Chollas 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 Chollas Hydrologic Sub Area (HSA) (Chollas watershed), part of the San Diego Bay watershed, representing 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 the Chollas watershed Metals TMDL and Diazinon TMDL (SDRWQCB 2002, 2007). The City of San Diego, City of La Mesa, City of Lemon Grove, County of San Diego, Caltrans, and the San Diego Unified Port District (Port of San Diego), as the Responsible Parties (RPs) for 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 for comprehensive load reduction in the Chollas watershed. As part of the CLRP Implementation Program, an Initial Structural and Nonstructural BMP Analysis was recommended in 2013 to provide assessment and additional information regarding the adequacy and cost-effectiveness of all BMPs recommended in the CLRP and their feasibility at meeting the TMDL wasteload allocations (WLAs). 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 quantify load reductions to support evaluation of WLA 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 WLAs.
- Adjustments of cost estimates and scheduling of BMPs to meet interim and final load reduction targets to attain WLAs.

The Initial Structural and Nonstructural BMP analysis includes modeling to quantify 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, each RP participated in a re-evaluation of its nonstructural BMPs to provide information for model representation and to determine if any adjustments were needed to facilitate a more feasible implementation. These combined efforts provided new information about which combination of nonstructural BMPs and distributed and centralized structural BMPs on public land is best suited to make progress toward load reductions to meet WLAs. Further modeling and cost-optimization was performed to identify the additional green streets and centralized BMPs on private land needed to ultimately meet the WLAs. The combined results of this modeling and optimization effort identified the most cost effective combination of BMPs. These results further validate the CLRP's Comprehensive Compliance Schedule, which is slightly adjusted 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 RPs to consider how modeling results can contribute to the load reduction analysis required in the WQIP for TMDL 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 of 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.

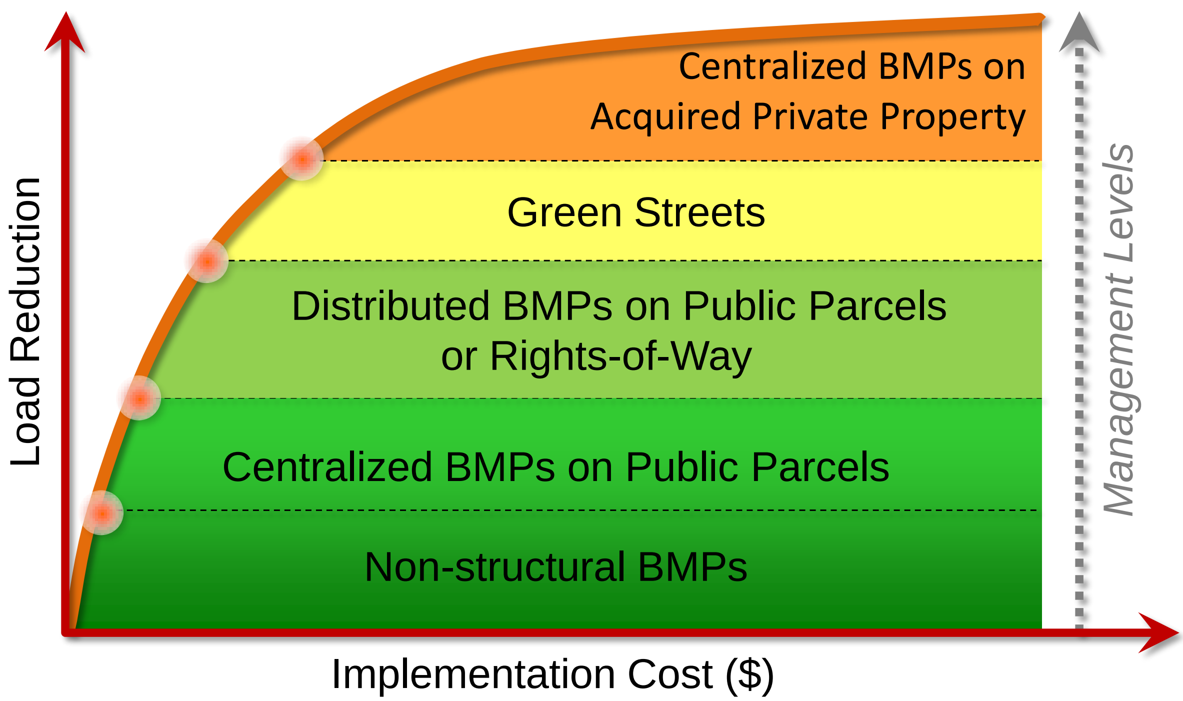

Figure 2-1. Conceptual cost-benefit curve and management levels

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 centralized BMPs on private property acquired by the RPs. Centralized structural BMPs on acquired private land represent the last level because of potential land acquisition costs. These BMPs 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 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, sediment, and metals were selected as the focus because of the priority in addressing the TMDL pollutants (sediment was used as a surrogate for toxicity). Individual quintiles scores for enterococcus, fecal coliform, and total coliform were averaged to develop a dry weather composite score. The wet weather score was based on the average of the bacteria, metals, and sediment 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 RPs. 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 85th percentile storm event consistent with existing RP 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 Chollas watershed is subject to bacteria and metals TMDLs for the creek and pending toxic pollutant TMDLs for the creek mouth area. 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 as well as the 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

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 Chollas Creek watershed is subject to those targets assigned to freshwater creeks (Table 2-1).

Table 2-1. Receiving water limitations for creeks 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%
Enterococcus	61 (104*)	22%	33	0%

* if designated as a “moderate to lightly used area” or less frequent usage frequency in the Basin Plan

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. Any day not classified as a wet day was considered a dry day. 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 Metals

WQOs and TMDL Numeric Targets

The Chollas Creek Dissolved Metals TMDL is concentration-based, and thus the WQOs and TMDL numeric targets closely reflect one another. This TMDL focused on copper, lead, and zinc because Chollas Creek is listed under Clean Water Act Section 303(d) for these metals and toxicity. The TMDL targets were set equal to the dissolved California Toxics Rule (CTR) criteria, and thus the TMDL targets are identical to the Basin Plan WQOs, detailed in Table 2-3. The WQOs/TMDL targets are expressed for acute (1-hour) and chronic (4-day) durations, and are based on hardness. Note that the TMDL WLAs for MS4s are applied to "urban runoff discharges before it is discharged to Chollas Creek." A margin of safety factor of 0.9 was applied to the WQOs/TMDL targets, and thus the WLAs are expressed as identical equations except a factor of 0.9 is inserted. Considering future adoption of the proposed Water Effects Ratio (WER), the margin of safety factor of 0.9 was not included in the numeric goal calculations as described below. The WER would develop a site specific objective to protect Cholas Creek's beneficial uses, instead of using the statewide default value.

Numeric goals for the dissolved metals were calculated following the same method as described in the bacteria compliance section. Since the WQOs are hardness-based equations, an average hardness value was calculated for wet and dry conditions based on recent TMDL compliance monitoring data (95 mg/L wet; 354 mg/L dry) and used to calculate static numeric goals for the CLRP modeling effort. In addition, the models simulate total metals rather than 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 factors specified in the TMDL were used to convert the WQOs and resulting numeric goals to total metals for comparison with the modeled loads. Acute WQOs were used to calculate the wet weather TMDL load, which represents the majority of the total loading because of the association between storm water runoff and metals concentrations. Chronic concentrations are typically associated with dry weather periods, therefore the chronic WQOs were used to calculate the dry weather TMDL loads. The required load reduction represents the difference between the modeled load for each parameter and the TMDL loads for wet and dry weather conditions (derived from the acute and chronic WQOs, respectively).

Table 2-3. Chollas Creek dissolved metals TMDL targets and Basin Plan WQOs

Metal	Numeric Target for Acute Conditions: Criteria Maximum Concentration	Numeric Target for Chronic Conditions: Criteria Maximum Concentration
Copper	(1) * (0.96) * {e^[0.9422 * ln(hardness) – 1.700]}	(1) * (0.96) * {e^[0.8545 * ln(hardness) – 1.702]}
Lead	(1) * {1.46203 – [0.145712 * ln(hardness]} * {e^[1.273 * ln(hardness) – 1.460]}	(1) * {1.46203 – [0.145712 * ln(hardness]} * {e^[1.273 * ln(hardness) – 4.705]}
Zinc	(1) * (0.978) * {e^[0.8473 * ln(hardness) + 0.884]}	(1) * (0.986) * {e^[0.8473 * ln(hardness) + 0.884]}

Hardness is expressed as mg/L
Calculated concentrations should have two significant figures [40 CFR 131.38(b)(2)]
The natural log and exponential functions are represented as "ln" and "e", respectively

Interim Milestones and Compliance Schedule

The Chollas Creek Dissolved Metals TMDL includes interim compliance milestones to measure progress towards achieving final TMDL attainment (Table 2-4). Interim milestones are expressed as the allowable percentage above the WLAs. For the modeling analysis, compliance with the exceedance frequency milestones was based on achieving an overall 80% load reduction by Year 10 (20% of the load reduction target is allowable) and 100% reduction by Year 20.

Table 2-4. Interim Milestones and Compliance Schedule for Chollas Creek Metals TMDL.

Compliance Year (year after TMDL effective date - 2008)	Allowable Exceedance of the WLAs (allowable percentage above)		
	Copper	Lead	Zinc
1 (by 2009)	100%	100%	100%
10 (by 2018)	20%	20%	20%
20 (by 2028)	0%	0%	0%

2.2.3 Toxics

WQOs and TMDL Numeric Targets

The Draft Sediment Toxics TMDLs for the mouths of Paleta, Chollas, and Switzer Creeks include mass- and concentration-based TMDLs. The mass-based TMDLs specifically address watershed contributions to the impaired creek mouth areas, whereas the concentration-based TMDLs address legacy sediment contamination. Polycyclic aromatic hydrocarbons (PAHs) represent the most significant category of toxic pollutants for the watershed, especially considering chlordane and polychlorinated biphenyls (PCBs) are banned substances with no active use. The CLRP modeling effort focused on demonstrating compliance with the Total PAHs numeric target for sediment that was derived during TMDL development (2,861 ug/kg). TMDL development was based on modeling sediment loading from the watershed and converting those loads to Total PAHs based on a regression analysis using recent total suspended solids (TSS) and Total PAHs water quality monitoring data collected by the City of San Diego. The regression equation relates TSS concentration (mg/L) to Total PAHs (ng/L) in the water column after log transformation (y=1.3103x). Modeled loads were calculated based on the estimated daily Total PAHs concentration multiplied by daily modeled flow to derive an annual load. The TMDL load was calculated by multiplying the Total PAHs target (2,861 µg/kg) by the modeled sediment load from WY2003. The numeric goal was calculated based on the difference between the modeled load and the TMDL load. The TMDL margin of safety of 5 percent was not included given this small level of uncertainty.

Interim Milestones and Compliance Schedule

The Draft Sediment Toxics TMDLs includes interim compliance milestones to measure progress towards achieving final TMDL attainment. These milestones are expressed as an increasing percentage of the required load reduction over time. As the TMDL is currently draft, the interim milestones may be revised based on comments received during public review, therefore these milestones were not evaluated. Final TMDL milestones can be evaluated later as part of the WQIP development process.

2.2.4 TMDL Load Reduction Summary

Table 2-5 and Table 2-6 present the calculated wet and dry weather loads and load reductions required based on the assumptions discussed above for each pollutant. Copper was determined to be the critical pollutant overall based on the wet weather percent reduction required. 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).

Table 2-5. Wet-weather pollutant loads and required reductions

Pollutant	Total Load	Non-Exceedance Load	Allowable Exceedance Load	Exceedance Load	Required Reduction
Fecal Coliform (Billion #/year)	939,537	41,275	628,115	270,147	28.8%
Enterococcus (Billion #/year)	7,280,200	5,532,655	5,532,655	1,741,230	23.9%
Copper (lbs/yr)	1,116.1	299.1	n/a	817.0	73.2%
Lead (lbs/yr)	961.5	961.5	n/a	0	0.0%
Zinc (lbs/yr)	7,220.0	2,557.6	n/a	4,662.4	64.6%
PAHs (g/yr)	33,648.54	14,492.89	n/a	19,155.65	56.9%

Table 2-6. Dry-weather pollutant loads and required reductions

Pollutant	Total Load	Non-Exceedance Load	Exceedance Load	Required Reduction
Fecal Coliform (Billion #/year)	64,095	769	63,326	98.8%
Enterococcus (Billion #/year)	724,346	5,070	719,276	99.3%
Copper (lbs/yr)	45.0	19.8	25.3	56.1%
Lead (lbs/yr)	39.0	11.5	27.5	70.4%
Zinc (lbs/yr)	293.4	242.2	51.3	17.5%

3 Quantitative Evaluation of Nonstructural Solutions

It is challenging to accurately quantify the benefits for most nonstructural BMPs 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 and education and public outreach as a way to improve pollutant source control. The benefits of pollutant and flow reductions 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 for each RP and describes the modeling process. A conservative load reduction of 5% is allocated for those BMPs that are not represented in the model.

The watershed model was run with a series of scenarios to quantify the effectiveness of each nonstructural BMP. Watershed model boundaries were intersected with jurisdictional boundaries so that modeled results of nonstructural BMPs could be reported for the RPs. The loads vary between the RPs according to (1) the extent to which opportunities exist for improvements to existing practices (or implementation of new programs), and (2) the anticipated level of implementation based on discussion with each RP.

The purpose of this section is to summarize the extent to which each nonstructural BMP contributes to pollutant removal in the Chollas watershed. Table 3-1 and Table 3-2 present the baseline watershed model flow and loads for the modeled year and further break out the totals for wet and dry conditions summarized by RP. Sediment is shown as a surrogate for PAHs in the following tables. In each of the subsequent sub-sections, the effectiveness of the BMPs are presented as a percent reduction relative to the baseline watershed model flow and loads presented in these tables.

Table 3-1. Wet-weather baseline flow and pollutant loads by RP

RP	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)
City of La Mesa	12,378	59.7	103.5	89.2	669.7	87,147	1,495.8	7,960
City of Lemon Grove	15,214	73.34	127.3	109.6	823.2	107,118	1,838.6	9,784
Port of San Diego*	20.9	0.10	0.17	0.2	1.1	147	2.5	13
San Diego County	945.6	4.56	7.9	6.8	51.2	6,657	114.3	608.03
City of San Diego	103,474	498.8	865.4	745.5	5,598.2	728,500	1,2504	66,538
Caltrans	1,415	6.82	11.8	10.2	76.6	9,967	171.1	910.3

* the model was updated to only represent the MS4 jurisdictional area for the Port of San Diego (NASSCO's leasehold area is subject to a separate permit)

Table 3-2. Dry-weather baseline flow and pollutant loads by RP

RP	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)
City of La Mesa	408.2	2.0	4.2	3.6	27.2	5,945.2	74.9	417.1
City of Lemon Grove	501.7	2.5	5.1	4.5	33.5	7,307.6	92.1	512.7
Port of San Diego*	0.2	0.0	0.0	0.0	0.0	2.5	0.0	0.2
San Diego County	31.2	0.2	0.3	0.3	2.1	454.1	5.7	31.9
City of San Diego	3,412.1	17.1	34.9	30.3	227.5	49,698.1	626.1	3,486.7
Caltrans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

* the model was updated to only represent the MS4 jurisdictional area for the Port of San Diego (NASSCO's leasehold area is subject to a separate permit)

3.1 Street Sweeping

Street sweeping was represented in the watershed model as an extension of additional routes, increase in sweeping frequency, 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 Appendix A. The resulting pollutant load reductions (relative to baseline conditions) attributed to street sweeping are summarized by RP in Table 3-3 and Table 3-4.

Table 3-3. Wet-weather flow and pollutant load reductions by RP attributed to street sweeping

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.00	0.93	1.30	1.10	1.32	0.30	0.27	0.25
City of Lemon Grove	0.00	0.80	1.02	0.99	1.08	0.21	0.19	0.22
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County	0.00	0.02	0.02	0.01	0.02	0.00	0.00	0.00
City of San Diego	0	0.91	1.16	1.05	1.34	0.23	0.19	0.21
Caltrans	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00

*n/a denotes that this BMP is not a candidate for an increase in future practice

Table 3-4. Dry-weather flow and pollutant load reductions by RP attributed to street sweeping

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City of Lemon Grove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City of San Diego	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Caltrans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

*n/a denotes that this BMP is not a candidate for an increase in future practice

3.2 Catch Basin Cleaning

Enhanced catch basin 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. Table 3-5 shows the average annual mass of pollutant load removed by RP attributed to the enhanced catch basin cleaning. Each RP that is identified as increasing this BMP has agreed to increase cleanings to four times per year per catch basin during the wet season. Catch basin cleaning is not assumed for dry weather.

Table 3-5. Wet-weather flow and pollutant load reduction attributed to enhanced catch basin cleaning

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.00	8.17	1.08	0.60	0.52	0.00	0.55	0.50
City of Lemon Grove	0.00	3.71	0.49	0.27	0.24	0.00	0.25	0.22
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
City of San Diego	0.00	17.52	2.32	1.28	1.11	0.00	1.19	1.06
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that this BMP is not a candidate for an increase in future practice

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 3-6 and Table 3-7 present the flow and pollutant load reductions associated with the proposed implementation of rain barrels.

Table 3-6. Wet-weather flow and pollutant load reduction attributed to rain barrels

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City of Lemon Grove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
City of San Diego	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that this BMP is not a candidate for an increase in future practice

Table 3-7. Dry-weather flow and pollutant load reduction attributed to rain barrels

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
City of Lemon Grove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
City of San Diego	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that this BMP is not a candidate for an increase in future practice

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 3-8 and Table 3-9 present the flow and pollutant load reductions associated with the proposed implementation of downspout disconnections.

Table 3-8. Wet-weather flow and pollutant load reduction attributed to downspout disconnections

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
City of Lemon Grove	0.01	0.02	0.01	0.02	0.02	0.02	0.01	0.01
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
City of San Diego	0.07	0.11	0.09	0.16	0.12	0.11	0.07	0.06
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that this BMP is not a candidate for an increase in future practice

Table 3-9. Dry-weather flow and pollutant load reduction attributed to downspout disconnections

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.01
City of Lemon Grove	0.01	0.02	0.01	0.03	0.02	0.02	0.02	0.01
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
City of San Diego	0.08	0.16	0.10	0.18	0.14	0.12	0.11	0.08
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that this BMP is not a candidate for an increase in future practice

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 3-10 and Table 3-11 present annual modeled flow and pollutant load reduction as a percentage of the baseline that is attributed to this irrigation runoff reduction program.

Table 3-10. Wet-weather flow and pollutant load reduction attributed to irrigation reduction

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.54	0.09	0.19	0.19	0.16	0.04	0.54	0.23
City of Lemon Grove	0.58	0.11	0.13	0.14	0.14	0.02	0.61	0.19
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County	0.54	0.09	0.17	0.18	0.18	0.04	0.59	0.21
City of San Diego	0.57	0.07	0.15	0.21	0.15	0.07	0.63	0.19
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that this BMP is not a candidate for an increase in future practice

Table 3-11. Dry-weather flow and pollutant load reduction attributed to irrigation reduction

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	67.44	61.36	58.71	58.02	59.23	58.65	60.33	58.04
City of Lemon Grove	66.31	60.32	58.54	57.76	58.95	58.04	59.34	57.61
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County*	69.12	62.97	59.1	58.8	60.02	59.73	61.34	58.26
City of San Diego	65.44	60.29	56.77	55.95	57.75	57.55	59.57	56.28
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that this BMP is not a candidate for an increase in future practice

3.6 Summary of Modeled Nonstructural BMPs

Finally, all nonstructural BMPs were included in the baseline watershed model to determine the aggregate flow and pollutant load reduction. The combined estimates are presented in Table 3-12 and Table 3-13.

Table 3-12. Wet-weather flow and pollutant load reduction attributed to all modeled non-structural practices

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.55	9.2	2.58	1.91	2.01	0.35	1.37	0.99
City of Lemon Grove	0.59	4.64	1.65	1.42	1.48	0.25	1.06	0.64
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County	0.54	0.11	0.19	0.19	0.2	0.04	0.59	0.21
City of San Diego	0.64	18.61	3.72	2.70	2.72	0.41	2.08	1.52
Caltrans	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00

*n/a denotes that these BMPs are not candidates for an increase in future practice

Table 3-13. Dry-weather flow and pollutant load reduction attributed to all modeled non-structural practices

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	67.45	61.38	58.72	58.04	59.25	58.66	60.34	58.05
City of Lemon Grove	66.32	60.34	58.55	57.79	58.97	58.06	59.36	57.62
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County	69.12	62.97	59.1	58.8	60.02	59.73	61.34	58.26
City of San Diego	65.52	60.46	56.87	56.14	57.9	57.68	59.68	56.36
Caltrans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

*n/a denotes that these BMPs are not candidates for an increase in future practice

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 non-modeled, non-structural BMPs are implemented and focused monitoring studies are performed to attempt to evaluate performance. 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 acquired by RPs.

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. Watershed model boundaries were intersected with jurisdictional boundaries so that model results of the structural BMPs could be reported for the RPs. The loads vary between the RPs according to (1) the extent to which opportunities exist for BMP implementation on public land within each RP jurisdiction, and (2) the physical characteristics of the potential BMP locations. 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 and Table 3-2.

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 Chollas watershed. The specific sites modeled are presented in Appendix A. Table 4-1 and Table 4-2 present the modeled flow and load reductions attributed to these centralized BMPs on public parcels.

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

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.46	0.29	0.44	0.39	0.38	0.29	0.47	0.40
City of Lemon Grove*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
City of San Diego	3.81	2.38	3.65	3.28	3.18	2.45	3.89	3.35
Caltrans	72.14	73.11	74.78	75.65	75.59	75.79	74.96	74.96

*n/a denotes that no parcels were available for centralized BMPs on public land

Table 4-2. Dry-weather low and pollutant load reduction attributed to centralized BMPs on public parcels

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.06	0.00	0.15	0.15	0.15	0.08	0.06	0.08
City of Lemon Grove*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
City of San Diego	0.50	0.01	1.27	1.27	1.25	0.69	0.48	0.70
Caltrans	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*n/a denotes that no parcels were available for centralized BMPs on public land

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 4-3 and Table 4-4 present the modeled flow and pollutant load reduction attributed to implementation of distributed BMPs on available public parcels.

Table 4-3. Wet-weather flow and pollutant load reduction attributed to distributed BMPs on public parcels

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	2.81	3.11	1.68	1.98	1.94	4.56	3.89	3.12
City of Lemon Grove	2.78	3.02	1.56	1.77	1.76	4.25	3.71	3.24
Port of San Diego	72.03	76.43	74.76	76.51	76.53	75.72	74.73	74.73
San Diego County	2.51	2.49	1.27	1.31	1.28	4.09	3.13	2.49
City of San Diego	2.53	2.57	1.32	2.07	2.04	4.15	3.25	2.53
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that no parcels were available for distributed BMPs on public land

Table 4-4. Dry-weather flow and pollutant load reduction attributed to distributed BMPs on public parcels

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	0.35	0.36	0.16	0.26	0.25	0.46	0.55	0.30
City of Lemon Grove	0.42	0.44	0.20	0.32	0.31	0.57	0.68	0.37
Port of San Diego	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
San Diego County	0.03	0.03	0.01	0.02	0.02	0.04	0.04	0.02
City of San Diego	2.89	3.03	1.38	2.15	2.12	3.85	4.60	2.54
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that no parcels were available for distributed BMPs on public land

4.3 Green Streets

The modeling shows that even the maximum deployment of nonstructural BMPs and centralized and distributed structural BMPs on public land provide only modest pollutant load reductions, well below those needed to meet the WLA reduction requirements. While the above BMPs represent the lowest cost BMPs for pollutant load reduction, more expensive structural solutions may be necessary to meet these requirements. The two alternatives considered for this study include green streets and centralized structural BMPs on private land acquired by RPs (discussed in the following sub-section). 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. For the Chollas watershed, the implementation of green streets does not provide sufficient load reductions for the critical pollutant (copper) to achieve compliance with WLA targets. Table 4-5 and Table 4-6 summarize the load reductions for all pollutants that can be attributed to the implementation of green streets. It is important to note that this management level, if chosen for implementation over centralized BMPs on private land acquired by RPs, represents the largest pollutant load reduction contribution of all management levels.

Table 4-5. Wet-weather flow and pollutant load reduction attributed green streets

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	22.96	50.18	51.48	46.00	59.25	52.19	48.66	42.32
City of Lemon Grove	21.59	48.05	50.21	44.21	57.06	50.00	46.73	41.02
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County	21.10	37.91	40.27	35.06	43.94	40.29	37.14	34.26
City of San Diego	20.89	41.38	43.14	37.99	47.76	43.49	40.86	36.47
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that green streets are not a candidate BMP for this RP and will not be implemented

Table 4-6. Dry-weather flow and pollutant load reduction attributed to green streets

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	43.58	67.09	64.65	62.85	67.72	62.71	65.18	59.20
City of Lemon Grove	42.17	64.31	62.72	60.19	64.90	59.93	62.07	57.17
Port of San Diego*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
City of San Diego	43.31	63.36	63.47	59.56	65.71	58.75	62.82	57.03
Caltrans*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that green streets are not a candidate BMP for this RP and will not be implemented

4.4 Centralized BMPs on Acquired Private Property

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. Centralized BMPs on acquired private land may not be considered for each jurisdiction until other BMP options are exhausted. Furthermore, based on the schedule determined in the Phase I CLRPs, the earliest centralized BMPs on private land may begin implementation is 2024. This gives much needed time for investigation of other more cost-effective BMP alternatives prior to implementation of centralized BMPs on acquired private land. For instance, research of nonstructural BMPs not presently modeled may provide definitive results for load reductions that can be later incorporated within the modeling analyses and provide a reduction in lieu of requiring centralized structural BMPs on acquired private land. Alternatively, implementation of green streets discussed in the previous section may provide a viable alternative should changes in road redevelopment procedures be achieved prior to 2024 when structural BMPs on private land are set to begin. Therefore, centralized structural BMPs on private land are meant to be a placeholder in the CLRP with an attempt to quantify the costs of meeting the load reduction targets beyond what can be presently quantified with nonstructural BMPs and structural BMPs on public land.

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. For the Chollas watershed, the implementation of centralized BMPs on private land provides sufficient load reductions for the critical pollutant to achieve compliance with WLA targets. Table 4-7 and Table 4-8 summarize the load reductions for all pollutants that can be attributed to the implementation of centralized BMPs on acquired private land.

Table 4-7. Wet-weather flow and pollutant load reduction attributed to centralized BMPs on private parcels

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	22.96	50.18	51.48	46.00	59.25	52.19	48.66	42.32
City of Lemon Grove	21.59	48.05	50.21	44.21	57.06	50.00	46.73	41.02
Port of San Diego	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County	21.10	37.91	40.27	35.06	43.94	40.29	37.14	34.26
City of San Diego	20.89	41.38	43.14	37.99	47.76	43.49	40.86	36.47
Caltrans	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that centralized BMPs on acquired private land will not be implemented for the selected RP

Table 4-8. Dry-weather flow and pollutant load reduction attributed to centralized BMPs on private parcels

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	68.14	83.06	81.70	80.67	83.88	80.31	81.95	78.12
City of Lemon Grove	67.56	80.83	81.29	78.04	83.66	78.76	80.69	75.79
Port of San Diego	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
San Diego County	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
City of San Diego	52.91	69.86	70.46	66.49	72.64	66.22	69.78	64.36
Caltrans	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*n/a denotes that centralized BMPs on private land will not be implemented for the selected RP

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 pollutant. The method for assessing the optimal strategy for each RP was based on cost-effectiveness curves similar to the conceptual diagram presented in Figure 2-1. The cost-effectiveness curves are shown in Figure 5-1 through Figure 5-6 for each RP, and assume that each RP is held to the same percent load reduction of 73.2% for the critical pollutant, copper. With each RP held equitably to the same load reduction percentage, this ensures an overall net load reduction for the entire watershed consistent with the required TMDL reduction, and that each RP does an equal amount of effort to achieve this goal relative to the loads from their jurisdiction. The result is that RPs with higher existing loads also have more loads to reduce to achieve the same percent reduction as RPs with lower existing loads (amount of loads are directly related to size of each RP jurisdiction).

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 and Appendix B summarize total cost estimates for BMP implementation in 2013 dollars.

As mentioned in the previous section, two alternatives were analyzed for optimization. The first scenario assumed that green streets could be implemented for all areas predetermined as feasible. There were no feasible locations in the watershed within Port of San Diego and Caltrans jurisdictions. If green streets (in addition to nonstructural and structural BMPs on public land) were not determined sufficient to meet the load reduction target, then the more expensive option for centralized structural BMPs on acquired private land were added to the optimization until the load reduction target was met. For comparison purposes, a second scenario was optimized that considered no green streets and relied only on centralized structural BMPs on private land (in addition to nonstructural BMPs and structural BMPs on public land) to meet the load reduction target. The following figures show the results of both scenarios and the overwhelming cost savings if green streets are considered as a major BMP for CLRP implementation. As a result, for those RPs where green streets are feasible, they are the recommended path for cost-effective implementation for the CLRP.

The optimization analysis and resulting cost effectiveness curves for each RP were also highly dependent on the nonstructural BMPs and structural BMPs on public land that each RP proposed implementing. For example, the City of San Diego is proposing a relatively greater effort for these BMPs, which reduced the need for more expensive alternatives such as centralized structural BMPs on private land to reach the target load reduction (Figure 5-3). If RPs do not have opportunities for significant load reductions from nonstructural BMPs or distributed or centralized structural BMPs on public land, the remaining option to achieve target load reduction is to implement centralized structural BMPs on acquired private land. The results provide an ideal opportunity for each RP to assess their strategy for BMP implementation and make adjustments, where possible, to revise BMP implementation plans to provide higher cost-effectiveness.

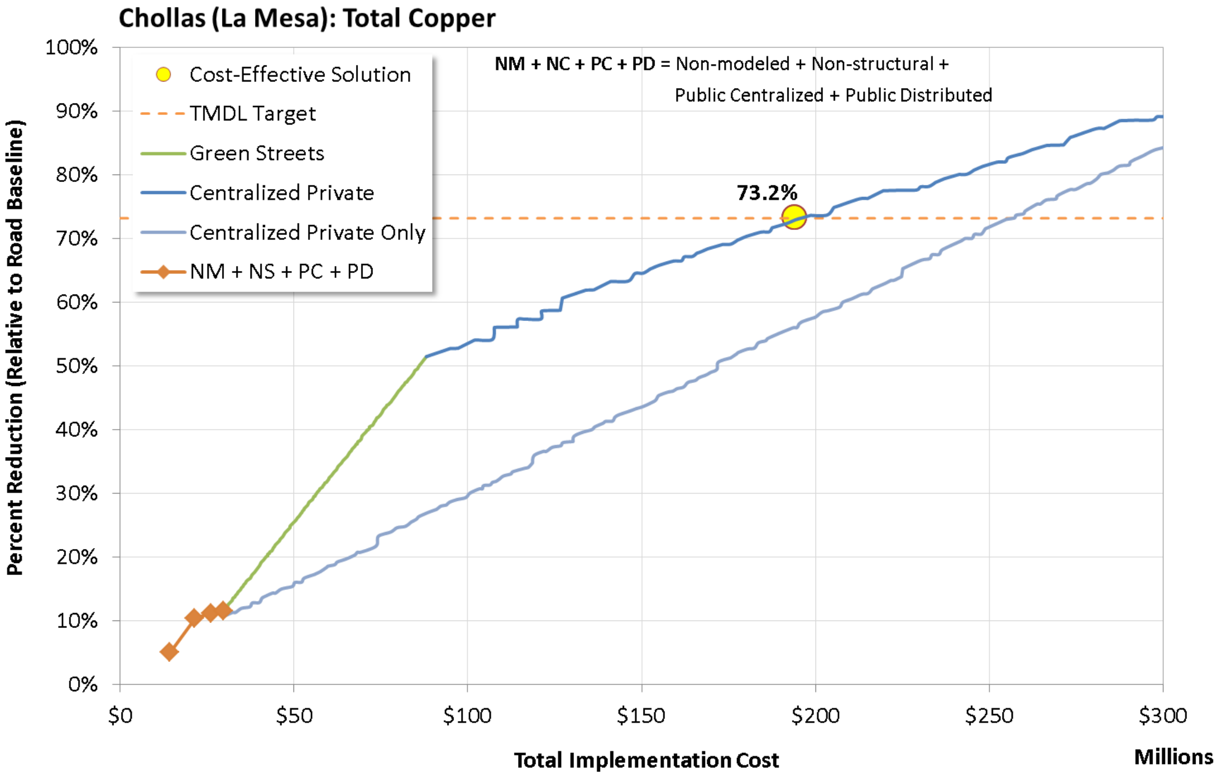

Figure 5-1. Cost-effectiveness curves for wet weather – City of La Mesa

The cost effectiveness curve for La Mesa (Figure 5-1) highlights the need for the full suite of BMPs to achieve WLA attainment and also illustrates the cost-saving power of the optimization approach. Due to the high load reduction requirement for copper, La Mesa must fully implement all identified opportunities for nonstructural BMPs, structural BMPs on public land, and candidate green streets BMPs. Once those BMPs are implemented and they are proven to meet their expected load reduction, the City will need to investigate more expensive alternatives such as acquiring additional land to build centralized BMPs to ultimately meet the load reduction target. It should be noted that the green streets optimization analysis reduces the total implementation costs compared to the non-green streets solution.

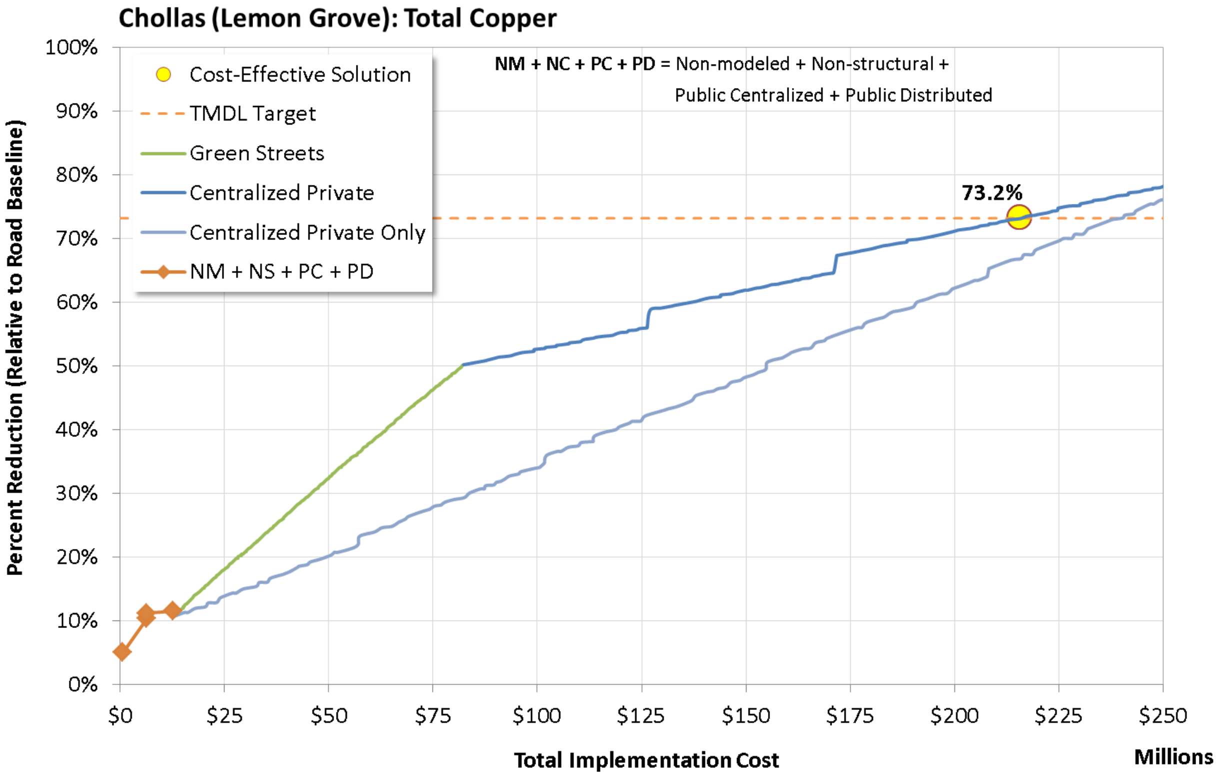

Figure 5-2. Cost-effectiveness curves for wet weather – City of Lemon Grove

Similar to La Mesa the City of Lemon Grove cost effectiveness curve (Figure 5-2) also shows the need for the full suite of BMPs to achieve WLA. Due to the high load reduction requirement for copper, Lemon Grove must fully implement all identified opportunities for nonstructural BMPs, structural BMPs on public land, and candidate green streets BMPs. Once those BMPs are implemented and they are proven to meet their expected load reduction, the City will need to investigate more expensive alternatives such as acquiring additional land to build centralized BMPs to ultimately meet the load reduction target. It should be noted that the green streets optimization analysis reduces the total implementation compared to the non-green streets solution.

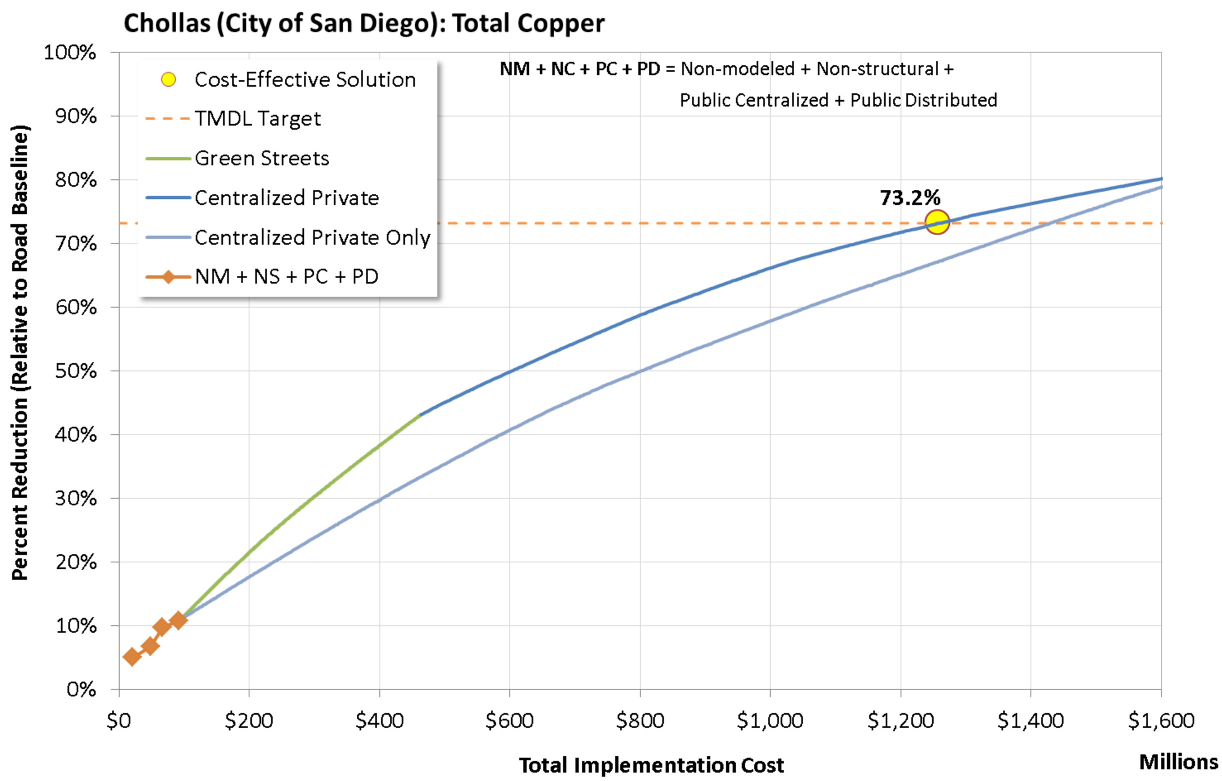

Figure 5-3. Cost-effectiveness curves for wet weather – City of San Diego

The cost effectiveness curve for the City of San Diego (Figure 5-3) also highlights the need for the full suite of BMPs to achieve WLA attainment and also illustrates the cost-saving power of the optimization approach. Due to the high load reduction requirement for copper, the City must fully implement all identified opportunities for nonstructural BMPs, structural BMPs on public land, and candidate green streets BMPs. Once those BMPs are constructed, the City will need to investigate more expensive alternatives such as acquiring additional land to build centralized BMPs to ultimately meet the load reduction target. It should be noted that the green streets optimization analysis reduces the total implementation costs compared to the non-green streets solution.

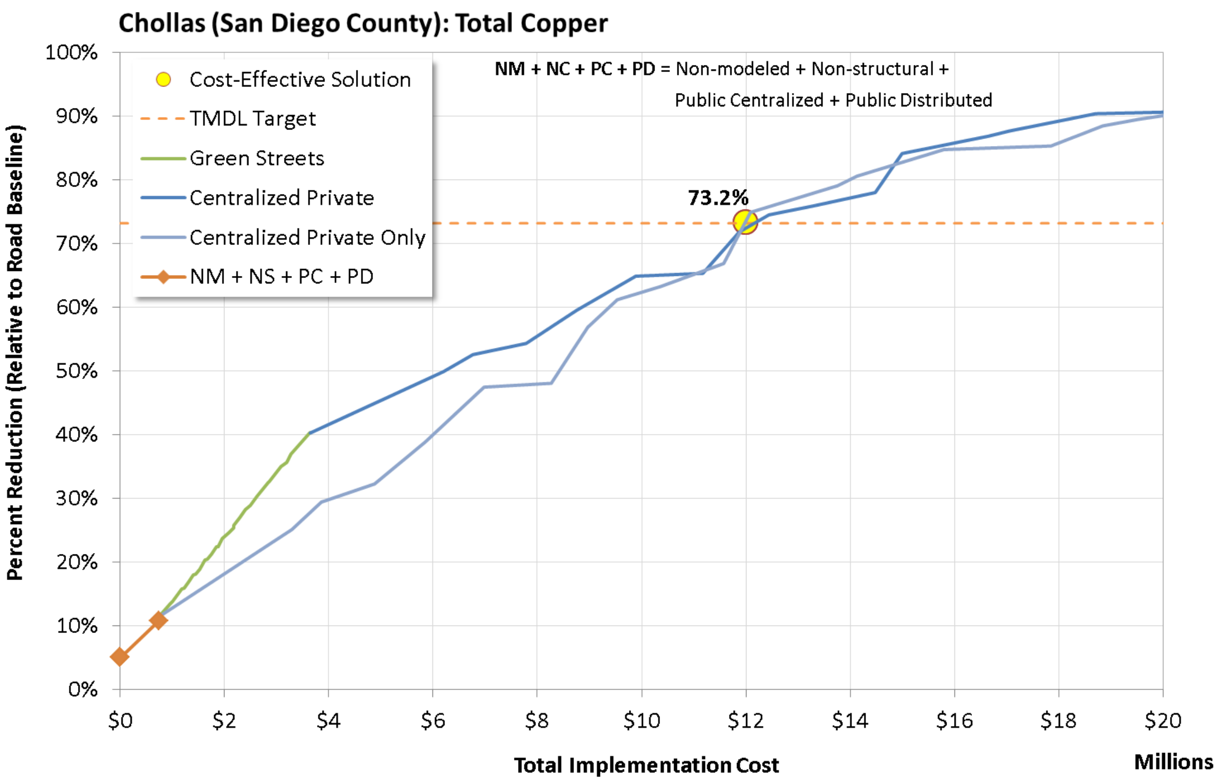

Figure 5-4. Cost-effectiveness curves for wet weather – County of San Diego

San Diego County is responsible for a very small percentage of the watershed as compared to the other RPs. In addition to nonstructural BMPs, it is recommended that the County increase street sweeping and reduce irrigation overspray. However, as with other RPs, structural solutions are necessary. The cost effectiveness curve (Figure 5-4) illustrates the extent to which structural BMPs on public and acquired private land and green streets are necessary to meet the WLA reduction targets.

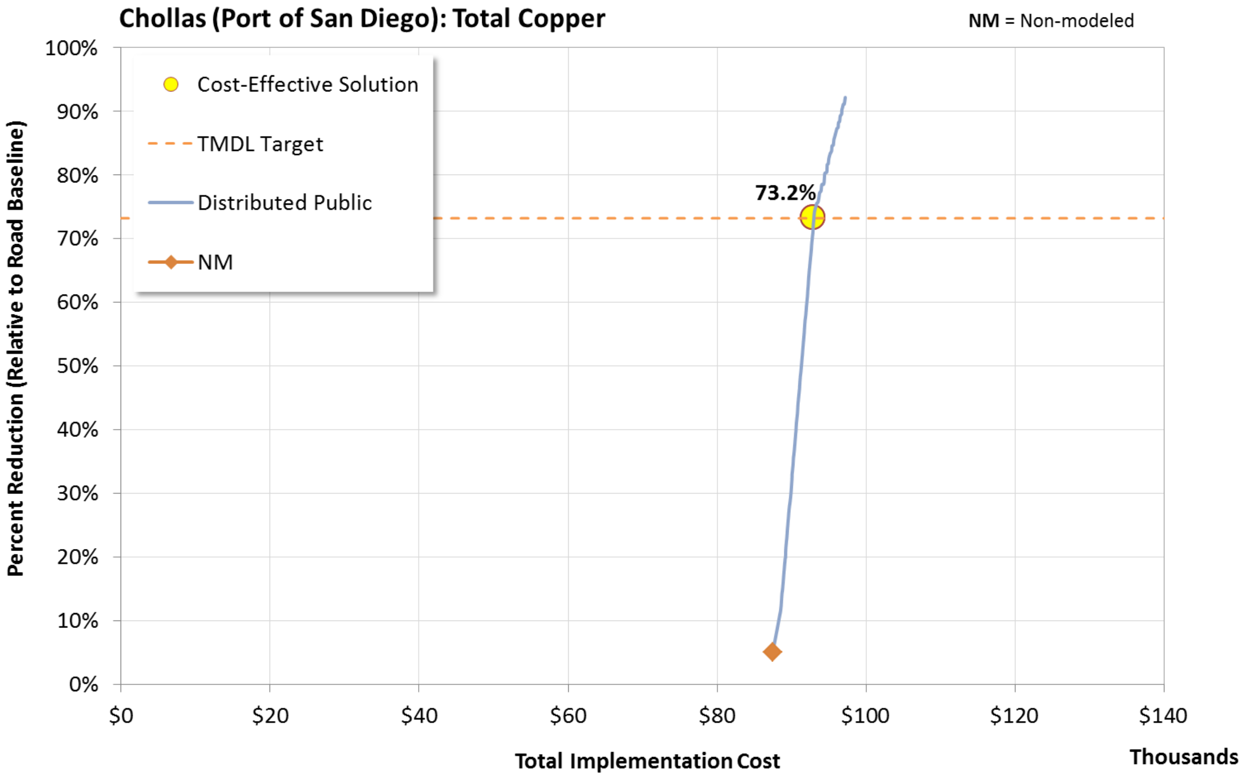

Figure 5-5. Cost-effectiveness curves for wet weather – Port of San Diego

The Port of San Diego is responsible for a small percentage of the watershed, primarily comprising of a portion of a parking lot in the Chollas Creek watershed. It is important to note that the Port currently employs many nonstructural BMPs to the maximum extent practical in this watershed, making future increases in effort not feasible, particularly for such a small area. Additional load reduction is required to achieve WLA targets. The Port intends on meeting this target through the implementation of small distributed BMPs to intercept and treat runoff from the parking lot in addition to the nonstructural non-modeled BMPs that the Port employs. It should be noted that the Port is further evaluating its jurisdictional authority in the watershed and may update their approach as necessary based on their findings. The cost effectiveness curve (Figure 5-5) demonstrates how this BMP will ensure that the Port meets the target.

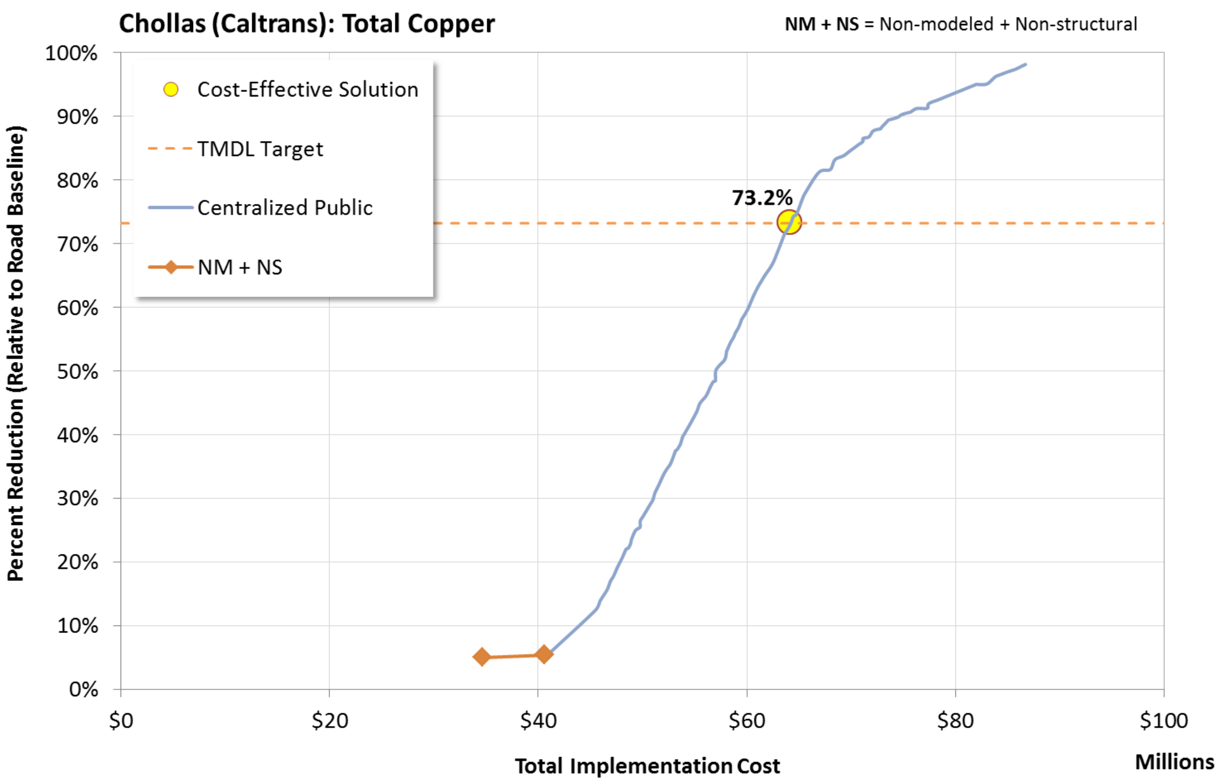

Figure 5-6. Cost-effectiveness curves for wet weather – Caltrans

Caltrans operates a section of freeway in the Chollas watershed. While Caltrans employs an aggressive nonstructural BMP program and is recommending to increase street sweeping activities in the future, additional structural measures are needed to achieve load reduction targets. Due to the fact that this RP does not hold jurisdiction over parcels that are available for purchase, structural BMPs are recommended for placement on land immediately adjacent to the freeway's impervious surfaces. Caltrans is recommended to implement a series of centralized BMPs to intercept and treat runoff from the freeways to meet load reduction requirements as illustrated in Figure 5-6.

To determine the maximum cost-effective implementation of green streets and centralized structural BMPs on acquired private land, the optimization included a spatial analysis to determine the most cost-effective levels of these BMPs for each modeled subwatershed. Figure 5-7 shows the optimal maximum cost-effective management levels (
Table 5-1) of green streets for each subwatershed (representing the end of the green lines in Figure 5-1, Figure 5-2, Figure 5-3, and Figure 5-4, where green streets apply). Green street management levels 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 (Appendix A), so management levels represent increases in implementation that are proportional to each subwatershed's maximum available opportunity. For the Chollas Creek watershed, all opportunities for feasible implementation of green streets were maximized since this option is less expensive than centralized structural BMPs on acquired private land. As stated previously, green streets are not an option for the Port of San Diego or Caltrans in this watershed. Within subwatershed, recommended BMP goals for cost-effective green street implementation are listed in Appendix A.

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

With green streets optimized, the additional level of centralized structural BMPs (see Section 4.4) on acquired private land were also optimized spatially with results presented in Figure 5-8 for the maximum needed to meet the load reduction target for each RP. For Figure 5-8, “percent utilization” refers to the size, or percentage, of the modeled unit centralized BMP in a given subwatershed that is required to meet the load reduction target. For instance, a subwatershed with 60% utilization would require a centralized BMP with a size that is 60% of the modeled unit centralized BMP (discussed in Appendix A).

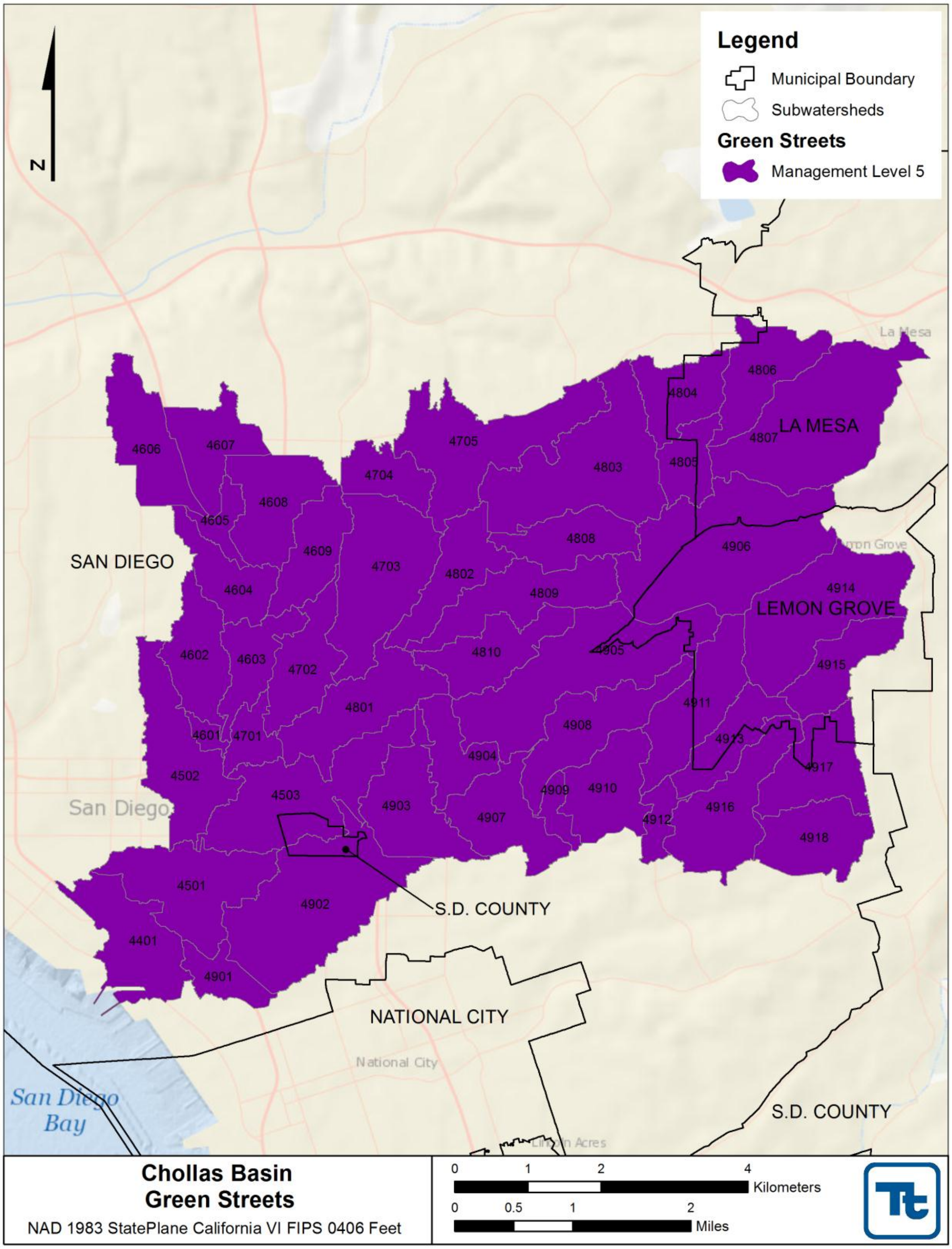

Figure 5-7. Spatially optimized implementation of green streets

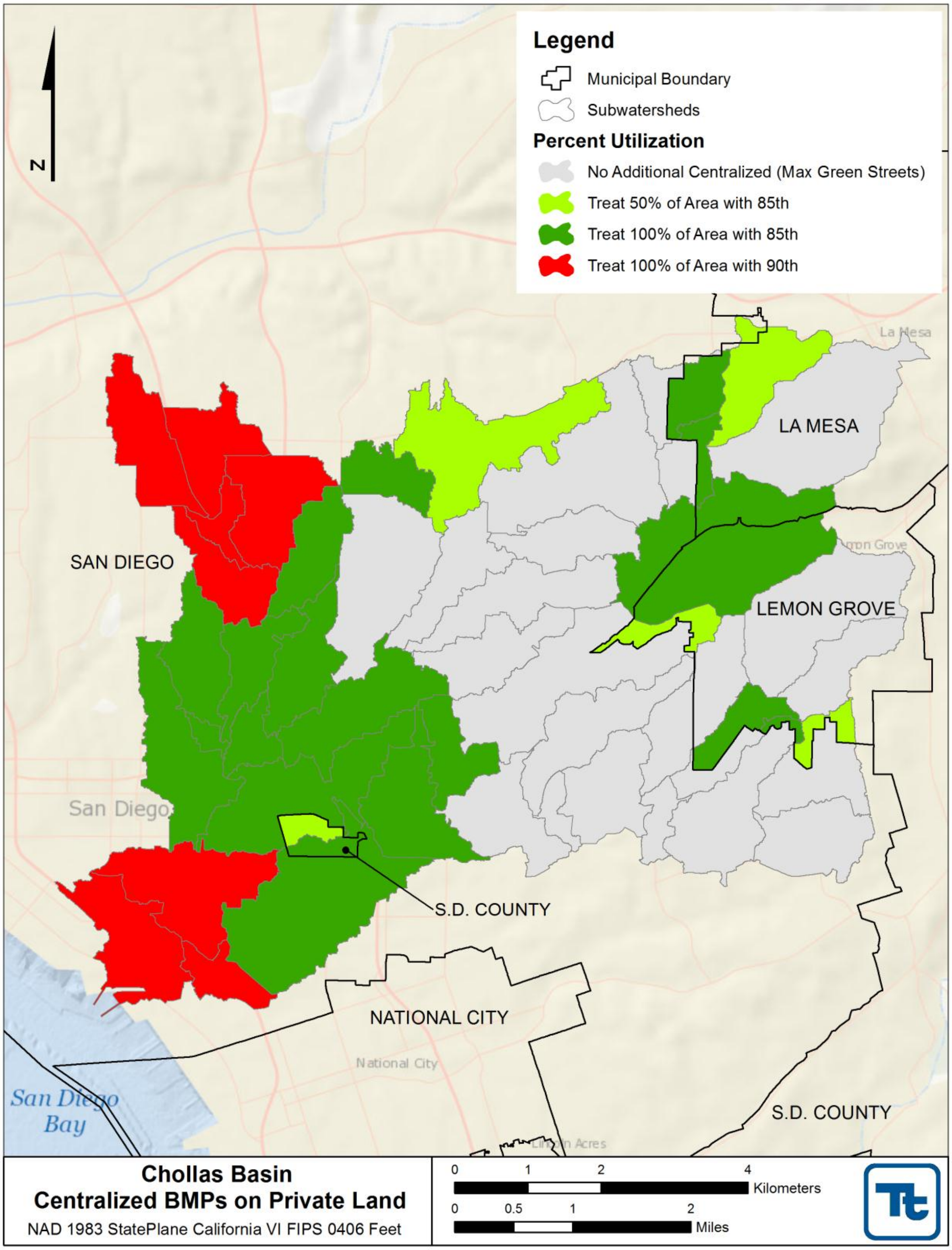

Figure 5-8. Spatially optimized implementation of centralized structural BMPs on acquired private land (in addition to green streets)

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 and Table 5-3 summarize pollutant load reductions for wet and dry weather conditions by individual RP for the critical pollutant, copper. These tables illustrate the contribution of each management level BMP commitment to achieving each RP's total pollutant load reduction target.

Table 5-2. Total wet weather critical pollutant load reductions per Responsible Party (%)

RP	Non-structural (not modeled)	Non-structural (modeled)	Centralized on Public	Distributed on Public	Green Streets	Centralized on Acquired Private Land	Total*
City of La Mesa	5.00	2.58	0.44	1.68	40.00	23.5	73.20
City of Lemon Grove	5.00	1.65	n/a	1.56	39.58	25.41	73.20
Port of San Diego	5.00	n/a	n/a	68.2	n/a	n/a	73.20
San Diego County	5.00	0.01	n/a	1.27	28.90	38.02	73.20
City of San Diego	5.00	3.15	3.65	1.32	32.36	27.72	73.20
Caltrans	5.00	0.01	68.19	n/a	n/a	n/a	73.20

*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. Total dry weather critical pollutant load reductions per Responsible Party (%)

RP	Non-structural (not modeled)	Non-structural (modeled)	Centralized on Public	Distributed on Public	Green Streets	Centralized on Acquired Private Land	Total*
City of La Mesa	5.00	58.72	0.15	0.15	35.98	0.00	100.0
City of Lemon Grove	5.00	58.55	n/a	0.19	36.26	0.00	100.0
Port of San Diego	5.00	n/a	n/a	95.00	n/a	n/a	100.0
San Diego County	5.00	59.10	n/a	0.01	35.89	0.00	100.0
City of San Diego	5.00	56.87	1.27	1.28	35.58	0.00	100.0
Caltrans	5.00	0.00	95.00	n/a	n/a	n/a	100.0

*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.

5.1 Other 303(d) Listed Pollutants

Nutrients (nitrogen and phosphorus), diazinon, and trash were also included on the 303(d) list for Chollas Creek. Nutrients were included in the modeling framework to estimate the secondary load reduction benefits for total nitrogen and total phosphorus based on the bacteria BMP implementation strategy. The adopted Chollas Creek diazinon TMDL is being addressed through ongoing compliance monitoring in the watershed. Diazinon was banned beginning in 2000 and monitoring has shown decreasing trends, including results below the TMDL WLAs since 2007, therefore diazinon was not included in the model. Trash could not be quantitatively modeled, although reductions in trash would occur in conjunction with the implementation of various BMPs (nonstructural BMPs in particular).

Table 5-4 and Table 5-5 present the total load reductions for all RPs for all pollutants of concern, including TMDL pollutants and the additional 303(d) pollutants.

Table 5-4. Total watershed wet weather load reductions of additional pollutants (%)

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	54.38	71.29	73.20	69.42	78.13	73.50	70.22	66.85
City of Lemon Grove	53.32	69.80	73.20	67.38	78.67	72.65	69.77	65.31
Port of San Diego	72.03	76.43	73.20	76.51	76.53	75.72	74.73	74.73
San Diego County	64.76	73.18	73.20	71.43	76.04	83.27	75.68	76.25
City of San Diego	57.30	71.11	73.20	68.35	76.76	75.81	71.92	69.09
Caltrans	72.14	73.11	73.20	75.65	75.59	75.79	74.96	74.96

Table 5-5. Total watershed dry weather load reductions of additional pollutants (%)

RP	Flow Volume (%)	Total Sediment (%)	Total Copper (%)	Total Lead (%)	Total Zinc (%)	Fecal Coliform (%)	Total Phos-phorus (%)	Total Nitrogen (%)
City of La Mesa	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
City of Lemon Grove	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Port of San Diego	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
San Diego County	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
City of San Diego	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Caltrans	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 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 Metals TMDL Basin Plan Amendment was approved in October 2008, which includes a 20-year implementation period set for final compliance in 2028. The Bacteria TMDL Basin Plan Amendment was approved in April 2011, which also includes a 20-year compliance schedule with final compliance to be met in April 2031. As a result, the CLRP for the Chollas Creek watershed incorporates a schedule for compliance with both TMDLs and recognizes 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 RPs (Appendix C). Phasing for green streets and centralized BMPs on acquired private land were slightly modified to ensure compliance with both TMDL schedules, and 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. 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 availability of resources and RPs will need to evaluate funding opportunities and other considerations. This assessment may identify a lack of funding that 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 Cost 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 accommodated. 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 for each individual RP through 2031. Detailed costs for individual BMPs for each RP are presented in Appendix B.
Table 6-1 provides a summary of total costs for compliance with the TMDLs for each individual RP. 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)

RP	Non-structural (not modeled)	Non-structural (modeled)	Centralized on Public	Distributed on Public	Green Streets	Centralized on Acquired Private Land	Total
City of La Mesa	$ 18.08	$ 10.85	$ 6.55	$ 5.82	$ 103.03	$ 134.51	$ 278.83
City of Lemon Grove	$ 1.01	$ 8.69	$ -	$ 5.01	$ 109.92	$ 169.05	$ 293.67
Port of San Diego	$ 0.13	$ -	$ 0.01	$ -	$ -	$ -	$ 0.14
San Diego County	$ -	$ 0.00	$ -	$ 1.12	$ 4.66	$ 11.12	$ 16.90
City of San Diego	$ 17.42	$ 40.95	$ 25.15	$ 41.19	$ 406.81	$ 905.17	$1,436.68
Caltrans	$ 53.30	$ 9.25	$ 24.41	$ -	$ -	$ -	$ 86.96

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, their effectivenessis 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 within each RP jurisdiction 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.

Green Streets

The development of green streets represents the largest investment necessary to meet the WLA reduction targets (assuming the RPs elect to implement green streets instead of centralized structural BMPs on private land). While it is critically important to first implement more cost effective nonstructural BMPs or structural BMPs on public property, a great deal of attention must be directed at appropriately prioritizing the implementation of green streets. Not only does the optimization analysis identify the most cost effective combination of green streets needed to meet the target, but also provides a quantitative measure of how efficient green streets applications would be in individual subwatersheds. Modeling indicates that green streets are more cost effective in certain locations due to key characteristics, such as rainfall patterns, soil types, land uses, and proximity to receiving waters. Figure 5-7 illustrates where green streets are most cost effective. The green streets program should be implemented using this ranking of subwatersheds as a guideline.

Centralized BMPs on Acquired Private Land

Centralized structural BMPs on acquired private land is the most expensive option in terms of construction, O&M, and land acquisition, and is therefore the least attractive for implementation. An analysis was performed that demonstrated the cost-savings if green streets were implemented instead of centralized structural BMPs on acquired private land. However, should green streets or any other management level not be implemented as proposed, centralized structural BMPs on private land are the last alternative to provide the necessary load reductions for WLA attainment. If centralized structural BMPs on private land are required, prioritization of siting and land acquisition for these BMP can rely on optimization results presented in Figure 5-8, which indicate the most cost-effective subwatersheds for implementation of centralized BMPs on private land within each RP jurisdiction. However, it is expected that site selection may also be driven by opportunity, for example, where land becomes available or potential partnerships can be made with the development community.

It is important to note that centralized structural BMPs on private land should be avoided if possible, whether through green streets or other opportunities for nonstructural or structural BMPs on public land. With the adaptive nature of the CLRP and opportunities for revisions in the future, it is advisable to seek other more cost effective BMP opportunities prior to the period needed for structural BMPs on private land. Therefore, centralized structural BMPs on private land are included in the present CLRP as a placeholder for demonstration of the cost savings associated with green streets or investments in other alternative BMPs.

7 Alternative Scenarios

There are several important regulatory considerations currently being evaluated by the RPs that would affect the calculation of allowable loads and load reductions, but still ensure protection of beneficial uses for Chollas Creek. 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. Such considerations include:

- Metals: the City of San Diego performed a WER study in Chollas Creek which demonstrated that site-specific WER values are greater than the default ratio of 1.0 and still protective of beneficial uses. Regulatory incorporation of the updated WER would allow for an increase in the metals TMDL targets for Chollas Creek.
- Bacteria: (1) potential refinements to the allowable exceedance frequency for dry and wet weather conditions based on recent reference monitoring data; and (2) application of a high flow suspension (HFS) provision that suspends recreational beneficial uses during large storm events where recreational activities would be hazardous because of the dangerous flow conditions.

As shown in Section 2, metals are the overwhelming critical pollutants requiring the greatest load reduction for wet weather (with copper as the critical pollutant), and therefore any modification to the load reduction target for bacteria will result in no change to the BMPs recommended for the CLRP or the ultimate total costs. For dry weather, neither the HFS or the exceedance frequency apply for bacteria, and therefore bacteria load reductions remain by far the dominant requirements (98.8% for fecal coliform; 99.4% for enterococcus) with the CLRP results un-impacted by WERs for metals. For these reasons, the WERs for wet weather conditions were the primary alternative scenarios considered.

As shown in Table 7-1, applying the updated WERs increased the copper target by over 300% while the zinc target only increased by about 45%. Therefore, the required load reduction for copper dropped more significantly than for zinc (as compared to the original load reduction required using the default WER). As a result of the WER, zinc is now the limiting metal in this alternative scenario (49.1% for wet weather). PAHs would be the limiting factor considering the original load reduction results for PAHs (56.9%) and bacteria (FC – 28.8%); however uncontrollable atmospheric deposition was considered the primary source of PAHs in the watershed. As a result, zinc was identified as the limiting metal with the updated WER.

Table 7-1. Alternative wet-weather pollutant loads and required reductions with WER

Pollutant	Required Reduction with Default WER	Required Reduction with Updated WER
Copper (lbs/yr)	73.2%	3.3%
Lead (lbs/yr)	0.0%	0.0%
Zinc (lbs/yr)	64.6%	49.1%

With zinc as the new critical pollutant with the updated WERs considered, new cost-effectiveness curves were produced for each RP that focus on zinc (Figure 7-1 through Figure 7-6). Table 7-2 presents corresponding cost-savings based on the difference in total costs presented in Table 6-1. The decisions to consider the updated WERs in a TMDL re-opener or within the MS4 permit will result in major cost savings to the RPs, and every effort should be made to incorporate such modifications into future regulatory requirements.

Table 7-2. Alternative scenario total costs for compliance (millions)

RP	Default WER (Million $)	Updated WER (Million $)	Cost Savings by Updating WER (Million $)
City of La Mesa	278.83	108.38	170.45
City of Lemon Grove	293.67	94.93	198.74
Port of San Diego	0.14	0.14	0.00
County of San Diego	16.90	6.93	9.97
City of San Diego	1,436.68	556.10	880.58
Caltrans	86.96	75.32	11.64
Total	2,113.18	841.80	1,271.38

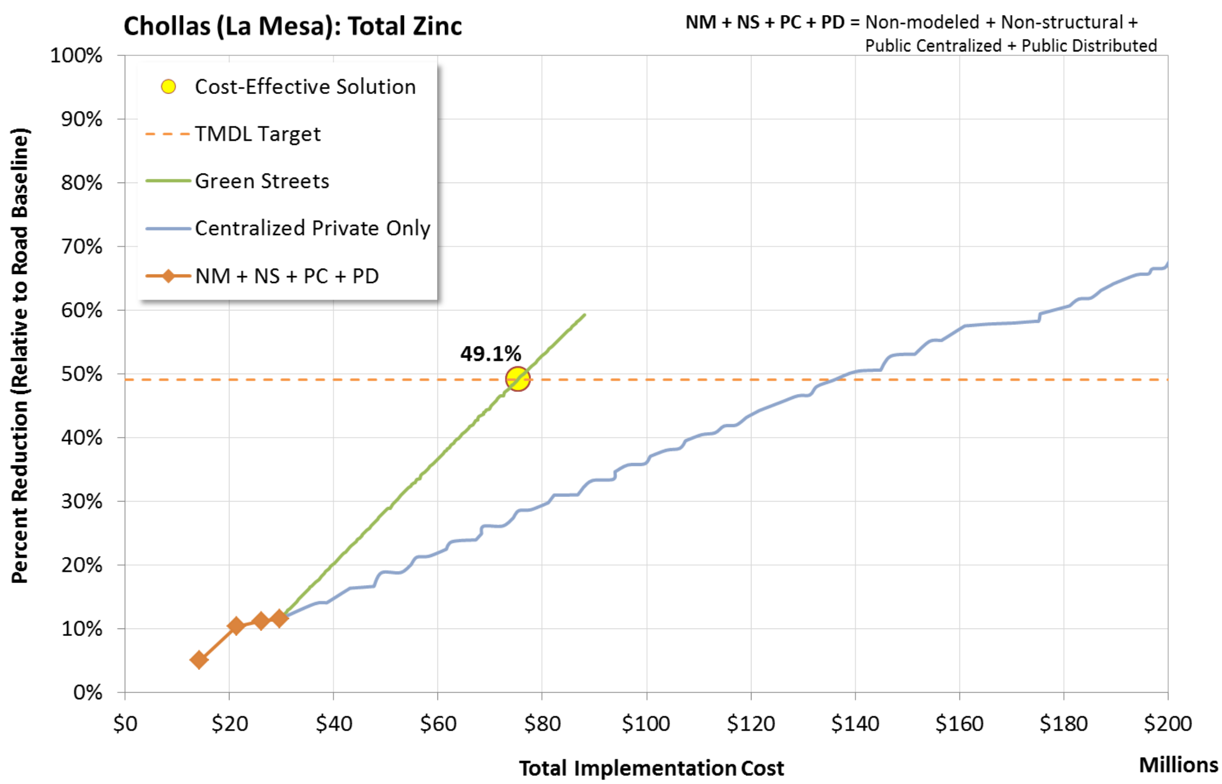

Figure 7-1. Cost-effectiveness curves for wet weather – City of La Mesa

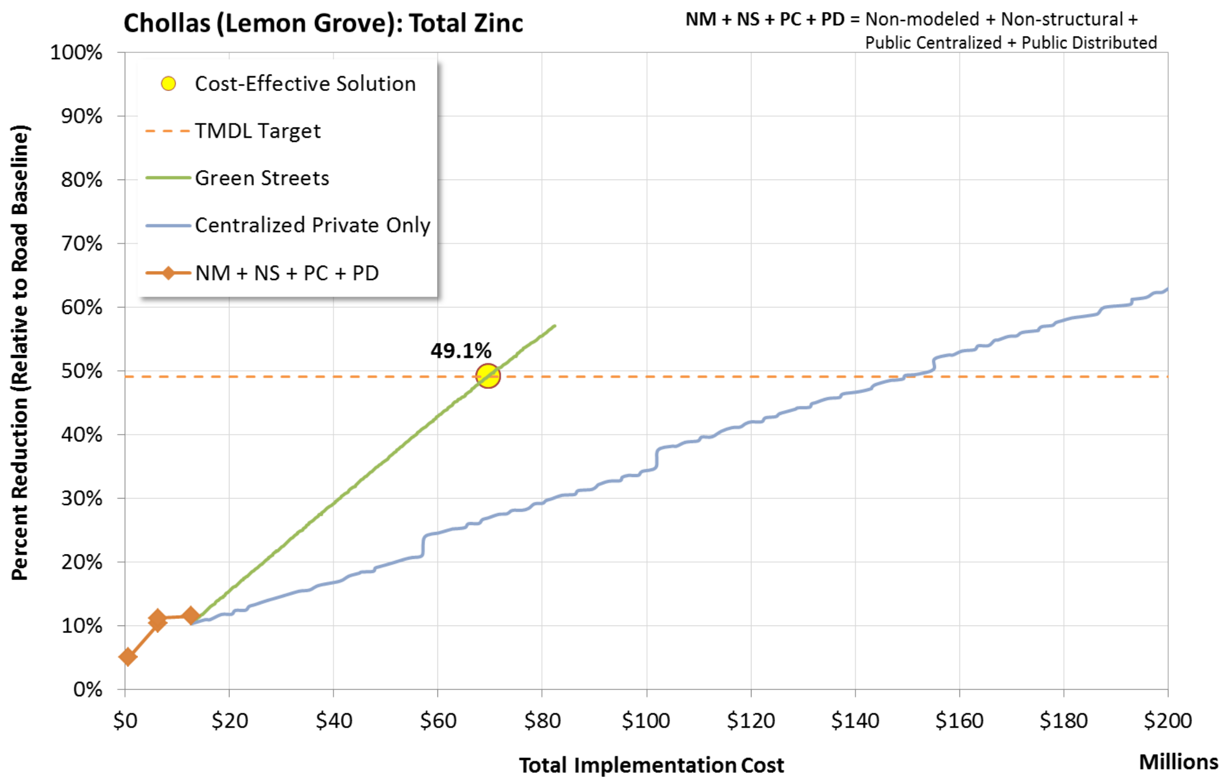

Figure 7-2. Cost-effectiveness curves for wet weather – City of Lemon Grove

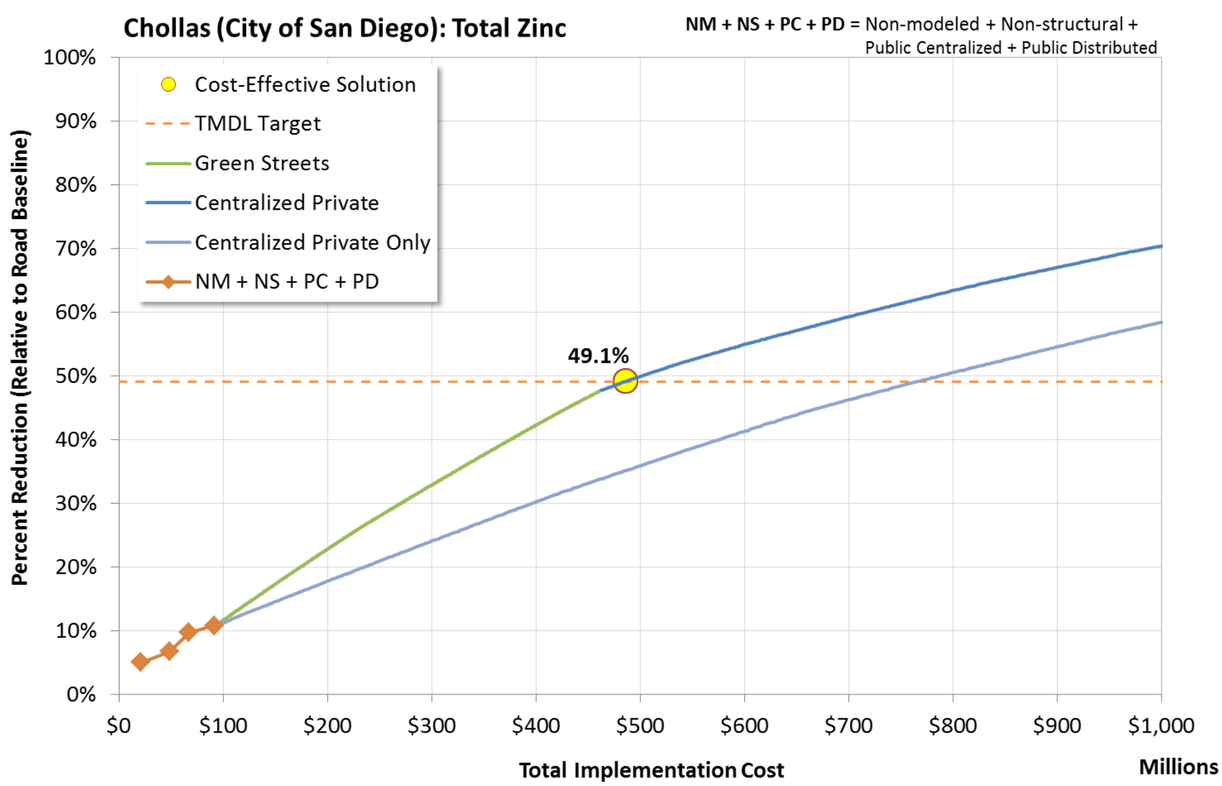

Figure 7-3. Cost-effectiveness curves for wet weather – City of San Diego

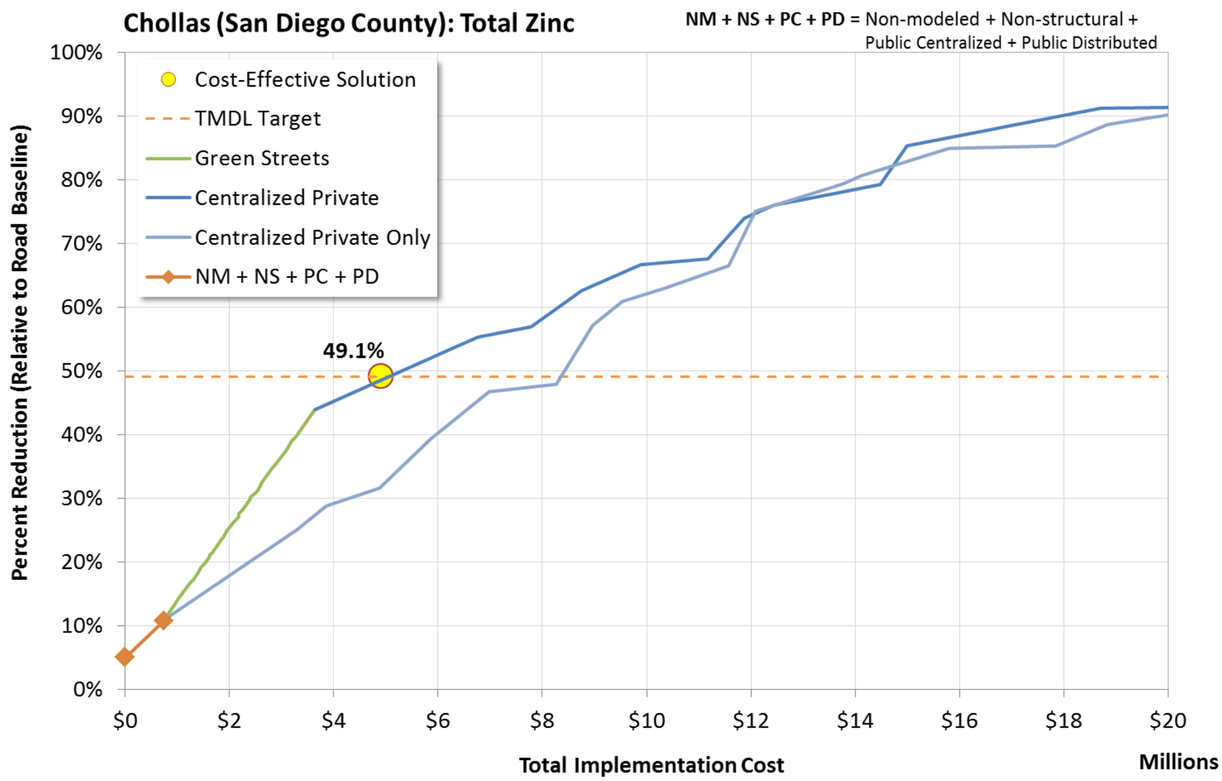

Figure 7-4. Cost-effectiveness curves for wet weather – County of San Diego

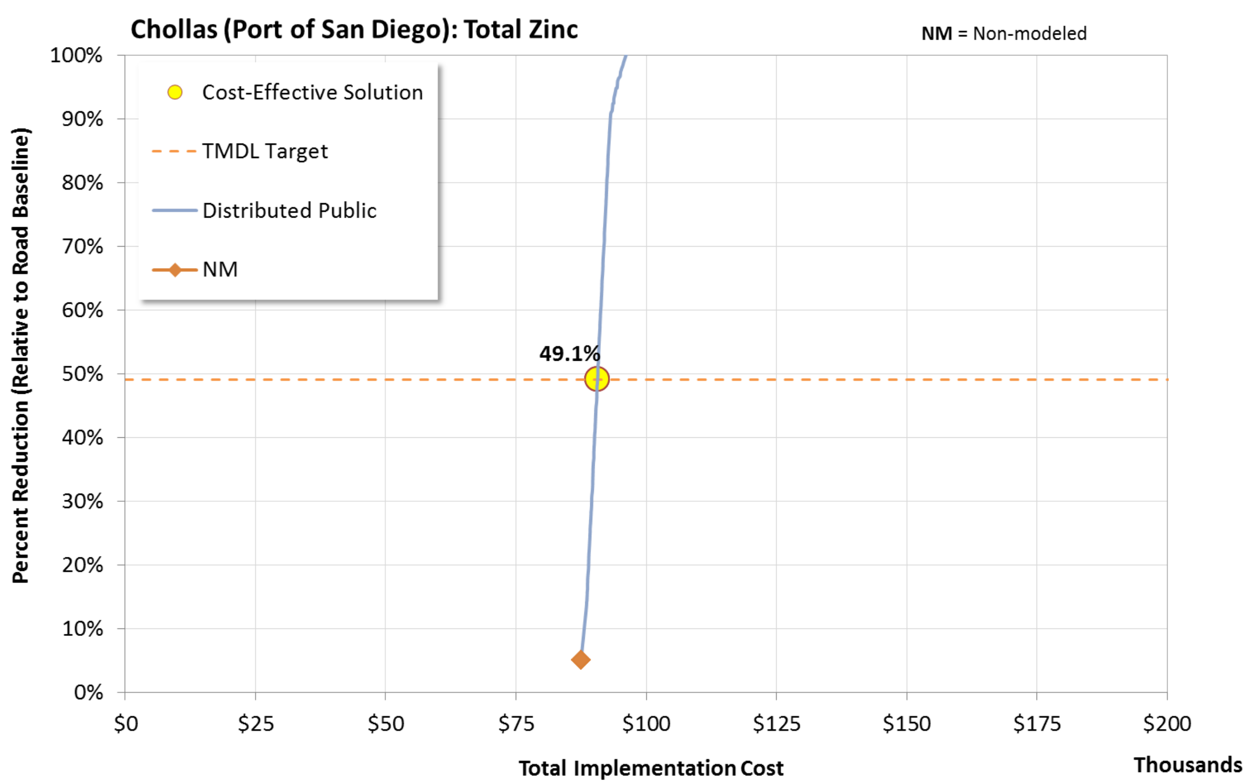

Figure 7-5. Cost-effectiveness curves for wet weather – Port of San Diego

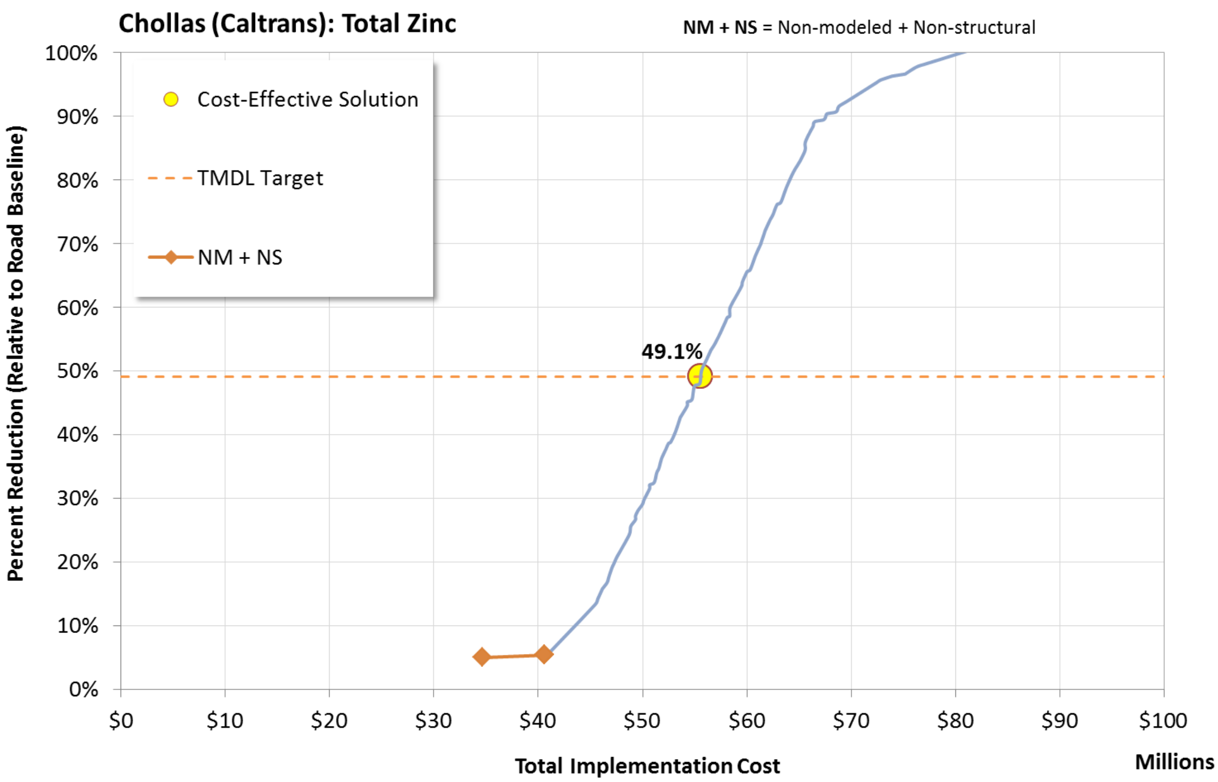

Figure 7-6. Cost-effectiveness curves for wet weather – Caltrans

8 References

Caraco, D. and T. Schueler. 1999. Stormwater Strategies for Arid and Semi-Arid Watersheds. Watershed Protection Techniques. 3(3): 695-706.

Los Angeles County. 2010. Multi-Pollutant TMDL Implementation Plan for the Unincorporated County Area of Los Angeles River Watershed. Los Angeles, CA. January 8

San Diego Region Water Quality Control Board (SDRWQCB). 2002. *Technical Report for Total Maximum Daily Load for Diazinon in Chollas Creek Watershed San Diego County*. August 14. Accessed April 30, 2012. http://www.waterboards.ca.gov/sandiego/water_issues/programs/tmdls/docs/chollascreekdiazinon/finaltechtmdl042903.pdf

SDRWQCB (San Diego Regional Water Quality Control Board). 2007. *Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay*. May 30.

SDRWQCB (San Diego Regional Water Quality Control Board). 2010. *Revised TMDL for Indicator Bacteria, Project I - Twenty Beaches and Creeks in the San Diego Region (including Tecolote Creek)*. Resolution No. R9-2010-0001. Approved February 10. http://www.waterboards.ca.gov/sandiego/water_issues/programs/tmdls/bacteria.shtml.

Shen, J., A. Parker, and J. Riverson. 2004. *A New Approach for a Windows-based Watershed Modeling System Based on a Database-supporting Architecture*. Environmental Modeling and Software, July 2004.

Tetra Tech and USEPA (U.S. Environmental Protection Agency). 2002. The Loading Simulation Program in C++ (LSPC) Watershed Modeling System – User's Manual. Tetra Tech, Inc., Fairfax, VA, and U.S. Environmental Protection Agency, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2003. *Fact Sheet: Loading Simulation Program in C++*. USEPA, Watershed and Water Quality Modeling Technical Support Center, Athens, GA. Available at: http://www.epa.gov/athens/wwqtsc/LSPC.pdf

USEPA (U.S. Environmental Protection Agency). 2009. SUSTAIN—*A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality*. EPA/600/R-09/095. U.S. Environmental Protection Agency, Office of Research and Development, Edison, NJ.