28.31	---	---	32.80
Commercial, Industrial, & Institutional	198.37	180.16	---	5.36	9.25	---	14.61
Transportation	249.13	192.1	---	---	---	---	0.0
Open Space	75.61	75.61	---	---	---	---	0.0
Centralized BMP	---	---	---	---	---	6.23(2)	6.23
Total	1,254.22	1,170.48	4.49	33.67	9.25	6.23	53.64

1 Distributed BMPs assumed to be located uniformly across land-use.
2 Centralized BMP capacity increased over WMMS calculated levels to account for not all Secondary Road area is suitable for retrofit with BMPs.

6.5 QUANTIFICATION ANALYSIS CONCLUSIONS

Due to the minimal amount of existing publicly-owned land within the unincorporated County Islands in the Machado Lake watershed, structural BMPs may need to be implemented in areas not currently owned by the County. To accomplish the installation of BMPs, negotiations would

need to occur between land owners and the County, incentive programs, County ordinances, and stormwater fees may need to be developed and instituted, and land acquisition may be necessary.

The monitoring program will provide stormwater sampling data to assess the site-specific level of nutrients and toxics associated with the sediment leaving County Islands. The measured pollutant levels from the monitoring program may provide more site specific pollutant loading scenarios from the watershed, which would help reevaluate reductions required to meet the WLAs. Currently, TP is the limiting constituent driving the number of BMPs. Additionally, the Nutrients TMDL is due to be reevaluated by 2016, and the reevaluation will include the information from special studies and the results of monitoring programs. The Nutrients TMDL reevaluation may be used to refine the loading capacity of Machado Lake, ultimately changing the WLAs. If, through monitoring, the loadings from the County Islands reveal that nonstructural BMPs are more effective than assumed by the Watershed Treatment Model, or the levels of constituents in the runoff from County Islands are lower than currently thought to exist, BMP implementation will be adjusted accordingly.

7 Multi-Benefits Analysis

This Implementation Plan outlines the management actions that may be needed to ultimately attain the WLAs of the Machado Lake Nutrient TMDL (LARWQCB, 2009) and the Machado Lake Toxics TMDL (LARWQCB, 2010), in the unincorporated County areas of the Machado Lake watershed. Although the primary intention of the proposed structural and nonstructural BMPs is to reduce nutrients and toxics loads to Machado Lake, the ancillary benefits include water supply improvement, community enhancement, and sediment reductions. This section describes the additional benefits that may be achieved as the management actions are implemented. It should be noted that they do not necessarily benefit the County directly.

7.1 WATER SUPPLY BENEFIT

7.1.1 Rain Water Harvesting

Rain water harvesting BMPs reduce the amount of stormwater runoff entering the storm drain system, thereby reducing pollutant loading to Machado Lake. These BMPs have the ancillary benefit of providing an alternate supply of non-potable water that can be used for a variety of uses, such as irrigation and toilet flushing. Outdoor irrigation can account for 60% of the per capita domestic water use, a per capita use of approximately 100 gallons per day in arid climates (So Cal LID). Toilet flushing typically accounts for 11% of the domestic water demand.

Small to medium scale systems can be employed in existing high-density residential areas to provide an alternate source of landscape irrigation water. Irrigation with captured rainwater must use drip or soaker hose irrigation systems because of LACDPH treatment requirements for surface sprinkling or spraying. A summary of the estimated annual irrigation needs for the County Islands in the Machado Lake watershed is presented in **Table 39**, and the assumptions used to determine the irrigation water needs are listed in **Table 40**. Estimates of the potential amount of rainwater that could be captured with small to medium scale systems that harvest roof top runoff are listed in **Table 41**.

Additional future benefit might be result from changes and clarifications to the plumbing and health codes that could facilitate larger scale systems, especially in areas of new or redevelopment, where indoor uses, such as toilet flushing, would constitute a significantly larger reuse of harvested rainwater.

Table 39: Estimated Landscape Irrigation Water Need

Land Use	Pervious Acreage	Irrigation Acre-Ft	Irrigation Need Acre-ft/year
Residential	380	7	1189

Table 40: Summary of Excess Irrigation Assumptions

Estimate Assumptions	Value
Number of wet days when irrigation systems are assumed not to be used[1]	35 days
Number of days landscape was watered[2]	110 days
Average amount watered 0.25 in[3]	0.02 ft

1. (NOAA, 2011) 35 days of rain measured greater than 0.01 inch in Los Angeles
2. 365 days per year minus 35 wet days divided by 3 (assumed water every third day, consistent with County Water Waster Ordinance (LADWP, 2010)
3. Assumption for the Marina del Rey Implementation Plan

Table 41: Estimated Amount of Captured Rainwater

Land Use	Impervious Cover Acreage	Rooftop Impervious Coverage Acreage(1)	Acre-ft Potential Runoff(2)	Capture Efficiency(3)	Acre-ft Captured/ Event
High Density Residential	422	34	3.6	90%	3.24

1. Assume 8% is roof top
2. Design Storm Event 1.25-in used in the Marina del Rey Implementation Plan
3. Marina del Rey Implementation Plan assumed 90% capture of the storm event.

7.1.2 *Bioretention and Porous Pavement*

Bioretention and porous pavement BMPs are proposed in the Implementation Plan. In retrofit situations, these practices convert impervious areas into pervious areas. In new development, these practices preserve pervious areas at development sites. Soil types in the County Islands in the Machado Lake watershed prevent much infiltration or ground water recharge. Section 2.2 Geological Setting and Soil (page 11) indicates a predominance of soils with high clay content, necessitating underdrains. For the bioretention and porous pavement BMPs. Nevertheless, these BMPs will result in additional infiltration of a portion of the rainwater they treat, which will result in enhanced groundwater recharge over conventional development.

7.1.3 *Irrigation Reduction*

Irrigation reduction is a proposed nonstructural BMP. Irrigation reduction has the direct water supply benefit of reducing the amount of potable water used for irrigation. Irrigation reductions could be achieved through outreach to residents and implementation of evapotranspiration controllers. Irrigation reductions will be aided by Ordinance No. 2008-0052U, which prohibits runoff from lawns and landscaping on to hardscape (streets, sidewalks). This ordinance also limits fertilizer running onto the street, thus reducing nutrient loads to stormwater.

Total excess runoff estimates are summarized in **Table 42**. Assumptions used in the irrigation reduction calculation are listed in **Table 43**. Based on the assumptions, excess irrigation within the County Islands is estimated at 179 acre-feet per year.

Table 42: Summary of Estimated Excess Irrigation Runoff in Acre-Feet per Year.

Land Use	Total Acreage	Pervious Acreage	Irrigation Acre-Ft	Irrigation Acre-ft/year	Excess Irrigation Runoff Ac-ft/year
Residential	800	378	7.6	833	166
Commercial	92	5	0.1	10	2
Industrial	129	15	0.3	32	6
Institutional	41	8	0.2	17	3
Total	1062	406	8.2	893	179

Table 43: Summary of Excess Irrigation Assumptions.

Estimate Assumptions	Value
Number of wet days when irrigation systems are assumed not to be used[1]	35 days
Number of days landscape was watered[2]	110 days
Average amount watered 0.25 in (or 0.02 ft)[3]	0.02 ft
Pervious acreage within county (excluding open space)[4]	406
Excess irrigation runoff (Percent of Total)[5]	20%

1 35 days of rain measured greater than 0.01 inch in Los Angeles (NOAA, 2011)
2 365 days per year minus 35 wet days divided by 3 (assumed water every third day, consistent with County Water Waster Ordinance (LADWP, 2010)
3 Marina del Rey Implementation Plan
4 Table 1 with no deductions were made for areas not irrigated
5 Professional judgment assumption, no literature values identified.

Water conservation outreach and use of evapotranspiration controllers will reduce the excess irrigation. Estimates of runoff reductions using evapotranspiration controllers ranged from 49% to 71% (Diamond, 2003). These estimates were conservatively modified by 20% to account for the assumption that the controllers will not be installed on all landscaping areas. An estimate of the reduction in irrigation runoff is provided in **Table 44**.

Table 44: Summary of Excess Irrigation Runoff in Acre-Feet per Year

Estimated Baseline Excess Irrigation (acre-ft/year)	Estimated Excess Irrigation Following ET Implementation (acre-ft/year)
179	145

7.2 COMMUNITY ENHANCEMENT BENEFITS

Water quality improvements benefit the community at large. These benefits include aesthetics, increases in property value, enhanced recreation opportunities, enhanced water supply, and lower costs for landscape maintenance. Ecosystem benefits are also realized from the improvements.

Biofiltration provides several community and ecosystem benefits, among them:

- Reduction in heat island effects,
- Increased green spaces within the urban environment,
- Increases in property values.

Rainwater harvesting systems provide an alternative source of water for non-potable uses and provide an opportunity for the community to actively engage in water hydrology and water conservation efforts.

Runoff reduction contributes to water conservation, provides habitat benefits through the reduction of the artificial dry weather flows, and reduces the cost of landscape maintenance. Improvements in Machado Lake water quality will provide the community with enhanced recreational opportunities. Water quality improvements are likely to improve wildlife viewing and fishing opportunities at the lake. Enhancements in habitat directly benefit the wildlife and provide habitat refuge in a highly urbanized area.

7.3 REDUCED SEDIMENT TO MACHADO LAKE

Best management practices proposed to reduce nutrients and toxics in the Machado Lake Implementation Plan include practices that will reduce sediment loads, especially as the WLAs for Toxics were assigned as a fraction of the suspended sediment loading to Machado Lake. Current sediment loading to the lake is estimated at 38,400 kg/yr. Reduction of sediment loading will provide for improved water quality in the lake, and will reduce future needs to dredge the lake.

Structural and nonstructural BMPs capture and remove sediment (TSS) from the watershed. Street sweeping and catch basin cleanouts are nonstructural practices that directly remove sediment loads from the watershed and manage them for proper disposal. Nonstructural practices also address the sources of sediment in the watershed, the public outreach, development construction, new development and public works elements of the County's stormwater management program play a role in encouraging erosion control and reducing sediment inputs to the storm drainage system. Bioretention and porous pavement are structural BMPs that either increase pervious areas or prevent conversion of pervious areas to impervious cover during development. These practices reduce the quantity and rate of runoff from developed areas, thereby reducing the demand on the storm drain system. The expected reductions in sediment loading for dry and annual weather flows are listed in **Table 45**.

Table 45: Summary of Estimated Reductions in Stormwater Total Suspended Solids Loads from Unincorporated County Islands within the Machado Lake Watershed.

Percent Reduction	Baseline TSS Loading kg/yr	% Reduction Total Suspended Solids	Post BMP Implementation Loading
Dry Weather Runoff	2,000	31%	1,380
Annual Runoff	38,400	90%(1)	3,810

1 Reductions based on nonstructural removal estimates and WMMS results

7.4 MULTI-BENEFIT SUMMARY

Precise benefit quantification is difficult given the absence of site specific information and uncertainty about BMP performance and efficiencies. A summary of the ancillary benefits to the proposed structural and nonstructural BMPs within the Machado Lake Watershed are listed in **Table 46**.

Table 46: Summary of Multi-Benefits of the Implementation Plan BMP Strategies.

BMP	Aesthetics	Capture and Reuse	Flood Protection	Groundwater Recharge	Habitat	Property Value	Water Conservation	TSS reduction
Rain Barrels/Cisterns		✓	✓				✓	
Bioretention	✓		✓	✓[1]		✓		✓
Porous Pavement			✓	✓[1]				
Irrigation Reduction					✓		✓	
Street Sweeping	✓							✓
Pet Waste Management	✓				✓			
Illicit Connection Removal	✓				✓		✓	
Catch Basin Clean Out			✓					✓
Tree Wells	✓							✓

1 Impervious soils in the watershed limit the groundwater recharge benefit.

8 Implementation Schedules

The estimated implementation schedules for the nonstructural and structural projects proposed as possible solutions to comply with WLAs from the Nutrient and Toxic TMDLs are discussed below. The schedules presented herein are sufficient for long-term planning and budgetary purposes. Through adaptive management and based on the future monitoring results and response of Lake Machado, the implementation schedules may be modified to reflect the increased knowledge of the watershed. Implementation of BMPs will occur as funding becomes available.

8.1 TMDL SCHEDULE

The nutrient TMDL implementation schedule consists of a phased approach, with interim WLAs to be met by March 11, 2014 and full compliance by September 11, 2018. The Toxics TMDL only specifies final compliance by September 30, 2019. The schedules for required actions for both the TMDLs are outlined in Table 47.

Table 47: Implementation Schedules for the Nutrient and Toxics TMDLs.

TMDL	Milestone	Date
Nutrient TMDL	Effective Date	March 11, 2009
	Submit Implementation Plan	September 12, 2011
	Begin Monitoring and Implementation	60-days from approval
	Information Item to LARWQCB on Implementation Progress	March 11, 2013
	Interim Limits Apply	March 11, 2014
	LARWQCB to Reconsider TMDL	September 11, 2016
	Final WLA applicable	September 11, 2018
Toxics TMDL	Effective Date	Not Currently Effective
	Draft Implementation Plan to attain WLA's	6 months from completion of Phase 1 Monitoring
	Final Implementation Plan to attain WLA's	1 year from completion of Phase 1 Monitoring
	Begin Implementation Plan	60-days from Regional Board approval of Implementation Plan
	Achieve WLAs for Toxics	September 30, 2019

8.2 LOAD REDUCTION SCHEDULE

The Nutrient TMDL contains a phased compliance schedule, with interim limits effective in the first quarter of 2014 and final allocations effective the third quarter of 2018. The Toxics TMDL currently included final WLA to be effective in the third quarter of 2019.

8.3 NONSTRUCTURAL SCHEDULES

An estimated schedule for the nonstructural BMPs described in Section 4 Nonstructural Solutions is summarized in **Table 48**. The schedule accounts for the planning and design of the nonstructural BMP programs and the long term implementation of the programs.

Table 48: Project Planning Timeline for Implementation of the Proposed Nonstructural Solutions for County Islands within the Machado Lake Watershed.

Non-Structural Project	Duration (months)	Timeline							
		2011	2012	2013	2014	2015	2016	2017	2018
Storm Drain Stenciling Program									
Focus on Island 1 Storm Drain Stencils	3-6								
Continuation of Existing Stenciling Program	Ongoing								
Catch Basin Cleanouts									
Purchase Advanced Cleaning Technology (i.e., steam cleaning), as needed									
Focus on Problem Areas in Islands 1 and 3	3-6								
Increase Frequency of Cleanouts	Ongoing								
Catch Basin Inserts									
Install Catch Basin Inserts in Island 3									
Downspout Disconnection Program									
Planning & Assessment	8-12								
Implementation	24								
Fats, Oils and Grease Outreach									
Focus on Residents in County Islands	8-12								
Continuation of Existing FOG Outreach	Ongoing								
Green Waste Outreach									
Planning & Assessment	8-12								
Implementation	24								
Horse Manure Outreach									
Planning & Assessment	8-12								
Implementation	24								
Illicit Connection Removal									
Survey System in County Islands	24								
Implementation	24-36								
Impervious Cover Reduction									
Assess Feasibility of Reducing Existing Impervious Cover	8-12								
Implementation, if appropriate	24								
Industrial/ Commercial Facilities Control Program									
Nutrients and Toxics Specific Training	3-6								
Outreach to Facilities to Improve Onsite Source Control Activities	8-12								
Continuation of Existing I/C Facilities Program	Ongoing								

Continued

Table 48: Continued.

Non-Structural Project	Duration (months)	Timeline							
		2011	2012	2013	2014	2015	2016	2017	2018
Landscape and Recreational Facilities Management									
Specialized Fertilizer/Plant Selection Training for Staff	3-6								
Fertilizer Reductions	Ongoing								
Assessment of Lawn Conversion	8-12								
Conversion of Lawn to Native Landscaping	24								
Continuation of Existing Landscape and Recreational Facilities Mgt Program	Ongoing								
Storage Facilities/Corp Yard Mgt									
Nutrients and Toxics Specific Training	3-6								
Continuation of Existing Storage Facilities/Corp Yard Mgt Program	Ongoing								
Oil Well ESC Outreach									
Planning & Assessment	8								
Implementation	Ongoing								
Pet Waste Outreach									
Planning & Assessment	8-12								
Implementation of Pet Waste Bag Dispenser Stations in County Islands	8-12								
Focus on County Island Resident Outreach	24								
Continuation of Existing Pet Waste Outreach	Ongoing								
Post Construction Requirements									
Specialized Nutrient, Toxics and Runoff Reduction Training for Staff	3-6								
Require Implementation of BMPs that Effectively Remove Nutrients and Toxics for Redevelopment Projects in County Islands	Ongoing								
Sewer System Maintenance									
Specialized Training for Staff	3-6								
Focus maintenance in County Islands	8-12								
Smart Gardening Program									
Planning & Assessment	8-12								
Implementation	Ongoing								

Continued

Table 48: Continued.

Non-Structural Project	Duration (months)	Timeline							
		2011	2012	2013	2014	2015	2016	2017	2018
Street and Parking Lot Sweeping									
Planning & Assessment	8-12								
Upgrade/Purchase More Effective Street Sweepers, as needed	3-6								
Conduct Residential Outreach	8-12								
Increase Frequency of Sweeping	Ongoing								

8.4 STRUCTURAL SCHEDULES

An estimated schedule for completing the tructural BMPs described in Section 5 is presented in **Table 49** below. The schedule includes meeting planning and permitting requirements, preparing engineering design documents, bidding and constructing the BMPs and ongoing operations. The timeframe for funding has not been included in this schedule. In addition to the projects noted in the Table, the schedule accounts for the ongoing redevelopment activities that are expected to occur in the County Islands. The schedule also accounts for the ongoing opportunities to retrofit BMPs whether they are on public right-of-ways or private properties.

Table 49: Implementation Schedule for Structural Projects.

Structural Project	Duration (months)	Timeline							
		2011	2012	2013	2014	2015	2016	2017	2018
South Coast Botanical Garden Parking Lot									
Planning and Permitting	6-12								
Engineering Design Documents	8-12								
Bid/Construct	3-6								
Operations									
Centralized Treatment Retrofit[2]									
Planning and Permitting	15-24								
Engineering Design Documents	6-8								
Bid/Construct	3-6								
Operations									
Commercial Parking Lot Retrofit – Option 1[2]									
Planning and Permitting	8-16								
Engineering Design Documents	8-12								
Bid/Construct	3-6								
Operations									
Commercial Parking Lot Retrofit – Option 2									
Planning and Permitting	8-16								
Engineering Design Documents	8-12								
Bid/Construct	3-6								
Operations									
Commercial Parking Lot Retrofit – Option 3[2]									
Planning and Permitting	8-16								
Engineering Design Documents	8-12								
Bid/Construct	3-6								
Operations									
Redevelopment[1]									
Private Development	Continuous								
Retrofit									
BMPs in Public Right of Way	As needed								
BMP on Private Property by Land Owner through Incentive Program[2]	As Needed								
BMPs on Leased Property[2]	As needed								

1 Redevelopment of property is assumed to continue at a moderate pace comparable to the last 20 years and redevelopment will be in accordance with the LID ordinance and SUSMP requirements.

2 Requires Public – Private partnership

9 Cost Estimates

The cost estimates for the proposed actions outlined in the Implementation Plan are presented in this section. At the planning level, the costs provided will allow an order of magnitude effort necessary to implement structural and nonstructural BMPs in the Machado Lake Watershed to meet the WLAs of both the Nutrient and Toxics TMDLs using the current information on the loading from the County Islands and effectiveness of implementing BMPs. Changes to the TMDLs, the model estimated loads through watershed specific monitoring, or assumed effectiveness of identified BMPs will result in a change in the required BMPs and their associated costs. Cost estimates presented are at the level of detail necessary for planning and strategic decision making. The BMPs are to be distributed uniformly across the County Islands, and site specific issues that may result in excessive costs are likely to occur in a portion of the installations. Costs presented in here cannot consider site specific issues and are likely to underestimate the final costs for applying the identified BMPs throughout the County Islands.

9.1 BEST MANAGEMENT PRACTICES COST ESTIMATES

The nonstructural costs estimates are presented in **Table 50**. An assumed 3% rate of inflation is used in the cost estimates to determine the cost estimates. Of the BMPs discussed in Section 4, the impervious cover reduction and sanitary sewer maintenance are not included in **Table 50**, as the impervious cover reduction ultimately is a component of the structural BMP program, and the sanitary sewer maintenance is required under the collection system permit.

Table 50: Nonstructural Best Management Practice Cost Estimates.

Program	Present Worth (2011 dollars)[1]
Storm Drain Stenciling Program	60,000
Catch Basin Cleanouts	1,100,000
Catch Basin Inserts[2]	2,000,000
Downspout Disconnection Program	150,000
Fats, Oils and Grease Outreach	60,000
Green Waste Outreach	60,000
Horse Manure Outreach	30,000
Illicit Connection Removal	140,000
Industrial/ Commercial Facilities Control Program	70,000
Landscape and Recreational Facilities Management	130,000
Storage Facilities	50,000
Oil Well ESC Outreach	80,000
Pet Waste Outreach	300,000
Post Construction Requirements	25,000
Sewer System Maintenance	110,000
Smart Gardening Program	550,000
Street and Parking Lot Sweeping	1,100,000
Total	6,015,000

1 Program costs through 2018 using 3% rate of inflation
2 Although normally considered structural BMPs, for the purposes of the model, catch basin inserts were accounted for as a nonstructural BMP.

Structural cost estimates are listed in **Table 51**. Implementation costs for the conceptual projects do not include engineering design, permitting, construction, building materials, or O&M. The details of the five conceptual designs are presented in Section 5.

As per the quantification analysis, structural BMPs are required in addition to the conceptual projects and projects situated on County lands. Typical costs for the additional projects are used to estimate the cost of projects on leased or private parcels. The costs do not reflect the costs of negotiation with land owners or the cost of land acquisition. The costs for additional projects are subject to change to reflect the specific site conditions.

Table 51: Program Cost Estimates of Structural Best Management Practices.

Structural Best Management Practice	Present Worth (2011 Dollars)[1]
Conceptual Projects	
South Coast Botanical Gardens	595,000[2]
Centralized Treatment Retrofit	4,570,000[2]
Commercial Parking Lot Retrofit – Option 1	145,000[2]
Commercial Parking Lot Retrofit – Option 2	1,280,000[2]
Commercial Parking Lot Retrofit – Option 3	125,000[2]
Redevelopment	0[3]
Additional County Projects	4,900,000[4]
Projects on Leased/Private Parcels	45,000,000[5]
Total	56,605,000[6]

1 Program cost estimate through 2018 assuming 3% rate of inflation.
2 Includes construction, engineering design, permitting, and O&M over 10-years; does not include land acquisition
3 Redevelopment subject to the LID Ordinance and SUSMP requirements to be implemented at developer's expense
4 County projects largely bioretention for secondary roadways, may require additional flow management to direct runoff to center median area.
5 Estimates subject to specific site variability and may require additional funds.
6 Cost estimate presented as simple summation.

9.2 COST SCHEDULE

The schedule for implementation to achieve the TMDL WLA, requiring 93.6% reduction in phosphorus load, is summarized in **Figure 24**. The schedules for nonstructural, structural, redevelopment, and leased property projects were used to distribute the implementation costs over time, ending in 2018, the compliance point for the Nutrients TMDL. The implementation path represented by **Figure 24**, is a method of compliance with the Nutrients and Toxics TMDLs. As the adaptive management and reevaluation of the Nutrient TMDL progresses, the required levels of pollutant loading and the compliance timeline may change. The actual costs and timing of implementation will depend on the specific site characteristics, special studies, and actual effectiveness of installed BMPs.

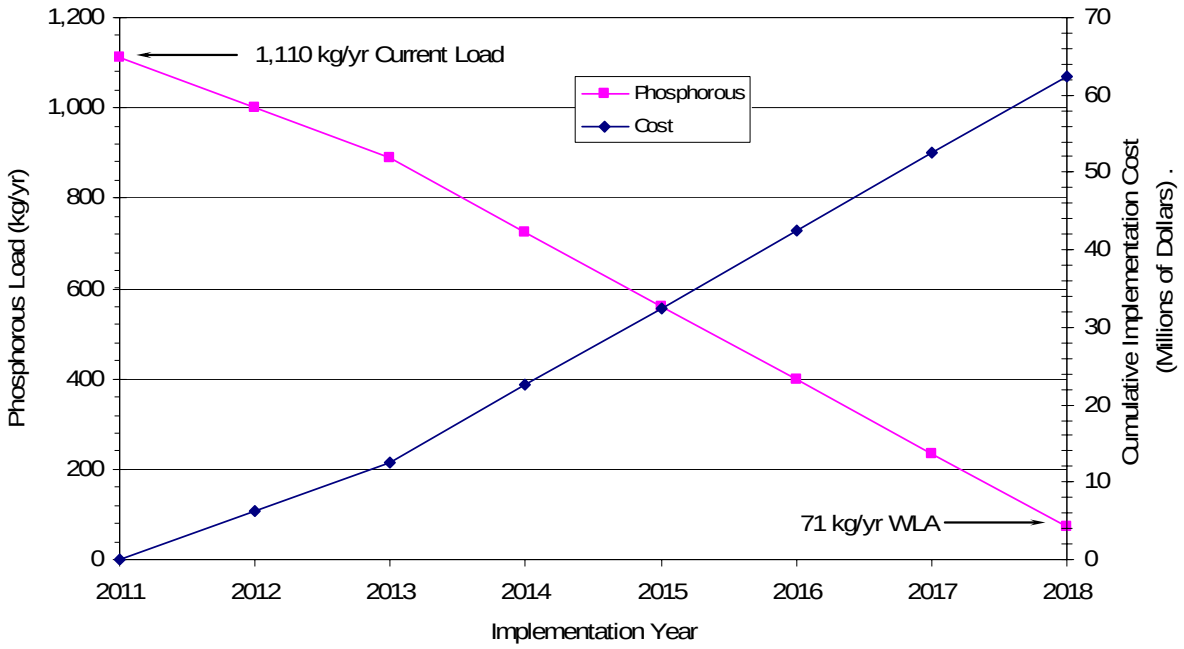


Figure 24: Load Reduction for Cumulative Spending to Achieve Phosphorus Load Allocation.

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Appendix A

Nutrient TMDL Basin Plan Amendment

Attachment A to Resolution No. R08-006

Amendment to the Water Quality Control Plan – Los Angeles Region

to Incorporate the

Total Maximum Daily Load for Eutrophic, Algae, Ammonia, and Odors (Nutrient) in Machado Lake

Adopted by the California Regional Water Quality Control Board, Los Angeles Region on May 1, 2008

Amendments

Table of Contents
Add:

Chapter 7. Total Maximum Daily Loads (TMDLs)

7- 29 Machado Lake Nutrient TMDL

List of Figures, Tables, and Inserts
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Chapter 7. Total Maximum Daily Loads (TMDLs)
Tables

7-29 Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL
7-29.1. Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL - Elements
7-29.2. Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL - Implementation Schedule

Chapter 7. Total Maximum Daily Loads (TMDLs)
Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL

This TMDL was adopted by:

The Regional Water Quality Control Board on May 1, 2008.

This TMDL was approved by:

The State Water Resources Control Board on **[Insert date].**
The Office of Administrative Law on **[Insert date].**
The U.S. Environmental Protection Agency on **[Insert date].**

This TMDL is effective on **[Insert Date]**

The elements of the TMDL are presented in Table 7-29.1 and the Implementation Plan in Table 7-29.2

Table 7-29.1. Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL: Elements

TMDL Element	Regulatory Provisions
Problem Statement	Excessive loadings of nutrients, in particular nitrogen (including ammonia) and phosphorus, cause eutrophic effects, including algae and odors, which impair the beneficial uses of Machado Lake. The nutrient enrichment results in high algal productivity; algal blooms have been observed in the lake during summer months. In addition, high nutrient concentrations contribute to excessive and nuisance macrophyte growth. Algae respiration and decay depletes oxygen from the water column creating an adverse aquatic environment. Machado Lake was placed on the Clean Water Act 303(d) list of impaired waterbodies in 1998, 2002, and 2006 for ammonia, algae, odors, and eutrophic. Applicable Water Quality Objectives for this TMDL are narrative objectives for Biostimulatory Substances and Taste and Odor; and numeric objectives for Dissolved Oxygen and Ammonia. The beneficial uses of Machado Lake include beneficial uses associated with recreation (REC 1 and REC 2), aquatic life (WARM, WILD, RARE, and WET) and water supply (MUN). This TMDL addresses the eutrophic, algae, ammonia, and odor listings which impair these uses.
Numeric Targets	The total phosphorus target for Machado Lake is 0.1 mg/L as a monthly average concentration in the water column, which is based upon US EPA Nutrient Criteria Technical Guidance Manual for Lakes and Reservoirs. A ratio of total nitrogen to total phosphorus of 10 is the basis for the total nitrogen (TKN + NO_3-N + NO_2 –N) numeric target of 1.0 mg/L as a monthly average concentration in the water column. The total nitrogen target incorporates all forms of nitrogen including TKN, which is the sum of organic nitrogen and ammonia nitrogen, nitrate nitrogen (NO_3-N), and nitrite nitrogen (NO_2-N). The total nitrogen target expressed as a monthly average is protective of chronic aquatic life exposure for ammonia. There is a separate numeric target for ammonia of 5.95 mg/L as an hourly average to be protective of acute aquatic life exposure. The chlorophyll *a* target is 20 ug/L based on EPA guidance and the Carlson Trophic Status Index. The dissolved oxygen target is a single sample concentration of no less than 5 mg/L measured at 0.3 meter above the sediments based on the Basin Plan objective. The following table provides the numeric targets for the Machado Lake TMDL.

<table>
<tr><th>TMDL Element</th><th>Regulatory Provisions</th></tr>
<tr><td></td><td>
<table>
<tr><th>Indicator</th><th>Numeric Target</th></tr>
<tr><td>Total Phosphorus</td><td>0.1 mg/L monthly average</td></tr>
<tr><td>Total Nitrogen (TKN + NO_3-N + NO_2 –N)</td><td>1.0 mg/L monthly average</td></tr>
<tr><td>Ammonia - N</td><td>5.95 mg/L one-hour average</td></tr>
<tr><td>Ammonia - N</td><td>2.15 mg/L 30 day average</td></tr>
<tr><td>Dissolved Oxygen</td><td>5 mg/L single sample minimum measured 0.3 meter above the sediments.</td></tr>
<tr><td>Chlorophyll a</td><td>20 µg/L monthly average</td></tr>
</table>
</td></tr>
<tr><td>Source Analysis</td><td>The point sources of nutrients into Machado Lake are stormwater discharges from the municipal separate storm sewer system (MS4), California Department of Transportation (Caltrans), and general construction and industrial discharges. Stormwater discharges to Machado Lake occur through the following subdrainage systems: Drain 553, Wilmington Drain, Project 77/510, and Walteria Lake. Discharges from Walteria Lake and Drain 553 are tributary to the Wilmington Drain, which then directly discharges in the northern portion of Machado Lake. Approximately, 88 % of the discharge into the lake enters through the Wilmington Drain.

The major nonpoint source of nutrients to Machado Lake is internal nutrient loading (nutrient flux from sediments). Atmospheric deposition is also a nonpoint source of total nitrogen. Nutrient loads from wind resuspension, bioturbation, birds, and general surface runoff are minor sources. Special studies may be conducted to further evaluate sources.</td></tr>
<tr><td>Linkage Analysis</td><td>The linkage analysis focuses on the relationship between the nutrient loading to the lake and the numeric targets established to measure attainment of beneficial uses. The Nutrient Numeric Endpoints BATHTUB Spreadsheet Model, which was developed by Tetra Tech for US EPA, was used to establish the linkage between nutrient loading to Machado Lake and the predicted water quality response. The model performs water and nutrient balance calculations under steady-state conditions. Eutrophication related water quality conditions are expressed in terms of total phosphorus, ortho-phosphourus, total nitrogen, inorganic nitrogen, chlorophyll a, transparency (Secchi depth), and hypolimnetic oxygen depletion rates. The linkage analysis demonstrates that assigning waste load and load allocations for total nitrogen and total phosphorus will address eutrophication related water quality conditions.</td></tr>
<tr><td>Waste Load Allocations</td><td>Waste load allocations are assigned to urban stormwater dischargers (MS4, Caltrans, general construction and general industrial) in both wet and dry weather. The final waste load allocations are assigned as concentration based allocations of 0.1 mg/L and 1.0 mg/L as monthly averages for total phosphorus and total nitrogen (TKN + NO_3-N + NO_2 –N), respectively.</td></tr>
</table>

TMDL Element	Regulatory Provisions

Interim WLAs are based on current in-lake concentrations. The effective date interim total nitrogen and total phosphorus waste load allocations are set as the 95th percentile of current concentrations in the lake. The 5 year interim total nitrogen WLAs are established as a 30 percent reduction from current in-lake concentrations. Concentration-based interim and final WLAs will be included in stormwater permits in accordance with NPDES guidance and requirements. The tables below present the interim and final waste load allocations for the stormwater discharges.

Waste Load Allocations	Total Phosphorus	Total Nitrogen ($TKN + NO_3\text{-}N + NO_2\text{-}N$)
	Final WLA (mg/L)	Final WLA (mg/L)
MS4 Permittees[1] Caltrans, General Construction and Industrial stormwater permits	0.1	1.0

1. Municipal Separate Storm Sewer System (MS4) Permittees that are responsible for discharges to Machado Lake include: Los Angeles County, Los Angeles County Flood Control District, and the Cities of Carson, Lomita, Los Angeles, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates, and Torrance.

Waste Load Allocations	Years After Effective Date	Interim Total Phosphorus WLAs (mg/L)	Interim Total Nitrogen (TKN + NO3-N + NO2-N) WLAs (mg/L)
MS4 Permittees, Caltrans, General Construction and Industrial Stormwater permits	At Effective Date[1]	1.25	3.50
	5[2]	1.25	2.45
	9.5 (Final WLAs[3])	0.10	1.00

[1] The compliance point for all effective date interim WLAs is measured in the lake.
[2] The compliance point for all year 5 interim WLAs is measured as specified in Implementation Plan Section II of Table 7-29.1
[3] The compliance point for all final WLAs is measured as specified in Implementation Plan Section II of Table 7-29-.1

<table>
<tr><th>TMDL Element</th><th>Regulatory Provisions</th></tr>
<tr><td>Load Allocations</td><td>
Load allocations are assigned for nonpoint source discharges to the lake, primarily internal loading from the lake. The final load allocations for internal loading are concentration based allocations of 0.1 mg/L and 1.0 mg/L as monthly averages for total phosphorus and total nitrogen (TKN + NO_3-N + NO_2 –N), respectively. Concentration based load allocations are appropriate and can be evaluated by monitoring the nutrient concentrations in the water column.

Interim LAs are based on current in-lake concentrations. The effective date interim total nitrogen and phosphorus load allocations are set at the 95th percentile of current concentrations in the lake. The 5 year interim total nitrogen LAs are established as a 30 percent reduction from current in-lake concentrations. The tables below present the final and interim load allocations for the nonpoint sources.

<table>
<tr><th rowspan="2">Load Allocations</th><th>Total Phosphorus</th><th>Total Nitrogen (TKN + NO_3-N + NO_2-N)</th></tr>
<tr><th>Final LA (mg/L)</th><th>Final LA (mg/L)</th></tr>
<tr><td>Internal Nutrient Load (City of Los Angeles Department of Recreation and Parks)</td><td>0.1</td><td>1.0</td></tr>
</table>

<table>
<tr><th>Load Allocations</th><th>Years After Effective Date</th><th>Interim Total Phosphorus LAs (mg/L)</th><th>Interim Total Nitrogen (TKN+NO3-N+NO2-N) LAs (mg/L)</th></tr>
<tr><td rowspan="3">Internal Nutrient Load (City of Los Angeles Department of Recreation and Parks)</td><td>At Effective Date</td><td>1.25</td><td>3.50</td></tr>
<tr><td>5</td><td>1.25</td><td>2.45</td></tr>
<tr><td>9.5 (Final LAs)</td><td>0.10</td><td>1.00</td></tr>
</table>
</td></tr>
<tr><td>Margin of Safety</td><td>The uncertainties associated with this TMDL are due to limited data from the stormdrains entering the lake and the inherent seasonal and annual variability in delivery of phosphorus and nitrogen for external sources and nutrient cycling within the lake. To address these uncertainties, conservative numeric targets were selected by establishing the targets under a critical lake volume. Likewise, the waste load and load allocations are based on a constant value for internal loading. Moreover, the lake conditions under which the load capacity was developed were based on dry weather critical conditions when the lake level is</td></tr>
</table>

TMDL Element	Regulatory Provisions
	reduced and therefore loading capacity is reduced. These conservative approaches provide an implicit margin of safety.
Seasonal Variations and Critical Conditions	The external nutrient loading to Machado Lake generally occurs during winter and spring months, in conjunction with storm events. During the dry season the lake receives minimal external loading. In the summer there is the release of nutrients from the sediments. At the same time there is very little water inflow and a decreased lake level due to evaporation. These seasonal variations cause increased nutrient concentrations. Moreover, the reduced lake volume during the summer months provides less assimilative capacity. The critical condition for the attainment of beneficial uses at Machado Lake occurs during the summer months. Also, the critical conditions for dissolved oxygen impairments related to algae growth are during the warm dry summer months when algal respiration is highest. The Machado Lake nutrient TMDL accounts for seasonal and critical conditions of the summer months by assigning a load allocation to the lake sediments and requiring a reduction in this source of nutrients to the lake, and by assigning WLAs to urban stormwater dischargers year-round.
Special Studies and Monitoring Plan	**Special Studies** Additional monitoring and special studies may be undertaken by dischargers and responsible agencies to evaluate the uncertainties and assumptions made in the development of this TMDL. (The results of special studies may be used to reevaluate waste load allocations and load allocations when the Machado Lake Nutrient TMDL is reconsidered.) ***Optional Study #1:*** Core flux study to estimate the nutrient flux from sediments under equilibrium conditions. Results from this study would be beneficial to gauge the success of implementation measures such as aeration. ***Optional Study #2:*** A study to understand factors such as nitrogen and phosphorus sedimentation rates (particulate settling velocities), the overall lake sedimentation rate, and sediment resuspension rate. These factors would be important for a Machado Lake nutrient budget and gauging the potential need for periodic hydraulic dredging. ***Optional Study #3***: A work plan for permittees to assess compliance with TMDL WLAs on a mass basis for total nitrogen and total phosphorous. The work plan should detail testing methodologies, BMPs, and treatments to be implemented to attain and demonstrate a reduction of total nitrogen and phosphorous loading on a mass basis. A final report including the results shall be submitted to the Regional Board for Executive Officer approval. Additional special studies proposed by stakeholders are optional and will be considered at the 7.5 year TMDL reconsideration. All proposed special study work plans and documents shall be submitted to the Regional Board for Executive Officer approval prior to special studies being initiated.

TMDL Element	Regulatory Provisions
	Monitoring Plan A Monitoring and Reporting Program (MRP) plan to assess compliance with LAs and WLAs measured in lake must be submitted to the Executive Officer for approval within one year of the effective date. Monitoring will begin 60 days after the Executive Officer has approved the monitoring plan. This MRP plan will be required as part of the Lake Water Quality Management Plan as discussed in the Implementation Section. The MRP plan will be designed to monitor and implement this TMDL. The monitoring plan is required to measure the progress of pollutant load reductions and improvements in water quality. The monitoring plan shall ▪ Determine attainment of total phosphorus, total nitrogen, ammonia, dissolved oxygen, and chlorophyll *a* numeric targets. ▪ Determine compliance with the waste load and load allocations for total phosphorus, and total nitrogen. ▪ Monitor the effect of implementation actions on lake water quality Responsible jurisdictions shall be required to begin monitoring sixty days after the Executive Officer approves the MRP. Field samples and water samples shall be collected bi-weekly on a year-round basis. The lake sampling sites will be located in the open water portion of the lake with one in the northern portion and one in the southern portion of the lake. *In situ* measurements of water quality shall be made. The water quality probes will be calibrated immediately prior to departure to the field against known pH, EC, and DO solutions. Secchi depth, a measurement of transparency, will also be measured with a standard Secchi disk or other approved method. Additionally, a staff gauge shall be placed in an appropriate location at the lake to measure changes in lake elevation. The monitoring plan shall consider stratification for the collection of water samples. Water samples shall be analyzed for constituents including but not limited to the following. ▪ Total nitrogen ▪ Total phosphorus ▪ Nitrate (NO_3-N) ▪ Total ammonia (NH_3-N) ▪ Ortho-phosphorus (PO_4) ▪ Total Dissolved Solids ▪ Total Suspended Solids ▪ Chlorophyll a ▪ Turbidity

TMDL Element	Regulatory Provisions
	Detection limits shall be less than the numeric targets in this TMDL. A monitoring report shall be prepared and submitted to the Regional Board annually within six months after the completion of the final sampling event of the year. If an alternative WLA compliance option is selected, an appropriate separate TMDL compliance MRP Plan and TMDL Implementation Plan must be submitted for Executive Officer approval. Annual monitoring reports demonstrating compliance or non-compliance with WLAs shall be submitted for Executive Officer approval. All compliance monitoring must be conducted in conjunction with a Regional Board approved Quality Assurance Project Plan (QAPP). The QAPP shall include protocols for sample collection, standard analytical procedures, and laboratory certification.

TMDL Element	Regulatory Provisions
Implementation Plan	Compliance with the TMDL is based on the assigned WLAs and LAs. Compliance with this TMDL will require the implementation of NPDES stormwater permit limits and lake management activities to reduce nutrient loading to the lake, reduce nutrient concentrations in the lake, prevent excessive algal biomass growth, and maintain an adequate dissolved oxygen concentration. Table 7-29.2 contains a schedule for responsible jurisdictions to implement BMPs and a Lake Water Quality Management Plan to comply with the TMDL. I. Implementation and Determination of Compliance with LAs Compliance with the LAs will be measured in the lake and will be achieved through a combination of implementation of lake management projects and BMPs to reduce external and internal nutrient loading to the lake and to reduce and manage internal nutrient sources. Load allocations will be implemented through the following: (1) Memorandum of Agreement (MOA), or (2) Clean Up and Abatement Order or Other Regulatory Order The responsible jurisdictions for the load allocations shall be allowed one year from the effective date of this TMDL to enter into a Memorandum of Agreement (MOA) with the Executive Officer, detailing the voluntary efforts that will be undertaken to attain the load allocations. The MOA shall comply with the Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options ("Policy"), including part II, section 2 c ii and related provisions, and shall be consistent the requirements of this TMDL. If the MOA is timely adopted, and so long as it is implemented, the program described in the MOA shall be deemed "certified", pursuant to the Policy, subject to the conditions of Policy section 2 e. The MOA shall include development of a Lake Water Quality Management Plan (LWQMP), must be approved by the Executive Officer, and may be amended with Executive Officer approval, as necessary. If a MOA is not established with responsible jurisdictions within one year or if responsible jurisdictions do not comply with the terms of the MOA, a cleanup and abatement order pursuant to Water Code section 13304, or another appropriate regulatory order, shall be issued to implement the load allocations. Furthermore, the implementation of the MOA must result in attainment of the TMDL load allocations. If the MOA and LWQMP are not implemented or otherwise do not result in attainment of load allocations, the certification shall be revoked, the MOA rescinded, and the load allocations shall be implemented through a cleanup and abatement order, or other order, as described above. Implementation of the MOA shall be reviewed annually by the Executive Officer as part of the Monitoring and Reporting Program (MRP) annual reports. To the satisfaction of the Executive Officer the LWQMP shall meet the following criteria:

TMDL Element	Regulatory Provisions
	■ One and one half years from the effective date of the TMDL responsible jurisdictions shall submit a LWQMP, MRP Plan and QAPP for approval by the Executive Officer. ■ The LWQMP shall include a list of cooperating parties. ■ The LWQMP shall address appropriate water quality monitoring and a timeline for the implementation of management practices to reduce and manage nutrient loading to the lake. The timeline shall ensure that the implementation actions are underway prior to Regional Board reconsideration of the TMDL. The LWQMP shall present a comprehensive management plan and strategy for achieving the LAs at Machado Lake and attaining numeric targets and beneficial uses. The LWQMP shall include a schedule for implementation actions. ■ The LWQMP shall achieve compliance with the load allocations through the implementation of lake management strategies to reduce and manage internal nutrient sources. The lake management implementation actions may include, but are not limited to the following: ■ Wetland restoration ■ Aeration system ■ Hydraulic Lake dredging ■ Hydroponic Islands ■ Alum treatment ■ Fisheries Management ■ Macrophyte Management and Harvesting ■ Maintain Lake Level – Supplemental Water ■ The LWQMP shall include a MRP Plan. The MRP shall include a requirement that the responsible jurisdictions report compliance and non-compliance with load allocations as part of annual reports submitted to the Regional Board. Compliance with the load allocations shall be measured in the lake at two locations, one in the north portion and one in the south. The average of these two sampling locations shall determine compliance with the load allocations. MRP protocols may be based on Surface Water Ambient Monitoring Program (SWAMP) protocols for water quality monitoring or alternative protocols proposed by dischargers and approved by the Executive Officer. ■ A QAPP shall also be submitted to the Regional Board for approval by the Executive Officer to ensure data quality. The QAPP shall include protocols for sample collection, standard analytical procedures, and laboratory certification. The QAPP may be based on SWAMP protocols for water quality monitoring and quality assurance or alternative protocols proposed by dischargers and approved by the Executive Officer.

TMDL Element	Regulatory Provisions
	■ The MOA and LWQMP program shall include assurances that it will be implemented by the responsible jurisdiction. ■ Implementation of the LWQMP program should include a Health and Safety Plan to protect personnel. The Executive Officer may require a revised assessment under the MOA and LWQMP: (a) To prevent nutrients from accumulating or recycling in the lake in deleterious amounts that impair water quality, contribute to negative eutrophic conditions or adversely affect beneficial uses; (b) To reflect the results of nutrient assessment or special studies Cleanup and Abatement Order or Other Regulatory Order: Alternatively, responsible jurisdictions may propose, or the Regional Board may impose, an alternative program which would be implemented through a cleanup and abatement order, or any other appropriate order or orders, provided the program is consistent with the allocations, reductions, and schedule described in Table 7-29.2. ❖ Determination of Compliance with Interim LAs Responsible parties shall comply with numeric interim LAs or may be deemed in compliance with the interim LAs through implementation of lake sediment removal and/or lake management implementation actions in accordance with the LWQMP schedule as approved by the Regional Board Executive Officer. II. Implementation and Determination of Compliance with WLAs WLAs will be incorporated into NPDES stormwater permits. Stormwater permittees may be deemed in compliance with waste load allocations by actively participating in a LWQMP and attaining the waste load allocations for Machado Lake. Stormwater permittees and the responsible party for the lake may work together to implement the LWQMP and reduce external nutrient loading to attain the TMDL waste load allocations measured in the lake. Alternatively, MS4 Permittees may be deemed in compliance with waste load allocations by demonstrating reduction of total nitrogen and total phosphorous on an annual mass basis measured at the stormdrain outfall of the permittee's drainage area. The annual mass based allocation shall be equal to a monthly average concentration of 0.1 mg/L TP and 1.0 mg/L TN based on approved flow conditions. Permittees must demonstrate total nitrogen and total phosphorous load reductions to be achieved in accordance with a special study workplan approved by the Executive Officer. Compliance may also be demonstrated as concentration based monthly averages

TMDL Element	Regulatory Provisions
	for TP and TN measured at the stormdrain outfall of the permittee's drainage area. MS4 Permittees shall be required to develop and implement a MRP plan and TMDL Implementation Plan. The MRP plan shall include a requirement that the responsible jurisdictions report compliance and non-compliance with waste load allocations as part of annual reports submitted to the Regional Board. ❖ Determination of Compliance with Interim WLAs Responsible parties may comply with the numeric interim WLAs or may be deemed in compliance with the interim WLAs through implementation of external nutrient source reduction projects in accordance with the TMDL Implementation Plan schedule as approved by the Regional Board Executive Officer. The Regional Board may revise these WLAs and the compliance point based on the collection of additional information developed through special studies or monitoring conducted as part of this TMDL. The Regional Board will reconsider the TMDL at 7.5 years from the effective date based on water quality monitoring and special studies.

TMDL Element	Regulatory Provisions
	III. APPLICATION OF ALLOCATIONS TO RESPONSIBLE JURISDICTIONS Responsible jurisdictions to attain WLAs for this TMDL include but are not limited to: • Caltrans • General Stormwater Permit Enrollees • MS4 Permittees including: ➢ Los Angeles County ➢ Los Angeles County Flood Control District ➢ Cities of Carson, ➢ City of Lomita, ➢ City of Los Angeles, ➢ City of Palos Verdes Estates, ➢ City of Rancho Palos Verdes, ➢ City of Redondo Beach, ➢ City of Rolling Hills, ➢ City of Rolling Hills Estates, ➢ City of Torrance. The City of Los Angeles, Department of Recreation and Parks is responsible jurisdiction to implement the assigned Load Allocations for this TMDL.

Table 7-29.2 Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL: Implementation Schedule

Task Number	Task	Responsible Jurisdiction	Date
1	Effective date interim waste load (WLA) and load allocations (LA) for total nitrogen and total phosphorus apply.	California Department of Transportation (Caltrans), Municipal Separate Storm Sewer System Permittees[4] (MS4 Permittees), City of Los Angeles – Department of Recreation and Parks	Effective Date of TMDL
2	Responsible jurisdictions shall enter into a Memorandum of Agreement (MOA) with the Regional Board to implement the load allocations.	City of Los Angeles – Department of Recreation and Parks	1 year from effective date of TMDL
3	Regional Board staff shall begin development of a Clean Up and Abatement Order or other regulatory order to implement the load allocations if an MOA is not established with responsible jurisdictions.	Regional Board Staff	1 year from effective date of TMDL
4	Clean Up and Abatement Order or other regulatory order adopted by the Regional Board if an MOA is not established with responsible jurisdictions. The Clean Up and Abatement Order or other regulatory order shall reflect the TMDL Implementation Schedule.	Regional Board Staff	1.5 years from effective date of TMDL
5	Responsible jurisdictions whose compliance is determined as concentration based WLAs measured at end of pipe shall submit a Monitoring and Reporting Program (MRP) Plan to the Executive Officer for approval.	Caltrans, MS4 Permittees	One year from effective date of TMDL
6	Responsible jurisdictions shall submit a Lake Water Quality Management Plan, MRP Plan and Quality Assurance Project Plan for approval by the Executive Officer to comply with MOA.	City of Los Angeles – Department of Recreation and Parks	1.5 years from effective date of TMDL
7	Responsible jurisdictions shall submit a work plan for optional special study #3 (if responsible jurisdictions choose to conduct this special study) for approval by the Executive Officer.	Caltrans, MS4 Permittees	One year from effective date of TMDL

[4] Municipal Separate Storm Sewer System (MS4) Permittees that are responsible for discharges to Machado Lake include: Los Angeles County, Los Angeles County Flood Control District, and the Cities of Carson, Lomita, Los Angeles, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates, and Torrance.

Task Number	Task	Responsible Jurisdiction	Date
8	Responsible jurisdictions shall submit work plans for optional special studies #1 and #2 (if responsible jurisdictions choose to conduct special studies) for approval by the Executive Officer.	Caltrans, MS4 Permittees, City of Los Angeles – Department of Recreation and Parks	1.5 years from effective date of TMDL
9	Responsible jurisdictions shall begin monitoring as outlined in the approved MRP plan.	Caltrans, MS4 Permittees, City of Los Angeles – Department of Recreation and Parks	Sixty days from date of MRP Plan approval
10	Responsible jurisdictions shall begin implementation of Lake Water Quality Management Plan.	City of Los Angeles – Department of Recreation and Parks	Sixty days from date of Lake Water Quality Management Plan approval
11	Responsible jurisdictions whose compliance is determined as concentration based WLAs measured at end of pipe shall submit a TMDL Implementation Plan including BMPs to address discharges from storm drains.	Caltrans, MS4 Permittees	Two years from effective date of TMDL
12	Responsible jurisdictions whose compliance is determined as concentration based WLAs measured at end of pipe shall begin implementation of BMPs to address discharges from stormdrains	Caltrans, MS4 Permittees	Sixty days from date of Implementation Plan approval
13	Responsible jurisdictions shall submit annual monitoring reports. The monitoring reports shall include a requirement that the responsible jurisdictions demonstrate compliance with the MOA. If the MOA and Lake Water Quality Management Plan are not implemented or otherwise do not result in attainment of load allocations, the Regional Board shall revoke the MOA and the load allocations shall be implemented through a Clean Up and Abatement Order or other regulatory order.	City of Los Angeles – Department of Recreation and Parks	Annually – from date of Lake Water Quality Management Plan approval
14	Responsible jurisdictions whose compliance is determined as concentration based WLAs measured at end of pipe shall submit annual monitoring reports.	Caltrans, MS4 Permittees	Annually – from date of MPR Plan approval
15	Optional Special Study #3 completed and final report submitted for Executive Officer approval.	Caltrans, MS4 Permittees	Within 2.5 years of effective date of TMDL

Task Number	Task	Responsible Jurisdiction	Date
16	Responsible jurisdictions shall submit a MRP Plan and TMDL Implementation Plan for the alternative mass based WLA compliance option (if selected), to the Executive Officer for approval.	Caltrans, MS4 Permittees	Within 2.5 years of effective date of TMDL
17	Responsible jurisdictions shall begin monitoring and implementing projects/programs as outlined in the approved MRP and TMDL Implementation Plan for the alternative mass based WLA compliance option.	Caltrans, MS4 Permittees	Sixty days from date of MRP/ Implementation Plan approval
18	Responsible jurisdictions whose compliance is determined as mass based WLAs measured at end of pipe shall submit annual monitoring reports.	Caltrans, MS4 Permittees	Annually – from date of MPR/ Implementation Plan approval
19	Optional Special Studies completed and Special Study final reports submitted for Executive Officer approval.	Caltrans, MS4 Permittees, City of Los Angeles – Department of Recreation and Parks	Within 6 years of effective date of TMDL
20	Regional Board staff and responsible jurisdictions will present an Information Item to the Regional Board on the progress of TMDL implementation efforts and compliance with implementation schedules.	Regional Board staff and responsible jurisdictions	4 years from effective date of TMDL
21	5 Year interim total nitrogen WLA and LA apply.	Caltrans, MS4 permittees, City of Los Angeles – Department Recreation and Parks	Within 5 years of effective date of TMDL
22	Regional Board will reconsider the TMDL to include results of optional special studies and water quality monitoring data completed by the responsible jurisdictions and revise numeric targets, WLAs, LAs, and the implementation schedule as needed.	Regional Board	7.5 years from effective date of TMDL
23	Responsible jurisdictions shall achieve Final WLAs and LAs for total nitrogen (including ammonia) and total phosphorus and demonstrate attainment of numeric targets for total nitrogen, ammonia, total phosphorus, dissolved oxygen, and chlorophyll a. Responsible parties shall demonstrate attainment of water quality standards for total nitrogen, ammonia, total phosphorus, dissolved oxygen, and biostimulatory substances in accordance with federal regulations and state policy on water quality control.	Caltrans, MS4 Permittees, City of Los Angeles – Department of Recreation and Parks	Within 9.5 years of effective date of TMDL

Appendix B

Toxics TMDL Basin Plan Amendment

Table 7-38.1. Machado Lake Pesticides and PCBs TMDL: Elements

TMDL Element	Regulatory Provisions
Problem Statement	Machado Lake is identified on the 1998, 2002, 2006, and 2008 Federal Clean Water Act Section 303(d) lists of impaired waterbodies due to chlordane, DDT, dieldrin, Chem A, and PCBs in fish tissue. Chem A (the abbreviation for 'chemical group A') is a suite of bio-accumulative pesticides that includes chlordane and dieldrin. The 1998 303(d) listing (and subsequent listings) for Chem A was predominately based on fish tissue concentrations of chlordane and dieldrin; there was only minimal detection of other Chem A pollutants in 1983 and 1984. Chlordane and dieldrin have been recently detected in fish tissue, while other Chem A pollutants have not been detected in 25 years. Therefore, this TMDL only addresses the Chem A pollutants (chlordane and dieldrin) that are causing impairment. Because of potential harm to human health and the environment, the use of these pollutants has been banned for many years; however, the physio-chemical properties of the pollutants cause them to persist in the environment. These pollutants, bound to soil particles, are easily transported with surface runoff to waterbodies. Contaminated sediments accumulate in the receiving waterbodies and aquatic organisms are exposed to the toxic pollutants. Sediment toxicity has been documented at Machado Lake, and it is likely that pesticides and PCBs contribute to the toxic condition of the sediments. Moreover, all of these pollutants biomagnify as they move up the food chain, thereby increasing concentrations in higher trophic-level aquatic organisms and wildlife. The exposure of the Machado Lake ecosystem to chlordane, DDT, dieldrin, and PCBs has impaired the aquatic life (WARM, WILD, RARE, WET) and recreation (REC-1, REC-2), including fishing, designated beneficial uses of the lake. This TMDL addresses these impairments. Applicable water quality objectives for this TMDL are narrative objectives for Chemical Constituents, Bioaccumulation, Pesticides, and Toxicity in the Basin Plan and the numeric water quality criteria promulgated in 40 CFR section 131.38 (the California Toxics Rule (CTR)).
Numeric Targets	Numeric targets are for pesticides and PCBs in water, sediment, and fish tissue to protect aquatic life, fishing, and other recreational uses in the lake. The CTR criteria for human health (including protection for consumption of organisms) are the numeric targets for the water column. These targets will protect both aquatic life and human health because the CTR human health criteria are more stringent than the aquatic life criteria.

TMDL Element	Regulatory Provisions

Pollutant	Water Column Target (µg/L)
Total PCBs	0.00017
4,4' DDT	0.00059
4,4' DDE	0.00059
4,4' DDD	0.00084
Chlordane	0.00059
Dieldrin	0.00014

The sediment numeric targets are based on the freshwater Threshold Effect Concentration (TEC) guidelines compiled by the National Oceanic and Atmospheric Administration (NOAA). The fish tissue numeric targets are based on the Office of Environmental Health Hazard Assessment (OEHHA) Fish Contaminant Goals (FCGs).

Pollutant	Sediment Target (ug/kg dry weight)	Fish Tissue Target (ng/g wet weight)
Total PCBs	59.8	3.6
DDT (all congeners)	4.16	No target
DDE (all congeners)	3.16	No target
DDD (all congeners)	4.88	No target
Total DDT	5.28	21.0
Chlordane	3.24	5.6
Dieldrin	1.9	0.46

Source Analysis

The point sources of pesticides and PCBs into Machado Lake are stormwater and urban runoff discharges from the municipal separate storm sewer system (MS4), California Department of Transportation (Caltrans), and general construction and industrial dischargers. Stormwater and urban runoff discharges to Machado Lake occur through the following subdrainage systems: Wilmington Drain, Project 77 and Project 510.

PCBs, DDT, dieldrin, and chlordane are no longer legally sold or used, yet, they remain ubiquitous in the environment, bound to fine-grained particles. When these particles become waterborne, the chemicals are ferried to new locations. The more recent small discharges of pesticides and PCBs to Machado Lake most likely come from the erosion of pollutant-laden sediment further up in the watershed. Urban runoff and rainfall higher in the watershed mobilize the particles, which are then washed into storm drains and channels that discharge to the lake.

<table>
<tr><th>TMDL Element</th><th>Regulatory Provisions</th></tr>
<tr><td></td><td>The major nonpoint source of pesticides and PCBs to Machado Lake is the internal lake sediments. The contaminated lake sediments are a reservoir of historically deposited pollutants. The resuspension of these sediments contributes to the fish tissue impairment in the lake. Additionally, the feeding behaviors of fish expose them to contaminated sediments. Therefore, a load allocation is assigned to the existing reservoir of contaminated sediment.

The estimated contribution of pesticides and PCBs from point sources is much smaller than the estimated contribution from internal lake sediments. However, a waste load allocation is assigned to ongoing point source discharges to the lake.</td></tr>
<tr><td>Linkage Analysis</td><td>A conceptual model links the source loading information to the numeric targets.

The chemical properties of pesticides and PCBs result in strong binding to particulate matter; therefore, most of the incoming contaminants from the watershed are bound to suspended sediment particles. When the contaminated suspended sediment settles to the lake bottom, pesticides and PCBs accumulate in the lake sediments. These pollutants are available to migrate to the water column and ultimately to the food web. Through bioturbation and feeding processes the contaminants may be taken up by benthic organisms. Once the sediment-bound PCBs and pesticides contaminate benthic organisms, the contaminants may move out of the lake sediments through each trophic level. Thus, the contaminated lake sediments are an important source. It is expected that if sediments within the lake and those loaded to the lake meet sediment numeric targets, then the fish tissue targets will be met as well. The monitoring program will consist of water, sediment, and fish tissue monitoring to assess this assumption.</td></tr>
<tr><td>Loading Capacity</td><td>The loading capacity is calculated as the volume of the active layer of sediment in the lake multiplied by the sediment numeric target.

Pollutant Loading Capacity = Volume Active Sediment x Target Concentration

However, in the case that the existing load is less than the loading capacity (dieldrin and PCBs); the loading capacity is set at the existing load. The existing load is calculated as the volume of the active layer of sediment in the lake multiplied by the observed pollutant concentration.

Existing Pollutant Load = Volume Active Sediment x Pollutant Concentration.
The loading capacity for each pollutant is presented as follows.
<table>
<tr><th>Pollutant</th><th>Loading Capacity (g)</th></tr>
<tr><td>Chlordane</td><td>1,275</td></tr>
<tr><td>Total DDT</td><td>2,078</td></tr>
<tr><td>Dieldrin</td><td>519</td></tr>
<tr><td>PCBs</td><td>14,049</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>TMDL Element</th><th>Regulatory Provisions</th></tr>
<tr><td>Waste Load Allocations</td><td>Waste load allocations (WLAs) for contaminants associated with suspended sediment are assigned to stormwater dischargers (MS4, Caltrans, general construction and general industrial dischargers) in both wet and dry weather.
<table>
<tr><th>Responsible Party</th><th>Pollutant</th><th>WLA for Suspended Sediment Associated Contaminants (µg/kg dry weight)</th></tr>
<tr><td rowspan="7">MS4 Permittees[1], Caltrans, General Construction and Industrial Stormwater Permittees, Other Non-stormwater NPDES Permittees</td><td>Total PCBs</td><td>59.8</td></tr>
<tr><td>DDT (all congeners)</td><td>4.16</td></tr>
<tr><td>DDE (all congeners)</td><td>3.16</td></tr>
<tr><td>DDD (all congeners)</td><td>4.88</td></tr>
<tr><td>Total DDT</td><td>5.28</td></tr>
<tr><td>Chlordane</td><td>3.24</td></tr>
<tr><td>Dieldrin</td><td>1.9</td></tr>
<tr><td colspan="3">[1] WLAs are applied with a 3-year averaging period.</td></tr>
</table></td></tr>
<tr><td>Load Allocations</td><td>Load allocations (LAs) addressing nonpoint sources of pesticides and PCBs are assigned to the existing lake sediments. The LAs are set to attain the lake loading capacity, including a 10% margin of safety.
<table>
<tr><th>Responsible Party</th><th>Pollutant</th><th>LA (grams)</th></tr>
<tr><td rowspan="4">City of Los Angeles, Department of Recreation and Parks</td><td>Chlordane</td><td>1,147</td></tr>
<tr><td>Total DDT</td><td>1,870</td></tr>
<tr><td>Dieldrin</td><td>467</td></tr>
<tr><td>PCBs</td><td>12,644</td></tr>
</table></td></tr>
</table>

[1] Municipal Separate Storm Sewer System (MS4) Permittees include: Los Angeles County, Los Angeles County Flood Control District, and the Cities of Carson, Lomita, Los Angeles, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates, and Torrance.

<table>
<tr><th>TMDL Element</th><th>Regulatory Provisions</th></tr>
<tr><td>Margin of Safety</td><td>The uncertainties associated with this TMDL are due to:

■ Limited data on the amount of pesticides and PCBs residing within the lake sediments
■ Limited data on the amount of pesticides and PCBs entering the lake
■ Estimated information on the volume of the active layer of sediment in Machado Lake
■ Estimated information on the watershed sediment deposition rate
■ Constant bulk density, sediment density, and sediment porosity values used to calculate the load associated with deposited sediment

To address these uncertainties, an implicit margin of safety is included by employing conservative assumptions in the TMDL analysis. Additionally, an explicit 10 % margin of safety is applied to the loading capacity for this TMDL.

<table>
<tr><th>Pollutant</th><th>Loading Capacity (g)</th><th>Loading Capacity with 10 % Margin of Safety</th></tr>
<tr><td>Chlordane</td><td>1,275</td><td>1,147</td></tr>
<tr><td>Total DDT</td><td>2,078</td><td>1,870</td></tr>
<tr><td>Dieldrin</td><td>519</td><td>467</td></tr>
<tr><td>PCBs</td><td>14,049</td><td>12,644</td></tr>
</table>
</td></tr>
<tr><td>Seasonal Variations and Critical Conditions</td><td>Pesticides and PCBs in fish tissue are a concern in Machado Lake due to long-term loading and bioaccumulation and biomagnification. Wet-weather events may produce extensive sediment redistribution and transport sediments to the lake. This would be considered the critical condition for loading and the CTR-based water column targets are protective of this condition. However, the effects of pesticides and PCBs in sediment and fish tissue are manifested over long time periods. The TMDL is established in a manner that accounts for the longer time periods in which ecological effects may occur.</td></tr>
<tr><td>Monitoring Plan</td><td>Responsible parties assigned both WLAs and LAs may submit one document that addresses the monitoring requirements (as described below) and implementation activities for both WLAs and LAs.

<u>Waste Load Allocation Compliance Monitoring</u>

Responsible parties assigned WLAs shall conduct monitoring to determine compliance with the WLAs. Samples will be analyzed for total suspended solids. Sampling shall be designed to collect sufficient volumes of suspended solids to allow for analysis of the following pollutants in the bulk sediment:</td></tr>
</table>

TMDL Element	Regulatory Provisions
	▪ Total Organic Carbon ▪ Total PCBs ▪ DDT and Derivatives ▪ Dieldrin ▪ Total Chlordane In addition to TMDL constituents, general water chemistry (temperature, dissolved oxygen, pH, and electrical conductivity) and a flow measurement will be required at each sampling event. General chemistry measurements may be taken in the laboratory immediately following sample collection, if auto samplers are used for sample collection or if weather conditions are unsuitable for field measurements. The monitoring shall be conducted in two phases at appropriate locations in the subwatershed. Phase 1 Phase 1 monitoring will be conducted for a two-year period. Samples will be collected during three wet weather events each year. The first large storm event of the season shall be included as one of the monitoring events. Phase 2 Phase 2 monitoring will commence once Phase 1 monitoring has been completed. Samples will be collected during one wet weather event every other year. Monitoring shall be conducted under a technically appropriate Monitoring and Reporting Plan (MRP) and Quality Assurance Project Plan (QAPP). The MRP shall include a requirement that the responsible parties report compliance and non-compliance with waste load allocations as part of annual (or biennial during Phase 2 monitoring) reports submitted to the Regional Board. The QAPP shall include protocols for sample collection, standard analytical procedures, and laboratory certification. All samples shall be collected in accordance with SWAMP protocols. Phase 1 sampling shall begin within 60 days of Executive Officer approval of the MRP and QAPP. Stormwater dischargers that fully divert a stormwater discharge to the sanitary sewer may document the diversion as a wet-weather monitoring event and report both the flow and pollutant concentration as zero. Unless all stormwater discharges are fully diverted to the sanitary sewer, at least one wet-weather event must be sampled according to the monitoring requirements above. Stormwater discharges that are not fully diverted are subject to the WLA compliance monitoring described above. The reported pollutant concentration of zero may be combined with other measured sample concentrations (from stormwater discharges that are not fully diverted) when demonstrating compliance with the WLA over the 3-year averaging period.

TMDL Element	Regulatory Provisions
	The Regional Board's Executive Officer may reduce, increase, or modify Phase 2 monitoring and reporting requirements, as necessary, based on the results of Phase 1 monitoring. Currently, several of the constituents of concern have numeric targets that are lower than the readily available detection limits. As analytical methods and detection limits continue to improve (i.e., development of lower detection limits) and become more environmentally relevant, responsible parties shall incorporate new method detection limits in the MRP and QAPP. The Regional Board may reconsider the TMDL WLAs based on the results of Phase 1 and 2 monitoring, if necessary. <u>Load Allocation Compliance and Numeric Target Assessment Monitoring</u> Monitoring to determine compliance with the TMDL load allocations and attainment of numeric targets shall be conducted as part of the Lake Water Quality Management Plan (LWQMP). This monitoring shall commence following the remediation of lake sediments as presented in the LWQMP. Lake sediment samples will be collected from three locations in the lake (northern end, mid point, southern end). Immediately following remediation of lake sediments, samples will be collected at a frequency appropriate to assess post remediation conditions and demonstrate compliance with LAs. Thereafter, samples will be collected every three years to assess attainment of numeric targets. All samples shall be collected in accordance with SWAMP protocols. Sediment samples will be analyzed for: ▪ Total Organic Carbon ▪ Total PCBs ▪ DDT and Derivatives ▪ Dieldrin ▪ Total Chlordane A water sample will be collected every three years from the mid point of the lake. Sample collection shall be associated with wet-weather conditions. Samples will be collected as a depth integrated water column sample and/or a bottom sample (collected near the sediments) as appropriate based on lake depth. All samples shall be collected in accordance with SWAMP protocols. Samples (unfiltered) will be analyzed for: ▪ Total PCBs ▪ DDT and Derivatives ▪ Dieldrin ▪ Total Chlordane Fish shall be collected for tissue analysis every 3 years. Fish tissue samples will be analyzed for:

TMDL Element	Regulatory Provisions
	▪ Total PCBs ▪ DDT and Derivatives ▪ Total Chlordane ▪ Dieldrin The fish collection and analysis shall be conducted in accordance with the U.S. EPA *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 1 Fish Sampling and Analysis* (EPA 823-B-00-0007) or updates. In addition to TMDL constituents, general water chemistry (temperature, dissolved oxygen, pH, and electrical conductivity) will be required at each sampling event. The Executive Officer may require additional monitoring depending on which implementation alternatives are pursued by the responsible parties. Currently, several of the constituents of concern have numeric targets that are lower than the readily available detection limits. As analytical methods and detection limits continue to improve (i.e., development of lower detection limits) and become more environmentally relevant, responsible parties shall incorporate new method detection limits in the MRP and QAPP. <u>Wilmington Drain Monitoring</u> The Los Angeles County Flood Control District shall monitor Wilmington Drain to demonstrate that Wilmington Drain is not re-contaminating Machado Lake. Monitoring shall include bed sediment sampling and visual inspection of channel maintenance and operation of best management practices (BMPs). Monitoring shall be required by Regional Board order or a conditional Water Quality Certification under section 401 of the Clean Water Act. This monitoring shall be initiated at the same time as all other required WLA monitoring.

TMDL Element	Regulatory Provisions
Implementation Plan	Compliance with the TMDL is based on the assigned WLAs and LAs. Compliance with this TMDL will require the implementation of NPDES permit limitations for urban runoff and stormwater discharges and cleanup of contaminated lake sediments. Table 7-38.2 contains a schedule for responsible parties to implement BMPs and a LWQMP to comply with the TMDL. I. Implementation of WLAs The TMDL WLAs shall be incorporated into the MS4, Caltrans, and general construction and industrial stormwater NPDES permits and any other non-stormwater NPDES permits. Permitted stormwater dischargers can implement a variety of implementation strategies to meet the required WLAs, such as non-structural and structural BMPs, and/or diversion and treatment to reduce sediment transport from the watershed to the lake. II. Implementation of LAs: Load allocations shall be implemented through the following: (1) Memorandum of Agreement (MOA), or (2) Cleanup and Abatement Order or Other Regulatory Order. The responsible parties for the load allocations shall be allowed one year from the effective date of this TMDL to enter into a Memorandum of Agreement (MOA) with the Regional Board, detailing the voluntary efforts that will be undertaken to attain the load allocations. The MOA shall include development of a LWQMP. The MOA shall comply with the Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options ("Policy"), including part II, section 2.c.ii. and related provisions, and shall be consistent with the requirements of this TMDL. If the MOA is timely adopted, and so long as it is implemented, the program described in the MOA shall be deemed "certified", pursuant to the Policy, subject to the conditions of section 2.e. of the Policy. The MOA must be approved by the Executive Officer, and may be amended with Executive Officer approval, as necessary. If an MOA is not established with responsible parties within one year or if responsible parties do not comply with the terms of the MOA, a cleanup and abatement order pursuant to California Water Code section 13304 or another appropriate regulatory order shall be issued to implement the load allocations. Furthermore, the implementation of the MOA must result in attainment of the TMDL load allocations. If the MOA and LWQMP are not implemented or otherwise do not result in attainment of load allocations, the certification shall be revoked, the MOA rescinded, and the load allocations shall be implemented through a cleanup and abatement order or other order as described above. Implementation of the MOA shall be reviewed annually by the Executive Officer

TMDL Element	Regulatory Provisions
	as part of the MRP annual reports. Responsible parties entering into an MOA with the Regional Board shall submit and implement a LWQMP. The LWQMP must be approved by the Executive Officer and may be amended by Executive Officer approval, as necessary. The LWQMP shall include an MRP to address appropriate monitoring and a clear timeline for the implementation of measures that will achieve the lake sediment LAs. The LWQMP shall include annual reporting requirements. In addition to the LWQMP and MRP, a QAPP shall also be submitted to the Regional Board for approval by the Executive Officer to ensure data quality. One and one half years from the effective date of the TMDL, the responsible parties entering into the MOA shall submit a letter of intent, LWQMP, MRP, and QAPP for approval by the Executive Officer in order to be in compliance with the MOA adopted as part of this TMDL. If there is already an MOA, LWQMP, MRP, and QAPP in place to implement the Machado Lake Nutrient TMDL, these documents may be amended to implement and attain the load allocations of this TMDL. The Executive Officer may require a revised assessment under the MOA and LWQMP: (a) To prevent pesticides and PCBs from accumulating or recycling in the lake in deleterious amounts that impair water quality and/or adversely affect beneficial uses; (b) To reflect the results of special studies. Cleanup and Abatement Order or Other Regulatory Order: Alternatively, responsible parties may propose or the Regional Board may impose an alternative program that would be implemented through a cleanup and abatement order, or any other appropriate order or orders, provided the program is consistent with the allocations and schedule described in Table 7-38.2. III. Compliance with Allocations and Attainment of Numeric Targets TMDL effectiveness will be determined through water, sediment, and fish tissue monitoring and comparison with the TMDL waste load and load allocations and numeric targets. The compliance point for the stormwater WLA is at the storm drain outfall of the permittee's drainage area. Alternatively, if stormwater dischargers select a coordinated compliance option, the compliance point for the stormwater WLA may be at storm drain outfalls which suitably represent the combined discharge of cooperating parties discharging to Machado Lake. Depending on potential BMPs implemented, alternative stormwater compliance points may be proposed by responsible parties subject to approval by the Regional Board Executive Officer. The compliance point for responsible parties receiving a load allocation is in Machado Lake.

TMDL Element	Regulatory Provisions
	Stormwater dischargers may coordinate compliance with the TMDL. Compliance with the TMDL may be based on a coordinated MRP and implementation plan. Dischargers interested in coordinated compliance shall submit a coordinated MRP and implementation plan that identifies stormwater BMPs and monitoring to be implemented by the responsible parties. After lake remediation activities, to address existing sediment contamination, are complete and LAs are attained, if Machado Lake is recontaminated as a result of continued polluted discharge from the surrounding watershed, the WLA compliance monitoring data will be used, along with other available information, to assess the relative contribution of watershed dischargers and determine their responsibility for secondary lake remediation activities. If a significant amount of contaminated sediment is transported to Machado Lake from the surrounding watershed after lake remediation actives are completed, but before monitoring is conducted to confirm attainment of LAs, Regional Board staff shall consider all information related to watershed discharges and lake conditions when assessing responsibility for secondary lake remediation activities. IV. Application of Allocations to Responsible Parties Responsible parties to attain WLAs for this TMDL include but are not limited to: • Caltrans • General Stormwater Permit Enrollees • MS4 Permittees including: ➢ Los Angeles County ➢ Los Angeles County Flood Control District ➢ City of Carson ➢ City of Lomita ➢ City of Los Angeles ➢ City of Palos Verdes Estates ➢ City of Rancho Palos Verdes ➢ City of Redondo Beach ➢ City of Rolling Hills ➢ City of Rolling Hills Estates ➢ City of Torrance • Other Non-stormwater Permittees The City of Los Angeles is the responsible jurisdiction to implement the assigned Load Allocations for this TMDL.

Table 7-38.2. Machado Lake Pesticides and PCBs TMDL: Implementation Schedule

Task Number	Task	Responsible Party	Deadline
Load Allocation Requirements			
1	Enter into a Memorandum of Agreement (MOA) with the Regional Board to implement the load allocations. If there is already an MOA in place to implement the Machado Lake Nutrient TMDL, the current MOA may be amended to address the requirements of this TMDL.	City of Los Angeles, Department of Recreation and Parks	1 year from effective date of TMDL
2	Begin development of a Cleanup and Abatement Order or other regulatory order to implement the load allocations if an MOA is not established with responsible parties.	Regional Board	1 year from effective date of TMDL
3	Issue a Cleanup and Abatement Order or other regulatory order if an MOA is not established with responsible parties. The Cleanup and Abatement Order or other regulatory order shall reflect the TMDL Implementation Schedule.	Regional Board	1.5 years from effective date of TMDL
4	Submit a LWQMP[2], MRP[3] Plan, and QAPP[4] for approval by the Executive Officer to comply with the MOA. If there is already a LWQMP, MRP Plan, and QAPP in place to implement the Machado Lake Nutrient TMDL, these documents may be amended to address the requirements of this TMDL.	City of Los Angeles, Department of Recreation and Parks	1.5 years from the effective date of the TMDL
5	Begin implementation of the LWQMP.	City of Los Angeles, Department of Recreation and Parks	60 days from date of LWQMP approval
6	Achieve LAs for Pesticides and PCBs and assess attainment of numeric targets.	City of Los Angeles, Department of Recreation and Parks	September 30, 2019
Waste Load Allocation Requirements			
7	Submit a MRP and QAPP for Executive Officer approval[6].	Caltrans, MS4 Permittees[5], General Construction and	6 months from effective date of TMDL or

[2] Lake Water Quality Management Plan
[3] Monitoring Reporting Program
[4] Quality Assurance Project Plan
[5] Municipal Separate Storm Sewer System (MS4) Permittees include: Los Angeles County, Los Angeles County Flood Control District, and the Cities of Carson, Lomita, Los Angeles, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates, and Torrance.

Task Number	Task	Responsible Party	Deadline
		Industrial Stormwater Permittees	September 11, 2011 whichever date is later
8	Begin monitoring as outlined in the approved MRP and QAPP.	Caltrans, MS4 Permittees, General Construction and Industrial Stormwater Permittees	60 days from date of approval
9	Conduct Phase 1 Monitoring	Caltrans, MS4 Permittees, General Construction and Industrial Stormwater Permittees	2 year monitoring period
10	Based on the results of Phase 1 Monitoring, submit an implementation plan to attain WLAs or document that WLAs are attained.	Caltrans, MS4 Permittees, General Construction and Industrial Stormwater Permittees	6 months from completion of Phase 1 Monitoring (Submit Draft Plan) 1 year from completion of Phase 1 Monitoring (Submit Final Plan)
11	Begin implementation actions to attain WLAs, as necessary.	Caltrans, MS4 Permittees, General Construction and Industrial Stormwater Permittees	60 days from date of plan approval
12	Achieve WLAs for Pesticides and PCBs	Caltrans, MS4 Permittees, General Construction and Industrial Stormwater Permittees	September 30, 2019

[6]The deadline for Responsible Parties assigned both WLAs and LAs to submit one document to address both WLA and LA monitoring requirements and implementation activities shall be 1.5 years from the effective date.