Appendix A – BMP Representation Summary

This appendix summarizes the assumptions regarding BMP implementation throughout the San Diego River watershed. It is important to note that this document provides details for future additional BMP implementation above and beyond current activities. The BMP Representation Memorandum which was previously submitted as part of the CLRP Phase II study provides a more robust summary of these activities.

1. Nonstructural BMPs

To assist in the phased reduction of pollutant loads, various nonstructural BMPs have been identified for implementation. These nonstructural BMPs include improvements to existing nonstructural BMP programs, as well as implementation of new nonstructural BMPs. LSPC watershed models were calibrated to in-stream monitoring data, which incorporates the effects of existing pollutant sources and current management actions upstream of the calibration points. Since the models are inclusive of current management practices, nonstructural BMPs will be modeled as additions to current nonstructural management programs. Estimated pollutant and flow reduction benefits from these current nonstructural BMPs will provide the baseline from which additional reductions will be achieved through implementation of structural and additional nonstructural BMPs to meet TMDL and CLRP requirements. In addition to those BMPs that are explicitly represented in the model, the effectiveness of many other nonstructural BMPs are not easily quantified and are therefore assigned a conservative pollutant load reduction value. Conceptual modeling approaches and BMP assumptions for each of the modeled nonstructural BMPs are detailed in this section.

1.1 Street Sweeping

Improved street and median sweeping technology enhances the potential for wet weather pollutant load reductions for bacteria, metals, non-metal toxics, and nutrients. Increasing the sweeping frequency, increasing the area of impervious cover swept, or upgrading the sweeping equipment can result in an increase in pollutant load removal. Note that while street sweeping can significantly reduce pollutant loads, the practice is not associated with runoff volume reduction.

1.1.1 Treatment Process Model Overview

The LSPC model's street sweeping BMP process for pollutant removal is illustrated in Figure 1-1. This BMP is explicitly represented in the model to simulate pollutant removal at the street level. Parameters of the street sweeping module can be adjusted to account for variable removal efficiencies (based on equipment type), sweeping frequency, and sweeping area coverage.

Ultimately, the total load of pollutants that are programmed to build up in the modeled watershed over time are re-programmed to be removed or reduced based on the assumed street sweeping practices occurring in the watershed. While the sweeping effectiveness parameters are best determined by scientific study, it is critical to document the following key variables relevant to street sweeping programs:

- Sweeping Equipment – Vacuum sweeping machines are generally more efficient than mechanical broom sweepers with regard to pollutant removal, especially in typical curb sweeping applications. Designed specifically to capture fine sediments in addition to coarse sediment and other solids, vacuum sweeping machines achieve greater sediment, nutrient, and metals removal as compared to mechanical broom sweepers, which are designed to capture coarse particles.

- Sweeping Frequency – More frequent sweeping activities can result in greater pollutant removal. Currently, sweeping routes are generally classified as High frequency (sweeping every 3 to 7 days), Medium frequency (monthly sweeping), or Low frequency (sweeping once every two months).
- Sweeping Routes – Increased treatment area can also result in greater pollutant removal.

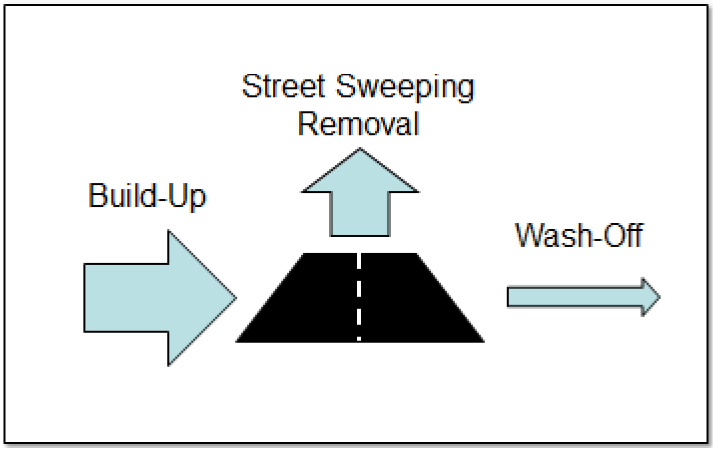


Figure 1-1 Street and Median Sweeping Treatment Process

1.1.2 Optimization Analysis

Street sweeping performance is a function of road area swept, the type of equipment used, and the frequency of sweeping. Recommendations for program enhancement could affect the selection of mechanical (broom) and enhanced (vacuum) sweeping of commercial and residential roads and medians at frequencies ranging from Bimonthly to twice a week. To develop a better understanding of the implications of assumptions associated with the proposed street sweeping program an optimization analysis was performed across all City of San Diego streets throughout Chollas, Scripps, Tecolote, and San Diego River watersheds. The optimization was set up to determine the optimal combination of enhancements to the street sweeping program to maximize sediment removal. Table 1-1 presents a summary of modeled street sweeping cost-benefit (in terms of sediment removal) across the four watersheds. Results from this optimization analysis are used to inform implementation decisions for individual watersheds.

Table 1-1. Summary of Street sweeping cost-effectiveness for sediment removal by type and frequency

Watershed	Subtotals (Variable Units)	Mechanical (Broom)					Enhanced (Vacuum)				
		BiMonthly	Monthly	BiWeekly	Weekly	2×Weekly	BiMonthly	Monthly	BiWeekly	Weekly	2×Weekly
Program Costs ($ Million)											
Chollas	$7.16	$0.61	$1.27	$0.00	$0.20	$0.12	$1.74	$2.45	$0.01	$0.46	$0.32
Scripps	$4.62	$0.79	$0.00	$0.23	$0.14	$0.05	$2.27	$0.00	$0.64	$0.37	$0.13
SDR	$9.93	$1.99	$0.22	$0.03	$0.30	$0.04	$5.70	$0.62	$0.09	$0.82	$0.12
Tecolote	$1.39	$0.34	$0.00	$0.00	$0.02	$0.00	$0.98	$0.00	$0.00	$0.05	$0.00
Program Sediment Removal (tons/year)											
Chollas	1,403	1.2	11.8	0.9	115.5	118.8	10.2	136.0	5.0	536	467
Scripps	834	11.6		50.2	60.6	30.8	62.3		243	252	123
SDR	2,743	119.0	17.4	9.5	314.7	53.0	539.6	92.2	51	1,340	205
Tecolote	648	69.3		1.3	53.0		313.0		5.6	206	
Program Cost-Effectiveness for Sediment ($/lb removed)											
Chollas	$2.55	$258	$53.52	$1.98	$0.86	$0.48	$84.88	$8.99	$1.01	$0.43	$0.34
Scripps	$2.77	$34		$2.30	$1.13	$0.79	$18.23		$1.31	$0.74	$0.54
SDR	$1.81	$8.34	$6.29	$1.74	$0.48	$0.42	$5.28	$3.34	$0.89	$0.31	$0.30
Tecolote	$1.07	$2.46		$0.28	$0.16		$1.56		$0.18	$0.11	

Color gradient indicates low to high cost effectiveness.

The results of this analysis suggest that increasing the frequency and/or using enhanced sweeping equipment is more cost effective for sediment removal, and that extremely infrequent sweeping (i.e. every other month) is the least cost-effective for reducing sediment delivery in runoff. The interaction between street sweeping and the other pollutants varies by pollutant, as summarized in Table 1-2.

Table 1-2. Summary of Street sweeping cost-effectiveness for copper, bacteria, and nutrients

Watershed	Subtotals	Mechanical (Broom)					Enhanced (Vacuum)				
		BiMonthly	Monthly	BiWeekly	Weekly	2×Weekly	BiMonthly	Monthly	BiWeekly	Weekly	2×Weekly
Program Cost-Effectiveness for Copper ($1,000/lb removed)											
Chollas	$1.13	$117	$23.8	$0.88	$0.38	$0.22	$37.72	$4.00	$0.45	$0.19	$0.15
Scripps	$1.23	$15		$1.02	$0.50	$0.35	$8.10		$0.58	$0.33	$0.24
SDR	$0.81	$3.71	$2.8	$0.77	$0.21	$0.19	$2.35	$1.48	$0.39	$0.14	$0.13
Tecolote	$0.48	$1.09		$0.12	$0.07		$0.70		$0.08	$0.05	
Program Cost-Effectiveness for Fecal Coliform ($1,000/Trillion removed)											
Chollas	$339	$41	$65	$516	$543	$631	$51	$158	$398	$434	$385
Scripps	$833	$488		$795	$743	$655	$370		$549	$455	$408
SDR	$303	$1,191	$532	$516	$878	$638	$767	$401	$398	$548	$384
Tecolote	$1,860	$1,594		$1,367	$1,044		$1,021		$850	$596	
Program Cost-Effectiveness for Nitrogen ($1,000/lb removed)											
Chollas	$16	$2	$3	$26	$26	$34	$2	$7	$20	$20	$19
Scripps	$41	$2		$1	$73	$129	$2		$1	$48	$73
SDR	$14	$1	$17	$2	$15	$77	$1	$27	$2	$10	$43
Tecolote	$86	$1		$48	$112		$1		$37	$74	

Color gradient indicates **low** to **high** cost effectiveness.

The modeled results suggest that:

- Street sweeping is cost effective for particulate matter like sediment and sediment-associated pollutants like metals, but not as cost effective for bacteria and nutrients. The metals removal cost-effectiveness gradient mirrors that of sediment removal.
- It is more cost-effective to sweep more frequently in watersheds with more rainfall.
- Because bacteria grow so quickly, increasing street-sweeping frequency provides little benefit for bacteria removal. In fact, the results suggest not sweeping as a means for controlling bacteria. Other BMPs may be more effective at bacteria management than sweeping, particularly those that are designed to reduce runoff volume.
- Similar to bacteria, more frequent street sweeping is also less cost-effective for nutrient removal. Direct source controls or practices that reduce runoff are likely more effective for nutrient removal than street sweeping.

Using the unit cost and performance information from modeling the proposed study, an optimization analysis was formulated to see if a more cost-effective management strategy could be derived to refine the proposed street sweeping program for the City of San Diego. The City provided a set of spatial and temporal constraints for each type of street sweeping, as defined in Table 1-3.

Table 1-3. Summary of Street sweeping cost-effectiveness for sediment removal by type and frequency

Legend:
● = 100% Maximum
◗ = 75% Maximum
○ = Not applicable

Land Use		Mechanical (Broom) Bimonthly	Mechanical (Broom) Monthly	Mechanical (Broom) Biweekly	Mechanical (Broom) Weekly	Mechanical (Broom) 2×Weekly	Enhanced (Vacuum) Bimonthly	Enhanced (Vacuum) Monthly	Enhanced (Vacuum) Biweekly	Enhanced (Vacuum) Weekly	Enhanced (Vacuum) 2×Weekly
Roads [a]	Commercial	●	●	●	●	●	◗	◗	◗	◗	◗
	Residential [c]	●	●	○	○	○	◗	◗	○	○	○
Medians [b]	Commercial	●	●	●	●	●	○	○	○	○	○
	Residential [c]	●	●	○	○	○	○	○	○	○	○

a. Candidate roads for sweeping exclude freeways and unimproved roads (without curb and gutter)
b. Only mechanical sweepers are used in medians/turn-lanes
c. The maximum sweeping frequency for residential roads and medians is bi-monthly

Because the proposed street sweeping program applies to all improved City of San Diego roads across watershed and jurisdictional boundaries, all roads with the potential for sweeping were evaluated in order to provide a direct comparison of optimization results against cost and benefit estimates for the proposed sweeping program. The constraints presented in Table 1-3 were applied spatially such that each of the 266 subwatersheds in the model (those having applicable city streets) had eleven possible options for sweeping—the ten combinations shown in Table 1-3, plus the option not to do street sweeping ($\sim 4 \times 10^{26}$ combinations). Figure 1-2 shows a near-optimal cost-effectiveness curve (derived after 10^8 iterations). The red circle in Figure 1-2 shows the originally proposed solution, which was determined based on interviews with the City of San Diego staff, while the green diamond shows one near the knee of the cost-effectiveness curve, where the slope of the curve begins to flatten. This cost-effectiveness curve suggests that there are strategies available that are more cost-effective than the originally proposed strategy. For example, the recommended strategy at the knee of the curve (green diamond) is 50 percent of the cost of the proposed strategy and provides 350 percent more sediment removal. The reason for this savings is that it selectively targets certain areas (i.e. commercial roads in wetter areas of the study area) with more frequent and/or enhanced street sweeping than others.

It should be noted that this analysis was performed for a 10-year record of rainfall and included a representative range of wet and dry years. The pollutant removal effectiveness (i.e., percent removal) is likely to be muted when evaluating these optimized results in the context of a typical year as is done for the analysis for the CLPR model. As a result, the street sweeping removals summarized in the body of the CLRP Phase II report will not be as pronounced as those shown in Figure 1-2.

Figure 1-2. Near-optimal street sweeping cost-effectiveness curve versus originally proposed program.

The percent reductions presented from this analysis are diluted by loading from other areas which are not being swept. Furthermore, existing sweeping activity is also reflected in the modeled baseline. The results only show the change attributable to additional or enhanced sweeping on City streets. For these reasons, the values shown are single digit reductions relative to the existing condition as the baseline. Presenting the results this way also presents street sweeping benefits relative to other practices and relative to cumulative reduction requirements at downstream endpoints.

1.1.3 Proposed Program Enhancements

Program enhancements are recommended based on a combination of optimization analysis results and findings gleaned from interviews with the City. The key findings of this analysis are:

- Enhancements of the street sweeping program should only be considered for those watersheds with metals load reduction requirements and not bacteria requirements.
- Sweeping of commercial areas should be performed at maximum frequency (2 times per week) with a regenerative air machine
- Converting to regenerative air sweeping in residential neighborhoods is not cost effective due to the limitations on sweeping frequency to bi-monthly
- Increasing frequency in residential neighborhoods being swept with mechanical brooms is not cost effective.

Because street sweeping is not effective for the critical pollutant, bacteria, no program enhancements were recommended for the City. Details regarding the interview process were presented in the BMP Representation Memorandum and detailed model parameters are summarized in Table 1-4.

Table 1-4 Summary of Model Parameters for Street Sweeping Program

Parameter	Value	Source
Start month of sweeping practices	Continuous program	City of San Diego
End month of sweeping practices	Continuous program	City of San Diego
Typical days between HIGH frequency route sweeping	3-7	City of San Diego
Typical days between MEDIUM frequency route sweeping	30	City of San Diego
Typical days between LOW frequency route sweeping	60	City of San Diego
Fraction of land surface available for street sweeping	Provided at subwatershed level	GIS
Mechanical broom machine, weekly sweeping TS removal	13%	CWP 2008
Vacuum machine, weekly sweeping TS removal	31%	CWP 2008
Mechanical broom machine, monthly sweeping TS removal	9%	CWP 2008
Vacuum machine, monthly sweeping TS removal	22%	CWP 2008
Fraction of sand in solids storage available for removal by sweeping practices	78%	City of San Diego street sweeping pilot studies
Fraction of silt/clay in solids storage available for removal by sweeping practices	6%	City of San Diego street sweeping pilot studies
Fraction of gravel in solids storage available for removal by sweeping practices	16%	City of San Diego street sweeping pilot studies
Concentration of copper in the removed sediment	93 mg/kg	City of San Diego street sweeping pilot studies
Concentration of zinc in the removed sediment	136 mg/kg	City of San Diego street sweeping pilot studies
Concentration of lead in the removed sediment	23 mg/kg	City of San Diego street sweeping pilot studies
Concentration of TKN in the removed sediment	495 mg/kg	City of San Diego street sweeping pilot studies
Concentration of total phosphorus in the removed sediment	199 mg/kg	City of San Diego street sweeping pilot studies
Concentration of bacteria in the removed sediment	$0.00000521 \times 10^{\wedge 12}$ colonies per pound of street sediment	Pitt 1986

Notes:

- The location of existing sweeping activities will be used to spatially identify subwatersheds that will receive enhanced and expanded sweeping applications.
- Proposed levels of enhanced and expanded sweeping activities will be distributed to the subwatershed level of the LSPC model.

1.2 Catch Basin Cleaning

Enhanced catch basin cleaning activities will contribute to watershed-scale pollutant load reductions. Note that while enhanced catch basin cleaning can significantly reduce pollutant loads, this BMP is not associated with runoff volume reduction. This section summarizes the findings of a study focused on optimizing the City of San Diego's catch basin cleaning program and results of interviews with City representatives.

1.2.1 Treatment Process Overview

A representation of the catch basin cleaning process and associated pollutant removal is provided in Figure 1-3. As the catch basin cleaning program improves effectiveness, pollutant loading to receiving waters through wash-off decreases. The primary method for improving pollutant reduction from catch basin cleaning activities is increased frequency of cleaning operations.

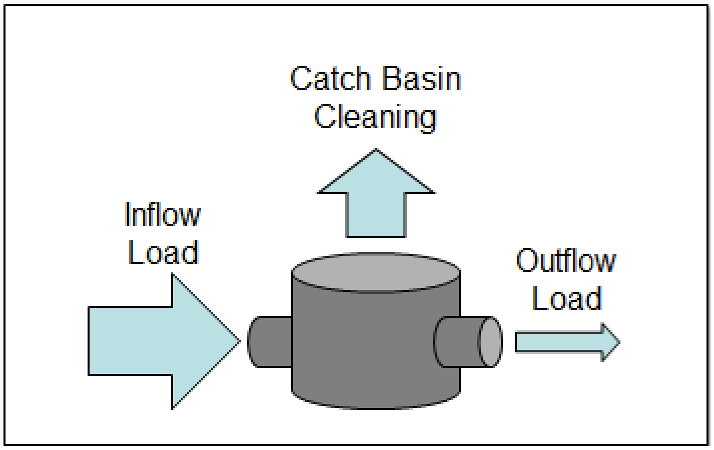


Figure 1-3 Catch Basin Cleaning Treatment Process

1.2.2 Optimization Analysis

To determine the maximum program enhancement scenario, manual clean-out data from 2009-2012 along with findings from Task Order 51 (The City of San Diego Catch Basin Cleaning Program Pilot Study) data was analyzed. As part of TO 51, a detailed assessment was performed to categorize catch basins according to their tendency to yield high, medium, or low debris weights per cleaning event. Previous studies also characterized typical pollutant loads per unit dry weight of debris. By combining these two pieces of information, estimates can be made regarding the effectiveness of the current program at reducing pollutant loads. In order to assess different possible scenarios for program enhancement, these data were used to perform an optimization analysis. Ultimately this information can be used to recommend the extent to which program enhancement is needed.

The TO 51 findings suggested that catch basins tend to fill up with debris quickly during storm events and remain at their capacity for debris storage until they are cleaned. Since current catch basin cleaning activities are typically performed only once annually, there is ample opportunity to substantially increase pollutant load removal by increasing the number of cleanings per basin. Several different scenarios were developed for possible future increases in catch basin cleanings (Table 1-5) and the associated pollutant load reductions were calculated based on concentrations of typical debris removal found in previous studies (Table 1-6). The results of this analysis are presented in Figure 1-4, which illustrates the cost-effectiveness of the increased cleaning activities relative to a 20-year implementation cost. As can be noted in Figure 1-4, enhanced catch basin cleaning activities (even for the most enhanced scenario 9) are not efficient for bacteria removal and result in zero percent reduction in fecal loads for all enhancement scenarios.

Table 1-5 Enhancement Scenarios

Enhancement Scenario	Number of Additional Cleanings per Year		
	High Yield Grids	Medium Yield Grids	Low Yield Grids
(1)	1	--	--
(2)	2	--	--
(3)	3	--	--
(4)	3	1	--
(5)	3	2	--
(6)	3	3	--
(7)	3	3	1
(8)	3	3	2
(9)	3	3	3

Table 1-6 Pollutant Concentrations Used to Calculate Reductions

Pollutant	Concentration (per kg of dry debris)	Source
Copper	75 mg/kg	City of San Diego TO 38
Zinc	232 mg/kg	City of San Diego TO 38
Lead	36 mg/kg	City of San Diego TO 38
Total Nitrogen	2,629 mg/kg	City of San Diego TO 38
Total Phosphorous	551 mg/kg	City of San Diego TO 38
Fecal Coliform	6.13 MPN/kg	City of San Diego TO 38

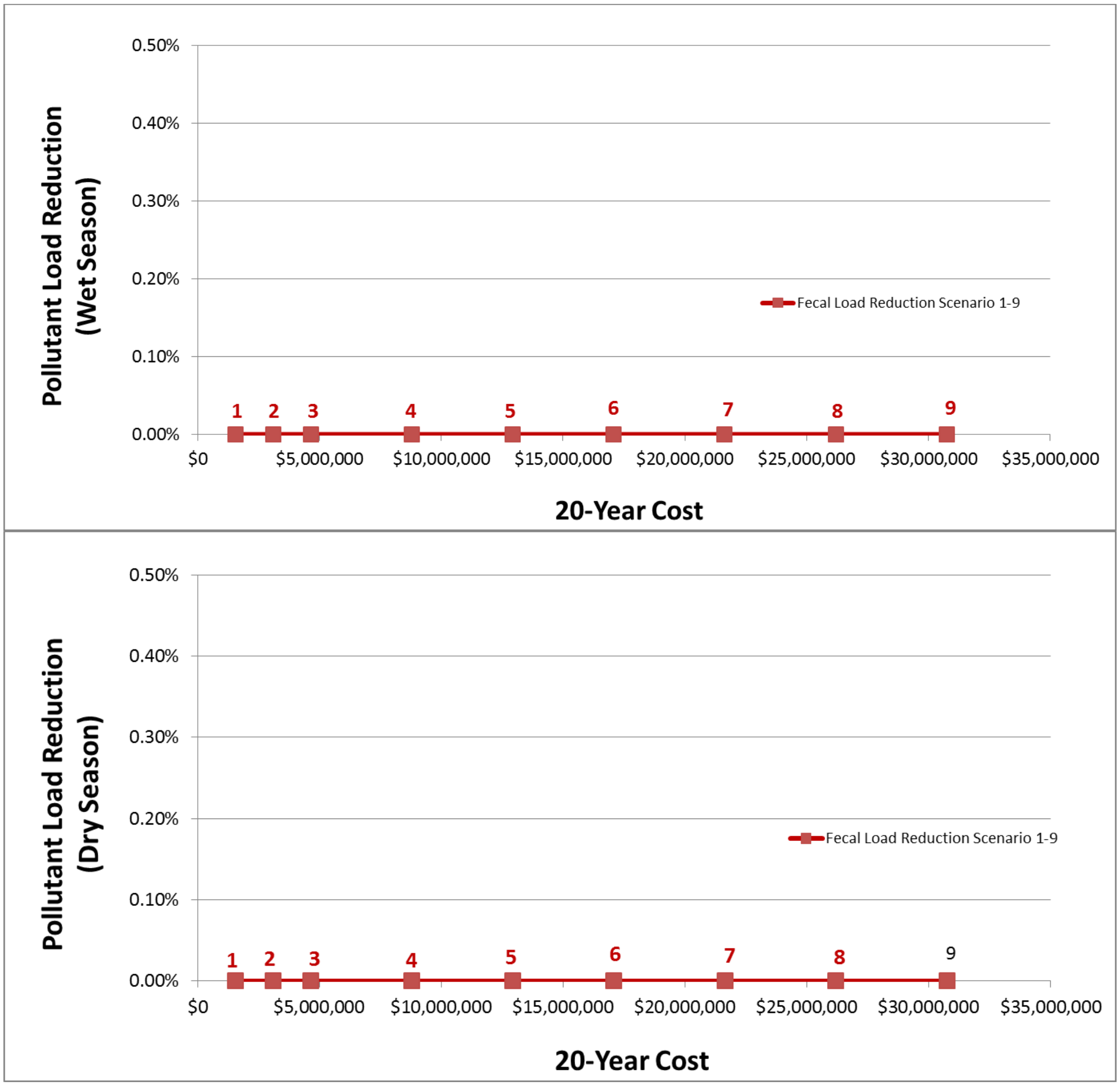


Figure 1-4 Catch Basin Cleaning Program Enhancement Scenarios (Wet and Dry Seasons)

1.2.3 Proposed Program Enhancements

Program enhancements are recommended based on a combination of optimization analysis results and findings gleaned from interviews with the City. Because the critical pollutant in the San Diego River watershed is bacteria, and because this BMP is not efficient in the reduction of bacteria loads (as displayed in Figure 1-4), no further catch basin cleaning program enhancements for the City of San Diego were recommended for this watershed.

1.3 Rain Barrels Incentive Program

Collection of rooftop runoff in rain barrel facilities can be part of a water conservation effort in which retained runoff is reused as irrigation. When reuse is not possible, the retained flows can be slowly released after a period of storage. To minimize the potential for dry weather flow generation and direct connection to impervious surfaces, any released flows can be routed through either landscaped areas, in which runoff load reduction can be attained through the processes of infiltration and evapotranspiration, or to bioretention BMPs as part of a longer treatment train approach.

1.3.1 Treatment Process Model Overview

The LSPC model's representation of rain barrel implementation for runoff volume reduction is provided in Figure 1-5. As the rain barrel program implementation increases, roof runoff is intercepted and temporarily stored in the barrel and the runoff volume (and associated pollutant load) to receiving waters decreases. Since the current rain barrel program implementation is relatively limited, methods for improving runoff volume reduction from rain barrel programs are primarily associated with additional rain barrel installations.

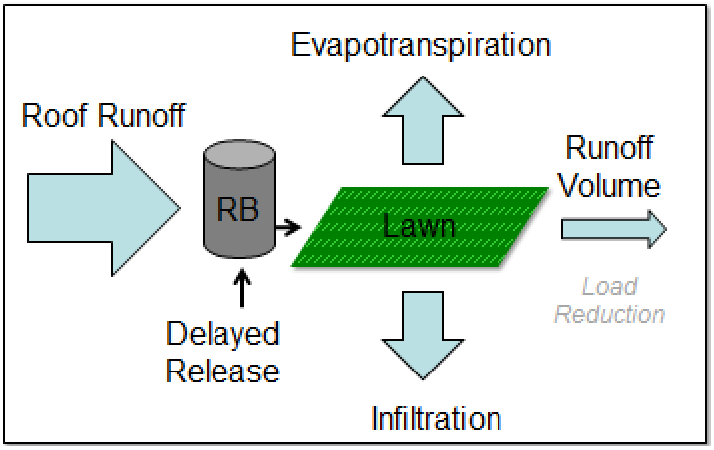


Figure 1-5 Rain Barrel Treatment Process

1.3.2 Proposed Program Enhancements

The City of San Diego Public Utilities Department currently operates a rebate program for rainwater harvesting practices, including rain barrels and cistern type devices. To date, the program has had limited implementation. Program enhancements are recommended based on findings gleaned from interviews with the City. Future rain barrel implementation assumptions were based on historical rebate data. Details regarding the interview process and rebate assumptions were presented in the BMP Representation Memorandum.

Assumptions regarding future implementation of the City of San Diego's rain barrel program are summarized in Table 1-7 below.

Table 1-7 Summary of Rain Barrel Program Enhancements

Annual Rain Barrel Implementation Metric	San Diego River Watershed
Single-family zoned parcels (SFZP)	56,922
SFZP percentage in City of San Diego	18.57%
Rain barrel installations per year*	71

*This value reflects the number of rain barrels that the City has committed to installing, however does not reflect what was modeled. 17 rain barrel installations per year were modeled.

Simulation of long term rainfall and runoff processes within the BMP modeling software will assist in the determination of average rain barrel capture performance (runoff reduction) per rooftop drainage acre. Rain barrel modeling parameters are summarized in Table 1-8.

Table 1-8 Summary of Model Parameters for Rain Barrel Program Enhancements

Parameter	Value	Source
Contributing rooftop area to rain barrel	200 ft^2	Typical value
Rain barrel size (gallons - average)	65	City of San Diego
Primary outlet diameter	0.5 inch (minimum)	City of San Diego
Outlet pipe invert location	< 6 inches above bottom of barrel	City of San Diego
Overflow pipe diameter (inch)	2 inch (minimum)	City of San Diego
Maximum rain barrel outflow via 0.5 inch primary outlet	0.010 cfs	Orifice equation with depth = 2.5 feet
Rain barrel dewatering time	18 minutes	Typical value
Assumed soil infiltration rate at rain barrel discharge	0.03 in/hr	Type D soil infiltration parameter range
Assumed potential evapotranspiration rate	1.43 inches per month	Minimum monthly value in San Diego region in 2012
Assumed potential evapotranspiration rate	0.002 in/hr	Typical value for region
Assumed allowable ponding depth in landscaping area	0.75 inch	Typical value for region
Required landscaped area downstream of rain barrel discharge location to prevent rain barrel runoff	144 ft^2	Typical value for region
Landscaped area dewatering time	23 hours	Typical value for region

1.4 Downspout Disconnection Incentive Program

Downspout disconnections provide a BMP alternative for runoff volume reduction in highly impervious watersheds. This cost-effective BMP, which provides for a disconnection of impervious surfaces between rooftops and sidewalks, driveways, or roads, can be modeled by routing runoff from impervious, directly connected rooftops over a segment of pervious land to simulate depression storage, infiltration processes, and overland flow routing on a typical lawn. This BMP is assumed for implementation only in single-family residential areas.

1.4.1 Treatment Process Model Overview

The LSPC model's downspout disconnection implementation for runoff volume reduction is provided in Figure 1-3. As the downspout disconnection program implementation increases, then the runoff volume and pollutant loads to receiving waters decreases. Since the downspout disconnection implementation program has recently initiated, methods for improving runoff volume reduction from downspout disconnections are primarily associated with additional facility installations.

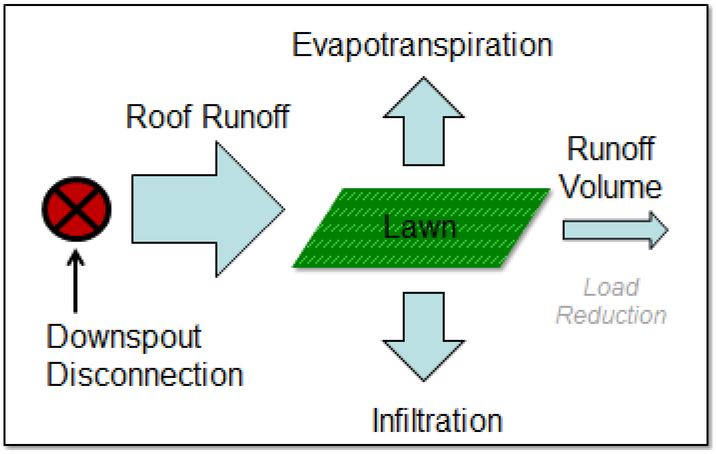


Figure 1-6 Downspout Disconnection Treatment Process

1.4.2 Proposed Program Enhancements

Program enhancements are recommended based on findings gleaned from interviews with the City. Future rain barrel implementation assumptions were based on historical rebate data. Details regarding the interview process and model assumptions were presented in the BMP Representation Memorandum and recommended program enhancements are summarized in Table 1-9.

Table 1-9 Summary of Downspout Disconnection Program Enhancements

Annual Downspout Disconnection Implementation Metric	San Diego River Watershed	City of San Diego Total
Single-family zoned parcels (SFZP)	56,922	306,593
SFZP percentage in City of San Diego	18.57%	100%
Downspout disconnection installations per year	325	1,750

Modeling assumptions for downspout disconnection implementation are detailed in Table 1-10.

Table 1-10 Summary of Downspout Disconnection Program Enhancements

Parameter	Value	Source
Contributing rooftop area to rain barrel	200 ft^2	Typical value
85th percentile flow to disconnection	0.001 cfs	Rainfall intensity = 0.2 in/hr
85th percentile runoff volume to disconnections	10 ft^3	P = 0.6 inches
Assumed soil infiltration rate at rain barrel discharge	0.03 in/hr	Type D soil infiltration parameter range
Assumed potential evapotranspiration rate	1.43 inches per month	Minimum monthly value in San Diego region in 2012
Assumed potential evapotranspiration rate	0.002 in/hr	Typical regional value
Assumed allowable ponding depth in landscaping area	0.75 inch	Typical regional value
Required landscaped area downstream of rain barrel discharge location to prevent rain barrel runoff	160 ft^2	Typical regional value
Landscaped area dewatering time	23 hours	Typical regional value

1.5 Irrigation Runoff Reduction

Reductions to irrigation runoff assist with runoff volume reduction goals and associated pollutant load reductions. This nonstructural BMP, which doubles as a water conservation initiative, incorporates good landscaping practices to limit irrigation runoff. Measures to reduce irrigation runoff can be implemented wherever landscapes are irrigated. Residential, commercial, recreational, and industrial land uses can be targeted by incentive policies and programs.

1.5.1 Treatment Process Model Overview

The LSPC model's representation of irrigation runoff reduction implementation is provided in Figure 1-4. As implementation of irrigation runoff reduction measures increases, then the runoff volume and associated pollutant loads to receiving waters decreases. Methods for implementing irrigation runoff reduction include the following.

- Turf conversion projects to reduce irrigation demand – Xeriscape conversion programs facilitate the transformation of residential lawns and gardens to low-irrigation landscapes using drought-tolerant plants and encouraging soil preparation, mulching, and zoned irrigation to reduce water use.

- Micro-irrigation practices – These measures are more efficient and use less water than conventional irrigation practices.

- Weather-based irrigation controllers – These devices reduce irrigation water use by meeting the actual needs of vegetation based on prevailing weather conditions, current and historic evapotranspiration soil moisture levels, and other factors relevant to adapt water application.

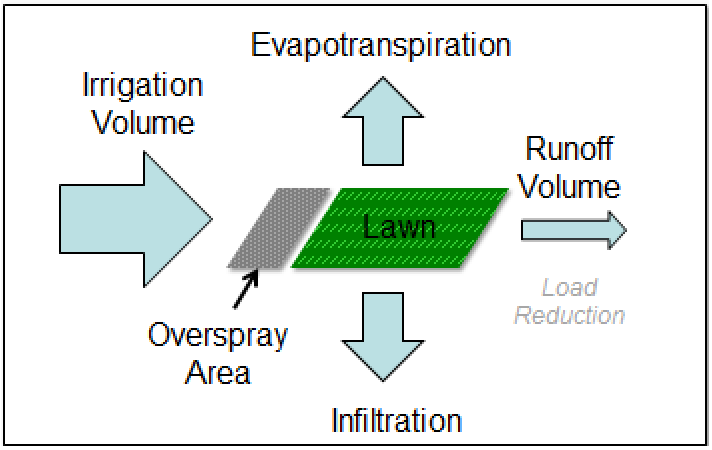


Figure 1-7 Irrigation Reduction Treatment Process

1.5.2 Proposed Program Enhancements

The City of San Diego Public Utilities Department currently operates a rebate program for irrigation runoff reduction practice. While combined with the City's rain barrel program from a budgetary and implementation standpoint, the irrigation reduction program will be modeled separately. Program enhancements are recommended based on findings gleaned from interviews with the City and other individual RP representatives. Future irrigation reduction implementation assumptions for the City of San Diego are based on targeted outcomes, rather than on the results of the existing program. The effects of the City of San Diego's irrigation runoff reduction program implementation were specifically modeled to result in:

1) elimination of all over-spray and

2) an overall 25% reduction in irrigation.

2. Structural BMPs

Structural BMPs provide the opportunity to intercept runoff and filtrate, infiltrate, or treat the stormwater. These structures tend to be more expensive than nonstructural BMPs, but they also tend to have predictable and reliable pollutant load removal effectiveness. Structural BMPs will be an important element of the overall CLRP compliance strategy. This section provides a summary of BMP representation information for the four different types of structural solutions evaluated as part of this analysis.

2.1 Centralized BMPs on Public Land

The construction of large centralized BMP facilities considered in this study focuses on surface BMPs that provide treatment via the processes of detention and infiltration. Specifically, these BMPs include infiltration basins and dry extended detention basins that are designed for extended residence times allowing water to infiltrate to native soils while accommodating for overflow and bypass during large storm events. The CLRP identified parcels that are likely suitable for locating centralized BMPs which can support watershed-scale implementation planning.

To better manage uncertainties associated with BMP placement and size, a standard centralized BMP representation was developed. Figure 2-1 presents a generalized schematic of a centralized, surface storage BMP that will be represented in the watershed model.

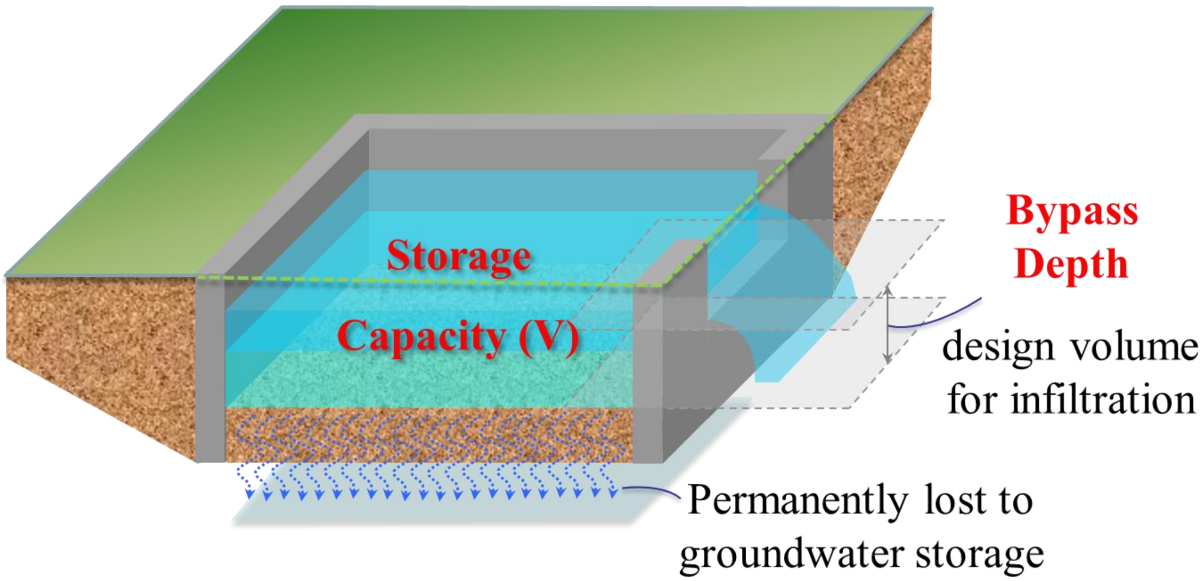


Figure 2-1 Centralized BMP representation.

Each of the centralized structural BMPs will be represented directly in the LSPC watershed model using a storage-discharge relationship to simulate outflow and a background infiltration rate reflective of the underlying soils. By incorporating these features directly into LSPC, the dynamic effect on volume and water quality incorporates all of the spatial variability (land use distribution and precipitation time series) within the watershed model. The static storage volume for each BMP facility will be calculated as the required volume corresponding to the 85th percentile rainfall depth based on the average percent imperviousness in the upstream contributing drainage area (City of San Diego 2008). The 85th percentile rainfall depth will be calculated uniquely for each centralized BMP using the weather station assigned to the model subwatershed that includes each BMP.

2.1.1 BMP Implementation in the Model

As part of CLRP Phase II, multiple desktop and field screening exercises were completed to develop a full understanding of the opportunities that exist for centralized BMP implementation in this watershed. The sites were pared down and prioritized based on feasibility, potential for pollutant load reduction, and other physical characteristics. The full list of BMP opportunities for this watershed is presented in Table 2-1.

Table 2-1 Centralized BMP opportunities in the San Diego River watershed

Candidate Opportunities					
Site ID #	APN	Name	Jurisdiction	Drainage Area (ac)	Percent Impervious
1	4491100800	Cleator Park	City of San Diego	333	TBD
2	4210500100 4213201100	Cabrillo Heights Park*	City of San Diego	238	TBD
3	4425200800	Presidio Hills Golf Course and Park	City of San Diego	142	TBD
4	4212901100	Montgomery Field Airport	City of San Diego	410**	TBD

Candidate Opportunities					
Site ID #	**APN**	**Name**	**Jurisdiction**	**Drainage Area (ac)**	**Percent Impervious**
5	4488000100	Ocean Beach Athletic Park and Robb Field	City of San Diego	315	TBD
6	4213000700 4210302200	Serra Mesa Park and Upslope Canyon	City of San Diego	267	TBD
7	3733022600 3730715500 3733022400	Lower North Shepherd Canyon	City of San Diego	757	TBD
8	4574000400	Springall Academy	City of San Diego	324	TBD
Planned and Implemented Opportunities					
None known within City of San Diego limits					

Source: Tetra Tech preliminary BMP screening 2013. Field verification of these sites is currently being performed

*There are several distributed BMPs planned by the City at this site (Cabrillo Heights Park), but space should allow for implementation of centralized BMPs. **Parcel drains to multiple subwatersheds.

Other Notes:
In addition to the candidate centralized BMPs listed in Table A-1, two City-owned parcels were recommended for centralized BMP implementation in the San Diego River CLRP: (1) Valley View Casino Center (San Diego Sports Arena), and (2) Qualcomm Stadium. Subsequent review of these sites deemed them less suitable for centralized BMP implementation than the candidate sites listed above.

2.2 Distributed BMPs on Public Land

Distributed BMPs represent small-scale structures that capture and treat stormwater runoff at the source. They are typically integrated into site designs and oftentimes serve multiple uses, such as landscaping or driving surfaces while also acting to remove pollutants. Two primary distributed features are considered for implementation of distributed BMPs on public land: (1) bioretention, and (2) permeable pavement. Both bioretention and permeable pavement are represented with the modeling framework to quantify the dynamic effects they have on both flow and pollutant reduction across a range of storm conditions.

2.2.1 Bioretention

Bioretention generally refers to small, shallow vegetated features constructed in green spaces alongside roads, sidewalks, and other paved surfaces. Depending on site-specific opportunities and constraints, these features can be designed and implemented in a linear configuration as bioswales (City of San Diego 2011). Bioretention is designed to capture and treat runoff from impervious surfaces such as roads, parking lots, median strips, or the right-of-way along public roads. These features provide benefits in terms reducing volume from smaller storms and also improving water through physical and biological filtration. Figure 2-2 presents a conceptual diagram of the treatment pathways and processes for a typical bioretention BMP.

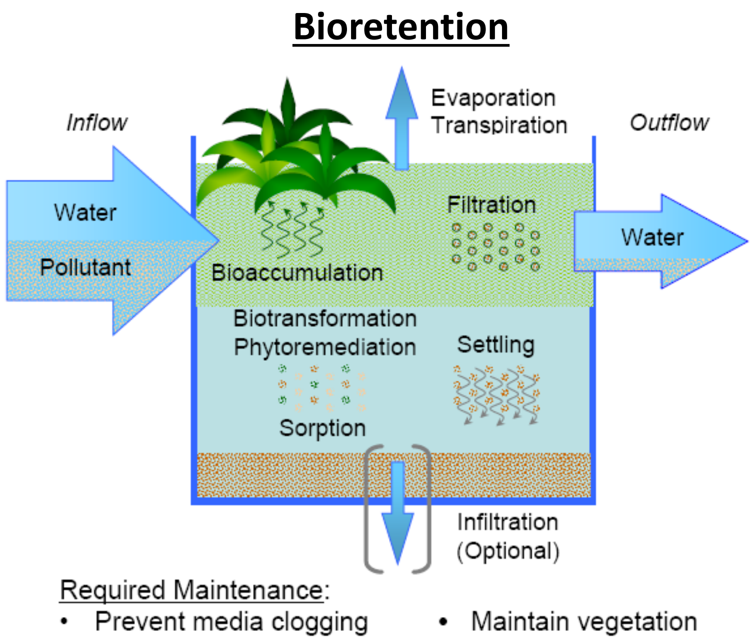


Figure 2-2 Conceptual diagram of typical bioretention BMP flow pathways and treatment mechanisms.

2.2.2 Permeable Pavement

Permeable pavement is typically used in place of traditional pavement to provide some infiltration capacity to native soils. In cases where the background infiltration capacity is poor, an underdrain may be included to convey stormwater to downstream treatment facilities. A number of variations exist which accommodate this infiltration function while maintaining the structural needs of the road surface. Common variations include permeable asphalt, pervious concrete and concrete pavers. Permeable pavement receives direct inflow consisting of stormwater runoff and pollutant load from impervious road surfaces only. Effectively, each unit of modeled permeable pavement would replace an equal area unit of existing traditional pavement. Figure 2-3 presents a conceptual diagram of the treatment pathways and processes for a typical permeable pavement BMP.

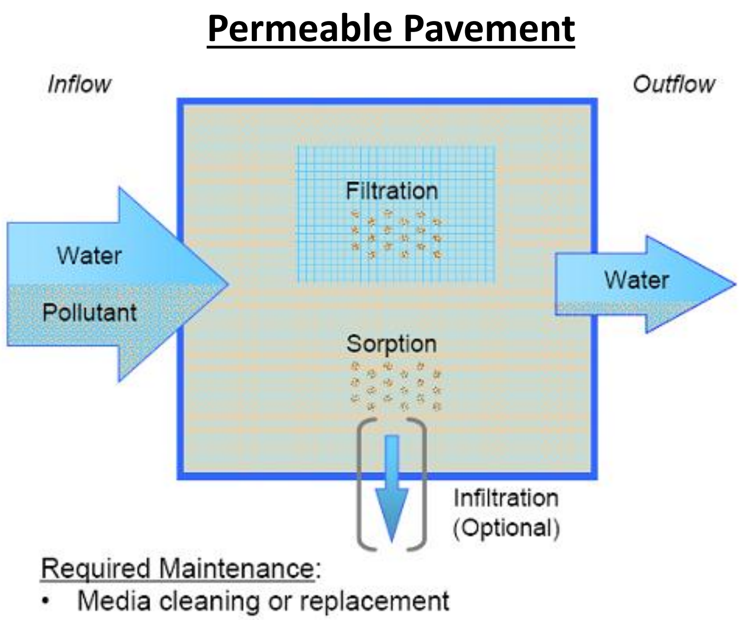
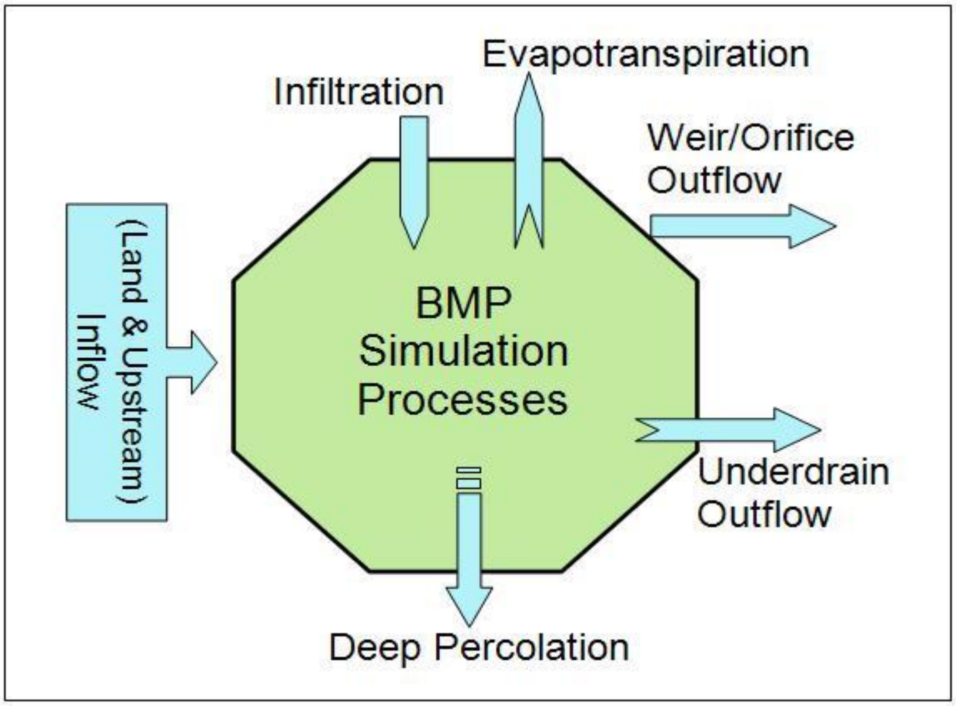


Figure 2-3. Conceptual diagram of typical permeable pavement BMP flow pathways and treatment mechanisms.

2.2.3 Model Representation

Bioretention and permeable pavement features will be evaluated using the modeling framework with runoff and pollutant loading boundary conditions generated using the LSPC watershed model. The model represents distributed BMPs using a set of (1) physical characteristics which describe the feature geometry, and (2) process-based parameters which describe the mechanisms related to flow and pollutant transport such as evapotranspiration, infiltration, and pollutant loss. Physically, both bioretention and pervious pavement can be conceptualized as having three compartments: (1) surface storage which provides volume for ponding (2) soil media or aggregate substrate, and (3) an optional underdrain reservoir when necessitated by background soil conditions.

The BMPs model incorporates a variety of pathways through which water and pollutants travel through the BMP (i.e. infiltration, evapotranspiration, weir overflow, and underdrain outflow). Figure 2-4 presents a schematic view of the soil media and underdrain components illustrating the related physical and process-based parameters. As discussed above, inflow from the land will be represented using the time series from the LSPC watershed model.



Source: Lee et al. 2012

Figure 2-4. Conceptual diagram of selected processes associated with structural BMPs.

While the model representation of permeable pavement is similar to bioretention, the two features are distinguished by a different set of physical and process-based parameters describing the function of infiltration both through the aggregate media and into background soils. For example, the ponding depth of pervious pavement is physically much smaller than that of bioretention, as stormwater would not be allowed to accumulate on the paved surface in practice. Also, because permeable pavement is not vegetated, the potential for evapotranspiration is also greatly diminished as compared to bioretention.

2.2.1 BMP Implementation in the Model

The CLRP Phase I identified public parcels that are likely suitable for distributed BMP development based on site characteristics and other important attributes. Selected sites were assessed using aerial imagery to estimate the typical area available for implementation of distributed BMPs throughout the watershed. A summary of BMP representation parameters is presented in Table 2-2.

Table 2-2 Summary of detailed model representation for distributed structural BMPs

	Bioretention	Permeable Pavement
Surface Parameters		
Unit size (sq ft.) *Varies with 85th percentile rainfall depth*	808 - 1,520	1,388 - 2,610
Design drainage area (acre)*	1	1
Substrate depth (ft)	3	2
Underdrain depth (ft)	None for B Soil 1.5 for C, D Soil;	None for B Soil 1.5 for C, D Soil;
Ponding depth (ft)	0.75	0.01

	Bioretention	Permeable Pavement
Subsurface Parameters		
Substrate layer porosity	0.4	0.4
Substrate layer field capacity	0.25	0.1
Substrate layer wilting point	0.1	0.05
Underdrain gravel layer porosity	0.4	0.4
Vegetative parameter, A	1	0
Monthly Growth Index	1	0
Background infiltration rate (in./hr), f_c	B - 0.8; C - 0.2; D - 0.01	B - 0.8; C - 0.2; D - 0.01
Media final constant infiltration rate (in./hr), f_c	2	2

2.3 Green Streets

Green streets provide an additional opportunity for locating BMPs in a publically owned location. To evaluate the extent to which green streets can help achieve compliance with WLA reduction targets, an assessment was performed to identify green streets opportunities on a watershed-wide basis. Available green street implementation and contributing areas were determined using available GIS information, sample roads, and existing project designs. The process began with identifying streets appropriate for green street retrofits and estimating the typical contributing area from surrounding parcels. Using the County roads information available on SANGIS, the roads were screened based on their functional class attribute so only roads with suitable characteristics were selected. The City of San Diego provided data that measures the street width from curb to curb and the right-of-way width allowing for a calculation of the space between the curb and edge of the right-of-way known as the parkway width. The parkway width information was combined with the selected function class roads and the median parkway width was identified for each of the function classes. An associated bioretention width was then assigned based on the available parkway width. The typical available length of BMP was estimated based on engineering judgment from designing green streets, such as the City of San Diego’s Bannock Avenue. The length of the bioretention cells was measured and compared to the length of each road segment to give an overall percentage of the roadway length that is available for BMP implementation. It was assumed that permeable parking lanes can also be installed in conjunction with each bioretention segment.

The contributing areas to the BMPs were found using random road sampling and identifying the surrounding drainage patterns. Using a random number generator, road segments of the identified function classes and surrounding land use were selected and the contributing area draining to the right-of-way was outlined based on a desktop analysis of topography, aerial imagery, and drainage infrastructure. Using the multiple samples for each function class and land use, the average contributing area of the surrounding parcels was identified. The roads deemed appropriate for BMP classification in the first step were tallied in each subwatershed and compared to the total roadway length within each subwatershed. This reduction percentage was assumed to be the available roads for BMP implementation across each subwatershed. The land uses in each subwatershed were multiplied by these two reducing factors to identify contributing areas to implementable roads. The areas were summed by subwatershed for the model input. Ultimately, the BMPs were represented in the modeling framework in the same way that they are described in Section 2.2 of this appendix.

Based on the feasible areas determined for green streets within each subwatershed, modeling optimization was performed to determine the most cost effective amount bioretention and permeable pavement needed in combination with the other nonstructural and structural BMPs identified. The optimal amount of BMPs within green streets for each modeled subwatershed (Figure 5-2 of the report) are listed in Table 2-3.

Table 2-3. Green streets implementation

Subwatershed ID	Bioretention (ft)	Permeable Pavement (ft)
5001	1,184	0
5002	2,444	180
5003	5,465	426
5004	2,837	858
5005	2,576	0
5006	1,743	130
5007	0	0
5008	3,497	792
5009	610	221
5010	733	0
5011	60	3
5012	15	0
5013	1,209	0
5017	0	0
5018	0	0
5195	1,572	123
5196	2,032	0
5197	5,871	37
5198	5,714	158
5271	0	0
5276	5,545	353
5277	3,854	509
5279	4,142	838
5280	14,996	0
5283	2,465	0
5285	4,657	0
5287	6,131	0
5288	13,238	1,590
5289	1,577	0
5290	10,782	360
5291	4,478	139
5292	93	0

Subwatershed ID	Bioretention (ft)	Permeable Pavement (ft)
5293	2,155	601
5294	0	0
5316	0	0
5317	2,801	723
5318	3,106	602
5319	7,755	0
5320	947	24
5321	3,543	219
5322	345	0
5323	853	248
5333	1,337	745
5334	853	14
5335	956	0
5340	7,300	1
5341	5,039	6
5342	3,246	71
5345	2,599	0
5346	2,670	21
5347	1,125	269
5348	4,797	42
5349	713	386
5350	0	0
5351	6,060	4,638
5352	4,595	518
5353	5,632	234
5354	8,538	128
5355	2,344	21
5357	2,398	20
5361	2,327	0
5362	5,651	13
5363	7,187	125
5364	5,859	77
5365	1,301	28
5366	7,371	23
5367	8,741	38
5368	10,371	0

Subwatershed ID	Bioretention (ft)	Permeable Pavement (ft)
5369	2,479	4
5370	1,387	40
5371	6,696	0
5372	9,279	79
5373	6,789	135
5374	1,821	110
5375	7,283	20
5376	1,698	36
5377	4,779	297
5378	495	0
5379	4,995	0
5380	6,835	11
5381	13,640	0
5382	9,019	38
5383	3,087	0
5384	12,220	11
5385	2,387	162
5386	11,854	497
5387	1,440	288
5388	4,911	0
5389	8,359	79
5390	246	0
5391	3,434	195
5392	5,961	0
5393	3,430	0
5394	2,296	0
5395	7,514	3
5396	2,077	46
5397	4,963	124
5398	1,051	419
5399	12,025	47
5400	7,481	37
5401	644	7
5402	2,118	33
5403	7,199	1,522
5404	1,851	55

Subwatershed ID	Bioretention (ft)	Permeable Pavement (ft)
5405	4,758	577
5406	10,019	232
5407	3,187	66
5408	2,241	304
5409	5,732	9
5410	10,970	2,576
5411	656	0
5412	5,971	44
5413	1,010	12
5414	2,641	263
5415	210	11
5416	9,213	24
5417	3,763	162
5418	10,291	75
5419	2,486	57
5420	829	12
5421	2,798	860
5422	5,086	62
5423	1,357	97
5424	11,293	135
5425	8,754	32
5426	4,602	129
5427	3,862	194
5428	3,743	114
5429	4,740	0
5430	12,230	53
5431	5,475	45
5432	8,891	5
5433	9,616	0
5434	4,803	0
5435	5,701	20
5436	6,598	221
5505	11,377	3

2.4 Centralized BMPs on Private Land

In the event that the combination of structural and nonstructural BMPs listed above are not sufficient to meet WLA reduction targets, additional land will be needed to construct centralized BMPs to achieve sufficient load reductions. Modeling of centralized BMPs on private land was considered only at a conceptual level as it is not feasible to consider all factors needed to locate specific centralized BMPs due to unknown locations and land availability. Individual SUSTAIN models were developed for each subwatershed to characterize the unit response of a hypothetical BMP. Initially, each BMP was sized to capture the 85th percentile storm by fixing the depth at4 feet and allowing the footprint to vary based on the required volume. Construction costs were incorporated as a function of BMP footprint and varied by watershed. A fixed land acquisition cost of $122/ft^2 was also considered. Modeling each individual subwatershed separately allows quantification of a unique BMP response which is a function of both variation in precipitation and a unique land use distribution.

3. References

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Appendix B – Updated Costs

Table B-1 City of San Diego

Activity #	Activity	Quantity	Units	20-Year Cost (2013 dollars)
	Nonstructural (Not Modeled)			
1	Enhance LID implementation for new development and redevelopment through zoning amendments			$25,005
2	Train Development Services Department staff on LID regulatory changes and LID Design Manual			$201,964
3	Develop regional training for and focus locally on enforcement of water-using mobile businesses			$260,912
5	Design and implement property- and PGA-based inspections and accelerated enforcement			$2,329,223
6	Trash areas: require full four-sided enclosure, siting away from storm drains, cover; consider retrofit requirement			$15,003
7	Animal-related facilities			$15,003
8	Nurseries and garden centers			$15,003
9	Auto-related uses			$15,003
10	Update Minimum BMPs for existing residential, commercial & industrial development & enforce			$129,188
11	Support partnership effort by social service providers to provide sanitation and trash management for persons experiencing homelessness			$33,340
12	Develop pilot project to identify and carry out site disconnections in targeted areas			$494,967
13	Continue to participate in source reduction initiatives			$126,688
15	Expand outreach to HOA common lands and HOA rebates			$218,490
17	Develop outreach and training program for property managers responsible for HOAs and Maintenance Districts			$69,065
18	Conduct trash clean-ups through community-based organizations involving target audiences			$180,036
19	Enhance education and outreach based on results of effectiveness survey and changing regulatory requirements			$1,512,110
20	Improve consistency & content of websites to highlight enforceable conditions & reporting methods			$27,626
25	Proactively monitor for erosion, and complete minor repair & slope stabilization			$1,059,952
26	Increase identification and enforcement of actionable erosion and slope stabilization issues on private property and require stabilization and repair			$5,344,137

31	Identify sewer leaks and areas for sewer pipe replacement prioritization			$3,201
	Nonstructural (Modeled)			
14a	Expand residential BMP (irrigation, rainwater harvesting and turf conversion) rebate programs to multi-family housing in target areas			$162,526
14b	Residential BMP Program: Rain Barrels			$130,816
14c	Residential BMP Program: Irrigation Control (Turf Conversion)			$394,584
14d	Residential BMP Program: Downspout Disconnect			$351,834
	Structural (Modeled)			
32	32. Centralized on Public			
	Centralized - Montgomery Field Airport	9.6	ac	$9,640,610
	Centralized - Presidio Park	3.1	ac	$5,228,705
	Centralized - Cleator Park	2.4	ac	$3,609,294
	Centralized - Sera Mesa Park and Upslope Canyon	2.1	ac	$7,766,819
	Centralized - Cabrillo Heights Park	1.9	ac	$8,341,886
	Centralized - Springall Academy	3.2	ac	$12,220,674
	Centralized - Ocean Beach Athletic Park and Robb Field	2.3	ac	$9,394,344
	Centralized - Lower North Shepherd Canyon	5.9	ac	$7,173,924
	Centralized BMP Design Support			$425,719
	Centralized BMP O&M - Supervision			$697,310
33	33. Distributed on Public			
	Distributed - Bioretention	16.0	ac	$73,419,367
	Distributed - Permeable Pavement	4.1	ac	
34	34. Green Streets			
	Distributed - Bioretention	73.0	ac	$331,001,751
	Distributed - Permeable Pavement	16.00	ac	
36	36. Planned BMPs			
	Planned	12	BMPs	$908,284

Appendix C – Updated Schedule

Table C-1 San Diego River Watershed Nonstructural BMP Implementation Schedule

	CLRP Implementation Schedule
	O&M

	RP	SAN DIEGO RIVER – IMPLEMENTATION YEAR																		
Management actions	**CSD**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**[1]
CLRP IMPLEMENTATION PROGRAM ACTIONS																				
Initial structural and nonstructural BMP analysis	✓																			
CLRP modifications and improvements	✓																			
CLRP reporting	✓																			
NONSTRUCTURAL																				
DEVELOPMENT REVIEW PROCESS																				
Amend regulations to facilitate LID implementation	✓																			
Train staff and boards	✓																			
ENHANCED INSPECTIONS and ENFORCEMENT																				
Mobile business training requirements	✓																			
Power washing discharges inspection/enforcement	✓																			
Property based inspections	✓																			
SUSMP and REGULATORY ENHANCEMENT[2]																				

[1] 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.

	RP	SAN DIEGO RIVER – IMPLEMENTATION YEAR																		
Management actions	**CSD**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031[1]**
Amend SUSMP, other code and zoning requirements, including the addition of retrofit requirements, to reduce pollutants from:																				
Trash enclosure & storage areas	✓																			
Animal-related facilities	✓																			
Nurseries and garden centers	✓																			
Auto-related uses	✓																			
Update minimum BMPs	✓																			
NEW/EXPANDED INITIATIVES																				
Address bacteria & trash impacts of homelessness	✓																			
Pilot projects to disconnecting impervious surfaces	✓																			
Support for brake pad partnership (source reduction initiatives)	✓																			
LANDSCAPE PRACTICES																				
Landscape BMP incentives, rebates, and training:																				
Residential properties	✓																			
Homeowners associations/property managers	✓																			
Non-residential properties	✓																			
Reduction of over-irrigation	✓																			
EDUCATION AND OUTREACH																				
Develop outreach and training program for property managers responsible for HOAs and Maintenance Districts	✓																			
Enhanced and expanded trash cleanup	✓																			

[2] Adoption of revised standards and use in development review at end of implementation period

	RP	SAN DIEGO RIVER – IMPLEMENTATION YEAR																		
Management actions	**CSD**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**[1]
programs																				
Enhance education and outreach based on results of effectiveness survey and changing regulatory requirements	✓																			
Improve Web resources on reporting	✓																			
MS4 MAINTENANCE																				
Proactive MS4 repair & replacement	✓																			
Increased channel cleaning & scour pond repair	✓																			
Erosion repair and slope stabilization:																				
Public property & right of way	✓																			
Enforcement on private properties	✓																			
CAPITAL IMPROVEMENT PROJECTS																				
Dry-weather flow separation	✓																			
Identify sewer leaks and areas for sewer pipe replacement prioritization	✓																			

Table C-2 San Diego River Watershed Structural BMPM Implementation Schedule

	Implementation/ Structural BMP Construction Schedule
	O&M

	BMPS PER RP	SAN DIEGO RIVER - IMPLEMENTATION YEAR																		
Management actions	**CSD**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
STRUCTURAL																				
STRUCTURAL: PLANNED AND IMPLEMENTED																				
PLANNED AND IMPLEMENTED BMPS: DISTRIBUTED																				
Planned - Distributed	**3**																			
	9																			
STRUCTURAL: NEW BMPS ON PUBLIC PARCELS																				
NEW BMPS: Centralized																				
	1																			
	1																			
	1																			
	1																			
	1																			
	1																			
	1																			
Centralized BMP	**1**																			
NEW BMPS: DISTRIBUTED[3]																				
Distributed BMP	**11%**																			

[3] New identified distributed BMPs were uniformly distributed over the period of implementation

Management actions	BMPS PER RP	SAN DIEGO RIVER - IMPLEMENTATION YEAR																		
	CSD	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	11%																			
	11%																			
	11%																			
	11%																			
	11%																			
	11%																			
	11%																			
	11%																			
NEW BMPS: GREEN STREETS[4]																				
Green Streets	11%																			
	11%																			
	11%																			
	11%																			
	11%																			
	11%																			
	11%																			
	11%																			
	11%																			

[4] New green street opportunities were distributed by area over the period of implementation

Appendix D – Water Quality Composite Scores

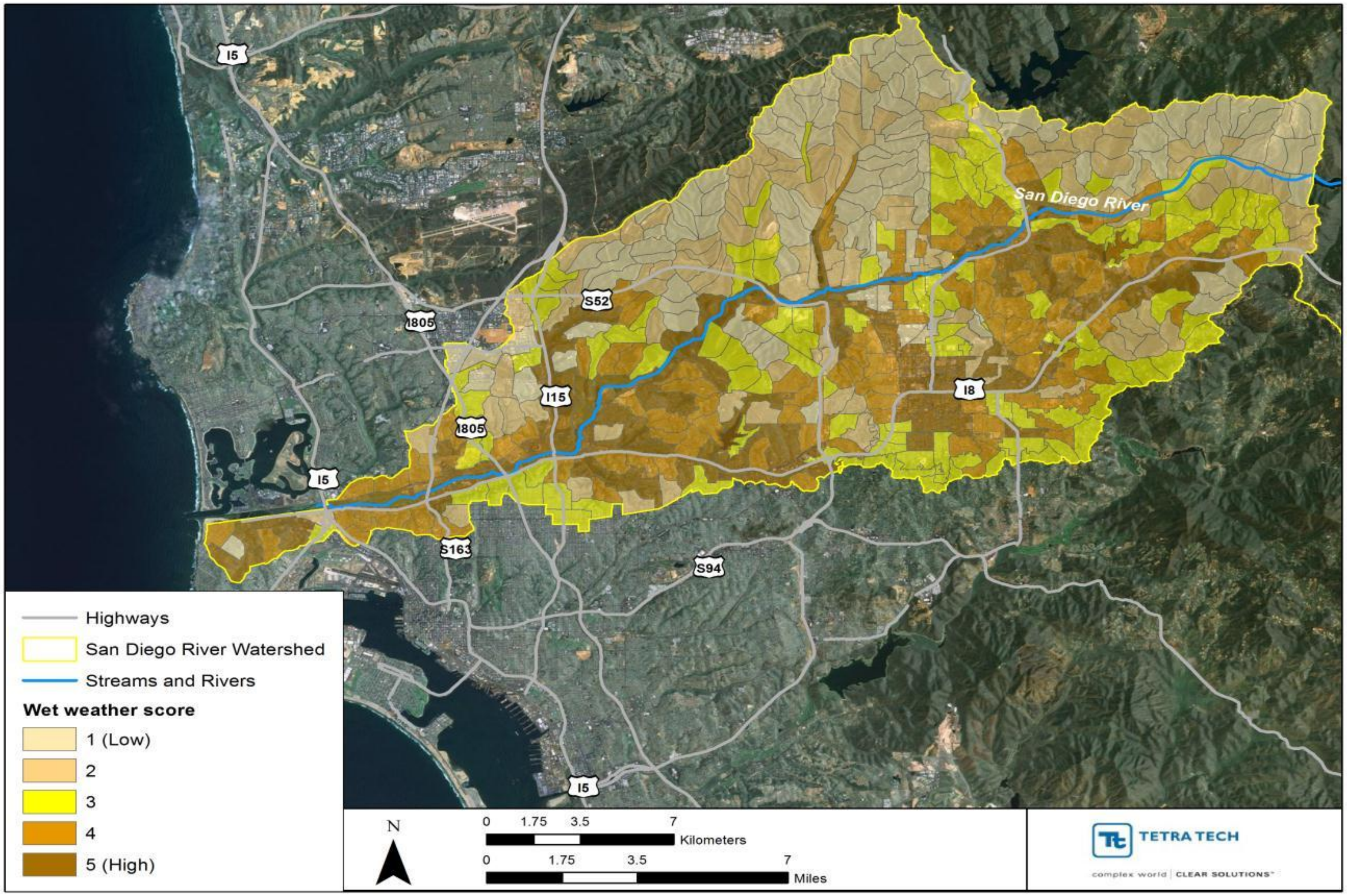

Figure D-1 San Diego River Watershed Wet Weather Composite Scores (Bacteria)

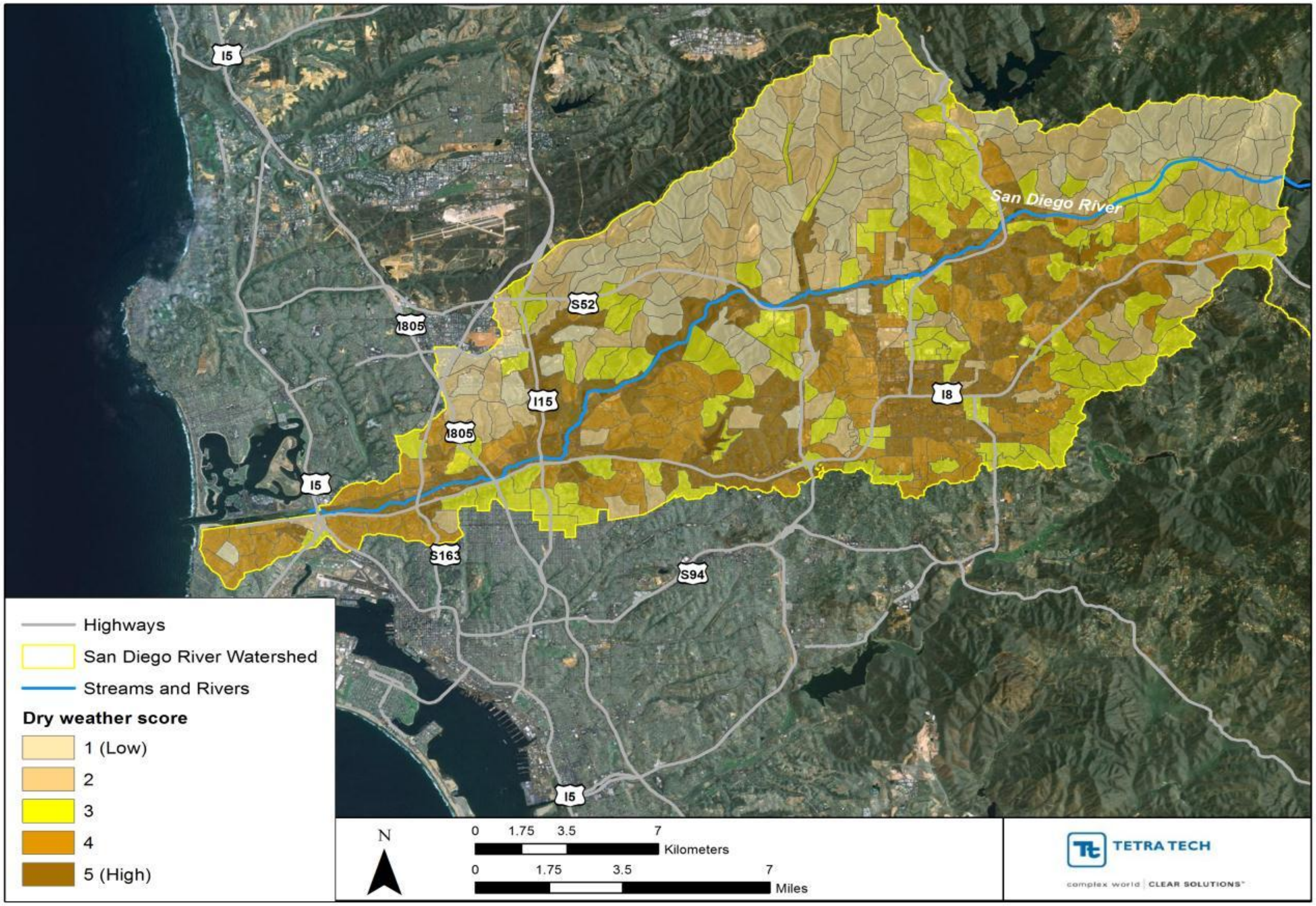

Figure D-2 San Diego River Watershed Dry Weather Composite Score (Bacteria)

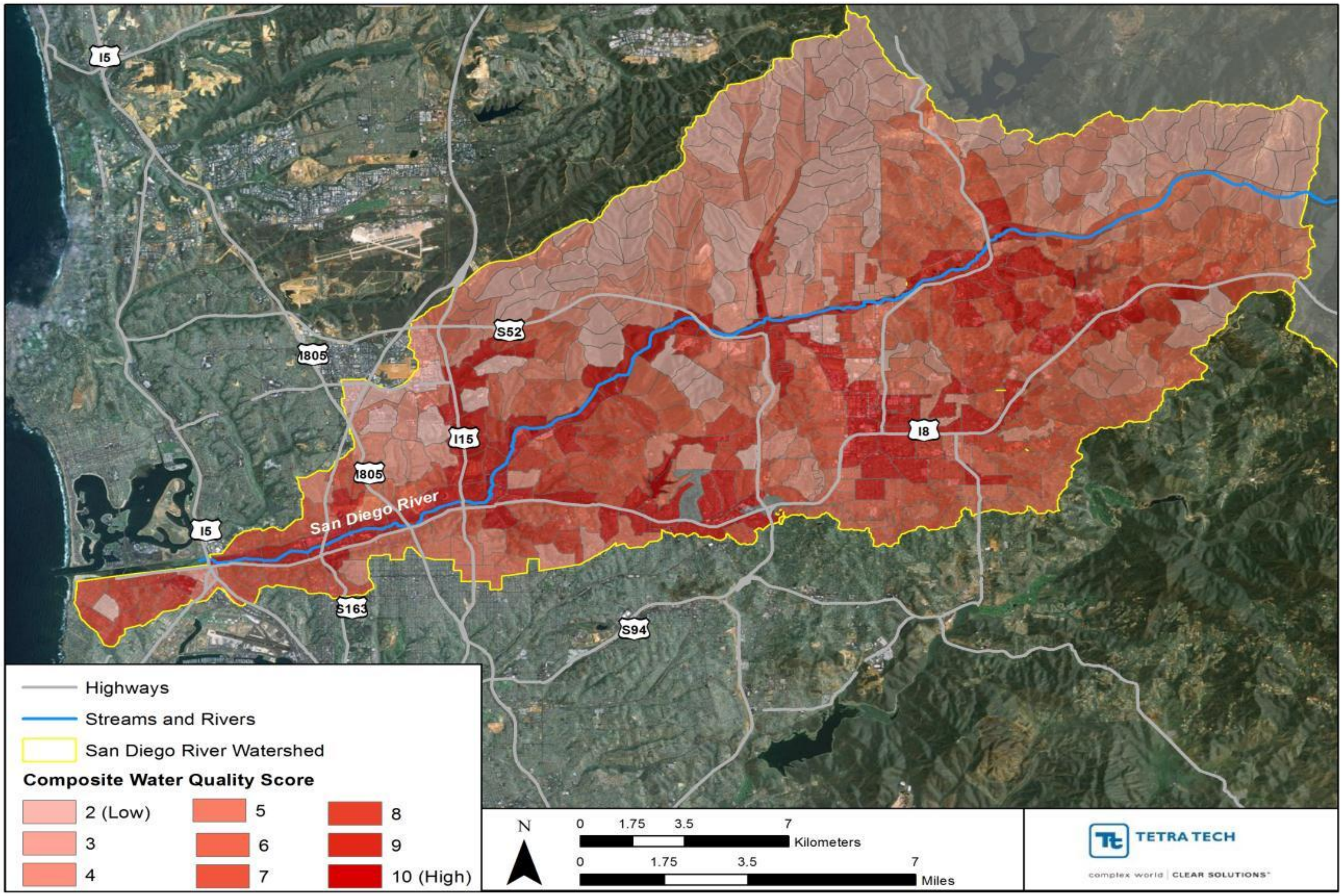

Figure D-3 San Diego River Watershed Water Quality Composite Score (Bacteria)

Appendix E – San Diego River Watershed Structural BMP Opportunities

This appendix details the prioritization methodology used to identify potential sites for structural BMP implementation in the San Diego River Watershed.

1 Introduction

Compliance with existing and future TMDL WLAs cannot be accomplished through implementation of nonstructural best management practices (BMPs) alone. It is important to research and evaluate the effectiveness and the feasibility of implementing end-of-pipe, in-line, and off-line structural treatment methods. Scale is also an important consideration in selecting structural BMPs. Large treatment structural BMPs, referred to as centralized BMPs, are regional facilities that receive flows from neighborhoods or larger areas, which often serve dual purposes for flood control or groundwater recharge. These BMPs are oftentimes located in public spaces and can be co-located within parks or green space. Alternatively, onsite distributed structural BMPs are built within the landscape at the site-scale, which often requires retrofit of site designs to accommodate the re-routing and positioning of BMPs onsite. Both centralized and distributed BMPs serve important purposes and should be considered in combination to determine the optimal level of implementation at each scale to meet TMDL WLAs. Opportunities for incorporating recreational open space should be identified and considered in implementing an integrated water resource approach to meet TMDL compliance.

After review of the San Diego River (SDR) Comprehensive Load Reduction Plan (CLRP) report, additional BMP opportunities may exist within the San Diego River watershed. The SDR CLRP report limits potential centralized BMP opportunities to a few high priority subwatersheds, ignoring opportunities in other areas of the watershed. The current approach also assumes that 25 percent of municipal land uses within high priority subwatersheds will be treated with distributed BMPs and assumes that 50 percent of those distributed BMPs will allow for infiltration while the remainder will be filtration. These assumptions should be verified by identifying specific parcels for distributed BMP implementation giving priority to areas where infiltration is feasible. Additional opportunities should be investigated to ensure that the optimal level of BMP implementation is developed to maximize water quality improvement to meet TMDL WLAs.

This Technical Memorandum identifies additional existing, planned, and candidate structural BMPs in the SDR watershed. Identified BMP practices and opportunities will be modeled during the Phase II CLRP alongside select nonstructural BMPs in order to quantify the associated benefits and impacts. Modeling will allow the City to determine an optimized combination of efforts to comply with WLAs.

2 Existing and Planned Structural BMPs

The RPs and private organizations have proposed and implemented a number of BMP projects in the region that together can significantly contribute to load reduction. As such, these existing or planned projects form a central part of the CLRP and provide a head start in CLRP implementation planning. The Phase I SDR CLRP identified 80 sites with implemented distributed BMPs in the SDR watershed. Ninety-four additional existing and planned BMP sites within the SDR watershed were since identified to supplement the original list. All 174 existing and planned BMP sites will be considered during modeling efforts and are illustrated in Figure 1. A full list of existing and planned BMPs is provided in Appendix A.

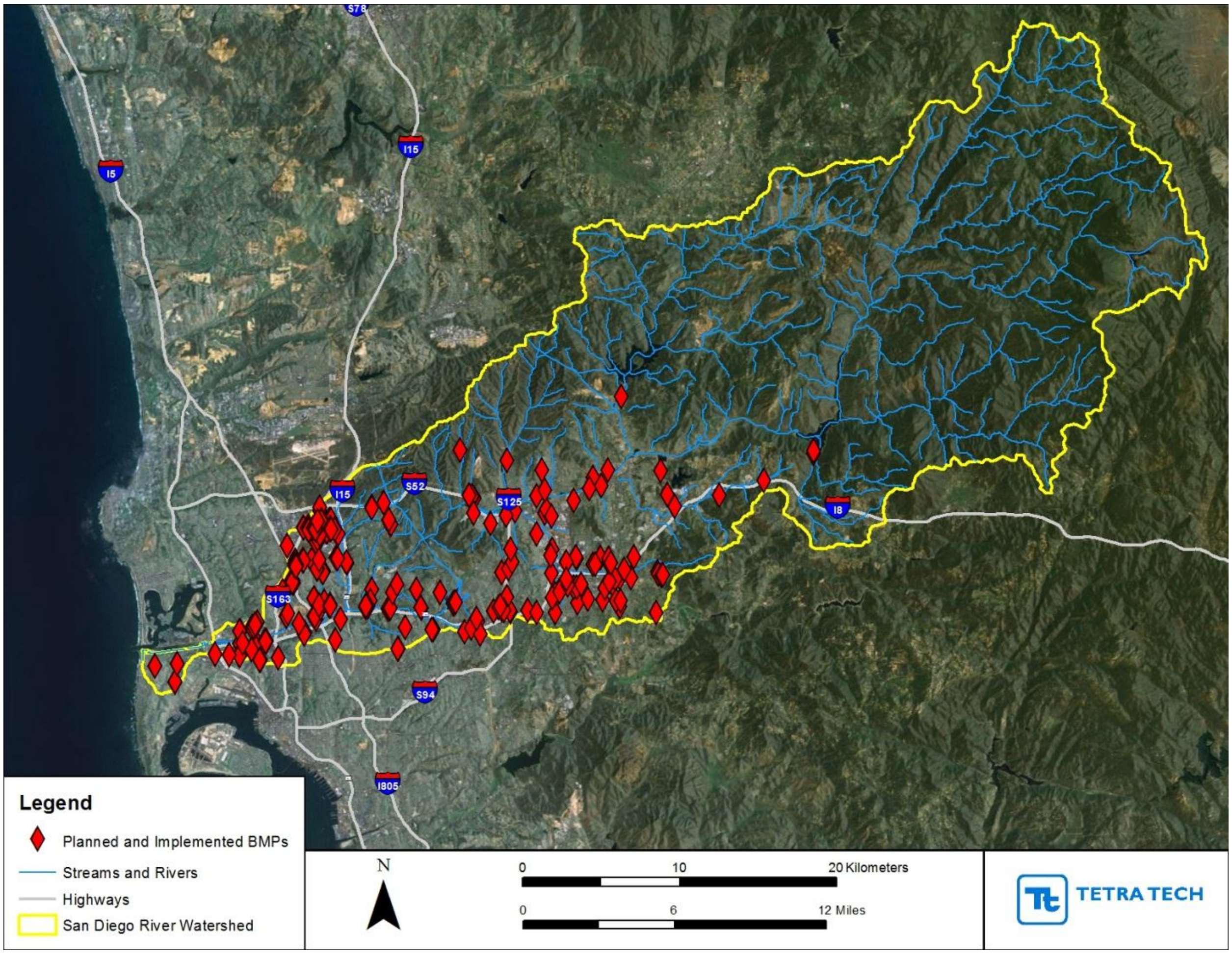

Figure 1: Known planned and implemented structural BMPs within the San Diego River watershed.

3 Candidate Structural BMP Screening and Prioritization Methodology

The first step in selecting the best potential candidate locations for distributed BMPs was a site-selection and prioritization analysis. This analysis began by assessing landscape characteristics, jurisdictional attributes, water quality needs, and general site sustainability. The site screening and prioritization process systematically evaluated and prioritized potential sites in each municipality of the SDR Watershed. This screening and prioritization process included geographic information system (GIS)-based analyses using the best available landscape and water quality data, and a reconnaissance-level aerial imagery survey. Approximately 158,514 parcels within the San Diego River watershed were screened for BMP opportunities based on the total count of assessor parcel numbers (APN). The advantage of this prioritization process is the ability to select BMP locations that are best suited for maximum cost-effectiveness, resulting in the greatest pollutant load reductions per dollar. Because structural BMPs at any scale involve identifying and setting aside land for stormwater treatment, assessing opportunities on existing, publicly owned lands is especially important. Structural treatment often can be integrated into parks or playing fields without compromising function, so opportunities for incorporating BMPs in recreation areas and other public open spaces are typically prioritized and used as a first step in evaluating available sites.

Data Summary

To support the site-selection process, several geospatial, tabular, and time-series data sets were used, including parcels, slopes, soils, land use, topography, regional watersheds, existing BMP locations, schools, parks, aerial imagery, and groundwater/soil contamination sites.. The majority of the data were obtained through the San Diego Association of Governments (SANDAG), San Diego Geographic Information Source (SanGIS), Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO), California State Water Resources Control Board (SWRCB) Geotracker, and the ESRI Maps and Data server. Table 1 summarizes the data used in the site-selection process.

TETRA TECH

Table 1. Summary of data used for site selection

Data set	Type	Description	Source
Parcels	GIS Shapefile	Parcel boundaries, ownership, and the Nucleus Use Code (a description of the use of the property) from the county assessor's data	SanGIS
Slopes	GIS Shapefile	Slopes derived from 1999 orthophotos and updated in 2004 and countywide DEM	SanGIS SANDAG
Soils	GIS Shapefile	Spatial extents of hydrologic soils groups (HSG)	NRCS SSURGO
Land use	GIS Shapefile	Land use categories defined by municipalities	SANDAG
Topography	GIS Shapefile	Elevation contours at 2-foot intervals for City of San Diego and countywide DEM	SanGIS
Watersheds	GIS Shapefile	Extent of regional watersheds	SanGIS
Road summary	GIS/Spreadsheet	Right-of-way width, traveled way width, road classification, and last known maintenance date	SanGIS and SD Street Division
BMP locations	GIS Shapefile	Existing BMP locations	City of San Diego
Schools	GIS Shapefile	School locations and acreage, extracted from the land use shapefile	SANDAG
Parks	GIS Shapefile	Active parks in San Diego County	SanGIS
Impervious Area	GIS Shapefile	Percent imperviousness for parcel data and percent impervious in a raster grid	City of San Diego and NRCS
Waterbodies	GIS Shapefile	Streams, rivers, lakes and other waterbodies	SANDAG SanGIS
Groundwater/soil contamination	Point Data	Past and current groundwater/soil remediation sites	California SWRCB Geotracker
Stormwater Data		Storm drain structures and pipe characteristics	SanGIS
ESA	GIS Shapefile	Jurisdictional Environmentally Sensitive Areas (ESAs) for San Diego County	SanGIS
Public Utilities	GIS Shapefile	Sewer main and water main locations and characteristics	SanGIS
Stormwater Outfalls	GIS Shapefile	Existing stormwater outfall locations and characteristics	City of San Diego
Geohazard Risk	GIS Shapefile	Geohazard codes and characteristics	SanGIS
MHPA	GIS Shapefile	Location of Multi Habitat Planning Areas	SanGIS
MSCP	GIS Shapefile	Location of Multi Species Conservation Program areas	SanGIS

Distributed BMP Primary Screening and Prioritization

In 2009 the City of San Diego performed the *Parcel Evaluation for BMP Implementation Study* that provided a GIS analysis and decision criteria for selecting parcels for BMP implementation in the city's jurisdiction. The study methodology served as a starting point in developing the prioritization and screening process. The process was further refined based on the experience of the RP jurisdictions and of Tetra Tech, and based on the CLRP Task 2 Pollutant Source Characterization data.

The site-selection process identified parcels potentially suitable for BMP implementation through two steps:

1. A primary screening to eliminate unsuitable parcels on the basis of physical and jurisdictional characteristics; and
2. A separate site prioritization process for distributed and centralized BMPs, to rank the suitability of the remaining parcels, using a methodology derived from the characteristics listed in Table 1.

The primary screening identified parcels potentially suitable for BMP implementation at both distributed and centralized scales. Note: Section 3 discusses additional screening criteria used for the centralized BMP sites. The primary screening for potential BMP opportunities was based on two parameters:

- **Parcel Zoning**: Parcels classified as single-family residential, based on the Nucleus Use Code attribute (a description of the use of the property provided by the county assessor), were not considered because of their small average size and the typically low cost/benefit ratio of implementing BMPs on single-family residential parcels. Research and experience nationally indicate that the runoff impacts of single-family parcels can be addressed more cost-effectively through outreach and education, or incentives for practices such as rainwater harvesting, improved irrigation, or turf and landscape conversion.
- **Slope**: Parcels with a slope greater than 15 percent were not considered for BMP opportunities, other than parcels located in canyon areas. The screening was expanded to include areas in and around canyons for centralized BMPs. For this analysis, slope was determined on the basis of Digital Elevation Maps (DEM) or other available topography data sets. In areas where the overall slope of the parcel was in question, slope was verified through review of aerial imagery. Parcels where the slope exceeds 15 percent were eliminated.

The results of the primary screening provided a base list of parcels potentially suitable for BMP implementation. A GIS analysis was performed on the parcels remaining after the primary screening to identify the potential sites for distributed BMP placement and to rank their potential suitability. The following characteristics were used in this ranking:

- **Public ownership**: Land costs generally are minimized by using existing public lands; therefore, a higher priority was placed on publicly owned parcels.
- **Infiltration capacity**: The mapped hydrologic soils groups were used as an initial estimate for the infiltration rate and storage capacity of the soils. Sites where mapped hydrologic soils groups have infiltration rates suitable for infiltration BMPs received higher priority for further investigation.
- **Contaminated sites**: Areas near contaminated sites received lower priority because of the potential for increased costs and complications during implementation.
- **Environmentally sensitive areas**: Areas where runoff can be treated before draining to an ESA were given a higher priority.

- **Total impervious area**: Parcels representing a larger total impervious area typically generate more runoff and greater pollutant loads and were given a higher priority. Impervious area was estimated using aerial imagery in areas where impervious data was not available.
- **Percent impervious**: Parcels with a higher percentage of impervious area relative to the size of the parcel also typically produce more runoff and were targeted on the basis of the greater potential to achieve volume reduction and water quality improvements.
- **Space requirements**: To determine if sufficient space is available to implement an appropriately sized BMP, the potentially available space on a parcel was evaluated on the basis of the size of the parcel and the amount of existing impervious area.
- **Proximity to existing BMPs**: To distribute treatment opportunities effectively throughout the watershed, areas in close proximity to existing or planned future BMPs were given a lower priority.
- **Proximity to parks and schools**: Areas closest to parks and schools were given a higher priority, in part to provide a greater opportunity for public outreach and education.
- **Proximity to the storm drainage network:** Areas in close proximity to the storm drain network were given a higher priority. Distributed BMPs on poor draining soils require underdrain systems that tap into existing infrastructure, and siting these in proximity to the storm drain network can minimize cost.
- **Multi-benefit use**: BMP implementation can achieve multiple purposes. For instance, some stormwater practices, such as infiltration basins or vegetated swales, can serve a dual purpose of stormwater management and community park space. Sites that offer multi-benefit opportunities received higher priority in the ranking.

Potential sites were prioritized using a scoring methodology developed in conjunction with the RPs and presented in Table 2. This scoring methodology puts a high emphasis on municipal or public ownership. Ownership can receive a maximum score of 10, while the remaining scoring criteria can achieve a maximum score of 5. Therefore, this methodology not only prioritizes locations where distributed BMPs are practically feasible but allows for the selection of BMPs in public parcels where the load reduction would be potentially most effective. The top ranked sites in the watershed for each RP were also identified, but efforts in this memorandum focus on sites within the City of San Diego.

Table 2. Prioritization criteria for potential distributed BMP locations

Factor	Score (1 = Worst, 5 = Best)				
	5	4	3	2	1
Parcel zoning and Ownership	City- or county-owned public parcels and rights of way were given a priority score of 10.	Other-owned public parcels (schools and universities, state and federal facilities, utilities, etc.) were given a priority score of 8		All private commercial or industrial parcels	All others
HSG soil type	A, B		C		D
Proximity to wells, water supplies, contaminated soils (feet)			> 100		< 100
Proximity to ESA (optional)	Adjacent	Drains to			
Impervious area (acres)	> 1	> 0.5	> 0.25	> 0.1	
% Imperviousness	60%–80%	80%–90%			< 50%
Existing/proposed BMP Site Proximity (miles)	> 5	4–5	3–4	2–3	< 2
Proximity to parks and schools (feet)			< 1,000		> 1,000
Proximity to storm drainage network (feet)			< 100	< 300	> 300

Centralized BMP Prioritization

Potential sites for centralized BMPs were screened and prioritized on the basis of the parcel characteristics listed in *Distributed BMP Primary Screening and Prioritization*, plus additional considerations and different numerical criteria for centralized BMPs that were developed and reviewed in discussions with the RPs. The additional considerations for identifying potential sites for centralized BMPs mainly regarded the use of open space and contributing watershed characteristics (see list below). The agreed-upon weighting for each factor is listed in Table 3.

- **Impervious area**: Parcels with the least amount of impervious area are given the highest priority to identify areas with the greatest available space for implementing a centralized BMP. Impervious area was estimated using aerial imagery in areas where impervious data was not available.
- **Proximity to parks and schools**: Parks typically have the largest available open area, with the lowest percent imperviousness, and are well suited for centralized BMP implementation. Schools also tend to have large open areas providing opportunities for BMP implementation. Areas classified as parks were given the highest priority, followed by schools. Other areas closest to parks and schools were given higher priority because of the opportunity for public outreach and education.

- **Proximity to the storm drainage network**: Because centralized BMPs are especially effective where runoff can be diverted from the existing drainage network for treatment and control, areas in close proximity to the storm drainage network received higher priority.
- **Multi-benefit use**: Centralized BMPs are often well suited to co-location with parks and playing fields. These received higher prioritization in this analysis.
- **Percent impervious**: Contributing drainage areas with a higher percentage of imperviousness produce increased runoff relative to the watershed size during storms. Higher impervious drainage areas were targeted for greater potential volume reduction and water quality improvements.
- **Proximity to corrugated metal pipe systems**: To incorporate future upgrades to the storm drainage network in the City of San Diego, the proximity to a corrugated metal pipe system was be considered and ranked on the basis of the necessity for rehabilitation.

Table 3. Prioritization criteria for centralized BMP implementation

Factor	Score (1 = Worst, 5 = Best)				
	5	4	3	2	1
Parcel type	City- or county-owned public parcels were assigned a priority score of 10.	Other-owned public parcels (schools/ universities, state and federal facilities, utilities) were assigned a priority score of 8.		All private commercial or industrial parcels	All others
HSG soil type	A, B		C		D[a]
Proximity to wells and water supplies, contaminated soils (feet)			> 100		< 100
% Imperviousness	≤ 30%	30%–40%			> 40%
Parcel size (acres)	≥ 200	150–200	100–150	1–100	< 1
Existing/proposed BMP site proximity (miles)	> 5	4–5	3–4	2–3	< 2
Proximity to parks and schools (feet)	Park	School	< 1,000		> 1,000
Proximity to storm drainage network (feet)			< 100	< 300	> 300
% Imperviousness of contributing area	> 70%	> 60%	> 50%	> 40%	< 40%
Proximity to corrugated metal pipe systems	Adjacent to CMP needing replacement		Adjacent to CMP needing rehabilitation		Adjacent to CMP requiring no action

[a]Many soils were unclassified or classified as "urban fill." Due to a propensity for compaction in urban settings and the abundance of soils classified as hydrologic soil group D within the watershed, these urban soils were treated as hydrologic soil group D.

Centralized BMP Aerial and Field Reconnaissance

After the priority parcels were determined, each was reviewed using aerial photography to assess the feasibility of the site. This was an important step to ensure that the initial screening processes did not unintentionally rule out any suitable land adjacent to the prioritized parcels and to identify any conflicts associated with routing storm water to potential retrofits. Factors considered during aerial investigation included:

- **Drainage area**: The drainage area to the top-ranked candidate centralized sites was delineated and sites with disproportionately small drainage areas (typically those near the watershed boundary) were disregarded.
- **Topographic/drainage setting**: Location with respect to existing drainageways, canyons, and storm drains was investigated to assess the feasibility of routing stormwater to the candidate centralized BMP.
- **Suitable adjacent lands**: Parcels adjacent to high-ranked candidate sites were inspected for centralized BMP feasibility.

Sites that were deemed feasible after the aerial photography review were used to target parcels where field investigations would be conducted. Field reconnaissance included:

- **Visual verification of drainage area boundaries**
- **Location and measurement of existing storm drain depths with respect to the existing grade and conceptual BMP depth**
- **Verification of topography and available area for centralized BMP implementation.**
- **Identification of factors that could pose conflicts to BMP implementation.**
- **Photographic documentation of the candidate site.**

Final recommendations for candidate centralized BMP implementation were provided based on priority ranking and results of visual inspection.

4 Primary Screening Results

Using the screening methodology discussed in the preceding section, all 158,514 parcels that intersect the SDR watershed were analyzed for distributed and centralized BMP suitability by filtering out parcels with steep slopes (greater than 10% of parcel area comprised of slopes steeper than 15%) and parcels classified as single-family residential. A summary of the resulting screened parcels is provided in

Table 4. Parcel quantities are based on the total number of assessor parcel numbers (APN). The resulting screened parcels were then prioritized for distributed and centralized BMP implementation per the prioritization criteria described in the CLRP Phase I reports.

Table 4: Results of primary screening for BMP suitability

Jurisdiction or Location	Number of Parcels Passing Primary Screening Criteria[a]	Description
SDR Watershed	15201	All public and private parcels
Public Parcels Only	784	All publically-owned parcels
City of San Diego Within Limits	149	Public parcels owned by City of San Diego within City limits
City of San Diego Outside Limits	20	Public parcels owned by City of San Diego outside City limits
San Diego County	71	Public parcels owned by San Diego County
City of El Cajon	70	Public parcels owned by City of El Cajon
City of Santee	38	Public parcels owned by City of Santee
City of La Mesa	25	Public parcels owned by City of La Mesa

[a]Screened parcels exclude parcels with single-family residential nucleus zoning code and parcels where slopes greater than 15% comprise greater than 10% of the total parcel area.

5 Candidate Distributed BMP Prioritization Results

Screened parcels were characterized, and prioritization scores were assigned for potential distributed BMP implementation. The scoring methodology prioritizes parcel-based opportunities for distributed BMP implementation based on physical characteristics of the parcel and surrounding areas. These physical characteristics consider the site's feasibility for BMP implementation and potential for BMP effectiveness. Aside to physical characteristics, publicly-owned parcels were given a higher priority to highlight the most cost-effective locations. The top 30 publicly-owned sites for distributed BMP implementation are listed in Table 5 and illustrated in Figure 2. A complete list of all parcels ranked for distributed BMP implementation is provided in the attached Appendix B.

Table 5. Primary screening results for distributed BMPs

Watershed Rank #	Watershed Score	APN	Parcel Owner	Total Parcel Acreage	Percent Impervious Cover (%)	Hydrologic Soil Group
1	35	4365400600	CITY OF SAN DIEGO	8.43	74	A
2	33	4575100100	SAN DIEGO UNIFIED SCHOOL DISTRICT	28.06	77	A
3	33	3822801600	UNITED STATES OF AMERICA	3.27	67	B
4	33	3942903500	LAKESIDE UNION SCHOOL DISTRICT	3.45	64	A
5	33	4574000400	SAN DIEGO UNIFIED SCHOOL DISTRICT	11.08	64	A
6	33	3941221900	LAKESIDE UNION SCHOOL DISTRICT	1.85	75	B
7	32	4822503400	CITY OF EL CAJON	1.37	83	B
8	32	3810503700	CITY OF SANTEE	1.37	68	B
9	31	5112101800	GROSSMONT UNION HIGH SCHOOL DISTRICT	9.34	66	B
10	31	6773900400	STATE OF CALIFORNIA PUBLIC WORKS BOARD	2.31	74	A
11	31	3921203200	LAKESIDE WATER DISTRICT	4.50	64	A
12	31	2883421600	RAMONA UNIFIED SCHOOL DISTRICT	11.36	25	B
13	31	4842406600	CAJON VALLEY UNION SCHOOL DISTRICT	8.98	65	B
14	31	4822601800	CAJON VALLEY UNION SCHOOL DISTRICT	8.42	63	B
15	31	2885975800	RAMONA UNIFIED SCHOOL DISTRICT	10.14	28	B
16	31	4365400700	CITY OF SAN DIEGO	3.91	75	D
17	31	3691210900	COUNTY OF SAN DIEGO	2.01	77	D
18	30	4210305400	CITY OF SAN DIEGO	4.07	87	D
19	30	4411600400	CITY OF SAN DIEGO	7.68	74	0
20	30	4821705000	CITY OF SAN DIEGO	1.22	74	B
21	30	4830212800	CITY OF SAN DIEGO	0.92	69	B
22	30	4700711700	CITY OF LA MESA	1.41	86	D
23	30	6773900700	STATE OF CALIFORNIA PUBLIC WORKS BOARD	4.30	82	A
24	30	3831245500	CITY OF SANTEE	1.01	71	B
25	30	4498608300	CITY OF SAN DIEGO	1.57	68	0
26	30	4313202100	CITY OF SAN DIEGO	1.58	80	D
27	30	4212910200	CITY OF SAN DIEGO	1.63	66	D
28	30	3822601200	CITY OF SAN DIEGO	7.84	11	A
29	30	4044414500	ALPINE UNION SCHOOL DISTRICT	12.82	22	B
30	30	4491100800	CITY OF SAN DIEGO	3.80	18	B

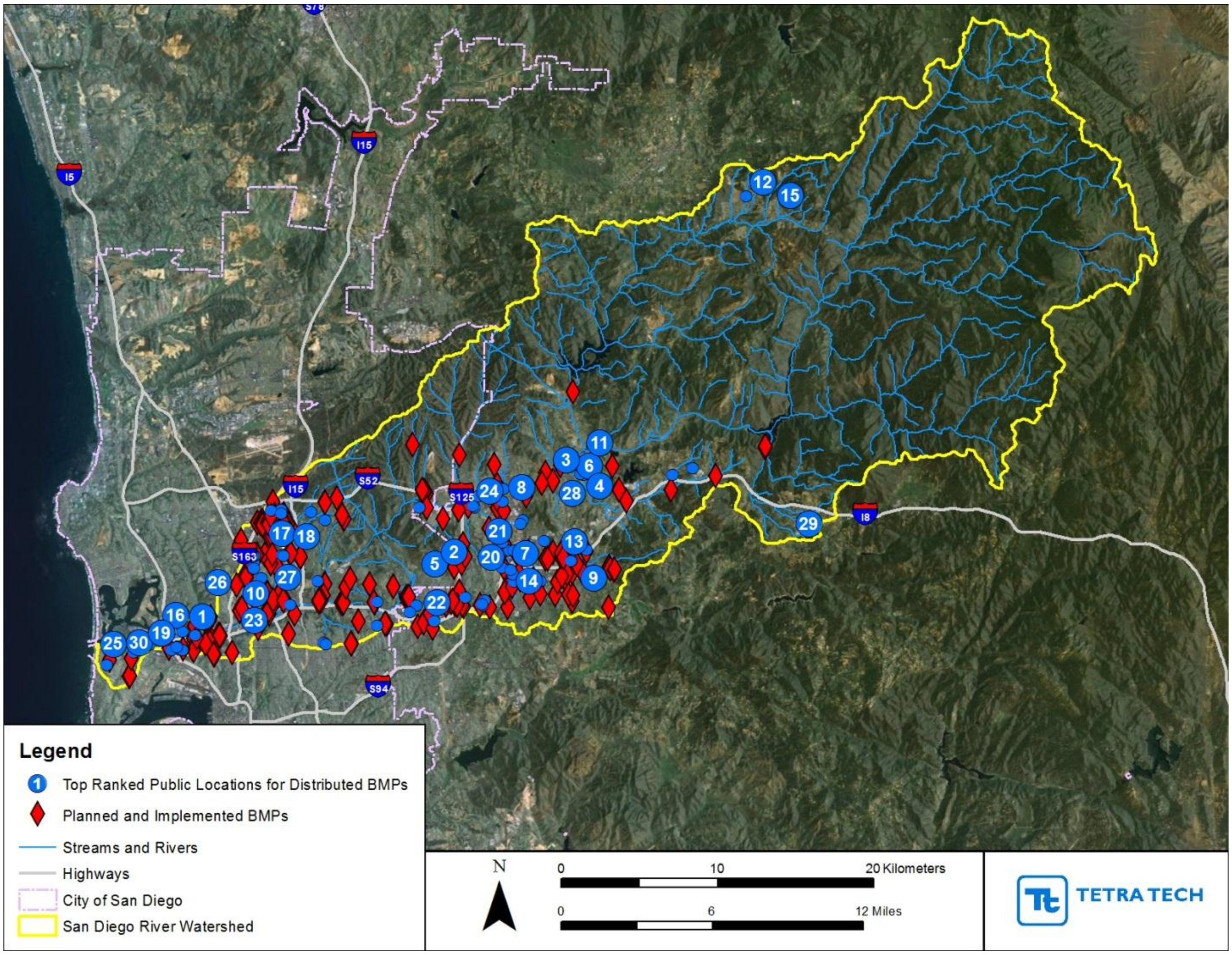

Figure 2. Primary Screening Results for Distributed BMPs

Although several distributed BMP sites may be located adjacent to each other and share a common owner, these sites were considered as single BMP opportunities. Combining opportunities may surface new sites to the top 30 but does not alter the ranking or scoring of individual parcels. A list of the top potential sites owned by the City of San Diego is shown in Table 6.

Table 6. High priority distributed BMP opportunities on parcels owned by the City of San Diego

Watershed Rank #	Watershed Score	APN	Parcel Owner	Total Parcel Acreage	Percent Impervious Cover (%)	Hydrologic Soil Group
1 (1)	35	4365400600	CITY OF SAN DIEGO	8.43	74	A
2 (16)	31	4365400700	CITY OF SAN DIEGO	3.91	75	D
3 (18)	30	4210305400	CITY OF SAN DIEGO	4.07	87	D
4 (19)	30	4411600400	CITY OF SAN DIEGO	7.68	74	0
5 (20)	30	4821705000	CITY OF SAN DIEGO	1.22	74	B
6 (21)	30	4830212800	CITY OF SAN DIEGO	0.92	69	B
7 (25)	30	4498608300	CITY OF SAN DIEGO	1.57	68	0
8 (26)	30	4313202100	CITY OF SAN DIEGO	1.58	80	D
9 (27)	30	4212910200	CITY OF SAN DIEGO	1.63	66	D
10 (28)	30	3822601200	CITY OF SAN DIEGO	7.84	11	A
11 (30)	30	4491100800	CITY OF SAN DIEGO	3.80	18	B
12 (31)	30	4631110100	CITY OF SAN DIEGO	0.23	62	C
13 (32)	30	3690402300	CITY OF SAN DIEGO	4.32	88	D
14 (45)	29	4210305600	CITY OF SAN DIEGO	3.60	77	D
15 (53)	29	4426212000	CITY OF SAN DIEGO	1.73	84	0
16 (54)	29	4821902100	CITY OF SAN DIEGO	1.68	76	D
17 (56)	29	3870300500	CITY OF SAN DIEGO	0.88	82	B
18 (67)	28	3941410600	CITY OF SAN DIEGO	0.17	70	D
19 (68)	28	4365400800	CITY OF SAN DIEGO	1.39	86	D
20 (70)	28	4210305500	CITY OF SAN DIEGO	3.17	88	D
21 (71)	28	4498700300	CITY OF SAN DIEGO	6.16	73	0
22 (72)	28	4332501600	CITY OF SAN DIEGO	132.19	73	0
23 (90)	28	3941410700	CITY OF SAN DIEGO	0.17	72	D
24 (92)	28	4640901300	CITY OF SAN DIEGO	0.48	61	D
25 (93)	28	4210400700	CITY OF SAN DIEGO	0.69	77	D
26 (95)	28	4415900500	CITY OF SAN DIEGO	5.23	66	0
27 (101)	27	4210306100	CITY OF SAN DIEGO	14.23	8	D
28 (102)	27	3734900600	CITY OF SAN DIEGO	5.24	25	D
29 (103)	27	4210306000	CITY OF SAN DIEGO	99.22	15	D
30 (125)	27	4212901100	CITY OF SAN DIEGO	409.77	36	D

6 Candidate Centralized BMP Prioritization Results

Screened parcels were characterized, and prioritization scores were assigned for potential centralized BMP implementation. City-owned parcels typically represent the most cost-effective locations for centralized BMP implementation, so the following results represent only parcels owned by the City of San Diego and located within the City limits (although all screened parcels within the SDR watershed were prioritized).

Aerial investigation of all City-owned parcels identified several potentially-suitable sites for centralized BMP implementation. Adjacent City-owned parcels were grouped into single "sites" and awarded the rank of the highest-scored parcel within the site; grouping adjacent public parcels maximizes the available area for structural BMP implementation and allows greater flexibility for retrofit design. Field reconnaissance refined the candidate sites to eight suitable locations, which are listed in Table 7 and shown in Figure 3. A complete list of all parcels ranked for centralized BMP implementation is provided in the attached Appendix C.

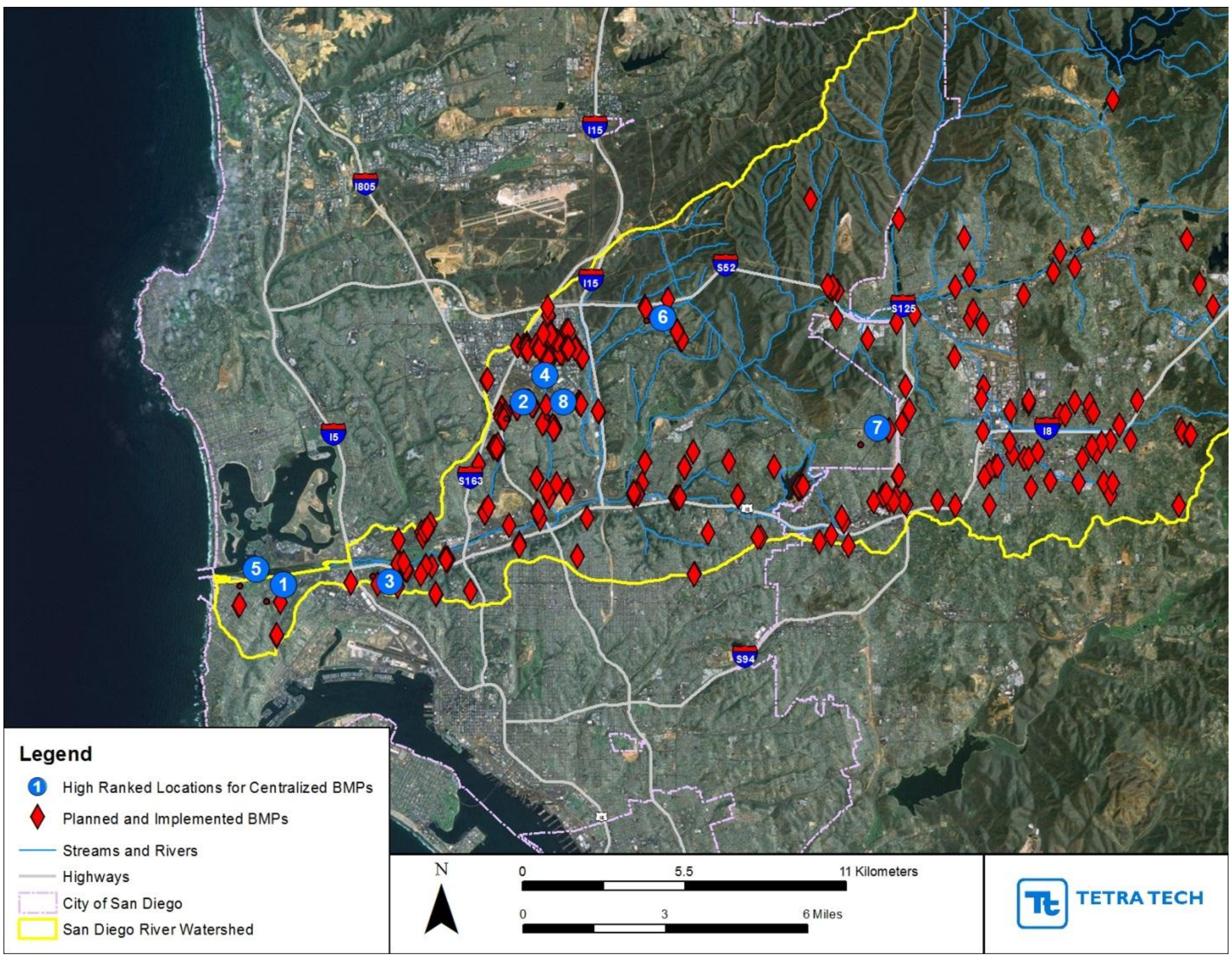

Figure 3. Primary Screening Results for Centralized BMPs

Table 7: Results of primary screening for BMP suitability

Site ID #	APN	Name	Approx. Street Address	Total Acreage	Approx. Drainage Area (ac)	Predominant Hydrologic Soil Group	City Rank (Watershed Rank)[a]
1	4491100800	Cleator Park	Nimitz Blvd at Famosa Blvd	3.8	333	B	1(3)
2	4210500100 4213201100	Cabrillo Heights Park[a]	8333 Hurlbut St	14	238	D	4 (27)
3	4425200800	Presidio Hills Golf Course and Park	4136 Wallace St	12	142	D	5(28)
4	4212901100	Montgomery Field Airport	3750 John J Montgomery Dr	410	410[b]	D	6 (29)
5	4488000100	Ocean Beach Athletic Park and Robb Field	2525 Bacon St	83	315	U (urban fill)	10 (49)
6	3733022600 3730715500 3733022400	Lower North Shepherd Canyon	Calle Mariselda	37	757	D	33(121)
7	4574000400	Springall Academy	6460 Boulder Lake Ave	11	324	A	38 (136)
8	4213000700 4210302200	Serra Mesa Park and upslope canyon	9020 Village Glen Dr	20	267	D	56 (281)

[a] Lower ranks correspond to higher priority, with 1 being highest-ranked parcel
[b] There are several distributed BMPs planned by the City at this site (Cabrillo Heights Park), but space should allow for implementation of centralized BMPs
[c] Parcel drains to multiple subwatersheds

In addition to the above identified opportunities, several centralized structural BMP locations were proposed in the Phase I SDR CLRP. Of these candidate sites, two parcels were located within the City of San Diego under the City's ownership: Qualcomm Stadium (APN 4332501600) and Valley View Casino Center (APN 4415900400). These sites were selected using a prioritization scheme that differed from the criteria applied to other surrounding watersheds.

When subjected to the prioritization criteria developed by the RPs, Qualcomm Stadium and Valley View Casino Center received low priority scores relative to other candidate centralized BMP parcels, as shown in Table 8. Low ranking of these sites primarily resulted from high impervious coverage (which implies higher cost for site preparation, construction, and opportunity costs for loss/disruption of existing parking space) and parcel type (public schools and parks received higher scores than "non-green" public parcels).

Table 8. Prioritization of Candidate Centralized BMP Sites from Phase 1 San Diego River CLRP

Criteria	Qualcomm Stadium		Valley View Casino Center	
	Value	Score	Value	Score
Parcel Type	Public, City-Owned	10	Public, City-Owned	10
Hydrologic Soil Group	U (urban fill)	1	U (urban fill)	1
Proximity to Water Supply Wells or Contaminated Sites	> 100 ft	3	> 100 ft	3
Parcel Percent Imperviousness	> 40% (73%)	1	> 40% (93%)	1
Parcel Acreage	132 acre	3	69 acre	2
Proximity to Existing/Planned BMPs	< 2 miles	1	< 2 miles	1
Proximity to Parks and Schools	> 1000 ft	1	> 1000 ft	1
Proximity to Storm Drain Network	< 100 ft	3	< 100 ft	3
Proximity to Degraded CMP	Not Adjacent to CMP	1	Not Adjacent to CMP	1
Total Score	**24**		**23**	
City Rank (Watershed Rank)[a]	**100 (402)**		**126 (564)**	

[a] Lower ranks correspond to higher priority, with 1 being highest-ranked parcel

Due to the expansive size and impervious area of these two sites, it is recommended that distributed controls (such as bioretention and permeable pavement) be incorporated throughout the parcels to conserve valuable parking space and reduce construction costs while simultaneously providing effective treatment and public education opportunities. Similar distributed controls have been effectively employed at sports complexes and public parking facilities in major cities nationwide (see examples in Figure 4 and Figure 5).

Figure 4. Permeable pavement and bioswales at the Los Angeles Zoo and Botanical Gardens (source: Tetra Tech, Inc.)

Figure 5. Mechanically-installed permeable pavement at US Cellular Field in Chicago, IL (source: North Carolina State University – Biological and Agricultural Engineering)

7 Summary and Next Steps

This Technical Memorandum characterized existing, planned, and candidate structural BMP opportunities within the SDR watershed in order to provide the City of San Diego with cost effective options for TMDL compliance and provide potential sites in addition to those identified in the Phase I CLRP report. Existing and planned BMPs within the SDR watershed were identified so that associated pollutant load reductions can be credited towards meeting the RPs WLAs. All parcels within the watershed were then screened and prioritized for both distributed and centralized BMP implementation. Candidate sites for centralized BMP retrofit were subjected to an aerial and field investigation to verify desktop analyses. Identified structural BMP opportunities and nonstructural BMPs are being modeled to determine an optimum combination of efforts to meet WLA in San Diego and throughout the region. The results of the Phase II CLRPs will provide the RPs with the necessary tools to protect the public health, safety, and welfare.

Attachment A: Existing and Planned Structural BMPs

Table A-1: Existing BMPs identified in the San Diego River Phase I CLRP (Geosyntec Consultants 2012)

Jurisdiction	Location	Type
County of San Diego	9410 Adlai Terrace, Lakeside	Extended Detention Basin
County of San Diego	Canita Lomas and Liberatore Lane, El Cajon	Subsurface Infiltration
County of San Diego	420 Hart Dr, El Cajon and PO Box 1507, Cardiff	Grass Swale
County of San Diego	9108 Lake Valley Road, Lakeside	Vegetated Filter Strip
County of San Diego	Laurel Canyon Rd a Vista Laurel Pl, Lakeside	Bioretention and Grass Swale
County of San Diego	9728 Marilla Drive, Lakeside	Bioretention Swale
County of San Diego	1178 Persimmon Ave, El Cajon	Grass Swale
County of San Diego	14878 Olde Highway 80, Lakeside	Permeable Paving, Porous Concrete
County of San Diego	15724 Olde Highway 80, El Cajon	Bioretention Swale
County of San Diego	10007 Riverford Road, Lakeside	Bioretention Swale
County of San Diego	11905 Riverside Drive, Lakeside	Wet pond
City of El Cajon	1501 East Washington Ave, El Cajon	detention basin and filter inserts
City of El Cajon	327/359 El Cajon Blvd, El Cajon	detention basins and inlet filters
City of El Cajon	245 E. Main St. El Cajon	downspout filters
City of El Cajon	1062 N. Second St, El Cajon	grass filter strip
City of El Cajon	605 W. Lexington Ave, El Cajon	gravel filter, rock energy dissipater, and bio-detention basin
City of El Cajon	1401/1409 East Main St, El Cajon	hydrodynamic separation system, inlet filters, and underground detention box
City of El Cajon	442/444 El Cajon Blvd, El Cajon	pervious swale and media filter vaults
City of El Cajon	335/355 North Second St, El Cajon	vegetated swale and outlet filter
City of El Cajon	1190 N. Second St., El Cajon	grass filter strip
City of El Cajon	1032 Broadway, El Cajon	inlet filter and grass buffer strip
City of El Cajon	343 E Main St, El Cajon	vegetated swales and filter inserts
City of El Cajon	938 E. Washington Ave, El Cajon	pervious swale
City of El Cajon	1301 N. Marshall Ave, El Cajon	gravel infiltration basin
City of El Cajon	608 Sandra Lane, El Cajon	grass-lined channel
City of El Cajon	1090 Broadway, El Cajon	grass filter strip and inlet filter inserts
City of El Cajon	613 Sandra Lane, El Cajon	detention basin
City of El Cajon	403/431 Wisconsin Lane, El Cajon	sand media filter, underground detention basin, and inlet filter
City of El Cajon	1470 E. Madison Ave, El Cajon	Pervious concrete swale
City of El Cajon	475/487 Foundation Lane, El Cajon	vegetated swale and inlet filter
City of El Cajon	635 Sandra Lane , El Cajon	Detention basin
City of El Cajon	1700 E. Main St, El Cajon	Vegetated swales, inlet filter, and infiltration basin
City of El Cajon	1108/1116 Anita Lee Lane, El Cajon	Grassy swales and curb outlet filters
City of El Cajon	670 El Cajon Blvd, El Cajon	Underground detention pipe and hydrodynamic separator
City of El Cajon	1273/1275 E. Main St, El Cajon	Vegetated swale and porous pavement,
City of El Cajon	912/930 Jamacha Rd, El Cajon	Infiltration system, vegetated swale, and storm drain inlet filters
City of El Cajon	1341 E Main St, El Cajon	vegetated swales, gravel infiltration areas, and inlet filter inserts
City of El Cajon	1380 El Cajon Blvd, El Cajon	underground detention system
City of El Cajon	1326/1350 Wendell Cutting Ct, El Cajon	vegetated swales, underground detention, and inlet filter
City of El Cajon	2095 East Madison Ave, El Cajon	biofilters and detention basin
City of El Cajon	1539 E. Main Street, El Cajon	underground detention pipe, pervious swale, and inlet filters
City of El Cajon	2000/2010 Gillespie Way, El Cajon	detention area in parking lot, vegetated swale, and filter inserts
City of El Cajon	1225/1285 East Washington Ave, El Cajon	Biofilters for each new housing unit (perimeter)
City of El Cajon	2766 Navajo Rd., El Cajon	Hydrodynamic separation system and underground detention box
City of El Cajon	Grossmont College Drive, El Cajon	hydrodynamic separation system and detention area
City of El Cajon	1630/1632 E Madison Ave, El Cajon	vegetated detention basin and inlet filters
City of El Cajon	198 W Main St, El Cajon	vegetated swales, hydrodynamic separator system, trash enclosure dry wells, and trench drain, downspout, inlet filters
City of El Cajon	1001 W. Bradley Ave, El Cajon	pervious swales, inlet filter, and detention basin
City of El Cajon	2062/2096 Ingamac Way Ave, El Cajon	extended detention basin and grassy swales
City of El Cajon	1435 E. Washington Ave, El Cajon	vegetated swale, two extended detention basin, and storm drain inlet filters

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Jurisdiction	Location	Type
City of El Cajon	Anjuli Ct, El Cajon	Hydrodynamics separator system
City of El Cajon	965 Arnele Ave, El Cajon	vegetated bioswales, pervious buffer strip, and bioretention swale.
City of El Cajon	298 Fletcher Pkwy, El Cajon	inlet filters, CDS hydrodynamic separator units, and filtration strip next to Garden Center
City of El Cajon	1935/1941 Granite Hills Dr., El Cajon	detention basin and vegetated channel
City of El Cajon	189 Roanoke Rd, El Cajon	vegetated swales and storm drain inlet filters
City of La Mesa	8085 University Avenue, La Mesa	Vegetated Swale, Vortex Seperator
City of La Mesa	8010 Parkway Dr., La Mesa	Media Filter
City of La Mesa	8860/8870 Center Dr., La Mesa	Media Filter, Bioswale
City of La Mesa	8727/8655 Fletcher Parkway, La Mesa	Media Filter, Drainage inserts
City of La Mesa	9001 Wakarusa St., La Mesa	Wetland/Detention Area
City of La Mesa	8881 Dallas St., La Mesa	Bioswale, Media Filter
City of La Mesa	5555 Grossmont center Dr., La Mesa	Media Filter
City of La Mesa	8725 Fletcher Parkway, La Mesa	Media Filter
City of Santee	Aubrey Glen, Hiser Road and Mission Gorge Road	Hydrodynamic Separator System
City of Santee	Autowerks, APN: 383-112-53	Drainage inserts and grass swales
City of Santee	Autumnwood II, APN: 381-681-20	Hydrodynamic Separator System
City of Santee	Boys and Girls Club, 8820 Tamberley Way	Grassy swale, drainage inserts.
City of Santee	Cabins at Lake 7, APN: 378 020 49, 376 010 07	Wet pond
City of Santee	Chapparel (Mission View Estates), West of Mesa Road	Bioswales and media filter
City of Santee	Ciraolo Industrial Building, APN: 381-540-10 and 11	Inlet filters, grass swale, downspout filters
City of Santee	Hartford Insurance, APN: 381-050-59	Vegetated swale, rocky swale, and drainage inserts
City of Santee	Morningside, APN: 384-081-16	Hydrodynamic Separator System
City of Santee	Rayo Wholesale, Rayo II, 11495 Woodside Avenue	Grass swale, Grassy detention basin with sand cone filter
City of Santee	Town Center Community Park, APN: 381-050-51, 52, and 381-051-06, 07	Media Filter, bioswales, buffer strips, inlet filters
City of Santee	Toyota, APN: 383-124-11	Extended detention basin, bioretention, inlet filters
Caltrans	SR 52 Unit 5A	Bioswales
Caltrans	SR 52 Unit 5A	Detention Basin
Caltrans	SR 52 : 52/15 Seperation To Mast Boulevard	Bioswales
Caltrans	SR 52: Cuyamaca Street To Magnolia Avenue	Bioswales
Caltrans	SR 52: Cuyamaca Street To Magnolia Avenue	Detention Basin

Table A-2: Summary of existing and proposed structural BMPs in San Diego River watershed (in addition to those proposed in San Diego River CLRP)

Project Name	Public/ Private	Drainage Inserts	Hydrodynamic Separators	Grass/Vegetated Swales	Downspout Filters	Detention Basins	Sand/Oil Separators	Baffle Boxes	Other
Allied Gardens Recreation Center	Public	Unknown							
College Rolando Branch Library	Public		2						
Complex St Green Mall	Public	3							
El Capitan Reservoir	Public	3							
Famosa Slough	Public	Unknown							
Fire Station #31	Public	1							
Mission Trail Regional Prk E Fortuna Equestrian Staging Area	Public			6					
Murray Reservoir	Public	5							
Park Ridge	Public	Unknown							
San Vicente Reservoir	Public	1							
Serra Mesa/Kearny Mesa Library	Public		1						
3555 Aero Court	Private			1					
7-Eleven (5102 Waring)	Private	1							
8825 and 8875 Aero Drive	Private	2							
A-1 Self Storage-Hotel Circle	Private	3							
AAA Auto Club Of Southern Improvement - Mission Vlley	Private	3							
Adams Avenue Building	Private				2				
Aero Drive Three	Private	3							
Alpha Mechanical Heating and Air Conditioning, Inc.	Private	1	1	1					
Alterra/Pravada	Private	11		2	6				1
Atlas Hotel Exhibit Hall	Private	10			6				
Avalon Fashion Valley	Private						3		
Boardwalk	Private	14							
Boi Residence	Private			1					
Bougainvilla Walk	Private	3							
Briercrest Park	Priavate					1			
Cabrillo Medical Center	Private	1							
Cambridge Health Center of San Diego, LLC	Private		1						
Children's Hospital	Private	5	1						
Children's Hospital Parking Structure	Private		1						
Church of Jesus Christ of Latter-Day Saints	Private	2		1					
First United Methodist Church Chapel and Music Building	Private	3							
Francis Parker School - Phase 3	Private		1						
Francis Parker School Phase I Middle and Upper School	Private		2						
Fun Bike Center	Private			2					
Grossmont Medical	Private	1	1	1					
Grossmont Trolley Theater Conv	Private	2							
Hanalei Hotel	Private								1

TETRA TECH

Project Name	Public/ Private	Drainage Inserts	Hydrodynamic Separators	Grass/Vegetated Swales	Downspout Filters	Detention Basins	Sand/Oil Separators	Baffle Boxes	Other
Hazard Commerical Park Lot 35	Private	2							
Highland Skypark	Private	7		3					
Holy Trinity	Private	2							
Jack Henry Parking Garage	Private	4							
John A Davis YMCA	Private								2
Kaiser	Private		1						
Kearny Expansion Plan	Private	3							
KFC Restaurant	Private	3							
Levanto FM/G/PI	Private	5	1						
Lot 1 and 2 Booth Business Park	Private			1					4
Lots 14 & 15, Block 4, Map No. 695	Private	2							
McLelland Auto Sales	Private								1
Mission City Corporate Center	Private	1							
Mission City North	Private		1						
Mission City North Lot 3	Private		1						
Mission City North Lots 6 & 7	Private		1						
Mission Skills Pole Yard	Private	2							
Mission Valley Heights	Private	4							
Mission Village Center PM/G/PI	Private	4							
Monde	Private				1				
Murray Canyon Apts	Private		1						
National University Portion Lot A	Private		1						1
North Island Credit Union - Self Certification	Private	3							
Pad `J' San Carlos Village	Private	3							
Presidio View	Private		3						
Providence Square	Private	4							
Rancho Viewridge	Private	1		1					1
RanRoy Printing Co.	Private	2							
Resmed Corporate Campus	Private		2	2					
Rio Courtyard LLC	Private		1						
Rio San Diego Plaza II	Private	2							
Rio Vesta West	Private		1						
Roman Catholic Bishop Of San Diego	Private	2		1					
Schnieder & Truman Addition	Private				5				
Scripps Health, A Non-Profit Public Benefit Corp.	Private						1		1
SDG&E Parking Lot Improvement	Private	1							
Sempra Energy Meter Reading Relocation	Private	3							
Sharp Memorial Hospital	Private		2						
Sharp Parking Facility	Private		1						
Sharp Parking Facility Garage 3	Private		1						

Project Name	Public/ Private	Drainage Inserts	Hydrodynamic Separators	Grass/Vegetated Swales	Downspout Filters	Detention Basins	Sand/Oil Separators	Baffle Boxes	Other
Simpson Parkview, LP	Private		2						
Social Security Facility	Private	3			1				
Spectrum Corporate Center	Private	11							
Spectrum Corporate Plaza Lot 3	Private		1						
St. Vincent De Paul Church	Private				1				
Sterling Collwood LP	Private		2						1
Sunroad Centrum G/PI/Ded	Private	13					1		
Sycamore Estates, Phase II	Private			1					
Temple Emanu-El	Private			2					
The Shop @ Spectrum, Grading, PI	Private	2		1					
Tierrasanta Vision Center, Family Optometry	Private				2				
Toyota San Diego	Private	10							
Tribeca at Spectrum	Private		1						
Urban Corps of San Diego	Private	2							
Wendy's Restaurant	Private	2							
YMCA Kearny Mesa	Private	2							

Appendix F – BMP Fact Sheets

Fact sheets for the centralized BMPs are presented below. These include:

Ocean Beach Athletic Park and Robb Field Centralized BMP Fact Sheet

Site Overview

Ocean Beach Athletic Area and Robb Field (Site) catchment is located in the westernmost portion of the San Diego River Watershed. It is bordered by Coronado Avenue on the southwest, Venice Street on the southeast, Voltaire Street on the northeast, and culminates near the San Diego River's outlet to the Pacific Ocean. The 315-acre drainage area is predominantly single-family residential. Based on NRCS data, the predominant soil type of the Site is unclassified urban soils (HSG U); therefore, pending a geotechnical investigation by a licensed geotechnical engineer, a subsurface detention gallery (Figure 1) would be appropriate to treat the drainage area. The available BMP area is outlined in Figure 2.

Figure 1. Example of a Subsurface Detention Gallery

Photo Source: http://www.conteches.com/Products/Stormwater-Management/Detention-and-Infiltration.aspx

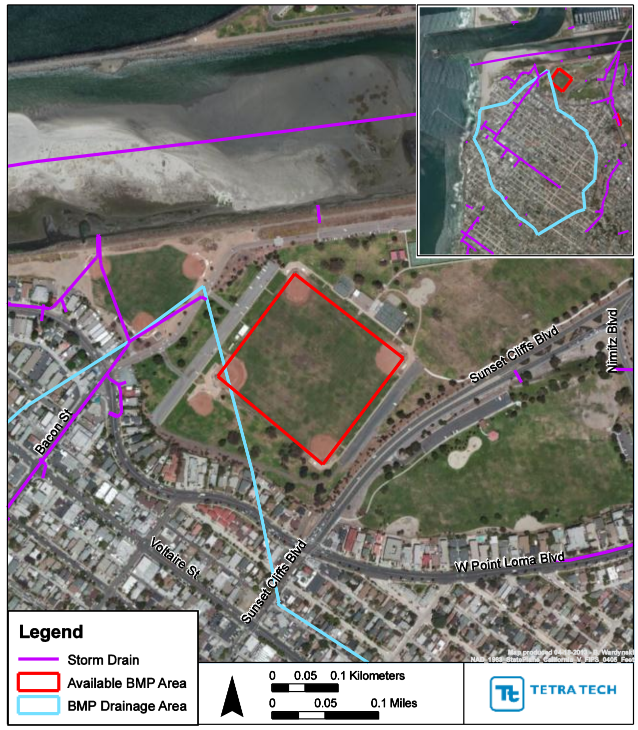

Figure 2. Available BMP area

BMP Design Considerations – Subsurface Detention Gallery

BMP design information for the Site is summarized in Table 1. This BMP type constructed beneath a field will allow for continued use of the space and will not rely on infiltration due to the likelihood of shallow groundwater. Intrusion of brackish water through downstream tide gates is expected, but should not negatively impact BMP performance. Stormwater will likely need to be pumped vertically to the BMP, which adds cost for materials, installation, electricity, and maintenance but reduces excavation costs. The available BMP area is proposed on public property, and therefore legal maintenance access is not an issue.

Table 1. BMP Design Information Summary

Subsurface Detention Gallery	
BMP Drainage Area (Acres)	315
Available BMP Area (Acres)	11.3
Treatment Volume Capacity (Ac-Ft)	6.8
BMP Surface Area (Acres)	2.3
Recommended Ponding Depth (Ft)	3.0

(Note: BMP surface area and depth are recommendations only)

There are no apparent environmental concerns in the area, although soil contamination potential should be investigated based on the history of the site and surrounding land uses.

BMP Performance and Costs

Expected Pollutant Reductions

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft3/yr)	Percent Load Reduction
Enterococcus	2.16E+05	63.4%
Fecal Coliform	2.62E+04	57.4%
Total Coliform	5.60E+05	60.2%
Nitrogen	1,951.63	42.6%
Phosphorus	317.31	42.1%
Cu	23.4	26.9%
Pb	19.1	26.9%
Zn	147.2	26.8%
Sediment	23,258.1	34.3%
Flow Volume	6,897,425	32.1%

Estimated Costs

Table 3. Implementation Costs

Cost Estimate	
Planning	$573,900
Design	$2,295,800
Permits/Studies	$15,000
Construction	$5,739,494
Annual Operation & Maintenance	$196,579
Total	$8,820,773

Costs are provided in 2013 dollars based on planning level estimates. Assumptions were derived from field visits and previous costing efforts for similar BMPs. Actual cost will vary depending on site conditions and utilities, final design components, and actual sediment/debris loading.

Montgomery Field Airport
Centralized BMP Fact Sheet

Site Overview

Montgomery Field Airport (Site) is located in the northwest portion of the San Diego River Watershed. The extensive site is divided into multiple catchments draining to the north, west, and south borders of the parcel. The 410-acre drainage area is predominantly open space and industrial land use. Based on NRCS data, the predominant soil type of the Site is hydrologic soil group D; therefore, pending a geotechnical investigation by a licensed geotechnical engineer, dry extended detention basins (Figure 1) throughout the property would be appropriate to treat the drainage area. The available BMP area is outlined in Figure 2.

Figure 1. Example of a Dry Extended Detention Basin

Photo Source: http://www.fxbrowne.com/html/newsletters/July_2010/news_jul10_st.htm

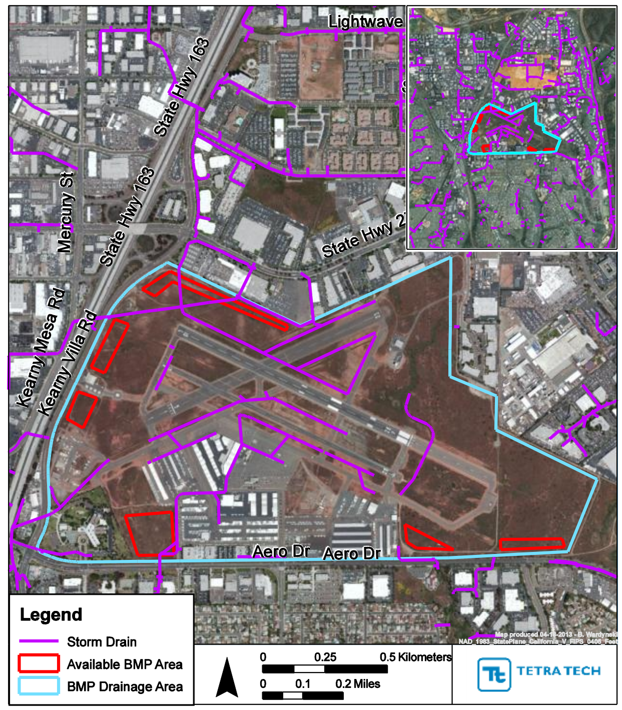

Figure 2. Available BMP area

BMP Design Considerations – Dry Extended Detention Basin

BMP design information for Montgomery Field Airport is summarized in Table 1. Because the Site drains towards multiple catchments, this BMP type can be installed throughout the perimeter and marginal land of the airport to intercept runoff. Practices should be sited sufficient distances from runways to prevent interference by birds. Stormwater can drain to the BMP by surface conveyance, which greatly reduces cost for materials, installation, and maintenance. There are no apparent environmental concerns in the area, although soil contamination potential from aircraft fueling and maintenance areas should be investigated.

Table 1. BMP Design Information Summary

Subsurface Detention Gallery	
BMP Drainage Area (Acres)	410
Available BMP Area (Acres)	--
Treatment Volume Capacity (Ac-Ft)	9.6
BMP Surface Area (Acres)	9.6
Recommended Ponding Depth (Ft)	1.0

(Note: BMP surface area and depth are recommendations only)

The available BMP area is proposed on public property, and therefore legal maintenance access is not an issue.

BMP Performance and Costs

Expected Pollutant Reductions

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft3/yr)	Percent Load Reduction
Enterococcus	2.81E+05	66.2%
Fecal Coliform	3.42E+04	60.4%
Total Coliform	7.28E+05	63.1%
Nitrogen	2,540.25	45.4%
Phosphorus	413.01	44.8%
Cu	30.5	30.1%
Pb	24.8	30.1%
Zn	191.6	30.0%
Sediment	30,272.8	37.6%
Flow Volume	8,977,726	34.3%

Estimated Costs

Table 3. Implementation Costs

Cost Estimate	
Planning	$218,300
Design	$873,200
Permits/Studies	$15,000
Construction	$2,182,877
Annual Operation & Maintenance	$829,592
Total	$4,118,969

Costs are provided in 2013 dollars based on planning level estimates. Assumptions were derived from field visits and previous costing efforts for similar BMPs. Actual cost will vary depending on site conditions and utilities, final design components, and actual sediment/debris loading.

Cabrillo Heights Park
Centralized BMP Fact Sheet

Site Overview

Cabrillo Heights Park (Site) catchment is located in the northwest portion of the San Diego River. It is bordered by Unida Pl and Altridge St on the east, Montgomery Field Airport on the north, Hurlbut St on the south, and culminates in a culvert flowing along the northern perimeter of Cabrillo Heights Park. The 238-acre drainage area contains a combination of commercial and single-family residential land use. Based on NRCS data, the predominant soil type of the Site is classified as hydrologic soil group D; therefore, pending a geotechnical investigation by a licensed geotechnical engineer, a subsurface detention gallery (Figure 1) would be appropriate to treat the drainage area. The available BMP area is outlined in Figure 2.

Figure 1. Example of a Subsurface Detention Gallery

Photo Source: http://www.conteches.com/Products/Stormwater-Management/Detention-and-Infiltration.aspx

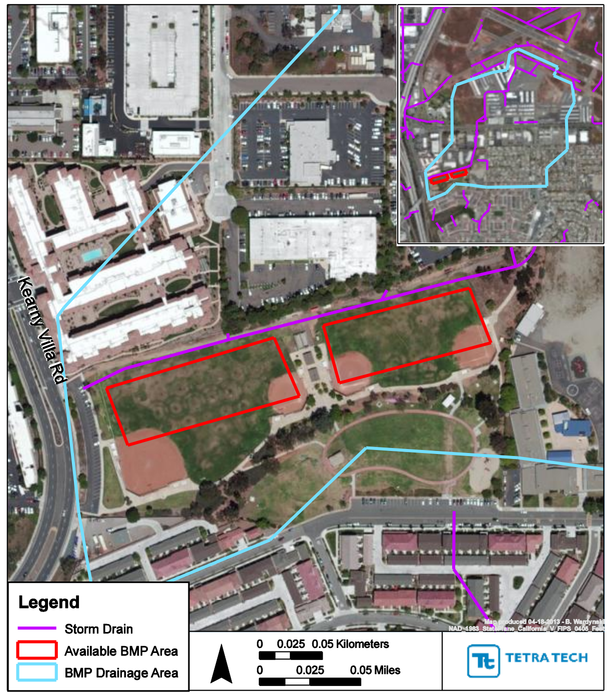

Figure 2. Available BMP area

BMP Design Considerations – Subsurface Infiltration/Detention Gallery

BMP design information for the Site is summarized in Table 1. This BMP type constructed beneath a field will allow for continued use of the space and could allow for marginal infiltration. Stormwater will need to be pumped at least 5 feet vertically to the BMP from the existing conduit, which adds cost for materials, installation, electricity, and maintenance but reduces excavation costs. There are no apparent environmental concerns in the area, although soil contamination potential should be investigated based on the history of the site and surrounding land uses.

Table 1. BMP Design Information Summary

Subsurface Detention Gallery	
BMP Drainage Area (Acres)	238
Available BMP Area (Acres)	4.9
Treatment Volume Capacity (Ac-Ft)	5.6
BMP Surface Area (Acres)	1.9
Recommended Ponding Depth (Ft)	3.0

(Note: BMP surface area and depth are recommendations only)

The available BMP area is proposed on public property, and therefore legal maintenance access is not an issue.

BMP Performance and Costs

Expected Pollutant Reductions

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft3/yr)	Percent Load Reduction
Enterococcus	9.01E+04	68.2%
Fecal Coliform	2.66E+04	63.7%
Total Coliform	2.45E+05	64.2%
Nitrogen	1,364.86	49.0%
Phosphorus	287.74	47.3%
Cu	15.1	38.1%
Pb	13.9	37.5%
Zn	118.1	38.6%
Sediment	19,518.2	42.2%
Flow Volume	6,668,512	37.7%

Estimated Costs

Table 3. Implementation Costs

Cost Estimate	
Planning	$498,800
Design	$1,995,200
Permits/Studies	$15,000
Construction	$4,987,885
Annual Operation & Maintenance	$160,523
Total	$7,657,408

Costs are provided in 2013 dollars based on planning level estimates. Assumptions were derived from field visits and previous costing efforts for similar BMPs. Actual cost will vary depending on site conditions and utilities, final design components, and actual sediment/debris loading.

Presidio Park
Centralized BMP Fact Sheet

Site Overview

Presidio Park (Site) catchment is located in the west portion of the San Diego River Watershed. It is bordered by Juan St on the southwest, Presidio Dr and Pine St on the north, Taylor St on the northwest, and flows to a storm drain that runs along Juan St. The 142-acre drainage area is predominantly single-family residential. Based on NRCS data, the predominant soil type of the Site is classified as hydrologic soil group D; therefore, pending a geotechnical investigation by a licensed geotechnical engineer, the site could be retrofit to provide storage in the form of stormwater wetland or a dry extended detention basin (Figure 1). The available BMP area is outlined in Figure 2.

Figure 1. Example of a Dry Extended Detention Basin

Photo Source:
http://www.fxbrowne.com/html/newsletters/July_2010/news_jul10_st.htm

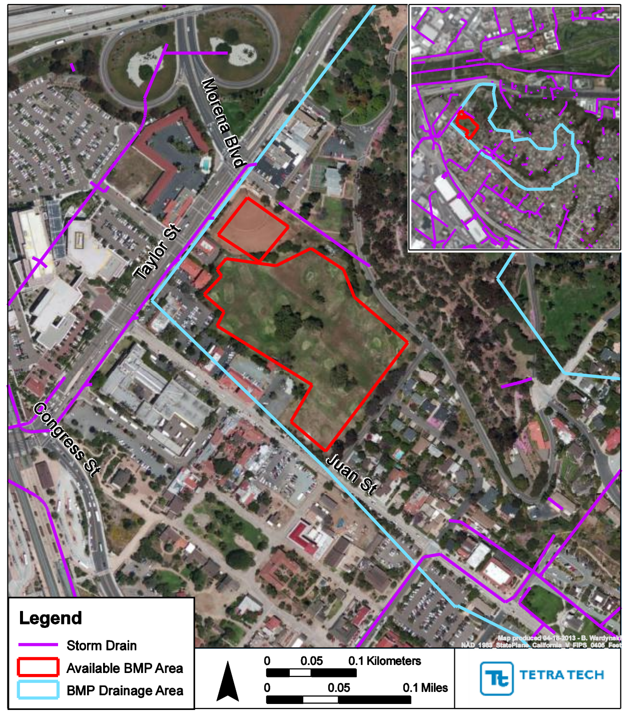

Figure 2. Available BMP area

BMP Design Considerations – Stormwater Wetland/Detention Basin

BMP design information for the Site is summarized in Table 1. This BMP type can be incorporated into the existing golf course to allow continued use of the space and will not rely on infiltration. Stormwater can be rerouted to the site by diverting flow from the existing storm drain along Juan Street. The elevation difference should allow for the pipe to be daylighted in the park, which reduces cost for materials, installation, electricity, and maintenance. Additional subsurface detention could be provided below the adjacent baseball field if needed. The available BMP area is proposed on public property, and therefore legal maintenance access is not an issue.

Table 1. BMP Design Information Summary

Subsurface Detention Gallery	
BMP Drainage Area (Acres)	142
Available BMP Area (Acres)	3.9
Treatment Volume Capacity (Ac-Ft)	3.1
BMP Surface Area (Acres)	3.1
Recommended Ponding Depth (Ft)	1.0

(Note: BMP surface area and depth are recommendations only)

There are no apparent environmental concerns in the area, although soil contamination potential should be investigated based on the history of the site and surrounding land uses.

BMP Performance and Costs

Expected Pollutant Reductions

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft3/yr)	Percent Load Reduction
Enterococcus	5.14E+04	65.6%
Fecal Coliform	7.69E+03	59.7%
Total Coliform	1.29E+05	62.4%
Nitrogen	658.36	43.7%
Phosphorus	124.63	41.9%
Cu	9.4	28.1%
Pb	6.9	27.7%
Zn	62.0	28.2%
Sediment	8,998.4	33.4%
Flow Volume	2,815,470	34.3%

Estimated Costs

Table 3. Implementation Costs

Cost Estimate	
Planning	$221,200
Design	$884,900
Permits/Studies	$15,000
Construction	$2,212,170
Annual Operation & Maintenance	$265,851
Total	$3,599,120

Costs are provided in 2013 dollars based on planning level estimates. Assumptions were derived from field visits and previous costing efforts for similar BMPs. Actual cost will vary depending on site conditions and utilities, final design components, and actual sediment/debris loading.

Springall Academy and San Carlos Recreation Area Centralized BMP Fact Sheet

Site Overview

Springall Academy (Site) catchment is located in the central portion of the San Diego River Watershed. It is bordered by Maury Dr and Mulvaney Dr on the north, Katherine St on the east, Lake Ashmere Dr and Mono Lake Dr on the south, and culminates in a drainage ditch flowing along the perimeter of the Site. The 324-acre drainage area is predominantly single-family residential. Based on NRCS data, the predominant soil type of the Site is classified as hydrologic soil group A; therefore, pending a geotechnical investigation by a licensed geotechnical engineer, a subsurface infiltration gallery (Figure 1) would be appropriate to treat the drainage area. The available BMP area is outlined in Figure 2.

Figure 1. Example of a Subsurface Infiltration Gallery

http://www.conteches.com/Products/Stormwater-Management/Detention-and-Infiltration/ChamberMaxx.aspx

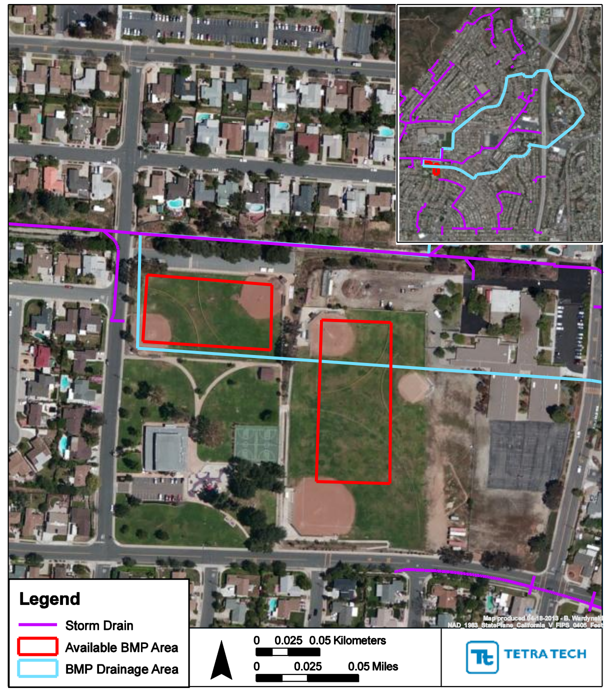

Figure 2. Available BMP area

BMP Design Considerations – Subsurface Infiltration Gallery

BMP design information for the Site is summarized in Table 1. This BMP type constructed beneath a field will allow for continued use of the space and should provide substantial infiltration capacity. Stormwater will need to be pumped at least 7 feet vertically to the BMP from the existing drainage ditch, which adds cost for materials, installation, electricity, and maintenance but reduces excavation cost. There are no apparent environmental concerns in the area, although soil contamination potential should be investigated based on the history of the site and surrounding land uses.

Table 1. BMP Design Information Summary

Subsurface Detention Gallery	
BMP Drainage Area (Acres)	324
Available BMP Area (Acres)	3.2
Treatment Volume Capacity (Ac-Ft)	9.6
BMP Surface Area (Acres)	3.2
Recommended Ponding Depth (Ft)	3.0

(Note: BMP surface area and depth are recommendations only)

The available BMP area is proposed on public property, and therefore legal maintenance access is not an issue.

BMP Performance and Costs

Expected Pollutant Reductions

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft3/yr)	Percent Load Reduction
Enterococcus	2.22E+05	88.2%
Fecal Coliform	2.70E+04	84.9%
Total Coliform	5.76E+05	86.6%
Nitrogen	2,007.41	75.8%
Phosphorus	326.38	74.7%
Cu	24.1	63.7%
Pb	19.6	63.3%
Zn	151.4	63.8%
Sediment	23,922.9	68.0%
Flow Volume	7,094,579	63.3%

Estimated Costs

Table 3. Implementation Costs

Cost Estimate	
Planning	$730,400
Design	$2,921,600
Permits/Studies	$15,000
Construction	$7,304,043
Annual Operation & Maintenance	$276,507
Total	$11,247,550

Costs are provided in 2013 dollars based on planning level estimates. Assumptions were derived from field visits and previous costing efforts for similar BMPs. Actual cost will vary depending on site conditions and utilities, final design components, and actual sediment/debris loading.

Cleator Park
Centralized BMP Fact Sheet

Site Overview

Cleator Park (Site) catchment is located in the western portion of the San Diego River Watershed. It is roughly bordered by Chatsworth Boulevard on the south and southeast, Venice Street on the northeast, and culminates in a drainage ditch that flows along Nimitz Blvd. The 333-acre drainage area is predominantly single-family residential. Based on NRCS data, the predominant soil type of the Site is classified as hydrologic soil group B; therefore, pending a geotechnical investigation by a licensed geotechnical engineer, an unlined stormwater wetland (Figure 1) would be appropriate to treat the drainage area. The available BMP area is outlined in Figure 2.

Figure 1. Example of a Constructed Wetland System

Photo Source: http://www.iees.ch/EcoEng071/EcoEng071_Turon.html

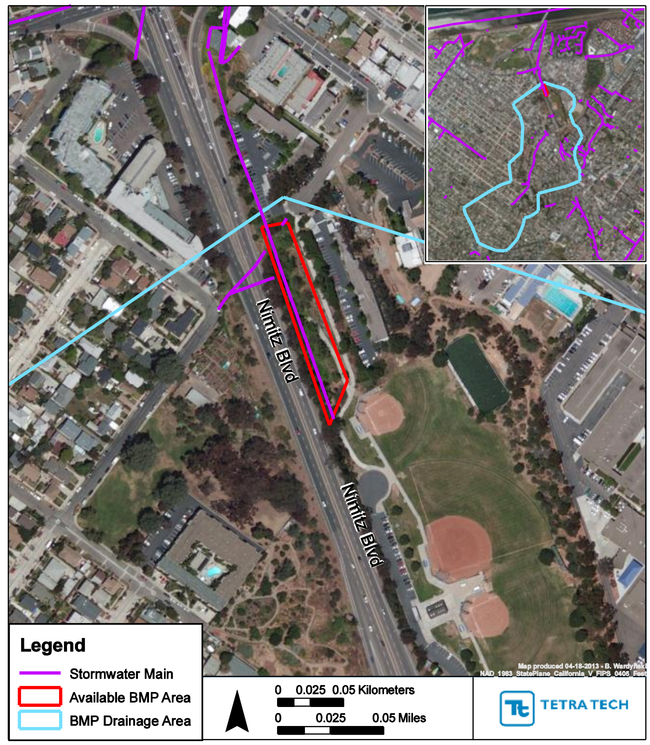

Figure 2. Available BMP area

BMP Design Considerations – Stormwater Wetland

BMP design information for the Site is summarized in Table 1. This BMP could be constructed by restricting outflow from the existing ditch. Microtopography and sinuosity should be added to the channel to increase residence time and treatment potential. Because site soils are relatively permeable, the system should not be lined to promote filtration through subsoils and exchange with groundwater. There are no apparent environmental concerns in the area, although soil contamination potential should be investigated based on the history of the site and surrounding land uses.

Table 1. BMP Design Information Summary

Subsurface Detention Gallery	
BMP Drainage Area (Acres)	333
Available BMP Area (Acres)	3.8
Treatment Volume Capacity (Ac-Ft)	7.2
BMP Surface Area (Acres)	2.4
Recommended Ponding Depth (Ft)	3.0

(Note: BMP surface area and depth are recommendations only)

The available BMP area is proposed on public property, and therefore legal maintenance access is not an issue.

BMP Performance and Costs

Expected Pollutant Reductions

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft3/yr)	Percent Load Reduction
Enterococcus	1.81E+05	74.2%
Fecal Coliform	1.94E+04	69.5%
Total Coliform	4.72E+05	71.6%
Nitrogen	1,517.93	56.3%
Phosphorus	279.37	54.0%
Cu	19.6	40.2%
Pb	17.3	39.8%
Zn	126.8	40.3%
Sediment	22,111.5	45.2%
Flow Volume	6,156,480	43.7%

Estimated Costs

Table 3. Implementation Costs

Cost Estimate	
Planning	$150,600
Design	$602,500
Permits/Studies	$15,000
Construction	$1,506,127
Annual Operation & Maintenance	$207,812
Total	$2,482,039

Costs are provided in 2013 dollars based on planning level estimates. Assumptions were derived from field visits and previous costing efforts for similar BMPs. Actual cost will vary depending on site conditions and utilities, final design components, and actual sediment/debris loading.

Lower North Shepherd Canyon
Centralized BMP Fact Sheet

Site Overview

Lower North Shepherd Canyon (Site) catchment is located in the north-central portion of the San Diego River Watershed. It is bordered by the Fortuna Mountain ridgeline and Mission Trails Regional Park on the east, Antigua Blvd on the south, Santo Rd on the northwest, and culminates at the Site. The 757-acre drainage area is predominantly open space and single-family residential. Based on NRCS data, the predominant soil type of the Site is classified as hydrologic soil group D; therefore, pending a geotechnical investigation by a licensed geotechnical engineer, an online stormwater wetland (Figure 1) would be appropriate to treat the drainage area. The available BMP area is outlined in Figure 2.

Figure 1. Example of a Constructed Wetland System

Photo Source: http://www.iees.ch/EcoEng071/EcoEng071_Turon.html

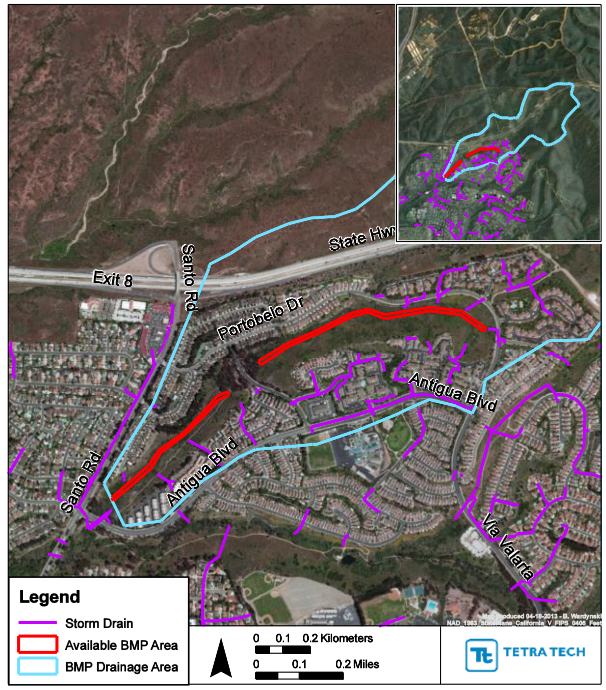

Figure 2. Available BMP area

BMP Design Considerations – Stormwater Wetland

BMP design information for the Site is summarized in Table 1. This BMP could be constructed by restricting outflow from the canyon and by adding microtopography and sinuosity to the canyon floor to increase residence time and treatment potential. Neighboring canyon areas could potentially be retrofit in a similar manner. There are no apparent environmental concerns in the area, although soil contamination potential should be investigated based on the history of the site and surrounding land uses.

Table 1. BMP Design Information Summary

Subsurface Detention Gallery	
BMP Drainage Area (Acres)	757
Available BMP Area (Acres)	6.4
Treatment Volume Capacity (Ac-Ft)	17.7
BMP Surface Area (Acres)	5.9
Recommended Ponding Depth (Ft)	3.0

(Note: BMP surface area and depth are recommendations only)

The available BMP area is proposed on public property, and therefore legal maintenance access is not an issue.

BMP Performance and Costs

Expected Pollutant Reductions

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft3/yr)	Percent Load Reduction
Enterococcus	4.67E+05	82.8%
Fecal Coliform	5.50E+04	79.3%
Total Coliform	1.23E+06	80.0%
Nitrogen	4,401.99	67.1%
Phosphorus	759.41	64.5%
Cu	50.5	56.4%
Pb	42.4	55.5%
Zn	321.8	56.9%
Sediment	55,465.0	59.0%
Flow Volume	17,127,890	53.2%

Estimated Costs

Table 3. Implementation Costs

Cost Estimate	
Planning	$368,300
Design	$1,473,100
Permits/Studies	$15,000
Construction	$3,682,678
Annual Operation & Maintenance	$510,571
Total	$6,049,649

Costs are provided in 2013 dollars based on planning level estimates. Assumptions were derived from field visits and previous costing efforts for similar BMPs. Actual cost will vary depending on site conditions and utilities, final design components, and actual sediment/debris loading.

Serra Mesa Park and Upslope Canyon Centralized BMP Fact Sheet

Site Overview

The Serra Mesa Park (Site) catchment is located in the northwest portion of the San Diego River Watershed. It is bordered Montgomery Field Airport on the north, Unida Pl and Ediwhar Ave on the west, Ruffin Rd and Castle Glen Dr on the east, and culminates at a Serra Mesa Park. The 267-acre drainage area is predominantly open space and commercial development with some single-family residential land use. Based on NRCS data, the predominant soil type of the Site is classified as hydrologic soil group D; therefore, pending a geotechnical investigation by a licensed geotechnical engineer, an online stormwater wetland (Figure 1) would be appropriate to treat the drainage area. Space is available beneath the adjacent baseball field to install a subsurface detention gallery if additional storage is required. The available BMP area is outlined in Figure 2.

Figure 1. Example of a Constructed Wetland System

Photo Source: http://www.iees.ch/EcoEng071/EcoEng071_Turon.html

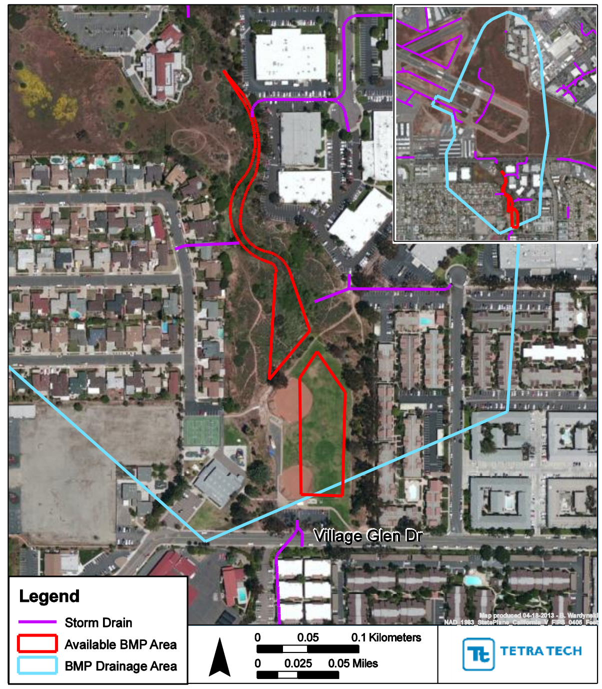

Figure 2. Available BMP area

BMP Design Considerations – Stormwater Wetland/Detention Basin

BMP design information for the Site is summarized in Table 1. This BMP could be constructed by restricting flow to the existing culvert that runs below the park and by adding microtopography and sinuosity to the canyon floor to increase residence time and treatment potential. Outflow from the wetland could be diverted to a subsurface detention gallery constructed below the park. There are no apparent environmental concerns in the area, although soil contamination potential should be investigated based on the history of the site and surrounding land uses.

Table 1. BMP Design Information Summary

Subsurface Detention Gallery	
BMP Drainage Area (Acres)	267
Available BMP Area (Acres)	1.3
Treatment Volume Capacity (Ac-Ft)	6.3
BMP Surface Area (Acres)	2.1
Recommended Ponding Depth (Ft)	3.0

(Note: BMP surface area and depth are recommendations only)

The available BMP area is proposed on public property, and therefore legal maintenance access is not an issue.

BMP Performance and Costs

Expected Pollutant Reductions

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft3/yr)	Percent Load Reduction
Enterococcus	1.21E+05	79.0%
Fecal Coliform	1.96E+04	75.1%
Total Coliform	3.41E+05	76.0%
Nitrogen	1,394.47	60.8%
Phosphorus	291.74	56.9%
Cu	14.7	49.3%
Pb	14.8	47.6%
Zn	103.9	50.5%
Sediment	21,753.9	48.7%
Flow Volume	6,634,432	47.8%

Estimated Costs

Table 3. Implementation Costs

Cost Estimate	
Planning	$446,900
Design	$1,787,600
Permits/Studies	$15,000
Construction	$4,469,086
Annual Operation & Maintenance	$180,082
Total	$6,898,668

Costs are provided in 2013 dollars based on planning level estimates. Assumptions were derived from field visits and previous costing efforts for similar BMPs. Actual cost will vary depending on site conditions and utilities, final design components, and actual sediment/debris loading.