DRAFT

Multi-Pollutant TMDL Implementation Plan for the Unincorporated Area of Marina del Rey Harbor Back Basins

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 Marina del Rey Harbor (MdRH) watershed with an integrated, adaptive management approach of best management practices (BMPs) implementation. The objective of this *Multi-Pollutant Total Maximum Daily Load* (TMDL) *Implementation Plan* (Implementation Plan) is to address current TMDLs established for MdRH Basins D, E, and F (Back Basins). The *TMDL for Toxic Pollutants in MdRH* (Toxics TMDL) lists several metals and toxic organic TMDLs that are considered the primary focus of this Implementation Plan. These pollutants include copper, lead, and zinc metals and chlordane and polychlorinated biphenyls (PCBs) toxic organics. The *MdRH Bacteria TMDL* (Bacteria TMDL) is also considered; however, progress toward bacteria compliance is ongoing and detailed in a separate, final implementation plan. This Implementation Plan examines the documentation and bacteria monitoring results since the completion of the bacteria-focused TMDL Implementation Plan. These data are reviewed in order to develop multi-pollutant implementation strategies that meet the reduction goals of the Toxics TMDL and enhance the strategies of the *MdRH Bacteria TMDL Implementation Plan* to ensure compliance will be achieved. This Implementation Plan does not supersede the *MdRH Bacteria TMDL Implementation Plan* or the *MdRH Bacteria Wet-Weather Quantification Analysis*, but rather builds on the recommendations and analyses made in these documents.

The management options described in this Implementation Plan are limited to unincorporated County areas. Various BMPs were identified and selected to treat stormwater runoff and dry-weather flows to reduce metals, bacteria, and toxic pollutants. The pollutant load reductions of management activities were estimated and related to those required to meet waste load allocations (WLAs) defined by approved TMDLs. The process of BMP selection included considering programs and improvements that effectively address metal, bacteria, and toxic pollutants to provide assurance that the above-mentioned Implementation Plan objective will be achieved. This plan also includes an integrated water resources approach that considers BMPs that can address multiple pollutants, while considering parallel water resources planning strategies for the watershed.

The Toxics TMDL presents two possible TMDL implementation schedules to meet WLAs for metal and toxic pollutants dependent on the implementation approach adopted by the County. An extended period (15 years) is allowed for the TMDL implementation period for the implementation of an integrated water resources approach (including beneficial reuse of stormwater) in recognition of the additional planning and time needed for this approach. Similarly, the Bacteria TMDL states that if an integrated water resources approach is implemented, bacteria compliance shall be achieved in the shortest time possible but not to exceed July 15, 2021. The County has adopted an integrated water resources approach. The metals and toxic pollutants schedule uses a phased approach, where compliance is to be achieved in incremental percentages of the watershed (compliance milestones). The compliance milestones represent the required load reductions to be achieved prior to the milestone date. The TMDL implementation schedules, as defined in the approved TMDLs, are presented in Table ES-1.

Table ES-1. Implementation Schedule for an Integrated, Multi-Pollutant Approach to the Marina del Rey Harbor Back Basins Total Maximum Daily Loads

Integrated TMDL	Action	Date
Metals and Toxic Pollutants TMDL Schedule using an Integrated Approach	Effective Date	March 22, 2006
	Draft TMDL Implementation Plan	March 22, 2011
	Final TMDL Implementation Plan	September 22, 2011
	TMDL Re-Opener	March 22, 2012
	25% of Load Reduction To Meet WLAs Achieved	March 22, 2013
	50% of Load Reduction To Meet WLAs Achieved	March 22, 2015
	75% of Load Reduction To Meet WLAs Achieved	March 22, 2017
	100% of Load Reduction To Meet WLAs Achieved (i.e., Pollutant Loading below WLAs)	March 22, 2021
Bacteria TMDL Schedule using an Integrated Approach	Effective Date	March 18, 2004
	Implementation Plan	March 30, 2005 Draft January 8, 2007 Final
	100% Dry Weather Compliance	March 18, 2007
	100% Wet Weather Compliance	July 15, 2021

To meet the schedule of compliance milestones, a combination of nonstructural and structural BMPs has been identified to be implemented in the watershed. Existing nonstructural BMPs were evaluated to identify opportunities to enhance existing BMPs and implement new nonstructural BMPs in order to reduce pollutant loads and meet WLAs. Nonstructural BMPs that address 12 main pollutant sources for MdRH were identified, and each pollutant source was prioritized. These relative priorities were assigned based on priority sources, number of priority pollutants, potential to transport to marina waters, and/or potential for bacterial regrowth, as determined from past special studies and reports. Generally, higher priority was given to projects building upon existing programs. Source identification studies, code modification evaluations, and other baseline projects were also given higher priority. Table ES-2 lists the pollutant source, nonstructural BMPs, targeted TMDLs, and source priority.

Table ES-2. Summary of Nonstructural Best Management Practices and Priorities

Pollutant Source	Nonstructural BMP	Targeted TMDL[1]	Source Priority (Star Rating)
General	Special studies	Bacteria and toxics[2]	***
MS4 Catchments	Cleaning program	Bacteria and toxics	***
Restaurants	Public outreach, targeted enforcement	Bacteria and toxics	***
Birds	Aggressive cleaning program in parking lot areas	Bacteria	***
Streets and Parking Lots	Street sweeping with advanced technologies	Bacteria and toxics	**
Boating Community	Public outreach – Green Marinas Program for boaters	Bacteria and toxics	**
Trash	Public outreach for RVs and restaurants, street sweeping	Bacteria and toxics	**
Parking Garage Structures	Public outreach for garage managers, Enforcement	Bacteria and toxics	**
Runoff Reduction	Green gardening incentives, irrigation enforcement	Bacteria	**
Sewage	Special studies, restroom cleaning outreach	Bacteria	*
Buildings and Construction	Product substitution for copper and zinc	toxics	*
Pet Waste	Pet-waste bag dispensers, public outreach for dog walkers/owners	Bacteria	*

1 – Although priorities are listed, the County may choose to implement BMPs with less of a rating prior to those with the higher and/or highest ratings based on the availability of funds, additional information, public participation, or other reasons.
2 – The term “toxics” describes both metal and toxic organic pollutants listed in the Toxics TMDL.

*** Highest priority	Target available funds to these solutions based on potential source identification studies.
** Higher priority	These solutions may be implemented if funding and resources are available.
* Lowest priority	Depending on remaining available funds and resources, and the results of potential special studies and effectiveness assessments, these solutions may be implemented per the phased approach.

The various types of structural BMPs that may be implemented within the MdRH watershed to reduce metals, bacteria, and toxic organic pollutants were evaluated to determine which structural BMPs are best suited considering the watershed constraints, such as shallow groundwater table and limited open space. Five sites were identified for conceptual design of potential structural BMPs that significantly reduce pollutants of concern. These five sites may serve as pilot projects, which may be assessed for effectiveness and used as a basis to implement future structural BMPs around the watershed. A summary of the proposed five sites for the construction of BMPs is provided in Table ES-3. Each of the selected BMPs addresses multiple pollutants (metals, bacteria, and toxic organics).

Table ES-3. Summary of Five Selected Site for Construction of Structural Best Management Practices

Site / BMPs	Drainage Area (acres)
Parking Lot 5 and Marina del Rey Library	
Bacterra™ bioretention technology	0.55
Biofiltration planter	2.05
Rain barrels / cisterns	0.05
Subtotal	***2.65***
Parking Lot 7	
Bioretention planter	0.86
Parking Lot 9	
Cisterns[1]	2.0
ClearWater BMP filtration system units[1]	2.0
Flow-through planter boxes[1]	2.0
Parking Lot 10	
Flow-through planter boxes[1]	2.4
Sand infiltration trench[1]	2.4
Parking Lot 11	
Biofiltration planter	0.82
Porous pavement	1.73
Subtotal	***2.55***
Total	**10.46**
[1]BMP treatment train	

A quantitative analysis was performed to evaluate the ability of proposed nonstructural and structural BMPs to meet the TMDL WLAs. The quantification of the effectiveness of nonstructural BMPs is a developing science. Although the effectiveness of individual or specific combinations of nonstructural BMPs is not widely documented in available literature, there are data on recent studies (e.g., street sweeping and source studies) that provided a basis for developing quantification estimates. The conservatively estimated total reduction that could be achieved from nonstructural BMPs is approximately 25%. The reductions that may be achieved through implementation of structural BMPs on the five sites selected for BMP construction were based on commonly used reduction efficiencies from published references and estimated to result in a zinc load reduction of approximately 9.3%. Zinc is the limiting pollutant for metals (i.e., reducing zinc appropriately will result in other metals meeting WLAs).

The anticipated pollutant loadings were determined using the Watershed Management Modeling System (WMMS) developed by the County. The WMMS is a regional modeling approach that has been used to support numerous TMDL developments throughout the County. This Loading Simulation Program in C++ (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. Table ES-4 provides a summary of the pollutant load of Toxic TMDL pollutants modeled by the WMMS.

Table ES-4. Summary of Pollutant Loading in the Unincorporated Area of Marina del Rey Harbor Back Basins Watershed

TMDL Pollutant	Existing Load (lbs/yr)	TMDL Reduction Targets (%)	TMDL Reduction Targets
Copper (lbs/Year)	6.34	90.9%	5.77
Lead (lbs/Year)	5.66	86.1%	4.88
Zinc (lbs/Year)	60.56	95.8%	58.03
Chlordane (lbs/Year)	n/m	n/m	n/m
PCBs (lbs/Year)	n/m	n/m	n/m
Bacteria – Summer Dry Weather	Varies[1]	n/a	0 exceedance days
Bacteria – Winter Dry Weather	Varies[1]	n/a	3 exceedance days
Bacteria – Wet Weather	Varies[1]	31%[2]	17 exceedance days

n/m – not meaningful; not enough data above detection limits
n/a – not applicable; dry weather flows should be reduced and/or diverted (low flow diversions)
1 – Exceedance days observed in current monitoring effort varies among sites comprising the Bacteria TMDL.
2 – Based on *MdRH Bacteria Wet-Weather Quantification Analysis* (MDRWRA, 2007)

The anticipated load reductions from nonstructural BMPs and the five sites selected for construction were incorporated in the WMMS. In addition to nonstructural BMPs and the five selected sites for construction, additional structural BMPs will likely be required to meet WLAs. The WMMS provided recommendations for the additional structural BMPs to meet TMDL WLAs. A summary of the recommended types and total volumetric capacities of additional BMPs that should be distributed around the unincorporated County area to achieve TMDL WLAs is provided in Table ES-5. A summary of the estimated zinc load reductions is also shown in Table ES-5.

Table ES-5. Summary of Best Management Practices and Anticipated Load Reductions in the in the Unincorporated Area of Marina del Rey Harbor Back Basins Watershed

Land Use	Land Area (acres)	BMP Type	Recommended BMP Capacity Volume (acre-ft)	Load Reduction Zinc (%)	Load Reduction Zinc (lbs/yr)
Multi-family residential	32	Water harvesting	0.08	0.8%	0.5
		Bio-retention	1.54	15.0%	9.1
Commercial, retail, & institutional	46.1	Porous pavement	1.36	13.7%	8.3
		Bio-retention	2.38	23.1%	14.0
Transportation	13.5	Bio-retention	0.93	9.0%	5.5
Open Space	15.5	–	–	–	–
Subtotal	**107.1**		**6.33**	**61.6%**	**37.3**
Nonstructural Best Management Practices				25.0%	15.1
Five Site Selected for Best Management Practices Construction				9.3%	5.6
			Total	**95.9%**	**58.1**

The following conclusions were drawn from the quantification analysis:

- Zinc, the limiting pollutant for metals, requires a load reduction of approximately 95.8% to meet the zinc WLA.
- BMPs proposed in this Implementation Plan address total suspended solids (TSS) and the potentially associated organic toxics. Model simulation indicates that the recommended

BMPs will reduce TSS-based Chlordane and PCBs by approximately 94%. Monitoring efforts, currently underway, shall provide data on actual concentrations and shall be used to refine the model simulation in the future.

- The BMPs proposed in this Implementation Plan reduce both the pollutants listed in the Toxics TMDL and bacteria. The Bacteria Quantification Analysis document (MDRWRA, 2007) estimates that a bacteria load reduction of approximately 31% or more would achieve compliance during the time frame evaluated (2004–2006). Assuming a bacteria removal efficiency of 50% (conservatively based on published bacteria removal efficiencies of typical BMPs), implementing approximately 90% or more of the required structural BMPs would result in approximately 31% or more reduction in the bacteria loading.
- To distribute the implementation of the BMPs around the unincorporated County MdRH, structural BMPs may be construction in conjunction with redevelopment and through additional projects on County projects. It may be necessary to include construction BMPs on private properties (leased parcels), which will require coordination and negotiations between the County and lessees.

Cost estimates were developed at the level of detail necessary for planning and strategy development for TMDL implementation of projects and programs in MdRH. Project-specific cost estimates were developed for individual nonstructural and structural projects. The nonstructural cost estimates consist of a 1-year initial pilot study cost, including project startup and assessment, and if applicable, ongoing operation and maintenance costs (O&M). Implementation costs for the five treatment conceptual design projects include engineering design, permitting, construction, building materials, and O&M. Cost for additional BMPs, beyond the identified nonstructural and five sites, were estimated based on the types and sizes of BMPs recommended by the WMMS. All costs are reported in 2011 dollars and are summarized in Table ES-6.

The cost estimates and the following implementation schedule are based on the WMMS model results. BMPs will be implemented using an adaptive approach and depending on the available resources. As data on the effectiveness nonstructural and the pilot structural BMPs are obtained, these estimates are likely to be modified. The implementation of these BMPs will depend on funding availability, permitting, lease agreements, and assessment results, and is therefore subject to change.

Table ES-6. Cost of Implementing Recommended Best Management Practices

Nonstructural Best Management Practices	Present Worth (2011 $)
MS4 / Sewage	$469,000
General	$324,000
Restaurants	$263,000
Birds	$806,000
Streets	$1,044,000
Trash	$160,000
Boaters	$194,000
Runoff	$447,000
Parking Garage	$312,000
Buildings	$2,994,000
Pets	$343,000
Subtotal (Non-Structural)	**$7,356,000**
Structural Best Management Practices	**Present Worth (2011 $)**
Five Project Sites	
Parking Lot 5 & MdR Library	$272,000
Parking Lot 7	$314,000
Parking Lot 9	$645,000
Parking Lot 10	$448,000
Parking Lot 11	$428,000
Five Project Sites Subtotal	$2,107,000
Redevelopment*	-
Additional County Projects	$4,519,000
Projects on Leased Parcels	$14,509,000
Subtotal (Structural)	**$21,135,000**
Total	**$28,491,000**

***** Redevelopment will be subject to the county *Standard Urban Storm Water Mitigation Plan* (SUSMP) requirements, which requires BMP implementation at the developer's expense.

The schedule developed to meet the TMDL WLAs shows that a 95.8% reduction of pollutant loading to MdRH is needed and may be achieved through the implementation of the proposed nonstructural and structural BMPs. The implementation schedules for nonstructural, structural, redevelopment, and leased property projects were used to distribute the implementation costs over time, ending at the TMDL compliance point in 2021. Figure ES-1 shows a potential, theoretical strategy to achieve compliance and is based on information currently available relating to the existing pollutant loads of the watershed. The actual implementation schedule and cost may vary depending on the results of monitoring efforts currently underway (e.g., Coordinated Monitoring Plan), special studies, and the effectiveness of source control BMPs.

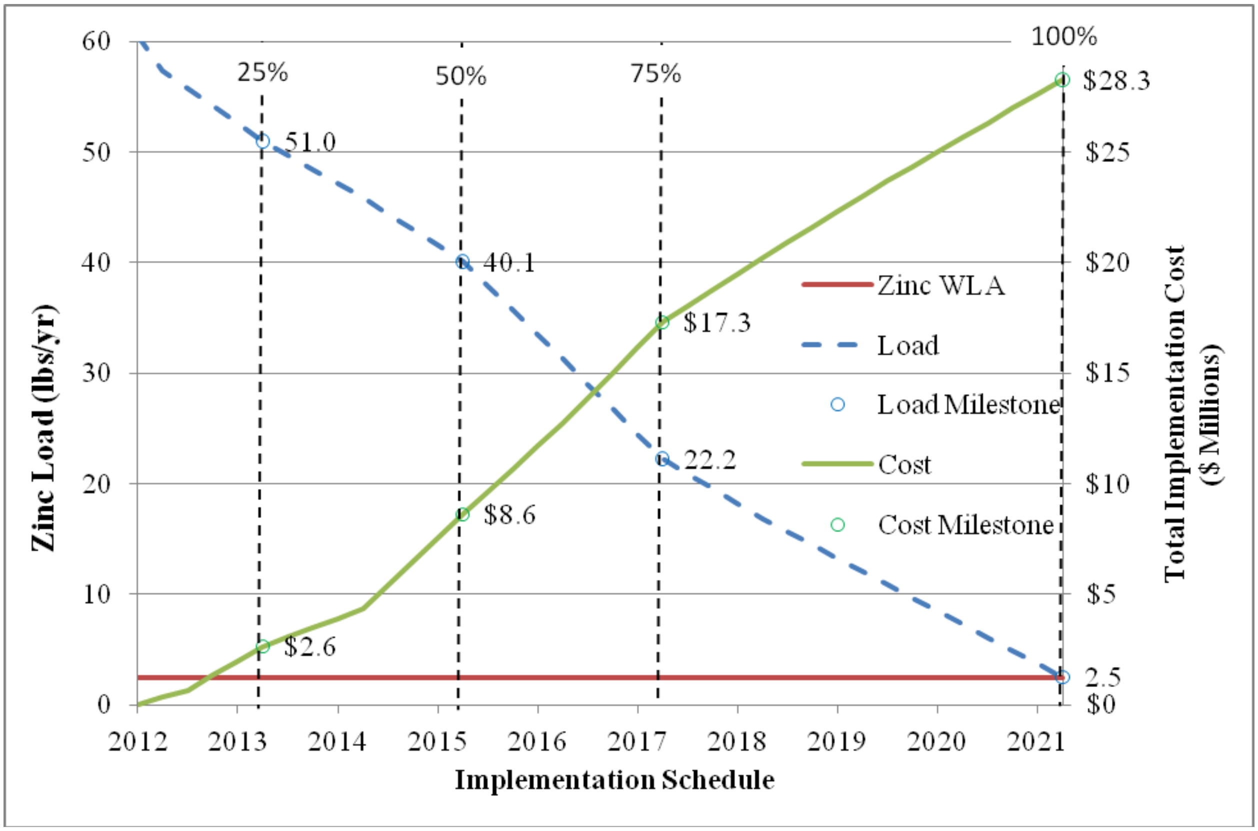

Figure ES-1. Load Reductions and Annual Spending Projected to Achieve the Zinc Waste Load Allocation

The Implementation Plan provides schedule and planning-level cost for BMPs in the unincorporated County areas of the MdRH watershed. The graphic and tables presented herein summarize the potential BMP strategies to meet phased WLAs. The County will implement these strategies as funding becomes available.

This Implementation Plan is intended to be iterative and adaptive to allow for modifications based on continued study of the drainage system, diagnosis of problem sources, and new technologies for treatment of stormwater runoff that continue to emerge.

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BMP	best management practice
BPJ	Best Professional Judgment
CCC	criterion continuous concentration
CD	compact disk
CL	confidence level
CMC	criterion maximum concentration
CMP	Coordinated Monitoring Plan
COC	chain-of-custody
CRG	CRG Marine Laboratories, Inc.
CRM	Certified Reference Material
CTR	California Toxics Rule
DDT	dichlorodiphenyltrichloroethane
DNA	deoxyribonucleic acid
DO	dissolved oxygen
DOC	dissolved organic carbon
DQO	data quality objective
EDD	electronic data deliverable
FIB	fecal indicator bacteria
GIS	geographic information system
GPS	Global Positioning System
HDPE	high-density polyethylene
HHW	household hazardous waste
LARWQCB	Los Angeles Regional Water Quality Control Board
MdRH	Marina del Rey Harbor
MDL	minimum detection limit
MLS	mass loading station
MPN	most probable number (a measure of indicator bacteria)
MPSL	Marine Pollution Studies Laboratory
MS4	Municipal Separate Storm Sewer System
MS/MSD	matrix spike/matrix spike duplicate
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
PBS	phosphate buffer saline
PIPP	Public Information and Participation Program
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QAP	Quality Assurance Program
QC	quality control
Q-PCR	Quantitative Polymerase Chain Reaction
RPD	relative percent difference
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SDRWQCB	San Diego Regional Water Quality Control Board
SOP	standard operating procedure

SRM	standard reference material
SUSMP	Standard Urban Storm Water Mitigation Plan
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TN	total nitrogen
TOC	total organic compound
TP	total phosphorus
TMDL	total maximum daily load
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Service
U.S.	United States
WLA	wasteload allocation
WMA	Watershed Management Area
WESTON®	Weston Solutions, Inc.
WQO	water quality objective
YSI	YSI 6-Series Multiparameter

1.0 INTRODUCTION

The Marina del Rey Harbor (MdRH) is a man-made pleasure-boat harbor with eight basins (Basins A through H). The Back Basins of the harbor include Basins D, E, and F. Land use in the MdRH watershed is primarily composed of (in descending order based on area) high-density single-family residential, retail/commercial, receiving water, multi-family residential, light industrial, education, mixed residential, urban vacant, open space/recreational, and transportation (see Table 1-1). MdRH opens to Santa Monica Bay through the Main Channel and shares a breakwater with Ballona Creek.

Table 1-1. Land Use within Marina del Rey Back Basin Watershed

Land Use	Area (acres)
High-Density Single Family Residential	343
Retail/Commercial	140
Receiving Waters	117
Multi-Family Residential	94
Light Industrial	88
Education	67
Mixed Residential	31
Urban Vacant	29
Open Space/Recreational	16
Transportation	14
Under Construction	10
Mixed Urban	3
Vacant	2
Institutional	1
Total	956

The Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties sets beneficial uses and water quality standards for water bodies in the region. The Back Basins D, E, and F were designated with several beneficial uses including REC-1, which is defined as recreational water activities involving body contact where ingestion of water is reasonably possible.

Section 303(d) of the Clean Water Act (CWA) requires each State to identify waterbodies with impaired water quality. Section 303(d) also requires each State to create a priority ranking for waters on the 303(d) list and establish total maximum daily loads (TMDLs) for such waters. In California, the State Water Resources Control Board and nine Regional Water Quality Control Boards (Regional Boards) are responsible for preparing 303(d) lists of impaired waterbodies and TMDLs, both subject to U.S. Environmental Protection Agency (USEPA) approval. Sediments in the Back Basins are on the 2002 Section 303(d) list for a variety of toxic pollutants including metals (copper, lead, and zinc), organic compounds (i.e., chlordane and PCBs) and sediment toxicity. (LARWQCB, 2005).

A consent decree, approved in March 22, 1999, established a 13-year schedule for the development of TMDLs in the Los Angeles Region. The consent decree combined more than 700 waterbody-pollutant combinations into 92 TMDL analytical units, with Analytical Unit 54 addressing the impairments in MdRH Back Basins associated with various organic pollutants and Analytical Unit 56 addressing impairments associated with metals (lead, copper, and zinc). The consent decree mandated that the USEPA must either approve a state TMDL for these analytical units or establish its own prior to March 22, 2006 (LARWQCB, 2005). As such, the Los Angeles Regional Water Quality Control Board (Regional Board) drafted the *TMDL for Toxic Pollutants in Marina del Rey Harbor* (Toxics TMDL) for subsequent approval by the USEPA. The Toxics TMDL went into effect on March 22, 2006.

The scope of this TMDL Implementation Plan is limited to the “land side” of MdRH watershed. It is anticipated the marina and “water side” of MdRH will fall within the jurisdiction of the California-Coastal Marinas Permit currently under development by the State Water Resources Control Board. Also, impairments at nearby Ballona Creek have been addressed in a separate TMDL. This Implementation Plan will address impairment of beneficial use due to elevated concentrations of copper, lead, and zinc, chlordane, and polychlorinated biphenyls (PCBs). Waste load allocations (WLAs) for these toxic constituents are defined in the Toxics TMDL (LARWQCB, 2005). An integrated multi-pollutant approach has been adopted, and therefore best management practices (BMPs) that also reduce indicator bacteria are proposed to achieve compliance. This document builds upon existing source evaluations, programs, and projects that have been implemented since the *MdRH Mother’s Beach and Back Basins Bacteria TMDL* (Bacteria TMDL) came into effect on March 18, 2004. This integrated, multi-pollutant TMDL Implementation Plan represents an expansion of the 2007 *MdRH Mother’s Beach and Back Basins Bacteria TMDL Implementation Plan* (MDRWRA, 2007).

1.1 Implementation Plan Objectives

The objective of this Implementation Plan is to outline the strategies and methods to achieve regulatory compliance with the Toxics TMDL (LARWQCB, 2005) in the unincorporated County areas of the MdRH Back Basin watershed. The strategies for compliance include the implementation of selected nonstructural and structural BMPs to provide quantifiable load reductions of the constituents listed in the Toxics TMDL. This Implementation Plan also calls for an adaptive management strategy so that resources will be used both effectively and efficiently. This is accomplished through evaluation of proposed BMPs and their adequacy to achieve estimated load reductions and making adjustments if necessary. In accordance with the Coordinated Monitoring Plan (CMP), monitoring will be conducted during the implementation period, and the results of monitoring will be evaluated so that BMP deployment may be adjusted to ensure regulatory compliance.

The Implementation Plan proposes the use of an integrated water resources approach that includes beneficial reuse of stormwater. This approach requires additional planning and time. The Toxics TMDL states that the Regional Board will consider extending the allowable time to implement TMDL to 15 years if an integrated approach is implemented. Based on this, the time line used in this Implementation Plan is 15 years.

1.2 MdRH Watershed Responsible Agencies

The MdRH watershed is approximately 1.5 square miles and is located in the Santa Monica Bay, California (Figure 1-1). The land includes the City of Los Angeles and Culver City, as well as the unincorporated County of Los Angeles (County) area. MdRH was developed in the early 1960s on land once known as the Playa del Rey estuary and inlets that formed part of the Ballona Creek Wetlands. MdRH opens into Santa Monica Bay and is an active harbor for pleasure craft. MdRH is the largest artificial small-craft harbor in the United States and a highly utilized Southern California recreational area. The harbor has more than 6,000 wet-berthed slips for private and commercial vessels, dry storage of approximately 3,000 boats, and launch facilities that provide access to approximately 240 trailered boats daily.

The responsible agencies are:

- City of Los Angeles (683.4 acres)
- County of Los Angeles (223 acres)
- City of Culver City (40 acres)
- Caltrans with (9.6 acres)

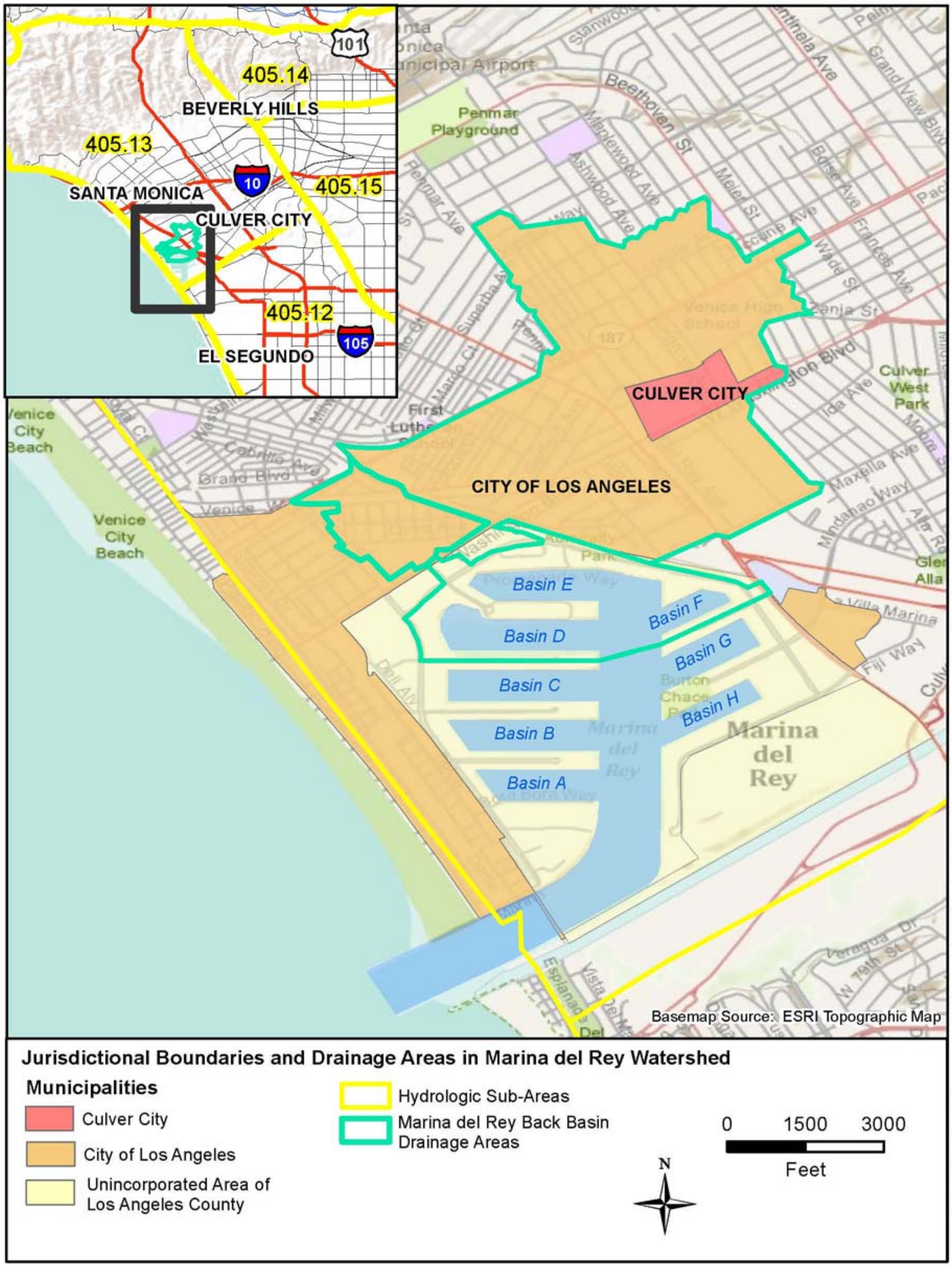


Figure 1-1. Jurisdictional Boundaries and Drainage Areas in Marina del Rey

1.3 Water Quality and Impairments

1.3.1 Designated Beneficial Uses

The Regional Board designates beneficial uses for surface waters (LARWQCB, 1995). MdRH is separated into two designated areas for the purposes of assigning beneficial uses:

- Marina del Rey Harbor
- Marina del Rey Public Access Beaches

These beneficial uses are presented in Table 1-2.

Table 1-2. Existing Beneficial Uses for Marina del Rey

Marina del Rey	Beneficial Uses
Harbor	NAV – Navigation REC-1 – Contact Recreation REC-2 – Noncontact Recreation COMM – Commercial MAR – Marine Habitat WILD – Wildlife Habitat SHELL – Shellfish Harvesting
Public Access Beaches	NAV – Navigation REC-1 – Contact Recreation REC-2 – Noncontact Recreation COMM – Commercial MAR – Marine Habitat WILD – Wildlife Habitat RARE – Endangered Species

The existing designated uses that protect aquatic life are marine and wildlife habitat (MAR and WILD). The existing beneficial uses associated with human use of the harbor are recreational use for water contact (REC-1), noncontact water recreation (REC-2), navigation (NAV), commercial and sport fishing (COMM), and shellfish harvesting (SHELL).

1.3.2 Section 303(d) List 2010

Section 303(d) of the federal CWA requires states to identify waters that do not meet applicable water quality standards despite the treatment of point sources by the minimum required levels of pollution control technology, and prioritize such waters for the purpose of developing TMDLs. A TMDL is defined as the “sum of the individual waste load allocations (WLAs) 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 constituent loads (the loading capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (USEPA, 2000).

The 2010 §303(d) list identifies a number of constituents for Marina del Rey Harbor – Back Basins (Table 1-3) (CSWRCB, 2010).

Table 1-3. Marina del Rey Harbor - Back Basins 2010 Section 303(d) List

Constituent	Year Listed
Chlordane (tissue and sediment)	1998
Copper (sediment)	1998
DDT* (tissue)	1992
Dieldrin* (tissue)	1992
Fish Consumption Advisory	1998
Indicator Bacteria	2006
Lead (sediment)	1988
PCBs (tissue and sediment)	1994
Sediment toxicity	1998
Zinc (sediment)	1988

*USEPA-approved TMDL has made a finding of nonimpairment for this constituent.

1.3.3 Bacterial TMDL Summary

Under the requirements of the Bacteria TMDL, Resolution No. 2003-012, dated September 4, 2003, the USEPA promulgated the TMDL for bacteria at MdRH on March 18, 2004. The responsible agencies identified for the Bacteria TMDL include the County of Los Angeles, City of Los Angeles, City of Culver City, and the California Department of Transportation (Caltrans).

The TMDL established bacterial compliance targets and WLAs based on the numeric targets set under the Assembly Bill 411 (commonly known as AB411) health standards. The TMDL WLAs are expressed as allowable exceedance days or the maximum number of days where sampling results can surpass the established Assembly Bill 411 standards without exceeding the limits in the Bacteria TMDL.

The bacterial indicator standards for the TMDL are presented in Table 1-4.

Table 1-4. Total Maximum Daily Load Compliance Limits

Indicator	Rolling 30-Day Geometric Mean Limit*	Single Sample Limit
Total Coliform	1,000 MPN/ 100 mL	1,000 MPN/ 100 ml if Fecal > 10% of Total, or 10,000 MPN/100 mL**
Fecal Coliform	200 MPN/ 100 mL	400 MPN/ 100 mL
Enterococcus	35 MPN/ 100 mL	104 MPN/ 100 mL

* = 30 day limit is based on the geometric mean of 30 sample days. For days without sampling, the result for that day is applied to the remaining days of the week until the next sample event (excluding wet-weather days).
** = Total coliform single sample limit of 10,000 most probable number (MPN) decreases to 1,000 when the fecal coliform value is greater than 10% of total coliform value.

The Bacteria TMDL is divided into three defined seasons:

- **Summer dry**: April 1 to October 31
- **Winter dry**: November 1 to March 31
- **Wet**: Year-round wet weather (defined as days of 0.1 inch of rain or more plus 3 days following the rain event)

Each season has its own compliance dates, requirements, and limits, as presented in Table 1-5.

Table 1-5. Total Maximum Daily Load Compliance Targets

Compliance Categories	Compliance Dates	Compliance Days/Year
Summer Dry	April 1–October 31	0 days per year (daily and weekly sampling)
Winter Dry	November 1–March 31	3 days per year (daily sampling) 0 days per year (weekly sampling)
Wet Weather	Rain event ≥ 0.1 inches at LAX rain gage, and 3 days following the end of the rain event	17 days per year (daily sampling) 3 days per year (weekly sampling)

Section 4 of the Bacteria TMDL Staff Report, “Assessing Sources,” identified the following potential bacteria sources:

- Point Sources
- Stormwater Runoff
- Nonpoint Sources

Progress on the Bacteria TMDL to date includes development of a Coordinated Monitoring Plan (Bacteria TMDL CMP) in July 2004 and submission of a Bacteria TMDL Implementation Plan in March 2005. A nonpoint source bacteria investigation was completed in 2006 in support of the TMDL, and monitoring under the Bacteria TMDL CMP began in early 2007 with an evaluation of the first year of monitoring data completed in early 2008 (WESTON, 2008a). Compliance with dry-weather requirements was scheduled for March 2007, and compliance with wet-weather requirements is scheduled for March 2021 (City of Los Angeles, 2009).

1.3.4 Toxics TMDL Summary

The Regional Board adopted the Toxic Pollutants in Marina del Rey Harbor TMDL on October 6, 2005 (LARWQCB , 2005). The Toxics TMDL became effective on March 22, 2006. The Toxics TMDL targets metals and organics in Basins D, E, and F of the MdRH (i.e., Back Basins). The constituents to be addressed are copper, lead, and zinc for metals, and chlordane and total PCBs for organics. MdRH Back Basins were included on the 1996, 1998, and 2002 California §303(d) list of impaired waterbodies (LARWQCB, 1996, 1998, 2002). The responsible agencies identified for the Toxics TMDL include the County of Los Angeles, City of Los Angeles, City of Culver City, and Caltrans.

1.3.4.1 Numeric Targets

Numeric targets for the Toxics TMDL were used to calculate WLAs for the metals and organic compounds causing water quality impairment, and/or to indicate attainment of water quality objectives (WQOs). Because the Basin Plan provides narrative, rather than numeric, objectives for sediments, it was necessary to translate the narrative objectives into numeric targets. The effects range low (ERL) (Long et al., 1995) guidelines are established as the numeric targets for sediments in the Back Basins of MdRH (Table 1-6).

Table 1-6. Numeric Targets for Sediment Quality in the Marina del Rey Back Basins

Organics	Numeric Target for Sediment
Chlordane	0.5 µg/kg
Total PCBs	22.7 µg/kg
Copper	34 mg/kg
Lead	46.7 mg/kg
Zinc	150 mg/kg

The California Toxics Rule (CTR) criterion for the protection of human health from the consumption of aquatic organisms was selected as the final numeric target for total PCBs in the water column (Table 1-7). The interim numeric target is applied until advances in technology allow for the ultra-low detection of PCBs.

Table 1-7. Numeric Targets for Total PCBs in the Water Column

TMDL Phase	Numeric Target (µg/L)
Interim	0.03
Final	0.00017

The fish tissue target of 5.3 µg/kg for total PCBs is derived from CTR human health criteria, which are adopted criteria for water designated to protect humans from consumption of contaminated fish or other aquatic organisms.

1.3.4.2 Waste Load Allocations

Loading capacity was estimated based on annual average total suspended solids (TSS) in the Back Basins of MdRH under the assumption that the finer sediments transport the majority of constituents. The Toxics TMDL for sediment was calculated based on the estimated loading capacity and the numeric sediment targets (Table 1-8).

Table 1-8. Total Maximum Daily Load Sediment Waste Load Allocations in Mass per Year

Metals	Numeric Target ERL (mg/kg)	TMDL (kg/year)
Copper	34	2.18
Lead	46.7	3.0
Zinc	150	9.6
Organics	**ERL (µg/kg)**	**TMDL (g/year)**
Chlordane	0.5	0.03
PCBs	22.7	1.46

In addition, concentration-based WLAs for minor National Pollutant Discharge Elimination System (NPDES) permits and nonstormwater NPDES permits are based on sediment numeric targets (Table 1-6).

Under the MdRH Toxics TMDL Coordinated Monitoring Plan (Toxics TMDL CMP) (County of Los Angeles, 2008) WLAs for stormwater were also prepared for each permittee (Table 1-9 and Table 1-10).

Table 1-9. Stormwater Waste Load Allocations for Metals

Permittees	Copper (kg/year)	Lead (kg/year)	Zinc (kg/year)
MS4	2.01	2.75	8.85
Caltrans	0.022	0.03	0.096
General Construction	0.033	0.045	0.144
General Industrial	0.004	0.006	0.018

Table 1-10. Stormwater Waste Load Allocations for Organics

Permittees	Chlordane (g/year)	Total PCBs (g/year)
MS4	0.0295	1.34
Caltrans	0.0003	0.015
General Construction	0.0005	0.022
General Industrial	0.0001	0.003

Progress on the Toxics TMDL to date includes development of a Toxics Coordinated Monitoring Plan in March 2007 and resubmittal in March 2008. Submission of a completed Implementation Plan is scheduled for March 2011. Compliance with dry- and wet-weather requirements is scheduled to occur between 2013 and 2021 (City of Los Angeles, 2009). This plan is summarized in Section 2.5.2.

2.0 MDRH WATERSHED

2.1 Historical Land Use

Historically, Marina del Rey was a saltwater estuary fed by freshwater from Ballona Creek. In 1953, the Los Angeles County Board of Supervisors authorized a $2 million loan to fund approximately half of the construction of a recreational small-craft harbor. U.S. Congress passed and President Dwight D. Eisenhower signed Public Law 780 making construction possible by funding the remaining half of the cost. On April 10, 1965, Marina del Rey was formally dedicated. MdRH is now heavily developed and includes numerous restaurants, hotels, residential high rises, retail shops, parking lots, playgrounds, picnic shelters, and recreational equipment rental facilities that surround the marina's basins.

2.2 General Site Conditions and Land Use

The MdRH watershed can be characterized into three main areas (Figure 2-1):

- The harbor water area, including the docks, Back Basins, Mother's Beach, and Oxford Basin.
- The land adjacent to the harbor Back Basins (Los Angeles County unincorporated area), including residential areas, streets, and other small land uses.
- The land outside the Los Angeles County unincorporated area draining into the harbor waters, including the cities of Los Angeles and Culver City, and Caltrans rights-of-way.

The MdRH watershed is highly developed with high-density single-family residences, multiple family residences, and mixed residential comprising the primary land use in the watershed (46.6%). Retail, commercial, and general office represent the second largest land use (12.2%). The receiving waters of MdRH constitute 11.6% of the land area, and marina facilities cover 9.2% of the land use. Open space and recreation represents 4.8% of the land use in the watershed. Light industrial and vacant/urban vacant each represent 4.7% of the land use. The remaining 6% of land area is covered by educational institutions (3.8%), under construction (1.2%), institutional and military installations (0.6%), transportation (0.3%), and mixed urban (0.2%). Land uses are summarized in Table 2-1 and present as a map in Figure 2-1.

Table 2-1. Land Uses in Marina del Rey Harbor

Type of Land Use	Portion of MdRH
Residential	46.6%
Commercial	12.2%
Receiving Waters	11.6%
Marina Facilities	9.2%
Open Space	4.8%
Industrial (light)	4.7%
Vacant	4.7%
Educational Institutions	3.8%
Construction	1.2%
Military	0.6%
Transportation	0.3%
Mixed Urban	0.2%

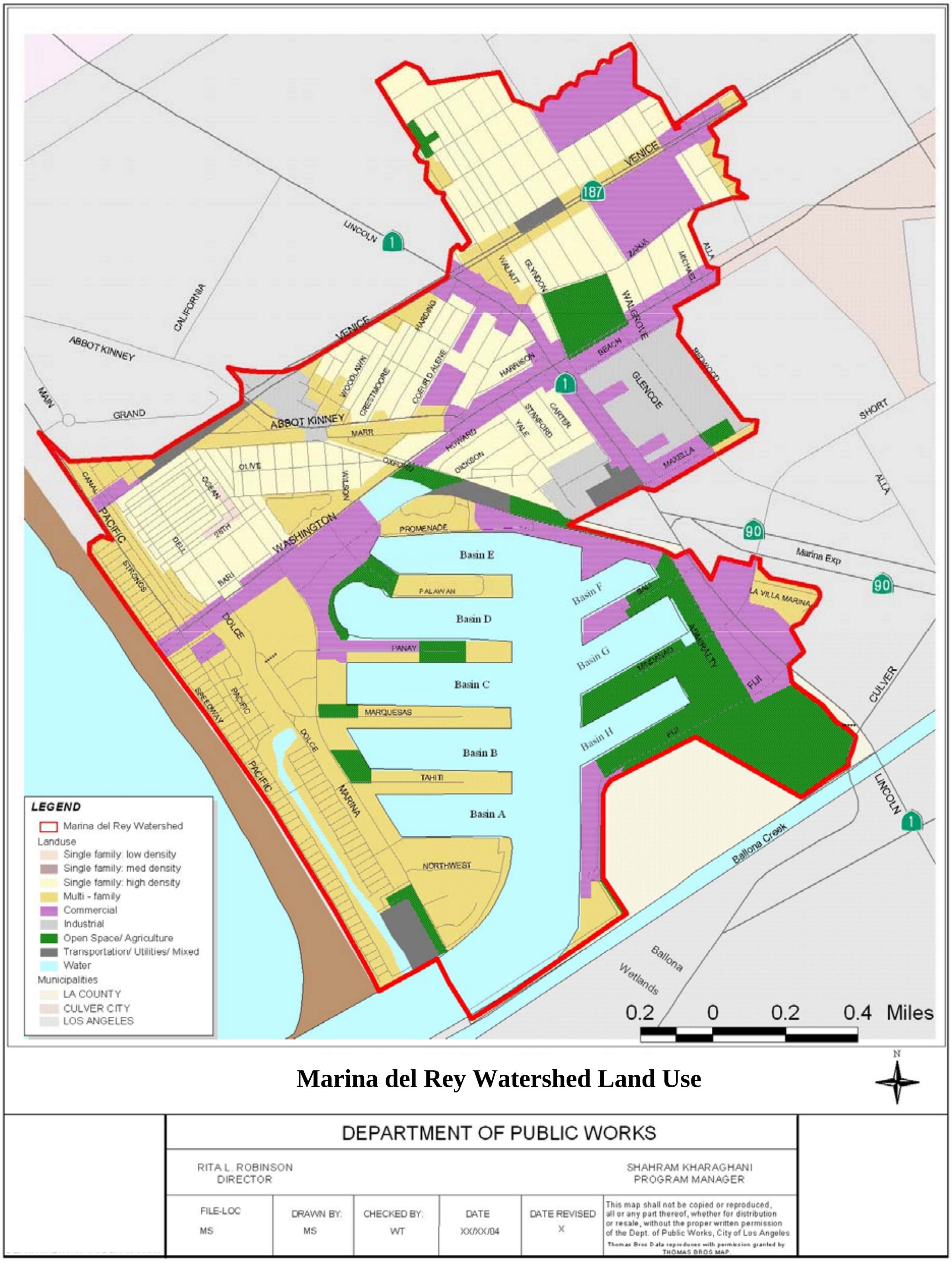


Figure 2-1. Map of Marina del Rey Harbor Land Use

2.3 Geological Setting and Soil

Surface geologic features include relatively flat urbanized terrain adjacent to a man-made small-craft harbor, located approximately 5 miles south of the Santa Monica Mountains and approximately 15 miles north of the Palos Verdes Peninsula hills. MdRH is northwest of the Playa del Rey Bluff, a westerly extension of the Baldwin Hills and Fox Hills that represents the southern flank of the Ballona Creek valley. Geologically, the Los Angeles basin is a deep, sediment-filled structural depression with recent sedimentary deposits overlying older sedimentary rocks (i.e., sandstone). Beneath the sedimentary rocks are older crystalline basement rocks, consisting of schists.

Tectonic forces beneath the earth uplifted, tilted, and folded the sedimentary rocks. These tectonic forces along both surface faults (e.g., the Newport-Inglewood and related faults) and buried thrust faults (e.g., Torrance-Wilmington, Elysian Park-Puente Hills, Las Cienegas-Coyote Hills, Los Angeles Basin, and Compton-Los Alamitos) formed the chain of hills extending northwest-southeast from north of Los Angeles to Long Beach.

Because of the lack of project-specific soil data, the Los Angeles County Department of Public Works Hydrology Manual (LADPW, 2006) was consulted to identify the soil type likely to be found at Marina del Rey. Soil conditions around the marina are classified as coastal sand and loamy soils, which have high percolation rates (infiltration capacity).

2.4 Site Hydrology

Prior to development, the area around the marina was a naturally occurring estuary consisting of open water, mudflats, and wetlands. Upon completion of the marina, the MdRH area was transformed into the world’s largest man-made small-craft marina. Development within and upstream of the marina also increased the amount of runoff that directly flows into the harbor. Many of MdRH’s prized commercial and office buildings are situated close to the harbor with only the width of a small access road as a buffer. Furthermore, there are numerous private and public asphalt parking lots adjacent to the water.

The MdRH Small Drain Survey (LACDBH, 2004b), completed for the Los Angeles County Department of Beaches and Harbors (LACDBH), identified over 720 small outfalls directly into the harbor, the majority of which serve the individual parcels and mole roads between the basins. The remaining drains are located in the streets surrounding the basins. The tributary drainage area to MdRH Back Basins located within the unincorporated area of Los Angeles County is approximately 227 acres and includes 217 acres that are drained by the above-mentioned small drains and Oxford Basin, which occupies approximately 10 acres. The drainage for Oxford Basin is described in the next paragraph. Figure 2-2 shows the drainage area to the Back Basins and the tributary drainage areas within each Municipal Separate Storm Sewer System (MS4) Permittee jurisdiction.

Oxford Basin, situated north of the MdRH, conveys runoff from a tributary area measuring approximately 660 acres that includes the City of Los Angeles and City of Culver City jurisdictions. The tributary area to Oxford Basin does not include the unincorporated county jurisdiction. Oxford Basin drains to Basin E through two tide gates and storm drain piping.

Having no jurisdiction area within the area tributary to Oxford Basin, the county does not have the jurisdiction, or responsibility, to implement pollutant reduction measures within the tributary area to Oxford Basin. Therefore, measures to control pollutant loading in the stormwater runoff into and out of Oxford Basin will not be included in this Implementation Plan, which has been developed for the Los Angeles County portions of MdRH.

Drainage from approximately 71 acres within the City of Los Angeles drains to Boone Olive Pump Station, which discharges to Basin E. Los Angeles County does not have the jurisdiction to implement pollutant reduction measures within the tributary area to Boone Olive Pump Station. Therefore, measures to control pollutant loading in the stormwater runoff into and out of the Boone Olive Pump Station will not be included in this Implementation Plan.

Parcel and land-use data are not currently available for Caltrans areas located within the Back Basins watershed. The Toxics TMDL lists 9.58 acres associated with the Caltrans Storm Water Permit (LARWQCB, 2005). The Caltrans properties are scattered around the MdRH drainage area with a portion of the Caltrans properties located within the unincorporated County area. The TMDL provides specific WLAs for the Caltrans Storm Water Permit independent from the WLAs for the MS4 Permit. Therefore, not identifying and separating the small areas of Caltrans properties located within the cities of Los Angeles and Culver City does not have an impact on the Implementation Plan.

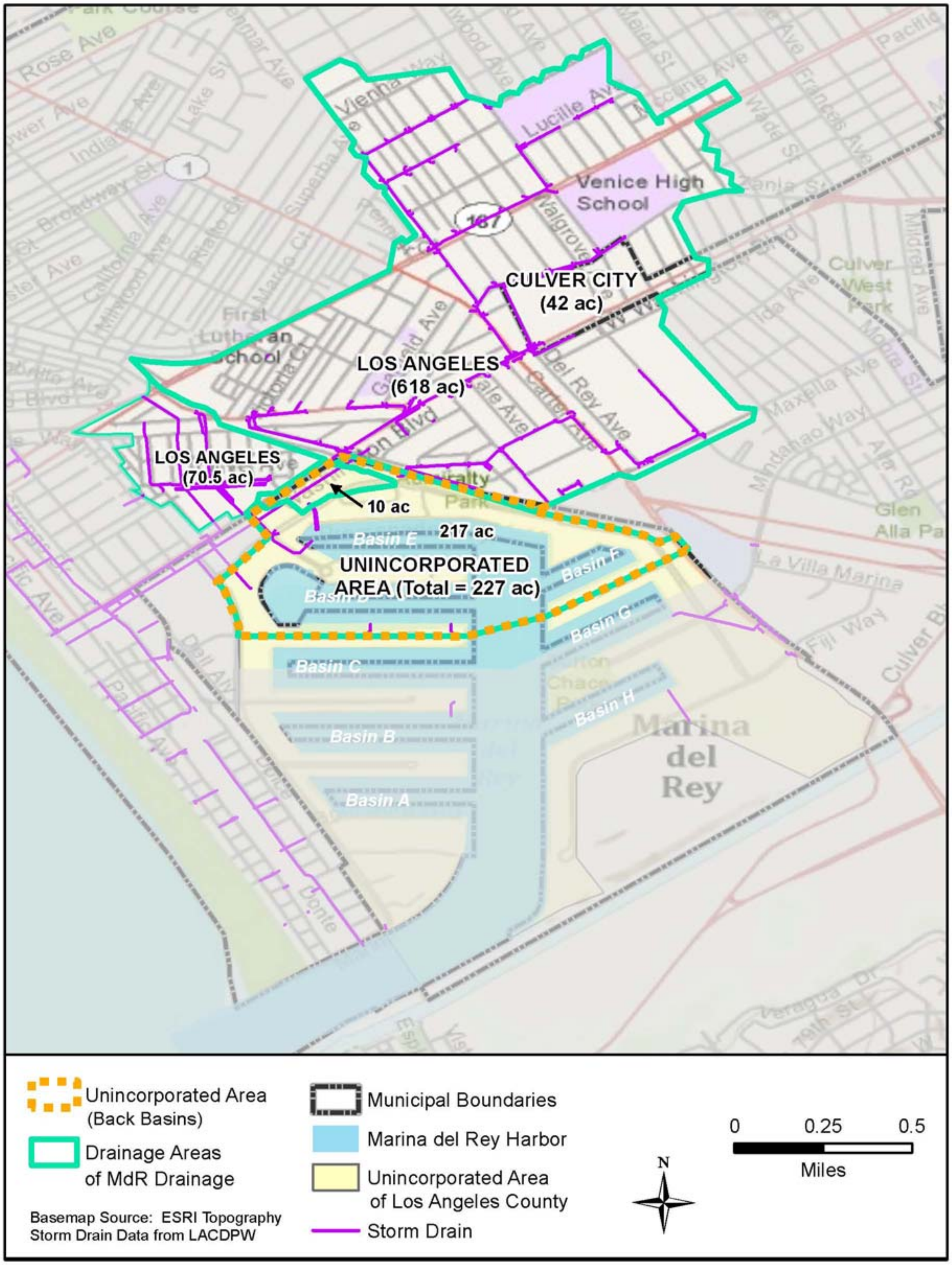


Figure 2-2. Marina del Rey Harbor Back Basins Drainage Areas

2.5 Current and Proposed Monitoring Activities

2.5.1 Marina del Rey Harbor Mother's Beach and Back Basins Bacteria TMDL Implementation Plan

The Bacteria TMDL Implementation Plan (MDRWRA, 2007) presents the study designs and action items developed by the Marina del Rey Watershed Responsible Agencies (MDRWRA) to meet the current bacterial indicator standards for dry and wet weather. The responsible parties consist of the County of Los Angeles, Cities of Los Angeles and Culver City, and Caltrans.

The Bacteria TMDL CMP proposes weekly sampling at nine compliance locations at Marina del Rey and the Back Basins to measure compliance with the WLAs (Figure 2-3). In addition, two samples, one at the surface and one at depth, will be collected at some sites (Sites MDRH6 and MDRH9). If bacterial exceedances are observed, then more intensive monitoring is required. In addition to these compliance monitoring sites, the Bacteria TMDL CMP proposes five ambient water quality monitoring sites in the non-§303(d) listed MdRH Basins. In January 2009, monitoring at the ambient sites was discontinued because of the low bacteria concentrations observed during the first 2 years of monitoring.

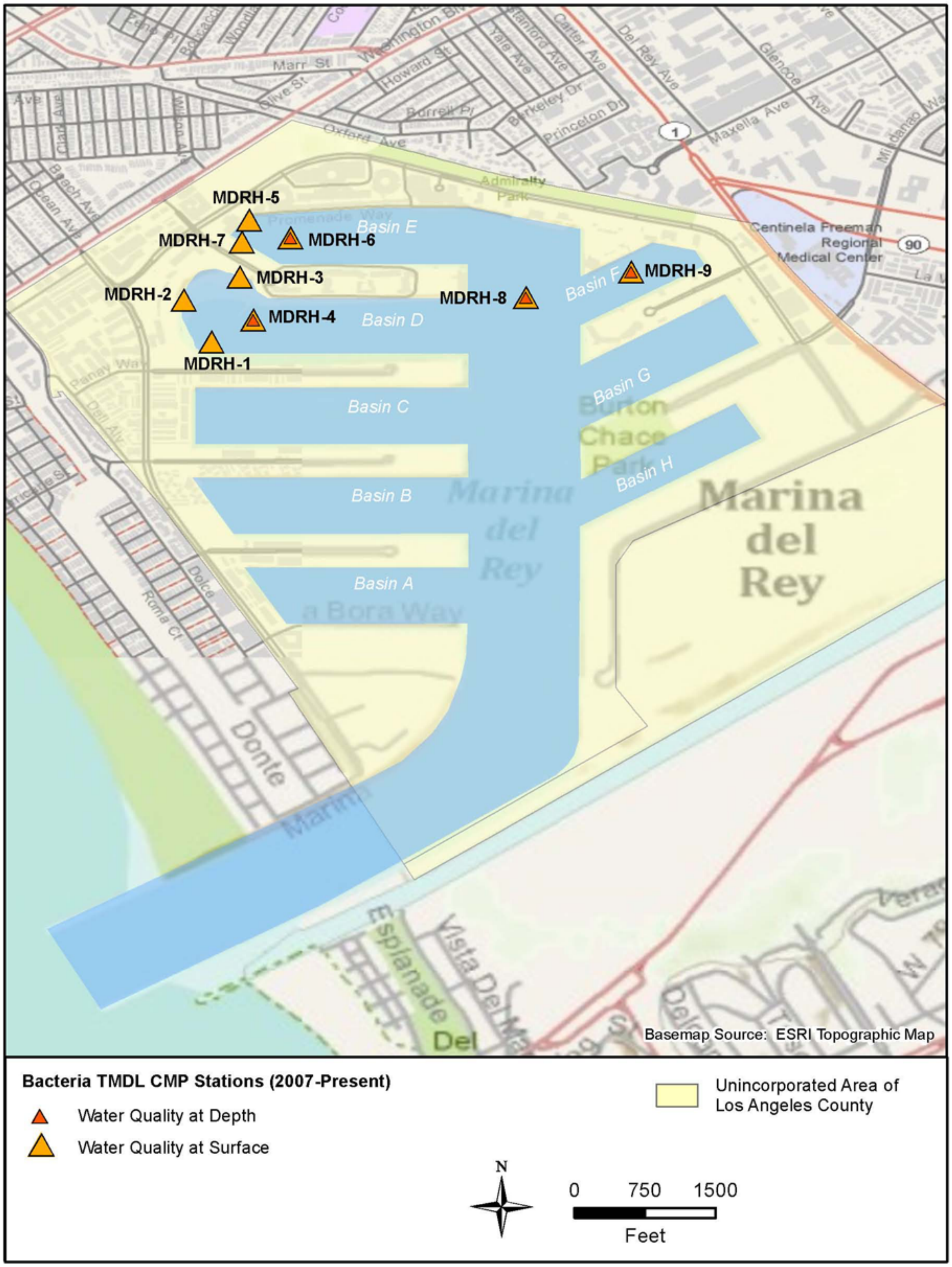


Figure 2-3. Marina del Rey Harbor Bacteria Total Maximum Daily Load Coordinated Monitoring Plan Station Locations

2.5.2 Marina del Rey Harbor Toxics TMDL Coordinated Monitoring Plan

To comply with the requirements of the Toxics TMDL, the Responsible Agencies developed a Toxics TMDL CMP (Figure 2-4). The TMDL CMP includes two key components:

- **Ambient Monitoring –** Monitoring conducted per storm event in the watershed to establish the ambient conditions of stormwater, with assessment of water, sediment, and bioaccumulation in the Back Basins.
- **Effectiveness Monitoring –** Stormwater quality monitoring conducted in the watershed during storm events with collection of sediments and bioaccumulation data in the Back Basins.

Watershed Locations
Both ambient and effectiveness program elements utilize the same five watershed monitoring locations with collection of water samples and storm-borne sediment sampling. Wet-weather monitoring will be conducted for a minimum of 10 events per year of 0.1 inch of rainfall or greater.

Back Basin Locations
Ambient and effectiveness water quality and sediment sampling in the Back Basins will be done in four sampling locations, mid-basin for Basins D, E, and F as well as the main channel. During the first 5 years of ambient monitoring, five additional sampling locations will be monitored in the MdRH for copper in the Front Basins. Bioaccumulation sampling will be done using bottom trawlers for fish and site-specific requirements for mussel harvesting.

Stormwater Monitoring
Flow proportional composite samples will be collected for both ambient and effectiveness monitoring with analysis of copper, lead, zinc, and hardness, as well as total chlordane, total PCBs, total dissolved solids, total suspended solids, and settleable solids.

Storm-borne Sediment Monitoring
Storm-borne sediment monitoring is to be conducted under the effectiveness monitoring element, and analyses will include copper, lead, and zinc, as well as chlordane, total PCBs, and TOC.

Harbor Water Quality Monitoring
Monthly samples will be collected under the ambient program and analyzed for copper, lead, zinc, and hardness, as well as chlordane and total PCBs.

Benthic Sediment Quality Monitoring (Back Basins)
Quarterly monitoring will be undertaken in the ambient monitoring program while monthly sampling will be conducted under the effectiveness monitoring program. Samples will be analyzed for copper, lead, and zinc, as well as chlordane and total PCBs. In addition, samples will be analyzed for TOC, grain size, and sediment toxicity (as amphipod mortality tests).

Figure 2-4. Marina del Rey Harbor Toxic Pollutants Total Maximum Daily Load Coordinated Monitoring Plan Location Map

Bioaccumulation
Annual monitoring under the ambient and effectiveness elements will be performed with assessment of total PCBs.

Sediment Toxicity Testing
Ambient monitoring toxicity testing will be conducted at four stations, quarterly for the first year and then semi-annually. Acute and chronic tests will be undertaken using amphipod mortality (for sediment), sea urchin fertilization (for pore water), and red abalone larval development (for overlying water). See Tables 4.4 and 4.9 of the Toxics TMDL CMP for more information.

Potential Sources and Data Gap Analysis
The proposed monitoring under the Toxics TMDL CMP will provide a platform for many of the data gaps discussed in this document. However, jurisdictional boundary monitoring may be required to assess inputs.

2.6 TMDL Schedule

The TMDL implementation schedule consists of a phased approach, with compliance to be achieved in incremental percentages of the watershed. This schedule is based on a combination of structural and nonstructural strategies designed specifically to reduce toxic pollutant loading to MdRH. An integrated water resources approach that includes beneficial reuse of stormwater will be adopted and therefore, the original 10-year compliance schedule is shown extended to 15 years in recognition of the additional planning and time needed for this approach. The compliance schedule, as defined in the Toxics TMDL, is presented in Table 2-2.

Table 2-2. Implementation Schedule for an Integrated, Multi-pollutant Approach to the Marina del Rey Harbor Total Maximum Daily Loads.

Integrated TMDL	Action	Date
Toxics TMDL Schedule using an Integrated Approach	Effective Date	March 22, 2006
	Draft TMDL Implementation Plan	March 22, 2011
	Final TMDL Implementation Plan	September 22, 2011
	TMDL Re-Opener	March 22, 2012
	25% of Load Reduction To Meet WLAs Achieved	March 22, 2013
	50% of Load Reduction To Meet WLAs Achieved	March 22, 2015
	75% of Load Reduction To Meet WLAs Achieved	March 22, 2017
	100% of Load Reduction To Meet WLAs Achieved (i.e., Pollutant Loading below WLAs)	March 22, 2021
Bacteria TMDL Schedule using an Integrated Approach	Effective Date	March 18, 2004
	Implementation Plan	April 6, 2006
	100% Dry Weather Compliance	March 18, 2007
	100% Wet-Weather Compliance	July 2021

3.0 POLLUTANT SOURCE CHARACTERIZATION

3.1 Historical Monitoring Results

3.1.1 Mother's Beach and Back Basins Bacteria TMDL Non-Point Source Study

The Mother's Beach and Back Basins Bacteria TMDL Non-Point Source Study was conducted to assess the bacterial sources that may potentially impact water quality at Mother's Beach and the Back Basins and attribute loads to these sources (WESTON, 2007). The study contained the following elements using a weight-of-evidence approach:

- Visual observations
- A public questionnaire
- Temporal and spatial bacteria sampling studies during both wet and dry conditions
- An illicit boating discharge investigation
- Hydrologic modeling
- Sewerage infrastructure inspections

In addition, molecular source tracking using Quantitative Polymerase Chain Reaction (Q-PCR) for the assessment of the presence or absence of *Bacteroides* species[1] and ribotyping techniques were used to determine potential nonpoint sources of contamination affecting the quality of the waters within the Back Basins of MdRH and Mother's Beach. After completing the source identification aspect of this study, loading was assessed for the primary contributors of bacterial pollution.

The results of the study were:

- *Spatial and Temporal Bacterial Investigation:* Circulation within MdRH was found to be limited in the Back Basins. Oxford Basin and the Boone Olive Pump Station were identified as potential sources of bacteria through an evaluation of Basin E during both dry (Table 3-1 and Figure 3-1) and wet weather (Figure 3-2). It was found that higher fecal coliform concentrations in dry weather were spatially correlated with discharge from Oxford Basin and Boone Olive Pump Station compared with other locations in MdRH. The geometric mean for dry-weather concentrations of enterococci was highest from Boone Olive Pump Station. Q-PCR analysis showed little human contamination throughout the Back Basins; human sources (direct human and/or sewage) were found to contribute only 3% of the bacteria load for both wet and dry weather overall. These investigations identified birds to be significant contributors to wet- and dry-weather bacterial loads. During these monitoring activities, visual observations of activities around MdRH were conducted and supplemented with "spot sampling." Anthropogenic sources and transport mechanisms for fecal indictor bacteria included boat-related

[1] Q-PCR is a process of amplifying specific sequences of DNA or RNA from a target species or group of species. In this instance *Bacteroides* species were used as an indicator of recent human fecal contamination. *Bacteroides* cells are present in the guts of all warm-blooded animals and can be identified through species-specific analysis as originating from human feces.

maintenance activities, trash and food waste, washing activities (restaurants, restrooms, parking areas, and buildings), landscaping, and the MS4.

Table 3-1. Summary of Bacterial Densities Collected During the Dry Weather Surveys (WESTON, 2007)

Station ID		Fecal Coliform (MPN/100mL)			Enterococci (MPN/100mL)		
		Minimum Density	Maximum Density	Geometric Mean	Minimum Density	Maximum Density	Geometric Mean
Basin D	**1**	<20	230	15	<10	63	7
	2	<20	300	17	<10	**1,872**	7
	3	<20	**1,100**	17	<10	**110**	7
	4	<20	**1,300**	27	<10	**857**	15
	5	<20	**1,300**	50	<10	**313**	15
Basin E	**6**	<20	**16,000**	95	<10	**1,782**	**39**
	7	<20	**3,000**	74	<10	**24,196**	**39**
	9	<20	**800**	33	<10	96	10
	10	<20	300	18	<10	**199**	12
	11	<20	**1,700**	41	<10	**697**	14
	18	<20	**2,200**	91	<10	**367**	23
Basin F	**12**	<20	40	12	<10	**467**	7
	13	<20	40	13	<10	41	9
	K	<20	**16,000**	109	<10	**14,136**	26
	N	<20	80	16	<10	31	8
Boone Olive	**16**	80	**35,000**	**1,872**	**156**	**5,475**	**1,021**
Oxford Basin	**8**	<20	**1,300**	53	<10	**1,106**	**35**
	14	<20	**11,000**	62	<10	**2,143**	**51**
	15	80	**300,000**	**8,195**	41	**2,755**	**686**
	19	<20	300	41	<10	**1085**	18

Values in red indicate exceedances of the single sample standard (maximum density).
Bolded values indicate a result greater than the 30-day geometric mean.

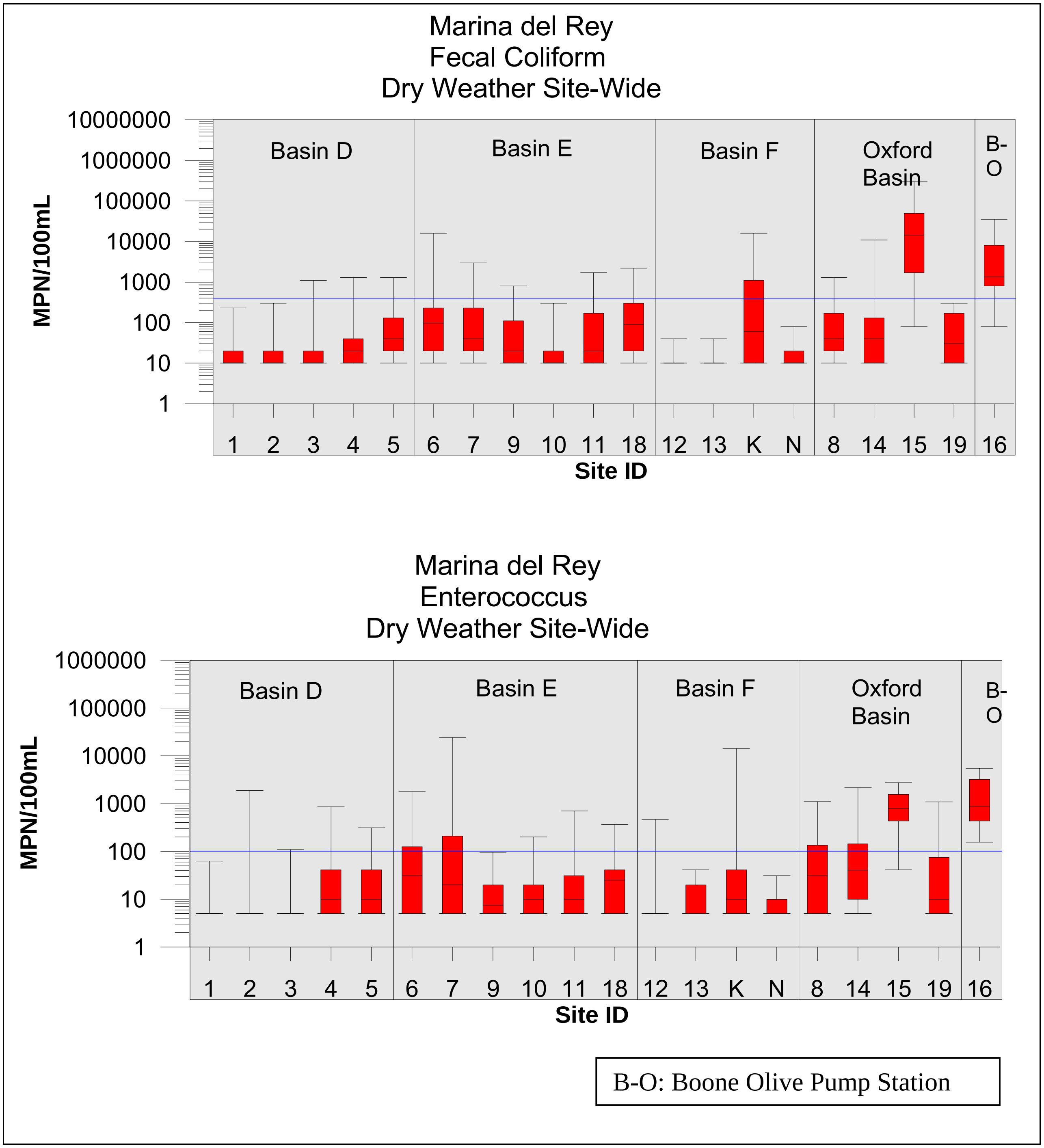


Figure 3-1. Box and Whisker Plots for Dry Weather Surveys (WESTON, 2007)

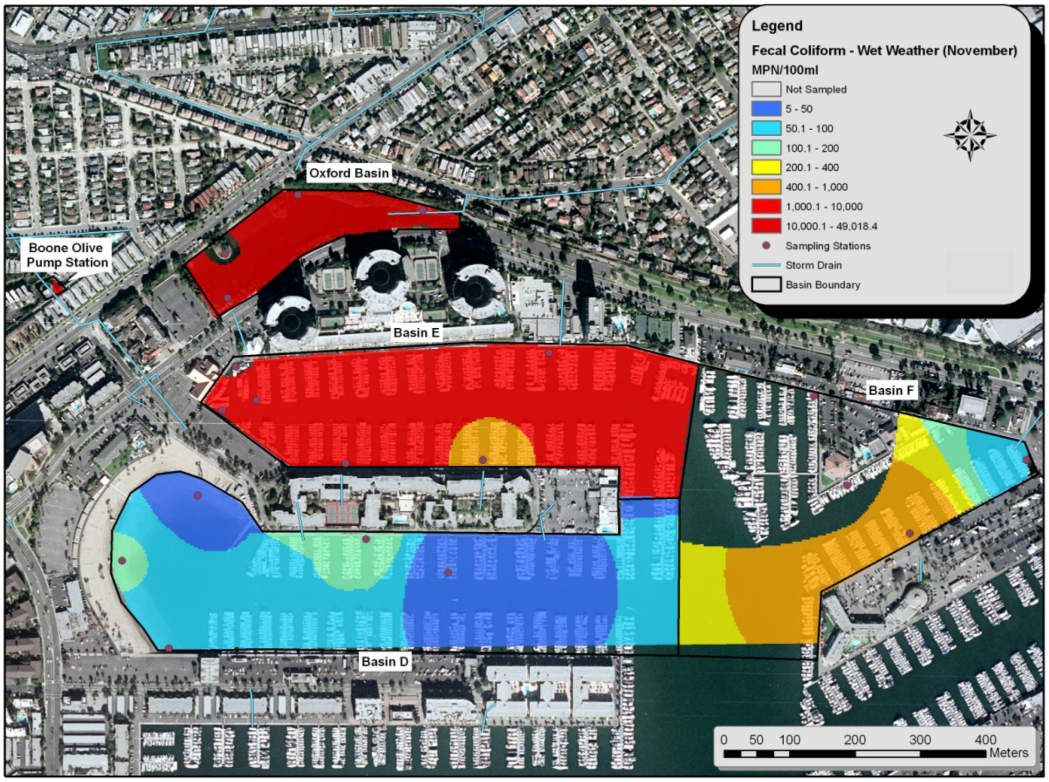


Figure 3-2. Wet Weather Interpolation for Fecal Coliforms (WESTON, 2007)

- *Sewerage Infrastructure Investigation:* The sewerage infrastructure investigation determined that the sanitary sewer lines surrounding the Back Basins of MdRH were identified to have structural defects and operation and maintenance (O&M) problems. As a result of this Non-Point Source Study and other monitoring data, the sanitary sewer lines were relined and leaks were repaired around the Back Basins during 2007–2008.

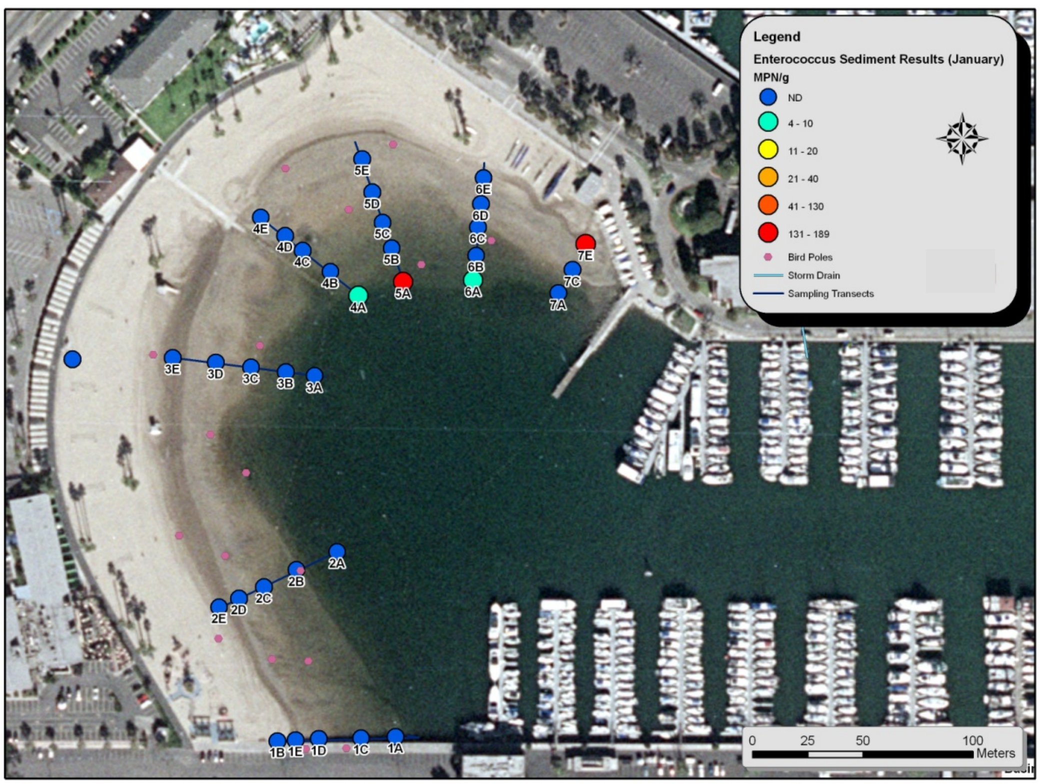
- *Illicit Boat Discharge Investigation:* Results based on this weight-of-evidence approach indicated that illegal discharges of sewage from boats in Basins D, E, and F were not likely a major cause of contamination. However, because illegal discharges of sewage from boat holding tanks is inherently episodic, results of this study did not conclusively eliminate this as a potential source.

- *Sediment Investigation:* Results from the sediment investigation conducted at Marina Beach (Mother's Beach) (Figure 3-3) indicated that the surficial sediments in the inter-tidal zone and beach face generally contained low concentrations of fecal indicator bacteria, suggesting that it was unlikely that sediment resuspension resulting from beach activity was contributing large amounts of bacteria to the water.

- *Bacterial Loading Estimates:* An Excel-based loading model was developed for the assessment of bacterial contributions. Because of the complexities of modeling bacteria in a tidal system, the model was limited in scope and was not designed for BMP development but rather as a tool for general assessment of different management actions. The bacterial results of a 1-day comprehensive bacterial sampling event, coupled with the sampling of four upstream sampling locations within the MdRH watershed, was incorporated into a hydrologic mass balance model to estimate bacteria concentrations in Oxford Basin and Basin E during dry weather. The model results suggested impacts to fecal coliform loads were attributable to effluent from Oxford Basin. Additionally, higher bacteria concentrations were measured from the Boone Olive Pump Station and were found to correlate with higher bacteria concentrations in Basin E. Based on the results of this Non-Point Source Study and other monitoring data, dry-weather diversions have been installed at the inlets to Oxford Basin and Boone Olive Pump Station. Updated data as summarized in Section 2.1.5 indicate that these measures have been effective in reducing dry-weather bacteria loading from these sources.

Although some upstream watershed-based sampling was performed as an additional special study, sampling to date was limited to four locations with three sampling events during the summer dry season. The data indicated higher concentrations of fecal coliforms at one site only.

Overall, the general results of the Mother's Beach and Back Basins Bacteria TMDL Non-Point Source Study suggested that the majority of the indicator bacteria in MdRH originated from direct and indirect (i.e., through storm drains) avian sources. However, in the case of Basin E, dry- and wet-weather point sources were identified as including discharges from Oxford Basin and Boone Olive Pump Station. As summarized, these results have led to control measures that include bird mitigation measures and dry-weather diversions at the inlets to Oxford Basin and Boone Olive Pump Station.



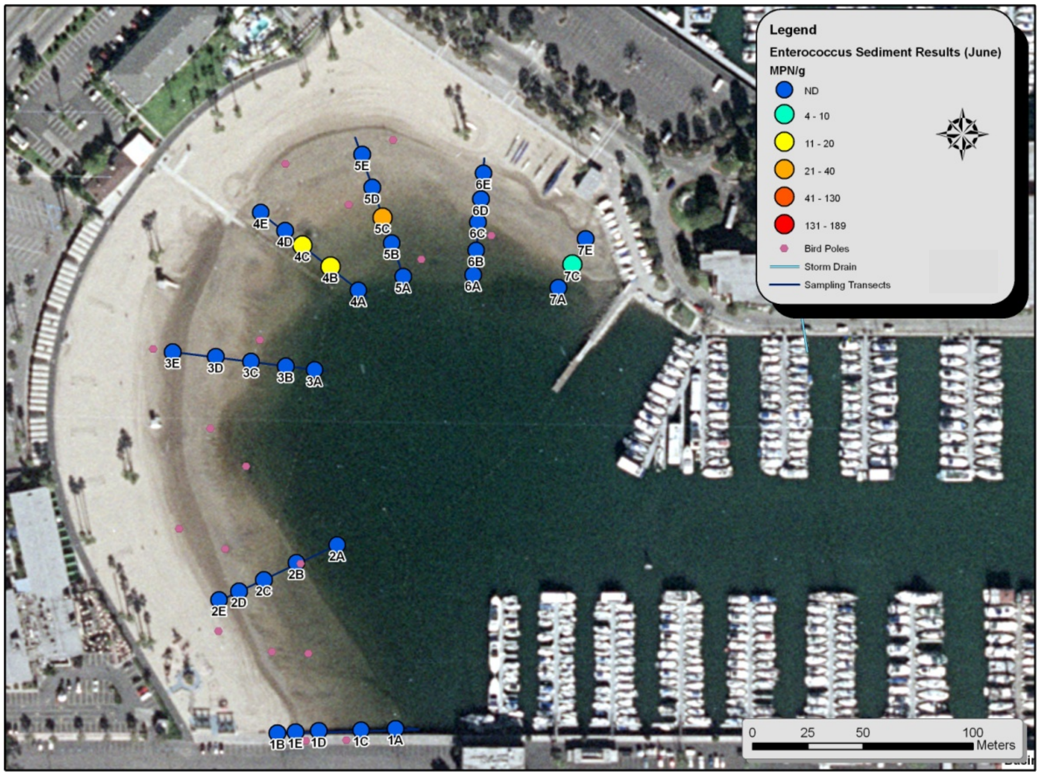


Figure 3-3. Sediment Results for Enterococci for January and June (WESTON, 2007)

Potential Sources and Data Gap Analysis

Jurisdictional monitoring between the unincorporated areas of MdRH and the upstream agencies (i.e., City of Los Angeles, City of Culver City, and Caltrans) would provide additional insight into contributions of bacteria, nutrients, metals, and other toxics by all four Responsible Agencies.

In addition, there is a lack of data characterizing flows from the MS4 outfalls that discharge directly to the Back Basins. The studies to date have focused on higher priority discharges from Oxford Basin and Boone Olive Pump Station. The contribution from the MS4 outfalls has not been defined and poses a data gap for designing structural BMPs to reduce pollutant concentrations and loads to MdRH during dry and wet weather from the unincorporated area. An MS4 and storm drain survey for illicit discharges, and focused monitoring to quantify the loading contributions from these outfalls, should be considered to develop future implementation activities.

3.1.2 Marina del Rey Harbor Mother's Beach and Back Basins Bacteria Indicator TMDL Compliance Study

The MdRH Mother's Beach and Back Basins Bacteria Indicator TMDL Compliance Study provided an analysis of compliance data collected in response to the MdRH Mother's Beach and Back Basins Bacterial Indicator TMDL (WESTON, 2008a). Eight months of TMDL compliance monitoring bacterial indicator data were analyzed for compliance with TMDL goals, and sampling stations were assessed for the applicability of CWA §303(d) listing status based on historic data from 10 years of sampling. The study also assessed differences between geometric mean calculation methods and how they affect TMDL compliance, as well as a comparison of bacterial levels before and after BMP implementation.

The following findings were reported from this study:

- TMDL compliance targets were met with the exception of compliance monitoring stations during summer dry-weather sampling events.

Table 3-2. Summary of Bacteria Compliance (2007)

Station Type	% within TMDL Compliance Targets		
	Summer Dry	Winter Dry	Wet Weather
Compliance Monitoring[1]	22%	89%	78%
Ambient Monitoring[1]	80%	100%	100%

1 This study was based primary on data collected prior to the implementation of several BMPs detailed in the MdRH Bacterial TMDL Implementation Plan (MDRWRA, 2005). Section 3.1.3 of this Implementation Plan presents a similar table based on additional monitoring.

- Analysis of historical data showed that all stations exceeded the TMDL single-sample compliance targets, although only four stations would have met the criteria for §303(d) listing. Because of this difference in assessment methodology, the TMDL compliance targets are expected to be more difficult to achieve than meeting the §303(d) listing policy.

- BMPs to address nuisance runoff and leaky sewers have been implemented in Basins D, E, and F and Mother's Beach. Beginning in fiscal year 1993, existing sewers and manholes surrounding Basins D, E, and F have been lined. During 2006–2007, low-flow and sheet-flow diversions were implemented within the drainage to Basins D and E. Data collected for TMDL and historical monitoring were used to evaluate differences between pre- and post- BMP implementation in Basins D, E, and F. Receiving water data in Basin E showed no significant difference between bacterial levels pre- and post-BMP implementation. Receiving water data in Basin D showed higher levels of total coliform and enterococcus post-BMP implementation when compared to pre-implementation levels. This may be due to the small sample size of data used in this analysis. Receiving water dry-weather data in Basin F showed higher levels of enterococcus after sewer lining was completed. Bacterial levels during days following mechanical circulation of water at Mother's Beach compared to bacterial levels on days when no mechanical circulation occurred showed no significant difference. Additional data have been collected since this reference was published. A summary of additional data, samples collected from March 2007 through May 2010, is provided in Section 3.1.3.

Potential Sources and Data Gap Analysis

The results of this study indicated that measurable concentration reductions were not observed from this short-term period after the implementation of sewer infrastructural improvements. This study also indicated that measurable concentration reductions were not evident in the short term following the implementation of mechanical circulation of waters at Mother's Beach. Similar to the results of the Mother's Beach and Back Basins Bacteria TMDL Non-Point Source Study, this study indicates that sewage is not a significant source of bacteria and that other sources need to be addressed (i.e., avian sources and upstream stormwater runoff inputs to Oxford Basin and Boone Olive Pump Station, and unknown nonpoint sources such as regrowth) or identified through additional monitoring. This long-term compliance monitoring will provide a monitoring tool for future evaluation of programmatic BMP effectiveness at the watershed-wide compliance level. Speciation analyses could also provide further insights into the impact of bacterial regrowth and species origins. Section 3.1.3 provides an analysis of additional data collected from March 2007 through May 2010.

3.1.3 Marina del Rey Harbor Mother's Beach and Back Basins Bacteria Indicator TMDL Data Evaluation (2007–2010)

The MdRH Bacteria TMDL compliance monitoring data collected beginning March 2007 through May 2010 was evaluated for compliance with Bacteria TMDL requirements. The number of exceedances of TMDL criteria at each station was evaluated based on the allowable exceedances during summery dry, winter dry, and wet weather for each indicator (Total coliform, *E. coli*, and enterococcus). An exceedance of any indicator bacteria was counted as an exceedance for that day. The results are presented in Table 3-3, below by Station Type (Compliance or Ambient). The results are also presented by calendar year in Table 3-4, because the TMDL criteria are set by year (allowable exceedance days per year). Data for ambient stations were collected from April 2007–October 2008.

Table 3-3. Summary of Bacteria Compliance (March 2007-October 2007)

Percentage of Stations Meeting TMDL Requirements			
Site	**Summer Dry**	**Winter Dry**	**Wet**
Compliance	8%	38%	23%
Ambient*	60%	80%	100%

*Data for ambient stations were collected from April 2007–October 2008

The results of the analysis of the overall dataset indicate:

- Three of the five TMDL ambient monitoring stations met summer dry TMDL compliance targets, MdRH-10, MdRH-11, and MdRH-14.
- Four of the five TMDL ambient monitoring stations met winter dry TMDL compliance targets, MdRH-10, MdRH-11, MdRH-12, and MdRH-14.
- All five TMDL ambient monitoring stations met wet-weather TMDL compliance targets.
- Only one of the thirteen TMDL compliance monitoring stations, MdRH-8 (Depth), met the summer dry TMDL compliance targets.
- Five of the thirteen TMDL compliance monitoring stations met the winter dry TMDL compliance targets, MdRH-6 (Depth), MdRH-7, MdRH-8 (Depth), MdRH-8 (Surface), and MdRH-9 (Depth).

- Three of the thirteen TMDL compliance monitoring stations met the wet-weather TMDL compliance targets, MdRH-4 (Surface), MdRH-8 (Depth), and MdRH-8 (Surface).

Table 3-4. Summary by Year of Bacteria Compliance (2007-2010*)

Percentage of Stations Meeting TMDL Requirements			
Year	Season	Compliance	Ambient
2007	Summer Dry	15%	80%
	Winter Dry	62%	100%
	Wet	85%	NA
2008	Summer Dry	31%	80%
	Winter Dry	69%	80%
	Wet	23%	100%
2009	Summer Dry	15%	NA
	Winter Dry	69%	100%
	Wet	62%	NA
2010*	Summer Dry	92%	NA
	Winter Dry	77%	NA
	Wet	46%	NA

* 2010 data only includes through May

When analyzed by year the following findings were made:

- In 2007 TMDL ambient monitoring stations met summer dry TMDL compliance targets at four of the five stations and all five of these stations met the winter dry TMDL compliance targets. MdRH-8 (Depth) was the only TMDL compliance station to meet summer dry TMDL compliance targets.
- In 2008 four of the five ambient monitoring stations met both summer dry and winter dry TMDL compliance targets. Four of the TMDL compliance stations met summer dry TMDL compliance standards.
- In 2009 all five of the ambient monitoring stations met winter dry TMDL compliance targets. MdRH-8 (Depth) was the only TMDL compliance station to meet summer dry TMDL compliance targets.
- 2010 data indicate 12 of the 13 TMDL compliance monitoring stations met the summer dry TMDL compliance targets. However, this dataset is incomplete. Data for 2010 were only available through May.

3.1.4 Marina del Rey Harbor Annual Report

The LACDBH has done annual monitoring in MdRH for over 25 years, with assessments of water column, fish surveys, and benthic sediments. These data are used by state, federal, and local governments to help develop BMPs designed to protect the beneficial uses of the marina. This section summarizes the results of these annual investigations from 2001 through 2008 (LACDBH, 2002 through 2005, 2007, and 2009).

Water

Monthly water quality assessments were undertaken to assess general water quality parameters. Overall results of the sampling suggested that stormwater discharges lead to increases in ammonia, bacteria counts, and biochemical oxygen demand (BOD) and decreases in clarity, salinity, and pH. The water quality in MdRH may be impacted by urban runoff from Ballona Creek, Boone Olive Pump Station, and Oxford Basin. Freshwater intrusion in the Back Basins generally leads to lower salinity. Dissolved oxygen is highest near the harbor entrance and decreases toward the Back Basins.

Monthly dry-weather bacteria monitoring at 18 locations measured total coliforms, fecal coliforms, and enterococci (Figure 3-4). The annual results suggest that drainage from Ballona Creek (Station 1) and Oxford Basin (Stations 13 and 22) contribute fecal indicator bacteria. In the most recent study (LACDBH, 2009), 11 of the 228 samples exceeded total coliform and fecal coliform WQOs, with the highest number of total coliform exceedances occurring within Oxford Basin. Within the sample set used for the TMDL Compliance Monitoring Program, only one site, located within Basin E, exceeded total coliform and fecal coliform WQOs. Enterococci concentrations exceeded WQOs at the two sites located in Oxford Basin (Figure 3-4).

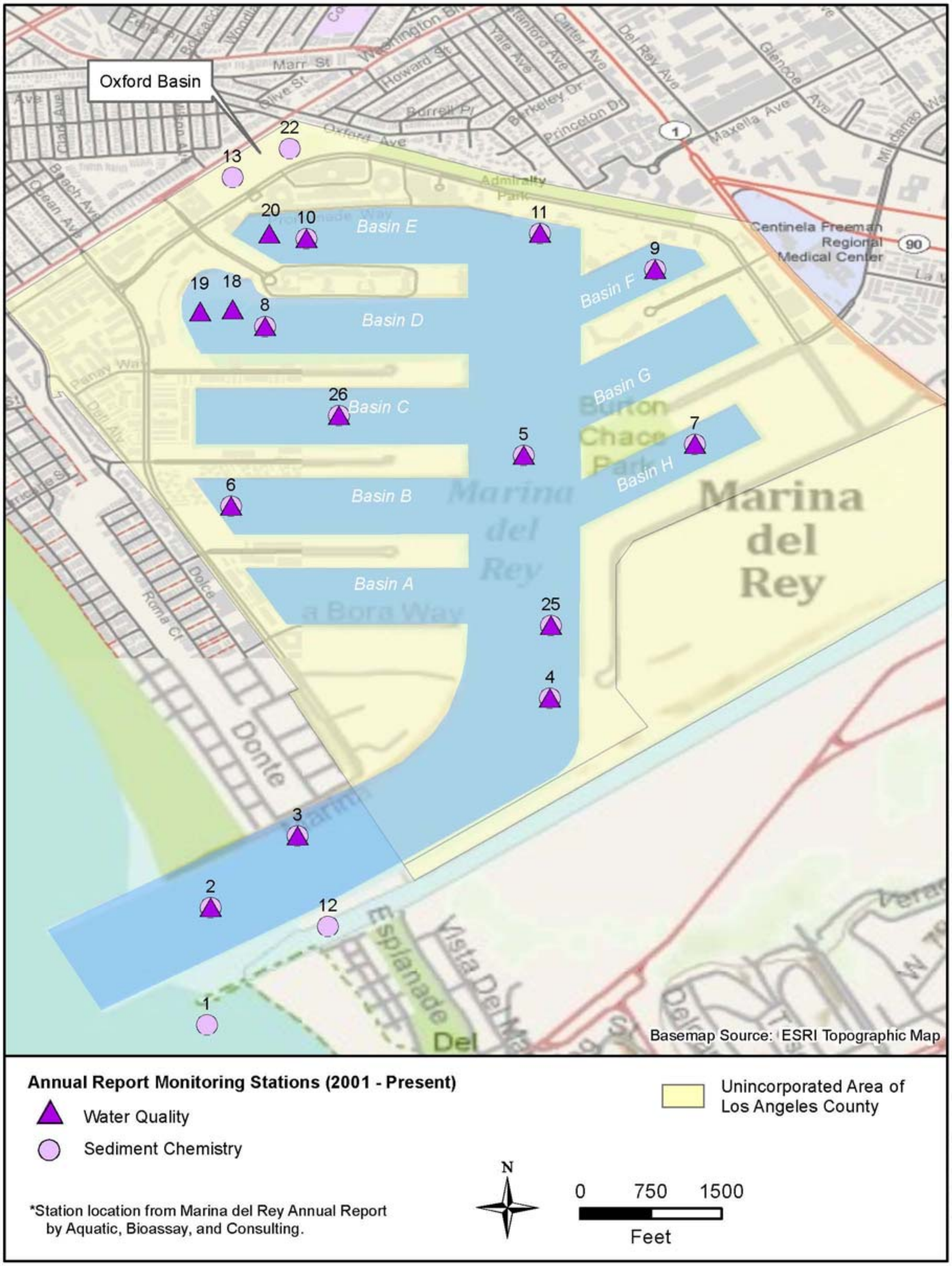


Figure 3-4. Marina del Rey Annual Report Sampling Locations
(LACDBH, 2002 through 2005, 2007, and 2009)

Figure 3-5. Monthly Enterococcus Concentrations (MPN/100mL) in Marina del Rey (LACDBH, 2009)

Sediment
Sediment sampling consisted of assessments of physical, chemical, and biological characteristics. Pesticides and PCBs were detected in sediments in the marina. The highest concentrations of dichlorodiphenyltrichloroethane (DDTs) measured were generally in Back Basin E near the tide gate connecting the marina with Oxford Basin and at the marina entrance. It was suggested that this might indicate that the sources for DDT in the Back Basins and at the entrance are different. PCB concentrations were found to be higher at the marina entrance compared to the other portions of MdRH. Concentrations of chlordane were highest at the marina entrance. These data are consistent with the Sediment Characterization Study presented in Section 3.1.5 of this Implementation Plan.

Heavy metal concentrations have remained consistent over the years and were generally found to be higher in the mid-channel and in Back Basins of the marina than near the entrance. Several metals, including arsenic, chromium, copper, mercury, nickel, tributyltin, and zinc were higher in the back of the mid-channel and Back Basins, and decreased toward the marina entrance. The presence of each of these metals was suggested to be the result of continuing deposition through both dry- and wet-weather runoff, boating, and historical deposits. Long-term metal spatial trends were investigated by averaging concentrations for each site in the harbor from 1997 to 2007. The concentrations of each of the metals were generally lower at the marina entrance and Ballona Creek, greatest in the mid-channel and Back Basins, and lower in the Oxford Basin. Exceptions to this were cadmium and tributyltin, which were lower and similar across sites in the marina. The concentrations of several metals (lead, nickel, and zinc) in Oxford Basin were similar to, or higher than, concentrations measured in the mid-channel and Back Basins, indicating that urban runoff was a contributor of these constituents to the marina. In comparison, several other metals (copper, mercury, silver) were lower in Oxford Basin compared to the marina, indicating that their sources were internal to the marina.

Benthic Infauna
Benthic infauna assessments were conducted annually in MdRH with assessments divided into three areas in the marina: the entrance, mid-channel, and Back Basins. As in most surveys, the composition of infauna in Marina del Rey was divided into two geographic areas: 1) the entrance and outer mid-channel and 2) the Back Basins. The entrance and mid-channel were characterized by high species abundances and numbers of species. In contrast, the Back Basins had generally lower abundances and numbers of species and diversity.

Fish Surveys
Semi-annual fish surveys have been conducted for over 25 years. In the past decade, fish surveys have used trawl netting (for bottom-dwelling fish), gill net (for mid-level fish), plankton net sampling (for larval fish and eggs), beach seine (for inshore fish), and diver-biologist-transect sampling (for reef fish). Combining all past surveys, 117 species of fish have been collected in the harbor, suggesting greater diversity than many other estuaries in the area. The majority of samples collected were composed of eggs, larvae, or juveniles, suggesting the harbor is an important nursery.

Potential Sources and Data Gap Analysis
The results of this study found higher chlordane and PCBs at the mouth of the MdRH and lower concentrations in the Back Basins, suggesting an external source of these constituents (i.e.,

Ballona Creek). The Marina del Rey Harbor Sediment Characterization Study (see Section 3.1.5) had similar findings. Heavy metal concentrations have remained consistent over the years and are generally highest in the mid-channel and Back Basins. This study has postulated that urban runoff is a source of metals. Maritime activities deposition has also been identified as a potentially significant contributor of metals. In contrast, Oxford Basin was found to have lower metals concentrations than the marina, and therefore was not identified as a significant source of metals into Basin E.

A potential data gap posed by the annual reports is the impact of Ballona Creek on the water and sediment quality of MdRH. This can be effectively addressed through modeling. Although not identified in the annual reports, the Toxics TMDL identifies atmospheric deposition as a potential source of copper, lead, and zinc, based on a 2004 regional study for coastal Los Angeles. Based on recent studies conducted in San Diego County, deposition rates vary within different watersheds and subwatersheds. Given MdRH's vicinity to Highway 90 and Highway 1, using general atmospheric deposition rates may pose a gap in actual metals loading. An atmospheric deposition special study may be conducted to evaluate the contribution from this source.

3.1.5 Marina del Rey Harbor Sediment Characterization Study

The Marina del Rey Harbor Sediment Characterization Study was completed in April 2008 in compliance with the "Requirement to Submit Information" letter from the Regional Board regarding sediment contamination in MdRH (WESTON, 2008b). The letter specified that the responsible agencies were to design a study plan to assess the areal extent of sediment contamination in the harbor for constituents listed in the Toxics TMDL including total PCBs, chlordane, copper, lead, and zinc.

In this study, 23 sites were assessed with the collection of sediment cores, with samples collected at the surface, top (0–10 cm) and bottom (11 cm and deeper). Sixteen predetermined sampling locations were assessed by removal of surface sediments and sediment cores. Pore water was collected from five of the 23 sites. Sediment samples were analyzed for benthic infauna, toxicity, and physical/chemical composition with regard to sediment grain size, total organic content (TOC), metals, organochlorine pesticides, and PCBs.

Results from the surface sediment analyses indicated that chlordane distribution was most highly concentrated at the mouth of the main channel (Figure 3-6). Copper (Figure 3-7), lead (Figure 3-8), and PCB (Figure 3-9) concentrations were highest in the mouths of each Back Basin and in the main channel. Metals were found to be higher in the main channel and the mouths of each Back Basin compared with concentrations farther into the Back Basins (Figure 3-7 and Figure 3-8).

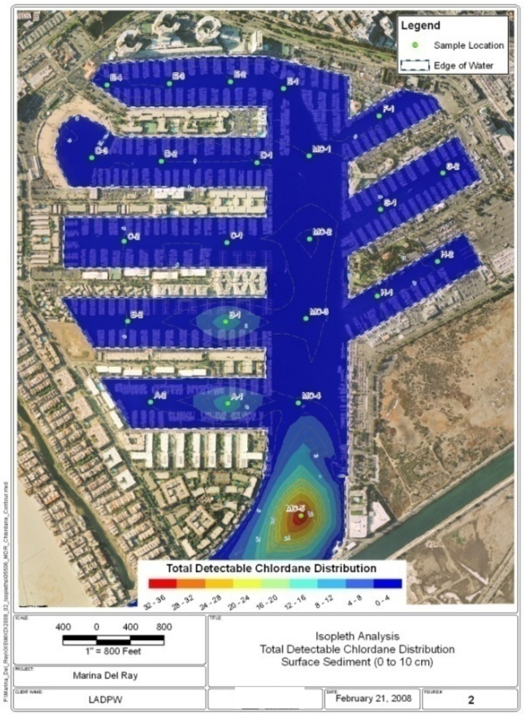


Figure 3-6. Distribution of Total Chlordane in Surface Sediment in Marina del Rey Harbor (WESTON, 2008b).

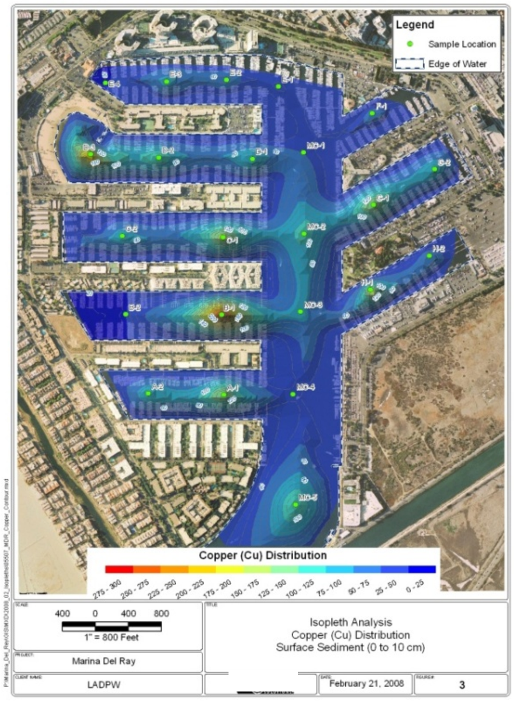


Figure 3-7. Distribution of Copper in Surface Sediment in Marina del Rey Harbor (WESTON, 2008b).

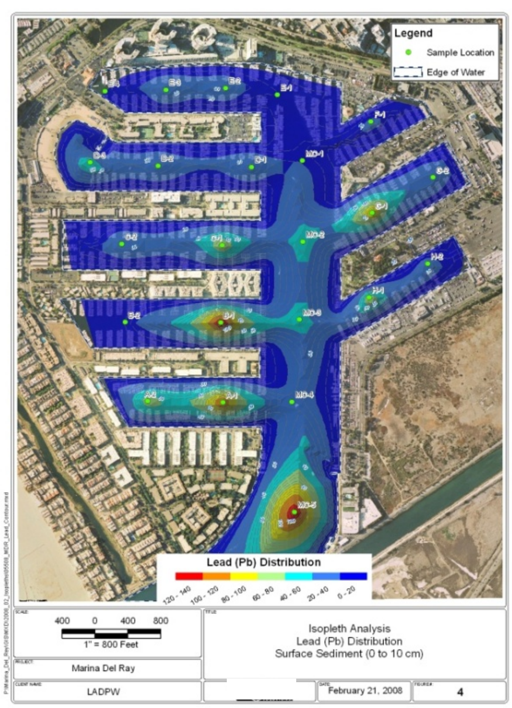


Figure 3-8. Distribution of Lead in Surface Sediment in Marina del Rey Harbor (WESTON, 2008b).

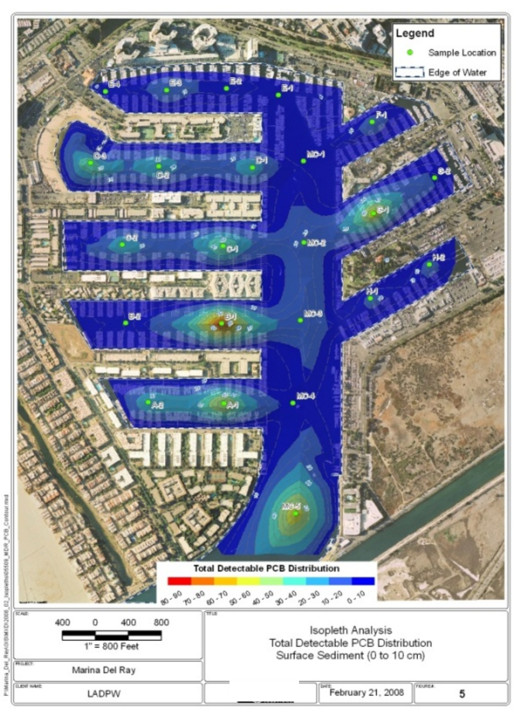


Figure 3-9. Distribution of Total PCBs in Surface Sediment in Marina del Rey Harbor (WESTON, 2008b).

These results are consistent with those of the MdRH Annual Report, which suggests influences external to the harbor for higher concentrations of chlordane and PCBs at the mouth of the harbor.

Potential Sources and Data Gap Analysis

The results of this study correlated well with those of the MdRH Annual Reports (LACDBH, 2002 through 2005, 2007, and 2009), which identified higher concentrations of chlordane and PCBs at the mouth of MdRH and lower concentrations in the Back Basins. The results are also correlated in identifying maritime activities as a potential source of metals in the Back Basins.

A potential data gap posed by the results of this sediment study is that further evaluation may be needed to assess the impact of Ballona Creek on the water and sediment quality of MdRH. This can be effectively done through an integrated pollutant loading model. The contribution to metals loading from marina activities (boat paint) and air deposition, as previously mentioned, may also be the subject of future studies to determine the priority source of metals loading.

3.1.6 Oxford Basin Sediment and Water Quality Characterization Study

The Oxford Basin Sediment and Water Quality Characterization Study was completed in 2010 to further assess the contribution of Oxford Basin to dry- and wet-weather bacteria and metals loading building on the previous studies summarized above. The study also assessed sediment quality in Oxford Basin to further evaluate alternatives to improve the overall sediment and water quality within Oxford Basin and Basin E (WESTON, 2010). Sampling locations for wet- and dry-weather water samples were in the Oxford Basin, Basin E, and Boone Olive Pump Station. Sediment sampling was confined to the Oxford Basin. Multiple cores per location were collected and, based on sediment stratification, split into vertical segments (assessed as either loose recently deposited unconsolidated or denser consolidated material) to evaluate the vertical resolution of potential chemical contamination.

Sediment samples were analyzed for bacteria, grain size, metals, pesticides, and PCBs, and general chemistry. In addition, native layers and excavation layers underwent additional testing for disposal assessment purposes. Each water sample, collected during dry or wet weather, was analyzed for metals, nutrients, bacteria, PCBs, volatile organic compounds, total and dissolved organic carbon, and total suspended and dissolved solids.

The sediment characterization portion of the study indicated that:

- Grain size analysis of the excavation sediments indicated predominantly silts and clays.
- Total PCBs were detected in unconsolidated layer sediments at two main sites, one in the easternmost portion of Oxford Basin and one in the mid portion of Oxford Basin. The PCB concentrations did not exceed their respective sediment quality objectives. These sites were also the locations with the highest concentrations of chromium and lead.
- Unconsolidated layers showed below detection limit concentrations for nutrients and all samples were below federal Toxicity Characteristic Leaching Procedure (TCLP) criteria for metals.

- Total and fecal coliforms were higher in sediments from the northeastern portion of the Basin compared with concentrations in the easternmost portion, which discharges into Basin E.

The dry-weather water quality portion of the study indicated that:

- Bacteria concentrations were below WQOs at all sites during ebb tides, but during flood tides were above WQOs within Oxford Basin.
- Within Oxford Basin and the exchange, metals concentrations were below WQOs for both total and dissolved states.
- Basin E had dissolved copper concentrations above the WQO during ebb tides.

The wet-weather water quality inter-transfer portion of the study indicated that:

- Bacteria concentrations exceeded WQOs in the Boone-Olive Pump Station, Oxford Basin, the exchange, and Basin E. Bacteria concentrations were not significantly higher in the Oxford Basin compared to Basin E. However, enterococci concentrations were significantly higher in discharges from the Boone Olive Pump Station.
- Dissolved copper exceeded the CTR saltwater criteria in the exchange water and in Basin E. No other metals exceedances were observed. These results suggest copper is not entering Basin E from the Oxford Basin.

Potential Sources and Data Gap Analysis

Overall, these results indicate that the dry weather diversion installed at the inflow to Oxford Basin has reduced the bacteria loading and the occurrence of exceedances of bacteria indicator concentrations in the Oxford Basin. These results differ from previous studies conducted prior to the construction of the diversions. However, there continues to be sources, such as birds and poor circulation in the upstream narrow section of Oxford Basin, that result in isolated exceedances of the WQO. Planned restoration activities in the future should consider the use of bird mitigation measures and improved circulation of Oxford Basin. The results of this study, which include sampling through the tidal cycle, indicate other more predominant sources of bacteria indicator concentrations above the WQO in Basin E. These other sources likely include birds and potentially the MS4 outfalls that discharge directly to the Back Basins as mentioned under the previous studies. The contribution of the MS4 outfalls to bacteria concentration exceedances in the Back Basins may be further investigated.

Stormwater flows entering Oxford Basin continue to impact water quality in Oxford Basin and Basin E. The potential impact from both dry-weather and wet-weather flows from the MS4 outfalls that discharge directly into the Back Basins is not fully known and should be further investigated.

The results of this study also indicate that Oxford Basin during dry-weather conditions is not a source of metals loading to the Back Basins. Metals' loading to the Back Basins is likely from marina activities and air deposition as discussed under previous studies. The results further indicate that sediments within Oxford Basin do not represent a measurable load of metals, PCBs, and pesticides to the Back Basins. Further characterization of the sediments and the potential impact to water quality at the sediment-water interface should be considered as part of the restoration study and design efforts. These additional investigations and testing can provide an estimate of the load reduction of toxics that can be achieved through the restoration efforts that include removal of portions of the unconsolidated sediments.

The lower concentrations of PCBs and chlordane found in sediments correlate well with other studies that found those constituents to be lower in the farthermost Back Basins compared with the harbor mouth. These results support the assumption that sources external to the marina (i.e., Ballona Creek) are the likely cause of these higher concentrations in these constituents. The impact of Ballona Creek on the water and sediment quality of MdRH may be addressed through an integrated pollutant loading model.

3.1.7 Southern California Bight '03

A regional monitoring program (known as the Southern California Bight '03) was conducted during 2003 with the coordination of 58 organizations within Southern California (Southern California Coastal Water Research Project (SCCWRP), 2007). Monitoring during this program occurred in MdRH at six stations for sediment chemistry, sediment toxicity, and benthic infauna (Figure 3-10).

Sediment concentrations of chlordane were below reporting limits, but the reporting limit was greater than the sediment numeric target of 0.5 µg/kg for the Toxics TMDL, and total PCB concentrations were below the sediment numeric target of 22.7 µg/kg for all six samples. All six sediment samples exceeded the TMDL numeric targets for copper, lead, and zinc (34, 46.7, and 150 mg/kg, respectively).

Eohaustorius estuarius toxicity was observed for three of six samples (stations 4149, BRI-01, and BRI-02) where the percent survival was both less than 80% of the control and significantly different from the control samples. These samples were located in the mouth of the MdRH (station 4149), at the western end of Basin E (BRI-01), and at the western end of Basin B (BRI-02).

Potential Sources and Data Gap Analysis

Although the Bight '03 program does not attempt to identify sources through its investigation, these data help support source identification studies. The results of the Bight study do suggest toxicity at the mouth of MdRH, which correlates with higher PCB and chlordane concentrations. These data points add to the hypothesis that sources external to MdRH likely contribute to water quality impacts within the MdRH. Ballona Creek has been identified as the most likely source.

Figure 3-10. Southern California Bight '03 Sediment Sampling Locations (SCCWRP, 2007)

3.1.8 Small Drain Survey

A small drain identification report was prepared as a requirement of the Bacteria TMDL (City of Los Angeles, 2004) and was therefore identified as a deliverable under the Bacteria TMDL CMP in July 2004. The purpose of the document was to identify all storm drain outlets that discharge into MdRH. In this project, approximately 724 storm drains were identified. The City of Los Angeles, Caltrans, and the City of Culver City are not responsible for any outlets that drain directly to MdRH. The County owns 20 storm drain outlets and two storm drain inlets that flow into the Oxford Basin. Four storm drain outlets were not assigned responsibilities. LACDBH is responsible for approximately 700 storm drain outlets associated with leased parcel sites.

Potential Sources and Data Gap Analysis
One significant data gap associated with storm drain systems in MdRH is the lack of data related to discharges into the MdRH MS4. Studies to date have not investigated sites of significant flows into the MdRH and their contribution to water and sediment quality. Comprehensive surveys, where flows and constituent concentrations are measured at multiple locations, with further investigation at sites with elevated loads, should be considered. In addition, investigations into illicit connections and illegal discharges may be necessary to assess the load reduction capabilities of the system.

3.2 Summary of Sources

Sediment, water quality, and benthic infauna have been monitored in MdRH since 2001 as special studies, on a monthly or quarterly basis, for both sediment and water. This section presents the interrelationship of the findings of those studies in terms of constituents, potential sources, and potential data gaps.

A summary of the identified constituent sources from key studies is presented in Table 3-5.

Table 3-5. Key Study Findings - Attributed Sources

Study	Bacteria	Metals	Chlordane and PCBs
Bacteria TMDL Non-Point Source Study	Oxford Basin, birds, and some anthropogenic sources	Not tested.	Not tested.
MdRH Mother's Beach and Back Basins Bacteria Indicator TMDL Compliance Study	Birds and some anthropogenic sources	Not tested.	Not tested.
MdRH Annual Reports	Oxford Basin	Maritime practices and storm drains	External to MdRH (Ballona Creek)
MdRH Sediment Characterization Study	Not tested.	Maritime practices and storm drains	External to MdRH (Ballona Creek)
Oxford Basin Sediment and Water Quality	Natural levels observed	Low concentrations observed	Low concentrations observed
Bight '03	Not tested.	Data supports results of other studies	Data supports results of other studies

3.2.1 Chlordane and PCBs

Sediment within MdRH was evaluated during the Sediment Characterization Study (WESTON, 2008b), the MdRH Annual Report, and the Southern California Bight '03 (SCCWRP, 2007). The results of these studies are consistent in finding that grain size was largest in the main channels, with smaller grain sizes in the farthermost reaches of the Back Basins. These results suggested that low flow and limited flushing have a strong impact on pollutant distribution.

Assessment of chlordane and PCBs in sediments from the Oxford Basin indicated concentrations below quality objectives and for the most part below detection limits. Assessment of sediments in the MdRH found chlordane and DDT concentrations to be highest at the mouth of the main channel and low in the Back Basins. The results of all studies suggest a source external to MdRH is contributing these constituents. The study authors generally concluded that the source was most likely Ballona Creek.

3.2.2 Metals

The results of most sediment studies conducted in the MdRH found copper and lead concentrations to be highest in the main channel and in the mouths of each Back Basin. These metal sources were generally identified as being maritime activities (such as hull leachate), discharge from storm drains into the receiving water, and atmospheric deposition.

The Oxford Basin Sediment and Water Quality Characterization (WESTON, 2010) provided insights into the potential for the Oxford Basin to act as a reservoir and potential source for contaminated sediments entering Basin E. The results of the study indicated low concentrations of metals, except chromium and lead, suggesting that resuspension of sediments in Oxford Basin is not likely to be a source of metals in Basin E.

3.2.3 Fecal Indicator Bacteria

Water quality has been comprehensively assessed throughout the MdRH as special studies and as part of continuous monitoring programs. As a result of these studies, a number of constituent sources have been identified.

Assessments of bacterial contributions to Basin E were consistent between the majority of projects, with the Oxford Basin and Boone Olive Pump Station, identified as a source of bacterial loads during wet weather. The most recent study did not indicate that Oxford Basin was a predominant contributor to bacteria concentrations in Basin E during dry-weather flows (the Oxford Basin Sediment and Water Quality Characterization (WESTON, 2010)). This study was undertaken after the installation of a dry-weather diversion into the Oxford Basin.

In the bacterial source identification study (WESTON, 2007), birds were identified as a key contributor throughout MdRH and management actions targeting this source were recommended. Anthropogenic sources and transport mechanisms included boat-related maintenance activities, trash and food waste, washing activities (restaurants, restrooms, parking areas, and buildings), landscaping, and the MS4. Another key factor in the presence of bacteria within MDRH is the limited flow through the marina waters. This lack of circulation increases the potential for bacterial reservoirs to inhabit locations such as pier supports and boat hulls. These locations are also prone to limited ultraviolet (UV) penetration and subsequently allow increased microbial longevity.

Bacterial concentrations in sediments were found to be very low in all studies, suggesting that marina sediments do not act as a significant reservoir of fecal indicator bacteria.

3.3 Pollutant Source Characterization

A summary of the potential sources of different constituents is presented in this section as an introduction to the proposed structural and nonstructural BMPs in the MdRH TMDL Implementation Plan. Further details regarding these BMPs will be presented in upcoming sections of the TMDL Implementation Plan.

3.3.1 Harbor-Based Sources

Likely sources of bacteria, copper, lead, zinc, total PCBs, and total chlordane that have been identified within the MdRH, but fall outside the scope of the MdRH TMDL Implementation Plan include:

- **Ballona Creek**: A number of the studies presented in this report identified external sources as the key contributors of PCBs and chlordane into the MdRH receiving waters. One key external source was identified as Ballona Creek. A need has been identified for an integrated watershed data that integrates all of the existing monitoring data as well as data currently being collected as part of the CMP into a single database. This consolidated database may document more clearly the impact of Ballona Creek on MdRH.
- **Boats**: Several studies attributed the higher metal concentrations found in the main channel and in the mouths of each Back Basin as being sourced from maritime activities. Anti-fouling, copper-based hull paint was specifically identified as a source of higher copper in the MdRH. While boat management and painting activities generally fall within the marina and future marina permit, boat-related activities conducted within the land-based unincorporated areas of the County may be addressed through nonstructural and structural solutions. Furthermore, the County may enhance existing educational materials and influence the larger marina community within MdRH through an optional, integrated Green Marinas public-education information and participation program.
- **Legacy Sediments**: Several studies have characterized the unconsolidated and consolidated sediments of the harbor and found higher concentrations of metals, PCBs, and chlordane. Disturbance of these sediments could cause resuspension in the water column and transport to other areas of the MdRH.
- **Boone Olive Pump Station**: During wet weather this site was identified as a key source of fecal indicator bacteria contributing to higher bacterial loads to Basin E.
- **Oxford Basin**: This water body was identified as a key potential source of metals and bacteria in a number of studies conducted prior to the installation of dry weather diversions. Assessment within Oxford Basin in 2010 during dry and wet weather suggested that Oxford Basin was not a significant contributor of pollutants (particularly metals). Dry-weather bacteria contributions from Oxford Basin appear to have decreased

with the construction of the dry-weather diversions. The Oxford Basin Low Flow Diversion (LFD) came online in January 2009 and the Washington and Thatcher LFD in December 2006. Further BMP evaluation may be required to assess the effectiveness of the diversions. During wet weather Oxford Basin has been found to contribute to bacteria concentrations in Basin E.

- **Natural Sources**: Birds have been found to be a significant source of fecal indicator bacteria to MdRH. Within the unincorporated areas of the county the impact of this natural source can be limited through structural BMPs, such as bird controls, and nonstructural BMPs, such as bird waste management programs.

3.3.2 Watershed-Based Sources

Likely sources of bacteria, copper, lead, zinc, total PCBs, and total chlordane from the watershed to the MdRH include:

- **Stormwater Runoff**: Sources during wet-weather flows can be transported significant distances and can carry significant contaminant loads. Jurisdictional boundary monitoring would allow accurate Responsible Agency load contributions. A survey of the MS4 in which flows and concentrations of specific constituents are assessed both temporally and spatially and follow-up investigations are undertaken would also provide valuable baseline information for BMPs and more accurately provide pollutant loading to facilitate engineering design of future BMPs.
- **Residential Contributions**: Use of certain building materials can contribute loads of copper and zinc (from structures such as roofing materials, gutters, and fencing). Over-irrigation and wash water can provide a transport mechanism for pollutants and provide a reservoir for bacteria growth/regrowth in soils and the MS4. Control of these sources can include structural solutions such as aggressive street and parking lot sweeping, enhanced trash management, and green gardening, and nonstructural solutions such as targeted educational and enforcement programs for irrigation and washing activities and/or facilities.
- **Commercial Contributions**: Certain commercial practices including poorly managed restaurant wash-down and trash storage can impact water quality. Management actions could include targeted trash inspection programs.
- **Atmospheric Deposition**: Atmospheric deposition of metals has been found to be a significant source of copper (brake pads) and zinc (brake pads and tires). Improvements to loads from these sources can be achieved through true source control activities, such as the Brake Pad Partnership and product substitution, and structural solutions, such as targeted aggressive street and parking lot sweeping.
- **Anthropogenic Fecal Sources**: Fecal sources can include poorly contained pet waste, bird attractants (such as open trash receptacles) and public restrooms. Another key anthropogenic source may be the illegal dumping of boat waste into the harbor. Solutions may include outreach regarding pet waste, RV waste and boat waste disposal, and enforcement programs, trash inspection programs, targeted restaurant inspections, and improved maintenance of restroom facilities.

4.0 PROPOSED NONSTRUCTURAL SOLUTIONS

The purpose of this section of the Implementation Plan is to identify BMPs that the County may implement on the "land side" of the unincorporated areas of MdRH. This Implementation Plan uses an integrated approach that addresses multiple pollutants, using nonstructural and structural solutions.

Section 4.1 focuses on the nonstructural solutions that may be implemented in MdRH using the phased adaptive management process defined in Section 4.1.1. Section 2.1.2 provides a list of solutions consisting of enhanced existing programs that the County is implementing and additional nonstructural solutions. This section also identifies potential special studies that will help fill the gaps in knowledge regarding sources and behaviors of bacterial, toxicological, and other pollutants of concern.

To best achieve the TMDL reductions, addressing pollutants on land, in the water, and at the land/water interface will be necessary. The scope of this integrated TMDL Implementation Plan is limited to the "land side" of MdRH because it is anticipated the marina and "water side" of MdRH will fall within the jurisdiction of the California-Coastal Marinas Permit currently under development by SWRCB.[2] Following the integrated approach used in this Implementation Plan, Section 2.2 contains a general "Green Marina" public information and participation program (PIPP) that identifies potential outreach materials and enhanced programs that may be used throughout MdRH.

4.1 Nonstructural Solutions

Nonstructural solutions consist of pollution prevention measures and source controls that are designed to prevent or minimize pollutants from entering urban runoff that could then impact water quality in MdRH.

- Pollution prevention measures target pollutants and wastes before they are generated. These measures typically emphasize conserving or reusing resources to prevent pollution.
- Source controls target specific sources of pollution to reduce or eliminate pollutants from entering the MS4 and impacting the receiving water. Source controls generally include institutional controls, such as codes, ordinances, and regulations. Source controls may also include outreach and education, and enforcement measures.
- True source controls recognize that the source of pollutant may be the physical design of a product, such as copper-based pesticides. In this instance, product regulation and true source control can only be achieved at the state or national level. True source controls support regulatory change outside the local jurisdiction.

The nonstructural pollution prevention measures and source controls described in this Implementation Plan are classified using a "three-legged stool" approach. The three legs of the stool consist of education, incentives, and enforcement. All three types of nonstructural solutions

[2] The development of the Coastal Marinas Permit is on hold.

are needed to effectively meet the requirements of the bacteria and toxics TMDLs. When used in combination, these types of BMPs have been proven to provide improved effectiveness at lower costs than many structural solutions.

- Education raises public awareness of minimum BMPs, good housekeeping activities, and pollution prevention solutions through Pollution Incident Prevention Plans (PIPPs).
- Incentives target specific pollutant sources with social and monetary incentives that may be used to encourage behavioral and operational changes that result in reduced or eliminated generation or migration of pollutants in urban runoff and stormwater.
- Enforcement targets specific pollutant sources using guidelines, code modifications, and inspections. Enforcement may be used to encourage behavioral and operational changes that reduce or eliminate sources of urban runoff and stormwater impacts.

While not an explicit pollution prevention measure or source control, special studies are another important aspect of the nonstructural program. Special studies are needed to fill the gaps in knowledge about priority pollutants of concern, pollutant sources and transport to the receiving water, and BMP structural design, and are necessary to ensure that TMDL compliance activities are designed and located based on scientifically sound data.

Nonstructural Solution - Example 1:
Institutional controls and regulatory change represents an important aspect of the enforcement leg of the stool. These nonstructural solutions lay the foundation for inspections and may incentivize targeted audiences to proactively modify behaviors and operations to avoid the need for regulatory enforcement. A phase-out and full ban on architectural copper and copper roofing is a potential county ordinance modification that will remove a source of copper from buildings. Similarly, developing county ordinances for the design, minimum level of treatment, reuse opportunities, and maintenance requirements for rain water harvesting systems (RWHS) (i.e., rain barrels and cisterns) would provide a standardized approach to using RWHS for stormwater reuse.

Nonstructural Solution - Example 2:
In 1998, the Brake Pad Partnership, consisting of brake manufacturers, stormwater agencies, and environmental groups formed to determine whether copper from brakes is a significant contributor to copper contamination to the receiving waters. Special studies conducted across California have shown that the copper content of brake pads is a source of copper loading and this research is being used to justify a legislative phase-out of copper in brake pads at the state level. The Brake Pad Partnership is an example of true source control that will remove copper brake pads from the market and therefore a source of loading to the environment. True source control is a proven effective solution (i.e., downward-trending Diazinon concentrations and infrequent detection in San Diego, CA, after the 2004 ban of Diazinon-based products).

4.1.1 Phased Adaptive Management Process

This Implementation Plan uses adaptive management to plan, implement, assess, and refine nonstructural solutions in MdRH (Figure 4-1). Adaptive management will allow the county to develop an overall program consisting of the "best" solutions based on the targeted pollutants, pollutant sources, and audiences. All planned activities will be based on the special studies, source evaluations, and structural solutions that the county has been implementing since the *MdRH Mother's Beach and Back Basins Bacteria TMDL* (LARWQCB, 2003) came into effect on March 18, 2004, and since the *TMDL for Toxic Pollutants in MdRH* came into effect on March 22, 2006 (LARWQCB, 2005). These activities are summarized in Table 4-1. These activities have been separated into an initial phase, to signify completion or implementation of an ongoing activity prior to the development of this integrated Implementation Plan.

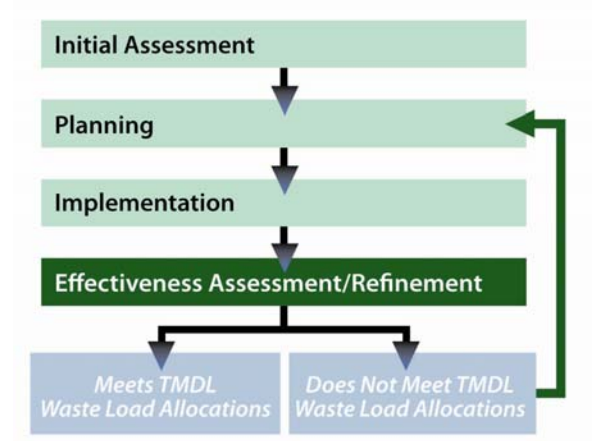


Figure 4-1. Adaptive Management Process with Phases

Table 4-1. Ongoing Nonstructural Solutions Implemented after the 2004 Effective Date of the Bacteria TMDL

Nonstructural Solution	BMP Type	Description	Date Implemented
Public Education and Outreach	Education	The county has developed multiple stormwater and environmentally related education materials based on the *Public Education Model Program* model developed in 2002. A summary of existing educational materials is provided in Section 2.2.	Ongoing 2002
Restaurant Inspections	Enforcement	Annual inspections targeting restaurants as a potential source of food waste (bacteria, trash, and other pollutants) from waste disposal, grease containers, mop sinks, and other housekeeping activities. Identifies facilities lacking minimum stormwater BMPs and housekeeping practices.	Ongoing 2004
Bacteria Source Identification	Special Study	Bacteria Non-Point Source Study, which identified and sampled potential sources of bacteria for wet- and dry-weather conditions.	Completed 2007
Sediment Characterization	Special Study	Marina del Rey Sediment Characterization Study, which assessed the extent of sediment contamination in the MdRH for constituents listed in the TMDL for toxic pollutants.	Completed April 2008
Storm Drain Identification	Special Study	Small Drain Survey, which identified all storm drain outlets discharging into MdRH (approximately 724 storm drains total) (LACDBH, 2004b).	Completed July 2004
Street Sweeping	Source Control	Streets and parking lots around MdRH are swept twice a week, on Mondays and Thursdays.	Ongoing 2008
Parking Lot Sweeping	Source Control	Parking lots around MdRH are swept at least twice a week, or per the following lot-specific schedules: • Lot 15: 6x/week (winter); daily (summer) • Lots 11, 13, and 16: 4x/week	Ongoing 2008

Phased Adaptive Management Approach Schedule

All nonstructural and structural solutions have been scheduled into a series of phases, wherein lessons learned from implemented solutions will be used to enhance subsequent projects and programs. It is assumed that solution planning and implementation to meet these TMDL compliance points will not be linear; therefore, this Implementation Plan assumes the county will implement solutions in three phases, with the option to create more phases as appropriate (Figure 4-2). The three phases were scheduled to work in concert with ongoing effort planned under the *Marina del Rey Harbor Mother's Beach and Back Basins Bacteria TMDL Implementation Plan* (MDRWRA, 2007). An overview of the nonstructural schedule is presented in Table 4-2.

Each phase of the nonstructural solutions schedule spans 5 years. Phase 2 and Phase 3 match BMP implementation phases defined in the Bacteria TMDL Implementation Plan, while Phase 1 provides a transitional overlap period. Nonstructural solutions implemented during Phase 1 (2010 to 2015) leverage existing effort. Phase 1 consists of special studies needed to fill data gaps identified in the Data Gap Section of this Implementation Plan, and to set a baseline condition for pilot projects. Phase 1 also consists primarily of enhanced, existing nonstructural solutions (i.e., restaurant inspections and existing education programs). Pilot projects and programs will undergo effectiveness assessment to identify opportunities for enhancement, and to ensure that the best solutions are implemented to address pollutants of concern. Ongoing compliance monitoring conducted in accordance with the Bacteria TMDL Coordinated Monitoring Plan (CMP) and Toxics TMDL CMP will provide ongoing status updates toward the WLAs. The subsequent two phases may be modified based upon the lessons learned during Phase 1 to address new sources through new nonstructural solutions and enhanced existing solutions. It is assumed that the County will adjust the implementation schedule based on the overall schedule, and ongoing gap analysis between the WLAs and actual monitoring data. The schedule for Phase 3 may need to be accelerated based on monitoring results prior to the March 22, 2017, 75% compliance deadline.

Table 4-2. Phased Schedule for Nonstructural Solutions

Phase	Time Line	Objective	Types of Nonstructural Solutions
INITIAL	2004–2010	1. Completed special studies, nonstructural solutions, and structural solutions per the TMDL compliance schedules. 2. Completed special studies, nonstructural solutions, and structural solutions per the Bacteria TMDL Implementation Plan (MDRWRA, 2007).	
	03/18/2004	Effective Date of the Bacteria TMDL (18-year compliance schedule for integrated, multi-pollutant approach)	
	03/22/2006	Effective Date of the Toxics TMDL (15-year compliance schedule for integrated, multi-pollutant approach)	
Phase 1	2010–2015 *(overlaps with Phase 2 of MDRWRA, 2007)*	1. Fill data gaps. 2. Establish a baseline condition for structural BMP pilot projects. 3. Enhance existing programs.	• Special studies. • Enhanced restaurant inspections. • Enhanced education. • Additional Nonstructural Programs built upon existing studies, reports, and recommendations.
Toxics TMDL Reopener	March 2012 *(6 years after TMDL effective date)*	1. Submit this Integrated TMDL Implementation Plan to the Regional Board for consideration for an extended implementation schedule under the Toxics TMDL. 2. Submit special study data to the Regional Board for consideration in reevaluating the TMDL WLAs.	

Table 4-2. Phased Schedule for Nonstructural Solutions

Phase	Time Line	Objective	Types of Nonstructural Solutions
Phase 2	2012–2017 *(Phase 3 of MDRWRA, 2007)*	1. Accelerate successful pilot programs from Phase 1, building upon lessons learned. 2. Redesign/optimize Phase 1 programs to answer new study questions. 3. Implement new nonstructural solutions and assessment studies.	• Phase 2 programs. • Optimized programs from Phase 1. • Additional nonstructural solutions.
	March 2015	50% WLA Compliance Point for the Toxics TMDL (Integrated Approach Schedule)	
	March 2017	75% WLA Compliance Point for the Toxics TMDL (Integrated Approach Schedule)	
Phase 3	2017–2021 *(Phase 4 of MDRWRA, 2007)*	1. Accelerate successful nonstructural programs from Phase 1/Phase 2, with emphasis on bacteria management.	• Phase 3 programs. • Optimized programs from Phase 1/Phase 2.
	03/22/2021	100% WLA Compliance Point - Toxics TMDL (Assuming an integrated, multi-pollutant approach)	
	07/15/2021	100% Wet-Weather WLA Compliance Point - Bacteria TMDL (Assuming an integrated, multi-pollutant approach)	

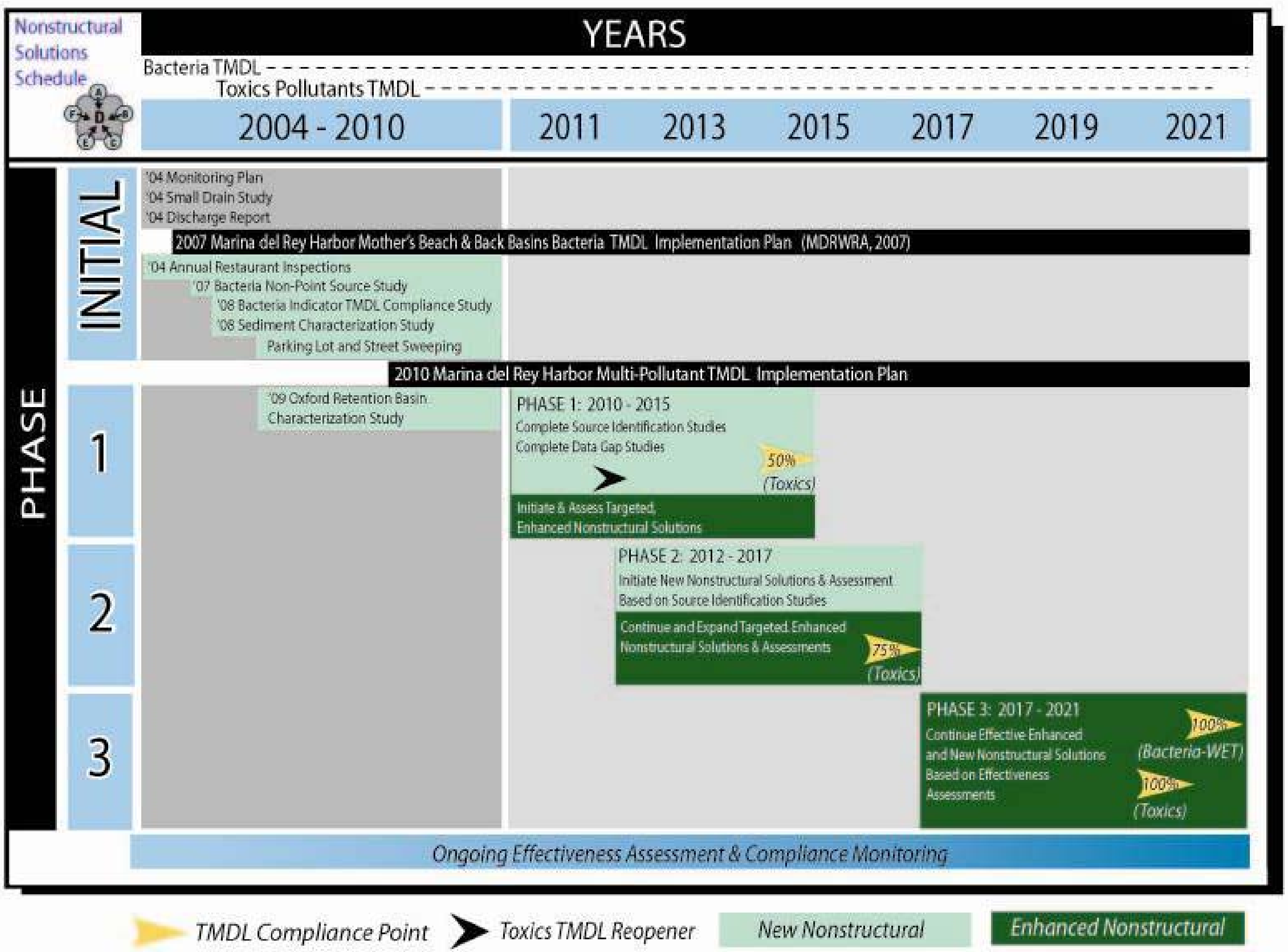


Figure 4-2. Phased Adaptive Management Process Used to Select, Schedule, and Implement Best Management Practices

4.1.2 Potential Nonstructural Solutions and Project Prioritization

Potential nonstructural solutions that may be implemented within the county's jurisdiction of the land side of MdRH have been selected to help reduce the pollutant loads to meet the TMDL WLAs. The nonstructural programs expand 1) upon existing programs, 2) were based upon applicable TMDL compliance approaches and recommendations in the *Marina del Rey Harbor Mother's Beach and Back Basins Bacteria TMDL Implementation Plan* (MDRWRA, 2007), or 3) were developed based on data available from past special studies. These proposed projects may be implemented as written, or adjusted by the county based on the assessment outcomes of implemented solutions, the availability of resources, and overall implementation schedule. All modifications to projects and the proposed schedule will be completed in accordance with the phased adaptive management process defined in this Implementation Plan.

The 12 main pollutant sources for MdRH were identified based on the results of the Bacteria Non-Point Source Study[3] and each pollutant source was prioritized as defined in Table 4-3. Generally, pollutant sources that contributed both bacterial and toxic pollutants were prioritized over sources that contributed to a single type of pollutant. The nonstructural solutions proposed in this Implementation Plan have been organized by priority pollutant source. Each nonstructural solution identifies the BMP type, goal, description, targeted pollutant and audience, assessment, and potential methods of measure for effectiveness assessment. Individual projects have also been assigned a "Highest," "Higher," and "Lower" relative priority. These relative priorities were assigned based on priority sources, number of priority pollutants, opportunity to transport to marina waters, and/or opportunities for bacterial regrowth, as determined from past special studies and reports. Generally, higher priority was given to projects building upon existing programs. Source identification studies, code modification evaluations, and other baseline projects were also given higher priority.

Table 4-3. Prioritization of Pollutant Sources in Marina del Rey Harbor

Pollutant Source	Targeted TMDL	Source Priority (Star Rating)
General	Bacteria and Toxics	Highest (***)
MS4 Catchments	Bacteria and Toxics	Highest (***)
Restaurants	Bacteria and Toxics	Highest (***)
Birds	Bacteria	Highest (***)
Streets and Parking Lots	Bacteria and Toxics	High (**)
Boating Community	Bacteria and Toxics	High (**)
Trash	Bacteria and Toxics	High (**)
Parking Garage Structures	Bacteria and Toxics	High (**)
Runoff Reduction	Bacteria	High (**)
Sewage	Bacteria	Lower (*)
Buildings and Construction	Toxics	Lower (*)
Pet Waste	Bacteria	Lower (*)

[3] Additional special studies that formed the basis for the nonstructural solution prioritization included the Bacterial TMDL Implementation Plan (MDRWRA, 2007), *Bacteria Indicator TMDL Compliance Study* (2008), and the *Small Drain Study* (LACDBH, 2004b).

GENERAL – Source with a "Highest" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Pollutant Loading Model and Database	Special Study – *Effectiveness Assessment*	Phase 1	***	Enhances models in Toxics TMDL, and MDRWRA, 2007.	Long-term Data Management and Assessment Tool Fill Data Gaps	This special study would integrate the county's land-use based regional water quality model, the Excel model produced for the Toxics TMDL, and the data collected under the 2010 Water Quality Monitoring Work Plan, and other special studies (i.e., Jurisdictional Boundary Monitoring, MS4 survey, Aerial Deposition, etc.) into a single model that may be used to accurately allocate loading to the land side of the unincorporated areas of MdRH and evaluate loading and load reductions to MdRH due to BMP implementation. The model would need to account for the different jurisdictional drainages to the MdRH watershed (i.e., unincorporated area, marina, City of Los Angeles, and Culver City) and the varying recommended watershed boundaries. The model would also need to account for the unique nonpoint sources in and around MdRH, such as birds and boats. The model should also be incorporated into a master data management database for MdRH that would integrate data from nonstructural activities and structural BMPs into load reductions. This feature would enhance the County's ability to plan and assess the entire MdRH program using up-to-date information.	All pollutants of concern.	County, City of L.A., Culver City, Caltrans	Data Management Model and Tool capable of integrating photos, inspection data, field notes, monitoring data, and other methods of measure.	Completed Model Completed Tool	$150–$250K
Lifeguard Outreach Program	Education	Phase 1	***	Enhances concept in MDRWRA, 2007.	Public Awareness Behavioral Change	In partnership with LACDBH, this project would involve training lifeguards stationed at facilities around MdRH (i.e., Marina Beach) in stormwater BMPs. Lifeguards would be provided basic public outreach handouts regarding trash management, pet waste management, and public sanitation (i.e., bather urination in the ocean) and, as appropriate, be encouraged to engage recreators about stormwater issues.	Bacteria, Trash	General Public	Pre/Post Survey Outreach Tracking	Change in awareness/ behavioral # Individuals Educated # Materials Distributed	$25– $50K Per Year
Total Suspended Solids (TSS)/Pollutant Correlations	Special Study – *Refine TMDL*	Phase 1	**	-	Fill Data Gap Refine TMDL and WLAs	The Toxics TMDL WLAs from the MS4 were based on a correlation analysis between TSS and pollutant concentrations. The TMDL recommends a special study to improve the correlation and potentially refine the WLAs when the TMDL is reopened. This special study would involve statistical analyses and correlations relating targeted pollutants.	TSS, PCBs, Chlordane, Metals	-	See Data Gap Monitoring Work Plan	See Data Gap Monitoring Work Plan	$150–300K (1–2 years)
Collaborative Environmentally Friendly Alternative Services Program	Education, Incentives, Source Control	Phase 2	**	-	List of Environmentally Friendly Services Behavioral Change Source Control	This program would set minimum qualifications to identify "environmentally friendly businesses and services" (i.e., waterless, sudsless, organic, recycled materials, nontoxic, etc.) for MdRH. This project may target trash area maintenance, parking lots, streets, dry dock/boat maintenance areas, landscape management, pest maintenance, on-land/in-water boat maintenance services, restaurants serving sustainable seafood, etc. These criteria would be vetted through a public participation process and then opened to the local business community. The objective of this program would be to compile and manage a list of green businesses. Efforts targeting restaurants may be coordinated with the Santa Monica Bay Restoration Commission (Clean Bay Restaurant Certification Program), Aquarium of the Pacific (sustainable seafood), and stakeholder groups such as the Westchester/LAX/Marina del Rey Chamber of Commerce and Marina del Rey Convention and Visitors Bureau.	Bacteria, Trash, Debris, Runoff, Oil and Grease, Suds, Metals, Pesticides	General Public, Hotels, Residential, Restaurants, Commercial, Boaters	Completed Brochure (ongoing) Pre/Post Survey evaluating public use of services (coordinated with service providers for data)	# Participating Services (type, potential pollutant, etc.) # Public Users Change in awareness/ behavior	$50–$100K Per Year
Product Substitution Campaign	True Source Control - *Enforcement/ Product Substitution*	Phase 2	*	-	Successful Product Substitution	Identify product use that contributes to pollutant loading and water quality degradation and identify substitutes that are less harmful to water quality. Coordinate with appropriate local, regional, state, and national stakeholders to plan and implement education/outreach to achieve voluntary movement toward use of substitute products, voluntary manufacture of substitute products (partnering with industry stakeholders), legislation changes, and/or other product substitution strategies. Example product substitution activities include providing data to the Department of Pesticide Regulation to ban use of synthetic pyrethroids in pesticides, evaluating alternative types of fencing (i.e., replacing galvanized metal products), prohibiting and/or restricting use of outdoor architectural copper, etc.	Metals, Pesticides	-	-	-	$50–$75K

1) All projects on this list of potential nonstructural solutions may, or may not, be implemented and/or adjusted by the County of Los Angeles based on the assessment outcomes of implemented solutions, the availability of resources, and overall implementation schedule. Modifications to this list will be completed in accordance with the phased adaptive management process defined in this Implementation Plan.
2) See Figure 4-2 for time frame, phase, and priority.
3) The implementation priority for nonstructural solutions is represented in this table using a three-star system, as follows:

Highest priority, **Three stars (***)**	Target available funds to these solutions based on source identification studies.
Higher priority, **Two stars (**)**	These solutions may be implemented if highest-priority activities are funded and resources are available.
Lowest priority, **One star (*)**	Depending on remaining available funds and resources, and the results of special studies and effectiveness assessments, these solutions may be implemented per the phased approach.

MS4 CATCHMENTS – Source with a "Highest" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Jurisdictional Boundary Monitoring	Special Study – *Source Identification and Pollutant Loading*	Phase 1	***	-	Fill Data Gap Baseline Loading Source Identification and Pollutant Loading Determination	Jurisdictional boundary monitoring in the upper watershed will be conducted to understand the load contribution of permit-required constituents. Samples will be collected in the MS4 at the jurisdictional boundary between the unincorporated areas of MdRH and the City of Los Angeles, Culver City, and Caltrans, where applicable. Dry-weather monitoring would be conducted during three 24-hour dry-weather monitoring events. Wet-weather monitoring would be conducted during storm events, including the first flush storm event of the wet-weather season. Samples may be collected as pollutographs or flow-weighted composites. Site selection would be determined based on a field reconnaissance. Preliminary site monitoring locations may include MS4 pipe accessed from catch basins northeast of Del Rey Avenue along Beach Avenue (Culver City); Oxford Basin and MS4 pipe upstream of Oxford Basin in Oxford Avenue or Berkeley Drive (City of L.A.); downstream of low-flow diversion structure at the intersection of Washington Blvd. and Thatcher Ave. (City of L.A.); intersection of Via Marina and Washington Ave. (City of L.A., Basin E); and storm drains along Lincoln Blvd. and Mindanao Way (Caltrans).	Bacteria, PCBs, Metals, Sediment, Pesticides, Chlordane, Runoff	County, City of L.A., Culver City, Caltrans	See Data Gap Monitoring Work Plan	See Data Gap Monitoring Work Plan	$300–$500K (2–3 years)
MS4/Storm Drain Survey	Special Study - *Source Identification*	Phase 1	***	-	Fill Data Gap Baseline Loading Source Identification	Conduct a special survey of storm drain system discharging to MdRH MS4 to identify sources of sewage odor and potential illicit discharges and illicit connections (ICIDs). This study would involve conducting wet-weather sampling at selected MS4 outfalls to determine the pollutant loading from these potential sources. This special study would also follow up ICIDs identified during previous special studies.	Bacteria, PCBs, Metals, Sediment, Pesticides, Chlordane, Runoff	-	See Data Gap Monitoring Work Plan	See Data Gap Monitoring Work Plan	$150–$450K (1–3 years)
Storm Drain Stenciling Program	Education	Phase 1	***	Enhances existing regional program.	100% identification of MS4 systems in MdRH Source Control Behavioral Change	If appropriate, this project would involve coordinating with other County resources to stencil all major storm drain facilities in the unincorporated areas of the MdRH identified during the Small Storm Drain Survey that are currently unstenciled. This project would also set a schedule for evaluating condition of stenciled storm drains and providing "touch-ups" as needed. As discussed in the PIPP section of this Implementation Plan, MdRH stencil may be updated to include the regional stormwater hotline phone number.	Trash, Debris, Oil/Grease, Runoff	General Public, Residential, Restaurants, Boaters, Commercial	Pre/Post Survey Optional: Trash assessment	Photos of MS4 # Stencilings # Re-Stencilings	$5K Per Year
Targeted Aggressive MS4 and Catch Basin Cleaning Program	Source Control	Phase 2	**	Enhances existing County program.	Source Control Load Reduction	This project would evaluate the existing catch basin and MS4 cleaning program implemented within MdRH and coordinate to ensure a baseline loading pre- and post-standard cleaning is conducted. The cleaning program would then be modified using aggressive techniques. Aggressive cleaning techniques may include dry-ice freezing, steam cleaning, and other available technologies. Aggressive cleaning may also increase frequency to an aggressive once-per-month frequency, or similar. Targeted cleaning programs may target specific types of catchments (i.e., in parking lots or near restaurant facilities). These data may build upon pre-existing catchment cleaning special studies conducted within the City of San Diego and elsewhere in California.	Trash, Debris, Bacteria, Metals	-	Pre/Post Survey Trash and Debris Monitoring Optional: Water Quality Monitoring (dry and wet weather), and biofilm study	Photos of MS4 Weight and Volume debris Water Quality Data for Targeted Pollutants Biofilm Data	$100–$200K Per Year

1) All projects on this list of potential nonstructural solutions may, or may not, be implemented and/or adjusted by the County of Los Angeles based on the assessment outcomes of implemented solutions, the availability of resources, and overall implementation schedule. Modifications to this list will be completed in accordance with the phased adaptive management process defined in this Implementation Plan.
2) See Figure 4-2 for time frame, phase, and priority.
3) The implementation priority for nonstructural solutions is represented in this table using a three-star system, as follows:

Highest priority, **Three stars (***)**	Target available funds to these solutions based on source identification studies.
Higher priority, **Two stars (**)**	These solutions may be implemented if highest-priority activities are funded and resources are available.
Lowest priority, **One star (*)**	Depending on remaining available funds and resources, and the results of special studies and effectiveness assessments, these solutions may be implemented per the phased approach.

RESTAURANTS – Source with a "Highest" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Restaurant-Related Code Survey and Modification	Enforcement	Phase 1, Phase 2	***	-	Enhance BMP/low-impact design (LID) requirements and enforcement opportunities	This project would involve reviewing the existing local, regional, and County regulations related to restaurant management (i.e., targeted legislation would primarily consist of individual stormwater permits and industrial waste permits for restaurants within MdRH) for opportunities to enhance on-site BMP and LID requirements. For example, the general requirement to prevent illicit discharges may be enhanced to require facilities to site all washing facilities either inside, or within a covered and bermed outdoor facility that has a sump floor-drain that is connected to the sanitary sewer. This same BMP would also be beneficial for trash areas and oil/grease traps. The proposed code modifications identified through this project may need to be evaluated by the Office of the County Counsel before implementation of related voluntary or mandatory BMP Implementation projects.	Bacteria, Oil/Grease, Suds, Trash, Debris, Runoff	Restaurants	Report	# Potential Code Modifications (type, change)	$75–$125K
Targeted Restaurant Inspections	Enforcement, Education	Phase 1	***	Restaurant Inspections.	Source Evaluation Behavioral Change Load Reduction	According to the Bacteria Non-Point Source Study, restaurant runoff resulted in some of the highest dry-weather bacterial sources. This project would be designed based on the existing annual inspection data identifying restaurant facilities with ongoing violations (i.e., 2 or more years of noncompliance with existing inspection program) to be targeted for enhanced education and enforcement. In addition to available inspection data, this project could benefit from targeting facilities subject to both an Industrial Waste (IW) permit and stormwater permit, or facilities with dining facilities located directly over the water, and would provide the greatest opportunity for measurable load reductions. This solution would involve modifying inspection forms and educational materials for the following: 1) Activities (i.e., washing, trash maintenance, food/ice disposal, landscaping, etc.), 2) BMPs (i.e., housekeeping, cover, containment, training, etc.), and/or 3) Types of facilities (i.e., restaurants, cafes, combined facilities, etc.). 4) Highlight economic benefits of stormwater pollution prevention and TMDL compliance.	Bacteria, Oil/Grease, Suds, Trash, Debris, Runoff	Restaurants	Inspection data. Optional: Water Quality Monitoring (dry and wet weather)	Change in Awareness and Behaviors # and Type of Violations # Targeted BMPs Water Quality Data for Targeted Pollutants	$10–$25K Per Year
Feasibility Evaluation for a "Business-led Voluntary Enhanced Restaurant BMP Implementation Program"	Education	Phase 1	**	Restaurant Inspections. Enhances concept in MDRWRA, 2007.	Information Sharing. Participation in Program and Associated Behavioral Change	This project would involve opening dialogue with regional stakeholder groups representing restaurants, with the purpose of identifying voluntary project partners. The project would be a business-led voluntary enhanced BMP implementation program targeted at restaurants in MdRH, built upon existing inspection programs and lessons learned. This project would involve conducting workshops with businesses to provide education and an exchange of ideas about the feasibility of implementing the proposed structural and nonstructural BMPs, incentives that would encourage voluntary participation, and recommended time line, and solicit voluntary participation in an incentive and/or monitoring program. This is a feasible program for MdRH. In 2010, several individual lessees provided pet-waste bags and receptacles on their own properties. Coordinating these efforts between lessees and the County effort would provide an enhanced outreach opportunity.	Bacteria, Oil/Grease, Suds, Trash, Debris, Runoff, Pet waste	Restaurants	Workshop minutes and notes.	List of voluntary participants for "Business-led Voluntary Enhanced Restaurant BMP Implementation Program"	$50–$100K (6 months–1 year)
Incentive Program Promoting a "Business-led Voluntary Enhanced Restaurant BMP Implementation Program"	Incentive	Phase 2	*	-	Behavioral Change Source Control	This project would develop an incentive program that would encourage voluntary participation in the Business-led Voluntary Enhanced Restaurant BMP Implementation Program. Incentives may include free advertising through the "Environmentally Friendly Services" program, points toward the Clean Bay Restaurant certification (by the Santa Monica Bay Restoration Commission), and lease incentives, monetary, or other types of incentives recommended by businesses participating in the program. This project may involve the following: • Selecting/developing the type of incentive offered to participating businesses, • Setting criteria for incentives to be distributed to participating restaurants, and • Developing an incentive tracking protocol/data management system.	Bacteria, Oil/Grease, Suds, Trash, Debris, Runoff	Restaurants	Finalized Incentive Program with means to track incentives, BMPs, etc.	Change in Awareness and Behaviors # Targeted BMPs	$100–$150K Per Year

1) All projects on this list of potential nonstructural solutions may, or may not, be implemented and/or adjusted by the County of Los Angeles based on the assessment outcomes of implemented solutions, the availability of resources, and overall implementation schedule. Modifications to this list will be completed in accordance with the phased adaptive management process defined in this Implementation Plan.
2) See Figure 4-2 for time frame, phase, and priority.
3) The implementation priority for nonstructural solutions is represented in this table using a three-star system, as follows:

Highest priority, **Three stars (***)**	Target available funds to these solutions based on source identification studies.
Higher priority, **Two stars (**)**	These solutions may be implemented if highest-priority activities are funded and resources are available.
Lowest priority, **One star (*)**	Depending on remaining available funds and resources, and the results of special studies and effectiveness assessments, these solutions may be implemented per the phased approach.

RESTAURANTS – Source with a "Highest" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Targeted Restaurant Inspections for the "Business-led Voluntary Enhanced Restaurant BMP Implementation Program"	Enforcement	Phase 3	*	-	Behavioral Change Source Control Load Reduction	This targeted inspection project would be targeted at voluntary businesses to evaluate and quantify performance. Inspections would provide an opportunity for ongoing dialogue with restaurant management and evaluate changes over time. Inspections may be in person, through phone communication or workshops, or other methods to evaluate difficulties with BMPs, frequency of implementation, and other relevant parameters. The results of this project would determine the feasibility and impact of mandatory implementation of the proposed code modifications.	Bacteria, Oil/Grease, Suds, Trash, Debris, Runoff	Restaurants	Inspection results Business implementation of enhanced BMPs Optional: Water Quality Monitoring (dry and wet weather)	Change in Awareness and Behaviors # and Type of Violations # Targeted BMPs Water Quality Data for Targeted Pollutants – Grabs	$10–$25K Per Year

BIRDS – Source with a "Highest" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Bird Waste Maintenance Program	Source Control	Phase 1	***	Bird Spikes BMP.	Source Control: 90% Reduction in Bird Waste on parking lots and public infrastructure	Bird spikes were identified in MDRWRA, 2007, as a potential structural BMP to deter birds. Birds are still observed in and around MdRH, roosting in the trees rather than on structures. To manage the bird waste, this project would involve high-pressure steam cleaning of marina areas around Marina Beach and Oxford Basin at an aggressive frequency (i.e., up to twice a month). Based on bacterial studies conducted in the City of San Diego, high-pressure steam cleaning is the only effective cleaning method to remove biofilm, such as bird waste. Water would need to be captured within berms, or similar, and disposed of in a sewer system. According to the source identification study, sites requiring cleaning include parking lot near Oxford Basin tide gates; parking lot and bike trail along Admiralty Way @ Site 15; and Site 7 @ pier in Basin E.	Bacteria	-	Pre/Post Survey Water Quality Monitoring (dry and wet weather) Modeled Load Reduction	Photos Water Quality Data for Targeted Pollutants Modeled based on area cleaned, waste thickness, and build-up rate	$100–$250K
Recreational Vehicle (RV) Overnight Parking Source Evaluation and Ordinance Change Program	Source Evaluation, Enforcement	Phase 1	**	Bird Spikes BMP. Enhances concept in MDRWRA, 2007.	Behavioral Change Source Control: Zero uncontained trash, Zero sewage ICIDs Reduction in attracted birds	Bird spikes were identified in MDRWRA, 2007, as a potential structural BMP to deter birds. Birds are still observed in and around MdRH, roosting in the trees, drawn to the area by unmanaged trash and food waste around MdRH. To reduce the draw for the birds, this project would target overnight RV parking/usage as a potential source of trash and food debris. This project would evaluate overnight RVs as a source of trash and debris through a visual survey program. This program would also be used to evaluate RVs as a source of sewage waste and ICIDs. Data from this survey would be supplemented with observational and historical data in coordination with local law enforcement. Based on the data, evaluate public reaction to restricting overnight RV parking in MdRH.	Bacteria, Trash	General Public	Pre/Post Survey Trash Survey Bird Survey	Photos Amount of Trash # Birds in Study Area # ICIDs	$75–$125K

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Higher priority, **Two stars (**)**	These solutions may be implemented if highest-priority activities are funded and resources are available.
Lowest priority, **One star (*)**	Depending on remaining available funds and resources, and the results of special studies and effectiveness assessments, these solutions may be implemented per the phased approach.

STREETS AND PARKING LOTS – Source with a "High" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Aggressive Street Sweeping Public Outreach	Education	Phase 1	***	Street Sweeping. Parking Lot Sweeping.	Enhanced Public Awareness and Community Buy-In	A street sweeping pilot study conducted by the City of San Diego (July 2010) indicated that changes in sweeping operations (i.e., sweeping frequency, machine type, monitoring programs, etc.) should be communicated to the community prior to study implementation. This project would develop appropriate education and outreach materials (i.e., pamphlets, door hangers, brochures, posters) for communities in which modified street sweeping and parking lot sweeping activities are taking place. Impacted communities may include businesses, hotels, boat owners, and other MdRH visitors.	Metals, Sediments, Trash, Debris, Bacteria	General Public, Hotels, Residential, Restaurants, Commercial	Pre/Post Survey Outreach Tracking (*hotline calls and complaints raised by sweeping schedule and parking issues*)	Change in awareness # Individuals Educated # Materials Distributed	$10–$50K
Aggressive Street Sweeping	Source Control	Phase 1	***	Enhances Existing Project.	Quantified Load Reduction due to sweeping at a given frequency, with a specific type of machine	A street sweeping pilot study conducted by the City of San Diego (July 2010) indicated that vacuum street sweeper outperformed standard mechanical sweeper in term of debris and metals removal along flat routes with established curbs and gutters. This structural solution would enhance the existing street-sweeping practices by replacing the equipment used with new technology (vacuum sweeper).	Metals, Bacteria, Trash, Debris, Sediment		Dry Weather: Measure weight of debris swept along MdRH streets with each machine (special study bins)	Dry Weather: Classify trash removed. Analyze debris for metals/ pollutants.	$1M–$2M *Based upon purchase of new sweeper technology(ies)*
Aggressive Parking Lot Sweeping Baseline Evaluation and Frequency Pilot Program (Study)	Source Control	Phase 1, Phase 2	**	Enhances Existing Project.	Quantified Load Reduction due to sweeping at a given frequency, with a specific type of machine.	This structural solution would enhance the existing parking lot street sweeping practices by increasing sweeping frequency at the study parking lot in intervals to determine the optimal load reduction potential. Once identified, this sweeping frequency could be applied at parking lots across MdRH. The sweeping frequency effectiveness assessment would be targeted at Lot 15 and Lot 18. These lots have a similar surface area and are located immediately adjacent to each other on opposite sides of Fiji Way. Lot 18 would be set as baseline condition for both Lots 15 and 18 (original 2x per week sweeping frequency). Debris weight data would be data collected from Lot 15 at the current high sweeping frequencies (i.e., 6x/week frequency during the winter and daily sweeping frequency during the summer). During the same monitoring period, debris weight data would be collected from Lot 18 at the standard frequency and then at incrementally higher frequencies.	Metals, Bacteria, Trash, Debris, Sediment		Dry/Wet Weather: Measure weight of debris swept from each Parking Lot (special study bins)	Dry Weather: Classify trash removed. Analyze debris for metals/ pollutants. Wet Weather: Wet-weather monitoring at low point on each parking lot.	$150–$200K
Brake Pad Partnership	True Source Control	Phase 1	**	-	Successful adoption of SB346	According to the Toxics TMDL and the anticipated higher metals loading results from the proposed Aerial Deposition Special Study, metals and particulate matter may be from air-based nonpoint sources. This project would involve providing support for bill SB346, which requires that brake pads contain no more than 5% copper by weight.	Metals, TSS	California Congress	-	-	$100K Per Year
Aerial Deposition Special Study	Special Study – *Source Identification*	Phase 1	**	-	Fill Data Gap (Site-Specific Deposition Data) Source Identification	Section 4.3.2 of the Toxics TMDL identified aerial deposition (i.e., the direct deposition of airborne particles to the water surface) as a source of metals to the Back Basins of MdRH. The TMDL estimates the annual loads of copper, lead, and zinc to the water based on a 2004 study for the Los Angeles Coastal region (Sabin et al., 2004). Aerial deposition studies conducted in San Diego County indicate that metals deposition is highly variable from area to area, watershed to watershed, because of different industrial land uses, high-traffic areas, prevailing winds, historical sources of pollution, and other site-specific parameters. Based on the high-traffic areas around MdRH, it is likely that the local aerial deposition rate is higher than indicated in the TMDL. This special study would determine the magnitude and spatial variation of aerial deposition loading of metals and total particulate matter to MdRH at each of the Back Basins.	Metals, TSS	-	See Data Gap Monitoring Work Plan	See Data Gap Monitoring Work Plan	$200–350K (1–2 years)

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BOATING COMMUNITY – Source with a "High" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
MdRH Environmentally Friendly Boating Guide and Boater Outreach Program	Education	Phase 1	***	Leverages existing outreach efforts by the County and environmental groups with a presence in MdRH	Public Awareness Behavioral Change	The Non-Point Source Study identified boat wash-down activities at a public parking facility in MdRH. This project would compile and enhance existing boater education materials into a single guidance document about environmentally friendly boat use. These materials could be provided by the LACDBH during the vehicle registration process for long-term boat trailer parking, at partnering commercial facilities, and boat yards across MdRH. Materials could also be provided to bait and tackle shops, private parking garages, hotels, and other facilities across MdRH. Enhanced materials may also be targeted at commercial mobile vehicle washing service providers, and be integrated into the Collaborative Environmentally Friendly Alternative Services Program (i.e., NS 27). Topics covered in the guidance may include the following: • Enhance existing materials on sewer pump-out stations. • Dry cleaning methods (i.e., rags, vacuuming, steam cleaning, dry ice cleaning, tarps/berms/capture and reuse systems) with overall "No Suds" cleaning policy. • Environmentally friendly, nontoxic paints, varnishes and teak cleaners (see Clean and Green Posters in Green Marina PIPP section). This program could be implemented in partnership with the Santa Monica Bay Restoration Commission, which has a presence in MdRH. General boater educational materials have already been developed through the "Dockwalkers" program, which may be enhanced for MdRH. The Santa Monica Bay Restoration Commission is also active in the "Honey Pot Days" and other boater outreach events ongoing in MdRH. For more information, see Section 2.2.	Suds, Oil and Grease, Bacteria, Runoff, Metals	Boaters, Commercial	Pre/Post Survey Outreach Tracking	Change in awareness/ behavior # Individuals Educated # Materials Distributed	$50–$100K Per Year
Oil Container Recycling Program	Source Control	Phase 3	*	-	Source Control Public Awareness	In 2005 and 2006, the Santa Monica Bay Restoration Commission, the Del Rey Landing Fuel Dock, and a waste management company piloted a used oil recycling and management program in MdRH. Through a targeted outreach program, the public was encouraged to leave "empty" oil containers at the fuel dock. On a routine schedule, the waste management company brought a special piece of equipment (i.e., granulator) to MdRH. The equipment grinded the used oil bottles and separated the plastic and oil. The oil was captured and stored in 55-gallon drums and reused. This pilot project resulted in 32 gallons of oil and 4,000 lb of waste recycled (2005–2006). The original pilot program was discontinued when the waste management company went out of business. This nonstructural solution may be redesigned and restarted through a partnering effort coordinated between the County, local/regional waste management companies, Santa Monica Bay Restoration Commission, and interested parties across MdRH. This project would be contingent upon developing or obtaining a new granulator system.	Oil and Grease	Boat Owners, Parking Garage Owners, Commercial	Pre/Post Survey Data capture	Number of containers collected Pounds of Plastic/ Gallons of Oil Recycled Change in awareness/ behavior	$50K–$1M (Cost depends upon whether appropriate equipment may be purchased, rented, or used through existing services)

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TRASH – Source with a "High" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Trash Receptacle Management Outreach	Education	Phase 1	***	Restaurant Inspections. Enhances available materials.	Source Control: Zero uncontained trash Behavioral Change	The Bacteria Non-Point Source Study identified improper trash management as a potential, manageable source of bacteria. Dumpster washing translated to fecal coliforms of 500,000 MPN/100mL. Uncovered and overflowing trash cans/dumpsters were a common issue observed during the dry-weather surveys, with food waste and trash observed on land and in the water. This project would enhance existing outreach materials regarding trash management (i.e., keep receptacles closed, avoid washing activities, etc.). This project would also increase trash-related educational signage (i.e., posters and/or decals bearing messages such as "Close me" affixed to trash cans) in areas with observed high frequencies of improper trash receptacle management. Target facilities in vicinity of Sites 12 and 13 (Basin F) and Basin D.	Trash, Debris, Bacteria (growth and birds)	Restaurants, Commercial, Boaters, Hotels, General Public	Pre/Post Survey Outreach Tracking	Change in awareness/ behavior # Individuals Educated # Materials Distributed	$10–$50K Per Year
Targeted Trash Receptacle Inspection Program	Enforcement	Phase 1, Phase 2, Phase 3	**	-	Source Control: Zero uncontained trash	Implement a targeted enforcement monitoring program at trash receptacles with high frequencies of improper trash receptacle management (i.e., in vicinity of Sites 12 and 13 [Basin F and Basin D]). Conduct up to once-weekly photo monitoring review. Compile several weeks (at least 1 month) of photos/data and provide to relevant facilities management stakeholder group, along with outreach materials. Continue monitoring for another month and follow up with formal inspection citing observations made during program. Continue monitoring for a third month to evaluate changes in behavior. This project may target restaurants, hotels/inns, MdRH facilities maintenance staff, subcontractors for trash removal, general public (i.e., RV parking lots), etc. This weekly trash inspection frequency is based on the recommended practice defined in the Clean Marinas California program.	Trash, Debris, Bacteria	Restaurants, Commercial, Boaters, Hotels, General Public	Inspection Results	Photos # Trash Violations	$25K–$50K Per Year
Education and Incentive Program Aspect of Coordinated Trash Removal and Sweeping Pilot Program	Incentive, Education	Phase 2, Phase 3	**	-	Source Control: Zero uncontained trash. Enhanced Public Awareness and Community Buy-In	As indicated in the Bacteria Non-Point Source Study, dry-weather visual observations noted 10 instances of trash removal, with debris left at MdRH four times. In the event that trash removal programs are managed by individual leaseholders, this project would provide an education and incentive program to facilitate coordinated trash removal and street-sweeping activities. Effort would include the following: • Coordinate with leaseholders, tenants, and MdRH facilities in the unincorporated areas of MdRH to identify the typical trash pick-up schedule and compare with existing street and parking lot sweeping schedule. • Identify opportunities to modify sweeping times to coincide with the most common trash removal schedule, implement and evaluate changes in trash/debris left post project implementation; • Offer BMP and appropriate trash removal training to trash removal companies identified as providing services to MdRH. Develop integrated educational signage and/or brochures about trash, bacteria, MdRH TMDL, and data from Non-Point Source Study to place in trash areas to serve as reminder for trash service companies. At present, the County's "Can It!" Campaign has never been implemented in MdRH. These materials may serve as a basic starting point for the educational PIPP. Provide incentives (*i.e., fee reductions, advertising, partnership placards, other*) to encourage a coordinated trash removal schedule (internally coordinated per site, and/or within region, and/or before sweeping). Target parking lots near Fisherman's Village (i.e., Lots 15 and 18).	Trash, Debris, Bacteria	Restaurants, Commercial, Hotels	Pre-/Post- Survey Classify trash problem reduction (type of trash). <u>Optional:</u> Dry-weather monitoring of trash collected (special monitoring program)	Photos # Trash Violations Pounds of Trash Removed or Reduced on-site (type)	$50–$75K Per Year

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TRASH – Source with a "High" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Coordinated Trash Removal and Sweeping Pilot Program	Source Control	Phase 3	**	-	Source Control: Zero uncontained trash	As indicated in the Bacteria Non-Point Source Study, dry-weather visual observations noted 10 instances of trash removal, with debris left at MdRH four times. This project design would be applied for the County-managed trash removal facilities in MdRH. This project would provide an enhanced structural solution to trash and debris through coordinated facilities maintenance. Effort would include the following: • Identify the typical trash pick-up schedule and compare with existing street and parking lot sweeping schedule. • Identify opportunities to modify sweeping times to coincide with the most common trash removal schedule, implement and evaluate changes in trash/debris left post project implementation. Target parking lots near Fisherman's Village (i.e., Lots 15 and 18).	Trash, Debris, Bacteria	Restaurants, Commercial, Hotels	Pre-/Post-Survey Optional: Trash and Debris monitoring program with trash classification (i.e., types, sources, locations of trash)	Photos Pounds of Trash and Debris Removed	$100–$200K

PARKING GARAGE STRUCTURES – Source with a "High" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Parking Garage Outreach Program	Education	Phase 1	***	-	Source Control: Zero discharge from parking garages	The Non-Point Source identified wash-down activities at parking garages across MdRH. This project would involve enhancing existing vehicle maintenance education materials for the context of privately operated parking garages. Enhanced materials may also be targeted at commercial mobile vehicle washing service providers, and be integrated into the Collaborative Environmentally Friendly Alternative Services Program (i.e., NS 23).	Suds, Oil and Grease, Bacteria, Runoff	Parking Garage Owners, Commercial	Pre/Post Survey Outreach Tracking	Change in awareness/ behavior # Individuals Educated # Materials Distributed	$10–$25K Per Year
Targeted Parking Garage Inspections	Enforcement	Phase 2	**	-	Source Control: Zero discharge from parking garages	The Non-Point Source identified wash-down activities at parking garages across MdRH. Similar to the Targeted Restaurant Inspection Program (NS 7 through NS 11), this project would involve enhancing or modifying existing inspection activities to target washing activities in privately managed parking garages. Before inspections can begin, the businesses responsible for each facility must be identified. This first round of inspections would first target facilities with historical washing activities identified through the illicit discharge program. Code review and modification may become necessary to provide grounds for ongoing inspections of parking garages independent of restaurants and other traditionally inspected commercial facilities.	Suds, Oil and Grease, Bacteria, Runoff	Parking Garage Owners, Commercial	Inspection data and recorded changes in behavior at targeted facilities. Optional: Water Quality Monitoring (dry and wet weather)	# Individuals Educated Change in awareness/ behavior Water Quality Data for Targeted Pollutants	$10–$20K Per Year
Parking Garage Structural BMP Incentive Program	Incentives	Phase 3	*	-	Source Control: Zero discharge from parking garages	This project would involve developing incentive programs to encourage voluntary participation in structural BMPs. Incentives may include free advertising through the "Environmentally Friendly Services" program (NS 27), lease incentives, monetary, other types of incentives recommended by businesses participating in the program, or incentives developed as a result of lessons learned from other incentive programs. This project may involve the following: • Selecting/developing the type of incentive offered to participating businesses, • Setting criteria for incentives to be distributed to participating restaurants, and • Developing an incentive tracking protocol/data management system (this may be integrated into existing databases developed for this Implementation Plan under Project NS 5).	Suds, Oil and Grease, Bacteria, Runoff	Parking Garage Owners	Implementation of Structural BMPs	Change in awareness/ behavior # BMPs Implemented Modeled load reduction (water balance)	$50–$100K Per Year

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RUNOFF REDUCTION – Source with a "High" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Cistern/Rain Barrel Code Modification	Enforcement - *Code Modification*	Phase 1	***	Enhances project in Geosyntec, 2009.	Effective code modification and established protocols.	This project would involve coordination with County health agencies to complete a human health risk assessment for surface water reused through rain barrels and/or cistern system. Study would also include an evaluation of the current literature. This project would also establish Countywide water treatment standards for cisterns based on risk and runoff source area (rooftop, parking lot, driveway, storm drain, etc.); update system design standard designs based on treatment standards and O&M requirements; and establish system audit/inspection protocols.	Bacteria (bird waste on roofs), Metals, Runoff	Hotels, Restaurants, Commercial	Report	# Potential Code Modifications (type, change)	$25K
Green Gardening and Runoff Reduction Outreach	Education	Phase 1	***	Enhances concept in MDRWRA, 2007.	Public Awareness Behavioral Change Convert one facility to green gardening/ year until 50% MdRH is converted	This project would enhance existing outreach and education materials with an extensive Green Gardening Guide document, which would be developed as handouts, posters, and website materials. Topics covered would include the following: • Drought-tolerant plants, native plants, xeriscaping, and xeroscaping, • Irrigation methods (i.e., drip irrigation, spray irrigation, irrigation timers, smart controllers, etc.) and associated water use/savings, • Irrigation management (i.e., sprinkler maintenance, watering needs), • Structural BMPs (i.e., rain barrels, cisterns, green roofs, etc.) and current legal restrictions or opportunities. Materials would be targeted at large facilities with vegetated spaces and therefore would have targeted examples that highlight cost benefits (i.e., reduced water bills, reduced landscape maintenance, etc.). Materials may need to be updated as code modification activities and other outreach programs are developed.	Bacteria (bird waste on roofs), Metals, Runoff	Hotels, Restaurants, Commercial, Residential	Pre/Post Survey Outreach Tracking	Change in awareness # Individuals/ Businesses Educated # Materials Distributed # Businesses with Green Garden features	$15–$25K Per Year
Over-irrigation Code Modification	Source Control	Phase 1	***	-	Zero dry-weather runoff	The Non-Point Source Study identified over-irrigation caused by broken sprinkler heads as a transport mechanism for pollutants and dry-weather discharge to MdRH. Currently, the stormwater inspection program identifies ICIDs and discharges to the storm drain caused by on-site operations. Existing forms lack a clear mechanism to enforce improper irrigation practices that result in dry-weather discharges. The County Health restaurant inspection program prohibits food storage near or under sprinkler spray, but otherwise lacks a mechanism for irrigation management. This project would involve modifying County codes and ordinances to require zero dry-weather discharge from all types of commercial and industrial facilities.	Runoff (transport mechanism for bacteria and other pollutants)	Hotels, Commercial, Restaurants	Pre/Post Survey Model of dry-weather flows due to over-irrigation	Photos	$50–$75K
Green Gardening and Runoff Reduction Incentive Program	Incentive, Education	Phase 2	**	Enhances concept in MDRWRA, 2007 and Geosyntec, 2009.	Public Awareness Behavioral Change Convert 50% of facilities to green gardening	This project would provide incentives for hotels, inns, and restaurants, and other targeted audiences to implement "green" gardening structural solutions (i.e., drip irrigation, smart irrigation timers, rain barrels, cisterns, green roofs, etc.). Incentives may include providing free products, free installation services, advertising for participating companies, or other incentives proposed by participating organizations.	Bacteria (bird waste on roofs), Metals, Runoff	Hotels, Restaurants, Commercial	Dry/Wet Weather: Water balance Optional: Dry-weather and wet-weather monitoring of targeted pollutants	# Individuals Educated Change in awareness/ behavior # Facilities Implementing Green Gardening	$50–$150K Per Year
Irrigation Enforcement Program	Source Control	Phase 2	**	-	Zero dry-weather runoff.	The Non-Point Source Study identified water from broken sprinkler heads and over-irrigation as a transport mechanism for pollutants and dry-weather discharge to MdRH. This study would involve developing an enforcement program (potentially integrated with other enforcement programs proposed in this Implementation Plan) for grassy and other vegetated areas around MdRH. The objective would be to identify facilities with ongoing irrigation problems and enforce a zero dry-weather runoff ordinance/code.	Runoff (transport mechanism for bacteria and other pollutants)	Restaurants, Hotels, Residential	Pre/Post Survey Model of dry-weather flows due to over-irrigation	# Code Violations (by type/site) # Broken Sprinklers	$10–$25K Per Year

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SEWAGE – Source with a "Lower" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Onshore Restroom Dye Study	Special Study – *Source Identification*	Phase 1	*	-	Fill Data Gap Source Identification	According to the Vessel Discharge Report (LACDBH, 2004c), day-use boaters often refrain from using onboard toilets in favor of using onshore restroom facilities immediately before and after short day trips. According to the Non-Point Source wash-down activities were observed at the public restroom at Marina Beach. This project would design a Special Study to evaluate discharges to MdRH from onshore restrooms. This may include the use of nontoxic blue dye set into restroom facilities and evaluate potential storm drain cross-connections (target locations where sewage sources were unidentified). At locations where overland flow would result in a discharge, this special study could be converted to a visual survey program, set to the regular restroom maintenance schedule.	Bacteria, Runoff	-	See Data Gap Monitoring Work Plan	See Data Gap Monitoring Work Plan	$100–$125K
Community Based Social Marketing Pilot for Restroom Maintenance	Education	Phase 2	**	Enhances available materials.	Source Control: Zero discharge from restrooms.	According to the Non-Point Source Study wash-down activities were observed at the public restroom at Marina Beach. This project would enhance existing education and BMP training materials. The target audience would be restroom maintenance staff. The effort would be to develop educational tools and training that effectively elicit behavioral change (i.e., discontinue restroom wash-down activities, use dry cleaning methods, etc.).	Bacteria, Runoff	Restroom Maintenance Staff, Boaters	Pre/Post Survey Outreach Tracking	Change in awareness/ behavior # Individuals Educated # Materials Distributed	$25–$50K

BUILDINGS and CONSTRUCTION – Source with a "Lower" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
New Construction Permit Review and Storm Water Pollution Prevention Plan (SWPPP) Evaluation Study	Enforcement	Phase 1	***	Coordinate with existing SUSMP evaluation and monitoring program.	Compliance with New Construction Permit	In September 2009, the SWRCB issued the General Permit for Discharges of Storm Water Associated with Construction Activity Construction General Permit Order 2009-0009-DWQ. The new Construction Permit significantly rewrote the requirements for construction-related SWPPPs, monitoring, reporting, BMPs, and personnel qualifications. The Construction Permit applies to "Dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres" and became effective July 1, 2010. Seven commercial/industrial facilities within MdRH are currently tracked under SUSUMP, zero-runoff requirements. This project would enhance the current SUSUMP protocols to ensure that all future projects comply with the new Construction Permit.	TSS, Metals, Runoff	All Construction Projects	-	-	$75–$100K
Alternatives to Architectural Copper Program	True Source Control, Enforcement-*Legislative Control*	Phase 2, Phase 3	**	-	Source Control	This project would formally adopt a ban, or create restrictions, on the use of architectural copper in outdoor applications. Prohibiting or limiting use of copper in rain gutters, roofing, and other outdoor applications would prevent copper from entering the MS4 system from new development and major redevelopment projects. This program may be enhanced with a PIPP and incentive program to encourage existing building to convert to noncopper building materials, or provide outreach targeted at architectural/building design companies (an Internet search identified 28 potential architectural firms with MdRH addresses). The cost/benefit of implementing this type of program within MdRH will need to be evaluated. The greatest cost/benefit ratio would be to implement as part of a Countywide program.	Copper	Hotels, Commercial, Residential, Design companies	Wet-weather monitoring of facilities with known copper features for load contribution	# Buildings/ Features converted # Architectural Plans Redesigned	$100–$300K

1) All projects on this list of potential nonstructural solutions may, or may not, be implemented and/or adjusted by the County of Los Angeles based on the assessment outcomes of implemented solutions, the availability of resources, and overall implementation schedule. Modifications to this list will be completed in accordance with the phased adaptive management process defined in this Implementation Plan.
2) See Figure 4-2 for time frame, phase, and priority.
3) The implementation priority for nonstructural solutions is represented in this table using a three-star system, as follows:

Highest priority, **Three stars (***)**	Target available funds to these solutions based on source identification studies.
Higher priority, **Two stars (**)**	These solutions may be implemented if highest-priority activities are funded and resources are available.
Lowest priority, **One star (*)**	Depending on remaining available funds and resources, and the results of special studies and effectiveness assessments, these solutions may be implemented per the phased approach.

PET WASTE – Source with a "Lower" Relative Priority Rating

Nonstructural Solution (1)	BMP Type	Phase (2)	Priority (3)	Enhanced Existing Activity	Goal	Description	Targeted Pollutants	Targeted Audience	Assessment Method	Potential Methods of Measure	Order of Magnitude Cost
Pet Waste Code Survey and Modification	Enforcement: *Code Modification*	Phase 2	*	-	Effective code modification	Analyze current "pooper scooper" ordinances. Modify codes as needed.	Bacteria	Pet Owners, Pet Walkers	Report Enforcement	# Potential Code Modifications (type, change)	$5K
Pet Waste Outreach and Incentive Program	Education, Incentive	Phase 2	**	Enhances available materials. Enhances concept in MDRWRA, 2007.	Zero uncontained pet waste	Enhance existing education and outreach materials (i.e., Pet Waste Tip Card and pet-waste bag dispensers available in County parks) with additional types of educational media (i.e., decals and fliers) and make available within MdRH. Educational materials would be targeted at major public areas (i.e., Marina Beach) and walking paths (i.e., piers). Materials would be targeted at "commercial" dog-walker and dog-owners. Education and outreach efforts may be enhanced through a combined education and incentive program. Incentives may include give-aways such as packets of pet-waste bags, pet-waste scoops, and leashes (to ensure no free-roaming pets). This program may involve interaction with MdRH lessors. Based on current information available to the LACDBH, some of the individual lessees provide pet-waste bags and receptacles on their own properties. Coordinating these efforts between lessees and the County effort would provide an enhanced outreach opportunity.	Bacteria	Pet Owners, Pet Walkers	Pre/Post Survey Outreach Tracking	Change in awareness/ behavior # Individuals Educated # Materials and/or Incentives Distributed	$50–$100K Per Year
Pet-Waste Code Enforcement	Enforcement, Education	Phase 2	**	-	Zero uncontained pet waste	Enforce existing "pooper scooper" ordinances and/or enhanced codes as needed and appropriate. This enforcement may involve verbal education of pet owners and pet walkers of existing ordinances and codes and paper citations. It is not anticipated that this program would only involve fines as a last resort for known violators.	Bacteria	Pet Owners, Pet Walkers	Enforcement	Change in awareness/ behavior	$25–$50K Per Year
Pet-Waste Bag Dispenser Pilot Program	Source Control	Phase 2	**	Enhances concept in MDRWRA, 2007.	Zero uncontained pet waste	Target pet-waste stations where Bacteria Non-Point Source Identification Study indicated high instances of dog waste, i.e., Marina Beach, Pier in Basin E (Site 7), Ritz-Carlton (Site 11), harbor streets (Site 3), and Site 12. Potentially evaluate the most effective form(s) of pet-waste stations (technologies, signage, etc.) and determine optimum installation density of stations.	Bacteria	Pet Owners, Pet Walkers	Pre-/Post- Survey Pet-Waste Pile Monitoring Program	Photos Change in awareness/ behavior Pounds of waste removed versus baseline condition	$25–$50K Per Year

1) All projects on this list of potential nonstructural solutions may, or may not, be implemented and/or adjusted by the County of Los Angeles based on the assessment outcomes of implemented solutions, the availability of resources, and overall implementation schedule. Modifications to this list will be completed in accordance with the phased adaptive management process defined in this Implementation Plan.
2) See Figure 4-2 for time frame, phase, and priority.
3) The implementation priority for nonstructural solutions is represented in this table using a three-star system, as follows:

Highest priority, **Three stars (***)**	Target available funds to these solutions based on source identification studies.
Higher priority, **Two stars (**)**	These solutions may be implemented if highest-priority activities are funded and resources are available.
Lowest priority, **One star (*)**	Depending on remaining available funds and resources, and the results of special studies and effectiveness assessments, these solutions may be implemented per the phased approach.

4.1.3 Recommendations

The following recommendations will result in pollutant load reductions:

- During Phase 1 complete special studies (as described in Section 4.1.1) to fill in gaps in available data regarding priority pollutants of concern, pollutant sources, and transport of pollutants to the receiving water. These studies will ensure that TMDL compliance activities are implemented and targeted based on scientifically sound data and can be used to determine structural BMP location and design.
- During Phase 1 implement enhanced nonstructural BMPs (education, incentive, and enforcement programs) to address multiple pollutants and target multiple sources according to the priority assigned in Section 4.1.2.
- Based on the adaptive management process, develop a long-term strategy for Phase 2 and Phase 3 using data gathered through compliance monitoring activities developed through this integrated Implementation Plan. During Phase 2, accelerate successful Phase 1 programs, building upon lessons learned. Redesign/optimize Phase 1 programs as needed and implement new Phase 2 programs as detailed in Section 4.1.2. During Phase 3 accelerate successful nonstructural programs from the previous phases, continuing to assess effectiveness and modify as needed to meet TMDL WLAs.

4.2 Public Information and Participation Program

The purpose of this Implementation Plan is to identify BMPs that may be implemented by the County on the "land side" of the unincorporated areas of MdRH. This section focuses on PIPPs that may be used across the entire MdRH. The Green Marina PIPP is an optional enhanced education program and has not been incorporated into the overall analysis of this Implementation Plan.

4.2.1 Existing Outreach Materials

In 2002, the County developed the *Public Education Model Program*, a framework document for Los Angeles County Copermittees to develop regionally consistent PIPPs. This framework defined educational goals, an overall approach, target audiences, audience-specific PIPPs, and measures of PIPP effectiveness. This framework has been used to develop a series of outreach programs and educational materials available for use in MdRH and throughout the County. Table 4-4 summarizes the educational materials currently available and materials that would need to be developed or updated for use in MdRH.

Table 4-4. Existing Outreach Materials Used in Existing Public Information and Participation Programs with Identified Potential Enhancements for Marina del Rey Harbor Program

Material/ PIPP	Standard Format	Targeted Pollutants	Targeted Audience	Existing/New	Synergy with Nonstructural Solution	Potential Enhancements for Marina del Rey Harbor	Examples/ Sources of New Materials
Bird Waste Outreach	Tip Card/Brochure Signage	Bacteria	General public, restaurants, boaters, commercial	NEW	GENERAL BIRDS TRASH	A general information brochure made available to restaurants, hotels/inns, boaters, yacht clubs, public parking facilities and long-term parking areas, and other public areas in MdRH would discuss the following: • Bird waste as a source of bacteria. • Bird attractants such as trash and food waste. • Provide a map highlighting existing bird deterrents, including bird spikes. Signage would have a format similar to the "Can It!" campaign with limited text and graphical imagery. Signage would indicate bird-related messages such as the following: • Don't Feed the Birds. • Properly dispose of fish waste (cover or trash). • Properly dispose of trash.	**"Can It!" Campaign**
Runoff Reduction Outreach Materials	Brochures and Handouts	Runoff (pollutant transport)	All structural facilities in MdRH	NEW	RUNOFF REDUCTION PARKING GARAGES	Materials would need to be developed discussing the following: • <u>Garden Gardening and Maintenance</u>: Including xeriscape and planting with native vegetation, pesticide application and management, sprinkler leak inspection and repair tips, and appropriate sprinkler placement (i.e., device relocation away from paved areas to reduce dry-weather flows). • <u>Green Gardening BMPs</u>: Including drip irrigation and low-flow infrastructure, "smart" irrigation systems that are weather- and soil moisture-based, downspout disconnections for roof areas and ground drains, rain barrels and cisterns, and green roofs. • <u>Regulations</u>: Including governing standards for design, treatment, and maintenance. • <u>Incentive Programs</u> *(as developed and appropriate).* For example, if stormwater discharge fees are implemented, a fee reduction would incentivize implementation of runoff-reduction methods above.	
Restroom Outreach	Signage Brochures and Handouts Training Video <u>Training materials</u>: PowerPoint presentation "To Do" Checklists	Bacteria, runoff (pollutant transport)	All MdRH facilities that have outdoor or separate restrooms	NEW	SEWAGE (Restrooms)	Educational and training materials would be targeted at staff responsible for restroom maintenance to encourage dry cleaning practices and prevent restroom washdown. Educational materials would highlight multiple messages including the following: • Dry cleaning methods. • Facilities with floor drains and other diversion structures discharging to the sanitary sewer with the directive to ensure all flows enter this floor drain/structure rather than exit facility (i.e., discharge to the street).	**City of Los Angeles Employee Training Program** – Video and Employee Handbook **http://www.ci.la.ca.us/SAN/wpd/Siteorg/education/ctyemptrng.htm**
Aggressive Street Sweeping Public Outreach	Brochures Posters/Signage Door hangers	Metals, sediments, trash, debris, bacteria	General public, hotels, residential, restaurants, and commercial	NEW	STREET SWEEPING, PARKING LOT SWEEPING	Develop program information provided online and as door hangers for impacted audiences. Information may include the following: • Program Description, Goals and Objectives • Frequently Asked Questions • Time line • Impacted Route	Coordinate with City of San Diego http://www.sandiego.gov/thinkblue/special-projects/streetsweeping.shtml

Table 4-4. Existing Outreach Materials Used in Existing Public Information and Participation Programs with Identified Potential Enhancements for Marina del Rey Harbor Program

Material/ PIPP	Standard Format	Targeted Pollutants	Targeted Audience	Existing/New	Synergy with Nonstructural Solution	Potential Enhancements for Marina del Rey Harbor	Examples/ Sources of New Materials
Incentive Program	Giveaways Advertizing/recognition Reimbursements/cost sharing	GENERAL	General public, restaurants, commercial, residential, boaters, pet owners, and dog walkers	NEW	GENERAL	There are currently no MdRH-wide incentive programs. Information obtained from the LACDBH indicates that individual lessees have voluntarily implemented pet waste and trash BMPs on their property. Incentives are an opportunity to guide, enhance, and reinforce these types of positive behaviors. Incentive programs are intended to encourage behavioral change in MdRH. Incentive programs (e.g., giveaways) may be used as a form of education and outreach, rewards for proactive environmental behavior (e.g., advertising and recognition), or BMP implementation (e.g., reimbursement/cost sharing).	**Clean Marinas California Program.** **Santa Monica Bay Restoration Commission** *Clean Bay Restaurant Certification Program.* **City of Los Angeles** Residential Incentives (i.e., pens, dry-erase boards, decals, magnets, pet-waste bags (available for order) http://www.ci.la.ca.us/SAN/wpd/Siteorg/education/genpub.htm
RV Waste Manage-ment Program	Option 1: Series of TipCards, posters, or other materials. Option 2: Glossy trifold document, or larger	Bacteria, Trash	RV Owners, General Public	NEW	NS 25, NS 23	Provide Information about: • Map of existing facilities related to RV parking • Topics related to waste management and TMDLs • Dump station facility hours, fees, policies, and voucher program	**Clean Water: It's a Team Effort Flier** http://www.ci.la.ca.us/san/wpd/Siteorg/program/Hyperion_flyer_Final.pdf
MdRH Environ-mentally Friendly Boating Guide and Boater Outreach Program	Option 1: Series of TipCards, Posters, or other materials. Option 2: Glossy trifold document, or larger. Option 3: Booklet similar to the BMP Fact Sheets.	Metals, sewage, oil/grease	Boaters, live-aboards, commercial, vessels, and bait and tackle	NEW	GENERAL	Provide information about: • Standard oil and waste maintenance, including the location and encouraged voluntary use of pump-out stations on/around the marina. • Dry boat cleaning methods that may be implemented onshore and on the water (i.e., rags, vacuuming, steam cleaning, dry ice cleaning, tarps/berms/capture and reuse systems). This may be incorporated into a MdRH "No Suds" regulatory policy. • Trash management BMPs. • Alternative, environmentally friendly boating products, including noncopper-based paints. At present, the LACDBH does not provide any educational materials to boaters during the vehicle registration process for long-term boat trailer parking, nor does it distribute materials during MdRH inspections. This guide may be provided by dockwalkers, at partnering commercial facilities (e.g., commercial fishing vessels, bait and tackle shops, private parking garages, and hotels), boat yards, and yacht clubs across MdRH. This document may be a used to supplement the outreach information currently provided in existing Dockwalker boater kits.	**Sea Grant Extension** – *Research on copper-based paint.* *Boater outreach materials.* **Boating Clean and Green Campaign.** **Santa Monica Bay Restoration Commission** *Dockwalkers Program/Boater Education Program and Honey Pot Days Bilge Pad Exchange Program.*
Tip Cards	Purpose of Storm Drains Tips: 1. Tips relating to proper material usage and application (i.e., pesticides). 2. Tips relating to material storage	GENERAL	General public, residential, restaurants, commercial, and industrial	EXISTING: • General Litter/ Stormwater • Car Care • Pet Waste • Pesticides • Gardening • Painting • Recycling	GENERAL TRASH RUNOFF REDUCTION PARKING GARAGES PET WASTE	Incorporate distribution of TipCards during all inspection, training, and targeted outreach activities. Provide English and Spanish versions of all materials. Provide a call-out to track type of card, and highlight other TipCards of interest to the reader (i.e., existing Gardening and Pesticide Cards and NEW Green Gardening Card) Ensure BMPs and practices listed with SWRCB are included.	**BMP Fact Sheet:** *Water Transportation and Ship Building and Repairing.* **MdRH Boater Pump-out Facilities Fact Sheet.** **Good Operating Practices for a Cleaner Ocean Posters**

Table 4-4. Existing Outreach Materials Used in Existing Public Information and Participation Programs with Identified Potential Enhancements for Marina del Rey Harbor Program

Material/ PIPP	Standard Format	Targeted Pollutants	Targeted Audience	Existing/New	Synergy with Nonstructural Solution	Potential Enhancements for Marina del Rey Harbor	Examples/ Sources of New Materials
	(cover, contain, etc.). 3. Tips relating to material management and disposal (cover, contain, leak prevention for trash, pet waste, oil, etc). 4. County-sponsored programs (i.e., recycling, household hazardous waste (HHW) management, trash, and oil collection centers). 888Clean LA Hotline			• Pools <u>NEW (alternative):</u> • Boat Care <u>NEW:</u> • Restaurant TipCard • LID TipCard • Mobile Washers • New Construction Permit	RESTAURANTS	<u>Pet Waste TipCard:</u> • Target at dog owners AND "professional dog walkers." • Incorporate graphic/photo of a pet-waste bag dispenser, or photo of proper practice.	*Auto Repair Industry.* SWRCB http://www.swrcb.ca.gov/water_issues/programs/outreach/erase_waste/reduce.shtml#litter. **Sea Grant Extension** – *Research on copper-based paint.* *Boater outreach materials.* **Boating Clean and Green Campaign.** **Santa Monica Bay Restoration Commission** • *Cruiser's Guide (covers harbors and boating from Santa Barbara to San Diego, MdRH not included)* • *Honey Pot Days.* • *Bilge Pad Exchange Program.*
						<u>Car Care/Boat Care Tip Card:</u> • Make document general for car maintenance and boat maintenance. Use **BMP Fact Sheet** for information and additional language. • Alternatively: Create a new TipCard specific for boat care in MdRH with information about boat ramps, washing activities, and sewer pump-outs (see **MdRH Boater Pump-out Facilities).**	
						<u>Restaurants Tip Card:</u> • Also provide versions in Mandarin. • Modify **BMP Fact Sheet** into a restaurant-specific TipCard format (potentially a fold-out flier). o Target washing activities and trash maintenance BMPs. o Provide contact information for MdRH Stormwater Coordinator for storm drain cleaning needs (Clean LA Program). o Highlight the economic benefits of stormwater programs (i.e., low maintenance costs through reduced irrigation or outdoor washing, less outdoor bird waste and unsanitary cross contamination, etc.). o Develop for different types of facilities (e.g., restaurants, cafes, and combined facilities).	**Recycling Tip Card** and **General Litter/Stormwater Tip Card.** **BMP Fact Sheet:** *Food and Related Products.*
						<u>LID Tip Card:</u> • Target commercial center (i.e., restaurants, hotels, and property management). • Identify code modifications to allow and regulate use of rain barrels, cisterns, green roofs, and other green-gardening techniques. • Basic xeriscaping techniques and tips. • Irrigation management techniques and general BMPs.	
						<u>Mobile Washers Tip Card:</u> • Target mobile car washers and parking facilities. • Dry cleaning BMPs or containment BMPs.	Coordinate with City of San Diego http://www.sandiego.gov/thinkblue/pdf/mobilebusinessbrochure.pdf.

Table 4-4. Existing Outreach Materials Used in Existing Public Information and Participation Programs with Identified Potential Enhancements for Marina del Rey Harbor Program

Material/ PIPP	Standard Format	Targeted Pollutants	Targeted Audience	Existing/New	Synergy with Nonstructural Solution	Potential Enhancements for Marina del Rey Harbor	Examples/ Sources of New Materials
						New Construction Permit Tip Card: • Water Level Risk Rating for MdRH. • Identify New Requirements (e.g., monitoring, risk assessment, Rain Event Action Plan).	*WESTON created an updated SWPPP template for the Port of Long Beach Environmental Planning Division.*
CAN IT! Campaign	Photo "Can It!"	Trash, bacteria (bird attractant)	Residential and commercial	EXISTING: • Cigarette Butts • Beverage Cup • Fry Box • Pet Waste NEW: • Fish Waste	TRASH PET WASTE RESTAURANTS	The "Can It" campaign has never been implemented in MdRH. Create decal version that easily adheres to trash cans around MdRH (specifically along walking paths), or provided as a give-away during outreach events in or around MdRH.	Useful facts and other information may be pulled from the City of Los Angeles *High Trash-Generation Areas and Control Measures Report* (2002) http://www.ci.la.ca.us/SAN/wpd/Siteorg/download/pdfs/reports/Trash_Gen_Study.pdf
Good Operating Practices for a Cleaner Ocean Posters	Posters	Trash, bacteria (as pollutant and as bird attractant), oil and grease, suds	Boaters, live-aboards, restaurants, commercial, and industrial.	EXISTING: • Auto Repair Industry • Gas Stations • Food and Restaurants • Managing Fats, Oil and Grease BMP	GENERAL RESTAURANTS BOATING COMMUNITY PARKING GARAGES	Auto Repair Industry (Green Marina Program) • Modify for small boats/residential-type boats.	**Santa Monica Bay Restoration Commission** *Dockwalkers Program/Boater Education Program and Honey Pot Days Bilge Pad Exchange Program.*
Businesses and Industries for a Clean Environ-ment: *BMP Fact Sheets*	Recommended BMPs and good housekeeping activities	GENERAL	Live-aboards, boaters, parking garages, mobile washers, commercial, and industrial	EXISTING ENHANCE: • Food and Related Products NEW: • Mobile Washing • Small Boats • Fish Processing	GENERAL RESTAURANTS BOATING COMMUNITY	Provide versions in English, Spanish, and Mandarin. Food and Related Products • Expand/update with outdoor water management (e.g., irrigation and washing activities versus dry cleaning techniques). • Incorporate recommendation for downspout disconnections for roof areas and decks. • Ensure language cross-over with Fat/Oil/Grease program and all relevant hotline information for all inspection programs. Parking Garages/Mobile Washing • Target mobile car washers and parking facilities. • Topics include dry cleaning BMPs, containment BMPs, and oil and grease management. Also identify potential structural BMPs that may be installed at low points in the garage facility, such as diversion sumps (gutter drains) and downspout disconnections (roof). • Coordinate with development of the Mobile Washers TipCard. Boat Maintenance (Green Marina Program) • Make a version for all boat maintenance activities (e.g., pump-out stations and voluntary program, noncopper-based paint alternatives, and dry cleaning activities). Fish Processing (Green Marina Program) • Targeted at on-land processing activities near docks, at restaurants, commercial fishermen, or public outings with chartered vessels, etc. • Topics include trash- and fish-waste management, ice management, cover and containment BMPs, appropriate product selection (plastic trash receptacles instead of metal).	**BMP Fact Sheet:** *Water Transportation and Ship Building and Repairing; Commercial/Industrial.*

Table 4-4. Existing Outreach Materials Used in Existing Public Information and Participation Programs with Identified Potential Enhancements for Marina del Rey Harbor Program

Material/ PIPP	Standard Format	Targeted Pollutants	Targeted Audience	Existing/New	Synergy with Nonstructural Solution	Potential Enhancements for Marina del Rey Harbor	Examples/ Sources of New Materials
Storm Drain Stencil		Trash, debris, oil/grease, runoff (pollutant transport)	General public, residential, restaurants, boaters, and commercial	EXISTING: Storm Drain Stencil	MS4 SYSTEM	• Provide contact information for MdRH Stormwater Coordinator for storm drain cleaning needs (Clean LA Program). Under current County policy, private developers are responsible for stenciling storm drains on private property, as required by the construction drawings. During the SUSMP inspections, the need for additional stencils may be identified by the inspecting officer. Developing this program may provide an opportunity for specially trained individuals to provide "touch-up" stenciling services (i.e., support staff/volunteers through the Dockwalker program).	Coordinate with City of San Diego **http://www.sandiego.gov/thinkblue/pdf/stencilinginstructions.pdf**.

Rather than distributing enhanced general materials, an enhanced PIPP for MdRH may involve developing marina-specific materials. Existing and enhancement materials may be modified for the targeted MdRH audience by including the following types of information:

- Contact information for the Stormwater Coordinator responsible for the MdRH area.
- Photos from MdRH depicting BMP demonstration projects.
- Photos from MdRH depicting good housekeeping activities and practices.
- Harbor overview maps identifying locations of existing facilities described in the educational material (e.g., boat-wash facilities, pet-waste bag dispensers, and street-sweeping/parking-lot sweeping routes).
- Provide educational materials in additional languages. SWRCB provides TipCards and other materials in English, Spanish, Korean, Vietnamese, and Mandarin/Chinese.
- Coordinating with existing materials developed by the Santa Monica Bay Restoration Commission, Aquarium of the Pacific, and other local organizations that have a presence in MdRH.

4.2.2 Green Marina Program

To best achieve the TMDL load reductions, pollutants on land, in the water, and at the land–water interface must be addressed. Although a full-scale Green Marina Program is beyond the scope of this Implementation Plan, it is prudent when designing PIPPs and nonstructural solutions to consider the larger marina audience. Many Green Marina programs have been implemented in California. Three major campaigns include the Clean Marinas California program, Boating Clean and Green campaign, and Sea Grant.

The **Clean Marinas California Program** is a partnership of private marina owners, government marina operators, and yacht clubs that was developed to provide clean facilities to the boating community and protect the state's waterways from pollution. The program is designed to educate, train, and encourage boaters and marina employees to protect the environment and water quality through the routine use of these BMPs. Marinas are reviewed by the Marina Recreation Association to determine that day-to-day activities and operations are enhancing the environment and water quality. Facilities that meet program standards and pledge to continue the use of BMPs are awarded the Clean Marina designation. An electronic copy of the program manual and recommended marina BMPs is available on the Clean Marinas California website (http://www.cleanmarinascalifornia.org/).

Sea Grant Extension is a partnership between the University of California and National Oceanic and Atmospheric Administration (NOAA). While primarily a college-level research and educational program, Sea Grant Extension provides science-based fact sheets and other education materials. Education topics focus on commercial fisheries and aquaculture, coastal resource development, and marine science education. Materials are available in both English and Spanish. Electronic materials may be requested through the Sea Grant website (http://seagrant.ucdavis.edu/publications.htm).

The **Boating Clean & Green Campaign** (Campaign) is a statewide educational and outreach program conducted by the California Coastal Commission and the California Department of Boating and Waterways that is designed to educate boaters about environmentally sound boating practices. The Dockwalkers program trains community volunteers to be marina stewards. Dockwalkers are provided training in environmentally friendly boating practices and BMPs that may be implemented on land and on the water to protect marina water quality, and then they educate the greater marina communities. This bottom-up program provides a "face" for environmentally friendly boating and marina management. The Campaign provides volunteers with educational materials (i.e., signs, posters, fliers, and boater kits available in both English and Spanish) and training. Boater education materials cover a range of topics and targeted pollutants, including oil and fuel management, gray water reuse, boat cleaning, sewage disposal and tank pump-out facilities, and marina trash. An annotated catalog of marina and recreational boater pollution education materials is available on the Boating Clean & Green website (http://www.coastal.ca.gov/ccbn/catalognew.html).

A Green Marina PIPP for MdRH may incorporate educational tools described by any of these programs, but the PIPP would be best served through an expansion of the existing Dockwalkers program. The California Coastal Commission and the California Department of Boating and Waterways have partnered with the Santa Monica Bay Restoration Commission to implement a Dockwalkers program in MdRH. Dockwalkers distribute educational materials to boaters and the MdRH community during outreach events such as Coastal Clean-Up Day and Honey Pot Days. Coastal Clean-Up Day is a statewide garbage collection event that takes place every year on the third Saturday of September. In MdRH, Dockwalkers pilot kayaks and lead volunteers in collecting trash from all basins, with emphasis on the low-circulatory, high-trash areas in Basin F and Basin G. During Honey Pot Days, the Santa Monica Bay Restoration Commission provides free on-the-water sewage pump-out services for boats moored in the marina. Dockwalkers discuss clean, safe, and green boating practices with the vessel owner (i.e., 30 minutes of face-to-face outreach) while the vessel's holding tank is being serviced. The vessel owner is provided a boater kit containing an oil-absorbing pillow, brochures, and other useful items. In exchange, the vessel owner is asked to complete a survey that tracks pump-out activities and provides feedback for program improvement. There were 10 scheduled Honey Pot Days in 2009, and multiple vessels signed up for individual service. The Green Marina PIPP could enhance these existing programs through coordinated development of outreach materials and funding for the Dockwalkers program for land-side events targeted at commercial vessels, fish-processors, bait and tackle facilities, yacht clubs, and the two boat maintenance yards in MdRH. Additional MdRH outreach materials can be coordinated through the proposed Collaborative Environmentally Friendly Alternative Services Program (NS 27), including "Can It!" decals.

5.0 STRUCTURAL SOLUTIONS

5.1 Treatment Strategies Evaluation of Structural BMPs

BMPs are used to mitigate urbanization effects for water quantity and quality. BMPs can reduce peak flows, runoff volumes, and the magnitude and concentration of constituents in runoff. The purpose of this report is to provide a planning-level review of the applicability and use of traditional treatment methods in the MdRH watershed. Since MdRH is densely urbanized and exhibits several limiting site characteristics, BMP options will be limited for this watershed. Furthermore, meeting the WLAs requires higher removal efficiencies than most standard types of BMPs provide.

A comprehensive review was conducted to evaluate a variety of treatment strategies to meet reductions in WLAs and minimize bacteria exceedances for drainage areas in the unincorporated area of MdRH. Potential treatment requirements, technologies, and management opportunities were identified for dry-weather flows and stormwater runoff that are to be treated for discharge or reuse. Factoring in the watershed constraints, a limited number of BMPs were determined to be feasible for the unincorporated MdRH watershed. BMP evaluations include cost estimates consistent with the treatment alternatives.

To comply with the numeric water quality targets established in the MdRH Mother's Beach and Back Basins Bacteria and Toxics TMDLs (LARWQCB, 2003), an effective combination of structural and nonstructural BMP strategies will need to be implemented throughout the watershed.

Traditional methods such as structural treatment controls of medium to high effectiveness were thoroughly examined for their ability to reduce pollutants of concern and provide multiuse benefits, which included flood control protection, recreational enhancements, and stormwater reuse.

5.2 Summary of Structural Solutions to Support TMDL Implementation

The evaluation matrix in Table 5-1 summarizes the findings of an extensive and comprehensive review of site-specific evaluation factors, which determined the feasibility of BMPs for the MdRH watershed (USDOT, 2010). Based on the parameters discussed in Sections 4.2 and 4.3, the implementation of filtration practices, porous pavements (using an underdrain system), proprietary devices, vegetative swales, and stormwater storage and reuse facilities are recommended for use in MdRH. An effective combination of LID techniques, modified for filtration instead of on-site infiltration because of the high groundwater table, with a limited treatment train will provide long-term sustainable solutions for TMDL compliance. Additionally, a field analysis concluded that implementation of feasible BMPs would be best situated in or adjacent to parking lots and defined outfalls.

Table 5-1. Review of Site-Specific Best Management Practices

Best Management Practices	Scoping				Evaluation									Final Selection				
					Controlling Factors		Additional Factors											
	Bacteria Removal Efficiency (%)	Configuration	Effective Life[1,3] (yrs)	Water Quantity Reduction	Applicable in Areas with High Groundwater Table	Applicable in Areas with High Groundwater Table Using Modifications or Underdrains	Area Required for BMP[1,5]	Independent of Natural Underlying Soils	Maintenance Requirements	Subsurface	Surface	Training	Viability in Urbanized Areas	Additional Benefits[7]	Capital Costs	Construction Timeline	Public Acceptance	No Safety Concerns
Detention and Retention Practices																		
Detention Tanks and Vaults	NA[1]	Offline	50–100	✓		✓	0.5–1%	✓	Frequent Cleanout	✓		Mod.	✓		Mod. - High	Mod. - High	✓	
Dry/Wet Ponds	70–88[2]	Both	20–50	✓	✓		10–20%	✓	Annual Inspection		✓	Low		✓	Mod.	Mod.	✓	
Extended Detention Basins	78	Both	--	✓			--		Biannual Inspection		✓	Low			Mod. - High	Mod.		
Wetlands and Shallow Marsh Systems	78[2]	Both	20–50		✓		10%		Annual Inspection		✓	Low		✓	Mod. - High	Mod. - High	✓	
Filtration Practices																		
Green Roofs	70–90[3]	Offline	--	✓	✓		NA	✓	Biannual Inspection		✓	Low	✓	✓	Mod. - High	Mod.	✓	✓
Filtration and Disinfection Facilities	70–90[3]	Both	--		✓		NA	✓	Frequent Inspection		✓	High	✓		High	Mod. - High		✓
Organic Media Filters	90[1]	Offline	5–20		✓		2–3%	✓	Annual Media Removal	✓	✓	Low	✓		High	Mod.	✓	✓
Surface Sand Filters	70–90[3]	Offline	5–20		✓		2–3%	✓	Biannual Media Removal		✓	Low			Mod.	Mod.		
Underground Sand Filters	70–90[3]	Offline	5–20		✓	✓	2–3%	✓	Annual Media Removal	✓		Mod.	✓		High	Mod.	✓	✓
Infiltration Practices																		
Bioretention[8]	70–90[3]	Both	5–20	✓		✓	4–10%	✓[6]	Mowing / Plants	✓	✓	Low	✓	✓	Mod.	Low	✓	✓
Infiltration Basin	75–98[1]	Offline	5–10	✓			2–4%		Mowing / Sediment Removal		✓	Low		✓	Mod.	Mod. - High	✓	
Infiltration Trench	75–98[1]	Both	10–15	✓		✓	2–4%		Biannual Inspection		✓	Mod.	✓		Mod. - High	Mod.		✓
Porous Pavements																		
Porous Pavements	NA[1,3]	NA	15–20	✓		✓	NA	✓[6]	Biannual Vacuum	✓	✓	Low	✓		Mod. - High	Mod. - High	✓	✓
Proprietary Devices																		
Cartridge Filters	50–80[1]	Offline	--		✓		<1%	✓	Frequent Cleanout	✓		Mod.	✓		Mod.	Low	✓	✓
Catch Basin Inserts	40–70	In-line	--		✓		None	✓	Frequent Cleanout	✓		Low	✓		Low	Low	✓	✓
Hydrodynamic Devices	40–70	Both	--		✓		None	✓	Periodic Cleanout	✓		Low	✓		Mod.	Low	✓	✓
Proprietary Biotreatment Devices	Up to 96	Offline	--		✓		--	✓	Periodic Cleanout	✓	✓	Mod.	✓	✓	Mod.	Low	✓	✓
Low Flow Diversions to Sanitary Sewers	100	In-line	--		✓		None	✓	Periodic Cleanout	✓		Mod.	✓		High	Mod. - High	✓	✓
Stormwater Storage																		
Cisterns	70–90[3]	Both	--	✓	✓		4%	✓	Biannual Inspection	✓	✓	Low	✓	✓	Low - Mod.	Low	✓	✓
Rain Barrels	70–90[3]	Both	--	✓	✓		4%	✓	Biannual Inspection		✓	Low	✓	✓	Low	Low	✓	✓
On-site Storage and Reuse	70–90[3]	Offline	--	✓	✓	✓	--	✓	Biannual Inspection	✓	✓	High	✓	✓	High	Mod. - High	✓	✓
Vegetated Swales																		
Vegetated Swales	25–50	In-line	5–20	✓	✓	✓	10–20%		Mowing		✓	Low	✓	✓	Low	Low	✓	

Notes:
1 U.S. Department of Transportation – Federal Highway Administration: Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring
2 Green Country Stormwater Alliance – National Pollutant Removal Performance Database, Version 3
3 Neponset River Watershed Association – Fact Sheet: The Wetlands Act & TMDLs
4 Assumes regular maintenance, occasional removal of accumulated materials, and removal of any clogged media.
5 Expressed as a percent of the total drainage area; can be modified to accommodate urban conditions.
6 When equipped with an underdrain system.
7 Recreational, wildlife habitat, aesthetics, etc.
8 Bioretention systems may include raised planters and flow-through planter boxes that act as LID filtration devices.

5.3 Integrated Water Resources

5.3.1 Rainwater Harvesting Background

By design, RWHSs remove stormwater runoff from the hydrologic system. By using the collected water for subsurface drip irrigation, the water is treated by evapotranspiration and infiltration. Evapotranspiration is the process in which water evaporates into the air or is absorbed and used by plant life. This process removes virtually all pollutants from the water. To determine whether the use of RWHSs to meet WLAs within MdRH is feasible, a document review was conducted.

5.3.2 Document Review

The Los Angeles County Department of Public Works (LADPW) Watershed Management Division and its consultant developed the Cistern Document to establish standards for the design of large-scale cisterns (Geosyntec, 2009). The geography and land use of the MdRH area is similar to that of Santa Monica Bay beaches. Thus, the findings within the reviewed document may be applicable to the unincorporated areas of MdRH.

Several documents are summarized in the Cistern Document relating to local requirements and regulations for RWHSs. The Los Angeles County Department of Public Health (LADPH) guidelines for RWHSs, *Requirements for the Installation and Pipeline Construction for Safe Reuse of Rainfall/Run-off, Non-Potable Cistern Water and Urban Run-off Water*, is the most applicable and restrictive document summarized (LADPH, 2009). The guidelines focus on projects that include below-grade piping, pumps, and storage tanks. Because harvested rainwater cannot be classified as recycled, reclaimed, or as another water source (as currently defined in these regulations), the use of collected rainfall has limited allowable usage. The LADPH document categorizes nonpotable cistern water and alternative nonpotable water supply, and states that untreated rainfall collected in a cistern can only be used for subsurface irrigation purposes. Furthermore, if stormwater is used for above-grade irrigation, it should be treated to Title 22 Standards for tertiary recycled water (Geosyntec, 2009).

The Cistern Document includes a literature review of 12 case studies; five of the case studies were located in Southern California, and the other seven were located in other states. The tanks ranged in size from 3,000–6,000 gallons for residential and smaller commercial use, to 100,000–200,000 gallons for institutional uses. The case studies indicate that RWHSs have a high degree of variability in size, treatment method, distribution system, and cost. The case studies also indicate that retrofit systems are typically much smaller and limit collection to rooftop runoff. Treatment of collected rainwater requires disinfection prior to indoor use (Geosyntec, 2009).

The Cistern Document provides several recommendations for pretreatment, storage, distribution, water end-use/treatment requirements, maintenance, inspections, and permitting. This information is useful to facilitate drafting cistern standards. The water end-use/treatment requirements section of the Cistern Document is applicable to the focus of this report, which is to evaluate the feasibility of using of RWHSs in the TMDL Implementation Plan. A few other states have standards requiring disinfection for indoor nonpotable uses; however, these states have less-stringent water criteria compared with the California recycled water standards and are primarily intended to prevent fouling of indoor nonpotable plumbing systems (Geosyntec, 2009). Changes in standards may allow the use of collected water as indoor toilet flushing water with little or no disinfection, which may allow for more widespread implementation of water harvesting systems.

A performance analysis of theoretical/simulated rainwater harvesting systems with varying tank sizes was evaluated by the Cistern Document for several different ratios of landscape area to drainage area. A model including historic rainfall data, the cistern volumes of the simulated systems, and typical evapotranspiration rates was used to determine the percentage of annual rainfall that could potentially be captured and reused. The results of the analysis, shown on Figure 5-1, show the points of diminishing returns in cistern volumes for each scenario of approximately 300 gallons and 700 gallons for each 1,000 ft^2 of tributary area for high-density/low-landscaped areas and low-density/high-landscaped areas, respectively. The analysis also shows the limitations on the percentage of annual runoff that can be captured and reused even with the use of large cisterns, especially in systems with low ratios of landscape area to drainage area (Geosyntec, 2009). Based on the graphs presented in the analysis, the percentage of rainwater runoff captured desired, and the land uses within MdRH area, rainwater capture systems should be designed with ratios for landscape area to drainage area of approximately one to two (i.e., landscape area equal to or slightly larger than drainage area).

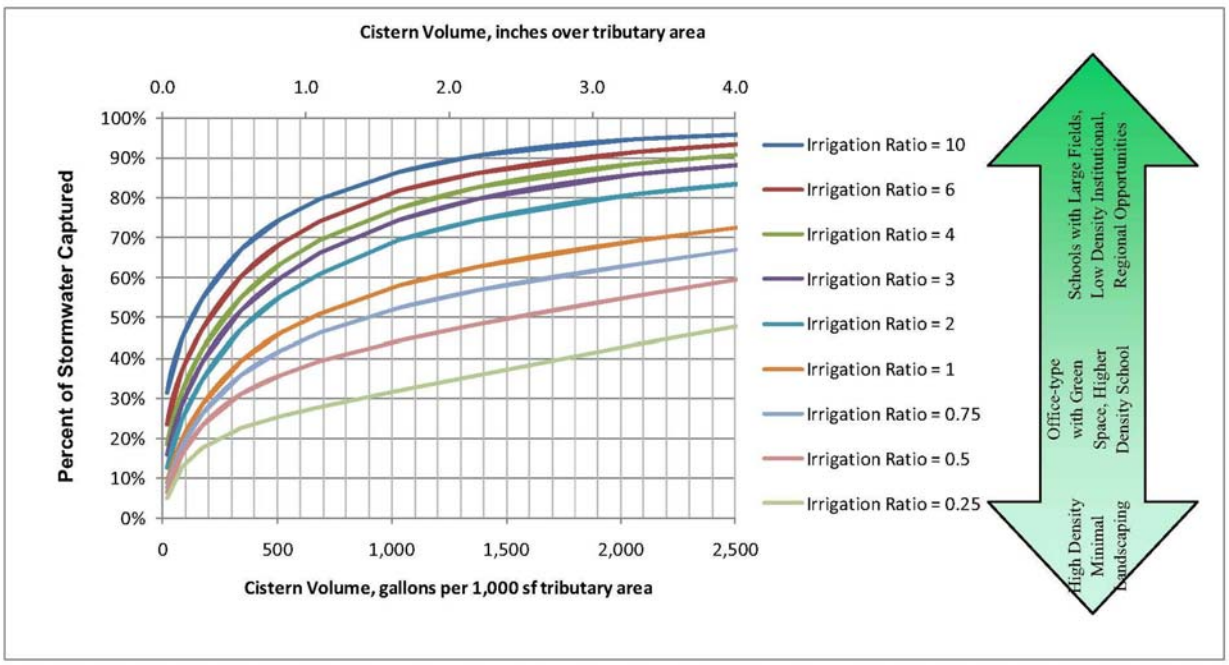

Figure 5-1.Rainwater Harvesting Systems Performance (Geosyntec, 2009)

The Cistern Document also conducted a cost-benefits analysis of RWHSs. Figure 5-2 illustrates the results of this analysis. In general, the systems are shown to be most cost effective when designed with 100-gallon cistern volume for each 1,000 ft^2 of tributary area independent of landscape area to drainage area ratio. This is much lower than the point of diminishing returns in cistern volumes compared to percentage of annual precipitation captured and reused. Thus, a system design with the highest cost benefit (i.e., approximately 100-gallon cistern volume for each 1,000 ft^2 of tributary area as shown on Figure 5-2) would capture a low percentage of stormwater runoff as shown on Figure 5-1.

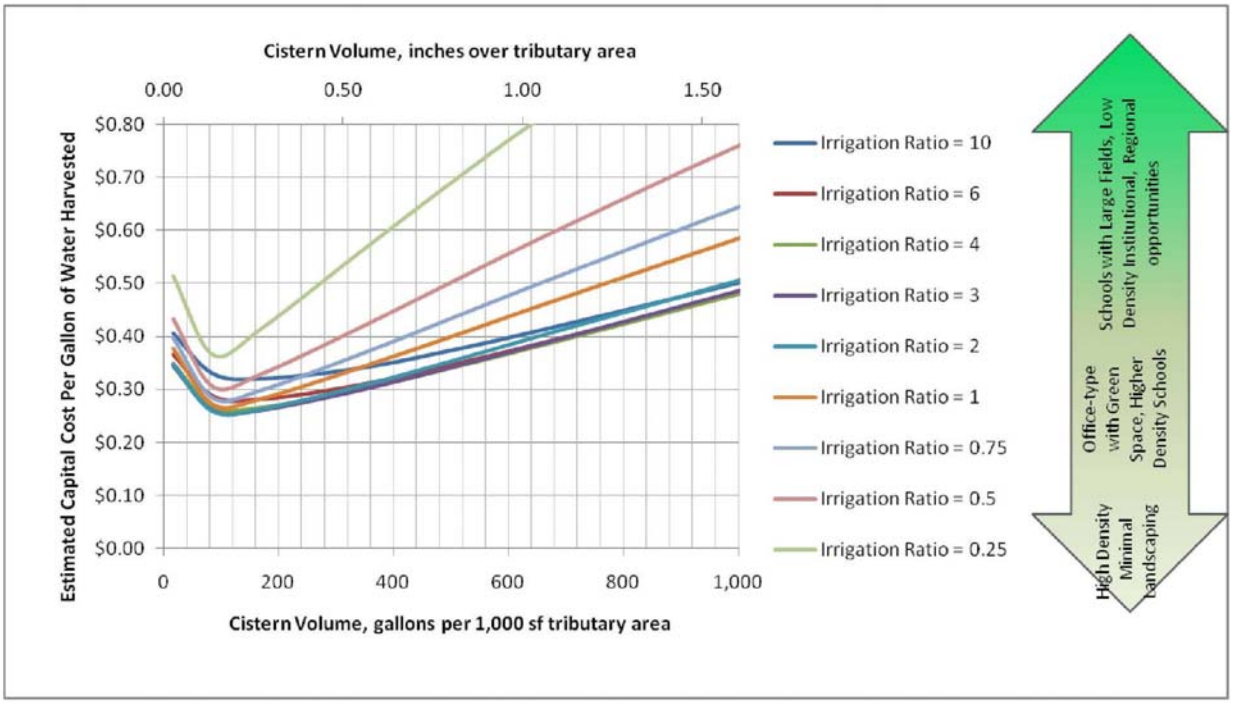

Figure 5-2. Estimated Capital Costs per Gallon of Water Harvested (Geosyntec, 2009)

5.3.3 Beneficial Reuse in Marina del Rey Harbor Watershed

RWHSs could play a focused role in achieving TMDL compliance. Smaller runoff harvesting systems may be best suited for the high-rise apartment/condominium buildings and multi-family and commercial low-rise buildings of MdRH than larger-scale collection systems. These smaller systems should be designed for properties where the landscaped area to drainage area (i.e., rooftop surface) is in the approximate range of 0.5–1.0. These systems should augment the irrigation of flower beds and planter boxes by using cost-effective drip-line irrigation systems, and/or may be designed to include the addition of raised planters that are located adjacent to existing structures. Small-scale rainwater harvesting systems would reduce waste loads through evapotranspiration, root uptake, filtration, and infiltration, which would result in both improved water quality and a reduction in the area’s water demand on a limited scale.

The findings of the Implementation Plan are that RWHSs should be used, on a limited basis, as a structural BMP to improve the water quality of runoff entering MdRH and will help in achieving TMDL compliance. The evaluation of rainwater harvesting systems for implementation on the site selected for BMP construction in Implementation Plan considers the use of RWHSs. During the implementation period, additional sites selected for the construction of structural BMPs shall consider incorporating RWHSs into the design. In addition, the quantification analysis of the Implementation Plans provides guidance of the required amount of RWHS implementation to meet WLAs.

5.4 Identified Sites for Treatment BMP Construction

BMPs are used to mitigate urbanization effects for water quantity and quality. BMPs can reduce peak flows, runoff volumes, and the magnitude and concentration of constituents in runoff. The purpose of this section is to provide siting, conceptual design, and implementation costs for potential structural BMPs that can be implemented within the unincorporated County area in the MdRH watershed. This effort involved a thorough examination of the hydrology, topography, land use, removal efficiencies, and other pertinent criteria and was conducted to determine which BMPs are practical for use in the unincorporated drainage area of Back Basin D, including Marina Beach, also commonly known as Mother's Beach, and Back Basins E and F.

Based on land-use data and a field reconnaissance through the MdRH watershed, five locations were selected for siting and conceptual design of potential structural BMPs that can significantly reduce pollutants of concern. Each potential conceptual design consists of a site description identifying physical constraints, site overview map identifying the potential siting of proposed BMPs, conceptual design, and implementation cost estimate. The following five potential BMP locations presented in this report are shown on Figure 5-3:

- Parking Lot 5 and adjacent Lloyd Taber Marina del Rey Library.
- Parking Lot 7.
- Parking Lot 9.
- Parking Lot 10.
- Parking Lot 11.

The selected sites with conceptual designs presented here are potential projects that may be implemented within the watershed. These sites and projects are subject to change based on additional monitoring and assessment data, rezoning, redevelopment, availability of funding, and/or at the County's discretion.

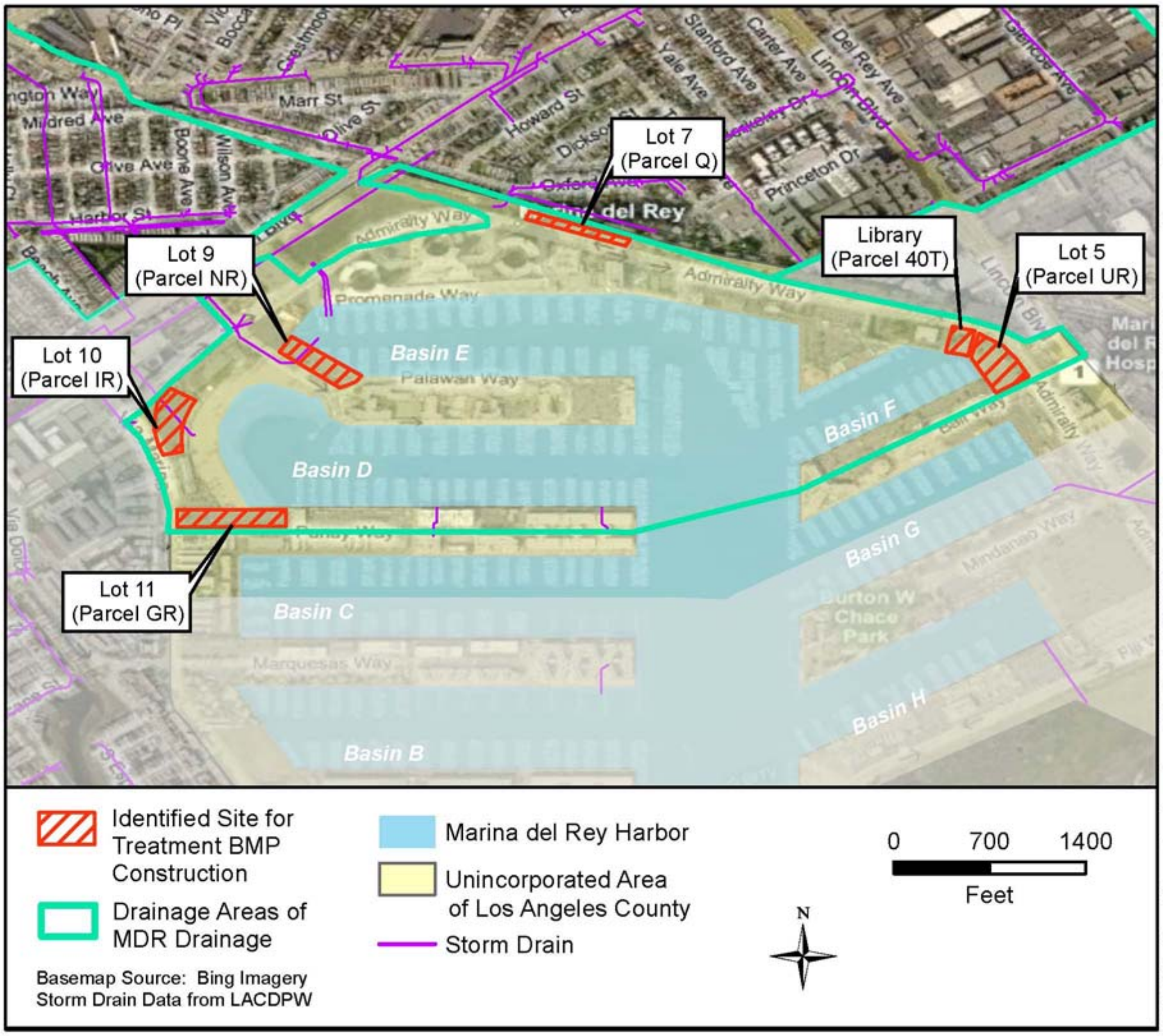

Figure 5-3. Marina del Rey Harbor Project Locations

5.4.1 Parking Lot 5 and Library Conceptual Design

5.4.1.1 Site Overview

Parking Lot 5 and the library are surrounded by urban development, including several commercial facilities, Basin F, Yvonne B. Burke Park, and Admiralty Way. Parking Lot 5 and the library are located at 4545 and 4533 Admiralty Way, respectively, near the intersection of Admiralty Way and Bali Way, along the northeastern edge of Basin F. The County Assessor Parcel Number is 4224-007-903. The Lease Parcel Number is Parcel UR and 40T for Lot 5 and the library, respectively.

The two parcels are composed of 2.65 acres of impervious surfaces. Runoff from Parking Lot 5 and a portion of the library's rooftop slopes toward two existing catch basin inlets in Lot 5 that discharge directly into Basin F. The remaining impervious surfaces of the library slope south into a small square drain inlet that also discharges directly into Basin F. The two lots total 257 regular parking stalls and five disabled parking spaces for a total of 262 parking spaces (RAJU, 2010). A significant portion of Parking Lot 5's asphalt is deteriorating and requires replacement. Figure 5-4 presents a site overview map of Parking Lot 5 and the library, and the proposed placement and type of BMPs for this area.

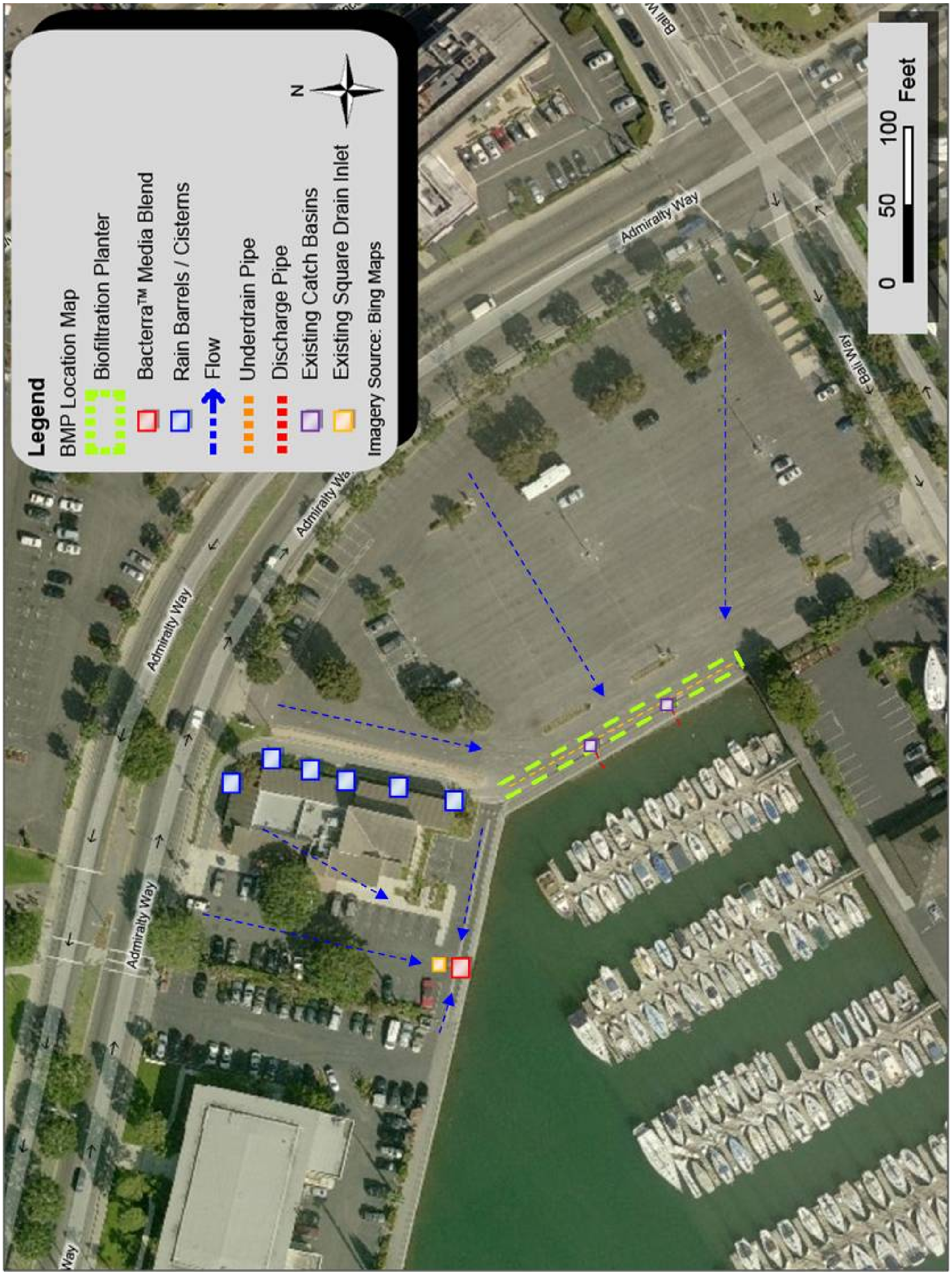

Figure 5-4. Site Overview Map with Best Management Practice Placement for Parking Lot 5 and the Library

5.4.1.2 Conceptual Designs

This subsection presents the conceptual design of three potential types of BMPs that can be implemented at Parking Lot 5 and the adjacent Lloyd Taber Marina del Rey Library. These BMPs include two proprietary biotreatment devices (Proprietary Device) and rainwater harvesting devices (i.e., Stormwater Storage and Rain Barrels).

<u>Lloyd Taber Marina del Rey Library</u>

The existing 13-inch^2 drain inlet on Parcel 40T (Lloyd Taber Marina del Rey Library) will be abandoned in place and filled with concrete slurry. Grades within the library parking lot drive aisles will be slightly altered to direct surface runoff toward the proposed Bacterra™ unit and catch basin (Figure 5-5). This will be accomplished by demolishing the existing asphalt and repaving. A Standard Plan Type 300-3 catch basin will need to be designed using a maximum V depth of 2.5 ft. A 6-ft by 12-ft Bacterra™ unit is recommended to treat the contributing drainage area. Runoff will be routed to the Bacterra™ unit. Filtered runoff from the Bacterra™ unit will discharge to the proposed catch basin that discharges directly to Basin F. Overflow from the Bacterra™ unit will bypass the unit and flow directly into the proposed catch basin.

Figure 5-5. Bacterra™ Bioretention Technology

<u>Parking Lot 5</u>

A 6-ft-wide biofiltration planter with curb cuts will need to be constructed adjacent to the existing walkway to capture sheet flow from Parking Lot 5. A typical biofiltration planter is shown in Figure 5-6. The existing bike trail and drive aisles will need to be reduced to accommodate the biofiltration planter. This BMP will function as a soil- and plant-based filtration device to remove pollutants through a variety of physical, biological, and chemical treatment processes. Filtered runoff will be collected by an underdrain system and discharged directly into Basin F. Flow-through biofiltration planters are composed of a shallow ponding area, mulch cover, engineered planting soil mix, and gravel with an embedded perforated underdrain pipe. Filtration rates are dependent on the engineered planting soil mix (i.e., low- and high-flow media) and can range from 2 inches per hour to as high as 50 inches per hour. A minimum filtration rate of 45 inches per hour is recommended. To provide adequate flood protection in the event of a large storm, a raised catch basin should be incorporated into the biofiltration planter to bypass the filtration process and allow direct discharge to Basin F.

Figure 5-6. Biofiltration Planter

Design information for these proprietary bioretention Bacterra™ devices are presented in Table 5-2 and Table 5-3.

Table 5-2. Bacterra™ Pollutant Removal Rates

Pollutants of Concern	Removal Rates
E. coli	99%
Fecal coliforms	98%
Enterococci	95%
TSS	85%
Predicted phosphorus	60–70%
Predicted nitrogen	43%
Predicted oil and grease	85%
Predicted heavy metal removal	33–82%

Source: Americast, 2010.

Table 5-3. Bacterra™ Sizing Table for Western Zone

Box Sizes (ft)	Commercial Drainage Area (acres)
4x6.5 or 6.5x4	≥0.22
4x8 or 8x4	0.23–0.27
Standard 6x6	0.28–0.31
6x8 or 8x6	0.32–0.41
6x10 or 10x6	0.42–0.51
6x12 or 12x6	0.52–0.62

Downspout disconnection will significantly reduce the amount of stormwater runoff from impervious roof surfaces through the use of rain barrels. This BMP system can be used next to buildings and other structures where soil moisture may pose a structural concern, and where high groundwater is present. A number of the library's downspouts, located on the eastern side of the building, will need to be connected to newly installed, aboveground decorative rain barrels/cisterns for rainwater harvesting and reuse (Figure 5-7). This will reduce the amount of rainfall that becomes polluted runoff into Basin F.

Figure 5-7. Rainwater Harvesting

Constituents targeted by the BMPs at Parking Lot 5 and the library include trash and debris, sediment, metals, bacteria, nutrients, organics, oil and grease, and TSS. BMPs will need to be designed for the 90th percentile 24-hour storm event (i.e., 1.32 inches for the Marina del Rey watershed) (Walden and Willardson, 2004). Additional design information will need to be considered in the final design of all BMPs (Table 5-4).

Table 5-4. Best Management Practice Design Information for Parking Lot 5 and the Library

Bacterra™ Bioretention Technology	
Drainage area	0.55 acre
Biofiltration Planter	
Drainage area	2.05 acres
Water quality flow rate	0.9 cubic ft per second (cfs)
Flow rate provided	0.91 cfs
Minimum filtration rate	45 inches per hour (inches/hr)
Surface area available	900 ft^2
Proposed surface area	900 ft^2
Rain Barrels/Cisterns	
Drainage area	0.05 acre
Quantity	6 barrels/cisterns
Water quality volume	240 ft^3
Volume provided	240 ft^3

5.4.1.3 Implementation Cost

The total estimated cost of implementing the proposed BMPs for Parking Lot 5 and the library is $296,500. A breakdown of the implementation costs is summarized in Table 5-5.

Table 5-5. Best Management Practice Implementation Costs

Description	Cost
Construction	$59,500
Construction management	$42,000
Engineering design	$60,000
Materials for BMPs	$70,000
O&M [1]	$30,000
Permits	$15,000
Post-construction monitoring	$20,000
Total (rounded)	**$296,500**

[1]O&M guidance is provided in Appendix C.

5.4.2 Parking Lot 7 Conceptual Design

5.4.2.1 Site Overview

Parking Lot 7 is surrounded by urban development, including a restaurant, hotel, residential homes, Yvonne B. Burke Park, and Admiralty Way. Basin E is roughly 450 ft south of this parking lot. Parking Lot 7 is located at 4350 Admiralty Way, near the intersection of Admiralty Way and Marina City Drive. The County Assessor Parcel Numbers are 4224-004-901 and 4224-006-900, respectively. The Lease Parcel Number is Parcel Q.

Parking Lot 7 is composed of 0.85 acre of impervious asphalt concrete that slopes south toward Admiralty Way. Runoff flows through four pairs of 4-inch-diameter curb core drains that outlet onto Admiralty Way, which is then collected by a 5-ft-wide catch basin, located approximately 2,000 ft east of the parking lot at the intersection of Admiralty Way and Palawan Way that discharges to Basin E. The lot includes 115 regular parking stalls and five disabled parking spaces for a total of 120 parking spaces (RAJU, 2010). Figure 5-8 presents a site overview map of Parking Lot 7 and the proposed placement and type of BMPs for this area.

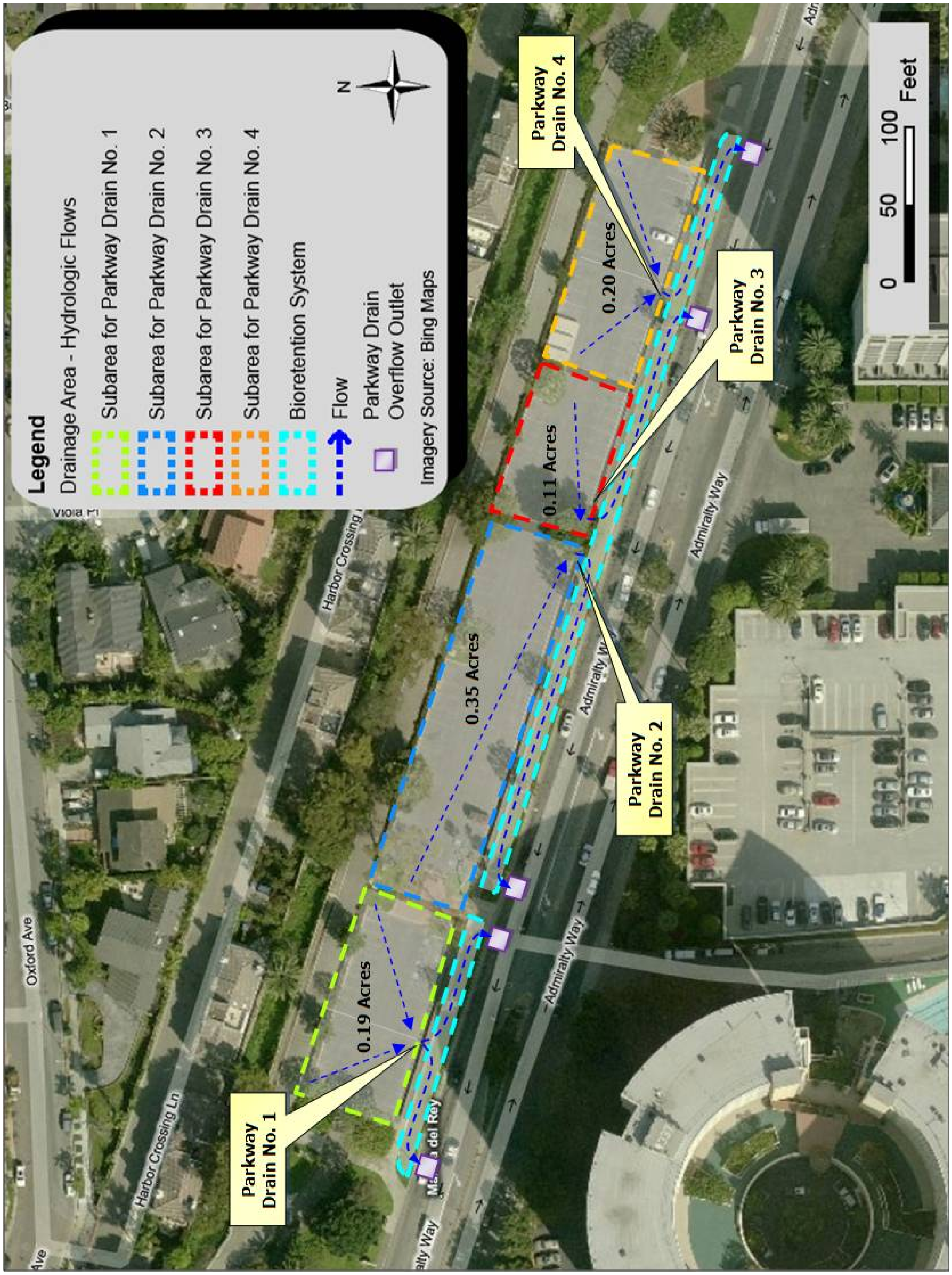

Figure 5-8. Site Overview Map with Best Management Practice Placement for Parking Lot 7

5.4.2.2 Conceptual Designs

This subsection presents the conceptual design of BMPs that can be implemented at Parking Lot 7. The proposed treatment strategy to remove pollutants of concern is to create a concave bioretention system in the landscaped right-of-way between Parking Lot 7 and Admiralty Way. Runoff will enter through the four pairs of existing curb core drains. Entrance velocities will need to be reduced using energy dissipaters to minimize erosive forces within the vegetated area. Several 7-ft-wide bioretention systems—sloped at 2.5:1 (Horizontal: Vertical), creating a 5-ft 4-inch base—will need to be constructed with a 4-inch reservoir to temporarily pond collected runoff for infiltration. See Figure 5-9 for typical concave bioretention system. Components of the bioretention systems will consist of plants and a 3-inch mulch cover, 18 inches of sandy loam soil or an engineered planting soil mix, and 12 inches of 0.5-inch open graded gravel wrapped in Geotextile filter fabric to create a void space reservoir for on-site infiltration.

Constituents targeted by the BMPs at Parking Lot 7 include trash and debris, sediment, metals, bacteria, nutrients, organics, oil and grease, and TSS. BMPs will need to be designed for the 90th percentile 24-hour storm event (i.e., 1.32 inches for the Marina del Rey watershed) (Walden and Willardson, 2004). A minimum infiltration rate of 10 inches per hour is required. To provide adequate flood protection in the event of a large storm, parkway drains should be incorporated into the bioretention systems to outlet excess runoff onto Admiralty Way. Additional design information will need to be considered in the final design of all BMPs (Table 5-6).

Figure 5-9. Typical Concave Bioretention System

Table 5-6. Best Management Practice Design Information for Parking Lot 7

Bioretention No. 1 – West	
Drainage area	0.10 acre
Surface area available	880 ft^2
Water quality volume required	400 ft^3
Water quality volume proposed	672 ft^3
Bioretention No. 1 – East	
Drainage area	0.10 acre
Surface area available	600 ft^2
Water quality volume required	400 ft^3
Water quality volume proposed	485 ft^3
Bioretention No. 2	
Drainage area	0.35 acre
Surface area available	2,500 ft^2
Water quality volume required	1,310 ft^3
Water quality volume proposed	1,644 ft^3
Bioretention No. 3	
Drainage area	0.11 acre
Surface area available	1,500 ft^2
Water quality volume required	435 ft^3
Water quality volume proposed	971 ft^3
Bioretention No. 4	
Drainage area	0.20 acre
Surface area available	1,100 ft^2
Water quality volume required	785 ft^3
Water quality volume proposed	821 ft^3

5.4.2.3 Implementation Cost

The total estimated cost of implementing the proposed BMPs for Parking Lot 7 is $350,000. A breakdown of the implementation costs is summarized in Table 5-7.

Table 5-7. Best Management Practice Implementation Costs

Description	Cost
Construction	$93,000
Construction management	$63,000
Engineering design	$70,000
Materials for BMPs	$83,500
O&M[1]	$10,000
Permits	$20,000
Post-construction monitoring	$10,000
Total (rounded)	**$350,000**

[1]O&M guidance is provided in Appendix C.

5.4.3 Parking Lot 9 Conceptual Design

5.4.3.1 Site Overview

Parking Lot 9 is surrounded by urban development, including several hotels, residential complexes, Basin E, and Palawan Way. Marina Beach is immediately south of this parking lot and across the street from Palawan Way. Parking Lot 9 is located at 14110 Palawan Way, near the intersection of Admiralty Way and Palawan Way, along the western edge of Basin E. The County Assessor Parcel Number is 4224-004-900 and the Lease Parcel Number is Parcel NR.

Parking Lot 9 is composed of 1.5 acres of impervious asphalt concrete that gently slopes northeast toward two existing catch basin inlets that directly discharge into Basin E. The lot includes 181 regular parking stalls and six disabled parking spaces for a total of 187 parking spaces (RAJU, 2010). A significant portion of the lot's asphalt is deteriorating and requires replacement. Figure 5-10 presents a site overview map of Parking Lot 9 and the proposed placement and type of BMPs for this area.

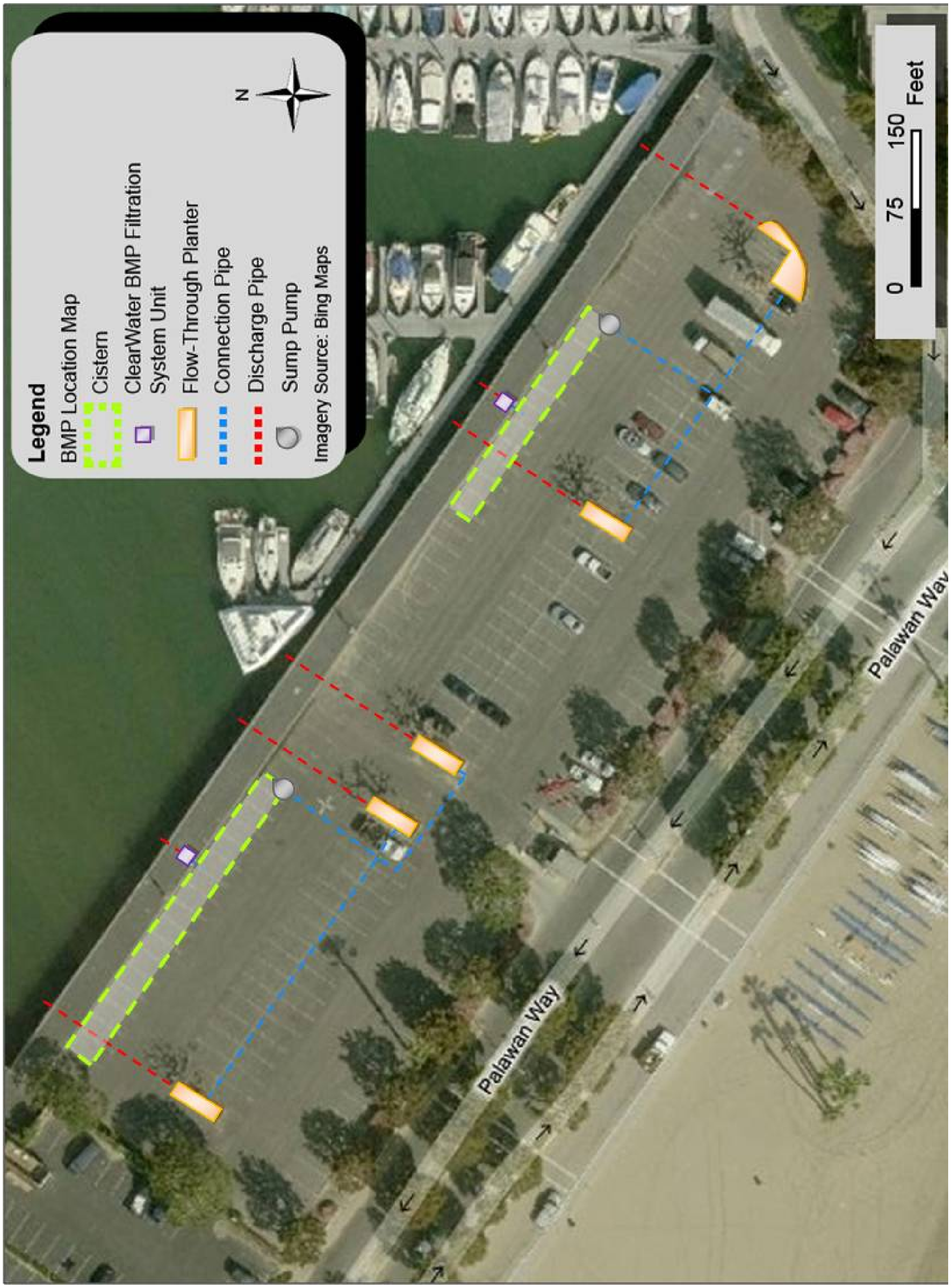

Figure 5-10. Site Overview Map with Best Management Practice Placement for Parking Lot 9

5.4.3.2 Conceptual Designs

This subsection presents the conceptual design of BMPs that can be implemented at Parking Lot 9. BMPs will need to consist of reconstructing two existing catch basins that directly discharge to Basin E and incorporating shallow subsurface cisterns to service each catch basin drainage area (Figure 5-11). Catch basin retrofits (Standard Plan Type 300-3 using a maximum V depth of 2.5 ft) will need to treat runoff using proprietary filtration devices (ClearWater BMP Filtration System Unit, Model No. BMP-04 Small Version, or equivalent (Figure 5-12)) for gross pollutants and oil and grease, and then direct captured runoff into underground cisterns for on-site storage. Assuming the cisterns are placed 1.5 ft below the existing parking lot surface and have a unit height of 2 ft, an area of approximately 2,840 ft^2 and 1,960 ft^2 for the westerly and easterly cisterns will be required, respectively. Catch basins will need to discharge into Basin E in an overflow condition to provide necessary flood protection for the area. Cisterns will also need to incorporate a pumping system to direct captured runoff to in-ground, flow-through planter boxes for LID filtration prior to discharge to Basin E. This will involve the reconstruction of existing parking lot planter areas to function as flow-through planter boxes to provide water quality treatment and drawdown of the captured runoff within 48 hours.

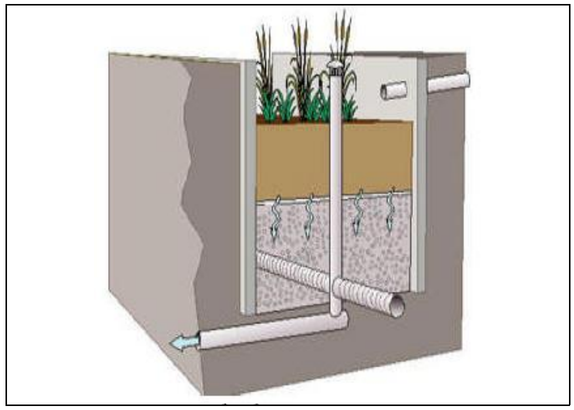

Figure 5-11. Flow-Through Planter Box

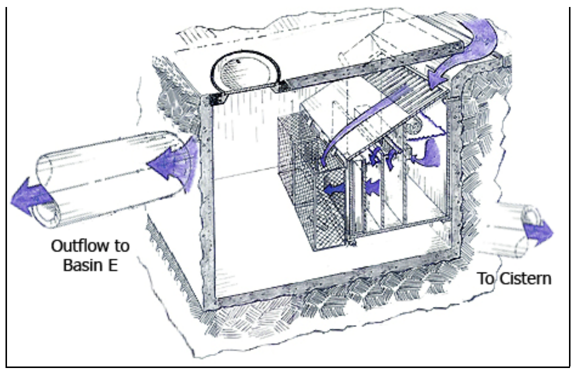

Figure 5-12. ClearWater Filtration System Unit

Constituents targeted by the BMPs at Parking Lot 9 include trash and debris, sediment, metals, bacteria, nutrients, organics, oil and grease, and TSS. BMPs will need to be designed for the 90^{th} percentile 24-hour storm event (i.e., 1.32 inches for the Marina del Rey watershed) (Walden and Willardson, 2004). Additional design information will need to be considered in the final design of all BMPs (Table 5-8).

Parking Lot 9 may be rezoned to multi-family residential and redeveloped in the next few years. The County should work with the developer, if possible, to achieve the maximum load reductions feasible by utilizing the concept design for the site shown in this report or a similar approach. At a minimum the County's *Standard Urban Storm Water Mitigation Plan* (SUSMP) and LID requirements will be incorporated into the site redevelopment plan. If the site is not redeveloped, the concept design presented in this section should be utilized within Parking Lot 9.

Table 5-8. Best Management Practice Design Information for Parking Lot 9

Cisterns	
West	
Drainage area	1.2 acres
Water quality volume	0.13 acre-ft
BMP height	2 ft
Surface area required	2,840 ft^2
East	
Drainage area	0.8 acre
Water quality volume	0.09 acre-ft
BMP height	2 ft
Surface area required	1,960 ft^2
Flow-Through Planter Boxes	
Surface area available	750 ft^2
Minimum filtration rate	5 inches/hr
Drawdown time	48 hrs
ClearWater BMP Filtration System Units	
Quantity – Model No. BMP-04 small version	2 units
Treatment capacity	2.50 acres
Bypass rate	0.46 cfs
Catch Basins	
Quantity – Standard Plan Type 300-3	2 basins
Maximum V depth	2.5 ft

5.4.3.3 Implementation Cost

The total estimated cost of implementing the proposed BMPs for Parking Lot 9 is $750,000. A breakdown of the implementation costs is summarized in Table 5-9.

Table 5-9. Best Management Practice Implementation Costs

Description	Cost
Construction	$116,000
Construction management	$107,000
Engineering design	$105,000
Materials for BMPs	$191,000
O&M[1]	$125,000
Permits	$30,000
Post-construction monitoring	$75,000
Total (rounded)	**$750,000**

[1]O&M guidance is provided in Appendix C.

5.4.4 Parking Lot 10 Conceptual Design

5.4.4.1 Site Overview

Parking Lot 10 is surrounded by urban development, including a restaurant, several hotels, residential complexes, corner park, Basin D, and Admiralty Way. Marina Beach is immediately east of this parking lot. Parking Lot 10 is located at 4101 Admiralty Way, near the intersection of Admiralty Way and Via Marina. The County Assessor Parcel Number is 4224-004-901 and the Lease Parcel Number is Parcel IR.

Parking Lot 10 is composed of 2.1 acres of impervious asphalt concrete that slopes easterly toward four existing trench drain inlets that directly discharge into Basin D. The corner park provides 0.3 acre of additional run-on onto Parking Lot 10. The lot includes 206 regular parking stalls and three disabled parking spaces for a total of 209 parking spaces (RAJU, 2010). The lot's asphalt is in excellent condition. Figure 5-13 presents a site overview map of Parking Lot 10 and the proposed placement and type of BMPs for this area.

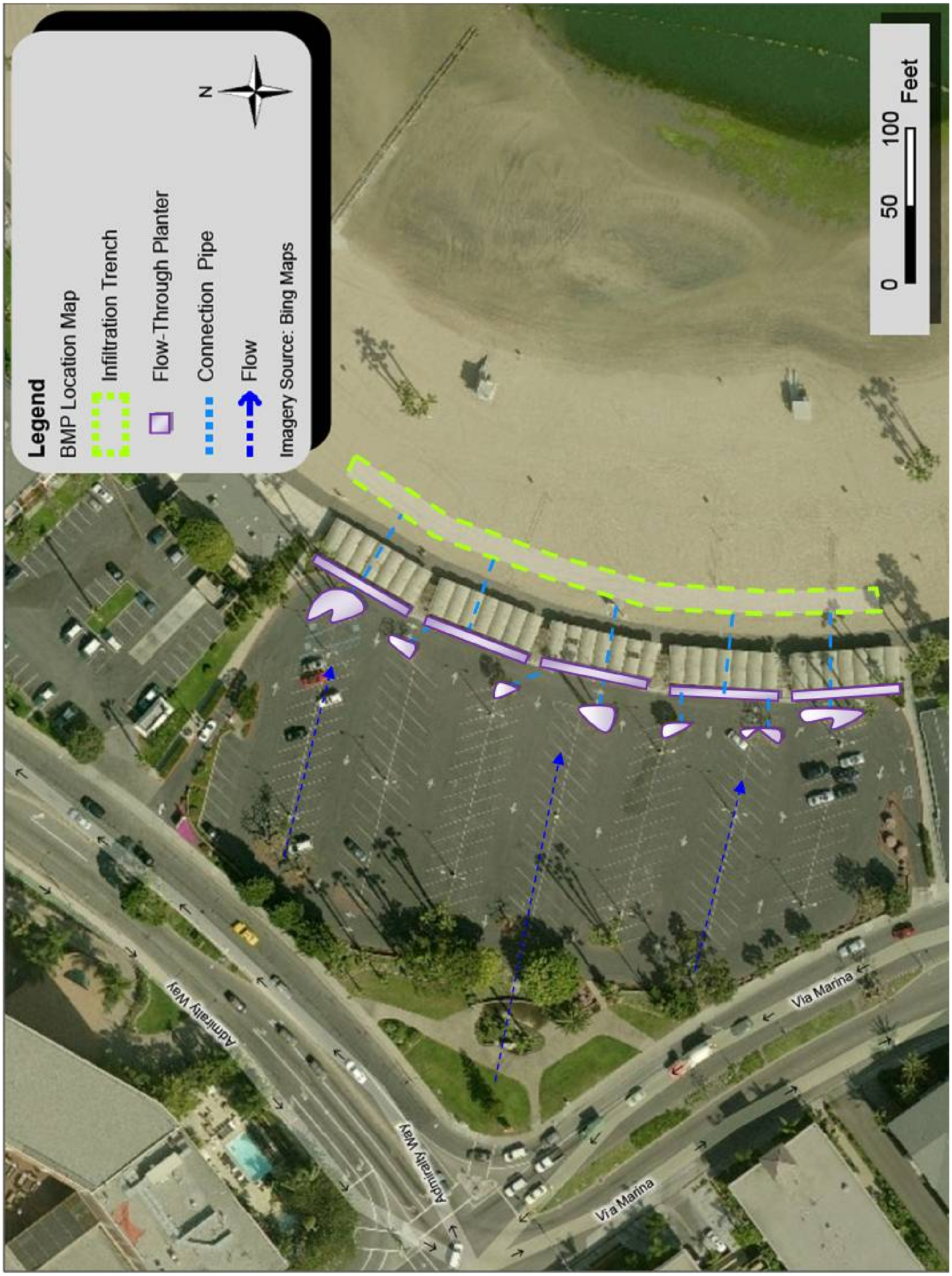

Figure 5-13. Site Overview Map with Best Management Practice Placement for Parking Lot 10

5.4.4.2 Conceptual Designs

This subsection presents the conceptual design of BMPs that can be implemented at Parking Lot 10. The proposed BMP treatment train will need to consist of reconstructing existing planter areas, behind the picnic shelters, with curb cuts and expand them outward 2 ft toward the parking lot. The most northern and southern planters adjacent to the parking stalls will be shifted westerly, as needed, to provide 13 ft of drive aisle space (Figure 5-14). This BMP will function as a soil and plant-based filtration device to remove pollutants through a variety of physical, biological, and chemical treatment processes. Filtered runoff will be directed by an underdrain system to an engineered infiltration trench (Figure 5-15). The planter shall be composed of soil media capable of supporting landscaping with a minimum filtration rate of 35 inches per hour. To provide adequate flood protection in the event of a large storm, a raised catch basin should be incorporated into the bioretention planter to bypass the filtration process and allow direct discharge to Basin D. The infiltration trench will be constructed a few feet beyond the asphalt walkway between the sand and picnic shelters using Atlantis D-Raintank Mini Modules. The assumed high groundwater table depth is 5 ft above mean sea level and the invert of the infiltration trench requires a minimum 1-ft clearance from the high groundwater table. The infiltration trench will be wrapped with Atlantis geotextile rolls to utilize the unsaturated native sands to filter, treat, and infiltrate this runoff before it reaches the saline water table below.

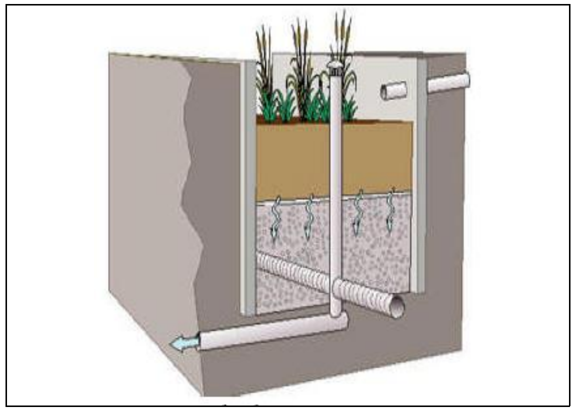

Figure 5-14. Flow-Through Planter Box

Figure 5-15. Hermosa Strand Infiltration Trench

Constituents targeted by the BMPs at Parking Lot 10 include trash and debris, sediment, metals, bacteria, nutrients, organics, oil and grease, and TSS. BMPs will need to be designed for the 90th percentile 24-hour storm event (i.e., 1.32 inches for the Marina del Rey watershed) (Walden and Willardson, 2004). A minimum infiltration rate of 0.5 inch per hour is required. Additional design information will need to be considered in the final design of all BMPs (Table 5-10).

Table 5-10. Best Management Practice Design Information for Parking Lot 10

Sand Infiltration Trench	
Drainage area	2.4 acres
Quantity – Atlantis D-Raintank Mini Module	4,850 trenches
Water quality volume required	0.22 acre-ft
Water quality volume provided	0.24 acre-ft
BMP height	1.56 ft
Surface area available	20,000 ft^2
Surface area proposed	6,730 ft^2
Drawdown time	48 hrs
Flow-Through Planter Boxes	
Surface area available	500 ft^2
Quantity	12 boxes
Water quality flow rate required	0.35 cfs
Water quality flow rate proposed	0.40 cfs
Minimum filtration rate	35 inches/hr

5.4.4.3 Implementation Cost

The total estimated cost of implementing the proposed BMPs for Parking Lot 10 is $500,000. A breakdown of the implementation costs is summarized in Table 5-11.

Table 5-11. Best Management Practice Implementation Costs

Description	Cost
Construction	$165,000
Construction management	$90,000
Engineering design	$90,000
Materials for BMPs	$100,000
O&M[1]	$20,000
Permits	$20,000
Post-construction monitoring	$10,000
Total (rounded)	**$500,000**

[1]O&M guidance is provided in Appendix C.

5.4.5 Parking Lot 11 Conceptual Design

5.4.5.1 Site Overview

Parking Lot 11 is surrounded by urban development, including two restaurants, hotels, residential complexes, Basin D, and Panay Way. Marina Beach is immediately north of this parking lot. Parking Lot 11 is located at 14101 Panay Way, near the intersection of Panay Way and Via Marina, along the southern edge of Basin D. The County Assessor Parcel Numbers are 4224-004-901 and 4224-004-902 and the Lease Parcel Number is Parcel GR.

Parking Lot 11 is composed of 2.1 acres of impervious asphalt concrete that slopes northeast toward an existing catch basin inlet that directly discharges into Basin D. The lot includes 255 regular parking stalls and eight disabled parking spaces for a total of 263 parking spaces (RAJU, 2010). The asphalt in the area of the proposed porous pavement BMP is deteriorating and in need of repair and/or replacement. Figure 5-16 presents a site overview map of Parking Lot 11 and the proposed placement and type of BMPs for this area.

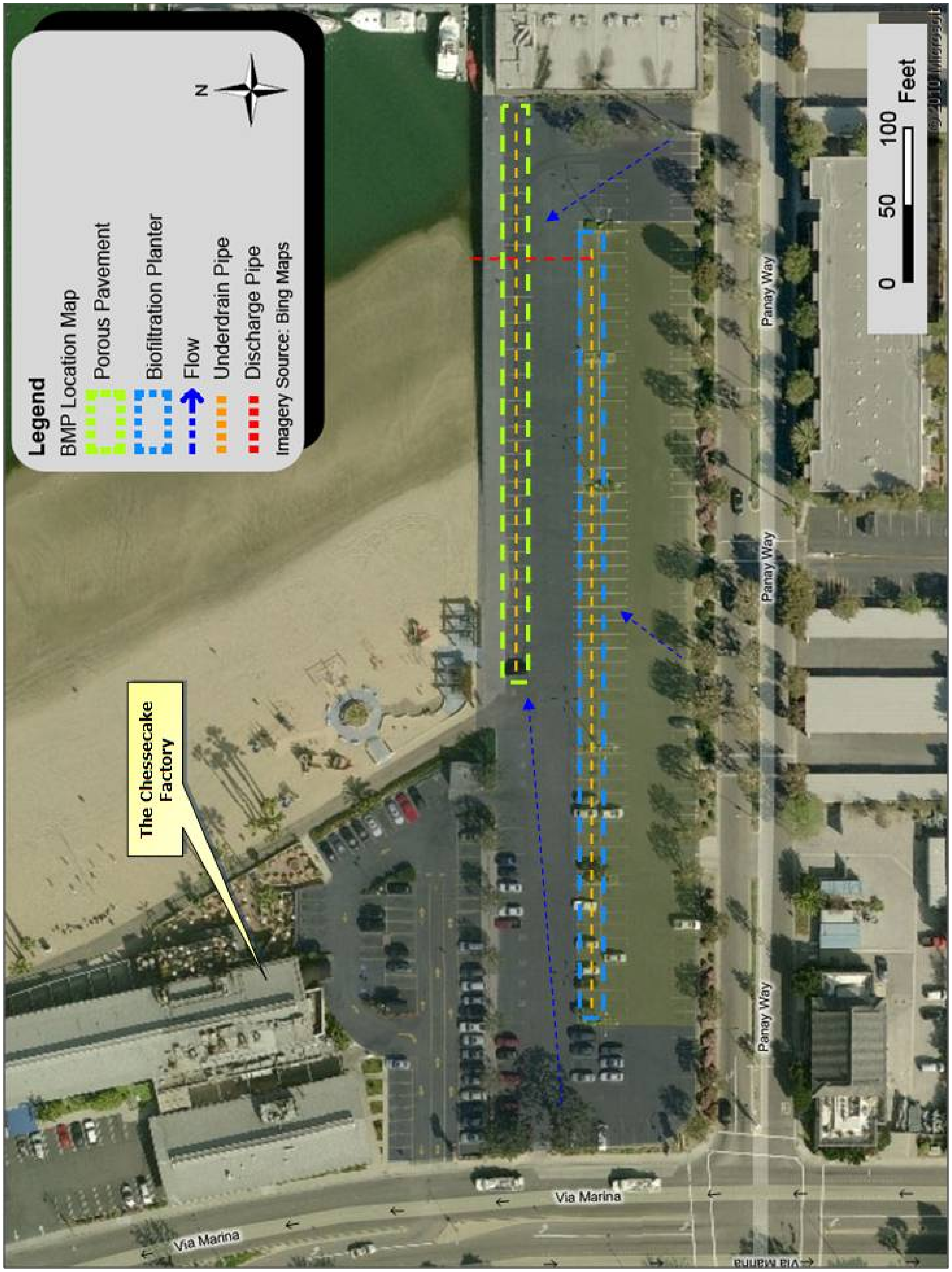

Figure 5-16. Site Overview Map with Best Management Practice Placement for Parking Lot 11

5.4.5.2 Conceptual Designs

This subsection presents the conceptual design of BMPs that can be implemented at Parking Lot 11. Using porous pavement (Figure 5-17) for the parking stalls immediately adjacent to Marina Beach and Basin D will allow dry-weather and wet-weather runoff from The Cheesecake Factory property and northern half of Parking Lot 11 to flow through the BMP's void spaces and undergo natural filtration prior to discharge into the existing catch basin and Basin D. Standard filtration rates through porous pavement BMPs range from 100 inches per hour to 300 inches per hour; however, only a minimum filtration rate of 5 inches per hour is required for this project site.

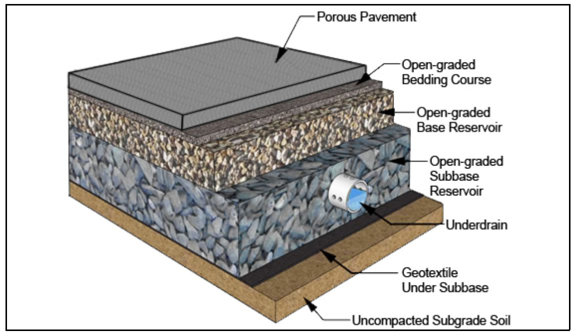

Figure 5-17. Porous Pavement

A 6-ft-wide biofiltration planter with curb cuts is proposed through the center parking aisle to capture sheet flow from the southern half of the parking lot. Figure 5-18 shows a typical biofiltration planter. This BMP will function as a soil- and plant-based filtration device to remove pollutants through a variety of physical, biological, and chemical treatment processes. Filtered runoff will be collected by an under-drain system and discharge to the existing catch basin and Basin D. A minimum filtration rate of 10 inches per hour is recommended. To provide adequate flood protection in the event of a large storm, a raised catch basin should be incorporated into the biofiltration planter to bypass the filtration process and allow direct discharge to Basin D.

Figure 5-18. Biofiltration Planter

Constituents targeted by the BMPs at Parking Lot 10 include trash and debris, sediment, metals, bacteria, nutrients, organics, oil and grease, and TSS. BMPs will need to be designed for the 90th percentile 24-hour storm event (i.e., 1.32 inches for the Marina del Rey watershed) (Walden and Willardson, 2004). Additional design information will need to be considered in the final design of all BMPs (Table 5-12).

Table 5-12. Best Management Practice Design Information for Parking Lot 11

Porous Pavement	
Drainage area	1.73 acres
Water quality flow rate	0.61 cfs
Minimum filtration rate	5 inches/hr
Surface area required	5,270 ft^2
Proposed surface area	6,579 ft^2
Biofiltration Planter	
Drainage area	0.82 acre
Water quality flow rate	0.56 cfs
Minimum filtration rate	10 inches/hr
Surface area required	2,420 ft^2
Proposed surface area	3,000 ft^2

5.4.5.3 Implementation Cost

The total estimated cost of implementing the proposed BMPs for Parking Lot 11 is $470,000. A breakdown of the implementation costs is summarized in Table 5-13.

Table 5-13. Best Management Practice Implementation Costs

Description	Cost
Construction	$90,000
Construction management	$76,000
Engineering design	$70,000
Materials for BMPs	$88,000
O&M[1]	$75,000
Permits	$20,000
Post-construction monitoring	$50,000
Total (rounded)	**$470,000**

[1]O&M guidance is provided in Appendix C.

5.5 Additional Structural Options for TMDL Implementation

The five sites selected for the construction of BMPs presented in this section may be monitored to determine the existing pollutant loading to each BMP and the effectiveness of each BMP (load reduction). The siting of future BMPs may be based on the five sites listed here. The effectiveness assessments of the five sites may be used to improve the design of future BMPs constructed in MdRH. The Quantification Analysis (Section 6) of the Implementation Plan provides details on the types and quantities of additional structural BMPs that may be implemented within the unincorporated County area of MdRH provided funding is available.

5.6 Regulatory Requirements and Environmental Permits

5.6.1 Regulatory Compliance

Consultation with regulatory agencies and the acquisition of permits is required before project components can be constructed. The following summarizes regulatory permits and approvals relevant to the implementation of the Water Quality Enhancement Projects in the Marina del Rey watershed.

5.6.2 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 a discretionary governmental approval will require at least some environmental review pursuant to CEQA, unless an exemption applies. The Water Quality Enhancement Projects will likely require the preparation of a Negative Declaration.

5.6.3 U.S. Army Corps of Engineers

Section 404 of the federal CWA 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 of disturbance, it is unlikely that a Section 404 permit will be required. If required and jurisdictional, 404 permitting could potentially be completed under the nationwide permit program. Coverage under the nationwide program can be authorized in 3 to 4 months from the time the permit application is deemed complete.

5.6.4 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 404 process. A biological resources report for the project site may be required as part of the permit application package to the USACE.

5.6.5 California Coastal Commission

Local Coastal Programs (LCPs) are basic planning tools used by local governments such as the County of Los Angeles to guide development in the coastal zone, in partnership with the California Coastal Commission. Los Angeles County's Marina del Rey LCP contains the ground rules for future development and protection of coastal resources. The LCP specifies the appropriate location, type, and scale of new or changed uses of land and water, and includes a land-use plan and measures to implement the plan. The program governs decisions that determine the short- and long-term conservation and use of coastal resources in the marina. While the LCP reflects unique characteristics of the MdRH watershed, regional and statewide interests and concerns are also addressed in conformity with Coastal Act goals and policies. The County of Los Angeles has the coastal permitting authority over most development that applies the requirements of the LCP in reviewing proposed developments. The Water Quality Enhancement Projects will need to comply with the Marina del Rey LCP and the goals and policies of the Coastal Act.

5.6.6 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, and approves and permits the take of birds, mammals, reptiles, amphibians, nongame 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.

5.6.7 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 (Construction General Permit, Water Quality Order No. 2009-0009-DWQ). Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling or excavation. To obtain coverage under the Construction General Permit a Legally Responsible Person will need to electronically file Permit Registration Documents (PRDs) with the SWRCB. 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 Construction General Permit 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 nonstormwater discharges.
- Specifies BMPs to reduce or eliminate pollutants in stormwater and authorized nonstormwater 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 of Los Angeles will need to electronically submit a PRD (includes a Notice of Intent, Risk Assessment, Site Map, SWPPP, annual fee, and certification) to obtain coverage under the Construction General Permit. The County of Los Angeles or construction contractor will need a Qualified SWPPP Developer (QSD) to prepare the project-specific 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 water quality pollution control BMPs.

5.6.8 Regional Water Quality Control Board, Los Angeles Region

Under Section 401 of CWA, 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 401 Water Quality Certification will be required for the project. If the project is not under USACE jurisdiction, the RWQCB may require Waste Discharge Requirements (since a 401 Water Quality Certification will not apply). 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.

5.6.9 Los Angeles County Department of Beaches and Harbors

The LACDBH has two groups that are appointed by the Los Angeles County Board of Supervisors to make recommendations and approvals on matters concerning modifications, improvements, development, painting, signage, landscaping, and O&M in Marina del Rey.

5.6.9.1 Small Craft Harbor Commission

The Small Craft Harbor Commission is responsible for making recommendations to the Los Angeles County Board of Supervisors concerning issues related to the operation and management of Marina del Rey. Proposed improvements for the Water Quality Enhancement Projects will need to be presented to the Commission. The Commission will likely suggest project modifications for incorporation and make final recommendations to the Board of Supervisors.

5.6.9.2 Design Control Board

Prior to the implementation of any exterior modifications or improvements to a Marina del Rey parcel, review and approval by the Design Control Board is required. This includes new development, renovations, repainting, signage, re-landscaping, etc. The Design Control Board can approve a submittal as proposed, approve it with revisions, or deny it. Depending on the type of request, additional permits may be required from the Los Angeles County Department of Public Works Division of Building and Safety, Department of Regional Planning, and California Coastal Commission. Proposed improvements for the Water Quality Enhancement Projects will need to be approved by the Design Control Board.

5.6.10 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.

6.0 QUANTIFICATION ANALYSIS

The quantification analysis for the MdRH TMDL Implementation Plan uses an integrated approach, considering reductions of both toxics and bacteria. In this section, there is a greater focus on the quantification of toxic constituents because the Bacteria TMDL Implementation Plan (MDRWRA, 2005) provides the planned nonstructural and structural BMPs that target the Bacteria TMDL goals. As an integrated implementation plan, many of the BMPs presented in this plan address both toxics and bacteria. For example, the LID projects presented in this plan are designed to address both toxics and bacteria in an integrated manner.

This quantification analysis includes the estimation of pollutant reductions of individual types of proposed nonstructural and structural implementation actions and strategies to estimate water quality benefits. The anticipated pollutant loading reductions in concentration or volume for combined structural and nonstructural solutions are determined using the Watershed Management Modeling System (WMMS) developed by the County. The reductions achieved through structural BMPs are based on published reduction efficiencies referenced from the International Stormwater BMP Database (BMPDB) (USACE and USEPA, 2006), Caltrans BMP study data, and other industry-accepted water quality monitoring BMP effectiveness results. The effectiveness of nonstructural solutions is based on recent studies of street sweeping in San Diego (WESTON, 2010b) and the source identification studies completed in MdRH.

The quantification analysis uses the set of defined projects presented in the previous sections from which load reductions achieved can be more precisely determined, and a set of actions that will most likely be implemented throughout the implementation schedule that are less defined at this stage. The estimated load reductions achieved will therefore be based on defined and future projects to demonstrate how compliance will be achieved through a combination of nonstructural and structural approaches. This approach provides for more adaptive management that uses resources more cost effectively. Based on assessment of the effectiveness of current and near-term watershed actions, certain BMP approaches will prove more cost effective than others. An adaptive management approach will allow for changes in the type and quantity of proposed programs/BMPs over the implementation schedule to ensure the most cost-effective measures are being implemented. These assessments take time and require flexibility in the implementation schedule and strategy.

Because of the known physical constraints in the MdRH drainage area, the implementation of cost-effective and practical structural BMPs will be limited. Knowing the constraints and challenges of meeting required load reductions for stormwater flows, this quantity assessment includes the assessment of a number of options to provide flexibility in the approaches to meet those reductions. This is most applicable with regard to meeting the last 20–30% of the load reduction. Based on a growing set of data, the difficulty and cost of removing this final portion of pollutant loading is significantly higher than the first 70-80% of the load reduction, particularly with treatment BMPs. With the particular site constraints of the MdRH area, these increasing challenges and costs can be anticipated.

The quantification analysis presented in this section is based on reductions provided from both nonstructural and structural BMPs that work together to reduce both constituent concentrations and load. Nonstructural source control BMPs are designed to reduce the concentration of constituents prior to entering the MS4 and will therefore reduce concentrations prior to entering structural BMPs located downstream of these sources. Based on the quantification analysis for nonstructural BMPs, an estimated 25% reduction of pollutants has been determined for these measures. It has been assumed for the quantification of structural BMPs that at least half of this total reduction in constituents will achieved prior to runoff entering the structural BMPs.

This section is presented in three key sub-sections. Section 6.1 presents the design and output from the County of Los Angeles's (County's) WMMS. This model was used to compute the load reductions achieved by both structural and nonstructural BMP implementation within the unincorporated areas of the County. The Nonstructural Analysis in Section 6.2 presents how the proposed solutions may be prioritized. This assessment is based upon actual data collected from recent pilot studies implemented across Southern California, where available and applicable, and best professional judgment. Similarly, Section 6.3 discusses the implementation of structural BMPs.

6.1 Watershed Management Modeling System

This section presents the inputs and results of watershed modeling used to estimate the pollutant load and concentration reductions that need to be achieved by the proposed suite of structural and nonstructural BMPs within the MdRH watershed. This analysis sets the required reductions to meet the Toxics TMDL WLAs. The quantification analysis for the MdRH TMDL Implementation Plan uses an integrated approach of considering reductions of both toxics and bacteria. In this section, there is a greater focus on the quantification of toxic constituents because the Bacteria TMDL Implementation Plan (MDRWRA, 2005) provides the planned nonstructural and structural BMPs that target the Bacteria TMDL goals. However, as an integrated implementation plan, many of the BMPs presented in this plan address both toxics and bacteria. For example, the LID projects presented in this plan are designed to address both toxics and bacteria in an integrated manner. The result of the analysis presented in this section is the required maximum load reduction (expressed as a percent of the total load) that establishes the target to be met by the proposed nonstructural and structural BMPs. The following sections will present the number and type of BMPs based on defined and anticipated solutions for MdRH watershed to meet both the Toxics TMDL and Bacteria TMDL targets.

6.1.1 Watershed Management Modeling System Details

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 Marina del Rey 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 Hydrologic modeling using a continuous simulation model

The LSPC watershed modeling system is 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, evapotranspiration, antecedent conditions, and land use-specific pollutant loading characteristics. Meteorological data from 1997 to 2006 were used to calibrate the model. Using existing meteorological data, hydraulic data, land use information, and monitoring data, each subwatershed is calibrated to most accurately simulate the runoff and pollutant load.

It 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 copper, zinc, lead, total nitrogen (TN), total phosphorus (TP), fecal coliform, and TSS. For the other pollutants (chlordane, DDT, PCBs, selenium, cadmium, or polyaromatic hydrocarbons (PAHs)), 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, copper, lead, and zinc. Annual load results were compared with the TMDL WLA to calculate the load reduction needed to meet the TMDLs.

6.1.1.2 Optimization BMP Design Approach

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

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 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 percent imperviousness 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 analysis of benefits versus costs of each practice. 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. In addition, these types of BMPs achieve water quality benefits through filtration, settling of sediment, and pollutants decay.

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 combinations 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 Risk Explicit Interval Linear Programming modeling framework. The approach provides an ideal mechanism to prioritize implementation options based on the risk and return tradeoff.

It should be noted that there are significant differences in BMP selection approach used in this study, compared to 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 BMPs needed. On the other hand, a continuous simulation and optimization BMP design approach offers a uniquely different approach. Each possible set of BMPs in this approach has a unique treatment capacity associated with it. The BMP optimization process results in a specified combination of BMPs that is required to attain TMDLs at the target location of a watershed.

6.1.2 Model Results

The WMMS is a recently developed modeling tool developed for the County to assess the load reduction due to BMP implementation within select watersheds. The WMMS is a land-use-based model that distributes loads across three basins, which are presented on Figure 6-1.

Basin 1 is the largest subwatershed, measuring 663 acres, and comprises the northeast portion of the MdRH watershed. Basin 1 is predominately high-density, single-family residential land use within the jurisdiction of the City of Los Angeles and Culver City with a small portion of the drainage area within the County (Oxford Basin). Basin 2 measures 70.5 acres and is the smallest subwatershed draining to MdRH. It is entirely within the jurisdiction of the City of Los Angeles and consists predominately of the residential land use. Basin 3 encompasses 103.6 acres within County jurisdiction. Basin 3 is adjacent to MdRH Back Basins D, E, and F and downgradient from Basin 1 and Basin 2. Land uses within the Basin 3 subwatershed consist of commercial, open recreation, multi-family residential, and transportation. Table 6-1 shows a summary of the three subwatersheds.

Table 6-1. Summary of Watershed Management Modeling System Subwatershed Areas

Subwatershed Designation	Area (acres)	Percentage of Total Watershed	Jurisdiction
Basin 1	663.3	79.2%	Predominately City of Los Angeles and Culver City
Basin 2	70.5	8.4%	City of Los Angeles
Basin 3	103.6	12.4%	Unincorporated County of Los Angeles
Total	**837.5**	**100%**	

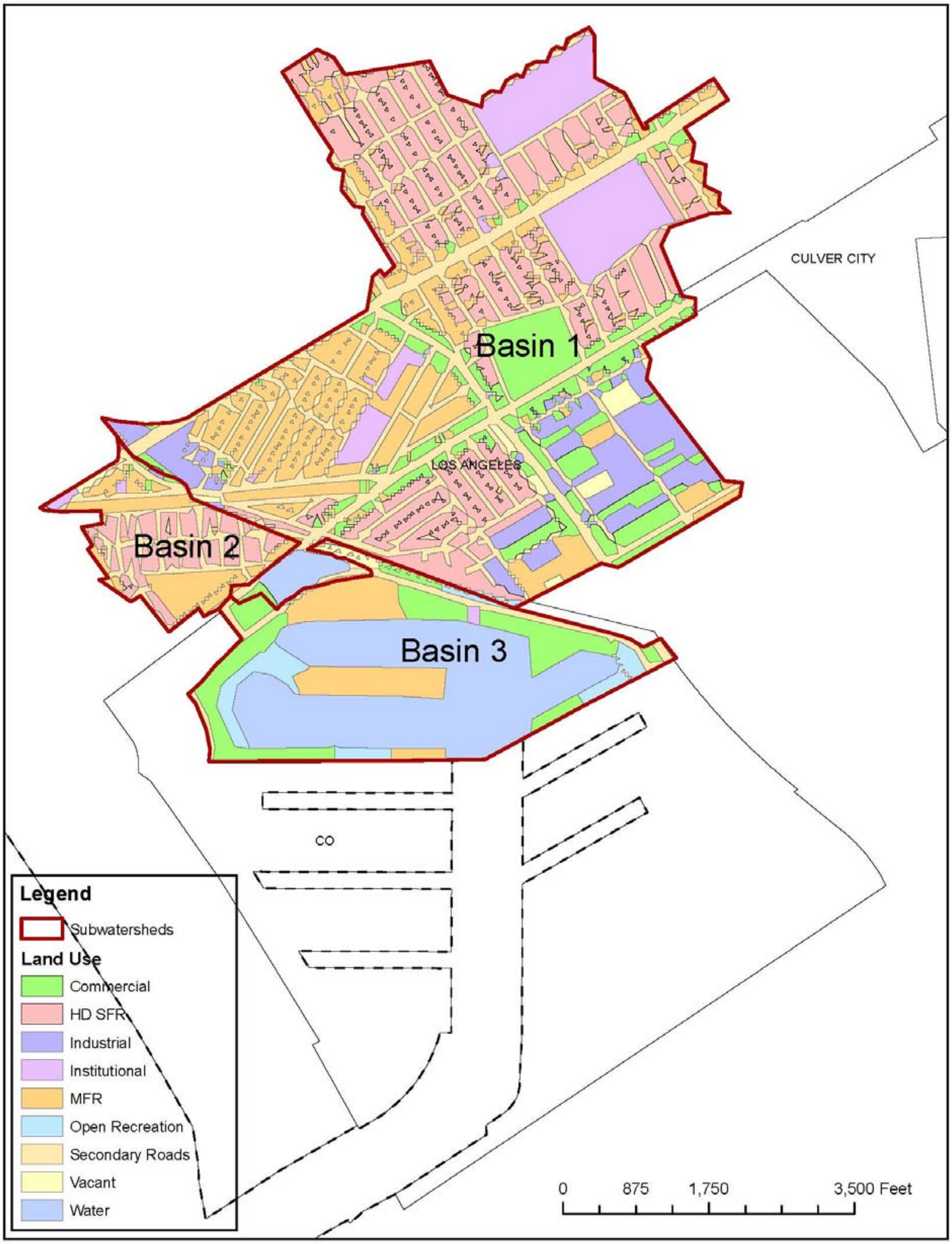

Figure 6-1. Land Uses and Subwatersheds of the Watershed Management Modeling System

The WMMS was used to estimate the average annual loads discharged to the MdRH Back Basins. The WMMS estimates the TSS load for each subwatershed. For copper, lead, and zinc, the model estimates the pollutant loading associated with the TSS load (existing pollutant loading is in units of milligrams per kilogram of TSS). Limited information is available for chlordane and PCBs. Therefore, the model assumes the ERL values for these two pollutants.

The WMMS was used to estimate the maximum TSS load from each subwatershed allowed for each type of pollutant without exceeding WLAs published in the *Total Maximum Daily Load for Toxic Pollutants in Marina del Rey Harbor* (Toxics TMDL). The required load reduction was determined by comparing the existing TSS load from each subwatershed with the allowed TSS load. The model indicates that zinc requires the greatest load reduction to achieve WLAs, and thus will be the controlling pollutant of concern for BMP implementation. The model estimates a load reduction of approximately 96% will be required to reduce zinc loading in the harbor to below the Toxics TMDL WLAs. Pollutant values used in the WMMS and maximum allowable TSS loading to the MdRH Back Basins, based on modeled pollutant sediment concentrations and WLA allotted to the MS4 permittees, are presented in Table 6-2. The existing TSS loads are presented in Table 6-3. The maximum permitted annual TSS loads, based on modeled pollutant sediment concentrations and WLA allotted to the County, are also presented in Table 6-3.

Table 6-2. Watershed Management Modeling System Pollutant Values and Annual Allowable Total Suspended Solid Loads to Marina del Rey Harbor Back Basins

Pollutant	**Effect Range Low** (mg/kg TSS)	**TMDL for MS4** (kg/yr)	**Model Calculation Sediment Concentration** (mg/kg TSS)	**Allowable TSS Load without Exceeding WLAs** (kg/yr)
Copper	34	2.01	394.7	5,092
Lead	46.7	2.75	352.7	7,796
Zinc	150	8.85	3,768	2,349
Chlordane[1]	5.00 x 10^-4	2.95 x 10^-5	5.00 x 10^-4	59,000
Total PCB[1]	2.27 x 10^-2	1.34 x 10^-3	2.27 x 10^-2	59,030

[1]Because of limited monitoring data, the sediment ERL values were used to model the TMDL values for Chlordane and total PCBs. These values are subject to change after monitoring data are obtained.

Table 6-3. Existing Total Suspended Solid Loads and Allowable Annual Loads for each Subwatershed

Pollutant	**Baseline** (existing) **TSS Load** (kg/yr)			**Maximum Allowed Load** (kg/yr) *(MS4 TMDL converted to TSS)*			**Maximum Load Reduction**
	Basin 1	**Basin 2**	**Basin 3**	**Basin 1**	**Basin 2**	**Basin 3**	
Copper	39,270	3,410	7,002	4,034	429	630	91%
Lead				6,175	657	964	86%
Zinc				**1,860**	**198**	**291**	**96%**
Chlordane[1]				46,732	4,970	7,299	–
Total PCB[1]				46,756	4,972	7,302	–

[1]Because of limited monitoring data, the sediment ERL values were used to model the TMDL values for Chlordane and total PCBs. These values are subject to change after monitoring data are obtained.

6.1.3 Best Management Practices Recommended by Model

The model provides an output of BMP capacity volume required by typical BMPs to meet WLAs. These typical BMPs include rainwater capture and reuse, bioretention, and porous pavement types of improvements. Other types of BMPs may be used, such as modular engineered wetlands that are designed for flow-based treatments instead of volume-based. During the implementation period, specific BMP types and capacities can be incorporated into the WMMS as part of the design phase to ensure BMPs proposed for construction are consistent with the Implementation Plan. Table 6-4 and Table 6-5 show the initial recommendations of the WMMS, accounting for the load reductions provided by the five sites proposed for structural BMP construction and load reduction of approximately 25% to account for nonstructural BMPs.

Table 6-4. Recommended Typical Best Management Practices for Model Subwatershed Basin 3

Pollutant	**Total Area** (acres)	**Required Treatment by Water Harvesting BMPs** (acre-ft)	**Required Treatment by Bioretention BMPs** (acre-ft)	**Required Treatment by Porous Pavement BMPs** (acre-ft)	**Total Treatment by BMPs** (acre-ft/acre)
Residential	30.8	0.08	1.47	–	0.050
Commercial, industrial, & institutional	45.1	–	2.32	1.36	0.082
Transportation	12.3	–	0.84	–	0.062
Open Space, Recreational, Vacant	15.5	–	–	–	–
Total	**103.6**	**0.08**	**4.63**	**1.36**	

Table 6-5. Recommended Typical Best Management Practices for Model Subwatershed Basin 1

Pollutant	**Total Area** (acres)	**Required Treatment by Water Harvesting BMPs** (acre-ft)	**Required Treatment by Bioretention BMPs** (acre-ft)	**Required Treatment by Porous Pavement BMPs** (acre-ft)	**Total Treatment by BMPs** (acre-ft/acre)
Residential	1.2	–	0.07	–	0.058
Commercial, industrial, & institutional	1.1	–	0.06	0.04	0.091
Transportation	1.2	–	0.09	–	0.075
Total	**3.5**	**–**	**0.22**	**0.04**	

6.2 Nonstructural Quantification Analysis

This analysis presents implementation of various combinations of the nonstructural solutions proposed to help achieve the required TMDL WLAs. The purpose of this analysis is to determine a quantifiable percent of the total reduction needed that could be achieved using nonstructural BMPs. As stated previously, the quantification of the effectiveness of nonstructural BMPs is a developing science. Although the effectiveness of individual or specific combinations of nonstructural BMPs is not well documented in available literature and existing TMDL implementation plans for other watersheds in the regions, there are data on recent studies (e.g., street sweeping and source studies) within the MdRH watershed that provide a basis for developing quantification estimates. It has also been recently documented (WESTON, 2010b) (Brown et al., 2010) (Pohl, 2010) (Cac and Ogawa, 2010) (Krieger et al., 2010) that nonstructural BMPs that target operational and true source controls provide for more cost-effective, long-term solutions than "end of pipe" treatment BMPs. Because this is an integrated implementation plan, the nonstructural BMPs presented in this section address both toxic and bacteria sources. A system of comparison and prioritization of nonstructural BMPs is also presented.

6.2.1 Load Reductions Associated with Nonstructural Solutions

The following sections provide supporting evidence and studies justifying the load reduction apportionment for various nonstructural programs, which may be implemented within the Back Basins of MdRH. When targeted at the actual pollutant source, studies have shown nonstructural solutions, such as operational source controls, to be very effective at removing the source and therefore reducing concentrations/loads to below regulatory requirements. For example, the *Mission Bay Clean Beaches Initiative Bacterial Source Identification Study* found birds and over-irrigation to be two major sources of bacterial contamination (WESTON, 2004). Monitoring conducted following a redesign of the irrigation system and relocation of an in-water raft popularly used by birds indicated that bacterial concentrations in the receiving waters were very low. During the study, there was one WQO exceedance. Follow-up studies showed that the source was not associated with irrigation runoff or birds (WESTON, 2006).

Furthermore, true source controls replacing or modifying the constituent content of products that have been determined to impact water quality should be part of the nonstructural BMP program. True source controls have been proven to be highly cost effective as in the case of the banning of the pesticide Diazinon, which has resulted in clear reduction from well above to now below the WQO in the Chollas Creek watershed, which is under a TMDL for this contaminant. The recent approved legislation reducing the concentration of copper in brake pads in California was achieved through the Brake Pad Partnership that provided scientific data on the impact of copper from brake pads on water quality in urban areas. This true source control approach will significantly reduce copper concentrations in most urbanized watersheds, including MdRH. In the urbanized Chollas Creek watershed (which is under a dissolved metals TMDL), it has been estimated that approximately 90% of the copper loading is from brake pad deposition (WESTON, 2009). Nearly all the required reduction of copper to meet the TMDL will therefore be achieved from this true source control strategy.

As indicated in the results of the WMMS presented in Section 6.1.2, zinc is the controlling constituent. Nonstructural BMPs that include both operational and true source control measures to reduce zinc loading have therefore been emphasized in this section.

To develop more accurate quantification of source control measures, source identification studies within the watershed or similar land uses and pollutant loading activities are needed. The County is currently conducting the Toxics TMDL monitoring program that will better define the sources and contributions within the MdRH watershed. The estimation of quantification of potential load reduction achieved from nonstructural BMPs at this time has used a conservative approach based on currently available studies. It is expected that the estimates of potential reductions presented in this section will be increased based on the current and future studies for toxics. The estimated effectiveness of nonstructural BMPs for bacteria are based on the Bacteria Source Identification Study conducted for MdRH (WESTON, 2007). The results of this and other studies were used to develop estimated reductions that could be achieved to meet the overall required TMDL WLAs.

6.2.1.1 Street and Parking Lot Sweeping

As stated, the determination of the effectiveness of nonstructural BMPs is a developing science. However, recent pilot studies conducted on the effectiveness of aggressive street sweeping in the City of San Diego provide a basis for estimated load reductions through these methods. Based on these pilot studies, aggressive street sweeping was shown to be effective in reducing metals and pesticide loading and, to a lesser extent, bacteria. Recent studies in the City of Newport Beach have indicated that aggressive street and gutter cleaning that removes existing biofilm can be effective in reducing bacteria concentrations in runoff (Skinner et al., 2010).

The objective of this analysis is to estimate the potential load reduction associated with sweeping the streets and parking lots within the unincorporated areas of MdRH draining to the Back Basins.[4] The current load reduction associated with these impervious surfaces was developed using the output from the WMMS and land-use data. It was determined that the transportation land use only characterized the streets of MdRH and generally did not include the parking lot impervious surfaces (i.e., commercial land use). Based on typical lot layout as determined by review of aerial photography and known sweeping routes (Figure 6-2), the pollutant loads were apportioned as shown in Table 6-6. It was assumed that trees and activities on and from adjacent properties potentially load pollutants to the streets and parking lots, thus adding to the potential load that may be addressed through sweeping. Based on this analysis, it is estimated that street sweeping and parking-lot sweeping could address up to 17% of the watershed load. The remaining section of this analysis used data collected during a recent street-sweeping evaluation study to determine whether this potential load reduction may be realistic.

[4]This analysis is only for the streets and eight parking lots within the drainage area to the Back Basins within the MdRH, which are not under private management (approximately 2.7 miles of street and parking lots 3–10).

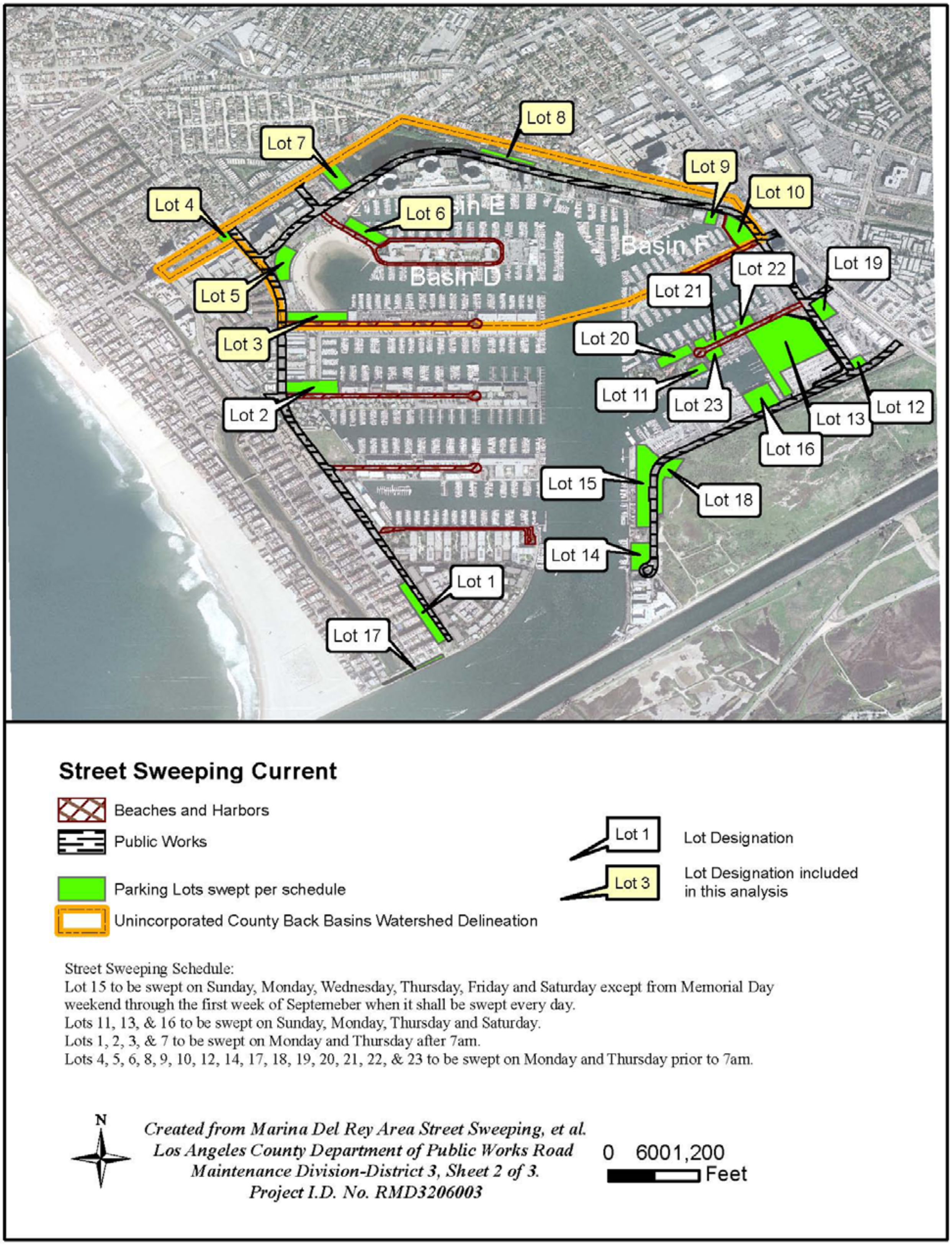

Figure 6-2. Street Sweeping Routes along the Back Basins

Table 6-6. Potential Load Apportioned to Streets and Parking Lots by Land Use Source[1]

Street Sweeping (land use)	**Area** (acres)	**TSS Load** (kg/yr)	**Portion of Land Use Load**	**Portion of Total Load**
Transportation	7.4	374	60%	9.6%
Multi-family residential	0.3	15	1%	0.2%
Commercial	0.4	33	1%	0.5%
Subtotal	***8.1***	***412***	**-**	***10.4%***
Parking Lot Sweeping (land use)	**Area** (acres)	**TSS Load** (kg/yr)	**Portion of Land Use Load**	**Portion of Total Load**
Transportation	4.9	623	40%	5.8%
Commercial	0.5	38	1%	0.6%
Subtotal	***5.4***	***672***	**-**	***6.4%***
Total	**13.5**	**1,083**	**-**	**16.8%**

[1]Results were based upon aerial photography and outputs from the watershed model. It was assumed that the secondary roads land use represented both streets and parking lots.

The load reductions associated with sweeping of streets and parking lots were based upon the BMP effectiveness assessment results from the *City of San Diego Targeted Aggressive Street Sweeping Pilot Study Effectiveness Assessment*, which was completed in 2010. This study evaluated the effectiveness of three types of street sweepers operating on nine routes across three watersheds. The study completed a grain-size and chemical analysis of debris swept from the street and paired sweeping activities with pollutograph-type water quality monitoring of the first flush of three storm events. The San Diego study was designed to evaluate the relative effectiveness of different sweepers and sweeping frequencies (debris and water quality data presented in the form of pollutant removal, grain size, and pollutant reduction rates). An analysis on the load reductions based on mass balance analysis was beyond the scope of the study (WESTON, 2010b). The debris data and TSS results represented the best data available for the two analyzed sweeping frequencies. As stated in the Toxics TMDL, the Regional Board allows for metals loads to be apportioned based on TSS results, and because the best study data were based on debris and TSS results, this information was used to streamline assumptions and estimate potential load reductions. The potential water quality load reduction for each sweeping option was estimated by multiplying distance to be swept (i.e., option-specific variable) by the average debris rate of removal (i.e., pounds/mile) by the portion of fines in the swept sediment by the potential load reduction calculated for a given pollutant (e.g., TSS reduction for water quality analysis).

This report analyzed four aggressive sweeping programs that may be implemented in MdRH. Option 1 includes sweeping the streets and parking lots of MdRH using a mechanical sweeper at an aggressive once-per-week frequency. Option 2 presents the impact of using a mechanical sweeper at a frequency of twice a week. Option 3 would enhance sweeping through the purchase of a new vacuum sweeper, which would be used to sweep once a week. Option 4 would increase the frequency of sweeping to twice per week and use enhanced sweeper technologies. The City of San Diego study indicated that the general public has a limited tolerance for street sweeping activities depending on available parking and community density. MdRH is a highly urbanized community that may be less tolerant to high-frequency sweeping and should be surveyed prior to program implementation.

Table 6-7 presents the load reductions for each of the four sweeping options. The results indicate that there is minimal benefit, in terms of additional debris and metals removal, by sweeping with a mechanical machine twice per week versus once per week. There would be potentially greater benefit in purchasing a new vacuum sweeper than increasing the sweeping frequency. As indicated in Table 6-7, up to 14% of the watershed load (9% and 5% load reductions for copper) may be addressed by sweeping streets and parking lots with a vacuum sweeper twice per week.

Table 6-7. Potential Load Reductions Associated with Street and Parking Lot Sweeping Options across Marina del Rey Harbor

Street Sweeping	TSS (kg/yr)	Portion Potential Load	Percentage Pollutant Load Reduction[1]				
			TSS	Copper	Lead	Zinc	Bacteria[2]
Option 1 – Mechanical, 1x/week	138	21%	2%	2%	5%	2%	*1%*
Option 2 – Mechanical, 2x/week	173	26%	3%	2%	7%	3%	*1%*
Option 3 – Vacuum, 1x/week	342	51%	5%	5%	14%	6%	*2.5%*
Option 4 – Vacuum, 2x/week	621	93%	10%	9%	25%	12%	*3%*
Parking Lot Sweeping	**TSS** (kg/yr)	**Portion Potential Load**	**Percentage Pollutant Load Reduction[1]**				
			TSS	**Copper**	**Lead**	**Zinc**	**Bacteria[2]**
Option 1 – Mechanical, 1x/week	75	18%	1%	1%	3%	1%	*0.5%*
Option 2 – Mechanical, 2x/week	94	23%	1%	1%	4%	2%	*0.5%*
Option 3 – Vacuum, 1x/week	187	45%	3%	3%	7%	3%	*1.5%*
Option 4 – Vacuum, 2x/week	360	87%	6%	5%	14%	7%	*3%*

[1]TSS load reductions were calculated using data from the City of San Diego Targeted Aggressive Street Sweeping Program. Load reductions for copper, lead, and zinc were based on the annual reduction in TSS, as allowed by the TMDL.

[2]Bacteria loads were not measured as part of the City of San Diego study. Bacteria load reductions were conservatively approximated as half the minimum potential load reduction calculated for TSS and metals.

A rough estimate of implementation cost for each option was compared to the anticipated load reduction for each sweeping program and this ratio was used to rank the options (Table 6-8). Although there will be higher initial capital costs associated with purchasing new machines, it is anticipated that the load reduction benefit associated with the newer machines will outweigh the cost.

Table 6-8. Relative Priority for Sweeping Options Based on Load Reduction and Cost

Sweeping Program Option	Approximate Start-Up Cost	Total Load Reduction	Relative Priority
Option 1	$250 K	3%	3
Option 2	$450 K	3%	LOWEST (4)
Option 3	$1.0 M	8%	2
Option 4	$1.2 M	14%	HIGHEST (1)

6.2.1.2 Bird and Pet Waste Management

As part of an integrated approach to address both toxic constituents and bacteria pollutant loading, the suite of nonstructural BMPs include operational source controls such as education/outreach, enforcement, and incentives to reduce bacteria loading. Measures that also reduce urban flows such as control of over-irrigation and washing activities will address the mechanism for transport of both bacteria and toxics. As mentioned, additional studies are needed to define and quantify the effectiveness of source control measures for toxic pollutants. These studies, outlined in the *MdRH Toxic Pollutants Coordinated Monitoring Plan* (LADPW, 2008), are underway by the County. Because a source identification study has been performed for bacteria, operational source controls can be better defined and estimation of reduction determined using these data and conservative assumptions. The following discussion will focus predominately on the sources of bacteria loading identified in the source study.

A ribotyping analysis of wet-weather and dry-weather samples collected as part of the *Mother's Beach and Back Basins Bacteria TMDL Non-Point Source Study* indicated that nonhuman sources were predominantly responsible for the bacterial loading to MdRH (Figure 6-3). Avian sources represented 74% of the wet-weather bacterial sources and 66% of the dry-weather bacterial sources. During a series of dry-weather surveys, over 922 birds and over 1,000 piles of bird waste around MdRH were observed (WESTON, 2007). If the current bird waste management program was expanded to target more aggressively the recreational areas along the waterfront through a combination of pollutant removal (street sweeping) and long-term bird deterrence, it is conservatively estimated that 10–15% of this source may be reduced. This type of program could potentially result in a 7–10% reduction in bacterial load.

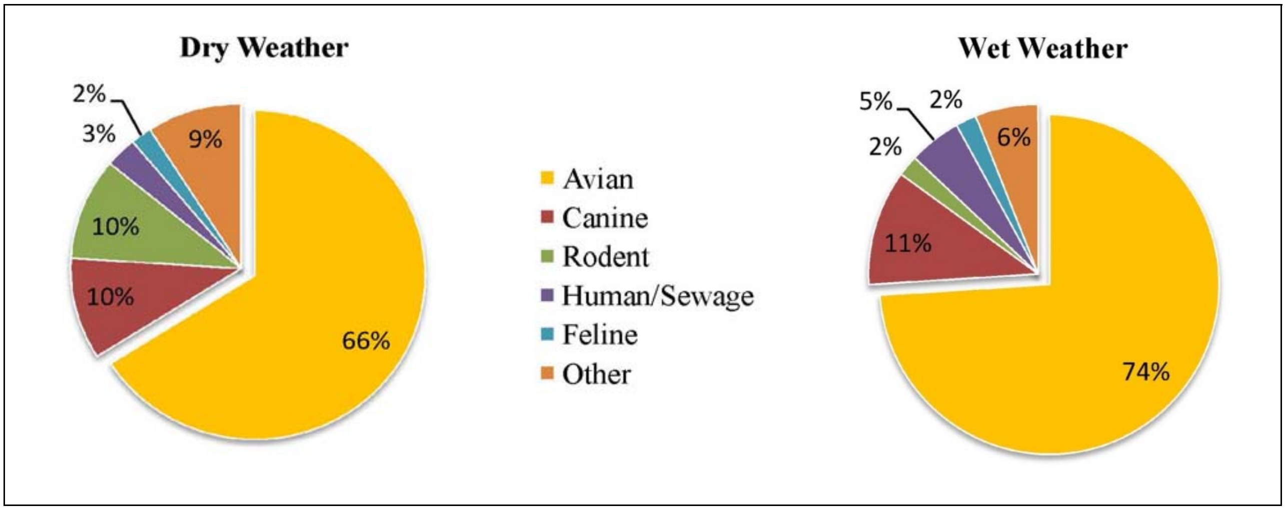

Figure 6-3. Ribotyping Results for Wet Weather and Dry Weather (WESTON, 2007)

Birds as well as rodents, and subsequently felines, are likely attracted to MdRH because of potential sources of food (e.g., unmanaged trash and food waste). Visual observations from the dry-weather survey noted 46 instances of uncovered trashcans, nine overflowing dumpsters, and nine occurrences of food waste on the land or in the water (WESTON, 2007). Targeted, more-aggressive operational source control programs to increase proper containment and management of solid waste can be integrated into existing programs targeted to restaurants, the boating community, and parking garage facilities. These programs are estimated to achieve a conservative 5% reduction in bacteria waste loads.

The Non-Point Source Study also found canines to represent 11% of the wet-weather source and 10% of the dry-weather source of bacterial loading. During a series of dry-weather surveys, 137 dog walkers were observed around MdRH. During the same survey 25 piles of dog waste were found and an additional 15 improper dog waste management occurrences were observed (WESTON, 2007). If an aggressive dog waste management program was implemented across MdRH, it is conservatively estimated that 10–20% of this source could be removed. This type of program is estimated to achieve an approximate reduction of 2–3% of the bacterial load reduction.

6.2.1.3 Other Sources and Programs

In addition to the visual observations from the dry-weather surveys, the Non-Point Source Study collected 67 spot samples to characterize the bacterial contamination across the Back Basins. The 21 spot samples with the highest bacterial results draining to basins D, E, and F are characterized on Figure 6-4.

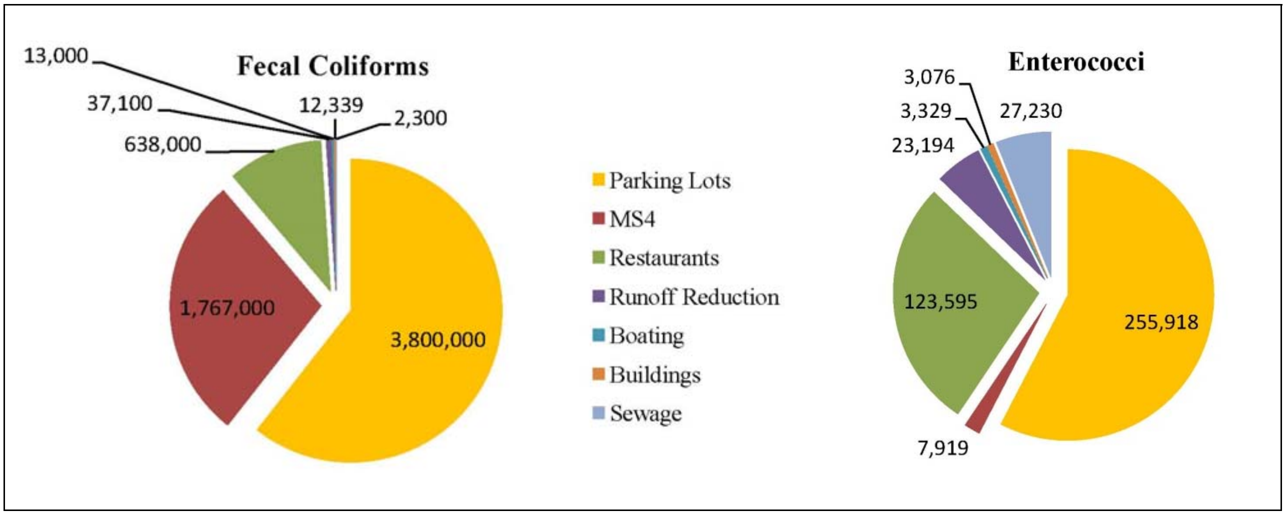

Figure 6-4. Dry Weather Spot Sample Indicator Bacteria Results for the Back Basins (WESTON, 2007)

Parking lot wash down activities adjacent to Basin E constituted two of the highest bacterial concentrations measured during the study (WESTON, 2007). Given that runoff from washing activities acts as a transport mechanism for pollutants on the generally unswept paved surfaces of garage structures, targeting parking garages would likely have a comparable reduction in metals loading. Operational source control measures that reduce urban runoff from sources such as over-irrigation and washing activities will therefore address both toxic constituents and bacteria by addressing the transport mechanism for these pollutants. This type of program could potentially result in a 3–6% pollutant load reduction.

Restaurant washing and waste management activities resulted in high enterococcus concentrations. Field observations often referred to grease stains and odor (WESTON, 2007). Dumpster washing also potentially serves as a transport mechanism for metals and other pollutants. Targeted and more-aggressive restaurant education, outreach, and incentive programs would serve as cost-effective operational source control measures for reducing loads to MdRH. Also, several restaurants within MdRH have voluntarily implemented dog waste management programs on their private facilities. There are opportunities to leverage existing County programs and existing efforts conducted within the restaurant community to achieve greater behavioral change that results in greater load reductions through targeting washing activities along with the solid waste management measures discussed previously. This type of program could potentially result in a 1–4% pollutant load reduction.

The dry-weather visual survey noted 25 instances of flow at storm drains and 21 instances of ponded water in the MS4. Of the 46 observations, 35 sites had algae growing in the water and/or within the pipe (WESTON, 2007). The algae growth indicates a steady source of runoff and may potentially indicate other pollutants (e.g., nutrients and metals). Spot samples of ICID flows generally had high fecal coliform concentrations. Reduction in urban runoff from activities such as over-irrigation and washing off of impervious surfaces will reduce pollutant transport and bacteria regrowth within the MS4. A pilot study completed by the City of San Diego in the San Diego River watershed indicates that aggressive MS4 catchment cleaning (e.g., steam cleaning) is effective at removing biofilm (WESTON, 2010c). Based on the results of this study and the Non-Point Source Study data, it was estimated that an MS4 program could result in a 1–3% pollutant load reduction.

The Non-Point Source Study collected spot samples from five instances of irrigation runoff, and two of the samples were collected at the entry point to the MS4. Given the freshwater source, runoff from over-irrigation is not a pollutant unto itself, but rather a transport mechanism for other pollutants. Bacterial concentrations were above the WQOs but generally lower than other sample results (WESTON, 2007). A runoff reduction program was given a greater potential for load reduction than buildings and construction sources, pet waste, and the boating community because of the higher potential frequency of occurrence and the opportunity to leverage programs to encourage implementation of BMPs (e.g., cisterns, rain barrels, and green roofs). This type of program could potentially result in a 1–2% pollutant load reduction.

The Rain Barrel Downspout Disconnect Program by the City of San Diego showed that during storm events, galvanized steel building materials can elevate the zinc concentrations. The three-storm average total zinc concentration from a building equipped with galvanized gutters and downspouts was 10 times greater than the average concentrations from a building with nongalvanized materials and the differences in spot concentrations were significantly greater (WESTON, 2010d). In MdRH, a phase-out and full ban on galvanized steel for gutters and downspouts, fencing, handrails, and other building materials represents a true source control measure that could significantly reduce the zinc load. Institutional controls and regulatory change also represent an important step toward laying the foundation for inspections and may encourage targeted audiences to proactively modify behaviors (e.g., rain barrel implementation, proactive housekeeping programs to avoid regulatory enforcement). A regulatory, true source control program targeted at buildings and construction materials could result in a 1–2% pollutant load reduction.

Based on phone interviews with representatives from the Santa Monica Bay Restoration Commission, in the recent past, the MdRH boating community has mobilized behind environmental stewardship programs (e.g., 2009–2010 Honey Pot Days and 2008–2010 bilge pad recycling program), and will likely continue to participate in these programs. Generally, boater outreach is outside the jurisdiction of the County, but opportunities are present to leverage existing programs to achieve land-side behavior change (i.e., trash management, reduced washing activities, product substitution, etc.). Because the scope of the Implementation Plan is restricted to land-side activities within the County's jurisdiction, and specifically limited marina programs, the load reduction credited to boater programs was restricted to 1%. The potential load reduction through boater programs is likely to be greater than 1%, but 1% is used as a conservative estimate

6.2.1.4 Potential Nonstructural Load Reduction by Program

As discussed, the quantification of the effectiveness of nonstructural BMPs is an emerging science. The Toxics TMDL assumed that nonstructural BMPs would be able to reduce loads by 30% (LARWQCB, 2005). Based on the estimates presented in this section the estimated total reductions that could be achieved from nonstructural BMPs is approximately 32%, which is similar to the estimate provided in the Toxics TMDL. The WMMS has conservatively assumed that nonstructural BMPs would be able to reduce the pollutant load to MdRH by 25%. This would reserve an additional 7% of load for unforeseen circumstances. Table 6-9 presents the pollutant load reductions possible by program.

Table 6-9. Load Reductions by Nonstructural Program and Pollutant Type

Nonstructural Program (targeted source)	**Range of Potential Load Reductions**			
	Metals – Minimum	**Metals – Maximum**	**Bacteria – Minimum**	**Bacteria – Maximum**
Sweeping (Streets/Parking Lots)	3%	14%	1.5%	6%
Birds	–	–	7%	10%
Parking garage structures	3%	6%	3%	6%
Restaurants	1%	4%	1%	4%
MS4 catchment/sewage	1%	3%	1%	3%
Runoff reduction	1%	2%	1%	2%
Buildings and construction	1%	2%	–	1%
Pet waste	–	–	1%	2%
Boating community	–	1%	–	1%
Total	**10%**	**32%**	**13.5%**	**35%**

6.3 Quantification Analysis – Conceptual Structural Best Management Practices

The quantification of the structural BMPs is first based on the determination of the effectiveness of the defined structural BMPs presented in the Implementation Plan. These defined projects take an integrated approach and address both toxic constituents and bacteria loading. From the quantification of these specific projects, future options will be developed to achieve the nonstructural BMPs of the overall reduction goals. As stated earlier the reduction goal for toxics is 96% and is controlled by zinc loading.

This analysis estimates the load reductions achieved by the five proposed projects described in the Structural BMP Section of the Implementation Plan. These estimates demonstrate how these BMPs will aid in reaching compliance with the existing TMDLs for MdRH. By first implementing and assessing a limited number of BMPs with the MdRH watershed, the County will be able to use a more iterative adaptive management approach to use County resources more cost effectively (i.e., replicate BMPs that cost effectively reduce pollutant loading during the TMDL implementation period).

6.3.1 Basis for Quantification

This quantification analysis utilizes the International Stormwater BMPDB, various Caltrans BMP studies, and other industry-accepted water quality monitoring BMP effectiveness results to determine the anticipated pollutant load reductions in concentration or volume for the proposed structural solutions at each project location.

6.3.1.1 International Stormwater Best Management Practice Database

The BMPDB was developed as an account of work sponsored by the Water Environment Research Foundation, American Society of Civil Engineers Environmental and Water Resources Institute, American Public Works Association, Federal Highway Administration, and USEPA. Features of the BMPDB include a database of over 400 BMP studies, performance analysis results, tools for use in BMP performance studies, monitoring guidance, and other study-related publications. The overall purpose of the BMPDB is to provide scientifically sound information to improve the design, selection, and performance of BMPs (USACE and USEPA, 2006). Continued population of the database and assessment of its data will ultimately lead to a better understanding of factors influencing BMP performance and help to promote improvements in BMP design, selection, and implementation. The BMPDB's published documents were thoroughly reviewed to assist in determining BMP effectiveness for this quantification analysis.

6.3.1.2 California Department of Transportation Treatment Best Management Practice Technology Report and Study Data

Caltrans formed a partnership with the Office of Water Programs at California State University, Sacramento (CSUS), through the California State University Foundation, and with the Department of Civil and Environmental Engineering at the University of California, Davis (UCD). Research engineers from these institutions work side by side with Caltrans personnel, planning and managing the research program. Through the CSUS–UCD partnership, Caltrans also has access to researchers at more than 30 campuses in the two university systems. Private engineering consulting firms and affiliated laboratories execute most field-based projects, such as those presented in the Caltrans BMP Retrofit Pilot Program Report, which document the pollutant removal test results of BMPs. Data included in the Caltrans Treatment BMP Technology Report and BMP Retrofit Pilot Program Report have assessed BMP effectiveness at various locations including Caltrans Park and Ride lots. These lots show similar characteristics to the proposed projects sites at MdRH, thus providing relevant data to support the quantification analysis.

6.3.2 Existing Conditions

Water quality models assist with determining existing water quality conditions and expected pollutant load reductions as a result of implementing post-construction BMPs. Models vary based on several different inputs including information such as land-use types, impervious cover, hydrology, rainfall data, pollutant load data, pollutant types, BMP capacities and removal efficiencies, soil parameters, and existing water quality data. TMDLs for the MdRH include bacteria, copper, lead, zinc, chlordane, and PCBs. The Simple Method Model was used to evaluate the proposed BMPs, which is generally appropriate for small, individual sites and when quick and reasonable stormwater pollutant load estimates are required. This technique requires a modest amount of information, including the drainage area, impervious cover, stormwater runoff pollutant concentrations, and annual precipitation. Table 6-10 provides a summary of the drainage areas and BMP capacities of the proposed five sites selected for BMP construction as part of this Implementation Plan. Specific design information for these BMPs is provided in the Structural BMP Section of the Implementation Plan.

Table 6-10. Project Site Flow Rates/Volumes

BMPs	Drainage Area (acres)	Flow Rate or Volume Provided
Parking Lot 5 and Marina del Rey Library		
Bacterra™ bioretention technology	0.55	0.11 cfs*
Biofiltration planter	2.05	0.91 cfs
Rain barrels / cisterns	0.05	240 ft^3
Subtotal	***2.65***	
Parking Lot 7		
Bioretention planter	0.86	4,593 ft^3
Parking Lot 9		
Cisterns[1]	2.0	9,600 ft^3
ClearWater BMP filtration system units[1]	2.0	
Flow-through planter boxes[1]	2.0	
Parking Lot 10		
Flow-through planter boxes[1]	2.4	10,454 ft^3
Sand infiltration trench[1]	2.4	
Parking Lot 11		
Biofiltration planter[2]	0.82	0.23 cfs
Porous pavement[3]	1.73	0.61 cfs
Subtotal	***2.55***	
Total	**10.46**	

*cfs = cubic feet per second.
[1]BMP treatment train.
[2]Flow rate or volume provided assumes a minimum filtration rate of 5 in./hr.
[3]Flow rate or volume provided assumes a minimum filtration rate of 5 in./hr.

To evaluate the proposed BMPs, the Simple Method Model was used to estimate TSS pollutant load from stormwater runoff for each conceptual structural BMP site. Sediment concentrations equal to those used in the County's WMMS were applied to the estimated TSS loads to calculate the pollutant loading of constituents listed in the Toxic TMDL. The County's WMMS incorporates the pollutant load reductions estimated by these five BMP sites and provides the estimated additional BMP capture volumes to achieve WLAs for the entire Basin 3 subwatershed. Applying the Simple Method Model, the existing conditions of each project yielded the following estimated annual pollutant loads shown in Table 6-11. Based on established TMDLs for the project area, Table 6-11 also summarizes the estimated annual TMDL WLAs applicable to MdRH runoff for comparison of these loads to the expected annual pollutant loads calculated for the existing conditions.

Table 6-11. Annual Waste Load Allocations

Pollutant of Concern	TMDL WLA[1] (lb/year)	Water Quality Model Pollutant Load (lb/year)
Parking Lot 5 and Marina del Rey Library		
Copper	0.014	0.18
Lead	0.019	0.16
Zinc	0.062	1.72
Chlordane	nd[2]	nd[2]
PCBs	nd[2]	nd[2]
Parking Lot 7		
Copper	0.005	0.06
Lead	0.006	0.05
Zinc	0.020	0.54
Chlordane	nd[2]	nd[2]
PCBs	nd[2]	nd[2]
Parking Lot 9		
Copper	0.011	0.14
Lead	0.014	0.12
Zinc	0.047	1.32
Chlordane	nd[2]	nd[2]
PCBs	nd[2]	nd[2]
Parking Lot 10		
Copper	0.013	0.17
Lead	0.017	0.15
Zinc	0.056	1.59
Chlordane	nd[2]	nd[2]
PCBs	nd[2]	nd[2]
Parking Lot 11		
Copper	0.013	0.17
Lead	0.018	0.15
Zinc	0.059	1.58
Chlordane	nd[2]	nd[2]
PCBs	nd[2]	nd[2]

[1]WLAs are for wet-weather conditions. Allotment based on total drainage areas of proposed BMPs.
[2]Nondetectable limit of 0.05 µg/L.

6.3.3 Best Management Practice Pollutant Removal Effectiveness

Several assumptions related to the function and benefits of the selected structural BMPs were required to complete the calculations. A thorough review of literature values relating to BMP effectiveness was performed. Based on the expected percentage of BMP effectiveness, Table 6-12 summarizes the expected pollutant percent reduction from the proposed structural BMPs at each project site.

Table 6-12. Expected Pollutant Percent Reduction from Structural Best Management Practices

BMPs	Drainage Area (acres)	BMP Effectiveness[1] (%)		
		Bacteria	TSS/Metals	Organics
Parking Lot 5 and Marina del Rey Library				
Bacterra™ bioretention technology	0.55	95	85	45
Biofiltration planter	2.05	82	86	32
Rain barrels / cisterns	0.05	100	100	100
Total Weighted Average (%)		**85**	**86**	**36**
Parking Lot 7				
Bioretention Systems	0.86	70	86	45
Total Weighted Average (%)		**70**	**86**	**45**
Parking Lot 9				
Cisterns	2.0[2]	0	0	0
ClearWater BMP filtration system units	2.0[2]	0	86	0
Flow-through planter boxes	2.0[2]	70	86	45
Total Weighted Average (%)		**70**	**86**	**45**
Parking Lot 10				
Flow-through planter boxes	2.4[2]	70	86	45
Sand infiltration trench	2.4[2]	95	98	95
Total Weighted Average (%)		**83**	**98**	**70**
Parking Lot 11				
Biofiltration planter	0.82	82	86	32
Porous pavement	1.73	95	95	95
Total Weighted Average (%)		**91**	**92**	**75**

[1]Caltrans Treatment BMP Technology Report, California Stormwater BMP Handbooks, International Stormwater BMPDB, County LID Standards Manual, and National Menu of Stormwater BMPs.
[2]BMP treatment train.

Based on the expected percent reduction from the proposed structural BMPs, Table 6-13 summarizes the expected annual pollutant load reductions resulting from BMP implementation at the five proposed project sites.

Table 6-13. Expected Annual Pollutant Load Reductions

Pollutants of Concern	Units	Parking Lot 5 and Marina del Rey Library	Parking Lot 7	Parking Lot 9	Parking Lot 10	Parking Lot 11
Bacteria						
Total coliforms	Billion colonies	52.35	34.07	79.23	55.46	30.91
Metals						
Copper	lbs	0.145	0.046	0.108	0.145	0.145
Lead	lbs	0.130	0.041	0.097	0.129	0.130
Zinc	lbs	1.387	0.438	1.033	1.380	1.385
Organics						
Chlordane	lbs	nd[1]	nd[1]	nd[1]	nd[1]	nd[1]
PCBs	lbs	nd[1]	nd[1]	nd[1]	nd[1]	nd[1]

[1]Nondetectable limit of 0.05 µg/L.

6.4 Quantification Analysis – Future Structural Best Management Practices

Additional BMPs will need to be implemented throughout MdRH to meet WLAs allotted to the County. This quantification analysis makes certain assumptions regarding future BMP implementation. During the implementation period, assumptions shall be evaluated, and, if necessary, the quantification analysis may be modified to better represent actual BMP implementation practices, BMP efficiencies, and pollutant concentrations in stormwater runoff.

Based on the Bacteria TMDL Implementation Plan, as of 2005, roughly half of the leaseholds around MdRH have proposed redevelopment plans since the early 1990s, and six projects were under construction in 2005 (MDRWRA, 2005). It is assumed, during the TMDL implementation period, redevelopment of leaseholds will continue at a pace fairly consistent with that of the last 20 years. Based on this assumption, percentages of land to be redeveloped during the implementation period are estimated at 20% for residential land use and 35% for other land uses (i.e., commercial, industrial, and retail). It is assumed that redevelopment will be subject to the County SUSMP and will incorporate LID features, including treatment BMPs. The SUSMP requires that stormwater runoff be treated by treatment BMPs. The SUSMP requires capturing and treating the volume from the 85th percentile storm event or treating the continuous flow rate generated by 0.2 inch per hour of precipitation. The potential load capture volumes were estimated using the SUSMP guidance as discussed above. The amount of land that is assumed to be redeveloped during the TMDL implementation period and the load reduction results are shown in Table 6-14. The treatment per unit area shows that the estimated volumes of treated runoff by BMPs within redeveloped sites are slightly less than the recommended BMP treatment estimated by the WMMS shown in Table 6-4 and Table 6-5. This difference will need to be offset by a slight increase in the capacities of BMPs implemented by the County around MdRH. There is a small area of unincorporated County land within the Basin 1 subwatershed. For the purposes of this analysis, it is assumed that no redevelopment will occur in this area during the implementation period.

Table 6-14. Total Load Reductions Due to Redevelopment during Implementation Period within Basin 3

Land Use	Total Area (acres)	Estimated Percent Redeveloped	Redeveloped Area (acres)	BMP Type	BMP Treatment Capacity (acre-ft)	Treatment Capacity (acre-ft/acre)
Multi-family residential	30.8	–	–	Water harvesting	–	–
				Bio-retention	–	
Commercial, retail, & institutional	45.1	25%	11.3	Porous pavement	0.237	0.057
				Bio-retention	0.404	
Transportation	12.3	–	–	Bio-retention	0	–
Open Space, Recreational, Vacant	15.5	–	–	–	–	–
Total	**103.6**		**11.3**		**0.64**	

In addition to the five sites identified for BMP implementation in Section 4.0 of this report, the County may need to implement BMPs on County properties to meet WLAs. Table 6-15 presents the potential implementation of BMPs on County properties within the modeled Basin 3 subwatershed, and Table 6-16 presents the potential implementation of BMPs on County properties within the modeled Basin 1 subwatershed.

Table 6-15. Annual Load Reductions from County Projects on County Properties within Basin 3

Land Use	Total Area (acres)	County Project Area (acres)	BMP Type	BMP Treatment Capacity (acre-ft)	BMP Treatment Capacity (acre-ft/ acre)
Multi-family residential	30.8	0	–	–	–
Commercial, retail, & institutional	45.1	2	Bio-retention	0.112	0.089
			Porous pavement	0.065	
Transportation	12.3	12.3	Bio-retention	0.84	0.068
Open Space, Recreational, Vacant	15.5	–	–	–	–
Total	**103.6**	**14.3**		**1.02**	

Table 6-16. Annual Load Reductions from County Projects on County Properties within Basin 1

Land Use	Total Area (acres)	County Project Area (acres)	BMP Type	Load Reduction Efficiency	BMP Treatment Capacity (acre-ft)	BMP Treatment Capacity (acre-ft/ acre)
Multi-family residential	1.2	0	–	–	–	–
Commercial, retail, & institutional	1.1	0	–	–	–	–
Transportation	1.2	1.2	Bio-retention	100%	0.090	0.075
Total	**3.5**	**1.2**			**0.090**	

6.5 Quantification Analysis Results

Summaries of the required BMP capacity volumes, BMP capacity volumes that will be provided by potential redevelopment and County projects, and the BMP capacity volumes remaining are provided in Table 6-17 for model subwatershed Basin 3.

Table 6-17. Summary of Best Management Practice Capacity Volumes for Basin 3

Land Use	BMP Type	Required BMP Capacity Volume (acre-ft)	Volume Treated by Redevelopment (acre-ft)	Volume Treated by Additional County Projects (acre-ft)	Treated Volume Remaining (acre-ft)
Multi-family residential	Water harvesting	0.08	–	–	0.08
	Bio-retention	1.47	–	–	1.47
Commercial, retail, & institutional	Porous pavement	1.36	0.237	0.065	1.06
	Bio-retention	2.32	0.404	0.112	1.80
Transportation	Bio-retention	0.84	–	0.84	0
	Total	**6.07**	**0.64**	**1.02**	**4.41**

The remaining 4.41 acre-ft of BMP capacity volume may be provided by implementing structural BMPs within leased properties. This will required negotiations with lessees on properties where leases will expire during the implementation period. To meet the WLAs it may also be necessary for the County to acquire land within the subwatershed to implement BMPs. Additional, ordinances, stormwater fees, and incentive programs may be developed that result in property owners and tenants implementing BMPs within the subwatershed. To successfully implement the previously mentioned options either individually or collectively, multi-departmental detailed planning will be required, which is beyond the scope of the Implementation Plan. The tables that follow in this section of the quantification analysis are provided to show the quantity of BMP capacity volumes (acre-ft) and the approximate densities (acre-ft of capacity per acre) that are required on lease parcels to meet WLAs so that County offices can make the appropriate decisions and initiate strategies to implement the adequate numbers of BMPs. The overall Implementation Plan calls for an adaptive management approach, and during the implementation period, source control measures may be more effective than assumed in this analysis. The established monitoring program will provide actual pollutant loading during the implementation period and shall be used as part of the adaptive management approach to determine whether smaller-capacity volumes for BMPs are required on these leased parcels.

Based on the County's WMMS, BMPs should be distributed uniformly throughout the unincorporated areas of the MdRH watershed, to the maximum extent possible. The quantification analysis examines both the tributary area and volume treated by BMPs. Table 6-18 shows the summary of areas remaining for each land-use type within model subwatershed Basin 3.

Table 6-19 shows remaining areas combined with the remaining BMP capacity volume required for the model Basin 3 subwatershed.

Table 6-18. Tributary Areas Remaining without Best Management Practices for Model Subwatershed Basin 3

Land Use	Total Area (acres)	Tributary Area – Five Sites (acres)	Tributary Area – Redevelopment (acres)	Tributary Area – County Projects (acres)	Tributary Area – Remaining (acres)
Residential	30.8	–	–	–	30.8
Commercial, industrial, & institutional	45.1	10.5	11.3	2	21.3
Transportation	12.3	–	–	12.3	0
Total	**88.2**	**10.5**	**11.3**	**14.3**	**52.1**

Table 6-19. Recommended Typical Best Management Practices on Remaining Areas for Model Subwatershed Basin 3

Land Use	Remaining Area (acres)	BMP Type	Remaining BMP Capacity Volume (acre-ft)	Remaining BMP Capacity Volume (acre-ft/acre)	Combined BMP Capacity Volume (acre-ft/acre)
Multi-family residential	30.8	Water harvesting	0.08	0.003	0.050
		Bioretention	1.47	0.048	
Commercial, retail, & institutional	21.3	Porous pavement	1.06	0.050	0.134
		Bioretention	1.80	0.085	
Transportation	0	Bioretention	–	–	–
Total	**52.1**		**4.41**		

Similar to the above analysis for model subwatershed Basin 3, Table 6-20 though Table 6-22 show the remaining BMP capacity volumes required, remaining land areas, and the resulting densities of BMP capacity volume for the model subwatershed Basin 1.

Table 6-20. Summary of Best Management Practice Capacity Volumes for Basin 1

Land Use	BMP Type	Required BMP Capacity Volume (acre-ft)	Volume Treated by Additional County Projects (acre-ft)	BMP Capacity Volume Remaining (acre-ft)
Multi-family residential	Water harvesting	–	–	–
	Bioretention	0.07	–	0.07
Commercial, retail, & institutional	Porous pavement	0.04	–	0.04
	Bioretention	0.06	–	0.06
Transportation	Bioretention	0.09	0.09	0
	Total	**0.26**	**0.09**	**0.17**

Table 6-21. Tributary Areas Remaining without Best Management Practices for Model Subwatershed Basin 1

Land Use	Total Area (acres)	Tributary Area – County Projects (acres)	Tributary Area – Remaining (acres)
Residential	1.2	–	1.2
Commercial, industrial, & institutional	1.1	–	1.1
Transportation	1.2	1.2	0
Total	**3.5**	**1.2**	**2.3**

Table 6-22. Recommended Typical Best Management Practices on Remaining Areas for Model Subwatershed Basin 1

Land Use	Remaining Area (acres)	BMP Type	Remaining BMP Capacity Volume (acre-ft)	Remaining BMP Capacity Volume (acre-ft/acre)	Combined BMP Capacity Volume (acre-ft/acre)
Multi-family residential	1.2	Water harvesting	–	–	0.058
		Bioretention	0.07	0.058	
Commercial, retail, & institutional	1.1	Porous pavement	0.04	0.036	0.091
		Bioretention	0.06	0.055	
Transportation	0	Bioretention	–	–	–
Total	**2.3**		**0.17**		

6.6 Quantification Analysis Conclusions

The results of the quantification analysis indicate that approximately 50% of the required load reductions may need to be accomplished through implementing BMPs on leased parcels throughout the unincorporated areas of the MdRH watershed. This may be accomplished through negotiations between land tenants and the County, land acquisition, stormwater fee and incentive program, or a combination of these actions.

BMPs may be implemented on a much smaller scale if additional nonstructural BMPs are implemented that include true source controls (e.g., reducing zinc content in tires and restricting the use of galvanized products). Additional future measures to address this remaining load may also include structural BMPs using a combination of cost-effective measures to achieve the overall goals. The results also indicate that as the concentration of constituents is reduced in the flows, the difficulty and corresponding cost to remove constituents from stormwater increases for treatment controls. There is therefore a diminishing return on the incremental pollutant reduction effort as the program reduces more than 50–60% of the load. These findings are consistent with other studies and the Ballona Creek TMDL Implementation Plan (LADPW, 2009), and is leading watershed managers to pursue more true source control measures and runoff volume reduction measures. Reduction of the volume of urban runoff and storm flows not only reduces the pollutant concentration, but also the volume to be potentially treated. Therefore, the future mixture of projects should include a greater emphasis on true source controls and measures that reduce the volume of urban runoff and storm flows into the MS4 and eventually into the Back Basins.

7.0 MULTI-BENEFITS ANALYSIS

The primary goal of the Implementation Plan is to reduce the loads of the toxics listed in the Toxics TMDL to below the WLAs apportioned to the County of Los Angeles (County). The Toxics TMDL states, if an integrated water resources approach that includes beneficial reuse of stormwater is pursued, the Regional Board will consider extending the allowable implementation period to 15 years, in recognition of the additional planning and time needed for this approach (LARWQCB, 2005). Water capture and reuse is being proposed to the maximum extent feasible given the constraints of limited areas for landscaping, and thus reuse, and the current regulations and restrictions being applied to rainwater reuse within the MdRH watershed. This section examines the enhanced benefits, beyond toxic pollutant load reductions, of implementing nonstructural and structural BMPs during the implementation period that can include the following:

- Beneficial reuse of captured stormwater.
- Increased infiltration and groundwater recharge.
- Water conservation.
- Reduction in bacteria loads to the harbor.
- Community enhancement benefits:
    - Property value increase due to additional green space.
    - Willingness to pay for no waterbodies being impaired.
    - Cleaner streets / trash control.
    - Improved beach tourism.
    - Ecosystem services.
- Reduction of sediment into harbor.

The benefits listed above can have different values for different groups of people. For instance, cleaner streets can be more valuable to area residents, whereas improved beach tourism can be more important to business owners and their staff. Therefore, cost-benefit estimates are assigned to each of the listed additional benefits to provide more tangible criteria of how these items benefit the area. The cost-benefit estimates allow the various benefits to be compared to one another. Based on the cost-benefit comparison, a scoring system that establishes the maximum number of points each benefit may receive was created. This scoring system is used in the alternatives analysis, which examines the benefits and risks of increasing nonstructural BMPs and/or water harvesting BMP to meet WLAs. The point system establishes a means to estimate whether each alternative meets the threshold or target (benefits outweigh risks) and thus may be used during the implementation period.

7.1 Water Supply Benefit

7.1.1 Capture and Reuse

Based on the existing developed conditions of MdRH, RWHSs will play a focused role in achieving TMDL compliance. The area is occupied, in general, by high-rise apartment/condominium buildings and multi-family and commercial low-rise buildings. On properties where the ratio of landscaped area (i.e., green space) to drainage area (i.e., rooftop surface or other impervious surface) is in the approximate range of 0.5–1.0, small-scale to medium-scale RWHSs could be implemented. These systems should be designed to augment the irrigation of flower beds and planter boxes within highly urbanized areas by using cost-effective drip-line irrigation systems. Additional small-scale RWHSs can be designed to include placing raised planters adjacent to existing structures. These systems would reduce waste loads through evapotranspiration, root uptake, filtration, and infiltration, resulting in both improved water quality and a reduction in the area's water demand.

Several of the sites selected for treatment-type BMPs include rainwater harvesting components. The design for the Parking Lot 5 and adjacent community library property integrates decorative rain barrels for runoff collection from the library for reuse. Parking Lot 9 proposes large underground cisterns for capture and temporary storage of runoff prior to being pumped to a flow-through filtration planter. The other sites selected for treatment BMP construction do not include a cistern because of site constraints (i.e., parking lots not conducive to integrating cisterns). The rain barrels incorporated into the Parking Lot 5 and library site will provide an opportunity for public outreach and awareness of RWHSs. Although unquantifiable at this time, this outreach can provide the additional benefit of encouraging residents and business owners to incorporate rainwater harvesting and reuse on their properties.

The unincorporated County area of the MdRH watershed was modeled as part of the Quantification Analysis in the Implementation Plan. The model output provides the calculated BMP capacity volumes required by various types of BMPs to achieve adequate load reductions to meet the WLAs listed in the Toxics TMDL. The BMPs in the model include rainwater harvesting and reuse systems. Based on the results of the model, the number of typical RWHSs was estimated. The tributary drainage area, or capture area, that the RWHSs can treat was calculated assuming a 1.25-inch design storm and 100% impervious surface (rooftop). The annual volume of stormwater capture was calculated using the capture area value, an average rainfall of 14.1 inches (consistent with County's model of the watershed, which is based on 1995–2006 rainfall data), and assuming the systems will capture approximately 90% of annual rainfall (based on the literature review detailed in Integrated Water Resources Section of the Implementation Plan and rainfall design storm of 1.25 inches). Annual cost savings were estimated by applying the value of $800 per acre-ft to the annual volume of stormwater capture. The $800 per acre-ft cost for water value is the same as used in *Alternative Approaches to Stormwater Quality Control* (Devinny et al., 2005), a report prepared for the Regional Board and referenced in the Toxics TMDL. The results of these calculations are summarized in Table 7-1.

Table 7-1. Water Reuse Calculation Summary

Water Capture Required by Water Harvesting BMPs (acre-ft)	Capture Area (acres)	Annual Volume of Stormwater Capture (acre-ft)	Annual Cost Savings
0.085	0.82	0.86	$690

The results indicate that stormwater runoff from this amount of area (1.67 acres) of the unincorporated area of MdRH being captured and reused provides for minor water savings benefits annually. There is potential for the cost of water to increase, which would in turn increase the annual cost-saving estimate provided in Table 7-1.

It is anticipated that the MdRH area, like typical coastal urban communities in the Los Angeles region, will experience significant amounts of redevelopment throughout the TMDL implementation period. The quantification analysis conducted for the Implementation Plan estimates the amount of redevelopment and provides justification for the assumptions used in the estimations. Redevelopment will be required to follow the County's SUSMP and LID Standards. Redevelopment that falls within these guidance documents is required to incorporate treatment BMPs and LID design. More specifically, the LID Standards require infiltration where technically feasible, and water capture and reuse elsewhere. Infiltration is not technically feasible in a majority of the unincorporated County jurisdiction located within the MdRH watershed. Thus, redevelopment occurring during the implementation period will most likely involve beneficial reuse systems in addition to those listed in Table 7-1. However, the rainwater harvesting systems that may be constructed as part of redevelopment in the area cannot be quantified at this time.

7.1.2 Groundwater Recharge

Structural BMPs designed to infiltrate stormwater runoff into the substrata, in addition to removing pollutants, may also provide an additional benefit in recharging the underlying aquifer. There are limited opportunities for infiltration-type BMPs within the unincorporated County area of the MdRH watershed primarily due to the shallow groundwater depths around the harbor. Saltwater intrusion likely extends in the subject area. Groundwater is not used as a drinking water source. Groundwater recharge from infiltration may limit saltwater intrusion. Because of the proximity of the subject area to tidally influenced waters and the high groundwater table, the benefits from infiltration are limited; the only potential benefit in control of saltwater intrusion at a distance from the marine that is not tidally influenced. Because of the limited amount of groundwater recharge opportunities, cost benefits associated with groundwater recharge were not estimated as part of this study.

7.1.3 Water Conservation

Irrigation water that runs off lawns and other landscaped areas can cause erosion and carry soil, trash, pet waste, and excess fertilizers and pesticides from the landscaped areas into the storm drains and harbor. Trash and decaying plant material can result in harmful bacteria at beaches. Pesticides can damage important ecosystems and cause health threats. Fertilizers can contribute to excessive plant and algae growth, and dead and/or dying plant material in the water can take the oxygen out of the water and suffocate other life in the water. The use of drip-irrigation systems, soil moisture sensors to shut off sprinklers when not needed, and ensuring that sprinklers are turned off during rainstorms will help to conserve water (City of Del Mar, 2010).

Within the unincorporated areas of the MdRH watershed, the majority of the properties have small landscaped areas and/or planters. Most of these areas are served by automatic irrigation systems that have the potential to over-irrigate. The *Mother's Beach and Back Basins Bacteria TMDL Non-Point Source Study* (WESTON, 2007) identified over-irrigation due to broken sprinkler heads as a transport mechanism for pollutants and dry-weather discharges to MdRH. Poor irrigation system design and operating systems for too long also result in over irrigation. Modified County codes and ordinances to require zero dry-weather discharge from different types of residential, commercial, and industrial properties would reduce this type of runoff. It is difficult to quantify the precise amount of water conservation possible through aggressive enforcement resulting in less over-irrigation runoff; however, through reasonable assumptions the potential amount of runoff reduction can be estimated. Conservative values were used as a basis for estimating the annual runoff volume from over-irrigation and include total landscaped area within the unincorporated area of 10% of total area; percentage of broken or improperly configured sprinklers of 5%; typical watering amount of 0.25 inch per day watered; and number of days watered of 306 per year (365 minus 59 wet days, which is 0.1 inch or more of rainfall and the following 72 hours) based on rainfall data from the City of Santa Monica, City Hall, rain gauge between 1927 and 2006. The results of these calculations are provided in Table 7-2.

Table 7-2. Water Conservation Calculation Summary

Total Area	Estimated Landscaped Area (acres)	Estimated Annual Over Irrigation Runoff (acre-ft per year)	Annual Cost Benefit
107.6	10.8	3.4	$2,750

The results of these calculations indicate that a minor annual cost benefit may be realized with an aggressive inspection and enforcement program to prevent over-irrigation within the unincorporated MdRH Back Basin tributary area.

7.2 Bacteria Load Reductions

The County's model of the watershed provides recommendations of quantities for typical structural BMPs that include bioretention, porous pavement, and rainwater harvesting. Each of these typical BMPs are designed to capture stormwater runoff; thus, these BMPs reduce the amount of stormwater runoff and associated bacteria loads reaching the harbor. There are cost savings associated with using BMPs that reduce both the pollutants listed in the Toxics TMDL and bacteria as opposed to implementing two sets of BMPs; one set to address pollutants listed in Toxics TMDL and one set to address bacteria. Based on the *MdRH Mother's Beach and Back Basin Bacteria Wet-Weather TMDL Quantification Analysis* (MDRWRA, 2007), during the wet-weather time frame examined (2004–2006), a load reduction of approximately 31% or more would have prevented the three exceedance days above the exceedance days allowed by Bacteria TMDL. Based on the quantification analysis for Toxics TMDL Implementation Plan, structural BMPs will need to capture approximately 71% of the toxic pollutants to meet the WLAs in the

Toxics TMDL. Assuming a bacteria removal efficiency of 50%, implementing approximately 90% or more of the required structural BMPs would result in approximately 31% or more reduction in the bacteria loading. Table 7-3 shows a summary of the approximate cost savings from implementing structural BMPs to address pollutants listed in the Toxics TMDL that also address bacteria.

Table 7-3. Integrated Structural Best Management Practices Savings

Typical Type of Integrated Structural BMPs Proposed in the Toxics TMDL Implementation Plan	Total Cost of Proposed Toxics TMDL Structural BMPs	Percentage of BMPs Required to Reduce Bacteria Exceedance Days[1]	Benefit Dollars
Five Selected Sites for BMP Construction	$2,367,000	100%	$2,367,000
Bioretention	$19,690,000	90%	$17,720,000
Porous Pavement	$3,920,000	90%	$3,528,000
Water Harvesting	$430,000	90%	$387,000
Total	**$26,410,000**	–	**$24,000,000**

[1]The percentage of proposed integrated structural BMPs proposed under this Implementation Plan required in order to meet bacteria load reductions.

Utilizing BMPs that reduce both toxic pollutants and bacteria loads provides for significant cost benefits. This is primarily due to the high cost associated with implementing structural BMPs throughout the watershed.

7.3 Community Enhancement Benefits

Improvements to water quality provide numerous benefits to surrounding communities, beyond that of pollutant load reductions. Some of those benefits are highlighted here and include the esthetic value of clean waterbodies and streets, ecosystem services (protection of near-shore marine ecosystems), and higher property values from increased green space and water. The community benefits are sometimes very transparent, such as street sweeping to remove fine particles and debris. Other community benefits are not transparent. An example of this is ecosystem services, which are the collective benefits that a community receives from a multitude of resources and processes that are supplied by natural ecosystems and may include the production of food and water, supporting nutrient cycles and crop pollination, and control of climate and disease. BMPs that reduce the amount of toxic pollutants entering the ecosystem help to maintain and could improve the ecosystem services value.

Another matrix used to evaluate benefits is a person's "willingness to pay" for a benefit. Numerous surveys have been conducted to estimate a person's willingness to pay for different types of benefits, including their willingness to pay for removing all impairments from bodies of water. The Devinny et al. (2005) study estimates that the average willingness to pay for removing all impairments from bodies of water to be $15.46 per month with stormwater pollution alone to about one-tenth this amount.

There may be a connection between clean streets and improved health benefits based on reducing exposure to fine particles from streets. This may be more applicable for people with asthma or at risk of developing asthma. Our review of currently available published reference did not provide for quantification of this benefit. Therefore, the potential improved health benefits based on reducing exposure to fine particles from streets is not included in the cost-benefit analysis of this report.

The Devinny et al. (2005) study, referenced in the Toxics TMDL, estimated the cost benefit for several community enhancements on a regional level (Table 7-4). The estimates presented in the Devinny et al. (2005) study were applied to the MdRH area based on land area (107.6 acres), shoreline (5% of region usable shoreline), households (6,321), or population (8,176), whichever method is more applicable to the benefit. The population and household estimates are based on the 2000 United States Census estimation of the population within the MdRH area (USCB, 2008).

Table 7-4. Community Enhancement Benefits Summary

Community Enhancement Benefits	Matrix or Units	Benefit per Matrix or Unit	Cost Benefit
Willingness to pay for no impairments	Per person per year	$18.55	$152,000/year
Ecosystem services	Per mile of shoreline per year	$600,000	$300,000/year
Property value improvements from green space	Per household average lump sum	$2,000	$2,100,000[1]
Beach tourism	Region-wide per year	$3,000,000	$150,000/year
Property value improvement for trash control / cleaner street	Per person per year	$9.28	$76,000/year

[1]Assumes that one-sixth of households benefit. This is based on approximately half of the households being located near the Back Basins and one-third of those realizing benefits. $10,000 per house used in Devinny et al. (2005) study based on the adding green space and wetland. $2,000 used in this study based on adding only additional green space.

The annual cost benefits for the community enhancements are fairly consistent among each other. The increase in property value from green space is the total estimated amount of property value increase at the end of the implementation period (2021). The total value or present worth value ($1,620,000) divided evenly across 9 years would provide a yearly benefit of $180,000 per year, which is consistent with the other community enhancements.

7.4 Reduced Sediment in the Harbor

A portion of nonstructural BMPs and the majority, if not all, structural BMPs result in TSS pollutant load reduction. Nonstructural BMPs provide source control to keep soils in place and not available for transport into harbor. Structural BMPs serve to capture TSS (i.e., sediment), preventing it from reaching the harbor. Periodically, maintenance crews remove the trapped sediment within the BMPs. The sediment removed from BMPs is discarded in a designated and approved landfill or facility. By having a system of BMPs to prevent erosion and remove sediment from the stormwater runoff, the frequency of dredging the harbor to ensure safe navigation of watercraft within the harbor will be reduced. The model created by the County estimates that stormwater runoff generated in unincorporated County areas in MdRH watershed contains approximately 7,000 kilograms per year (i.e., 7.7 tons per year) of TSS. The model calls for a load reduction of approximately 96%. This load reduction would result in removing approximately 7.4 tons of sediment per year. Using estimated costs of transport and disposal at Otay Landfill in Chula Vista, California, as outlined in the *Oxford Retention Basin Sediment and*

Water Quality Characterization Study (WESTON, 2010), the annual benefit of reducing sediment in the harbor is summarized in Table 7-5.

Table 7-5. Reduced Sediment in the Harbor Calculation Summary

Dredging Costs	Dewatering Costs	Transport & Disposal Costs	Annual Sediment Load Removed	Annual Benefit
$10/ton	$25/ton	$45/ton	7.4 tons	$600

The annual benefit associated with reduced dredging, dewatering, transport, and disposal of sediment from the MdRH is minor. This estimate assumes that large quantities (greater than 10,000 tons) of materials are removed as part of an overall dredging project.

7.5 Multi-Benefit Summary

There are many multi-benefits associated with the implementation of the nonstructural and structural BMPs beyond reductions in pollutants listed in the Toxics TMDL. Some of the benefits are easy to quantify and can be done fairly accurately. The quantification of other additional benefits is done with much less certainty (e.g., increases in property value); however, additional benefits will be realized, and the quality of life for the MdRH residents and visitors will be improved to some degree as a result of implementing BMPs throughout the MdRH watershed.

The nonstructural and structural BMPs selected for the Implementation Plan each provide multiple numbers of additional benefits listed in this report. As part of the Implementation Plan, five sites were selected as potential properties for BMP implementation. A variety of factors influenced the selection and/or location of a particular BMP system. These included goals from regulatory agencies such as water quality standards. Others included physical site constraints in the MdRH. To the maximum extent possible, BMPs with multi-benefits were selected. Table 7-6 shows a summary of the potential multi-benefits associated with the five sites selected for BMP implementation.

Table 7-6. Summary of Multi-Benefits for the Five Selected Sites

SITE / BMP	Aesthetics	Capture & Reuse	Bacteria Load Reduction	Flood Control Protection	Groundwater Recharge	Ecosystem Services	Property Value	Water Conservation
Parking Lot 5 & Marina del Rey Library								
Bacterra™ bioretention technology	X	–	X	–	–	X	X	–
Biofiltration planter	X	–	X	–	–	X	X	–
Rain barrels / cisterns	–	X	X	X	–	X	–	X
Parking Lot 7								
Bioretention planter	X	–	X	X	–	X	X	–
Parking Lot 9								
Cisterns	–	X	X	X	–	X	–	X
ClearWater BMP Filtration System	–	–	–	–	–	X	X	–
Flow-through planter boxes	X	–	X	–	–	X	X	–
Parking Lot 10								
Flow-through planter boxes	X	–	X	–	–	X	X	–
Sand infiltration trench	–	–	–	X	–	X	–	–
Parking Lot 11								
Biofiltration planter	X	–	X	–	–	X	X	–
Porous pavement	–	–	X	–	–	X	X	–
"X" indicates that a quantifiable benefit is realized by the BMP. "–"indicates that a quantifiable benefit is not realized by the BMP.								

Table 7-7 provides a summary of the costs associated with the benefits, beyond water quality improvement, assuming that nonstructural and structural BMPs are implemented throughout the unincorporated County areas of MdRH Back Basins watershed, as recommended in the Implementation Plan based on the quantification analysis and results of the County's watershed model. This includes various nonstructural BMPs that provide public education and outreach and true source control. Structural BMPs include the designated BMPs at five selected sites and the other BMPs identified in the quantification analysis section of the Implementation Plan. Present worth calculation is based on the 2011 dollars, interest rate of 3%, and implementation period of 9 years (i.e., 2012–2021).

Table 7-7. Summary of Additional Benefit from Base Modeled Summary

Benefit	Annual Benefit ($)	Present Worth[2] ($)
Water capture	800	5,700
Water conservation	2,750	21,400
Bacteria load reduction from structural BMPs	2,667,000	20,050,000
Willingness to pay for no waterbody impairments	150,000	1,180,000
Ecosystem services	300,000	2,340,000
Property value improvements from green space[1]	2,100,000	1,620,000
Beach tourism	150,000	1,170,000
Property value increase for trash control	76,000	590,000
Reduced sediment in the harbor	600	4,700

[1]Property value improvement is not an annual benefit, but rather, the estimated total benefit that may be realized at the end of the implementation period.
[2]Present worth calculation based on 3% interest rate over the remaining implementation period of 9 years.

The TMDL Implementation Plan includes an alternatives analysis that considers the effects of increasing nonstructural BMPs and/or water harvesting BMPs in order to comply with WLAs. The alternatives analysis establishes a set of criteria and a point system as a means to compare various potential alternatives with one another. The multi-benefits achieved by BMPs are considered part of the criteria. Several multi-benefits may exist for each alternative. Scoring used in the alternatives analysis for the multi-benefit provided is as follows:

- Water capture – 2 points
- Water conservation – 1 point
- Bacteria load reduction from structural BMPs – 3 points
- Willingness to pay for no waterbodies being impaired – 0.5 points
- Property value increase for trash control – 0.5 points
- Ecosystem services – 1 points
- Beach tourism – 1 point
- Reduced sediment in the harbor – 1 point
- Property value improvements from green space and water – 1 point

Additionally, this multi-benefit analysis may be used during the implementation period as part of the adaptive management strategy. The suite of BMPs may be refined during the implementation period based on new technologies and the outcome of monitoring efforts. This results of this analysis presented in this report should be considered and may aid in the selection process of when refining the suite of BMPs to meet WLAs.

8.0 ANALYSIS OF ALTERNATIVES

The results of the quantification analysis conducted for the Implementation Plan show that nonstructural BMPs may provide approximately 25% of load reductions required of toxic pollutants listed in the Toxics TMDL. This analysis was conducted based on the information currently available, which, in general, is not specific to the MdRH watershed; but rather, generally applicable to the entire Los Angeles Region. Efforts are currently underway to collect data specific to the MdRH watershed. One example of this is the stormwater monitoring occurring in the watershed as detailed in the *MdRH Toxic Pollutants TMDL Coordinated Monitoring Plan* (Toxics CMP) (LADPW et al., 2008). As data specific to the area become available, values used in the quantification analysis may be revised to better represent the area, which may result in the implementation of fewer structural BMPs to achieve the WLAs listed in the Toxics TMDL.

Implementing and evaluating the effectiveness of nonstructural BMPs is an emerging science. To provide acceptable levels of assurance that the estimated load reductions will be obtained, the nonstructural BMP load reductions detailed in the quantification analysis of the Implementation Plan are conservative and generally based on the programs that are supported by documentation. Additional nonstructural BMPs, such as true source control, may provide significant amounts of load reductions. Many of these true source control type nonstructural BMPs rely on legislative actions at the state and federal levels, and sometimes the voting public. Therefore, the feasibility of implementing these BMPs is less certain, and thus, at this time, cannot be quantified with high load reduction percentages. However, if ordinances and laws are enacted that minimize the use of toxic pollutants listed in the TMDL, significant reductions in stormwater pollutants may be realized, which in turn will reduce the number of structural BMPs required to meet the WLAs listed in the Toxics TMDL.

This alternatives analysis considers various values of load reductions achieved from nonstructural BMPs from those used in the quantification analysis to represent different scenarios, or evaluations that may occur in the future. There is less certainty that these alternative evaluations will occur in comparison to the scenario that the quantification analysis is based on. These alternative evaluations are provided as plans that may be implemented if true source control measures currently in place result in significant load reduction and additional measures are implemented, such as ordinances that reduce the use of products containing zinc within the watershed.

One example of an existing true source control measure is Senate Bill 346, recently signed into law, that phases out the use of copper in brake pad manufacturing and will significantly reduce copper loading over the next 20 years. The effects of recently passed legislation to reduce toxics in manufactured goods and the current efforts underway to reduce additional toxics should be tracked by watershed managers on a yearly basis, at a minimum. If products that are currently contributing significantly to the toxic pollutant loads within MdRH are replaced with products that do not, then the options presented in this alternatives analysis may be used, in part or in whole, depending on the circumstances and results of monitoring at the time. Additionally, the County may use this analysis to initiate the process for implementing certain alternatives (nonstructural BMPs) listed.

This analysis identifies several potential alternatives that if implemented would reduce loading of toxic pollutants in MdRH. A list of potential benefits and criteria scoring is created, and each alternative is evaluated to determine which benefits the alternative would provide. Based on this, a benefit score is given to each alternative. Next, a list of potential obstacles and criteria scoring is presented, and each alternative is evaluated to determine which obstacles are applicable and the resulting obstacle score for each alternative. A comparison of the benefits and obstacles for each alternative is shown. The alternatives are bundled into two groups for evaluation. One group consists of enhanced nonstructural BMPs, and the other consists of enhanced water harvesting BMPs.

8.1 Potential Alternatives

Based on published resources, knowledge of emerging strategies to reduce pollutant loading, and WLAs listed in the Toxics TMDL, a list of potential alternatives includes:

- True Source Control – Effects of banning the installation of lead weights to balance tires in California (California Health and Safety Code Section 25215.6, ban effective date January 1, 2010).
- True Source Control – Phasing out of copper in brake pads (Senate Bill 346 signed into law).
- True Source Control – Zinc in tires potentially being phased out.
- Evaluation of monitoring results to assess loading of organic toxics in stormwater runoff.
- Street Sweeping and Aerial Deposition Special Studies.
- Public-private partnership to replace/paint zinc-coated surfaces.
- Ordinance changes to allow use of captured rainwater for indoor plumbing (flushing water for toilets).
- Public-private partnership to construct RWHS on leased parcels.
- Construction of a central treatment plant.
- Infrastructure to pump collected water to nearest water treatment plant.

8.2 Criteria List and Benefit Scoring of Potential Alternatives

The following criteria and scoring was developed to evaluate the benefits of the potential alternatives for comparison with the obstacles. The scoring list provides numeric values if certain conditions are met; however, the actual score for each alternative may fall in between the values listed. The criteria list and scoring are as follows:

1) Load reduction effectiveness is the highest weighted criteria. For an alternative to be practical, it must contribute to the overall load reduction goals of the Implementation Plan. Scoring for this criteria is as follows:
    - High pollutant load reduction potential if implemented.
        - Score: 10 points

- Medium pollutant load reduction potential if implemented.
  - Score: 7 points
- Low pollutant load reduction potential if implemented.
  - Score: 5 points

2) Cost associated with implementing BMPs. The scoring for cost is primarily to identify options that may be cost prohibitive, such as collecting and processing through advance treatment 90% of all stormwater runoff in the watershed. Scoring for this criteria is as follows:
   - Relative low costs when compared to the implementation of structural BMPs required to obtain equivalent load reductions. An example of this is the administrative cost associated with supporting legislation to reduce the use of toxic pollutants in manufactured goods.
     - Score: 5 points
   - Medium costs, such as public outreach and enforcement.
     - Score: 3 points
   - Very high costs, similar to those of typical structural BMPs.
     - Score: 0 points
3) Technical feasibility of BMP to be implemented. Scoring for this criteria is as follows:
   - Technically proven and well-documented load reduction potential.
     - Score: 5 points
   - Reasonable certainty that BMP will function and result in load reductions.
     - Score: 3 points
   - Not proven but BMP most likely will result in some load reduction.
     - Score: 1 point
4) Is the alternative supported by existing legislation or ordinance changes that have been signed into law? Scoring for this criteria is as follows:
   - Legislation or ordinance that has already been signed into law.
     - Score: 10 points.
   - Legislation or ordinance that has been drafted, but not approved.
     - Score: 3 points.
   - Alternative is not reliant on legislation or ordinance, or alternative is reliant on legislation or ordinance that has not yet been drafted.
     - 0 points.
5) Multi-benefits realized by the alternative. Several multi-benefits may exist for each alternative. More information relating to multi-benefits is provided in the Multi-Benefits Section of the Implementation Plan. Scoring for each multi-benefit is as follows:
   - Water capture.
     - Score: 2 points
   - Water conservation.
     - Score: 1 point
   - Bacteria load reduction from structural BMPs.
     - Score: 3 points
   - Willingness to pay for no waterbody impairments.
     - Score: 0.5 points
   - Property value improvements from trash control.
     - Score: 0.5 points

- Ecosystem services.
  - Score: 1 points
- Beach tourism.
  - Score: 1 point
- Reduced sediment in the harbor.
  - Score: 1 point
- Property value improvements from green space.
  - Score: 1 point

Each potential alternative is evaluated using this criteria and a score is determined for each benefit. The scores for each benefit are summed to determine the overall benefit score for each alternative. Table 8-1 shows the results of this evaluation. The benefit scores are compared to the similarly calculated obstacle score in the following section.

Table 8-1. Criteria List and Scoring for Alternatives

Alternative	Load Reduction Effectiveness	Cost	Technical Feasibility	Ordinance or Legislation signed into law	Multi-Benefits Realized	Subtotal
Lead Weights from Tires	5	5	3	10	3	26
Brake Pad Partnership	7	5	3	10	3	28
Ordinance to reduce the use of products that contain zinc	7	3	3	0	3	16
Zinc phased out of tires	10	3	3	0	3	19
Evaluation of monitoring results to assess loading of organic toxics in stormwater runoff	5	3	1	0	3	12
Rainwater use for indoor plumbing ordinance	5	3	3	0	9	20
Street Sweeping and Aerial Deposition Special Studies	5	5	3	0	4	17
Public/Private partnership to replace/paint zinc-coated surfaces	10	3	3	0	3	19
Public-Private partnership to construct rainwater harvesting system on leased parcels	10	0	5	0	10	25
Construction of central treatment plant	10	0	1	0	10	21
Infrastructure to pump collected water to nearest water treatment plant	10	0	1	0	10	21

8.3 Obstacle Evaluation and Final Score

The alternatives obstacle evaluation determines the obstacles, or challenges, associated with each alternative, provides a score for each, and presents a numerical comparison to the benefit score of each alternative. The obstacle score is determined based on the County's ability, or lack of, to implement the alternative. For example, an alternative being dependant on State Legislation to pass a law is consider a large obstacle and would receive a high score negative score. An alternative only requiring funding is considered to have a low level obstacle, unless it takes significantly more funding than other similar programs, in which case the alternate would have a medium or large level obstacle. Several factors were examined to determine the obstacle level, as follows:

1) If the alternative is dependent on changes to ordinances.
   - Score: minus 5 points
2) If the alternative is dependent new legislation.
   - Score: minus 5 points
3) If there is a potential to have public backlash due to unwelcome construction and/or changes to established community features.
   - Score range: 0 points if no anticipated public backlash. Minus 5 points if significant public backlash anticipated.
4) If there is a potential that the alternative will not be realized prior to the end of the implementation period (March 2021).
   - Score range: 0 points if alternative will be fully implemented. Minus 10 points if only be partially implemented (less than 25%).

Each potential alternative is evaluated using this criteria and a score is determined for each type of obstacle. The scores for the obstacles are summed to determine the overall obstacle score for each alternative. The obstacle score is compared to the benefit score shown in the previous section to calculate the total score for each alternative. Table 8-2 shows the results of this evaluation. A high positive score indicates good potential benefits with little obstacle. A low score indicates that the obstacle associated with that alternative is high under existing circumstances. A low score does not exclude that alternative from being considered, but rather indicates a higher obstacle for that alternative in comparison to other alternatives that have higher scores.

Table 8-2. Obstacle Scores and Total Score for Alternatives

Alternative	Requires New Ordinance Changes	Requires New Legislation	Public Backlash Potential	Alternative may not be Realized Prior to 2021	Obstacle Score	Total Score
Lead Weights from Tires	0	0	0	-3	-3	**23**
Brake Pad Partnership	0	0	0	-10	-10	**18**
Ordinance to reduce Zinc	-5	0	-2	-5	-12	**4**
Zinc phased out of tires	0	-5	-2	-10	-17	**2**
Evaluation of monitoring results to assess loading of organic toxics in stormwater runoff	0	0	0	-5	-5	**7**
Rainwater use for indoor plumbing ordinance	-5	0	-2	-3	-10	**10**
Street Sweeping and Aerial Deposition Special Studies	0	0	0	0	0	**17**
Public/Private partnership to replace/paint zinc-coated surfaces	0	0	-4	0	-4	**15**
Public-Private partnership to construct rainwater harvesting system on leased parcels	-5	0	-5	0	-10	**15**
Construction of central treatment plant	0	0	-5	-5	-10	**11**
Infrastructure to pump collected water to nearest water treatment plant	0	0	-5	-5	-10	**11**

Based on the evaluation, all of these alternatives have positive scores and seem feasible. Attempting to get legislation signed into law to phase out zinc use in manufacturing of tires has the lowest score. Tire wear is a know source of zinc pollution in stormwater runoff, and this true source control has the potential to significantly reduce zinc loading in stormwater runoff. However, the time frame to get legislation introduced, signed into law, and implemented into the manufacturing practices (approximately 15 to 20 years) would exceed the implementation period, which currently ends in March, 2021. Although this alternative has scored the lowest, it should not be discarded as a viable cost effective long-term solution. True source control alternatives do have longer implementation time frames and challenges due to the legislative process, but they offer the most cost effective long-term sustainable solution for toxic pollutants. The organization California Stormwater Quality Association (CASQA) is working with cities, industry, and regulatory agencies towards true source control solutions. CASQA was a strong supporter of the Brake Pad Partnership that led to legislation to reduce the copper concentration in brake pads. CASQA is moving forward with assessing other constituents that includes zinc in supporting true source control solutions. This alternative should therefore be retained and support given to organizations like CASQA that are working towards these cost effective long-term solutions for applicable constituents such as zinc.

The feasible alternatives are grouped into two alternative evaluations and presented in the following section. One alternative evaluation combines the source control and special studies alternatives listed and estimates potential load reductions and the resulting reductions in cost for structural BMPs required. The second alternative evaluation examines the maximum amount of rooftop RWHSs that could be implemented if ordinance were changed to allow reuse as flushing water for toilets and/or if other end uses for collected rainwater were established.

8.4 Alternative Evaluation – Enhanced Nonstructural Best Management Practices

This alternative evaluation groups several nonstructural BMPs together, including true source controls and special studies, to evaluate the maximum potential load reduction that may be quantified if successfully implemented. True source control measures minimize toxic pollutants, such as metals listed in the TMDL, from entering the environment by preventing or minimizing the use of such pollutants in the manufacture of certain products that are known sources of pollution to stormwater runoff. By replacing products that contain toxic pollutants with products that do not contain toxic pollutants, load reductions are achieved. Monitoring and special studies may be conducted during the implementation period that results in a more accurate estimation of the current pollutant loading from stormwater runoff in the unincorporated area MdRH. This more accurate pollutant loading estimation may be less than the loading calculated by the County’s watershed model; and thus load reductions, when compared to the baseline set by the model, will be quantified. The remaining load reductions required to meet the WLAs listed in the Toxics TMDL, beyond those achieved by nonstructural BMPs, will need to be addressed through the implementation of structural BMPs. By potentially maximizing the load reductions achieved by nonstructural BMPs, fewer structural BMPs are required for compliance in comparison with the base model alternative evaluation criteria, which is detailed in the Quantification Analysis Section of the Implementation Plan.

8.4.1 Nonstructural Best Management Practices Currently Identified for Implementation

Several identified alternatives are nonstructural BMPs that are currently in place or proposed for implementation prior to March 2011. Load reductions may be realized by these identified nonstructural BMPs with little or no additional effort by the County.

8.4.1 Lead Wheel Weights Ban

One source of lead in the environment is lead wheel weights that fall off vehicles. These weights can be washed into storm drain inlets that connect to the MdRH, where over time they can dissolve into stormwater runoff. Lead wheel weights also can be abraded from traffic, creating lead dust, which is then aerially deposited in the watershed and conveyed into MdRH during storm events. USEPA estimates that 1.6 million pounds of lead is abandoned on U.S. roadways from weights that have fallen off wheels. California State Legislature recently signed into law (in effect after January 1, 2010) a prohibition on the manufacture, sale, or installation of wheel weights that contain more than 0.1% lead (DTSC, 2010).

8.4.2 Copper being Phased Out of Brake Pads

From brake pads, small amounts of debris are released onto streets, into the air, and eventually into waterways each time drivers apply their brakes. Much of this debris contains copper. Senate Bill 346 requires brake pad manufacturers to reduce the use of copper in brake pads sold in California to no more than 5% by 2021 and no more than 0.5% by 2025 (Suscon, 2010). Brake pads are currently manufactured with as much as 20% copper (SCVUPPP, 2010).

8.4.3 Evaluation of Organic Pollutants within Stormwater Runoff

Several studies were reviewed and summarized in the Implementation Plan. Some of these reviewed studies included assessments of sediments in the MdRH and found chlordane and DDT concentrations to be highest at the mouth of the main channel and lower in the Back Basins. The conclusions of these studies suggest a source external to MdRH is contributing to these constituents. The study authors generally concluded that the source was most likely Ballona Creek. Monitoring currently underway within the MdRH (in accordance with the Toxics CMP) may indicate that the organic pollutants chlordane and DDT are not a result of stormwater runoff into the MdRH Back Basins.

8.4.4 Additional Nonstructural Best Management Practices

Currently, there are no source control measures that have the potential to significantly reduce zinc loading from stormwater runoff. Galvanized metals are metals coated with zinc to protect them from corrosion. The zinc gradually dissolves when it contacts water. Zinc in stormwater runoff directly from galvanized metal surfaces is typically very high, between 1,000 and 15,000 μg/L (Golding, 2008). The zinc concentration in stormwater runoff, on average, will need to be about 14 μg/L or less to be in compliance with the TMDL based on average annual rainfall, impervious cover around MdRH, and WLA allotted to the County. This value is in great contrast to typical values of zinc in runoff generated on surfaces with galvanized materials. Preventing the use of galvanized items and removing galvanized items currently installed in the area are source control measures to reduce zinc in runoff. Painting galvanized surfaces is another way to reduce the amount to zinc loading in stormwater runoff.

Within the unincorporated County areas of MdRH Back Basin watershed there are several potential uses of galvanized items. Some of these galvanized items may include:

- Roofs
- Roof HVAC, ductwork, turbines, equipment boxes
- Roof gutters and downspouts
- Chain-link fence
- Light Poles
- Doors
- Certain White Paints
- Exterior Stairways
- Exterior Railings
- Truck and boat trailer frames and panels

The County may consider implementing new ordinances and updating building standards to prevent the use of items with galvanized surfaces exposed to rainfall in future redevelopment projects around MdRH. The County may development a program to partner with property lessees to reduce loading from existing galvanized surfaces. This may include the County providing funding to paint galvanized surfaces on each leased parcel. The first phases of this type of public-private partnership should include a detailed survey of galvanized items on public and leased properties. The results of the galvanized surface survey could provide cost estimates for painting or replacing items and the associated load reductions possible by doing so.

Additional zinc load reductions may be achieved by an aggressive street sweeping program that utilizes vacuum-assisted sweepers. Tires contain zinc at approximately 1% by weight. Tire tread wear releases fine particles of zinc-laden dust (Golding, 2008). These particles can be removed from the watershed using street sweepers. As detailed in the Nonstructural BMPs Section of the Implementation Plan, vacuum-assisted sweepers are more effective at removing fine particles. Fine particles bind a high proportion of heavy metals including zinc. To prioritize street-sweeping efforts and to assess the overall contribution of aerial deposition to metals loads within area, the County may conduct an Aerial Deposition Special Study, with special consideration for Highway 1 and Highway 90. To assess the effectiveness of vacuum-assisted sweeping and determine the appropriate sweeping frequency, the County may conduct a Street Sweeping Effectiveness Special Study. This special study would also provide further quantification of load reductions associated with the vacuum-assisted sweeping.

Additional long-term zinc reductions may be realized through the support of state-wide efforts to enact legislation to reduce zinc concentration in tires. Tire wear is a known source of zinc pollution in stormwater runoff, and this true source control has the potential to significantly reduce zinc loading in stormwater runoff. The time frame to get legislation introduced, signed into law, and implemented into the manufacturing practices (approximately 20 years) would exceed the implementation period, which currently ends in March 2021. However, supporting state-wide efforts to reduce zinc concentration in tires may provide long-term load reductions that could be realized beyond the March 2021 time frame.

8.4.5 Enhanced Nonstructural Best Management Practices Alternative Evaluation Conclusions

The combination of nonstructural BMPs described in this alternative evaluation will result in significant reductions in pollutant loads entering MdRH. Without conducting the above-mentioned special studies (Zinc Survey, Aerial Deposition, and Street Sweeping Assessment), it is difficult to accurately approximate the potential load reductions that may be realized once these nonstructural BMPs listed are fully implemented. Based on the estimates of current zinc loading in MdRH and typical widespread use of galvanized materials for rooftop equipment, downspouts, fences, and railing, it is reasonable to assume that the full implementation of this alternative evaluation will increase load reduction associated with nonstructural BMPs from 25% to between 40% and 75%. Load reductions of copper are estimated to between 35% and 70%. Load reductions of lead are estimated to between 30% and 65%.

The remaining load reductions would need to be addressed by structural BMPs. Model results indicate that zinc is the driver for load reductions (requires the highest percentage of load reduction to meet WLA). A zinc load reduction of approximately 95% is required to achieve the WLA. Load reductions of 86% and 91% are required to be in compliance with WLAs for lead and copper, respectively. Based on zinc being the driver to meet WLA for metals and the above estimate of load reductions from nonstructural BMPs (between 40% and 75%), structural BMPs would still be required to reduce loads by approximately 20% to 55%. Assuming that a cost of $21.1 million is required to implement structural BMPs to achieve the base model alternative evaluation load reductions of 70% and assuming a linear relationship between cost and load reductions, cost savings would be between $4.5 and $15.0 million, minus the cost of implementing the zinc-targeted nonstructural BMPs and special studies, which are estimated to cost approximately $2.5 million. Therefore, the net potential cost savings are estimated to be between $2.0 and $12.5 million. The relationship between cost and load reduction is not linear; however, assuming a linear relationship provides a rough estimate.

Greater long-term cost reduction can be realized if legislation is adopted to reduce zinc concentrations in tires. As discussed, this alternative has a greater time frame and more unknowns due to the legislative process. However, this alternative could provide a cost-effective long-term solution and should be considered. For this alternative evaluation, load reductions from the true source control of reducing zinc in tires are considered zero during the implementation period and thus do not contribute to the above-mentioned cost-benefit analysis.

8.5 Alternative Evaluation – Enhanced Water Harvesting

In accordance with the base model alternative, as shown in the quantification analysis section of the Implementation Plan, RWHSs are proposed as a structural BMP to improve the water quality of runoff entering MdRH and help in achieving TMDL compliance. The design of systems must consider site constraints such as the existing high-density built-out nature of the area, high groundwater table, limited existing landscaping, and limited end-use options available, under current health code regulations, for collected rainwater. Thus, there are limited opportunities for retrofitting of high-rise buildings with rainwater harvesting systems. This alternative evaluation examines the average annual amount of rainfall capture possible if harvesting systems were implemented on all rooftops located within the unincorporated MdRH Back Basins watershed assuming policies are changed that allow additional end uses of collected rainwater.

8.5.1 Evaluation of Available Rooftop Areas

Using aerial photographs and GIS software, the total surface area of the rooftops within the drainage area was estimated at approximately 19.3 acres. Figure 8-1 shows the identified rooftop areas within the unincorporated County Back Basin watershed.

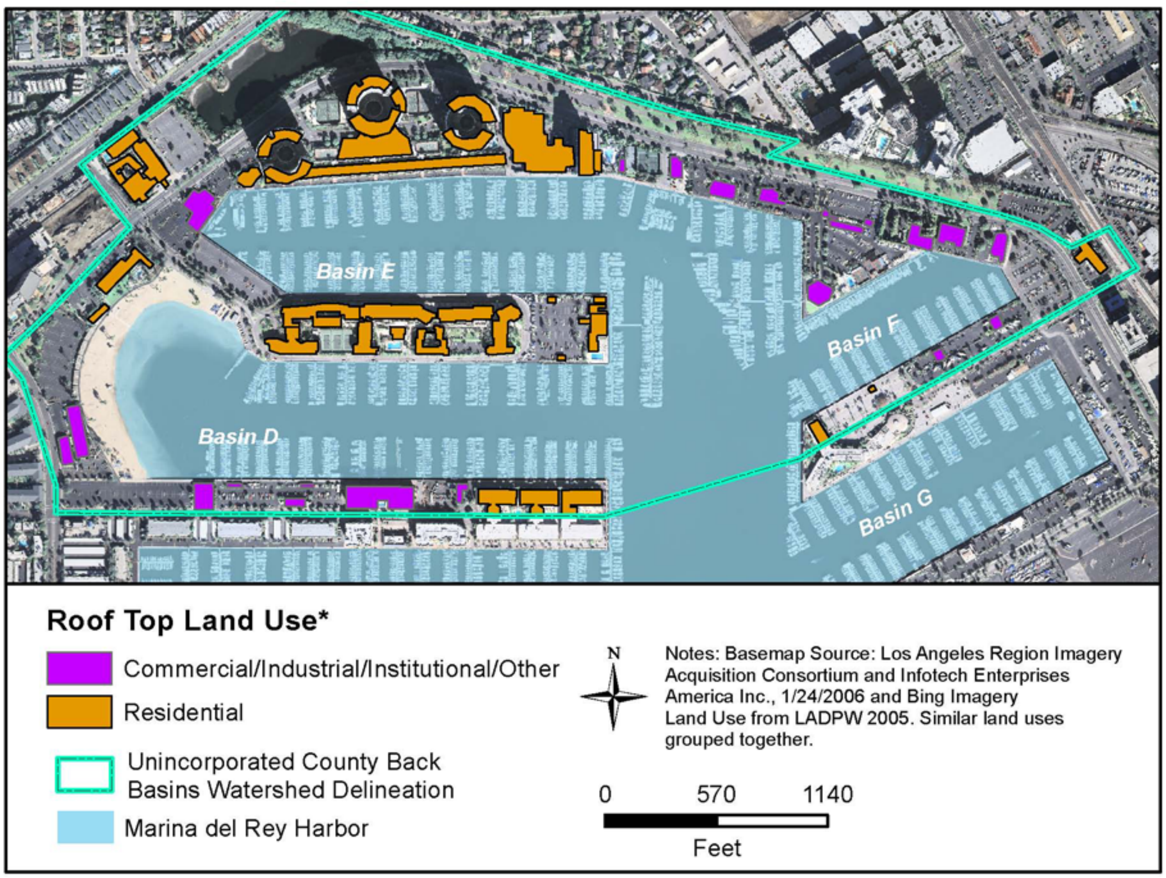

Figure 8-1. Rooftop Areas within the Unincorporated County of Los Angeles Marina del Rey Harbor Back Basin Drainage Area

Table 8-3 shows the land-use areas and associated rooftop areas where RWHSs could be implemented. The annual volume of stormwater capture was calculated based on the rooftop surface area, an average rainfall of 14.1 inches (consistent with County's model of the watershed, which is based on 1995–2006 rainfall data), and assuming the systems will capture approximately 90% of annual rainfall (based on the literature review detailed in Integrated Water Resources Section of the Implementation Plan and rainfall design storm of 1.25 inches). The results of these calculations are presented in Table 8-3. Table 8-4 shows a comparison between the potential annual capture volume and the annual water demand based on population.

Table 8-3. Water Harvesting Potential if System Implemented to Collect Runoff from All Rooftops

Land Use	Land Area (acres)	Roof Top Area (acres)	Total Capacity of BMPs Volume (acre-feet)	Annual Capture Volume (acre-feet)	[1]Water Supply Annual Cost Benefit
Residential	30.8	14.6	1.5	15.4	$12,400
Commercial/ Industrial/ Institutional/Other	72.8	4.7	0.5	5.0	$4,000
Total	103.7	19.3	2.0	20.4	$16,400

[1]Cost Benefit determined by multiplying Annual Capture Volume by $800 per acre-ft.

Table 8-4. Annual Water Demand Based on Population and Comparison to Potential Harvested Rainwater

Annual Capture Volume (acre-feet)	[1]Total Annual Water Demand (acre-ft)	Percentage of Annual Total Water Demand
20.4	1,540	1.3%

[1]Based on residential population of 8,176 (USCB, 2008) and water usage per capita rate of 168 gpd (LBWD, 2006).

The results of the potential rainwater harvesting estimates show that maximizing rainwater harvesting may offset a fraction of the water consumed by residents in MdRH. Rainwater harvesting combined with conservation efforts, such as low-flow showers and high-efficiency appliances, could play an important role in balancing the future water demand in the area.

8.5.2 Potential Load Reductions

Significant load reductions may be realized by maximizing rainwater harvesting. To evaluate the potential load reductions by this alternative evaluation, the Simple Method Model was used to estimate TSS pollutant load from stormwater runoff for each land use. Sediment concentrations equal to those used in the County's WWMS were applied to the estimated TSS loads to estimate the pollutant loading, and thus load reductions, of constituents listed in the Toxic TMDL. The results of these calculations are provided in Table 8-5.

Table 8-5. Total Annual Load Reductions from Water Harvesting Alternative Evaluation

Land Use	Roof Top Area (acres)	Copper Load Reduction (lb)	Lead Load Reduction (lb)	Zinc Load Reduction (lb)	Percentage of Total Zinc Load Removed
Residential	14.6	0.7	0.7	7.0	12.0%
Commercial/ Industrial/ Institutional/Other	4.7	0.3	0.3	3.3	5.6%
Total	19.3	1.1	1.0	10.3	17.6%

The results of load reduction estimates indicate that widespread implementation of RWHSs could contribute greatly to meeting WLAs in the Toxics TMDL. For this rainwater harvesting alternative evaluation to be feasible, the County would most likely need to modify existing policies that regulate the end use of collected rainwater. The County may also need to establish a public-private partnership with property lessees to construct water harvesting systems on leased parcels.

LADPH regulations state that captured rainwater can only be used for subsurface drip line irrigation unless treated to Title 22 Standards for tertiary recycled water (Geosyntec, 2009). If this LADPH ordinance were changed to allow harvested rainwater to be used for toilet flushing, more widespread use of RWHSs may be implemented throughout MdRH.

An additional end use for harvested rainwater could be to direct collected rainwater to a centrally located treatment plant for processing for use as recycled or potable water supply. A treatment plant would require large capital investment to construct and maintain. Instead of constructing and operating a treatment plant locally, infrastructure could be constructed to pump the collected rainwater to the nearest water treatment plant.

Implementing water harvesting systems throughout the unincorporated County MdRH Back Basins watershed, including leased parcels, will require a public-private partnership to facilitate the construction of RWHSs on developed privately leased properties. This may include the County funding initial construction of such systems, and property lessees being responsible for maintaining the systems. A permit for the systems may allow the County to have oversight of installed systems through annual inspections.

8.5.3 Enhanced Rainwater Harvesting Alternative Evaluation Conclusions

The results of this evaluation show that significant load reductions may be achieved through the widespread implementation of RWHSs. Overall, approximate load reductions of approximately 18% may be possible if RWHSs are implemented to collect runoff from all rooftops throughout the unincorporated County MdRH Back Basin watershed. To facilitate the construction of water harvesting on leased parcels, the County will need to establish a public-private partnership program with parcel lessees. LADPH regulations may need to be changed to allow the use of collected water for indoor toilet flushing. Other end uses of collected rainwater may be evaluated for potential implementation, which include construction of a treatment plant to process water for reuse or construction of infrastructure to pump collected water to the nearest water treatment plant for processing.

Implementation costs associated with RWHSs are similar to the costs of implementing other types of capture structural BMPs such as porous pavement and bioretention systems. Each type of capture BMP requires a storage component. Costs for these storage components are similar to each other. RWHSs may require additional cost for infrastructure to convey collected rainwater to a storage and treatment facility and for the end reuse systems. These costs would be partially offset by the cost of water supply. Water costs may increase, making the infrastructure costs of this alternative more cost competitive with other types of structural BMPs.

9.0 IMPLEMENTAION SCHEDULES

The main purpose of this section of the Implementation Plan is to present TMDL compliance schedule and implementation schedules for each of the nonstructural and structural projects and programs developed for MdRH. These schedules may be used by the County for long-term planning and budgeting efforts. Based upon an adaptive management strategy, as more and watershed-specific information relating to pollutant loads is available, more detailed schedules may be developed using this basic framework.

This section includes the following:

- TMDL schedule.
- Load reduction schedule to meet the WLAs.
- Detailed implementation schedules for nonstructural programs.
- Detailed implementation schedule for structural projects.

9.1 TMDL Schedule

The Regional Board adopted the Toxics TMDL on October 6, 2005 (LARWQCB, 2006). The Toxics TMDL presents two possible TMDL implementation schedules based upon the implementation approach adopted by the County. The TMDL specific implementation plan approach allows 10 years to meet the sediment WLAs. An extended period, a total of 15 years, is allowed for the TMDL implementation period for the implementation of an integrated water resources approach (including beneficial reuse of stormwater) in recognition of the additional planning and time needed for this approach.

The County has adopted an integrated water resources approach. The TMDL implementation schedule, as defined in the Toxics TMDL and Bacteria TMDL, is presented in Table 2-2. The schedule uses a phased approach, where compliance is to be achieved in incremental percentages of the watershed (compliance milestones). The compliance milestones represent the minimum amount of load reductions to be achieved prior to the milestone date. Load reductions achieved are in comparison to the existing loads reaching MdRH as determined by the WMMS, which estimates existing pollutant load values that are very similar to the existing load values estimated by the Simple Method Model that was used to develop the Toxics TMDL. To meet the compliance milestone a combination of structural and nonstructural strategies designed specifically to reduce toxic pollutant and bacterial loading to MdRH will be implemented. The final compliance point occurs in 2021.

Table 9-1. Implementation Schedule for an Integrated, Multi-pollutant Approach to the Marina del Rey Harbor Total Maximum Daily Loads

Integrated TMDL	Action	Date
Metals and Toxic Pollutants TMDL Schedule using an Integrated Approach	Effective Date	March 22, 2006
	Draft TMDL Implementation Plan	March 22, 2011
	Final TMDL Implementation Plan	September 22, 2011
	TMDL Re-Opener	March 22, 2012
	25% of Load Reduction To Meet WLAs Achieved	March 22, 2013
	50% of Load Reduction To Meet WLAs Achieved	March 22, 2015
	75% of Load Reduction To Meet WLAs Achieved	March 22, 2017
	100% of Load Reduction To Meet WLAs Achieved (i.e., Pollutant Loading below WLAs)	March 22, 2021
Bacteria TMDL Schedule using an Integrated Approach	Effective Date	March 18, 2004
	Implementation Plan	April 6, 2006
	100% Dry Weather Compliance	March 18, 2007
	100% Wet Weather Compliance	July 15, 2021

9.2 Load Reduction Schedule

A phased implementation approach, using a combination of nonstructural and structural BMPs will be used to achieve compliance with the Toxics TMDL WLAs. As detailed in the Quantification Analysis Section of this report, zinc loading requires the largest load reduction and is thus the compliance diver for the Toxics TMDL (i.e., based on available data, if BMPs are implemented to achieve zinc WLA, then other toxic pollutant loads would also be below WLAs). Based on the existing pollutant loads, estimated by the County's WMMS model, a total zinc load reduction of approximately 95.9% will be required to meet the zinc WLA allotted to the County. A summary of the compliance milestones and actual zinc load reductions required to meet the milestones is presented in Table 9-2.

Table 9-2. **Toxics Waste Load Allocations and Zinc Load Reductions for Modeled Basin 3 Watershed**

Load Reduction	Existing (Modeled)	2013	2015	2017	2021
Percentage of the Total Load Reduction Required To Meet Toxics TMDL Zinc WLA (%)	0%	25%	50%	75%	100%
Actual Load Reductions (%)	0%	24%	47.9%	71.9%	95.9%
Zinc Load Removed from Watershed (lb/year)	0	14.5	29	43.5	58
Remaining Zinc Load (lb/year)	60.5	46	31.5	17	2.5

Numeric load reductions are assigned to nonstructural programs and projects based upon the estimated load reduction range developed for each of the 12 main pollutant sources for MdRH (Section 4.0 of the Implementation Plan) and in the Quantification Analysis (Section 6.0 of the Implementation Plan). Generally, it is assumed that a program/project will capture the full load reduction after 2 years of implementation. The combined nonstructural programs/projects proposed are assumed to reduce up to 25% of the pollutant loading to MdRH. These programs should be implemented early in the implementation period to maximize the cumulative pollutant load removals throughout the implementation period. More details on the nonstructural BMPs implementation schedule are provided in Subsection 9.3. The resulting load removal potential provided by the implementation of nonstructural BMPs is summarized in Table 9-3.

Numeric load reductions are assigned to the five structural BMPs (Section 5.0 of the Implementation Plan) based upon treatment capacity and average pollutant removal efficiency. These structural projects combined are assumed to reduce up to 9.3% of the pollutant loading on the unincorporated County MdRH watershed. Based upon the implementation time frame for each project, load reduction potential (projects with larger drainage area remove more load and should be implemented first), and the feasible project implementation (i.e., cannot construct all projects at once because of resulting impact from construction activities), the schedule for completing the five projects is presented in Table 9-3.

There are opportunities to implement structural BMPs on County properties beyond the five sites identified for BMP construction identified in this Implementation Plan. More specially, there are approximately 13.5 acres of transportation land-use properties where structural BMP may be implemented provided funding and resources are available. The WMMS provides recommendations for bioretention-type structural BMPs on these transportation properties. Additional County properties (e.g., fire station) are located within the MdRH watershed where structural BMPs may be implemented provided funding and resources are available. For planning purposes, this Implementation Plan estimates, in addition to the above-mentioned 13.5 acres of transportation land-use properties, approximately 2 acres of additional County properties may be retrofitted with structural BMPs that result in load reductions. Table 9-3 shows load reductions that may be achieved by the implementation of structural BMPs on these additional County properties.

As discussed in the Quantification Analysis Section of the Implementation Plan, it is assumed that redevelopment of leaseholds will keep pace with that of the last 20 years and is assumed to occur on approximately 25% of the commercial land-use parcels during the implementation period. This redevelopment will be subject to the County SUSMP. The SUSMP requires that stormwater runoff be treated by treatment BMPs, and will likely incorporate other LID features. It is assumed that approximately 11.3 acres of commercial land will be redeveloped during the implementation period and result in a zinc load reduction of approximately 6.2%. It is assumed that the redevelopment will occur at a constant uniform rate and result in an additional 0.7% load reduction potential annually over the 9-year remaining implementation schedule.

The remaining zinc load reductions needed to achieve the compliance milestone load reductions in the unincorporated County MdRH watershed may be provided by implementing structural BMPs within leased properties. As discussed in the Quantification Analysis Section of the Implementation Plan, recommended types of structural BMPs that may be implemented include water harvesting, bioretention, and porous pavement projects. To successfully implement these BMPs on leased properties, multi-departmental, detailed planning, and coordination with lessees will be required during the implementation period. For purposes of this Implementation Plan, it is estimated that the implementation of structural BMPs on leased properties will begin during 2013 (first project completed in 2014) and continue at a fairly constant rate during the remaining implementation period provided funding and resources are available.

Table 9-3 shows a potential schedule strategy that may be utilized to reduce zinc pollutant loading based on current information relating to pollutant loading and the compliance milestones provided in the Toxics TMDL WLAs. Monitoring efforts underway as detailed in the CMP for the MdRH may provide information to refine the estimate of existing pollutant loading in the watershed. Additional special studies and source control measures may be completed and result in additional load reductions, beyond the conservatively estimated load reductions provided in the Quantification Analysis Section. These efforts (monitoring, special studies, and source control nonstructural BMPs) may provide for fewer structural BMPs to be implemented during the implementation period. Thus, Table 9-3 provides theoretical strategy (or example strategy) for meeting the compliance milestones in the Toxics TMDL.

Table 9-3. Zinc Load Reductions Needed To Achieve the Compliance Milestone per Toxics Total Maximum Daily Load Schedule

Best Management Practice	Cumulative Load Reduction				
	2011	2013	2015	2017	2021
Required Pollutant Load Reduction (% Zinc)	-	24.0%	47.9%	71.9%	95.9%
Nonstructural - Metals/Toxics	5.2%	17.0%	21.0%	25.0%	25.0%
Structural - Parking Lot 5 & MdR Library	-	2.3%	2.3%	2.3%	2.3%
Structural - Parking Lot 7	-	-	0.7%	0.7%	0.7%
Structural - Parking Lot 9	-	-	-	1.7%	1.7%
Structural - Parking Lot 10	-	-	2.3%	2.3%	2.3%
Structural - Parking Lot 11	-	2.3%	2.3%	2.3%	2.3%
Redevelopment (Commercial Land Uses)	-	1.4%	2.8%	4.2%	6.2%
Additional County Projects	-	1.2%	4.2%	8.2%	10.8%
BMP Implementation on Leased Property	-	-	12.7%	25.5%	44.6%
TOTAL LOAD REDUCTION	**14.5%**	**24.2%**	**48.3%**	**72.2%**	**95.9%**

* Table shows potential strategy to achieve compliance milestones published in the Toxics TMDL provided funding and resources are available. Additional monitoring and special studies may indicate that existing pollutant loading differs from that provided by the watershed model. Actual implementation of nonstructural and structural BMPs may be revised based on additional information provided by monitoring and/or special studies.

Table 9-3 shows that the first compliance milestone may be primarily accomplished through the implementation of various nonstructural BMPs. The subsequent compliance milestones may require a larger proportion of structural BMPs than the first compliance milestone. Watershed managers shall evaluate additional information provided by monitoring efforts to compare it to the assumptions made in the Implementation Plan. The level of nonstructural BMPs and distribution of structural BMPs may need to be revised based on additional pollutant loading information collected in the future. Detailed information on the potential implementation schedule of specific nonstructural and structural BMPs is provided in the following subsections.

9.3 Nonstructural Schedules

Twelve main pollutant sources for MdRH were identified and prioritized for nonstructural projects and programs. Generally, the pollutant sources that contributed both bacterial and toxic pollutants were prioritized over sources that contributed to a single type of pollutant.

Detailed schedules for implementation for the proposed nonstructural projects and programs are organized by pollutant source priority in Table 9-4 through Table 9-6. These schedules include an approximate duration and recommended implementation time line for planning and assessing the effectiveness of the nonstructural projects/programs, and a long-term implementation schedule. All programs and projects are assumed to be stand-alone; however, it is generally understood that these efforts in MdRH may include synergies, which may provide for a more efficient implementation of similar programs.

Table 9-4. Implementation Schedule for Nonstructural Projects and Programs with the Highest Relative Priority

"HIGHEST" Priority Pollutant Source	Nonstructural Solution	BMP Priority [1]	Duration (months)	PHASE 1 & PHASE 2								PHASE 3
				2010	2011	2012	2013	2014	2015	2016	2017	2018 - 2021
General	**Pollutant Loading Model and Database**	***	-									
	Design and Testing	-	*6–12*									
	Long-Term Implementation and Updates	-	*Annual*									
	Total Suspended Solids/Pollutant Correlations	**	*6–12*									
	Lifeguard Outreach Program	***	-									
	Planning & Assessment	-	*6–12*									
	Long-Term Implementation	-	*Annual*									
	Collaborative Environmentally Friendly Alternative Services Program	**	-									
	Planning & Assessment	-	*6*									
	Long-Term Implementation	-	*12–24*									
	Product Substitution Campaign *(General)*	*	-						*As appropriate. As needed.*			
Birds	**Bird Waste Maintenance Program**	***	-									
	Planning & Assessment	-	*6–12*									
	Long-Term Implementation	-	*Annual*									
Municipal Separate Storm Sewer System (MS4)	**Jurisdictional Boundary Monitoring**	***	*24*									
	MS4/Storm Drain Survey	***	*24*									
	Storm Drain Stenciling Program	***	*Ongoing (Annual)*									
	Targeted Aggressive MS4 and Catch Basin Cleaning Program	**	-									
	Planning & Assessment	-	*12–24*									
	Long-Term Implementation	-	*Annual*									
	RV Overnight Parking Source Evaluation and Ordinance Change Program	**	-									
	Planning & Assessment	-	*6–12*									
	Long-Term Implementation	-	*Annual*									
Restaurants	**Restaurant-Related Code Survey and Modification**	***	*6–12*									
	Targeted Restaurant Inspections	***	*Ongoing Since 2004*									
	Evaluation/Assessment/Modification	-	*6*									
	Business-led Voluntary Enhanced Restaurant BMP Implementation Program	** / *	-									
	Feasibility Evaluation	**	*6*									
	Incentive Program	*	*12–24*						*If appropriate.*			
	Targeted Restaurant Inspections	*	*12–24*								*If appropriate.*	

1) Highest priority (three star, ***) BMPs are implemented as a result of the source identification studies. Higher priority (two star, **) BMPs are implemented after highest priority BMPs, given available resources and ongoing water quality need. Similarly, lowest priority (one star, *) BMPs are implemented depending upon available funds, resources, and needs. Priorities are discussed in Section 4.0.

Represents overall project schedule. (dark green)

Provides additional information regarding project implementation schedule. (light green)

Table 9-5. Implementation Schedule for Nonstructural Projects and Programs with a Relatively High Priority

"HIGH" Priority Pollutant Source	Nonstructural Solution	BMP Priority [1]	Duration (months)	PHASE 1 & PHASE 2								PHASE 3
				2010	2011	2012	2013	2014	2015	2016	2017	2018 - 2021
Trash	**Trash Receptacle Management Outreach**	***	-									
	Planning & Assessment	-	*3–6*									
	Long-Term Implementation	-	*Annual*									
	Targeted Trash Receptacle Inspection Program	**	-									
	Planning & Assessment	-	*3–6*									
	Long-Term Implementation	-	*Annual*									
	Coordinated Trash Removal and Sweeping Pilot Program	**	-									
	Education and Incentive Program	-	*6*									
	Planning & Assessment	-	*12–24*									
	Long-Term Implementation	-	*Annual*									*If appropriate.*
Streets and Parking Lots	**Aggressive Street Sweeping**	***	*Ongoing Since 2008*									
	Aggressive Street Sweeping Public Outreach	***	*12–24*			*As needed.*						
	Aerial Deposition Special Study	**	*12*									
	Brake Pad Partnership	**	*Annual*					*If appropriate.*				
	Aggressive Parking Lot Sweeping	**	*Ongoing Since 2008*									
	Baseline Assessment of Parking Lot Conditions	-	*6–8*									
	Pilot Study - Frequency/Machine Evaluation	-	*12–24*									
Runoff Reduction	**Cistern/Rain Barrel Code Modification**	***	*6–12*									
	Green Gardening and Runoff Reduction Outreach	***	-									
	Planning & Assessment	-	*12–24*									
	Long-Term Implementation	-	*Annual*									*If appropriate.*
	Green Gardening/Runoff Reduction Incentive Program	**	-									
	Planning & Assessment	-	*12–24*									
	Long-Term Implementation	-	*Annual*									*If appropriate.*
	Over-Irrigation Code Modification	***	*3–6*									
	Irrigation Enforcement Program	**	-									
	Planning & Assessment	-	*12–24*									
	Long-Term Implementation	-	*Annual*									
Boating Community	**Environmentally Friendly Boating Guide/Boater Outreach Program**	***	*12–36*								*If appropriate.*	
	Oil Container Recycling Program	*	-									*If appropriate.*
Parking Garage Structures	**Parking Garage Outreach Program**	***	-									
	Planning & Assessment	-	*6*									
	Long-Term Implementation	-	*Annual*								*If appropriate.*	
	Targeted Parking Garage Inspections	**	-									
	Planning & Assessment	-	*6*									
	Long-Term Implementation	-	*Annual*									
	Parking Garage Structural BMP Incentive Program	*	-									
	Planning & Assessment	-	*6*									
	Long-Term Implementation	-	*Annual*									*If appropriate.*

1) Highest priority (three star, ***) BMPs are implemented as a result of the source identification studies. Higher priority (two star, **) BMPs are implemented after highest priority BMPs, given available resources and ongoing water quality need. Similarly, lowest priority (one star, *) BMPs are implemented depending upon available funds, resources, and needs. Priorities are discussed in Section 4.0.

Represents overall project schedule.

Provides additional information regarding project implementation schedule.

Table 9-6. Implementation Schedule for Nonstructural Projects and Programs with the Lowest Relative Priority

"LOWEST" Priority Pollutant Source	Nonstructural Solution	BMP Priority [1]	Duration (months)	PHASE 1 & PHASE 2								PHASE 3
				2010	2011	2012	2013	2014	2015	2016	2017	2018 - 2021
Buildings and Construction	**New Construction Permit/Stormwater Pollution Prevention Plan (SWPPP) Evaluation**	***	*3–6*									
	Alternatives to Architectural Copper Program	**	-							*If appropriate.*		
	Planning & Assessment	-	*6–12*									
	Long-Term Implementation	-	*12–24*									
Pet Waste	**Pet-Waste Bag Dispenser Pilot Program**	**	-									
	Planning & Assessment	-	*12–24*									
	Long-Term Implementation	-	*Annual*									
	Pet-Waste Program	** / *	-								*If appropriate.*	
	Pet-Waste Outreach and Incentive Program	**	*12–24*									
	Pet-Waste Code Survey and Modification	*	*3–6*									
	Pet-Waste Code Enforcement	**	*12*									
Sewage	**Onshore Restroom Dye Study**	*	*6*									
	Community-Based Social Marketing - Restrooms	**	*6–12*						*If appropriate.*			
	Planning & Assessment	-	*6*									
	Long-Term Implementation	-	*Annual*									

1) Highest priority (three star, ***) BMPs are implemented as a result of the source identification studies. Higher priority (two star, **) BMPs are implemented after highest priority BMPs, given available resources and ongoing water quality need. Similarly, lowest priority (one star, *) BMPs are implemented depending upon available funds, resources, and needs. Priorities are discussed in Section 4.0.

(dark green) Represents overall project schedule.

(light green) Provides additional information regarding project implementation schedule.

9.4 Structural Schedule

A schedule for the implementation of the five treatment projects detailed in the Structural BMPs Section of the Implementation Plan is presented in Table 9-7. This table includes planning and permitting requirements, final engineering design of the conceptual plans, construction, O&M, and assessment monitoring. Monitoring activities may take place before and after completion of construction to establish the baseline condition and the resulting improvement in water quality from project implementation.

Table 9-7. Implementation Schedule for Structural Projects

Structural Project	Duration (months)	2010	2011	2012	2013	2014	2015	2016	2017	2018 - 2021
Parking Lot 5	-									
Planning & Permitting	8–14									
Engineering Design	12–18									
Construction	3–6									
O&M	Annual									
Parking Lot 7	-									
Planning & Permitting	8–14									
Engineering Design	12–18									
Construction	3–6									
O&M	Annual									
Parking Lot 9 [1]	-									
Planning & Permitting	8–18									
Engineering Design	12–18									
Construction	6–12									
O&M	Annual									
Parking Lot 10	-									
Planning & Permitting	8–14									
Engineering Design	12–18									
Construction	3–6									
O&M	Annual									
Parking Lot 11	-									
Planning & Permitting	8–14									
Engineering Design	12–18									
Construction	3–6									
O&M	Annual									
Redevelopment [2]	-									
BMP Implementation on Leased Property [3]	-									

Represents overall project schedule.
Provides additional information regarding project implementation schedule.

[1] Parking Lot 9 may be rezoned to multi-family residential and redeveloped in the next few years. If this site is not redeveloped, this conceptual design should be utilized. Otherwise, the County should work with the developer, if possible, to achieve the maximum load reductions possible. Activity durations have been extended to account for additional coordination and planning efforts related to this project.
[2] Redevelopment of leaseholds will continue at a pace fairly consistent with that of the last 20 years and redevelopment will be in accordance with the SUSMP.
[3] It may be necessary to implement structural BMPs within leased properties. This will require negotiations with lessees on properties where leases will expire during the implementation period and potential public-private partnerships on other leased parcels.

10.0 COST ESTIMATES

The main purpose of this section of the Implementation Plan is to present the implementation costs for the nonstructural and structural projects and programs developed for MdRH. These cost estimates may be used by the County for long-term planning and budgeting efforts. Based upon an adaptive management strategy, as more and watershed-specific information relating to pollutant loads becomes available, more detailed cost estimates may be developed using this basic framework.

10.1 Best Management Practices Cost Estimates

Cost estimates were developed at the level of detail necessary for planning and strategy development for TMDL implementation of projects and programs in MdRH. Project-specific cost estimates were developed for individual nonstructural and structural projects. Implementation costs were estimated for collaborating with developers on redevelopment projects and collaborating with lessee to implement projects on leased property.

The nonstructural cost estimates consist of a 1-year initial pilot study cost, including project start-up and assessment, and if applicable given the type of project/program ongoing O&M costs. O&M costs were applied over 9 years (i.e., 2012 through 2020) with an inflation rate of 3% per year. These values were used based on a similar methodology used for the Ballona Creek TMDL Implementation Plan (LADPW, 2009) and other studies. All nonstructural costs are reported in 2011 dollars. The total cost of implementing all 43 nonstructural projects and programs is approximately $7.4 million. Costs are broken down by priority pollutant source in Table 10-1. A more detailed, year-by-year breakdown of nonstructural BMP costs is provided in Appendix D.

Table 10-1. Cost of Implementing Nonstructural Solutions, By Targeted Pollutant Source

Pollutant Source	Pollutant Source Priority	Number of Nonstructural Projects	Present Worth (2011 $)
MS4 / Sewage	*** HIGHEST ***	6	$469,000
General		5	$324,000
Restaurants		5	$263,000
Birds		2	$806,000
Streets	** HIGH **	5	$1,044,000
Trash		4	$160,000
Boaters		2	$194,000
Runoff		5	$447,000
Parking Garage		3	$312,000
Buildings	* LOWEST *	2	$2,994,000
Pets		4	$343,000
TOTAL (Nonstructural)	**-**	**43**	**$7,356,000**

Implementation costs for the five treatment conceptual design projects include engineering design, permitting, construction, building materials, and O&M. More details on these five treatment projects are presented in the Structural BMP Section of the Implementation Plan. The costs to implement these five projects are summarized in Table 10-2. A more detailed, year-by-year breakdown of the costs associated with the implementation of these five projects is provided in Appendix D.

As detailed in the Quantification Analysis Section of this Implementation Plan, additional structural BMPs may be on County and leased parcels. Using typical costs for the BMP types recommended by the WMMS (water harvesting, bioretention, and porous pavement) costs were estimated for the quantity of the BMPs required to meet the storage capacities recommended by the WMMS. Typical O&M costs for these projects were included in these cost estimates. The O&M costs were estimated based on 4.5 years, which is approximately the average time that projects would require O&M during the implementation period. More details on the costs for each type of BMP are provided in Appendix D. The results of the cost estimates for these potential additional projects are provided in Table 10-2.

Table 10-2. Cost of Implementing Recommended Treatment Conceptual Designs

Structural Best Management Practices	Present Worth (2011 $)
Five Project Sites	
Parking Lot 5 & MdR Library	$272,000
Parking Lot 7	$314,000
Parking Lot 9	$645,000
Parking Lot 10	$448,000
Parking Lot 11	$428,000
Five Project Sites Subtotal	**$2,107,000**
Redevelopment*	-
Additional County Projects	$4,519,000
Projects on Leased Parcels	$14,509,000
TOTAL (Structural)	**$21,135,000**

***** Redevelopment will be subject to the County SUSMP requirements, which requires BMP implementation at the developer's expense.

10.2 Cost Schedule

The schedule developed to meet the TMDL WLAs shows that a 95.9% reduction of pollutant loading to MdRH is needed and may be achieved through the implementation of the proposed nonstructural and structural BMPs. The implementation schedules for nonstructural, structural, redevelopment, and leased property projects were used to distribute the implementation costs over time, ending at the TMDL compliance point in year 2021. The creation of these tables, which are provided in the appendices, represents a potential, theoretical strategy to achieve compliance and is based on information currently available relating to the existing pollutant loads of the watershed. The actual implementation schedule and cost may vary depending on the results of monitoring efforts currently underway (CMP), special studies, and the effectiveness of source control BMPs. Figure 10-1 is based on the theoretical schedule and graphically depicts the cumulative costs associated with implementing BMPs and anticipated resulting load reductions corresponding to implementation of the BMPs.

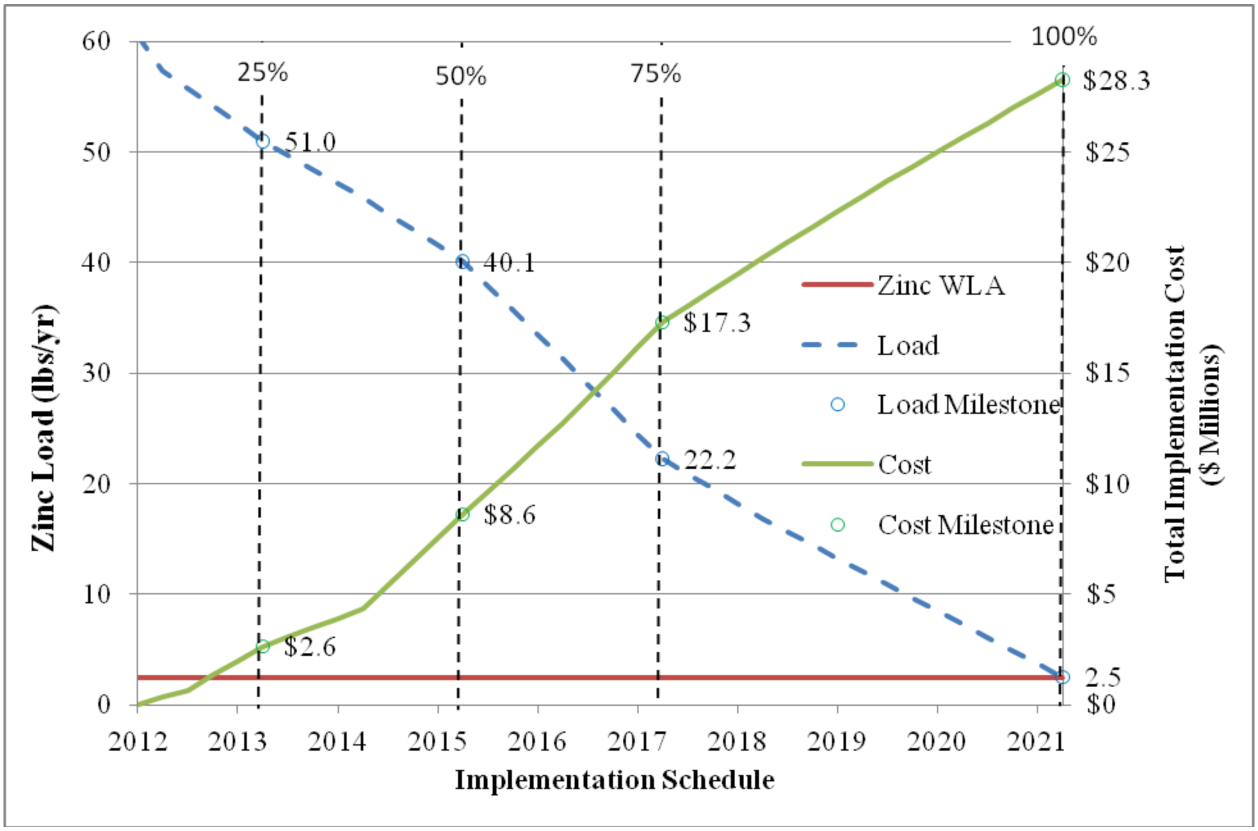

Figure 10-1. Load Reductions and Annual Spending Projected to Achieve the Zinc Waste Load Allocation

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