Scripps Watershed Comprehensive Load Reduction Plan – Phase II

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1 Introduction

In 2012, a Comprehensive Load Reduction Plan (CLRP) was prepared for the Scripps Hydrologic Area (HA) (Scripps watershed), part of the Mission Bay watershed in the City of San Diego (City). This document represents an integrated water quality plan combining multiple permit-based and voluntary strategies and best management practices (BMPs) into a comprehensive approach for achieving compliance with the *Revised Total Maximum Daily Loads for Indicator Bacteria, Project 1 – Twenty Beaches and Creeks in the San Diego Region* (Bacteria TMDL) which was approved by the San Diego Regional Water Quality Control Board (Regional Board) and took effect April 4, 2011 (SDRWQCB 2010). This CLRP also integrates considerations for addressing regulations associated with Areas of Special Biological Significance (ASBS), also adjacent to the Scripps watershed. The City, as the sole Responsible Party (RP) in the watershed, will use this CLRP to develop watershed implementation programs, evaluate their effectiveness, and make adjustments over the anticipated 20-year implementation period.

Phase I of the CLRP (completed in 2012) recommended a number of nonstructural and structural BMPs were recommended in the CLRP for comprehensive load reduction in the Scripps watershed. As part of the CLRP Implementation Program, an Initial Structural and Nonstructural BMP Analysis was recommended in 2013 to provide assessment and much-needed additional information regarding the adequacy and cost-effectiveness of all BMPs recommended in the CLRP and their feasibility at meeting the TMDL wasteload allocation (WLA) and ASBS regulations. The purpose of this CLRP Phase II is to address this Initial Structural and Nonstructural BMP Analysis, and provide:

- Modeling and cost-optimization of BMPs to provide quantification of load reductions to support evaluation of WLA compliance and ASBS compliance, and selection of the most cost-effective BMP strategy for implementation.
- Improvements of and modifications to BMP recommendations, as needed, that considered feasibility for implementation and further assurance of load reductions to meet the WLA and ASBS regulations.
- Adjustments of cost estimates and scheduling of BMPs to meet interim and final load reduction targets to attain WLAs and ASBS regulations.

The Initial Structural and Nonstructural BMP analysis includes modeling to provide quantification of load reductions achieved with each BMP category, as well as a cost optimization approach to select the most cost-effective BMPs to achieve increasing load reductions. Parallel to this effort, the City participated in a re-evaluation of nonstructural BMPs to provide essential information for model representation, and to determine if any adjustments were needed based on assumptions in the CLRP to provide more feasibility for implementation. These combined efforts provided new information regarding the progress made towards load reductions to meet the WLA and ASBS regulations, based on the nonstructural BMPs and distributed and centralized structural BMPs on public land that were recommended in the CLRP and adjusted during CLRP Phase II. Further modeling and cost-optimization was performed to identify the additional green streets and centralized BMPs on private land needed to ultimately meet the WLA and ASBS regulations. This information on cost-effectiveness of each BMP category for increasing load reductions provided further validation of the CLRP's Comprehensive Compliance Schedule, with minor adjustments provided to better accommodate its feasibility for implementation.

Final recommendations for the BMPs and their associated costs and implementation schedule for the CLRP should be based on the Phase II results reported here, which should be considered as an improvement to all recommendations made in the 2012 CLRP. As such, this CLRP Phase II report should be considered a companion document to the comprehensive planning and documentation provided in the original 2012 CLRP.

Given the timing of new requirements of the Municipal Separate Storm Sewer System (MS4) permit and the associated required Water Quality Improvement Plan (WQIP), the results presented here also provide an ideal opportunity for the City to consider how modeling results can contribute to the load reduction analysis required in the WQIP for TMDL and ASBS pollutants, and how results can be presented in the WQIP.

2 Technical Approach Summary

2.1 Modeling Overview

Modeling provides information about the expected performance of BMPs and projections about the extent of management required to achieve instream water quality objectives. The CLRPs follow a cost-effective BMP implementation strategy that begins with enhancements to existing nonstructural BMP programs and development of new programs in some cases. This step is followed by structural BMP development on public land, and finally by structural BMP development on private land if necessary to meet TMDL reduction objectives. Implementation of a green streets program was also evaluated as a more cost-effective alternative to centralized structural BMP development on private land. Figure 2-1 presents a conceptual diagram that shows each of these management levels along a cost-effectiveness curve. Each management level describes a set a BMP practices (and degree of implementation) that was evaluated using the modeling system. Successive management levels are comprised of different individual practices, and are considered to be inclusive of or additive to the previous level.

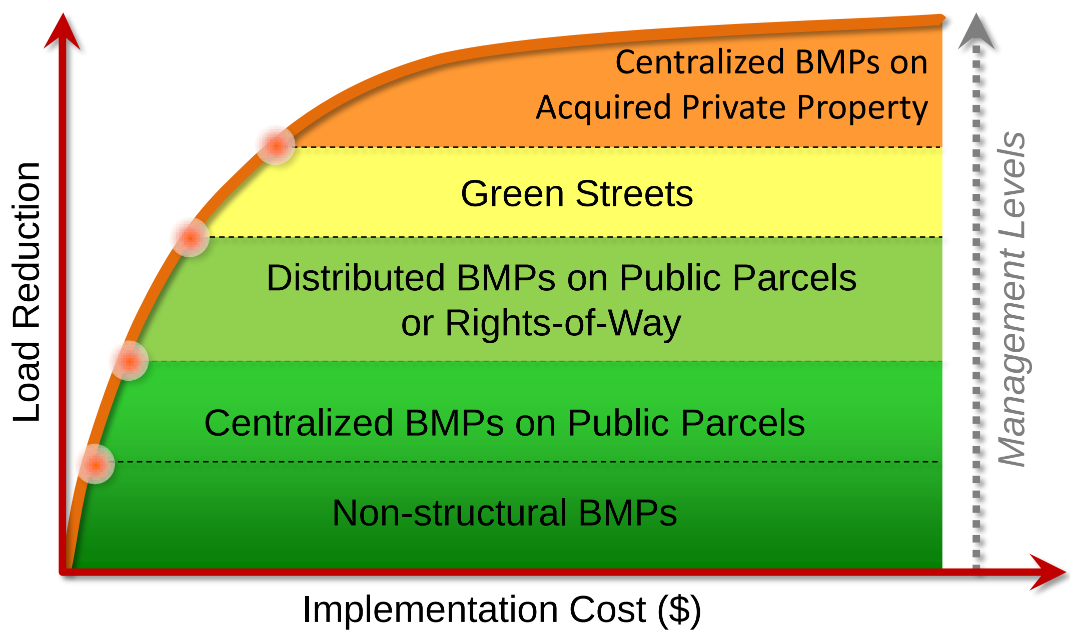

Figure 2-1. Conceptual cost-benefit curve and management levels

The first two levels include practices that are the least expensive and easiest to implement. For example, centralized BMPs on public parcels are likely among the most cost-effective options because (1) there is no associated land acquisition cost, and (2) they provide economies of scale by treating a larger area where runoff originates from both private and public parcels. In addition, nonstructural practices such as street sweeping and catch basin cleaning reduce pollutant loads upstream of the BMPs, thereby reducing the required size and/or number of structural BMPs. The third level includes distributed BMPs on public land that, although cost-effective, are often limited in their overall contribution to watershed load reductions due to the limited availability of publicly owned parcels for implementation.

After considering centralized and distributed options on public lands, the potential benefits from an expanded green streets program were evaluated at the fourth level. Green streets represent a public BMP option that has the benefit of treating runoff from adjacent private lands and can help offset private centralized BMP development. Centralized structural BMPs on private land represent the last level because of potential land acquisition costs and the logistical challenges of ensuring proper maintenance on private land. Centralized structural BMPs on private land are assumed to be the most expensive option because the costs associated with purchasing large parcels of land for constructing centralized BMPs will typically outweigh the benefits. Additional information on each of these management levels and associated BMP types is provided in Sections 3 and 4 below and in the Appendix A.

The modeling system that was used to quantify and evaluate the various BMP types and management levels incorporates a watershed loading model to estimate baseline water quality and flow conditions, a site-scale BMP optimization model, and a non-linear watershed-scale optimization model to assist with evaluating multiple BMP scenarios concurrently. The modeling approach builds on the information and modeling efforts that were completed during Phase I CLRP development. Existing Loading Simulation Program in C++ (LSPC) (Shen et al. 2004; Tetra Tech and USEPA 2002; USEPA 2003) watershed models were updated and standardized in Phase II to (1) establish a level of consistency and comparability for areas with similar physical characteristics, and (2) provide reasonable assurance that the modeled existing condition is a representative baseline condition from which to measure the cost and benefits of BMP implementation. The revised models were also used to update the water quality composite scores referenced in the Phase I CLRPs (Appendix D). For each subwatershed, dry and wet weather composite scores were calculated based on the average annual modeled pollutant loads which were then ranked in order from high to low and grouped into quintiles. A score of 5 indicates that the subwatershed pollutant loading was in the top 20th percentile (high pollutant loading); whereas a score of 1 represents a subwatershed loading in the bottom 20th percentile (low pollutant loading). Bacteria was selected as the focus because of the priority in addressing bacteria loads. Individual quintiles scores for enterococci, fecal coliform, and total coliform were averaged for dry and wet weather separately to develop composite scores. An overall composite water quality score was also calculated based on the sum of the dry and wet composite scores.

The modeled baseline condition implicitly represents current benefits of existing BMPs (including recent BMPs that may be providing water quality benefits that were not accounted for in TMDL development); therefore, any and all recommended BMPs derived through this modeling effort are considered above and beyond what is currently in place. The LSPC model for each watershed provided the foundation for BMP optimization analyses in later stages and for estimating the required TMDL load reductions that are discussed in Section 2.2. LSPC was also used to help estimate the pollutant reduction and flow benefits from the proposed nonstructural BMP enhancements and new programs that were developed in collaboration with the City. This information was derived based on the anticipated level of implementation of each BMP type within each watershed and represents the nonstructural BMP baseline. The aggregate benefits from the nonstructural BMPs provided the starting point for evaluating additional structural BMP implementation needs to meet the load reduction objectives.

Successive management levels representing structural BMPs were evaluated, starting with site-scale analyses using the System for Urban Stormwater Treatment and Analysis INtegration (SUSTAIN) (USEPA 2009). SUSTAIN was used to model BMP performance and cost-benefit optimization within representative subwatersheds using time-series input from the LSPC watershed models. During optimization, BMP sizing was adjusted to optimize the treatment of upstream impervious areas and consider the 85^{th} percentile storm event consistent with existing structural BMP programs. SUSTAIN incorporates BMP cost functions that allowed for cost-benefit evaluation and optimization of management alternatives.

2.2 Determination of TMDL Reduction Objectives

The primary goal of the CLRP modeling effort is to optimize the implementation of BMPs (number, type, size, and location) for compliance with TMDLs, while quantifying the load reduction achieved for other priority pollutants. The Scripps watershed is subject to bacteria TMDLs. This first step in the load reduction analysis is the interpretation of the TMDLs and their associated numeric goals and WLAs, and applying the CLRP watershed model for determining necessary pollutant load reductions to meet those objectives.

Numeric goals were calculated for each parameter based on the difference between the modeled load and calculated TMDL load for Water Year (WY) 2003. WY 2003 was selected based on an analysis of rainfall data collected within the region from 1990 through 2010. This year represents typical wet and dry weather conditions and provides an appropriate benchmark to use in defining numeric goals and the resulting BMP implementation needs. Modeled loads above the TMDL load were considered as a required reduction and subtracted from the model baseline load to develop an instream load reduction target.

Each parameter has special considerations based on how the Basin Plan Water Quality Objectives (WQOs) are expressed, associated TMDL requirements, and other regulatory requirements. Key compliance elements and the calculated numeric goals/reduction targets are presented in the following sections.

2.2.1 Bacteria

WQOs and TMDL Numeric Targets

Several impaired beaches within the Scripps watershed were included in the Bacteria TMDL. For efficiency, the modeling analysis considered the entire watershed (not including the southern area that drains to Mission Bay). Modeled bacteria loads and daily flows were summed across the watershed to calculate the applicable numeric goals (load reduction targets). Note that the ASBS calculations described in the following sub-section were based on the delineated ASBS drainage area.

The Bacteria TMDL is expressed as both a concentration-based and load-based target. Determination of MS4 compliance, as described in the Basin Plan Amendment, is based on both receiving water conditions and measurements of bacteria loading from MS4 outfalls. The concentration-based receiving water component of the TMDL is reflected by the TMDL targets, which are separated into a dry weather component, based on the geometric mean WQOs, and a wet weather component, based on the single sample WQOs. These targets are used to generate "Receiving Water Limitations" in the TMDL, which means the MS4s are assigned much of the responsibility for attaining the TMDL targets (or, at a minimum, demonstrating that non-MS4 sources are responsible for non-attainment). The Scripps watershed is subject to those targets assigned to beaches (Table 2-1).

Table 2-1. Receiving water limitations for beaches from the Bacteria TMDL

	Wet Weather Days		Dry Weather Days	
Indicator Bacteria	Wet Weather Numeric Objective (MPN/100mL)	Wet Weather Allowable Exceedance Frequency	Dry Weather Numeric Objective (MPN/100mL)	Dry Weather Allowable Exceedance Frequency
Fecal Coliform	400	22%	200	0%
Total Coliform	10,000	22%	1,000	0%
Enterococcus	104	22%	35	0%

Fecal coliform was used to represent bacteria in the load reduction calculations. The TMDL load for fecal coliform was calculated by multiplying the WQOs by the daily modeled streamflow. Modeled daily loads greater than this threshold were flagged as an exceedance. Modeled daily loads were also classified as occurring on either wet days or dry days because of different compliance requirements. A wet day is defined as a day with at least 0.2 inch of rainfall plus the three following days. For wet weather, the Bacteria TMDL specifies an allowable exceedance frequency of 22 percent based on reference conditions, while no exceedances are allowed during dry weather. For WY2003, the number of wet days was 42, therefore the number of allowable wet weather exceedance days was 9 (rounded). The allowable exceedance load for wet weather was calculated by summing the top 9 days with the highest modeled daily loads. This load was then subtracted from the modeled wet weather total for the year. The difference between the remaining modeled load and the TMDL load represents the load reduction required for wet weather.

For dry weather, the WQOs represent 30-day geometric mean concentrations that require interpretation for use in developing the associated TMDL load. For the CLRP, a 30-day period in July 2003 was selected for modeling the dry period as it best represents a period unimpacted by rainfall and dominated by dry urban runoff. The 30-day geometric mean concentrations for each parameter were assumed for each dry day during this period and multiplied by the daily modeled flows to calculate the TMDL load. The dry weather load reduction was simply the difference between the modeled existing load and the TMDL load for the total number of dry days.

Interim Milestones and Compliance Schedule

The Bacteria TMDL includes interim compliance milestones to measure progress towards achieving final TMDL attainment (Table 2-2). Interim milestones are expressed in terms of exceedance frequency reduction. For the modeling analysis, compliance with the exceedance frequency milestones was based on achieving an equivalent load reduction for wet and dry weather conditions (50% and 100% of the load reduction targets).

Table 2-2. CLRP milestones and compliance schedule from the Bacteria TMDL

Compliance Year (year after TMDL effective date - 2011)	Exceedance Frequency Reduction Milestone
7 (by 2018)	50% for dry weather
10 (by 2021)	100% for dry weather 50% for wet weather
20 (by 2031)	100% for wet weather

2.2.2 ASBS Priority Pollutants

The California Ocean Plan prohibits waste discharges to ASBS with exceptions granted for select discharges (SWRCB 2005). Storm water runoff from the City is permitted into the La Jolla State Marine Conservation Area (ASBS No. 29) per Resolution 2012-0012 (SWRCB 2012). The Resolution includes narrative effluent limitations that require an iterative approach for evaluating and implementing BMPs that will prevent storm water from altering natural ocean water quality. BMPs to control storm water discharges to the ASBS shall be designed to achieve the Ocean Plan Table B instantaneous maximum WQOs or a 90% reduction in pollutant loading.

For the CLRP modeling analysis, concentration-based Ocean Plan effluent limitations, rather than the narrative requirements, form the basis for determining ASBS load reduction targets (SWRCB 2005). The Ocean Plan effluent limitations were also used in favor of the more generic 90% pollutant load reduction target. To focus the list of Table B constituents, the greatest threats to the ASBS were selected. The La Jolla Shores Coastal Watershed Management Plan identified metals (copper, chromium, nickel and arsenic), bacteria, and sediment as high priority pollutants of concern within the ASBS (SIO et al. 2008). Because dry weather discharges are prohibited to the ASBS, the targets identified for compliance with ASBS provisions pertain to wet weather conditions only, although load reduction targets were calculated for dry weather to be consistent with the presentation of bacteria compliance results for the broader Scripps watershed.

The WQOs listed in Table B of the Ocean Plan are equal to the instantaneous maximum concentration acceptable after initial dilution within the receiving water. To calculate concentration limits that would apply to storm water effluent, the Ocean Plan provides an equation based on background seawater concentrations and the minimum probable initial dilution of the effluent. To obtain an appropriate minimum initial dilution value, the City conducted a dilution and dispersion study for ASBS No. 29 similar to the study conducted and used in the University of California – San Diego, Scripps Institute of Oceanography (UCSD/SIO) discharge effluent limitations to the San Diego-Scripps State Marine Conservation Area (ASBS No. 31) (Jenkins et al. 2013; Jenkins et al. 2007). The goal was to produce a site-specific minimum probable initial dilution for the ASBS. The most conservative dilution factor was estimated to be 12.6:1 (based on storm drain SDL-062). CLRP (ASBS) load reduction targets were calculated based on the instantaneous maximum concentrations specified in Table B of the Ocean Plan for the ASBS priority pollutants. Dilution-adjusted discharge effluent limitations were calculated using the conservative initial dilution estimate (12.6:1). The Table B concentrations (without dilution) were used to calculate the CLRP load reduction targets for the ASBS drainage area and demonstrate compliance with the ASBS requirements because the dilution study has not yet been submitted and approved by the Regional Board.

Copper was used to represent metals for the CLRP load reduction calculations considering copper has one of the lowest effluent limit concentrations and extensive literature and monitoring data were available to develop modeling parameters (Table 2-3). The models simulate total metals rather than total recoverable (dissolved) metals due to the availability of extensive literature and monitoring data relating model parameters to total metals. As a result, the total-to-dissolved metals conversion factor specified in the Chollas dissolved metals TMDL was used to convert the Table B total recoverable value to total copper (SDRWQCB 2007). This value was then multiplied by the daily modeled flows to calculate the total copper wet weather load target for the ASBS drainage area. The required wet weather load reduction represents the difference between the modeled (existing) load and the target load for the ASBS drainage area.

Table 2-3. Ocean Plan Table B Priority Metals Water Quality Objectives

	Instantaneous Maximum Concentration at Completion of Initial Dilution	Discharge Effluent Limitations ASBS No. 29 (Dm = 12.6:1)
Total Recoverable Arsenic (µg/L)	80	1050.2
Total Recoverable/ Hexavalent Chromium (µg/L)	20	272
Total Recoverable Copper (µg/L)	30	382.8
Total Recoverable Nickel (µg/L)	50	680

Ocean Plan bacteria standards apply to the area between the shoreline and a distance of 1,000 feet from the shoreline or the 30-foot depth contour, whichever is further from the shoreline. These standards mimic the AB411 concentrations and are therefore similar to the Basin Plan and receiving water limitations for beaches in the Bacteria TMDL. Ocean Plan standards, however, do not specify an allowable exceedance frequency considering the statewide application of this policy. The need to include an allowable exceedance frequency was identified during development of the Bacteria TMDL, therefore, a 22% allowable exceedance frequency was included in the load reduction calculations consistent with the Basin Plan beach WQOs. Table B concentrations and dilution-adjusted values (single sample maximum and 30-day geometric mean) are shown in Table 2-4. Note that background seawater concentrations for bacteria are not included in the Ocean Plan, therefore, a value of zero was used in the effluent calculations. Without dilution, the wet weather load calculations are equivalent to those using the Basin Plan beach WQOs per the Bacteria TMDL requirements. Unique to the ASBS is the calculation of the load reduction target based on the model results for the ASBS drainage area.

Table 2-4. Ocean Plan Bacteria Effluent Limitations

	30-Day Geometric Mean (five most recent samples)	Single Sample Maximum	30-Day Geometric Mean Discharge Effluent Limitations ASBS No. 29 (Dm = 12.6:1)	Single Sample Discharge Effluent Limitations ASBS No. 29 (Dm = 12.6:1)
Total Coliform density per 100 ml	1,000[i]	10,000	13,600	136,000
Fecal Coliform density per 100 ml	200	400	2,720	5,440
Enterococcus density per 100 ml	35	104	476	1,414

Sedimentation measures were not included in Table B of the Ocean Plan. The Ocean Plan does list effluent limitations (after initial dilution is completed) specifically for POTWs and industrial discharges for suspended solids, settleable solids, and turbidity. Although these effluent limits do not apply to municipal stormwater discharges, they were used to gauge the amount of sediment load reduction that may be needed. The CLRP models include TSS, therefore TSS was used to represent sediment loading for the ASBS. While Table A does not include a TSS maximum limit, the narrative objective states that the limit shall not be lower than 60 mg/l. This value was used to calculate the sediment load reduction target for the ASBS drainage area (multiplied by modeled daily flows) for TSS (Table 2-5). Since the Ocean Plan values are effluent limits, separate calculations were not needed to adjust for initial dilution.

Table 2-5. Ocean Plan Table A Sediment Effluent Limitations.

	Maximum at Any Time
Suspended Solids (mg/l)	+ (calculated using default value of 60)
Settleable Solids (ml/l)	3.0
Turbidity (NTU)	225

+ Dischargers shall remove 75% of suspended solids from the influent stream before discharging wastewater to the ocean, except that the effluent limitation to be met shall not be lower than 60 mg/l unless a lower effluent concentration is approved by the Regional Board and EPA.

Interim Milestones and Compliance Schedule

The ASBS Resolution states that all non-authorized storm water dischargers were prohibited on the effective date of the resolution (adopted March 2012), Within 18 months from the effective date, any non-structural controls that are necessary to comply with the special conditions must be implemented. In addition, the dischargers are required to submit a draft ASBS Pollution Prevention Plan to the State Board or Regional Board describing its strategy to comply with these special conditions. The Plan is required to describe appropriate non-structural controls and a time schedule to implement structural controls to comply with the special conditions of the Resolution. Within 30 months from the effective date, the final ASBS Pollution Prevention Plan is required to be submitted (the City of San Diego is currently developing this plan). Within six years of the effective date of the Exception, any structural controls identified in the ASBS Pollution Prevention Plan shall be operational. In addition, within six years the dischargers must comply with the requirement that their discharges into the affected ASBS maintain natural ocean water quality. Attainment of this is calculated by the post-storm receiving water quality data equaling less than the 85th percentile threshold of reference water quality data and the pre-storm receiving water levels.

2.2.3 TMDL and ASBS Load Reduction Summary

Table 2-6 and Table 2-7 present the calculated wet and dry weather loads and load reductions for the Scripps watershed (excluding the Mission Bay drainage area) based on the Bacteria TMDL requirements discussed above. The critical bacteria constituent for the Scripps watershed with the greatest required load reduction is fecal coliform based on wet weather conditions. To meet the ASBS requirements, load estimates were calculated for the ASBS drainage area separately (Table 2-8).

Copper was identified as the critical pollutant requiring the greatest load reduction (without dilution) based on wet weather conditions. ASBS results using the modeled initial dilution value (12.6:1) are also shown for comparison, although the dilution study has not yet been submitted and approved by the Regional Board. Dry weather loads are not shown for the ASBS drainage area because bacteria represents the only significant pollutant during dry weather conditions, which will be addressed through meeting the Bacteria TMDL requirements. The assumption used in the CLRP is that by focusing on the critical pollutant for load reduction analyses, other pollutants will be addressed (many of the BMPs address multiple pollutants). Regardless, load reductions for the other pollutants are verified later in the analysis to ensure that necessary reductions are demonstrated.

Table 2-6. Bacteria wet-weather pollutant loads and required reductions – Scripps watershed

Pollutant	Total Load	Non-Exceedance Load	Allowable Exceedance Load	Exceedance Load	Required Reduction
Scripps watershed (excluding Mission Bay drainage area)					
Fecal Coliform (Billion #/year)	275,374	12,247	240,379	22,748	8.3%
Total Coliform (Billion #/year)	6,026,406	304,608	5,484,212	237,586	3.9%

Table 2-7. Bacteria dry-weather pollutant loads and required reductions – Scripps watershed

Pollutant	Total Load	Non-Exceedance Load	Exceedance Load	Required Reduction
Scripps watershed (excluding Mission Bay drainage area)				
Fecal Coliform (Billion #/year)	6.56	0.05	6.51	99.2%
Total Coliform (Billion #/year)	215.92	0.43	215.48	99.8%

Table 2-8. ASBS wet-weather pollutant loads and required reductions

Pollutant	Total Load	Non-Exceedance Load	Allowable Exceedance Load	Exceedance Load	Required Reduction
ASBS No. 29 drainage area (No Dilution; Total Sediment loads were calculated based on ASBS effluent limits)					
Fecal Coliform (Billion #/year)	67,442	3,089	58,681	5,671	7.8%
Total Coliform (Billion #/year)	1,422,593	76,985	1,288,412	57,195	3.9%
Total Copper (lbs/year)	59	48	0	11	18.4%
Total Sediment (lbs/year)	77,646	77,463	0	184	0.2%
ASBS No. 29 drainage area (Dilution 12.6:1; Total Sediment loads were calculated based on ASBS effluent limits)					
Fecal Coliform (Billion #/year)	67,442	33,527	33,583	332	0.49%
Total Coliform (Billion #/year)	1,422,593	1,221,785	201,064	255	0.02%
Total Copper (lbs/year)	59	59	0	0	0.00%
Total Sediment (lbs/year)	77,646	77,463	0	184	0.2%

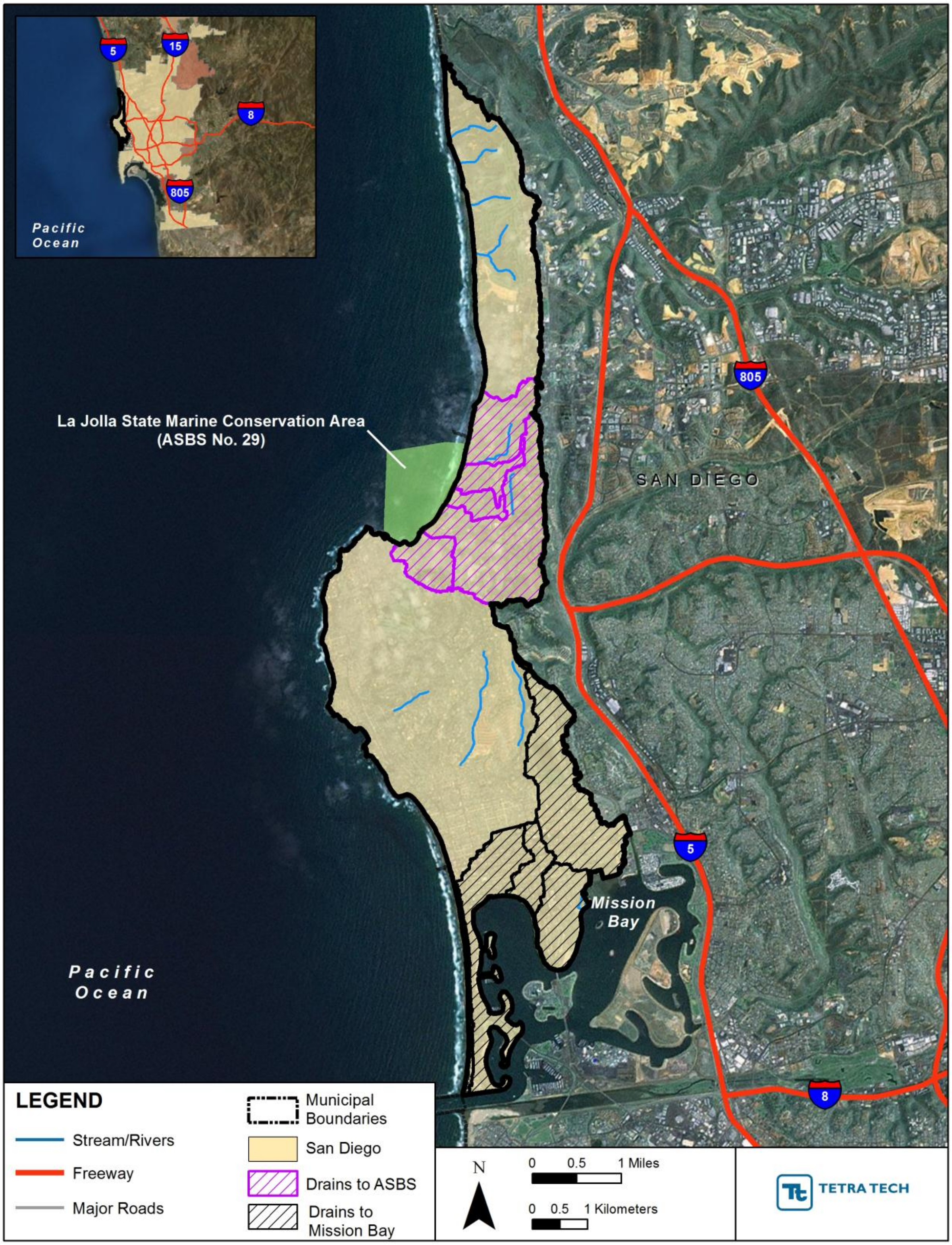

Figure 2-2. Scripps Watershed Drainage Areas

3 Quantitative Evaluation of Nonstructural Solutions

For most nonstructural BMPs, it is challenging to accurately quantify their benefits in terms of pollutant load reductions because it often requires extensive survey and monitoring information. Nevertheless, on the basis of best available information, the Phase I CLRPs documented effectiveness and estimated future levels of implementation of the various nonstructural BMPs that will be implemented in the region over the next 20 years. Most of those BMPs included a focus on increased training/education and public outreach as a way to improve pollutant source control. The pollutant and flow reduction benefits from several nonstructural BMPs such as street sweeping, catch basin cleaning, rain barrels, downspout disconnections, and irrigation runoff reduction practices can be estimated using quantitative methods. Appendix A outlines the implementation level for each BMP and describes the modeling process. For those BMPs that are not represented in the model, a conservative load reduction is allocated. The watershed model was run with a series of scenarios to quantify the effectiveness of each nonstructural BMP.

The purpose of this section is to summarize the extent to which each nonstructural BMP contributes to pollutant removal in the Scripps watershed. Table 3-1 presents the baseline watershed model flow and loads for the modeled year and further breaks out the totals for wet and dry conditions. In each of the subsequent sub-sections, the effectiveness of the respective BMPs are presented as a percent reduction relative to the baseline watershed model flow and loads presented in this table.

Table 3-1. Baseline flow and pollutant loads for wet and dry weather

Condition	Flow Volume (Million ft3/yr)	Total Sediment (tons/yr)	Total Copper (lbs/yr)	Total Lead (lbs/yr)	Total Zinc (lbs/yr)	Fecal Coliform (Billion #/yr)	Total Phos-phorus (lbs/yr)	Total Nitrogen (lbs/yr)
Scripps watershed (excluding Mission Bay drainage area)								
Wet weather	40,586	158	242	230	1,516	275,374	4,773	23,551
Dry weather	86.1	0.3	0.1	0.1	0.4	6.6	12.0	29.8
ASBS No. 29 drainage area								
Wet weather	9,600	36	54	53	337	61,864	1,116	5,339
Dry weather	25	0.05	0.04	0.02	0.11	1.9	3.3	8.4

3.1 Street Sweeping

Enhanced street sweeping activities provide direct, additional load reduction for specific pollutants. Sediment and other debris that collect on roadways, medians, and gutters are removed from the watershed with each sweeping, along with the associated mass of other pollutants. However, results presented in Appendix A indicated that street sweeping does little in terms of bacteria load reductions. Since bacteria are the only TMDL pollutant for the non-ASBS area of the Scripps watershed, this BMP is only recommended for the ASBS area of the watershed where additional pollutants require reduction.

Street sweeping was represented in the ASBS drainage area of the watershed model as an extension of additional routes or application to an existing route using enhanced equipment. The frequency of street sweeping also varied for specific road segments throughout the region, as detailed in Appendix A. The resulting pollutant load reductions (relative to baseline conditions) attributed to street sweeping are summarized in Table 3-2.

Table 3-2. Flow and pollutant load reductions attributed to street sweeping

Condition	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
ASBS No. 29 drainage area								
Wet weather	0.00	0.003	0.010	0.005	0.009	0.001	0.001	0.001
Dry weather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.2 Catch Basin Cleaning

Enhanced catch basins cleaning programs provide direct, additional load reduction. Sediment and other debris trapped in catch basins are removed from the collection system with each cleaning, along with the associated mass of other pollutants. The additional material removed for each subwatershed credited to enhanced catch basin cleaning and the associated pollutant loads were previously established through a City of San Diego pilot study and are summarized in Appendix A. However, results reported in Appendix A indicated that enhanced catch basin cleaning has little impact on bacteria load reductions. Since bacteria is the only pollutant of concern for the non-ASBS portion of the Scripps watershed, enhanced catch basin cleaning is not recommended for these areas. As a result, enhanced catch basin cleaning is only recommended for areas draining to the ASBS to address ASBS-specific pollutants of concern. Table 3-3 shows the average annual mass of pollutant load removed attributed to the enhanced catch basin cleaning in the ASBS drainage area.

Table 3-3. Flow and pollutant load reduction attributed to enhanced catch basin cleaning

Condition	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
ASBS No. 29 drainage area								
Wet weather	0.00	4.28	0.64	0.32	0.32	0.00	0.24	0.23
Dry weather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.3 Rain Barrels Incentive Program

Rain barrels act as mechanisms to temporarily detain and re-route runoff from otherwise directly-connected impervious areas to nearby pervious areas or other vegetated areas such as rain gardens, swales, and the like. Assumptions about the modeling process and the extent of implementation are presented in Appendix A. Due to the limited extent of implementation of this program, load reduction values are quite small. Table 3-4 presents the flow and pollutant load reductions associated with the proposed implementation of rain barrels.

Table 3-4. Flow and pollutant load reduction attributed to rain barrels

Condition	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
Scripps watershed (excluding Mission Bay drainage area)								
Wet weather	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01
Dry weather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASBS No. 29 drainage area								
Wet weather	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01
Dry weather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.4 Downspout Disconnection Incentive Program

Downspout disconnections provide a similar watershed impact as rain barrels and downspout disconnections are modeled similarly. Assumptions about the modeling process and the extent of implementation are also presented in Appendix A. Implementation of this program is substantially greater than the rain barrel program, although the total load reduction numbers remain small. Table 3-5 presents the flow and pollutant load reductions associated with the proposed implementation of downspout disconnections.

Table 3-5. Flow and pollutant load reduction attributed to downspout disconnections

Condition	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
Scripps watershed (excluding Mission Bay drainage area)								
Wet weather	0.13	0.23	0.22	0.35	0.31	0.26	0.12	0.12
Dry weather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASBS No. 29 drainage area								
Wet weather	0.15	0.27	0.27	0.41	0.38	0.31	0.14	0.15
Dry weather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.5 Irrigation Runoff Reduction

Irrigation runoff reduction was modeled as a turf conversion and irrigation efficiency program as documented in Appendix A. Turf conversion transforms area from grasses that require regular irrigation to other, native pervious cover which would not require regular irrigation. The irrigation efficiency program sets the goal of eliminating irrigation overspray practices over the course of the 20-year implementation period. The extent to which each of these programs is assumed to be implemented within the watershed is summarized in Appendix A. Table 3-6 presents annual modeled flow and pollutant load reduction as a percentage of the baseline that is attributed to this irrigation runoff reduction program. It should be noted that the impact of the elimination of irrigation overspray on dry weather pollutant load reductions in the City of San Diego is heavily muted due to the way in which dry weather flows are tabulated for this analysis (as described in Section 2.2).

Table 3-6. Flow and pollutant load reduction attributed to irrigation reduction

Condition	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
Scripps watershed (excluding Mission Bay drainage area)								
Wet weather	1.41	1.31	0.33	0.56	0.14	0.10	1.87	0.65
Dry weather	85.09	85.14	86.45	86.52	86.04	85.28	84.33	84.55
ASBS No. 29 drainage area								
Wet weather	1.52	1.43	0.42	0.62	0.17	0.14	2.11	0.82
Dry weather	69.78	69.89	72.03	70.12	70.05	69.98	75.01	72.62

3.6 Summary of Modeled Nonstructural BMPs

Finally, all nonstructural BMPs were included in the baseline watershed model to calculate the aggregate flow and pollutant load reduction. The combined estimates are presented in Table 3-7.

Table 3-7. Flow and pollutant load reduction attributed to all modeled non-structural practices

Condition	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
Scripps watershed (excluding Mission Bay drainage area)								
Wet weather	1.50	1.50	0.51	0.88	0.42	0.33	1.95	0.73
Dry weather	85.09	85.14	86.45	86.52	86.04	85.28	84.33	84.55
ASBS No. 29 drainage area								
Wet weather	1.68	2.16	1.62	1.47	1.37	0.56	2.34	1.09
Dry weather	69.78	69.89	72.03	70.12	70.05	69.98	75.01	72.62

3.7 Non-modeled Nonstructural BMPs

In addition to those BMPs modeled above, the Phase I CLRP also identified a number of additional nonstructural BMPs that, although they have the potential for significant pollutant reduction, lack the data necessary for model representation. These BMPs are summarized in Appendix A. These pollution protection measures often seek to change behaviors at residential, commercial, and industrial sites to reduce exposure of pollutants to rainfall. While these practices have been demonstrated to be effective in places where they have been pioneered in western U.S. communities (Caraco and Schueler 1999), quantification of benefits in terms of load reductions attributed to these BMPs are challenging and often require extensive survey and monitoring information to gauge performance (Los Angeles County 2010). With the number of non-modeled, nonstructural BMPs included in the Phase I CLRP, some pollutant load reductions are expected. For the purposes of benefit analyses and justification of funding for these BMPs, the collective load reduction for all non-modeled, nonstructural BMPs are assumed to be 5 percent, for both wet and dry conditions. This assumption represents a conservative estimate that is comparable to the load reductions associated with non-structural BMPs that can be modeled. This assumption will be assessed in the future as BMPs are implemented and focused monitoring studies are performed to attempt to evaluate performance. As the WQIP is developed and updated in the future throughout the implementation period, the modeling system can be updated over time as data become available for quantifying the effectiveness of additional nonstructural BMPs.

4 Quantitative Evaluation of Structural Solutions

Evaluation of structural BMPs requires modeling the re-routing of runoff that would normally drain directly to the drainage network into infiltration or filtration-based BMPs. These structural BMPs can be placed throughout the contributing watershed; their collective ability to filter and infiltrate water improves water quality by removing pollutants from the system. The model simulates the filling, draining, and pollutant removal dynamics of these BMPs. The extent to which these BMPs can be implemented and the BMP modeling assumptions are summarized in Appendix A. These BMPs are broken down into four categories based on the availability of land: (1) centralized BMPs on public land, (2) distributed BMPs on public land, (3) green streets, and (4) centralized BMPs on private land.

Several analyses were run with a series of scenarios to quantify the effectiveness of each of the structural BMPs on public land first using the SUSTAIN model, as described in Section 2. The purpose of this section is to summarize the extent to which structural BMPs contribute to pollutant removal in the watershed. In each of the sub-sections, the effectiveness of the BMP category is presented as a percent reduction relative to the baseline watershed model flow and loads presented in Table 3-1.

4.1 Centralized BMPs on Public Land

The centralized structural BMPs on public parcels incorporated in the model consisted mostly of detention and infiltration facilities. These features were largely located on soils with low infiltration capacities in the watershed. The specific sites modeled are presented in Appendix A. Table 4-1 presents the modeled flow and load reductions attributed to these centralized BMPs on public parcels.

Table 4-1. Flow and pollutant load reduction attributed to centralized BMPs on public parcels

Condition	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
Scripps watershed (excluding Mission Bay drainage area)								
Wet weather	0.08	0.31	0.05	0.07	0.08	2.26	0.07	1.23
Dry weather	9.02	7.74	7.19	6.35	5.44	16.00	11.50	15.21
ASBS No. 29 drainage area								
Wet weather	0.08	0.11	1.27	1.29	1.30	2.65	0.21	1.82
Dry weather	7.20	7.27	7.13	7.47	7.46	7.79	6.75	7.15

The City also currently operates 31 low flow diversion facilities within the Scripps watershed. These were included in the baseline model of existing conditions and are therefore not included within the flow and pollutant load estimates for dry weather in Table 4-1. Based on review of information on these diversions and communications with City staff, a cumulative diverted flow rate of 12.9 cubic feet per second (cfs) was assumed in the model for these facilities, with individual facility locations and diversion rates represented appropriately.

4.2 Distributed BMPs on Public Land

Both bioretention and permeable pavement were considered for implementation of distributed BMPs on public parcels. Parcels were screened during the Phase I CLRPs to identify the opportunity for implementation, accounting for feasibility constraints such as site slope. Both bioretention and permeable pavement options were configured with and without underdrains depending on the underlying soils. For instance, Hydrologic Soil Group B areas were modeled without underdrains and Hydrologic Soil Group C and D areas were modeled with underdrains. Details on the distributed BMP model representations are presented in Appendix A. Table 4-2 presents the modeled flow and pollutant load reduction attributed to implementation of distributed BMPs on available public parcels.

Table 4-2. Flow and pollutant load reduction attributed to distributed BMPs on public parcels

Condition	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
Scripps watershed (excluding Mission Bay drainage area)								
Wet weather	2.73	2.62	1.67	2.40	2.67	4.90	3.37	2.93
Dry weather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASBS No. 29 drainage area								
Wet weather	4.83	4.78	3.24	4.46	5.16	9.32	6.09	5.50
Dry weather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

4.3 Green Streets

The modeling shows that the maximum deployment of nonstructural BMPs and centralized and distributed structural BMPs on public land provide the necessary load reductions to meet WLA requirements for bacteria, but are insufficient for metals reduction requirements of the ASBS. Therefore, additional analysis of green streets was performed for the ASBS area to meet the necessary metals reductions. For comparison of the cost savings associated with these BMPs and their load reduction assumptions, additional load reductions and associated costs of green streets and centralized structural BMPs on private land (discussed in the following sub-section) were analyzed and presented in the optimization results for Section 5.

Implementing green streets involves constructing structural BMPs, such as bioretention and permeable pavement in the rights of way of various streets. Although they are more expensive than the previously mentioned BMPs, green streets are very efficient at removing pollutant loads in watersheds because of their proximity to pollutant generating surfaces and their location in the existing surface conveyance infrastructure of the stormwater collection system. Additional advantages of green streets include the fact that they are located in the right of way (and therefore have no land acquisition costs) and are more conveniently accessed for maintenance activities.

A detailed desktop analysis was performed throughout the watershed to evaluate the opportunities for retrofitting existing rights-of-way to green streets. The latest information on road coverage, road type, potential drainage area, soil types, and construction infeasibility was combined to identify the number of potential green streets miles in the watershed. The results of this analysis are summarized in Appendix A. The findings of this analysis were then loaded into SUSTAIN, which comprehensively evaluated and optimized the cost and pollutant removal effectiveness for numerous different combinations of green streets. A cost effectiveness curve was generated from this effort and is presented in Section 5 of this report.

4.4 Centralized BMPs on Acquired Private Land

Due to the high cost of land acquisition associated with centralized structural BMPs on acquired private land, these BMPs are considered a last resort for implementation to meet necessary load reductions. As with green streets, additional load reductions associated with centralized BMPs on acquired private land were considered in the optimization analysis, presented in Section 5, to demonstrated the overwhelming cost savings associated with nonstructural BMPs and structural BMPs on public land, which were sufficient to meet the required load reduction to meet the WLA.

Unlike the green streets optimization, which was based upon a detailed desktop analysis of BMP opportunities, the optimization of centralized BMPs on private land was founded on a higher level planning analysis due to the unknown locations and availability of private land acquisition. Specific spatial and climatic characteristics of each individual subwatershed were loaded into SUSTAIN and hypothetical BMPs were simulated with a fixed drainage area necessary to capture the design storm as detailed in Appendix A. The optimization analysis included numerous combinations of BMP location and size scenarios to develop a cost effectiveness curve, which is presented in Section 5 as an alternative to the green streets approach.

5 Optimization Analysis Results

The previous section provided a quantitative analysis of the load reductions achieved for each type of BMP. The focus of the optimization analysis is to consider costs as part of the overall strategy for watershed-wide implementation of these BMPs. This analysis considers implementation of the various BMP levels, while incrementally considering costs for implementation and mapping progress toward achieving the load reduction targets identified for each TMDL and ASBS pollutant. The method for assessing the optimal strategy was based on a cost-effectiveness curve similar to the conceptual diagram presented in Figure 2-1. It is important to note that the optimization process depended on evaluating and comparing the cost-effectiveness of various BMP alternatives. Detailed BMP cost functions consider BMP construction, maintenance, and land acquisition for BMP implementation. Section 6.2 and Appendix B summarize total cost estimates for BMP implementation in 2013 dollars.

The cost-effectiveness curve is shown in Figure 5-1 to address Bacteria TMDL requirements for the entire Scripps watershed excluding the Mission Bay drainage area, and demonstrates the strategies to meet the 8.3% load reduction of fecal coliform for Scripps watershed. The optimization analysis demonstrated that nonstructural BMPs and structural BMPs on public land (not including green streets) were sufficient to achieve the required load reduction to meet the Bacteria TMDL (Figure 5-1). Results also show the significant cost savings associated with nonstructural BMPs, particularly the non-modeled nonstructural BMPs with an assumed load reduction of 5%. This savings is demonstrated by assessing the additional BMPs needed for further load reduction should the nonstructural BMPs later prove to not achieve their assumed benefit. Both green streets and centralized BMPs on acquired private land were considered in this additional optimization. The first scenario assumed that green streets could be implemented for all areas predetermined as feasible. For comparison purposes, a second scenario was optimized that considered no green streets and relied only on centralized structural BMPs on acquired private land (in addition to nonstructural BMPs and structural BMPs on public land) to meet the load reduction target.

Figure 5-2 shows the cost-effectiveness curve and associated strategies for the ASBS drainage area to address the 18.4% reduction for the critical pollutant copper. The analysis demonstrated that nonstructural BMPs, structural BMPs on public land, and green streets were needed to achieve the required load reduction for copper (Figure 5-2). Similar to the bacteria analysis, an alternative scenario was assessed providing a comparison of the costs and benefits of centralized structural BMPs on acquired private land as an alternative to green streets. These results show that green streets provide a cost savings of approximately $12 million over the alternative for centralized structural BMPs on acquired private land.

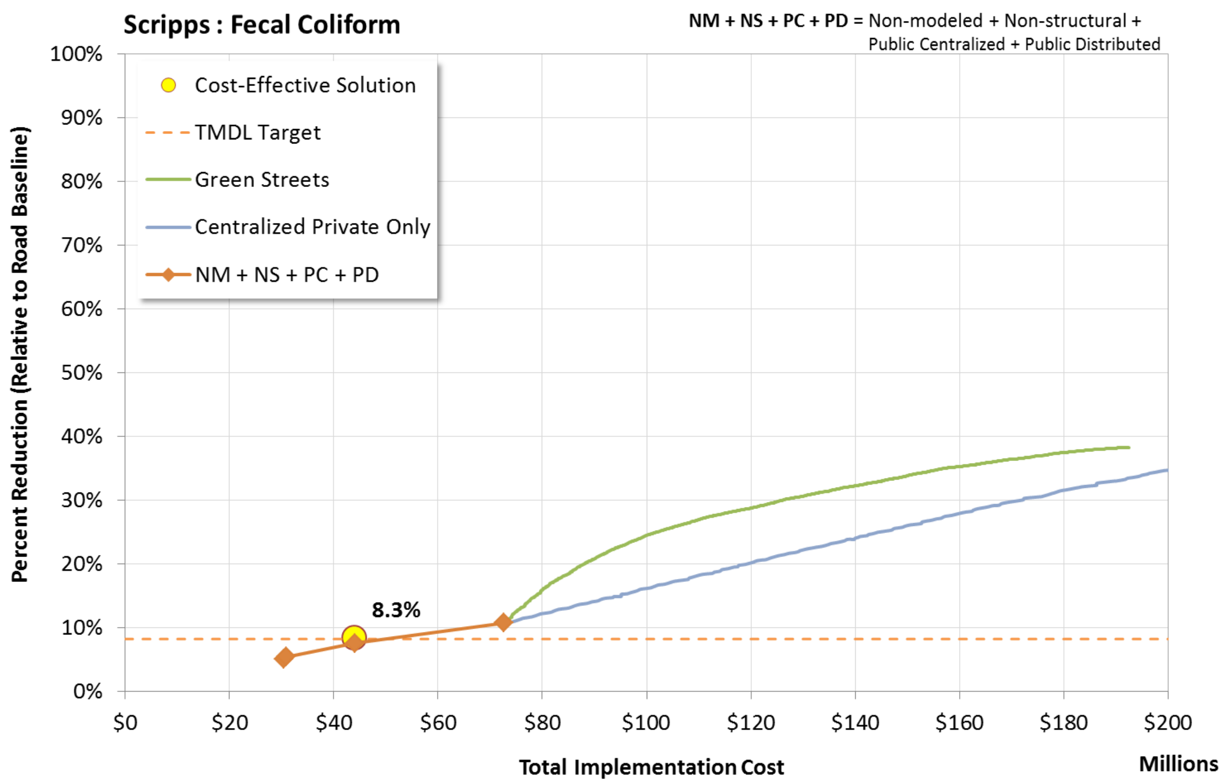

Figure 5-1. Cost-effectiveness curves for wet weather - Scripps watershed (excluding Mission Bay drainage area)

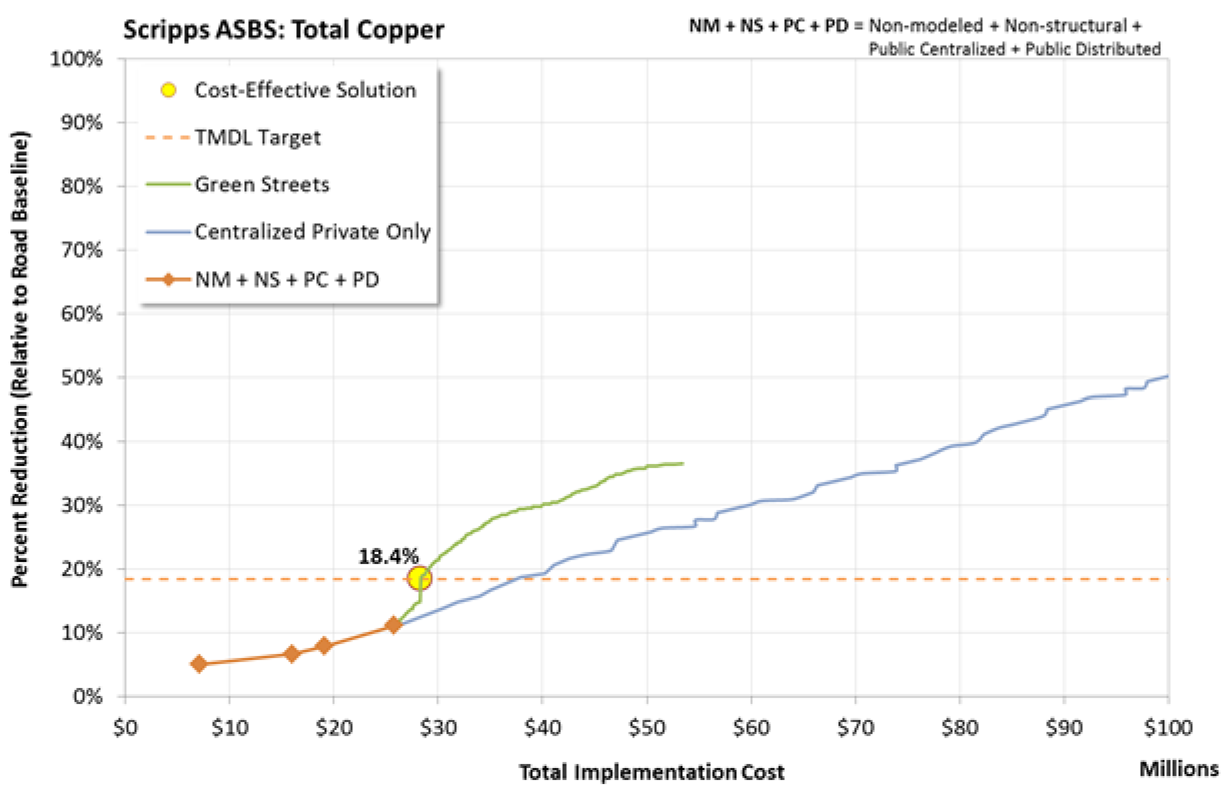

Figure 5-2. Cost-effectiveness curves for wet weather - ASBS No. 29 drainage area

To determine the maximum cost-effective implementation of green streets in the ASBS portion of the watershed, the optimization included a spatial analysis to determine the most cost-effective levels (see Section 4.3) of green streets for each modeled subwatershed. Figure 5-3 shows the optimal maximum cost-effective levels of green streets, which focused on a single subwatershed for implementation to provide the necessary load reduction (representing the point for meeting the target load reduction in Figure 5-1). Green street management levels (Table 5-1) represent increments of implementation of the maximum feasible green streets implementation opportunity (see Appendix A). The opportunity for feasible green streets is unique to each subwatershed, so management levels represent increases in implementation that are proportional to each subwatershed's maximum available opportunity. Within the optimal subwatershed for green street implementation, 4,951 feet of bioretention and 4,660 feet of permeable pavement are recommended as goals for cost-effective implementation.

Table 5-1. Management levels for green streets

Management Level	Description
0	No Management
1	20% of available GS opportunity
2	40% of available GS opportunity
3	60% of available GS opportunity
4	80% of available GS opportunity
5	100% of available GS opportunity

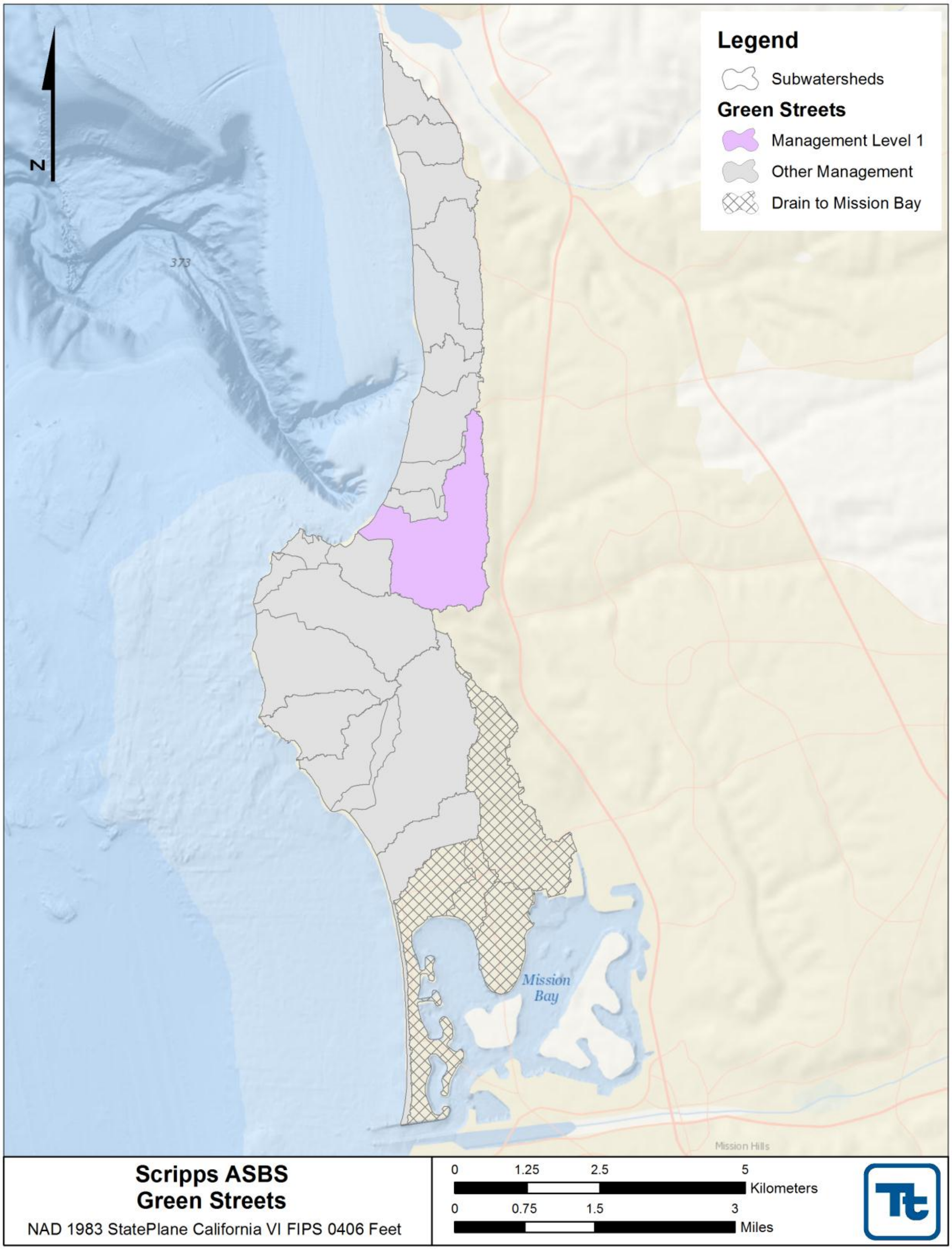

Figure 5-3. Spatially optimized implementation of green streets

The cost effectiveness curves above were only required for evaluation of wet weather results. Once the BMPs were optimized for wet weather, the models were used to simulate associated pollutant reductions for dry weather. Table 5-2 summarizes pollutant load reductions for wet and dry weather conditions for the critical pollutants for the TMDL and ASBS areas. It should be noted that neither green streets nor centralized BMPs on acquired private land are required to meet the target of 8.3 percent reduction. In fact, the combination of nonstructural BMPs and structural BMPs on public land achieve a load reduction that exceeds this target. These tables illustrate the contribution of each management level BMP commitment to achieving the total pollutant load reduction target. Table 5-3 presents load reductions at each management level for all other pollutants of concern. Note the Scripps watershed does not include any additional 303(d) listed pollutants.

Table 5-2. Total critical pollutant load reductions

Season	Non-structural (not modeled) (%)	Non-structural (modeled) (%)	Centralized on Public (%)	Distributed on Public (%)	Green Streets (%)	Centralized on Acquired Private Land (%)	Total* (%)
Scripps watershed (excluding Mission Bay drainage area)							
Wet weather	5.00	0.32	1.63	3.75	n/a	n/a	10.71
Dry weather	5.00	85.28	9.72	0.00	n/a	n/a	100.00
ASBS No. 29 drainage area							
Wet weather	5.00	1.62	1.27	3.24	7.3	n/a	18.4
Dry weather	5.00	72.03	7.13	0.00	15.84	n/a	100.00

*The load reduction analysis and scheduling of BMPs was performed for final targets only. Interim targets and associated schedules will be further evaluated through an adaptive process as BMPs are implemented and their effectiveness is assessed.

Table 5-3. Load reductions of additional pollutants

Condition	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
Scripps watershed (excluding Mission Bay drainage area)								
Wet weather	10.3	10.1	9.0	9.5	8.9	10.7	13.3	11.4
Dry weather	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ASBS No. 29 drainage area								
Wet weather	14.2	17.4	18.4	17.6	20.0	21.7	19.1	14.3
Dry weather	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

6 Updated CLRP Implementation Program

Phase 1 of the CLRP provided a foundational cost and schedule framework for compliance with TMDL and ASBS requirements. It is necessary to update these elements of the plan to incorporate optimization modeling results and new information regarding implementation of nonstructural BMPs. Updates to costs and schedules are presented in this section.

6.1 Updated BMP Implementation Schedule

The Bacteria TMDL Basin Plan Amendment was approved in April 2011, which represents the start date for complying with the WLAs and other TMDL requirements. CLRPs for all watersheds incorporate a 20-year compliance schedule and recognize BMP development and planning efforts that have been completed to date, including development of the CLRP itself. A BMP Implementation Schedule was developed during Phase 1 efforts to focus on the BMP actions that may be implemented in future years according to the following overarching strategy: nonstructural BMPs were scheduled to be implemented in years 0–5; currently planned structural BMPs on public land in years 0–10, centralized and distributed structural BMPs on public land in year 3-15, and structural BMPs on acquired private land in years 15-20.

The Comprehensive Compliance Schedule was updated during Phase II efforts to reflect phasing and cost considerations discussed with the City (Appendix C). Phasing remained unchanged for all planned structural BMPs identified in the final CLRP Phase I reports, but implemented structural BMPs were removed from the schedule. In addition, any planned/implemented BMPs on acquired private land were omitted from the schedule such that costing efforts could focus on publically-funded projects. To account for a 5-year lead-in period before new, candidate structural BMPs are to be implemented, the schedule was further updated such that implementation of new structural practices will begin during fiscal year 2019; the CLRP Phase 1-proposed end dates for structural BMP implementation were retained. All nonstructural BMPs were subject to the same scheduling as Phase I efforts. Most of the planned or newly identified BMP opportunities are not funded, and the time frame to secure the necessary funding for each BMP is not incorporated in the implementation schedules. BMP implementation is subject to evaluation of funding opportunities and other considerations and lack of funding could delay the implementation start and end dates. These challenges can be continually re-evaluated and addressed through an adaptive management process throughout the implementation period.

6.2 Updated Costs Estimates

In addition to updating the schedule from Phase 1, costs for individual BMPs were revisited. Nonstructural costs were updated based on interviews with key staff to ensure that the appropriate levels of implementation and resources were accounted for. Costs for structural BMPs were updated based on the modeling results which identified the necessary level of implementation for compliance. Annual maintenance costs were also refined based on interviews with operations and maintenance staff. Based on the updated unit costs and the updated schedule, costs were recalculated for each BMP. Table 6-1 provides a summary of total costs for compliance with the TMDLs. Detailed costs for individual BMPs are presented in Appendix B. Costs are based on 2013 dollars and are not adjusted for present value or inflation. It should be noted that costs presented in the cost effectiveness curves in Section 5 do not correspond directly to costs listed in Table 6-1, since optimization analyses were based on automated cost-functions within the model for comparative analysis, while the costs presented below were based on more rigorous engineering cost analyses utilizing information on BMPs provided by model output.

Table 6-1. Total BMP costs for compliance (millions)

Non-structural (not modeled)	Non-structural (modeled)	Centralized on Public	Distributed on Public	Green Streets	Centralized on Acquired Private Land	Total
$ 13.53	$ 10.39	$ 15.78	$ 20.51	$ 7.71	$ -	$ 67.92

6.3 Considerations for BMP Implementation

The CLRP Phase I outlined a CLRP Implementation Program to attain compliance with the TMDLs and facilitate strategic decision making, assessment, and adaptation of the CLRP. In the coming years, lessons will be learned from projects implemented, conditions will change, new technologies will emerge, and unanticipated challenges will present themselves. Thus, implementation of the CLRP will require continued evaluation and adaptation throughout the 20-year implementation period to ensure that strategies are optimized.

The prioritization process for implementing BMPs must carefully consider many factors, including feasibility, cost effectiveness, and the potential for pollutant load reductions. These factors have been considered and/or analyzed as part of the CLRP development process for each individual management level and the results of these analyses integrated into the scheduling and implementation level decisions presented above. Further prioritization, however, is necessary to ensure that those BMPs with the highest feasibility, highest cost effectiveness, and greatest potential for pollutant load reductions are implemented early in the implementation schedule. This section provides a brief summary of considerations that should be made for each management level as they are implemented.

Nonstructural BMPs

While nonstructural BMPs are known to be the most cost-effective for pollutant load reduction, many of their effects are often difficult to measure or quantify directly in the field. As a result, true cost effectiveness numbers are difficult to obtain. As technical or scientific methods emerge to address such needs, the foundational assumptions for these BMPs should be updated to reflect the most recent understanding. Ultimately, pollutant removal through nonstructural means is likely to continue to be the most cost effective activity due to the absence of construction, land purchase, or maintenance costs. Therefore, with additional studies to quantify the effectiveness of nonstructural BMPs, and with increasing focus on the more successful nonstructural BMPs in terms of pollutant removal, their demonstrated load reductions can potentially offset the need for more costly structural BMPs, particularly those that require land acquisition.

Centralized BMPs on Public Land

Prioritization of centralized structural BMPs on public land may be performed at many stages of the planning process. Early stage prioritization is generally based on regional datasets for soils, topography, and other landscape or land use features. Later stage planning focuses on individual sites and incorporates site-specific information to help determine feasibility, such as drainage area and available space. Both of these efforts were completed as part of the CLRP Phase I and the results were integrated into a prioritized list of BMP opportunities. This list represents the most efficient path for implementing centralized structural BMPs on the publicly owned sites identified.

Distributed BMPs on Public Land

The CLRP Phase I presented a number of publicly owned parcels that were prioritized for implementation of distributed structural BMPs. These prioritizations should be considered during the implementation of distributed BMPs, which account for areas if higher pollutant reduction expected based on physical characteristics, potential for pollutant load reduction (Water Quality Composite Scores shown in Appendix D), and other factors related to feasibility.

7 Alternative Scenarios

There are several important regulatory considerations currently being evaluated by the City that would affect the calculation of allowable loads and load reductions, but still ensure protection of beneficial uses for San Diego River. These considerations were incorporated into alternative modeling scenarios for evaluation of their sensitivity on cost for CLRP implementation. The resulting information can help guide ongoing discussions regarding prioritization of regulatory decisions on recent and ongoing scientific studies on water quality targets, each of which is aimed at protecting those beneficial uses.

Alternative scenarios were evaluated considering the ASBS dilution study results and possible changes to the allowable bacteria exceedance frequency. Approval of the dilution study is expected; therefore, it is likely that compliance with the ASBS requirements will be based on the dilution-adjusted effluent limitations. Considering dilution, the results from Table 2-8 show that fecal coliform bacteria is the critical pollutant for the ASBS drainage area (not copper), although the required load reduction is less than 1%. Based on these results, the required load reduction for the alternatives analysis was calculated for the broader Scripps watershed (excluding the Mission Bay drainage area, but including the ASBS drainage area) to meet the more stringent Bacteria TMDL requirements. Essentially, this resulted in eliminating the need for green streets within the ASBS drainage area, resulting in a cost savings of $7.71 million if the dilution factor is approved by the Regional Board.

Table 7-1. Summary of costs considering ASBS dilution factor

Scenario	Total Cost (Million $)
Without ASBS dilution factor	67.92
With ASBS dilution factor	60.21

The allowable exceedance frequency of bacteria, based on a reference condition, is also a critical assumption for the TMDL and CLRP which has significant impact on the overall cost for meeting the WLA. Should additional study of reference conditions result in a change in the allowable exceedances, the resulting exceedance frequency can be incorporated within a re-opener of the Bacteria TMDL and result in major cost savings to the City. The impacts of the sensitivity of the wet weather bacteria exceedance frequency on modeled required load reductions and costs were assessed. Table 7-2 presents the loads attributed to increased exceedance frequencies of 35% and 50% and the impact on required load reductions. As shown, increases of the exceedance frequency results in significant reductions of the required load reductions to comply with the TMDL. Table 7-3 presents corresponding cost-savings of each alternative scenario. It should be noted that results for 14 days (35%) in Table 7-3 included all non-modeled and modeled nonstructural and therefore results in a load reduction of 5.32, slightly higher than the required reduction of 5.16%. Likewise, the results for 21 days (50%) only included non-modeled nonstructural which included the assumed load reduction of 5% and will likely exceed the required load reduction of 0.30%. Based on these results, every effort should be made to re-open the TMDL and incorporate such modifications based on sufficient scientific justification that an alternative exceedance frequency is applicable for Scripps.

Table 7-2. Alternative wet-weather pollutant loads and required reductions (Billion #/yr)

Scenario	Total Load	Non-Exceedence Load	Allowable Exceedence Load	Exceedance Load	Required Reduction
9 days (22% - existing requirement)	275,374	12,247	240,379	22,748	8.3%
14 days (35%)	275,374	12,247	248,918	14,209	5.16%
21 days (50%)	275,374	12,247	262,301	826	0.30%

Table 7-3. Alternative scenario total costs for compliance (millions)

Scenario	Total Cost (Million $)	Cost Savings From Existing Requirement (Million $)
9 days (22% - existing requirement)	67.92	
14 days (35%)	23.92	44.00
21 days (50%)	13.53	54.39

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