Multi-Pollutant TMDL Implementation Plan for the Unincorporated County Area of Los Angeles River Watershed

Appendices

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Contents

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Appendix A. TMDL Summaries

To provide a summary of the Los Angeles River TMDLs, the following pages include the Attachments to the Resolutions for Amending LARWQCB's Water Quality Control Plan to incorporate the TMDLs. Amendments are included in the following order:

- TMDL for Metals in the Los Angeles River and Tributaries
- TMDL for Nitrogen Compounds and Related Effects in the Los Angeles River
- TMDL for Trash in the Los Angeles River Watershed

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Attachment A to Resolution No. R2007-014

Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate the Los Angeles River and Tributaries Metals TMDL

Adopted by the California Regional Water Quality Control Board, Los Angeles Region on [*insert date*].

Amendments:

Table of Contents
Add:

List of Figures, Tables and Inserts
Add:

Chapter 7. Total Maximum Daily Loads (TMDLs) Summaries, Section 7-13 (Los Angeles River and Tributaries Metals TMDL)
Add:

This TMDL was adopted by

The Regional Water Quality Control Board on [*insert date*].

This TMDL was approved by:

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

The following table includes the key elements of this TMDL.

Table 7-13.1 Los Angeles River and Tributaries Metals TMDL: Elements

Element	Key Findings and Regulatory Provisions
Problem Statement	Segments of the Los Angeles River and its tributaries are on the Clean Water Act section 303(d) list of impaired waterbodies for copper, cadmium, lead, zinc, aluminum and selenium. The metals subject to this TMDL are toxic pollutants, and the existing water quality objectives for the metals reflect national policy that the discharge of toxic pollutants in toxic amounts be prohibited. When one of the metals subject to this TMDL is present at levels exceeding the existing numeric objectives, then the receiving water is toxic. The beneficial uses impaired by metals in the Los Angeles River and its tributaries are those associated with aquatic life and water supply, including wildlife habitat, rare, threatened or endangered species, warm freshwater habitat, wetlands, and groundwater recharge. TMDLs are developed for reaches on the 303(d) list and for reaches where recent data indicate additional impairments. Addressing the impairing metals throughout the Los Angeles River watershed will ensure that the metals do not contribute to an impairment elsewhere in the watershed. Metals allocations are therefore developed for upstream reaches and tributaries that drain to impaired reaches. These TMDLs address wet- and dry-weather discharges of copper, lead, zinc and selenium and wet-weather discharges of cadmium. Impairments related to cadmium only occur during wet weather. Impairments related to selenium are confined to Reach 6 and its tributaries. Dry-weather impairments related to zinc only occur in Rio Hondo Reach 1. The aluminum listing was based on water quality objectives set to support the municipal water supply beneficial use (MUN). MUN is a conditional use in the Los Angeles River watershed. The United States Environmental Protection Agency (USEPA) has determined that TMDLs are not required for impairments of conditional uses.
Numeric Target *(Interpretation of the numeric water quality objective, used to calculate the waste load allocations)*	Numeric water quality targets are based on the numeric water quality criteria established by the California Toxics Rule (CTR). The targets are expressed in terms of total recoverable metals. There are separate targets for dry and wet weather because hardness values and flow conditions in the Los Angeles River and tributaries vary between dry and wet weather. The dry-weather targets apply to days when the maximum daily flow in the River is less than 500 cfs. The wet-weather targets apply to days when the maximum daily flow in the River is equal to or greater than 500 cfs. The dry-weather targets for copper and lead are based on chronic CTR criteria. The dry-weather targets for zinc are based on acute CTR criteria. Copper, lead and zinc targets are dependent on hardness to adjust for site specific conditions and conversion factors to convert between dissolved and total recoverable metals. Copper and lead targets are based on 50^{th} percentile hardness values. Zinc targets are based on 10^{th} percentile hardness values. Site-specific copper conversion factors are applied immediately downstream of the Tillman and LA-Glendale

Element	Key Findings and Regulatory Provisions
	water reclamation plants (WRP). CTR default conversion factors are used for copper, lead, and zinc in all other cases. The dry-weather target for selenium is independent of hardness or conversion factors.

Dry-weather conversion factors:

	Default	Below Tillman WRP	Below LA-Glendale WRP
Copper	0.96	0.74	0.80
Lead	0.79		
Zinc	0.61		

Dry-weather numeric targets (µg total recoverable metals/L)

	Cu	**Pb**	**Zn**	**Se**
Reach 5, 6 and Bell Creek	30	19		5
Reach 4	26	10		
Reach 3 above LA-Glendale WRP and Verdugo	23	12		
Reach 3 below LA-Glendale WRP	26	12		
Burbank Western Channel (above WRP)	26	14		
Burbank Western Channel (below WRP)	19	9.1		
Reach 2 and Arroyo Seco	22	11		
Reach 1	23	12		
Compton Creek	19	8.9		
Rio Hondo Reach 1	13	5.0	131	
Monrovia Canyon		8.2		

The wet-weather targets for cadmium, copper, lead and zinc are based on acute CTR criteria and the 50th percentile hardness values for storm water collected at the Wardlow gage station. Conversion factors for copper, lead and zinc are based on a regression of dissolved metals values to total recoverable metals values collected at Wardlow. The CTR default conversion factor is applied to cadmium. The wet-weather target for selenium is independent of hardness or conversion factors.

Wet-weather conversion factors:

Cadmium	0.94
Copper	0.65
Lead	0.82
Zinc	0.61

Wet-weather numeric targets (µg total recoverable metals/L)

Cd	Cu	Pb	Zn	Se
3.1	17	62	159	5

Element	Key Findings and Regulatory Provisions
Source Analysis	There are significant differences in the sources of metals loadings during dry weather and wet weather. During dry weather, most of the metals loadings are in the dissolved form. The three major publicly owned treatment works (POTWs) that discharge to the river (Tillman WRP, LA-Glendale WRP, and Burbank WRP) constitute the majority of the flow and metals loadings during dry weather. The storm drains also contribute a large percentage of the loadings during dry weather because although their flows are typically low, concentrations of metals in urban runoff may be quite high. The remaining portion of the dry weather flow and metals loadings represents a combination of tributary flows, groundwater discharge, and flows from other permitted NPDES discharges within the watershed. During wet weather, most of the metals loadings are in the particulate form and are associated with wet-weather storm water flow. On an annual basis, storm water contributes about 40% of the cadmium loading, 80% of the copper loading, 95% of the lead loading and 90% of the zinc loading. This storm water flow is permitted through two municipal separate storm sewer system (MS4) permits, a separate Caltrans MS4 permit, a general construction storm water permit and a general industrial storm water permit. Nonpoint sources of metals may include tributaries that drain the open space areas of the watershed. Direct atmospheric deposition of metals on the river is also a small source. Indirect atmospheric deposition on the land surface that is washed off during storms is a larger source, which is accounted for in the estimates of storm water loadings. The sources of selenium appear to be related to natural levels of selenium in soils in the upper watershed. Separate studies are underway to evaluate whether selenium levels represent a "natural condition" for this watershed.
Loading Capacity	**Dry Weather** Dry-weather TMDLs are developed for the following pollutant waterbody combinations (allocations are developed for upstream reaches and tributaries to meet TMDLs in downstream reaches): • Copper for the Los Angeles River Reaches 1, 2, 3, 4, and 5, Burbank Channel, Compton Creek, Tujunga Wash, Rio Hondo Reach 1. • Lead for the Los Angeles River Reaches 1, 2, 3, 4, and 5, Burbank Channel, Rio Hondo Reach 1, Compton Creek, Monrovia Canyon Creek. • Zinc for Rio Hondo Reach 1. • Selenium for Reach 6, Aliso Creek, Dry Canyon Creek, McCoy Canyon Creek. For dry weather, loading capacities are equal to reach-specific numeric targets multiplied by reach-specific critical dry-weather flows.

Element	Key Findings and Regulatory Provisions
	Summing the critical flows for each reach and tributary, the critical flow for the entire river is 203 cfs, which is equal to the combined design flow of the three POTWs (169 cfs) plus the median flow from the storm drains and tributaries (34 cfs). The median storm drain and tributary flow is equal to the median flow at Wardlow (145 cfs) minus the existing median POTW flow (111 cfs). The dry-weather loading capacities for each impaired reach include the critical flows for upstream reaches. The dry-weather loading capacity for Reach 5 includes flows from Reach 6 and Bell Creek, the dry-weather loading capacity for Reach 3 includes flows from Verdugo Wash, and the dry-weather loading capacity for Reach 2 includes flows from Arroyo Seco.

Dry-weather loading capacity (total recoverable metals)

	Critical Flow (cfs)	Cu (kg/day)	Pb (kg/day)	Zn (kg/day)
LA River Reach 5	8.74	0.65	0.39	
LA River Reach 4	129.13	8.1	3.2	
LA River Reach 3	39.14	2.3	1.01	
LA River Reach 2	4.44	0.16	0.084	
LA River Reach 1	2.58	0.14	0.075	
Tujunga Wash	0.15	0.007	0.0035	
Burbank Channel	17.3	0.80	0.39	
Rio Hondo Reach 1	0.50	0.015	0.0061	0.16
Compton Creek	0.90	0.041	0.020	

No dry-weather loading capacities are calculated for lead in Monrovia Canyon Creek or selenium in Reach 6 or its tributaries. Concentration-based allocations are assigned for these metals in these reaches.

Wet Weather

Wet-weather TMDLs are calculated for cadmium, copper, lead, and zinc in Reach 1. Allocations are developed for all upstream reaches and tributaries to meet these TMDLs.

Wet-weather loading capacities are calculated by multiplying daily storm volumes by the wet-weather numeric target for each metal. The resulting curves identify the load allowance for a given flow.

Wet-weather loading capacity (total recoverable metals)

Metal	Load Duration Curve (kg/day)
Cadmium	Daily storm volume x 3.1 µg/L
Copper	Daily storm volume x 17 µg/L
Lead	Daily storm volume x 62 µg/L
Zinc	Daily storm volume x 159 µg/L

Element	Key Findings and Regulatory Provisions
Load Allocations *(for nonpoint sources)*	**Dry Weather** Dry-weather nonpoint source load allocations (LAs) for copper and lead apply to open space and direct atmospheric deposition to the river.

Element	Key Findings and Regulatory Provisions
	Dry-weather open space load allocations are equal to the critical flow for the upper portion of tributaries that drain open space, multiplied by the numeric targets for these tributaries.

Open space dry-weather LAs (total recoverable metals)

	Critical Flow	Cu (kg/day)	Pb (kg/day)
Tujunga Wash	0.12	0.0056	0.0028
Arroyo Seco	0.33	0.018	0.009

Load allocations for direct atmospheric deposition to the entire river are obtained from previous studies (3 kg/year for copper, 2 kg/year for lead and 10 kg/year for zinc.) Loads are allocated to each reach and tributary based on their length. The ratio of the length of each river segment to the total length of the river is multiplied by the estimates of direct atmospheric loading to the entire river.

Direct air deposition dry-weather LAs (total recoverable metals)

	Cu (kg/day)	Pb (kg/day)	Zn(kg/day)
LA River Reach 6	$3.3x10^{-4}$	$2.2x10^{-4}$	
LA River Reach 5	$3.6x10^{-4}$	$2.4x10^{-4}$	
LA River Reach 4	$8.1x10^{-4}$	$5.4x10^{-4}$	
LA River Reach 3	$6.04x10^{-4}$	$4.03x10^{-4}$	
LA River Reach 2	$1.4 x10^{-3}$	$9.5x10^{-4}$	
LA River Reach 1	$4.4x10^{-4}$	$2.96x10^{-4}$	
Bell Creek	$2.98x10^{-4}$	$1.99x10^{-4}$	
Tujunga Wash	$7.4x10^{-4}$	$4.9x10^{-4}$	
Verdugo Wash	$4.7x10^{-4}$	$3.2x10^{-4}$	
Burbank Channel	$7.1x10^{-4}$	$4.7x10^{-4}$	
Arroyo Seco	$7.3x10^{-4}$	$4.9x10^{-4}$	
Rio Hondo Reach 1	$6.4x10^{-4}$	$4.2x10^{-4}$	$2.1x10^{-3}$
Compton Creek	$6.5x10^{-4}$	$4.3x10^{-4}$	

A dry-weather concentration-based load allocation for lead equal to the dry-weather numeric target (8.2 μg/L) applies to Monrovia Canyon Creek. The load allocation is not assigned to a particular nonpoint source or group of nonpoint sources.

A dry-weather concentration-based load allocation for selenium equal to the dry-weather numeric target (5 μg/L) is assigned to Reach 6 and its tributaries. The load allocation is not assigned to a particular nonpoint source or group of nonpoint sources.

Wet Weather

Wet-weather load allocations for open space are equal to the percent metals loading from open space (predicted by the wet-weather model) multiplied by the total loading capacity, then by the ratio of open space

<table>
<tr><th>Element</th><th>Key Findings and Regulatory Provisions</th></tr>
<tr><td></td><td>
located outside the storm drain system to the total open space area. There is no load allocation for cadmium because open space is not believed to be a source of the wet-weather cadmium impairment in Reach 1.

Wet-weather open space LAs (total recoverable metals)

<table>
<tr><th>Metal</th><th>Load Allocation (kg/day)</th></tr>
<tr><td>Copper</td><td>2.6x10^{-10} µg /L/day x daily storm volume(L)</td></tr>
<tr><td>Lead</td><td>2.4x10^{-10} µg /L/day x daily storm volume(L)</td></tr>
<tr><td>Zinc</td><td>1.4x10^{-9} µg /L/day x daily storm volume(L)</td></tr>
</table>

Wet-weather load allocations for direct atmospheric deposition are equal to the percent area of the watershed comprised by surface water (0.2%) multiplied by the total loading capacity.

Wet-weather direct air deposition LAs (total recoverable metals)

<table>
<tr><th>Metal</th><th>Load Allocation (kg/day)</th></tr>
<tr><td>Cadmium</td><td>6.2x10^{-10} µg /L/day x daily storm volume(L)</td></tr>
<tr><td>Copper</td><td>3.4x10^{-10} µg /L/day x daily storm volume(L)</td></tr>
<tr><td>Lead</td><td>1.2x10^{-10} µg /L/day x daily storm volume(L)</td></tr>
<tr><td>Zinc</td><td>3.2x10^{-9} µg /L/day x daily storm volume(L)</td></tr>
</table>

A wet-weather concentration-based load allocation for selenium equal to the dry-weather numeric target (5 µg/L) is assigned to Reach 6 and its tributaries. The load allocation is not assigned to a particular nonpoint source or group of nonpoint sources.
</td></tr>
<tr><td>

Waste Load Allocations *(for point sources)*
</td><td>

Dry Weather

Dry-weather point source waste load allocations (WLAs) apply to the three POTWs (Tillman, Glendale, and Burbank). A grouped waste load allocation applies to the storm water permitees (Los Angeles County MS4, Long Beach MS4, Caltrans, General Industrial and General Construction), which is calculated by subtracting load allocations (and waste load allocations for reaches with POTWs) from the total loading capacity. Concentration-based waste load allocations are developed for other point sources in the watershed.

Mass- and concentration-based waste load allocations for Tillman, Los Angeles-Glendale and Burbank WRPs are developed to meet the dry-weather targets for copper and lead in Reach 4, Reach 3 and the Burbank Western Channel, respectively.
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</table>

Element	Key Findings and Regulatory Provisions
	POTW dry-weather WLAs (total recoverable metals):

	Cu	**Pb**
Tillman		
Concentration-based (µg/L)	26	10
Mass-based (kg/day)	7.8	3.03
Glendale		
Concentration-based (µg/L)	26	12
Mass-based (kg/day)	2.0	0.88
Burbank		
Concentration-based (µg/L)	19	9.1
Mass-based (kg/day)	0.64	0.31

Dry-weather waste load allocations for storm water are equal to storm drain flows (critical flows minus median POTW flows minus median open space flows) multiplied by reach-specific numeric targets, minus the contribution from direct air deposition.

Storm water dry-weather WLAs (total recoverable metals)

	Critical Flow (cfs)	**Cu (kg/day)**	**Pb (kg/day)**	**Zn (kg/day)**
LA River Reach 6	7.20	0.53	0.33	
LA River Reach 5	0.75	0.05	0.03	
LA River Reach 4	5.13	0.32	0.12	
LA River Reach 3	4.84	0.06	0.03	
LA River Reach 2	3.86	0.13	0.07	
LA River Reach 1	2.58	0.14	0.07	
Bell Creek	0.79	0.06	0.04	
Tujunga Wash	0.03	0.001	0.0002	
Burbank Channel	3.3	0.15	0.07	
Verdugo Wash	3.3	0.18	0.10	
Arroyo Seco	0.25	0.01	0.01	
Rio Hondo Reach 1	0.50	0.01	0.006	0.16
Compton Creek	0.90	0.04	0.02	

A zero waste load allocation is assigned to all industrial and construction storm water permittees during dry weather. The remaining waste load allocations are shared by the MS4 permittees and Caltrans.

Other NPDES Permits

Concentration-based dry-weather waste load allocations apply to the other NPDES permits* that discharge to the reaches and tributaries in the following table.

* “Other NPDES permits” refers to minor NPDES permits, general non-storm water NDPES permits, and major permits other than the Tillman, LA-Glendale, and Burbank POTWs.

Element	Key Findings and Regulatory Provisions

Other dry-weather WLAs (µg total recoverable metals/L)

	Cu	Pb	Zn	Se
Reach 5, 6 and Bell Creek	30	19		5
Reach 4	26	10		
Reach 3 above LA-Glendale WRP and Verdugo	23	12		
Reach 3 below LA-Glendale WRP	26	12		
Burbank Western Channel(above WRP)	26	14		
Burbank Western Channel (below WRP)	19	9.1		
Reach 2 and Arroyo Seco	22	11		
Reach 1	23	12		
Compton Creek	19	8.9		
Rio Hondo Reach 1	13	5.0	131	

Wet Weather

During wet-weather, POTW allocations are based on dry-weather in-stream numeric targets because the POTWs exert the greatest influence over in-stream water quality during dry weather. During wet weather, the concentration-based dry-weather waste load allocations apply but the mass-based dry-weather allocations do not apply when influent flows exceed the design capacity of the treatment plants. Additionally, the POTWs are assigned reach-specific allocations for cadmium and zinc based on dry weather targets to meet the wet-weather TMDLs in Reach 1.

POTW wet-weather WLAs (total recoverable metals):

	Cd	Cu	Pb	Zn
Tillman				
Concentration-based (µg/L)	4.7	26	10	212
Mass-based (kg/day)	1.4	7.8	3.03	64
Glendale				
Concentration-based (µg/L)	5.3	26	12	253
Mass-based (kg/day)	0.40	2.0	0.88	19
Burbank				
Concentration-based (µg/L)	4.5	19	9.1	212
Mass-based (kg/day)	0.15	0.64	0.31	7.3

Element	Key Findings and Regulatory Provisions
	Wet-weather waste load allocations for the grouped storm water permittees are equal to the total loading capacity minus the load allocations for open space and direct air deposition and the waste load allocations for the POTWs. Wet-weather waste load allocations for the grouped storm water permittees apply to all reaches and tributaries.

Storm water wet-weather WLAs (total recoverable metals):

Metal	Waste Load Allocation (kg/day)
Cadmium	$3.1x10^{-9}$ x daily volume(L) – 1.95
Copper	$1.7x10^{-8}$ x daily volume (L) – 10
Lead	$6.2x10^{-8}$ x daily volume (L) – 4.2
Zinc	$1.6x10^{-7}$ x daily volume (L) – 90

The combined storm water waste load allocation is apportioned between the different storm water categories by their percent area of the portion of the watershed served by storm drains.

MS4 wet-weather WLAs (total recoverable metals):

Metal	Waste Load Allocation (kg/day)
Cadmium	$2.8x10^{-9}$ x daily volume(L) – 1.8
Copper	$1.5x10^{-8}$ x daily volume (L) – 9.5
Lead	$5.6x10^{-8}$ x daily volume (L) – 3.85
Zinc	$1.4x10^{-7}$ x daily volume (L) – 83

Caltrans wet-weather WLAs (total recoverable metals):

Metal	Waste Load Allocation (kg/day)
Cadmium	$5.3x10^{-11}$ x daily volume(L) – 0.03
Copper	$2.9x10^{-10}$ x daily volume (L) – 0.2
Lead	$1.06x10^{-9}$ x daily volume (L) – 0.07
Zinc	$2.7x10^{-9}$ x daily volume (L) – 1.6

General Industrial wet-weather WLAs (total recoverable metals):

Metal	Waste Load Allocation (kg/day)
Cadmium	$1.6x10^{-10}$ x daily volume(L) – 0.11
Copper	$8.8x10^{-10}$ x daily volume (L) – 0.5
Lead	$3.3x10^{-9}$ x daily volume (L) – 0.22
Zinc	$8.3x10^{-9}$ x daily volume (L) – 4.8

General Construction wet-weather WLAs (total recoverable metals):

Metal	Waste Load Allocation (kg/day)
Cadmium	$5.9x10^{-11}$ x daily volume(L) – 0.04
Copper	$3.2x10^{-10}$ x daily volume (L) – 0.2
Lead	$1.2x10^{-9}$ x daily volume (L) – 0.08
Zinc	$3.01x10^{-}9$ x daily volume (L) – 4.8

Each storm water permittee under the general industrial and construction storm water permits will receive individual waste load allocations per acre based on the total acres of their facility.

Element	Key Findings and Regulatory Provisions
	Individual General Construction or Industrial Permittees WLAs (total recoverable metals): **Metal** — **Waste Load Allocation (g/day/acre)** Cadmium — $7.6x10^{-12}$ x daily volume(L) – $4.8x10^{-6}$ Copper — $4.2x10^{-11}$ x daily volume (L) – $2.6x10^{-5}$ Lead — $1.5x10^{-10}$ x daily volume (L) – $1.04x10^{-5}$ Zinc — $3.9x10^{-10}$ x daily volume (L) – $2.2x10^{-4}$ **Other NPDES Permits** Concentration-based wet-weather waste load allocations apply to the other NPDES permits* that discharge to all reaches of the Los Angeles River and its tributaries. **Wet-weather WLAs for other permits (total recoverable metals)** **Cadmium (µg /L)** — **Copper (µg /L)** — **Lead (µg /L)** — **Zinc (µg /L)** 3.1 — 17 — 62 — 159 * "Other NPDES permits" refers to minor NPDES permits, general non-storm water NDPES permits, and major permits other than the Tillman, LA-Glendale, and Burbank POTWs.
Margin of Safety	There is an implicit margin of safety that stems from the use of conservative values for the translation from total recoverable to the dissolved fraction during the dry and wet periods. In addition, the TMDL includes a margin of safety by evaluating wet-weather conditions separately from dry-weather conditions, which is in effect, assigning allocations for two distinct critical conditions. Furthermore, the use of the wet-weather model to calculate load allocations for open space can be applied to the margin of safety because it tends to overestimate loads from open spaces, thus reducing the available waste load allocations to the permitted discharges.
Implementation	The regulatory mechanisms used to implement the TMDL will include the Los Angeles County Municipal Storm Water NPDES Permit (MS4), the City of Long Beach MS4, the Caltrans storm water permit, major NPDES permits, minor NPDES permits, general NPDES permits, general industrial storm water NPDES permits, and general construction storm water NPDES permits. Nonpoint sources will be regulated through the authority contained in sections 13263 and 13269 of the Water Code, in conformance with the State Water Resources Control Board's Nonpoint Source Implementation and Enforcement Policy (May 2004). Each NPDES permit assigned a WLA shall be reopened or amended at reissuance, in accordance with applicable laws, to incorporate the applicable WLAs as a permit requirement. The Regional Board shall reconsider this TMDL by January 11, 2011 based on additional data obtained from special studies. Table 7-13-2 presents the implementation schedule for the responsible permittees.

Element	Key Findings and Regulatory Provisions
	Non storm water NPDES permits (including POTWs, other major, minor, and general permits): Permit writers may translate applicable waste load allocations into effluent limits for the major, minor and general NPDES permits by applying the effluent limitation procedures in Section 1.4 of the State Water Resources Control Board's Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (2000) or other applicable engineering practices authorized under federal regulations. Compliance schedules may be established in individual NPDES permits, allowing up to 5 years within a permit cycle to achieve compliance. Compliance schedules may not be established in general NPDES permits. A discharger that can not comply immediately with effluent limitations specified to implement waste load allocations will be required to apply for an individual permit in order to demonstrate the need for a compliance schedule. If a POTW demonstrates that advanced treatment (necessitating long design and construction timeframes) will be required to meet final waste load allocations, the Regional Board will consider extending the implementation schedule to allow the POTW up to January 11, 2016 to achieve compliance with the final WLAs. Permittees that hold individual NPDES permits and solely discharge storm water may be allowed (at Regional Board discretion) compliance schedules up to January 11, 2016 to achieve compliance with final WLAs. **General industrial storm water permits:** The Regional Board will develop a watershed-specific general industrial storm water permit to incorporate waste load allocations. <u>Dry-weather implementation</u> Non-storm water flows authorized by Order No. 97-03 DWQ, or any successor order, are exempt from the dry-weather waste load allocation equal to zero. Instead, these authorized non-storm water flows shall meet the reach-specific concentration-based waste load allocations assigned to the "other NPDES permits". The dry-weather waste load allocation equal to zero applies to unauthorized non-storm water flows, which are prohibited by Order No. 97-03 DWQ. It is anticipated that the dry-weather waste load allocations will be implemented by requiring improved best management practices (BMPs) to eliminate the discharge of non-storm water flows. However, permit writers must provide adequate justification and documentation to demonstrate that specified BMPs are expected to result in attainment of the numeric waste load allocations.

Element	Key Findings and Regulatory Provisions
	Wet-weather implementation General industrial storm water permittees are allowed interim wet-weather concentration-based waste load allocations based on benchmarks contained in EPA's Storm Water Multi-sector General Permit for Industrial Activities. The interim waste load allocations apply to all industry sectors and apply until no later than January 11, 2016. **Interim wet-weather WLAs for general industrial storm water permittees (total recoverable metals)*** **Cd (µg/L)** / **Cu(µg/L)** / **Pb(µg/L)** / **Zn(µg/L)**: 15.9 / 63.6 / 81.6 / 117 *Based on USEPA benchmarks for industrial storm water sector Until January 11, 2011, interim waste load allocations will not be interpreted as enforceable permit conditions. If monitoring demonstrates that interim waste load allocations are being exceeded, the permittee shall evaluate existing and potential BMPs, including structural BMPs, and implement any necessary BMP improvements. It is anticipated that monitoring results and any necessary BMP improvements would occur as part of an annual reporting process. After January 11, 2011, interim waste load allocations shall be translated into enforceable permit conditions. Compliance with permit conditions may be demonstrated through the installation, maintenance, and monitoring of Regional Board-approved BMPs. If this method of compliance is chosen, permit writers must provide adequate justification and documentation to demonstrate that BMPs are expected to result in attainment of interim waste load allocations. The general industrial storm water permits shall achieve final wet-weather waste load allocations no later than January 11, 2016, which shall be expressed as NPDES water quality-based effluent limitations. Effluent limitations may be expressed as permit conditions, such as the installation, maintenance, and monitoring of Regional Board-approved BMPs if adequate justification and documentation demonstrate that BMPs are expected to result in attainment of waste load allocations. **General construction storm water permits:** Waste load allocations will be incorporated into the State Board general permit upon renewal or into a watershed-specific general permit developed by the Regional Board. Dry-weather implementation Non-storm water flows authorized by the General Permit for Storm Water Discharges Associated with Construction Activity (Water Quality Order No. 99-08 DWQ), or any successor order, are exempt from the dry-weather waste load allocation equal to zero as long as they comply with the provisions of sections C.3.and A.9 of the Order No. 99-08 DWQ, which state that these authorized non-storm discharges

Element	Key Findings and Regulatory Provisions
	shall be (1) infeasible to eliminate (2) comply with BMPs as described in the Storm Water Pollution Prevention Plan prepared by the permittee, and (3) not cause or contribute to a violation of water quality standards, or comparable provisions in any successor order. Unauthorized non-storm water flows are already prohibited by Order No. 99-08 DWQ. <u>Wet-weather implementation</u> By January 11, 2013, the construction industry will submit the results of BMP effectiveness studies to determine BMPs that will achieve compliance with the final waste load allocations assigned to construction storm water permittees. Regional Board staff will bring the recommended BMPs before the Regional Board for consideration by January 11, 2014. General construction storm water permittees will be considered in compliance with final waste load allocations if they implement these Regional Board approved BMPs. All permittees must implement the approved BMPs by January 11, 2015. If no effectiveness studies are conducted and no BMPs are approved by the Regional Board by January 11, 2014, each general construction storm water permit holder will be subject to site-specific BMPs and monitoring requirements to demonstrate compliance with final waste load allocations. **MS4 and Caltrans permits** Applicable CTR limits are being met most of the time during dry weather, with episodic exceedances. Due to the expense of obtaining accurate flow measurements required for calculating loads, concentration-based permit limits may apply during dry weather. These concentration-based limits would be equal to dry-weather reach-specific numeric targets. Each municipality and permittee will be required to meet the storm water waste load allocations shared by the two MS4s and Caltrans permittees at the designated TMDL effectiveness monitoring points. A phased implementation approach, using a combination of non-structural and structural BMPs may be used to achieve compliance with the waste load allocations. The administrative record and the fact sheets for the MS4 and Caltrans storm water permits must provide reasonable assurance that the BMPs selected will be sufficient to implement the waste load allocations. The implementation schedule for the MS4 and Caltrans permittees consists of a phased approach. The watershed is divided into five jurisdictional groups based on the subwatersheds of the tributaries that drain to each reach of the river, as presented in Table 7-13-3. Each jurisdictional group shall achieve compliance in prescribed percentages of its subwatershed(s), with total compliance to be achieved within 22 years. Jurisdictional groups can be reorganized or subdivided upon approval by the Executive Officer.

Element	Key Findings and Regulatory Provisions
Seasonal Variations and Critical Conditions	Seasonal variations are addressed by developing separate waste load allocations for dry weather and wet weather. For dry weather, critical flows for each reach are established from the long-term flow records (1988-2000) generated by stream gages located throughout the watershed and in selected reaches. The median dry-weather urban runoff plus the combined design capacity of the three major POTWs is selected as the critical flow since most of the flow is from effluent which results in a relatively stable dry-weather flow condition. In areas where there are no flow records, an area-weighted approach is used to assign flows to these reaches. Wet-weather allocations are developed using the load-duration curve concept. The total wet-weather waste load allocation for wet weather varies by storm. Given this variability in storm water flows, no justification was found for selecting a particular sized storm as the critical condition.
Compliance Monitoring and Special Studies	Effective monitoring will be necessary to assess the condition of the Los Angeles River and its tributaries and to assess the on-going effectiveness of efforts by dischargers to reduce metals loading to the Los Angeles River. Special studies may also be appropriate to provide further information about new data, new or alternative sources, and revised scientific assumptions. Below the Regional Board identifies the various goals of monitoring efforts and studies. The programs, reports, and studies will be developed in response to subsequent orders issued by the Executive Officer. **Ambient Monitoring** An ambient monitoring program is necessary to assess water quality throughout the Los Angeles River and its tributaries and the progress being made to remove the metals impairments. The MS4 and Caltrans storm water NPDES permittees in each jurisdictional group are jointly responsible for implementing the ambient monitoring program. The responsible agencies shall sample for total recoverable metals, dissolved metals, including cadmium and zinc, and hardness once per month at each ambient monitoring location at least until the TMDL is re-considered at year 5. The reported detection limits shall be below the hardness adjusted CTR criteria. Eight ambient monitoring points currently exist in the Los Angeles River and its tributaries as part of the City of Los Angeles Watershed Monitoring Program. These monitoring points could be used to assess water quality.

<table>
<tr><th>Element</th><th>Key Findings and Regulatory Provisions</th></tr>
<tr><td></td><td>
<table>
<tr><th>Ambient Monitoring Points</th><th>Reaches and Tributaries</th></tr>
<tr><td>White Oak Avenue</td><td>LA River 6, Aliso Creek, McCoy Creek, Bell Creek</td></tr>
<tr><td>Sepulveda Boulevard</td><td>LA River 5, Bull Creek</td></tr>
<tr><td>Tujunga Avenue</td><td>LA River 4, Tujunga Wash</td></tr>
<tr><td>Colorado Boulevard</td><td>LA River 3, Burbank Western Channel, Verdugo Wash</td></tr>
<tr><td>Figueroa Street</td><td>LA River 3, Arroyo Seco</td></tr>
<tr><td>Washington Boulevard</td><td>LA River 2</td></tr>
<tr><td>Rosecrans Avenue</td><td>LA River 2, Rio Hondo (gage just above Rio Hondo)</td></tr>
<tr><td>Willow Street</td><td>LA River 1, Compton Creek (gage at Wardlow)</td></tr>
</table>

TMDL Effectiveness Monitoring

The MS4 and Caltrans storm water NPDES permittees in each jurisdictional group are jointly responsible for assessing progress in reducing pollutant loads to achieve the TMDL. Each jurisdictional group is required to submit for approval by the Executive Officer a coordinated monitoring plan that will demonstrate the effectiveness of the phased implementation schedule for this TMDL (See Table 7-13.2), which requires attainment of the applicable waste load allocations in prescribed percentages of each subwatershed over a 22-year period. The monitoring locations specified for the ambient monitoring program may be used as effectiveness monitoring locations.

The MS4 and Caltrans storm water NPDES permittees will be found to be effectively meeting dry-weather waste load allocations if the in-stream pollutant concentration or load at the first downstream monitoring location is equal to or less than the corresponding concentration- or load-based waste load allocation. Alternatively, effectiveness of the TMDL may be assessed at the storm drain outlet based on the waste load allocation for the receiving water. For storm drains that discharge to other storm drains, the waste load allocation will be based on the waste load allocation for the ultimate receiving water for that storm drain system. The MS4 and Caltrans storm water NPDES permittees will be found to be effectively meeting wet-weather waste load allocations if the loading at the downstream monitoring location is equal to or less then the wet-weather waste load allocation.

The general industrial storm water permit shall contain a model monitoring and reporting program to evaluate BMP effectiveness. A permittee enrolled under the general permit shall have the choice of conducting individual monitoring based on the model program or participating in a group monitoring effort. MS4 permittees are
</td></tr>
</table>

Element	Key Findings and Regulatory Provisions
	encouraged to take the lead in group monitoring efforts for industrial facilities within their jurisdiction because compliance with waste load allocations by these facilities will in many cases translate to reductions in metals loads to the MS4 system. The Tillman, LA-Glendale, and Burbank POTWs, and the remaining permitted discharges in the watershed will have effluent monitoring requirements to ensure compliance with waste load allocations. **Special Studies** The implementation schedule (see Table 7-13.2) allows time for special studies that may serve to refine the estimate of loading capacity, waste load and/or load allocations, and other studies that may serve to optimize implementation efforts. The Regional Board will re-consider the TMDL by January 11, 2011 in light of the findings of these studies. Studies may include: • Refined flow estimates for the Los Angeles River mainstem and tributaries where there presently are no flow gages and for improved gaging of low-flow conditions. • Water quality measurements, including a better assessment of hardness, water chemistry data (e.g., total suspended solids and organic carbon) that may refine the use of metals partitioning coefficients. • Effects studies designed to evaluate site-specific toxic effects of metals on the Los Angeles River and its tributaries. • Source studies designed to characterize loadings from background or natural sources • Review of water quality modeling assumptions including the relationship between metals and total suspended solids as expressed in the potency factors and buildup and washoff and transport coefficients. • Evaluation of aerial deposition and sources of aerial deposition. • POTWs that are unable to demonstrate compliance with final waste load allocations must conduct source reduction audits by January 11, 2008. • POTWs that will be requesting the Regional Board to extend their implementation schedule to allow for the installation of advanced treatment must prepare work plans, with time schedules to allow for the installation advanced treatment. The work plan must be submitted January 11, 2010.

Table 7-13.2 Los Angeles River and Tributaries Metals TMDL: Implementation Schedule

Date	Action
January 11, 2006	Regional Board permit writers shall incorporate waste load allocations into NPDES permits. Waste load allocations will be implemented through NPDES permit limits in accordance with the implementation schedule contained herein, at the time of permit issuance, renewal, or re-opener.
January 11, 2010	Responsible jurisdictions and agencies shall provide to the Regional Board results of the special studies. POTWs that will be requesting the Regional Board to extend their implementation schedule to allow for the installation of advanced treatment must submit work plans.
January 11, 2011	The Regional Board shall reconsider this TMDL to re-evaluate the waste load allocations and the implementation schedule.
NON-STORM WATER NPDES PERMITS (INCLUDING POTWS, OTHER MAJOR, MINOR, AND GENERAL PERMITS)	
Upon permit issuance, renewal, or re-opener	The non-storm water NPDES permits shall achieve waste load allocations, which shall be expressed as NPDES water quality-based effluent limitations specified in accordance with federal regulations and state policy on water quality control. Compliance schedules may allow up to 5 years in individual NPDES permits to meet permit requirements. Compliance schedules may not be established in general NPDES permits. If a POTW demonstrates that advanced treatment will be required to meet final waste load allocations, the Regional Board will consider extending the implementation schedule to allow the POTW up to January 11, 2016 to achieve compliance with the final WLAs. Permittees that hold individual NPDES permits and solely discharge storm water may be allowed (at Regional Board discretion) compliance schedules up to January 11, 2016 to achieve compliance with final WLAs.
GENERAL INDUSTRIAL STORM WATER PERMITS	
Upon permit issuance, renewal, or re-opener	The general industrial storm water permitees shall achieve dry-weather waste load allocations, which shall be expressed as NPDES water quality-based effluent limitations specified in accordance with federal regulations and state policy on water quality control. Effluent limitations may be expressed as permit conditions, such as the installation, maintenance, and monitoring of Regional Board-approved BMPs. Permittees shall begin to install and test BMPs to meet the interim wet-weather WLAs. BMP effectiveness monitoring will be implemented to determine progress in achieving interim wet-weather waste load allocations.

Date	Action
January 11, 2011	The general industrial storm water permits shall achieve interim wet-weather waste load allocations, which shall be expressed as NPDES water quality-based effluent limitations. Effluent limitations may be expressed as permit conditions, such as the installation, maintenance, and monitoring of Regional Board-approved BMPs. Permittees shall begin an iterative BMP process including BMP effectiveness monitoring to achieve compliance with final waste load allocations.
January 11, 2016	The general industrial storm water permits shall achieve final wet-weather waste load allocations, which shall be expressed as NPDES water quality-based effluent limitations. Effluent limitations may be expressed as permit conditions, such as the installation, maintenance, and monitoring of Regional Board-approved BMPs.
GENERAL CONSTRUCTION STORM WATER PERMITS	
Upon permit issuance, renewal, or re-opener	Non-storm water flows not authorized by Order No. 99-08 DWQ, or any successor order, shall achieve dry-weather waste load allocations of zero. Waste load allocations shall be expressed as NPDES water quality-based effluent limitations specified in accordance with federal regulations and state policy on water quality control. Effluent limitations may be expressed as permit conditions, such as the installation, maintenance, and monitoring of Regional Board-approved BMPs.
January 11, 2013	The construction industry will submit the results of wet-weather BMP effectiveness studies to the Regional Board for consideration. In the event that no effectiveness studies are conducted and no BMPs are approved, permittees shall be subject to site-specific BMPs and monitoring to demonstrate BMP effectiveness.
January 11, 2014	The Regional Board will consider results of the wet-weather BMP effectiveness studies and consider approval of BMPs.
January 11, 2015	All general construction storm water permittees shall implement Regional Board-approved BMPs.
MS4 AND CALTRANS STORM WATER PERMITS	
April 11, 2007	In response to an order issued by the Executive Officer, each jurisdictional group must submit a coordinated monitoring plan, to be approved by the Executive Officer, which includes both TMDL effectiveness monitoring and ambient monitoring. Once the coordinated monitoring plan is approved by the Executive Officer ambient monitoring shall commence within 6 months.

Date	Action
January 11, 2010 (Draft Report) July 11, 2010 (Final Report)	Each jurisdictional group shall provide a written report to the Regional Board outlining the how the subwatersheds within the jurisdictional group will achieve compliance with the waste load allocations. The report shall include implementation methods, an implementation schedule, proposed milestones, and any applicable revisions to the TMDL effectiveness monitoring plan.
January 11, 2012	Each jurisdictional group shall demonstrate that 50% of the group's total drainage area served by the storm drain system is effectively meeting the dry-weather waste load allocations and 25% of the group's total drainage area served by the storm drain system is effectively meeting the wet-weather waste load allocations.
January 11, 2020	Each jurisdictional group shall demonstrate that 75% of the group's total drainage area served by the storm drain system is effectively meeting the dry-weather WLAs.
January 11, 2024	Each jurisdictional group shall demonstrate that 100% of the group's total drainage area served by the storm drain system is effectively meeting the dry-weather WLAs and 50% of the group's total drainage area served by the storm drain system is effectively meeting the wet-weather WLAs.
January 11, 2028	Each jurisdictional group shall demonstrate that 100% of the group's total drainage area served by the storm drain system is effectively meeting both the dry-weather and wet-weather WLAs.

Table 7-13.3 Los Angeles River and Tributaries Metals TMDL: Jurisdictional Groups

Jurisdictional Group	Responsible Jurisdictions & Agencies	Subwatershed(s)
1	Carson County of Los Angeles City of Los Angeles Compton Huntington Park Long Beach Lynwood Signal Hill Southgate Vernon	Los Angeles River Reach 1 and Compton Creek
2	Alhambra Arcadia Bell Bell Gardens Bradbury Carson Commerce Compton County of Los Angeles Cudahy Downey Duarte El Monte Glendale Huntington Park Irwindale La Canada Flintridge Long Beach City of Los Angeles Lynwood Maywood Monrovia Montebello Monterey Park Paramount Pasadena Pico Rivera Rosemead San Gabriel San Marino Sierra Madre South El Monte South Pasadena Southgate Temple City Vernon	Los Angeles River Reach 2, Rio Hondo, Arroyo Seco, and all contributing sub watersheds
3	City of Los Angeles County of Los Angeles Burbank Glendale La Canada Flintridge Pasadena	Los Angeles River Reach 3, Verdugo Wash, Burbank Western Channel
4-5	Burbank Glendale City of Los Angeles County of Los Angeles San Fernando	Los Angeles River Reach 4, Reach 5, Tujunga Wash, and all contributing subwatersheds
6	Calabasas City of Los Angeles County of Los Angeles Hidden Hills	Los Angeles River Reach 6, Bell Creek, and all contributing subwatersheds

Attachment A to Resolution No. 03-009

Amendment to the Water Quality Control Plan – Los Angeles Region

to Incorporate the

Los Angeles River Nitrogen Compounds and Related Effects TMDL

Adopted by the California Regional Water Quality Control Board, Los Angeles Region on July 10, 2003.

Amendments

Table of Contents
Add:

List of Figures, Tables, and Inserts
Add:

Chapter 7. Total Maximum Daily Loads (TMDLs)
Los Angeles River Nitrogen Compounds and Related Effects TMDL

This TMDL was adopted by:

The Regional Water Quality Control Board on July 10, 2003.

This TMDL was approved by:

The State Water Resources Control Board on November 19, 2003.
The Office of Administrative Law on February 27, 2004.
The U.S. Environmental Protection Agency on March 18, 2004.

Deleted: [Insert Date]
Deleted: [Insert Date]
Deleted: [Insert Date]

Table 7-8.1. LOS ANGELES RIVER NITROGEN COMPOUNDS AND RELATED EFFECTS TMDL: Elements

Element	Los Angeles River Nitrogen Compounds and Related Effects TMDL
Problem Statement	Reaches of the Los Angeles River and its tributaries were listed as impaired for nitrogen compounds (ammonia, nitrate, and nitrate) and related effects such as algae, pH, odor, and scum on the 2002 303(d) list. These reaches were listed because numeric and narrative water quality objectives for nitrogen compounds and related effects were exceeded, thereby impairing warm, freshwater, and wildlife habitats, and recreation beneficial uses.
Numeric Target *(Interpretation of the numeric water quality objective, used to calculate the load allocations)*	Numeric targets for this TMDL are listed as follows: a) Total ammonia as nitrogen (NH_3-N) Numeric targets are dependent on temperature and pH of receiving water. Based on the last three years of temperature and pH data, the ammonia numeric targets for receiving waters correspondent to major discharge points are provided below: ***Receiving water correspondent to major discharge point*** ***One-hour average*** ***Thirty-day average*** Los Angeles River Reach 5 (within Sepulveda Basin) - Donald C. Tillman WRP 4.7 mg/L 1.6 mg/L Los Angeles River Reach 3 (Riverside Dr. to Figueroa St.) - Los Angeles/ Glendale WRP 8.7 mg/L 2.4 mg/L Burbank Western Channel - Burbank WRP 10.1 mg/L 2.3 mg/L b) Nitrate-nitrogen and nitrite-nitrogen ***Constituent*** ***Thirty-day average*** Nitrate-nitrogen (NO_3-N) 8 mg/L Nitrite-nitrogen (NO_2-N) 1 mg/L Nitrate-nitrogen plus nitrite-nitrogen (NO_3-N + NO_2-N) 8 mg/L Numeric targets to address narrative objectives required to protect warm

Element	**Los Angeles River Nitrogen Compounds and Related Effects TMDL**
	freshwater and wildlife habitats are intended to implement the narrative objectives and may be revised based on the results of monitoring and studies conducted pursuant to the implementation plan.
Source Analysis	The principal source of nitrogen compounds to the Los Angeles River is discharges from the Donald C. Tillman Water Reclamation Plant (WRP), the Los Angeles-Glendale WRP, and the Burbank WRP. During dry weather period, the major POTWs contribute 84.1% of the total dry weather nitrogen load. Urban runoff, stormwater, and groundwater discharge may also contribute nitrate loads. Further evaluation of these sources is set forth in the Implementation Plan.
Linkage Analysis	Linkage between nutrient sources and the instream water quality was established through hydrodynamic and water quality models. The Environmental Fluid Dynamics Code 1-D was used to model the hydrodynamic characteristics of the Los Angeles River and the Water Quality Analysis Simulation Program was used to model water quality. Additional studies were conducted to develop the residence time and determine the nutrient uptake rates by algae.
Wasteload Allocations (for point sources)	1. Major point sources: a) Total ammonia as nitrogen (NH_3-N): ***POTW*** ***One-hour average WLA*** ***Thirty-day average WLA*** Donald C. Tillman WRP 4.2 mg/L 1.4 mg/L Los Angeles-Glendale WRP 7.8 mg/L 2.2 mg/L Burbank WRP 9.1 mg/L 2.1 mg/L b) Nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N), and Nitrate-nitrogen plus nitrite-nitrogen (NO_3-N + NO_2-N): ***Constituent*** ***Thirty-day average WLA**** NO_3-N 7.2 mg/L

Element	Los Angeles River Nitrogen Compounds and Related Effects TMDL
	NO_2-N 0.9 mg/L NO_3-N + NO_2-N 7.2 mg/L *Receiving water monitoring is required on a weekly basis to ensure compliance with the water quality objective. 2. <u>Minor point sources</u>: Waste loads are allocated to minor point sources enrolled under NPDES or WDR permits including but not limited to Tapia WRP, Whittier Narrows WRP, Los Angeles Zoo WRP, industrial and construction stormwater, and municipal storm water and urban runoff from municipal separate storm sewer systems (MS4s): a) Ammonia wasteload allocations (WLAs) for minor point sources are listed below by receiving waters: ***Water Body*** ***One-hour average WLA*** ***Thirty-day average WLA*** Los Angeles River above Los Angeles-Glendale WRP (LAG) 4.7 mg/L 1.6 mg/L Los Angeles River below LAG 8.7 mg/L 2.4 mg/L Los AngelesTributaries 10.1 mg/L 2.3 mg/L b) WLAs for nitrate-nitrogen, nitrite-nitrogen, and nitrate-nitrogen plus nitrite-nitrogen for minor discharges are listed below: ***Constituent*** ***Thirty-day average WLA*** NO_3-N 8.0 mg/L NO_2-N 1.0 mg/L NO_3-N + NO_2-N 8.0 mg/L
Load Allocation *(for nonpoint*	The Source Assessment indicates that nitrogen loads from nonpoint sources are negligible compared to loading from point sources <u>and their contribution</u>

Element	Los Angeles River Nitrogen Compounds and Related Effects TMDL
sources)	is adequately accounted for in the margin of safety. Consequently, load allocations will not be developed unless it is determined they are necessary after load reductions are effected through implementation of the wasteload allocations. Additional monitoring is included in the implementation plan to verify the nitrogen nonpoint source contributions.
Implementation	1. Refer to Table 7-8.2 2. The Implementation Plan includes upgrades to the WRPs discharging to Los Angeles River for removal of ammonia, nitrate, and nitrite. At the discretion of the Regional Board, the following interim limits for ammonia, and nitrate plus nitrite will be allowed for major point sources for a period not to exceed 3.5 years from the effective date of this TMDL. Effluent limits for the individual compounds NO_3-N, and NO_2-N are not required during the interim period. ***Interim Limits for NH_3-N*** ***Total ammonia as Nitrogen*** ***POTW*** ***Daily Maximum**** ***Monthly Average**** Donald C. Tillman WRP 21.7 mg/L 21.0 mg/L Los Angeles-Glendale WRP 19.4 mg/L 16.5 mg/L Burbank WRP 24.1 mg/L 22.7 mg/L *The monthly average and daily maximum interim limits are based on the 95th and 99th percentiles of effluent performance data reported by dischargers. ***Nitrite-nitrogen + Nitrate-nitrogen*** ***Monthly Average*** 8.0 mg/L The Implementation Plan also includes additional studies to evaluate the effectiveness of nitrogen reductions on related effects such as algae growth, odors and scum. Ammonia and nitrate reductions will be regulated through effluent limits prescribed in NPDES permits.
Margin of Safety	An explicit margin of safety of 10% of the ammonia, nitrate, nitrite and nitrate + nitrite loads is allocated to address uncertainty in the sources and linkage analyses. In addition, an implicit margin of safety is incorporated

Element	Los Angeles River Nitrogen Compounds and Related Effects TMDL
	through conservative model assumptions and statistical analysis.
Seasonal Variations and Critical Conditions	The critical condition identified for this TMDL is based on low flow condition. The driest six months of the year are the most critical condition for nutrients because less surface flow is available to dilute effluent discharge.

Table 7-8.2. IMPLEMENTATION SCHEDULE **Implementation Tasks**	**Completion Date**
1. Apply interim limits for NH_3-N and NO_3-N + NO_2-N to major Publicly Owned Treatment Works (POTWs). 2. Apply Waste Load Allocations (WLAs) to minor point source dischargers and MS4 permittees. 3. Begin to include monitoring for nitrogen compounds in NPDES permits for minor NPDES dischargers above 0.1 mgd as permits are renewed.	Effective Date of TMDL
4. Submittal of a Monitoring Work Plan by MS4 permittees to estimate nitrogen loadings associated with runoff loads from the storm drain system for approval by the Executive Officer of the Regional Board. The Work Plan will include monitoring for ammonia, nitrate, and nitrite. The Work Plan may include a phased approach wherein the first phase is based on monitoring from the existing mass emission station in the Los Angeles River. The results will be used to calibrate the linkage analysis. The Work Plan will also contain protocol and a schedule for implementing additional monitoring if necessary. The Work Plan will also propose triggers for conducting source identification and implementing BMPs, if necessary. Source identification and BMPs will be in accordance with the requirements of MS4 permits.	1 year after the Effective Date of TMDL
5. Submittal of a Workplan by major NPDES permittees to evaluate the effectiveness of nitrogen reductions on removing impairments from algae odors, scums, and pH for approval by the Executive Officer of the Regional Board. The monitoring program will include instream monitoring of algae, foam, scum, pH, and odors in the Los Angeles River. In addition, groundwater discharge to Los Angeles River will also be analyzed for nutrients to determine the magnitude of these loadings and the need for load allocations. The Workplan will include protocol and schedule for refining numeric targets for nitrogen compounds and related effects such as excessive algae in the Los Angeles River. The Workplan will also contain protocol and a schedule for identification of limiting nutrients.	1 year after the Effective Date of TMDL
6. Submission of a special studies Workplan by the City of Los Angeles to evaluate site-specific objectives for ammonia, nitrate, and nitrite, including the following issues: pH and temperature distribution downstream of the D.C. Tillman WRP to determine the point of compliance for ammonia, establishment of ammonia WLAs based on seasonality.	1 year after Effective Date of TMDL
2. Submission of all results from Task 6, and results from water effects ratio study for ammonia which has been performed by the City of Los Angeles.	No later than 2.5 years after Effective Date of TMDL.

Table 7-8.2. IMPLEMENTATION SCHEDULE **Implementation Tasks**	**Completion Date**
8. Regional Board considers site-specific objectives for ammonia, nitrate, nitrite and nitrite + nitrate and revision of wasteload allocations based on results from Tasks 6 and 7. The Regional Board will consider factors such as seasonal variation, averaging periods, and water effects ratios when determining whether it is appropriate to adopt site-specific objectives for ammonia. If a site specific objective is adopted by the Regional Board, and approved by relevant approving agencies, this TMDL will need to be revised, readopted, and reapproved to reflect the revised water quality objectives.	No later than 3.5 years after Effective Date of TMDL.
9. Interim limits for ammonia and nitrate + nitrite expire and WLAs for ammonia, nitrate, nitrite, and nitrate + nitrite apply to major point sources.	3.5 years after Effective Date of TMDL
10. Complete evaluation of monitoring for nutrient effects and determine need for revising wasteload allocations, including but not limited to establishing new WLAs for other nutrient and related effects such as algal growth	4 years after Effective Date of TMDL
11. Regional Board considers results of Tasks 5 and 10 and revises or establishes WLAs as appropriate.	5 years after Effective Date of TMDL

Attachment A to Resolution No. 03-016

Revision of interim effluent limits for ammonia in the Amendment to the Water Quality Control Plan for the Los Angeles Region to include a TMDL for Nitrogen Compounds and Related Effects in the Los Angeles River, Resolution 03-009

Adopted by the California Regional Water Quality Control Board, Los Angeles Region on December 4, 2003.

Amendments

Tables
7-8.1 Los Angeles River Nitrogen Compounds and Related Effects TMDL: Elements

This TMDL was adopted by:

The Regional Water Quality Control Board on December 4, 2003.

This TMDL was approved by:

The State Water Resources Control Board on March 24, 2004.
The Office of Administrative Law on September 27, 2004.
The U.S. Environmental Protection Agency on [Insert Date].

Table 7-8.1. LOS ANGELES RIVER NITROGEN COMPOUNDS AND RELATED EFFECTS TMDL: Elements

Element	Los Angeles River Nitrogen Compounds and Related Effects TMDL
Implementation	2. The Implementation Plan includes upgrades to the WRPs discharging to Los Angeles River for removal of ammonia, nitrate, and nitrite. At the discretion of the Regional Board, the following interim limits for ammonia, and nitrate plus nitrite will be allowed for major point sources for a period not to exceed 3.5 years from the effective date of this TMDL. Effluent limits for the individual compounds NO_3-N, and NO_2-N are not required during the interim period. ***Interim Limits for NH_3-N and NO_3-N + NO_2-N*** ***Total ammonia as Nitrogen*** ***POTW*** ***Daily Maximum**** ***Monthly Average**** Donald C. Tillman WRP ~~21.7~~ 24.7 mg/L ~~21.0~~ 20.5 mg/L Los Angeles-Glendale WRP ~~19.4~~ 24.2 mg/L ~~16.5~~ 18.8 mg/L Burbank WRP 24.1 mg/L 22.7 mg/L *The monthly average and daily maximum interim limits are based on the 95th and 99th percentiles of effluent performance data reported by dischargers. ***Nitrite-nitrogen + Nitrate-nitrogen*** ***Monthly Average*** 8.0 mg/L

Attachment A to Resolution No. 07-012

Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate the TMDL for Trash in the Los Angeles River Watershed

Adopted by the California Regional Water Quality Control Board, Los Angeles Region on August 9, 2007.

Amendments:

Table of Contents
Add:

Chapter 7. Total Maximum Daily Loads (TMDLs) Summaries

List of Figures, Tables and Inserts
Add:

Chapter 3. Water Quality Objectives
Regional Objectives for Inland Surface Waters

Floating Material 3-9

A fourth paragraph will be added under Floating Material referencing specific guidelines for the Los Angeles River. Additional narrative to read: "See additional regulatory guidelines described under the Los Angeles River Trash Total Maximum Daily Load (Chapter 7)."

Solid, Suspended, or Settleable Materials 3-16

A fourth paragraph will be added under Solid, Suspended, or Settleable Materials referencing specific guidelines for the Los Angeles River. Additional narrative to read: "See additional regulatory guidelines described under the Los Angeles River Trash Total Maximum Daily Load (Chapter 7)."

* The complete administrative record for the TMDL is available for review upon request.

Attachment A to Resolution No. 2007-012

Chapter 7. Total Maximum Daily Loads (TMDLs) Summaries, Section 7-2 (Los Angeles River Watershed Trash TMDL)

This TMDL was adopted by the Regional Water Quality Control Board on August 9, 2007.

This TMDL was approved by:
The State Water Resources Control Board on [Insert Date].
The Office of Administrative Law on [Insert Date].
The U.S. Environmental Protection Agency on [Insert Date].

The following table includes all the elements of this TMDL.

Table 7-2.1. Los Angeles River Watershed Trash TMDL: Elements

Element	Key Findings and Regulatory Provisions
Problem Statement	Trash in the Los Angeles River is causing impairment of beneficial uses. The following designated beneficial uses are impacted by trash: water contact recreation (REC1); non-contact water recreation (REC2); warm freshwater habitat (WARM); wildlife habitat (WILD), estuarine habitat (EST); marine habitat (MAR); rare and threatened or endangered species (RARE); migration of aquatic organisms (MIGR); spawning, reproduction and early development of fish (SPWN); commercial and sport fishing (COMM); shellfish harvesting (SHELL); wetland habitat (WET); and cold freshwater habitat (COLD).
Numeric Target *(Interpretation of the numeric water quality objective, used to calculate the waste load allocations)*	Zero trash in all waterbodies.
Source Analysis	Stormwater discharge is the major source of trash in the river. Nonpoint sources, i.e., direct deposition of trash by people or wind into the water body, is a de minimus source of trash loading to the LA River.
Loading Capacity	Zero
Waste Load Allocations	Baseline Waste Load Allocations for each city in the Los Angeles River Watershed are as provided in Table 7.2.2. The TMDL requires phased reductions over a period of 9 years, from existing baseline loads to zero (0). Phase II stormwater permittees (including educational institutions) also have a final wasteload allocation of zero. An implementation schedule for these permittees will be established once their stormwater permit has been developed.
Load Allocations	The load allocations for nonpoint source trash discharges to the LA River are zero.
Implementation	This TMDL will be implemented through stormwater permits and via the authority vested in the Executive Officer by section 13267 of the Porter-Cologne Water Quality Control Act: (Water Code section 13000 et seq.). Compliance with the final waste load allocation may be achieved through a full capture system. A full capture system is any device or series of devices that traps all particles retained by a 5 mm mesh screen and has a design treatment capacity of not less than the peak flow rate (Q) resulting from a one-year, one-hour, storm in the subdrainage area. The Rational Equation is used to compute the peak flow rate: $Q = C \times I \times A$, where Q = design flow rate (cubic feet per second, cfs); C = runoff coefficient (dimensionless); I = design rainfall intensity (inches per

Element	Key Findings and Regulatory Provisions
	hour, as determined per the rainfall isohyetal map in Figure A), and A= subdrainage area (acres). The isohyetal map may be updated annually by the Los Angeles County hydrologist to reflect additional rain data gathered during the previous year. Annual updates published by the Los Angeles County Department of Public Works are prospectively incorporated by reference into this TMDL and accompanying Basin Plan amendment. The Executive Officer has authority to certify, as full-capture, any trash reduction system that meets the operating and performance requirements as described above. To the extent nonpoint source implementation of load allocations is necessary, it will be accomplished, consistent with the *Plan for Nonpoint Source Pollution Control Policy*, with waste discharge requirements, waivers of waste discharge requirements, or any appropriate order, including a cleanup and abatement order, pursuant to e.g., sections 13263, 13269, and/or 13304. An implementation report, outlining how responsible agencies intend to comply with the TMDL, will be prepared six months after the effective date of the TMDL.
Margin of Safety	"Zero discharge" is a conservative standard which contains an implicit margin of safety.
Seasonal Variations and Critical Conditions	Discharge of trash from the storm drain occurs primarily during or shortly after a rain event of greater than 0.25 inches.

Figure A

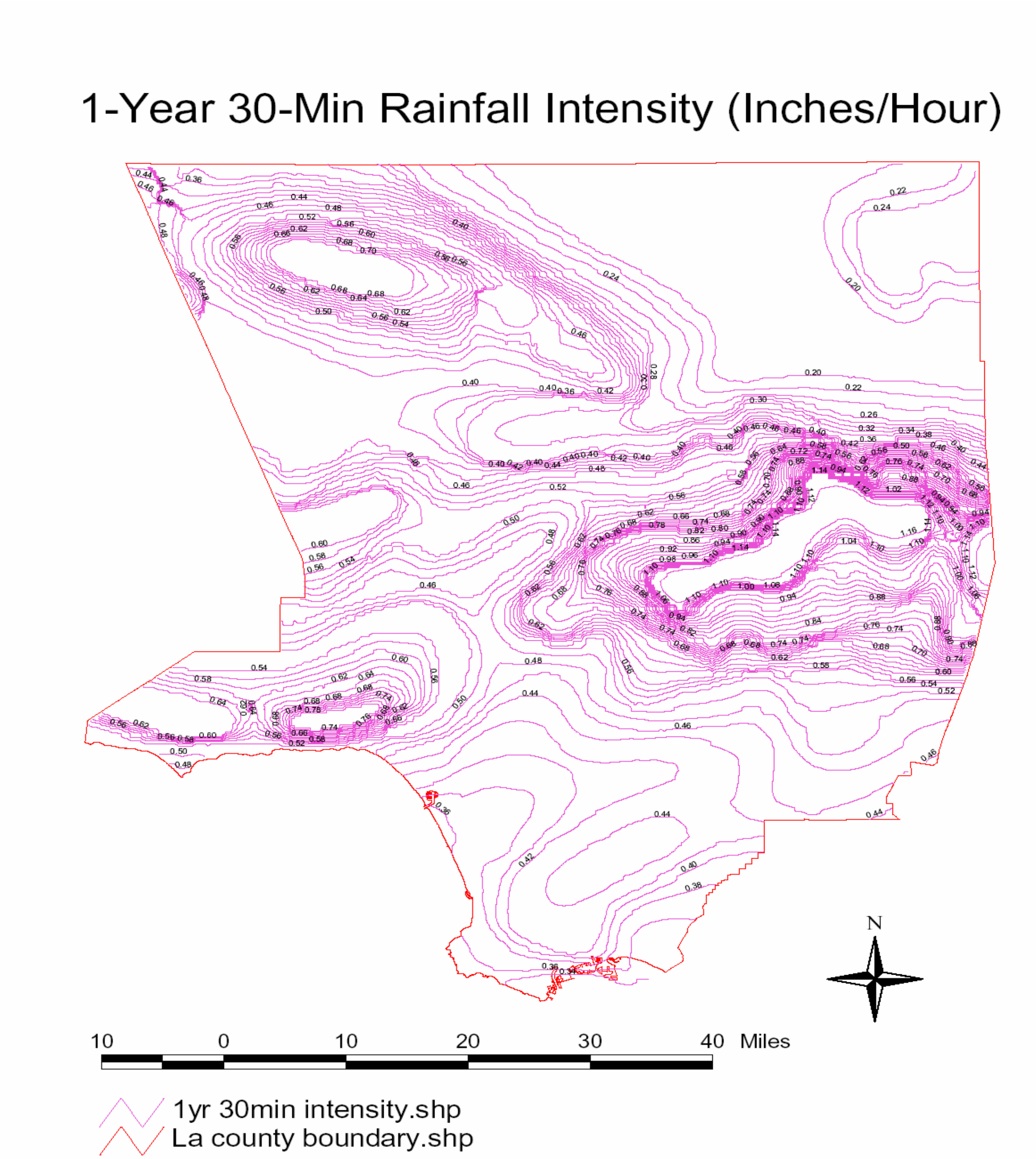


Figure A: Isohyethal Map of Rainfall Intensities in Portions of Los Angeles County

Attachment A to Resolution No. 2007-012

Table 7-2.2. Los Angeles River Trash TMDL Baseline Waste Load Allocations (gallons and lbs of trash).

City	WLA (gals)	WLA (lbs)
Alhambra	39903	68761
Arcadia	50108	93036
Bell*	16026	25337
Bell Gardens	13500	23371
Bradbury	4277	12160
Burbank*	92590	170389
Calabasas	22505	52230
Carson	6832	10208
Commerce	58733	85481
Compton*	53191	86356
Cudahy	5935	10061
Downey	39063	68507
Duarte	12210	23687
El Monte	42208	68267
Glendale*	140314	293498
Hidden Hills	3663	10821
Huntington Park	19159	30929
Irwindale	12352	17911
La Cañada Flintridge	33496	73747
Long Beach*	87135	149759
Los Angeles*	1374845	2572500
Los Angeles County*	310223	651806
Lynwood	28201	46467
Maywood	6129	10549
Monrovia	46687	100988
Montebello	50369	83707
Monterey Park	38899	70456
Paramount	27452	44490
Pasadena*	111998	207514
Pico Rivera	13953	22549
Rosemead	27305	47378
San Fernando	13947	23077
San Gabriel	20343	36437
San Marino	14391	29147
Santa Clarita	901	2326
Sierra Madre	11611	25192
Signal Hill	9434	14220
Simi Valley	137	344
South El Monte	15999	24319
South Gate	43904	72333
South Pasadena	14907	28357
Temple City	17572	31819
Vernon	47203	66814
Caltrans	59421	66566

*Military Installations were not included in calculation of Baseline WLA.

August 9, 2007

Table 7.2.3. Los Angeles River Trash TMDL: Implementation Schedule.[1]

(Required percent reductions based on initial baseline wasteload allocation of each city)

End of Storm Year	Implementation	Waste Load Allocation	Compliance Point
Sept 30, 2008	Implementation: Year 1	60% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans	Compliance is 60% of the baseline load
Sept 30, 2009	Implementation: Year 2	50% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans	Compliance is 55% of the baseline load calculated as a 2-year annual average
Sept 30, 2010	Implementation: Year 3[2]	40% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans	Compliance is 50% of the baseline load calculated as a rolling 3-year annual average
Sept 30, 2011	Implementation: Year 4	30% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans	Compliance is 40% of the baseline load calculated as a rolling 3-year annual average
Sept 30, 2012	Implementation: Year 5	20% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans	Compliance is 30% of the baseline load calculated as a rolling 3-year annual average
Sept 30, 2013	Implementation: Year 6	10% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans	Compliance is 20% of the baseline load calculated as a rolling 3-year annual average
Sept 30, 2014	Implementation: Year 7	0% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans	Compliance is 10% of the baseline load calculated as a rolling 3-year annual average
Sept 30, 2015	Implementation: Year 8	0% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans	Compliance is 3.3% of the baseline load calculated as a rolling 3-year annual average
Sept 30, 2016	Implementation: Year 9	0% of Baseline Waste Load Allocations for the Municipal permittees; and Caltrans	Compliance is 0% of the baseline load calculated as a rolling 3-year annual average

[1] "Notwithstanding the zero trash target and the baseline waste load allocations shown in Table 5, a Permittee will be deemed in compliance with the Trash TMDL in areas served by a Full Capture System within the Los Angeles River Watershed."

[2] As specified in Section VI.A., the Regional Board will review and reconsider the final Waste Load Allocations once a reduction of 50% has been achieved and sustained in the watershed.

Appendix B. Monitoring Data and Analysis

A variety of monitoring has been conducted in the Los Angeles watershed. The majority of data has been collected by LACDPW and SCCWRP. Data summarized for this report include recent data (since 1997) collected at mass loading stations by LACDPW and SCCWRP. Station information is provided in Table B-1. The monitoring station locations (including all monitored sites) are indicated on the maps that follow (Figure B-1, Figure B-2). The maps present both wet (and unspecified) and dry monitoring locations.

Table B-1. Los Angeles River Watershed Monitoring Stations

Source	Station ID Number	Start	Stop	Station Description
LACDPW	S10	1/1/1997	4/9/2007	Los Angeles River – ME station
	TS01	11/8/2002	2/2/2004	Aliso Creek at Saticoy Street
	TS02	11/8/2002	2/2/2004	Bull Creek at Victory Blvd
	TS03	11/8/2002	2/2/2004	Burbank Western System at Riverside Drive
	TS04	11/8/2002	2/2/2004	Verdugo Wash at Jackson Street
	TS05	11/8/2002	2/2/2004	Arroyo Seco Channel at Griffin Ave
	TS06	11/8/2002	2/2/2004	Rio Hondo Channel upstream of Beverly Blvd.
SCCWRP	ME01	1/26/2001	11/12/2001	ME LA River above Arroyo Seco
	ME02	1/26/2001	11/1/2003	Verdugo Wash
	ME03	1/26/2001	2/3/2004	ME LA River at Wardlow
	ME04	2/10/2001	4/7/2001	Arroyo Seco

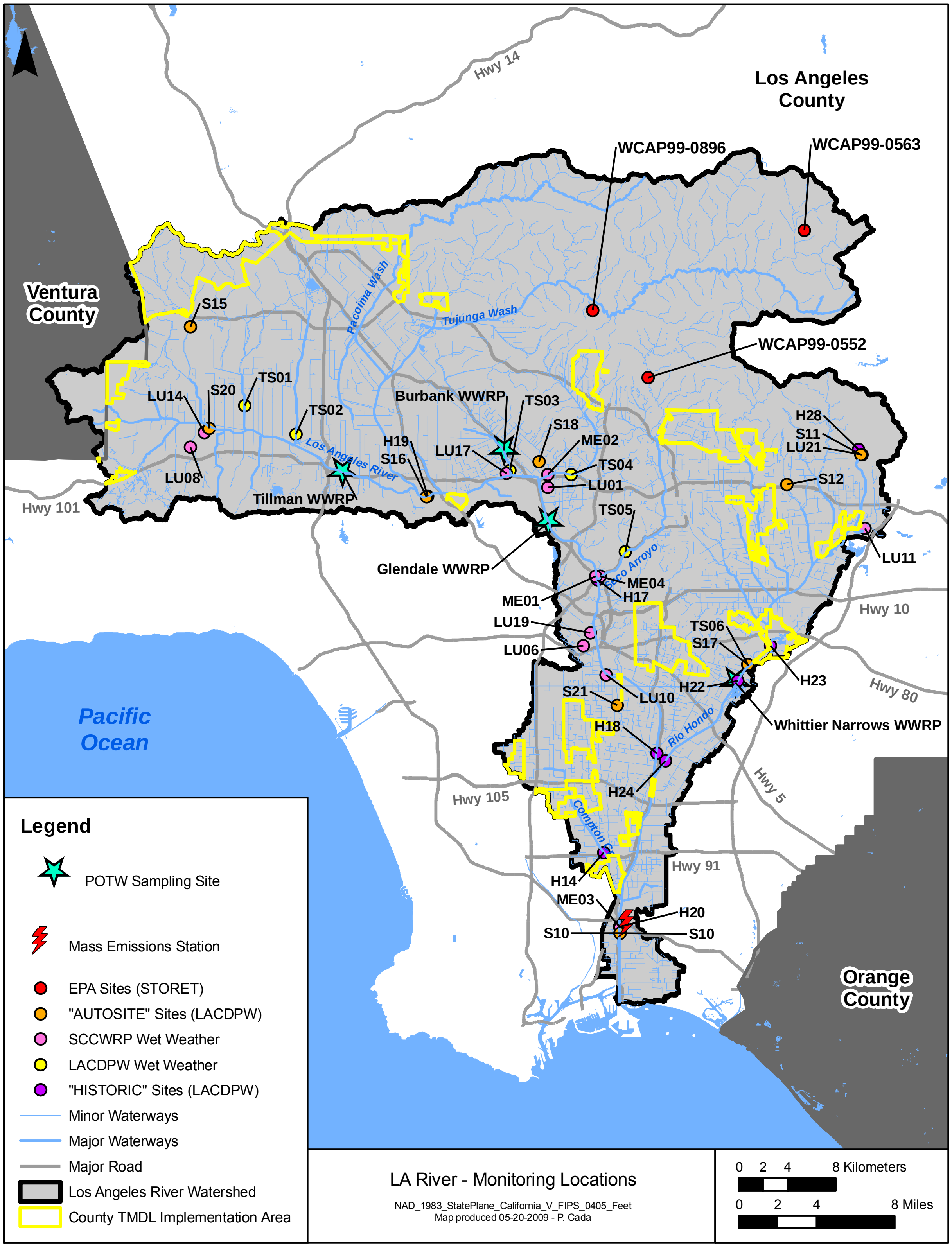


Figure B-1. Los Angeles Watershed Wet Weather Monitoring Locations

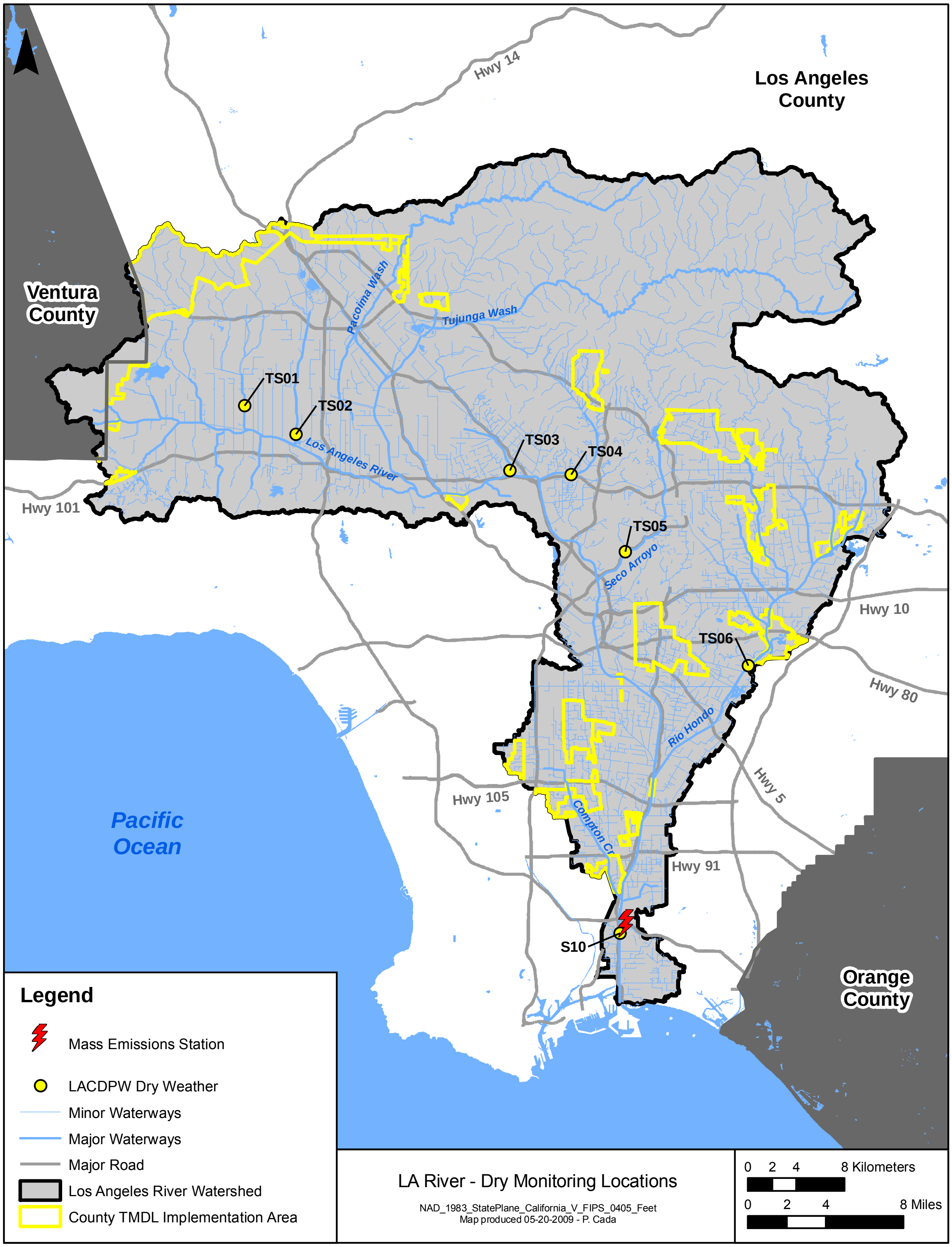


Figure B-2. Los Angeles River Watershed Dry Weather Monitoring Locations

B.1. Wet Weather Monitoring

Flow-weighted mean concentrations were calculated for the selected LACDPW and SCCWRP monitoring sites in the Los Angeles River watershed (Table B-2 through Table B-6). The discussion that follows focuses on comparing several tributary stations (Aliso Creek, Bull Creek, Verdugo Wash, Arroyo Seco, and Rio Hondo).

Metals concentrations (copper, lead, and zinc) and fecal coliform tend to be lower at upper tributary stations (TS01, TS02) compared to those further downstream in the watershed. SCCWRP sampling suggests some of the highest metal concentrations are found at the Verdugo Wash site, although LACDPW puts it more in line with TS05 and TS06. Cadmium and selenium results fall within relatively narrow ranges and do not differ greatly between sites, particularly when comparing median LACDPW values. One exception is the non-detects for selenium at TS04.

Average nutrient concentrations fall within relatively tight ranges among all stations for LACDPW data. Average TP was usually between 0.4 and 0.7 mg/L. TN was high with average values for regular LACDPW data greater than 4 mg/L. The lowest average and median TN was at the Verdugo Wash site.

Few detectable levels of the legacy pollutant DDT have been observed at mass emissions stations in the Los Angeles Region (4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were measured). Ackerman and Schiff (2003) report EMCs for DDT for only agricultural land use (others were not detected). PCBs and chlordane are also referred to as legacy pollutants, and similar to DDT, watershed sources of those pollutants might exist but are difficult to pinpoint. However, no detectable levels of PCBs and chlordane have been observed at County mass emissions stations.

PAHs are more common than legacy pollutants described above; however, they are non-detect in regular LACDPW sampling. Flouranthene, phenanthrene, and pyrene are the most commonly detected in SWCCRP sampling. Several others have been detected. The range of total PAHs in the MS4 water quality assessment was 523 to 5,256 ng/L. The highest values were found at ME02 (Verdugo Wash). Stein et al. (2006) found that the dominant source of origin was pyrogenic (combustion of organic matter) in the Los Angeles region that was deposited through atmospheric deposition. The mean EMC for PAHs in this research is 2,300 ng/L.

Table B-2. Wet Weather Monitoring of Heavy Metals (Zinc, Copper, Lead, in µg/L) in the Los Angeles River Watershed

Station	Total Zinc					Total Copper					Total Lead				
	Count	Min	Max	Avg.	Med	Count	Min	Max	Avg.	Med	Count	Min	Max	Avg.	Med
S10[a]	29	21.3	2,590	226	104	34	8.2	424	45	20	28	1.6	1,070	61.2	8.2
TS01	8	45	289	102	80	8	11.9	73	26	17	8	1.1	19	4.5	1.7
TS02	9	10	324	75	37	9	6.7	65	19	9	9	1	203	24.7	1.6
TS03	9	53	240	123	115	9	11.2	103	34	25	9	1.4	34	8.1	2.1
TS04	9	44	223	100	71	9	7.8	62	24	18	9	1.5	30	13.1	14.3
TS05	9	40	926	199	68	9	6.4	92	28	21	9	1.4	292	38.9	2.5
TS06	9	39	395	108	68	9	10.7	123	29	14	9	2.1	71	12.2	2.8
ME01	3	83.8	548.2	240	87	3	17.1	148	61	19	3	9.5	89	36.8	11.9
ME02	4	74.3	1,002.9	476	413	4	15.4	160	90	92	4	8.6	128	71.7	75.2
ME03	5	56.1	937.7	333	201	5	10.3	151	53	30	5	4.4	100	42.2	29.9
ME04	2	77.3	129.4	103	103	2	11.9	22	17	17	2	8.7	19	14	14

a. Storm 1/1/1999 for S10 removed from analysis because samples were reported discretely and flow data was unavailable to calculate a flow-weighted mean.

Table B-3. Wet Weather Monitoring of Cadmium and Selenium in the Los Angeles River Watershed (µg/L)

Station	Weather	Total Cadmium					Total Selenium				
		Count	Min	Max	Avg	Med	Count	Min	Max	Avg	Med
S10	Wet	13	0.27	11.0	2.1	0.60	6	1.06	4.1	2.3	1.60
TS01	Wet	3	0.398	1.0	0.6	0.43	1	2.5	2.5	2.5	2.50
TS02	Wet	3	0.29	3.2	1.5	0.86	1	1.04	1.0	1.0	1.04
TS03	Wet	5	0.25	1.2	0.6	0.44	2	1.21	3.6	2.4	2.39
TS04	Wet	5	0.3	142.0	28.7	0.32	0	Non Detect			
TS05	Wet	3	0.4	2.3	1.1	0.62	2	1.36	2.20	1.78	1.78
TS06	Wet	2	0.33	1.4	0.9	0.88	2	1.27	1.86	1.57	1.57
ME01	Wet	1	3.02	3.0	3.0	3.02	0	Not Sampled			
ME02	Wet	2	3.16	3.4	3.3	3.29	0	Not Sampled			
ME03	Wet	3	0.94	2.9	1.7	1.19	0	Not Sampled			
ME04	Wet	0	Non Detect				0	Not Sampled			

Table B-4. Wet Weather Monitoring of Fecal Coliform in the Los Angeles River Watershed (MPN/100 mL)

Station	Fecal Coliform					
	Count	Min	Max	Avg	Median	GeoMean
S10	30	2,400	24,000,000	1,457,780	240,000	233,361
TS01	9	11,000	110,000	51,333	34,000	38,890
TS02	9	5,000	140,000	49,556	30,000	32,427
TS03	9	800	130,000	49,200	30,000	27,794
TS04	9	11,000	500,000	184,889	170,000	108,020
TS05	10	17,000	500,000	152,700	100,000	108,760
TS06	9	17,000	500,000	170,778	80,000	110,941
ME01	3	5,773	51,214	21,050	6,163	12,214
ME02	3	8,394	96,009	38,166	10,095	20,112
ME03	3	4,763	11,900	7,707	6,458	7,153
ME04	2	12,291	19,440	15,866	15,866	15,458

Table B-5. Wet Weather Monitoring of Nutrients in the Los Angeles River Watershed (mg/L)

Station	TP					TN				
	Count	Min	Max	Avg	Med	Count	Min	Max	Avg	Med
S10	34	0.19	2.00	0.56	0.49	25	1.62	31.84	6.05	4.76
TS01	8	0.38	2.25	0.73	0.51	5	1.10	15.16	6.81	6.51
TS02	8	0.05	1.39	0.36	0.21	6	2.27	12.88	7.13	6.40
TS03	8	0.26	1.99	0.68	0.50	9	2.46	16.69	6.74	5.97
TS04	9	0.23	1.05	0.46	0.37	6	1.23	12.01	4.42	2.70
TS05	9	0.20	1.43	0.61	0.48	7	3.24	34.37	11.77	6.93
TS06	8	0.28	1.03	0.49	0.42	9	1.40	13.16	5.81	4.75

There was an insufficient number of samples and detections in the SCCWRP ME data.

Table B-6. Wet Weather Monitoring of PAHs in the Los Angeles River Watershed (ng/L)

Parameter	2/10/2001	11/12/2001		4/7/2001	11/1/2003	5/2/2003	2/2/2004
	ME04	ME01	ME02	ME04	ME02	ME03	ME03
1-Methylnaphthalene	13.6	29.7	46.0	ND	76.8	ND	78.3
2,3,5-Trimethylnaphthalene	ND	ND	ND	ND	88.6	ND	57.9
2,6-Dimethylnaphthalene	23.6	135.0	361.6	ND	90.0	ND	126.0
2-Methylnaphthalene	10.6	63.7	78.5	ND	124.9	ND	129.4
Acenaphthene	10.9	19.4	27.7	ND	15.8	ND	42.5
Anthracene	12.4	39.9	58.2	16.1	30.7	ND	40.5
Benz(a)anthracene	50.5	235.1	355.9	47.7	206.8	ND	116.0
Benzo(a)pyrene	34.7	152.6	200.4	40.8	228.4	ND	139.4
Benzo(b)fluoranthene	53.5	382.1	551.8	60.8	382.1	ND	246.4
Benzo(e)pyrene	44.6	209.1	274.5	51.2	321.6	ND	241.2
Benzo(g,h,i)perylene	44.4	164.7	151.9	45.5	369.6	ND	312.5
Benzo(k)fluoranthene	21.9	96.5	135.3	25.0	295.1	ND	205.0
Biphenyl	11.3	89.6	103.3	ND	32.6	ND	114.0
Chrysene	94.7	287.0	456.1	89.4	460.7	ND	328.8
Dibenz(a,h)anthracene	12.2	33.1	40.9	ND	47.3	ND	52.7
Fluoranthene	125.7	475.9	780.8	152.7	639.1	143.6	455.7
Naphthalene	ND	78.3	96.0	ND	120.1	ND	166.2
PAH Total	ND	3473.5	5,255.9	871.4	5,095.5	523.2	4,100.7
Perylene	16.8	53.6	163.9	ND	94.1	ND	78.3
Phenanthrene	88.9	308.4	452.8	112.3	350.4	97.4	308.6
Pyrene	119.7	450.8	710.5	144.4	683.5	135.9	462.8

B.2. Dry Weather Monitoring

Statistical summaries of dry weather concentrations were developed for selected LACDPW sites (Table B-7 through Table B-10). Hot spots for dry weather metals include TS03 for zinc and copper and TS06 for zinc. These sites also have high fecal coliform, although concentrations are lower than in wet weather monitoring. Nutrient concentrations were just as high, or higher in some cases, compared to wet weather data. Chlordane, DDT, PCBs, and PAHs were not detected in these data.

Table B-7. Dry Weather Monitoring of Heavy Metals (Zinc, Copper, Lead, in µg/L) in the Los Angeles River Watershed

Station	Total Zinc					Total Copper					Total Lead				
	Count	Min	Max	Avg	Med	Count	Min	Max	Avg	Med	Count	Min	Max	Avg	Med
S10	10	22.3	133	47	34	10	8.7	26	17	17	10	0.8	4	2	2
TS01	3	16.8	88	48	39	3	15.4	29	21	20	3	0.7	2	1	1
TS02	3	13.9	66	38	33	3	6.7	27	14	8	2	1.1	2	1	1
TS03	3	57.9	137	108	128	3	17.4	40	30	32	3	1.4	2	2	2
TS04	3	15	57	31	21	3	4.2	19	11	11	3	0.8	1	1	1
TS05	3	9.98	60	36	38	3	7.1	17	12	12	3	0.9	2	1	1
TS06	3	68	87	77	76	3	5.6	24	17	21	3	0.7	2	2	2

Table B-8. Dry Weather Monitoring of Cadmium and Selenium in the Los Angeles River Watershed (µg/L)

Station	Weather	Total Cadmium					Total Selenium				
		Count	Min	Max	Avg	Med	Count	Min	Max	Avg	Med
S10	Dry	0	Non Detect				9	1.87	7.2	3.5	2.90
TS01	Dry	1	0.80	0.80	0.80	0.80	2	4.39	5.2	4.8	4.77
TS02	Dry	1	0.47	0.47	0.47	0.47	2	1.46	2.7	2.1	2.07
TS03	Dry	0	Non Detect				2	3.18	3.6	3.4	3.37
TS04	Dry	0	Non Detect				2	1.02	1.2	1.1	1.09
TS05	Dry	0	Non Detect				2	1.69	1.9	1.8	1.78
TS06	Dry	0	Non Detect				1	1.13	1.1	1.1	1.13

Table B-9. Dry Weather Monitoring of Fecal Coliform in the Los Angeles River Watershed (MPN/100mL)

Station	Fecal Coliform					
	Count	Min	Max	Avg	Median	GeoMean
S10	16	20	16,000,000	1,110,015	2,400	4,474
TS01	3	200	500	333	300	311
TS02	3	80	17,000	6,127	1,300	1,209
TS03	3	80	50,000	16,960	800	1,474
TS04	3	80	500	270	230	210
TS05	3	300	1,700	833	500	634
TS06	3	40	50,000	17,113	1,300	1,375

Table B-10. Dry Weather Monitoring of Nutrients in the Los Angeles River Watershed (mg/L)

Station	TP					TN				
	Count	Min	Max	Avg	Med	Count	Min	Max	Avg	Med
S10	10	0.21	8.24	1.22	0.48	10	2.92	11.74	6.73	6.99
TS01	3	0.17	0.69	0.35	0.19	2	4.79	6.20	5.49	5.49
TS02	3	0.11	0.41	0.21	0.12	1	2.98	2.98	2.98	2.98
TS03	3	1.46	1.99	1.75	1.81	3	3.61	6.95	5.52	5.99
TS04	3	0.10	0.15	0.12	0.10	3	1.79	2.35	2.04	2.00
TS05	0	ND				2	3.51	16.74	10.12	10.12
TS06	3	0.07	0.48	0.31	0.39	3	4.40	7.96	6.49	7.12

B.3. References

Ackerman, D., and K. Schiff. 2003. Modeling storm water mass emissions to the Southern California Bight. *Journal of Environmental Engineering* 129(4):308–317.

Stein, E.D., L.L. Tiefenthaler, and K. Schiff. 2006. Watershed-based sources of polycyclic aromatic hydrocarbons in urban storm water. *Environmental Toxicology and Chemistry* 25(2):373–385.

Appendix C. Public Information and Participation Programs

The County has several Public Information and Participation Programs. Most of these programs are organized by the Public Relations Group, including the Stormwater/Urban Runoff Education Program, the Used Oil and Filter Recycling Program, Environmental Defenders, Generation Earth, Plan-It Earth, and the Restaurant Training Program. In addition to programs run by the Public Relations Group, the County also supports the Brake Pad Partnership. The Environmental Programs Division (EPD) promotes the 888-Clean-LA hotline and www.CleanLA Web site, which direct the public to all the County's environmental programs. Each of these programs is described in detail below.

C.1. Stormwater/Urban Runoff Education Program

C.1.1. Goals and Objectives

- Receive 35 million impressions annually
- Reach numerical behavior change targets
- K-12 education
- Comply with all additional public involvement and public participation requirements in the 2001 permit
- Behavior change targets
  - Dumping used motor oil into storm drains from 6 percent to 2 percent
  - Littering from 13 percent to 10 percent
  - Hosing leaves and dirt into the street from 12 percent to 9 percent
  - Dumping directly into the storm drains from 5 percent to 2 percent
  - Dropping cigarette butts on the ground from 16 percent to 12 percent
  - Leaving dog droppings on the ground from 4 percent to 1 percent
  - Rinsing out paint brushes into the street from 6 percent to 2 percent
  - Emptying car ashtrays into the street from 3 percent to 1 percent

C.1.2. Description

A comprehensive outreach campaign to target urban runoff and polluted stormwater runoff. The program was launched to educate the public about what they can do to prevent pollution and keep local waterways clean to help meet water quality requirements. The program uses a variety of different outreach efforts to demonstrate the effect of everyday activities on the environment.

C.1.3. Target Audience

Home mechanics, general public, homeowners, managers of restaurants and retail gas outlets chains, vehicle owners who change their oil and oil filters

C.1.4. Message Packaging or Supporting Materials

Current program outreach activities include paid advertising, media relations, and corporate partnerships. In addition, the program provides technical assistance to the incorporated cities to help promote cohesive pollution prevention efforts throughout the region.

- Public service announcements (PSAs)
  - Dog waste Web banner advertisement

- Pool Web banner advertisement
- Cigarette Web banner advertisement
- Bus king dog waste advertisement
- Bus king pool advertisement
- Bus shelter dog waste advertisement
- Bus shelter pool advertisement
- Bus shelter cigarettes advertisement
- Yard waste Web banner advertisement
- Over water Web banner advertisement
- Spanish litter bug advertisement
- LED ribbon board
- Television PSA slate
- Manhattan Beach pool/spa flyer
- Good cleaning practices—food and restaurant industry
- Managing fats, oil, and grease BMP poster
- Recycle used oil posters
- Used oil filter exchange event posters

- Tip cards
  - Pick up after your pooch
  - Don't paint the town red
  - A yard is a terrible thing to waste
  - Are you a litter bug and don't know it?
  - Storm drains are for rain and recycling tips handout
- Press releases
  - It is a spring cleaning season: Keep the watershed clean too!
  - Cigarette butt litter is choking Los Angeles
  - Pick up after your pooch!
  - It's back to school time! LACDPW reminds residents to teach kids an important lesson: Put trash where it belongs!
  - With storm season approaching, the County of Los Angeles advises residents to keep their street gutters clean!
- News clips
  - Cigarette butt litter is choking Los Angeles County
  - Street cleaning
  - Friday is take your dog to work day
- Reports and presentations
  - County of Los Angeles fiscal year 2007–08 summary of stormwater education activities
  - County of Los Angeles fiscal year 2007–08 assessment of in-school stormwater education programs
  - Stormwater public education program resident population—Tracking evaluation
- Billboards
- Movie theater advertisements
- Business outreach program
  - County departments
  - Independent pet stores, veterinary hospitals, County animal shelters
  - Private companies with more than 500 employees
  - Collateral materials
  - PSAs and newsletter articles
  - Corporate and community partnership programs
- Public participation events
  - Co-sponsor coastal cleanup day
    - Schools have competitions for picking up the most trash

- Attend countywide outreach events on request
    - Organizations frequently request that LACDPW attend community events to provide informational materials, collateral items, and a watershed model display
    - Usually staff from the Public Relations Group, Watershed Management Division (WMD), or EPD provide collateral materials and attend the events
- Public education and participation advisory panel
    - Representatives from the environmental community, co-permittee cities, regional support staff, and public education and marketing experts
- A seasonal campaign for the proper disposal of sanitary waste from recreational vehicles (RVs)
    - The 2009 press release was distributed in July. The press release contains information on proper disposal of RV septage

C.1.5. Languages

All products are in English. The following materials/messages are in other languages:

- PSAs
    - Litter bug advertisement
        - Spanish
    - Managing fats, oil, and grease BMP poster
        - English
        - Spanish
        - Mandarin
- Tip Cards
    - A yard is a terrible thing to waste
        - English
        - Spanish

C.1.6. Evaluation Method

In 1997 before the start of the new public outreach campaign, the County collected baseline data concerning residents' attitudes and behaviors. An annual telephone interview of randomly selected County residents is used to collect information on the outreach campaign. The results are compared to the baseline data to determine if there was an increase or decrease in self-reporting of conducting polluting behaviors. The County also tracks hotline calls and Web site hits.

C.1.7. Program Cost

The contract budget for this program is $790,000 in fiscal year 2009–2010. A new agreement is being prepared in fiscal year 2009-2010, but will not be awarded until fiscal year 2010–2011. Prior to this fiscal year, the contract amount was $1.5 million.

C.1.8. Division

Public Relations Group

C.2. Used Motor and Oil Filter Recycling Program

C.2.1. Goals and Objectives

Reduce the incidence of illegal disposal of used oil in landfills and storm drains by educating the public about used oil recycling options.

C.2.2. Description

This education campaign encourages home mechanics (i.e., do-it-yourselfers) to recycle used motor oil and oil filters at certified collection events or centers.

C.2.3. Target Audience

Home mechanics

C.2.4. Message Packaging or Supporting Materials

2009 Sample Advertisements and Flyers

- Used Motor Oil Branding Advertisement
- Upcoming Used Motor Oil and Filter Collection Events Flyer
- Used Motor Oil and Oil Filter Collection Event Flyer
- Upcoming Used Oil Filter Exchange Events Flyer
- Used Oil Filter Exchange Event Flyer

Certified Collection Support and Outreach

- Site visits
- Oil container giveaway promotion
- Co-sponsorship of oil recycling and oil filter exchange events
- Temporary mobile collection event

C.2.5. Languages

English, Spanish, Chinese, Korean, Vietnamese, Cambodian

C.2.6. Evaluation Method

The amount of used motor oil collected, the amount of used oil filters collected, and a telephone survey is used to evaluate the program.

C.2.7. Program Cost

The contract amount for this program was $475,000 dollars in fiscal year 2009–2010. This program is mostly funded through a grant.

C.2.8. Division

Public Relations Group

C.3. Environmental Defenders

C.3.1. Goals and Objectives

Environmental Defenders educates and empowers elementary school children in the County to protect the local environment. The program offers a free school assembly and other programs to help local schools with a number of environmental issues.

C.3.2. Description

The program is a 30-minute school assembly program for elementary school children. The program involves two professional children's theatre actors and teaches children how to protect the environment.

C.3.3. Target Audience

Elementary school children

C.3.4. Message Packaging or Supporting Materials

- Teacher resource packet
- Activity book
- Lyrics and songs
- Tip sheets
- Pledge cards
- Certificates
- Program CDs

C.3.5. Languages

English

C.3.6. Evaluation Method

Teacher surveys, teacher focus groups, and student assessments are used to evaluate the program. Approximately 890 teachers were surveyed.

C.3.7. Program Cost

The contract amount for this program is $700,000 in fiscal year 2010–2011.

C.3.8. Division

Public Relations Group

C.4. Generation Earth

C.4.1. Goals and Objectives

The LACDPW partners with TreePeople, an environmental volunteer organization, to develop and implement an environmental education program primarily aimed at teens. Generation Earth was created to educate middle and high school students to reduce the amount of waste going to landfills and pollutants going into waterways. The program helps teachers, schools, and communities to implement campus and community projects that produce positive measurable effects on the environment.

C.4.2. Description

Generation Earth is an environmental education program from LACDPW. They offer professional development workshops, mentorship, and assistance with service learning projects that help youth make a positive difference at school, at home, and, eventually, out in the world. This program is presented by TreePeople for secondary school children and encourages students to make a difference in their local environment through campus and eco-projects.

C.4.3. Target Audience

Secondary school children

C.4.4. Message Packaging or Supporting Materials

Generation Earth has organized its Web site into four sections: Students, Teachers, Schools, and Youth Groups. Materials related to each section are listed below.

For Students

- Publications
  - Waste audit
  - Water audit
  - Project manager action guide
  - Student action guide
  - Service project idea mapping

For Teachers

- Publications
  - Waste audit
  - Water audit
  - Teacher action guide
  - Student action guide
  - Project manager action guide
- Activities/Tools
  - Environmental behaviors bingo
  - Check this out activity
  - Make a difference activity
  - Service project idea mapping
  - Lesson plan builder
  - Pre/post test
  - Generation Earth project experience
- Lesson plans
- Field trip ideas
- Bus request form

For Schools

- Workshops

For Youth Groups

- What a waste action booklet
- From the streets to the sea action booklet
- Registration form
- Teen action project final report

C.4.5. Languages

English

C.4.6. Evaluation Method

Teacher surveys, teacher focus groups, and student assessments are used to evaluate the program.

C.4.7. Program Cost

The contract amount for this program was $670,000 in fiscal year 2009–2010.

C.4.8. Division

Public Relations Group

C.5. Plan-It Earth

C.5.1. Goals and Objectives

Educate students about environmental issues by providing a subscription to the *Los Angeles Times*.

C.5.2. Description

This program was started in 1993 and the current contract is pending. This program involves an 8-week subscription to the *Los Angeles Times* to improve student's knowledge on environmental issues by reading the paper. The program also involves a teacher's guide and lesson plans. Students can write an essay or create a piece of art related to environmental issues. The winner's essay or art is published in the *Los Angeles Times*.

C.5.3. Target Audience

6th to 9th grade children

C.5.4. Message Packaging or Supporting Materials

All materials are provided by the contractor who assumes all costs of development, production, and administration of the program.

- Teacher's guide
- Lesson plans
- *Los Angeles Times* subscription
- Program announcement cards
- Flyer and program updates
- Broadcast FAX
- Four quarter-page advertisements in the *Los Angeles Times*
- Certificates

- T-shirts
- Award ceremony
- Teacher packets
    - Parent letter in English and Spanish
    - Curriculum materials
    - Workshop flyer

C.5.5. Languages

All materials are in English, and the parent letter is presented in both English and Spanish.

C.5.6. Evaluation Method

Monthly report and post-program evaluation is performed by the contractor. The monthly report includes a summary of the following:

- Work completed during the month
- Work expected to be completed during the next month
- Name of schools, including location and grades registered for this program
- Names of teachers, school name, and grade level of teachers who attended the workshops
- Listing of schools that were contacted regarding this program
- Status of public outreach campaign
- Total number of schools enrolled
- Report is due the third Monday of each month
- An updated budget for each task

The contractor will provide a final analysis of the program within 2 months of the end of each program year that documents all work completed. The analysis will also include any program enhancement recommendations.

C.5.7. Program Cost

The contract amount for this program was $25,000 in fiscal year 2009–2010. The County does not intend to renew this contract.

C.5.8. Division

Public Relations Group

C.6. Restaurant and Retail Gas Outlet Training Program

C.6.1. Goals and Objectives

The goal of the restaurant and retail gas outlet training program is to reduce the amount of oil and grease in runoff from restaurants.

C.6.2. Description

The County program for restaurant BMPs started in 2004 and includes restaurant BMP guidelines, a watershed model showing the potential for oil and grease to affect the watershed, a PowerPoint presentation that is available on its Web site, role playing, and collateral materials for owners including posters, buckets with BMPs printed on them, brochures, and the like. Public Relations Group invites restaurants and/or retail gas outlets owners, corporate managers, and employees in specific watersheds or cities to training events at least once a year.

C.6.3. Target Audience

Restaurant and Retail Gas Outlets owners, corporate managers and employees

C.6.4. Message Packaging or Supporting Materials

- Restaurant BMP guidelines
- Watershed model showing the potential for oil and grease to affect the watershed
- PowerPoint presentation (available on the Web site)
- BMP training program
- Workshops
- Collateral materials including posters and buckets
- Partner with co-permittee cities for list of restaurants and retail gas outlets

C.6.5. Languages

English and Spanish

C.6.6. Evaluation Method

EPD staff conduct stormwater inspections for restaurants in the unincorporated areas of the County, and they handle appropriate follow-up for BMP violations.

Public Relations Group invites restaurant or retail gas outlet owners/managers to BMP workshops in their community. LACDPW staff or a consultant contacts invitees to confirm workshop attendance and responds to requests for collateral materials.

C.6.7. Program Cost

The Public Relations Group provided staff rates involved with the restaurant BMP trainings. Public Relations Group staff involved with BMP training include administrative assistants levels II ($51.93 per hour) and III ($57.88 per hour), program managers level I ($61.26 per hour) and II ($69.48 per hour), and management specialist level I ($76.86 per hour), as well as outside consultants. In the past it has taken the Public Relations Group three to six months to plan a training event. The County typically sends out approximately 600 letters for each annual training workshop. The cost to conduct a BMP workshop (which is done annually) is approximately $13,000, which includes the labor cost of the consultant, mailings, refreshments, and the like.

C.6.8. Division

Public Relations Group

C.7. (888)Clean LA

C.7.1. Goals and Objectives

EPD developed the (888)Clean LA hotline and www.CleanLA.com Web site to educate the public about the County's many environmental programs and to provide the public with important information about protecting the environment.

C.7.2. Description

The (888)Clean LA hotline and www.CleanLA.com Web site provides a wide variety of environmental information and services to the public in both English and Spanish and has grown to become an important resource for environmental information. More than 150 different Web sites now link to the information accessible through www.CleanLA.com, on topics such as Yard Waste Recycling, Used Motor Oil Centers, Household Hazardous Waste, Business Recycling and more. The Web site is well organized and easy to navigate.

C.7.3. Target Audience

General Public, Contractors, Business Owners

C.7.4. Message Packaging or Supporting Materials

The hotline and Web site are tools for residents to use to learn more about the proper disposal of household hazardous waste, used motor oil recycling, stormwater pollution prevention, illegal dumping, and other environmental issues.

The Web site provides information about several environmental issues including links to programs and information for trash collection, tire recycling/rubberized asphalt, yard waste management programs, 3 Rs (reduce, reuse, recycle), industrial waste, solid waste, household hazardous waste, used motor oil, underground storage tanks, construction and demolition debris, youth education, stormwater pollution prevention, water conservation, and illegal dumping.

C.7.5. Languages

The site is in English and Spanish

C.7.6. Division

Environmental Programs Division

Appendix D. Field Investigations for Distributed BMPs

Field investigations at each of the 24 identified parcel groups were performed to evaluate key soil and infiltration characteristics that are essential to understanding how distributed structural BMPs can take advantage of soil properties. The field investigations are described in the following sections.

D.1. Methods

D.1.1. Infiltration Rate

The County's *Low Impact Development Standards Manual* (County of Los Angeles 2009) recommends that the infiltration rate be at least 0.5 in/hr for infiltration BMPs, such as bioretention. Soil infiltration rate was verified using the *Standard Test Method for Infiltration Rate in Field Soils Using Double-Ring Infiltrometer* specified in American Society for Testing and Materials (ASTM) D 3385 (ASTM 2009). That test measures infiltration rates for soils with a hydraulic conductivity between 10^{-6} centimeters per second (cm/s) and 10^{-2} cm/s. The double-ring infiltrometer (Figure D-1) used consists of two rings where the ratio of the diameter of the inner and outer rings is approximately two. Where possible, the soils were excavated to the approximate depth of the base of a potential distributed-type BMP. The rings were sealed by forcing them into the soil a few inches (Figure D-2).

Figure D-1. Double Ring Infiltrometer

Figure D-2. Sealing the Rings

The inner and outer rings were filled with water, and the initial level of water in the inner ring, outer ring, and current time (effectively time 0) were recorded (Figure D-3). All three parameters were measured and recorded approximately every 5 minutes. The test was completed when enough time elapsed, typically around 2 hours, to determine the surface infiltration rate (USEPA 1999). The infiltration rate is equivalent to the maximum steady-state or average incremental infiltration velocity (ASTM 2009).

For each site, the double-ring infiltrometer test was performed three times at different locations in close proximity (Figure D-4). The surface infiltration rate for each site was determined by averaging the results from the three test locations. By performing the tests at three locations, the variability of the infiltration rates at each site can be documented. A log of the soil borings performed in the water table analysis was recorded to help classify the soils, to verify the HSG, and to help determine the infiltration rates.

Figure D-3. Infiltrometer Test Setup

Figure D-4. Site Investigation

D.1.2. Water Table

A combination of methods was used to determine the depth of the water table at each site. The County's *Hydrology Manual* (County of Los Angles 2006) and the Natural Resources Conservation Service (NRCS) soils data were referenced to estimate the depth of the water table corresponding to the soil type at the site. At least one boring with a soil log was performed at each site (Figure D-5). Typical water table indicators were indentified, such as soil mottling and reduced soils, to determine the seasonal high water table depth. Monitoring well data collected by the LACDPW was also compared to the observed water table depths to help estimate the water table depth.

Note: Depth to the water table is not a defining characteristic of the site.

Figure D-5. Soil Boring

D.1.3. Soils Classification

Soils were classified using the U.S. Department of Agriculture (USDA) Textural Triangle (USDA NRCS 2007). The distribution of the HSG classification for each soil boring is presented graphically in Table D-1 through Table D-3, and Table D-4 provides a text version.

Table D-1. Soil Boring Composition for HSG A Soils

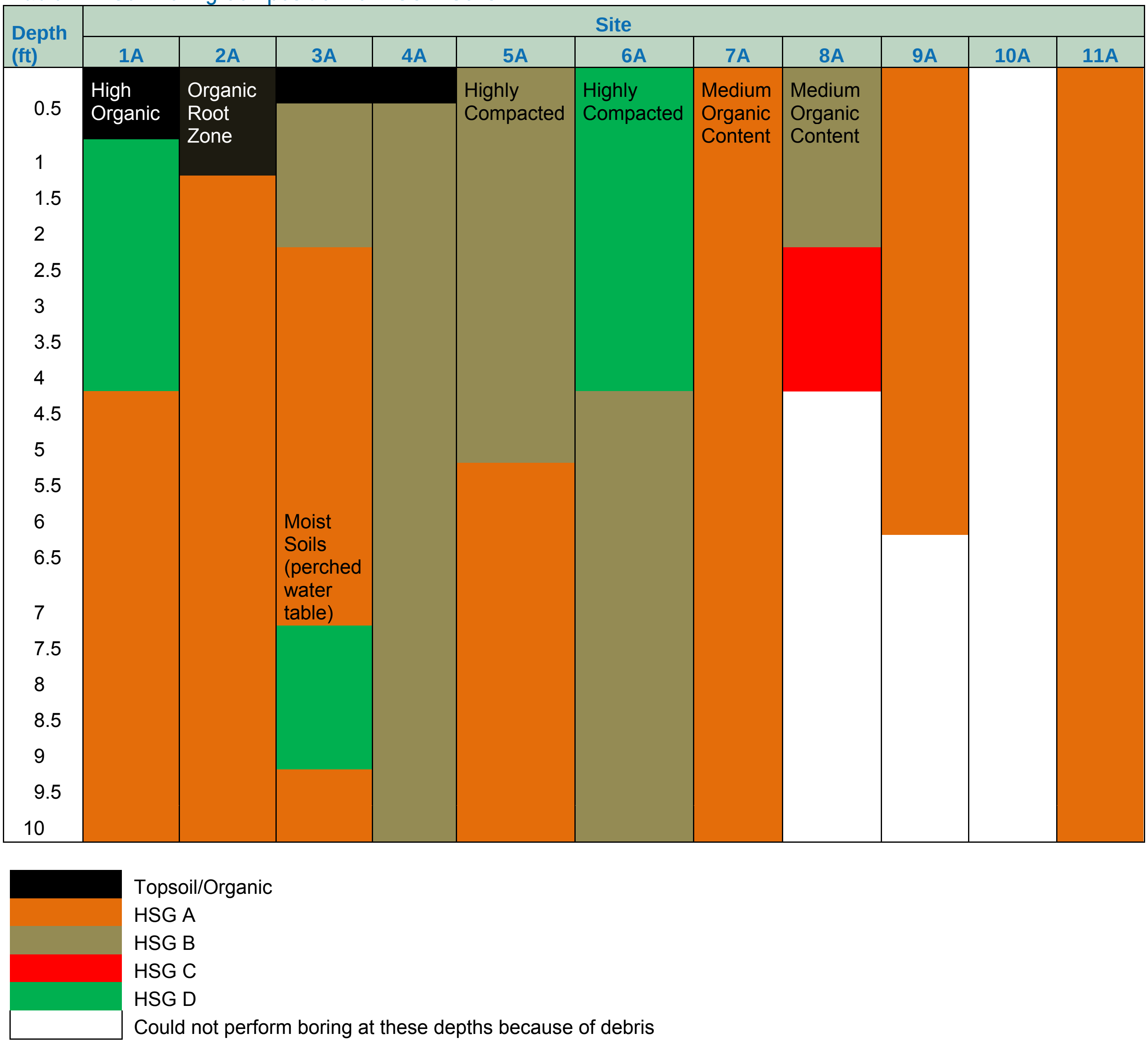
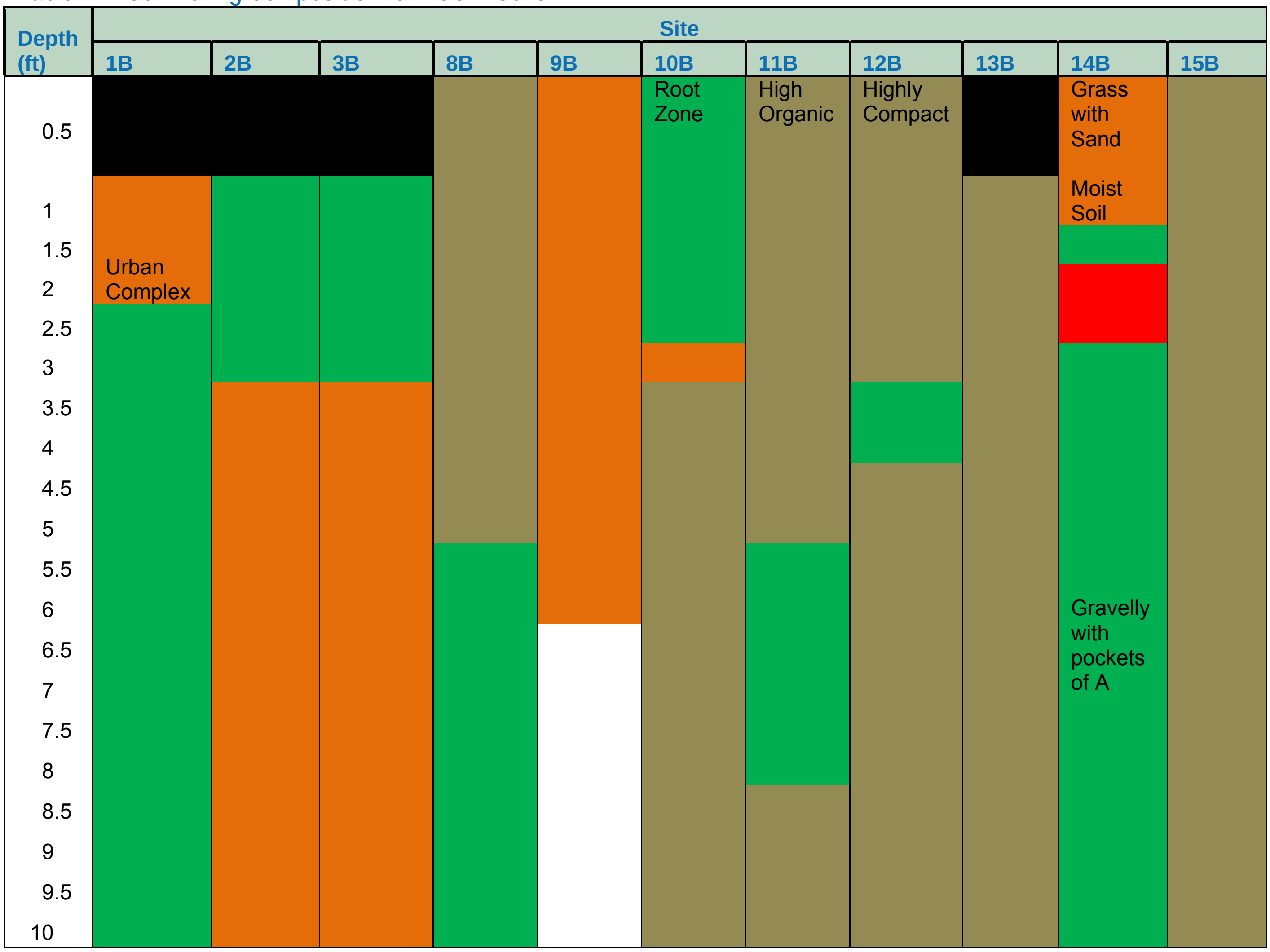


Table D-2. Soil Boring Composition for HSG B Soils



Topsoil/Organic
HSG A
HSG B
HSG C
HSG D
Could not perform boring at these depths because of debris

Table D-3. Soil Boring Composition for HSG C Soils

Depth (ft)	Site	
	2C	3C
0.5		Urban Complex
1		
1.5		
2		
2.5		
3		
3.5		
4		
4.5		
5		
5.5		
6		
6.5		
7		
7.5		
8		
8.5		
9		
9.5		
10		

Topsoil/Organic
HSG A
HSG B
HSG C
HSG D
Could not perform boring at these depths because of highly compacted soils

Table D-4. Soil Boring Log

Site	Boring Soil Sample Composition				
1A	0-10 inches top soil	10 inches–4 ft, sandy clay (D)	4–7 ft, sandy loam/loamy sand (A)	7–10 ft, sand	
2A	0–0.5 ft, organic root zone	0.5 to 4 ft, loamy sand (A)	4–7 ft, loamy sand to sandy loam (A)	7–10 ft, sand with some fines (A)	
3A	0–1 ft silt loam (B)	1–2ft, loam (B)	2–7 ft, sandy loam (A)	7–9 ft, clay (D)	9–10 ft, sand (A)
4A	0–10 ft, silt loam (B)				
5A	0–2 ft, loam (B)	2–5 ft, silt loam (B)	5–9 ft, loamy sand (A)		
6A	0–4 ft, silty clay loam (D)	4–10 ft, silt loam (B)			
7A	0–1 ft, sandyloam, medium o.c. (A)	1–2 ft, gravelly sandy loam (A)	2–4 ft, gravelly sandy loam (A)		
8A	0–2 ft, loam, medium o.c. (B)	2–4 ft, sandy clay loam, low o.c. (C)	N/A	N/A	
9A	0–6ft, sandy loam (A)	could not go deeper due to debris			
10A	N/A	N/A	N/A	N/A	
11A	0–1 ft, loamy sand (A)	1–2.5 ft, sandy loam (A)	2.5–9 ft, loamy sand (A)		
1B	0–4 inches Root Zone, highly organic	4 inches–2 ft, Sandy Loam Urban Complex (A)	2–6 ft, Clay (D)	6–10 ft, Sandy Clay (D)	
2B	0–4 inches root zone	4 inches–3 ft Sandy Clay (D)	3–5 ft, Sandy Loam (A)	5–10 ft, loamy sand (A)	
3B	0–4 ft, organic	4 inches–3 ft, sandy clay (D)	3–5 ft, sandy loam (A)	5–10 ft, loamy sand (A)	
8B	0–2 ft, loam to clay loam, with medium organic matter content (B–C)	2–3 ft, silt loam (B)	3–5 ft, loam (B)	5–10 ft, clay loam (D)	
9B	0–6 ft, sandy loam (A)	could not go deeper due to debris			
10B	0–2.5 ft, clay loam (D)	2.5–3 ft, sandy loam (A)	3.5–9 ft, clay loam (B)		
11B	0–2 ft, silt loam, high organic (B)	2–5 ft, silt loam (B)	5–8 ft, silty clay loam (D)	8–10 ft, silt loam (B)	
12B	0–3 ft, loam (B)	3–4 ft, clay loam (D)	4–10 ft, loamy sand with pockets of silt loam (A–B)		
13B	0–6 inches topsoil, organic	6 inches–10 ft, silt loam (B)			
14B	0–1 ft, grass sand	1–1.5 ft, clay (D)	1.5–2.5ft, sandy clay loam (C)	2.5–3.5 ft, gravelly loamy sand (A)	3.5–5 ft, gravelly sandy clay loam (D with some A)

Site	Boring Soil Sample Composition				
15B	0–10 ft, silty loam (B)				
2C	0–3 ft, clay loam (D)	could not go deeper due to compaction			
3C	0–2 inches, root zone	2 inches–1 ft, urban complex	1–3 ft, clay with organics (D)	3–10 ft, clay (D)	

D.2. Results and Discussion

D.2.1. Infiltration Rate

According to the USDA NRCS, each HSG exhibits the range of infiltration rates presented in Table D-5.

Table D-5. NRCS Hydrologic Soil Group

HSG	Min		Max
A	7.8 in/hr		
B	0.8 in/hr	to	7.8 in/hr
C	0.1 in/hr	to	0.8 in/hr

Source: Soil Survey Division Staff 1993

The infiltration rates presented in Table D-6 and the soil boring compositions shown in Table D-1 through Table D-4 were collected between June 12, 2009, and July 10, 2009. The reported management category at one of the sites is not accurate compared with the observations in the field. Site 13B, Rio Hondo High School, was rated in management category C; however, observations made at the site indicate that the site is in management category E. The site was evaluated with the observed management category. Each of the sites investigated show some variability in the measured infiltration rate. All 24 sites, with the exception of one HSG C site, have an average measured infiltration rate greater than 0.5 in/hr—the minimum infiltration rate recommended by the County's *LID Manual*—making them suitable for infiltration style BMPs (County of Los Angeles 2009). Of the 24 sites investigated, 11 were reported to be HSG A soils, and 4 are in the expected range. Nine sites were reported to be in the HSG B range and 4 are in the expected range, while 2 of the sites have measured infiltration rates higher than expected, and 3 of the sites are lower than expected. One of the sites reported to be HSG C soils shows measured infiltration rates in the expected range while the other was higher.

Table D-6. Measured Infiltration Rates

			Infiltrometer Results (in/hr)				
Site	Area	Management Category	Test 1	Test 2	Test 3	Avg.	Within HSG Range?
1A	Whitter Narrows Recreation Area	C	3.0	1.0	0.3	1.4	<
2A	Park/Open Space	C	5.1	6.8	2.4	4.8	<
3A	Mona Park	C	11.0	11.0	4.0	8.7	yes
4A	G.W. Carver Park	C	0.2	0.8	1.9	0.9	<
5A	Roosevelt Park	C	0.2	3.0	0.4	1.2	<
6A	Ted Watkins County Park	C	0.4	2.0	3.0	1.8	<
7A	Altadena Golf Course	E	30.0	2.6	18.3	17.0	yes
8A	Open Space	E	4.5	5.2	2.9	4.2	<

			Infiltrometer Results (in/hr)				
Site	Area	Management Category	Test 1	Test 2	Test 3	Avg.	Within HSG Range?
9A	Wilson Debris Basin	G	15.0	13.5	6.0	11.5	yes
10A	Cresent Valley High School	D	4.1	5.8	2.7	4.2	<
11A	Eaton Canyon Golf Course	E	21.0	3.5	14.0	12.8	yes
1B	Los Angeles County Fire Station	A	4.5	15.0	14.0	11.2	>
2B	Belvedere Park	A	3.0	4.5	0.5	2.7	yes
3B	Park/Open Space	C	0.4	2.9	0.7	1.3	yes
8B	Hamilton Elementary School	E	4.5	0.2	14.6	6.4	yes
9B	Carver Elementary School	E	13.5	15.0	7.0	11.8	>
10B	Magic Johnson Park	C	1.5	1.9	0.8	1.4	yes
11B	Mary Mcleod Bethune Park	C	0.4	0.4	0.4	0.4	<
12B	Fire Station 16	C	0.8	0.8	0.1	0.5	<
13B	Rio Hondo Elementary School	C/E	0.4	1.0	0.4	0.6	<
14B	Augustus F Hawkins Natural Park	C	18.8	18.8	0.4	12.6	>
15B	Open Space	C	3.2	12.0	13.5	9.6	>
2C	George Washington High School	A	1.5	0.4	0.40	0.8	yes
3C	Garfield Community Adult School	A	10.9	13.5	8.0	10.8	>

D.2.2. Hydrologic Soil Group Characteristics

The results of the infiltration measurements within HSG areas supported the assessment of potential distributed BMPs within the areas. When the measurements are averaged by HSG (Table D-7), the soils reported to be in HSG A have an average infiltration rate below the range reported by the NRCS, the HSG B soils are within the range the NRCS range, and the HSG C soils are above the range. Several factors contribute to those results:

- As indicated by the standard deviation in measured infiltration rates, substantial variability was recorded in the infiltration tests.
- Some uncertainty exists in the classification of the soil types contributing to the variability in the measured infiltration rates. For example, site 4A (G.W. Carver Park) was reported by the NRCS to be HSG A; however, the field survey found HSG B soils for the entire profile. The NRCS data show that this area of HSG A is within a surrounding area of predominately HSG B soils, which is the likely cause of the observed discrepancy.
- In the majority of the soil borings, the reported HSG soil is present at some depth in the profile. Some of the soils and resulting infiltration rates are affected by or are a result of disturbance from construction or urban related activities and infill including restricting soil layers at varying depths below the surface.

Table D-7. Infiltration Rate Analysis by HSG

HSG	Mean	Median	Min	Max	Standard Deviation
A	6.2	4.2	0.9	17.0	5.5
B	5.3	2.7	0.4	12.6	5.1
C	5.8	5.8	0.8	10.8	7.1

HSG C soils are typically regarded as being unsuitable for infiltration BMPs because of low infiltration rates; however, the higher-than-expected infiltration rates indicate that HSG C soils might have more infiltration capacity than previously determined.

D.2.3. Management Category Characteristics

The measured infiltration rate can be correlated to the management category as an indication of the effect of urban related activity. Some of the discrepancies in the measured infiltration rates could be correlated to the following:

- Increased impervious configuration and road density. For example, site 8A has a measure infiltration rate below the range for HSG A soils. The site is in a space adjacent to several roads with loam to sandy clay loam soils, possibly fill material brought in for constructing the road.
- Several sites reported to be HSG B or C sites have sandy or urban complex soils at the surface from construction fill material resulting in higher-than-expected infiltration rates.
- Multiple sites in concentrated urban areas were highly compacted near the surface resulting in lower-than-expected infiltration rates.

Soils in areas with highly concentrated impervious configurations are more likely to have a mixture of several soil types, especially near the surface. BMPs should be designed with the imported soil characteristics in mind.

D.2.4. Water Table

None of the borings performed at each site show any indication of the seasonal high water table within 10 feet of the surface. Well data[1] for Site 10-A (Well # 5058H) show an average depth of 115 feet. That is well beyond the 10-foot minimum recommended in the County's *LID Manual*.

D.3. References

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[1] Well data could represent deeper water depths and not surface depths.

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Appendix E. Field Investigation for Centralized BMPs

After the list of priority locations for centralized BMPs had been developed, field investigations were performed to collect information that might affect centralized BMP design, construction, and monitoring.

E.1. Field Investigation Methods

E.1.1. Infiltration Rate

The County's *Low Impact Development Manual* (County of Los Angeles 2009) recommends that the infiltration rate be at least 0.5 in/hr for infiltration BMPs, such as bioretention. Soil infiltration rate was verified using the *Standard Test Method for Infiltration Rate in Field Soils Using Double-Ring Infiltrometer* specified in ASTM D 3385 (ASTM 2009). That test measures infiltration rates for soils with a hydraulic conductivity between 10^{-6} centimeters per second (cm/s) and 10^{-2} cm/s. The double-ring infiltrometer (Figure E-1) consists of two rings where the ratio of the diameter of the inner and outer rings is approximately two. Soils were excavated to a depth of approximately one foot (Figure E-1). The rings were sealed by forcing them into the soil a few inches (Figure E-2).

Figure E-1. Double-Ring Infiltrometer

Figure E-2. Sealing the Rings

The inner and outer rings were then filled with water, and the initial level of water in the inner ring, outer ring, and time (effectively time 0) were recorded (Figure E-3). All three parameters were measured and recorded approximately every 5 minutes. The test was completed when enough time elapsed, typically around 2 hours, to determine the surface infiltration rate (USEPA 1999). The infiltration rate is equivalent to the average incremental infiltration velocity or the infiltration rate once the test has stabilized (ASTM 2009).

For each site, the double-ring infiltrometer test was performed three times at different locations within approximately 30 feet of each other (Figure E-4). The surface infiltration rate for each site was determined by averaging the results from the three test locations. By performing the tests at three locations, the variability of the infiltration rates at each site can be documented. A record of the soil borings performed in the water table analysis was documented to help classify the soils, to verify the HSG, and to help determine the infiltration rates.

Figure E-3. Infiltrometer Test Setup

Figure E-4. Site Investigation

E.1.2. Water Table

A combination of methods was used to determine the depth of the water table at each site. NRCS soils data (USDA NRCS 2007) were referenced to estimate the depth of the water table corresponding to the soil type at the site. At least one boring with a soil log was performed at each site (Figure E-5). Typical water table indicators were indentified, such as soil mottling and reduced soils to determine the seasonal, high-water table depth. Monitoring well data collected by the County were also compared to the observed water table depths to help estimate the water table depth.

Note: Depth to the water table is not a defining characteristic of the site.

Figure E-5. Soil Boring

E.1.3. Soil Quality

It is important to determine if background levels of pollutants in the underlying soils could affect the performance of an infiltration BMP. Because of the nature of infiltration BMPs, it is also important to verify whether pollutants in the soils could be transported into the groundwater. Brownfield sites or areas that were landfills are not suitable sites for infiltration BMPs. Samples of the soil at each site were collected and were analyzed by an independent laboratory to determine background levels of pollutants. The analysis was used to determine the suitability of the soils for vegetation and if the soils need to be amended to be appropriate for a centralized BMP.

E.1.4. Site Slope

The slope of the site was verified visually to confirm that the slope is appropriate for a centralized BMP. Areas of the site where the slope is too steep for a BMP to be plausible were not considered in the estimate of available BMP area.

E.2. Field Investigation Results and Discussion

Field investigations were performed at 18 potential centralized BMP sites identified using the GIS screening analysis outlined in the previous section (Table E-1). Data was compiled for site 19, South Compton Creek Wetland, using the design provided by LACDPW and available GIS data.

Table E-1. Potential Centralized BMPs

Area	Management Category	Parcel Area	Available BMP Area	Total Watershed Treatment Area	Unincorporated County Watershed Treatment Area	Average % Impervious - Total Watershed Treatment Area	Average % Impervious Unincorporated Lands BMP Drainage Area	Thomas Guide
Enterprise Park	C	10.02	5.07	80.2	44.8	45.3%	47.7%	734-E2
Magic Johnson Park	C	111.4	15.91	259.3	254.7	37.7%	37.2%	734-E2
Mona Park	C	14.38	5.61	1,799.2	1,005.5	59.5%	59.1%	734-H1
G.W. Carver Park	C	13.34	5.24	3,104.0	1,381.3	56.0%	50.2%	704-F7
Ted Watkins Park	C	27.67	14.01	3,535.2	1,297.9	48.1%	52.0%	704-F5
Roosevelt Park	C	24.35	11.41	87.5	87.5	39.8%	39.6%	704-G1
Bethune Park	C	5.27	2.41	1,254.8	115.8	64.1%	63.3%	674-F6
Northside Drive Median	C	2.75	2.72	97.1	35.0	61.0%	58.1%	676-A2
Salazar Park	A	7.92	5.36	106.8	104.6	61.0%	60.6%	635-D7
Obregon Park	C	10.94	4.60	46.3	46.3	59.9%	59.9%	635-E6
Belvedere Park	A	28.91	21.43	211.0	208.4	59.9%	60.1%	635-G5
Whittier Narrows Park	C	127.08	41.82	347.1	36.2	67.7%	46.4%	637-A5
Whittier Narrows Recreation Area	C	402.92	78.26	1,042.7	23.5	72.9%	26.0%	636-J4
Hugo Reid Park	A	6.69	2.77	901.7	187.9	51.5%	55.1%	566-J5
Farnsworth Park	D	8.48	4.25	33.7	21.9	16.2%	24.5%	536-A4
Loma Alta County Park	E	6.82	4.27	941.4	202.9	15.9%	15.9%	535-G4
Two Strike Park	D	8.19	2.65	637.0	469.1	12.8%	17.2%	504-G7
Charles White County Park	D	3.50	3.89	696.3	696.3	39.8%	39.8%	535-H6
Compton Creek Wetland	C	8.50	5.50	26,944.0	6,253.0	61.4%	59.0%	N/A

Note: All areas are in acres.

At least a portion of each of the watershed treatment areas that could be treated at each site is within the Unincorporated County area. The available BMP area includes any open areas that could be retrofitted for stormwater treatment including parking lots, tennis and basketball courts, athletic fields, and open space. Areas of dense or mature trees and building foundations that could be affected by infiltration were avoided. With a few exceptions, the impervious percentage of the sites in management categories A or C are higher than the impervious percentage of site in management categories D and E, as expected. The impervious percentage for Magic Johnson Park and Roosevelt Park are lower than expected most likely because the parks are included in the watershed treatment area where the other parks were not. Because the parks have such large areas of open space, it caused an uncharacteristically low impervious percentage. The sites at the base of the Angeles Mountains in the headwater of the Los Angeles River have large, undeveloped areas in the watershed treatment areas accounting for the low impervious percentages.

E.2.1. Infiltration Rates

Infiltration rates and soil composition analysis were measured at each site sometime between August 4 and August 14, 2009, (Table E-2) with the exception of the South Compton Creek Wetland.

Table E-2. Measured Infiltration Rates

Area	Test 1 (in/hr)	Test 2 (in/hr)	Test 3 (in/hr)	Avg. (in/hr)	Reported HSG[a]
Enterprise Park	1.88	0.38	1.13	1.1	B
Magic Johnson Park	1.50	1.90	0.80	1.4	B
Mona Park	11.00	11.00	4.00	8.7	A
G.W. Carver Park	0.20	0.80	1.90	0.9	A
Ted Watkins Park	0.40	2.00	3.00	1.8	A
Roosevelt Park	0.20	3.00	0.40	1.2	A
Bethune Park	0.40	0.40	0.40	0.4	B
Northside Drive Median	15.00	24.00	2.60	13.9	B
Salazar Park	5.60	0.40	14.30	6.8	B
Obregon Park	0.23	3.00	0.06	1.1	D
Belvedere Park	3.00	4.50	0.50	2.7	B
Whittier Narrows Park	4.15	9.40	7.950	7.2	A
Whittier Narrows Recreation Area	3.00	1.00	0.30	1.4	B
Hugo Reid Park	1.50	4.50	3.50	3.2	A
Farnsworth Park	5.00	10.88	11.25	9.0	A
Loma Alta County Park	8.25	30.75	> 50	29.7	A
Two Strike Park	33.00	9.75	10.00	17.6	A
Charles White County Park	0.05	0.38	1.50	0.6	A
Compton Creek Wetland	N/A	N/A	N/A	N/A	B

a. HSG as indicated by the Soil Survey Division Staff 1993

Variability was observed in the infiltration tests at each site. EPA found similar variability (USEPA 1999) in a study in Alabama. Surface infiltration is affected by compaction caused by land use activities, such as mowing or recreation, and can be variable. The amount of compaction can be affected by activities such as lawn mowing where equipment repeatedly passes over the same area. By taking the average of the three infiltration rates at each site, the average conditions are reported.

Bethune Park is the only site where measured infiltration rates are below the minimum recommended by the *Los Angeles County Low Impact Development Standards Manual* of 0.5 in/hr. The tests performed at the park were close enough to the minimum that infiltration would be possible with minimal soil amendments. The soil boring sample composition (Table E-3 and Table E-4) indicates that the soils are highly organic at the surface, thus limiting infiltration; however, the soils at and below the surface are classified as HSG B (USDA NRCS 2007) and would be suitable for infiltration and could support a centralized BMP. Further analysis is recommended before a centralized BMP is implemented at Bethune Park.

Table E-3. Soil Boring Composition

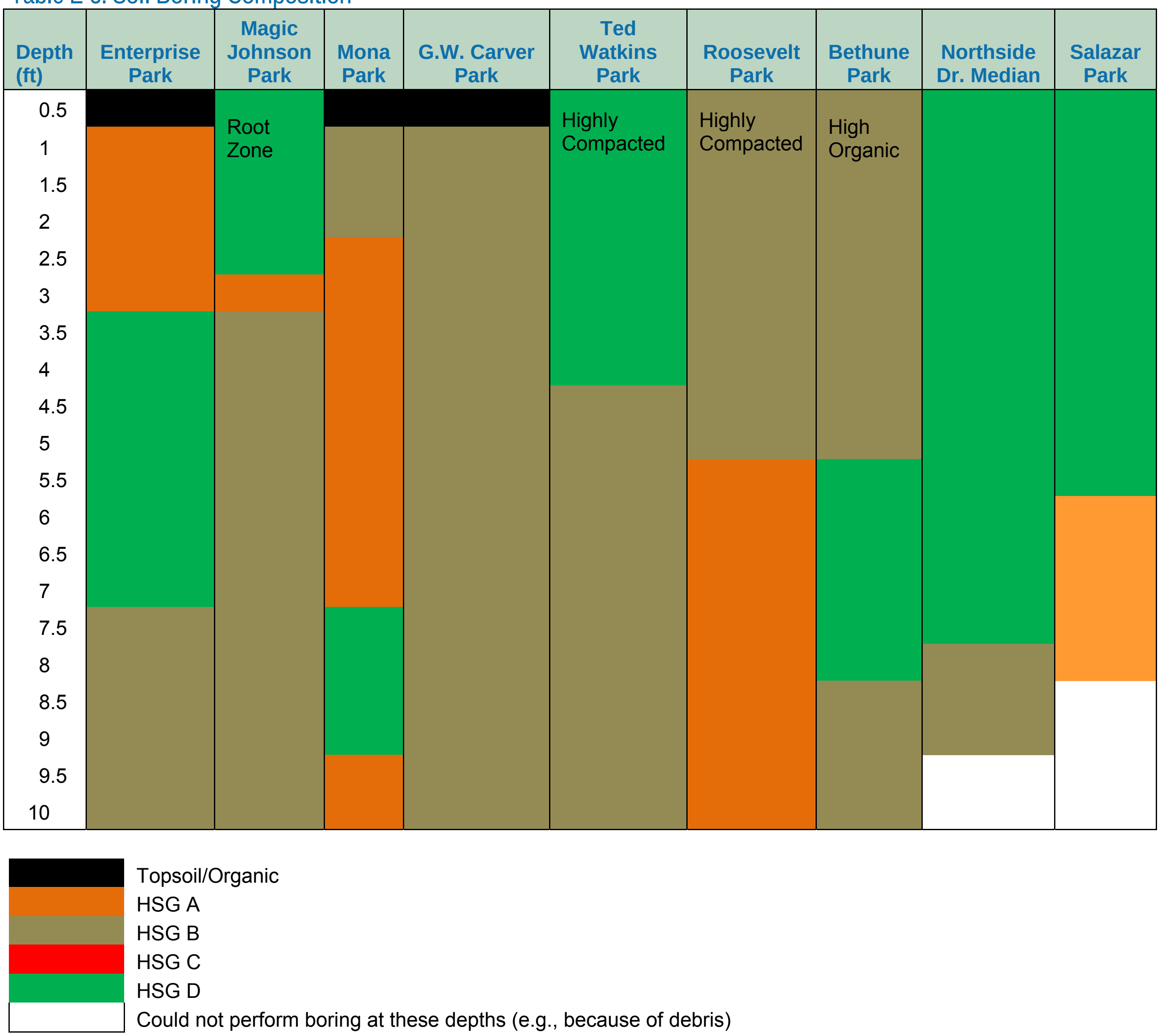

Table E-3. (Continued)

Depth (ft)	Obregon Park	Belvedere Park	Whittier Narrows Park	Whittier Narrows Recreation Area	Hugo Reid Park	Farnsworth Park	Loma Alta Park	Two Strike Park	Charles White Park
0.5		Highly Organic		Highly organic					
1			organic root zone						
1									
1.5									
2									
2.5									
3									
3.5									
4									
4.5									
5									
5.5									
6									
6.5									
7									
7.5									
8									
8.5									
9									
9.5									
10									

Topsoil/Organic
HSG A
HSG B
HSG C
HSG D
Could not perform boring at these depths because of debris

Table E-4. Soil Boring Log

Site	Boring Soil Sample Composition			
Enterprise Park	Organic Topsoil, 0-3 ft, Silt Loam (A)	3-7 ft, Clay (D)	7-10 ft, Loam (B)	
Magic Johnson Park	0-2.5 ft, clay loam (D)	2.5-3 ft, sandy loam (A)	3.5-9 ft, clay loam (B)	
Mona Park	0-1 ft silt loam (B)	1-2 ft, loam (B)	2-7 ft, sandy loam (A)	7-9 ft, clay (D)
G.W. Carver Park	0-10 ft, silt loam (B)			
Ted Watkins Park	0-4 ft, silty clay loam (D)	4-10 ft, silt loam (B)		
Roosevelt Park	0-2 ft, loam (B)	2-5 ft, silt loam (B)	5-9 ft, loamy sand (A)	
Bethune Park	0-2 ft, silt loam, high organic (B)	2-5 ft, silt loam (B)	5-8 ft, silty clay loam (D)	8-10 ft, silt loam (B)
Northside Drive Median	0-7.5 ft, Clay Loam (D)	7.5-9 ft, Loam (B)	Could not go deeper due to debris	
Salazar Park	0-3.5 ft, Silty Clay (D)	3.5-5.5 ft, Clay (D)	5.5-8 ft, Sandy Loam (A)	
Obregon Park	0-1 ft, Clay Loam (D)	1-9 ft, Clay (D)	Could not go deeper	
Belvedere Park	0 - 4 inches root zone	4 inches - 3 ft Sandy Clay (D)	3-5 ft, Sandy Loam (A)	5-10 ft, loamy sand (A)
Whittier Narrows Park	0-0.5 ft, organic root zone	0.5-4 ft, loamy sand (A)	4-7 ft, loamy sand to sandy loam (A)	7-10 ft, sand with some fines (A)
Whittier Narrows Recreation Area	0-10 inches top soil	10 inches - 4 ft, sandy clay (D)	4-7 ft, sandy loam/loamy sand (A)	7-10 ft, sand (A)
Hugo Reid Park	0-2 ft, Silty Clay (D)	Could not go deeper due to debris		
Farnsworth Park	0-5 ft, Silt (B)	5-7 ft, Silty Loam (B)	Could not go deeper due to debris	
Loma Alta County Park	0-4 ft, Sand (A)	4-8 ft, Loamy Sand (A)	8-8.5 ft, Clay (D)	8.5-10 ft, Loamy Sand (A)
Two Strike Park	0-2.5 ft, Loam (B)	Could not go deeper due to debris		
Charles White County Park	0-10 ft, Silt Loam (B)			
South Compton Creek Wetland	N/A	N/A	N/A	N/A

Several sites were observed to have HSG D soils at some place in the soil profile. The HSG D soils are typically clay or silt and would limit infiltration but not entirely prevent it. Infiltration rates in the BMP at sites with an HSG D layer would be nearest to the average surface infiltration rate until the capacity of the soils above the HSG D layer was exceeded, at which point the infiltration rate of the BMP would be equal to the infiltration rate of the HSG D layer. BMPs that provide some storage, such as extended dry detention basins, could be used at sites with lower infiltration rates where more time would be required for the stormwater to infiltrate into the lower soil layers. Some sites, such as Magic Johnson Park and Ted Watkins Park, have HSG D soils at the surface, while HSG A or B soils were observed below the expected depth of a centralized BMP. The HSG D soils would be removed in construction. While the infiltration rates are low at the surface, higher infiltration rates could be expected after implementing a centralized BMP. The only site where HSG D soils were observed for the length of the soil borings is Obregon Park, indicating that centralized BMPs could be successfully implemented in the remaining sites by excavating below the observed HSG D soils and exposing soils with higher infiltration capacities.

E.2.2. Water Table

None of the borings performed at a site show any indication of the seasonal, high-water table within 10 feet of the surface. Well data collected by the County (Table E-5) closest to the sites investigated support the observations reported in the field. The historic record shows a range in water table depth from 32 to 328 feet—well beyond the 10-foot minimum recommended in the County's *LID Manual*.

Table E-5. LACDPW Well Data

Well #	Average Depth (ft)	Combined Average (ft)
5058H	90.9	115.0
5068C	139.1	
1446B	152.8	152.8
4113A	398.1	226.4
4122A	54.7	
4198C	128.8	131.0
4198G	126.7	
4198L	137.4	
1453D	174.7	169.6
1453E	164.5	
1446B	152.8	152.8
1451K	188.0	187.3
1451M	186.5	
1477J	110.2	110.2
1446B	152.8	152.8
2669A	188.4	188.4
1453D	174.7	169.6
1453E	164.5	
1311D	74.9	77.3
1311E	79.7	
1445F	146.3	146.3
2535J	32.3	32.3
4081C	309.7	275.6
4081D	241.6	
4061A	183.1	194.8
4061B	206.4	
4096	221.6	221.6
4117	331.0	328.6
4117C	326.2	

E.2.3. Soil Quality

Soils analyses were performed for each site at the estimated depth of a centralized BMP, approximately 6 feet. PEC have been established by MacDonald et al. (2000) for priority metals listed as impairments in the Los Angeles River watershed (Table E-6). The PEC gives an indication of the concentration where an environmental effect can be observed. Each of the sites investigated has metals concentrations in the soils less than the PEC values.

Table E-6. Metals Concentrations for Investigated Sites

Source	Cadmium	Copper	Lead	Selenium	Silver	Zinc
EPA PEC[a]	4.98	149	128	N/A	1.06	459
Enterprise Park	ND	14.7	3.5	ND	ND	51.9
Magic Johnson	ND	12.5	4.7	ND	ND	42.2
Mona Park	ND	36.0	4.1	ND	ND	66.1
GW Carver Park	ND	36.8	6.7	ND	ND	78.3
Ted Watkins Park	ND	21.3	2.5	ND	ND	64.1
Roosevelt Park	ND	8.6	1.8	ND	ND	38.6
Bethune Park	ND	26.1	3.7	ND	ND	79.4
Northside Drive Median	ND	13.8	4.2	ND	ND	44.1
Salazar Park	ND	10.2	4.6	ND	ND	36.1
Obregon Park	ND	23.8	4.2	ND	ND	67.2
Belvedere Park	ND	9.7	3.9	ND	ND	36.2
Whittier Narrows Park	ND	18.1	2.7	ND	ND	40.8
Whittier Narrows Recreation Area	ND	26.8	3.3	ND	ND	56.3
Hugo Reid park	ND	50.8	15.3	ND	ND	93.4
Farnsworth Park	ND	8.5	5.6	ND	ND	37.4
Loma Alta Park	ND	9.0	3.6	ND	ND	34.1
Two Strike Park	ND	21.5	21.5	ND	ND	113.0
Charles White Park	ND	11.4	6.5	ND	ND	47.4

ND = None Detected
Note: All numbers reported in mg/kg
a. MacDonald et al. 2000

Concentration of nutrients and pH in the soils was also analyzed for each site. Research was conducted to determine the appropriate levels of nutrients in water; however, no research was found for the appropriate level of nutrients in the soils. Table E-7 presents the pH and nutrient concentrations at each site. The pH at each site is neutral and would not cause any effect on water quality or vegetation. This report will be updated after PEC levels are established for nutrients, and pH in soils are established.

Table E-7. pH and Nutrient Concentrations for Investigated Sites

Site	pH	Phosphorous (Total)	Nitrate-Nitrite (as N)	Total Kjeldahl Nitrogen	Ammonia (as N)	Nitrogen (Total)
Enterprise Park	8.42	790	0.6	200	14	201
Magic Johnson	8.70	460	1.7	460	28	462
Mona Park	8.30	180	1.6	520	31	522
G.W. Carver Park	8.37	220	1.1	240	39	241
Ted Watkins Park	8.22	880	0.8	220	11	221
Roosevelt Park	8.26	1,300	10.0	200	14	210
Bethune Park	8.17	970	7.0	340	14	347
Northside Drive Median	8.06	130	ND	210	11	210
Salazar Park	7.83	28	ND	240	11	240
Obregon Park	7.56	460	ND	360	22	360
Belvedere Park	7.86	340	ND	110	8	110
Whittier Narrows Park	7.66	600	2.0	250	20	252
Whittier Narrows Recreation Area	7.94	710	0.9	180	11	181
Hugo Reid park	8.06	97	1.8	1,300	84	1,302
Farnsworth Park	7.34	170	0.5	250	28	251
Loma Alta Park	7.77	340	0.6	84	11	85
Two Strike Park	6.86	600	8.8	1,100	110	1,109
Charles White Park	7.54	400	1.3	250	22	251

Note: All nutrient numbers reported in mg/kg

E.3. Site Features and Observation

Section 5.2.1 summarized the individual site characteristics and BMP recommendations for each of the 18 potential sites. The following sections provide a more detailed map of the available BMP area and photographs of the watershed treatment area and available BMP area for each site.

E.3.1. Enterprise Park

Figure E-6 presents a map of the area available for the BMP in Enterprise Park. Figure E-7 and Figure E-8 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

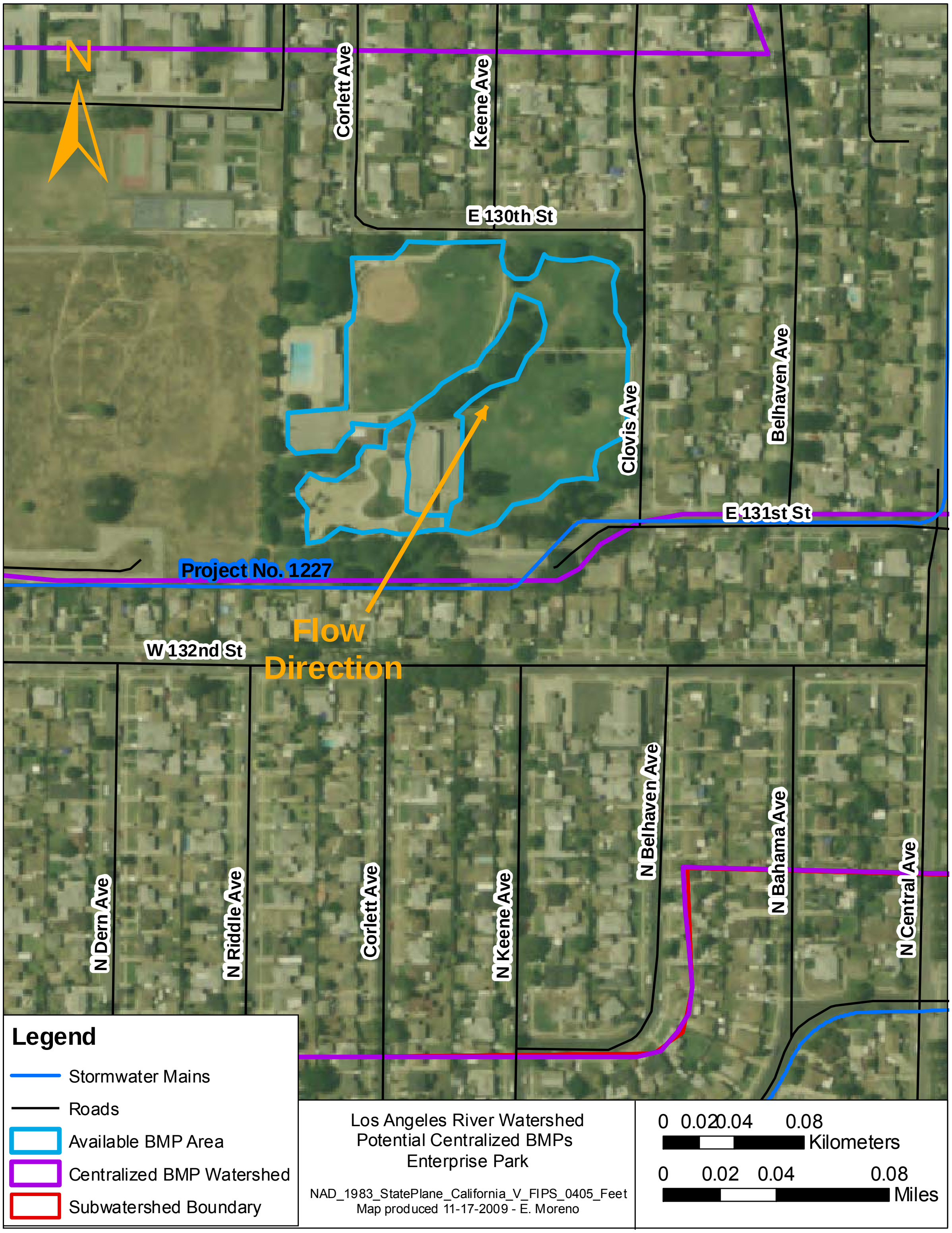

Figure E-6. Enterprise Park Available BMP Area

Figure E-7. Enterprise Park Watershed Treatment Area

Figure E-8. Enterprise Park Available BMP Area

E.3.2. Magic Johnson Park

Figure E-9 presents a map of the area available for the BMP in Magic Johnson Park. Figure E-10 and Figure E-11 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

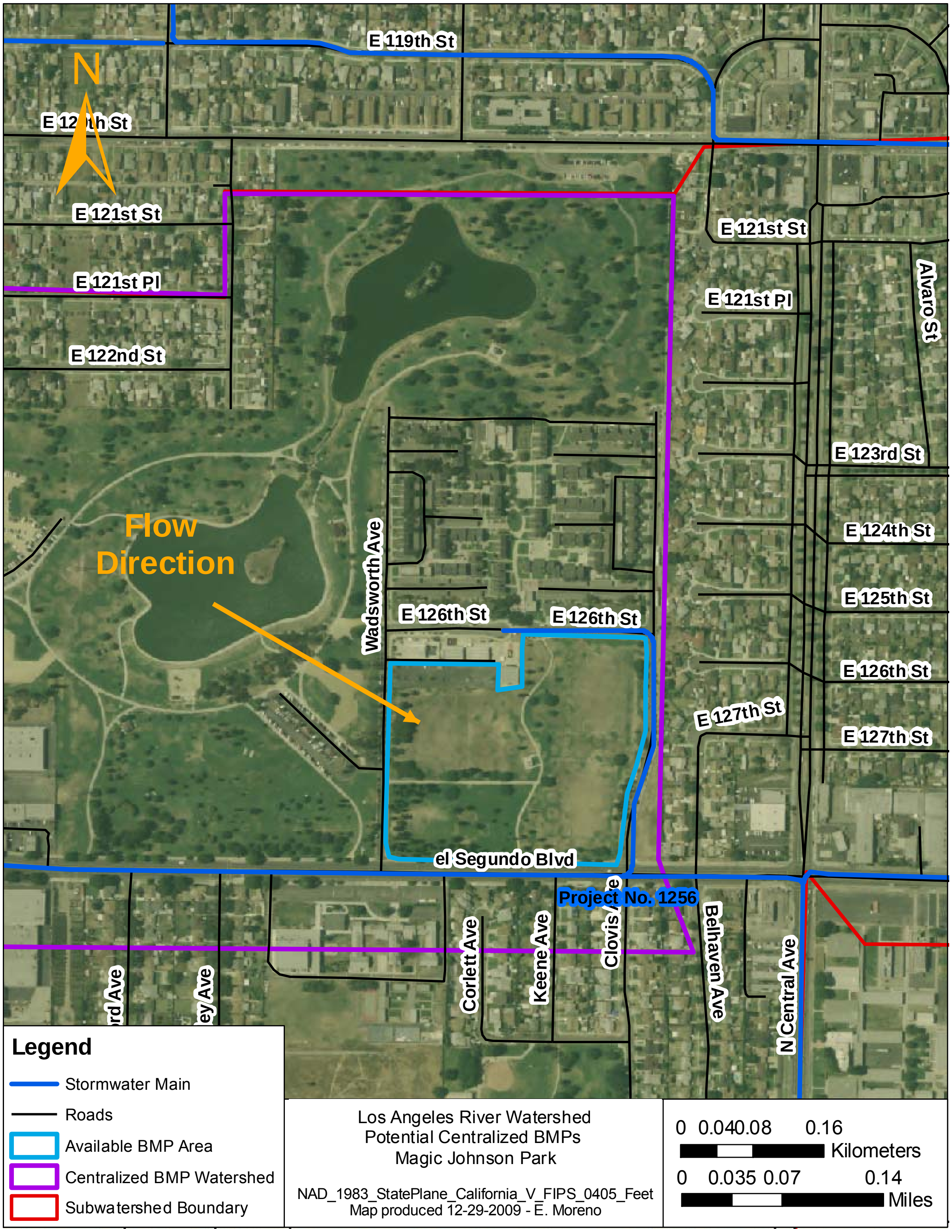

Figure E-9. Magic Johnson Park Available BMP Area

Figure E-10. Magic Johnson Park Watershed Treatment Area

Figure E-11. Magic Johnson Park Available BMP Area

E.3.3. Mona Park

Figure E-12 presents a map of the area available for the BMP in Mona Park. Figure E-13 and Figure E-14 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

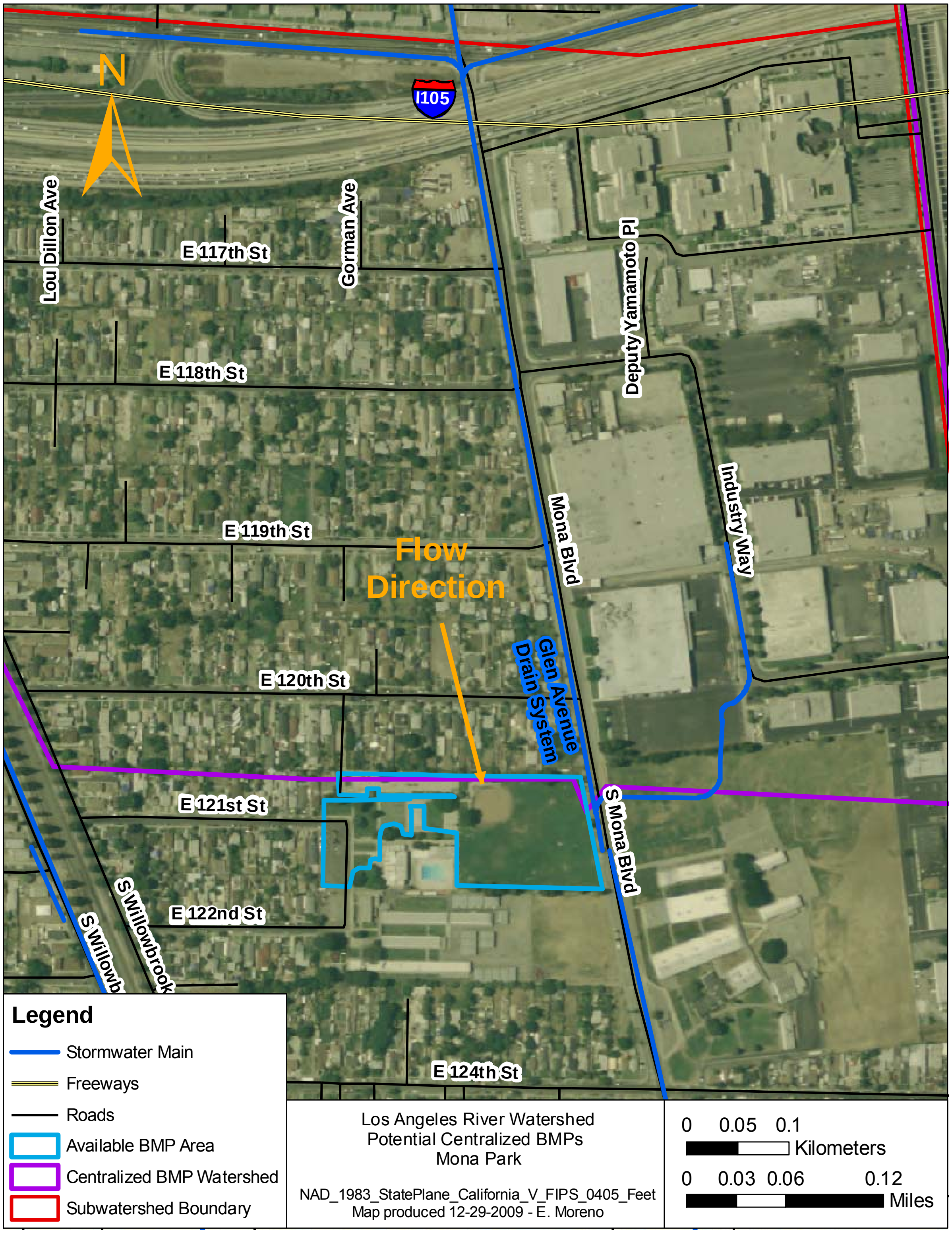

Figure E-12. Mona Park Available BMP Area

Figure E-13. Mona Park Watershed Treatment Area

Figure E-14. Mona Park Available BMP Area

E.3.4. G.W. Carver Park

Figure E-15 presents a map of the area available for the BMP in G.W. Carver Park. Figure E-16 and Figure E-17 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

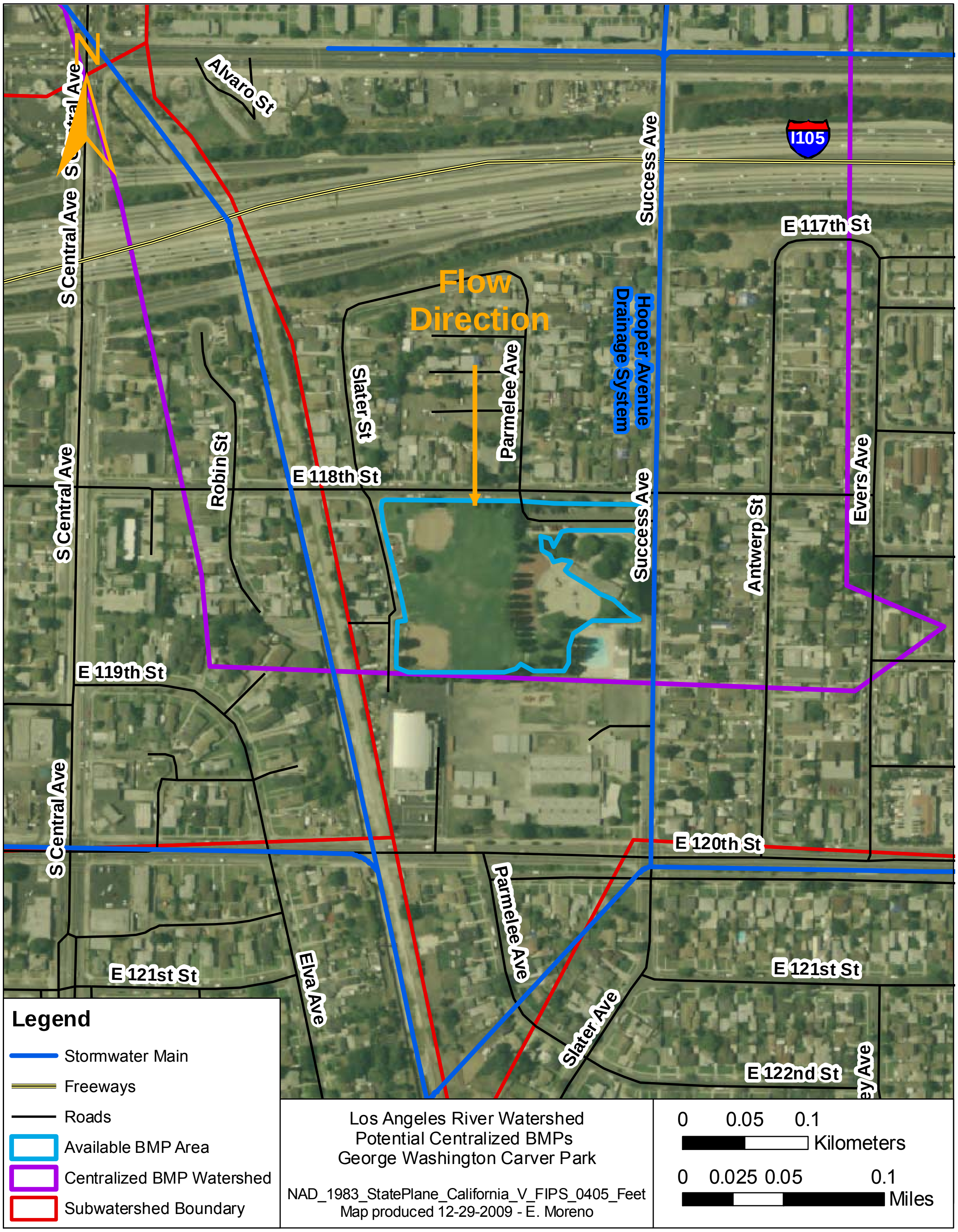

Figure E-15. G.W. Carver Park Available BMP Area

Figure E-16. G.W. Carver Park Watershed Treatment Area

Figure E-17. G.W. Carver Park Available BMP Area

E.3.5. Ted Watkins Park

Figure E-18 presents a map of the area available for the BMP in Ted Watkins Park. Figure E-19 and Figure E-20 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

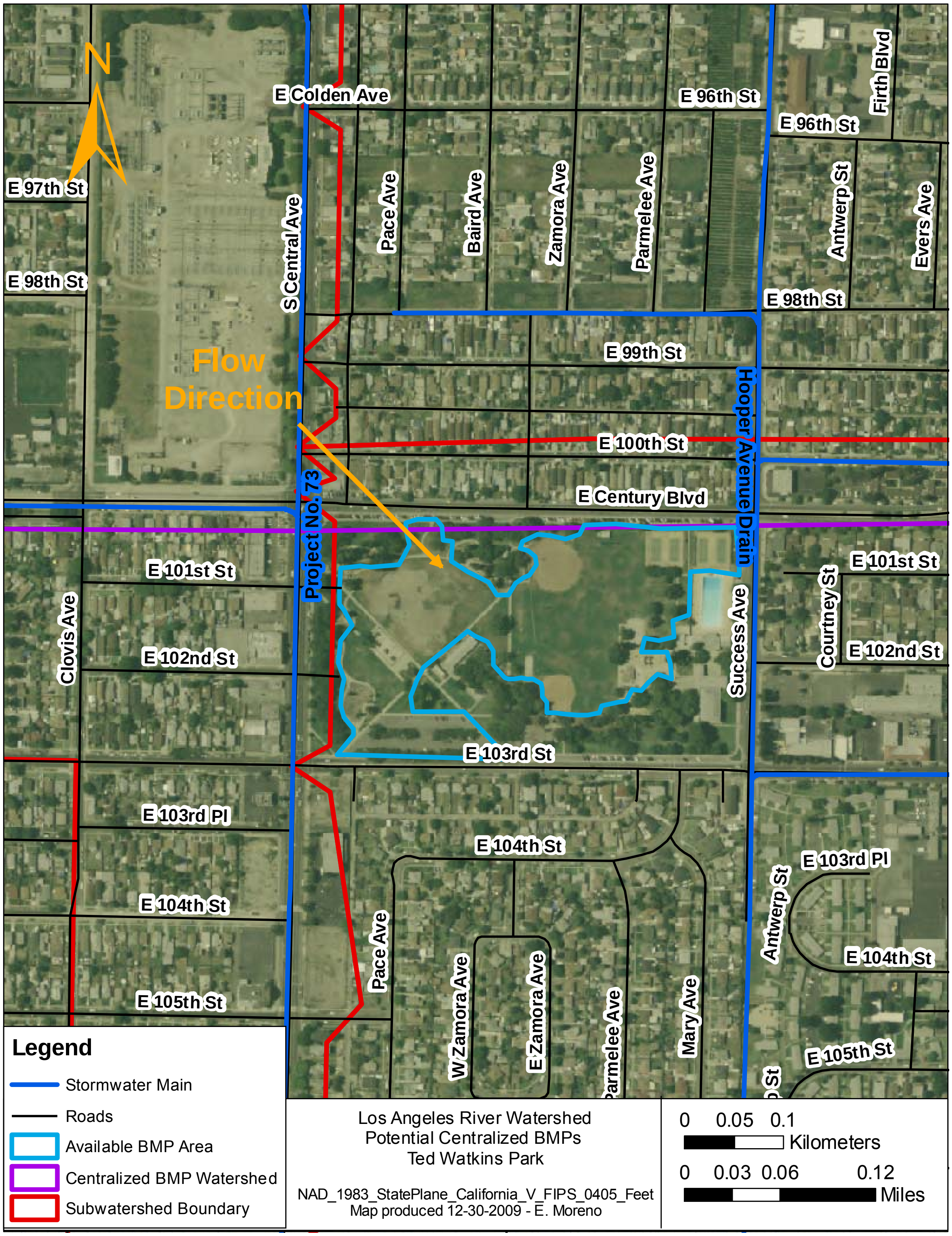

Figure E-18. Ted Watkins Park Available BMP Area

Figure E-19. Ted Watkins park Watershed Treatment Area

Figure E-20. Ted Watkins Park Available BMP Area

E.3.6. Roosevelt Park

Figure E-21 presents a map of the area available for the BMP in Roosevelt Park. Figure E-22 and Figure E-23 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

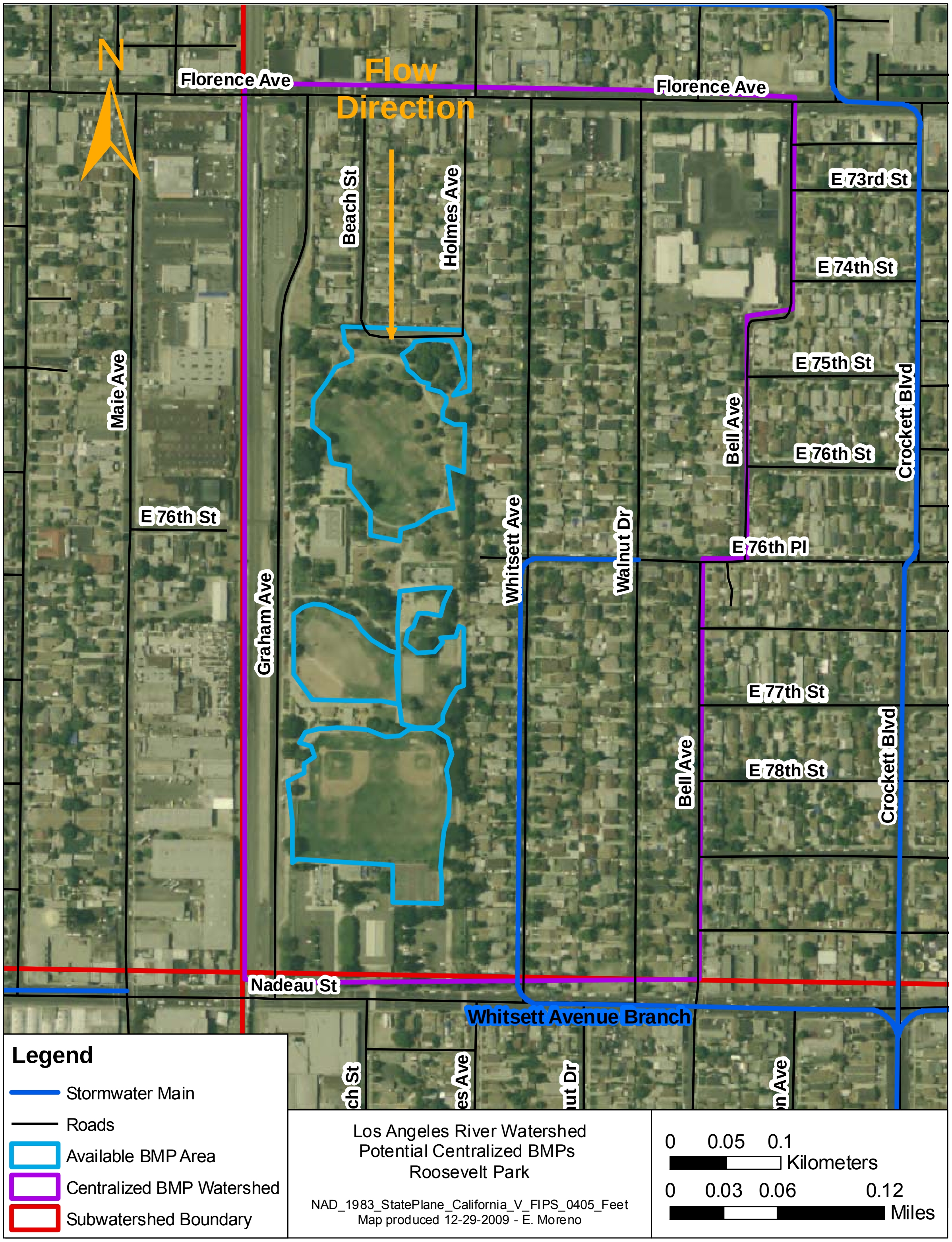

Figure E-21. Roosevelt Park Available BMP Area

Figure E-22. Roosevelt Park Watershed Treatment Area

Figure E-23. Roosevelt Park Available BMP Area

E.3.7. Bethune Park

Figure E-24 presents a map of the area available for the BMP in Bethune Park. Figure E-25 and Figure E-26 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

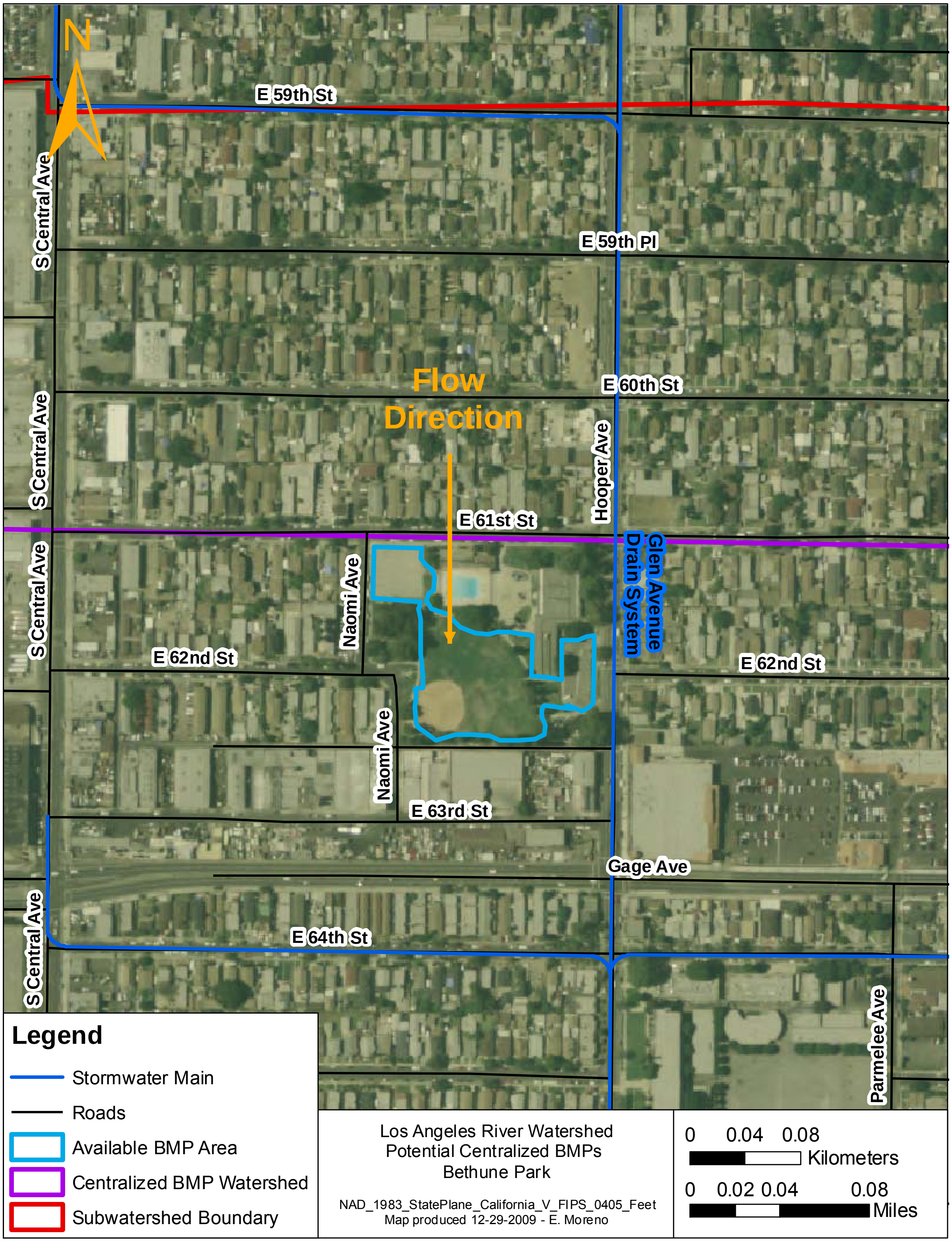

Figure E-24. Bethune Park Available BMP Area

Figure E-25. Bethune Park Watershed Treatment Area

Figure E-26. Bethune Park Available BMP Area

E.3.8. Northside Drive Median

Figure E-27 presents a map of the area available for the BMP in the Northside Drive median. Figure E-28 and Figure E-29 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

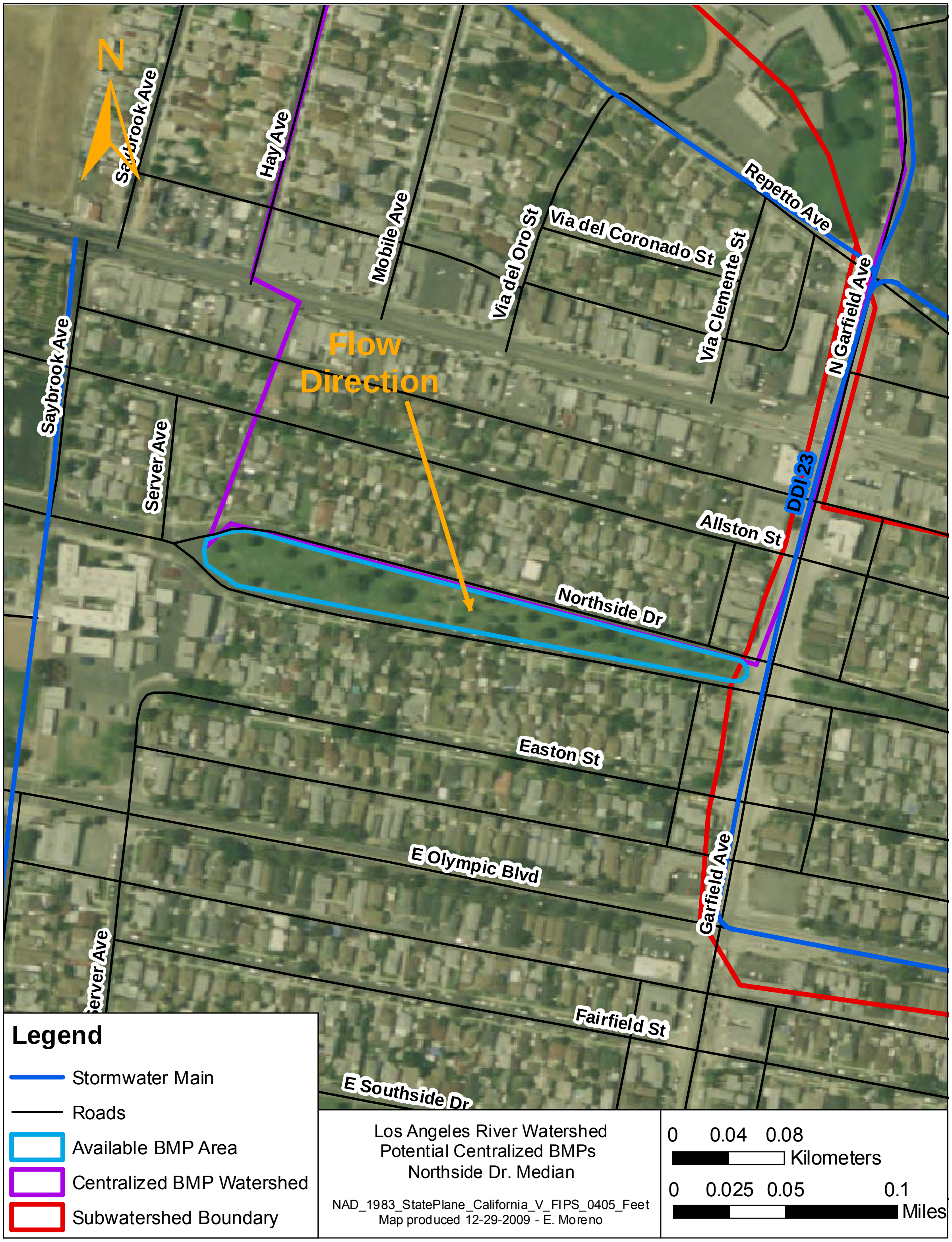

Figure E-27. Northside Drive Median Available BMP Area

Figure E-28. Northside Drive Watershed Treatment Area

Figure E-29. Northside Drive Available BMP Area

E.3.9. Salazar Park

Figure E-30 presents a map of the area available for the BMP in Salazar Park. Figure E-31 and Figure E-32 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

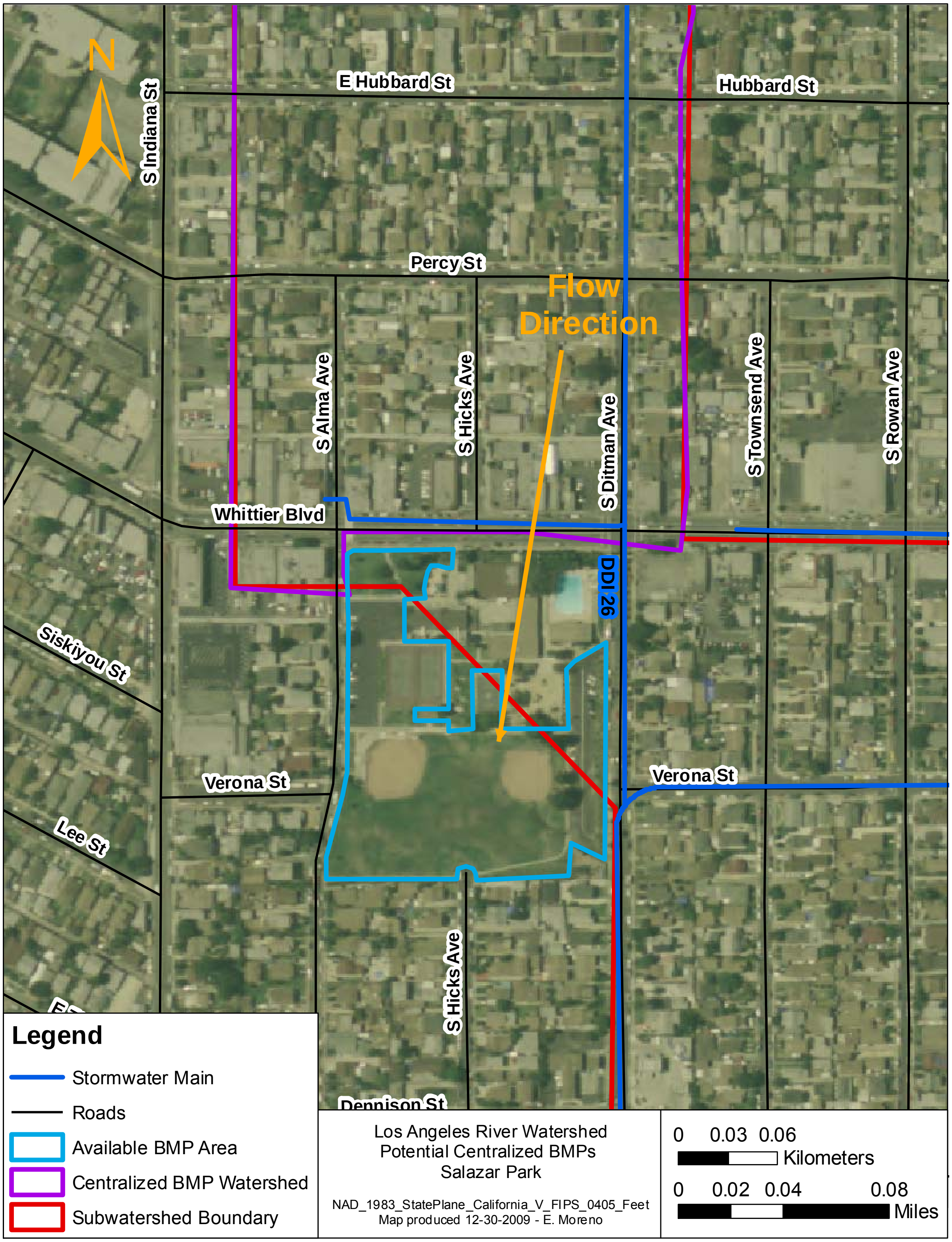

Figure E-30. Salazar Park Available BMP Area

Figure E-31. Salazar Park Watershed Treatment Area

Figure E-32. Salazar Park Available BMP Area

E.3.10. Obregon Park

Figure E-33 presents a map of the area available for the BMP in Obregon Park. Figure E-34 and Figure E-35 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

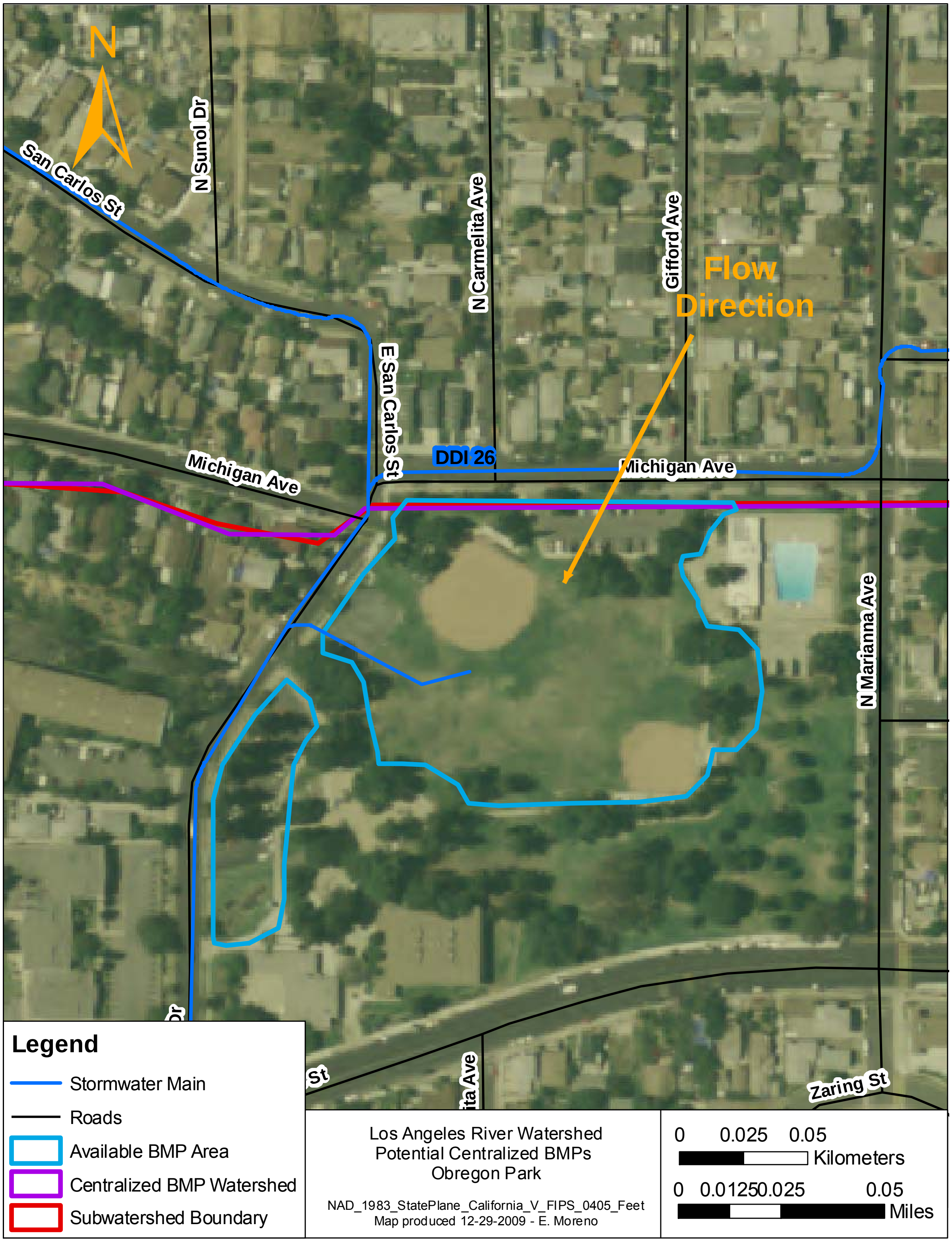

Figure E-33. Obregon Park Available BMP Area

Figure E-34. Obregon Park Watershed Treatment Area

Figure E-35. Obregon Park BMP area

E.3.11. Belvedere Park

Figure E-36 presents a map of the area available for the BMP in Belvedere Park. Figure E-37 and Figure E-38 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

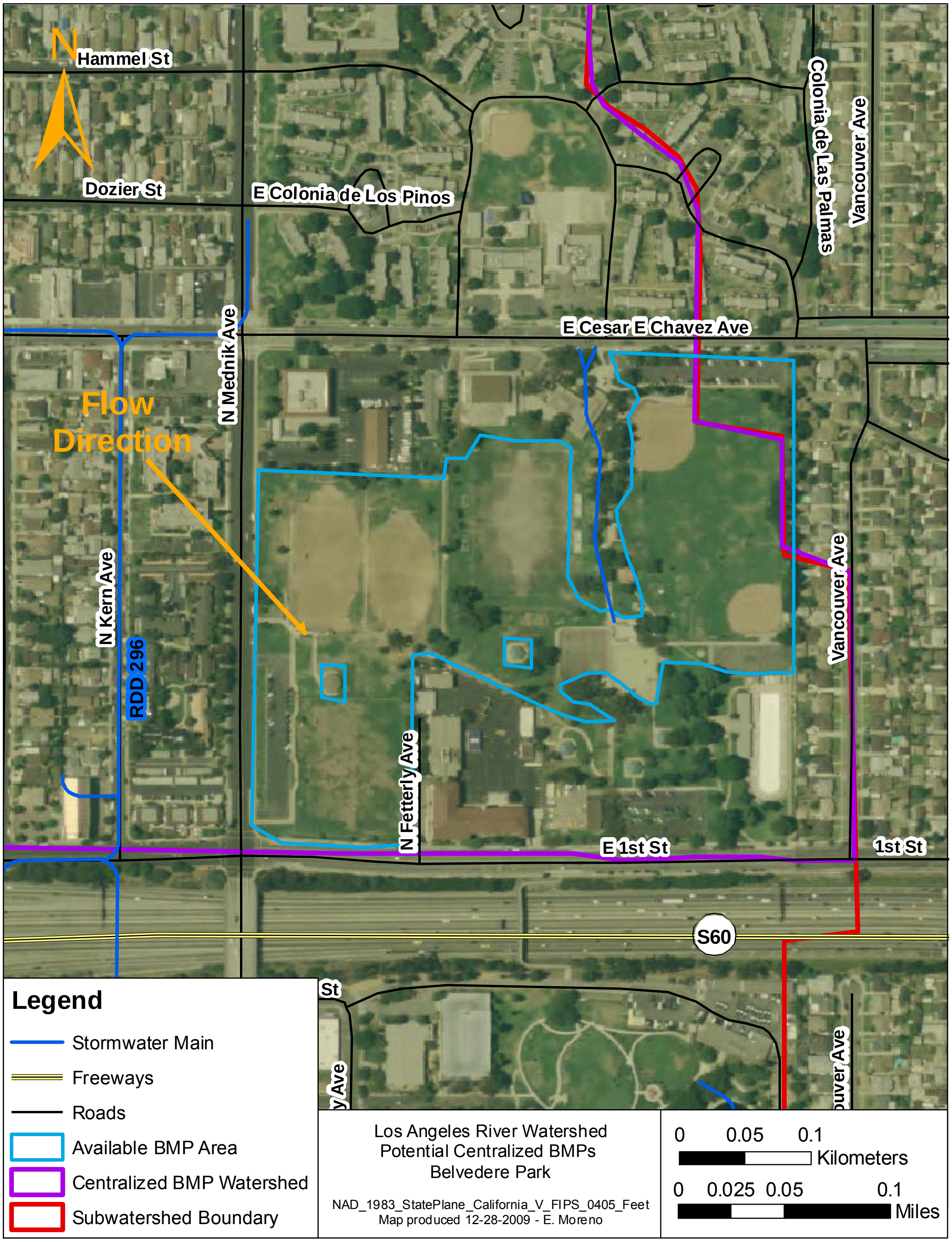

Figure E-36. Belvedere Park Available BMP Area

Figure E-37. Belvedere Park Watershed Treatment Area

Figure E-38. Belvedere Park Available BMP Area

E.3.12. Whittier Narrows Park

Figure E-39 presents a map of the area available for the BMP in Whittier Narrows Park. Figure E-40 and Figure E-41 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

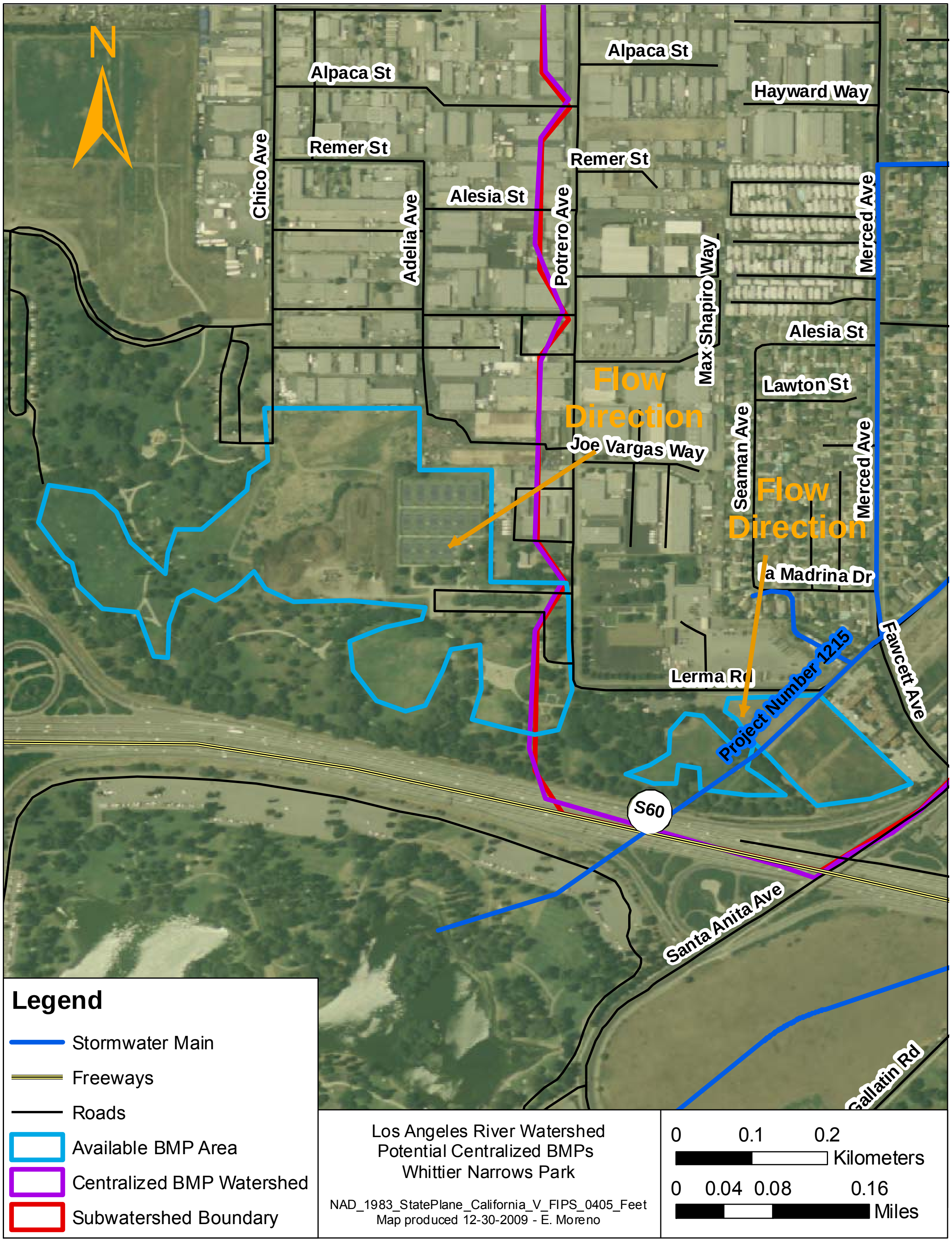

Figure E-39. Whittier Narrows Park Available BMP Area

Figure E-40. Whittier Narrows Park Watershed Treatment Area

Figure E-41. Whittier Narrows Available BMP Area

E.3.13. Whittier Narrows Recreation Area

Figure E-42 presents a map of the area available for the BMP in Whittier Narrows Recreation Area. Figure E-43 and Figure E-45 presents photographs of the watershed treatment area and the area available for the BMP, respectively. Figure E-44 shows the stormwater outfall into the Rio Hondo Channel.

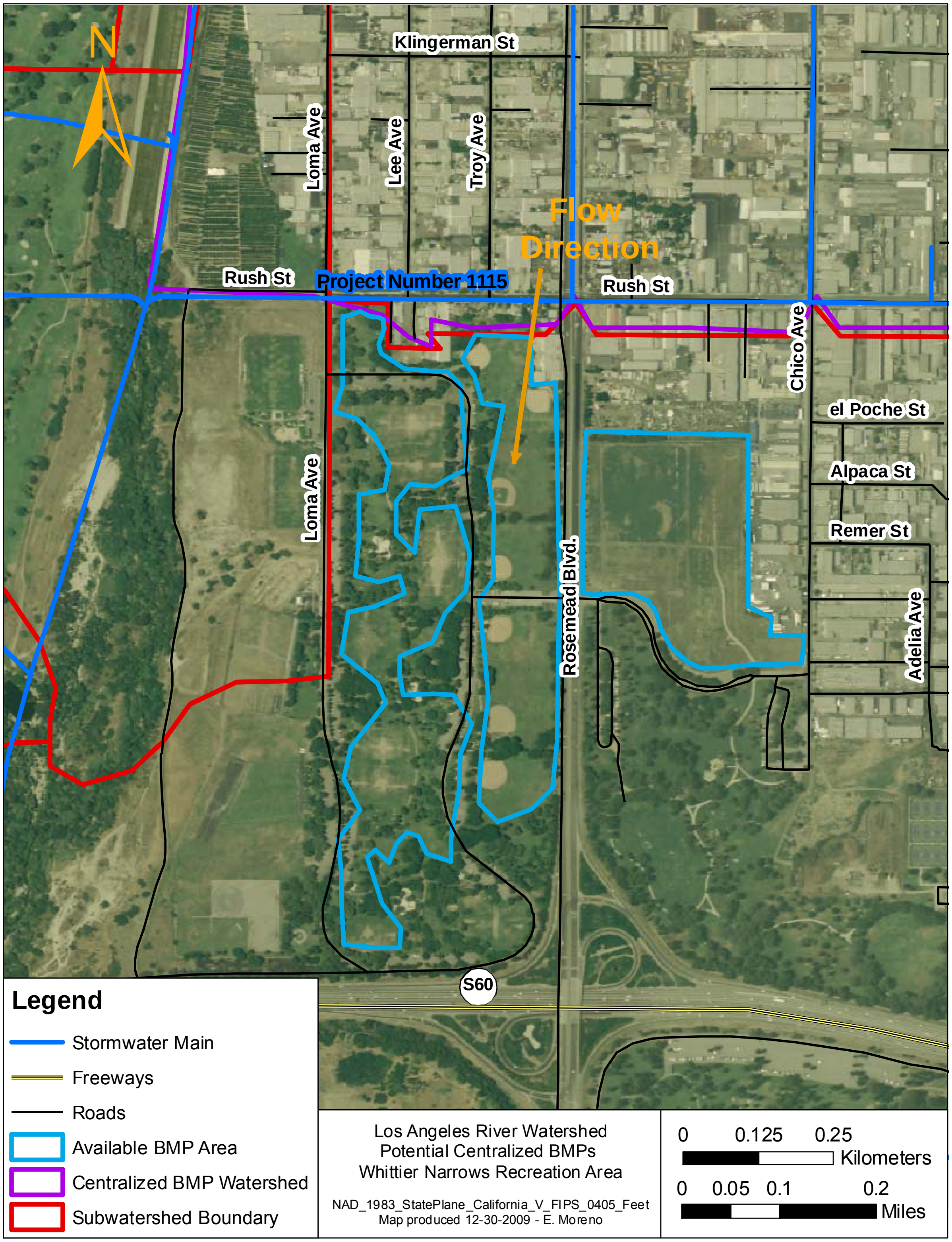

Figure E-42. Whittier Narrows Recreation Area BMP area.

Figure E-43. Whittier Narrows Recreation Area Watershed Treatment Area

Figure E-44. Stormwater outfall at the end of Rush St.

Figure E-45. Whittier Narrows Recreation Area Available BMP Area

E.3.14. Hugo Reid Park

Figure E-46 presents a map of the area available for the BMP in Hugo Reid Park. Figure E-47 and Figure E-48 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

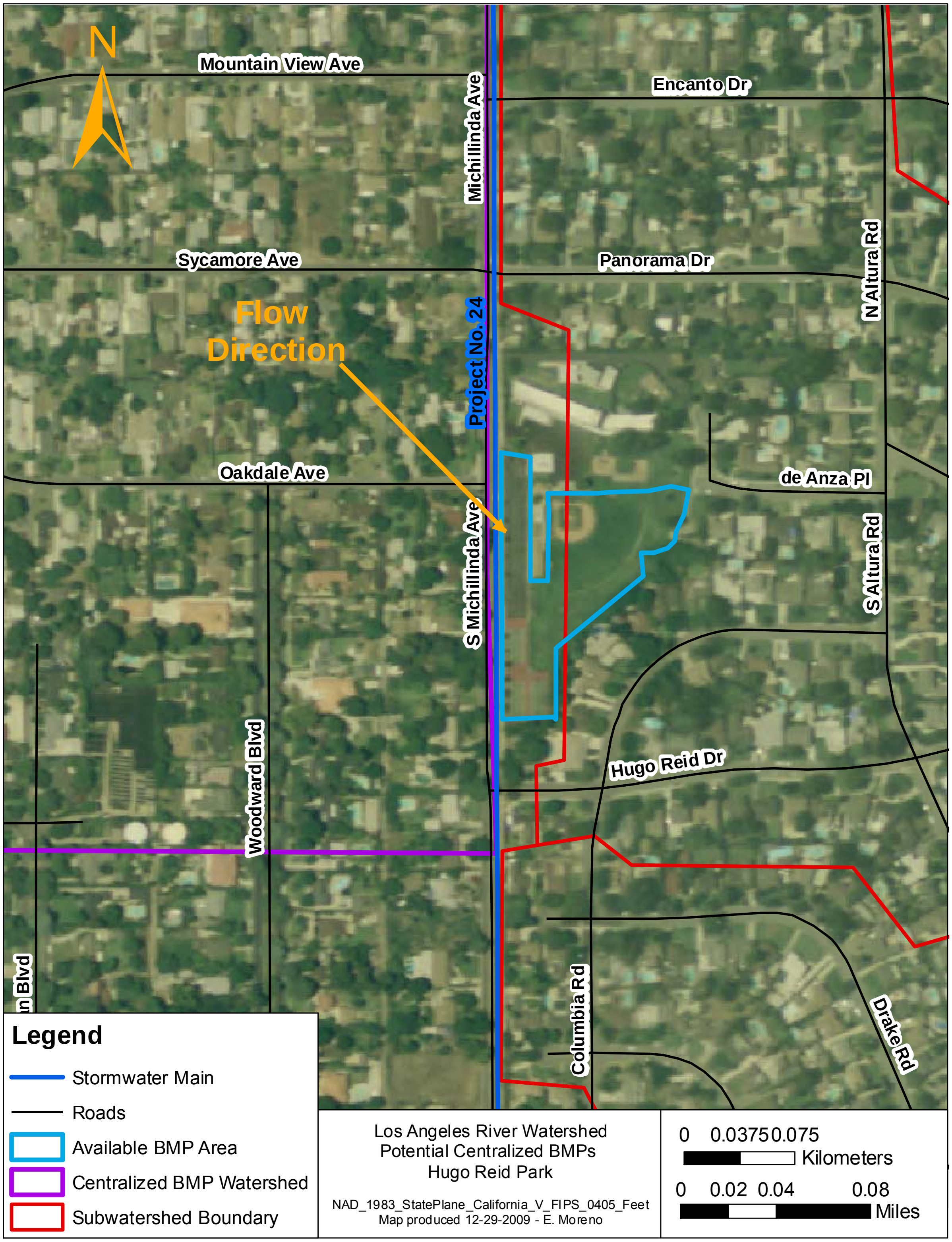

Figure E-46. Hugo Reid Park Available BMP Area

Figure E-47. Hugo Reid Park watershed treatment area

Figure E-48. Hugo Reid Park available BMP area

E.3.15. Farnsworth Park

Figure E-49 presents a map of the area available for the BMP in Farnsworth Park. Figure E-50 and Figure E-51 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

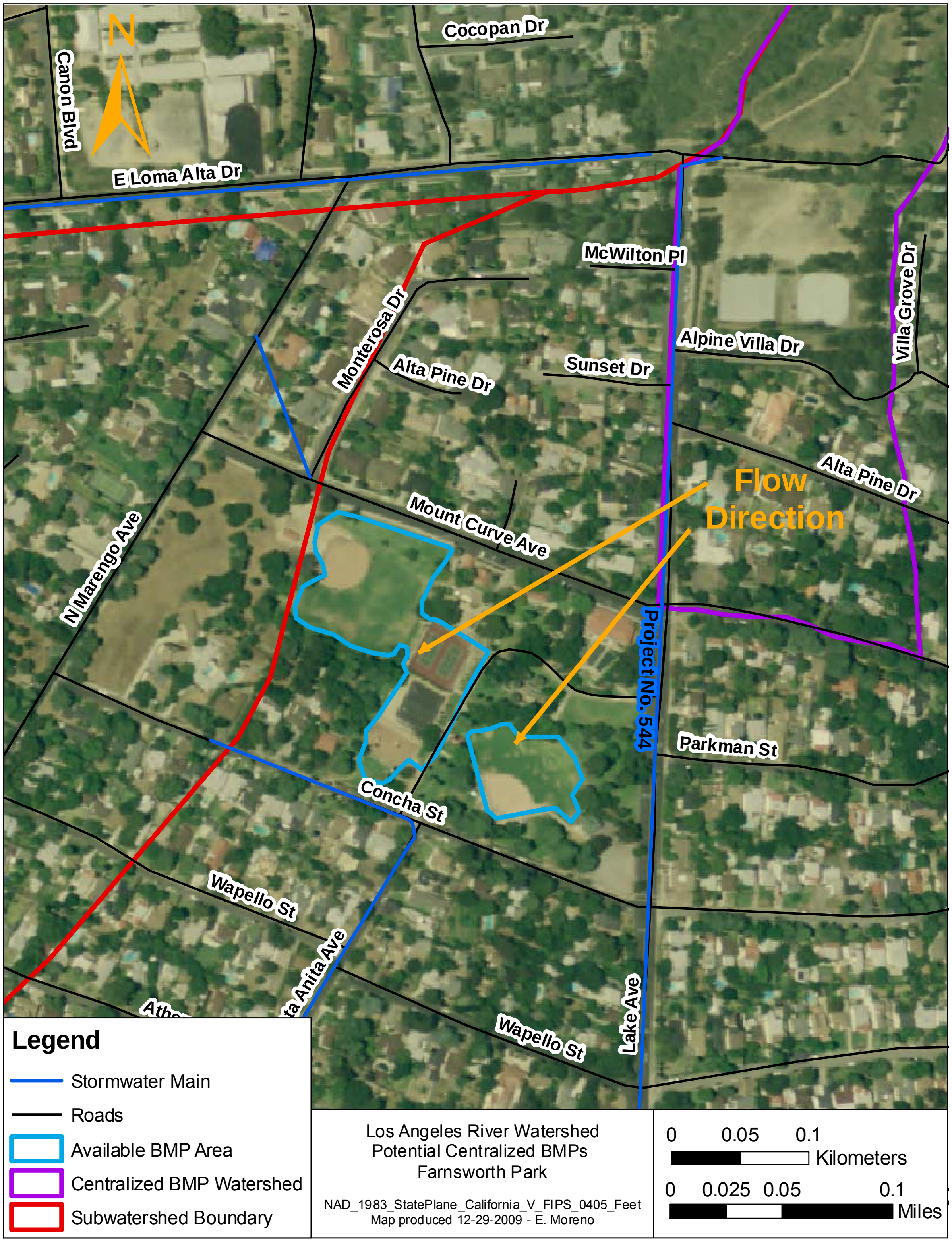

Figure E-49. Farnsworth Park Available BMP Area

Figure E-50. Farnsworth Park Watershed Treatment Area

Figure E-51. Farnsworth Park Available BMP Area

E.3.16. Loma Alta Park

Figure E-52 presents a map of the area available for the BMP in Loma Alta Park. Figure E-53 and Figure E-54 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

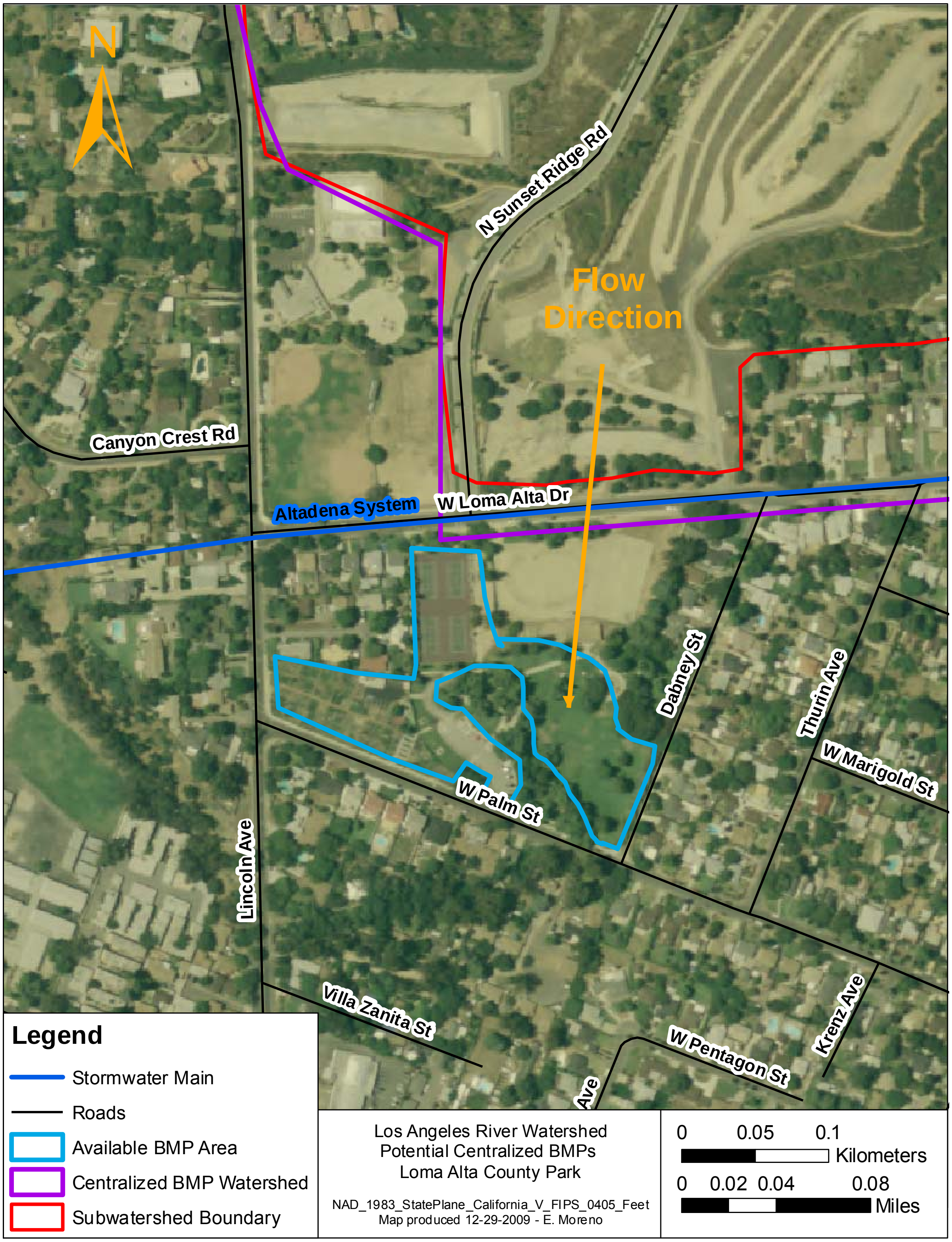

Figure E-52. Loma Alta Park Available BMP Area

Figure E-53. Loma Alta Park Watershed Treatment Area

Figure E-54. Loma Alta Park Available BMP Area

E.3.17. Two Strike Park

Figure E-55 presents a map of the area available for the BMP in Two Strike Park. Figure E-56 and Figure E-57 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

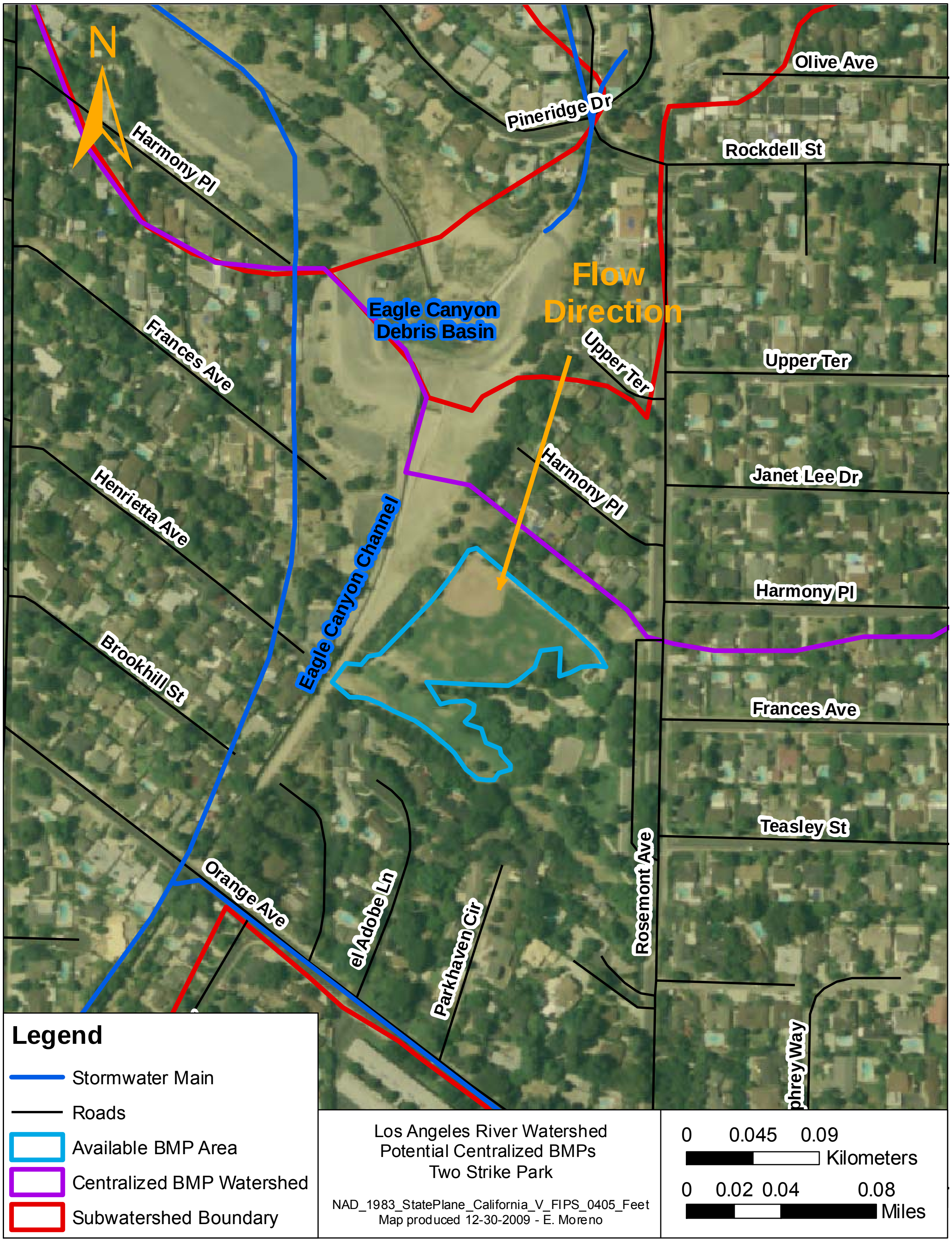

Figure E-55. Two Strike Park Available BMP Area

Figure E-56. Two Strike Park Watershed Treatment Area

Figure E-57. Two Strike Park Available BMP Area

E.3.18. Charles White Park

Figure E-58 presents a map of the area available for the BMP in Charles White Park. Figure E-59 and Figure E-60 presents photographs of the watershed treatment area and the area available for the BMP, respectively.

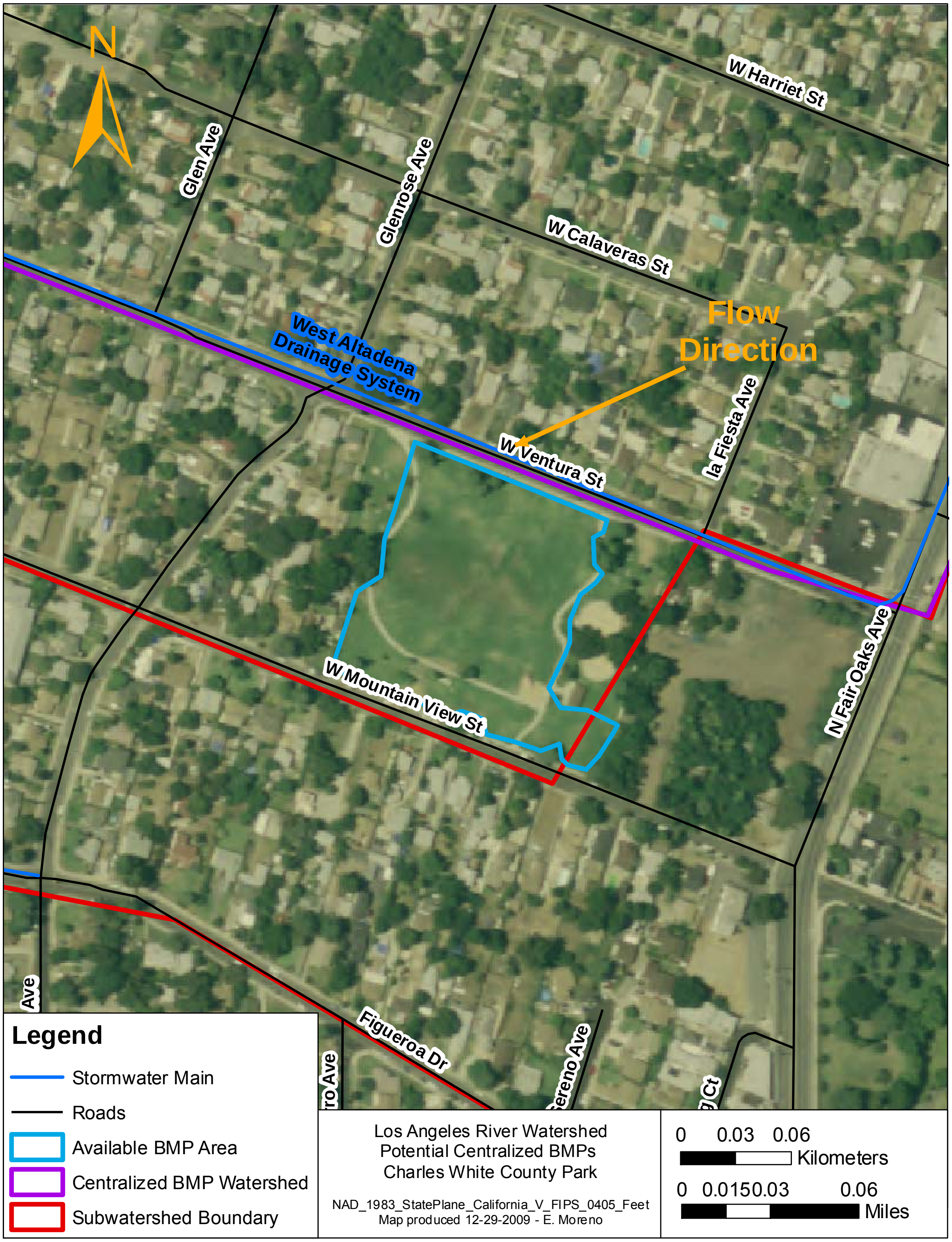

Figure E-58. Charles White Park BMP Area

Figure E-59. Charles White Park Watershed Treatment Area

Figure E-60. Charles White Park Available BMP Area

E.3.19. Compton Creek Wetland

Figure E-61 presents a map of the area available for the BMP in the Compton Creek Wetland.

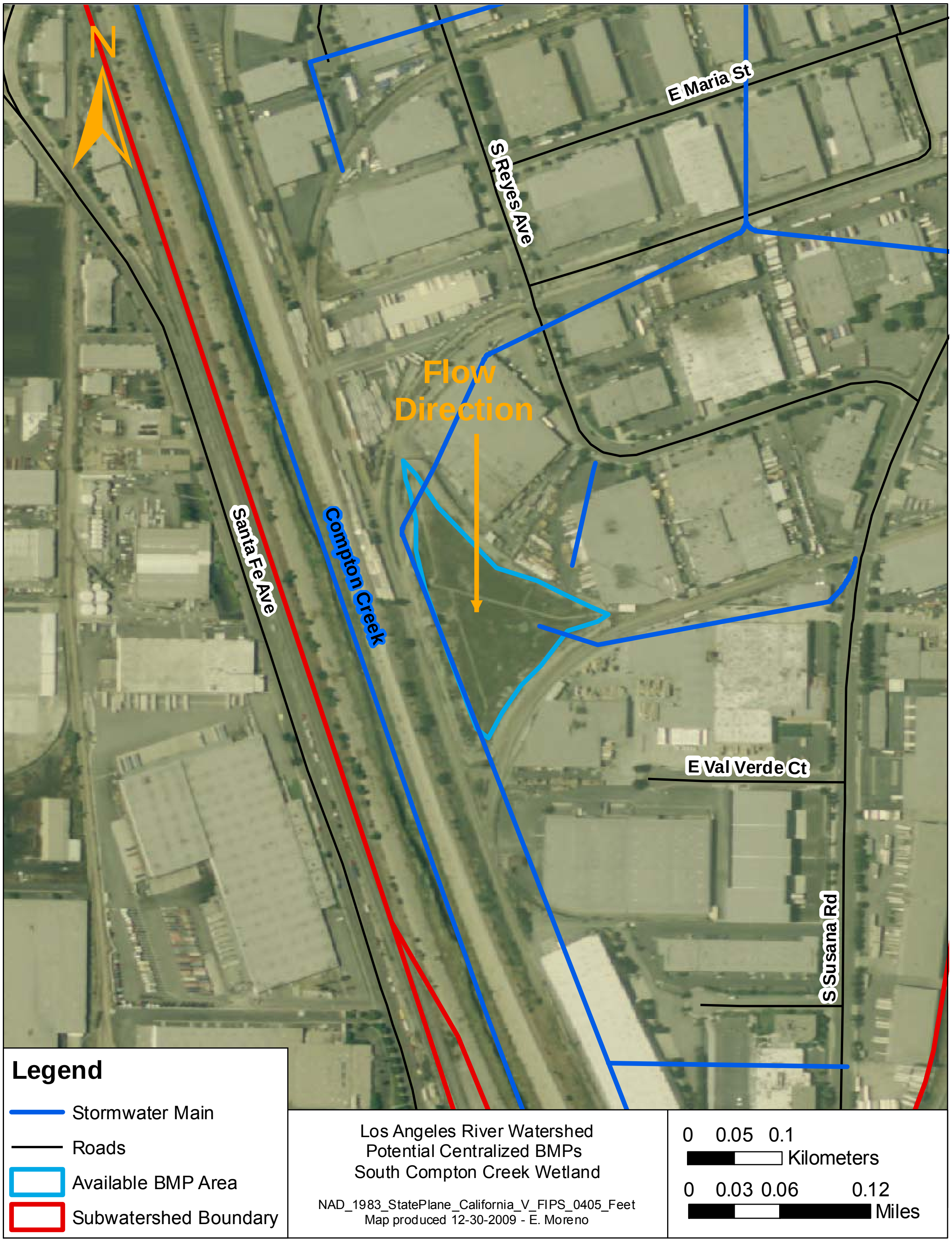

Figure E-61. Compton Creek Wetland Available BMP Area

E.4. Summary

Each of the sites investigated was selected using a GIS screening process. The sites are County-owned parcels with available space to treat the area that could be drained to the site. Each site has HSG A, B, or C soils, indicating that the infiltration rate would be sufficient for an infiltration BMP. Each site provides a multi-use benefit including park space, recreation areas, athletic fields, and parking areas.

The data compiled in this report will be integrated and used for Section 3, *Evaluation of Structural BMPs*. The measured infiltration rates, the available space for the BMP, the watershed treatment area, and the soil type will be used in the model to further investigate which type and size of BMP would be most appropriate for each site. The effect of each site and the specific BMP will be evaluated, along with BMP options in the Los Angeles River watershed, to determine the effect on water quality in the watershed.

E.5. References

ASTM (American Society for Testing and Materials). 2009. *Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer*. ASTM D 3385. American Society for Testing and Materials, West Conshohocken, PA.

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USEPA (U.S. Environmental Protection Agency). 1999. *Infiltration through Disturbed Urban Soils and Compost-Amended Soil Effects on Runoff Quality and Quantity*. EPA-600-R-00-016. U.S. Environmental Protection Agency, Washington, DC.

Appendix F. BMP Fact Sheets

The following factsheets are included in this appendix:

- Belvedere Park Centralized BMP Fact Sheet
- Bethune Park Centralized BMP Fact Sheet
- Charles White Park Centralized BMP Fact Sheet
- Compton Creek Wetland Centralized BMP Fact Sheet
- Enterprise Park Centralized BMP Fact Sheet
- Farnsworth Park Centralized BMP Fact Sheet
- G.W. Carver Park Centralized BMP Fact Sheet
- Hugo Reid Park Centralized BMP Fact Sheet
- Loma Alta Park Centralized BMP Fact Sheet
- Magic Johnson Park Centralized BMP Fact Sheet
- Mona Park Centralized BMP Fact Sheet
- Northside Drive Median Centralized BMP Fact Sheet
- Obregon Park Centralized BMP Fact Sheet
- Roosevelt Park Centralized BMP Fact Sheet
- Salazar Park Centralized BMP Fact Sheet
- Ted Watkins Park Left Centralized BMP Fact Sheet
- Ted Watkins Park Right Centralized BMP Fact Sheet
- Ted Watkins Park Centralized BMP Fact Sheet
- Two Strike Park Centralized BMP Fact Sheet
- Whittier Narrows Park Centralized BMP Fact Sheet
- Whittier Narrows Recreation Area Centralized BMP Fact Sheet
- Pilot Roadside BMP Project Fact Sheet
- Centralized BMPs on Private Property Project Fact Sheet
- Distributed Structural BMPs Fact Sheet Catch Basin Inserts
- Nonstructural BMP Fact Sheet

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Belvedere Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Belvedere Park is mostly residential (58%), with commercial (41%), and undeveloped (1%) areas. An infiltration basin (Figure 1) providing 13.8 AF of storage (2.5 acres and 6 feet deep) would be necessary to treat the 208-acre unincorporated County drainage area. Soils data collected at the site indicate that the subsoils would need to be amended to a depth of 3 feet to provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin

Photo: County of Los Angeles LID Standards Manual, 2009

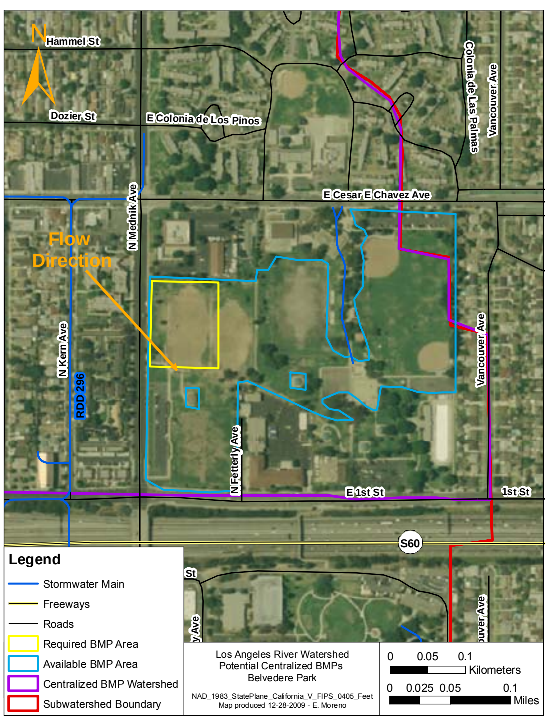

Figure 2. Required BMP Area

To treat the area around the park, flow in the storm drain RDD 296, passing along North Kern Street, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	12.9	78%
Zinc	119.0	80%
TSS	0.32	75%
Cadmium	34,479.9	78%
Fecal Coliform	1.759E+13	80%
Flow Volume	8,414,423	75%

Additional Design Considerations

BMP design information for Belvedere Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.3

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	208.0
Treatment Volume Capacity (AF)	13.8
BMP Surface Area (acres)	2.5
Recommended Ponding Depth (ft)	6.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$548,500.00
Design	$822,700.00
Permits/Studies	$50,000.00
Construction	$2,742,250.00
Operation & Maintenance	$2,300,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$6,540,000.00

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Bethune Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Bethune Park consists of residential (63%), with industrial (31%), some commercial (4%) and few undeveloped (2%) areas. An infiltration basin (Figure 1) providing 0.9 AF of storage (0.2 acres and 8 feet deep) would be necessary to treat the 116-acre unincorporated County drainage area. Soils data collected at the site indicate that the subsoils would provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin
Photo: County of Los Angeles LID Standards Manual, 2009

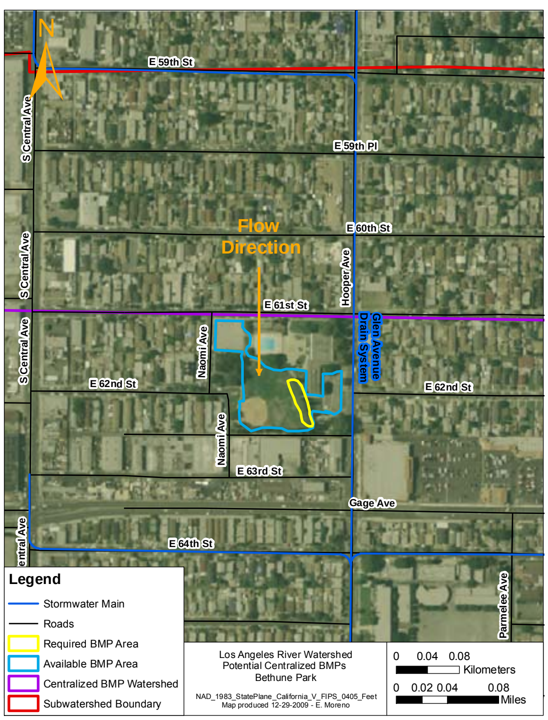

Figure 2. Required BMP Area

To treat the area around the park, flow in the Glen Avenue drainage system, passing along Hooper Avenue, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	6.9	16%
Zinc	64.8	16%
Cadmium	0.18	15%
TSS	18,509.1	15%
Fecal Coliform	1.021E+13	26%
Flow Volume	4,756,491	15%

Additional Design Considerations

BMP design information for Bethune Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	116.0
Treatment Volume Capacity (AF)	0.9
BMP Surface Area (acres)	0.2
Recommended Ponding Depth (ft)	8.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$88,400.00
Permits/Studies	$50,000.00
Construction	$294,400.00
Operation & Maintenance	$250,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$1,010,000.00

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Charles White Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Charles White Park is mostly residential (96%) with some commercial (3.6%) and undeveloped (0.4%) areas. An infiltration basin (Figure 1) providing 21.0 AF of storage (3.9 acres and 6 feet deep) would be necessary to treat the 696-acre unicorporated County drainage area. Soils data collected at the site indicate that the subsoils are appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin
Photo: County of Los Angeles LID Standards Manual, 2009

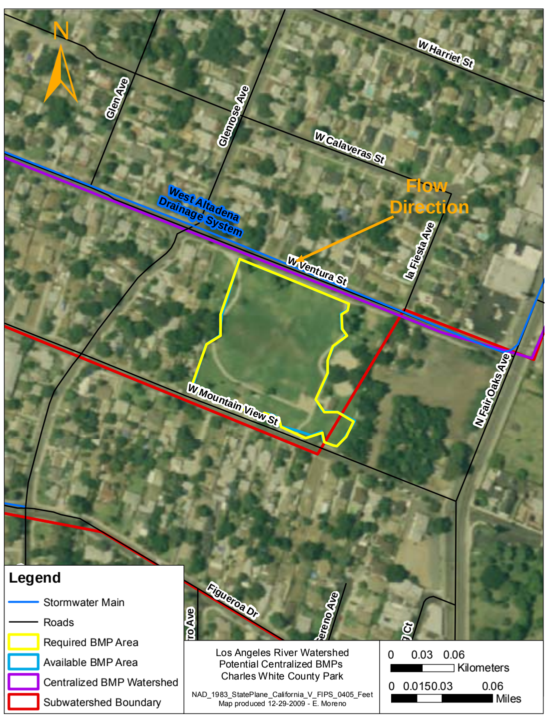

Figure 2. Required BMP Area

To treat the area around the park, flow in the West Altadena Drainge System along Ventura Street would have to be diverted into the park. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	30.9	51%
Zinc	284.0	52%
Cadmium	0.97	55%
TSS	79,632.0	51%
Fecal Coliform	3.84E+13	55%
Flow Volume	25,831,406	55%

Additional Design Considerations

BMP design information for Charles White Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	696.0
Treatment Volume Capacity (AF)	21.0
BMP Surface Area (acres)	3.9
Recommended Ponding Depth (ft)	6.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$792,500.00
Design	$1,188,700.00
Permits/Studies	$50,000.00
Construction	$3,962,167.00
Operation & Maintenance	$3,320,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$9,390,000.00

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Compton Creek Wetland
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to the Compton Creek Wetland is mostly residential (64%) with industrial (16%), commercial, (12%) and undeveloped (8%) areas. A stormwater wetland, designed by LACDPW, (Figure 1) providing 3.7 AF of storage (4.3 acres and approximately 2 feet deep) would be necessary to treat the 6,253-acre unicorporated County drainage area. LACDPW determined that a stormwater wetland is the most appropriate BMP for the site. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of a Stormwater Wetland

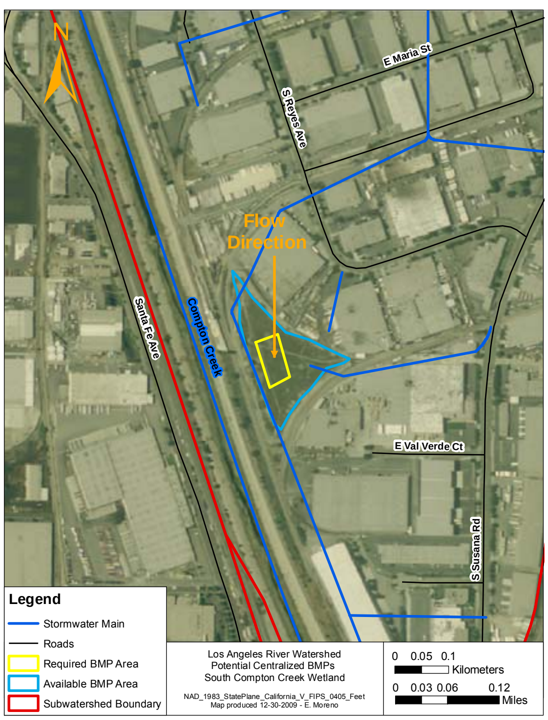

Figure 2. Required BMP Area

For stormwater to be treated in the wetland, a low-flow diversion structure will be installed upstream in Compton Creek. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	308.6	16%
Zinc	2982.9	16%
Cadmium	8.86	7%
TSS	902,091.8	15%
Fecal Coliform	4.184E+14	16%
Flow Volume	236,579,079	7%

Additional Design Considerations

BMP design information for Compton Creek Wetland is summarized in Table 2. Estimated implementation costs, based on the estimate provided by LACDPW, are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	6,253.0
Treatment Volume Capacity (AF)	3.7
BMP Surface Area (acres)	4.3
Recommended Ponding Depth (ft)	2.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Table 3. Implementation Costs

Cost	
Planning	$962,600.00
Design	$1,443,800.00
Permits/Studies	$50,000.00
Construction	$4,812,770.00
Operation & Maintenance	$2,400,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$9,740,000.00

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Enterprise Park
Centralized BMP Fact Sheet

Design and Site Overview

Enterprise Park is in a mainly residential area within the Los Angeles River watershed. The 44.5-acre unicorporated County area that drains adjacent to the park through the storm drain Project No. 1227 is mostly residential (51%), with some industrial (4%) and commercial (23%) areas. An infiltration basin (Figure 1) providing 3.9 AF of storage (0.7 acres and 7.5 feet deep) would be necessary to treat the drainage area. Soils data collected at the site indicate that the subsoils would need to be amended to 7.5 feet to provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin

Photo: County of Los Angeles LID Standards Manual, 2009

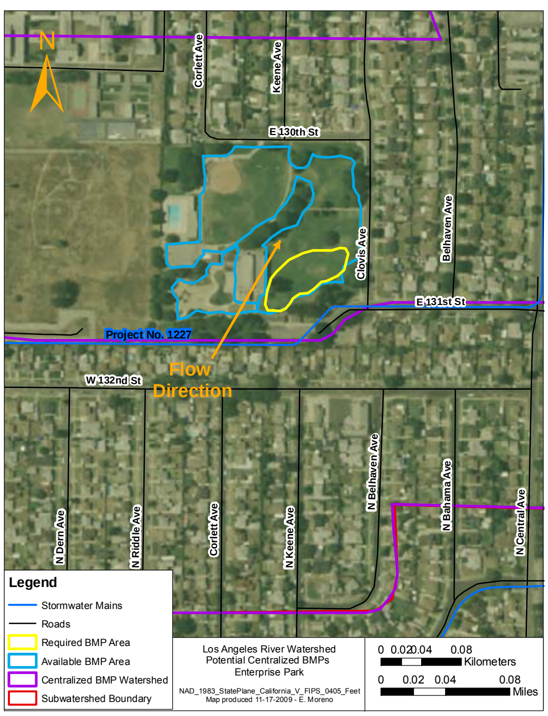

Figure 2. Required BMP Area

To treat the area around the park, flow in the storm drain Project 1227 would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	2.0	95%
Zinc	19.1	95%
Cadmium	0.06	91%
TSS	6,076.0	92%
Fecal Coliform	3.163E+12	92%
Flow Volume	1,479,595	91%

Additional Design Considerations

BMP design information for Enterprise Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (acres)	44.5
Treatment Volume Capacity (AF)	3.9
BMP Area (acres)	0.7
Maximum Ponding Depth (ft)	7.5

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$246,900.00
Permits/Studies	$50,000.00
Construction	$822,833.00
Operation & Maintenance	$690,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$2,130,000.00

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Farnsworth Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Farnsworth Park is mostly undeveloped (74%) with some residential (26%) areas. An infiltration basin (Figure 1) providing 0.5 AF of storage (0.1 acres and 8 feet deep) would be necessary to treat the 21.9-acre unincorporated County drainage area. Soils data collected at the site indicate that the subsoils are appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin
Photo: County of Los Angeles LID Standards Manual, 2009

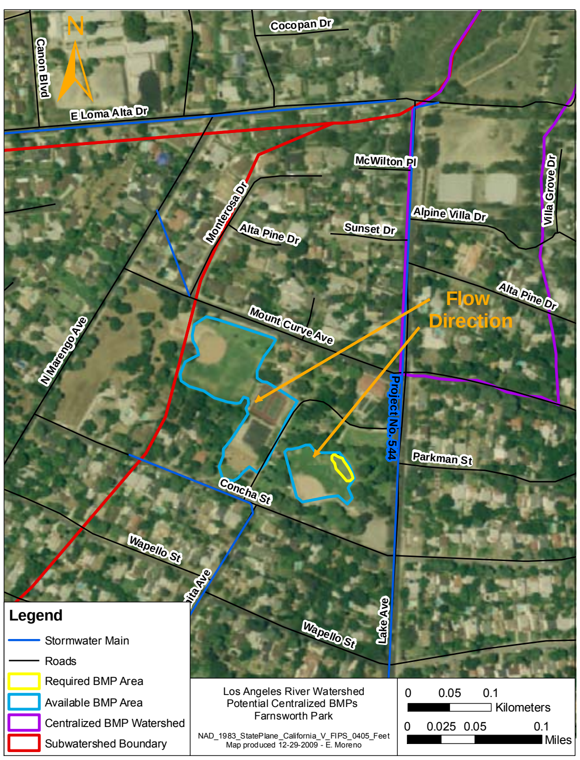

Figure 2. Required BMP Area

To treat the area around the park, flow in storm drain Project No. 544, running adjacent to the park along Lake Avenue, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	0.4	75%
Zinc	4.8	73%
Cadmium	0.02	59%
TSS	1,628.6	71%
Fecal Coliform	5.1E+11	71%
Flow Volume	490,595	59%

Additional Design Considerations

BMP design information for Farnsworth Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	21.9
Treatment Volume Capacity (AF)	0.5
BMP Surface Area (acres)	0.1
Recommended Ponding Depth (ft)	8.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$63,800.00
Permits/Studies	$50,000.00
Construction	$212,708.00
Operation & Maintenance	$180,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$830,000.00

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G.W. Carver Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to G.W. Carver Park is mostly residential (71%), with commercial (18%), and some industrial (7%) and undeveloped (4%) areas. An infiltration basin (Figure 1) providing 5.0 AF of storage (0.9 acres and 7 feet deep) would be necessary to treat the 1,381-acre unincorporated County drainage area. Soils data collected at the site indicate that the subsoils would need to be amended to a depth of 8 feet to provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin
Photo: County of Los Angeles LID Standards Manual, 2009

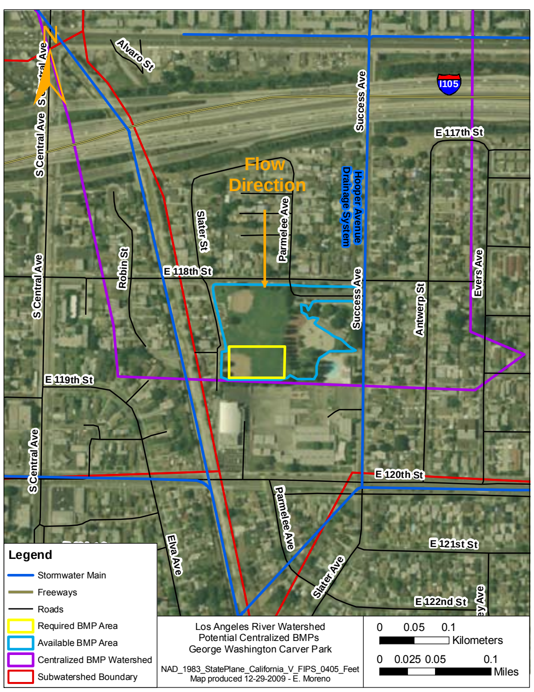

Figure 2. Required BMP Area

To treat the area around the park, flow in the Hooper Avenue drainage system, passing along Success Avenue, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	68.3	9%
Zinc	634.8	9%
Cadmium	1.72	10%
TSS	181,934.7	9%
Fecal Coliform	9.99E+13	16%
Flow Volume	46,034,795	10%

Additional Design Considerations

BMP design information for G.W. Carver Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	1,381.0
Treatment Volume Capacity (AF)	5.0
BMP Surface Area (acres)	0.9
Recommended Ponding Depth (ft)	7

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, it is recommended to pump water from the stormwater drain into the BMP. The cost of a 1,000-gpm pump station is included.

Table 3. Implementation Costs

Cost	
Planning	$332,900.00
Design	$499,300.00
Permits/Studies	$50,000.00
Construction	$1,644,250.00
Stormwater Pump Station (1,000 gpm)	$350,000.00
Operation & Maintenance	$1,040,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$4,010,000.00

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Hugo Reid Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Hugo Reid Park is mostly residential (68%) with commercial (20%) and some undeveloped (12%) areas. An infiltration basin (Figure 1) providing 3.2 AF of storage (0.6 acres and 7 feet deep) would be necessary to treat the 187-acre unincorporated County drainage area. Soils data collected at the site indicate that the subsoils would need to be amended to a depth of 7 feet to provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin
Photo: County of Los Angeles LID Standards Manual, 2009

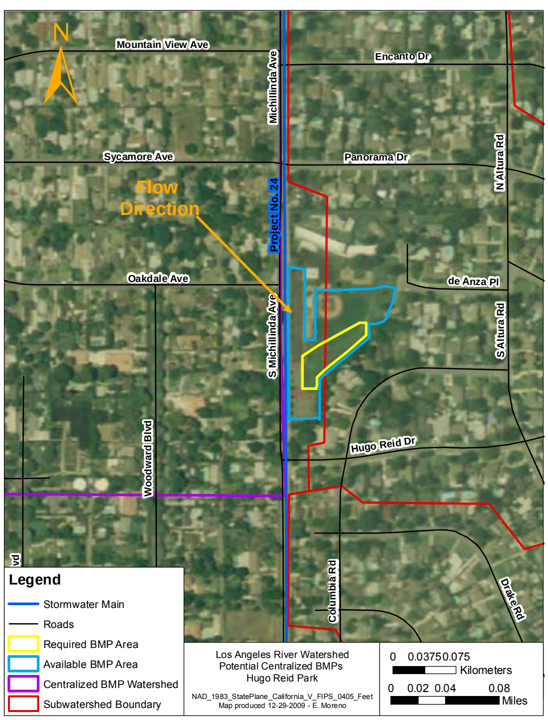

Figure 2. Required BMP Area

To treat the area around the park, flow in the storm drain Project No. 24, passing along Michillinda Avenue, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	13.6	36%
Zinc	106.1	41%
Cadmium	0.27	34%
TSS	35,123.0	33%
Fecal Coliform	1.93E+13	39%
Flow Volume	7,213,788	34%

Additional Design Considerations

BMP design information for Hugo Reid Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	187.0
Treatment Volume Capacity (AF)	3.2
BMP Surface Area (acres)	0.6
Recommended Ponding Depth (ft)	7.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$203,800.00
Permits/Studies	$50,000.00
Construction	$679,417.00
Operation & Maintenance	$570,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$1,830,000.00

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Loma Alta Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Loma Alta Park is mostly undeveloped (69.5%) with some residential (29.7%) and commercial (0.7%) areas. An infiltration basin (Figure 1) providing 10.2 AF of storage (1.9 acres and 6.5 feet deep) would be necessary to treat the 203-acre unicorporated County drainage area. Soils data collected at the site indicate that the subsoils are appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin
Photo: County of Los Angeles LID Standards Manual, 2009

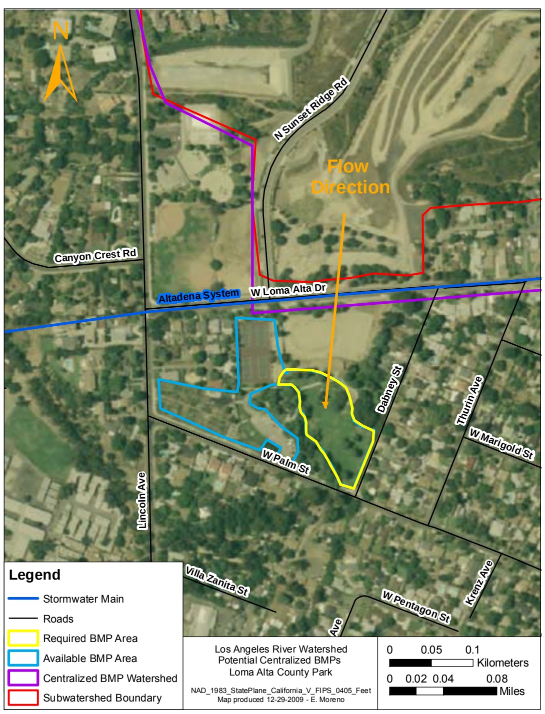

Figure 2. Required BMP Area

To treat the area around the park, flow in the Altadena drainage system, passing adjacent to the park along West Loma Alta Drive, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	5.9	88%
Zinc	58.3	91%
Cadmium	0.24	79%
TSS	20,476.1	87%
Fecal Coliform	7E+12	79%
Flow Volume	6,277,241	79%

Additional Design Considerations

BMP design information for Loma Alta Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	203.0
Treatment Volume Capacity (AF)	10.2
BMP Surface Area (acres)	1.9
Recommended Ponding Depth (ft)	6.5

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$459,600.00
Design	$689,300.00
Permits/Studies	$50,000.00
Construction	$2,297,750.00
Operation & Maintenance	$1,920,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$5,490,000.00

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Magic Johnson Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Magic Johnson Park is mainly residential (76.6%), with some commercial (17.8%), little undeveloped area (5.5%), and no industrial areas. An infiltration basin (Figure 1) providing 20 AF of storage (3.7 acres and 6 feet deep) would be necessary to treat the 254.7-acre unincorporated County drainage area. Soils data collected at the site indicate that the subsoils would provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin
Photo: County of Los Angeles LID Standards Manual, 2009

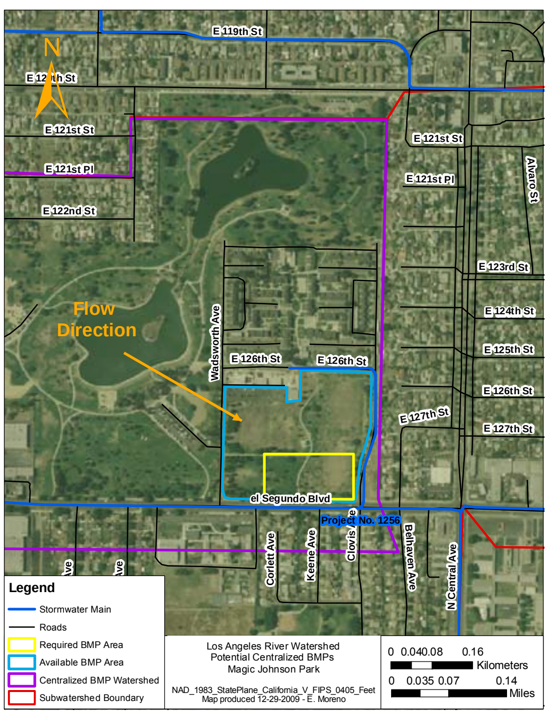

Figure 2. Required BMP Area

To treat the area around the park, flow in the storm drain Project No. 1256 passing along El Segundo Boulevard south of the park, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	10.9	96%
Zinc	95	98%
Cadmium	0.26	94%
TSS	28,170.2	96%
Fecal Coliform	2.0735E+13	96%
Flow Volume	6,912,123	94%

Additional Design Considerations

BMP design information for Magic Johnson Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	254.7
Treatment Volume Capacity (AF)	20.0
BMP Surface Area (acres)	3.7
Recommended Ponding Depth (ft)	6.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$756,400.00
Design	$1,134,500.00
Permits/Studies	$50,000.00
Construction	$3,781,542.00
Operation & Maintenance	$3,170,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$8,970,000.00

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Mona Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Mona Park is mainly residential (63.7%), with industurial (21.7%), and some commercial (7.6%) and undeveloped (7.0%) areas. An infiltration basin (Figure 1) providing 3.4 AF of storage (0.6 acres and 8 feet deep) would be necessary to treat the 1,005-acre unincorporatred County drainage area. Soils data collected at the site indicate that the subsoils might need to be amended to a depth of 8 feet to provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin.
Photo: County of Los Angeles LID Standards Manual, 2009

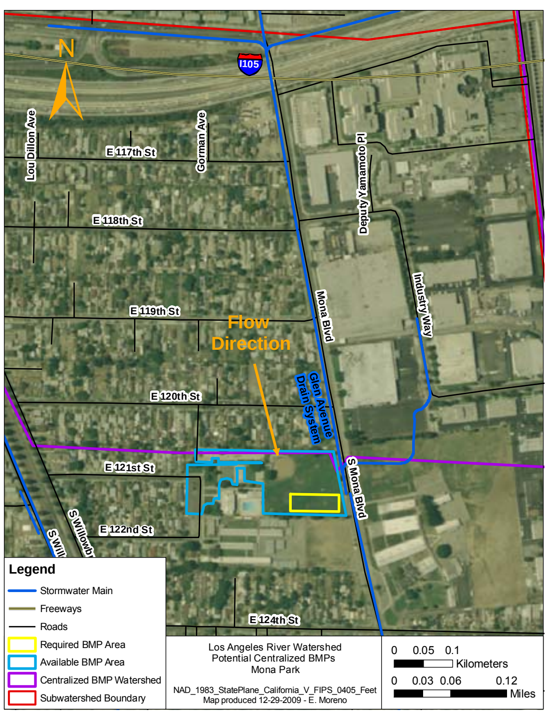

Figure 2. Required BMP Area.

To treat the area around the park, flow in the Glenn Avenue drainage system, passing along Mona Boulevard, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	53.7	10%
Zinc	512.1	10%
Cadmium	1.39	10%
TSS	150,803.5	10%
Fecal Coliform	7.73E+13	16%
Flow Volume	37,217,320	10%

Additional Design Considerations

BMP design information for Mona Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	1,005.0
Treatment Volume Capacity (AF)	3.4
BMP Surface Area (acres)	0.6
Recommended Ponding Depth (ft)	8.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, it is recommended to pump water from the stormwater drain into the BMP. The cost of an 800-gpm pump station is included.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$363,200.00
Permits/Studies	$50,000.00
Construction	$910,792.00
Stormwater Pump Station (800 gpm)	$300,000.00
Operation & Maintenance	$1,010,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$2,960,000.00

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Northside Drive Median Centralized BMP Fact Sheet

Design and Site Overview

The area draining to the Northside Drive Median consists of residential (76%) and commercial (31) areas. An infiltration basin (Figure 1) providing 2.3 AF of storage (0.4 acre and 8 feet deep) would be necessary to treat the 35-acre unicorporated County drainage area. Soils data collected at the site indicate that soils would need to be amended to a depth of 8 feet to achieve proper infiltration for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin

Photo: County of Los Angeles LID Standards Manual, 2009

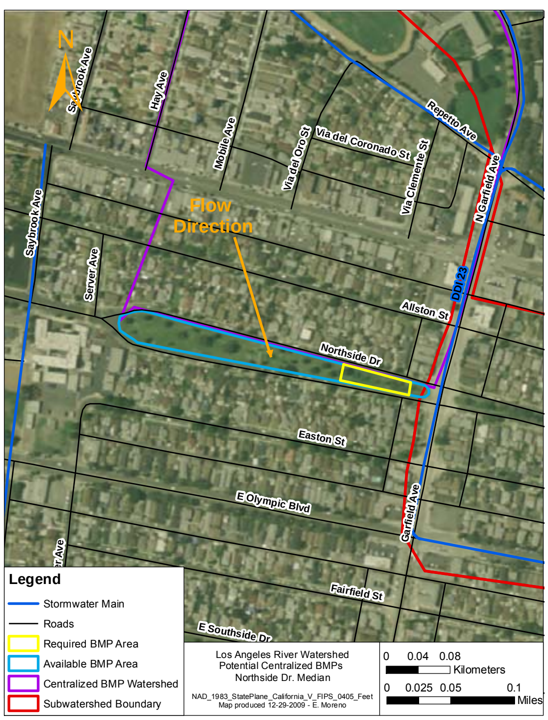

Figure 2. Required BMP Area

To provide treatment in the median, flow in the storm drain DDI 23, passing along Garfield Avenue, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	2.3	83%
Zinc	20.1	85%
Cadmium	0.05	75%
TSS	5,083.4	84%
Fecal Coliform	4.608E+12	87%
Flow Volume	1,377,249	75%

Additional Design Considerations

BMP design information for the Northside Drive Median is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	35.0
Treatment Volume Capacity (AF)	2.3
BMP Surface Area (acres)	0.4
Recommended Ponding Depth (ft)	8.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$120,000.00
Permits/Studies	$50,000.00
Construction	$400,056.00
Operation & Maintenance	$340,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$1,230,000.00

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Obregon Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Obregon Park is mostly residential (77%) and commercial (20%) with some undeveloped (3%) areas. An extended dry detention basin (Figure 1) providing 18.4 AF of storage (4.6 acres and 8 feet deep) would be necessary to treat the 225.5-acre unicorporated County drainage area. Soils data collected at the site indicate that the subsoils have low infiltration rates requiring an extended dry detention basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Extended Dry Detention Basin

Photo: Technical Manual for Stormwater Best Management Practices in the County of Los Angeles, 2004

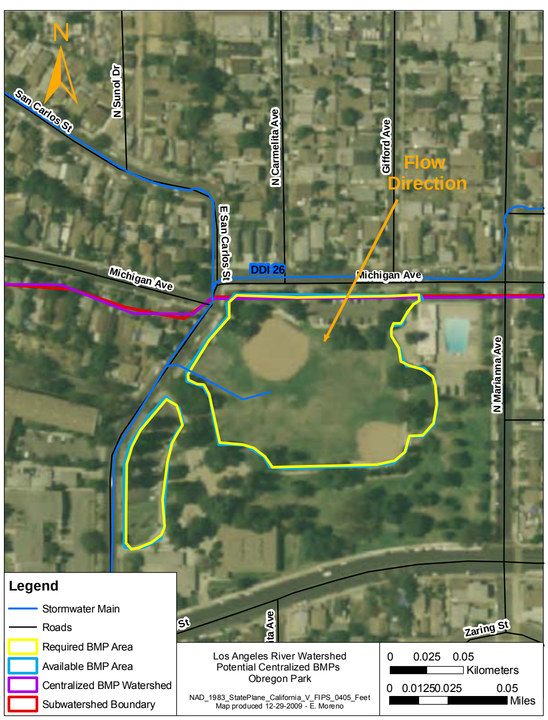

Figure 2. Required BMP Area

To treat the area around the park, flow in the storm drain DDI 26, passing along North Sunol Drive, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	5.9	75%
Zinc	55.2	75%
Cadmium	0.15	78%
TSS	14,258.6	74%
Fecal Coliform	1.386E+13	82%
Flow Volume	4,028,944	78%

Additional Design Considerations

BMP design information for Obregon Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	225.5
Treatment Volume Capacity (AF)	18.4
BMP Surface Area (acres)	4.6
Recommended Ponding Depth (ft)	8.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, it is recommended to pump water from the stormwater drain into the BMP. The cost of a 4,000-gpm pump station is included.

Table 3. Implementation Costs

Cost	
Planning	$1,197,800.00
Design	$1,796,600.00
Permits/Studies	$50,000.00
Construction	$5,088,542.00
Stormwater Pump Station (4,000 gpm)	$900,000.00
Operation & Maintenance	$2,990,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$12,100,000.00

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Roosevelt Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Roosevelt Park is mostly residential (79%), with commercial (13%), some undeveloped (8%) and no industrial areas. An infiltration basin (Figure 1) providing 3.7 AF of storage (0.7 acre and 7 feet deep) would be necessary to treat the 87.5-acre unincorporated County drainage area. Soils data collected at the site indicate that the subsoils would provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin
Photo: County of Los Angeles LID Standards Manual, 2009

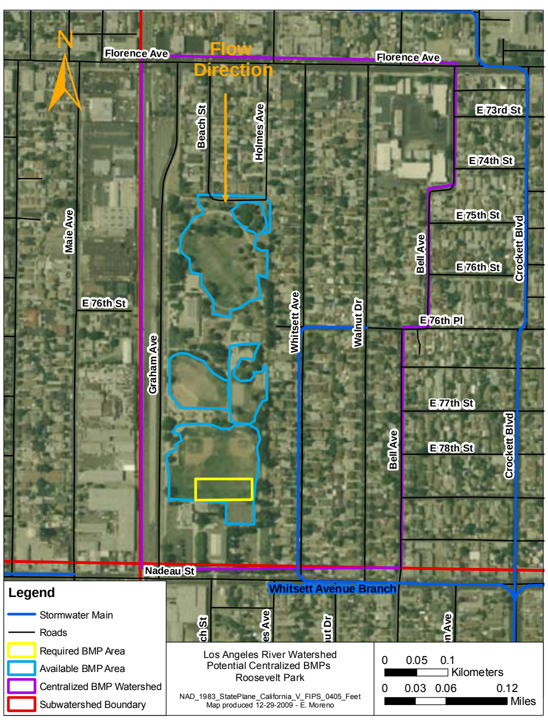

Figure 2. Required BMP Area

To treat the area around the park, flow in the Whitsett Avenue drainage system, passing along Whitsett Avenue, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	3.5	89%
Zinc	29.8	89%
Cadmium	0.09	82%
TSS	9,627.4	89%
Fecal Coliform	4.596E+12	91%
Flow Volume	2,446,094	82%

Additional Design Considerations

BMP design information for Roosevelt Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	87.5
Treatment Volume Capacity (AF)	3.7
BMP Surface Area (acres)	0.7
Recommended Ponding Depth (ft)	7.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$281,000.00
Permits/Studies	$50,000.00
Construction	$936,583.00
Operation & Maintenance	$780,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$2,370,000.00

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Salazar Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Salazar Park is mostly residential (75%), with commercial (15%), and undeveloped (10%) areas. An infiltration basin (Figure 1) providing 9.9 AF of storage (1.8 acres and 6.5 feet deep) would be necessary to treat the 105-acre unicorporated County drainage area. Soils data collected at the site indicate that the subsoils would need to be amended to a depth of 6 feet to provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin

Photo: County of Los Angeles LID Standards Manual, 2009

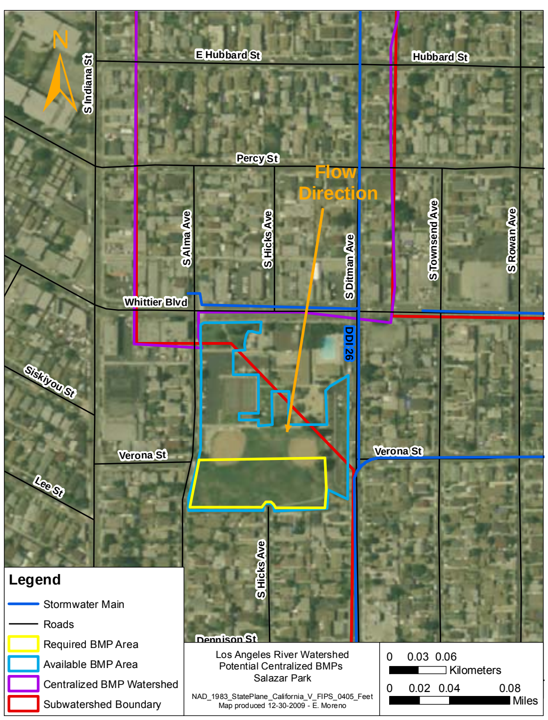

Figure 2. Required BMP Area

To treat the area around the park, flow in the storm drain DDI 26, passing along South Ditman Avenue, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	7.2	92%
Zinc	65.5	93%
Cadmium	0.16	88%
TSS	17,279.1	92%
Fecal Coliform	1.0564E+13	91%
Flow Volume	4,304,302	88%

Additional Design Considerations

BMP design information for Salazar Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	105.0
Treatment Volume Capacity (AF)	9.9
BMP Surface Area (acres)	1.8
Recommended Ponding Depth (ft)	6.5

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$380,200.00
Design	$570,300.00
Permits/Studies	$50,000.00
Construction	$1,900,833.00
Operation & Maintenance	$1,590,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$4,570,000.00

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Ted Watkins Park Left
Centralized BMP Fact Sheet

Design and Site Overview

The drainage area that can be treated in Ted Watkins Park can be diverted from two separate drainage systems (referred to as Left and Right). The area referred to as Ted Watkins Park Left is the area draining through the storm drain Project No. 73 along South Central Avenue. The drainage area is residential (72%), with commercial (18%), and some industrial (7%) and undeveloped (3%) areas. An infiltration basin (Figure 1) providing 1.3 AF of storage (0.2 acre and 8 feet deep) would be necessary to treat the 42-acre unincorporated County drainage area. Soil data collected at the site indicate that the subsoils, below 4 feet, would provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

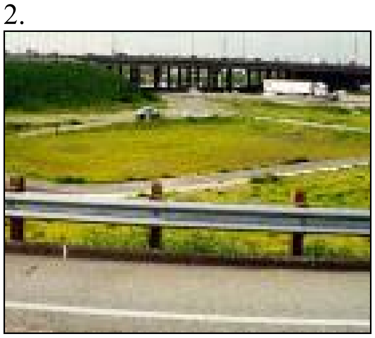

Figure 1. Example of an Infiltration Basin

Photo: County of Los Angeles LID Standards Manual, 2009

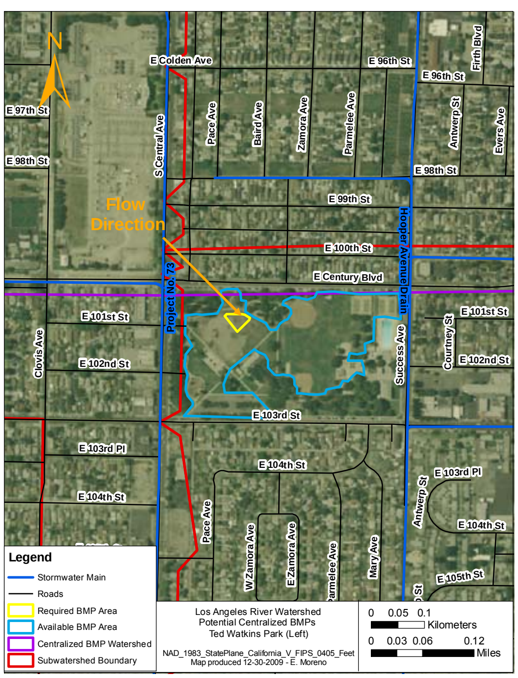

Figure 2. Required BMP Area

The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	2.2	68%
Zinc	19.6	70%
Cadmium	0.05	63%
TSS	5,260.1	70%
Fecal Coliform	3.355E+12	77%
Flow Volume	1,456,878	63%

Additional Design Considerations

BMP design information for Ted Watkins Park Left is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	42.0
Treatment Volume Capacity (AF)	1.3
BMP Surface Area (acres)	0.2
Recommended Ponding Depth (ft)	8.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, it is recommended to pump water from the stormwater drain into the BMP. The cost of a 300-gpm pump station is included.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$201,900.00
Permits/Studies	$50,000.00
Construction	$512,833.00
Stormwater Pump Station (300 gpm)	$160,000.00
Operation & Maintenance	$560,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$1,810,000.00

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Ted Watkins Park Right
Centralized BMP Fact Sheet

Design and Site Overview

The drainage area that can be treated in Ted Watkins Park can be diverted from two separate drainage systems (referred to as Left and Right). The area referred to as Ted Watkins Park Right is the area draining through the Hooper Avenue drainage system along Success Avenue. The drainage area is residential (72%), with commercial (18%), and some industrial (7%) and undeveloped (3%) areas. An infiltration basin (Figure 1) providing 5.4 AF of storage (1 acre and 6.5 feet deep) would be necessary to treat the 1,256-acre unincorporated County drainage area. Soils data collected at the site indicate that the subsoils, below 4 feet, would provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin

Photo: County of Los Angeles LID Standards Manual, 2009

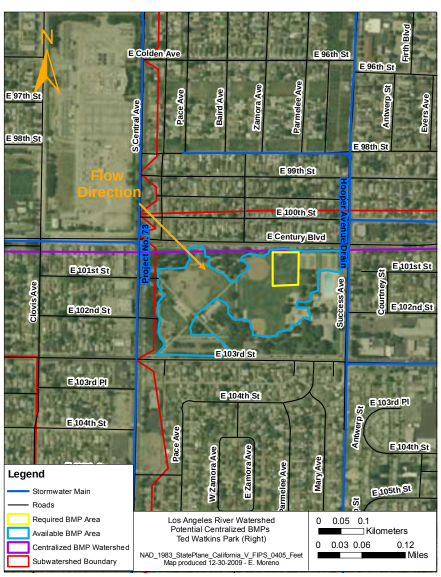

Figure 2. Required BMP Area

To treat the area around the park, flow in the Hooper Avenue drainage system, passing along Success Avenue, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	70.7	12%
Zinc	661.6	12%
Cadmium	1.81	12%
TSS	187,679.4	11%
Fecal Coliform	1.145E+14	20%
Flow Volume	48,221,827	12%

Additional Design Considerations

BMP design information for Ted Watkins Park Right is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	1,256.0
Treatment Volume Capacity (AF)	5.4
BMP Surface Area (acres)	1.0
Recommended Ponding Depth (ft)	6.5

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, it is recommended to pump water from the stormwater drain into the BMP. The cost of a 1,200-gpm pump station is included.

Table 3. Implementation Costs

Cost	
Planning	$369,400.00
Design	$554,000.00
Permits/Studies	$50,000.00
Construction	$1,446,667.00
Stormwater Pump Station (1,200 gpm)	$400,000.00
Operation & Maintenance	$1,550,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$4,440,000.00

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Ted Watkins Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Ted Watkins Park is mostly residential (72%), with commercial (18%), and little industrial (7%) and undeveloped (3%) areas. An infiltration basin (Figure 1) providing 6.7 AF of storage (1.2 acres and 6 feet deep) would be necessary to treat the 1,298-acre unicorporated County drainage area. Soils data collected at the site indicate that the subsoils, below 4 feet, would provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin

Photo: County of Los Angeles LID Standards Manual, 2009

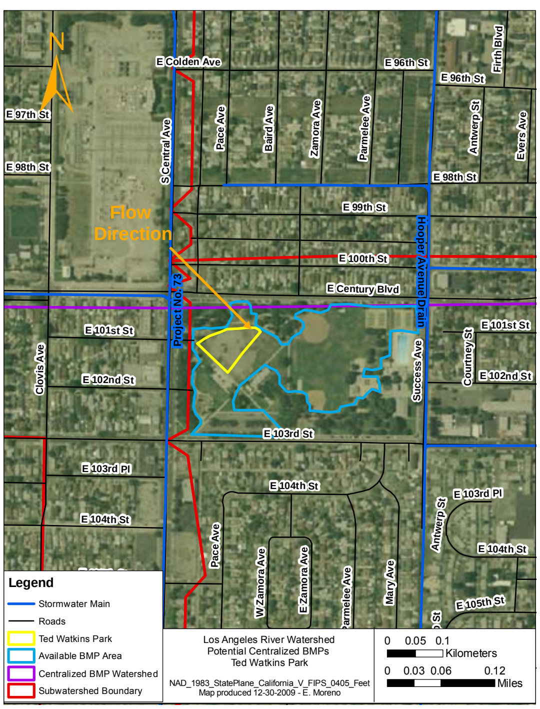

Figure 2. Required BMP Area

To treat the area around the park, flow in the Hooper Avenue drainage system, passing along Success Avenue, and the storm drain Project No. 73, along South Central Avenue, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	72.9	13%
Zinc	681.2	14%
Cadmium	1.86	14%
TSS	192,939.5	13%
Fecal Coliform	1.179E+14	22%
Flow Volume	49,678,705	14%

Additional Design Considerations3

BMP design information for Ted Watkins Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	1,298.0
Treatment Volume Capacity (AF)	6.7
BMP Surface Area (acres)	1.2
Recommended Ponding Depth (ft)	6.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, it is recommended to pump water from the stormwater drain into the BMP. The cost of a 1,500-gpm pump station is included.

Table 3. Implementation Costs

Cost	
Planning	$508,800.00
Design	$763,200.00
Permits/Studies	$50,000.00
Construction	$2,094,000.00
Stormwater Pump Station (1,500 gpm)	$450,000.00
Operation & Maintenance	$2,130,000.00
Pre-and Post-Construction Monitoring	$69,000.00
Total	$6,070,000.00

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Two Strike Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Two Strike Park is mostly undeveloped (72%) with some residential (28%) areas. An infiltration basin (Figure 1) providing 14.2 AF of storage (2.6 acres and 6.5 feet deep) would be necessary to treat the 469-acre unicorporated County drainage area. Soils data collected at the site indicate that the subsoils are appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin
Photo: County of Los Angeles LID Standards Manual, 2009

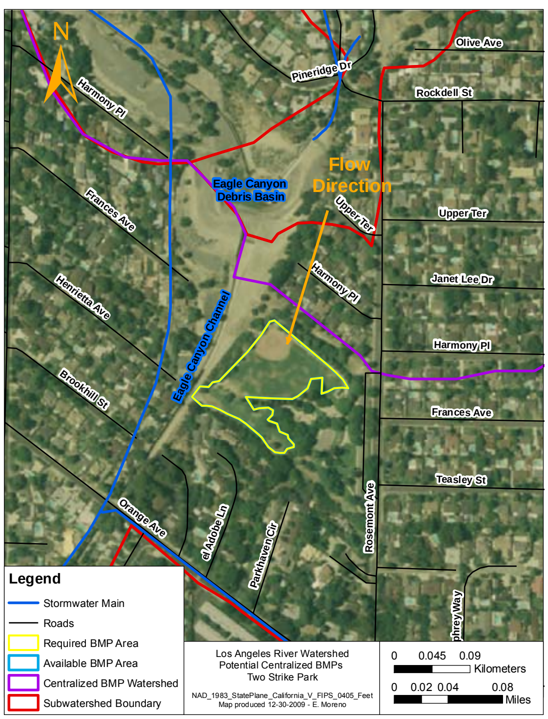

Figure 2. Required BMP Area

To treat the area around the park, flow in the Eagle Canyon Channel would have to be diverted into the park. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	8.1	93%
Zinc	77.5	94%
Cadmium	0.28	85%
TSS	24,252.9	92%
Fecal Coliform	9.31E+12	86%
Flow Volume	7,450,037	85%

Additional Design Considerations

BMP design information for Two Strike Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	469.0
Treatment Volume Capacity (AF)	14.2
BMP Surface Area (acres)	2.6
Recommended Ponding Depth (ft)	6.5

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$533,800.00
Design	$800,700.00
Permits/Studies	$50,000.00
Construction	$2,668,833.00
Operation & Maintenance	$2,240,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$6,370,000.00

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Whittier Narrows Park
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to Whittier Narrows Park is undeveloped (66.8%) with commercial (33.1%) and a small amount of residential (0.1%) areas. An infiltration basin (Figure 1) providing 2.4 AF of storage (0.4 acre and 8 feet deep) would be necessary to treat the 36-acre unicorporated County drainage area. Soils data collected at the site indicate that the subsoils are appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin

Photo: County of Los Angeles LID Standards Manual, 2009

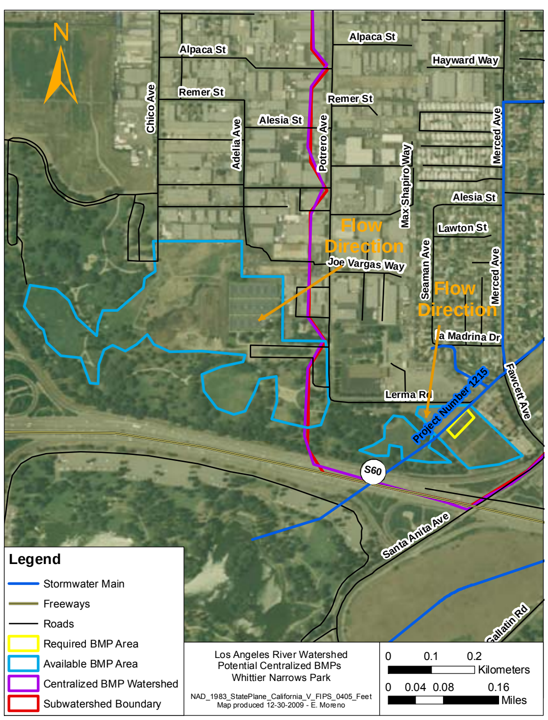

Figure 2. Required BMP Area

To treat the area around the park, flow in the storm drain Project No. 1213 flowing into the park along Lema Road would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	1.5	100%
Zinc	15.0	99%
Cadmium	0.04	95%
TSS	5,382.6	99%
Fecal Coliform	6.8564E+11	99%
Flow Volume	1,123,825	95%

Additional Design Considerations

BMP design information for Whittier Narrows Park is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	36.0
Treatment Volume Capacity (AF)	2.4
BMP Surface Area (acres)	0.4
Recommended Ponding Depth (ft)	8.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, if the BMP is too shallow, stormwater might need to be pumped from the stormwater drain into the BMP. The cost of a pump station is not included in the cost estimate.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$144,300.00
Permits/Studies	$50,000.00
Construction	$480,917.00
Operation & Maintenance	$400,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$1,400,000.00

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Whittier Narrows Recreation Area
Centralized BMP Fact Sheet

Design and Site Overview

The area draining to the Whittier Narrows Recreation Area is mostly undeveloped (79%), with commercial (10%), residential (8%) and some industrial (3%) areas. An infiltration basin (Figure 1) providing 0.9 AF of storage (0.2 acres and 8 feet deep) would be necessary to treat the 23-acre unicorporated County drainage area. Soils data collected at the site indicate that the subsoils would need to be amended to a depth of 4 feet to provide infiltration rates appropriate for an infiltration basin. The area required for the BMP is outlined in Figure 2.

Figure 1. Example of an Infiltration Basin

Photo: County of Los Angeles LID Standards Manual, 2009

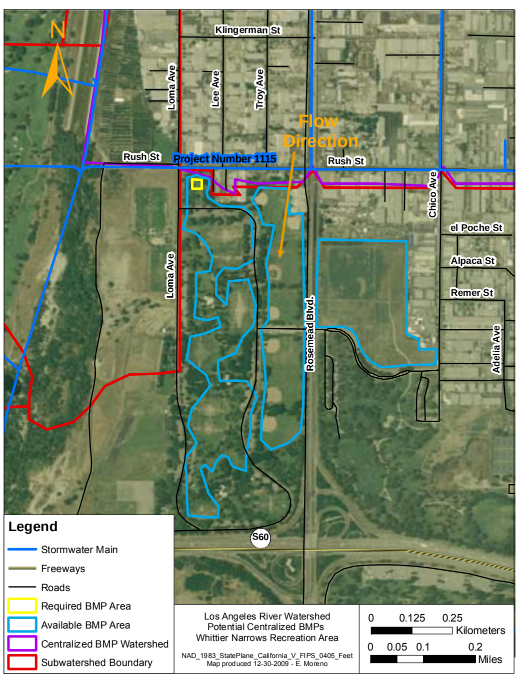

Figure 2. Required BMP Area

To treat the area around the park, flow in the storm drain Project No. 1115, passing along Rush Street adjacent to the park, would have to be diverted. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	0.6	100%
Zinc	5.9	95%
Cadmium	0.01	80%
TSS	3,933.7	94%
Fecal Coliform	4.362E+12	96%
Flow Volume	335,133	80%

Additional Design Considerations3

BMP design information for the Whitier Narrows Recreation Area is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Infiltration Basin	
Watershed Treatment Area (Unincorporated County Acres)	23.0
Treatment Volume Capacity (AF)	0.9
BMP Surface Area (acres)	0.2
Recommended Ponding Depth (ft)	8.0

The presented BMP surface area and depth are recommendations. The estimated load reduction can be met by a BMP with the recommended treatment volume capacity. The area and depth of the BMP could be varied to optimize the use of the available BMP area.

Because of the size and depth of the stormwater drainage system, it is recommended to pump water from the stormwater drain into the BMP. The cost of a 200-gpm pump station is included.

Table 3. Implementation Costs

Cost	
Planning	$250,000.00
Design	$153,000.00
Permits/Studies	$50,000.00
Construction	$359,917.00
Stormwater Pump Station (200 gpm)	$150,000.00
Operation & Maintenance	$430,000.00
Pre- and Post-Construction Monitoring	$69,000.00
Total	$1,440,000.00

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Pilot Roadside BMP
Project Fact Sheet

Design and Site Overview

The *Los Angeles River Watershed Management Plan* identifies and recommends a demonstration site integrating the use of roadside BMPs, such as linear bioretention areas, to treat stormwater runoff from surface streets. Linear Bioretention (Figure 1) measuring approximately 0.06 acre could be installed in the right-of-way of publicly owned streets to treat stormwater from 1 acre of road surface. Soils data has been collected in two areas directly adjacent to roads—one in a median area and one in the right-of-way. The data indicate that infiltration rates at the surface and in the sublayers would provide adequate infiltration for a bioretention area. An example of a roadside BMP implemented in the Sun Valley area of Los Angeles along Elmer Avenue is shown in Figure 2. Roads are typically a source of metals, nutrients, and PAHs.

Figure 1. Example of a Linear Bioretention Area
Photos: Los Angeles Basin Water Augmentation Study – Neighborhood Retrofit Concept Plan

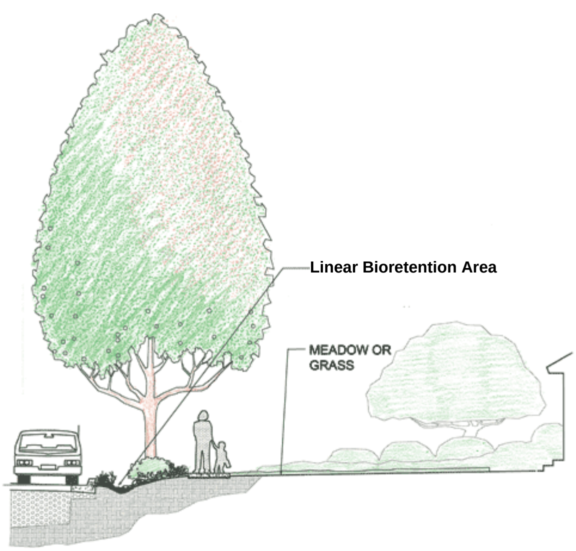

Figure 2. Elmer Avenue Linear Bioretention Area.
Drawing: Water World

The watershed treatment area that would drain into a roadside BMP was estimated to be 1 acre and would be composed entirely of the road surface. The pollutant load reductions that would result from BMP implementation are summarized in Table 1. (Note: Values are based on rainfall events occurring in Water Year 2003.)

Table 1. Expected Pollutant Reductions

Pollutant	Watershed Load (lb, counts, or ft^3/yr)	Percent Load Reduction
Copper	0.12	75%
Zinc	1.08	76%
Lead	0.12	75%
TSS	288.7	76%
Fecal Coliform	1.73E+10	68%
Flow Volume	61,107	56%

Additional Design Considerations

BMP design information for a typical roadside BMP is summarized in Table 2. Estimated implementation costs are presented in Table 3.

Table 2. BMP Design Information Summary

Dry Extended Basin	
Watershed Treatment Area (acres)	1.00
BMP Area (acres)	0.05
Maximum Ponding Depth (ft)	0.50
Substrate Depth (ft)	3.00
Substrate Porosity (ft)	0.40
Treatment Volume Capacity (AF)	0.10

Table 3. Implementation Costs

Cost	
Planning	$150,000
Design	$80,000
Construction	$50,000
Operation & Maintenance	$15,000
Pre and Post-Construction Monitoring	$124,000
Total	$419,000

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Centralized BMPs on Private Property Project Fact Sheet

Overview

Implementing BMPs on public property can achieve an 18% reduction in copper. (Of all the metals TMDL pollutants, copper requires the greatest reduction. Therefore, it is assumed that all pollutant targets are met if the copper requirements are met.) To meet the 30% copper reduction target, a combination of BMPs on public and private property will be necessary. Therefore, private properties will need to be evaluated for potential BMP construction according to certain site requirements.

Evaluating Private Parcels for BMP Suitability

The following criteria must be met for a site to be considered:

Proximity to the drainage network: A drainage network should be in close proximity to the parcel where stormwater can be routed to minimize the cost of modifying the drainage system.

Percent impervious area: Locations with a higher percent of impervious area should be targeted for greater potential volume reduction and water quality improvements.

Watershed treatment area: sufficient space should exist on the parcel for BMPs to adequately treat, store, and infiltrate runoff from the Unincorporated County drainage area.

Soil type: Soil type serves as a proxy for infiltration rate and water holding capacity. Sites with HSG A, B, or C soils have suitable infiltration for infiltration BMPs and should be further investigated. Soil types should be verified in the field.

Slope: Sites should be screened for moderate slopes (less than 10%). If moderate slopes are present (as verified in the field), the sites can be considered for centralized BMPs.

Multi-benefit use: Centralized BMPs can offer multiple benefits. For example, infiltration basins can be used for stormwater management and community park space. Parks or open space can be altered to enhance stormwater treatment and storage.

Other site characteristics: Surface infiltration rate and depth to the seasonal high groundwater table should be verified in the field.

Selecting Centralized BMP Type

The two BMP types that can be installed are infiltration basins and dry extended detention basins (Figure 1). Table 1 summarizes the site requirements for each BMP type.

Figure 1. (a) Infiltration Basin (b) Dry Extended Detention Basin

Photo: County of Los Angeles LID Standards Manual, 2009

Table 1. BMP Construction Requirements

Site Feature	Infiltration Basin	Dry Extended Detention Basin
Hydrologic Soil Group	A or B	Low B or C
Surface Infiltration Rate	> 2 in/hr	> 0.5 in/hr
Depth to Groundwater	> 10 ft	> 10 ft

BMP Costs and Effectiveness

Table 2 summarizes additional costs and BMP storage required to add the necessary treatment to meet the reduction targets. Table 3 shows the additional pollutant reductions that can be achieved.

Table 2. Costs and Storage Requirements

Parameter	Reduction of Copper		
	18.4%–30%	18.4%–50%	18.4%–70%
Cost ($ millions)	$401.10	$1,343.90	$2,800.70
Storage (AF)	250.0	711.0	1,448.0
Surface Area (acre)	46.0	151.0	328.0

Table 3. Pollutant Reductions

Pollutant	Existing Load	Reduction of Copper		
		18.4% –30%	18.4% –50%	18.4% –70%
Flow Volume (cubic ft/yr)	991,014,657	12%	33%	51%
TSS (lb/yr)	10,518,165	7%	16%	25%
Copper (lb/yr)	1,502	12%	32%	52%
Lead (lb/yr)	1,232	13%	36%	57%
Zinc (lb/yr)	12,854	11%	36%	57%
Fecal Coliform (#/yr)	2.E+15	26%	46%	67%

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Distributed Structural BMPs Fact Sheet
Catch Basin Inserts

Overview

Catch basins are storm drain inlets with sumps that capture some debris before it enters the storm drain pipe. Full capture devices (≤ 5 mm mesh size) are being installed in catch basins to prevent additional trash and debris from entering storm drains.

Full capture devices are designed to capture trash but do not provide for sediment capture. The efficiency of a catch basin can be greatly improved by installing an insert (Figure 1), which captures trash, oil/grease, organics, and other pollutants and has the potential to remove a significant fraction of sediment and associated metals.

Figure 1. Catch Basin Insert
Photo: County of Los Angeles LID Standards Manual, 2009

Catch Basin Insert Implementation

Catch basin inserts are a simple but effective distributed structural practice for treating wet weather flows. The Los Angeles River watershed has a high density of catch basins, making catch basin inserts a good choice to treat substantial drainage areas.

Two phases of catch basin insert implementation are proposed:

Phase I: Install catch basin inserts for catch basins that have not been retrofitted yet with full-capture devices, which accounts for approximately 66 percent of all basins.

Phase II: Install catch basin inserts in the remaining 34 percent of catch basins in the implementation area.

Implementing such catch basin retrofits would involve internal planning, a pilot study to gain approval from the RWQCB for meeting trash TMDL requirements, device installation, and ongoing maintenance (sediment and debris removal) as part of existing catch basin inspection and cleaning activities.

BMP Cost and Effectiveness

The costs associated with installing catch basin inserts throughout the Los Angeles River watershed are summarized in Table 1. The estimated costs include planning, design, operation, maintenance, and monitoring costs.

Table 1. Catch Basin Insert Costs

Phase	Estimated Cost
Phase II	$23,140,000
Phase III	$12,340,000

Catch basin insert pollutant removal performance for the Los Angeles River watershed treatment area is summarized in Table 2.

Table 2. Expected Pollutant Reductions

Pollutant	Watershed Load (lb/yr)	Percent Load Reduction
Total Copper	1,503.7	5.4%
Total Lead	1,233.7	6.6%
Total Zinc	12,867.6	5.9%

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Nonstructural BMP Fact Sheet

Overview

As a result of the review of existing programs that address the TMDL pollutants, several program enhancements and one new program are recommended and will offer additional water quality benefits and contribute to load reductions to meet the TMDL WLAs.

Implementing Nonstructural BMPs

The proposed BMPs include

- **Smart Gardening Program Enhancements** that will extend the reach of the water conservation and pollution prevention messages to the Los Angeles River watershed. This BMP includes holding workshops (Figure 1) in the Los Angeles River watershed and developing a stormwater-focused tip card for distribution to workshop attendees.
- **TMDL-Specific Stormwater Training** emphasizing BMPs that can mitigate the TMDL pollutants of concern for employees whose activities can affect stormwater pollution.
- **Enhancement of Commercial and Industrial Facility Inspections** to strengthen oversight and ensure that activities associated with the businesses do not become pollutant sources.
- Developing **Enforcement Escalation Procedures** that can be enhanced to more effectively address known sources of pollution.
- **Improved Street Sweeping Technology** can maximize the effectiveness of sweeping and improve the quality of stormwater runoff from streets by upgrading to regenerative air sweepers.
- Incentives programs that can be developed for the **Reduction of Irrigation Return Flow**, including rebates for smart irrigation controller use, a xeriscaping conversion incentives program, and demand-side management practices that charge high-volume irrigators more for water.

Figure 1. Smart Gardening Learning Center

Photo: County of Los Angeles LID Standards Manual, 2009

BMP Costs and Effectiveness

Table 1 shows costs, relative pollutant-removal effectiveness, and whether dry and wet weather flows are addressed. All the proposed BMPs address the highest-priority pollutants: bacteria, metals, and non-metal toxics. All the existing BMP enhancements address both dry and wet weather flows, while reduction of irrigation return flow addresses dry weather flows only.

Table 1. Nonstructural BMP Costs and Pollutants and Flows Addressed

BMP	Cost[a]	Pollutants Addressed					Condition	
		Bacteria	Metals	Non-Metal Toxics	Nutrients	Trash	Wet	Dry
Smart Gardening Program Enhancements	$370,000	◗	◗	◗	◗	○	✓	✓
TMDL-Specific Stormwater Training	$320,000	◗	◗	◗	◗	◗	✓	✓
Enhancement of Commercial and Industrial Facility Inspections	$14,000	◗	◗	◗	◗	○	✓	✓
Enforcement Escalation Procedures	--[b]	◗	●	◗	◗	○	✓	✓
Improved Street Sweeping Technology	$12,690,000	◗	◗	◗	◗	○	✓	
Reduction of Irrigation Return Flow	$11,060,000	●	●	◗	●	○	✓	✓

● addresses the pollutant; ◗ partially addresses the pollutant; O does not address the pollutant

a. PV costs are included for planning, permitting, and other upfront costs, as well as annual and long-term costs, including program operation and evaluation.

b. A reasonably accurate cost could not be estimated for the enforcement escalation procedures BMP.

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Appendix G. BMP Model Configuration for the County TMDL Implementation Area

The County has developed a comprehensive BMP decision support system based on a combination of LSPC and BMP simulation and optimization tools. The following provides a description of this tool and its application to the County TMDL Implementation area to guide structural BMP selection.

G.1. Watershed Model: LSPC Model Development

Through a joint effort of the RWQCB, USEPA, SCCWRP, and Tetra Tech, a regional modeling approach was developed to simulate the hydrology and transport of sediment and metals. The approach is based on HSPF and the LSPC, a version of HSPF, recoded into C++. The regional approach has been used to support metals TMDLs for Los Angeles River.

The County has consolidated the models into a uniform model configuration and calibration approach as part of the effort to support development of a comprehensive watershed-scale BMPDSS for the County. The LSPC watershed modeling system simulates hydrology, sediment, and general water quality on land and is combined with a stream fate and transport model. This model was used to generate wet weather loading for the unincorporated County areas, as described in the Pollutant Source Characterization and Prioritization in Section 3. Wet weather loading estimates were developed using the modeled constituents including copper, zinc, lead, TN, TP, fecal coliform, and TSS. For the other pollutants (chlordane, DDT, PCBs, selenium, cadmium, and PAHs), loading estimates were developed as a function of runoff volume or TSS load, also described in Section 3.

G.2. Description of BMPDSS and the BMPDSS Pilot Study

To demonstrate how data from the watershed models can be used in combination with detailed BMP modeling and cost functions, the Los Angeles County Flood Control District (LACFCD) and USEPA Region 9 collaborated on a pilot study to test a methodology for quantifying and evaluating cost-effective BMP implementation alternatives for achieving TMDL targets. The primary objectives of the pilot study were to do the following:

- Investigate and review the performance of BMP optimization solution techniques using County data sets
- Evaluate the benefits and costs of various proposed management options, focusing on structural BMP solutions

A two-step approach was performed. Step One identified the optimal distributed (site-scale) BMP types and configurations for each land use type. In Step Two, the results from Step One were applied to a pilot watershed that involved simulating the entire watershed and centralized BMP sites, as well as watershed-level optimization, to determine the cost-effective BMP implementation plans to achieve WLA targets set forth by the TMDL. This approach evaluated both distributed BMPs at a larger watershed scale, as well as centralized BMP options where possible, to facilitate BMP implementation decision making. Given the defined objectives and constraints, the original pilot study identified the near-optimal structural solutions at various WLA targets that could lead to significant cost saving. Those solutions were composed of centralized BMP sizes, distributed BMP treatment capacity, and percent of area treated for each land use category within the delineated subwatersheds.

Centralized BMPs were generally favored because of their relatively lower costs, as defined by the given cost functions and the exclusion of land acquisition cost. Also the land uses that had higher unit area pollutant loading rates and occupied a larger percentage of the study area received a higher level of treatment. While the results were seemingly intuitive, the use of a comprehensive, process-based model permitted characterization of BMP implementation details under various watershed physiographical and meteorological conditions to achieve specific management goals.

This study demonstrated the application of BMPDSS, linking with watershed model output through the use of land use time series, to support stormwater management decision making and to determine the most cost-effective BMP implementation plan—both at the land-use-site scale and watershed level. It is important to note that optimization analysis in general heavily relies on the accuracy of BMP cost estimation and BMP effectiveness representation.

One distinction between the approach used in the original pilot and this application is that the current approach includes both structural and nonstructural BMPs for complete assessment of potential load reductions that can be achieved. A combination of both structural and nonstructural BMPs provides additional load reduction opportunity that might help with meeting TMDL WLAs.

A complete discussion of the configuration of BMPDSS for the County TMDL Implementation Area is provided below.

G.3. BMPDSS Configuration for the County TMDL Implementation Area

The LACDPW subwatershed layer used in the watershed model divides the Los Angeles River watershed into 1,016 hydrologically connected subwatersheds. The sizes of those subwatersheds range between 3.6 and 8,129 acres, with an average size of approximately 500 acres. To isolate the contributing loads from unincorporated County areas from other contributors, the watershed model information was re-sampled for areas within the County unincorporated boundaries. Federally owned lands in the unincorporated County boundaries were also excluded from consideration. The remaining unincorporated County areas on nonfederal land are referred to in this analysis as the TMDL Implementation Areas. Figure G-1 illustrates the relevant areas.

For the subwatersheds that intersect with unincorporated County area, unincorporated and incorporated areas were divided into two separate modeled land segments. The two separate land segments are routed to the same reach. Figure G-2 is a conceptual schematic for the original and the modified model configuration used for evaluating flow and pollutant load contributions from unincorporated County area. Only contributions from unincorporated County areas (those that pass the intermediate evaluation point) were evaluated for this TMDL implementation planning effort.

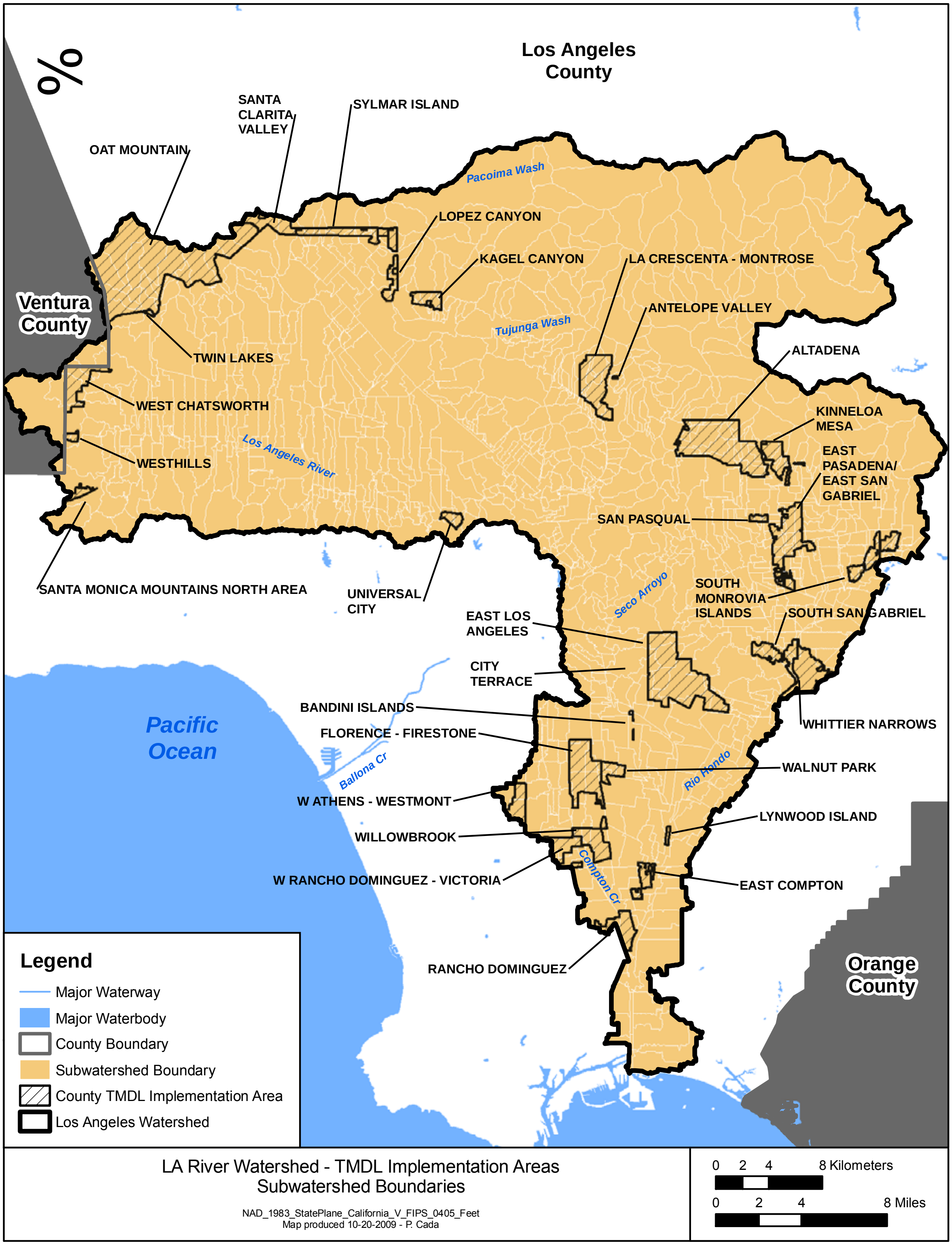


Figure G-1. Modeled Subwatersheds and TMDL Implementation Area in the Los Angeles River Watershed

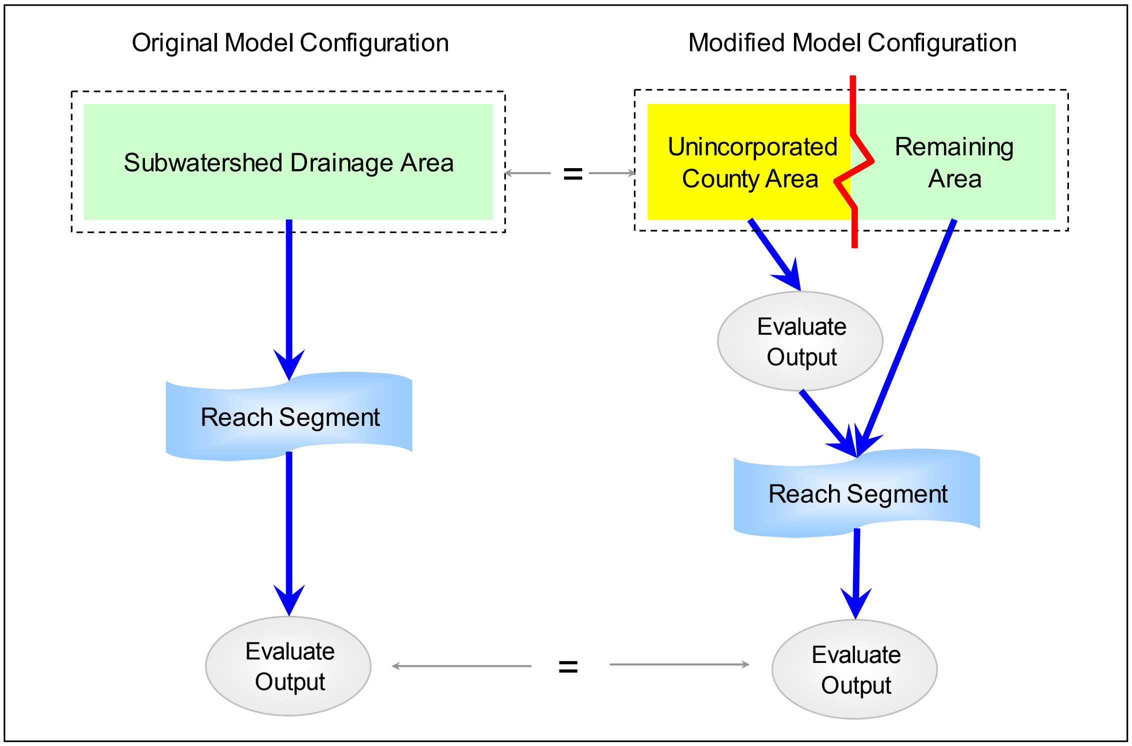


Figure G-2. Conceptual Schematic for the Original and Modified Model Configurations

Hydrologic Response Units (HRUs) in the County's watershed model represent various combinations of land use, soil type, and slope. Hydrologic and pollutant loading varies by HRU. The HRU is the smallest modeling unit in the watershed model. Table G-1 presents a list of the 21 modeled HRUs and describes their classification into broader groups of urban impervious, urban pervious or non-urban areas.

Within urban land use parcels, all the pervious areas were divided between urban grass irrigated and urban grass non-irrigated, and then summed. In the Calleguas Creek and Santa Clara River watersheds, Aqua Terra (2005, 2008) developed an approach for simulating irrigation application for watershed modeling. Values for percent irrigated in the Los Angeles River watershed by land use are assumed to be similar to those derived in those nearby regional watersheds. The amount of urban grass that is assumed irrigated is 50 percent for low-density residential, 70 percent for medium-density residential, 80 percent for high-density residential and 85 percent for commercial or industrial or transportation land uses.

Using the intersected GIS layers for the TMDL Implementation Areas and the HRUs, the distribution of HRU areas per land segment was determined. Having separate land segments for unincorporated and incorporated areas per subwatershed allowed for application of BMPs to only the unincorporated County areas.

Table G-1. Modeled HRUs in TMDL Implementation Area

HRU Code	HRU Description	General Cover Type	Area (acre)
1	High-density single-family residential	Urban Impervious	3,125.0
2	Low-density single-family residential moderate slope	Urban Impervious	110.4
3	Low-density single-family residential steep slope	Urban Impervious	33.8
4	Multifamily residential	Urban Impervious	2,110.0
5	Commercial	Urban Impervious	1,019.4
6	Institutional	Urban Impervious	712.6
7	Industrial	Urban Impervious	1,711.5
8	Transportation	Urban Impervious	791.5
9	Secondary roads	Urban Impervious	2,412.7
10	Urban grass Irrigated	Urban Pervious	10,376.1
11	Urban grass Non-irrigated	Urban Pervious	3,715.9
12	Agriculture moderate slope B	Non-Urban Pervious	19.9
13	Agriculture moderate slope D	Non-Urban Pervious	275.2
14	Vacant moderate slope B	Non-Urban Pervious	221.2
15	Vacant moderate slope D	Non-Urban Pervious	617.6
16	Vacant steep slope A	Non-Urban Pervious	75.2
17	Vacant steep slope B	Non-Urban Pervious	2,528.0
18	Vacant steep slope C	Non-Urban Pervious	3,602.7
19	Vacant steep slope D	Non-Urban Pervious	7,677.5
20	Water	Non-Urban Pervious	101.7
TOTAL			41,237.7

The irrigation water demand is a function of the potential evapotranspiration. To calculate the irrigation demand, potential evapotranspiration must be adjusted according to crop or cover type and irrigation efficiency. Table G-2 shows how the model coefficient is computed using (1) the crop/cover coefficient and (2) average irrigation efficiency values for both irrigated urban grass and agricultural land segments in the model.

Table G-2. Effective Irrigation Coefficients Used in the Model

HRU	Crop/Cover Coefficient (K_c)	Irrigation Efficiency (IE)	Model Coefficient ($ET_c = K_c / IE$)
Irrigated Urban Grass	0.60	0.85	0.71
Agriculture (all slopes and soils)	0.75	0.75	1.00

ET = evapotranspiration

G.3.1. Weather Zones

In the Los Angeles County Regional watershed model, there were 46 unique weather stations serving the County TMDL Implementation Area. However, using 46 sets of weather patterns and their associated runoff characteristics would be impractical for the fine spatial scale and resolution associated with this optimization modeling effort. A spatial and temporal analysis was performed to categorize the weather patterns into zones with similar characteristics. An area-weighting method considering precipitation intensity and volume was used to categorize the study area into three representative weather zones for modeling purposes.

Because BMP sizing requirements are typically governed by rainfall intensity, the 85th percentile rainfall depth was used as the primary sorting parameter. First, a summary table was created for each of the 46 rainfall gages that included (1) 85th percentile rainfall intensity (estimated from the County's contour layer), (2) long-term average annual rainfall volume, and (3) total area of influence for each of the 46 weather stations overlapping county unincorporated areas. Second, the table was sorted by increasing 85th percentile rainfall intensity. Third, the cumulative area was computed by increasing 85th percentile rainfall intensity, and both were plotted on a graph (Figure G-3). Finally, the study area was divided into three approximately equal areas, within which the area-weighted average intensity and annual average volume were computed. The station having the closest area-weighted average intensity and long-term average rainfall volume within each of the three equal-area zones was selected as the most representative weather gage for that weather zone. As illustrated in Figure G-3, the selected gages were the Potrero Heights gage (#170) for Zone 1 *Low*, the North Hollywood Lakeside gage (#13) for Zone 2 *Mid*, and the Westwood U.C.L.A gage (#680) for Zone 3 *High*.

It is important to note that while the three derived weather zones might not always be spatially collocated with the selected rainfall gages, they are statistically representative of the assigned areas in terms of 85th percentile rainfall intensity and annual average rainfall volume—the two hydrological factors that most influence BMP sizing requirements. Figure G-4 is a map showing the TMDL Implementation Areas by weather zone, together with the 85th percentile rainfall intensity contour and average annual precipitation.

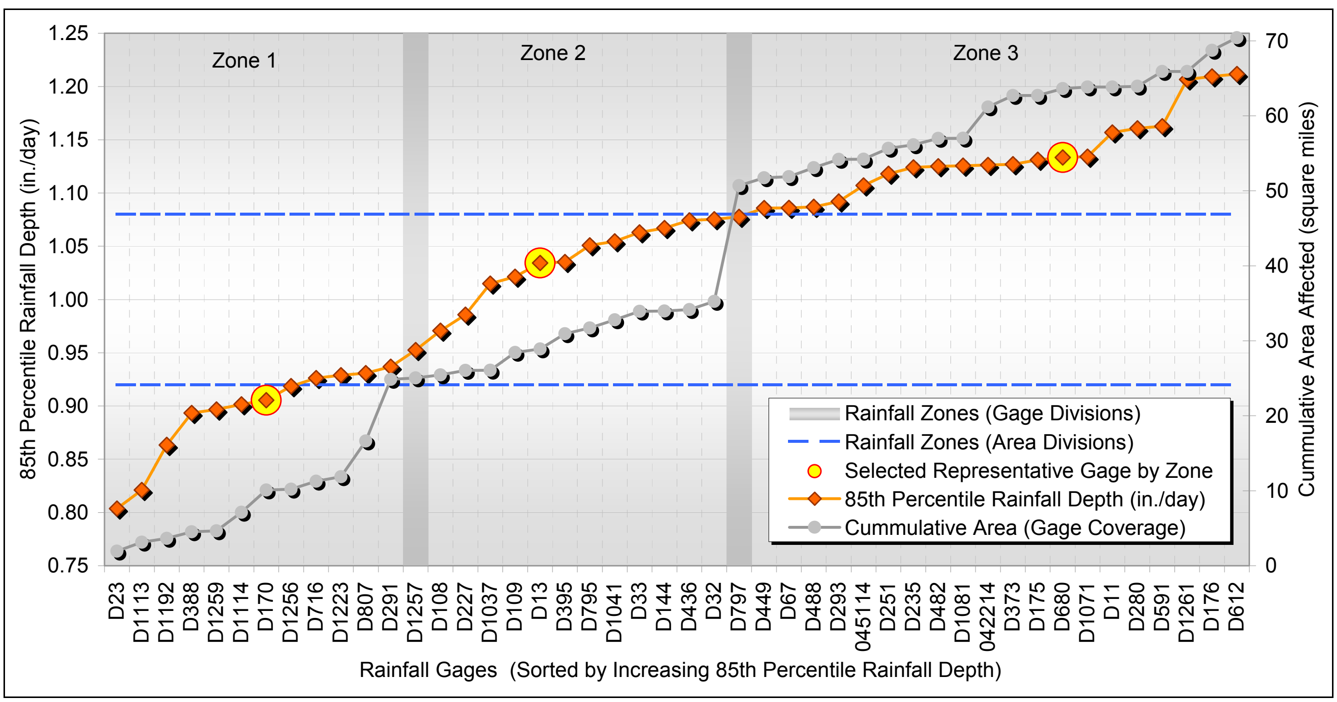


Figure G-3. Graphical Summary of the Intensity/Volume Area-Weight Method for Determining Weather Zones

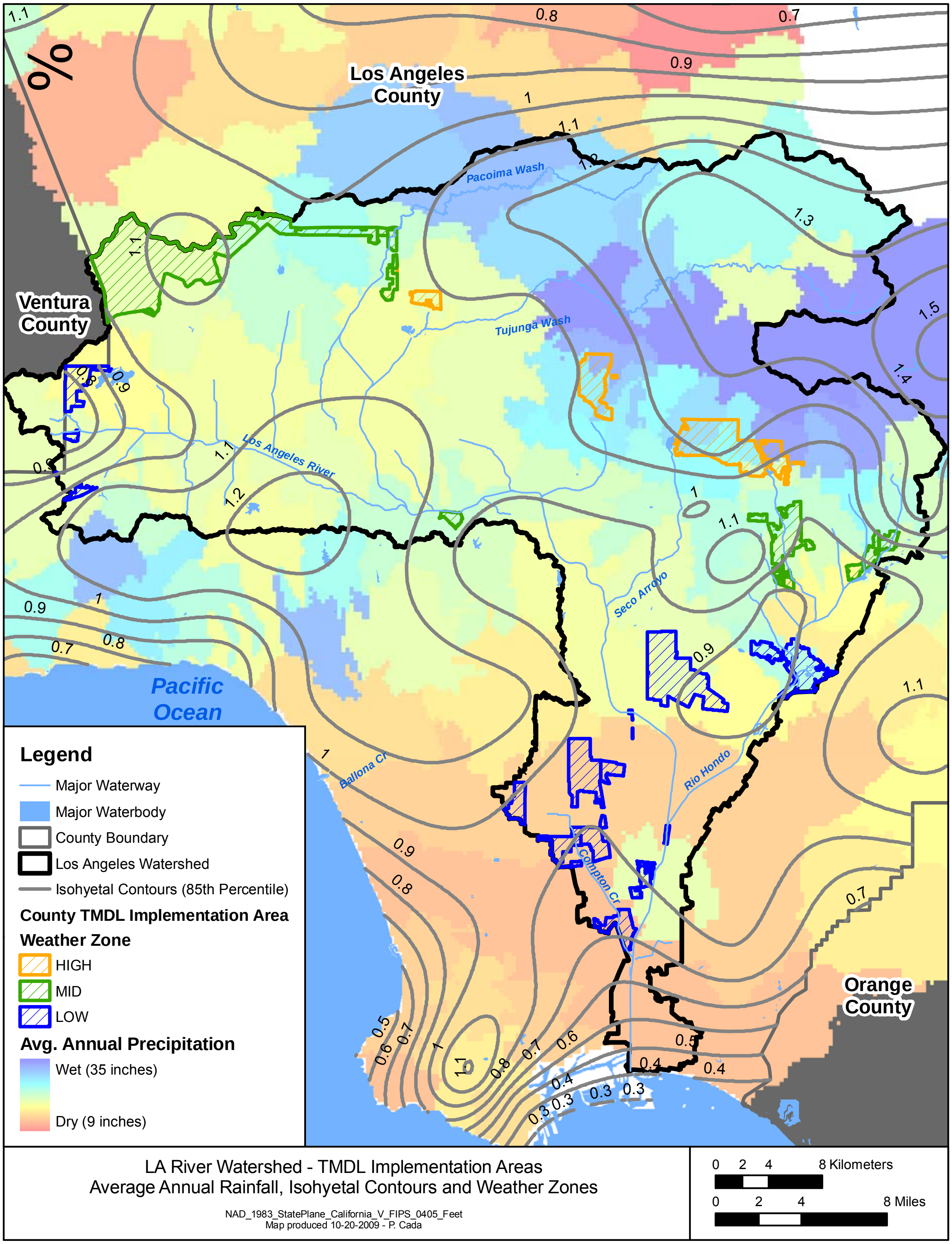


Figure G-4. Los Angeles River Watershed TMDL Implementation Area Weather Zone Classification

G.3.2. HRU Composition of Private Centralized BMP Drainage Areas Zones

Table G-3. HRU Composition of Private Centralized BMP Drainage Areas Zones

HRU Description	Zone 1		Zone 2		Zone 3		Zone 4		Zone 5		Zone 6		Zone 7		Zone 8	
	acre	%	acre	%	acre	%	acre	%	acre	%	acre	%	acre	%	acre	%
High-density single-family residential	227.3	9.7	101.4	8.7	605.9	13.9	284.3	13.9	17.4	0.9	621.1	8.5	64.2	0.5	647.4	17.5
Low-density single-family residential moderate slope	2.3	0.1	0.0	0.0	15.8	0.4	9.1	0.4	21.7	1.1	27.6	0.4	11.4	0.1	1.1	0.0
Low-density single-family residential steep slope	0.0	0.0	0.0	0.0	14.4	0.3	1.5	0.1	0.0	0.0	3.2	0.0	5.2	0.0	1.8	0.0
Multifamily residential	158.6	6.8	280.2	24.0	151.7	3.5	46.3	2.3	0.0	0.0	789.7	10.8	26.5	0.2	185.4	5.0
Commercial	81.7	3.5	49.7	4.3	87.9	2.0	48.5	2.4	27.5	1.4	308	4.2	28.2	0.2	151.8	4.1
Institutional	98.5	4.2	42.3	3.6	103.3	2.4	35.3	1.7	13.4	0.7	170.2	2.3	16.6	0.1	74.7	2.0
Industrial	644.2	27.5	3.9	0.3	63.1	1.4	9.3	0.5	104.6	5.4	298	4.1	159.7	1.2	169.4	4.6
Transportation	74.1	3.2	22.3	1.9	85.5	2.0	4.1	0.2	81.9	4.2	281	3.8	120.8	0.9	23	0.6
Secondary roads	225.9	9.6	160.7	13.8	300.5	6.9	132.4	6.5	16.2	0.8	748	10.2	47.5	0.4	251.2	6.8
Urban grass Irrigated	619.6	26.4	389.1	33.3	1,738.8	39.8	704.1	34.5	685.4	35.4	2,103.8	28.8	1,266.1	9.4	1,259.9	34.0
Urban grass Non-irrigated	150.3	6.4	116.1	9.9	650.9	14.9	251.1	12.3	581.9	30.1	750.8	10.3	400.1	3.0	314.3	8.5
Agriculture moderate slope B	0.0	0.0	0.0	0.0	0.0	0.0	8.8	0.4	0.0	0.0	0.0	0.0	10.8	0.1	0	0.0
Agriculture moderate slope D	2.3	0.1	0.0	0.0	1.7	0.0	4	0.2	68.1	3.5	61.6	0.8	51.8	0.4	36.3	1.0
Vacant moderate slope B	0.0	0.0	0.0	0.0	0	0.0	24.8	1.2	1.3	0.1	5.2	0.1	145.9	1.1	37	1.0
Vacant moderate slope D	53.7	2.3	2.2	0.2	6.2	0.1	25.9	1.3	77.3	4.0	103.8	1.4	297.2	2.2	26.8	0.7
Vacant steep slope A	0.0	0.0	0.0	0.0	0.0	0.0	13.6	0.7	0.0	0.0	0.0	0.0	35.5	0.3	26.1	0.7
Vacant steep slope B	0.0	0.0	0.0	0.0	404	9.2	47	2.3	45.1	2.3	19.8	0.3	1,728.3	12.8	20.6	0.6
Vacant steep slope C	0.0	0.0	0.0	0.0	18.5	0.4	110.4	5.4	101.1	5.2	1	0.0	3,288.6	24.3	82.3	2.2
Vacant steep slope D	5.6	0.2	0.0	0.0	122.4	2.8	281.8	13.8	11.6	0.6	1,011.1	13.8	5,802.0	42.9	400.2	10.8
Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.5	4.2	2.7	0.0	5.2	0.0	0.0	0.0
Total	2,344.1	100.0	1,167.9	100.0	4,370.6	100.0	2,042.3	100.0	1,936	100.0	7,306.6	100.0	13,511.6	100.0	3,709.3	100.0

G.4. Identification of Options for Distributed Structural BMPs

A number of implementation options for distributed structural BMPs have been identified through review of County and regional stormwater reference materials. This section describes each of the distributed structural BMPs being considered, with the exception of catch basin distributed BMPs which were represented in LSPC and included in the baseline scenario. The following section explains how each of these structural BMPs are configured for modeling purposes, both in terms of the sizing criteria, as well as spatial orientation and configuration within their respective drainage areas.

G.4.1. Description of Distributed Structural BMPs Considered

Distributed stormwater BMPs are installed to treat runoff on-site before it reaches storm drain systems. The design volume for BMPs can be determined using the 85th percentile 24-hour rainfall event (LACDPW 2002, 2004, 2009a, 2009b). The County (LACDPW 2009a) has defined an order of preference in the selection and application of BMPs as follows:

1. Infiltration systems
2. Biofiltration/retention systems
3. Stormwater capture and reuse
4. Mechanical/hydrodynamic units

Infiltration is not possible in all development scenarios, specifically in locations where seasonal high groundwater is within 10 feet of the surface, where the base soil infiltration rates are less than 0.5 inch per hour, and where there are site-specific restrictions (LACDPW 2009a). In general, where natural undisturbed soil infiltration rates are less than 0.5 inch per hour, an underdrain system should be considered.

Three types of BMPs are prioritized for evaluation in this project: bioretention, porous pavement, and linear bioretention trenches. Those BMPs were selected by considering applicability, cost-effectiveness, and the climate conditions of the project area.

Bioretention

Bioretention is a shallow vegetated depression that provides storage, infiltration, and encourages evapotranspiration. A bioretention system is essentially a surface and subsurface water filtration system. Bioretention systems incorporate both plants and underlying filter soils for removal of contaminants. The practice is effective in removing sediments and attached pollutants by filtration through the underlying filter media layer and plant uptake. For areas with low infiltrating soils, bioretention can be designed with an underdrain system that routes treated runoff that passes through soil medium back to the storm drain system.

It is critical in designing a bioretention system to consider soil characteristics and amendments, depth to groundwater, storage capacity, and plant selection. Bioretention provides storage above ground (i.e., ponding area) and in the voids of the planting media soil. The County's *Storm Water Best Management Practice Design and Maintenance Manual* requires that the runoff entering a bioretention system completely drain the ponding area and the planting soil within 48 hours (LACDPW 2009b). In addition, the design percolation rate can be calculated by applying correction factors to the field-measured percolation rate. The County also suggests that a percolation testing correction factor of 0.25 be applied for bioretention sizing, providing a safety factor of four (LACDPW 2009b).

Suggested bioretention sizing criteria are summarized below:

- Ponding depth: maximum of 1.5 feet (LACDPW 2009b)
- Media depth: minimum of 2 feet, but 3 feet is preferred (LACDPW 2009b)

- Porosity of planting media: Planting media shall consist of 60 to 70 percent sand, 15 to 25 percent compost, and 10 to 20 percent clean topsoil (LACDPW 2009b). Porosity of the media can be assumed to be 40 percent.

Porous Pavement

Porous pavement practices are usually a combination of a filter system through surface materials and an underground reservoir for water storage. Porous pavement includes permeable asphalt, pervious concrete, interlocking concrete pavers, and permeable pavers. This BMP can be used for infiltrating stormwater while simultaneously providing a stable load-bearing surface. On the basis of site conditions, it might allow further infiltrating water. Porous pavement can be used in walkways, patios, plazas, driveways, parking lots, and some portions of streets. According to the County's *Low-Impact Development Standards Manual*, at least 50 percent of the pavement on the lot must be porous in all new development and redevelopment under the jurisdiction of the County (LACDPW 2009a).

The manual also states that porous pavement must not be used on sites with a likelihood of high oil and grease concentrations (LACDPW 2009a). This includes vehicle wrecking or impound yards, fast food establishments, automotive repair and sales, and parking lots that receive a high number of average daily trips (> 1,000). Although this practice is appropriate for all soil types, it requires an underdrain system for soils that do not infiltrate well (less than 0.5 inches per hour). Runoff from unpaved areas should not be directed toward porous pavement because of the potential for sediment particles clogging the pores in the pavement (LACDPW 2009a).

Suggested porous pavement sizing criteria are summarized below:

- Ponding depth: not applicable in general.
- Media depth: 2 to 4 feet (LACDPW 2009a).
- Porosity of reservoir: The reservoir subbase consists of 1.5 to 3 inches of crushed stone (LACDPW 2009a). Porosity of the reservoir can be assumed to between 40 percent and 50 percent.

Linear Bioretention Trench

Linear bioretention trenches are strip bioretention areas designated to treat sheet flow runoff from adjacent paved areas. Caltrans presented this practice as an on-site BMP option for narrow right-of-ways typical of roadside areas, where space availability might be a limiting factor of implementing distributed BMPs (Caltrans 2008). However, Caltrans does not provide quantitative specifications on sizing this BMP (e.g., depth). Instead, it recommends that site-specific factors be considered during sizing and design. This practice is functionally identical to bioretention.

Suggested bioretention sizing criteria are summarized below:

- Ponding depth: 0.1 to 0.5 feet
- Media depth: minimum of 1 to 3 feet
- Porosity of planting media: can be assumed to be 40 percent

G.4.2. Representation of Distributed Structural BMPs

BMP Implementation by Land Use Group

Each drainage area can be characterized by the prevailing land cover and configuration. From a modeling perspective, this configuration determines the types of BMPs that can be implemented, as well as the potential flow routing configuration through the BMP or BMP network. Distributed structural BMPs are proposed for two types of County TMDL Implementation Areas: (1) publicly owned institutional and industrial parcels and (2) one acre of road surface for a pilot project. The areas have been divided into two representative types of land use areas, each with its own flow routing schematic. They are (1) Institutional and Industrial Areas and (2) Public Transportation Areas.

Institutional and Industrial Areas

Institutional and industrial areas consist of building rooftops, parking areas, roads, and pervious landscaped areas. From the County's Land Use and Zoning Code (http://planning.lacounty.gov/luz), such areas must have a minimum of 10 percent of the net area landscaped with a lawn, shrubbery, flowers or trees. Bioretention can be installed in the landscaped areas, but available space for bioretention might not be large enough to control 100 percent runoff from all impervious surfaces. Porous pavement can be implemented in the parking areas to control runoff from the other paved parking areas. Porous pavement overflow is routed to bioretention. Schematic representation of BMP implementation and flow pathway for institutional areas is presented in Figure G-5.

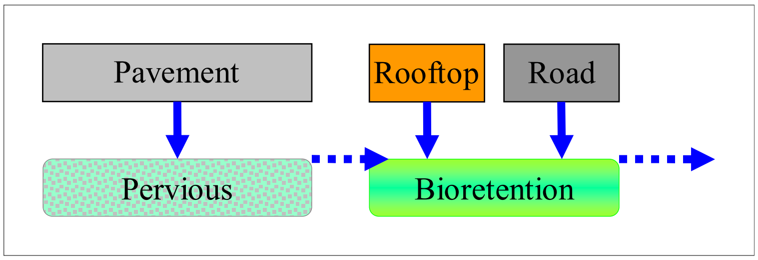


Figure G-5. Distributed BMPs and Flow Pathway for Institutional Areas

Public Transportation Areas

Public transportation areas consist of paved roads and narrow landscaped areas within the right-of-way. The County does not control the runoff from Interstate highways, only the secondary roads. Because the secondary roads normally do not have wide right-of-way areas, linear bioretention trenches (i.e., vegetated swale or buffers with underground media storage) might be the only option for on-site distributed BMPs. Schematic representation of BMP implementation and flow pathway for public transportation areas are presented in Figure G-6.

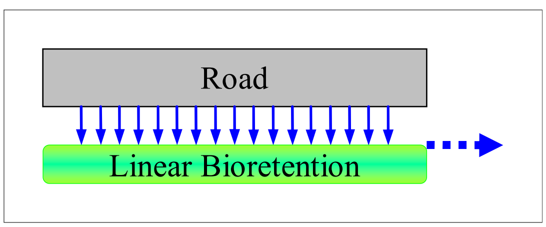


Figure G-6. Distributed BMPs and Flow Pathway for Public Transportation Areas

Three different types of distributed BMPs were used in this analysis. Table G-4 shows the vertical physical configurations for each BMP type. Table G-5 lists the model parameter values that were used for each BMP type. While most of the model parameters are constant, background soil infiltration rate is a site dependent parameter. As revealed in the field investigation tests, although there is a general trend of higher infiltration rates for A-B soils and lower infiltration rates for C-D soils, the rates vary greatly from site to site, even for sites with the same HSG. To a degree, the variation is due to soil disturbance on urban landscapes. Given the dispersed nature of distributed BMPs, it is not feasible to quantify the background infiltration rates for every potential site at this planning stage. Instead, the field investigation results (presented in Appendix D) were averaged to derive soil infiltration rates for the high infiltration (A and B soil) and low infiltration (C and D soil) soil groups. It is important to note that the field investigation was designed to focus on the urban soils (Management Category A to E), thus provided a reliable means of estimating the infiltration rates at the potential BMP sites.

Table G-4. Distributed BMP Vertical Physical Configurations

Parameter	Bioretention	Porous Pavement	Linear Bioretention Trench
Substrate depth (ft)	3	2	3
Underdrain depth (ft)	1 (C-D soil) 0 (A-B soil)	1 (C-D soil) 0 (A-B soil)	0
Maximum ponding depth (ft)	0.8	0.1 (represent depression storage)	0.5

Source: Prince George's County 2001; USEPA 1999a, 1999b, 1999c

Table G-5. Distributed BMP Simulation Parameters

Parameter	Bioretention	Porous Pavement	Linear Bioretention Trench
Infiltration[a]			
Substrate layer porosity	0.4	0.45	0.4
Underdrain gravel layer porosity	0.5	0.5	N/A
Vegetative parameter, A	0.6	0	0.6
Underdrain background infiltration rate[b] (in/hr), f_c	Varies by Soil Type: C-D-soils: 0.3 in/hr, A-B-soils: 1.2 in/hr		
Media final constant infiltration rate (in/hr), f_c	4	8	4
Water Quality[c]			
TSS 1st order decay rate (1/day), *k*	0.2	0.2	0.2
TSS filtration removal rate[d], P_{rem} (%)	80%	60%	80%
Copper 1st order decay rate (1/day), *k*	0.2	0.2	0.2
Copper filtration removal rate[d], P_{rem} (%)	70%	50%	70%
Lead 1st order decay rate (1/day), *k*	0.2	0.2	0.2
Lead filtration removal rate[d], P_{rem} (%)	60%	40%	60%
Zinc 1st order decay rate (1/day), *k*	0.2	0.2	0.2
Zinc filtration removal rate[d], P_{rem} (%)	90%	70%	90%
Fecal Coliform 1st order decay rate (1/day), *k*	0.8	0.8	0.8
Fecal Coliform filtration removal rate[d], P_{rem} (%)	50%	30%	50%

a. Source: Prince George's County 2001; LACDPW 2006
b. Derived from field investigation for distributed BMPs in Appendix D, A correction factor of 0.25 (i.e., providing a safety factor of 4) is applied to the field percolation testing data to estimate the infiltration rates used in the model, as suggested by LADPW (2009b)
c. Based on calibration using University of Maryland monitoring data (Prince George's County 2003)
d. For simplicity, the rate of pollutant particulate removal by filtration at soil particles is represented in terms of ratio of liquid phase concentrations between inflow into and outflow out of BMPs soil medium.

BMP Sizing by Water Quality Control Volume

Water quality treatment requirements state that the runoff from the water quality design storm event (85^{th} percentile, 24-hour rainfall event) associated with the developed site hydrology must be treated before discharge in compliance with the NPDES Municipal Storm Water Permit for the County (LACDPW 2009a). Volume-based BMP sizing can be done by applying the 85^{th} percentile, 24-hour storm depth. If distributed BMPs are designed to control 100 percent runoff from impervious surfaces on-site, the size of on-site distributed BMPs can be determined by balancing the runoff volume from the 85^{th} percentile storm with the storage volume of distributed BMPs. If we conservatively assume that depression storage on impervious surfaces is negligible and that all imperviousness is directly connected in a given drainage area, the design runoff volume can be approximated as follows:

$$\text{Design Runoff Volume} = (\text{85th Percentile Rainfall Depth}) \times (\text{Impervious Area})$$

The storage volume of a distributed BMP can be estimated as follows:

$$\text{BMP Storage Volume} = \sum \text{Surface Area} \times (\text{Ponding Depth} + [\text{Media Depth} \times \text{Porosity}])$$

Where Ponding Depth is the allowable water storage depth *above* the surface of the BMP, and the total subsurface storage depth is estimated as the soil Media Depth times the Porosity, which is the void ratio of the planting media.

For each BMP, the total required BMP surface area can also be calculated by rearranging the terms of the two previous equations as follows:

$$\text{BMP Surface Area} = \frac{\text{Design Runoff Volume}}{\text{Ponding Depth} + (\text{Media Depth} \times \text{Porosity})}\text{, or}$$

$$\text{BMP Surface Area} = \frac{\text{85th Percentile Rainfall Depth} \times \text{Impervious Area}}{\text{Ponding Depth} + (\text{Media Depth} \times \text{Porosity})}$$

Appropriate unit conversion should be applied to all the above calculations.

Design Storms for the County TMDL Implementation Area

As described in section G.3.1 (Weather Zones), the Los Angeles River County TMDL Implementation Area is classified into three weather zones, i.e., low, mid, and high. The 85th percentile 24-hour rainfall depths are

- Low weather zone: 0.905 inch
- Mid weather zone: 1.034 inch
- High weather zone: 1.092 inch

The total runoff volume generated by the design storm events can be used as stormwater volume control targets for the distributed BMPs.

G.5. Description of Centralized Structural BMPs Considered

Centralized BMPs have been shown to provide a cost-effective way of treating runoff collected from larger areas of mixed land use characteristics. Two centralized structural BMP types are considered in the modeling analysis: (1) Extended Dry Detention Basins, and (2) Infiltration Basins.

G.5.1. Infiltration Basin

Infiltration basins are shallow surface basins that are designed to infiltrate stormwater through permeable soils (LACDPW 2009a, 2009b). Infiltration basins retain runoff until it gradually infiltrates through the soil and eventually into the groundwater. Infiltration basins are similar in function to infiltration trenches except that an infiltration basin's stored volume is held above ground, while an infiltration trench's stored volume is held below ground. The practice removes sediments and attached pollutants, reduces runoff volumes, and reduces downstream peak flows and velocities. However, the practice is not recommended at sites receiving high sediment loadings because of the potential for clogging and the associated maintenance burden. Infiltration basins require a minimum soil infiltration rate of 0.5 inch per hour (LACDPW 2009b). If infiltration rates exceed 2.4 inches per hour, the runoff should be fully treated in an upstream BMP before infiltration to protect groundwater quality. Pretreatment for coarse sediment removal is required in all instances (see Table G-6 and Table G-7).

Main infiltration basin design criteria can be summarized as follows (LACDPW 2009b):

- Ponding depth: 4 feet min. to 8 feet max., plus 1 foot minimum sediment storage depth.
- No topsoil may be added to the basin bed.
- Top 1-foot of soil media must either be replaced or amended uniformly without compaction.
- Amending excavated material with 2–4 inches of coarse sand is recommended for soils with borderline infiltration capacity.

Table G-6. Centralized BMP Simulation Parameters

Parameter	Extended Dry Detention Basin	Infiltration Basin
Infiltration[a]		
Substrate layer porosity	0.4	0.4
Underdrain gravel layer porosity	N/A	N/A
Vegetative parameter, *A*	0.6	0.6
Background infiltration rate[b] (in/hr), f_c	0.4	Varies by soil type
Media final constant infiltration rate (in/hr), f_c	1	4
Water Quality[c]		
TSS 1st order decay rate (1/day), *k*	0.2	0.2
TSS filtration removal rate[d], P_{rem} (%)	N/A	80%
Copper 1st order decay rate (1/day), *k*	0.2	0.2
Copper filtration removal rate[d], P_{rem} (%)	N/A	70%
Lead 1st order decay rate (1/day), *k*	0.2	0.2
Lead filtration removal rate[d], P_{rem} (%)	N/A	60%
Zinc 1st order decay rate (1/day), *k*	0.2	0.2
Zinc filtration removal rate[d], P_{rem} (%)	N/A	90%
Fecal Coliform 1st order decay rate (1/day), *k*	0.8	0.8
Fecal Coliform filtration removal rate[d], P_{rem} (%)	N/A	50%

a. Source: Prince George's County 2001; LACDPW 2006
b. Derived from field investigation for distributed and centralized BMPs reported in Appendix D
c. Based on calibration using University of Maryland monitoring data (Prince George's County 2003)
d. For simplicity, the rate of pollutant particulate removal by filtration at soil particles is represented in terms of ratio of liquid phase concentrations between inflow into and outflow out of BMPs soil medium. However, Phase II of the study will use more process-based expression for filtration such as first order irreversible rate expression.

Table G-7. Centralized BMP Physical Configurations

Parameter	Extended Dry Detention Basin	Infiltration Basin
Substrate depth (ft)	N/A	1
Maximum ponding depth (ft)	4	5

Source: LACDPW 2002, 2004, 2009b.

G.5.2. Extended Dry Detention Basin

Extended dry detention basins are basins whose outlets have been designed to detain the runoff from a water quality design storm for 36 to 48 hours to allow sediment particles and associated pollutants to settle and be removed (LACDPW 2009a). Extended dry detention basins do not have a permanent pool; they are designed to drain completely between storm events. They can be designed for both pollutant removal and flood control, but the basin must not interfere with flood control functions of existing conveyance and detention structures. The practice removes pollutants primarily through gravitational settling of suspended solids and through infiltration. Clay or impervious soils should not affect pollutant removal effectiveness because the main removal mechanism is settling.

Main extended dry detention basin sizing criteria can be summarized as follows (LACDPW 2009b):

- Side slopes: Not to exceed 3:1
- Depth for water quality design stage: max. 5 feet
- Volume of sediment forebay: 25 percent of the total basin volume

G.6. BMP Cost Functions

This document describes the proposed BMP cost-estimation methods. Cost estimation is a critical for the optimization process, as a key component of the optimization is evaluating and comparing the cost effectiveness of various BMP alternatives.

The BMP cost function that was used is a generic, modular cost function that allows the user to modify the parameters for their individual project needs.

The cost function is:

$$\text{Total Cost} = [\text{LinearCost} \times (\text{BMPLength})^{\text{LenthExp}} + \text{AreaCost x } (\text{BMPSurfaceArea})^{\text{AreaExp}} + \text{TotalVolCost x } (\text{BMPTotalVol})^{\text{TotalVolExp}} + \text{MediaVolCost} \times (\text{BMPMediaVol})^{\text{MediaVolExp}} + \text{UnderDrainVolCost} \times (\text{BMPUnderDrainVol})^{\text{UDVolExp}} + \text{ConstantCost}] \times (1+\text{PercentCost}/100)$$

The exponents in the equation represent the cost efficiencies gained as the size of the BMP increases. An exponent of 1 represents the unit cost with no scaling efficiencies. An exponent less than 1 indicates increased cost efficiencies at increased BMP sizes. An exponent greater than 1 indicates diminishing cost efficiencies as the BMP size increases. Cost function calculations developed for the County assume that there are no efficiencies of scale.

Each cost parameter can be defined in terms of units of volume, area, length, and percent or constant cost, based on the appropriate units for each specific BMP.

O&M costs can be calculated converting the annualized O&M costs to a PV using the function below, where *AV* is the annualized O&M cost. The resulting PV O&M costs can then be added to the cost function as either a constant cost or percent cost.

$$PV = AV \times [\{1 - (1 / (1 + i)^n)\} / i] = AV \times 12.462$$

where n = number of years in the life of the project (assumed 20 years in this study); i = interest rate (0.05 is standard for project analysis).

A cost analysis was performed for typical centralized and distributed structural BMPs to develop cost functions that can be used to estimate the cost of a typical stormwater BMP. The cost analysis provides the detail necessary for planning purposes and overall strategy development.

For structural BMP projects, costs are included for planning, design, permits, construction, O&M, and post-construction monitoring, where applicable. Costs were estimated for centralized and distributed BMPs on public property eliminating the need to estimate land acquisition costs. Costs were developed for the three types of distributed structural BMPs on public property: porous pavement, bioretention areas, and rain barrels/cisterns. Separate costs were developed for both high and low soil infiltration rates (i.e., with and without underdrains) for the porous pavement and bioretention areas. Costs were developed for two types of centralized BMPs: infiltration basins and extended dry ponds. No distinction in cost was made for the various implementation areas, i.e., commercial, road, industrial or institutional. The assumptions made in developing the cost estimates are described below.

The costs estimated were based on cost functions derived from literature sources and some are specific to conditions in the County. The costs estimated in this section provide a more detailed consideration of components and steps involved.

G.6.1. General Cost Assumptions for Structural BMPs

Planning

Costs for planning include the effort required to further develop the project concept which, depending on the complexity of the project, could result in preparing a Project Concept Report. Additional administrative costs could be required to administer, manage, and coordinate the project's implementation and are included with the planning costs. Administrative costs can vary widely with the complexity of the project, but for purposes of comparison, a value of 5 percent of the capital costs is assumed for planning.

Permitting

Regulatory requirements must be met, and environmental permits are required to implement most BMPs. The applicability of many regulations for a specific project depends on its site or design characteristics. Because the requirements imposed by regulatory agencies often have an effect on the project cost, the associated costs were included in the analysis for centralized BMPs. Because the opportunities identified for distributed structural BMPs are for areas of impervious cover and not applied to vacant or open spaces, the permitting effort anticipated for such projects is minimal, if any. Therefore, no separate costs are identified in the analysis for permitting. It is assumed that any permitting costs associated with the construction phase, such as erosion and sedimentation control, are included with the construction costs.

Design

Designing structural BMPs requires collecting data, analyzing it, and preparing documents that can be used for constructing a project. Data collection could include geotechnical investigations, field investigation of existing utilities (potholing), and a topographic survey for mapping. The design deliverables are project plans and specifications that can be bid by a contractor for construction. Engineering costs can vary widely depending on the complexity of the project. For the purposes of the cost estimates, fixed rates of 5 and 10 percent were applied to the distributed and centralized BMP construction costs, respectively, to estimate the design/engineering cost. A lower percent was used for distributed BMP design costs because those BMPs are expected to have less time-intensive designs compared to centralized BMPs.

Construction

The typical levels of construction cost estimates are as follows:

- Preliminary/Order of Magnitude—provide a range of costs at the planning level for a conceptually defined project
- Budget—cost estimates based on layouts and specific quantities
- Final/Definitive—prepared after the design documents are complete

Because of the preliminary nature of the modeling efforts, the estimates developed are considered to be in the preliminary/order of magnitude level estimates, with an expected accuracy of about plus 40 percent to minus 25 percent. The estimates for centralized BMPs on private property and distributed BMPs are expected to have a lower accuracy because such cost estimates are not site-specific and are in the preliminary/order of magnitude category. To the extent possible, construction costs are based on the following approximate quantifications of the BMPs major components and are summarized in Table G-8:

- **Mobilization:** Mobilization costs are highly variable depending on the magnitude of the project. A mobilization factor of 5 percent was included.
- **Excavation and removal:** Excavation and removal costs include the cost of excavating the volume of soil required to provide the required storage, hauling the removed dirt off-site, and disposal at an appropriate facility. The estimate is based on previous concept-level LACDPW and North Carolina State University estimates.
- **Asphalt/Base Removal:** Costs are included for areas that can be implemented as a retrofit. For most retrofit projects, an impervious surface is removed and replaced with a pervious option such as porous pavement or a bioretention area. The estimate is based on data from R.S. Means (2007).
- **Reinforced Concrete Pipe:** Costs were derived from R.S. Means (2007) and are included to estimate the costs for constructing a storm drain extension of or to bypass an existing storm drain system.
- **Media:** Filter media would be required at any site where soils have low infiltration rates to improve infiltration capacity. Media is required at any site where underdrains are necessary. The cost estimate is based on quotes from vendors in Southern California.
- **Underdrain:** Underdrains are required in areas with low infiltration rates. Underdrains are typically used in distributed sites to improve infiltration and filtering capacity. The cost estimate is based on the underdrain components, including 4-inch perforated PVC pipe spaced at 5 feet on center and filter materials, and current R.S. Means (2007) unit cost estimates.
- **Gravel Sub-base:** A gravel sub-base consisting of a washed No. 57 stone typically used as a base for roads and any construction. A gravel sub-base is required for porous pavement and any BMP where underdrains are required. The estimate is based on quotes from vendors for No. 57 stone and R.S. Means (2007).
- **Porous Pavement:** This cost estimate is based on estimates provided by North Carolina State University and the Interlocking Concrete Pavement Institute. The estimate includes all components for porous pavement installation (removal of existing impervious, excavation and removal, site prep, sub-base, porous pavement material, and installation)
- **Landscaping:** One of the benefits of distributed BMPs is that they can be integrated into the site plan and often incorporated into the landscaping. Landscaping costs were estimated using data from North Carolina State University.
- **Native Landscaping:** It is suggested to use native landscaping for any BMP because native landscaping is more adapted to the natural conditions increasing the survivability.

- **Contingency:** Because some of the project components have not been fully defined at this preliminary stage, a contingency factor of 25 percent should be applied to the construction costs to estimate the total construction costs and capture expected but as yet unidentified additional costs. The costs could arise from site-specific field conditions such as those associated with utility relocations, dewatering, and erosion and sedimentation control. At this stage of project development, the contingency also includes an allowance for such items as field facilities and construction scheduling, which might be required but are not specifically itemized. The contingency factor has *not* been applied to any of the cost functions or component cost estimates itemized in Table G-8.

Table G-8. Per Unit Cost Estimates for Construction Components

Construction Component	Cost	Notes
Mobilization	5% of construction total	
Excavation and Removal	$25.00/yd^3	
Asphalt/Base Removal	$8.00/yd^3	
Site Preparation	$20.00/ft^2	
Reinforced Concrete Pipe	$8.00 per diameter (inch) per length (ft)	
Media	$30.00/yd^3	
Underdrain	$6.00/ft	Underdrains are typically spaced about 5 feet apart on center
Gravel Sub-base (washed No.57 stone)	$52.50/yd^3	Typically priced per ton
Porous Pavement	$15.00/ft^2	
Landscaping (includes mulch/sod and vegetation)	$5.00/ft^2	
Native Landscaping	$25.00/ft^2	
Planning	5% of total construction costs	
Permits/Studies	Included in design	
Design (Centralized)	10% of total construction costs	
Design (Distributed)	5% of total construction costs	
Contingency for Planning Estimate (Centralized)	25% of total construction costs	
Contingency for Planning Estimate (Distributed)	15% of total construction costs	

G.6.2. Operation and Maintenance

The following assumptions were used to estimate the O&M costs:

- Infiltration Basin Annual Maintenance Cost: 6.72 percent of the construction cost
- Extended Detention Basin Annual Maintenance Cost: 4 percent of the construction cost
- Porous Pavement Annual Maintenance Cost: $0.0076 per square foot
- Bioretention Annual Maintenance Cost: $0.05 per gallon void capacity

As noted in the general cost assumptions for all BMPs above, the planning through construction phases for individual cost estimates is assumed to occur in Year 0, and O&M costs are assumed to begin in year 1 and end in year 20. O&M cost functions are derived from Cutter et al. (2008).

G.6.3. Post-Construction Monitoring

For centralized BMPs (either on public or private property), pre-construction monitoring is assumed to occur up to 1 year before construction. The recommended time frame is 3 years of pre-construction monitoring; however, the implementation schedules are unlikely to allow for that time frame. Post-construction monitoring is assumed to occur 3 years after construction is complete. The cost of pre- and post-construction monitoring for each centralized BMP is estimated to be about $70,000, including the cost of automatic samplers, lab analysis, and labor. This is based on quotes from equipment suppliers, private laboratories in Southern California, and labor rates provided by the County. The level of effort required for the labor costs was estimated using the monitoring experience of Tetra Tech employees.

For distributed BMPs, a paired watershed approach is proposed in which two drainage areas of similar land use, soils, topography, and other features are monitored during pre-construction, and a distributed BMP is constructed to treat one of the drainage areas. Post-construction monitoring would be performed for both drainage areas. The results would be compared to assess the pollutant reduction provided by the treated drainage area. Pre-construction monitoring is assumed to occur up to 1 year before construction. The recommended time frame is 3 years of pre-construction monitoring; however, the implementation schedules are unlikely to allow for that time frame for the first distributed BMP projects. Post-construction monitoring is assumed to occur 3 years after construction is complete. The cost estimate assumes that for each type of distributed BMP, one site would be monitored as a representative site. The cost of pre- and post-construction monitoring for both centralized BMPs on public property is estimated to be about $124,000, including the cost of automatic samplers, lab analysis, and labor. This is based on quotes from equipment suppliers, private laboratories in Southern California, and labor rates provided by the County. The level of effort required for the labor costs was estimated based on the monitoring experience of Tetra Tech employees.

G.6.4. Land Acquisition

All cost estimates for this analysis were made assuming BMPs would be on public lands. If BMPs were applied on private lands, the estimated cost for the acquisition of private lands in the County is estimated to be $128.70/ft^2, based on the typical cost for vacant land in Los Angeles is shown in Table G-9 (reproduced from Cutter et al. 2008).

Table G-9. Costs for Vacant Land in Los Angeles

	Land Type[a]			
	Commercial	Industrial	Residential	Total
Southwest Los Angeles County				
Cost ($/m^2)	$1,344	$493	$1,801	$1,385
Observations	$3,100	$1,033	$2,519	$6,652
San Fernando West of Pasadena				
Cost ($/m^2)	$717	$348	$747	$696
Observations	$721	$226	$1,270	$2,217
San Gabriel Area				
Cost ($/m^2)	$637	$280	$659	$580
Observations	$1,518	$517	$861	$2,895
Total				
Cost ($/m^2)	$1,058	$413	$1,301	$1,057
Observations	$5,339	$1,776	$4,650	$11,765

Source: Cutter et al. 2008

a. Vacant land sales listed in the Costar sales database from 2003 to 2005, adjusted to 2005 dollars.

G.6.5. Distributed BMP Cost Functions

Bioretention Area with Underdrain

Construction Cost

Area Cost = [Site Preparation ($20.00/ft^2) + Landscaping ($5.00/ft^2) + Underdrain ($1.2/ ft^2)] × Area (ft^2) = $26.20/ft^2 × Area (ft^2)

(*Note: Underdrains are typically spaced about 5 feet apart on center. Underdrain Cost = $6.00/ft × Underdrain Length (ft) = $6.00/ft × Length x Width/5 = $6.00/ft × Area /5 = $1.2 × Area (ft^2))*

Volume Cost = [Excavation and Removal ($0.93/ft^3)] × Volume (ft^3) = $0.93/ft^3 × Volume (ft^3)

Media Cost = $1.11/ft^3 × Media Volume (ft^3)

Underdrain Gravel Cost = $1.94/ft^3 × Gravel Volume below Underdrain (ft^3)

Construction Cost = Area Cost + Volume Cost + Media Cost + Underdrain Gravel Cost = {26.2 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)} + {1.94 × Underdrain Gravel Volume (ft^3)}

Proportional Constant Cost = Planning (5%) + Design (5%) + Mobilization (5%) = 15% of Construction Cost = 0.15 × [{26.2 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)} + {1.94 x Underdrain Gravel Volume (ft^3)}]

Maintenance Cost

Annual O&M Cost (PV, $) = 12.462 × Media Volume (ft^3) × Porosity × Unit Cost ($0.37/ft^3) = 4.61 × Media Volume (ft^3) × Porosity = 1.844 × Media Volume (ft^3)
(*Note: Porosity is assumed as 0.4.*)

Total Cost

Total Cost ($) = Construction Cost + Annual O&M Cost = [30.13 × Area (ft^2)] + [1.07 × Volume (ft^3)] + [3.1205 × Media Volume (ft^3)] + [{2.23 x Underdrain Gravel Volume (ft^3)}]

Bioretention Area without Underdrain

Construction Cost

Area Cost = [Site Preparation ($20.00/ft^2) + Landscaping ($5.00/ft^2)] × Area (ft^2) = $25.00/ft^2 × Area (ft^2)

Volume Cost = [Excavation and Removal ($0.93/ft^3)] × Volume (ft^3) = $0.93/ft^3 × Volume (ft^3)

Media Cost = $1.11/ft^3 × Media Volume (ft^3)

Construction Cost = Area Cost + Volume Cost + Media Cost = {25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)}

Proportional Constant Cost = Planning (5%) + Design (5%) + Mobilization (5%) = 15% of Construction Cost = 0.15 × [{25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)}]

Maintenance Cost

Annual O&M Cost (PV, $) = 12.462 × Media Volume (ft^3) × Porosity × Unit Cost ($0.37/ft^3) = 4.61 × Media Volume (ft^3) × Porosity = 1.844 × Media Volume (ft^3)
(Note: Porosity is assumed as 0.4.)

Total Cost

Total Cost ($) = Construction Cost + Annual O&M Cost = [28.75 × Area (ft^2)] + [1.07 × Volume (ft^3)] + [3.1205 × Media Volume (ft^3)]

Porous Pavement with Underdrain

Construction Cost

Area Cost = $15.00/$ft^2$ × Area (ft^2) + Underdrain Cost = [$15.00/$ft^2$ + Underdrain ($1.2/ ft^2)] × Area (ft^2) = $16.20/$ft^2$ × Area (ft^2)

(Note: This area cost includes removal of existing impervious, excavation, site prep, sub base, pervious concrete materials 0.5 feet thick, installation, and underdrain cost. Underdrains are typically spaced about 5 feet apart on center. Underdrain Cost = $6.00/ft × Underdrain Length (ft) = $6.00/ft × Length x Width/5 = $6.00/ft × Area /5 = $1.2 × Area ($ft^2$))

Underdrain Gravel Cost = Excavation and Removal ($0.93/$ft^3$) + Gravel Cost ($1.94/ft^3) = $2.87/$ft^3$ × Gravel Volume below Underdrain (ft^3)

Construction Cost = Area Cost + Underdrain Gravel Cost = {16.2 × Area (ft^2)} + {2.87 x Underdrain Gravel Volume (ft^3)}

Proportional Constant Cost = Planning (5%) + Design (5%) + Mobilization (5%) = 15% of Construction Cost = 0.15 × [{16.2 × Area (ft^2)} + {2.87 x Underdrain Gravel Volume (ft^3)}]

Maintenance Cost

Annual O&M Cost (PV, $) = 12.462 × Area ($ft^2$) × Unit Cost ($0.0076/ft^2) = 0.0947 × Area (ft^2)

Total Cost

Total Cost ($) = Construction Cost + Annual O&M Cost = [18.7247 × Area (ft^2)] + [3.3 x Underdrain Gravel Volume (ft^3)]

Porous Pavement without Underdrain

Construction Cost

Area Cost = $15.00/$ft^2$ × Area (ft^2)
(Note: This area cost includes removal of existing impervious, excavation, site prep, sub base, pervious concrete materials, and installation.)

Construction Cost = Area Cost = {15 × Area (ft^2)}

Proportional Constant Cost = Planning (5%) + Design (5%) + Mobilization (5%) = 15% of Construction Cost = 0.15 × {15 × Area (ft^2)}

Maintenance Cost

Annual O&M Cost (PV, $) = 12.462 × Area ($ft^2$) × Unit Cost ($0.0076/ft^2) = 0.0947 × Area (ft^2)

Total Cost

Total Cost ($) = Construction Cost + Annual O&M Cost = 17.3447 × Area (ft^2)

Rain Barrels

For barrels > 60 gallons of capacity, average cost is \$1.67/gallon. Maintenance costs are negligible. Estimated costs are derived from price quotes from commercial suppliers.

G.6.6. Centralized BMP Cost Functions

Extended Dry Detention Basin

Construction Cost

Area Cost = [Site Preparation (\$20.00/ft^2) + Landscaping (\$5.00/ft^2)] × Area (ft^2) = \$25.00/ft^2 × Area (ft^2)

Volume Cost = [Excavation and Removal (\$0.93/ft^3)] × Volume (ft^3) = \$0.93/ft^3 × Volume (ft^3)

Media Cost = \$1.11/ft^3 × Media Volume (ft^3)

Construction Cost = Area Cost + Volume Cost + Media Cost = {25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)}

Proportional Constant Cost = Planning (5%) + Design (10%) + Mobilization (5%) = 20% of Construction Cost = 0.2 × [{25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)]

Total Construction Cost = Construction Cost + Proportional Constant Cost = 1.2 × [{25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)]

Maintenance Cost

Annual O&M Cost (PV, \$) = 12.462 × (4% of Total Construction Cost) = 12.462 × 0.04 × 1.2 × [{25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)}]

Total Cost

Total Cost (\$) = Total Construction Cost + Annual O&M Cost = {1.2 + (12.462 × 0.04 × 1.2)} × [{25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)] = [44.9544 × Area (ft^2)] + [1.6723 × Volume (ft^3)] + [1.996 × Media Volume (ft^3)]

Infiltration Basin without Underdrain

Construction Cost

Area Cost = [Site Preparation (\$20.00/ft^2) + Landscaping (\$5.00/ft^2)] × Area (ft^2) = \$25.00/ft^2 × Area (ft^2)

Volume Cost = [Excavation and Removal (\$0.93/ft^3)] × Volume (ft^3) = \$0.93/ft^3 × Volume (ft^3)

Media Cost = \$1.11/ft^3 × Media Volume (ft^3)

Construction Cost = Area Cost + Volume Cost + Media Cost = {25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)}

Proportional Constant Cost = Planning (5%) + Design (10%) + Mobilization (5%) = 20% of Construction Cost = 0.2 × [{25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)}]

Total Construction Cost = Construction Cost + Proportional Constant Cost = 1.2 × [{25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)}]

Maintenance Cost

Annual O&M Cost (PV, \$) = 12.462 × (6.72% of Total Construction Cost) =12.462 × 0.0672 × 1.2 × [{25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)}]

Total Cost

Total Cost ($) = Total Construction Cost + Annual O&M Cost = {1.2 + (12.462 × 0.0672 × 1.2)} × [{25 × Area (ft^2)} + {0.93 × Volume (ft^3)} + {1.11 × Media Volume (ft^3)}] = [55.1234 × Area (ft^2)] + [2.0506 × Volume (ft^3)] + [2.4475 × Media Volume (ft^3)]

G.6.7. Estimated BMP Cost Summary

Table G-10 summarizes the estimated costs for the components of each BMP. The values for each component reflect the total construction and maintenance costs, including the proportional constant cost. These values do not include the contingency factor of 25 percent.

Table G-10. Summary of Estimated BMP Component Costs

Type	BMP	Area cost (/ft^2)	Total Volume Cost (/ft^3)	Media Volume Cost (/ft^3)	Underdrain Cost (/ft^3)
Distributed	Rain barrel	0	15	0	0
	Bioretention area with underdrain	30.13	1.07	3.1205	2.23
	Bioretention area without underdrain	28.75	1.07	3.1205	0
	Porous pavement with underdrain	18.7247	0	0	3.30
	Porous pavement without underdrain	17.3447	0	0	0
Centralized	Extended dry detention basin	44.9544	1.6723	1.996	0
	Infiltration basin without underdrain	55.1234	2.0506	2.4475	0

G.7. Simulation Period

To determine a representative year for optimization, a statistical evaluation of a few selected rainfall gages was performed. The updated County watershed model recognizes the highly variable nature of precipitation across the entire County by using data from 148 local rainfall gages. The objective of this analysis was to select a regionally representative average year. Four rainfall gages were selected from among the available regional rainfall gages for the analysis:

- Los Angeles Intl AP (045114)
- Los Angeles Downtown (045115)
- Pasadena (046719)
- Mt Wilson No 2 (046006)

The gages were selected to provide both a spatial variation and topographic relief. Figure G-7 shows the four stations relative to other available rainfall gages in the region. The isohyetal contours and annual average precipitation gradient in the figure were previously summarized for the 20-year period 1/1/1987–12/31/2006. Figure G-8 shows average hydrologic year (HY) rainfall measurement together with gage elevation at the four selected stations.

The selected gages capture a wide range of rainfall variability within the region. The gages are also among some the most populated areas of the watershed, making them fairly well representative of the prevailing environmental conditions in the region. The analysis was done in two steps.

1. Identify a number of individual water years (3) within the 20-year period that have total rainfall volumes that are closest to the average rainfall volume over the 20-year period. The results from step 1 are shown in Figure G-9. Water years 1996, 2003, and 1997, respectively, were the three closest years in terms of having the smallest absolute difference between total annual precipitation volume and the 20-year average at all four stations.

2. At each gage, perform rainfall volume duration and intensity duration analyses to determine which of the selected years with the closest average rainfall volume also has a well distribution in terms of volume and intensity.

    a. The first step is to summarize 20 years of precipitation records into *precipitation events*, where an event is defined as a rainfall series preceded by a 72-hour dry antecedent period. This storm separation approach is similar to the TMDL definition of a wet interval for fecal coliform exceedence evaluation. For this study, a *precipitation interval* defines the entire period of time that the precipitation event occurs.

    b. Next, the storms are sorted by increasing volume. At each gage location, storms occurring within each of the selected years from step 1 are highlighted for comparison relative to the other remaining storms.

    c. Average storm intensity is also plotted and ranked in ascending order for comparison.

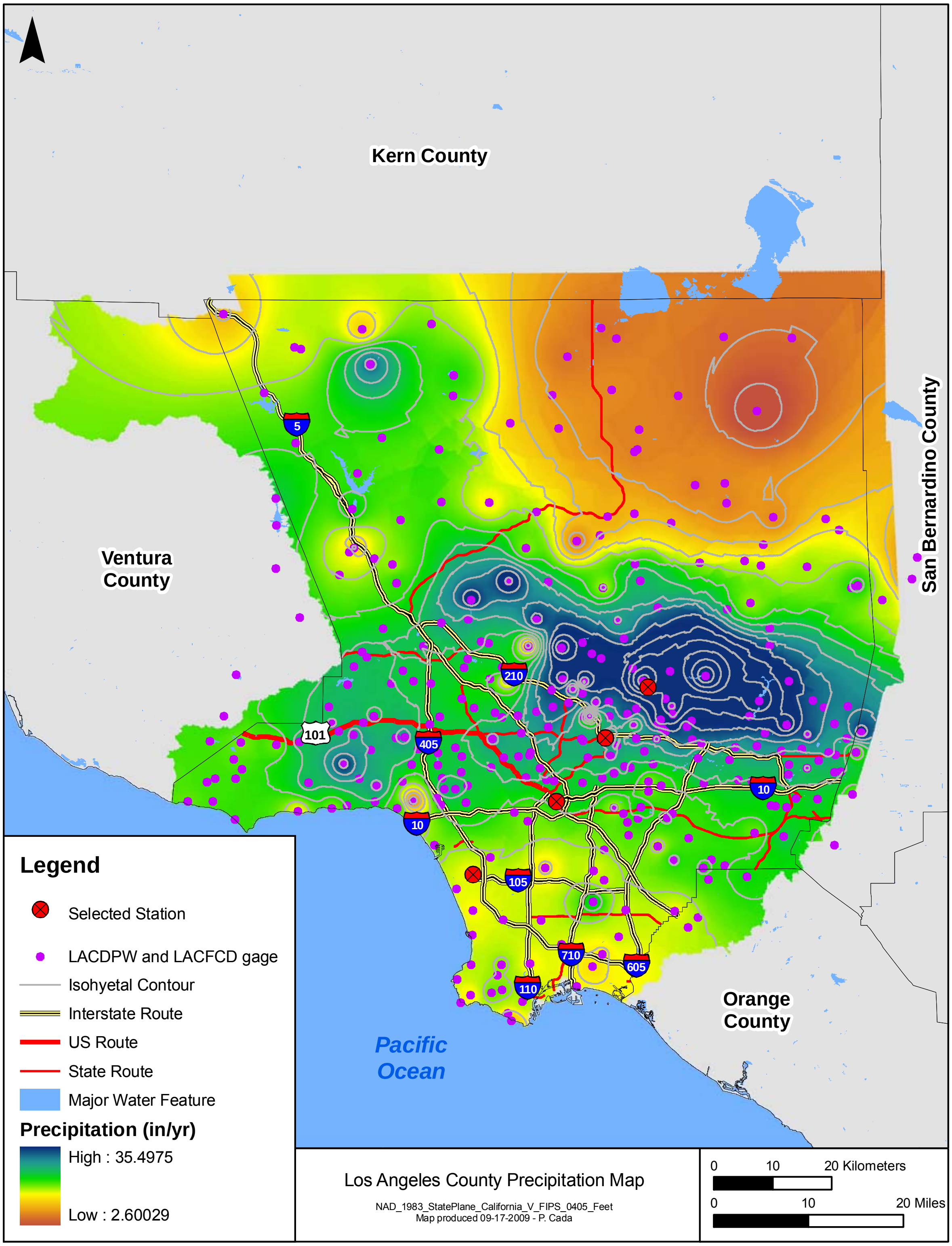


Figure G-7. Selected Stations for Regional Rainfall Volume and Intensity Duration Analysis

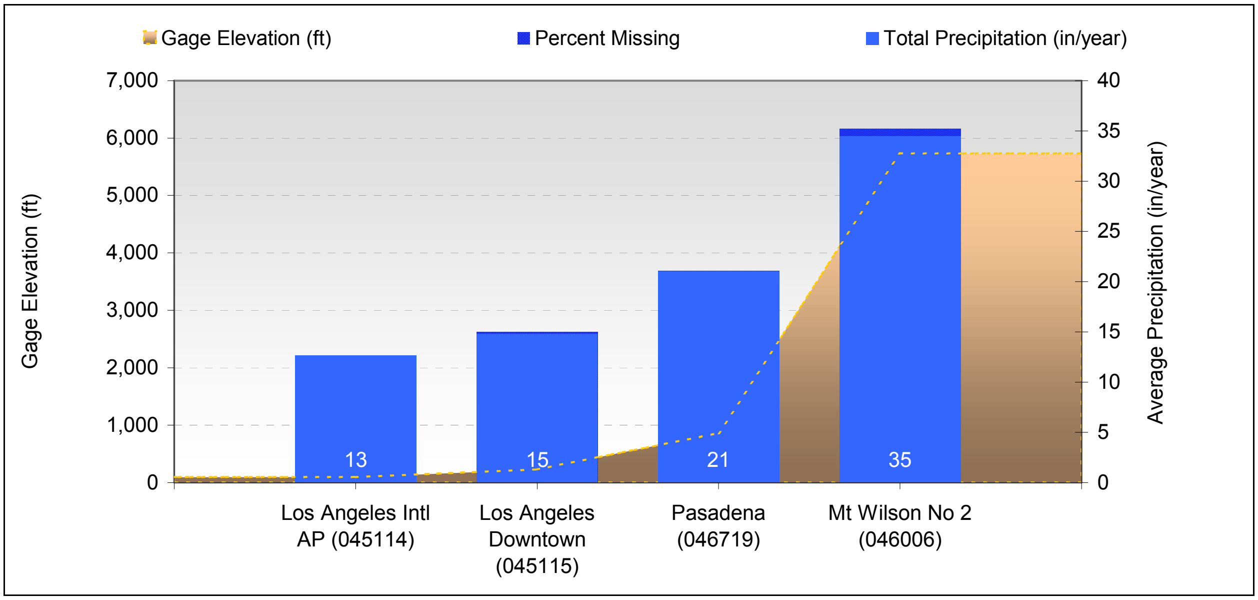
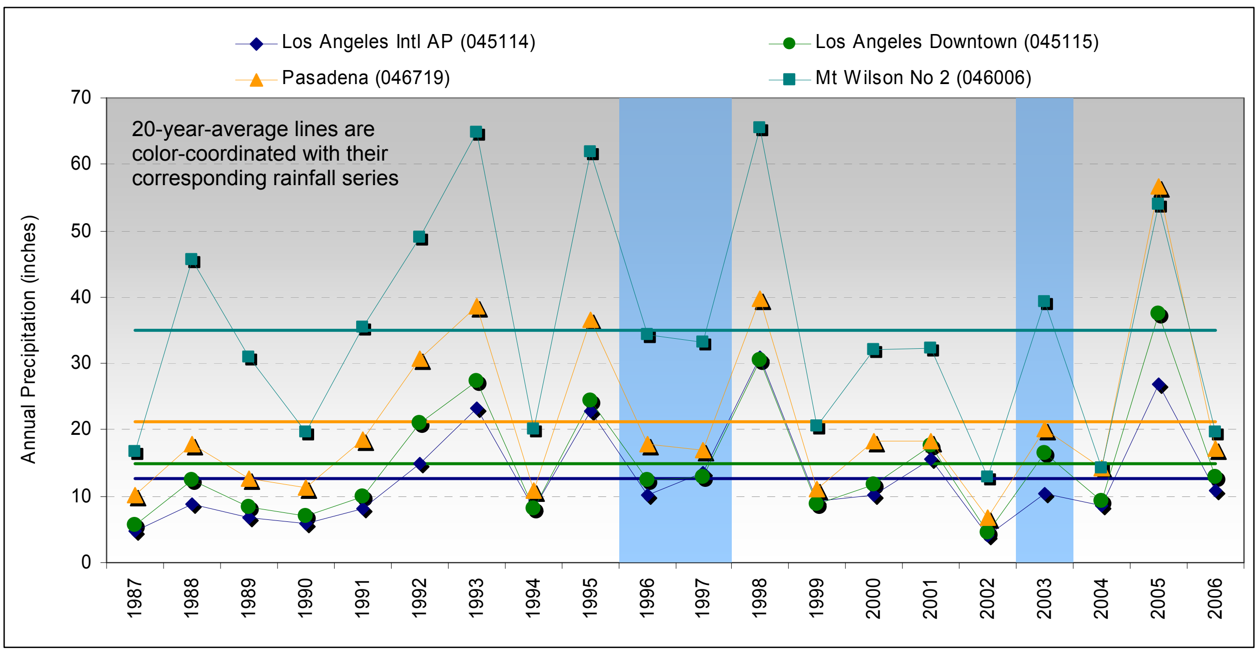


Figure G-8. Average Rainfall and Elevation at Selected Stations (10/1/1987–9/30/2006)



Highlighted years have the smallest absolute difference from the 20-year average.

Figure G-9. Total Annual Precipitation Volumes vs. 20-Year Annual Average Precipitation at Four Gages in the Los Angeles Region

Figure G-10 through Figure G-13 show the Step 2 analysis graphs of rainfall volume and intensity duration at each of the four selected precipitation gages. In the graphs, rainfall event totals are read on the left axis, and average rainfall intensities are read on the right axis. The intensities for the selected years are highlighted from among the rest of the data. On a rainfall duration graph, the x-axis indicates the percent of events that have a magnitude (or intensity) that is lower than the corresponding event. The color-coordinated dots correspond to points along the rainfall volume curve for selected storms, for the selected years.

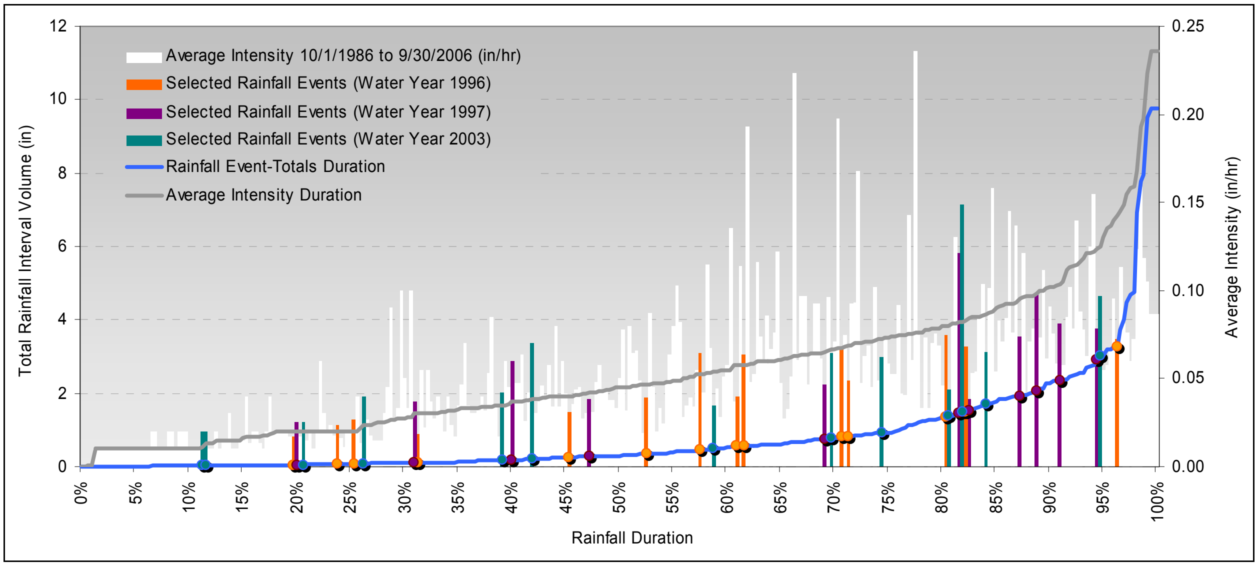


Figure G-10. Rainfall Volume and Intensity Duration Analysis at Los Angeles International AP gage (045114)

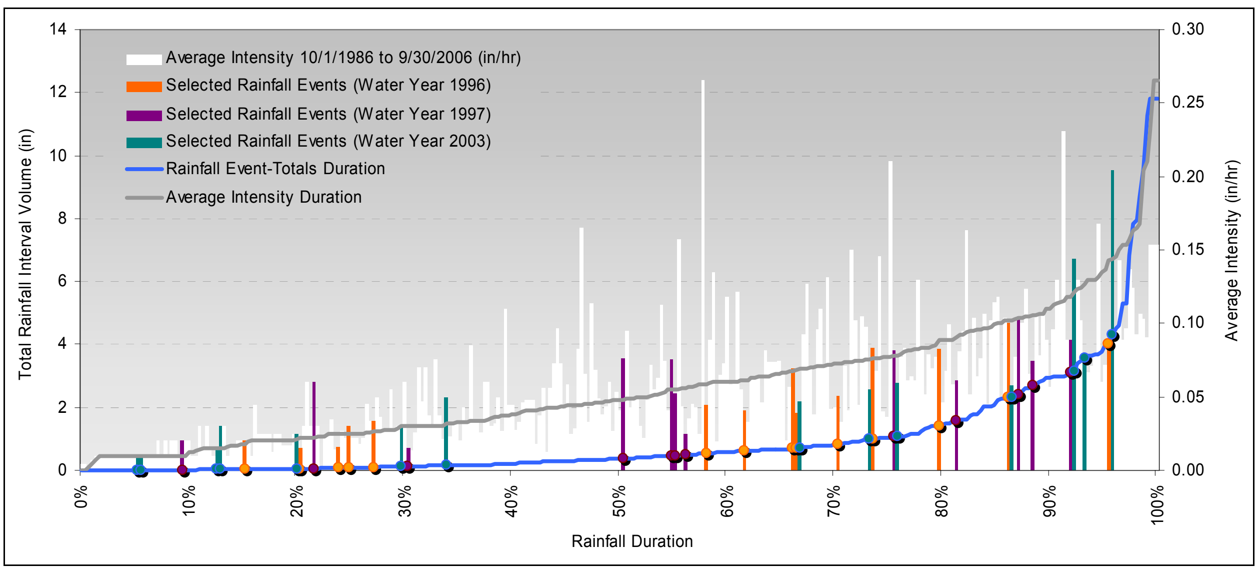


Figure G-11. Rainfall Volume and Intensity Duration Analysis at Los Angeles Downtown Gage (045115)

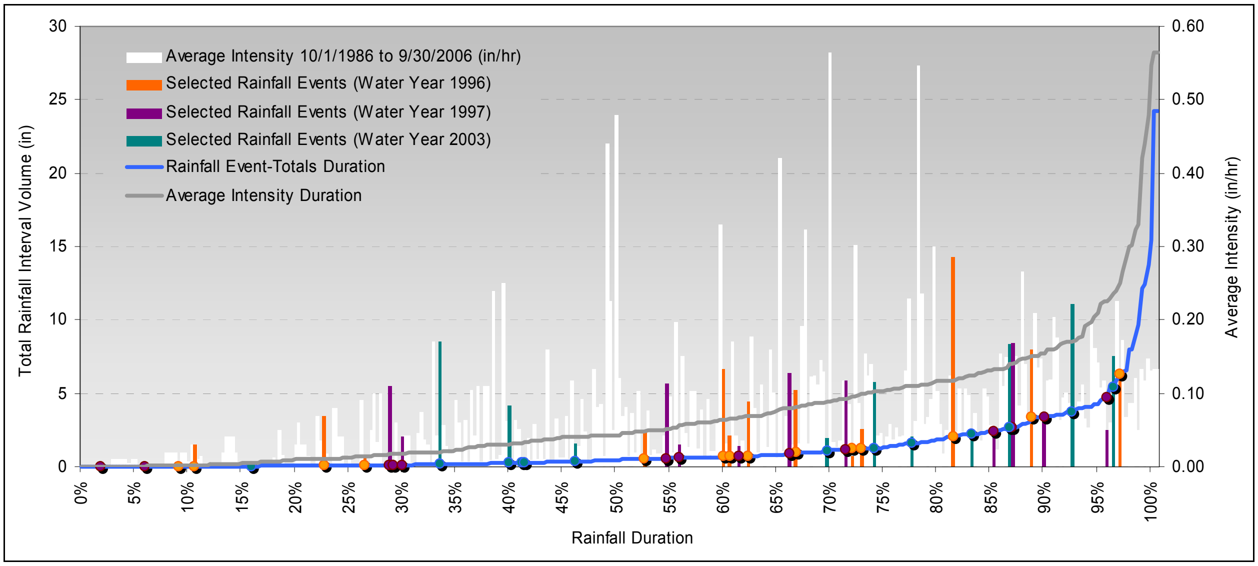


Figure G-12. Rainfall Volume and Intensity Duration Analysis at Pasadena Gage (046719)

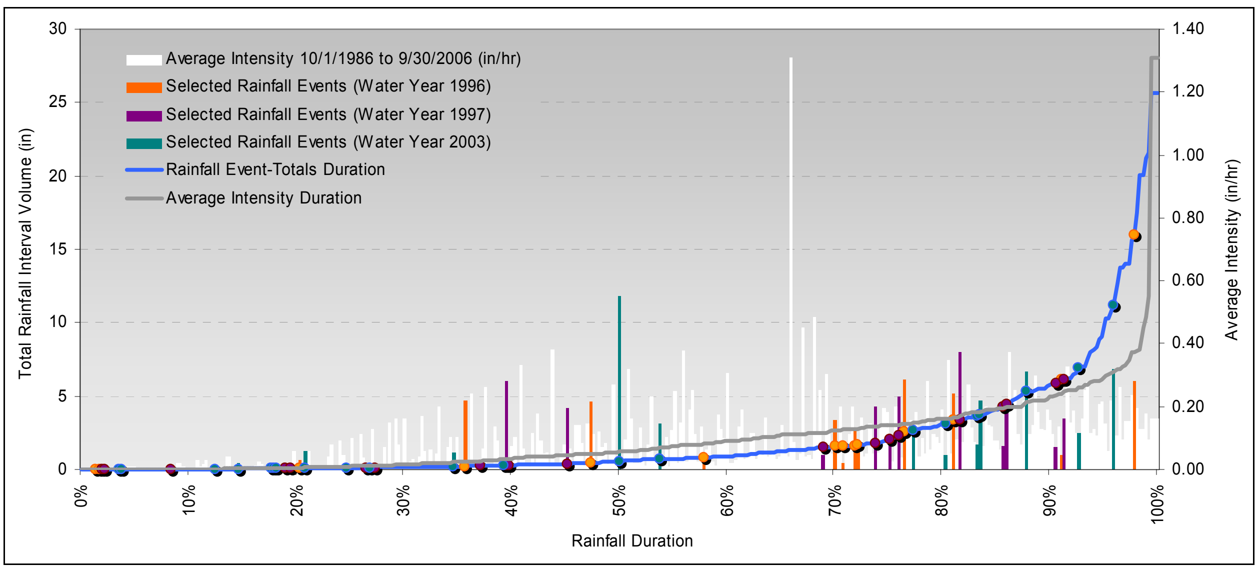


Figure G-13. Rainfall Volume and Intensity Duration Analysis at Mt Wilson No 2 Gage (046006)

The rainfall duration analysis showed that of the three selected years with the smallest absolute difference between total annual precipitation and the 20-year average rainfall values, HY 2003 also had the most evenly distributed storms among the percentile ranges. While 1996 was the closest in terms of total volume, more than 50 percent of the storms in that year at all the gages were above the 70th percentile range. Figure G-14 and Figure G-15 show water year 2003 rainfall duration summary results at Los Angeles Intl AP and Pasadena, respectively. These graphs show the number of events occurring in each percentile bin (which are divided into 10 percentile ranges).

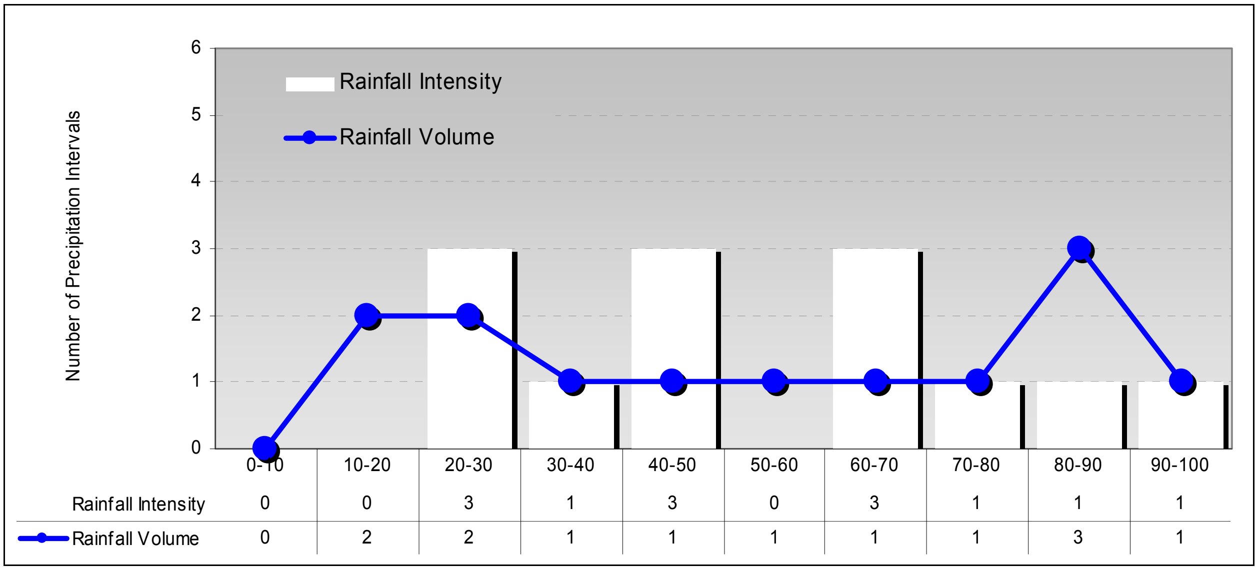


Figure G-14. Water Year 2003 Rainfall Duration Summary at Los Angeles International AP (045114)

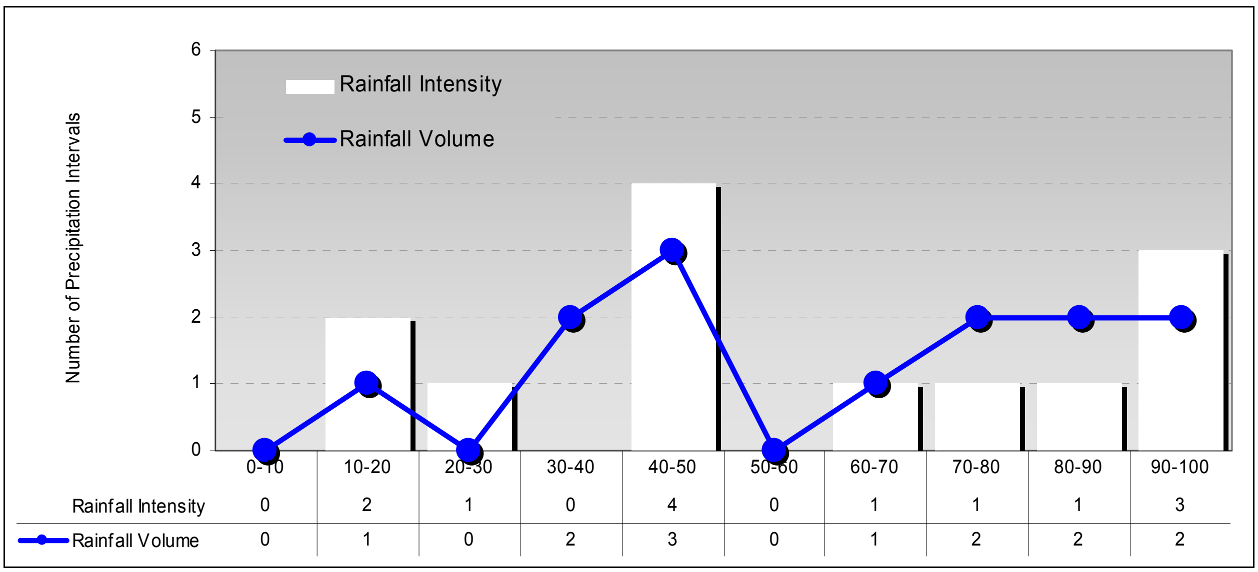


Figure G-15. Water Year 2003 Rainfall Duration Summary at Pasadena (046719)

Of the years evaluated in this analysis, HY 2003 has the most normally distributed storms in terms of volume and intensity duration. While an attempt was made to select a naturally occurring average water year, the analysis process also highlighted the strong variability in rainfall patterns, both in terms of total volume and intensity, within the Los Angeles regional watersheds.

G.8. Additional Discussion of Structural BMP Optimization Results

As discussed in Section 6, Figure G-16 shows the results of optimization of structural BMPs to achieve increasing load reductions. The following sections provide additional discussion of these results.

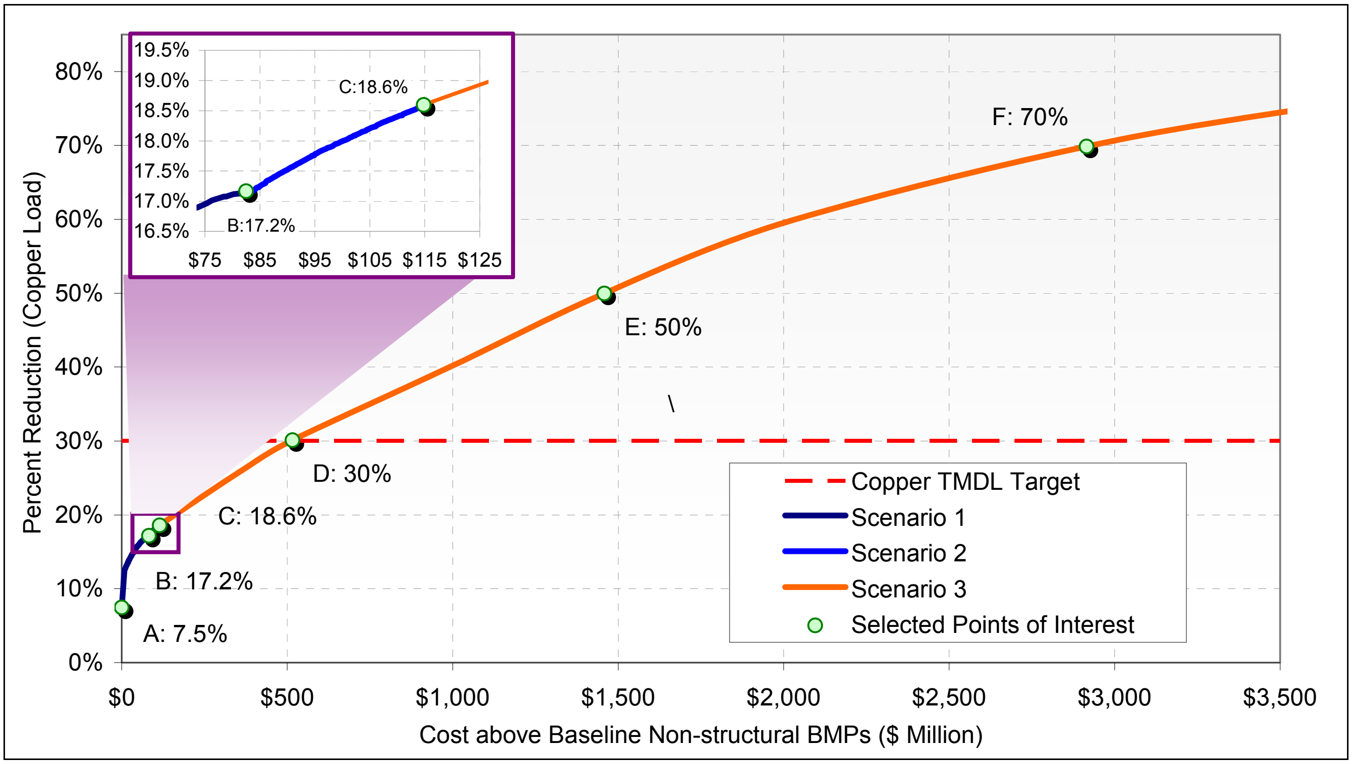


Figure G-16. Pollutant Reduction vs. Minimum Cost Relationship Derived from Scenarios 1, 2, and 3

G.8.1. Public Centralized BMPs (Point B)

Twenty public centralized BMP sites, as described in Section 6, were evaluated. Point B represents the maximum optimal public centralized BMP solution. Table G-11 lists the optimal BMP sizes of the 20 potential sites, the estimated costs and cost-effectiveness. Table G-12 indicates the flow and pollutant reductions that can be achieved by each individual site.

Table G-11. Optimal Maximum Centralized BMPs (Point B) Size on Public Land Derived from Optimization Scenario 1

Public Centralized BMP sites	Unincorporated Impervious Drainage Area (acres)	BMP Surface Area (acres)	BMP Type	Storage Capacity (AF)	Estimated Cost ($)	Copper Load Reduction (lb/yr)	Cost-Effectiveness ($1,000/lb copper reduction)
Belvedere Park	126	2.5	Infiltration Basin	13.8	7,756,321	10.1	771
Bethune Park	73	0.2	Infiltration Basin	0.9	534,760	1.1	508
Charles White County Park	277	3.9	Infiltration Basin	21.0	11,840,123	15.8	751
Enterprise Park	21	0.7	Infiltration Basin	3.9	2,176,574	1.9	1,139
Farnsworth Park	5	0.1	Infiltration Basin	0.5	254,851	0.3	742
G.W. Carver Park	74	0.9	Infiltration Basin	5.0	2,831,088	6.1	466
Hugo Reid Park	104	0.6	Infiltration Basin	3.2	1,785,904	4.9	363
Loma Alta County Park	65	1.9	Infiltration Basin	10.2	5,762,575	5.2	1,098
Magic Johnson Park	95	3.7	Infiltration Basin	20.0	11,258,434	10.5	1,075
Mona Park	547	0.6	Infiltration Basin	3.4	1,895,775	5.5	347
Northside Drive Median	20	0.4	Infiltration Basin	2.3	1,281,698	1.9	680
Obregon Park	122	4.6	Extended Detention Basin	18.4	11,135,663	4.4	2,531
Roosevelt Park	34	0.7	Infiltration Basin	3.7	2,074,842	3.1	663
Salazar Park	64	1.8	Infiltration Basin	9.9	5,557,437	6.6	842
Compton Creek Wetland	2,184	0.9	Wetland	3.7	2,844,569	48.6	59
Ted Watkins Park Left	21	0.2	Infiltration Basin	1.3	730,496	1.5	484
Ted Watkins Park Right	652	1.0	Infiltration Basin	5.4	3,068,083	8.3	369
Two Strike Park	81	2.6	Infiltration Basin	14.2	8,006,650	7.5	1,070
Whittier Narrows Park	16	0.4	Infiltration Basin	2.4	1,362,981	1.5	881
Whittier Narrows Recreation Area	5	0.2	Infiltration Basin	0.9	479,436	0.6	781

Table G-12. Pollutant Reductions Achieved by Optimal Maximum Centralized BMPs Size on Public Land Derived from Optimization Scenario 1

Public Centralized BMP Sites	Copper		Zinc		TSS		Fecal Coliform		Flow Volume	
	Load Reduction (lb/yr)	Reduction (% of total)	Load Reduction (lb/yr)	Reduction (% of total)	Load Reduction (lb/yr)	Reduction (% of total)	Load Reduction (counts/yr)	Reduction (% of total)	Reduction (cubic ft/yr)	Reduction (% of total)
Belvedere Park	10.1	0.67%	94.7	0.74%	26,754	0.25%	1.40E+13	0.77%	6,326,791	0.64%
Bethune Park	1.1	0.07%	10.1	0.08%	2,797	0.03%	2.70E+12	0.15%	699,877	0.07%
Charles White County Park	15.8	1.05%	147.9	1.15%	40,575	0.39%	2.10E+13	1.15%	14,272,117	1.44%
Enterprise Park	1.9	0.13%	18.2	0.14%	5,607	0.05%	2.90E+12	0.16%	1,344,507	0.14%
Farnsworth Park	0.3	0.02%	3.5	0.03%	1,153	0.01%	3.60E+11	0.02%	287,752	0.03%
G.W. Carver Park	6.1	0.41%	58.1	0.45%	15,909	0.15%	1.58E+13	0.85%	4,380,952	0.44%
Hugo Reid Park	4.9	0.33%	43.3	0.34%	11,742	0.11%	7.50E+12	0.41%	2,445,148	0.25%
Loma Alta County Park	5.2	0.35%	53.3	0.41%	17,846	0.17%	5.50E+12	0.30%	4,936,707	0.50%
Magic Johnson Park	10.5	0.70%	93.3	0.73%	26,991	0.26%	2.00E+13	1.08%	6,505,051	0.66%
Mona Park	5.5	0.36%	50.3	0.39%	14,755	0.14%	1.27E+13	0.69%	3,726,521	0.37%
Northside Drive Median	1.9	0.13%	17.0	0.13%	4,264	0.04%	4.00E+12	0.21%	1,037,002	0.10%
Obregon Park	4.4	0.29%	41.2	0.32%	10,516	0.10%	1.13E+13	0.61%	3,157,616	0.32%
Roosevelt Park	3.1	0.21%	26.6	0.21%	8,552	0.08%	4.20E+12	0.23%	2,001,579	0.20%
Salazar Park	6.6	0.44%	60.9	0.47%	15,845	0.15%	9.60E+12	0.52%	3,784,259	0.38%
Compton Creek Wetland	48.6	3.24%	469.3	3.65%	134,910	1.28%	6.74E+13	3.76%	15,415,564	1.56%
Ted Watkins Park Left	1.5	0.10%	13.7	0.11%	3,673	0.03%	2.60E+12	0.14%	919,766	0.09%
Ted Watkins Park Right	8.3	0.55%	78.8	0.61%	21,468	0.20%	2.30E+13	1.23%	5,907,996	0.59%
Two Strike Park	7.5	0.50%	72.9	0.57%	22,216	0.21%	8.00E+12	0.43%	6,306,320	0.64%
Whittier Narrows Park	1.5	0.10%	14.9	0.12%	5,342	0.05%	6.80E+11	0.04%	1,068,774	0.11%
Whittier Narrows Recreation Area	0.6	0.04%	5.6	0.04%	3,692	0.04%	4.20E+12	0.22%	269,666	0.03%
Total	145.4	9.69%	1,373.6	10.7%	394,607	3.74%	2.37E+14	13.0%	84,793,964	8.6%

G.8.2. Distributed Structural BMPs on Publicly Owned Land (Point C)

Table G-13 is a summary of BMP details for the optimal public distributed structural BMPs at Point C.

Table G-13. Optimal Distributed BMPs Size on Public Land Derived from Optimization Scenarios 2 (Point C, with Nonstructural BMP, Excluding Area Draining to Public Centralized BMP Sites)

Location	Weather Zone	Infiltration Rate	Land Use	BMP Type[a]	BMP Impervious Drainage Area			BMP Cost ($Mil)	BMP Surface Area (acre)	Load Reduction (Copper)	
					Max (acre)	Treated (acre)	% Treated			(lb/yr)	% Total Existing Load
Within Compton Treatment Wetland Drainage Area	Low	High	Institutional	PP	39.1	39	100%	2.22	2.94	2.02	0.13%
	Low	High		BR	6.0	2	33%	0.14	0.08	0.00	0.00%
	Low	High	Industrial	PP	35.1	35	100%	2.00	2.64	1.82	0.12%
	Low	High		BR	18.9	4	21%	0.28	0.15	0.44	0.03%
	Low	Low	Institutional	PP	19.0	0	0%	--	0.00	0.00	0.00%
	Low	Low		BR	12.2	0	0%	--	0.00	0.00	0.00%
Outside of Public Centralized BMP Drainage Area	High	High	Institutional	PP	37.4	35	94%	2.41	3.19	1.97	0.13%
	High	High		BR	23.9	22.5	94%	1.88	1.02	0.69	0.05%
	High	High	Industrial	PP	35.8	35	98%	2.41	3.19	1.84	0.12%
	High	High		BR	19.3	12	62%	1.00	0.55	0.00	0.00%
	High	Low	Institutional	PP	6.5	5	77%	0.44	0.46	0.00	0.00%
	High	Low		BR	4.2	1	24%	0.09	0.05	0.00	0.00%
	Low	High	Industrial	PP	59.0	59	100%	3.36	4.45	3.06	0.20%
	Low	High		BR	31.8	30	94%	2.08	1.13	1.40	0.09%
	Low	Low	Institutional	PP	85.1	85	100%	6.15	6.41	3.88	0.26%
	Low	Low		BR	54.4	11	20%	0.85	0.41	1.89	0.13%
	Low	Low	Industrial	PP	45.6	45	99%	3.26	3.40	2.05	0.14%
	Low	Low		BR	24.5	22.5	92%	1.73	0.85	0.22	0.01%
	Mid	High	Institutional	PP	8.6	6	70%	0.39	0.52	0.26	0.02%
	Mid	High		BR	5.5	1	18%	0.08	0.04	0.04	0.00%
	Mid	High	Industrial	PP	10.7	9	84%	0.59	0.78	0.35	0.02%
	Mid	High		BR	5.8	4	69%	0.32	0.17	0.08	0.01%
	Mid	Low	Institutional	PP	14.9	10.5	71%	0.87	0.91	0.00	0.00%
	Mid	Low		BR	9.5	0	0%	-	0.00	0.00	0.00%
	Mid	Low	Industrial	PP	12.5	0	0%	-	0.00	0.06	0.00%
	Mid	Low		BR	6.7	1	15%	0.09	0.04	0.00	0.00%
	Mid	Mid	Secondary Road	L-BR	1.0	1	100%	0.09	0.05	0.09	0.01%

a. PP = Porous Pavement, BR = Bioretention, L-BR = Linear Bioretention

G.8.3. Centralized BMPs on Private Land (Points D, E and F)

Points D, E, and F on the curve in Figure G-16 indicate the cost-benefit at three selected private centralized BMP implementation levels. It is important to note that all three solutions share the same assumption of treating 100 percent of the drainage area using the potential centralized structural BMPs in the selected BMP Drainage Zones. For example, for Point D, 100 percent of BMP drainage zones 3, 5, and 7 are treated; for Point E, 100 percent of zones 1, 3, 5, 6, and 7 are treated; for Point F, 100 percent of all the zones are treated. Table G-14 summarizes the optimization details at the three selected points of interest (D, E, and F). That information includes the following:

- Drainage area information
- BMP surface area to impervious drainage area ratio
- Load reduction per unit impervious area treated
- Cost per pound of copper removal
- Treatment capacity, expressed as runoff depth captured and treated

Results show that the point D solution has the lowest BMP surface area to drainage area ratio and, consequently, the lowest treatment storage capacity, while point F has the highest. As a result, point D presents the lowest pollutant removal per unit impervious drainage area treated, while point F shows the highest. For point D, this means to reduce the same amount of pollutant load as seen at point F, more drainage area needs to be treated using the point D BMP design specifications. The results also show that infiltration basins are preferred over extended detention basins, and zones with higher unit area pollutant loadings receive higher treatment.

Table G-15 lists the flow and pollutant reductions achieved by the three solutions (i.e., D, E, and F).

Table G-14. Optimal Private Centralized BMPs Derived from Optimization Scenario 3 (Points D, E, and F)

Private Centralized BMP Drainage Zones		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
BMP Type		Infiltration Basin	Extended Detention Basin	Infiltration Basin	Extended Detention Basin	Infiltration Basin	Extended Detention Basin	Infiltration Basin	Extended Detention Basin
Drainage Area	Total Area (acres)	2,344.1	1,167.9	4,370.6	2,042.3	1,936	7,306.6	13,511.6	3,709.3
	Impervious Area (acres)	1,512.56	660.4	1,427.96	570.64	282.62	3,246.87	480.09	1,505.72
	Total Pollutant Load (Copper lb/yr)	127.2	69.7	160.2	66.1	40.5	337.2	154.2	199.0
	% Impervious	64.5%	56.5%	32.7%	27.9%	14.6%	44.4%	3.6%	40.6%
BMP Surface Area/Impervious Drainage Area (%)	Point D	0.0%	0.0%	2.7%	0.0%	2.1%	0.0%	1.5%	0.0%
	Point E	2.1%	0.0%	2.7%	0.6%	2.1%	2.4%	1.5%	0.0%
	Point F	3.0%	5.7%	2.7%	5.1%	5.7%	3.3%	1.5%	4.2%
Load Reduction per Unit Impervious Area Treated (Copper lb/ac treated Imp)	Point D	0	0	0.094	0	0.087	0	0.073	0
	Point E	0.073	0	0.094	0.007	0.087	0.063	0.073	0
	Point F	0.081	0.093	0.094	0.080	0.130	0.080	0.073	0.083
Cost-effectiveness ($1,000/lb Copper reduced)	Point D	n/a	n/a	2,484	n/a	2,099	n/a	1,778	n/a
	Point E	2,497	n/a	2,484	7,290	2,099	3,035	1,778	n/a
	Point F	3,192	4,903	2,484	5,135	3,791	3,309	1,778	4,048
Treated Runoff Depth (in)	Point D	0	0	1.75	0	1.36	0	0.97	0
	Point E	1.36	0	1.75	0.39	1.36	1.56	0.97	0
	Point F	1.94	3.69	1.75	3.30	3.69	2.14	0.97	2.72

Table G-15. Pollutant Reductions Achieved by Optimal Maximum Centralized BMPs Size on Private Land Derived from Optimization Scenarios 3

TMDL Alternative	Total Cost	Flow Volume		Copper		Zinc		TSS		Fecal Coliform	
		Flow Reduction (cubic ft/yr)	Reduction (% of total)	Load Reduction (lb/yr)	Reduction (% of total)	Load Reduction (lb/yr)	Reduction (% of total)	Load Reduction (lb/yr)	Reduction (% of total)	Load Reduction (counts/yr)	Reduction (% of total)
Point D	508,839,359	225,114,296	23%	449	30%	4,177	32%	1,559,519	15%	4.88E+14	26%
Point E	1,451,583,885	433,204,918	44%	754.4	50%	7,288.8	57%	2,504,335.6	24%	8.42E+14	46%
Point F	2,908,380,749	615,966,576	62%	1,047.3	70%	10,011.1	78%	3,465,434.5	33%	1.23E+15	67%

G.8.4. Alternative Solutions (D, E', and F')

As discussed above, Solution D meets the TMDL reduction targets by treating 100 percent of the drainage area. Considering the possibility that there might not be enough opportunity in zones 3, 5, and 7 to treat 100 percent of the drainage area, it is necessary to develop other alternatives that, even though they are less cost-effective, allow less percentage area of treatment. The hypothesis is to treat less drainage area with larger BMPs to achieve the same load reductions. Given the hypothetical nature of the private centralized BMP analysis, the intention here is not to identify the exact solutions. Rather it is to show the examples of alternative solutions for meeting TMDL targets. Two alternative solutions, E' and F', are derived from solutions E and F, respectively (Figure G-17). Solution E' was to treat 38 percent of the drainage areas that were treated in Solution E with the same BMP sizing specified in Solution E. Similarly, Solution F' was to treat 24 percent of the drainage areas that were treated in Solution F with the same BMP sizing specified in Solution F. The BMP details for each zone are summarized in Table G-16 (Solution D), Table G-17 (Solution E'), and Table G-18 (Solution F'). The total costs, flow and pollutant reductions are summarized in Table G-19.

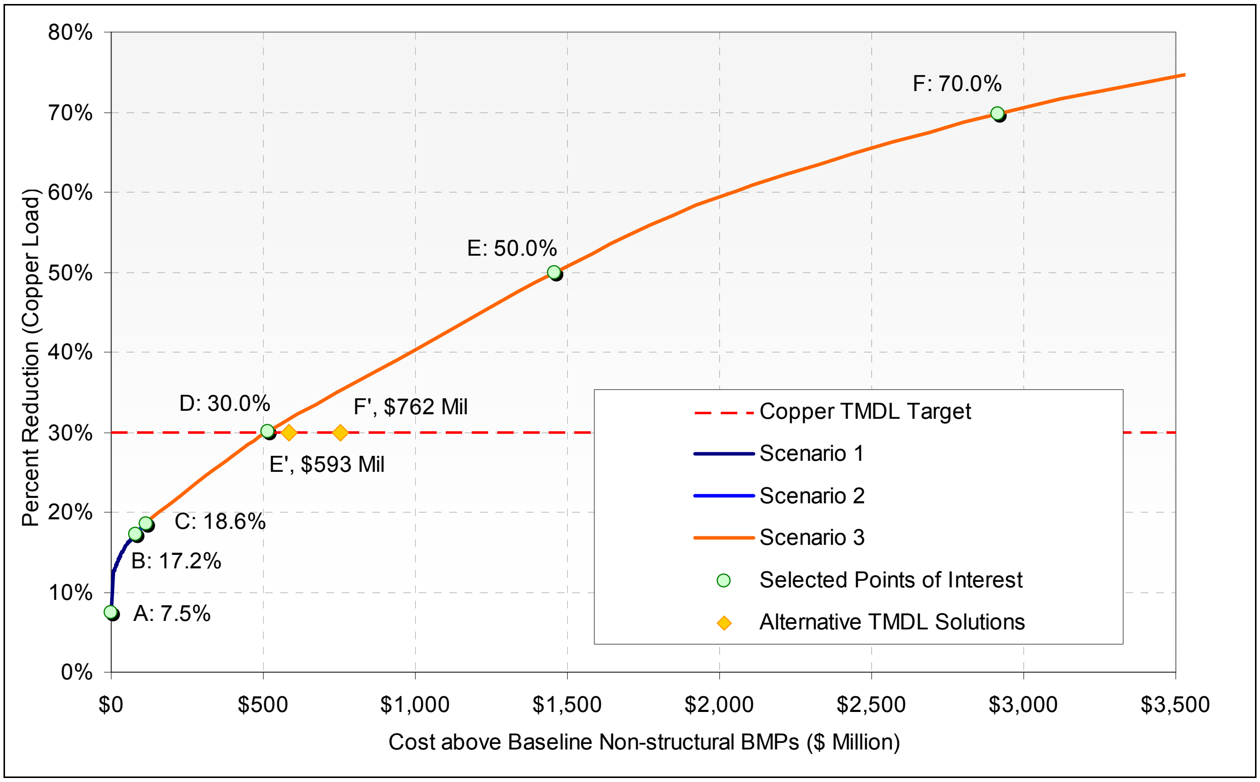


Figure G-17. TMDL Alternative Solutions and Pollutant Reduction vs. Minimum Cost Relationship Derived from Scenarios 1, 2, and 3

Table G-16. Private Centralized BMPs Cost and Configurations (Point D)

Public Centralized BMP Zones	BMP Type[a]	Total Unincorporated Impervious Drainage Area (acres)	Treated Unincorporated Impervious Drainage Area (% of total)	BMP Surface Area (acre)	Storage Capacity (AF)	Copper Load Reduction (lb/yr)	Estimated Cost ($ million)	Cost-Effectiveness ($1,000/lb copper reduced)
Zone 1	IB	1428.56	0	0.0	0	0.0	0.0	--
Zone 2	Ex-DB	660.4	0	0.0	0	0.0	0.0	--
Zone 3	IB	1340.46	100	34.4	186	120.0	298.0	2,484
Zone 4	Ex-DB	570.64	0	0.0	0	0.0	0.0	--
Zone 5	IB	191.62	100	4.9	26	20.0	42.0	2,099
Zone 6	Ex-DB	3067.87	0	0.0	0	0.0	0.0	--
Zone 7	IB	463.09	100	7.1	38	34.4	61.1	1,778
Zone 8	Ex-DB	1504.22	0	0.0	0	0.0	0.0	--

a. IB = infiltration basin, Ex-DB = extended detention basin

Table G-17. Private Centralized BMPs Cost and Configurations (Point E')

Public Centralized BMP Zones	BMP Type[a]	Total Unincorporated Impervious Drainage Area (acres)	Treated Unincorporated Impervious Drainage Area (% of total)	BMP Surface Area (acre)	Storage Capacity (AF)	Copper Load Reduction (lb/yr)	Estimated Cost ($ million)	Cost-Effectiveness ($1,000/lb copper reduced)
Zone 1	IB	1428.56	38	11.4	61.6	37.6	98.8	2,627
Zone 2	Ex-DB	660.40	0	0.0	0.0	0.0	0.0	--
Zone 3	IB	1340.46	38	13.8	74.3	46.6	119.2	2,557
Zone 4	Ex-DB	570.64	0	0.0	0.0	0.0	0.0	--
Zone 5	IB	191.62	38	1.5	8.3	4.8	13.2	2,736
Zone 6	Ex-DB	3067.87	38	28.0	111.9	70.3	224.6	3,195
Zone 7	IB	463.09	38	2.6	14.3	12.6	22.9	1,814
Zone 8	Ex-DB	1504.22	0	0.0	0.0	0.0	0.0	--

a. IB = infiltration basin, Ex-DB = extended detention basin

Table G-18. Private Centralized BMPs Cost and Configurations (Point F')

Public Centralized BMP Zones	BMP Type[a]	Total Unincorporated Impervious Drainage Area (acres)	Treated Unincorporated Impervious Drainage Area (% of total)	BMP Surface Area (acre)	Storage Capacity (AF)	Copper Load Reduction (lb/yr)	Estimated Cost ($ million)	Cost-Effectiveness ($1,000/lb copper reduced)
Zone 1	IB	1428.56	24	10.3	55.5	25.3	89	3,526
Zone 2	Ex-DB	660.40	24	9.0	36.1	14.8	73	4,903
Zone 3	IB	1340.46	24	8.7	46.9	27.8	75	2,710
Zone 4	Ex-DB	570.64	24	7.0	27.9	10.9	56	5,135
Zone 5	IB	191.62	24	2.6	14.2	4.4	23	5,197
Zone 6	Ex-DB	3067.87	24	24.3	97.2	54.4	195	3,589
Zone 7	IB	463.09	24	1.7	9.0	7.7	14	1,877
Zone 8	Ex-DB	1504.22	24	15.2	60.7	30.0	122	4,052

a. IB = infiltration basin, Ex-DB = extended detention basin

Table G-19. Pollutant Reductions Achieved by Optimal Maximum Centralized BMPs Size on Private Land Derived from Optimization Scenarios 3

TMDL Alternative	Total Cost	Flow Volume		Copper		Zinc		TSS		Fecal Coliform	
		Flow Reduction (cubic ft/yr)	Reduction (% of total)	Load Reduction (lb/yr)	Reduction (% of total)	Load Reduction (lb/yr)	Reduction (% of total)	Load Reduction (lb/yr)	Reduction (% of total)	Load Reduction (counts/yr)	Reduction (% of total)
Point D	508,818,696	225,114,296	23%	449.3	30%	4,176.9	32%	1,559,518.6	15%	4.88E+14	26%
Point E'	586,343,835	217,111,967	22%	450.6	30%	4,262.4	33%	1,369,557.5	13%	4.55E+14	25%
Point F'	754,599,708	210,054,389	21%	449.3	30%	4,202.0	33%	1,332,815.4	13%	4.57E+14	25%

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Appendix H. Summary of Groundwater Basin Characteristics

H.1. San Fernando Valley Basin

The San Fernando Valley Basin, also referred to as the Upper Los Angeles River Basin (ULARA), includes water-bearing formations beneath the San Fernando Valley, Tujunga Valley, Browns Canyon, and the alluvial areas in the vicinity of La Crescenta and Eagle Rock. It is surrounded by bedrock that underlies the surrounding Santa Monica and San Gabriel mountains.

The aquifer is mainly unconfined with some localized confinement. Groundwater flows generally from the edges of the basin to the middle and then primarily from west to east. The western portion of the basin is characterized by mostly fine materials with low transmissivity, while the eastern portion is characterized by sandy material and gravel with a high transmissivity.

The total groundwater storage capacity of the basin is calculated as 3.67 million AF. The basin has been adjudicated, and there are 146 active production wells. No aquifer storage recovery (ASR) wells are in the basin. In general, groundwater storage has been in steady decline as a result of over-pumping and limited natural and active recharge. The available groundwater basin storage, i.e., the amount of unused space in the basin that can be used for storage, is estimated to be 504,475 AF (Metropolitan Water District of Southern California 2007). The storage is available because of the depleted state of groundwater and represents the decline in storage since 1928.

Primary inflows to the basin are imported water, precipitation, and stormwater runoff. Precipitation in the San Fernando Valley ranges from 15 to 23 inches per year with an average of about 17 inches. However, because natural recharge is limited, the basins rely on active means of recharge with recharge of captured runoff being the largest component. About 314 acres of spreading grounds are in the San Fernando Valley Basin with an estimated recharge capacity of 104,000 AFY. This basin includes Hansen, Pacoima, Lopez, Branford, and Tujunga spreading grounds. LACDPW operates the Pacoima, Big Tujunga, and Hansen dams for flood control and to regulate storm flows so that they can be recaptured in the downstream spreading grounds listed above. Data are presented in Table H-1 for a comparison of active recharge volume with the available capacity for spreading. For a listing and additional detail of the spreading grounds in the San Fernando Valley Basin and other basins in the Los Angeles River watershed, see Table H-5 at the end of this section. Figure H-1 shows the locations of the spreading grounds in the Los Angeles River watershed.

Table H-1. Summary of Groundwater Storage and Recharge Parameters for the San Fernando Valley Basin

Groundwater Basin	Groundwater Production (avg. 1985–2004)	Active Recharge (avg.1985–2004)	Spreading Ground Recharge Capacity	Unused Storage Available
San Fernando Valley	99,454 AFY	34,000 AFY	104,000 AFY	504,475 AF

Source: Metropolitan Water District of Southern California 2007

Contamination is a significant concern for the San Fernando Valley Basin. Some of the constituents of concern include high total dissolved solids, nitrates, volatile organic compounds (VOCs), total and hexavalent chromium, and perchlorate.

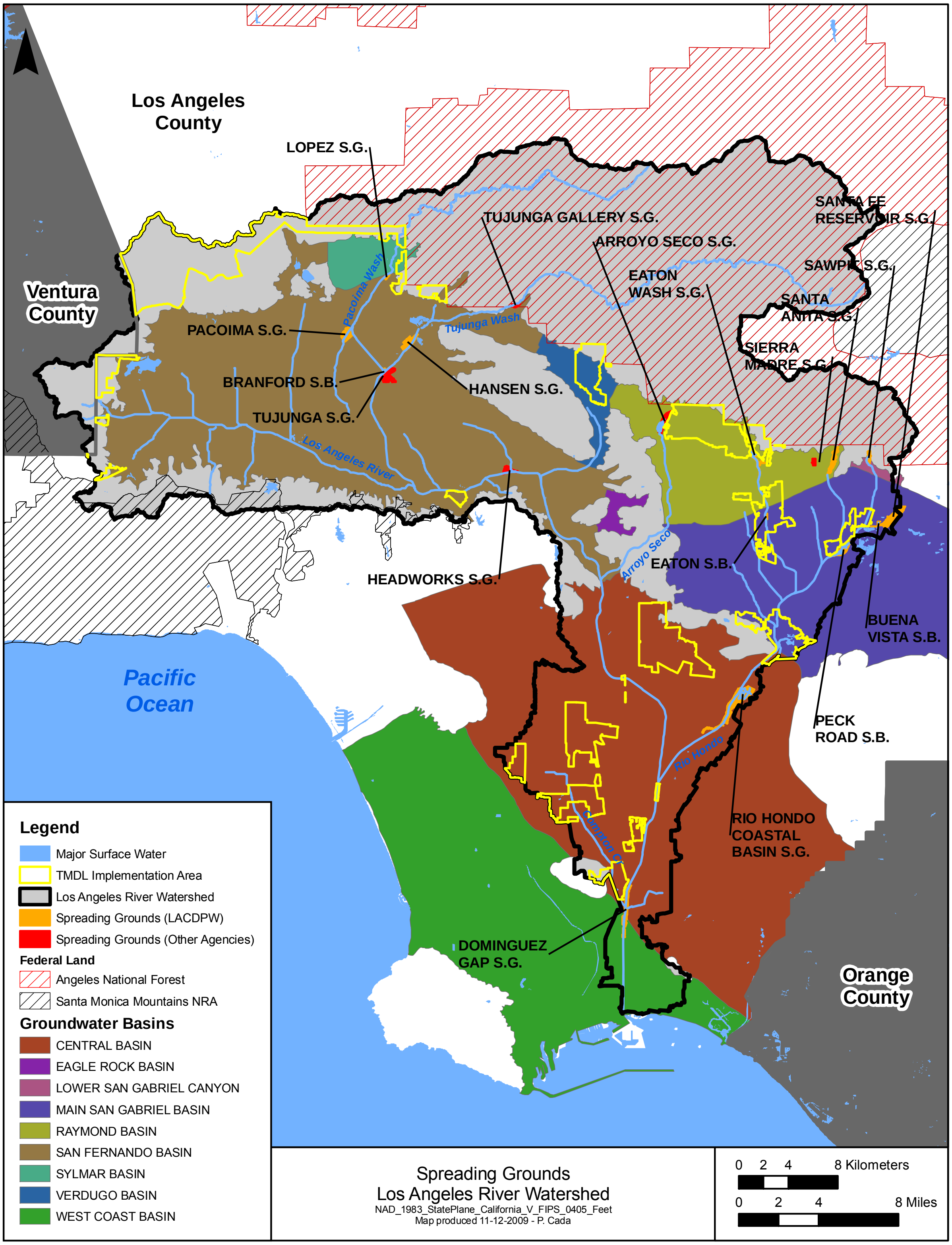


Figure H-1. Spreading Grounds within the Region

H.2. Raymond Basin

The Raymond Basin is within the boundaries of the Los Angeles River watershed in the northwest portion of the San Gabriel Valley in the County. The basin is bounded by the San Gabriel Mountains to the north, the San Rafael Hills to the west, and the Raymond Fault to the south and east where it is hydraulically connected to the Main San Gabriel Basin.

Groundwater generally flows southeast. The water-bearing materials of the basin are primarily alluvial gravel, sand, and silt deposits from mountain streams. Water in the alluvium is typically unconfined, and the clast sizes grade from coarser to finer moving away from the San Gabriel Mountains.

The total groundwater storage capacity of the basin is calculated as 1.45 million AF. The basin has been adjudicated, and about 45 active production wells exist. Seven ASR wells are in the basin. It has suffered declining water levels in the past 20 years. While the basin was adjudicated and the decline is recognized, the trend has not turned. The judgment, which established water rights and responsibility for managing the quantity of the basin's groundwater, allows parties to increase extraction by performing recharge operations. The available groundwater basin storage, i.e., the amount of unused space in the basin that can be used for storage, is estimated to be at least 250,000 AF (Metropolitan Water District of Southern California 2007).

Direct precipitation and surface runoff from the San Gabriel Mountains naturally recharge the Raymond Basin and are its largest source of inflow. Precipitation averages range from about 19 inches in the valley to 24 inches in the upland areas. Average precipitation over the basin is 21 inches. Approximately 37,500 AFY of surface runoff is captured for recharge through spreading grounds, with more than 90 percent provided by the Arroyo Seco, Eaton Wash, Santa Anita and Sierra Madre spreading grounds. Table H-2 allows for a comparison of groundwater production and the potential for increasing this production in terms of additional recharge capacity and volume of storage that is available.

Table H-2. Summary of Groundwater Storage and Recharge Parameters for Raymond Basin

Groundwater Basin	Groundwater Production (Avg. 1985–2004)	Active Recharge (Avg. 1985–2004)	Spreading Basin Recharge Capacity	Unused Storage Available
Raymond Basin	32,969 AFY	18,500 AFY	37,500 AFY	250,000 AF

Source: Metropolitan Water District of Southern California 2007

Groundwater quality in the Raymond Basin is considered to be mostly good to fair. The primary constituents of concern include nitrate, perchlorate and VOCs. Blending with imported water and groundwater treatment facilities are used to address the contamination.

H.3. Central Basin

The Central Basin is central in the County and lies under portions of the Los Angeles River watershed. To the east and northeast, the basin is bounded by tertiary rock formations of the Elysian, Repetto, Merced, and Puente hills. To the southeast, the basin is bounded by the Coyote Creek drainage divide. The southwestern portion of the basin is bounded by the Newport-Inglewood Fault, and the northern portion of the basin is bounded by a surface divide formation known as the La Brea High.

Groundwater in the Central Basin is in the confined pressure areas and unconfined forebay areas consisting of Holocene and Pleistocene age sediment. The pressure areas of the basin exist in depths up to 2,200 feet, while the forebay areas reach depths of up to 1,600 feet. The majority of groundwater production is from the deeper pressure aquifers in the southern regions. Smaller volumes of water are locally extracted from shallower alluvial formations in the northern forebay areas. The basin is replenished directly through percolating precipitation, stream flow, and active recharge, which occurs primarily in the northern forebay areas. Unrestricted flow between northern and southern aquifers allows for direct recharge of the deeper portions of the southern basin where permeable sediments are exposed at the ground surface.

The total storage capacity of the Central Basin is approximately 13.8 million AF. Of that capacity, 267,900 AFY has been adjudicated, and 217,367 AFY has been allocated as managed safe yield. Average precipitation available for recharge throughout the basin ranges from 1 to 13 inches with an average of around 12 inches. Approximately 497 production wells and 4 ASR wells exist with a combined injection capacity exceeding 3,250 AFY. Three primary spreading basins, covering more than 1,000 acres, are also used for active recharge. They include the Rio Hondo, San Gabriel River Coastal, and the San Gabriel Canyon spreading grounds. The gross capacity of the basins is about 398,000 AFY. LACDPW uses captured runoff, imported Metropolitan Water District water, and recycled water for recharge.

Note that unlike the San Fernando Valley and Raymond basins that underlie the Los Angeles River watershed in their entirety, a large portion of the Central Basin underlies the San Gabriel River watershed. For this reason, not all information presented here for the Central Basin is relevant to the Los Angeles River watershed and the study area. For example, a significant amount of recharge to the basin that is included in the summary in Table H-3 occurs at the San Gabriel River Basin and San Gabriel River, neither of which is in the Los Angeles River watershed.

Table H-3. Summary of Groundwater Storage and Recharge Parameters for the Central Basin

Groundwater basin	Groundwater production (avg. 1985–2004)	Active recharge (avg. 1985–2004)	Spreading basin recharge capacity	Unused storage available for storage
Central Basin	189,597 AFY	141,000 AFY	398,000 AFY	330,000 AF

Source: Metropolitan Water District of Southern California 2007

Water quality in the water-producing aquifers of the Central Basin is generally good, containing VOCs and other constituents at or near quality standards. Constituents of concern in the basin include total dissolved solids, VOCs, perchlorate, nitrate, iron and manganese, and chromium.

H.4. San Gabriel Valley Groundwater Basin

The San Gabriel Valley Groundwater Basin is in eastern Los Angeles County and is partially in the Los Angeles River watershed. The remaining portion of the basin is in the Upper San Gabriel River watershed. The basin includes the water-bearing sediments that underlie most of the San Gabriel Valley. The basin is bounded on the north by the Raymond Fault and the San Gabriel Mountains. The hills near Montebello (Repetto and Merced Hills) bound the basin to the west, and the Puente Hills form the southern boundary. The eastern boundary is defined by the Chino Fault and the San Jose Fault. Precipitation in the San Gabriel Valley ranges from 15 to 31 inches and averages around 19 inches per year.

The aquifers of the San Gabriel Valley Basin consist mainly of unconsolidated and semi-consolidated, unconfined alluvial sediments ranging in size from coarse gravel to fine-grained sand, with the finer sediments in the west and central portions of the basin. The alluvial fans along the San Gabriel Mountains and the stream deposits that follow the major rivers across the valley are conducive to surface water percolation in the basin. Specific yields average about 8 percent in the eastern basin, 9 to 10 percent in the western basin, and increase to about 14 percent in the central portion of the basin. Surrounding those water-bearing aquifers is a series of impermeable and semi-permeable formations. Generally, groundwater flows through the basin from east to west, and then flows southward into the Central Basin.

Usable storage of the basin is approximately 800,000 AF, while unused storage is about 500,000 AF. Natural recharge of the basin is mostly from percolation of rainfall and runoff from the surrounding mountains and hills. Groundwater elevations have consistently met target levels; as a result, the available storage space for supplemental water is limited. However, with operating safe yields for HY 2005–2006 of upwards of 240,000 AFY exceeding natural safe yields of 152,700 AFY, the basin relies on outside water sources for storage (Table H-4). Water that is imported comes primarily from Metropolitan Water District and the San Gabriel Valley Municipal Water District and is spread throughout 17 spreading basins that cover more than 1,100 acres (Table H-5; not all spreading grounds are listed). The basin has 310 wells and no ASR wells.

Table H-4. Summary of Groundwater Storage and Recharge Parameters for the San Gabriel Valley Basin

Groundwater Basin	Groundwater Production (avg. 1985–2004)	Active Recharge (avg.1985–2004)	Spreading Ground Recharge Capacity	Unused Storage Available for Storage
San Gabriel Valley	256,430 AFY	152,000 AFY	619,355 AFY	None

Source: Metropolitan Water District of Southern California 2007

Similar to what was noted for the Central Basin, not all information presented in the above table is relevant to the Los Angeles River watershed.

Water quality throughout most of the basin is good; however, the region has been known to have issues with nitrates, which are most prominent in the eastern portions of the basin. Other constituents of concern include perchlorate and VOCs such as TCE and PCE.

H.5. Summary of Spreading Grounds for Groundwater Basins Underlying the County TMDL Implementation Area

Table H-5 provides a summary of spreading grounds operated to provide recharge of groundwater basins overlying the County TMDL Implementation Area.

Table H-5. Los Angeles River Watershed Spreading Grounds

Basin	Spreading Facility	Owner/Operator	Wetted Area (acres)	Capacity for Spreading/Storage (AF)	Recharge Capacity (cfs)
San Fernando Valley Basin[a]	Branford	LACDPW	7	137	1
	Hansen	LACDPW	105	279	150
	Lopez	LACDPW	12	24	15
	Pacoima	LACDPW	107	440	65
	Tujunga	LADWP	83	--	99
Raymond Basin	Arroyo Seco	City of Pasadena	15.1	--	18
	Eaton Wash	LACDPW	25	525	14
	Santa Anita	LACDPW	8	25	5
	Sierra Madre	City of Sierra Madre	9	--	15
Central Basin	Dominguez Gap[b]	LACDPW	24	234	1
	Rio Hondo Coastal	LACDPW	430	3,694	400
San Gabriel Valley Basin	Buena Vista	LACDPW	6	177	6
	Eaton	LACDPW	10	284	20
	Peck Road	LACDPW	105	3,347	25
	Santa Fe Reservoir	LACDPW	168	540	400
	Sawpit	LACDPW	4	13	12
	San Gabriel Canyon	LACDPW	140	8,170	50
	San Gabriel Coastal	LACDPW	96	550	75

a. Tujunga Gallery and Headworks spreading grounds, which LACDWP owns, are in the San Fernando Valley Basin; however, recharge data for those facilities are not included in the analysis or in the Table H-1 summary.
b. Dominguez Gap spreading ground, while shown in the Central Basin recharges the West Basin and is therefore not included in the study area.

H.6. References

Metropolitan Water District of Southern California. 2007. *Groundwater Assessment Study – Report No. 1308*. Metropolitan Water District of Southern California, Los Angeles, CA.

Appendix I. Pertinent Regulations and Permits

I.1. Federal Regulations

I.1.1. Clean Water Act

The Federal Water Pollution Control Act of 1948 was promulgated to "enhance the quality and value of our water resources and to establish a national policy for the prevention, control and abatement of water pollution." The act defines *Waters of the United States* as all surface waterbodies of the United States, including all rivers, streams, lakes, wetlands, estuaries and territorial seas (see CWA section 502[7] and 40 CFR 122.2). The act was amended in 1972 and again in 1977, when it became known as the CWA (33 *United States Code* 25). The amendments establish a system for regulating pollutant discharges into the Waters of the United States including

- A permit structure designed to control and eventually eliminate pollutant discharges
- The requirement to develop water quality standards and pollution control programs
- The requirement to implement grant programs to install infrastructure intended to prevent pollutant discharges

The CWA established the baseline goal of attaining fishable, swimmable waters throughout the United States.

In California, the Porter-Cologne Water Quality Control Act of 1962 (Porter-Cologne Act) is the principal law governing water quality, and it establishes state authority over water rights and policy. The Porter-Cologne Act is codified under Title 23 of the California Code of Regulations (CCR) and, unlike the CWA, applies to both surface water and groundwater. The Porter-Cologne Act designates the SWRCB as the statewide water quality planning agency and gives authority to nine partially self-directed RWQCBs.

The County is within the regulatory jurisdiction of the LARWQCB, Region 4 (a map of the jurisdiction is at www.waterboards.ca.gov/waterboards_map.shtml). The LARWQCB developed the *Water Quality Control Plan: Los Angeles Region Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties* (Basin Plan) (LARWQCB 2009) to establish and protect current and future *beneficial uses* of surface water and groundwater within the region through narrative and numerical objectives and to comply with the state's anti-degradation policy. Implementation of water quality objectives is accomplished through planning activities, inspections and enforcement, and by regulating discharges through permitting. The LARWQCB is authorized to regulate any discharges to waters of the state that can affect water quality. *Waters of the state* are defined by the Porter-Cologne Act as, "any surface water or groundwater, including saline waters, within the boundaries of the state."

The County's BMP implementation activities may be subject to provisions of the following three CWA sections:

- Section 401, which is administered by the SWRCB and the LARWQCB
- Section 402, which is administered by the SWRCB, the LARWQCB, and the County of Los Angeles
- Section 404, which is administered by the USACE

Section 401

Under CWA section 401, every applicant for a federal permit or license for any activity that could result in a discharge to a waterbody must obtain State Water Quality Certification (401 Certification) to ensure that the proposed activity will comply with state water quality standards (USEPA 2009a). In general, a 401 Certification is required for all projects in which a USACE CWA section 404 permit (described below) is obtained or will discharge dredged or fill material to Waters of the United States, including removing vegetation or channel materials for flood control, constructing levees, and filling wetlands. If the LARWQCB deems a project exempt from the provisions of section 401, it may regulate the dredge and fill activity under state authority in the form of Waste Discharge Requirements (WDRs) or Certification of WDRs (Ventura County Planning Division 2006).

To initiate the 401 Certification process, a biological assessment is typically performed in which any potential effect on Waters of the United States, adjacent wetlands, and receiving waters is determined. Coordination between the County and the LARWQCB is recommended before the application is submitted. An LARWQCB Section 401 Water Quality Certification Application Form should then be prepared and submitted (LARWQCB 2004). On average, the 401 Certification application process takes 3 to 4 months to complete from the time of application to the time of approval.

Section 402: National Pollutant Discharge Elimination System

The NPDES regulates the discharge of pollutants into the Waters of the United States. Stormwater discharges from the County MS4s to Waters of the United States are permitted under the Los Angeles County Municipal Storm Water NPDES Permit as Amended by Regional Board Order R4-2007-0042 on August 9, 2007 (Board Order 01-182; NPDES Permit No. CAS004001) (http://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/los_angeles_ms4/2010-01-28/Permit.pdf). The permit requires the County to develop a Stormwater Quality Program to control stormwater pollution to the maximum extent practicable. The County program has the following components:

- Public Information and Participation
- Industrial/Commercial Facilities Control
- Development Planning
- Development Construction
- Public Agency Activities
- IC/ID Elimination Program

The County's Municipal Storm Water Permit does not define specific requirements for selecting and installing BMPs; however, when designing and selecting BMPs, the ordinances and guidelines described below should be considered.

A stormwater ordinance was adopted in accordance with the Municipal Storm Water NPDES Permit and under Los Angeles, California County Code Title 12, Chapter 12.80, Stormwater and Runoff Pollution Control (http://ordlink.com/codes/lacounty/_DATA/TITLE12/Chapter_12_80_STORMWATER_AND_R.html). The ordinance regulates discharges to the MS4, prohibits illicit discharges, requires runoff management such as good housekeeping practices, describes inspections, and identifies violations and enforcement procedures.

In addition to the ordinance, the County has prepared the following guidance documents for developers, planners, engineers, and those involved in the project design and permitting process:

- *Standard Urban Stormwater Mitigation Plan* (SUSMP) was developed to control the post-construction discharge of stormwater pollutants from new development and significant redevelopment projects (County of Los Angeles 2002).

- *Stormwater Best Management Practice Design and Maintenance Manual* provides design criteria and guidance for installing stormwater treatment systems and maintaining public systems (LACDPW 2009a).

- *Los Angeles County-Wide Structural BMP Prioritization Methodology* provides a systematic way of prioritizing structural BMP projects within Los Angeles County watersheds to optimize pollutant reductions in a cost-effective manner (LACDPW 2006a).

- *Technical Manual for Stormwater Best Management Practices in the County of Los Angeles* was prepared to assist with the selection and development of post-construction BMPs within Los Angeles County (LACDPW 2004).

Discharges of stormwater to Waters of the United States from construction projects that result in soil disturbance of at least one acre are regulated under General Permit for Waste Discharge Requirements for Discharges of Storm Water Associated with Construction Activity (NPDES General Permit CAS000002) Water Quality Order 98-08-DWQ (www.waterboards.ca.gov/water_issues/programs/stormwater/docs/finalconstpermit.pdf) (General Permit). Additionally, projects of less than one acre but that are part of a larger common plan of development that encompasses one or more acres of soil disturbance are also regulated under the General Permit. The General Permit requires a SWPPP that describes BMPs to prevent pollutant and sediment discharges from the construction site, as well as an inspection and monitoring program. A Notice of Intent, in Attachment 2 of the General Permit, is to be submitted to the SWRCB along with a project site map and fee at least 2 weeks before construction initiation.

The SWPPP must remain on-site at all times, and regular inspections must be performed to assess the effectiveness of the BMPs. Stormwater samples must be collected if there is reason to suspect that non-visible pollutants have come into contact with stormwater or the site discharges to a waterbody listed on the *2006 CWA Section 303(d) List of Water Quality Limited Segments Requiring TMDLs*. If permit coverage is not terminated within a year, an annual report must be completed and submitted to the LARWQCB. To terminate permit coverage, a Notice of Termination is to be completed and submitted to the SWRCB. The Construction Storm Water General Permit is being revised and is at www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml.

When submitting grading plans to the County, a local SWPPP must also be provided that describes erosion and sediment control measures that will be implemented on the construction site. A Wet Weather Erosion Control Plan must also be submitted annually.

California Water Code section 13263(i) allows the LARWQCB to prescribe general WDRs for a category of discharges if it finds that all the following criteria apply to the discharges in that category:

- The discharges are produced by the same or similar operations.
- The discharges involve the same or similar types of waste.
- The discharges require the same or similar treatment standards.
- The discharges are more appropriately regulated under general discharge requirements than individual discharge requirements.

The LARWQCB regulates specific discharges using WDRs. A Report of Waste Discharge must be filed with the LARWQCB.

The following WDRs could apply to the implementation of structural BMPs in the County:

- General NPDES Permit No. CAG994004 applies to any discharges of groundwater from construction sites or dewatering discharges to surface waters.
- Order No. 93-010, General WDRs for Specified Discharges to Groundwater in Santa Clara River and Los Angeles River Basins applies to construction dewatering discharged to groundwater.

Section 404

The primary federal program regulating activities in wetlands is section 404 of the CWA. It provides USEPA and the USACE regulatory and permitting authority over activities that result in the discharge of dredged or fill material into navigable Waters of the United States. The limits of USACE jurisdiction following the U.S. Supreme Court's decision in *Rapanos v. United States* and *Carabell V. United States* are (1) traditional navigable water, (2) wetlands adjacent to traditional navigable waters, (3) non-navigable tributaries of traditional navigable waters that are relatively permanent when the tributaries flow year-round or have continuous flow at least seasonally (typically 3 months), and (4) wetlands that directly abut such tributaries (USEPA 2008).

The USACE has developed standard methods and data reporting forms contained in the *Interim Regional Supplement to the Corps of Engineering Wetland Delineation Manual: Arid West Region*, a supplement to the USACE's *Wetland Delineation Manual* (USACE 1987), to determine the presence or absence of wetlands and Waters of the United States. The procedures described in the supplement are used to identify wetlands and Waters of the United States at a project site that are potentially subject to regulation under CWA section 404.

Most projects conducted in or adjacent to streams or wetlands will require a section 404 permit. A section 404 permit is required if materials, including dirt, rocks, geotextiles, concrete, or culverts, are moved or placed into or within USACE jurisdictional areas. Permit coverage may be granted if the following are performed: (1) actions are taken to avoid wetland impacts, (2) potential impacts are minimized, and (3) compensation for any unavoidable impact is provided.

Proposed activities are regulated through a permit review process. An individual permit is required for potentially significant impacts. Individual permits are reviewed by the USACE and evaluated under a public interest review, as well as the environmental criteria set forth in the CWA section 404(b)(1) Guidelines. However, for most discharges that will have only minimal adverse effects, a general permit could be suitable. The section 404 general permit process is more streamlined than the individual permit process because of the elimination of the individual review, provided that the general or specific conditions for general permit coverage are met. General permits are issued on a nationwide, state, or regional basis for categories of activities.

- Regional General Permits are issued for common maintenance-type activities with minimal effect on the environment and often include preapproval from the LARWQCB section 401 certification or from the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service for ESA consultations. Permit coverage takes approximately 1 to 6 months for existing activity categories or 6 months to 1 year for new and unique activity categories.
- Nationwide Permits are written for categories of projects that occur nationwide, such as road crossings, bank stabilization, repairs to existing structures, flood control maintenance, and wetland restoration for wildlife habitat. Permit coverage takes from three to nine months.
- An Individual Permit may be required if more than one-half acre of permanent impacts could occur. Public review is required for an IP, which lengthens the amount of time between permit application and permit coverage (6 months to a year under the best circumstances, but can be multiple years).

The 404 Permit process should begin with a consultation with USACE. Before applying for a section 404 permit, a wetland delineation and estimation of USACE jurisdictional area should be performed. LARWQCB 401 Water Quality Certification must also be obtained when applying for a Nationwide Permit or Individual Permit, and a California Coastal Commission Letter of Concurrence must be obtained for projects in the Coastal Zone. After any pre-application steps are completed, the USACE *Application for Department of the Army Permit* should be prepared and submitted (Ventura County Planning Division 2006).

The USACE section 404 permit also requires that a section 106 review be conducted as part of the permit application. Section 106 is a document review of the project site for historical significance. On the basis of the results, additional studies could be required, such as an additional Historical/Archaeological Report or mitigation to protect the historical significance of the site. The review search and approval duration varies on the project scope.

Rivers and Harbors Appropriation Act of 1899

Although not part of the CWA, the Rivers and Harbors Appropriation Act of 1899 (Rivers and Harbors Act) preceded the CWA in protecting navigable Waters of the United States The law prohibits dumping refuse into navigable waters or the creation of any navigational obstruction. It also regulates the construction of wharves, piers, jetties, bulkheads, and similar structures in ports, rivers, canals, or other areas used for navigation (USFWS undated). Upon state legislature approval, structures can be constructed in navigable waterways if the affected waters are entirely within one state and provided that the plans are approved by the Chief of Engineers and the Secretary of Army. Discharges of refuse or fill material or construction activities in waterways require a permit from the USACE as described in the section 404 discussion above.

I.1.2. Endangered Species Act

(See State Regulations section, subsection Wildlife: State and Related Federal Requirements.)

I.1.3. Forest Service Permits

The U.S. Forest Service (USFS) allows special uses of USFS land through a permitting process. An applicant may obtain a special-use authorization from the USFS by completing the required documentation and presenting a request that is consistent with USFS regulations and other policies. The application requires a project description, environmental protection plan, map or plat of the site, documentation of technical and financial capability, and a description of nonfederal alternatives considered. Applications can be obtained from local USFS offices. For developers and businesses, an application fee will be required, and once the permit is obtained, using the land could require an annual rental fee (USFS 2009). The County has historically been exempt from paying USFS fees.

I.1.4. Migratory Bird Treaty Act

(See State Regulations section, subsection Wildlife: State and Related Federal Requirements.)

I.1.5. National Environmental Policy Act

EPA administers the National Environmental Policy Act (NEPA). Title I of NEPA contains a Declaration of National Environmental Policy, which requires the federal government to use all practicable means to create and maintain conditions under which man and nature can exist in productive harmony. Section 102 requires federal agencies to incorporate environmental considerations in their planning and decision making through a systematic interdisciplinary approach. Specifically, all federal agencies are to prepare detailed statements assessing the environmental effect of, and alternatives to, major federal actions significantly affecting the environment. Such statements are commonly referred to as environmental impact statements (EISs) (USEPA 2009b).

The role of a federal agency in the NEPA process depends on the agency's expertise and relationship to the proposed undertaking. The agency carrying out the federal action is responsible for complying with the requirements of NEPA. Federal agencies, together with state, tribal, or local agencies, may act as joint lead agencies. A federal, state, tribal, or local agency having special expertise with respect to an environmental issue or jurisdiction by law may be a cooperating agency in the NEPA process (USEPA 2009b).

The NEPA process consists of evaluating the environmental effects of a federal undertaking including its alternatives. There are three levels of analysis depending on whether an undertaking could significantly affect the environment. Those three levels include categorical exclusion determination; preparation of an environmental assessment/finding of no significant impact (EA/FONSI); and preparation of an EIS (USEPA 2009b).

At the first level, an undertaking may be categorically excluded from a detailed environmental analysis if it meets certain criteria that a federal agency has previously determined as having no significant environmental impact. A number of agencies have developed lists of actions that are normally categorically excluded from environmental evaluation under their NEPA regulations. For example, the nationwide section 404 permits issued by the USACE have integrated a NEPA categorical exclusion in them. At the second level of analysis, a federal agency prepares a written EA to determine whether a federal undertaking will significantly affect the environment. If the answer is no, the agency issues a FONSI. The FONSI may address measures that an agency will take to reduce (mitigate) potentially significant impacts. If the EA determines that the environmental consequences of a proposed federal undertaking could be significant, an EIS is prepared. An EIS is a more detailed evaluation of the proposed action and alternatives. After a final EIS is prepared and at the time of its decision, a federal agency will prepare a public record of its decision addressing how the findings of the EIS, including consideration of alternatives, were incorporated into the agency's decision-making process (USEPA 2009b).

USEPA (Region 9 for California projects) is required to review and publicly comment on the environmental impacts of major federal actions including actions that are the subject of EISs. If USEPA determines that the action is environmentally unsatisfactory, it is required by section 309 to refer to the Council on Environmental Quality (USEPA Region 9 2009). Approval can take a minimum of 6 to 12 months up to several or more years.

I.2. State Regulations

I.2.1. California Air Resources Board Regulations

The CARB regulates air pollution sources in California, including construction vehicle emissions. All self-propelled off-road diesel vehicles over 25 horsepower used in California—except personal use vehicles, vehicles used solely for agriculture, vehicles that are awaiting sale (rental vehicles are not exempt), vehicles covered by the cargo-handling rule, and vehicles that can be moved only on rail—are covered by the regulations. The regulations impose limits on idling, buying older off-road diesel vehicles, and selling vehicles beginning in 2008; require all vehicles to be reported to CARB and labeled in 2009. In 2010 the regulations begin gradual requirements for fleets to clean up their fleet by getting rid of older engines, using newer engines, and installing exhaust retrofits. The overall purpose of the regulation is to reduce emissions of oxides of nitrogen and particulate matter from off-road diesel vehicles (CARB 2009a).

The purpose of this airborne toxic control measure is to reduce diesel particulate matter emissions from portable diesel-fueled engines having a rated brake horsepower of 50 and greater (> 50 bhp). The regulations specify fuel type, particulate matter standards and fleet requirements for portable generators. Fleet managers are required to keep adequate records showing compliance with the requirements and to submit to the RWQCB (CARB 2009b.)

The Portable Equipment Registration Program (PERP) is a voluntary, statewide program to register portable equipment such as air compressors, generators, concrete pumps, tub grinders, wood chippers, water pumps, drill rigs, pile drivers, rock drills, abrasive blasters, aggregate screening and crushing plants, concrete batch plants, and welders. With certain limited exceptions, portable equipment registered in PERP may be operated throughout the state without obtaining permits from any of California's 35 air quality management or air pollution control districts (air districts). Nothing is required to be registered in PERP. Registration in PERP is completely voluntary. The permit requirement at the local air district is mandatory, however. The type of portable equipment that needs a permit is determined by the local air districts only. An owner/operator of portable equipment that needs a permit may then choose to register in PERP in lieu of having to get a permit from the air districts (CARB 2009c).

I.2.2. California Environmental Quality Act

The specific goals of the CEQA are for California's public agencies to identify the significant environmental effects of their actions and either avoid those significant environmental effects or mitigate those significant environmental effects where feasible. CEQA applies to *projects* proposed to be undertaken or requiring approval by state and local government agencies (State of California Office of Planning and Research 2001). According to CEQA, projects are, "activities [that] have the potential to have a physical impact on the environment and [might] include the enactment of zoning ordinances, the issuance of conditional use permits and the approval of tentative subdivision maps." If a project requires approvals from more than one public agency, one public agency must serve as the *lead agency*.

The lead agency is, "the public agency [that] has the principal responsibility for carrying out or approving a project [that might] have a significant effect on the environment." The lead agency is responsible for completing an environmental review process defined by CEQA. This review process includes (1) determining if the activity is a *project* subject to CEQA, (2) determining if the project is exempt from CEQA, and (3) performing an Initial Study to identify the environmental impacts of the project and determine whether the identified impacts are *significant* (State of California Office of Planning and Research 2001). On the basis of the findings of significance, one of the following documents must be prepared:

- Negative Declaration if the review finds no significant impacts
- Mitigated Negative Declaration if the review finds significant impacts but the project can be altered to avoid or mitigate those significant impacts
- Environmental Impact Report if the review finds significant impacts.

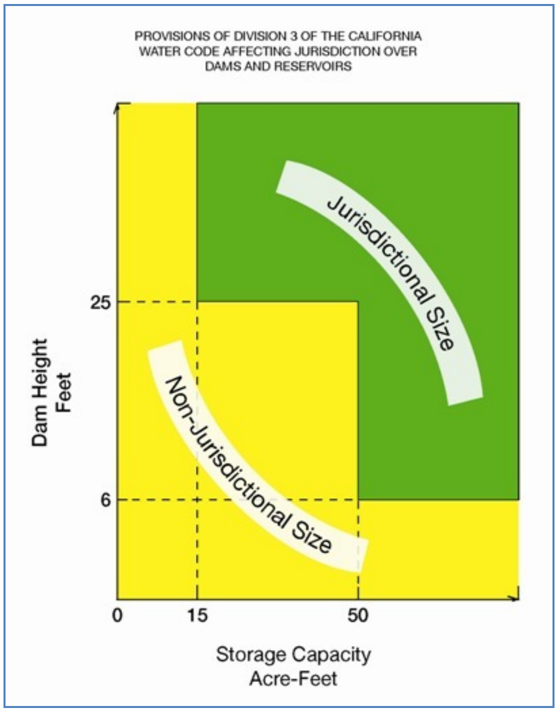
Some projects may be determined to be exempt (http://ceres.ca.gov/ceqa/guidelines/art18.html%20or%20http:/ceres.ca.gov/ceqa/guidelines/art19.html) from CEQA by law because the project could fall under a category of projects that have already been determined to generally not have significant environmental impacts (State of California Office of Planning and Research 2001). Examples include resource and environmental protection actions by regulatory agencies, wildlife habitat acquisition, habitat restoration on 5 acres or less, maintenance activities, or emergencies. Retrofits to existing structures may be considered an exception. Article 18 (http://ceres.ca.gov/ceqa/guidelines/art18.html) and Article 19 (http://ceres.ca.gov/ceqa/guidelines/art19.html) of the act contain details on exemptions and exceptions to CEQA.

BMP implementation could require consideration of cultural resources as part of CEQA documentation. The purpose of a cultural resources study is to identify significant impacts and potentially significant impacts of a proposed project to cultural resources, and to provide mitigation measures to reduce effects on a level less than significant. Procedures outlined in CEQA regulations are typically used to conduct the studies.

I.2.3. Dam Safety Laws

California dam safety laws and regulations are administered by the California Department of Water Resources, Division of Safety of Dams (DSOD). The Statutes and Regulations Pertaining to Supervision of Dams and Reservoirs (www.water.ca.gov/damsafety/docs/statutes-regulations.pdf) California Water Code, Division 3, Dams and Reservoirs, Part 1, Supervision of Dams and Reservoirs, Chapter 1, Definitions, 6000-6008) are in place to protect people against loss of life and property from dam failure. The DSOD implements the statutes and regulations. Division engineers and engineering geologists review and approve plans and specifications for the dam design and oversee their construction to ensure compliance with the approved plans and specifications. Reviews include site geology, seismic setting, site investigations, construction material evaluation, dam stability, hydrology, hydraulics, and structural review of appurtenant structures (DSOD 2009).

The statutes and regulations define a *dam* as any artificial barrier, together with appurtenant works, that does or could impound or divert water, and that either (a) is or will be 25 feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier, as determined by the department, or from the lowest elevation of the outside limit of the barrier, as determined by the department, if it is not across a stream channel or watercourse, to the maximum possible water storage elevation or (b) has or will have an impounding capacity of 50 AF or more (DSOD 2009). Figure I-1 illustrates the jurisdictional height of dams.



Jurisdictional height of a dam is the vertical distance measured from the lowest point at the downstream toe of the dam to its maximum storage elevation, which is typically the spillway invert elevation. This same approach is also used for calculating the dam height for determining the annual fee.

Figure I-1. Jurisdictional Sizing of Dams

The following exemptions apply to this definition:

- Obstructions in a canal to raise, lower or divert water there from
- Levees, railroad fills
- Road or highway fills
- Circular tanks
- Tanks elevated above the ground
- Certain noncircular tanks in San Diego County
- Barriers off-stream for agricultural use or use as sewage sludge drying facilities
- Obstructions in channels or watercourses that are 15 feet or less in height, with the single purpose of spreading water within the bed of the stream or watercourse upstream for percolation underground
- Wastewater control facility ponds, which are 15 feet or less in height, have a maximum storage capacity of 1,500 AF or less, are off-stream, and the operating public agency adopts certain resolutions
- Federal dams

To construct or enlarge, repair or alter, or remove a dam, an applicant must submit the appropriate application (www.water.ca.gov/damsafety/forms/index.cfm) to the DSOD. If work on an existing dam requires more than routine maintenance and significantly affects the dam, a permit is likely needed. Some examples of work requiring an alteration application include abandoning or replacing the outlet conduit, modifications to the outlet system that will affect emergency draw down requirements, significant penetration(s) of the water barrier, and excavating more than a few feet into the embankment (DSOD 2009).

Each application requests basic information regarding ownership, location, dam type, proposed work, and such. Detailed information about the proposed work is typically provided in plans and specifications that can be submitted later. An applicable fee should be submitted at the time of the application. DSOD engineers and geologists inspect the site and the subsurface exploration to learn firsthand of the geologic conditions. The DSOD thoroughly reviews the plans and specifications prepared by the owner to ensure that the dam is designed to meet minimum requirements and that the design is appropriate for the known geologic conditions. Technical resources (www.water.ca.gov/damsafety/techreference/index.cfm) are used to conduct these reviews (DSOD 2009).

I.2.4. Lake and Streambed Alteration Program

California Department of Fish and Game (DFG) administers the regulations under the Lake and Streambed Alteration Program. The Fish and Game Code (section 1602) requires that any person, business, state or local government agency, or public utility notify DFG of any proposed activity that will substantially divert or obstruct the natural flow of any river, stream or lake; substantially change or use any material from the bed, channel, or bank of any river, stream, or lake; or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it could pass into any river, stream, or lake. If DFG determines that the activity could substantially adversely affect fish and wildlife resources, a Lake or Streambed Alteration Agreement will be prepared. The agreement includes reasonable conditions necessary to protect those resources and must comply with CEQA. The entity may proceed with the activity in accordance with the final agreement (DFG 2009a).

The notification requirement applies to any work undertaken in or near any river, stream, or lake that flows at least intermittently through a bed or channel in California. That includes ephemeral streams, desert washes, and watercourses with a subsurface flow. It might also apply to work undertaken within the floodplain of a body of water. Projects that require notification include construction projects that could substantially modify a river, lake or stream; gravel, sand and rock extraction; timber harvesting; water diversion, obstruction, extraction or impoundment; and routine maintenance activities of a number of existing private or public facilities, such as canals, channels, culverts, and ditches (DFG 2009a).

If a project requires notification, the applicant will need to complete the Notification of Lake or Streambed Alteration Form (www.nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=3754) (Form FG 2023 (Rev. 7-06)) and submit the form, with the appropriate fee, to the appropriate DFG regional office. The notification form must describe the project, its potential impacts, and any measures planned to mitigate the impacts of the project (e.g., erosion control, other impact avoidance measures and any mitigation or compensation that is proposed). In addition, the DFG may require the applicant to submit a biological or hydrological study (DFG 2009a). The time required to complete the notification form will depend on the size and complexity of the project.

If DFG determines that a Lake or Streambed Alteration Agreement is required, DFG will submit an agreement to the applicant for review within 60 days of receiving the completed application. The draft agreement will include measures the DFG determines are necessary to protect fish, wildlife, and plant resources while conducting the project. After receiving the draft agreement, the applicant has 30 days to notify the DFG whether the measures in the draft agreement are acceptable. After the DFG receives the signed draft agreement, the DFG confirms it has received the correct notification fee, has complied with CEQA, and has received written proof that the filing fee (specified in Fish and Game Code section 711.4) has been paid, if a filing fee is required. If those have occurred, DFG signs the agreement, and the project described in the notification and covered by the agreement may begin, provided the applicant has obtained all necessary local, state, and federal permits or other authorizations (DFG 2009a). The time required to process the notification form and agreement will vary according to the complexity of the project, the completeness of the original notification form, and the negotiation time between the DFG and the applicant should an agreement be required.

I.2.5. Porter-Cologne Water Quality Control Act

(See the Federal Regulations section, subsection: Clean Water Act.)

I.2.6. Recycled Water Laws

(See Local Regulations section, subsection: Recycled Water Laws.)

I.2.7. State Lands Leasing and Permits Regulation

The California State Lands Commission (CSLC) was created to manage and protect the important natural and cultural resources on certain public lands in the state and the public's rights to access those lands. The public lands under the CSLC's jurisdiction are of two types—sovereign and school lands. Sovereign lands include the beds of California's naturally navigable rivers, lakes, and streams, as well as the state's tide and submerged lands along the state's more than 1,100 miles of coastline, extending from the shoreline out to three miles offshore (CSLC 2009a).

The CSLC may lease sovereign lands for any public trust purpose. CSLC leases of sovereign lands generally fall into several categories: recreational, commercial, industrial, right-of-way, and salvage. Specific examples of such leases include private recreational piers, commercial marinas, yacht clubs, marine terminals, industrial wharves, oil and gas pipelines, fiber optic cables, outfalls, bank stabilization, and wetlands and habitat management projects (CSLC 2009a).

Public and private entities can apply to the CSLC for leases or permits on state lands for many purposes. Applications (www.slc.ca.gov/Online_Forms/LMDApplication/APPLICATION_GUIDELINES.pdf) for the use of any of these lands can be made to the CSLC. They must include an outline of the proposed project, supporting environmental data, and payment of appropriate fees. CSLC staff then review the applications and make recommendations to the CSLC for action (CSLC 2009b).

The issuance by the CSLC of any lease, permit or other entitlement for use of state lands is first reviewed for compliance with the provisions of CEQA. The CSLC will not consider proposed projects until the requirements of CEQA have been satisfied, and the commission may not issue a lease for use of *Significant Lands* (defined at PRC section 6370 *et seq*) if such proposed use is detrimental to the identified values. Most leases or other entitlements for use of state lands could require approvals from other federal, state, or local agencies. On many proposed projects, the CSLC is the lead agency under CEQA (the public agency with the principal responsibility for carrying out or approving a project) and is therefore responsible for preparing the environmental documentation appropriate to each project (CSLC 2009b).

Not later than 30 calendar days after CSLC receives an application for a development project, the staff will notify the applicant in writing whether the application is complete. If the application is determined not to be complete, the staff specify what additional information is required. After receiving any additional material, the staff respond within 30 days as to whether the application is complete. Where the CSLC is the lead agency and a CEQA environmental impact review is prepared, CSLC must approve or disapprove a development project within one year from the date on which the application was received and accepted as complete by the CSLC staff. Where a negative declaration is prepared or if the development project is exempt from CEQA, the development project will be approved or disapproved within 6 months from the date the application was received and accepted as complete by the staff. One extension of that period of up to 90 days may be allowed if mutually agreed to by the staff and the applicant. Where the commission is a responsible agency, it must approve or disapprove a development project within 180 days from the date the lead agency approves the project, or within 180 days from the date the application was received and accepted as complete by the staff of the CSLC, whichever is later (CSLC 2009b).

The requirements apply to state park land as well. California law allows for disturbance of park land if a special use permit is obtained under 14 CCR section 4309 (http://weblinks.westlaw.com/result/default.aspx?cnt=Document&db=CA-ADC-TOC%3BRVADCCATOC&docname=14CAADCS4309&findtype=W&fn=_top&ifm=NotSet&pbc=4BF3FCBE&rlt=CLID_FQRLT24458283615157&rp=%2FSearch%2Fdefault.wl&rs=WEBL9.07&service=Find&spa=CCR-1000&vr=2.0).

I.2.8. Wildlife: State and Related Federal Requirements

Effects on endangered or threatened species are regulated under both the CESA administered by California DFG and the federal ESA administered by USFWS. Species that are protected under these laws are designated on the state and federal endangered and threatened species lists. The term *take* is used to describe the effect on a species. Under section 2081 of the DFG code, a development project that coincides with the occurrence of a listed species must have an incidental take permit. To obtain this permit, the applicant must meet the following criteria (DFG 2009b):

1. The authorized take is incidental to an otherwise lawful activity.
2. The impacts of the authorized take are minimized and fully mitigated.
3. The measures required to minimize and fully mitigate the impacts of the authorized take
    a. are roughly proportional in extent to the impact of the taking on the species
    b. maintain the applicant's objectives to the greatest extent possible
    c. are capable of successful implementation
4. Adequate funding is provided to implement the required minimization and mitigation measures and to monitor compliance with and the effectiveness of the measures.
5. Issuance of the permit will not jeopardize the continued existence of a state-listed species.

A mitigation plan is attached to a permit that outlines how those criteria will be met. Measures for meeting the criteria vary and could include avoidance measures or acquisition and transfer of habitat management lands (including funds for protecting and maintaining land in perpetuity). Applicants must avoid all take for *fully protected* species and *specified birds* as defined in Fish and Game Code sections (www.leginfo.ca.gov/cgi-bin/calawquery?codesection=fgc&codebody=&hits=20) 3505, 3511, 4700, 5050, 5515, and 5517 (DFG 2009b). All take of bird species protected under the Migratory Bird Treaty Act (USFWS 2009a; administered by the USFWS) must also be avoided, as stated in section 3515 of the DFG code.

An applicant determines whether an incidental take permit and Habitat Conservation Plan (HCP) are required by contacting the nearest DFG office. The potential need for a permit can be assessed by using the DFG's online mapping resources (www.dfg.ca.gov/biogeodata/). In the case of the County, DFG's South Region office should be contacted. If a listed species is present on the property and the project will result in a take of that species, a permit is required. Permit processing is likely to take between 3 and 12 months or longer depending on the project circumstances and whether a federal permit is required.

To meet federal ESA requirements for a take of federally listed species, an incidental take permit (www.dfg.ca.gov/habcon/cesa/incidental/CodeRegT14_783.pdf) must also be obtained by developing an HCP that outlines plans to offset effects on the species listed as threatened or endangered (www.fws.gov/Endangered/wildlife.html; USFWS 2009b). HCP must meet the following criteria (USFWS 2009c):

1. Taking will be incidental.
2. The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of the taking.

3. The applicant will ensure that adequate funding for the plan will be provided.
4. Taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild.
5. Other measures, as required by the Secretary, will be met.

Like CESA, mitigation measures for ESA vary by the project and could include the following:

- Payment into an established conservation fund or bank
- Preservation (via acquisition or conservation easement) of existing habitat
- Enhancement or restoration of degraded or a former habitat
- Establishment of buffer areas around existing habitats
- Modifications of land use practices and restrictions on access

Under ESA, an incidental take permit is not required for plant species. However, if a permit is required for other endangered or threatened species and an HCP must be prepared, the HCP must analyze the effects of the action on any endangered or threatened plant species. Accordingly, if a plant is on the California threatened or endangered list, a permit must be obtained through DFG (USFWS 2009c).

The timeline for federal incidental permit processing varies by project complexity and whether USFWS must require NEPA documentation. Minor, or *Low Effect*, HCPs do not require USFWS to prepare NEPA documentation, and the target processing time for those HCPs is 3 months. HCPs that require an EA under NEPA have a target processing time of 4 to 6 months, and for HCPs requiring an EIS, processing might take up to 12 months or longer (USFWS 2005).

A section 7 Consultation might also be required under the ESA if the project has a *federal nexus*, usually in the form of another federal permit or federal funding, at some stage of the project and with any federal agency. The type of consultation will be either informal or formal, depending on whether the project affects listed or protected species (USFWS 2009d). If the project has a federal nexus, it will also require NEPA documentation, which is described under the Federal Regulations section of this report.

Data on endangered and threatened species observations are available from the California Natural Diversity Database, which the Biogeographic Data Branch of DFG developed, and these data estimate the approximate spatial range of the species (BDB 2009). Using these data, a simple index was developed as a measure of the likelihood that a BMP site location will require CESA/ESA documentation and permitting. The index is based on the count of extant endangered or threatened species observations in a subbasin divided by the subbasin's area. The sole purpose of the index is to gage the likelihood that an endangered or threatened species will be found on a proposed BMP site. The index should not be interpreted as a measure of population density or other biological factors. Figure I-2 illustrates the spatial distribution of this index in Los Angeles River watersheds. The burden of CESA/ESA is evaluated further in later sections of this report, but the index indicates that most of the County TMDL Implementation Area has a small likelihood of required CESA/ESA documentation compared to other jurisdictions.

As noted above under the CESA requirements, species for which no take is allowed include those listed as *fully supported*, *specified* bird species, and bird species protected under the Migratory Bird Treaty Act.

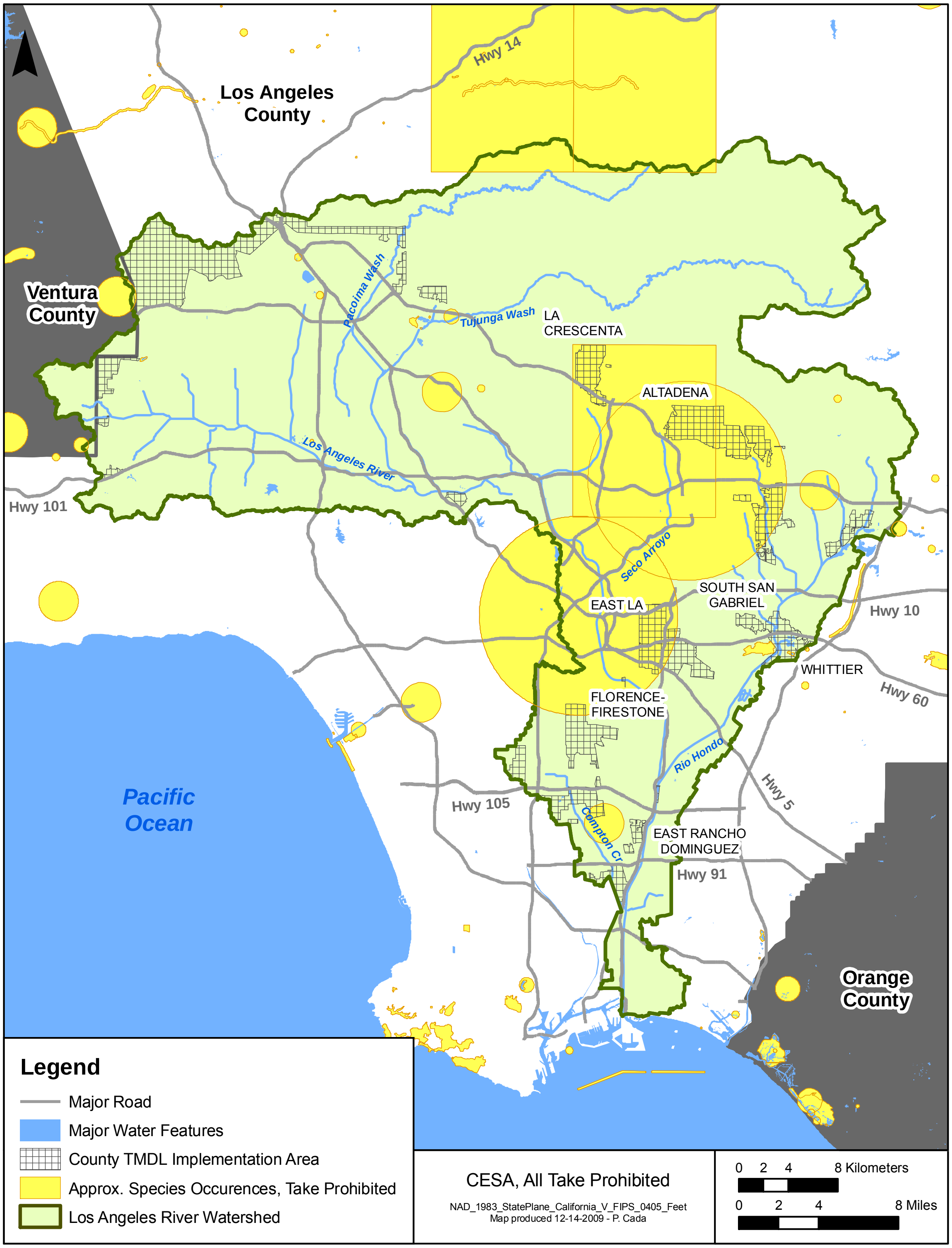


Figure I-2. Potential Locations of All Take Prohibited Species under CESA

I.3. Local Regulations

I.3.1. Drought-Tolerant Landscaping Requirements

Drought-tolerant landscaping requirements became effective on January 1, 2009 (County of Los Angeles 2009a; County of Los Angeles Department of Regional Planning 2009). The requirements apply to all development projects within County TMDL Implementation Areas except

- Any project involving construction on a lot with an existing single-family residence not involving the complete replacement of that residence
- Registered historical sites
- Public recreational lawns
- Any new or renovation project for a park
- Any area of a project dedicated solely and permanently to edible plants, such as orchards and vegetable gardens.

The following may be exempt from the provisions:

- Landscaping for a manufactured cut or fill slope equal to or exceeding a gradient of 3:1, when LACDPW makes a determination that an exemption is necessary to comply with the requirements of the building code regulating engineered grading.
- Landscaped areas required for LID, water quality facilities such as vegetated swales, rain gardens, detention ponds or basins, areas of the project used to contain pollutants, or areas irrigated by reclaimed water, when LACDPW makes a determination that an exemption is necessary for compliance with the LID standards.

The requirements for development sites are as follows:

- A minimum of 75 percent of the total landscaped area must contain plants from the drought-tolerant plant list (http://planning.lacounty.gov/assets/upl/project/green_drought-tolerant-plants.pdf).
- A maximum of 25 percent of the total landscaped area can consist of turf. Turf cannot be planted in strips that are less than 5 feet wide, and the total landscaped area cannot contain more than 5,000 square feet of turf.
- All turf in such total landscaped area must be water-efficient. The green building technical manual contains a list of turf that meets this requirement (http://planning.lacounty.gov/assets/upl/project/green_water-efficient-turf-list.pdf).
- The plants in the total landscaped area must be grouped in hydrozones in accordance with their respective water, cultural (soil, climate, sun, and light), and maintenance requirements.
- Single-family residences must include turf in the residence's rear and side yards in the measurement of turf used for the total landscaped area.

To comply with the drought-tolerant landscaping requirements, as part of the development site plan review, the site plan and landscape plans for the project must depict or list any drought-tolerant and non-drought-tolerant landscaping that will be incorporated into the project. In addition, the site plan must outline the areas of the project to be landscaped with drought-tolerant plants or turf, and calculations need to be provided showing the percent of landscaped area devoted to each. During installation, plants may be replaced without additional approval as long as the same relative percentage of drought-tolerant plants to turf as originally designed is maintained.

A covenant needs to be recorded indicating that the owner is aware of the drought-tolerant landscaping requirements and how the requirements apply to the owner's project. The County Fire Department may place planting restrictions on the project on the basis of that department's fuel modification plan guidelines.

A modification may be granted when topographic features, lot size, or other conditions make it unreasonable, impractical, or otherwise creates an unnecessary hardship to require compliance with the landscaping requirements or when the nature of a large-scale or multi-lot project necessitates flexibility in the project design that affects the landscaping for the project.

A flowchart for Los Angeles County's drought-tolerant landscaping requirements is at http://planning.lacounty.gov/green.

I.3.2. Geotechnical Reporting Requirements

Engineering Geology Reports

Different types of engineering geology reports are required depending on the stage of development review or approval requested, such as environmental impact, tentative subdivision, building or grading permit, rough grading, final map recordation, and such. The proposed development, site conditions, and most importantly, the nature and extent of potential geotechnical hazards ultimately dictate the scope of the investigation and the applicability of these or any other guidelines. Varying geologic conditions, purposes, and project proposals will require reports of different length, scope, and orientation. Nevertheless, for a report to be considered adequate for a typical hillside site and plan it should, at a minimum, include the following:

- An evaluation of at least one set of stereo aerial photographs for the potential presence of landslides or faults.
- A review of published maps of the California Geological Survey, U.S. Geological Survey, State Seismic Hazard Mapping Act, and Alquist-Priolo Earthquake Fault Zoning Act.
- A review of LACDPW's development files of adjoining property(ies), and published and unpublished maps of the U.S. Geological Survey and California Geological Survey. Discrepancies between researched data and data obtained by the consultant must be resolved.
- An accurate site location map.
- A regional geology map or cross sections as applicable to depicting site stability.
- A site geology map and geologic cross sections to illustrate local geologic structure.
- Exploration data to substantiate geometry and geologic conditions relative to stability.
- Geology cross sections for use by a soils engineer for stability analyses.
- Plot of geology versus depth of data obtained in exploration borings on geology maps and cross sections for assessment of site stability.
- An explanation of how the geologic data presented substantiates conclusions drawn.

The following are the types of reports required for purposes of the various development stages, all of which are described in detail in the County's *Manual for Preparation of Geotechnical Reports* (LACDPW 2006b):

- Environmental Impact Reports
- Tentative Subdivision Map Reports
- Grading Plan Reports
- Building Plan Reports
- In-Grading Geology and Soils Reports

- Final Geology and Soils Reports
- *Restricted Use Area* Letter/Report
- Report for Reconstruction (Damage due to Geologic Hazard)
- Change of Consultants Letter
- Fault Investigation
- Seismic Hazard Investigation

Soils Engineering Report

The report must demonstrate that life or limb, property, and public welfare will be safeguarded in accordance with the provisions of the current edition of the County's Building Code, which requires that the building site be free of geotechnical hazards such as landslide, settlement, or slippage, and that the proposed work will not adversely affect off-site areas. The following are minimum standards/contents of a soils engineering report:

- The report must have been prepared within one year before submittal. For soils reports older than one year before submittal, an update report/letter will be required, as a minimum, to verify the validity and applicability of the original report.
- The report must contain the description of the site (e.g., location, size, topography) to be developed and the description of the proposed grading/building for the development.
- The report must describe the current site environment and the effect of the development on the site. The past use of the area must also be noted. If the site is suspected to have environmental concerns, a copy of the permit, letter of nonobjection, processed application, and such, as applicable, will be required from the appropriate state agencies (e.g., Division of Oil, Gas, and Geothermal Resources; Department of Toxic Substances Control; South Coast Air Quality Management District; RWQCB; and others).
- The report will provide a general geologic summary as it affects the project development. If applicable, the report should reference an engineering geology report.
- The report will describe the encountered materials during the subsurface exploration. Reference will be made to the boring logs, trenches, pits, and other information.
- The historical groundwater highs and lows must be included in the report. A discussion as to the possible effect of groundwater on the project construction will be presented.
- The report will describe all laboratory testing conducted along with any other substantiating data used in the engineering analyses. Reference will be made to all laboratory test results contained in the Appendix.
- The report will describe and address all engineering analyses conducted, including slope stability analyses, liquefaction analyses, settlement analyses, and the like. Supporting analyses, calculations, computer printouts, diagrams, and such, will be contained in the Appendix, as necessary.
- The report must clearly state all conclusions and recommendations by the soils engineer. All mitigation measures must have supporting engineering analyses, and figures and diagrams as necessary.
- The soils engineer of record must provide a statement in compliance with section 111 of the County of Los Angeles Building Code. The statement must clearly make a finding regarding the proposed building/grading construction against hazard from future landsliding, settlement, or slippage and a finding regarding the effect the proposed building/grading construction will have on the stability of property outside the building site. The finding must be substantiated by appropriate data and analyses.
- The report must include a geotechnical map showing location of subsurface exploration, geology of the site, lot lines, existing and proposed grades, locations of sewage disposal systems, existing and recommended remedial measures, and recommended restricted use area(s).

The following are the types of soil engineering reports that could be required, all of which are described in detail in the County's *Manual for Preparation of Geotechnical Reports* (LACDPW 2006b):

- Environmental Impact Documents
- Geotechnical Site Inspection Report
- Tentative Subdivision Report
- Grading Plan Report
- Building Plan Report
- In-Grading Soils Engineering Report
- Rough Grading Soils Engineering Report
- Infrastructure Report

LACFCD finds that improvements and modifications to district facilities are exempt from the requirements of the County's Building and Grading Code. The County's Building Code is contained in Title 26 of the Los Angeles County Code. The following is an excerpt from the Code pertinent to the operations of LACFCD facilities: "…101.3 Scope. The provisions of this Code shall apply to the construction, alteration, moving, demolition, repair, use of any building or structure and grading within the unincorporated territory of the County of Los Angeles and to such work or use by the County of Los Angeles in any incorporated city not exercising jurisdiction over such work or use. The provisions of this code shall not apply to certain governmental agencies, special districts, and public utilities as determined by the building official…and hydraulic flood control structures…"

I.3.3. Green Building Requirements

The County's Green Building requirements became effective January 1, 2009, and apply to all projects in the County TMDL Implementation Areas. Exceptions include agricultural accessory structures, registered historic sites, and first-time tenant improvements with a gross floor area of less than 10,000 square feet. Areas of a project that include warehouse/distribution buildings, refrigerated warehouses, and industrial/manufacturing buildings are exempt from the energy-conservation and third-party standards and rating system requirements. Any office space, non-refrigerated, non-warehouse, and non-industrial/manufacturing areas of a building that are physically separated from the exempted area described above, must comply with all green building requirements. Table I-1 summarizes the green building requirements for different types of projects and different application filing dates.

The green building standards include energy conservation, indoor and outdoor water conservation, resource conservation (i.e., waste minimization/recycling), tree planting, and, in some cases for projects after January 1, 2010, third-party certification standards. The two categories of requirements most pertinent to water quality, outdoor water conservation, and tree planting are described below:

- Outdoor water conservation involves installing a smart irrigation controller for any area of a lot that is landscaped or designated for future landscaping and meets the drought-tolerant requirements described above.
- The tree planting requirements vary depending on the land use. Single-family residence lots are required to plant and maintain two 15-gallon trees, at least one of which must be from the drought-tolerant plant list. Multi-family building lots require a minimum of one 15-gallon tree planted and maintained for every 5,000 square feet of developed area, at least 50 percent of which must be from the drought-tolerant plant list. Hotel/motel, lodging house, and nonresidential building lots are required to plant and maintain a minimum of three 15-gallon trees for every 10,000 square feet of developed area, at least 65 percent of which must be from the drought-tolerant plant list.

Table I-1. Green Building Requirements for Projects

Project Description	Building Permit Application Filing Date	
	Before January 1, 2010	On or After January 1, 2010
Residential projects with < 5 dwelling units	County Green Building Standards	County Green Building Standards
Residential projects with ≥ 5 dwelling units	County Green Building Standards	County Green Building Standards & (GPR or CGB or LEED™ Certified)
Hotels/motels, lodging houses, nonresidential, and mixed-use buildings, with a gross floor area of < 10,000 square feet	County Green Building Standards	County Green Building Standards
Hotels/motels, lodging houses, nonresidential, and mixed-use buildings, and first-time tenant improvements, with a gross floor area of ≥ 10,000 square feet and < 25,000 square feet	County Green Building Standards	County Green Building Standards & LEED Certified
Hotels/motels, lodging houses, nonresidential, and mixed-use buildings, and first-time tenant improvements, with a gross floor area of ≥ 25,000 square feet	County Green Building Standards	County Green Building Standards & LEED Silver
High-rise buildings > 75 feet in height	County Green Building Standards	County Green Building Standards & LEED Silver

Source: County of Los Angeles Department of Regional Planning 2009
Note: If a project falls within more than one project description in this table, the project description with the more stringent green building requirements applies.

Exceptions are allowed for impracticality according to lot size or other site condition, in which case, twice the required number of trees may be planted off-site. Any existing mature tree on the lot can count toward the tree planting requirements even if it is not on the drought-tolerant plant list, and it must be shown on the site plan submitted to the County.

Developers can comply with the green building requirements as part of the development site plan review as long as the site plan or building plans/specifications clearly depict or list any green building elements that will be incorporated into the project. A separate site plan does not need to be developed to meet the green building requirements.

A flowchart for the County's green building requirements can be found at http://planning.lacounty.gov/green.

I.3.4. LID Requirements/LID Manual

The County's LID standards were in effect starting January 1, 2009, and apply to all development projects within the unincorporated County TMDL Implementation Areas for which permits were submitted on or after January 1, 2009 (County of Los Angeles 2009b). Public road and flood projects use a different set of standards, the LACDPW standards, which also incorporate LID. The requirements are triggered on the basis of the extent to which a development site's impervious surface is altered, as follows:

- Where the development results in an alteration of at least 50 percent of the impervious surfaces of an existing developed site, the entire site must be brought into compliance with the standards and requirements of this Chapter
- Where the development results in an alteration of less than 50 percent of the impervious surfaces of an existing developed site, only such incremental development must meet the standards and requirements of this Chapter

- Where a development results in an alteration of less than 50 percent of the impervious surfaces of an existing developed site consisting of four or fewer residential units, the development will be exempt from this Chapter.

The standards specify that developers must mimic undeveloped stormwater and urban runoff rates and volumes in any storm event up to and including the "50-year capital design storm event," as defined by LACDPW. They also require that pollutants of concern be prevented from leaving the development site in stormwater as the result of storms, up to and including a water quality design storm event. Finally, the standards require that hydromodification effects on natural drainage systems be minimized.

To meet the standards described above, developments are required to install and maintain minimum site design features as follows:

- A development consisting of four or fewer residential units must implement at least two LID BMP alternatives listed in the County's LID Manual (County of Los Angeles 2009c).
- A development consisting of five or more residential units, or a nonresidential development, is required to infiltrate the excess runoff volume generated either at the lot level or for the entire development site. The tributary area of a subregional facility is limited to 5 acres, but may be exceeded on a case-by-case basis with approval. If infiltration of all excess volume is not technically feasible, on-site storage, reuse, or other water conservation uses of the excess volume is required as specified in the County's LID Manual.

Developers are required to undergo a site plan review and an LID plan review. The site plan review is conducted by the County's Department of Regional Planning. The site plan submitted for the development must clearly depict all LID standards that will be incorporated into the development. Regional Planning approves compliance with the standards in concept only, subject to the setback and development standards set forth in Title 22 of the Los Angeles County Code. LACDPW makes the final approval and reviews the site plan for green building requirements (Title 22, Chapter 22.52, Part 20) and drought-tolerant landscaping requirements (Title 22, Chapter 22.52, Part 21) to the extent that those requirements apply to the development.

In addition to the site plan, developers also must submit an LID plan for review and approval that provides a comprehensive, technical discussion of how the development will comply with the LID Manual. A deposit and fee are required. The time for obtaining LID plan approval is as follows:

- For subdivisions, the LID plan needs to be approved before the tentative map approval.
- For any development requiring a conditional use permit, the LID plan needs to be approved before the issuance of any such conditional use permit or other entitlement.
- For all other development, the LID plan needs to be approved before issuance of a grading permit, and when no grading permit is required, before the issuance of a building permit.

A site's LID features need to be maintained and remain operable at all times and must not be removed unless replaced with other LID features in accordance with the LID standards. A covenant or agreement must be recorded indicating that the owner is aware and agrees to the LID standards, including a diagram of the site indicating the location and type of each LID feature incorporated into the development. The covenant or agreement must be recorded before final map approval for subdivisions and before issuing a grading permit or building permit if no grading permit is required, for all other developments.

A flowchart for Los Angeles County's green building requirements can be found at http://planning.lacounty.gov/green.

I.3.5. Stormwater Requirements

The County stormwater ordinance prohibits non-stormwater discharges to the municipal separate storm drain system and receiving waters. This includes a ban on littering, dumping of hazardous materials, toxic chemicals, landscape debris, and sanitary/septic waste. Construction site operators are required to implement runoff pollution mitigation measures, and public facilities are required to obtain NPDES permit coverage if applicable. Good housekeeping and other stormwater BMPs are required for industrial and commercial facilities.

The ordinance (part 12.80.530) specifies that installation of structural BMPs requires approval from the director and may require a plan review. Additionally, application and issuance of operating permits may be required if industrial stormwater is being treated (see County Code Title 20 Utilities, Chapter 20.36 Industrial Waste). The ordinance (part 12.80.540) also stipulates that BMPs cannot transfer pollutants to air, groundwater, surface soils, or other media in a manner that is not consistent with environmental laws and regulations. Finally, BMPs (12.80.580) are required to have inspection access, and the ordinance grants the County inspection authority for any BMP or stormwater management structure (County of Los Angeles 2009b).

I.3.6. Tree Protection Requirements

The Los Angeles County Oak Tree Ordinance (Los Angeles County Code Title 22 Planning and Zoning, Chapter 22.56 Conditional Use Permits, Variances, Nonconforming Uses, Temporary Uses and Director's Review, Part 16 Oak Tree Permits) has been established to recognize oak trees as significant historical, aesthetic, and ecological resources (County of Los Angeles Fire Department 2005). The Los Angeles County Oak Tree Ordinance applies to all County TMDL Implementation Areas. It specifies that a person may not cut, destroy, remove, relocate, inflict damage, or encroach into the protected zone of any tree of the oak tree genus that is 8 inches or more in diameter at 4.5 feet above mean natural grade, or in the case of oaks with multiple trunks, combined diameter of 12 inches or more of the two largest trunks, without first obtaining a permit. A permit is also required for any activity that might affect any oak tree, regardless of size, that was provided as a replacement tree pursuant to the Los Angeles County Oak Tree Ordinance.

Exceptions include the following (County of Los Angeles 2009d):

- Cases of emergency caused by an oak tree being in a hazardous or dangerous condition, or being irretrievably damaged or destroyed through flood, fire, wind or lightning, as determined after visual inspection by a licensed forester with the department of forestry and fire warden
- Emergency or routine maintenance by a public utility necessary to protect or maintain an electric power or communication line or other property of a public utility
- Tree maintenance, limited to medium pruning of branches not to exceed two inches in diameter in accordance with guidelines published by the National Arborists Association intended to ensure the continued health of a protected tree
- Trees planted, grown, or held for sale by a licensed nursery
- Trees within existing road right-of-ways where pruning is necessary to obtain adequate line-of-sight distances or to keep street and sidewalk easements clear of obstructions, or to remove or relocate trees causing damage to roadway improvements or other public facilities and infrastructure within existing road right-of-ways, as required by the director of LACDPW
- Removal of limbs within 10 feet of a chimney to maintain fire clearances (County of Los Angeles Fire Department 2005)

Obtaining an oak tree permit requires filling out an application form (http://planning.lacounty.gov/apps/—see the Oak Tree Permit section) and preparing an Oak Tree Report (this must be prepared by an approved expert) (County of Los Angeles Department of Regional Planning 2008; County of Los Angeles Fire Department 2005).

A hearing may be scheduled on a case-by-case basis, and the hearing may be combined if other applications have been filed for the property. Neither a public notice nor public hearing is required when removal or relocation of only one tree is proposed in conjunction with a single-family residence listed as a permitted use in the zone.

I.3.7. Additional County Permits

Additional permits from the LACDPW may be required depending on the design of a BMP. Applications for flood permits (http://dpw.lacounty.gov/spats/public/spatsfaq/forms/Road_Permit_Application.pdf) and road permits (http://dpw.lacounty.gov/spats/public/spatsfaq/forms/Flood_Permit_Application.pdf) are available online. Those application processes are likely to be more streamlined than typical because the projects will likely originate from LACDPW.

I.3.8. Recycled Water Laws

The Cross Connection and Water Pollution Control Program is responsible for overseeing new and converted recycled water reuse sites from the planning stage through final approval. This responsibility extends to consulting with project managers and engineering staff regarding plan check; attending construction meetings; conducting on-site field reviews; and granting the final approval for the safe use of recycled water. The objective is to convert new and existing major landscape irrigation systems and selected industrial facilities to recycled water using water quality criteria and guidelines for new construction found in the *Purple Book*, California Health Laws Related to Recycled Water.

Recycled water is limited to use that is approved by the California Department of Public Health, the LARWQCB, and the County's Department of Public Health. Any unauthorized use of recycled water is prohibited. Recycled water may be used only in those areas approved by the local water utility company. Approval by the local water utility company will be granted only when the applicable regulatory agencies complete all requirements (County of Los Angeles Department of Public Health 2009). Applicants must complete forms and guidelines (www.lacsd.org/civica/filebank/blobdload.asp?BlobID=4251) provided by the County.

I.3.9. Regional Planning

The County planning policies that can affect proposed BMPs are the General Plan (Land Use Element), community plans (which are components of the General Plan), Zoning Ordinance, Community Standards District requirements, Coastal District requirements, and Significant Ecological Areas (SEA) requirements. An update to the General Plan, developed in 2008, is in draft form (County of Los Angeles 2008). The Land Use Element of the County's General Plan outlines the general location and intensity of land use; community plans specify the location and intensity of land use. When reviewing community plans as well as proposed zoning and rezoning within County TMDL Implementation Areas, the County ensures that planned development and proposed zoning is consistent with the goals and objectives of the Land Use Element of the General Plan or the applicable community plan.

While the General Plan provides guidance and policy on land use matters, the County's Zoning Code (Title 22) regulates land use through six major zoning categories (County of Los Angeles 2009d)

- **Residential**—Residential uses, including single-family, multi-family, mixed residential and agriculture, and planned residential development.
- **Agricultural**—Light and heavy agriculture, including varying intensities of crops and livestock.
- **Combining**—Allows for a mix for uses, including residential, commercial, office, and parking, depending on the specific zone.

- **Commercial**—Districts vary in the types of commercial uses allowed, from unlimited commercial uses to specific types, like neighborhood business.
- **Industrial**—Includes various manufacturing districts and buffer districts that specify limits to land uses.
- **Special Purpose**—A number of districts fall under this category, including institutions, mixed-use development, open space, and resort and recreation.

In addition, the Zoning Code divides many of the County TMDL Implementation Areas into community standards districts (CSDs), each of which contains development standards. Most CSDs have a community plan that agrees with the General Plan but outlines more detailed requirements.

There are 12 CSDs within the Los Angeles River watersheds: Altadena; East Compton; East Los Angeles; East Pasadena-East San Gabriel; Florence-Firestone; La Crescenta-Montrose; Santa Monica Mountains North Area; South San Gabriel; Walnut Park; West Athens-Westmont; West Rancho Domingues-Victoria; and Willowbrook. The extent of the areas in the Los Angeles River watershed covered by CSDs is shown in Figure I-3.

Figure I-4 illustrates where the general zoning categories apply in the unincorporated County. Each zoning category contains several unique zones regulating allowable uses. The zones contained within the Los Angeles River watershed fall within all above general zoning categories.

The General Plan also defines SEAs where the County seeks to maintain biological diversity. Planning within the SEAs does not involve area-wide preservation but instead focuses on maintaining a sustainable balance between new development and resource conservation. The Chatsworth Reservoir, Santa Susana Mountains, Santa Susana Pass, Simi Hills, and Whittier Narrows Dam County Recreation Area SEAs are within the Los Angeles River watersheds (County of Los Angeles 2008). The extent of the SEAs in the Los Angles River watershed is shown in Figure I-5.

If a development is proposed within an SEA, an additional level of County review is required before approval, and an applicant is required to complete documentation (http://planning.lacounty.gov/apps) in addition to the site plan application. This review is conducted by the SEA Technical Advisory Committee, which is a seven-member advisory committee to the Regional Planning Commission specializing in the species and ecosystems of the County. During the permitting process, the Technical Advisory Committee will review the proposed project and make recommendations intended to reduce or avoid impacts, particularly in the most sensitive areas of the site (County of Los Angeles 2008).

Applicants whose site plans have a natural slope of 25 percent or greater may be required to obtain a Hillside Management Conditional Use Permit (Los Angeles County Code 22.56.215). Required documentation includes a Burden of Proof (http://planning.lacounty.gov/assets/upl/apps/hillside-management_bop_20080619.pdf) that the project is designed to protect public safety.

For all sites subject to a site plan review, the County zoning code contains site dimension and setback requirements that vary depending on the location and use of the property. Those requirements are outlined in Title 22 of the Los Angeles County Code (http://ordlink.com/codes/lacounty/_DATA/TITLE22/index.html) and must be reflected in the site plan unless a variance is obtained.

In addition to the above requirements, the General Plan also outlines districts subject to the California Coastal Act (California Coastal Commission 2009). Any development within specified coastal zones must apply for a coastal development permit (www.coastal.ca.gov/cdp/CDP-ApplicationForm-scc.pdf), meet additional site design requirements, and complete additional documentation (http://planning.lacounty.gov/apps) required by the County. Figure I-6 shows the boundary of the coastal zone in the vicinity of the Los Angeles River watershed. None of the County TMDL Implementation Area in the Los Angeles River watershed intersects with the coastal zone.

Site plan review by the County's Department of Regional Planning is typically completed within 6 to 8 weeks of the date of application. If the site is within a Community Standards District or SEA, the review period will be longer, and the County's Regional Planning Commission may request additional adjustments to the site plan. Because the projects implemented through the TMDL implementation plans will originate from within the County, review time will be reduced from the typical estimates. County project review time typically takes 2 weeks.

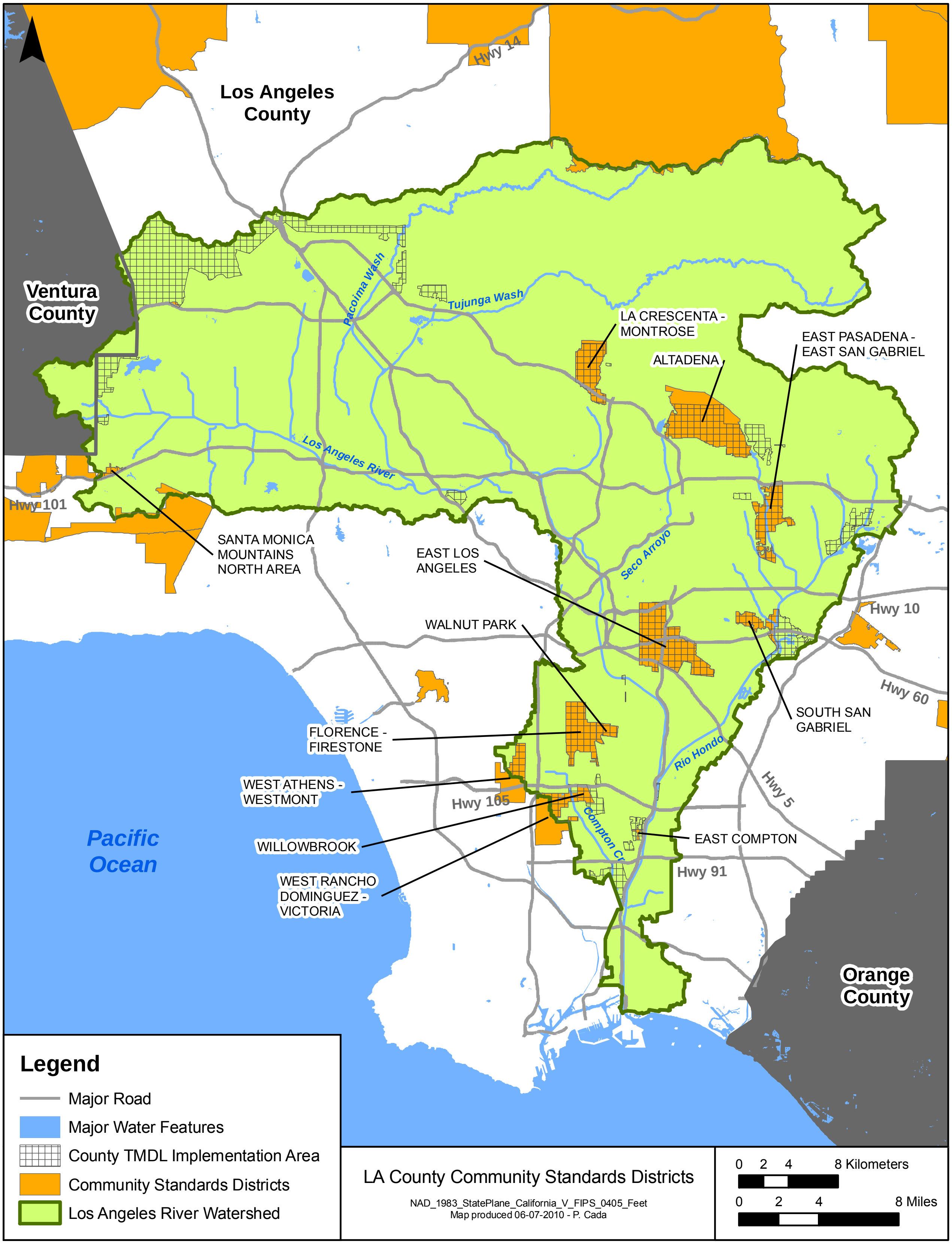


Figure I-3. Los Angeles River Community Standards Districts

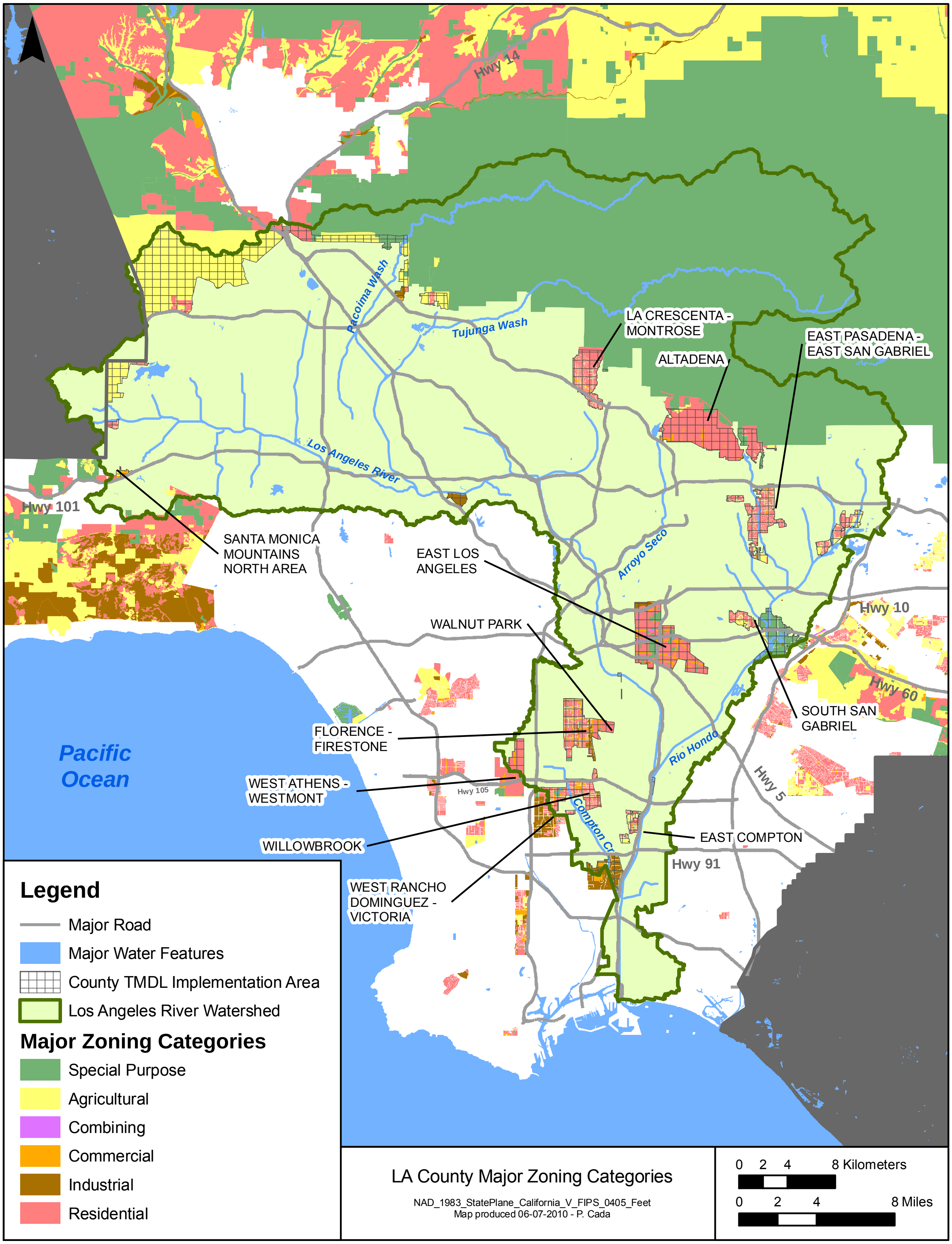


Figure I-4. Los Angeles River Major Zoning Categories

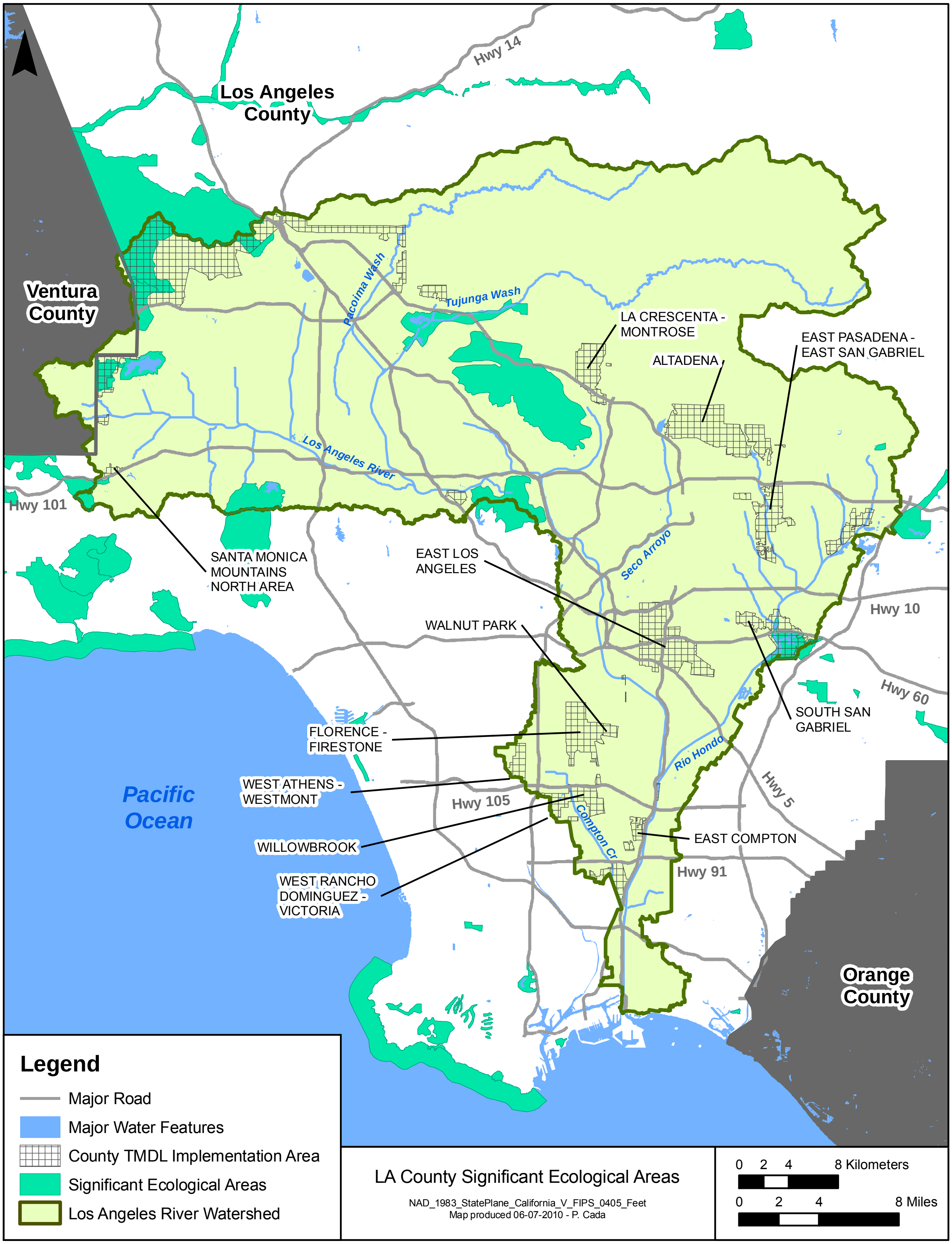


Figure I-5. Los Angeles River Significant Ecological Areas

Figure I-6. Coastal Zone in the Los Angeles River Watershed

I.3.10. Sanitation Districts of Los Angeles

The Sanitation Districts are a partnership of 24 independent special districts serving about 5.3 million people in the County. The Sanitation Districts' service area covers approximately 800 square miles and encompasses 78 cities and unincorporated territory in the County. The Sanitation Districts regulate industrial dischargers. The Wastewater Ordinance (www.lacsd.org/info/industrial_waste/wastewater_ordinance.asp) requires any business that desires to discharge industrial wastewater to the districts' sewerage system to first obtain an Industrial Wastewater Discharge Permit. Businesses that discharge only domestic wastewaters (wastewaters from restrooms, drinking fountains, showers, or air conditioners used for human comfort), or businesses that are determined to have an insignificant impact on the districts' facilities might not be required to obtain an Industrial Wastewater Discharge Permit. However, exemption from obtaining a permit does not relieve a company of the responsibility to comply with conditions regulating prohibited and restricted waste discharges, or rainwater diversion requirements specified in the districts' wastewater ordinance.

The criteria listed below are to be used in determining if a facility is exempt from obtaining an Industrial Wastewater Discharge Permit. That determination is to be made only by Sanitation District personnel. Facilities determined by the districts to have a potential adverse effect on the sewerage system could be required to obtain a permit.

Exempt companies include the following:

1. All restaurants and hotels
2. Small food-processing establishments with wastewater flows less than 500 gallons per day (exception: facilities discharging excessive oil and grease, excessive dissolved sulfides, or high-strength waste)
3. All retail grocery stores (exception: centralized food processing facilities for distribution to other grocery stores)
4. All 1-hour photo shops and small photo-processing facilities (exception: centralized film processing facilities)
5. School and commercial laboratories
6. Medical and professional buildings (exception: hospitals with overnight beds)
7. All pet shops, animal kennels, animal hospitals, and animal shelters
8. Warehouses
9. Auto dealers and auto repair shops (exception: radiator shops)
10. Car washes with flows less than 6 million gallons per year
11. All automotive service stations
12. Recreational vehicle dump stations
13. Other companies might be exempt as determined on a case-by-case basis

Permit applications are reviewed by engineering staff to determine if the pretreatment equipment proposed is adequate to meet appropriate discharge limits and to determine compliance with the Sanitation Districts' spill containment, flow monitoring, rainwater diversion, and combustible gas monitoring policies.

An applicant must complete an adequate permit submittal. The complete permit submittal must then be sent to the local agency (i.e., the local city or the LACDPW) for initial processing before districts' review. Contact the applicable local agency for the appropriate permit processing fee that might be required. County contract cities are those cities that contract with the LACDPW for sewerage services. Companies in the contract cities or County TMDL Implementation Areas should send permit submittals to the LACDPW.

The permit submittal has three main parts: (1) Permit Application Form (www.lacsd.org/civica/filebank/blobdload.asp?BlobID=2459) (2) Plans, and (3) Supporting Information. Once the permit application package has been received, the permit is logged in and checked for completeness. If the submittal is determined to be incomplete, it will be automatically rejected. If determined to be complete, the permit application package will be reviewed by an Industrial Waste Section project engineer. As part of the engineer's review, additional information may be required. In some cases this can be done by phone or mail, although if necessary a company representative may be asked to meet at the Districts' Joint Administration Office to clarify certain points. If the required information is not provided, the permit application package will be rejected and returned with a list of specific corrections. Once the corrections are made, the resubmittal must be made directly to the Districts within the specified time or enforcement actions will be initiated. Once the application is determined to be complete and correct, a connection fee evaluation will be performed (LACSD 2009a).

Once the connection fee payment has cleared, the approved permit will be issued. The approved permit will include a list of requirements. The company is required to comply with all indicated items on this list as a condition of the permit approval. Failure to comply with permit requirements leads to enforcement actions and possible revocation of the Industrial Wastewater Discharge Permit (www.lacsd.org/info/industrial_waste/permit.asp).

As a condition for approval of an Industrial Wastewater Discharge Permit, an applicant might be subject to participation in the districts' Self Monitoring Program. This program requires a company to regularly furnish chemical analyses of its industrial wastewater to the districts. The type and frequency of tests to be performed are determined on a case-by-case basis depending on the quality and quantity of the industrial discharge and are included as requirements in the permit.

Regarding the connection to sanitary sewers for industrial waste discharge, the LACSD requires that an application (www.lacsd.org/civica/filebank/blobdload.asp?BlobID=2445) and a complete set of plans be submitted to connect to the sanitary sewer system. The fee will vary by District (www.lacsd.org/info/wastewater_services/default.asp) (LACSD 2009b).

Under the jurisdiction of LACDPW, oil/water separators might be required to treat discharges to the sanitary sewer from food establishments (LACDPW 2009b) or industrial facilities (LACSD 2009b). Installation of oil/water separators into the storm sewer system to treat runoff will be considered a standard urban stormwater mitigation plan BMP and will need prior approval by LACDPW as well (LACDPW 2009b).

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Appendix J. Structural BMP Conceptual Monitoring Plan

Performance monitoring of stormwater BMPs is an important component of any watershed restoration program. Monitoring provides the BMP designer a mechanism to validate certain design assumptions and to quantify compliance with pollutant-removal performance objectives. The following conceptual monitoring plan was developed as a general guide for how centralized BMPs should be monitored as part of the Los Angeles River watershed TMDL implementation.

J.1. Pollutants of Concern

Selecting constituents for laboratory analysis primarily considered the TMDL pollutants of concern but also included additional constituents that are commonly sampled to assess BMP performance.. The table below summarizes the pollutants recommended for structural BMP monitoring (Table J-1).

Table J-1. Pollutants Recommended for Structural BMP Monitoring

Metals	Nutrients	Other	Pathogens
Cadmium, copper, lead, selenium, silver, and zinc	Ammonia-N, total Kjeldahl nitrogen, nitrite/nitrate-N, TP, and orthophosphate	TSS, pH, PAH, total PCBs, and oil and grease	*E. Coli*, *Enterococcus*, fecal coliform, and total coliforms

J.2. Monitoring Assumptions

To develop the conceptual monitoring plan and cost estimate, several assumptions were made about the anticipated designs of structural BMPs. Incorporating primary devices (i.e., weirs, flumes, culverts operating under inlet control) to allow for measuring inflow and outflow rates is assumed to be included in BMP designs. It was also assumed that construction costs of primary devices is included in construction estimates, and access to sample collection locations would not require confined space entry precautions such as hoists, forced air, or air quality meters.

J.3. Monitoring Approach for Centralized Structural BMPs

When specific monitoring plans are developed for each structural BMP, the approach should adhere to the American Society of Civil Engineers (ASCE)/USEPA *Stormwater BMP Performance Monitoring Manual* (ASCE and USEPA 2002). That manual provides guidelines for developing sampling protocols for determination of BMP performance. Adhering to the guidelines described in the manual would better enable the County to meet requirements for including the sites into the ASCE/USEPA international BMP database and participate in local, regional, and national discussions on stormwater BMP performance. In addition, the results of the monitoring approach would provide quantifiable measures as to the compliance of BMP discharge with receiving water standards and BMP pollutant removal with TMDL objectives.

The monitoring approach suggested by ASCE/USEPA uses an upstream/downstream sample location setup. The upstream sampler should be at the upstream limit of the BMP before any pretreatment devices such as forebays or filter strips. The downstream sampler should be at the outlet control device just upstream of the discharge of treated runoff to receiving waters. Samplers should be at a primary device to allow the use of a flow-monitoring device and use of the sampler for flow-paced sampling.

Monitoring should be conducted before and after construction. For the pre- and post-monitoring periods, the monitoring program should be implemented to collect samples from a minimum of four storm events per year for a period of no less than 3 years (12 storms total). Events should be representatively distributed throughout the average precipitation regime. As noted in Section 11, the TMDL implementation schedules might not allow for the full 3 years of pre-construction monitoring; in such cases, the maximum time available for pre-construction monitoring should be used.

Grab samples should be collected at the same locations as the flow-paced samples. Samplers should be programmed to collect single-event, flow-weighted samples. It is assumed that a dedicated automatic sampler would be purchased for each site. However, it might be possible to use the samplers at other sites that do not need to be monitored during the same storm event. Additionally, grab samples should be collected for those constituents with critical, hold-time requirements. Sample analysis should be conducted by a lab that is certified to conduct the analyses of interest.

Appropriate collection of stormwater runoff samples is a labor-intensive process. It is assumed that the County would provide the staffing for implementing and executing the monitoring plan.

J.4. Monitoring Approach for Distributed Structural BMPs

For distributed BMPs on public property, a paired watershed approach is proposed in which two drainage areas of similar land use, soils, topography, and other features are monitored during pre-construction, and a distributed BMP is constructed to treat one of the drainage areas. Post-construction monitoring is then performed for both drainage areas. The results should be compared to assess the pollutant reduction provided by the treated drainage area. One pair of drainage areas would be chosen to represent each distributed BMP type.

Aside from the unique characteristics of the paired approach, the monitoring guidelines for the centralized BMPs, outlined above, should be applied to the distributed BMPs. The recommended time frame is 3 years of pre-construction monitoring; however, the implementation schedules are unlikely to allow for that time frame for the first distributed BMP projects. Post-construction monitoring is assumed to occur 3 years after construction is complete.

J.5. References

ASCE (American Society of Civil Engineers) and USEPA (U.S. Environmental Protection Agency). 2002. *Stormwater BMP Performance Monitoring Manual*. American Society of Civil Engineers, Reston, VA, and U.S. Environmental Protection Agency, Washington, DC.

Appendix K. Cost Assumptions and Estimates

For structural BMP projects, cost assumptions and estimates are included for planning, design, permits, construction, O&M, and post-construction monitoring, where applicable. Costs were estimated for each of the centralized BMPs on public property, and the costs were used to estimate an approximate cost per acre of drainage area for the centralized BMPs on private property. Unit area costs were developed for the three types of distributed structural BMPs on public property identified in Section 5: porous pavement, bioretention and linear bioretention trenches. For each of these BMP types, separate costs were developed for both high- and low-infiltration rates in soil.

Though appropriate for relative comparisons, the costs estimated for the optimization are not specific to proposed sites or conditions within the County. The costs estimated in this appendix provide a more detailed consideration of components and steps involved. The relative comparison between BMPs is consistent with the optimization results. This applies to all structural BMP costs estimates, distributed and centralized.

The cost estimates in this appendix reflect PV costs independent of the BMP implementation schedule. For the phased implementation of BMPs recommended in Section 10, costs after 2010 are discounted according to the year the costs occur as specified in the implementation schedule. As a result, most of the costs – including planning and construction costs occurring in later years –reported in Section 10 are less than those reported in this appendix.

The following tables report the components considered, their cost, and the total cost estimate for each BMP or BMP type. All costs are in 2009 dollars and PV terms. The cost estimates represent the *Probable Program Cost* only. These figures are supplied as a guide only and could deviate from the actual program cost. The accuracy of these cost estimates is affected by the fluctuation in cost of material, labor, components, or unforeseen contingencies within the market place.

The abbreviations used in the tables are defined as follows:

CY: Cubic yard
LF: Linear foot
LS: Lump sum
SF: Square foot
SY: Square yard

K.1. Catch Basin Distributed BMPs: Cost Assumptions and Estimates

Two phases of catch basin inserts are proposed. In Phase 2, catch basin inserts for sediment and trash removal would be installed in 66 percent of the catch basins in the County TMDL implementation Area. In Phase 3, near the end of TMDL implementation, catch basin inserts would be installed in the remaining catch basins in the implementation area. Costs were based on the County's experience with the full capture device installation program, vendor prices for sediment removal inserts, and best professional judgment.

The planning costs, which include administrative costs, were estimated as 20 percent of the purchase and installation costs. The purchase and installation costs were based on the average cost of catch basin inserts from several vendors and USEPA (2009). These costs are assumed to include all necessary construction components, including mobilization. In addition to the insert cost, the purchase of a vacuum truck was included, which would be required for removing sediment during maintenance (USEPA 2009). Design costs are assumed to be 10 percent of purchase and installation costs.

Maintenance of the sediment-removal portion of the inserts would likely occur as part of the maintenance that is being planned for the full capture devices. Therefore, the full cost of maintenance is not attributed to this BMP, and only the additional cost attributed to the sediment-removal portion of the inserts is included. That additional cost includes operating the vacuum truck, which was assumed to cost similar to the operation of the County's street sweepers at $80 per hour. Depending on the type of insert, materials might need to be replaced periodically at an approximate cost of $125 per year. Staff and disposal costs are assumed not to increase significantly from what is needed for the full capture devices. Necessary monitoring is assumed to be included in the O&M activities for the full capture devices.

Table K-1. Distributed BMPs: Catch Basin Inserts Phase 2

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$1,842,600
2	**Design**	1	LS	--	$921,300
3	**Pilot Study**	1	LS	--	$100,000
4	**Purchase and Installation**				
	Catch Basin Insert Purchase and Installation	3,071	Each	$3,000	$9,213,000
	Vacuum Truck Purchase	1	Each	$150,000	$150,000
	Purchase and Installation Total				$9,363,000
5	**Operation, Maintenance, and Monitoring**	1	LS	--	$10,910,000
	Project Total				$23,136,900
	Total Estimate (rounded)				$23,140,000

Table K-2. Distributed BMPs: Catch Basin Inserts Phase 3

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$961,800
2	**Design**	1	LS	--	$480,900
3	**Pilot Study**	1	LS	--	$100,000
4	**Purchase and Installation**				
	Catch Basin Insert Purchase and Installation	1,603	Each	$3,000	$4,809,000
	Vacuum Truck Purchase	2	Each	$150,000	$300,000
	Purchase and Installation Total				$5,109,000
5	**Operation, Maintenance, and Monitoring**	1	LS	--	$5,690,000
	Project Total				$12,341,700
	Total Estimate (rounded)				$12,340,000

K.2. Other Structural BMPs: Cost Assumptions and Estimates

Below are general cost assumptions developed for public property distributed BMPs (such as porous pavement and bioretention areas) and for centralized BMPs on public and private property. More detailed assumptions are provided, as needed, by subsection.

Planning

Costs for planning include the effort required to further develop the project concept, which, depending on the complexity of the project, could result in preparing a Project Concept Report. Additionally, administrative costs for the County to administer, manage and coordinate the project's implementation are included with the planning costs. Administrative costs can vary widely with the complexity of the project, but for purposes of comparison, a value of 20 percent of the capital costs is assumed for planning. For centralized BMPs, a minimum planning cost of $250,000 was also assumed.

Permitting

Section 8 identifies regulatory requirements and environmental permits required to implement potential BMPs. The section addresses the regulations that apply to general types of structural BMPs and notes that the applicability of many of the regulations for a specific project depends on its site or design characteristics. Because the requirements imposed by regulatory agencies often have an effect on the project cost, permits were assessed for each of the centralized BMP projects on public property, and the associated cost is included in the analysis.

Because the opportunities identified for distributed structural BMPs in Section 5 are for areas of impervious cover and not applied to vacant or open spaces, the permitting effort anticipated for such projects is minimal, if any. Therefore, no separate costs are identified in the analysis for permitting. It is assumed that any permitting costs associated with the construction phase, such as erosion and sedimentation control, are included with the construction costs.

Design

Designing structural BMPs requires collecting data, analyzing it, and preparing documents that can be used for constructing a project. Data collection could include geotechnical investigations, field investigation of existing utilities (potholing), and a topographic survey for mapping. The design deliverables are project plans and specifications used for contractor bidding. Engineering costs can vary widely depending on the complexity of the project. For the purposes of the cost estimates, fixed rates of 10 and 30 percent were applied to the distributed and centralized BMP construction costs, respectively, to estimate the design/engineering cost. A lower percent was used for distributed BMP design costs because those BMPs are expected to have less time-intensive designs compared to centralized BMPs.

Construction

The typical levels of construction cost estimates are as follows:

- **Preliminary/Order of Magnitude**—provide a range of costs at the planning level for a conceptually defined project
- **Budget**—cost estimates based on layouts and specific quantities
- **Final/Definitive**—prepared after the design documents are complete

Because of the preliminary nature of the projects, the estimates developed for the proposed centralized BMPs on public property lie between the preliminary/order of magnitude and budget level estimates, with an expected accuracy of about plus 40 percent to minus 25 percent. The estimates for centralized BMPs on private property and distributed BMPs are expected to have a lower accuracy because such cost estimates are not site-specific and are in the preliminary/order of magnitude category.

Mobilization and park restoration costs were estimated as percentages of construction costs, independent of each other. Mobilization costs were estimated as 10 percent of all other construction costs except park restoration, and park restoration costs were estimated as 20 percent of all other construction costs except mobilization. Park restoration costs were included for centralized BMPs that would be located on park property. These costs were calculated prior to calculating contingency.

To the extent possible, construction costs are based on approximate quantifications of the BMPs major components. Because some of the project components have not been fully defined at this preliminary stage, a contingency factor of 25 percent was applied to the construction cost subtotal to estimate the total construction costs and capture expected but as yet unidentified additional costs. The costs could arise from site-specific field conditions such as those associated with utility relocations, dewatering, and erosion and sedimentation control. At this stage of project development, the contingency also includes an allowance for such items as additional mobilization, field facilities, and construction scheduling, which might be required but are not specifically itemized.

Operation and Maintenance

Consistent with the O&M assumptions used in the optimization (Appendix G), the following assumptions were used:

- Infiltration Basin Annual Maintenance Cost: 6.72 percent of the construction cost
- Extended Detention Basin Annual Maintenance Cost: 4 percent of the construction cost
- Porous Pavement Annual Maintenance Cost: $0.0076 per square foot
- Bioretention Annual Maintenance Cost: $0.05 per gallon void capacity

As noted in the general cost assumptions for all BMPs above, the planning through construction phases for individual cost estimates is assumed to occur in year 0, and O&M costs are assumed to begin in year 1 and end in year 20.

Post-Construction Monitoring

Appendix H outlines the recommended monitoring plan for the structural BMPs. For centralized BMPs (either on public or private property), pre-construction monitoring is assumed to occur up to 1 year before construction. The recommended time frame is 3 years of pre-construction monitoring; however, the implementation schedules are unlikely to allow for that time frame. Post-construction monitoring is assumed to occur 3 years after construction is complete. The cost of pre- and post-construction monitoring for each centralized BMP is estimated as about $69,000, including the cost of automatic samplers, lab analysis, and labor.

For distributed BMPs on public property, a paired watershed approach is proposed in which two drainage areas of similar land use, soils, topography, and other features are monitored during pre-construction, and a distributed BMP is constructed to treat one of the drainage areas. Post-construction monitoring would be performed for both drainage areas. The results would be compared to assess the pollutant reduction provided by the treated drainage area. Pre-construction monitoring is assumed to occur up to 1 year before construction. The recommended time frame is 3 years of pre-construction monitoring; however, the implementation schedules are unlikely to allow for that time frame for the first distributed BMP projects. Post-construction monitoring is assumed to occur 3 years after construction is complete. The cost estimate assumes that for each type of distributed BMP, one site would be monitored as a representative site. The cost of pre- and post-construction monitoring for both centralized BMPs on public property is estimated as about $124,000, including the cost of automatic samplers, lab analysis, and labor.

The planning-level cost estimates for porous pavement BMPs were developed using the above-stated assumptions that apply to all distributed, structural BMPs. The construction cost component of the estimate was developed specifically for porous pavement with the following additional assumptions:

1. Existing asphalt removal is required.
2. BMPs in low infiltration soil areas require additional excavation, deeper substrate material and installation of an underdrain system consisting of perforated PVC pipe.
3. The design parameters include a 2-foot depth for the substrate and a 1-foot depth for the underdrain.

Costs for bioretention BMPs were developed similarly to those for porous pavement, with the following construction cost considerations:

1. Existing asphalt removal is required.
2. BMPs in low-infiltration soil areas require additional excavation, deeper substrate material, and installing an underdrain system consisting of perforated PVC pipe spaced at 5 feet on center.
3. The design parameters include a 3-foot depth for the substrate and an additional 1-foot depth for the underdrain in low-infiltration soil areas.
4. A ponding depth of 0.5 foot is assumed for the excavation quantity take-off.

Construction costs were developed for a 1-acre surface area. Planning and design costs, which represent a percentage of the capital costs, are summed with O&M and post-construction monitoring costs to develop a planning-level unit cost for each type of BMP. To estimate the alternatives costs, the unit cost per acre is applied toward the total implementation surface area to estimate a total project cost for each type of distributed BMP.

Because the components for linear bioretention trench BMPs are similar to those for bioretention BMPs, the unit costs are assumed to be the same for both BMPs.

K.2.1. Cost for Distributed BMPs on Public Land

Table K-3 presents the square foot costs estimated for each type of distributed BMP. The assumptions for each BMP are described below. Because monitoring would not be conducted at each BMP site, the square foot unit costs are reported with and without monitoring costs. The cost analysis for the distributed BMPs on public property is presented in the tables below. Because bioretention and linear bioretention trenches are estimated to have the same cost, one table of detailed costs is provided for both BMPs per soil type. Since the soil properties for the 1-acre linear bioretention pilot project are unknown, the average of the low- and high-infiltration costs was used for this project.

Table K-3. Unit Cost Estimates for Other Distributed BMPs on Public Land

Description	Square Foot Unit Price without Monitoring	Square Foot Unit Price with Monitoring
Porous Pavement (low-infiltration soils)	$32.00	$35.00
Porous Pavement (high-infiltration soils)	$27.00	$30.00
Bioretention (low-infiltration soils)	$31.00	$34.00
Bioretention (high-infiltration soils)	$27.00	$29.00
Linear Bioretention (low-infiltration soils)	$31.00	$34.00
Linear Bioretention (high-infiltration soils)	$27.00	$29.00

Table K-4. Distributed BMPs on Public Land: Bioretention and Linear Bioretention Cost Estimate, Low Infiltration

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$168,778
2	**Design**	1	LS	--	$84,389
3	**Permits/Studies**	1	LS	--	$0
4	**Construction**				
	Mobilization	1	LS	--	$61,400
	Asphalt/Base Removal	4,840	SY	--	$38,720
	Excavation/Haul (4.5 ft. depth)	7,260	CY	$8	$290,400
	Media (3 ft. depth)	4,840	CY	$40	$145,200
	Underdrain	8,712	LF	$30	$52,272
	Planting	43,560	SF	$6	$87,120
	Construction Total for 1 acre (43,560 SF)			$2	$675,112
	Contingency (25%)				$168,778
	Construction Total				$843,890
5	**O&M**	1	LS		$243,633
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$124,000
	Project Total			--	$1,464,690
	Total Estimate (rounded)				$1,470,000
	Unit Cost without monitoring	1	SF	$31	
	Unit Cost with monitoring	1	SF	$34	

Table K-5. Distributed BMPs on Public Land: Bioretention and Linear Bioretention Cost Estimate, High Infiltration

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$136,655
2	**Design**	1	LS	--	$68,328
3	**Permits/Studies**	1	LS	--	$0
4	**Construction**				
	Mobilization	1	LS	--	$49,700
	Asphalt/Base Removal	4,840	SY	--	$38,720
	Excavation/Haul (3.5 ft.)	5,647	CY	$8	$225,880
	Media (3 ft. depth)	4,840	CY	$40	$145,200
	Planting	43,560	SF	$30	$87,120
	Construction Total for 1 acre (43,560 SF)			$2	$546,620
	Contingency for Planning Stage Estimate (25%)				$136,655
	Construction Total				$683,275
5	**O&M**	1	LS		$243,633
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$124,000
	Project Total			--	$1,255,890
	Total Estimate (rounded)				$1,260,000
	Unit Cost without monitoring	1	SF	$27	
	Unit Cost with monitoring	1	SF	$29	

Table K-6. Distributed BMPs on Public Land: Porous Pavement Cost Estimate, Low Infiltration

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$211,373
2	**Design**	1	LS	--	$105,687
3	**Permits/Studies**	1	LS	--	$0
4	**Construction**				
	Mobilization	1	LS	--	$76,900
	Asphalt/Base Removal	4,840	SY	$8	$38,720
	Excavation/Haul (3 ft. depth)	4,840	CY	$40	$193,600
	Underdrain	8,712	LF	$6	$52,272
	Gravel Sub-base (2.5 ft.)	4,840	SY	$35	$169,400
	Porous Pavement (.5 ft. thickness)	4,840	SY	$65	$314,600
	Construction Total for 1 acre (43,560 SF)				$845,492
	Contingency for Planning Stage Estimate (25%)				$211,373
	Construction Total				$1,056,865
5	**O&M**	1	LS	--	$4,126
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$124,000
	Project Total				$1,502,050
	Total Estimate (rounded)				$1,510,000
	Unit Cost without monitoring	1	SF	$32	
	Unit Cost with monitoring	1	SF	$35	

Table K-7. Distributed BMPs on Public Land: Porous Pavement Cost Estimate, High Infiltration

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$179,250
2	**Design**	1	LS	--	$89,625
3	**Permits/Studies**				$0
4	**Construction**				
	Mobilization	1	LS	--	$65,200
	Asphalt/Base Removal	4,840	SY	$8	$38,720
	Excavation/Haul (2 ft. depth)	3,227	CY	$40	$129,080
	Gravel Sub-base (1.5 ft.)	4,840	SY	$35	$169,400
	Porous Pavement (.5 ft. thickness)	4,840	SY	$65	$314,600
	Construction Total for 1 acre (43,560 SF)				$717,000
	Contingency for Planning Stage Estimate (25%)				$179,250
	Construction Total				$896,250
5	**O&M**	1	LS	--	$4,126
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$124,000
	Project Total				$1,293,251
	Total Estimate (rounded)				$1,300,000
	Unit Cost without monitoring	1	SF	$27	
	Unit Cost with monitoring	1	SF	$30	

K.2.2. Centralized BMPs on Public Land Cost Estimates

In developing the cost estimates for each of the 20 centralized BMPs, the general cost assumptions discussed in Section K.2 for structural BMPs apply, with further refinement as discussed below.

Permits

Three types of centralized BMPs are identified for LAR TMDL treatment: (1) infiltration basins, (2) extended dry detention basins, and (3) wetlands. Section 8 identifies the permit requirements for infiltration basins, and the requirements for extended dry detention basins are thought to be similar. Those requirements were assessed for applicability to the 19 infiltration and detention basin BMPs that were identified and are listed below. Where additional permit requirements are specific to a project, those are listed under the project heading. The applicable wetland permit requirements are listed under the Compton Creek Wetland project because it is the only wetland-type BMP identified in the plan.

- **CARB Regulations**—It is likely that the air quality requirements would pertain only to the construction phase and could be readily met by the contractor.
- **Geotechnical Reporting Requirements**—A soils investigation would be required for the project's design. It is not anticipated that it would be required before this phase, and its costs are included with the design.
- **Tree-related CEQA and Tree Protection Requirements**—No tree-related CEQA or Tree Protection requirements are anticipated because the BMPs are on existing park fields.

- **Sedimentation and Erosion Control Requirements**—Such elements would be implemented with the project's design. During construction, the contractor building the BMPs would be responsible for controlling erosion and stormwater runoff.
- **Permits Related to Endangered and Threatened Species**—All BMPs are expected to require a survey to determine whether protected species or habitat are present or could be affected by the BMP. A survey cost of $50,000 per BMP was assumed to cover such a survey and any mitigated negative declaration that might be required. If an incidental take permit or other actions are required, the permitting costs would increase substantially.
- **Additional Requirements**—Other documentation, especially through the CEQA process, could be required following a detailed survey of the site for potential listed species impacts, cultural resources, or other protected features. The permitting cost of $50,000 is estimated to cover a survey that would determine additional permitting needs and the minimum actions that might be required. Additional permitting costs could arise depending on the survey results. Such costs could be reduced by combining permitting for multiple sites. A combined survey might cost between $200 and $300, could take about one year to complete, and could cover BMPs implemented within a span of about 3 years.

Construction

The major construction components of infiltration and extended dry detention basins were identified and quantified for developing the cost estimates. The major components include connection to an existing storm drain, means for diverting stormwater to the basin, and basin construction.

The assumptions for the general basin layout and related appurtenances were as follows:

- Quantities for storm drain pipe were estimated on the basis of the closest distance from the edge of BMP to the existing storm drains from which the stormwater will be diverted.
- The depths of the infiltration basins were calculated assuming 3:1 side slopes. Basin depths were assumed not to exceed 8 feet.
- The connection to the existing storm drain for diversion of stormwater into the basins was assumed to be at the mid-point of the storm drain.
- A minimum slope of 0.25 percent was assumed for the new connecting piping.

On the basis of those assumptions, where the new piping invert is lower than the bottom of the basin (or 8 feet, whichever is lower), it was assumed that additional lift to fill the basin was required. The required pumping capacity is based on completely filling the basin in a 24-hour period. The pumping station costs were developed referencing *Pumping Station Design* (Sanks 1989), Figure 29-4, Construction Costs of Pre-Fabricated Wastewater Pumping Stations and adjusted using ENR construction cost index for 2009.

Landscaping costs assume seeding/sod and irrigation of the basin area. The cost estimate details for each of the 20 centralized BMPs are given below.

Belvedere Park

The 39.1-acre regional Belvedere Park is in the heart of the unincorporated County area of City Terrace – East Los Angeles. The facility includes open space for a 2.5-acre infiltration-type BMP with storage capacity of 13.8 AF. Implementing the project will require the following:

- Diversion from 54 inches (assumed) RDD 296 Storm Drain with 500 feet of connecting pipe
- 2.5-acre by 6-foot-deep basin, resulting in an excavation/haul quantity of 22,300 CY

Table K-8. Centralized BMPs on Public Land: Belvedere Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$548,500
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$822,700
4	**Construction**				
	Mobilization	1	LS	--	$168,800
	Storm Drain	500	LF	$200	$100,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (2.5 ac x 6')	22,300	CY	$40	$892,000
	Fine Grading and Surface Preparation	12,100	SY	$10	$121,000
	Landscaping	108,900	SF	$5	$544,500
	Park Restoration	1	LS	--	$337,500
	Subtotal				$2,193,800
	Contingency for Planning Stage Estimate (25%)				$548,450
	Construction Total				$2,742,250
5	**O&M**	1	LS	--	$2,300,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$6,532,450
	Total Estimate (rounded)				$6,540,000

Bethune Park

Bethune Park, in the unincorporated County community of Florence-Firestone, includes open space for an infiltration-type BMP. The BMP optimization results have sized a 0.2-acre basin with 0.9 AF of storage for treatment. Implementing the BMP would require the following:

- Diversion from the Hooper Avenue Drain System (7'6" (W) x 6'6" (H) reinforced concrete box [RCB] with 4 feet of cover) with 200 feet of connecting pipe
- 0.2-acre by 8-foot-deep basin, resulting in an excavation/haul quantity of 1,450 CY

Table K-9. Centralized BMPs on Public Land: Bethune Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$88,400
4	**Construction**				
	Mobilization	1	LS	--	$18,100
	Storm Drain	200	LF	$200	$40,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.2 ac x 8')	1,450	CY	$40	$58,000
	Fine Grading and Surface Preparation	967	SY	$10	$9,667
	Landscaping	8,700	SF	$5	$43,500
	Park Restoration	1	LS	--	$36,233
	Subtotal				$235,500
	Contingency for Planning Stage Estimate (25%)				$58,875
	Construction Total				$294,400
5	**O&M**	1	LS	--	$250,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$1,001,800
	Total Estimate (rounded)				$1,010,000

Charles White Park

The 5-acre Charles White Park in the unincorporated County area of Altadena has been identified as a site for an infiltration-type BMP. The BMP optimization results size the 3.9-acre infiltration basin for 21 AF of storage. Implementing the project would require the following:

- Diversion from the West Altadena Drainage System (48" reinforced concrete pipe [RCP] with about 4 feet of cover) with 50 feet of connecting pipe
- 3.9-acre by 6-foot-deep basin, resulting in an excavation/haul quantity of 34,000 CY

Table K-10. Centralized BMPs on Public Land: Charles White Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$792,500
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$1,188,700
4	**Construction**				
	Mobilization	1	LS	--	$243,800
	Storm Drain	50	LF	$200	$10,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (3.9 ac x 6')	34,000	CY	$40	$1,360,000
	Fine Grading and Surface Preparation	18,878	SY	$10	$188,778
	Landscaping	169,900	SF	$5	$849,500
	Park Restoration	1	LS	--	$487,656
	Subtotal				$3,169,733
	Contingency for Planning Stage Estimate (25%)				$792,433
	Construction Total				$3,962,167
5	**O&M**	1	LS	--	$3,320,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$9,382,367
	Total Estimate (rounded)				$9,390,000

Enterprise Park

The 10-acre Enterprise Park is in the Rosewood community of unincorporated County. The park includes open space that has been identified as a site for an infiltration-type BMP. From the BMP optimization results, a 0.7-acre infiltration basin with a 3.9 AF storage capacity is identified to meet TMDL requirements. The following would be required for this project:

- Diversion from storm drain in 131st Street (39" RCP) assumed with 150 feet of connecting pipe
- 0.7-acre basin with 7.5-foot depth, resulting in an excavation/haul quantity of 6,500 CY

Table K-11. Centralized BMPs on Public Land: Enterprise Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$246,900
4	**Construction**				
	Mobilization	1	LS	--	$50,600
	Storm Drain	150	LF	$200	$30,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.7 ac x 7.5')	6,500	CY	$40	$260,000
	Fine Grading and Surface Preparation	3,389	SY	$10	$33,889
	Landscaping	30,500	SF	$5	$152,500
	Park Restoration	1	LS	--	$101,278
	Subtotal				$658,267
	Contingency for Planning Stage Estimate (25%)				$164,567
	Construction Total				$822,833
5	**O&M**	1	LS	--	$690,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$2,128,733
	Total Estimate (rounded)				$2,130,000

Farnsworth Park

Farnsworth Park in the unincorporated County area of Altadena has been identified as a site for an infiltration-type BMP. The optimization results have size a 0.1-acre basin with 0.5 AF of storage. Implementing the project would require the following:

- Diversion from the Project No. 544 storm drain (36" RCP with 3 feet of cover) with 200 feet of connecting pipe
- 0.1-acre by 8-foot-deep basin, resulting in excavation/haul of 850 CY

Table K-12. Centralized BMPs on Public Land: Farnsworth Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$63,800
4	**Construction**				
	Mobilization	1	LS	--	$13,100
	Storm Drain	200	LF	$200	$40,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.1 ac x 8')	850	CY	$40	$34,000
	Fine Grading and Surface Preparation	489	SY	$10	$4,889
	Landscaping	4,400	SF	$5	$22,000
	Park Restoration	1	LS	--	$26,178
	Subtotal				$170,167
	Contingency for Planning Stage Estimate (25%)				$42,542
	Construction Total				$212,708
5	**O&M**	1	LS	--	$180,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$825,508
	Total Estimate (rounded)				$830,000

G.W. Carver Park

The 7.2-acre G.W. Carver Park is in unincorporated County, neighboring the communities of Willowbrook, Compton, and the city of Los Angeles. The BMP optimization results identify a 0.9-acre basin with a storage capacity of 5 AF for infiltration treatment. Implementing the project would require the following:

- Diversion from Hooper Avenue Storm Drain (double 8'3" (W) x 7' (H) RCB with 4 feet of cover in Success Ave) with 400 feet of connecting pipe
- 0.9-acre basin, 7 feet deep, resulting in an excavation/haul quantity of 8,100 CY
- Lift station capacity of 1,130 gpm, assuming a 5 AF volume basin filled in 24 hours

Table K-13. Centralized BMPs on Public Land: G.W. Carver Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$332,900
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$499,300
4	**Construction**				
	Mobilization	1	LS	--	$102,400
	Storm Drain (24-inch RCP)	400	LF	$200	$80,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Stormwater Lift Station/Wet Well (1,000 gpm)	1	Each	$350,000	$350,000
	Excavation for Infiltration Basin (0.9 ac x 7')	8,100	CY	$40	$324,000
	Fine Grading and Surface Preparation	4,367	SY	$10	$43,667
	Landscaping	39,300	SF	$5	$196,500
	Park Restoration	1	LS	--	$204,833
	Subtotal				$1,331,400
	Contingency for Planning Stage Estimate (25%)				$332,850
	Construction Total				$1,664,250
5	**O&M**	1	LS	--	$1,390,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$4,005,450
	Total Estimate (rounded)				$4,010,000

Hugo Reid Park

Hugo Reid Park in the city of Arcadia adjacent to the unincorporated County area of East Pasadena, has been identified through the BMP optimization results as the site for a 0.6-acre infiltration basin. The BMP would have a storage capacity of 3.2 AF, and implementing it would require the following:

- Diversion from Project Number 24 storm drain (69" RCP with 3 feet of cover) with 100 feet of connecting pipe
- 0.6-acre by 7-foot-deep basin, resulting in excavation/haul quantity of 5,200 CY

Table K-14. Centralized BMPs on Public Land: Hugo Reid Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$203,800
4	**Construction**				
	Mobilization	1	LS	--	$41,800
	Storm Drain Pipe	100	LF	$200	$20,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.6 ac x 7')	5,200	CY	$40	$208,000
	Fine Grading and Surface Preparation	2,911	SY	$10	$29,111
	Landscaping	26,200	SF	$5	$131,000
	Park Restoration	1	LS	--	$83,622
	Subtotal				$543,533
	Contingency (25%)				$135,883
	Construction Total				$679,417
5	**O&M**	1	LS	--	$570,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$1,822,217
	Total Estimate (rounded)				$1,830,000

Loma Alta Park

The 7.3-acre Loma Alta Park is in the unincorporated County area of Altadena. The BMP optimization results identify the park as the site for a 1.9-acre infiltration basin with 10.2 AF of storage. Implementing the project would require the following:

- Diversion from the Altadena System storm drain (6' (W) x 6' (H) with 10 feet cover with 400 feet of connecting pipe
- 1.9-acre by 6.5-foot-deep basin, resulting in excavation/haul quantity of 16,500 CY

Table K-15. Centralized BMPs on Public Land: Loma Alta Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$459,600
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$689,300
4	**Construction**				
	Mobilization	1	LS	--	$141,400
	Storm Drain	400	LF	$200	$80,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (1.9 ac x 6.5')	16,500	CY	$40	$660,000
	Media	4,600	CY	$30	$138,000
	Fine Grading and Surface Preparation	9,200	SY	$10	$92,000
	Landscaping	82,800	SF	$5	$414,000
	Park Restoration	1	LS	--	$282,800
	Subtotal				$1,838,200
	Contingency (25%)				$459,550
	Construction Total				$2,297,750
5	**O&M**	1	LS	--	$1,920,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$5,485,650
	Total Estimate (rounded)				$5,490,000

Magic Johnson Park

The southeastern corner of the 94-acre Earvin "Magic" Johnson Park has been identified as a site for an infiltration basin. From the BMP optimization model, the basin would be 3.7 acres in size with 20 AF of storage. Implementing the project would require the following:

- Diversion from the storm drain in El Segundo Boulevard (72" RCP) with 100 feet of connecting pipe
- 3.7-acre by 6-foot-deep basin, resulting in excavation/haul quantity of 32,300 CY

Table K-16. Centralized BMPs on Public Land: Magic Johnson Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$756,400
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$1,134,500
4	**Construction**				
	Mobilization	1	LS	--	$232,700
	Storm Drain	100	LF	$200	$20,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (3.7 ac x 6')	32,300	CY	$40	$1,292,000
	Fine Grading and Surface Preparation	17,911	SY	$10	$179,111
	Landscaping	161,200	SF	$5	$806,000
	Park Restoration	1	LS	--	$465,422
	Subtotal				$3,025,233
	Contingency (25%)				$756,308
	Construction Total				$3,781,542
5	**O&M**	1	LS	--	$3,170,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$8,961,442
	Total Estimate (rounded)				$8,970,000

Mona Park

Mona Park in the unincorporated County area of south Los Angeles is an 8.4-acre recreational facility. From the BMP optimization results, a 0.6-acre infiltration basin with 3.2 AF of storage has been identified for this site. Implementing the project would require the following:

- Diversion from Glen Avenue Drain System (9'6" (W) x 8' (H) RCB with 5 feet of cover) and 100 feet of connecting pipe
- 0.6-acre basin by 8-foot depth, 3:1 side slopes—excavation/haul of 5,500 CY
- Lift station capacity of 800 gpm, assuming a 3.2 AF basin filled in 24 hours

Table K-17. Centralized BMPs on Public Land: Mona Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$363,200
4	**Construction**				
	Mobilization	1	LS	--	$74,500
	Storm Drain	100	LF	$200	$20,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.6 ac x 8')	5,500	CY	$40	$220,000
	Stormwater Pump Station/Wet Well (800 gpm)	1	Each	$300,000	$300,000
	Media	500	CY	$30	$15,000
	Fine Grading and Surface Preparation	2,911	SY	$10	$29,111
	Landscaping	26,200	SF	$5	$131,000
	Park Restoration	1	LS	--	$149,022
	Subtotal				$968,633
	Contingency (25%)				$242,158
	Construction Total				$1,210,792
5	**O&M**	1	LS	--	$1,010,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$2,952,992
	Total Estimate (rounded)				$2,960,000

Northside Drive Median

The wide grassy median in Northside Drive has been identified in the BMP optimization results as a site for a 0.4-acre infiltration basin with 2.3 AF of storage. Implementing the project would require the following:

- Diversion from DDI 23 Storm Drain (8'6" (W) x 11' (H) RCB with 2 feet of cover) and 20 feet of connecting pipe.
- 0.4-acre by 8-foot-deep basin, resulting in an excavation/haul quantity of 3,750 CY

Table K-18. Centralized BMPs on Public Land: Northside Drive Median BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$120,000
4	**Construction**				
	Mobilization	1	LS	--	$29,100
	Storm Drain	20	LF	$200	$4,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.4 ac x 8')	3,750	CY	$40	$150,000
	Fine Grading and Surface Preparation	1,944	SY	$10	$19,444
	Landscaping	17,500	SF	$5	$87,500
	Subtotal				$320,044
	Contingency (25%)				$80,011
	Construction Total				$400,056
5	**O&M**	1	LS	--	$340,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$1,229,056
	Total Estimate (rounded)				$1,230,000

Obregon Park

Obregon Park is in the unincorporated County area of City Terrace – East Los Angeles and has been identified in the BMP optimization results as a site for a 1.7-acre extended detention basin with 6.6 AF of storage. Implementing the project would require the following:

- Diversion from DDI 26 (11' (W) x 8' (H) storm drain) about 4 feet of cover), junction structure, inlet structure, outlet structure, 100 feet of pipe, pumps?
- 1.7-acre by 4.5-foot-deep basin, resulting in an excavation/haul quantity of 10,700 CY
- Sediment forebay (25 percent of total basin volume), resulting in an excavation/haul quantity of 2,675 CY
- Lift station capacity of 1,500 gpm, assuming a 6.6-AF basin filled in 24 hours.

Table K-19. Centralized BMPs on Public Land: Obregon Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$1,197,800
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$1,796,600
4	**Construction**				
	Mobilization	1	LS	--	$368,500
	Storm Drain	100	LF	$200	$20,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Outlet Structure	1	Each	$25,000	$25,000
	Excavation for Detention Basin (1.7 ac x 4.5')	29,700	CY	$40	$1,188,000
	Excavation for Forebay	7,425	CY	$40	$297,000
	Stormwater Pump Station/Wet Well (1,500 gpm)	1	Each	$400,000	$900,000
	Fine Grading and Surface Preparation	22,278	SY	$10	$222,778
	Landscaping	200,500	SF	$5	$1,002,500
	Park Restoration	1	LS	--	$737,056
	Subtotal				$4,790,833
	Contingency (25%)				$1,197,708
	Construction Total				$5,988,542
5	**O&M**	1	LS	--	$2,990,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$12,091,942
	Total Estimate (rounded)				$12,100,000

Roosevelt Park

Roosevelt Park along Graham Avenue in unincorporated County is a recreational facility that has been identified in the BMP optimization results as a site for a 0.7-acre infiltration basin with 3.7 AF of storage. Implementing the BMP would require the following:

- Diversion from the Whitsett Avenue Drainage System (smaller storm drain assumed since close to beginning of system) and 600 feet of connecting pipe (residences may prevent direct route from Whitsett Avenue)
- 0.7-acre by 7-foot-deep basin; resulting in an excavation/haul quantity of 6,000 CY

Table K-20. Centralized BMPs on Public Land: Roosevelt Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$281,000
4	**Construction**				
	Mobilization	1	LS	--	$57,600
	Storm Drain	600	LF	$200	$120,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.7 ac x 7')	6,000	CY	$40	$240,000
	Fine Grading and Surface Preparation	3,389	SY	$10	$33,889
	Landscaping	30,500	SF	$5	$152,500
	Park Restoration	1	LS	--	$115,278
	Subtotal				$749,267
	Contingency (25%)				$187,317
	Construction Total				$936,583
5	**O&M**	1	LS	--	$780,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$2,366,583
	Total Estimate (rounded)				$2,370,000

Salazar Park

The 8.4-acre Salazar Park is in an unincorporated County area of City Terrace – East Los Angeles. From the BMP optimization, a 1.8-acre infiltration basin with 9.9 AF of storage has been identified for treatment of unincorporated County drainage area. Implementing the BMP would require the following:

- Diversion from the 39" Ditman Street Lateral and 100 feet of connecting pipe
- 1.8-acre by 6.5-foot-deep basin, resulting in an excavation/haul quantity of 16,000 CY

Table K-21. Centralized BMPs on Public Land: Salazar Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$380,200
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$570,300
4	**Construction**				
	Mobilization	1	LS	--	$117,000
	Storm Drain	100	LF	$200	$20,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (1.8 ac x 6.5')	16,000	CY	$40	$640,000
	Fine Grading and Surface Preparation	8,722	SY	$10	$87,222
	Landscaping	78,500	SF	$5	$392,500
	Park Restoration	1	LS	--	$233,944
	Subtotal				$1,520,667
	Contingency (25%)				$380,167
	Construction Total				$1,900,833
5	**O&M**	1	LS	--	$1,590,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$4,560,333
	Total Estimate (rounded)				$4,570,000

Compton Creek Wetland

The proposed site for the BMP is in the unincorporated County area of Rancho Dominguez, adjacent to Compton Creek. Implementing the project components would require the following:

- Diversion from Compton Creek to a detention basin with 750 feet of connecting pipe
- Grading approximately 4.3 acres of detention basin into wetland configuration, resulting in an excavation quantity of 16,500 CY and fill quantity of 2,700 CY
- Observation area and associated site improvements

Table K-22. Centralized BMPs on Public Land: Compton Creek Wetland BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$962,600
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$1,443,800
4	**Construction**				
	Mobilization	1	LS	--	$296,200
	Storm Drain	211	LF	$1,300	$274,300
	Flow Control Structure	1	LS	--	$860,000
	Inlet Structure	1	Each	$50,000	$50,000
	Outlet Structure	1	Each	$50,000	$50,000
	Rip Rap	1,344	CY	$145	$194,880
	Excavation for Wetland (1.7 ac x 4.5')	16,500	CY	$40	$660,000
	Fill	2,700	Each	$45	$121,500
	Observation Area	1	LS	--	$211,000
	Landscaping/Irrigation	1	LS	--	$540,000
	Park Restoration	1	LS	--	$592,336
	Subtotal				$3,850,216
	Contingency (25%)				$962,554
	Construction Total				$4,812,770
5	**O&M**	1	LS	--	$2,400,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$9,738,170
	Total Estimate (rounded)				$9,740,000

Ted Watkins Park

The 27-acre Ted Watkins Park is in the unincorporated County area of South Los Angeles. The BMP optimization results identify two infiltration basins for this site. The two drainage areas could also be routed to a single BMP, which could reduce costs, although preliminary cost estimates indicate that the cost of a single BMP would be similar to the two separate BMPs. The two BMPs are noted as a Left and a Right portion of Ted Watkins Park.

Ted Watkins Park Left. The infiltration basin identified for the west side of the park is 0.2 acre in size with a storage capacity of 1.3 AF. Implementing the project would require the following:

- Diversion from the Project 73 storm drain (8’3” (W) x 10’ (H) RCB with 7 feet of cover) and 300 feet of connecting pipe
- 0.3-acre by 8-foot-deep basin, resulting in an excavation/haul quantity of 2,100 CY

Table K-23. Centralized BMPs on Public Land: Ted Watkins Park Left BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$201,900
4	**Construction**				
	Mobilization	1	LS	--	$41,400
	Storm Drain	300	LF	$200	$60,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.3 ac x 8')	2,100	CY	$40	$84,000
	Stormwater Pump Station/Wet Well (300 gpm)	1	Each	$160,000	$160,000
	Fine Grading and Surface Preparation	1,456	SY	$10	$14,556
	Landscaping	13,100	SF	$5	$65,500
	Park Restoration	1	LS	--	$82,811
	Subtotal				$538,267
	Contingency (25%)				$134,567
	Construction Total				$672,833
5	**O&M**	1	LS	--	$560,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$1,803,733
	Total Estimate (rounded)				$1,810,000

Ted Watkins Park Right. The infiltration basin identified for the east side of this site is 1 acre in size with a storage capacity of 5.4 AF. Implementing the project would require the following:

- Diversion from the Hooper Avenue Drain System (double 7' (W) x 7' (H) RCB with 4 feet of cover), and 450 feet of connecting pipe
- 1-acre by 6.5-foot-deep basin, resulting in an excavation/haul quantity of 8,750 CY

Table K-24. Centralized BMPs on Public Land: Ted Watkins Park Right BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$369,400
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$554,000
4	**Construction**				
	Mobilization	1	LS	--	$113,600
	Storm Drain	450	LF	$200	$90,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Detention Basin (1 ac x 6.5 ')	8,750	CY	$40	$350,000
	Stormwater Pump Station/Wet Well (1,200 gpm)	1	Each	$400,000	$400,000
	Fine Grading and Surface Preparation	4,844	SY	$10	$48,444
	Landscaping	43,600	SF	$5	$218,000
	Park Restoration	1	LS	--	$227,289
	Subtotal				$1,477,333
	Contingency (25%)				$369,333
	Construction Total				$1,846,667
5	**O&M**	1	LS	--	$1,550,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$4,439,067
	Total Estimate (rounded)				$4,440,000

Two Strike Park

Two Strike Park in unincorporated County area of La Crescenta has been identified as a site for an infiltration-type BMP. The optimization results size a 2.6-acre infiltration basin with 14.2 AF of storage to meet TMDL requirements. Implementing the project would require the following:

- Diversion from the Eagle Canyon Channel
- 2.6-acre by 6.5-foot-deep basin, resulting in an excavation/haul quantity of 22,900 CY

Table K-25. Centralized BMPs on Public Land: Two Strike Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$533,800
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$800,700
4	**Construction**				
	Mobilization	1	LS	--	$164,200
	Storm Drain	20	LF	200	$4,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (2.6 ac x 6.5')	22,900	CY	$40	$916,000
	Fine Grading and Surface Preparation	12,589	SY	$10	$125,889
	Landscaping	113,300	SF	$5	$566,500
	Park Restoration	1	LS	--	$328,478
	Subtotal				$2,135,067
	Contingency (25%)				$533,767
	Construction Total				$2,668,833
5	**O&M**	1	LS	--	$2,240,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$6,362,333
	Total Estimate (rounded)				$6,370,000

Whittier Narrows Park

The Whittier Narrows Park is a large recreational area that is south of the city of South El Monte and includes large, open spaces. The BMP optimization results identify a 0.4-acre infiltration basin with 2.4 AF of storage for treatment. Implementing the BMP would require the following:

- Diversion from 1213 Drain (8’9” (W) x 3’9” (H) with 2 feet of cover) with 20 feet of connecting pipe
- 0.4-acre by 8-foot-deep basin, resulting in an excavation/haul quantity of 3,875 CY

Table K-26. Centralized BMPs on Public Land: Whittier Narrows Park BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$144,300
4	**Construction**				
	Mobilization	1	LS	--	$29,600
	Storm Drain	20	LF	$200	$4,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.4 ac x 8 ')	3,875	CY	$40	$155,000
	Fine Grading and Surface Preparation	1,944	SY	$10	$19,444
	Landscaping	17,500	SF	$5	$87,500
	Park Restoration	1	LS	--	$59,189
	Subtotal				$384,733
	Contingency (25%)				$96,183
	Construction Total				$480,917
5	**O&M**	1	LS	--	$400,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$1,394,217
	Total Estimate (rounded)				$1,400,000

Whittier Narrows Recreation Area

The large Whittier Narrows Recreation Area includes significant areas of open space. The park has been identified as a site for an infiltration-type BMP for an unincorporated County drainage area that includes 5 impervious acres. The BMP optimization results size a 0.2-acre basin with 0.9 AF of storage for treatment. Implementing the BMP would require the following:

- Diversion from the Project Number 1115 storm drain system (6'9" (W) x 8'9" (H) RCB with 9 feet of cover), with 100 feet of connecting pipe
- 0.2-acre by 8-foot-deep basin, resulting in an excavation/haul quantity of 1,500 CY
- Lift station capacity of 200 gpm, assuming 0.9 AF basin fills in 24 hours

Table K-27. Centralized BMPs on Public Land: Whittier Narrows Recreation Area BMP Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	1	LS	--	$250,000
2	**Permits/Studies**	1	LS	--	$50,000
3	**Design**	1	LS	--	$153,000
4	**Construction**				
	Mobilization	1	LS	--	$31,400
	Storm Drain	100	LF	$200	$20,000
	Junction Structure	1	Each	$5,000	$5,000
	Inlet Structure	1	Each	$25,000	$25,000
	Excavation for Infiltration Basin (0.2 ac x 8 ')	1,500	CY	$40	$60,000
	Pump Station/Wet Well (200 gpm)	1	Each	$150,000	$150,000
	Fine Grading and Surface Preparation	978	SY	$10	$9,778
	Landscaping	8,800	SF	$5	$44,000
	Park Restoration	1	LS	--	$62,756
	Subtotal				$407,933
	Contingency (25%)				$101,983
	Construction Total				$509,917
5	**O&M**	1	LS	--	$430,000
6	**Pre- and Post-Construction Monitoring**	1	LS	--	$69,000
	Project Total				$1,461,917
	Total Estimate (rounded)				$1,470,000

K.2.3. Costs for Centralized Structural BMPs on Private Property

To estimate planning-level, construction, and O&M cost estimates for centralized structural BMPs on private property, a relationship between costs and storage capacities was developed for the centralized infiltration basins on public property. A linear regression provided the most realistic estimate of centralized BMPs on private property. The linear regression was applied to the recommended storage capacity to estimate total costs for planning through construction and annual operation and maintenance. Pre- and post-construction monitoring costs were calculated using the monitoring cost for centralized BMPs on public property multiplied by the estimated number of centralized BMPs on private property. The number of BMPs is based on the total acres of required treated drainage area (1,995 acres) divided by the assumed treatment area for each infiltration basin (60 acres).

Because this is privately owned land, estimated land acquisition costs were also included. Fee simple acquisition of the BMP site was assumed. Acquisition through purchase of conservation easements would likely be possible on some sites, in which case the cost estimates would be lower.

Initial steps in the land acquisition include identification of potential parcels for BMPs and landowner outreach. Criteria would be developed to prioritize parcels and landowner information would be obtained from the property tax database for high and medium priority parcels. Once landowner contact information is compiled into a priority parcel database, a landowner outreach strategy should be developed. The strategy should include at minimum:

- Development of Information Packet
    - Develop a cover letter explaining the purpose and contents of the packet.
    - Provide a narrative of BMP construction process; sequential pictures of BMP construction process, showing various stages of excavation, construction, and vegetation growth; copies of 30 percent design drawings of the site for one or more BMP; and several examples of BMP finished products.
    - Determine if construction easement is needed and what options are available for the easement, and possible location of maintenance easement.
    - Determine which acquisition options are available (e.g., fee simple acquisition may not be possible if the BMP is not on the edge of a property).
    - Include the following example documents: Option Agreement Template, BMP Easement Template, and Temporary Construction Easement Template.

- Initial Landowner Contact
    - Develop the message and information that will be provided during the initial contact, including brief explanation of BMP design and potential benefits of project.

- First On-site Meeting with the Landowner
    - Develop key talking points for first on-site meeting with landowner.
    - Develop form to document landowner interest including but not limited to landowner's concerns and questions, landowner's provisions for agreeing to the project (e.g., requires a fence around the BMP), and level of interest.

- Maintain Database of Priority Parcels
    - Update priority parcel database at least annually, including updating new parcel identification, progress on landowner contacts, and status of negotiation/agreement.

Table K-28. Centralized BMPs on Private Land Estimated Costs

Description	Infiltration Basins Cost
Land Acquisition	$5.6 million/acre
Planning through Construction	$425,600/acre-ft
Maintenance	$2,452,000/year
Pre-Construction Monitoring	$940,000/year
Post-Construction Monitoring	$446,000/year
Total PV Cost[a]	**$349,530,000**

a. The total PV cost is calculated independent of the implementation schedule.

K.3. Nonstructural BMPs: Cost Assumptions and Estimates

For nonstructural BMP projects, costs are included for planning, permitting, and other upfront costs. In addition, annual and long-term costs are estimated, which include program operation and evaluation costs. The general assumptions made in developing the cost estimates are described in the following section.

K.3.1. General Cost Assumptions for Nonstructural BMPs on Public Property

Planning

For most nonstructural BMPs, planning costs include the approximate cost of staff time to attend planning meetings toward implementing the BMP. The same assumptions for meeting cost were used for each nonstructural BMP. Each meeting length was assumed to be 2 hours, and it was assumed that four staff members would attend each meeting: administrative assistant level II, program manager level I, program manager level II, and management specialist level I. Hourly rates for the staff used approximately represent staff rates from County departments. Each meeting cost is estimated as $500. The number of meetings varies for some nonstructural BMPs, but it was assumed that at least three planning meetings would be required: (1) initial discussion involving brainstorming, questions, and planning assignments; (2) presenting and discussing initial plans; and (3) finalizing implementation plans.

Permitting

As discussed in Section 8, very few permitting requirements are likely to be required for nonstructural BMPs. For all the nonstructural BMPs recommended, the permitting cost is assumed to be zero.

Other Upfront Costs

Each nonstructural BMP varies as to the type of materials, labor, and other costs required to implement the program. Such cost assumptions were developed separately for each BMP.

Program Operating Costs

Annual costs to operate programs were estimated for each nonstructural BMP.

Program Evaluation

For each nonstructural BMP, approximate costs for monitoring or program evaluation are included. For some BMPs, program evaluation was already being conducted for an existing program and additional costs evaluation costs would not be necessary.

Table K-29. Nonstructural BMPs: TMDL-Specific Stormwater Training

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	3	Meeting	$800	$2,400
2	**Training Material Preparation**	1	LS	--	$8,000
3	**Program Operation (20 years)**				
	Training Materials	1	LS	--	$6,000
	Material Updates	1	LS	--	$26,000
	Staff Attendance at Training	1	LS	--	$62,000
	Individual Division Training (first three years)	1	LS	--	$203,000
	Program Operation Total				$297,000
4	**Program Evaluation**	1	LS	--	$8,000
	Project Total				$315,400
	Total Estimate (rounded)				$320,000

Table K-30. Nonstructural BMPs: Enhancement of Commercial and Industrial Facility Inspections

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	2	Meeting	$1,000	$2,000
3	**Program Operation (20 years)**				
	Conduct Audits (every 5 years)	1	LS	--	$3,000
	Communicate Audit Results (after every audit)	1	LS	--	$2,000
	Program Operation Total				$5,000
4	**Program Evaluation (every 5 years, 20 years total)**	1	LS	--	$7,000
	Project Total				$14,000
	Total Estimate (rounded)				$14,000

Table K-31. Nonstructural BMPs: Smart Gardening Program Enhancements—Workshops in the Los Angeles River Watershed

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Initial Workshops**				
	Department and division planning meetings	3	meeting	$500	$1,500
	Conduct 10 workshops per year for 3 years	1	LS	--	$38,100
	Initial Workshops Total				$39,600
2	**Long-term Workshop Program**				
	Department and division planning meetings	3	meeting	$500	$1,500
	Design of information center	1	Each	$500	$500
	Construction of information centers	3	Each	$4,500	$13,500
	Design of learning center	1	Each	$11,500	$11,500
	Construction of learning center	1	Each	$115,000	$115,000
	Conduct workshops (10 workshops per year for 17 years, 7 off-site)	1	LS	--	$144,300
	Information center maintenance	1	LS	--	$30,400
	Learning center maintenance	1	LS	--	$33,800
	Long-term Workshop Program Total				$316,700
3	**Post-Implementation Evaluation**	1	LS	--	$0
	Project Total				$356,300
	Total Estimate (rounded)				$357,000

Table K-32. Nonstructural BMPs: Smart Gardening Program Enhancements—Workshop Tip Cards on Water Quality

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**	3	meeting	$700	$2,100
2	**Tip Card Development**	1	LS	--	$1,200
3	**Tip Card Printing (Distributed at 200 workshops over 20 years)**	1	LS	--	$1,500
	Project Total				$4,800
	Total Estimate (rounded)				$5,000

Table K-33. Nonstructural BMPs: Reduction of Irrigation Return Flow

Item	Description	Estimated Quantity	Unit	Unit Price	Total
A. Smart Controller Rebates Program					
1	**Planning and Initial Marketing**				
	Initial Planning	800	hours	$65	$52,000
	Marketing Tools	1	LS	--	$40,000
	Planning and Initial Marketing Total				**$92,000**
2	**Program Operation (20 years)**				
	Program Maintenance	1	LS	--	$1,410,000
	Direct Mailings (2,600 letters, once per year)	1	LS	--	$65,000
	Rebates (130 per year)	1	LS	--	$486,000
	Contractor Installation	1	LS	--	$194,000
	Program Operation Total				**$2,155,000**
3	**Post-Implementation Evaluation (20 years)**				
	Participant Surveys (130 per year)	1	LS	--	$3,200
	Staff Hours	1	LS	--	$106,000
	Post-Implementation Evaluation Total				**$109,200**
	Project Total				**$2,356,200**
	Total Estimate (rounded)				**$2,360,000**
B. Xeriscaping Incentives Program					
1	**Planning and Initial Marketing**				
	Initial Planning	800	hours	$65	$52,000
	Marketing Tools	1	LS	--	$40,000
	Planning and Initial Marketing Total				**$92,000**
2	**Program Operation (20 years)**				
	Program Maintenance	1	LS	--	$1,147,000
	Direct Mailings (2,600 letters, once per year)	1	LS	--	$65,000
	Incentives (130 3,000-SF conversions per year)	1	LS	--	$7,290,000
	Program Operation Total				**$8,502,000**
3	**Post-Implementation Evaluation (20 years)**				
	Participant Surveys (130 per year)	1	LS	--	$3,200
	Staff Hours	1	LS	--	$106,000
	Post-Implementation Evaluation Total				**$109,200**
	Project Total				**$8,703,200**
	Total Estimate (rounded)				**$8,700,000**

Table K-34. Nonstructural BMPs: Improved Street Sweeping Technology

Item	Description	Estimated Quantity	Unit	Unit Price	Total
1	**Planning**				
	Meetings	3	meeting	$1,000	$3,000
	Program set-up (specs, ordering, staff coordination, etc.)	1	LS	--	$5,000
	Planning Total				$8,000
2	**Program Operation**				
	Labor	1	LS	--	$6,070,000
	Vehicle Rental, Fuel, and Maintenance	1	LS	--	$6,550,000
	Program Operation Total				$12,620,000
3	**Program Evaluation**	1	LS	--	$58,000
	Project Total				$12,686,000
	Total Estimate (rounded)				$12,690,000

K.4. References

Sanks, R.L., ed. 1989. *Pumping Station Design*. Butterworth-Heinemann, Boston, MA.

USEPA (U.S. Environmental Protection Agency). 2009. *National Pollutant Discharge Elimination System (NPDES) Menu of BMPs*. U.S. Environmental Protection Agency, Office of Wastewater Management. www.epa.gov/npdes/stormwater/menuofbmps. Accessed September 2009.

Appendix L. Detailed TMDL Plan Evaluation

This appendix provides the detailed evaluation of the recommended TMDL Implementation Plan on the basis of the decision criteria outlined in Section 10.

L.1. Detailed Evaluation Criteria

Evaluation criteria were identified that fall into six categories:

- **Certainty of Meeting TMDL Requirements**— As the BMPs are phased in over time, are TMDL requirements met for the County's County TMDL Implementation Area?
- **Cost Effectiveness**—How do the life cycle costs and cost effectiveness compare among phases?
- **Complementary Integration**—How well do the BMPs complement each other in meeting water quality objectives (e.g., a vegetated swale draining to a bioretention cell)? Are certain projects time-sensitive or phase-sensitive (e.g., an upstream BMP might need to be implemented for a downstream BMP to function sustainably over time)?
- **Feasibility**—What constraints exist on-site or in the community that affect the feasibility of implementation?
- **Integrated Water Resources Planning**—How well do the BMPs meet the County's integrated water resources planning objectives?
- **Other Sustainability Benefits**—Do the BMPs provide other sustainability benefits or affect sustainability negatively?

The first four evaluation criteria were applied to evaluate and recommend BMPs for the TMDL Implementation Plan. The category Complementary Integration was used as a guide to the timing of BMP implementation. All the categories of the criteria were used to evaluate the recommended TMDL Implementation Plan to identify areas of strength and as well as areas that might be strengthened in the future through adaptive management.

Table L-1 provides more detail on the six criteria, specific criteria.

Table L-1. Decision Criteria and Rankings

Evaluation Category/Criteria	Description
Certainty of Meeting TMDL Requirements	
Meets Phased Load Reduction Requirements	Different phases of implementation have different goals in terms of necessary load reduction. BMPS were evaluated on the basis of which have the highest certainty of meeting TMDL requirements.
Cost	
Life Cycle Cost	This draws from Tasks 3, 4, and 6 evaluations and the optimization analysis. For structural BMPs, the life cycle costs are initial installation costs as well as maintenance and replacement costs. For nonstructural BMPs, components of life cycle costs vary depending on the BMP.
Cost-effectiveness	This criterion draws on the structural BMPs cost-effectiveness data and the perceived cost-effectiveness for nonstructural BMPs.

Evaluation Category/Criteria	Description
Feasibility	
Natural Constraints	Natural constraints were considered such as slope, soils, and water table.
Physical Constraints	Existing or planned physical constraints were considered, including utility easements, existing or planned roads or park facilities, and existing BMP placement.
Ownership (type and number of owners)	For structural BMPs, the site's land ownership characteristics can significantly affect BMP feasibility. Publicly owned lands in the County TMDL Implementation Area would receive the highest priority for siting BMPs (excluding the public forest area land).
Administrative	Relative administrative feasibility of implementing different structural and nonstructural BMPs are assessed.
Political/Public Support	For a given site, which BMPs would likely have strong public support, which would raise opposition, and which would be neutral?
Degree of Certainty/Uncertainty	Because feasibility is based on qualitative assessments and what is known about existing technologies, this criterion notes the degree of certainty or uncertainty regarding BMP implementation feasibility. The uncertainty of obtaining regulatory and permit requirements was considered.
Complementary Integration	
Supports/Conflicts/Neutral	The suite of potential BMPs were evaluated according to which are supportive of each other or complementary in meeting water quality objectives, which are neutral, and which pose conflicts in functional integration.
Timing/Phase Sensitive/Neutral	BMPs were evaluated on the basis of whether they are time sensitive or phase sensitive in meeting water quality objectives (i.e., which BMPs should be implemented first for other BMPs to function as intended over time).
Integrated Water Resources Planning	
Improve Water Quality	Comply with water quality regulations (including TMDLs) by improving the quality of urban runoff, stormwater, and wastewater.
Water Conservation	Reduce water demand and use.
Groundwater Replenishment	Increase rainwater infiltration and enhances recharge of groundwater.
Enhanced Habitat	Protect, restore, and enhance natural processes and habitats.
Improved Aesthetics	Enhance the beauty of neighborhoods or districts through increased open space and landscaping/plantings, decreased trash, water amenities, etc.
Enhance Open Space and Recreation	Increase watershed friendly recreational space for all communities.
Flood Protection	Decreases runoff contributing to flooding. Enhances public infrastructure related to flood protection.,
Other Sustainability Benefits	
Integration of Natural and Built Environment	Reduces and treats runoff from the built environment close to its source using green infrastructure and natural processes.
Integration of Water Cycle	Employs practices that mimic and integrate the natural water cycle (rainfall, evaporation, runoff, infiltration, groundwater recharge, maintenance of stream baseflow).

Evaluation Category/Criteria	Description
Energy Reduction/Neutral	Employs practices that reduce energy requirements or do not add to energy demand.
Neutral or Positive Air Quality Benefits	Uses practices, such as natural green infrastructure and greenways, or processes that are neutral or positive for air quality.
Hydrologically Neutral or Restorative	Does not affect the volume, peak, or duration of the stream hydrographs, or restores a more natural stream hydrology.
Supports Healthy and Enjoyable Living, Working, and Recreation Space	Uses practices such as green infrastructure that are aesthetically pleasing, incorporated into the living and working environment, or add to recreation area.
Supports/Enhances Social Consecutiveness	Use of linear green infrastructure, which provide connectivity through walking or biking, or other aesthetically pleasing BMPs that can be used to create outdoor spaces.

L.2. TMDL Plan Evaluation

The recommended TMDL Implementation Plan was evaluated using the criteria described above. Each BMP was reviewed on the basis of the criteria. Then, it was determined whether the recommended Implementation Plan generally met, partially met, or did not meet the criteria. The following sections summarize the results of the evaluation.

L.2.1. Certainty of Meeting TMDL Requirements

As discussed in Section 6 the BMP phasing recommended by the optimization is estimated to achieve the metals TMDL requirements for wet weather. The BMPs proposed in the optimization also would provide some progress in meeting toxics and nutrient reduction requirements while also reducing bacteria loading. The TMDL Implementation Plan provide further opportunities to meet multiple TMDL requirements through the nonstructural BMPs. Section 4 discusses the pollutant removal benefits of the nonstructural BMPs. This decision criteria category relates to the certainty that the Implementation Plan and its BMPs would meet the phased load reduction requirements in the Los Angeles River watershed for multiple TMDLs. How each BMP meets these criteria is discussed below.

- **Structural BMPs**
  - The certainty that structural BMPs meet TMDL requirements are largely dependent on how these BMPs are designed and maintained. The optimization assumed that the structural BMPs would be designed according to standard engineering practices and maintained throughout their lifetime such that the expected treatment would be achieved. With those conditions in place, structural BMPs tend to provide more certainty than nonstructural BMPs because they represent permanent treatment facilities that can be designed according to requirements.

- **Nonstructural BMPs**
  - When the Implementation Plan was developed, most nonstructural BMPs were placed in Phase 1 unless it was unlikely that a BMP could be accomplished in that time frame. This helps increase the certainty of meeting TMDL requirements.
  - Some nonstructural BMPs provide greater certainty than others. Those that rely on voluntary participation, such as the Smart Gardening Program Enhancements, have a lower certainty, or higher risk, than those BMPs that involve regulatory requirements, such as inspections of commercial and industrial facilities.

It is assumed that the TMDL Implementation Plan meets this criteria category because, despite uncertainties, it was developed to maximize the available opportunities for meeting TMDL requirements.

L.2.2. Cost

The cost estimates developed in Section 9 were used to estimate the PV costs of the Implementation Plan BMPs. The individual BMP costs were entered into a cash flow spreadsheet according to when costs occur in the proposed schedules (Section 11). Copper was selected to represent the general cost-effectiveness for wet weather pollutant removal. The load reduction, cost, and cost-effectiveness of each implementation phase are summarized in Table L-2 for BMPs addressing wet weather metals pollutant reduction. The costs presented are different than those provided in the optimization because the TMDL Implementation Plan costs are based on more detailed, site-specific cost estimates. According to the detailed cost estimates, Phases 1 and 2 are estimated to be similar in cost-effectiveness, and Phase 3 is estimated to be much less cost-effective than Phases 1 and 2.

Table L-2. Wet Weather Metals Cost-Effectiveness Comparison of Phases

Phase	Metric	Load Reduction/Costs
1	Load Reduction (lbs copper/yr)	114
	Cost of Quantified BMPs	$44,400,000
	Cost-effectiveness ($ per lb reduced)	$20,000
2	Load Reduction (lbs copper/yr)	117
	Cost of Quantified BMPs	$45,100,000
	Cost-effectiveness ($ per lb reduced)	$19,000
3	Load Reduction (lbs copper/yr)	226
	Cost of Quantified BMPs	$202,000,000
	Cost-effectiveness ($ per lb reduced)	$45,000
Total	Load Reduction (lbs copper/yr)	457
	Cost of Quantified BMPs	$291,500,000
	Cost-effectiveness ($ per lb reduced)	$32,000

For wet weather reduction of bacteria and toxics, cost-effectiveness conclusions are expected to be similar to the conclusions for wet weather metals. Phases 1 and 2 are expected to be much more cost-effective than Phase 3.

Reduction of Irrigation Return Flow, proposed for Phase 2, is expected to achieve the greatest dry weather pollutant removal (both metals and nutrients) compared to the other proposed BMPs. Phase 1 seeks to accomplish a number of nonstructural BMPs that would provide dry weather pollutant reduction, especially the Smart Gardening Program Enhancements. The Phase 1 nonstructural BMPs cost much less than the Reduction of Irrigation Return Flow BMP, but they are expected to provide much less pollutant removal as well. As a result of the cost comparison, Phases 1 and 2 are expected to provide similar cost-effectiveness for dry weather pollutant removal. Catch basin inserts in Phase 3 would provide some metals and bacteria reduction if dry weather flows reach storm drains. However, Phase 3 is likely to be least cost-effective for dry weather because of its high overall cost.

It was determined that the proposed BMPs partially meet the cost criteria because of the cost-effectiveness of the earlier implementation phases.

L.2.3. Feasibility

Under the feasibility decision criteria, the TMDL Implementation Plan was evaluated on the basis of what constraints exist on-site or in the community that would prevent or slow implementation or render implementation less effective. Feasibility is considered separately for each type of proposed BMP below.

- **Infiltration Basin Centralized BMPs on Public Land**
  - In relation to natural and physical site constraints, the 18 infiltration basins proposed have suitable slopes, soils, and depth to water table.
  - Administratively, coordination between the LACDPW and Parks and Recreation departments would be needed to ensure that both departments' goals would be met by the proposed changes to the park sites. The recreational amenities at the sites are not likely to be negatively affected over the long term; although, during construction, some areas could be inaccessible.
  - The sites are on County-owned land, so there are no ownership barriers or property acquisition costs associated with the options. Also, they would be considered capital improvement projects similar to construction projects that the County undertakes regularly. Obtaining permits for BMP construction should not be problematic, particularly because the areas are already disturbed.
- **Dry Detention Basin Centralized BMP on Public Land (Obregon Park)**
  - Regarding site constraints, soil amendments would be required to restore infiltration to rates needed for a dry extended detention basin and a stormwater main would need to be rerouted.
  - Administrative coordination would be needed between LACDPW and Parks and Recreation departments to ensure that both departments' goals would be met by the proposed changes to the park. The recreational amenities at the site are not likely to be negatively affected over the long term; although, during construction, some areas could be inaccessible.
  - The site is on publicly owned land, so there are no ownership barriers or property acquisition costs associated with the options. Also, it would be considered a capital improvement project similar to construction projects that the County undertakes regularly. Obtaining permits for BMP construction should not be problematic, particularly because the area is already disturbed.
- **Constructed Wetland Centralized BMP on Public Land (Compton Creek)**
  - The Compton Creek Wetland is in the design phase and is scheduled to be installed in the summer of 2011.
  - The project includes diversion from Compton Creek to a detention basin, grading of the basin into a wetland configuration, building an observation area and completing associated site improvements. It will require federal CWA 404 and 401 permits, state CEQA and Lake and Streambed Alteration Program permits, and County geotechnical and sedimentation/erosion reporting and controls. Obtaining permits for BMP construction should not be problematic because the area is already disturbed, and the project is a retrofit that will enhance water quality and provide other environmental amenities.
  - The site is on publicly owned land, so there are no ownership barriers or property acquisition costs associated with the options.
- **Centralized BMPs on Private Land**
  - The extent to which BMPs can be implemented on private property depends on a number of factors. Site characteristics such as slope, soil, water table, available space, and existing structures and uses would be important. Voluntary or incentivized participation in a private property BMP program is assumed for this BMP. Therefore, successful implementation depends on landowner willingness to sell or donate land for the BMPs.

  - A major constraint for feasibility of centralized BMPs on private land is the ability to identify available and strategically located sites to treat 100 percent of the County TMDL Implementation Area per requirements of the phased WLAs for Los Angeles River TMDLs. However, as report in Section 6, the County has performed a robust quantitative analysis that suggests alternative strategies for centralized BMP implementation could treat less than 100 percent of the drainage area and still meet TMDL reduction targets. Although implementation of these or similar strategies that address a portion of the drainage area will be more expensive, these could result in more feasible implementation of centralized BMPs on public land.

- **Pilot Distributed BMP Project for a County Road**
  - The public roads 1-acre pilot project site should be selected to minimize natural constraints, although soil amendments or other design elements might be needed. Utilities and existing roads/driveways might require additional design or coordination and cooperation among public agencies and utility companies. The project would require significant interdepartmental communication to ensure that departments and divisions whose operations could be affected (e.g., road maintenance, flood maintenance, and construction divisions; fire department) understand and agree to the proposed changes.
  - The selected site would be publicly owned, so there would be no ownership barriers or property acquisition costs. Nearby residents and business owners might object to the pilot project because of effects during and after construction if the street configuration changes and affects access, traffic flow, or parking. Vegetated swales and bioretention areas along road right-of-ways should have public support if they are designed with aesthetics in mind. To minimize public opposition, designs should maintain or enhance walkability and accessibility for people with disabilities and should not impede sight lines for traffic or pedestrians.
  - Because the site has not yet been chosen, it is difficult to assess what types of feasibility issues would be encountered. LID practices are designed to fit into existing urban spaces, so it is likely that a design could be developed that minimizes public impacts. The lead department for the pilot project should ensure that other agencies' and departments' concerns are addressed in the individual designs to minimize intraorganizational opposition.

- **Distributed BMPs on Public Land**
  - These BMPs would have similar physical constraints as described for the road BMP pilot project above. Some of the sites could be on property owned by governments different from the implementing agency, so interdepartmental or interagency coordination would likely be needed. Because individual sites have not yet been identified, the question of permits needed cannot be addressed. Although, individual sites could be selected to minimize such concerns, and the types of BMPs used are not likely to present substantial permitting requirements.

- **Catch Basin Inserts**
  - The major feasibility consideration for this BMP is that the implementation time frame would depend on gaining approval by the RWQCB to use catch basin inserts instead of, or in addition to, full capture devices.
  - The BMP retrofits are not likely to cause public opposition because they are not visible and be designed to minimize maintenance or flooding issues that would affect the public. Nor are the retrofits expected to require environmental permits. Uncertainty exists regarding the performance and maintenance needs of these devices, but a design could be chosen that would not significantly increase current maintenance efforts.

- **TMDL-Specific Stormwater Training**
  - This BMP is expected to present few feasibility issues. It can be based partially on existing training programs and would require staff coordination mostly within a single department. Public opposition would not be a factor because this BMP solely involves County staff.
- **Enhancement of Commercial and Industrial Facility Inspections**
  - Inspection audits would be relatively easy to implement if interdepartmental coordination of this nature is supported by management. Additional staff time would need to be dedicated to inspections, increasing the per-inspection cost and potentially diverting staff resources from other tasks. To ensure success, proper communication should be given to the auditees, explaining the reasons for the audits.
- **Smart Gardening Program Enhancements: Smart Gardening Workshops**
  - The learning centers proposed could replace open space at parks, so building and environmental permits would be required. The center would likely garner public support; however, the process of modifying an existing park facility to accommodate it could be opposed by neighborhood residents and park users. The ideal circumstance with regard to changing land use would be to identify an underused, already built area in a park and replace it with a learning center and demonstration garden to minimize effects on existing recreation infrastructure and valued park amenities.
- **Smart Gardening Program Enhancements: Smart Gardening Tip Cards**
  - This BMP would be relatively easy to execute and would require coordination between LACDPW divisions. The County has developed tip cards in the past, and feasibility constraints are expected to be minimal. No public opposition is expected, as this merely provides a public service.
- **Enforcement Escalation Procedures**
  - It is feasible to assume that a staff member from the District Attorney’s office can be dedicated to pursuing stormwater violations, particularly if fines collected as a result of the increased effort offset the cost of the staff member’s time. Possible barriers would be coordination with the District Attorney’s office, lack of resources (staff or funding) for an additional staff member, and costs associated with processing and tracking the additional enforcement actions.
  - Facility operators would likely object to increased enforcement, and enforcing against small businesses could be politically unpalatable. The enforcement actions could result in negative press for the stormwater program depending on the circumstances of individual cases. The costs associated with increased staff and administrative burdens might not be offset by the additional fines collected as a result of increased enforcement follow-up.
- **Reduction of Irrigation Return Flow**
  - In addition to the aforementioned BMPs, this BMP involves programs to reduce irrigation return flow. Because the focus of the BMPs would be on private property, they would rely on incentives for voluntary participation. The water customers in the watershed receive their water from a private company, and the programs proposed are typically operated by a water supply agency. Implementing the BMP would be administratively difficult because the County would not have a direct relationship with water supply customers, though a partnership with the water supply agency might allow for data sharing to target advertising and incentives to key water consumers (the feasibility of a partnership between the County and the water supply agency is unknown). The County could establish its own incentive programs, but it would not be able to target its advertising to the largest-volume irrigators without information from the water supply agency.
- **Improved Street Sweeping Technology**
  - This BMP is expected to present few feasibility issues. Regenerative air sweepers would be employed in addition to or in conjunction with mechanical sweepers biweekly, necessitating upgrades of street

sweeping equipment used on routes in the County TMDL Implementation Area. This could be accomplished through rescheduling and redistributing existing equipment (from non-TMDL areas) and purchasing new regenerative air sweepers over time. Public opposition would not be a factor.

All BMPs above are expected to at least partially meet the feasibility criteria. Where feasibility constraints exist, planning and implementation methods are available to minimize the constraints. The BMPs were selected for the plan on the basis of a reasonable likelihood that they could be feasibly implemented. Until the planning stages are begun, further determination of feasibility is limited. It was determined that the TMDL Implementation Plan partially meets the feasibility criteria.

L.2.4. Complementary Integration

The purpose of this evaluation criterion is to detect projects that are time- sensitive or phase-sensitive in achieving long-term sustainability or functionality of a BMP. It also defines the degree to which the proposed BMPs are complementary in meeting water quality objectives, either the design or installation of BMPs *working together*, or programs that are synergistic. It was determined that the timing of the BMPs hinges more on feasibility rather than its long-term function or sustainability. Most of the recommended BMPs complement two or more proposed BMPs, and no implementation conflicts are posed among the BMPs recommended. Table L-3 summarizes the complementary integration of BMPs.

Table L-3. Complementary Integration of BMPs

BMPs Included in the TMDL Implementation Plan	**Public Property Centralized BMPs**	**Public Road Distributed BMP**	**Catch Basin Inserts**	**TMDL-Specific Stormwater Training**	**Enhancement of Commercial and Industrial Facility Inspections**	**Smart Gardening Program Enhancements**	**Reduction of Irrigation Return Flow**	**Enforcement Escalation Procedures**	**Institutional Distributed BMPs**	**Improved Street Sweeping Technology**	**Private Property Centralized BMPs**
Public Property Centralized BMPs				✓	✓						
Pilot Distributed BMP Project for a County Road				✓		✓	✓		✓	✓	
Catch Basin Inserts				✓		✓					
TMDL-Specific Stormwater Training	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Enhancement of Commercial and Industrial Facility Inspections	✓			✓	✓		✓	✓	✓		
Smart Gardening Program Enhancements		✓	✓	✓			✓				
Reduction of Irrigation Return Flow		✓		✓	✓	✓					
Enforcement Escalation Procedures				✓	✓						
Distributed BMPs on Public Land		✓		✓	✓					✓	
Improved Street Sweeping Technology		✓		✓					✓		
Centralized BMPs on Private Land				✓							

L.2.5. Integrated Water Resources Planning

This criterion evaluates the degree to which the BMPs recommended for the TMDL Implementation Plan contribute to integrated water resources planning, including the following:

- Improved water quality
- Water conservation
- Groundwater replenishment
- Improved aesthetics
- Enhanced open space and recreational spaces
- Enhanced habitat
- Flood protection

As discussed in Section 7, the BMPs for the TMDL Implementation Plan provide multiple water resources benefits. Various strategic planning efforts are underway that have a common goal of diversifying water supplies for the region, with a special emphasis on developing local supplies. Many agencies rely on artificial recharge of aquifers to support local groundwater production. Several planned projects in these regional plans fall within the TMDL Implementation Area: the Obregon Park BMP, Charles White Park BMP, and the Compton Creek BMP. These projects were included in the TMDL Implementation Plan. Moreover, all centralized and distributed BMPs proposed can support rainwater capture and groundwater replenishment.

The TMDL Implementation Plan also meets other goals articulated in the County's integrated water resources policy, including enhanced habitat, enhanced open space and recreation opportunities, and flood protection. Table L-4 highlights how each recommended BMP provides multiple water resources benefits. Note that the private centralized BMPs could provide additional benefits depending on their actual design and location.

Table L-4. Support of Integrated Water Resources Planning

BMPs Included in the TMDL Implementation Plan	Water Quality	Water Conservation	Groundwater Replenishment	Improved Aesthetics	Open Space/Recreation	Enhanced Habitat	Flood Protection
Public Property Centralized BMPs: Infiltration Basins	✓	✓	✓	✓	✓		✓
Public Property Centralized BMPs: Extended Detention	✓	✓	✓	✓	✓		✓
Public Property Centralized BMPs: Wetland	✓			✓		✓	
Public Road Distributed BMPs	✓	✓	✓	✓	✓	✓	✓
Catch Basin Inserts	✓						
TMDL-Specific Stormwater Training	✓						
Enhancement of Commercial and Industrial Facility Inspections	✓						
Smart Gardening Program Enhancements	✓	✓	✓		✓	✓	
Reduction of Irrigation Return Flow	✓	✓	✓				
Enforcement Escalation Procedures	✓						

BMPs Included in the TMDL Implementation Plan	Water Quality	Water Conservation	Groundwater Replenishment	Improved Aesthetics	Open Space/Recreation	Enhanced Habitat	Flood Protection
Improved Street Sweeping Technology	✓				✓		
Distributed Institutional BMPs	✓	✓	✓	✓	✓	✓	✓
Private Property Centralized BMPs: Infiltration Basins	✓	✓	✓	✓			✓
Private Property Centralized BMPs: Extended Detention Basins	✓	✓	✓	✓			✓

L.2.6. Other Sustainability Benefits

The TMDL Implementation Plan was evaluated on the basis of whether the proposed BMPs provide other sustainability benefits or affect sustainability negatively. As described in Table L-1 criteria included the following:

- Integration of Natural and Built Environment
- Integration of Water Cycle
- Energy Reduction/Neutral
- Neutral or Positive Air Quality Benefits
- Hydrologically Neutral or Restorative
- Supports Healthy and Enjoyable Living, Working, and Recreation Space
- Supports/Enhances Social Connectivity

The proposed BMPs are discussed below in relation to how they address these criteria. Table L-5 indicates which BMPs provide sustainability benefits.

- **Centralized BMPs on Public and Private Property**
  - The centralized BMPs on both public and private property would integrate the water cycle. These regional BMPs would treat runoff from the surrounding area and the site itself. The proposed BMPs are green infrastructure practices that would enhance the infiltration of rainfall from surrounding impervious areas, mitigating the negative impact of existing development and promoting groundwater recharge. The BMPs would help to restore natural stream hydrology by returning runoff to the ground and promoting groundwater recharge and stream baseflow. Therefore, they would help integrate the natural and built environment and would be hydrologically restorative.
  - The centralized BMPs would affect energy use and air quality during the construction phase and during maintenance activities that require heavy machinery. Where the BMPs replace impervious surfaces, they also help reduce the heat island effect and related energy expenditures.
  - Most of the proposed infiltration basins would replace existing open space and therefore would neither create nor alter recreation space. Underground storage can be used without affecting recreation facilities on the surface, although it would present an additional cost. Because the centralized BMPs on public property generally support enjoyable recreational space, they were

determined to meet the Supports Healthy and Enjoyable Living, Working, and Recreation Space criterion. The private centralized BMPs would also meet that criterion.

- The public centralized BMP sites are not expected to contribute to social connectivity, though opportunities to enhance greenspace connectivity might exist at private property sites, and the centralized BMPs can be designed to maximize this benefit.

- **Distributed BMPs**
  - The distributed BMPs proposed are all green infrastructure practices that would reduce and treat runoff from the built environment close to its source using natural processes. The BMPs mimic and integrate the natural water cycle (rainfall, evaporation, runoff, infiltration, groundwater recharge, maintenance of stream baseflow) and would have a positive effect on the volume, peak, or duration of the stream hydrographs, restoring a more natural stream hydrology.
  - Cumulatively, implementing green infrastructure practices, especially retrofits that replace elements of the built environment with green space, contribute to a reduction in the urban heat island effect, which could result in energy savings over the long term. Such practices should have a slight positive or neutral effect on air quality. Aesthetics would be enhanced by the distributed BMPs, particularly if the BMPs are replacing paved areas with little aesthetic quality.
  - The extent to which the distributed BMPs would provide a social benefit other than aesthetics has yet to be determined and would depend on the site and the chosen BMP design. Some pilot project locations would lend themselves more to public use than others, such as if the BMPs are near park space or in areas with heavy pedestrian use.

- **Nonstructural BMPs**
  - The nonstructural BMPs are expected to be relatively neutral in terms of energy use and air quality. The majority of the nonstructural BMPs, however, do not offer any sustainability or social benefits, with the exception of the Smart Gardening Program Workshops and Tip cards. The workshops and tip cards would encourage the creation of garden landscapes (either from impervious areas or lawns, which tend to be compacted in urban areas) and would benefit hydrology by enhancing stormwater infiltration.
  - Additionally, the Smart Gardening techniques demonstrated at the workshops encourage the creation of natural, low-impact landscaping and smart watering. They might slightly reduce energy demand through reduced water use at residences and businesses. Smart Gardening techniques also encourage the creation of green space, both at the learning centers and at residences and businesses if attendees of the workshops put the techniques into practice, which would increase green space and contribute to a reduction in the urban heat island effect. Home gardens that might result from the workshops would also enhance neighborhood appearance and foster time spent outdoors tending to gardens.
  - Reduction of Irrigation and Return Flow through reduced irrigation water use offers the sustainability benefits of water conservation and integration of the water cycle. If xeriscaping is encouraged, it can reduce energy and nutrient inputs in addition to conserving water. Xeriscaping that replaces elements of the built environment can reduce the urban heat island effect, enhance property aesthetics, and encourage residents to spend more time outside, either through gardening or recreation. However, it is expected that most reduction in irrigation and return flow would involve existing landscaped areas, and, therefore, this BMP does not meet the remaining sustainability criteria, including integration with the built environment.

Table L-5. Other Sustainability Benefits

BMP	Integration of Natural and Built Environment	Integration of Water Cycle	Energy Reduction/Neutral	Neutral or Positive Air Quality Benefits	Hydrologically Neutral or Restorative	Supports Healthy and Enjoyable Living, Working, and Recreation Space	Supports/Enhances Social Connectivity
Centralized Structural BMPs on Public Land							
Belvedere Park Centralized BMP	✓	✓			✓	✓	
Bethune Park Centralized BMP	✓	✓			✓	✓	
Charles White County Park Centralized BMP	✓	✓			✓	✓	
Enterprise Park Park Centralized BMP	✓	✓			✓	✓	
Farnsworth Park Centralized BMP	✓	✓			✓	✓	
G.W. Carver Park Centralized BMP	✓	✓			✓	✓	
Hugo Reid Park Centralized BMP	✓	✓			✓	✓	
Loma Alta County Park Centralized BMP	✓	✓			✓	✓	
Magic Johnson Park Centralized BMP	✓	✓			✓	✓	
Mona Park Centralized BMP	✓	✓			✓	✓	
Northside Drive Median Centralized BMP	✓	✓			✓	✓	
Obregon Park Centralized BMP	✓	✓	✓		✓	✓	
Roosevelt Park Centralized BMP	✓	✓			✓	✓	
Salazar Park Centralized BMP	✓	✓			✓	✓	
Compton Creek Wetland Centralized BMP	✓	✓	✓	✓	✓	✓	
Ted Watkins Park Left Centralized BMP	✓	✓			✓	✓	
Ted Watkins Park Right Centralized BMP	✓	✓			✓	✓	
Two Strike Park Centralized BMP	✓	✓			✓	✓	
Whittier Narrows Park Centralized BMP	✓	✓				✓	✓
Whittier Narrows Recreation Area Centralized BMP	✓	✓			✓	✓	
Distributed Structural BMPs on Public Land							
Pilot Distributed BMP Project for a County Road	✓	✓	✓	✓	✓	✓	
Distributed Structural BMPs on Public Land	✓	✓	✓	✓	✓	✓	
Catch Basin Inserts			✓	✓			
Nonstructural BMPs							
TMDL-Specific Stormwater Training			✓	✓			
Enhancement of Commercial and Industrial Facility Inspections			✓	✓			
Smart Gardening Program Enhancements	✓	✓	✓	✓		✓	
Reduction of Irrigation Return Flow		✓	✓	✓			
Enforcement Escalation Procedures			✓	✓			
Improved Street Sweeping Technology				✓			
Centralized Structural BMPs on Private Land	✓	✓	✓		✓	✓	

L.2.7. Summary of Evaluation

The most important criterion, Certainty of Meeting TMDL Requirements, is fully met, while the next most important criteria, cost and feasibility, are partially met. The latter calls for adaptive management approach to identify and employ new, cost effective BMPs or strategies if they become available in the future. On the whole, the recommended BMPs do a good job of meeting multiple benefits and supporting other County policies and initiatives.

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Appendix M. Assumptions for Development of TMDL Implementation Schedules

The following provides summarizes BMP implementation assumptions that informed the TMDL implementation schedule reported in Section 11.

M.1. Project Schedules for Nonstructural BMPs

The schedules for each nonstructural BMP are based on time frame recommendations from case study research and best professional judgment. Generally, two schedule components are estimated: (1) Planning, and (2) Program Operation and Evaluation. Best professional judgment was used as to the minimum planning time frames for all BMPs as follows:

- Program involving a small number of training events: 6 months minimum
- Program involving a bid package for construction: 9–12 months minimum
- Program involving multiple County departments: 2 years minimum
- Program involving studies: 9 months minimum

Planning considerations for specific BMPs include the following:

- **TMDL-Specific Stormwater Training**—Because the stormwater training program involves planning for a training event, the minimum 6-month planning duration is assumed.
- **Enhancement of Commercial and Industrial Facility Inspections**—An auditing program should take a relatively small time to set up because it involves brief coordination between two divisions and does not require developing training materials or any formal review or approval. The required planning time frame is estimated as 3 months.
- **Smart Gardening Program Enhancements: Workshops in Los Angeles River Watershed**—The schedule for the BMP is broken into the Initial Workshops and Long-term Workshop Program components, and each component has separate time frames for planning and program operation and evaluation. The schedule follows the time frame outline for the program as outlined in the cost estimate of the program enhancements in Appendix K. Planning for the information and learning centers begin 1.5 years after the initial training workshops begin and is expected to take about 6 months. Constructing the information center would occur during the third and final year of the initial training workshops.
- **Smart Gardening Program Enhancements: Workshop Tip Cards on Water Quality**—The planning component for water quality tip cards is assumed to include the design of the tip cards. Planning through design of the materials is assumed to take about 6 months; although, it could occur faster, depending on staff availability.
- **Reduction of Irrigation Return Flow**—A long planning time frame (5 years) is assumed for reducing irrigation return flows because it involves coordinating multiple County departments and building partnerships with other agencies. All three example programs would require substantial time to develop the program strategies and structure.
- **Enforcement Escalation Procedures**—Because the BMP involves coordinating multiple County departments, the planning time frame was assumed to be 3 years. More time could be needed to reach an agreement between departments or implement necessary administrative changes.
- **Improved Street Sweeping Technology**—Planning and equipment acquisition under this BMP was assumed to require one year. Then, a 20-year period was assumed for program operation.

For all nonstructural BMPs, unless otherwise noted above, program operation and evaluation is assumed to occur over a 20-year time frame. Frequency of program evaluations varies depending on the BMP, but for the purposes of the schedules, it was assumed that the evaluations would occur generally in the 20-year time frame.

M.2. Project Schedules for Distributed BMPs on Public Land

As outlined below, separate considerations were made for scheduling distributed BMPs on public land, which differed for catch basin inserts and structural BMPs on public parcels.

Catch Basin Inserts Phases 2 & 3

Catch basin inserts would require about 9 months to develop design specifications, test devices, conduct a department review, prepare a report, and gain RWQCB approval for using the devices to comply with trash TMDLs. The planning component is titled *planning through construction* to account for installing the devices in the same schedule component. It is assumed that the phase 2 installation could be accomplished in 3 years. That schedule might require that priority be given to installing the inserts over other installations outside the Los Angeles River watershed. Installing the Phase 3 catch basin inserts is assumed to occur over a 5-year period.

Distributed Structural BMPs on Public Land

Implementation time frames were developed for the distributed structural BMP projects, which include the phases for planning, data collection, design, permits, bidding, construction, O&M, and pre- and post-construction monitoring. Durations were assigned to each phase on the basis of an understanding of the activities required for each. Because of the large number of distributed BMPs requiring implementation in the County TMDL Implementation Area, a tiered and rolling scheduling approach was used to organize and realistically plan for successful BMP implementation.

As a basis for project scheduling, the number of distributed BMPs was estimated that would treat the minimum drainage areas required for each BMP type and location. By doing so allows the workload to be distributed across the project target dates using different implementation tiers to lessen the workload at the beginning (2009) and end (2021) dates. Each of the tiers, which are phased in one-year increments, represents a number of BMPs to be implemented in a single planning/construction/bidding process. The implementing department or agency would choose the number of bids allocated to the projects in each tier. The following assumptions were used to estimate the number of BMPs and implementation tiers:

- Bioretention cells rarely exceed between 4,000 and 5,000 square feet in surface area. For example, a 5,000-square-foot bioretention cell can treat a 2-acre watershed with 90 percent impervious surface for a 0.75-inch rainfall event. Because land area is very limited in the Los Angeles River watershed, 2,500 square feet of average surface area is more realistic for a bioretention cell. As a result, it is assumed that one bioretention cell would treat one acre of drainage area.
- Roadside bioretention has a higher drainage area to treatment area ratio than regular bioretention cells because they provide conveyance treatment in addition to infiltrative treatment. In the Los Angeles River watershed, a typical roadside bioretention cell is assumed to expand several blocks and treat approximately 5 acres of impervious roadway.
- Porous pavements most often have 1:1 drainage to treatment area ratios. Because larger parking lots should be targeted for porous pavement asphalt, it was assumed that each acre of parking lot would constitute one porous pavement BMP.
- Project phases (discussed below) from planning through construction require the same amount of time for all three distributed BMP types.

The preliminary project phases are as described below. Note that the project phases for distributed BMPs vary slightly from the centralized BMP project schedule, and the total project time from planning through construction for a distributed BMP is assumed to be 14 months. The schedules are based on the following assumptions:

- **Planning**—The planning phase requires further development of the project concept resulting in a Project Concept Report. Preliminary sizing and watershed delineation could also be included in the planning phase. If project approval is recommended during the planning phase, the implementing agency or department would move forward with necessary environmental documentation. The duration is assumed to be one month.
- **Data Gathering**—Before detailed BMP design, site data such as topographical surveys, soil tests, geotechnical analyses, and the like would need to be collected. The duration is assumed to be one month.
- **Permits**—Compared to the centralized BMPs, a shorter duration for the distributed BMP permitting phase is assumed because the permitting process often occurs simultaneously with the design phase, especially for smaller structural projects. The duration is assumed to be 2 months.
- **Design/Bid/Award**—Because preliminary design was conducted during the data gathering phase, the design phase develops the project concepts into finished drawings, including specifications and a project manual (often supplied by the local municipality). The design phase could include several submittal processes so the County's hydraulic/hydrology group could be involved for the proposed modifications to its storm drain facilities. Having final design documents allows the project to be competitively bid. The schedule assumes a 30-calendar-day bid period, followed by another 30 days for bid review, selection, and contract award. The duration is assumed to be 5 months.
- **Construction—**The construction phase duration is based on a generalized breakdown of the activities required for its completion. Construction starts with the contractor's mobilization, including vendor and subcontractor procurement, materials submittals, permit acquisitions, and temporary facilities. Although distributed BMPs are much smaller than centralized ones and take less time to construct, infiltrative BMPs like porous pavement and bioretention cells require extra time for excavation and bed-media preparation. Roadside bioretention could require temporary road closings that can also influence the construction schedule. The duration is assumed to be 5 months.
- **O&M**—It is assumed that maintenance is required throughout the project lifetime of 20 years.
- **Monitoring**—Pre-construction monitoring would take place at least one year before construction, and post-construction monitoring would take place 3 years following construction.

M.3. Project Schedules for Centralized Structural BMPs on Public Property

The project schedules for the 20 proposed centralized structural BMPs include phases for planning, design, permits, construction, O&M, and post-construction monitoring. Durations are assigned to each phase on the basis of an understanding of the activities required for each. The schedules are based on the following assumptions:

- **Planning—**The planning phase requires further development of the project concept resulting in a Project Concept Report. If project approval is recommended during the planning phase, the agency would move forward with the design.
- **Permits**—On the basis of an assessment of the permits and regulatory compliance measures that might be necessary for the project, the schedule includes six months for preparing environmental documents and the minimum 6-month review time anticipated for application approval.
- **Design/Bid/Award**—The schedule for the design phase begins with preliminary design to further develop the project concepts and establish the basis for design. A geotechnical investigation and report

and utility research would occur toward the beginning of the design phase. During the design phase, the County's hydraulic/hydrology group would be involved for the proposed modifications to its storm drain facilities. Having final design documents allows the project to be competitively bid. The schedule assumes a 30-calendar-day bid period, followed by another 30 days for bid review, selection, and contract award.

- **Construction**—The construction phase duration is based on a generalized breakdown of the activities required for its completion. Construction starts with the contractor's mobilization, including vendor and subcontractor procurement, materials submittals, permit acquisitions, and temporary facilities. Because all the centralized structural BMPs involve some form of basin construction, a relatively substantial amount of time has been allocated for excavation and surface preparation. Large basins have a longer duration for those activities than small basins, and vice versa. Projects with significant appurtenances, such as longer lengths of pipe, flow control structures, or pumping facilities, also have extended durations.
- **O&M**—It is assumed that maintenance is required throughout the project life of 20 years.
- **Pre- and Post-Construction Monitoring**—Pre-construction monitoring would take place at least 1 year before construction, and post-construction monitoring would take place 3 years following construction.

It is projected that not all centralized BMPs on public property can be implemented in Phase 1 because of the limited time frame (less than 2 years). Therefore, the schedule assumes that construction for all BMPs proposed for Phase 1 will begin in the phase and will be completed within a few years of the Phase 2 start.

M.4. Project Schedules for Centralized BMPs on Private Property

The schedules for centralized BMPs on private property are based on the overall periods estimated for the public property centralized BMPs. Six months were added to the project time frame to account for the process of acquiring land from private owners.