Draft Los Angeles River Metals TMDL Implementation Plan

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Acronyms

μg/g	microgram per gram
μg/L	micrograms per liter
$\mu g/m^2$	micrograms per square meter
APN	Assessor's Parcel Number
bgs	below ground surface
BMP	Best Management Practice
BPP	Brake Pad Partnership
CCWMP	Compton Creek Watershed Management Plan
CEH	Center for Environmental Health
CEQA	California Environmental Quality Act
CF	conversion factor
cfs	cubic feet per second
City of Los Angeles	City
CMP	Coordinated Monitoring Plan
CNDDB	California Natural Diversity Database
CRA	Community Redevelopment Agency
CWA	Clean Water Act of 1972
DCT	D.C. Tillman
DFG	Department of Fish and Game
DIYs	do-it-yourselfers
EMCs	Event Mean Concentrations
EPA	Environmental Protection Agency
ft MSL	feet mean sea level
GIS	geographic information system
IBA	Important Bird Area
Implementation Plan	TMDL Implementation Plan
IRP	Integrated Resources Plan
IRWMP	Integrated Regional Water Management Plan
LACDPW	LA County Department of Public Works
LAG	Los Angeles Glendale
LAR	Los Angeles River
LARMP	Los Angeles River Master Plan
LARRMP	Los Angeles River Revitalization Master Plan
LARWQCB	Los Angeles Regional Water Quality Control Board
mg/km	milligrams per kilometer
mgd	million gallons per day
MS4	Municipal Separate Storm Sewer System
NCDC	National Climatic Data Center
NGO	non-governmental organizations
NOAA	National Oceanic and Atmospheric Administration

NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
Porter-Cologne Act	Porter-Cologne Water Quality Control Act of 1970
POTW	publicly owned treatment works
ppm	parts per million
RHSG	Rio Hondo Spreading Grounds
RWQCB	Regional Water Quality Control Board
S&T	Status and Trends
SBPAT	Structural BMP Prioritization Analysis Tool
SCAG	Southern California Area Governments
SEA	Significant Ecological Area
State	State of California
State Board	California State Water Resources Control Board
SUSMP	Standard Urban Stormwater Mitigation Plan
TMDL	total maximum daily load
TPWP	Tujunga/Pacoima Watershed Plan
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WQCMPUR	Water Quality Compliance Master Plan for Urban Runoff
WRP	Water Reclamation Plants

Executive Summary

ES.1 Introduction

The Los Angeles River (LAR) Metals Total Maximum Daily Load (TMDL) Implementation Plan (Implementation Plan) defines the approach and steps that the City of Los Angeles (City) will take to comply with the requirements of the *Los Angeles River and Tributaries Total Maximum Daily Loads for Metals* (Metals TMDL). The Implementation Plan follows the principles of the Water Quality Compliance Master Plan for Urban Runoff (WQCMPUR) and the Integrated Resources Plan (IRP). These principles include:

- *Integrated Plan:* Identify urban runoff management projects that have multiple benefits and treat multiple pollutants.

- *Green Solutions:* Wherever possible, implement solutions that are "green," sustainable, and work with the existing natural environment.

- *Build on Existing Programs:* Review existing urban runoff programs and identify opportunities to improve current water quality programs.

- *Stakeholder Involvement:* Identify the best projects and concepts through collaboration with the many active organizations and individual stakeholders in the watershed.

- *Adaptive Management:* Develop a plan that embraces the need to refine itself based on the information gathered over time through the implementation of both successful and unsuccessful programs and projects.

ES.2 Regulatory Requirements

The Los Angeles Regional Water Quality Control Board (LARWQCB) adopted the Metals TMDL for the LAR Watershed on June 2, 2005. Following State Board and State Office of Administrative Law approvals, EPA Region 9 approved the TMDL on December 22, 2005. The TMDL originally became effective on January 11, 2006. Following resolution of legal challenges to TMDL provisions, the LARWQCB approved a revised TMDL Resolution Basin Plan Amendment on September 6, 2007. After State and EPA Region 9 review, the revised TMDL effective date was October 29, 2008. This Implementation Plan is written in response to the TMDL's requirement to submit an Implementation Plan by January 11, 2010.

The Metals TMDL includes wasteload allocations applicable to urban runoff under both dry and wet weather conditions. These allocations are considered necessary to protect the beneficial uses expected be impacted by existing metals loadings to the LAR: wildlife habitat, warm freshwater water habitat, rare threatened or endangered species, wetland habitat, marine habitat, and groundwater recharge.

Implementation of the TMDL by MS4 permittees involves a phased approach. Compliance is mandated within 22 years of the TMDL effective date. Final and interim compliance dates include:

- **October, 2008** – submit a Coordinated Monitoring Plan (CMP) that includes both TMDL effectiveness and ambient monitoring.
- **January 11, 2010** – submit results of any special studies to the LARWQCB.
- **January 11, 2010** and **July 11, 2010** – submit draft and final reports, respectively, summarizing how compliance with wasteload allocations will be achieved.
- **January 11, 2012** – demonstrate 50 percent compliance with dry weather wasteload allocations, and 25 percent compliance with wet weather wasteload allocations.
- **January 11, 2020** – demonstrate 75 percent compliance with dry weather wasteload allocations.
- **January 11, 2024** – demonstrate 100 percent compliance with dry weather and 50 percent compliance with wet weather wasteload allocations.
- **January 11, 2028** – demonstrate 100 percent compliance with both dry and wet weather wasteload allocations.

The City met its requirement to prepare a CMP by October 2008. This Implementation Plan fulfills the requirements of the January 11, 2010 deadline to submit a report summarizing how the City will achieve compliance with wasteload allocations.

ES.3 Implementation Plan Development Process

This Implementation Plan was developed through the execution of the following four key steps:

- Characterize watershed system conditions and conduct watershed-wide analyses to support water quality planning and BMP alternatives development activities;
- Identify range of green BMP opportunities for managing urban runoff in the City of Los Angeles;
- Select structural and institutional BMPs for phased implementation to comply with TMDL targets; and
- Quantify nexus between BMPs selected and compliance with TMDL targets.

Throughout the Implementation Plan development process City staff collaborated with other city agencies, jurisdictions, non-governmental organizations (NGOs), and other stakeholders to identify opportunities for collaboration. This process included three community stakeholder workshops held in March, July and September 2009.

ES.4 Watershed Characterization

The LAR Watershed covers an area of 834 square miles bounded by the Santa Monica, Santa Susana, and San Gabriel mountain ranges to the north and west. The lower part of the watershed captures runoff from highly urbanized areas surrounding downtown Los Angeles. The total length of the LAR is approximately 52 miles from headwaters to mouth, where it flows into the Pacific Ocean.

The LARWQCB's *Water Quality Control Plan for the Coastal Watersheds of Los Angeles and Ventura Counties* (Basin Plan) identifies six reaches of the LAR as well as several major tributaries (e.g., Tujunga Wash, Arroyo Seco, Rio Hondo and Compton Creek). Various Metals TMDL requirements apply to all of these waterbodies.

The LAR Watershed is comprised of many jurisdictions with responsibilities under the TMDL, including the City of Los Angeles, County of Los Angeles, and 42 other cities. Including natural undeveloped lands, the City represents 33 percent of the total area of the LAR Watershed. Excluding natural lands, the City comprises approximately 50 percent of the LAR Watershed.

Precipitation and Flow

There is a wide range of variability in event-specific and annual rainfall across the LAR Watershed, due to the orographic effects of the mountain ranges. Mean annual rainfall ranges from 12.2 to 17.6 inches, and the 85th percentile storm event depth ranges from 1.3 to 2.0 inches. The majority of rainfall occurs between October and May.

Flow in the LAR Watershed is highly variable. This variability is due to the nature of typical rain events (i.e., short–duration high-intensity), urbanized and highly impervious conditions, and presence of steep mountain slopes surrounding valley areas. Dry weather flows fluctuate from upstream to downstream along the LAR mainstem and in tributaries due to effluent discharges from the D.C. Tillman, Los Angeles-Glendale, and Burbank Water Reclamation Plants. Average dry weather flow increases with increased distance downstream. During wet weather, river flows may increase by two to three orders of magnitude above dry weather flow conditions.

Water Quality

On-going water quality monitoring programs include the City of Los Angeles Status and Trends Monitoring, CMP, and the Municipal Separate Storm Sewer System (MS4) monitoring program. The water quality monitoring results show that dry weather exceedances of TMDL targets occasionally occur, especially for total copper and total zinc. During wet weather, metals concentration exceedances occur more frequently, again especially for total copper and total zinc.

ES.5 BMP Evaluation

The process to identify BMPs for implementation that support the City's efforts to comply with the Metals TMDL requirements included both detailed technical analyses and stakeholder input. Numerous potential BMP opportunities were considered, including both institutional and structural. In addition, existing BMP activities were evaluated for their potential to support compliance with TMDL targets, including Proposition O projects and other watershed projects regardless of whether they are being implemented by the City or other stakeholders.

Institutional BMPs

Institutional BMPs focus on preventing and removing stormwater volumes and pollutant loads at their source. When used in conjunction with green structural BMPs as part of a comprehensive stormwater management program, they may improve overall pollutant removal and help reduce maintenance requirements. Institutional BMPs range from activities, such as land use planning and infrastructure maintenance, to more site-specific activities, such as targeted inspections or enforcement actions for businesses considered likely to be significant sources of metals. Many of these BMPs can be implemented at different levels ranging from individual actions to municipal, state, or business initiatives. Benefits of institutional BMPs include:

- *Potential cost savings*—Institutional BMPs typically do not require large capital expenditures to construct facilities; however, long-term operating costs can be significant for educational, inspection, and enforcement programs.
- *Areal treatment coverage*—Many institutional BMPs are implemented through city-wide programs. Unlike a structural BMP facility, the coverage and subsequent benefits of these institutional BMPs are not limited to the catchment area served.
- *Retrofit potential*—Many institutional BMPs target existing development and can be implemented under the space constraints prevalent in built-out urban environments.
- *Target specific pollutants or sources*—BMPs can target a specific pollutant of concern or the specific source of the pollutant. For example, the brake pad replacement initiative targets both a specific metal (copper) and a significant source of the pollutant in urban runoff.

Green Structural BMPs

The Los Angeles County-wide Structural BMP Prioritization Analysis Tool (SBPAT) provided the means for identifying potential structural BMP locations and types for implementation. SBPAT uses a GIS-based decision tool that relies on four steps for identifying BMP implementation opportunities (Figure ES-1):

SBPAT screens areas based on need (i.e., pollutant load generation and downstream impairments), and then identifies opportunities (i.e., appropriateness of the area, adjacent storm drains) for BMP implementation. These opportunities are ranked based on factors such as effectiveness, cost, and maintenance requirements. The BMP rankings were used to assist with the selection of the best regional and distributed green BMPs for each potential BMP location. The selection process also considered the opportunity to use an Integrated Water Resources Approach or implement BMPs that provide multiple benefits at a potential BMP location.

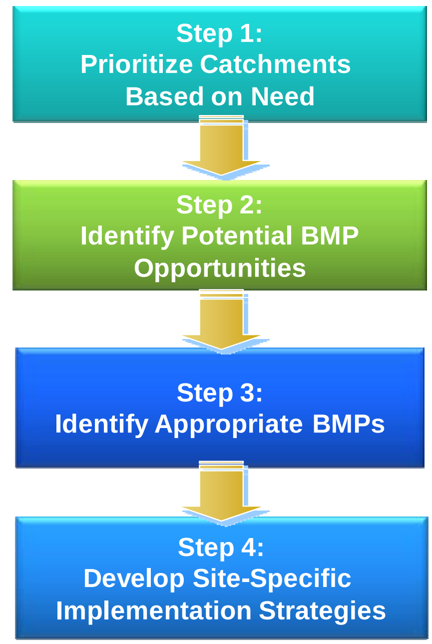

Figure ES-1
Steps for Selection of Structural BMPs

Structural BMPs include one of two types:

- *Regional BMPs:* Defined as centralized stormwater facilities designed to treat urban runoff from a relatively large drainage area (drainage areas ranging from 20 acres to several hundred acres). These BMPs include infiltration facilities, detention basins, subsurface flow wetlands (including detention), surface flow wetlands, treatment facilities, manufactured separation systems (e.g., hydrodynamic separators and trash nets/screens), and channel naturalization (e.g., storm drain daylighting, revegetation, and wetland channel establishment).

- *Distributed BMPs:* Defined as stormwater collection devices and landscaping practices dispersed throughout a catchment that serve relatively small drainage areas (typically 10 acres or less). These BMPs include, for example, cisterns, bioretention, vegetated swales, green roofs, porous/permeable pavements, gross solids removal devices, media filters, and catch basin inserts.

A screening methodology consisting of the following four general screening categories (each of which has additional screening factors) was applied to evaluate BMP opportunities:

- Cost
- Effectiveness
- Ease of implementation
- Other environmental factors

The results of the assessment based on the above screening categories were refined to evaluate the feasibility of establishing infiltration basins at candidate regional BMP locations. Analyses considered distance from contaminated sites, depth to groundwater, minimum saturated hydraulic conductivity (K_{sat}), and location relative to landslide and liquefaction zones.

Planning and siting of potential regional and distributed structural BMPs is particularly challenging because of the highly developed conditions in the watershed. Because the majority of structural regional BMPs will need to be retrofitted into developed areas of the watershed, the BMP analysis required significant site-specific BMP evaluations, including additional data collection and field inspections in order to screen, prioritize, and finally select sites.

Completion of the site-specific evaluation steps resulted in 17 potential regional and 100 distributed BMP locations. These potential BMP projects were further evaluated for inclusion and prioritization within the Implementation Plan.

ES-6 Implementation Plan

Compliance with TMDL targets can be achieved through the implementation of a BMP program that takes into account the combined water quality benefits achieved through different BMP programs. Figure ES-2 illustrates the framework used to build this Implementation Plan. The following sections summarize the key elements of this framework. Implementation of all of these components is subject to available funding to cover capital, operation and maintenance, program management, and administration costs. It is also important to note that the time provided by the TMDL to achieve the first milestone for wet weather is not adequate in light of resource shortages, the required number of projects to be constructed, and the length of time required to properly complete a project. For example, a review of City projects and regional BMP projects shows that the time to complete pre-design, design, bid/award, construction, and post-construction activities is typically 32 months for a distributed BMP and 60 months for a regional BMP.

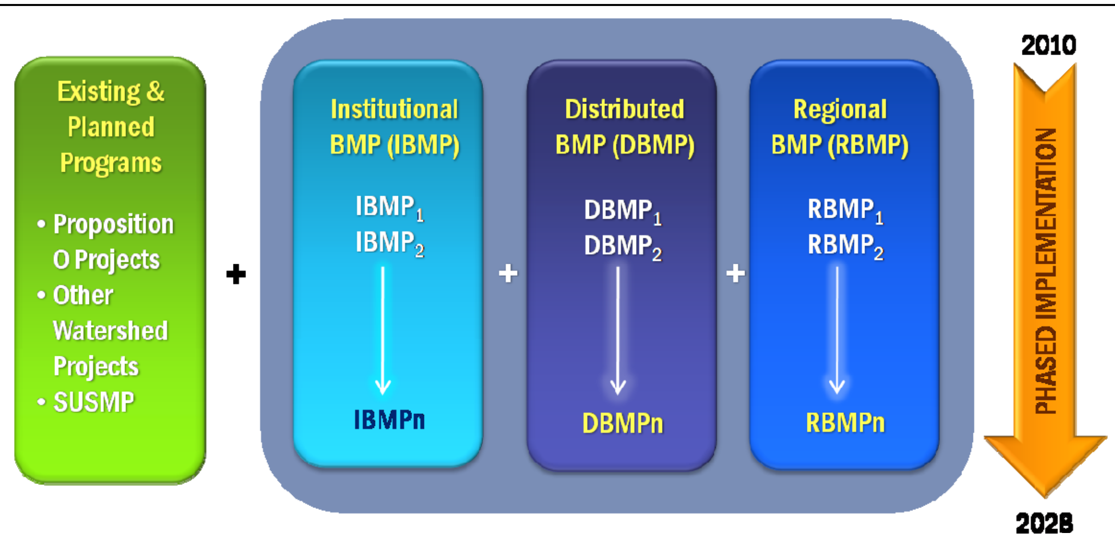

Figure ES-2
Overview of Proposed Comprehensive BMP Program

Existing and Planned BMP Projects

A number of major Proposition O projects will be completed prior to the Metals TMDL compliance target dates. Each of these projects provides a significant water quality benefit. Additional smaller projects (e.g., Oros Green Street) also provide benefits. The urban runoff from approximately 3,100 acres is expected to receive treatment as a result of the completion of the major Proposition O projects in the LAR Watershed.

A number of other major watershed projects are in development or planned for completion prior to the Metals TMDL compliance target dates. Additional smaller projects (e.g., Riverdale and Elmer Green Streets) also provide benefits. Similar to the Proposition O projects, each of these major projects provides a significant water quality benefit. The urban runoff from approximately 13,300 acres is expected to receive treatment as a result of the completion of the major watershed projects.

Standard Urban Stormwater Mitigation Plan (SUSMP)

Throughout TMDL implementation period, new development and redevelopment activities will continue in the City of Los Angeles. Many of these development activities are subject to MS4 permit SUSMP requirements for managing urban runoff. Where SUSMP requirements apply, the BMPs installed on-site must be able to infiltrate, capture and reuse, or treat all of the runoff from an 85th percentile storm, which is equivalent to a 3/4-inch, 24-hour storm event. New City guidelines approved on July 9, 2008 require developers to give top priority to BMPs that infiltrate stormwater and lowest priority to mechanical/hydrodynamic units.

A review of City development records showed that on average, approximately 250 acres of new development or redevelopment projects have been implemented across the City each year since 2001. The Implementation Plan assumes that throughout the period of implementation, this rate of development will continue. The enhanced SUSMP guidelines adopted in 2008 will be vigorously applied to these projects and further modified as needed to comply with MS4 permit requirements.

Institutional BMPs

The City will implement a variety of institutional BMPs to reduce metals loadings in the watershed. Many of these BMPs are consistent with ongoing City efforts to implement institutional BMPs in other watersheds, e.g., Ballona Creek. In some cases, these BMPs recognize or supplement institutional BMPs already being implemented through the City's MS4 permit program. However, other BMPs are new and recommended for implementation to help address urban runoff management concerns in general, and target metals sources specifically. Specific institutional BMP activities have been categorized into four broad areas. These categories and the primary BMPs being considered for implementation include:

- Direct Source Control—BMPs that directly address metals sources are included in this category. Sources are addressed either through pollution prevention or activities that reduce the volume of urban runoff. Planned BMPs include:
  - Product Replacement – The purpose of this BMP is to reduce a significant source of metals in the environment by developing safe alternative products. To implement this BMP, the City will continue to support efforts to reduce metals in vehicle brake pads and wheel weights through pending legislation.
  - Enhanced Street Sweeping – This BMP focuses on enhancing street sweeping activities to achieve a modest 5 percent increase in material picked up by 2028. To achieve this goal, the City will evaluate opportunities to increase the efficiency of its existing street sweeping program.
  - Downspout Disconnection – This BMP can greatly reduce stormwater runoff volumes and involves encouraging property owners to disconnect their roof downspouts and redirect the stormwater runoff to pervious surfaces, rain gardens, rain barrels or cisterns. The pilot program underway in the Ballona Creek Watershed will be expanded to include the LAR Watershed.
- Program Development—This category addresses the need for ordinance, policy, and guidance development. BMPs include:
  - Source Control Incentive Programs – The City will consider developing incentive programs to control metals at their source, especially on commercial and industrial parcels.
  - Green Policy/Guidance Development – The City will continue its efforts to work collaboratively with City agencies and other jurisdictions to establish revised or new policies that facilitate the implementation of green urban runoff management BMPs.
  - Stream Protection Ordinance – The City will complete development of its Stream Protection Ordinance to provide a mechanism to protect lands adjacent to waterbodies.
  - Source Control Ordinances – The City will evaluate its existing ordinances to determine whether additional or modified city ordinances would make residents and businesses more responsive to source control measures.
- Education and Outreach—Some of the BMPs in this category are already being implemented; however, they are included in the Implementation Plan to document continued commitment to this BMP category, or recognition that some programs may need to be evaluated and revised to create better-targeted messages addressing metals sources. BMPs include:

  - Urban Runoff Websites – The City will continue to manage its stormwater website (www.lastormwater.org) to provide information on urban runoff management practices, and add specific information on LAR Metals TMDL implementation.

  - Regulatory and Policy Education – The City will develop and implement a process to educate and provide outreach to appropriate City departments and agencies to support implementing newly developed policies, ordinances, and incentive programs.

  - Targeted Metals Education & Outreach – The City will evaluate its existing education and outreach program to determine the need to enhance this effort to improve the effectiveness of this BMP, especially as targeted to metals reduction.

  - Rapid Transit Promotion – The City will evaluate the potential to partner with regional transportation agencies to promote use of rapid transit to minimize the number of vehicle miles driven in the watershed. Where partnerships are possible, the City will evaluate with these agencies opportunities to develop and implement incentives to reduce the number of vehicle miles driven.

  - Education and Outreach Effectiveness Evaluation – The City will develop evaluation and monitoring methods to better understand the performance of education and outreach programs. This information can be used to better prioritize educational campaigns.

  - Watershed-wide Education – This ongoing BMP focuses on improving the consistency and efficiency of urban runoff management education efforts watershed-wide.

  - Education and Outreach Funding – The City will work with its watershed partners to establish a long-term stable fund for supporting watershed-wide education activities that is cost-shared among jurisdictions and organizations.

  - Environmental Learning Center – The City will complete construction of the Environmental Learning Center, and establish a secure funding source so that the facility is regularly open to provide environmental education

- Planning and Coordination—Coordination will be needed both within and among agencies to successfully execute BMPs in the watershed. Such coordination can create opportunities, increase efficiency and effectiveness, and minimize the likelihood that other agencies or jurisdictions work at cross-purposes. BMPs include:

  - Interagency Task Force – Establish a task force with appropriate representation to coordinate the review and revision or adoption of new policies and ordinances in a consistent manner in the watershed. Other functions could include facilitation of BMP implementation and coordination of similar institutional BMP programs across jurisdictions.

- Collaborative Watershed Projects – The City will continue to work collaboratively with the NGOs where opportunities exist to cost share on the implementation of BMP projects that are consistent with the goals of this Plan.

- General Plan Update – Consistent with the WQCMPUR, the City will work with its planning department to consider options for revising the City's General Plans to facilitate urban runoff management, particularly as redevelopment opportunities become available.

Green Structural BMPs

The top ranked regional and distributed BMP sites underwent final review and analysis to divide the potential sites into Priority 1 and Priority 2 projects. Priority 1 sites are proposed for implementation under this Implementation Plan according to the schedule described below[1]. Priority 2 sites are held in reserve at this time. As the TMDL implementation process moves forward, where additional regional and distributed BMP projects are needed, the Priority 2 sites serve as the pool from which new projects may be drawn. The City may also supplement these Priority 2 sites in the future where opportunities become available.

Regional BMP Projects

Four Priority 1 sites have been selected for implementation under this Plan; the remaining sites are considered Priority 2 sites. Table ES-1 summarizes the conceptual plan for each of these four Priority 1 projects.

Table ES-1 Characteristics of Four Priority 1 Regional BMP Sites with Potential BMP Options

Site Name	Owner	Subwatershed	Drainage Area (ac)	Potential BMP Type	BMP Footprint (ac)
Pierce College	Los Angeles Community College District	LAR Reach 6	2,380	Detention Basin	39
Van Nuys Sherman Oaks Park	City of Los Angeles	LAR Reach 4	1,520	Detention Basin/Wetland	27
North Hollywood Park	City of Los Angeles	LAR Reach 4	4,360	Detention Basin/ Infiltration	14
Compton Creek	City of Los Angeles	Compton Creek	7,100	Wetland/ Detention Basin	8.5

[1] The City may substitute one or more of these priority projects with other regional and/or distributed BMP projects if it is determined that a project is not feasible, e.g., the land is unavailable, or a project opportunity becomes available that is functionally equivalent, i.e., provides necessary volume of treatment and/or accomplishes the goals of this TMDL Implementation Plan.

Distributed BMP Projects

A screening process was used to narrow the 100 candidate distributed BMP sites to 50 Priority 1 sites. Factors included areas with highest frequency of water quality impairments, subwatersheds that did not have any regional BMP sites, sufficiency of public right-of-ways for installing BMPs, and sites with educational land uses. The remaining distributed BMP sites have been retained as potential Priority 2 sites.

ES-7 Implementation Schedule

The metals TMDL includes separate compliance requirements for dry and wet weather (Table ES-2). These compliance requirements are based on the percent of the drainage within the City of Los Angeles' jurisdiction that is in compliance with the TMDL targets.

Table ES-2 Metals TMDL Compliance Targets

Flow Condition	Target Date	Compliance Target (Percent of City of Los Angeles Drainage Area)
Dry Weather	2012	50%
	2020	75%
	2024	100%
Wet Weather	2012	25%
	2024	50%
	2028	100%

CMP data collected between October 2008 and August 2009 demonstrate that more than 75 percent of the City's drainage area within the LAR Watershed is in compliance with dry weather Metals TMDL targets for copper and lead (total and dissolved). Accordingly, for dry weather, the focus of BMP implementation activities will be on compliance with the 2024 target.

In contrast to the dry weather data, CMP wet weather data collected in 2009 indicate that the City is not currently in compliance with any of the total copper and total zinc metals wet weather targets (although the City was in compliance with all lead and cadmium targets). Given these results, the focus of BMP implementation under this Plan is on the wet weather targets, in particular for total copper and total zinc. Because many of the BMPs planned for implementation will also result in dry weather load reductions, the City's focus on wet weather compliance will result in compliance with dry weather targets.

Tables ES-3 and ES-4 summarize the proposed schedule for structural and institutional BMP implementation to achieve compliance with Metals TMDL wet weather targets applicable to the City's portion of the LAR Watershed. Implementation of this schedule is dependent on adequate program funding. Quantitative analyses demonstrate that implementation of this Plan will result in the required metals load reductions within the City's jurisdiction to achieve compliance with the wet weather targets. However, even if an adequate funding source is established in the short term, the City will not be able to construct by 2012 all the necessary structural BMPs required to comply with the 2012 wet weather target date. A review of City projects shows that the length of time required to complete a BMP project (including pre-design, design, bid/award, construction, and post-construction activities) is typically 32 months for a distributed BMP and 60 months for a regional BMP. Regardless, the City is committed to expediting the planning, design, and construction phases for each structural BMP project to the maximum extent practicable. The following sections describe the general implementation approach for each BMP Implementation Category.

Table ES-3 Planned Implementation of Structural BMPs to Achieve TMDL-specific Targets

Implementation Category	BMP/Program	TMDL Target (Acres Treated)		
		2012	2024	2028
Existing & Planned Projects	Proposition O (see Table 4-1 for projects and TMDL target dates)	1,910	255	5,130
	Other Watershed Projects (see Table 4-2 for projects and TMDL target dates)	10,280	590	480
New Green Structural BMPs	Distributed BMPs (Priority 1 projects by 2012; Priority 2 plus other projects by 2028)	1,400	5,000	
	Regional BMPs (Priority 1 - Compton Creek and North Hollywood Park)	11,460	--	--
	Regional BMPs (Priority 1 – Pierce College and Van Nuys Sherman Oaks)	--	3,900	--
	Regional BMP Priority 2 projects	--	--	15,000

Table ES-4 Planned Implementation of Institutional BMPs to Achieve TMDL-specific Targets

Institutional Program	BMP Type	2012 Target	2024 Target	2028 Target
Direct Source Control	Brake Pad Replacement	6.5% average copper content	5.7% average copper content	5.0% average copper content
	Enhanced Street Sweeping	5% increase in sediment removal		
	Downspout Disconnection	2,500 downspout disconnects/year		
Development/ Redevelopment Standards	Enhanced Program	250 acres/year		
Other BMP Categories Types	Education & Outreach, Program Development, Planning & Coordination	Water quality benefits not quantified. Continuous implementation through 2028; specific goals summarized in Table 4-14		

Existing and Planned BMP Projects

For Proposition O and other watershed projects, Table ES-3 summarizes the acres of runoff treated, based on the known or estimated project characteristics and the expected completion date relative to the TMDL target dates. The City will continue to monitor these projects throughout the TMDL implementation period to verify that the expected water quality benefits from each project occur.

SUSMP

Since 2001, City records indicate that an average of 250 acres of projects that meet SUSMP requirements are implemented each year in the Los Angeles River Watershed. It has been assumed that this rate of implementation will continue. The City will continue to enhance the SUSMP requirements as required by MS4 permit requirements.

Institutional BMPs

The Implementation Plan provides a general schedule for each institutional BMP planned for implementation. Where appropriate, these activities will be implemented in conjunction with other TMDL implementation activities, e.g., the Ballona Creek Bacteria and Metals TMDL Implementation Plans. This Plan adopts quantitative targets for only the few institutional BMPs for which water quality benefits can be estimated (see Table ES-4): Brake pad replacement program; enhanced street sweeping, and downspout disconnections.

Given the high uncertainty surrounding water quality benefits achievable by implementing many institutional BMPs (e.g., education and outreach), the benefits that may occur from these BMPs were not quantified for the purposes of developing this Implementation Plan. The benefits of these activities are still expected to be significant; however, by not attempting to quantify these benefits, the City has increased the margin of safety associated with its quantitative analysis.

Green Structural BMPs

Regional BMPs

Table ES-3 indicates the number of acres from which runoff is derived and targeted for treatment through the implementation of regional BMPs. These acres vary depending on the wet weather target date. The four Priority 1 projects[2] have the capacity to treat stormwater from about 15,360 acres. Sufficient treatment capacity exists in the four projects to provide the approximately 11,460 acres of needed treatment by 2012 and the additional approximately 3,900 acres needed by 2024.

The City plans to implement two of the four priority regional BMP projects by 2012 and the other two projects by 2024. Given the need to treat runoff from 11,460 acres by

[2] The City may substitute one or more of these priority projects with other regional and/or distributed BMP projects if it is determined that a project is not feasible, e.g., the land is unavailable, or a project opportunity becomes available that is functionally equivalent, i.e., provides necessary volume of treatment and/or accomplishes the goals of this TMDL Implementation Plan.

2012, the two largest of the four projects (Compton Creek and North Hollywood Park) are planned for completion by 2012. The remaining two projects will be completed by 2024.

The City plans to implement additional regional BMPs by 2028 that provide treatment for runoff from an additional 15,000 acres. Unless alternative opportunities become available that have not been identified to date, the City will implement selected projects from the list of Priority 2 regional BMP sites developed under this Plan. While the quantitative analysis demonstrates that these projects only need to be completed by 2028, the actual timing for implementation of these projects will be determined at a later date. It is likely that the City will phase the planning, design, and construction of these projects beginning prior to 2024 with completion of all work by 2028.

The City plans to achieve multiple-objectives with each of the regional BMP projects, e.g., increased open space, recreational benefits, and compliance support for other pollutants. Accordingly, it is expected that most regional BMP projects will require extensive planning, stakeholder input, and coordination with multiple agencies. All will be subject to resolution of substantive permitting and right-of-way issues. Final project flow rates and treatment levels will depend on the available area and detailed project engineering design. The treatment volumes for projects may fall below the full treatment volumes anticipated by this Plan if necessitated by the results of detailed engineering feasibility studies. Additional projects may be added to replace treatment volumes for purposes of meeting goals of TMDL Implementation Plan.

Distributed Structural BMPs

Table ES-4 indicates that achieving compliance with the 2012 wet weather TMDL target requires that the runoff from 1,400 acres receives treatment from implementation of distributed BMPs. Preliminary analyses indicate that the 50 Priority 1 distributed BMP projects may provide sufficient treatment capacity to meet the 1,400 acres treated target shown for 2012.

Between 2012 and 2028, an additional 5,000 acres of treated runoff is required to achieve the compliance goals set for 2024 and 2028. The remaining Priority 2 distributed BMP sites could be implemented following completion of the Priority 1 projects. It is estimated that these projects can provide up to an additional 1,200 acres of treatment.

The City expects to implement projects at a regular pace over the 16-year period from 2013 to 2028. Accordingly, the City will implement projects that provide an additional 300 to 350 acres of treatment each year. Based on the average project size of 35.4 acres (average of Priority 1 and Priority 2 projects combined), the City plans to implement nine to 10 distributed projects per year.

Similar to the regional BMP projects, it is expected that most distributed BMP projects will require extensive planning, stakeholder input, and coordination with multiple agencies. All will be subject to the resolution of substantive permitting and right-of-way issues. Final treatment benefits associated with each project will depend on the available area and detailed project engineering design.

ES-8 Program Costs

Implementation costs were developed based on planning level information. These program costs do not include already funded Proposition O and other watershed projects and continued implementation of the SUSMP program.

A cost estimate was prepared for each Priority 1 regional BMP project. The estimated capital cost for these four projects is about $100,000,000. Using the average cost per treated acre for these projects, it is estimated that an additional $98,000,000 in capital expenditures for regional BMP projects will be needed by 2028. The estimated cost for distributed BMP projects is based on the average cost per treated acre calculated from representative projects. Based on this approach, the capital cost for Priority 1 distributed BMP projects is estimated at $49,000,000; the capital cost of the Priority 2 distributed projects is estimated to cost an additional $175,000,000. The total capital cost for new structural regional and distributed BMPs is estimated at $422,000,000 with an additional $11,500,000 in annual operation and maintenance costs by 2028.

Many institutional BMP activities may continue at existing funding levels or with only modest increases. However, the capital cost of implementation of the downspout disconnection program at the implementation rate planned for in this Plan is estimated at $76,500,000 over the period from 2010 to 2028.

Section 1
Introduction

1.1 TMDL Implementation Plan Development

The Los Angeles River (LAR) Metals Total Maximum Daily Load (TMDL) Implementation Plan (Implementation Plan) defines the approach and steps that the City of Los Angeles (City) will take to comply with existing and pending requirements of the *Los Angeles River and Tributaries Total Maximum Daily Loads for Metals* (Los Angeles River Metals TMDL). The Metals TMDL subdivides the watershed into the following six reaches:

- Los Angeles River Reach 1, including Compton Creek
- Los Angeles River Reach 2, including Rio Hondo and Arroyo Seco
- Los Angeles River Reach 3, including Verdugo Wash and Burbank Western Channel
- Los Angeles River Reach 4, including Tujunga Wash
- Los Angeles River Reach 5
- Los Angeles River Reach 6, including Bell Creek, McCoy and Dry Canyons

Including natural undeveloped lands, the City represents 33 percent of the total area of the Los Angeles River Watershed. Excluding natural lands, the City comprises approximately 50 percent of the Los Angeles River Watershed. The remaining area is under the jurisdiction of numerous other cities and Los Angeles County [1].This Plan only applies to the City of Los Angeles. Input from other cities, agencies, and other stakeholders has been incorporated, as needed.

1.2 Guiding Principles

The Implementation Plan will use an integrated water resources management approach that will address multiple pollutants, identify beneficial use opportunities, and collaborate with other existing watershed plans in its overall solution. A guiding plan in the development of this Implementation Plan is the City's Water Quality Compliance Master Plan for Urban Runoff (WQCMPUR)[2]. The WQCMPUR has three strategies (City of Los Angeles 2009):

1) Water Quality Management Initiative for project identification.
2) Citywide Coordination Initiative to develop ordinances and collaborative approaches within and among agencies.
3) Outreach Initiative for source control.

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[1] Table 7-13.3 of the TMDL Basin Plan Amendment lists the other responsible jurisdictions and agencies. The relevant TMDL Resolution and associated Basin Plan documents are at http://www.swrcb.ca.gov/rwqcb4/water_issues/programs/tmdl/tmdl_list.shtml.

[2] WQCMPUR is available at http://lastormwater.org/Siteorg/program/masterplan.htm

This TMDL Implementation Plan supports these three initiatives. Further, the WQCMPUR included an Action Plan (see Table ES-3 of the WQCMPUR executive summary). The Action Plan identifies high priority items including the development of multiple TMDL Implementation Plans and watershed specific Water Quality Management Plans, which are currently in development. Following the principles of the WQCMPUR and Integrated Resources Plan (IRP), this TMDL Implementation Plan incorporates the following guiding principles:

- Integrated Plan: identify urban runoff management projects that have multiple benefits and treat multiple pollutants.
- Green Solutions: wherever possible, implement solutions that are "green," sustainable, and work with the existing natural environment.
- Build on Existing Programs: review existing urban runoff programs and identify opportunities to build upon current water quality programs.
- Stakeholder Involvement: identify the best projects and concepts through collaboration with the many active organizations and individual stakeholders in the watershed.
- Adaptive Management: develop a plan that embraces the need to refine itself based on the information gathered over time through the implementation of both successful and unsuccessful programs and projects.

1.3 Regulatory and Permitting Requirements

1.3.1 Background

The Clean Water Act of 1972 (CWA) provides the basis for the protection of all inland surface waters, estuaries, and coastal waters. The federal Environmental Protection Agency (EPA) is responsible for administering the CWA and developing regulations, but may delegate its authority to the State of California (State).

The State implements the CWA by establishing water quality protection laws and regulations and issuing discharge permits through State regulatory agencies. At its own discretion, the State has established requirements in many instances that are more stringent than federal requirements for CWA implementation.

California's primary statute governing water quality is the Porter-Cologne Water Quality Control Act of 1970 (Porter-Cologne Act). The Porter-Cologne Act grants the California State Water Resources Control Board (State Board) and nine California Regional Water Quality Control Boards broad powers to protect water quality, and it is the primary vehicle for the administration of California's regulations under the federally delegated responsibilities of the CWA. The governing Regional Board for the Los Angeles area watersheds is the Los Angeles Regional Water Quality Control Board (LARWQCB).

Biennially, the LARWQCB prepares a list of impaired waterbodies in the region, referred to as the 303(d) list (a reference to the applicable CWA section). The 303(d) list defines the impaired waterbody and the specific pollutant(s) for which it is impaired. All waterbodies on the 303(d) list are subject to the development of a TMDL. A TMDL establishes the maximum amount of a pollutant that a waterbody can receive and still meet the applicable water quality standard for that pollutant. Depending on the nature of the pollutant, TMDL implementation may require a cap on pollutant contributions from point sources (wasteload allocation), nonpoint sources (load allocation), or both.

The development of TMDLs affecting waters in the Los Angeles area watersheds is the responsibility of the LARWQCB. TMDL adoption requires an amendment to the regional water quality regulations (Basin Plan) and is subject to a substantial public review process. After the LARWQCB adopts the TMDL as a Basin Plan amendment, it is submitted to the State Board for approval. If approved by the State Board, the TMDL is submitted to EPA Region 9 for final review and federal approval. The TMDL does not take effect until the EPA has issued its formal approval.

Once a TMDL becomes effective, the schedule for TMDL implementation by each named responsible jurisdiction becomes active. TMDL-specific implementation requirements vary, but typically include preparation of a Coordinated Monitoring Plan (CMP) for the affected watershed, and development of an Implementation Plan detailing how responsible jurisdictions plan to achieve compliance with the TMDL requirements.

1.3.2 Metals TMDL Development History

The Basin Plan (LARWQCB 1994, as amended) defines 14 beneficial uses for the Los Angeles River. Per the TMDL (LARWQCB 2005), the beneficial uses that are most likely to be impacted by metals loadings to the Los Angeles River are the beneficial uses associated with aquatic life (i.e., wildlife habitat, warm freshwater water habitat, rare threatened or endangered species, wetland habitat, and marine habitat) and water supply (i.e., groundwater recharge).

To address metals TMDL development requirements, the LARWQCB published for public review draft technical documents, including a proposed Basin Plan Amendment (July 12, 2004), Tentative Resolution (September 2, 2004), California Environmental Quality Act (CEQA) Checklist (July 12, 2004), and Staff Report (July 9, 2004). Following opportunity for public comment, the LARWQCB adopted the TMDL on June 2, 2005 (Appendix A). State Board and State Office of Administrative Law approvals occurred on October 20, 2005 and December 9, 2005, respectively. EPA Region 9 approved the TMDL on December 22, 2005 and the TMDL originally became effective on January 11, 2006.

Following resolution of legal challenges to TMDL provisions, the LARWQCB approved a revised TMDL Resolution Basin Plan Amendment on September 6, 2007. After State and EPA Region 9 review, the revised TMDL effective date was October

29, 2008. This Implementation Plan is written in response to requirements contained in the Los Angeles River Metals TMDL.

1.3.3 Metals TMDL Numeric Limits

This section addresses the requirements established by the Los Angeles River Metals TMDL (LARWQCB 2005), which addresses impairments for the following metals: copper, lead, zinc, selenium, and cadmium. It also provides a regulatory context for these TMDL requirements, and identifies other potential water quality concerns that were addressed or considered in conjunction with the development of this TMDL.

Tables 1-1 through 1-3 (LARWQCB 2005) summarize the numeric targets and wasteload allocations for the Los Angeles River Metals TMDL applicable to the management of urban runoff. The focus of this TMDL Implementation Plan is to address these targets, although other pollutants of concern identified on the 303(d) list have been evaluated, as appropriate, so that the recommended BMP projects address as many pollutants as possible when implemented, including bacteria for which a TMDL is currently under development.

Table 1-1 Numeric Targets

		Cadmium	Copper[2,4,5]	Lead[2,4,5]	Zinc[3,4]	Selenium[7]
Dry Weather[1]	Conversion Factors (ratio of dissolved/total recoverable)					
	Default[6]	-	0.96	0.79	0.61	-
	Below Tillman WRP[6]	-	0.74	-	-	-
	Below LAG WRP[6]	-	0.8	-	-	-
	Numeric Targets (µg total recoverable metals/L)					
	Reach 5, 6, and Bell Creek	-	30	19	-	5
	Reach 4	-	26	10	-	-
	Reach 3 (above LAG WRP and Verdugo)	-	23	12	-	-
	Reach 3 (below LAG 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	131	-
	Monrovia Canyon	-	-	8.2	-	-
Wet Weather	Conversion Factors8,,9,10	0.94	0.65	0.82	0.61	-
	Numeric Targets (µg total recoverable metals/L)	3.1	17	62	159	5

Notes:
1 Dry weather targets apply to days when max daily flow in the river is less than 500 cubic feet per second (cfs) at Wardlow gage.
2 Dry weather targets for copper and lead are based on chronic California Toxic Rule (CTR) criteria.
3 Dry weather targets for zinc are based on acute CTR criteria.
4 Copper, lead and zinc targets dependent on hardness.
5 Copper and lead targets based on 50th percentile hardness values, since targets based on 10th percentile hardness values.
6 Site specific copper conversion factor (CF) applied immediately downstream of Tillman and Los Angeles Glendale (LAG) Water Reclamation Plants (WRP). CTR default CFs are used for copper, lead and zinc in all other cases.
7 Dry and wet weather target for selenium independent of hardness or CF.
8 Wet weather targets for cadmium, copper, lead and zinc based on acute CTR criteria and the 50th percentile hardness values for stormwater collected at Wardlow gage station.
9 CF for copper, lead and zinc are based on a regression of dissolved metals values to total recoverable metals values collected at Wardlow gage.
10 CTR default CF is applied to cadmium.

Table 1-2 Loading Capacity

Flow Condition	Waterbody	Critical Flow[2] (cfs)	Cadmium	Copper	Lead	Zinc
			(kg/day)			
Dry Weather[1,3]	LAR Reach 5	8.74	-	0.65	0.39	-
	LAR Reach 4	129.13	-	8.1	3.2	-
	LAR Reach 3	39.14	-	2.3	1.01	-
	LAR Reach 2	4.44	-	0.16	0.084	-
	LAR Reach 1	2.58	-	0.14	0.075	-
	Tujunga Wash	0.15	-	0.007	0.0035	-
	Burbank Channel	17.3	-	0.8	0.39	-
	Rio Hondo Reach 1	0.5	-	0.015	0.0061	0.16
	Compton Creek	0.9	-	0.041	0.02	-
Wet Weather[4]			micrograms per liter (µg/L)			
	Daily Storm Volume (L) times:		3.1	17	62	159

Notes:

1 For dry weather, loading capacities are equal to reach-specific numeric targets multiplied by reach-specific critical dry weather flows.

2 Critical flow for entire river is 203 cfs, by summing critical flows for each reach and tributary. This is equal to the combined design flow of the 3 publicly owned treatment works (POTWs) (169 cfs) (Tillman, Los Angeles Glendale, Burbank) plus median flow from storm drains and tributaries (34 cfs). Median storm drain and tributary flow is equal to the median flow at Wardlow gage (145 cfs) minus the existing median POTW flow (111 cfs).

3 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 flow from Verdugo Wash; the dry-weather loading capacity for Reach 2 includes flow from Arroyo Seco.

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

Table 1-3 Stormwater Wasteload Allocations (Total Recoverable Metals)

Flow Condition	Waterbody	Critical Flow (cfs)	Cadmium	Copper	Lead	Zinc
			(kg/day)			
Dry Weather[1]	LA River Reach 6	7.2	-	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	0.1	-
	Arroyo Seco	0.25	-	0.01	0.01	-
	Rio Hondo Reach 1	0.5	-	0.01	0.006	0.16
	Compton Creek	0.9	-	0.04	0.02	-
Wet Weather[2]			(µg /L/day)			
		Daily Storm Volume (L) times:	3.1×10^{-9} - 1.95	1.7×10^{-8} - 10.4	6.2×10^{-8} - 4.2	1.6×10^{-7} - 90

Notes:

1 Dry weather wasteload allocations for stormwater 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.

2 Wet weather wasteload allocations for the grouped stormwater permittees are equal to the total loading capacity minus the load allocations for open space and direct air deposition and the wasteload allocations for the POTWs. Wet weather wasteload allocations for the grouped stormwater permittees apply to all reaches and tributaries.

1.3.4 TMDL Compliance Requirements

Coordinated Monitoring Plan

Compliance with this metals TMDL included the development of a CMP by the responsible agencies, and submittal to the LARWQCB 15 months after the effective date of the TMDL. The TMDL required that the monitoring program address the following three components: ambient monitoring, compliance assessment monitoring, and special studies. Objectives of the CMP included data collection to evaluate uncertainties and assumptions within the TMDL; appraise wasteload allocations compliance; and consider potential management scenarios.

Implementation Plan and Compliance Schedule

Total compliance with the Los Angeles River Metals TMDL dry and wet weather targets is mandated by 2028 (Figure 1-1). Final and interim compliance dates include:

- **By October, 2008** – submit a CMP that includes both TMDL effectiveness and ambient monitoring
- **January 11, 2010** – submit results of special studies to the LARWQCB
- **January 11, 2010 and July 11, 2010** – submit draft and final reports, respectively, summarizing how subwatersheds will comply with wasteload allocations
- **January 11, 2012** – demonstrate 50 percent compliance with dry weather wasteload allocations, and 25 percent compliance with wet weather wasteload allocations.
- **January 11, 2020** – demonstrate 75 percent compliance with dry weather wasteload allocations
- **January 11, 2024** – demonstrate 100 percent compliance with dry weather and 50 percent compliance with wet weather wasteload allocations
- **January 11, 2028** – demonstrate 100 percent compliance with both dry and wet weather wasteload allocations

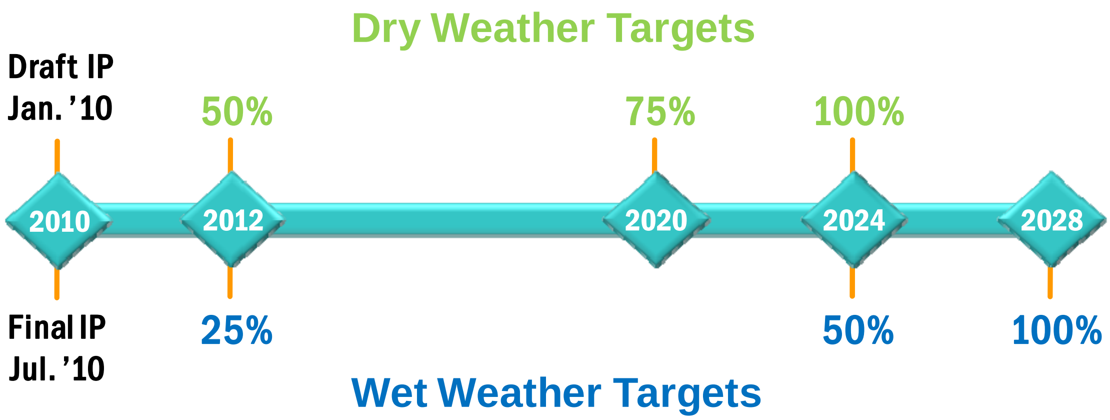

Figure 1-1
Metals TMDL Compliance Targets for Dry and Wet Weather

1.4 Implementation Plan Development Process

Development of the Implementation Plan development for this TMDL included several key steps (Figure 1-2). The first step involved characterization of runoff in the watershed, compilation of available baseline data and system conditions, and preliminary watershed-wide data analyses to support subsequent water quality planning and Best Management Practice (BMP) alternatives development activities.

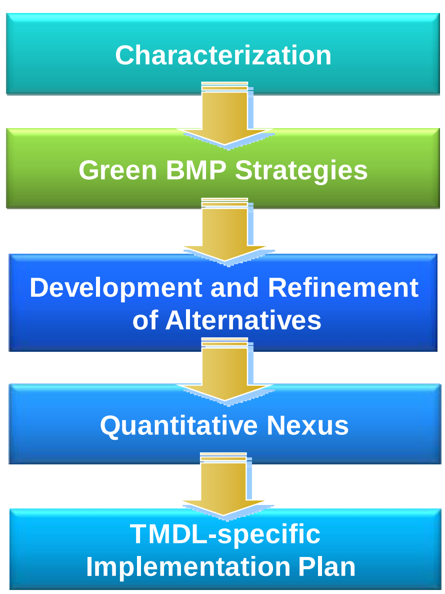

Figure 1-2
Key Steps in Implementation Plan Development

The next steps included identifying a range of green BMP strategies for managing runoff in the City of Los Angeles. This involved an analysis to identify candidate locations for regional and distributed structural BMPs within high-priority catchments, based on watershed-wide geographic information system (GIS)-based parcel screenings. It also included reviewing existing watershed plans and participating in discussions with key Los Angeles River watershed stakeholders to identify watershed collaboration opportunities.

Following the evaluation of potential strategies for achieving compliance, the City evaluated various BMP alternatives for inclusion in the Implementation Plan. The City analyzed the quantitative nexus between the selected BMPs and compliance with TMDL targets to ensure compliance. The process for plan development as well as the findings from technical analyses provided the basis for the City's Metals TMDL Implementation Plan.

Stakeholder Coordination

Throughout the implementation plan development process City staff collaborated with other City agencies, jurisdictions, non-governmental organizations (NGOs), and other stakeholders to identify opportunities for collaboration. This includes improving upon existing watershed programs, and obtaining ideas from stakeholders regarding BMP implementation opportunities. The process also included three community stakeholder workshops. Additional information regarding the stakeholder coordination process is included in Section 3.

Section 2
Los Angeles River Watershed

2.1 Watershed Description

The LAR Watershed covers an area of 834 square miles bounded by the Santa Monica, Santa Susana, and San Gabriel mountain ranges to the north and west. The lower part of the watershed captures runoff from highly urbanized areas surrounding downtown Los Angeles. From its headwaters to Queensway Bay estuary and the Pacific Ocean, the LAR flows approximately 52 miles. There are many tributaries to the LAR, which bring runoff to the river from the San Fernando Valley in the upper watershed, from the San Gabriel Mountains and urbanized areas north and east of the river in the middle of the watershed, and from densely developed areas in the lower part of the watershed (Figure 2-1). Significant portions of the LAR and many of its tributaries have been channelized to facilitate better flood protection. In addition, several dams and reservoirs have been constructed within the watershed for flood control and groundwater recharge. In areas where the seasonally high groundwater table is close to the surface, flood control channels are soft bottomed to allow groundwater to recharge surface runoff.

There are numerous jurisdictions within the LAR Watershed, including the City of Los Angeles, County of Los Angeles, and 42 other cities. In the upper watershed (Reaches 4, 5, and 6) most of the drainage area falls within the City. Drainage to Reach 3 of the LAR, in the middle to the watershed, includes portions of Los Angeles as well as the cities of Burbank, Glendale, La Crescenta-Montrose, La Canada Flintridge, and Pasadena. In the lower part of the watershed (Reaches 1 and 2), downtown Los Angeles, other cities, and the County of Los Angeles, make up the jurisdictions with MS4 outfalls to the river.

2.1.1 Topography

The topography of the LAR Watershed is diverse with vast amounts of land area within the Santa Monica, Santa Susana, and San Gabriel Mountains with peak elevations of almost 2,000 feet mean seal level (ft MSL). Most of the watershed is at lower elevation ranging from near sea level to 250 ft MSL. These lower elevation areas include the San Fernando Valley and coastal zones (Figure 2-2). Due to the locations of the mountain ranges, flows in the LAR take a long path from its headwaters to the Pacific Ocean. Near the headwaters, the river flows inland prior to turning south toward the coast. The Verdugo Mountains, a small mountain range northeast of the City of Glendale, create a sharp watershed divide between the Burbank Western Channel and Verdugo Wash.

Localized topography will be an important factor in the evaluation of potential BMP sites because of its role in determining the location of landslide and liquefaction zones, facility planning, and the efficiency of runoff capture.

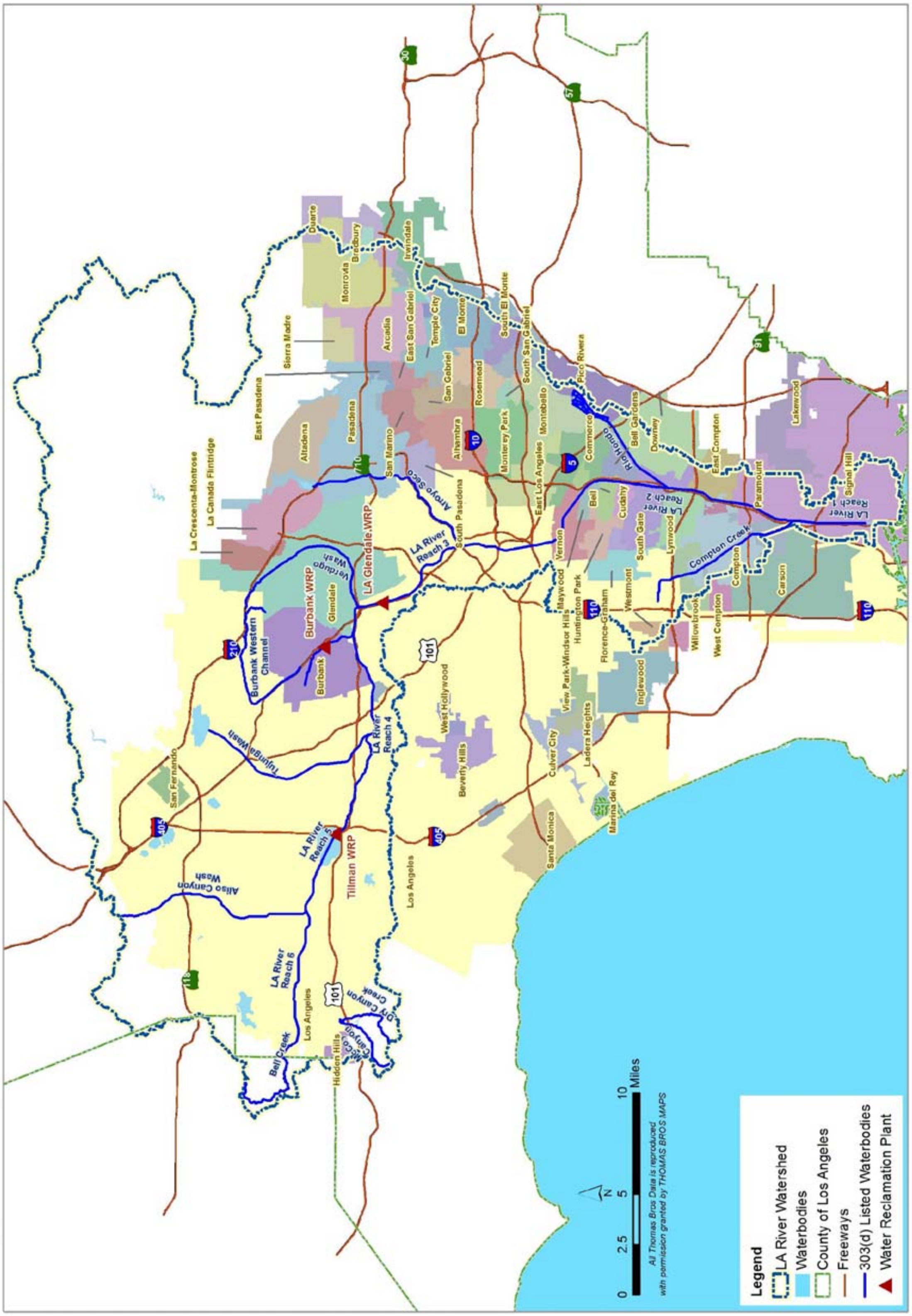

Figure 2-1
Study Area
Los Angeles River Watershed

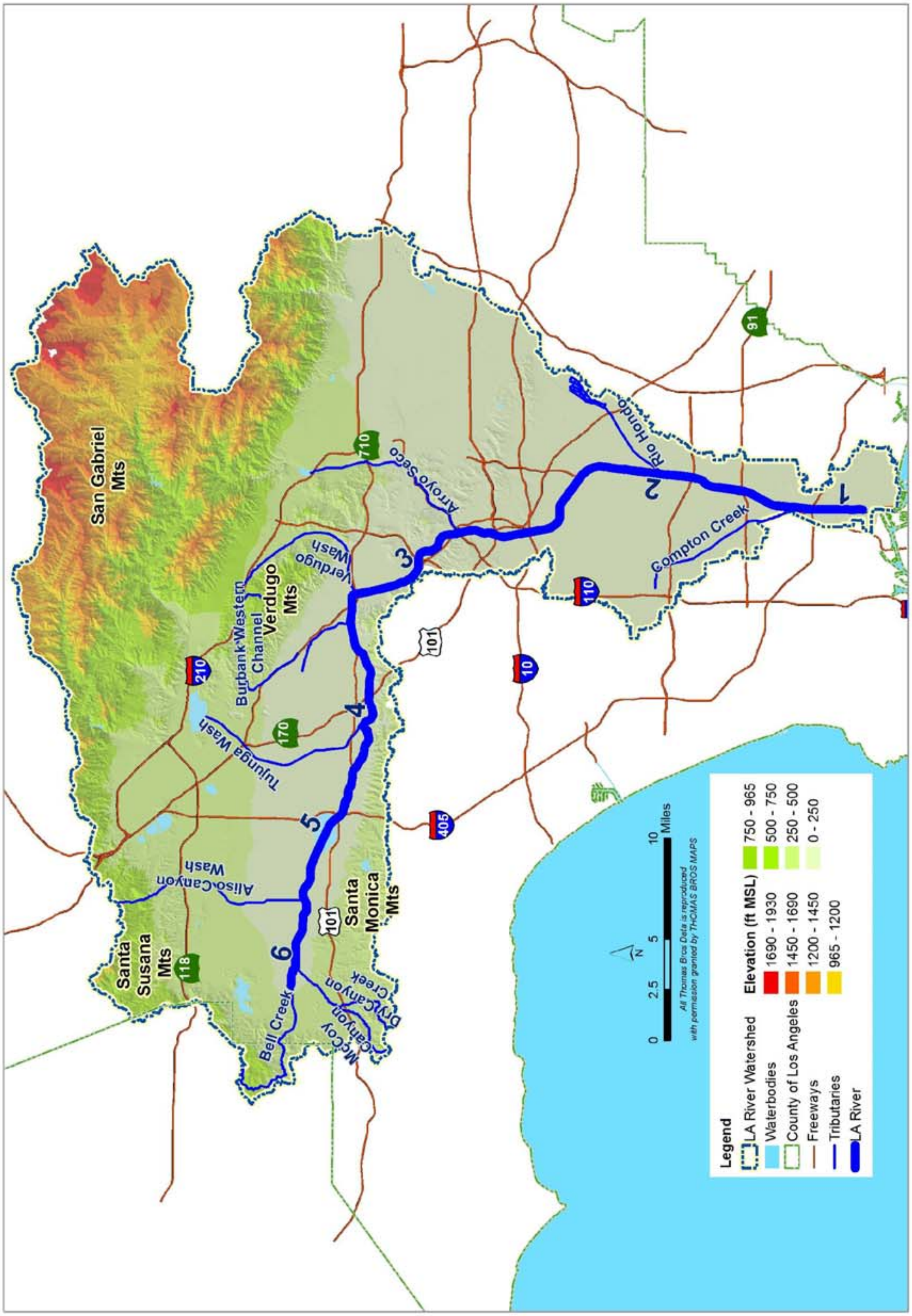

Figure 2-2
Topography
Los Angeles River Watershed

2.1.2 Hydrologic Connectivity

The Basin Plan identifies six major reaches of the LAR as well as several major tributaries. The reaches of the LAR are labeled starting at the estuary boundary with Reach 1 and increasing upstream. The delineation of subwatershed areas for each reach of the LAR and all major tributaries shows how runoff and associated pollutants move from source areas to receiving waterbodies (Figure 2-3).

Generally, the upper part of the river flows eastward through the San Fernando Valley, with tributaries draining southward from urbanized areas to the main river channel. The river then turns southward at the Glendale Narrows and flows to the Pacific Ocean. Each of the six reaches of the LAR is unique as described below:

- Reach 6 of the LAR is the furthest upstream and drains runoff for approximately 6 miles through the western San Fernando Valley. Tributaries to this reach include Arroyo Calabasas (which includes McCoy Canyon and Dry Canyon Creek), Bell Creek, and Aliso Canyon Wash. Aliso Canyon Wash and Arroyo Calabasas are natural unlined streams within the hilly terrain of the watershed headwaters and become concrete lined channels or storm drains within the San Fernando Valley, where the density of urban development is greatest. The other tributaries within the LAR Reach 6 watershed are completely channelized and concrete-lined.

- Reach 5 of the LAR is a relatively short segment (about 2 miles) where the river flows through Sepulveda Flood Control Basin, just west of the 405 Freeway in the San Fernando Valley. Bull Creek is a major tributary to Reach 5. In addition, a major source of water to Reach 5 is effluent from the D.C. Tillman (DCT) WRP, which has a treatment capacity of 80 million gallons per day (mgd).

- Reach 4 of the LAR continues eastward for approximately 11 miles through the San Fernando Valley, beginning downstream of the Sepulveda Dam. Developed areas discharge urban stormwater directly to the river. In addition, two large tributaries to Reach 4 are Pacoima Wash and Tujunga Wash. These tributaries drain portions of the Angeles National Forest and are channelized below flood control basins at the base of mountains. These tributaries primarily convey urban stormwater discharges south into the LAR.

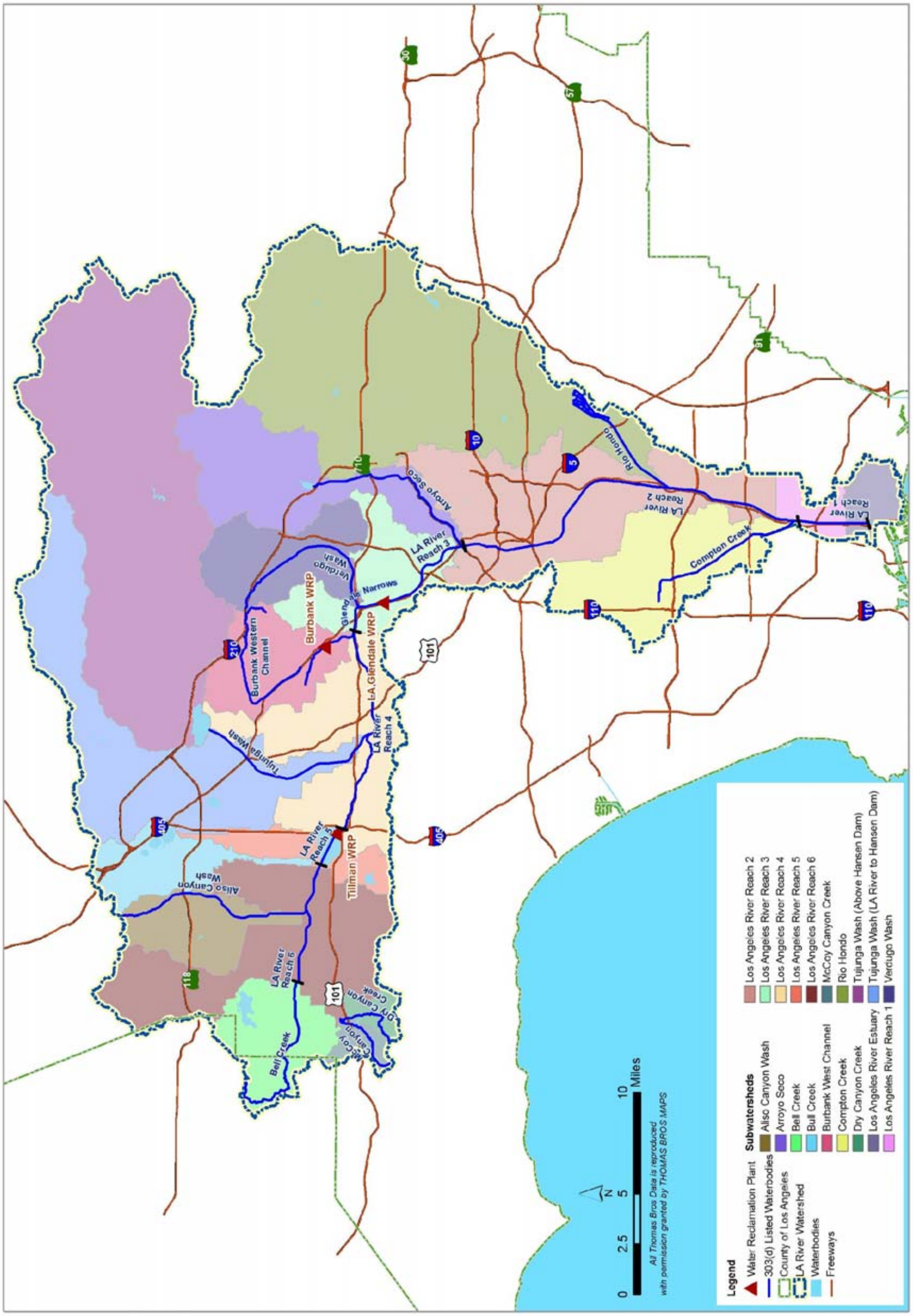

Figure 2-3
Watersheds of Los Angeles River Reaches and Tributaries
Los Angeles River Watershed

- Reach 3 of the LAR is approximately 8 miles, with its upstream end at the confluence with the Burbank Western Channel. This channel conveys approximately 9 mgd of effluent from the City of Burbank WRP as well as urban stormwater runoff discharges to the river. Downstream of the Burbank Western Channel, the river confluences with the Verdugo Wash, and then parallels the 5 Freeway. Verdugo Wash primarily conveys stormwater runoff from urban areas south of the 210 Freeway and canyon runoff from the Verdugo Mountains to the LAR. Downstream of the Verdugo Wash confluence, the river bends southward into an area known as the Glendale Narrows. Due to historically high groundwater tables in the Glendale Narrows, the bottom of the LAR is unlined allowing natural springs to recharge runoff in the river. Effluent from the City of Los Angeles Glendale (LAG) WRP discharges into Reach 3 in the Glendale Narrows. This WRP has a capacity of 20 mgd.

- Reach 2 of the LAR is approximately 19 miles in length and drains a large watershed, which includes undeveloped mountainous areas in the Angeles National Forest as well as urban areas in cities northeast of downtown Los Angeles. Reach 2 begins at the confluence of the Arroyo Seco and LAR and ends at the confluence of Compton Creek and LAR. The primary tributary to this reach is the Rio Hondo. During dry weather conditions, most runoff in the Rio Hondo is diverted to the Rio Hondo Spreading Grounds (RHSG). During wet weather periods, runoff periodically exceeds the groundwater recharge capacity of the RHSG and flows southwest to the LAR.

- Reach 1 of the LAR is relatively short, extending about 3.4 miles from the confluence with Compton Creek at its upstream end to the Willow Street bridge downstream. The last remaining section of the LAR (approximately 1.6 miles) coincides with the LAR estuary, ending downstream just past the Ocean Boulevard bridge where the LAR empties into Long Beach Harbor. Compton Creek is the only major tributary to Reach 1. Both Compton Creek and Reach 1 of the LAR are mostly channelized.

Pollutants from urbanized portions of the watershed flow to impaired waterbodies through a vast stormwater drainage network (Figure 2-4) owned by the City and Los Angeles County. Basic facility information for each of these stormwater drainage features will be used to aid in siting potential BMPs. In general, the proximity of a candidate BMP site to the stormwater drainage network is recognized as a benefit when prioritizing BMP alternatives.

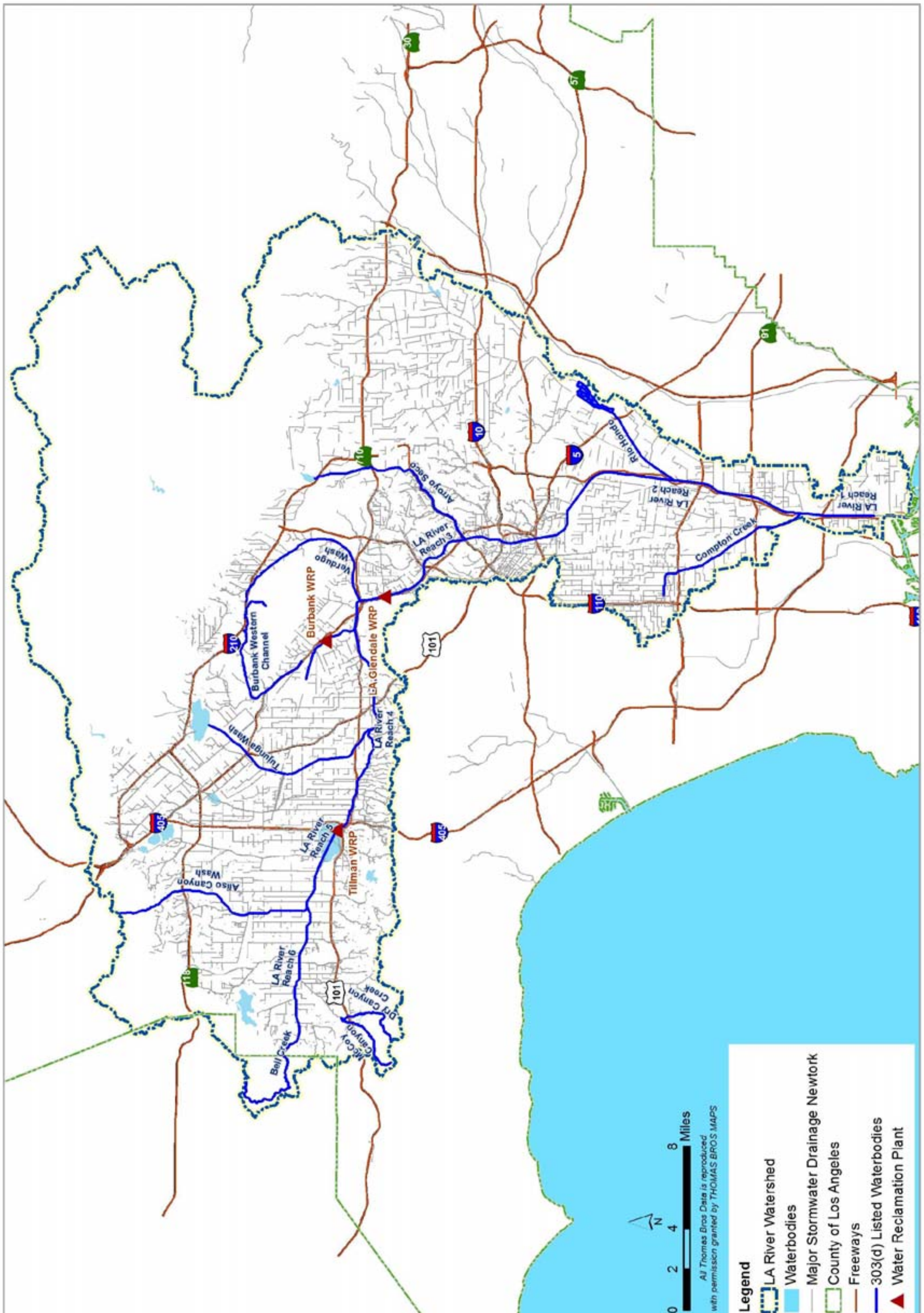

Figure 2-4
Major Stormwater Drainage Newtork
Los Angeles River Watershed

2.1.3 Subcatchment Areas

Delineation of subcatchments in the LAR Watershed facilitated identification of areas with the greatest potential pollutant loading to downstream receiving waterbodies. The average size of subcatchment area delineation considered the specific tasks involved in the development of the TMDL implementation plan. The Hydraulic Water Conservation Division of the LA County Department of Public Works (LACDPW) developed a set of subcatchments encompassing the entire LAR Watershed area as well as other watersheds in Los Angeles County. The primary purpose was to develop a set of subcatchments for implementing the National Pollutant Discharge Elimination System (NPDES) permit for MS4 discharges, for which LACDPW is the Principal Permittee. Within the LAR Watershed, this subcatchment delineation characterizes approximately one thousand distinct hydrologic drainage areas to receiving waterbody outfalls (Figure 2-5). The average size of these subcatchments within the LAR Watershed is approximately 500 acres. These subcatchments are used for prioritization of areas for maximum pollutant load reduction. A very intensive drainage study by the City of Los Angeles generated another set of subcatchments for the City with an average area of 40 acres. This fine level of disaggregation provided is beneficial for the City in evaluating spatially distributed BMP opportunities for the TMDLIP.

2.1.4 Rainfall Data Summaries

There is a wide range of variability in event and annual rainfall across the LAR Watershed, due to the orographic effects of the mountain ranges. Annual rainfall depths in higher elevation areas in the northern and western portion of the watershed are greater than within the San Fernando Valley or coastal plane. The National Climatic Data Center (NCDC) maintains 11 meteorological stations throughout the LAR Watershed for which there are long-term rainfall records (Figure 2-6). Table 2-1 summarizes the period of record, location, elevation, and general rainfall characteristics for each rainfall station. The mean annual rainfall based on long-term historical data from these stations ranges from 12.2 to 17.6 inches, and the 85th percentile storm event depth ranges from 1.3 to 2.0 inches (Figure 2-7). As shown in Table 2-2, the majority of rainfall occurs between October and May.

From historical records of rainfall at these and other rainfall stations in the region, a countywide isohyets (i.e., lines of equal rainfall) map was developed (National Oceanic and Atmospheric Administration [NOAA] 2006). Figure 2-8 shows the rainfall isohyets for the 85th percentile, 24-hour rainfall events throughout the LAR Watershed. Storm event rainfall in the higher elevation areas of the Santa Monica, Santa Susana, San Gabriel, and Verdugo Mountains is greater than the storm events that occur in the lower elevations of the San Fernando Valley and coastal plain. In addition, within the lower elevation parts of the watershed, rainfall event depths are higher inland than at the coast.

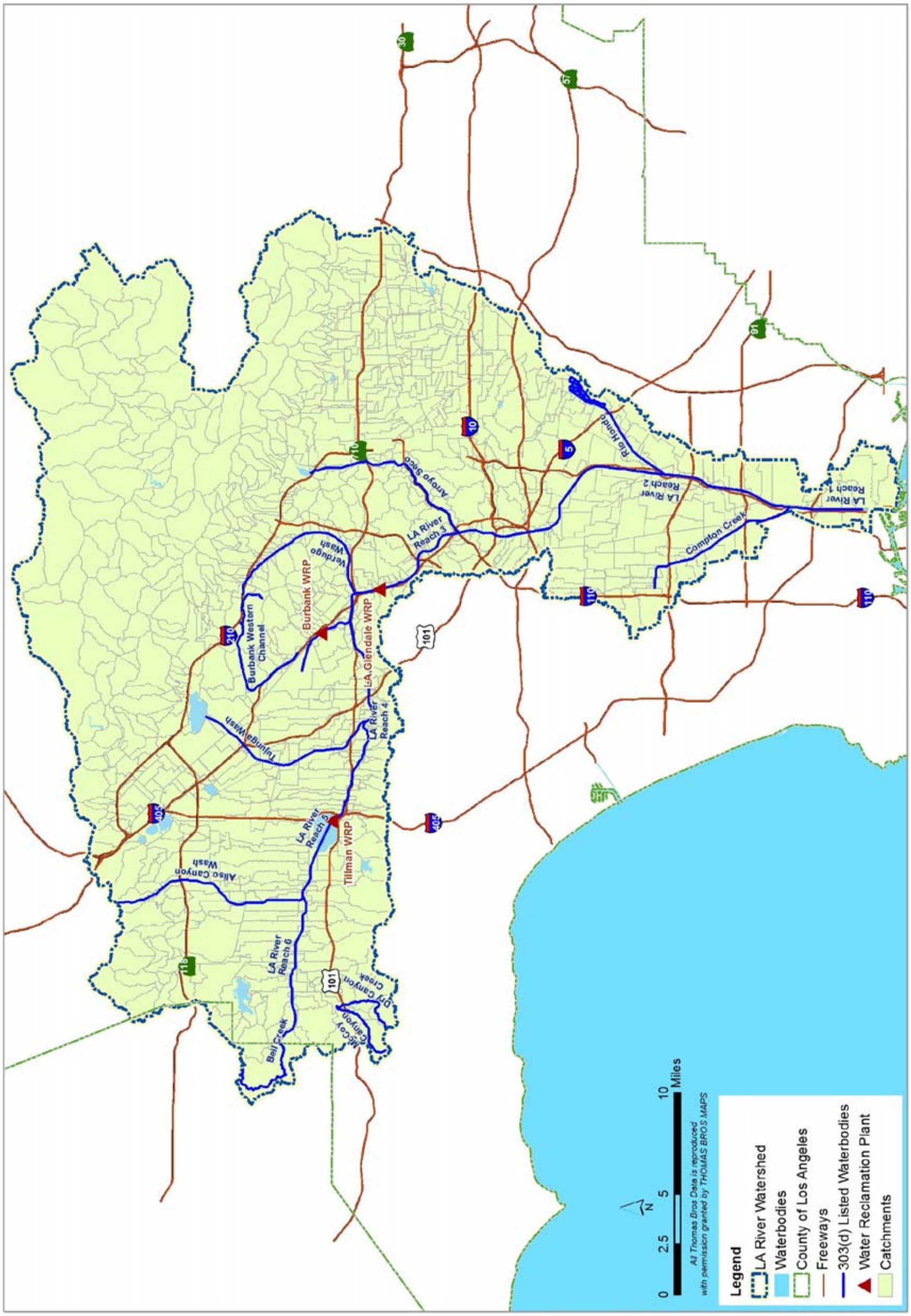

Figure 2-5
Catchments
Los Angeles River Watershed

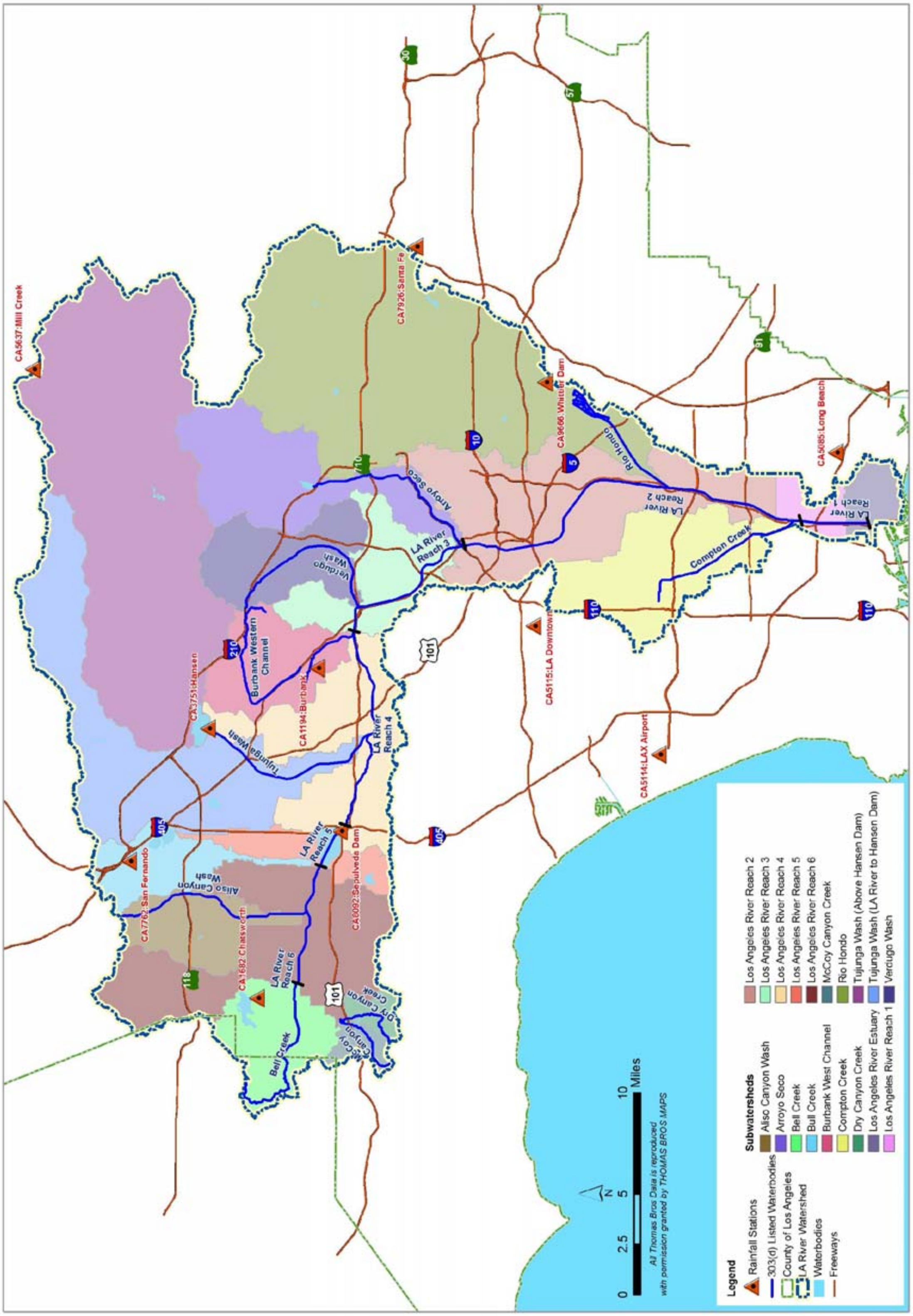

Figure 2-6
National Climatic Data Center Rainfall Stations
Los Angeles River Watershed

Table 2-1 Summary of Rainfall Stations in the Vicinity of the LAR Watershed

NCDC Station ID	Station Name	Period of Record	Latitude	Longitude	Elevation (ft)	Mean Annual Precipitation (in)	85th Percentile Storm (in)
CA1194	Burbank	1948 - 2007	34.183	-118.333	655	13.9	1.6
CA1682	Chatsworth	1948 - 2007	34.225	-118.618	910	14.0	1.4
CA3751	Hansen	1948 - 2007	34.261	-118.385	1087	14.3	1.6
CA5114	LAX Airport	1948 - 2007	33.938	-118.406	100	12.2	1.4
CA5115	LA Downtown	1948 - 2007	34.028	-118.296	185	14.5	1.5
CA5085	Long Beach	1976 - 2007	33.812	-118.146	31	12.6	1.4
CA5637	Mill Creek	1972 - 2006	34.387	-118.075	4990	17.6	1.3
CA7762	San Fernando	1948 - 2007	34.317	-118.500	1250	16.7	2.0
CA7926	Santa Fe	1948 - 2007	34.113	-117.969	425	15.7	1.9
CA8092	Sepulveda Dam	1948 - 2007	34.166	-118.473	680	14.8	1.9
CA9666	Whittier Dam	1972 - 2007	34.020	-118.086	200	13.5	1.7

Source: http://lwf.ncdc.noaa.gov/oa/climate/climatedata.html

Table 2-2 Summary of Average Monthly Rainfall for Stations in the Vicinity of the LAR Watershed

Month	Burbank (in/mo)	Chatsworth (in/mo)	Hansen (in/mo)	LAX Airport (in/mo)	LA Downtown (in/mo)	Long Beach (in/mo)	Mill Creek (in/mo)	San Fernando (in/mo)	Santa Fe (in/mo)	Sepulveda Dam (in/mo)	Whittier Dam (in/mo)
January	3.1	3.1	3.1	2.8	3.3	2.9	3.1	3.8	3.5	3.4	2.8
February	3.0	3.3	3.2	2.8	3.3	3.1	4.5	3.6	3.6	3.5	3.7
March	2.4	2.1	2.2	1.9	2.4	2.3	3.2	2.4	2.5	2.2	2.2
April	1.1	0.9	1.1	0.8	1.0	0.6	1.0	1.3	1.2	1.0	0.7
May	0.3	0.3	0.3	0.2	0.3	0.3	0.4	0.3	0.3	0.2	0.3
June	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1
July	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
August	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1
September	0.2	0.1	0.2	0.2	0.3	0.2	0.4	0.2	0.2	0.2	0.3
October	0.5	0.4	0.5	0.4	0.4	0.6	0.9	0.5	0.4	0.4	0.4
November	1.4	1.5	1.5	1.3	1.5	0.9	1.2	1.8	1.6	1.6	0.9
December	1.8	2.1	1.9	1.7	2.0	1.6	2.3	2.6	2.1	2.1	2.0
Total	13.9	14.0	14.3	12.2	14.5	12.6	17.6	16.7	15.6	14.7	13.5

Note: See Table 2-1 for period of record and station details

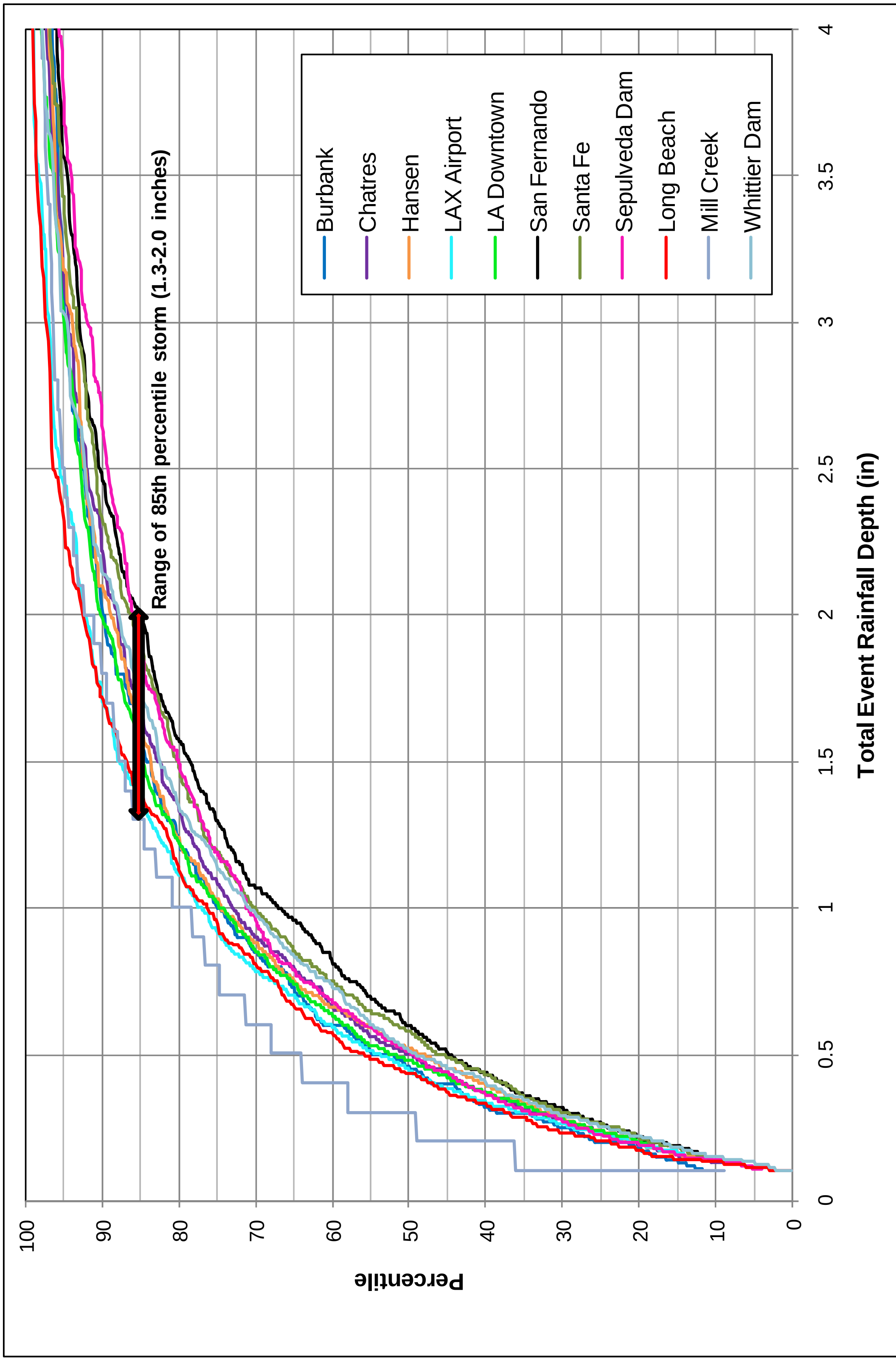

Figure 2-7
Storm Event Depth Cumulative Frequency Curves for NCDC Rainfall Stations near the LAR Watershed

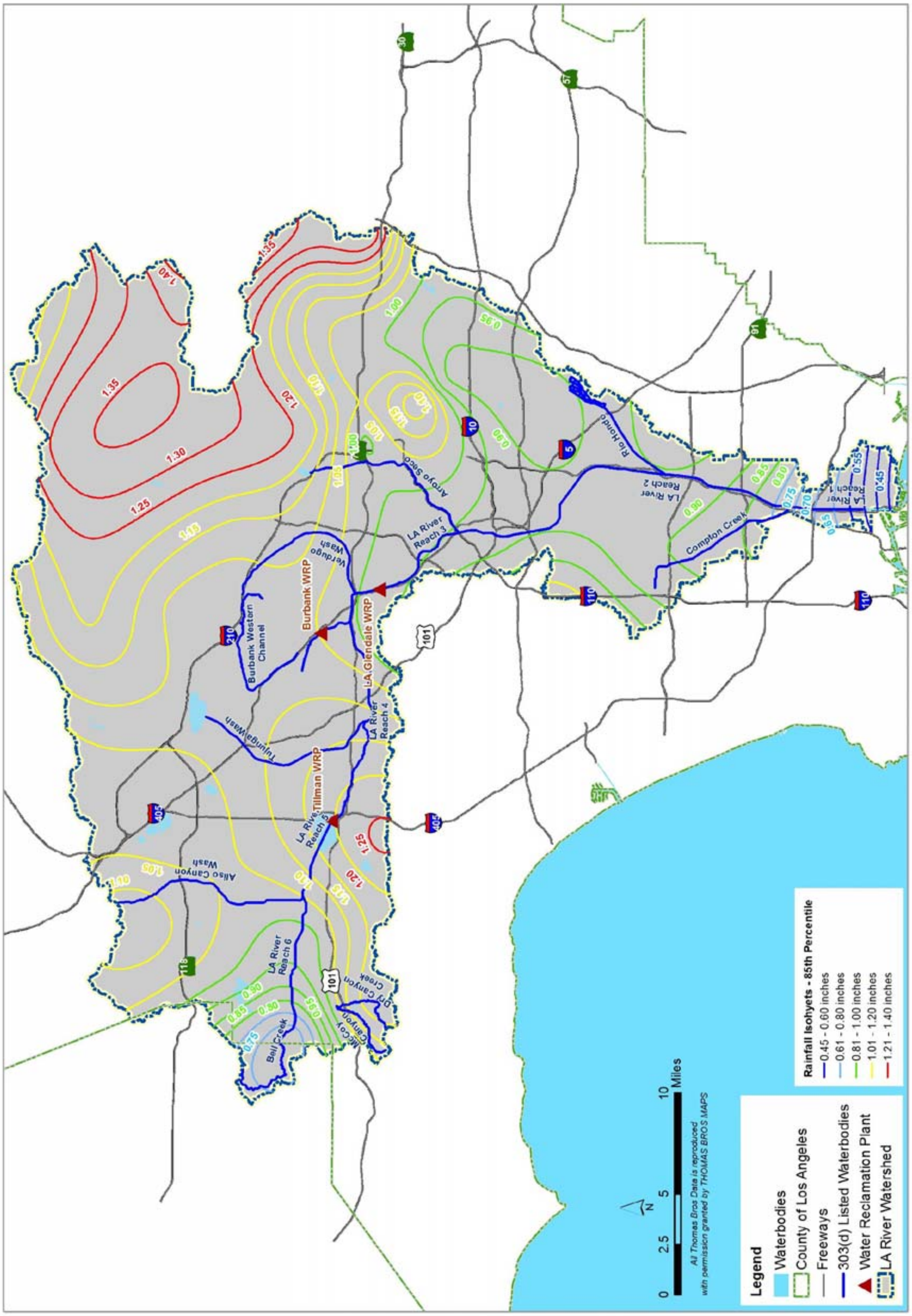

Figure 2-8
Rainfall Isohyets (85th Percentile)
Los Angeles River Watershed

2.1.5 Land Use and Impervious Area

The existing land use distribution for each subcatchment directly affects the pollutant loading potential and the potential load reductions achievable through implementation of downstream structural BMPs. The Southern California Area Governments (SCAG) maintains GIS coverage of land use in parts of southern California, which is the most extensive source of existing land use information available for the LAR Watershed. The maintenance of this geographic dataset (with the most recent update in 2005) involves interpretation of aerial photography.

Figure 2-9 shows the land use distribution within the LAR Watershed, based on the SCAG 2005 update. While there are many unique categories of land use delineated in the SCAG dataset, aggregation to seven general categories facilitates the development of more understandable maps. The distribution of land use shows some significant differences between major subwatersheds (Table 2-3). Generally, LAR Reach 2, Compton Creek, and Rio Hondo watersheds have a prevalence of commercial, industrial, and transportation (categorized as 'Other Urban') areas compared with subwatersheds within the San Fernando Valley, which have a larger fraction of urbanized land use in residential land use types.

Imperviousness is the fraction of the total area covered in impervious surfaces, such as roads, rooftops, sidewalks, patios, parking areas, and highly compacted soil. Rainfall and dry weather water sources (irrigation, car washing etc.) that fall on pervious surfaces have a chance to infiltrate and possibly recharge groundwater and reduce the total amount of runoff generated from an area. The degree to which infiltration can occur in pervious areas is a function of soil infiltration properties, as described in the following section.

The Los Angeles County Hydrology Manual (LACDWP 2006) provides an estimate of the imperviousness of different land uses. Table 2-4 shows the estimated watershed wide imperviousness based on estimated imperviousness in each of the land use types within the LAR Watershed. The imperviousness of individual subcatchments is important for determining BMP design criteria, such as the water quality treatment volume for potential structural BMPs.

2.1.6 Soil Types

The underlying soil type directly affects infiltration of runoff over pervious areas in a watershed. Infiltration capacity, hydraulic conductivity, and water holding properties of soil vary widely within the LAR Watershed; therefore, it is important to consider soil types when simulating watershed runoff. In addition, soil types are one of several critical factors in determining the feasibility of infiltration BMPs. The types of soils within the LAR Watershed extracted from the LACDPW database are modified from historical Natural Resources Conservation Service (NRCS) soils series boundaries and recent double ring infiltrometer testing.

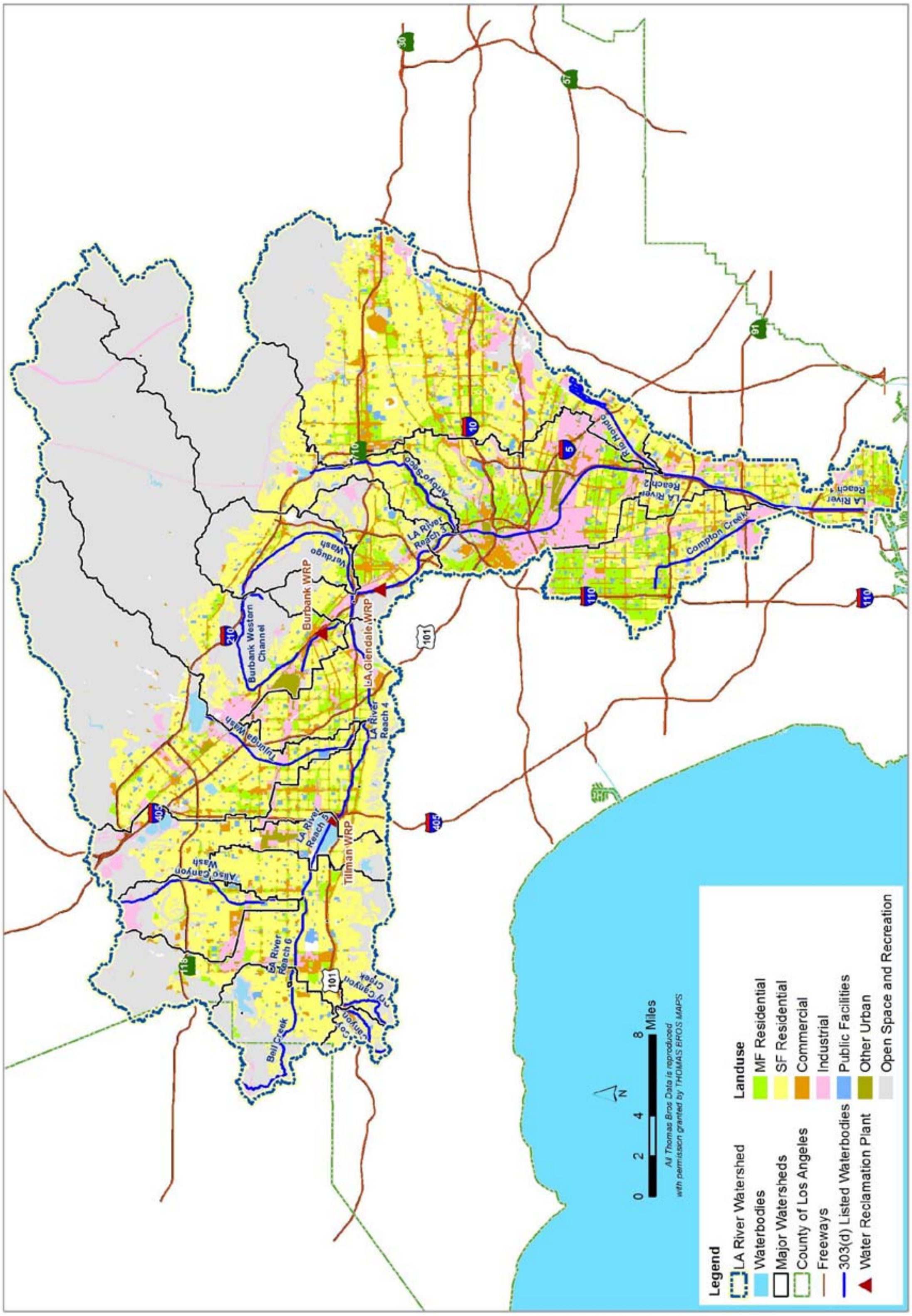

Figure 2-9
Land Use (SCAG, 2005)
Los Angeles River Watershed

Table 2-3 Distribution of General Land Use Groups in Subwatersheds to LA River Reaches and Major Tributaries

Watershed	Agricultural (acres)	Commercial (acres)	Industrial (acres)	Transportation (acres)	Open Space / Rec (acres)	SF Residential (acres)	MF Residential (acres)	Total Acreage
Aliso Canyon Wash	134	1,337	1,348	440	3,468	6,383	463	13,574
Arroyo Seco	48	1,716	192	371	37,915	8,100	988	49,329
Bell Creek	54	875	293	8	7,721	7,086	206	16,243
Burbank Western Channel	146	1,775	1,532	1,245	8,000	4,918	773	18,389
Compton Creek	108	5,046	2,762	1,633	728	8,693	6,840	25,811
Dry Canyon Creek	26	130		23	1,396	1,376	25	2,977
LA River Reach 1	303	3,690	1,849	1,322	2,002	9,027	3,052	21,244
LA River Reach 2	76	8,187	7,660	4,028	4,136	8,723	6,769	39,579
LA River Reach 3	29	2,447	908	812	7,163	6,436	1,838	19,633
LA River Reach 4	147	3,847	1,864	1,200	4,523	14,439	3,638	29,656
LA River Reach 5	316	3,054	630	1,303	7,315	8,401	356	21,375
LA River Reach 6	386	3,876	1,331	545	13,645	17,850	2,104	39,737
McCoy Canyon Creek	54	195	8	201	1,355	1,442	31	3,285
Rio Hondo	693	11,582	4,230	2,262	23,920	35,811	6,527	85,025
Tujunga Wash	626	4,938	1,717	1,634	102,841	17,091	2,458	131,306
Verdugo Wash	8	1,036	27	480	8,373	6,148	607	16,679
Total Area	3,154	53,732	26,351	17,507	234,500	161,923	36,674	533,843

Table 2-4 Estimated Imperviousness for the Los Angeles River Watershed Area

Code	Land Use Description	Imperviousness Factor (1)	LAR Watershed Acres (2)	Impervious Acres
Agricultural				
2110	Irrigated Cropland and Improved Pasture Land	2%	542	11
2120	Non-Irrigated Cropland and Improved Pasture Land	2%	10	0
2200	Orchards and Vineyards	2%	100	2
2300	Nurseries	15%	1,471	221
2600	Other Agriculture	42%	18	8
2700	Horse Ranches	42%	1,014	426
	Subtotal	21%	3,154	667
Commercial				
1211	Low- and Medium-Rise Major Office Use	91%	3,188	2,901
1212	High-Rise Major Office Use	91%	399	363
1213	Skyscrapers	91%	56	51
1221	Regional Shopping Center	95%	650	618
1222	Retail Centers (Non-Strip With Contiguous Interconnected Off-Street	96%	3,537	3,396
1223	Modern Strip Development	96%	9,204	8,835
1224	Older Strip Development	97%	7,236	7,019
1231	Commercial Storage	90%	496	446
1232	Commercial Recreation	90%	920	828
1233	Hotels and Motels	96%	450	432
1241	Government Offices	91%	1,155	1,051
1242	Police and Sheriff Stations	91%	179	163
1243	Fire Stations	91%	300	273
1244	Major Medical Health Care Facilities	74%	965	714
1245	Religious Facilities	82%	1,532	1,256
1246	Other Public Facilities	91%	539	491
1247	Non-Attended Public Parking Facilities	91%	349	318
1251	Correctional Facilities	91%	160	146
1252	Special Care Facilities	74%	613	454
1253	Other Special Use Facilities	86%	288	247

Table 2-4 Estimated Imperviousness for the Los Angeles River Watershed Area

Code	Land Use Description	Imperviousness Factor [1]	LAR Watershed Acres [2]	Impervious Acres
1271	Base (Built-up Area)	65%	166	108
1340	Wholesaling and Warehousing	91%	3,339	3,039
1420	Communication Facilities	82%	195	160
1431	Electrical Power Facilities	47%	3,586	1,685
1432	Solid Waste Disposal Facilities	15%	1,459	219
1433	Liquid Waste Disposal Facilities	96%	33	31
1434	Water Storage Facilities	91%	650	591
1435	Natural Gas and Petroleum Facilities	91%	199	181
1436	Water Transfer Facilities	96%	663	637
1500	Mixed Commercial and Industrial	91%	303	276
	Subtotal	86%	42,808	36,928
Education				
1261	Pre-Schools/Day Care Centers	68%	60	41
1262	Elementary Schools	82%	4,574	3,751
1263	Junior or Intermediate High Schools	82%	1,638	1,343
1264	Senior High Schools	82%	2,945	2,415
1265	Colleges and Universities	47%	1,572	739
1266	Trade Schools and Professional Training Facilities	91%	135	123
	Subtotal	77%	10,924	8,411
Industrial				
1311	Manufacturing, Assembly, and Industrial services	91%	21,147	19,244
1312	Motion Picture and Television Studio Lots	82%	488	401
1313	Packing Houses and Grain Elevators	96%	15	14
1314	Research and Development	91%	587	534
1321	Manufacturing	91%	120	109
1322	Petroleum Refining and Processing	91%	20	18
1323	Open Storage	66%	1,361	898
1324	Major Metal Processing	91%	25	22
1325	Chemical Processing	91%	51	46
1331	Mineral Extraction - Other Than Oil and Gas	10%	961	96
1332	Mineral Extraction - Oil and Gas	10%	1,578	158
	Subtotal	82%	26,351	21,540
Other Urban				
1411	Airports	91%	1,509	1,373
1412	Railroads	15%	1,714	257
1413	Freeways and Major Roads	91%	8,432	7,674
1414	Park-and-Ride Lots	91%	68	62
1415	Bus Terminals and Yards	91%	335	305
1416	Truck Terminals	91%	792	721
1417	Harbor Facilities	91%	1	1
1440	Maintenance Yards	91%	757	689
1450	Mixed Transportation	90%	1,692	1,523
1460	Mixed Transportation and Utility	91%	214	195
1600	Mixed Urban	89%	498	443
1700	Under Construction	91%	1,495	1,360
	Subtotal	83%	17,507	14,602
Open Space / Recreation				
1272	Vacant Area	2%	5	0
1437	Improved Flood Waterways and Structures	100%	5,626	5,626
1438	Mixed Wind Energy Generation and Percolation Basin	100%	15	15
1810	Golf Courses	3%	4,680	140
1821	Developed Local Parks and Recreation	10%	4,631	463
1822	Undeveloped Local Parks and Recreation	2%	3	0
1831	Developed Regional Parks and Recreation	2%	1,470	29
1832	Undeveloped Regional Parks and Recreation	1%	1,245	12
1840	Cemeteries	10%	1,752	175

Table 2-4 Estimated Imperviousness for the Los Angeles River Watershed Area

Code	Land Use Description	Imperviousness Factor [1]	LAR Watershed Acres [2]	Impervious Acres
1850	Wildlife Preserves and Sanctuaries	2%	231	5
1860	Specimen Gardens and Arboreta	15%	440	66
1880	Other Open Space and Recreation	10%	1,047	105
3100	Vacant Undifferentiated	1%	212,167	2,122
3200	Abandoned Orchards and Vineyards	2%	21	0
3300	Vacant With Limited Improvements	42%	67	28
4100	Water, Undifferentiated	100%	1,099	1,099
4200	Harbor Water Facilities	100%	1	1
	Subtotal	4%	234,500	9,887
Single-Family Residential				
1111	High-Density Single Family Residential	42%	148,934	62,552
1112	Low-Density Single Family Residential	21%	11,204	2,353
1131	Trailer Parks and Mobile Home Courts, High-Density	91%	1,226	1,115
1151	Rural Residential, High-Density	15%	42	6
1152	Rural Residential, Low-Density	10%	517	52
	Subtotal	41%	161,923	66,078
Multi-Family Residential				
1121	Mixed Multi-Family Residential	74%	921	681
1122	Duplexes, Triplexes and 2-or 3-Unit Condominiums and Townhouses	55%	602	331
1123	Low-Rise Apartments, Condominiums, and Townhouses	86%	18,335	15,768
1124	Medium-Rise Apartments and Condominiums	86%	1,070	920
1125	High-Rise Apartments and Condominiums	90%	133	120
1140	Mixed Residential	59%	15,613	9,212
	Subtotal	74%	36,674	27,033
Grand Total		**34%**	**522,918**	**176,735**

[1] Source: LA County Hydrology Manual, Appendix D
[2] Source: Southern California Association of Governments (SCAG) Land Use Data (2005)

Potential soil infiltration rates estimated for each soil type throughout the LAR Watershed have significant spatial variability (Figure 2-10). Criteria for selecting infiltration facilities (basins, trenches, or dry wells) as a feasible BMP option documented in several handbooks, generally recommend a minimum permeability of 0.5 to 1.0 inches/hour (Caltrans 2007; CASQA 2003).

2.1.7 Parcel Data

Structural BMPs to be included in the Implementation Plan are typically sited on undeveloped parcels of land. A review of the existing LA County parcel role shows that there are many potential opportunities for siting new structural BMPs on publicly owned lands within the LAR Watershed (Figure 2-11).

Regional structural BMPs are large facilities, such as detention ponds, that receive drainage from an upstream area on the order of several hundred acres. In the LAR Watershed, potential regional structural BMP siting opportunities typically require large undeveloped parcels (e.g., greater than one acre). The Implementation Plan prioritizes City owned properties over other public entities, such as schools/ universities, county, state and federal lands, or utility and highway corridors.

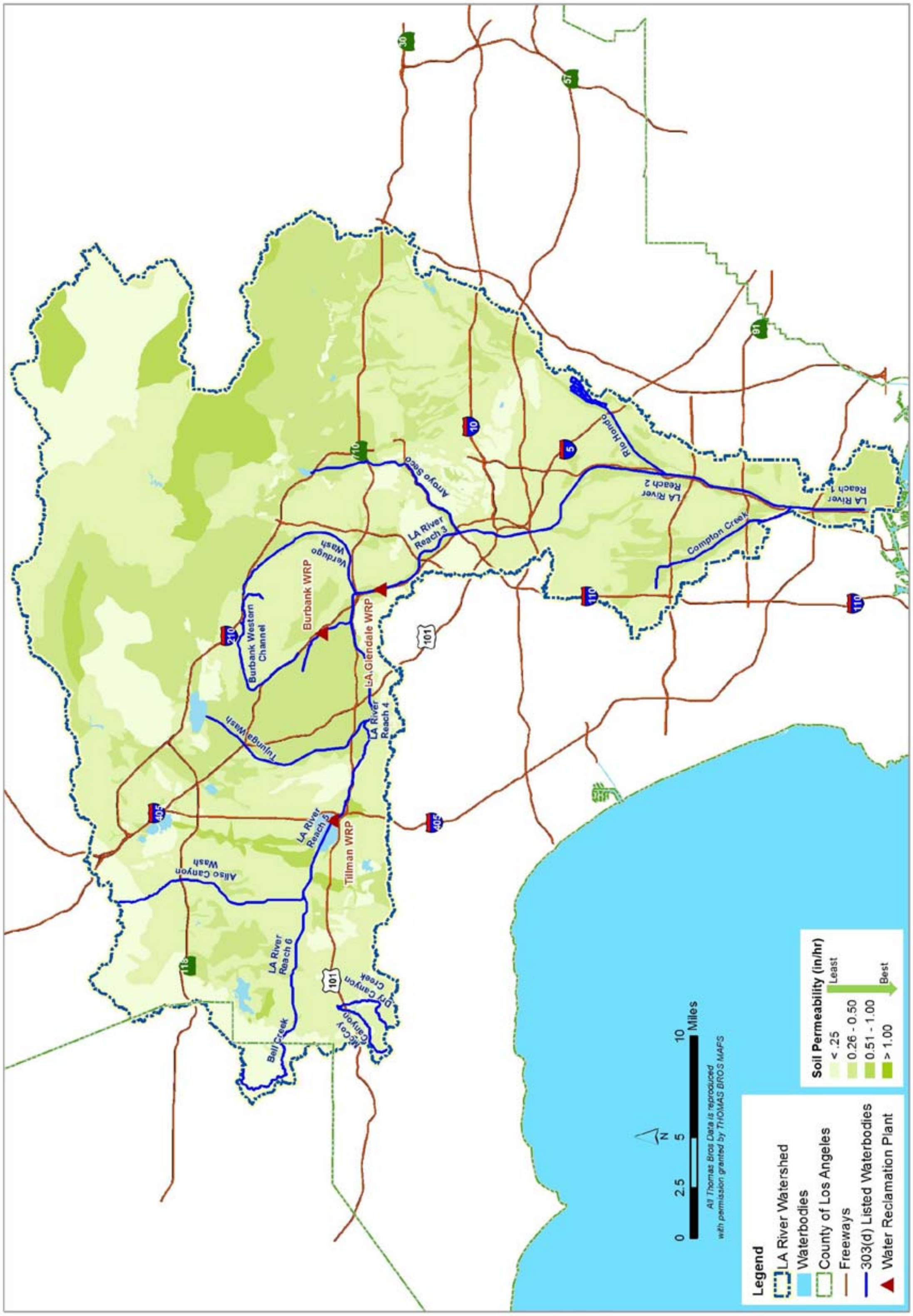

Figure 2-10
Soil Permeability
Los Angeles River Watershed

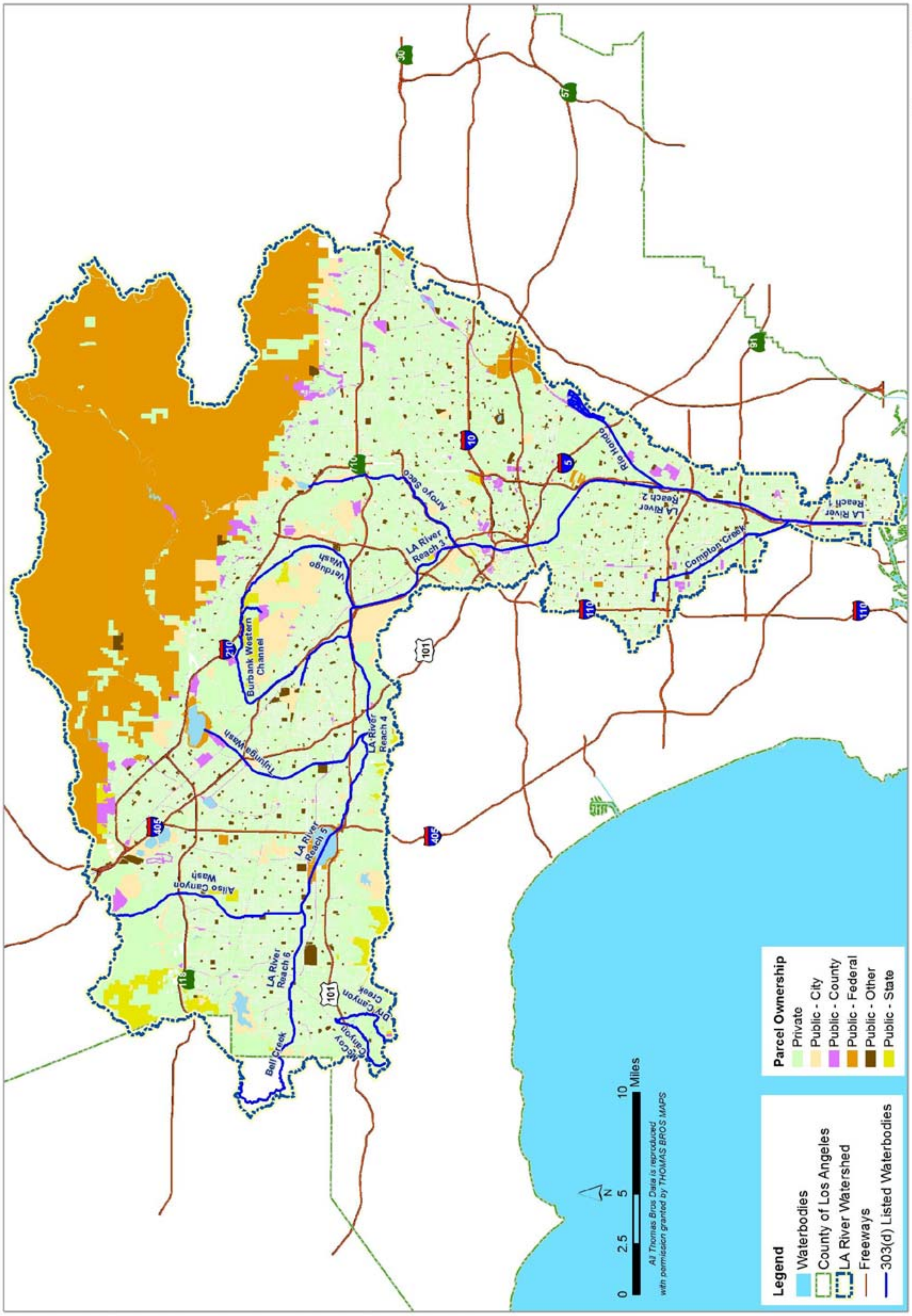

Figure 2-11
Parcel Data
Los Angeles River Watershed

Distributed structural BMPs typically include smaller onsite controls that treat stormwater runoff from a smaller catchment area; typically 10 acres. Distributed structural BMPs have small footprints and require much less area than regional structural BMPs (e.g., only a portion of a parcel may be required). However, the evaluation of parcels as candidate BMP sites is similar, whereby city or county owned properties are preferred over other public entities.

2.1.8 Depth to Groundwater

Depth to groundwater is important when selecting infiltration BMPs, since high groundwater conditions can inhibit effective infiltration of stormwater runoff. Infiltration of stormwater can also aggravate groundwater contamination plumes. In the LAR Watershed, infiltration is primarily a concern in the eastern San Fernando Valley, where the Watermaster is working to reduce stormwater infiltration to protect the groundwater from contamination plumes. Figure 2-12 highlights areas where the depth to groundwater is less than 30-feet below the ground surface (bgs). The feasibility of infiltration BMPs is influenced by high water table conditions, which are known to occur near the LAR, especially within the Glendale Narrows, and at the base of the mountains where there are several surface runoff recharge facilities.

2.1.9 Liquefaction and Landslide Zones

Liquefaction refers to the behavior of soils, such as loose sand, that under conditions such as an earthquake will go from a solid state to a liquefied state, having a consistency similar to that of a heavy liquid. Liquefaction occurs in saturated soils, where the water pressure increases with the earthquake event, which changes the behavior of the soil. Liquefaction zones within the LAR Watershed create conditions that preclude siting of some types of structural BMPs (Figure 2-13). These zones tend to occur where depth to groundwater is relatively low and near most surface waterbodies.

Landslides occur when a slope's stability changes from stable to unstable, because of many natural factors, including earthquakes, groundwater pressure, heavy rains, as well as human factors, including the use of heavy machinery, blasting, or earthwork. Within the LAR Watershed, zones of landslide potential occur within the mountainous regions (Figure 2-13). The potential for landslides precludes the implementation of most typical structural BMPs.

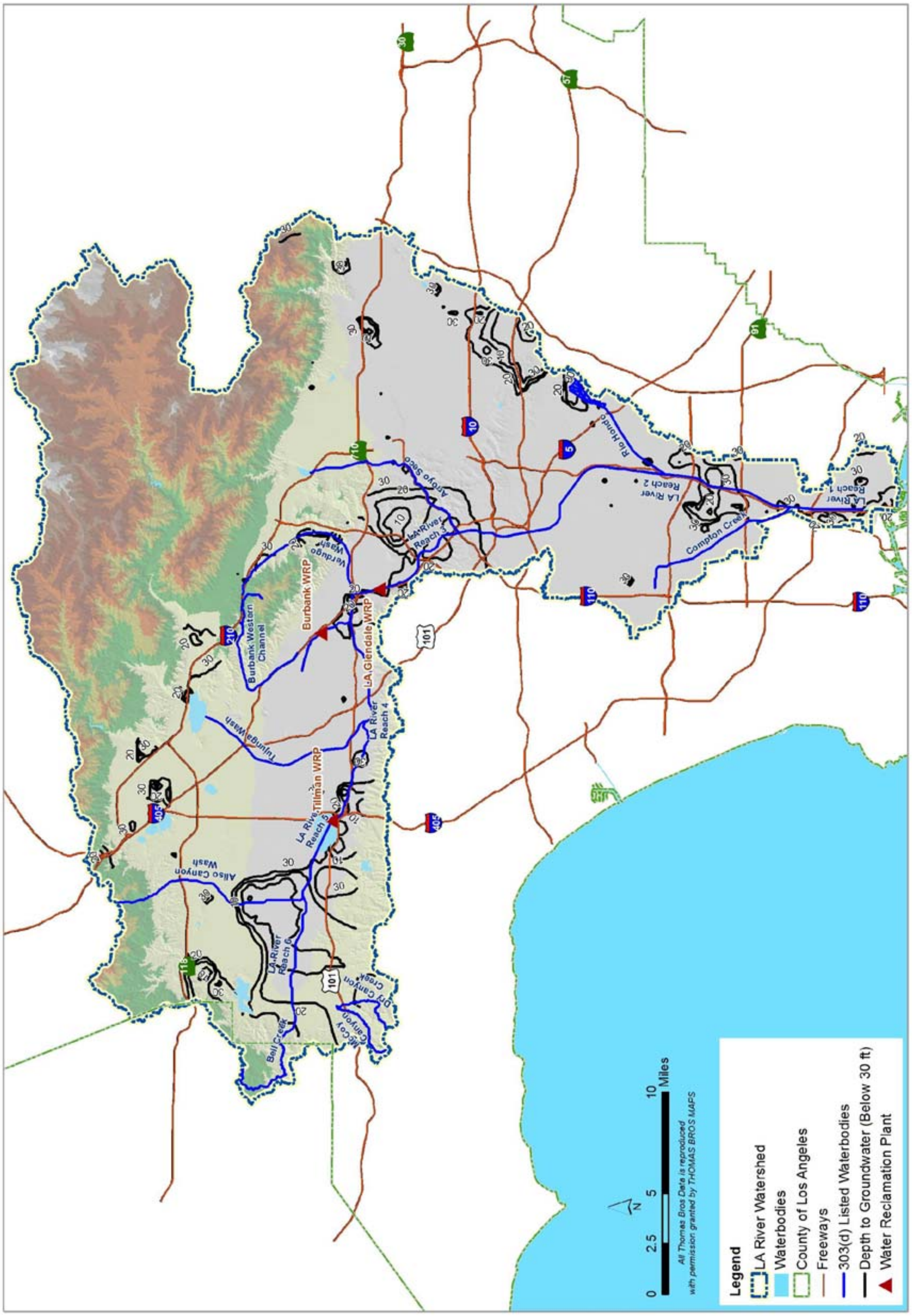

Figure 2-12
Depth to Groundwater
Los Angeles River Watershed

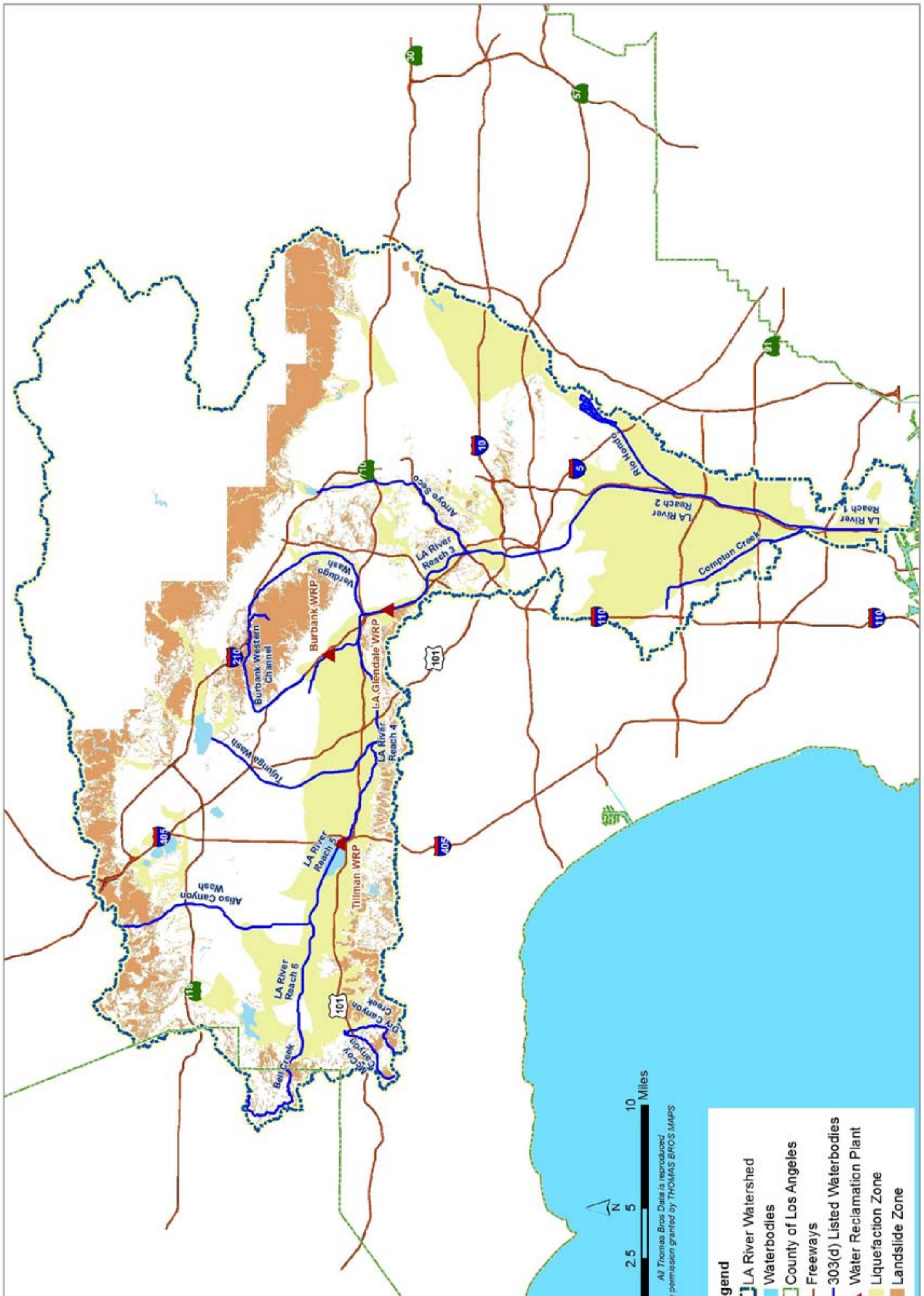

Figure 2-13
Liquefaction and Landslide Zones
Los Angeles River Watershed

2.1.10 Environmentally Sensitive Areas

Implementation of structural BMPs at some locations may not be compatible with environmentally sensitive areas. However, opportunities to integrate structural BMPs into habitat enhancement, conservation, and/or endangered, threatened, or sensitive species recovery efforts do exist within the watershed. Figure 2-14 shows where environmentally sensitive areas exist within the LAR watershed. These areas include:

- *Areas identified in the California Natural Diversity Database (CNDDB)* – Maintained by the California Department of Fish and Game (DFG), the CNDDB is a library of the status and locations of California's rare species and natural community types. The CNDDB identifies all federally and state listed plants and animals, all species that are candidates for listing, all species of special concern, and those species considered "sensitive" by government agencies and the conservation community. Figure 2-14 identifies areas recognized in the CNDDB as important areas for biological diversity, species/habitat considerations, and consultation with resource agencies, including DFG, U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), and/or the Regional Water Quality Control Board (RWQCB).

- *Significant Ecological Area (SEA)* – SEAs have valuable plant and/or animal communities and are believed to be integral to the preservation of threatened or endangered species and the conservation of biological diversity in the County. Protection of these areas is the primary means by which the County of Los Angeles General Plan manages biological resources.

- *Critical Habitat Areas* – The USFWS designates critical habitat areas for numerous threatened and endangered species. Within the LAR Watershed, critical habitat designations exist for four species—the Arroyo toad (*Bufo californicus*), least Bell's vireo (*Vireo bellii pusillus*), Braunton's milk-vetch (*Astragalus brauntonii*) and Santa Ana sucker (*Catostomus santaanae*). Critical habitat areas for the Brauton's milk-vetch and Santa Ana Sucker within the LAR Watershed have been mapped by USFWS[1] (Figure 2-14).

- *Audubon's Important Bird Area (IBA)* – IBAs are sites that provide essential habitat for one or more species of bird and include sites for breeding, wintering, and/or migrating birds. IBAs may include public or private lands, or both, and they may be protected or unprotected. Audubon has identified IBAs within the LAR Watershed (Figure 2-14, Audubon California, November 2008).

- *Other Areas* - Various types of park and conservation areas with different uses are located throughout the LAR watershed.

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1 Source: U.S. Fish and Wildlife Service Environmental Conservation Online System, http://ecos.fws.gov/ecos_public/index.do;jsessionid=168BC1D054D9B1BB540D6C329388B2CD .

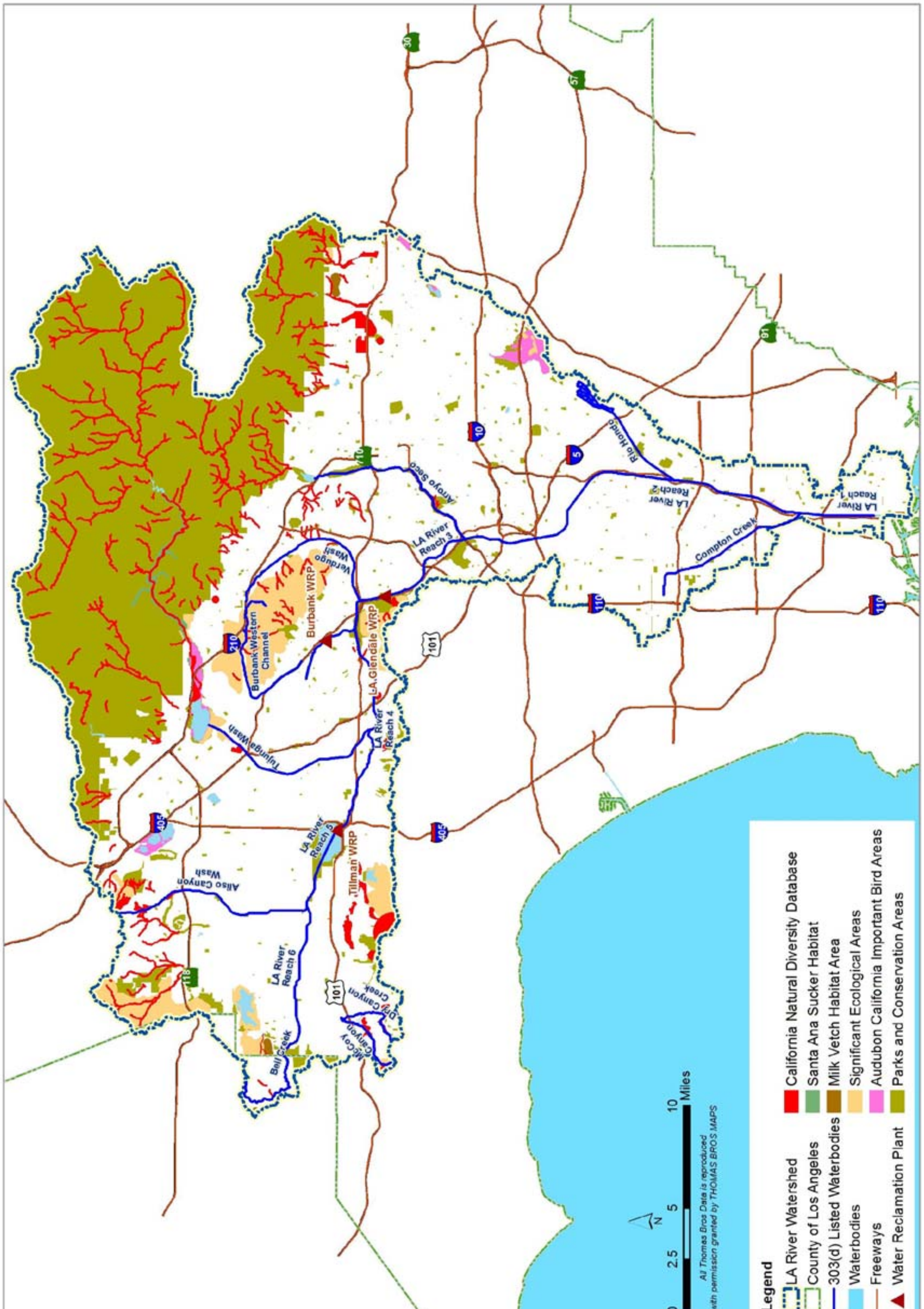


Figure 2-14
Environmentally Sensitive Areas
Los Angeles River Watershed

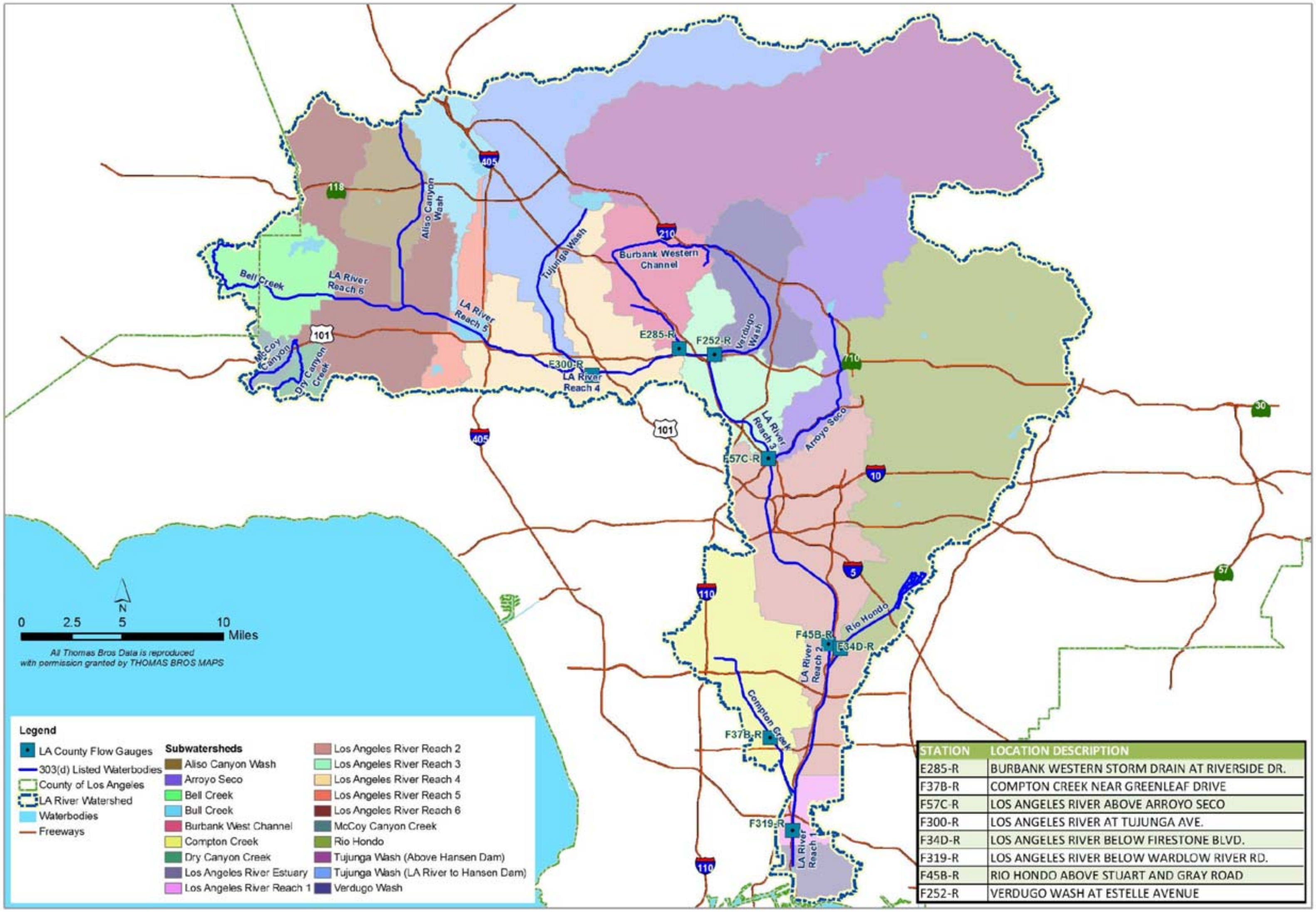
2.2 Hydrologic and Water Quality

2.2.1 Flow Data

Flow in the LAR Watershed is monitored by Los Angeles County at four sites in the LAR main channel, and four tributaries including Burbank Western Channel, Verdugo Wash, Rio Hondo, and Compton Creek (Figure 2-15). Table 2-5 summarizes the flow data record for each site, identifying where data gaps exist. Figures 2-16 and 2-17 show the variations in daily stream flow at these stations from 1993 to 2008. These figures demonstrate that the watershed experiences intense spikes in flow, due to short–duration high-intensity precipitation, urbanized and highly impervious conditions, and presence of steep mountain slopes surrounding valley areas. Dry weather flows fluctuate from upstream to downstream along the LAR mainstem due to effluent discharges from the Tillman, LAG, and Burbank WRPs. Daily flow frequency curves for the LAR mainstem and tributaries show that the LAR mainstem maintains about 150 cfs continuously due to WRP discharges and other dry weather runoff sources, while tributaries may experience almost no flow at times (Figure 2-18). Burbank Western Channel also has continuous flow due to the discharge of treated effluent. The LAR mainstem and Burbank Western Channel have less flow variability than flows in the tributaries that do not receive effluent discharges (Figure 2-19). The overall average dry weather flow at the most upstream flow monitoring site on the LAR mainstem is 88 cfs at Tujunga Wash. Average dry weather flow increases with increased distance downstream reaching an average of 153 cfs at the most downstream LAR mainstem flow monitoring site at Wardlow.

Table 2-5 Data Gaps in the Flow Record at Los Angeles County Stations - October 1993–September 2008

Station	Data Gaps
LAR at Tujunga	Oct-Dec 1997
	Jan-Sept 1998
	Oct-Dec 2008
LAR at Arroyo Seco	Feb-Jun 1994
	Feb, Apr-Sept 1996
	Mar-Sept 1998
	Oct-Dec 2008
LAR at Firestone	Apr-Sept 1998
	Oct-Dec 2008
LAR at Wardlow	May-June 1995
	Apr-Dec 1998
	Jan-Dec 1999
	Jan-Jul 2000
	Oct-Dec 2008
Burbank Western Channel	Sept 1998
	Oct-Dec 2008
Verdugo Wash	Apr-Sept 1998
	Oct-Dec 2008
Rio Hondo	Aug-Sept 1998
	Oct-Dec 1999
	Jan-Dec 2000
	Jan-Dec 2001
	Jan-Feb 2002
	Oct-Dec 2008
Compton Creek	Apr-Sept 1998
	Oct-Dec 2008



STATION	LOCATION DESCRIPTION
E285-R	BURBANK WESTERN STORM DRAIN AT RIVERSIDE DR.
F37B-R	COMPTON CREEK NEAR GREENLEAF DRIVE
F57C-R	LOS ANGELES RIVER ABOVE ARROYO SECO
F300-R	LOS ANGELES RIVER AT TUJUNGA AVE.
F34D-R	LOS ANGELES RIVER BELOW FIRESTONE BLVD.
F319-R	LOS ANGELES RIVER BELOW WARDLOW RIVER RD.
F45B-R	RIO HONDO ABOVE STUART AND GRAY ROAD
F252-R	VERDUGO WASH AT ESTELLE AVENUE

Figure 2-15
Lps Angeles County Department of Public Works Flow Gauges
Los Angeles River Watershed

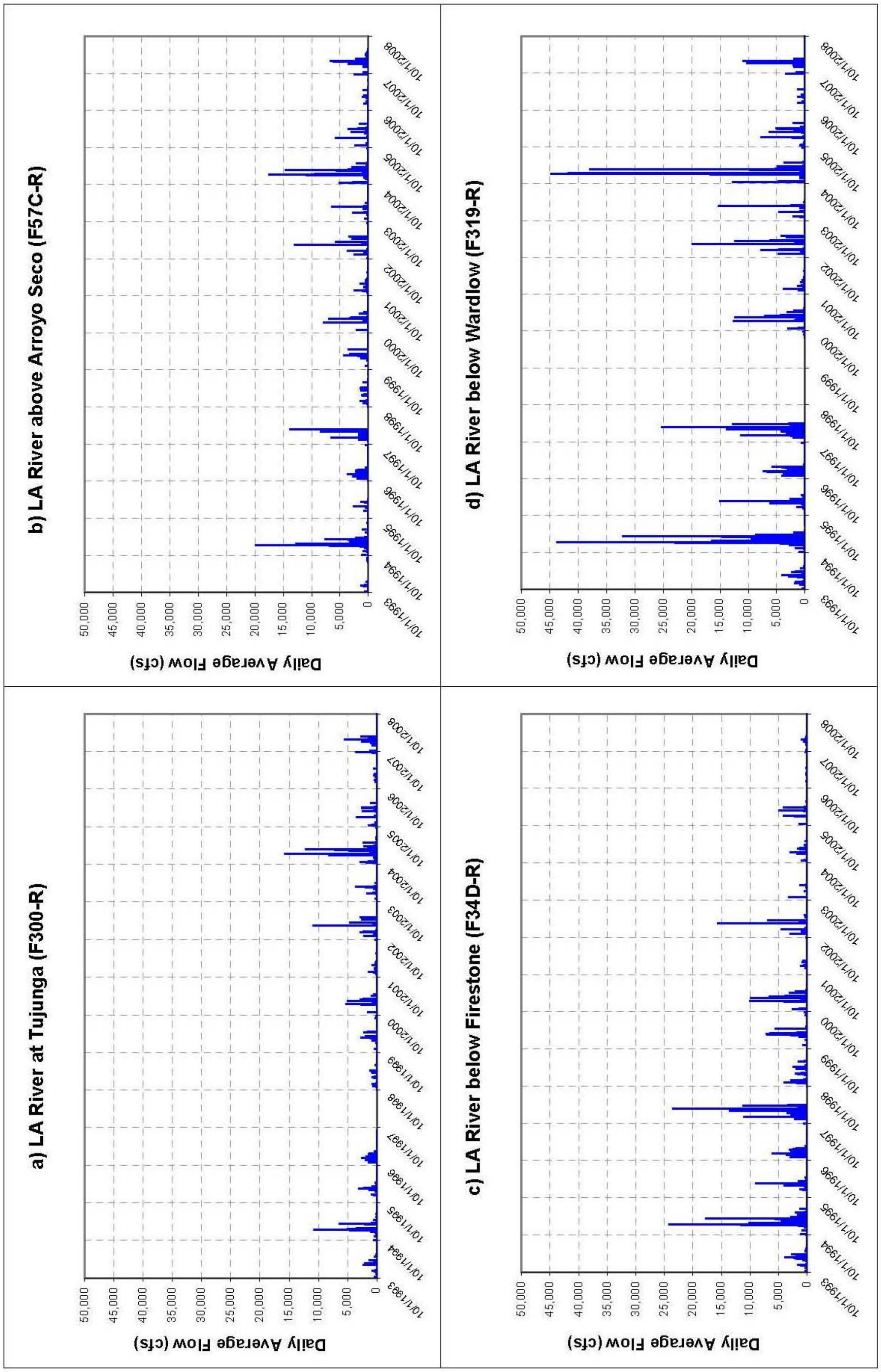


Figure 2-16: Time Series Flow Plots for the Los Angeles River Main Channel Stations from upstream (a) to downstream (d)

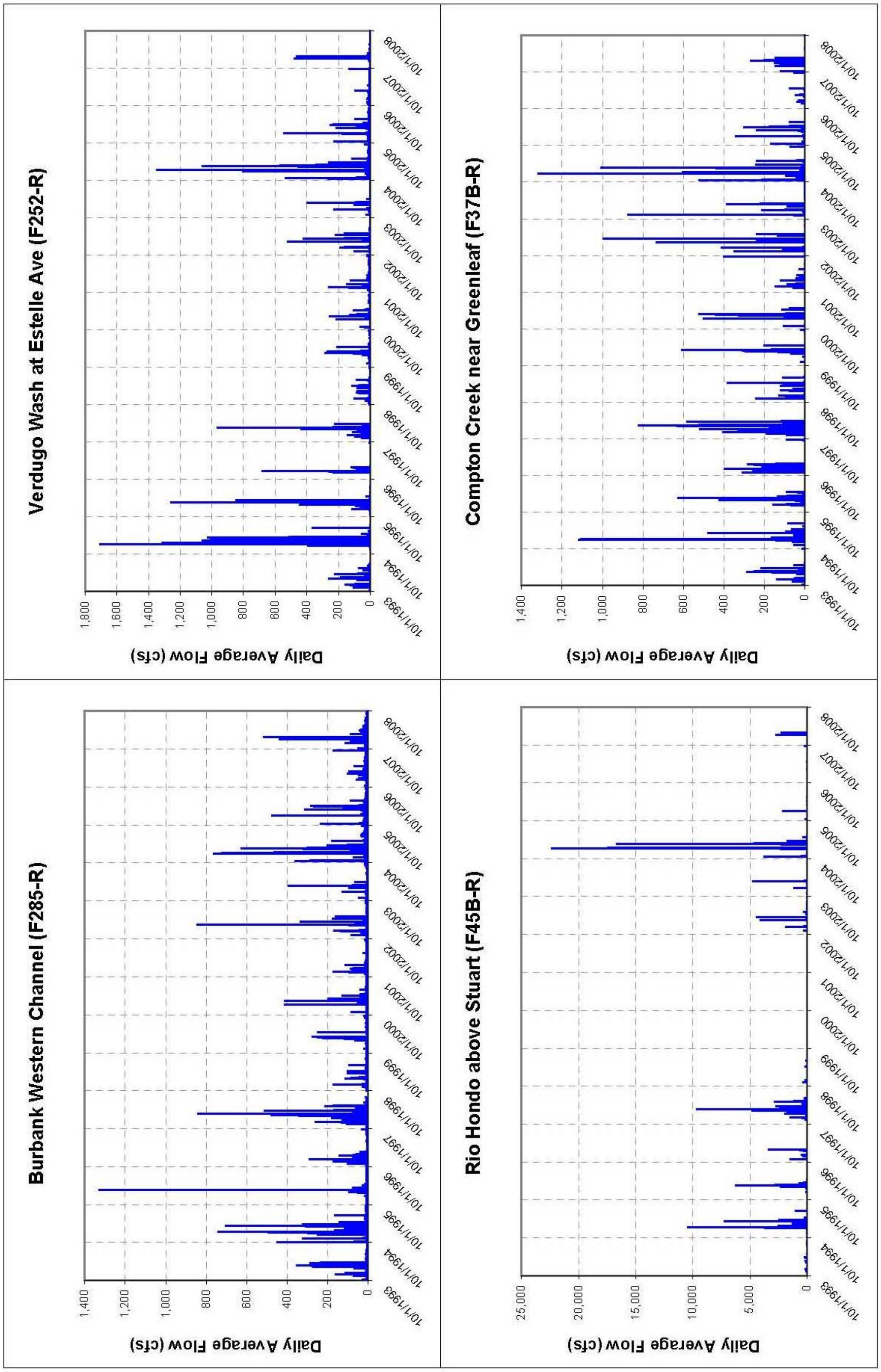


Figure 2-17: Time Series Flow Plots for the Los Angeles River Tributary Stations

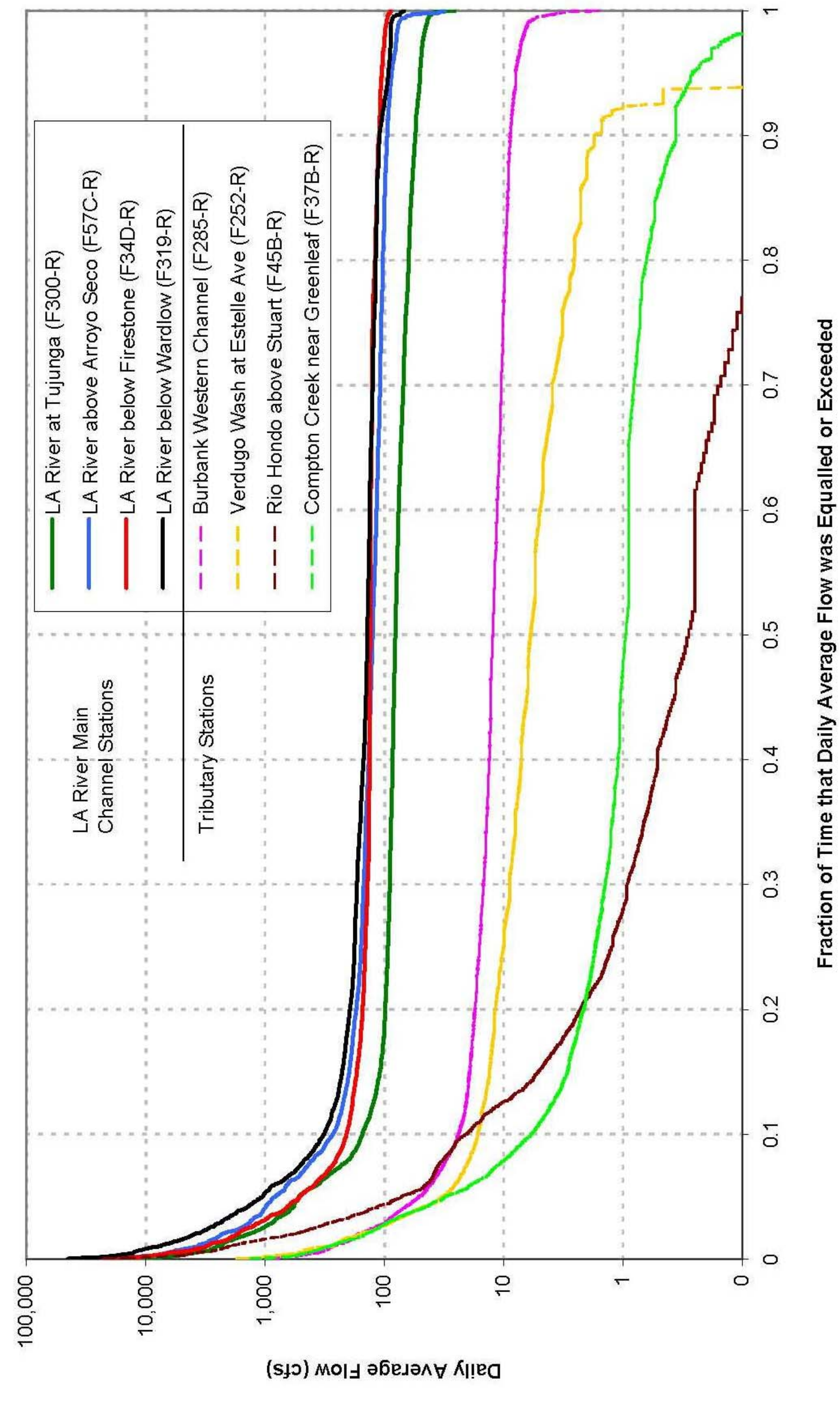


Figure 2-18: Flow Exceedance Plot for the Los Angeles River and its Tributary Stations

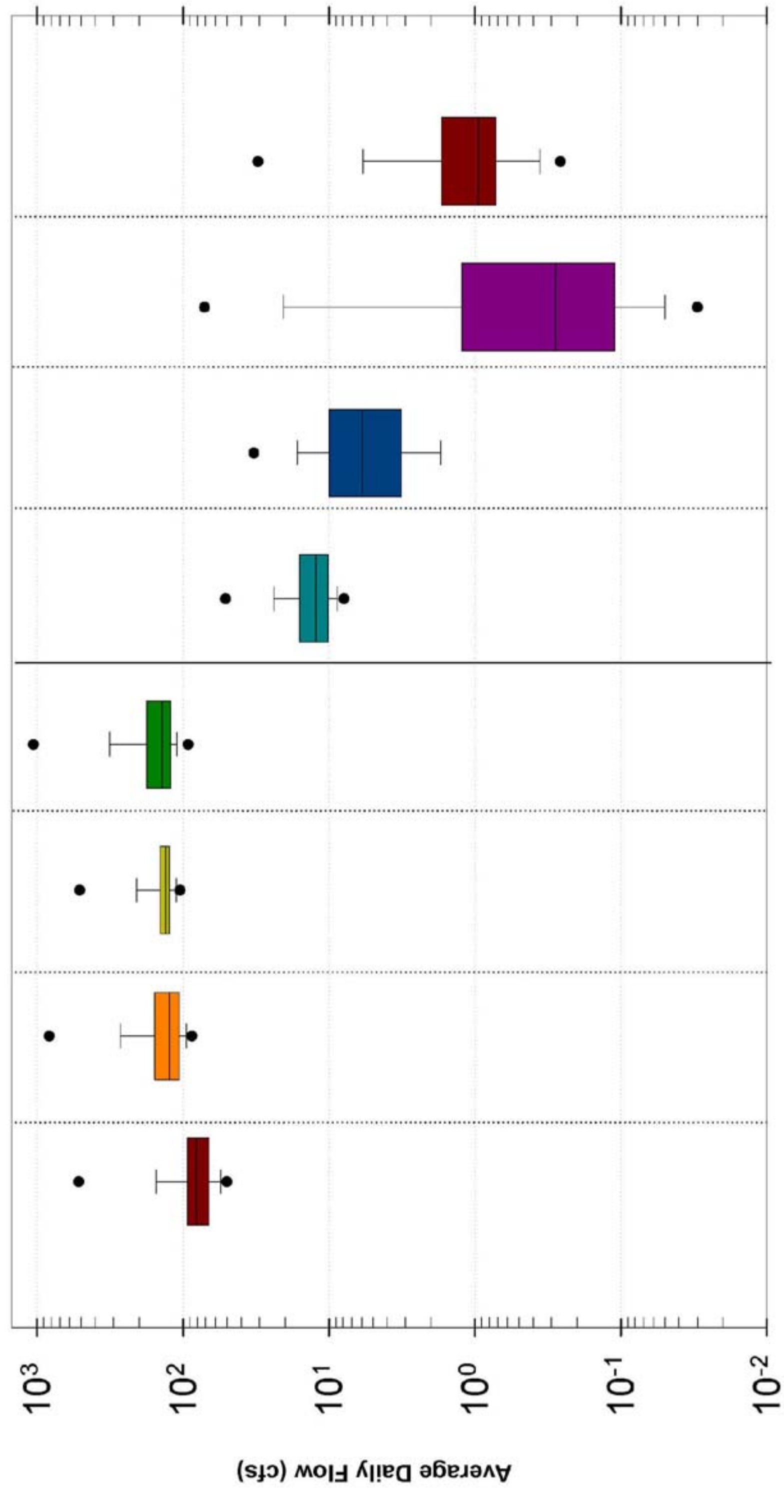


Figure 2-19: Flow Variations for Los Angeles River and Tributary Stations. Boxes span from 25th-75th percentile values, with the median in between. Whiskers indicate 10th/90th percentile values, and dots indicate 5th/95th percentile values. N indicates number of data points for each box.

During wet weather, river flows may increase by two to three orders of magnitude. Wet weather flows were distinguished from dry weather flows by applying the criterion used in the development of the LAR Metals TMDL. A wet weather day is any day when the maximum daily flow measured at the Wardlow station is equal to or greater than 500 cfs; however, this flow is currently being evaluated by the CMP Technical Committee. A dry weather day is any day when the maximum daily flow in the LAR is less than 500 cfs. During periods of missing data at the Wardlow station, other upstream flow monitoring stations were used as surrogates.

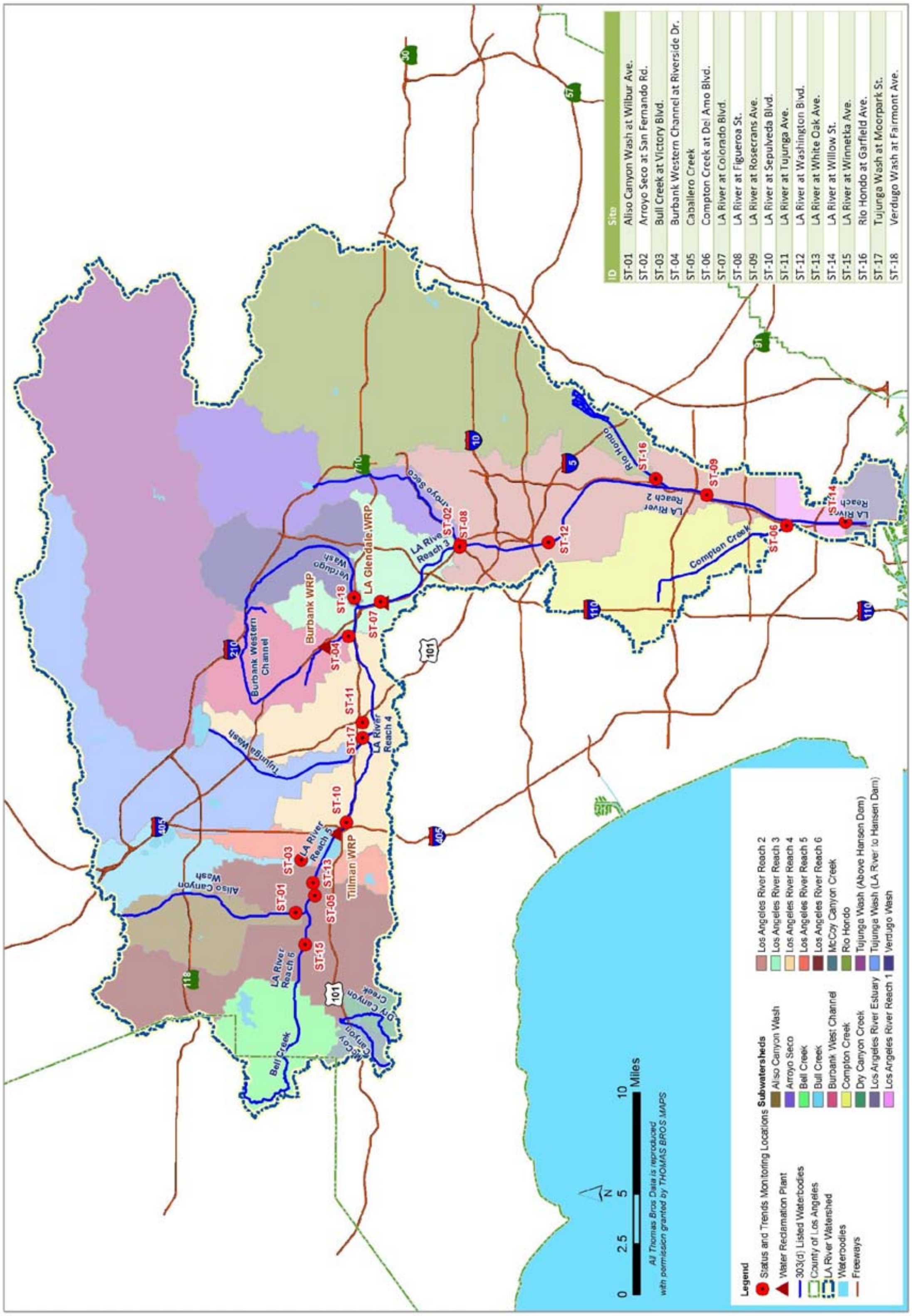
2.3 Surface Water Quality Data

2.3.1 Data Sources

Water quality data were gathered from a number of sources for the period of 1993-2008. Table 2-6 summarizes the number of sample locations, water quality parameters, and period of record for each data source. Monitoring locations for three key monitoring programs (City of Los Angeles Status and Trends [S&T], Los Angeles County Department of Public Works NPDES, and Water Reclamation Plant NPDES) are shown in Figures 2-20, 2-21, and 2-22. Given the potential for differences in how samples were collected and analyzed by various monitoring programs, data from different sources were not combined for interpretation.

Table 2-6 Summary of Water Quality Data from Los Angeles River Watershed

Data Source	Number of Sites	Constituents Sampled	Period of Record
Los Angeles County Department of Public Works NPDES	9	Bacteria, nutrients, metals, conventional, organics, pesticides	1994 - 2008
City of Los Angeles Watershed Monitoring Program, Status & Trends	18	Bacteria, metals conventional	2001 - 2008
City of Los Angeles, Department of Public Works, Bureau of Sanitation (Biotic Ligand Model)	8	Conventional	3/2006 - 12/2007
City of Los Angeles Water Reclamation Plant NPDES Monitoring	6	Bacteria, nutrients, metals, conventional	1996 - 2008
City of Burbank Water Reclamation Plant NPDES Monitoring	4	Bacteria, nutrients, metals, conventional	1998 - 2008
Southern California Coastal Water Research Project Runoff Characterization Study, Snapshot Surveys, and Reference Loading Study	178	Bacteria, nutrients, metals, pesticides	2000 - 2007
Friends of the Los Angeles River	1	Fish tissue analysis (mercury, PCBs)	2007
Bacteria Source Identification Study	125	Bacteria	8/2007 - 10/2007
Southern California Marine Institute	25	Bacteria, nutrients, metals, conventional	1997 - 2006



ID	Site
ST-01	Aliso Canyon Wash at Wilbur Ave.
ST-02	Arroyo Seco at San Fernando Rd.
ST-03	Bull Creek at Victory Blvd.
ST-04	Burbank Western Channel at Riverside Dr.
ST-05	Caballero Creek
ST-06	Compton Creek at Del Amo Blvd.
ST-07	LA River at Colorado Blvd.
ST-08	LA River at Figueroa St.
ST-09	LA River at Rosecrans Ave.
ST-10	LA River at Sepulveda Blvd.
ST-11	LA River at Tujunga Ave.
ST-12	LA River at Washington Blvd.
ST-13	LA River at White Oak Ave.
ST-14	LA River at Willow St.
ST-15	LA River at Winnetka Ave.
ST-16	Rio Hondo at Garfield Ave.
ST-17	Tujunga Wash at Moorpark St.
ST-18	Verdugo Wash at Fairmont Ave.

Figure 2-20
City of Los Angeles Status and Trends Water Quality Monitoring Locations
Los Angeles River Watershed

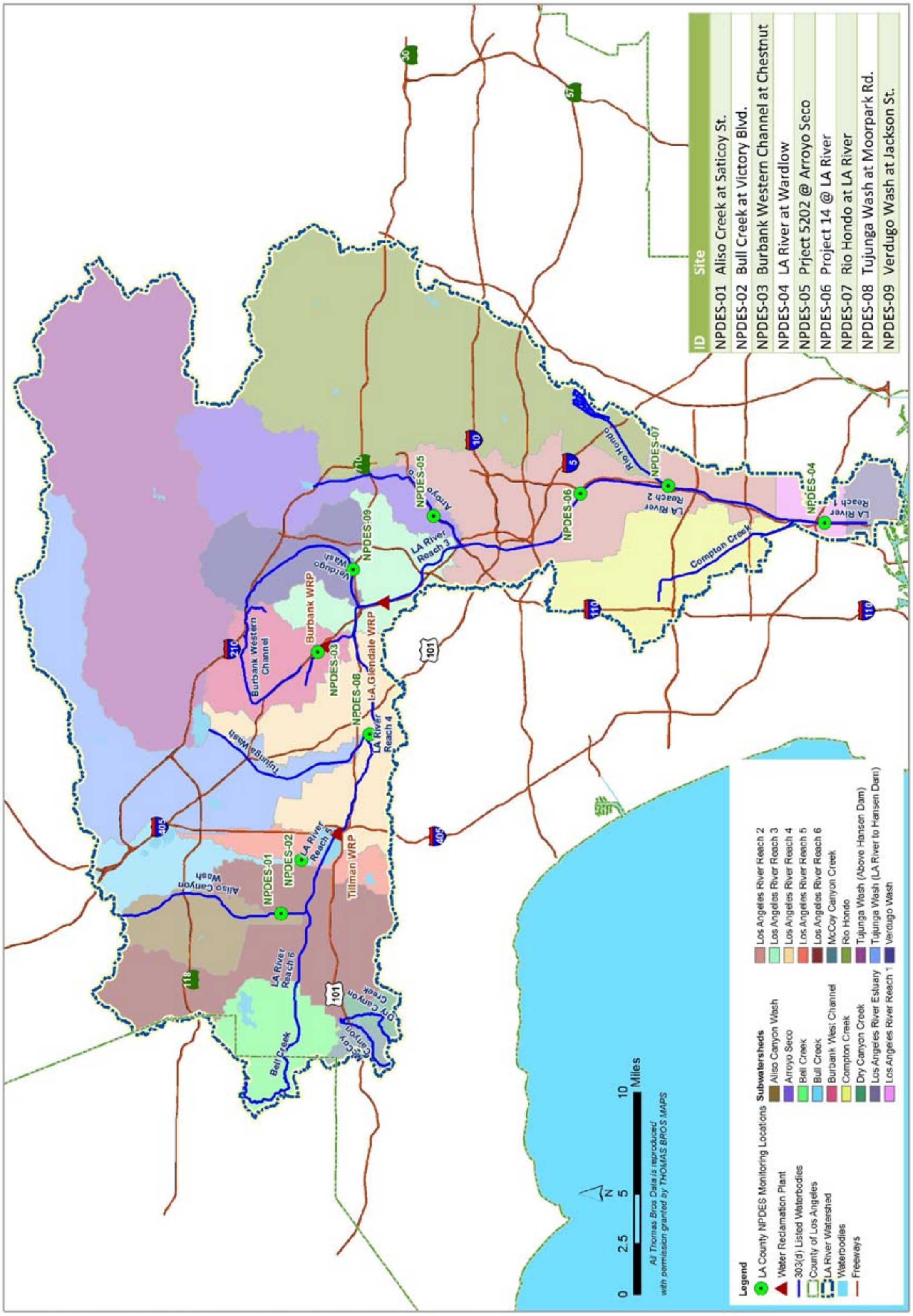


Figure 2-21
Los Angeles County Department of Public Works NPDES Water Quality Monitoring Locations
Los Angeles River Watershed

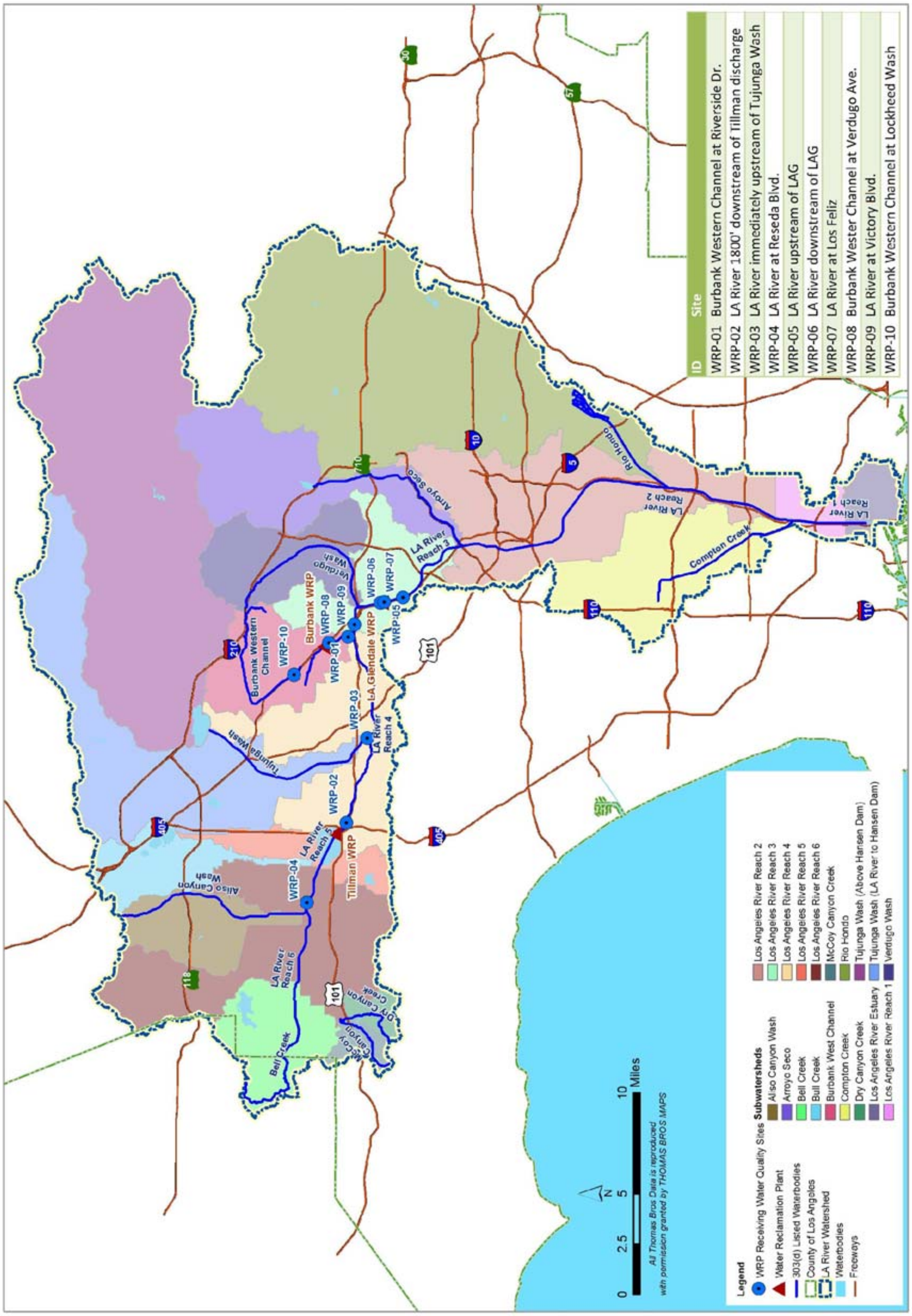


Figure 2-22
Receiving Waterbody Monitoring Locations for Water Reclamation Plants
Los Angeles River Watershed

2.3.2 Monitoring Data Summary

Appendix B provides a complete accounting of the water quality data from each source and sample location, including general descriptive statistics (e.g., mean, maximum, and minimum), number of samples analyzed, and number of numeric targets that were exceeded. Appendix B also includes plots of monitoring results for each pollutant, and, where applicable, the numeric targets for the constituent. Tables 2-7 and 2-8 summarize metals exceedances at the stations where data were available for the dry weather and wet weather sampling, respectively. The wet weather was determined based on the (500 cfs) mean daily flow at Wardlow. The data presented shows the number of exceedances, the total number of samples taken, and the total number of non-zero detects. Dry and wet-weather dissolved and total targets for metals are generally reach-specific, but have been set for several metals. Overall, wet weather exceedances were observed for both dissolved and total copper, lead, and zinc; and a low number of exceedances were observed for total selenium and cadmium (but not for dissolved). Dry weather exceedances were observed for both dissolved and total copper, lead, and zinc, and a high number of exceedances were observed for total selenium in Reach 6.

For cadmium, copper, lead, and zinc, the calculation of numeric targets in the TMDL considered the hardness of the water. The S&T median hardness over the full period of record was within 10 percent of the median hardness used to develop the TMDL at all reaches except Rio Hondo Reach 1 (Table 2-9). Given this similarity, this assessment compared the water quality data directly to the established numeric targets.

The LAR mainstem water quality data were evaluated to identify any temporal or spatial patterns or variations in metals concentrations over the 2001 to 2008 period of record. Trends were evaluated separately for each data source and only where sufficient data were available. This analysis screened out non-detect measurements to facilitate comparison of concentrations between sites, thus the magnitude of elevated concentrations rather than the frequency of detection is evaluated.

Table 2-7 Summary of Metals Water Quality Exceedances for Dry Weather

Waterbody/ Reach	Site	Data Source - Agency	Cadmium Dissolved	Cadmium Total	Copper Dissolved	Copper Total	Lead Dissolved	Lead Total	Selenium Dissolved	Selenium Total	Zinc Dissolved	Zinc Total
Aliso Canyon Wash	Aliso Canyon Wash at Wilbur Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arroyo Seco	Arroyo Seco at San Fernando Rd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	0/39(34)	1/39(38)	2/39(16)	8/39(26)	NA	NA	NA	NA
Burbank Western Channel	Griffith Park/Victory Blvd.	City of Burbank NPDES Monitoring Data (1995 - 2008)	NA	NA	-	1/5(2)	-	0/5(0)	NA	NA	NA	NA
Burbank Western Channel	Lockheed Wash	City of Burbank NPDES Monitoring Data (1995 - 2008)	NA	NA	-	21/72(66)	-	1/71(52)	NA	NA	NA	NA
Burbank Western Channel	Riverside Drive	City of Burbank NPDES Monitoring Data (1995 - 2008)	NA	NA	13/15(15)	49/70(69)	-	0/55(42)	NA	NA	NA	NA
Burbank Western Channel	Verdugo Ave	City of Burbank NPDES Monitoring Data (1995 - 2008)	NA	NA	-	36/60(56)	-	1/59(37)	NA	NA	NA	NA
Burbank Western Channel	Burbank Western Channel at Riverside Dr.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	43/50(49)	43/50(50)	0/50(27)	5/50(32)	NA	NA	NA	NA
Compton Creek	Compton Creek at Del Amo Blvd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	2/39(34)	6/39(39)	2/39(33)	5/39(36)	NA	NA	NA	NA
LA River - Reach 1	LA River at Willow St.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	0/83(71)	3/83(74)	4/83(27)	5/83(41)	NA	NA	NA	NA
LA River - Reach 1	LA River at Wardlow	LA County DPW NPDES	NA	NA	1/14(14)	4/13(13)	0/14(6)	2/13(11)	NA	NA	NA	NA
LA River - Reach 2	LA River at Washington Blvd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	1/83(69)	9/83(73)	2/83(26)	4/83(41)	NA	NA	NA	NA

Table 2-7 Summary of Metals Water Quality Exceedances for Dry Weather

Waterbody/ Reach	Site	Data Source - Agency	Cadmium Dissolved	Cadmium Total	Copper Dissolved	Copper Total	Lead Dissolved	Lead Total	Selenium Dissolved	Selenium Total	Zinc Dissolved	Zinc Total
LA River - Reach 2	LA River at Rosecrans Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	2/83(73)	7/83(76)	2/83(24)	6/83(34)	NA	NA	NA	NA
LA River - Reach 3	LA River upstream of LAG	City of LA WRP NPDES Monitoring Data (1998-2008)	NA	NA	5/32(23)	4/25(25)	1/31(7)	0/25(13)	NA	NA	NA	NA
LA River - Reach 3	LA River downstream of LAG	City of LA WRP NPDES Monitoring Data (1998-2008)	NA	NA	1/32(22)	1/24(24)	2/31(9)	0/24(11)	NA	NA	NA	NA
LA River - Reach 3	LA River at Los Feliz	City of LA WRP NPDES Monitoring Data (1998-2008)	NA	NA	5/26(16)	1/25(25)	2/25(7)	0/25(11)	NA	NA	NA	NA
LA River - Reach 3	LA River at Colorado Blvd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	5/94(87)	14/94(91)	4/94(35)	7/94(46)	NA	NA	NA	NA
LA River - Reach 3	LA River at Figueroa St.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	1/83(73)	0/83(76)	3/83(29)	5/83(40)	NA	NA	NA	NA
LA River - Reach 4	LA River immediately upstream of Tujunga Wash	City of LA WRP NPDES Monitoring Data (1998-2008)	NA	NA	20/27(24)	2/26(26)	7/27(8)	2/26(13)	NA	NA	NA	NA
LA River - Reach 4	LA River at Sepulveda Blvd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	23/83(77)	15/83(80)	3/83(27)	8/83(43)	NA	NA	NA	NA
LA River - Reach 4	LA River at Tujunga Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	5/75(65)	14/75(70)	5/75(23)	11/75(37)	NA	NA	NA	NA
LA River - Reach 5	LA River 1800' downstream of Tillman discharge	City of LA WRP NPDES Monitoring Data (1998-2008)	NA	NA	10/28(23)	2/26(26)	8/28(10)	1/26(9)	NA	NA	NA	NA

Table 2-7 Summary of Metals Water Quality Exceedances for Dry Weather

Waterbody/ Reach	Site	Data Source - Agency	Cadmium Dissolved	Cadmium Total	Copper Dissolved	Copper Total	Lead Dissolved	Lead Total	Selenium Dissolved	Selenium Total	Zinc Dissolved	Zinc Total
LA River - Reach 6	LA River at Reseda Blvd.	City of LA WRP NPDES Monitoring Data (1998-2008)	NA	NA	4/27(23)	2/26(26)	3/27(7)	0/26(9)	NA	-	NA	NA
LA River - Reach 6	LA River at Winnetka Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	0/39(34)	3/39(37)	0/39(14)	2/39(24)	NA	33/39(39)	NA	NA
LA River - Reach 6	LA River at White Oak Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	2/83(71)	6/83(77)	0/83(16)	1/83(36)	NA	71/83(76)	NA	NA
Rio Hondo	Rio Hondo at Garfield Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	28/35(34)	33/35(35)	4/35(22)	17/35(32)	NA	NA	1/35(34)	3/35(35)
Tujunga Wash	Tujunga Wash at Moorpark St.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	18/35(33)	23/35(34)	2/35(19)	5/35(25)	NA	NA	NA	NA
Verdugo Wash	Verdugo Wash at Fairmont Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	NA	NA	1/39(33)	1/39(38)	0/39(12)	1/39(23)	NA	NA	NA	NA

Table 2-8 Summary of Metals Water Quality Exceedances for Wet Weather

Waterbody/ Reach	Site	Data Source - Agency	Cadmium Dissolved	Cadmium Total	Copper Dissolved	Copper Total	Lead Dissolved	Lead Total	Selenium Dissolved	Selenium Total	Zinc Dissolved	Zinc Total
Aliso Canyon Wash	Aliso Canyon Wash at Wilbur Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/4(1)	0/4(1)	0/4(4)	1/4(4)	0/4(1)	0/4(1)	NA	2/4(4)	0/4(4)	0/4(4)
Arroyo Seco	Arroyo Seco at San Fernando Rd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/4(0)	0/4(1)	0/4(4)	0/4(4)	0/4(1)	0/4(3)	NA	0/4(3)	0/4(4)	0/4(4)
Bull Creek	Bull Creek at Victory Blvd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/4(2)	0/4(4)	1/4(4)	1/4(4)	0/4(3)	0/4(1)	NA	2/4(4)	0/4(3)	1/4(4)

Table 2-8 Summary of Metals Water Quality Exceedances for Wet Weather

Waterbody/ Reach	Site	Data Source - Agency	Cadmium Dissolved	Cadmium Total	Copper Dissolved	Copper Total	Lead Dissolved	Lead Total	Selenium Dissolved	Selenium Total	Zinc Dissolved	Zinc Total
Burbank Western Channel	Lockheed Wash	City of Burbank NPDES Monitoring Data (1995 - 2008)	-	0/1(0)	-	0/1(0)	-	0/1(0)	NA	-	-	0/1(1)
Burbank Western Channel	Verdugo Ave	City of Burbank NPDES Monitoring Data (1995 - 2008)	-	0/1(0)	-	0/1(0)	-	0/1(0)	NA	-	-	0/1(1)
Burbank Western Channel	Griffith Park/Victory Blvd.	City of Burbank NPDES Monitoring Data (1995 - 2008)	-	0/1(0)	-	0/1(0)	-	0/1(0)	NA	-	-	0/1(1)
Burbank Western Channel	Burbank Western Channel at Riverside Dr.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/5(1)	0/5(2)	5/5(5)	3/5(5)	0/5(1)	0/5(4)	NA	0/5(4)	0/5(5)	0/5(5)
Caballero Creek	Caballero Creek	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/4(3)	0/4(3)	1/4(4)	0/4(4)	0/4(1)	0/4(2)	NA	2/4(4)	0/4(4)	0/4(4)
Compton Creek	Compton Creek at Del Amo Blvd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/4(0)	0/4(1)	1/4(4)	2/4(4)	0/4(2)	0/4(4)	NA	0/4(3)	0/4(4)	0/4(4)
LA River - Reach 1	LA River at Wardlow	LA County DPW NPDES	0/13(1)	0/13(1)	1/13(12)	4/13(13)	0/13(6)	0/13(9)	NA	0/13(1)	0/13(8)	0/13(9)
LA River - Reach 1	LA River at Willow St.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/7(2)	1/7(4)	2/7(6)	3/7(6)	0/7(3)	0/7(5)	NA	0/7(6)	1/7(7)	2/7(7)
LA River - Reach 2	LA River at Washington Blvd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/8(1)	1/8(3)	4/8(7)	4/8(8)	0/8(2)	0/8(5)	NA	0/8(5)	1/8(8)	0/8(8)
LA River - Reach 2	LA River at Rosecrans Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/7(1)	1/7(4)	2/7(6)	3/7(6)	0/7(2)	0/7(5)	NA	0/7(6)	1/7(7)	2/7(7)
LA River - Reach 3	LA River at Colorado Blvd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/8(2)	0/8(3)	4/8(7)	4/8(7)	0/8(2)	0/8(4)	NA	1/8(6)	2/8(8)	1/8(8)

Table 2-8 Summary of Metals Water Quality Exceedances for Wet Weather

Waterbody/ Reach	Site	Data Source - Agency	Cadmium Dissolved	Cadmium Total	Copper Dissolved	Copper Total	Lead Dissolved	Lead Total	Selenium Dissolved	Selenium Total	Zinc Dissolved	Zinc Total
LA River - Reach 3	LA River at Figueroa St.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/8(3)	1/8(4)	3/8(7)	5/8(7)	0/8(2)	0/8(5)	NA	0/8(6)	1/8(7)	0/8(8)
LA River - Reach 4	LA River at Sepulveda Blvd.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/8(3)	1/8(6)	4/8(7)	7/8(8)	0/8(3)	0/8(5)	NA	1/8(6)	1/8(8)	1/8(8)
LA River - Reach 4	LA River at Tujunga Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/7(3)	1/7(5)	5/7(6)	6/7(6)	0/7(1)	0/7(4)	NA	0/7(5)	1/7(7)	1/7(7)
LA River - Reach 6	LA River at Winnetka Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/4(2)	0/4(3)	1/4(4)	1/4(4)	0/4(1)	0/4(1)	NA	2/4(4)	0/4(3)	0/4(4)
LA River - Reach 6	LA River at White Oak Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/8(3)	1/8(7)	3/8(7)	4/8(7)	0/8(3)	0/8(5)	NA	4/8(6)	1/8(8)	0/8(8)
Rio Hondo	Rio Hondo at Garfield Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/4(0)	0/4(1)	1/4(4)	1/4(4)	0/4(1)	0/4(2)	NA	0/3(2)	0/4(4)	0/4(4)
Tujunga Wash	Tujunga Wash at Moorpark St.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/3(0)	0/3(0)	0/3(3)	0/3(3)	0/3(0)	0/3(2)	NA	0/3(3)	0/3(1)	0/3(3)
Verdugo Wash	Verdugo Wash at Fairmont Ave.	City of Los Angeles Watershed Monitoring Program, Status and Trends (2001 - 2008)	0/4(0)	0/4(1)	0/4(4)	0/4(4)	0/4(1)	0/4(3)	NA	0/4(3)	0/4(4)	0/4(4)

Table 2-9 Dry-Weather Hardness Comparison

LAR TMDL Reach	LAR TMDL Median Hardness (mg/L)	City of LA Status & Trends Median Hardness (mg/L)	Percent Difference
LA Reach 5 above Tillman	702	--	--
LA Reach 4 below Tillman	246	224.5	-9%
LA Reach 3 Above LAG WRP	282	290	3%
LA Reach 3 below LAG WRP	278	265	-5%
LA Reach 2	268	265	-1%
LA Reach 1	282	261	-7%
Burbank (above WRP)	326	--	--
Burbank (below WRP)	229	207.5	-9%
Compton Creek	225	213	-5%
Rio Hondo Reach 1	141	267	89%
Monrovia Canyon Creek	209	--	--

The City of Los Angeles watershed monitoring program status and trends dry weather dissolved metals data showed the following trends (see also Appendix B):

- Cadmium concentrations are relatively consistent from upstream to downstream with a slight increase in concentration over time
- Copper concentrations are lowest in LAR Reach 6 and similar at other reaches and appear to have slightly decreased over time
- Lead concentrations are relatively consistent from upstream to downstream and have declined slightly over time
- Zinc concentrations are lowest in LAR Reach 6 and have generally declined over time, highest in LAR Reach 4, and consistent for other reaches with no significant changes over time

The City of Los Angeles watershed monitoring program status and trends dry weather total metals data showed the following trends (see also Appendix B):

- Cadmium concentrations are relatively consistent from upstream to downstream with no noticeable changes over time
- Copper concentrations are highest in LAR Reach 4 and similar for other reaches and concentrations have slightly declined over the past 3 years in most reaches
- Lead concentrations are relatively consistent from upstream to downstream (with the exception of 2001 and 2002) and have declined slightly over time
- Zinc concentrations are lowest in LAR Reach 6, the highest in LAR Reach 4, and relatively consistent for the other reaches with no significant changes over time
- Selenium concentrations are highest in LAR Reach 6 and relatively consistent in other reaches with no significant changes over time

The Los Angeles County Department of Public Works NPDES monitoring data showed the following trends (see also Appendix B):

- Cadmium, lead, zinc, and selenium concentrations do not appear to vary spatially or temporally within the LAR mainstem (although total selenium data are limited)
- Dissolved and total copper concentrations are highest in LAR Reach 4, and decrease slightly over time in LAR Reaches 5 and 6

2.4 Groundwater Quality Data

The LAR Watershed lies within the San Fernando Valley, Central, and West Coast groundwater basins. Groundwater quality data were gathered from the Water Replenishment District of Southern California for the Central Basin, and the San Fernando Basin Watermaster for the San Fernando Valley Basin. Additional information was gathered from the ongoing San Fernando Valley Basin Groundwater Monitoring Program conducted by EPA.

The specific reaches of concern within the LAR were determined to be Reaches 3 and 5, as these are the reaches with natural soft bottoms and have the greatest potential for groundwater to influence surface water flow and water quality. Well information was gathered in the vicinity of LAR Reach 3. A subset of 38 shallow wells (top of screening less than 50 feet bgs) shows that nutrient and metals concentrations are high in groundwater that may be reaching Reach 3 of the Los Angeles River (Tables 2-10 and 2-11).

Table 2-10 Upper Portion of Reach 3, Los Angeles River - Metals Data for Shallow Wells

Statistic	Cadmium (µg/L)	Copper (µg/L)	Selenium (µg/L)	Zinc (µg/L)
Number of Samples	2	11	2	40
Date From	1/6/2006	11/8/1994	5/5/2000	11/8/1994
Date To	1/6/2006	1/6/2006	1/6/2006	1/6/2006
Minimum	0.4	2.6	6.1	2.4
Maximum	0.4	79.0	7.1	360.0
Mean	0.4	25.7	6.6	166.7
Standard Deviation	0.0	26.5	0.7	104.8
Coefficient of Variation	0.02	1.03	0.11	0.63

Source: USEPA, San Fernando Valley Basin Groundwater Monitoring Program (1994-2008)

Notes:
1. Shallow wells are defined as wells with the top of screen less than 50 feet from groundwater
2. Metal concentrations are a combination of dissolved metals and total metals; source data do not differentiate between the two types
3. Removed 5/5/2000 outlier data from statistical analysis: Cadmium = 210 µg/L; Copper = 340 µg/L; Lead = 260 µg/L and 140 µg/L; Selenium = 10 µg/L; Zinc = 430 µg/L

Table 2-11 Lower Portion of Reach 3, Los Angeles River - Metals Data for Shallow Wells

Statistic	Cadmium (µg/L)	Copper (µg/L)	Lead (µg/L)	Selenium (µg/L)	Zinc (µg/L)
Number of Samples	17	45	21	35	34
Date From	10/28/1994	10/21/1994	10/21/1994	10/21/1994	10/21/1994
Date To	12/18/2006	12/20/2006	12/18/2006	12/20/2006	12/20/2006
Minimum	0.1	1.1	0.0	0.7	0.7
Maximum	5.3	13.6	3.7	11.6	38.4
Mean	1.2	5.6	0.7	4.0	6.7
Standard Deviation	1.5	3.2	0.9	2.2	7.9
Coefficient of Variation	1.22	0.58	1.28	0.55	1.18

Source: USEPA, San Fernando Valley Basin Groundwater Monitoring Program (1994-2008)

Notes:
1. Shallow wells are defined as wells with the top of screen less than 50 feet from groundwater
2. Metal concentrations are a combination of dissolved metals and total metals; source data do not differentiate between the two types
3. Removed 3/18/2005 outlier data from statistical analysis: Cadmium = 710 µg/L

Section 3
BMP Evaluation

This section describes the City's process for identifying and evaluating alternatives for BMP implementation to achieve metals TMDL targets. This process included a combination of data collection and evaluation, watershed technical analyses, and stakeholder input. All potential BMP opportunities were considered, including both institutional and structural.

Because the LAR Watershed is highly developed, available sites are limited for implementing structural BMPs. Accordingly, the City will implement both structural and institutional BMPs within its jurisdiction to comply with the metals TMDL targets established for the LAR. The following sections describe the BMP opportunities available to the City for achieving compliance with metals TMDL targets. These opportunities range from BMP projects already in design and construction (e.g., Proposition O), to potential new green structural projects.

3.1 Existing and Planned BMPs

The LAR Watershed is the focus of multiple planning and BMP implementation efforts. Many of the potential projects envisioned by planning efforts can potentially contribute to the management of urban runoff. Proposition O implementation activities and the work of other organizations have already resulted in the implementation of many beneficial projects. The following sections describe opportunities available through Proposition O and other developing watershed projects. In addition, information is provided on other proposed projects or activities that also have the potential to provide future water quality benefits.

3.1.1 Proposition O

Los Angeles voters passed Proposition O in November 2004, which authorized the City of Los Angeles to issue up to $500 million in general obligation bonds for water pollution mitigation projects to meet federal CWA requirements. Proposition O also funds improvements to protect water quality, provide flood protection, and increase water conservation, habitat protection, and open space. The water quality benefits expected from Proposition O projects planned for completion during the implementation phase of the metals TMDL will be included in this Implementation Plan.

3.1.2 Other Watershed Projects

Both governmental and non-governmental organizations have teamed up to implement a number of projects in the watershed that can provide multiple benefits. These benefits are similar to those obtained from Proposition O projects (e.g., water quality, flood protection, increased water conservation, habitat protection, and increased open space). Funding sources and collaboration partnerships vary.

3.1.3 Watershed Planning Efforts

Completed planning efforts within the LAR Watershed address multiple objectives, including urban runoff management. Specific structural BMP projects proposed in these plans have the potential to provide future metals loading reductions as plan-specific recommendations are implemented. Key examples of these plans include:

- **Water Quality Compliance Master Plan for Urban Runoff (WQCMPUR)—** Prepared by the City's Department of Public Works Bureau of Sanitation (LABOS), the WQCMPUR establishes a long-term strategy for urban runoff management.

- **City of Los Angeles Integrated Resources Plan (IRP)—**LABOS and Department of Water and Power (LADWP) prepared the IRP to meet the CWA requirement that cities update their facility plans. The IRP includes water resource goals that apply to urban runoff management.

- **Los Angeles County Integrated Regional Water Management Plan (IRWMP)—** The IRWMP was developed to identify opportunities to achieve several watershed management objectives in the County of Los Angeles, including water supply reliability, water quality improvement, habitat restoration/enhancement, creation of recreational open space, and other potential integrated benefits.

- **Los Angeles River Revitalization Master Plan (LARRMP)—**The LARRMP, prepared by the City of Los Angeles Department of Public Works Bureau of Engineering (LABOE), and LADWP, created a 20-year plan for developing and managing the LAR.

- **Tujunga/Pacoima Watershed Plan (TPWP)—**Prepared by The River Project, this plan focuses on watershed management alternatives to improve water quality and provide other community benefits in the Tujunga Wash and Pacoima Wash watersheds, which are tributary to Reach 4 of the LAR.

- **Compton Creek Watershed Management Plan (CCWMP)—**This plan, prepared by the Los Angeles and San Gabriel Watershed Council, identifies watershed management alternatives to improve water quality and provide other community benefits in the Compton Creek watershed.

- **Los Angeles River Master Plan (LARMP)—**The LARMP, prepared by Los Angeles County, Department of Public Works, examined the river mainstem and Tujunga Wash tributary to identify ways to revitalize and improve the publicly-owned rights-of-ways along each waterbody.

Table 3-1summarizes potential projects within the City's jurisdiction identified by the LARRMP, TPWP, and IRWMP plans. Some of these projects are already being implemented, as noted by an asterisk (*). In the future, additional projects identified in these plans may be implemented, which could provide additional urban runoff management benefits.

Table 3-1 Summary of Projects Identified by Watershed Planning Efforts within the City of Los Angeles (* - indicates that the project is being developed or is planned for development)

Project Name	Watershed Plan	Proponent
Canoga Park Opportunity Area	LARRMP	City of Los Angeles
River Glen Opportunity Area	LARRMP	City of Los Angeles
Taylor Yard Opportunity Area	LARRMP & IRWMP	City of Los Angeles
Chinatown-Cornfields Opportunity Area	LARRMP	City of Los Angeles
Reseda Blvd Opportunity Area	LARRMP & IRWMP	City of Los Angeles
Downtown Industrial Opportunity Area	LARRMP	City of Los Angeles
Sepulveda Basin Agricultural Opportunity Area	LARRMP	City of Los Angeles
Sepulveda Basin Opportunity Area	LARRMP	City of Los Angeles
Studio City Opportunity Area	LARRMP	City of Los Angeles
Tujunga Wash Confluence Opportunity Area	LARRMP & IRWMP	City of Los Angeles
Weddington Park Opportunity Area	LARRMP	City of Los Angeles
Spreading Grounds Opportunity Area	LARRMP	City of Los Angeles
Ferraro Fields Opportunity Area	LARRMP	City of Los Angeles
*Arroyo Seco Confluence Opportunity Area	LARRMP & IRWMP	Arroyo Seco Foundation
Mission Rd Rail Yard Opportunity Area	LARRMP	City of Los Angeles
Sears / Cron Coach Opportunity Area	LARRMP	City of Los Angeles
*North Atwater Park	IRWMP	City of Los Angeles, Los Angeles County, Army Corp of Engineers
*South Los Angeles Wetlands Park	IRWMP	Los Angeles, Bureau of Sanitation
Aliso and Limekiln Creeks at Vanalden	IRWMP	Mountain Recreation and Conservation Authority
Sycamore Grove Park	IRWMP	Los Angeles Recreation & Parks
Bell Creek Riverfront Natural Park	IRWMP	Mountain Recreation and Conservation Authority
Lederer Ranch	IRWMP	Mountain Recreation and Conservation Authority
South Central City Services Green Building	IRWMP	Watershed Council
Echo Park Minipark	IRWMP	City of Los Angeles
*Echo Park Lake Rehabilitation and Stormwater BMPs	IRWMP	Los Angeles Recreation & Parks
Dorris Place Treatment Wetland	IRWMP	Los Angeles, Bureau of Sanitation & North East Trees
Hollenbeck Park Lake Rehab and Stormwater BMPs	IRWMP	Los Angeles Recreation & Parks
Lincoln Park Lake Rehab and Stormwater BMPs	IRWMP	Los Angeles Recreation & Parks
Los Angeles Parks & Rec CSY Stormwater Retrofit	IRWMP	Los Angeles Recreation & Parks
Mid-Valley Senior Citizen Center Stormwater Retrofit	IRWMP	Los Angeles Recreation & Parks
Asphalt Plant at Pacoima Wash Stormwater Retrofit	IRWMP	Los Angeles Recreation & Parks
Sheldon Pit Stormwater Infiltration / Tujunga Wash Diversion	TPWP & IRWMP	Los Angeles County Flood Control District
Boulevard Pit Stormwater Infiltration	TPWP & IRWMP	Los Angeles Department of Water & Power
Sun Valley Residential LID Retrofit	IRWMP	Watershed Council & Los Angeles, Bureau of Sanitation
*LADWP Valley Generation Station Stormwater Retrofit	TPWP & IRWMP	Los Angeles Department of Water & Power & Los Angeles County Flood Control District
Sun Valley Middle School Stormwater Infiltration	IRWMP	Los Angeles County Flood Control District

Table 3-1 Summary of Projects Identified by Watershed Planning Efforts within the City of Los Angeles (* - indicates that the project is being developed or is planned for development)

Project Name	Watershed Plan	Proponent
LADWP Corridor - Sun Valley	IRWMP	Los Angeles County Flood Control District
*Strathern Pit Stormwater Infiltration	IRWMP	Los Angeles County Flood Control District
Arroyo Calabasas Ventura Blvd - Caltrans	IRWMP	Mountain Recreation and Conservation Authority
Arroyo Calabasas Fallbrook	IRWMP	Mountain Recreation and Conservation Authority
*Aliso Canyon and LAR Confluence Infiltration	IRWMP	Mountain Recreation and Conservation Authority
Woodley Chase Open Space	IRWMP	Mountain Recreation and Conservation Authority
Santa Susana Creek at MTA Corridor	IRWMP	Mountain Recreation and Conservation Authority
Brown's Canyon at Plummer	IRWMP	Mountain Recreation and Conservation Authority
Brown's Canyon at Hwy 118	IRWMP	Mountain Recreation and Conservation Authority
Boyle Heights Green Corridor	IRWMP	Mountain Recreation and Conservation Authority
Vista Hermosa Proposed Park	IRWMP	Mountain Recreation and Conservation Authority
Marsh Park	IRWMP	Mountain Recreation and Conservation Authority
Hazard Park Stream Restoration	IRWMP	North East Trees, EII, City of Los Angeles
*Whitnall Powerline Easement Stormwater Recharge Project	TPWP & IRWMP	Los Angeles Department of Water & Power & The River Project
Railroad ROW Improvement	TPWP & IRWMP	The River Project
CBS-Viacom Radio Community Park	TPWP & IRWMP	The River Project
Tujunga Wash Parallel Swale Section 1135	TPWP & IRWMP	Los Angeles County Flood Control District
Sylmar HS Retrofit	TPWP	The River Project
Panorama City Creek	TPWP & IRWMP	Panorama City Neighborhood
Van Nuys Blvd Pocket Park	TPWP & IRWMP	Panorama City Neighborhood

3.2 Standard Urban Stormwater Mitigation Plans

Urban runoff discharge in the City of Los Angeles area is permitted under a single NPDES Municipal Separate Storm Sewer System (MS4) permit issued to Los Angeles County and 84 incorporated cities (all cities in the county except the City of Long Beach) (LARWQCB 2001). A key component of NPDES MS4 permits are requirements associated with new site development or redevelopment, which requires that these projects incorporate stormwater mitigation measures. These measures are addressed by developers through the preparation of a Standard Urban Stormwater Mitigation Plan (SUSMP) or a Site-Specific Mitigation Plan (City of Los Angeles 2007). The primary purpose of these plans is to reduce the quantity and improve the quality of stormwater runoff leaving a project site.

The current SUSMP outlines the necessary BMPs that must be incorporated into project design plans for the following categories of new development or redevelopment:

- Single-family hillside homes (only development of one acre or more of surface area is subject to the SUSMP numerical design criteria requirement)
- Ten or more unit homes (includes single family homes, multifamily homes, condominiums, and apartments)
- Automotive service facilities
- Restaurants
- One hundred thousand or more square-feet of impervious surface in industrial/commercial development
- Retail gasoline outlet
- Parking lots of 5,000 square feet or more of surface area, or with 25 or more parking spaces
- Redevelopment projects[1] in subject categories that meet redevelopment thresholds
- Location within, directly adjacent to, or discharging directly to an environmentally sensitive area

Future MS4 permits may include additional categories of new development or redevelopment requiring compliance with SUSMP. The City's existing SUSMP guidelines require that developers maximize pervious surfaces to allow rainwater percolation into the ground. In addition, when selecting BMPs for a development, the priority for BMP selection from highest to lowest is:

- Infiltration systems
- Biofiltration/bioretention systems
- Stormwater capture and reuse
- Mechanical units
- Combination of the above

[1] Redevelopment includes any land-disturbing activity that results in the creation, addition, or replacement of 5,000 square feet or more of impervious surface area on an already developed site.

3.3 Institutional BMPs

Institutional BMPs focus on preventing and removing stormwater volumes and constituent loads at their source. When used in conjunction with green structural BMPs as part of a comprehensive stormwater management program, they may improve overall pollutant removal and help reduce maintenance requirements. Institutional BMPs range from activities, such as land use planning and infrastructure maintenance, to more site-specific activities, such as targeted inspections or enforcement actions for businesses that are considered to contribute high sources of metals. Many of these BMPs can be implemented at different levels ranging from individual action to municipal, state, or business initiatives. Benefits of institutional BMPs include:

- *Potential cost savings*—Institutional BMPs typically do not require large capital expenditures to construct facilities; however, long-term operating costs can be significant for educational, inspection, and enforcement programs.

- *Areal treatment coverage*—Many institutional BMPs are implemented through city-wide programs. Unlike a structural BMP facility, the coverage and subsequent benefits of these institutional BMPs is not limited to the catchment area served.

- *Retrofit potential*—Many institutional BMPs target existing development and can be implemented under the space constraints prevalent in built-out urban environments.

- *Target specific pollutants or sources*—BMPs can target a specific pollutant of concern or the specific source of the pollutant. For example, the brake pad replacement initiative targets both a specific metal (copper) and a significant source of the pollutant in urban runoff.

Institutional BMPs that could potentially be implemented in the LAR Watershed to help meet metals TMDL requirements are described in the following sections. Where appropriate, information on the sources of metals is provided as well.

3.3.1 Product Replacement

Metals used in building and transportation products are a significant source of metals in urban environments. The use of safer alternative products that replace products that are known sources of metals can significantly reduce metal loads in the LAR Watershed over time. The process of replacing vehicle brakes pads, vehicle tires, and rooftop materials would partially reduce or eliminate the source of different pollutants from the watershed, thereby reducing loading of metals to receiving waterbodies. Areas to target for use of replacement products include:

Vehicle Brakes Pads

One of the most significant sources of copper in urban watersheds is copper contained in vehicle brake pads. Metals emissions from brake pads depend upon factors such as:

- Traffic volumes and types of vehicles
- Frequency and severity of braking
- Vehicle speed
- Type of brake lining (disc or drum) and brake condition (original manufacturer pads have higher copper content than aftermarket replacement pads)

In California, a Brake Pad Partnership (BPP) has been established to guide efforts to reduce the use of copper in brake pad manufacturing. BPP is a collaborative effort representing water quality regulatory agencies, automobile brake pad manufacturers, environmental groups, and stormwater management agencies. The BPP was originally developed to understand the impact of brake pad debris on waterways specifically in the San Francisco Bay.

Recent studies conducted through the BPP provide an estimate of the loading of copper from brake pad usage to roadways and the atmosphere in the San Francisco Bay watersheds of 0.45 milligrams per kilometer (mg/km) driving (Rosselot 2006). This rate of copper wear from brake pads accounts for 15 to 50 percent of copper loads in the subwatershed of the San Francisco Bay, based on results of a mechanistic water quality model using the BPP findings as key input data (Aqua Terra 2007). The results of these studies show that brake pads manufactured with reduced or zero copper content would reduce or eliminate buildup of copper within watershed areas from outfitted vehicles.

The BPP is currently pursuing legislation that reduces the amount of copper used in brake pads over a phase period of time. The currently proposed legislation (SB 346) places a 5 percent by weight limit on the amount of copper used in brakes sold in California by 2021. This percentage would be reduced to just 0.5 percent by 2032. The legislation also requires that the copper is not replaced with materials that could also impair water quality. Continued stakeholder support of this legislation is considered critical to the success of this legislative effort.

Vehicle Tires

Tire wear debris is a potentially significant source of zinc on roadway surfaces where stormwater runoff transfers pollutants to receiving waterbodies. Several studies have estimated the contributions of zinc and other metals, typically found in tire tread, to roadways from driving. The zinc content in tire tread rubber ranges from 0.69 to 1.55 percent by weight, with a typical zinc content of about one percent (Councell et al. 2004). Davis et al. (2001) analyzed samples collected from abraded tire powder from four different brands of tires and found concentrations from other metals of concern of 17 microgram per gram (µg/g) lead, 5 µg/g copper, and 1 µg/g of cadmium.

The wear rate for tire tread and associated metals is highly dependent on driving speed and styles. Councell et al. (2004) conducted a literature review and reported that an estimated 0.05 mg of tire tread debris per km traveled is a good estimate of "average" driving conditions. Metals emissions from tire wear to roadways are the product of metal content in tire tread and rate of tread wear. The emission of zinc from tires to roadways is approximately 5 mg/km traveled with a range of possible values from 2.1 mg/km to 14.0 mg/km.

Tires with reduced metals content would reduce or eliminate the buildup of metals on roadways in the watershed from outfitted vehicles. However, no efforts exist at this time to develop an alternative product that reduces the metals content of vehicle tires. Accordingly, the only means to reduce this source of metals at this time is to continue to implement programs that reduce the number of vehicle miles traveled on Los Angeles roadways, e.g., through programs that increase the use of mass transit.

Vehicle Tire Lead Weights

The lead contained in vehicle wheel weights is an important source of lead in the environment. According to the Center for Environmental Health (CEH), an estimated 500,000 pounds of lead from wheel weights reach California waterways from wheel weights that fall off of cars (www.ceh.org). This estimate is based on an extrapolation of U.S. Geological Survey (USGS) data on wheel weight use and California Department of Transportation monitoring studies of lead sources in transportation corridors (see CEH testimony that supports Senate Bill 757, which promotes exchanging lead weights with an alternative product, posted at www.ceh.org).

Efforts are moving forward to replace lead wheel weights with an alternative product. A legislative bill (SB 757) is currently working its way through the California legislature that will prohibit the manufacture, sale, or installation in California of wheel weights that contain more than 0.1 percent lead. The bill also contains language to make sure that the lead wheel weights are not replaced with a constituent that is also an environmental concern, e.g., zinc.

Roof Materials

Metals leached from roofing materials during storm events can be a significant source of metals loading to downstream waters. For example, zinc sources in roof materials include galvanized gutter and downspouts, nails, solder, wood preservative chemicals (zinc naphthalene), and fungi resistant chemicals (zinc sulfate and zinc chloride). Chang et al. (2004) evaluated roof runoff water quality from 16 structures with 4 different types of roofing materials. They observed mean zinc concentrations in rooftop runoff that were significantly greater than the mean zinc concentration contained in rainwater. Mean zinc concentrations varied by roof material type (wood shingle, 16,300 µg/L; galvanized metals, 11,800 µg/L; aluminum, 3,200 µg/L; and composite shingle, 1,400 µg/L) (Chang et al. 2004).

To estimate the mass load from rooftops attributable to roofing material, excluding the role of roof metals from atmospheric deposition, Van Metre and Mahler (2003) related mass emissions from asphalt shingle and galvanized metal roofs. The study found lead to be significantly greater in asphalt shingles than galvanized metal roofs. Conversely, cadmium and zinc were significantly greater in galvanized metal than asphalt shingle roofs. The results of the analysis showed that leaching of lead from asphalt shingle roofs mobilizes an estimated 67 micrograms per square meter ($\mu g/m^2$) during most storm events. Leaching of cadmium and zinc from galvanized metal roofing mobilizes 1.5 $\mu g/m^2$ and 1,385 $\mu g/m^2$ in most storm events, respectively. Another study estimated that new copper roofs release approximately 1087 mg/m^2 (Barron 2001). Davis et al. (2001) analyzed metals concentrations in runoff from a sample of residential, commercial, and institutional roofs and found loading rates similar to the other studies.

Roofing materials with low levels of cadmium, copper, lead, and zinc would reduce the concentration of these metals in rooftop runoff. However, no efforts are underway at this time to produce roofing materials with reduced concentrations. An alternative is to implement institutional BMPs that facilitate efforts to contain onsite urban runoff. These BMPs could greatly reduce metals loadings from rainfall on roofs. Examples of such BMPs include redirection of roof downspouts and the use of rain barrels or cisterns to collect roof runoff for reuse on lawns or gardens. These BMPs can be implemented in all types of land uses including residential, commercial, and industrial.

Pesticides

In addition to brake pads, the BPP has investigated urban copper from other sources. One study found that copper from pesticides applied to urban land contributed the largest source of copper releases in San Francisco Bay Watersheds. For example, in 2003 alone, approximately 100,000 kg of copper was released from pesticides applied to urban land. This accounted for 42 percent of the total human sources of copper released in the Bay Area (Rosselot 2007).

Comparable studies have not been conducted in the Los Angeles area. Regardless, it is likely that products such as pesticides could be a significant copper source in the watershed. Not only is copper contained in pesticides but it is also a constituent in algaecides, which are used in urban lakes. While reductions in this source of copper loading may be achieved through product replacement (if alternative products become available), reductions may also be achieved through education on the proper use and disposal of chemicals.

3.3.2 Education and Outreach

Education and outreach programs, tailored to residents and businesses, on water quality impacts from controllable sources include brochures, posters, websites, event attendance, utility bill inserts, surveys, and others. Education and outreach programs focus on changing the behaviors that contribute to pollutant loadings in the watershed. For metals, important areas where education and outreach activities can enhance source control include:

Individual Car Washing

Metals associated with brake pad and tire wear accumulate on vehicles in and around the wheels. Consequently, an additional source of metals loading in urban watershed comes from residents washing off individual cars in driveways, parking lots, and other areas where wash water flows directly to storm drains. Past surveys have indicated that 56 to 73 percent of car owners wash their own cars, and over 90 percent of those let water drain to the pavement (CWP 2008). Davis et al. (2001) collected runoff from spraying vehicle wheels and found mean concentrations of 1.9 µg/L cadmium, 280 µg/L copper, 11 µg/L lead, and 330 µg/L zinc. These results suggest that a portion of metals loading in receiving water is derived from individual car washing.

Program options to reduce this metals source include outreach materials to encourage (1) car owners to use commercial car washes, or (2) wash cars on permeable surfaces. For charity car washes, car wash kits could be provided to block runoff from reaching a storm drain, or storm drain inserts could be used to catch water.

Used Oil

Used oil is a significant source of metals and other toxic contaminants into receiving waterbodies (Nixon and Saphores 2007). Used oil within urban areas is released to the environment from vehicle leaks and improper disposal. EPA estimates that only 50 percent of used oil in the United States is recycled, noting that the predominant source of illegal discharges of used oil is from do-it-yourselfers (DIYs). Davis et al. (2001) evaluated metals in used oil and found mean concentrations of 400 parts per million (ppm) cadmium, 15,400 ppm copper, 5,400 ppm lead, and 1,800,000 ppm zinc. Other studies in urban watersheds have found that a portion of receiving waterbody loads of cadmium, copper, lead, and zinc are derived from improperly disposed used oil, and oil leaks from vehicles (Schueler 2000). Schueler 2000 estimated that 15 percent of used motor oil is illegally dumped in urban storm drains within the Chesapeake Bay watershed.

Vehicle Maintenance

Homeowners often perform DIY maintenance on cars, including oil changes. This activity can result in the build-up of metals around areas where maintenance activities are carried out. Education and outreach BMP activities could include materials to educate homeowners on minimizing the automotive wastes that end up in storm drains. These educational materials would be cross-linked with materials developed to manage used oil disposal and car washing sources.

3.3.3 Street Sweeping

During wet weather runoff, metals are typically bound to sediment particles that are washed into waterbodies through storm drains. BMPs that remove fine particulates from impervious surfaces can improve water quality by reducing this important source of metals during wet weather.

Several studies conducted on the effectiveness of street sweeping for pollution reduction have shown variable results depending on traffic volume, type of sweeper used, frequency of sweeping, land use, and pavement type (Hererra 2006). The BPP reported an efficiency rate between 20 and 31 percent for mechanical sweepers (Rosselet 2007). Depending on frequency, new vacuum sweepers have shown a reduction of 50 to 88 percent in annual sediment loading for a residential street. Brinkman and Graham (2001) found that the frequency of street sweeping necessary to maximize sediment removal is once every week.

The City currently implements an extensive street sweeping program. However, there may be additional opportunities to further enhance this program and increase the effectiveness of sediment removal. Enhancement may be accomplished through activities such as equipment upgrades, targeting hot spots, and changing the frequency of sweeping. Pilot studies may be needed to determine how to best achieve additional benefits.

3.3.4 Catch Basin Cleaning

Studies have shown that catch basins can be effective in removing 40 to 50 percent of total suspended solids (Herrera 2006). As noted above, metals are often bound to fine particulates that become suspended solids during runoff events. Catch basin performance declines as flow increases, catch basin turbulence increases, and retention time decreases. In addition, when over 50 percent of the catch basin is full, sediments can be re-suspended (Herrera 2006). Catch basin cleaning can maintain higher pollutant removal rates and reduce remobilization of pollutants entrained in the sediment, such as bacteria. However, increasing the cleaning frequency to more than quarterly provides little additional benefit. For example, one study determined that semi-annual cleaning is optimal for the average catch basin (Herrera 2006).

Based on the findings of these studies, it is clear that catch basin cleaning is an important institutional BMP to reduce metals loadings to waterbodies. However, the City has already implemented an extensive catch basin cleaning program. Accordingly, achieving additional load reduction benefits may be limited. This may be an area for additional study.

3.3.5 Policies and Ordinances

Water quality benefits can be achieved through the development and implementation of new or modified policy ordinances that improve urban runoff management through the use of green solutions. Green solutions are defined as structural BMPs focused on (City of Los Angeles 2009):

- Reducing the volume of urban runoff (thereby indirectly improving water quality)
- Removing pollutants from urban runoff through natural processes

Green solutions are urban runoff management alternatives that increase the area of green space and include an integrated water resources approach (e.g., infiltration of urban runoff for groundwater recharge, or capture and use for irrigation). Implementation of green solutions can be facilitated by adopting new, or revising existing, City policies associated with development. Examples of areas where policy development can especially benefit water quality include low impact development and green street or green roof building requirements.

In addition to policy development, the City can develop new, or modify existing, ordinances that provide water quality benefits when implemented. Examples of areas where ordinances may be particularly important for reducing metals in urban runoff include habitat protection, source control, and water conservation. Currently, the City is working with stakeholders to develop a Stream Protection Ordinance to restore and protect the open space associated with natural streams. Ordinance adoption, which is expected in the near future, will protect habitat, reduce runoff pollutant loads, and reduce stormwater peak flows. Stream protection, in particular the restoration of stream natural functions, has been shown to reduce the levels of nutrients (nitrogen and phosphorus), sediment (less erosion), bacteria, and metals.

3.3.6 Planning and Coordination

The City of Los Angeles General Plan is a comprehensive, long-range planning document that serves as a policy guide for all City programs. Many of the issues of concern regarding the quality of urban runoff are related to urban growth, e.g., land use, zoning, and development requirements. Accordingly, it is critical that urban runoff management be incorporated into General Plan policies to ensure that new development and redevelopment projects integrate urban runoff management into their design. Revisions to the General Plan have been identified as a priority in the City's WQCMPUR (City of Los Angeles 2009).

As noted in Section 3.1, watershed planning activities are currently being carried out in the LAR Watershed by others. These activities have resulted in the identification of many BMP opportunities, many of which can improve the quality of urban runoff. Even if the project proponent is not associated with the City, there are opportunities for collaboration through cost-sharing if the project has water quality benefits that support the implementation of this TMDL. Accordingly, establishing mechanisms to increase collaboration on projects is an institutional BMP that can potentially be implemented.

3.4 Structural BMPs

The Los Angeles County-wide Structural BMP Prioritization Analysis Tool (SBPAT)[2], coupled with the use of other modeling analysis tools, provided the means for identifying potential BMP locations and types for implementation. SBPAT screens areas based on need (i.e., pollutant load generation and downstream impairments), and then identifies opportunities (i.e., appropriateness of the area, adjacent storm

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[2] Developed by Geosyntec Consultants for the County of Los Angeles Department of Public Works, Heal the Bay, and the City of Los Angeles Bureau of Sanitation.

drains) for BMP implementation. SBPAT uses a GIS-based decision tool that relies on four steps for identifying BMP implementation opportunities (Figure 3-1):

1. ***Catchment Prioritization***—Prioritize catchments based on water quality management need (e.g., pollutant-loading, receiving water issues) (Section 3.4.1).

2. ***Identification of Potential Structural BMP Opportunities***—Identify potential BMP opportunities within high priority catchments based on factors such as parcel size, land use, and ownership (Section 3.4.2).

3. ***Structural BMP Prioritization***—Identify appropriate BMPs based on factors such as cost, maintenance, and effectiveness for the pollutants of concern (Section 3.4.3).

4. ***Site-Specific BMP Evaluation***—Develop site-specific implementation strategies based on desktop analyses and field investigations (Section 3.4.4).

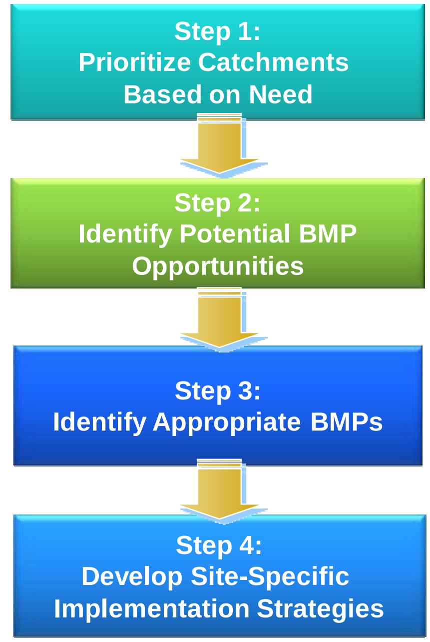

Figure 3-1
Steps for Selection of Structural BMPs

The following sections summarize the methods and provide outcomes from each of these four steps as applied to the development of the LAR Metals TMDL Implementation Plan. A more detailed explanation of the methodology may be found in Appendix C or in the SBPAT Guidance Manual (Geosyntec 2008a).

3.4.1 Catchment Prioritization

There is significant spatial variability in the potential for pollutant loading in the LAR Watershed. Identification of areas or subcatchments with the greatest pollutant loading potential provides a mechanism for prioritizing areas for implementing water quality control measures or BMPs. Through this prioritization process, the TMDL implementation plan can target more effective watershed management strategies for meeting numeric water quality targets.

Wet weather events are the predominant source of annual pollutant loads for most constituents of concern in the LAR watershed. An effective TMDL implementation plan focuses potential structural BMPs on subcatchments with the greatest potential for wet weather pollutant loading. However, there is limited information characterizing water quality during wet weather events from individual subcatchments in the LAR Watershed. One alternative to implementation of a costly monitoring program to gather wet weather data throughout the MS4 system is to utilize land use based Event Mean Concentrations (EMCs) to estimate pollutant loading potential.

A simple mass balance, using EMCs and runoff volumes, was used to calculate pollutant loading potential in each subcatchment. The subcatchment delineation prepared by Los Angeles County provides a basis for identifying areas with the greatest pollution loading potential. Within the LAR Watershed, this subcatchment delineation includes approximately one thousand distinct hydrologic drainage areas (see Figure 2-5). The average size of these subcatchments within the LAR Watershed is approximately 500 acres. This level of watershed disaggregation is appropriate for prioritizing projects for the metals TMDL implementation plan[3]. Pollutant loading estimates were not developed for cadmium and selenium (two metals included in the TMDL) for the following reasons. Cadmium was not detected in 80 percent of the samples collected from LACDPW monitoring stations. Cadmium detections occurred more frequently (~40 percent of samples) at transportation land use assessment sites, but concentrations are often less than the TMDL wet weather numeric target. Therefore, it is presumed that BMPs treating runoff from transportation land use areas will address most cadmium sources from the watershed. The aqueous chemistry of selenium is not similar to copper, lead, zinc, or TSS, and sources of selenium are typically not land-use based. Selenium concentrations in southern California are believed to be naturally elevated as a consequence of groundwater flowing through marine sedimentary formations (LARWQCB 2005).

The distribution of modeled loads across the watershed varies, as shown for total copper, total lead, and total zinc in Figures 3-2 to 3-4. Generally, subcatchments with the greatest copper and zinc loading potential occur where transportation related land uses are most prevalent. There is a more diverse spatial distribution of subcatchments with moderate to high potential loading of lead than for copper and zinc.

The spatial distribution of event loading varies for different pollutants of concern because pollutant accumulation and mobilization processes are unique for each land use and pollutant. Because BMPs—which are capable of addressing multiple pollutant concerns simultaneously—may be implemented, it is appropriate to develop a TMDL Implementation Plan that simultaneously considers the full range of water quality conditions in waterbodies throughout the watershed. To address this issue, the pollutants of concern were analyzed collectively through the development of a multi-pollutant catchment prioritization index (CPI). Figure 3-5 illustrates the outcome of this analysis using the same color coding scheme described above.

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[3] For more detailed analyses, e.g., evaluations of distributed BMP sites, a smaller catchment size was used for the analysis, typically about 40 acres.

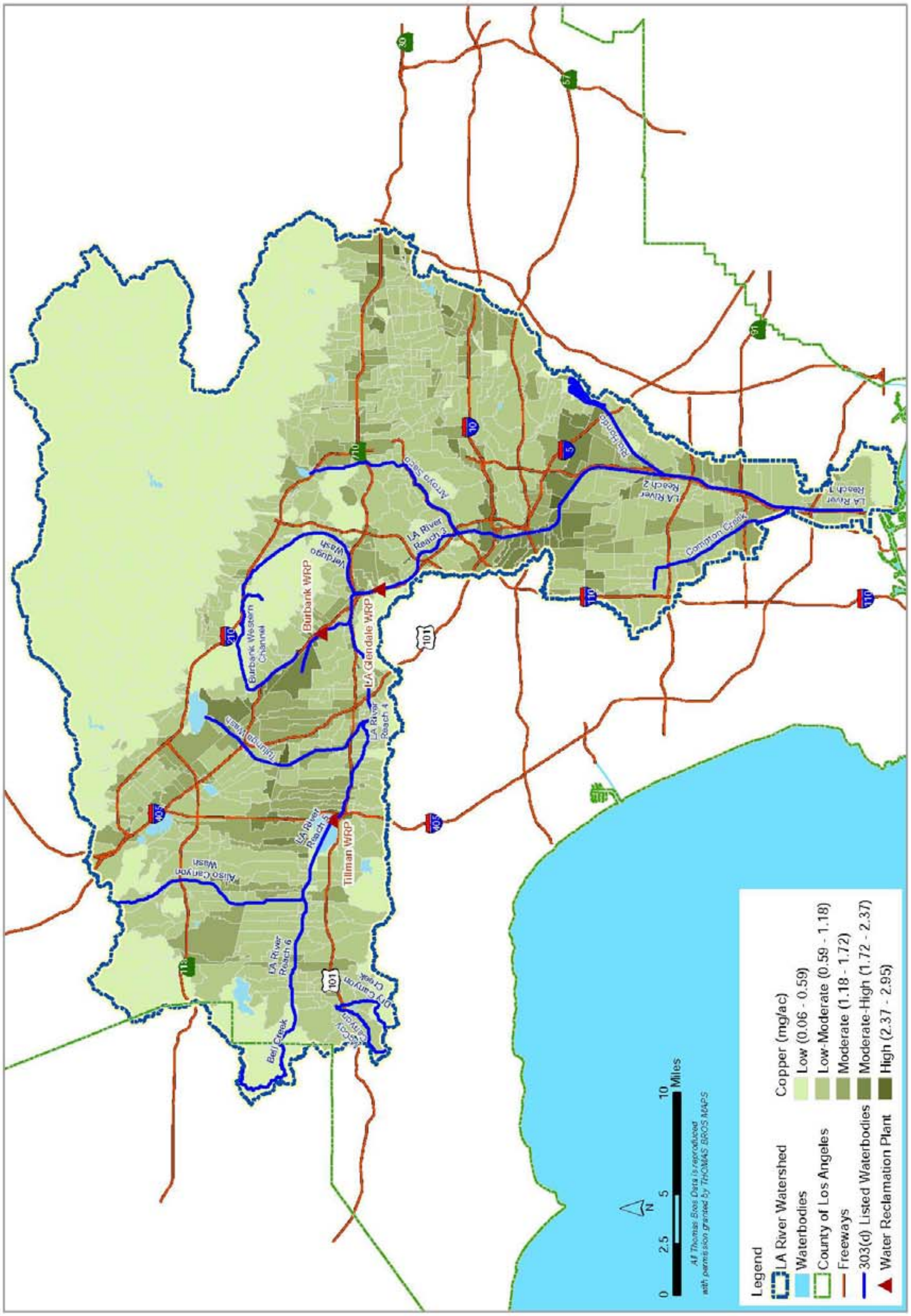

Figure 3-2
Catchment Prioritization – Copper
Los Angeles River Watershed

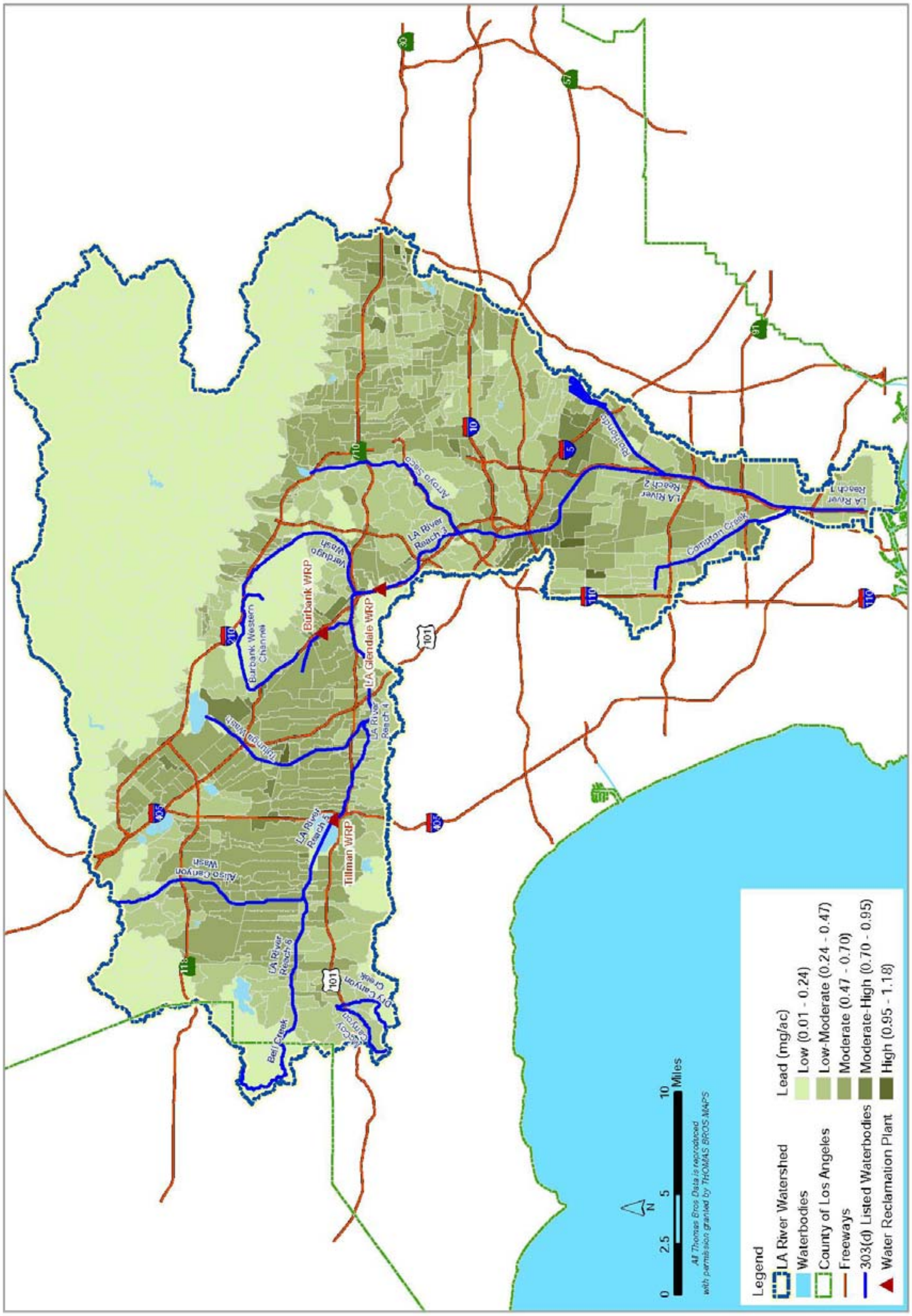

Figure 3-3
Catchment Prioritization – Lead
Los Angeles River Watershed

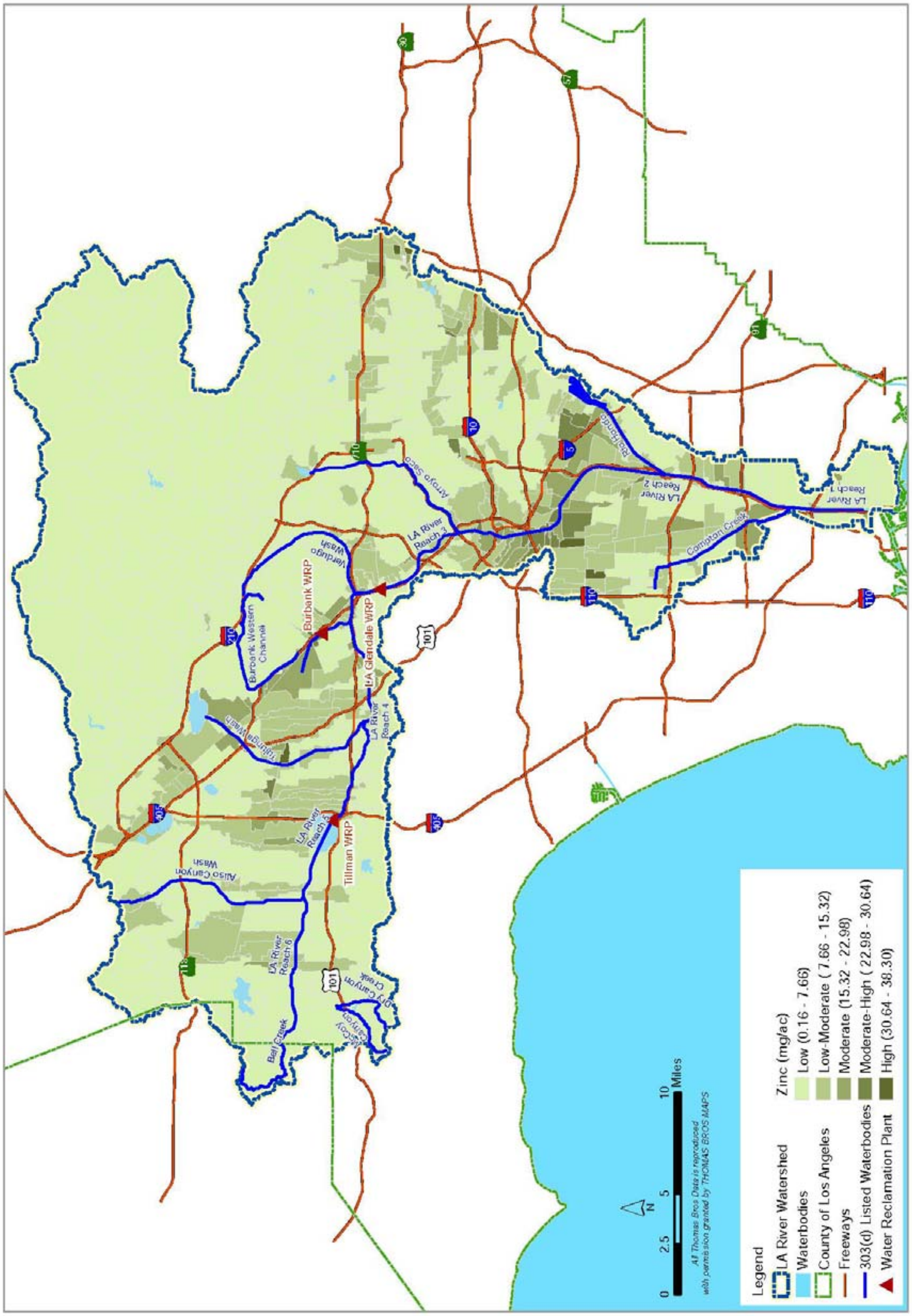

Figure 3-4
Catchment Prioritization – Zinc
Los Angeles River Watershed

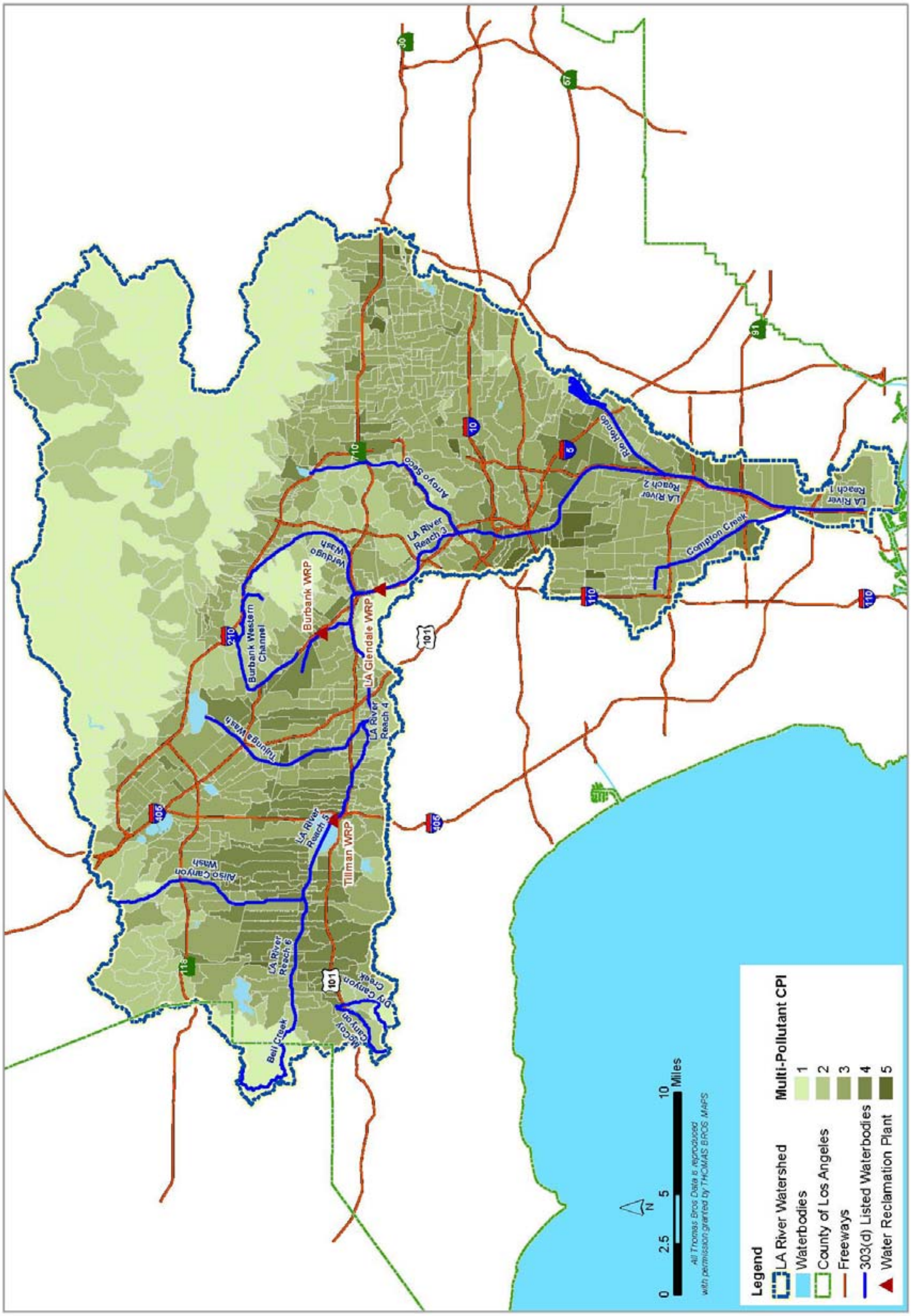

Figure 3-5
Multi-Pollutant CPI for Subcatchment Prioritization
Los Angeles River Watershed

Ultimately, catchment prioritization results are expressed in two ways: (1) as individual catchment areas, expressed as the CPI; or (2) as a group of adjacent drainage areas that converge at a common outlet, which is expressed as a nodal catchment prioritization index or NCPI. For the purposes of subsequent analyses, CPI scores represent the priority ranking of catchments for identifying distributed BMP opportunities, and NCPI represents the priority ranking for identifying areas for regional BMP opportunities. Table 3-2 summarizes the distribution of catchment CPIs and NCPIs for all subcatchments in the LAR Watershed. A score of 5 indicates the highest potential for pollutant loading. Identifying BMP opportunity sites within the City of Los Angeles focused on the catchments or groups of catchments with priority scores of 4 or 5.

Table 3-2 Distribution of CPI and NCPI Scores in the Los Angeles River Watershed

Priority Score	Number of Catchments (CPI)	Number of Catchments (NCPI)
5	40	29
4	174	125
3	447	461
2	349	396
1	2	1
Total	**1,012**	**1,012**

3.4.2 Identification of Structural BMP Opportunities

Overview

The second step of this process focuses on identifying candidate locations for regional and distributed structural BMPs in high-priority catchments (those with a CPI or NCPI of 4 or 5). This section describes in general the process for identifying BMP opportunities and summarizes the findings from the analysis. Appendix C provides additional information on the methodology.

Determining the feasibility of constructing and operating structural BMPs at a potential site depends on many factors and must account for the amount of runoff captured. Generally, sites with available open space, public ownership, and close proximity to storm drain systems are the best candidates for retrofitting catchments with structural BMPs in already developed areas.

Candidate locations for structural BMPs were limited to parcels in the watershed's high priority catchments. Site characteristics and potential constraints in high CPI and NCPI catchments were evaluated in a process to identify candidate BMP locations, as illustrated in Figure 3-6. This process uses watershed-wide GIS analysis to extract parcels from the County of Los Angeles database based on several criteria suitable for BMP siting, and removes parcels from this list based on constraints. The criteria for retaining and then removing parcels differ depending on the scale and type of BMP (e.g., regional vs. distributed BMP). Parcels that did not meet the following predefined criteria were excluded from the list of candidate BMP locations:

- Site area and ownership, land use: sites were screened to ensure they were of sufficient size, determine public vs. private ownership (preference for publicly-owned), and type of land use
- Development/land use proximity to storm drain: for regional BMPs, close proximity to a storm drain is a benefit
- Contaminated sites screening: sites with contaminant concerns were avoided
- Environmentally sensitive area (ESA) screening: sites with species or habitat concerns were avoided
- Topography: hilltops or steep sloped areas were removed from further consideration
- High Priority (CPI) Catchments Screening: site selection focused on areas with the highest water quality concerns

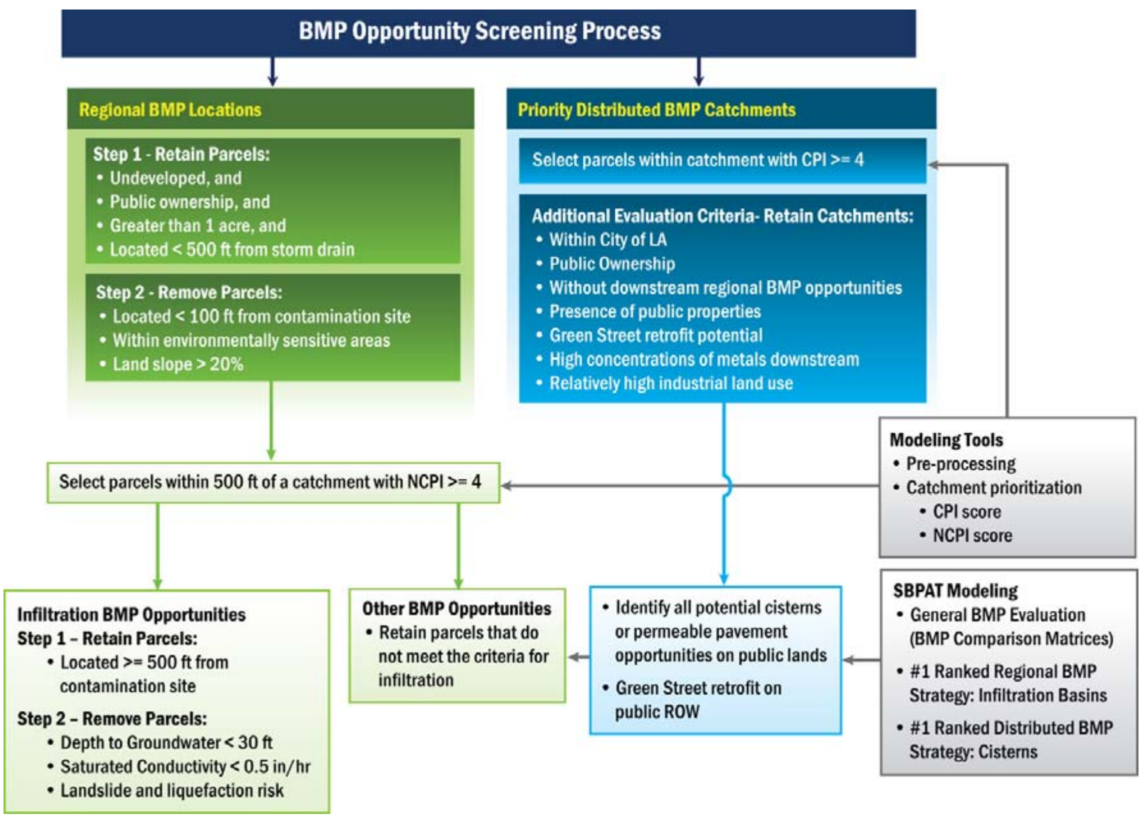

Figure 3-6
Procedure Used to Evaluate Structural BMPs at Candidate Locations in the Los Angeles River Watershed

Additional analyses were conducted to identify potential locations for green street retrofits as a type of distributed BMP. Streets are a part of the City's storm drain system as stormwater runoff flows down the streets along gutter curbs and into catch basins that are connected to storm drain lines that flow directly into the LAR and its tributaries. The City's street infrastructure currently plays a major role in flushing these pollutants to receiving waterbodies. Parkways along streets and alleys have the potential to be converted to Green Streets. The public right-of-way (ROW) provides a large area where infiltration swales or other types of pervious surfaces can be constructed to collect, retain, or detain stormwater runoff. The transformation of the City's existing paved streets into Green Streets can alleviate many of the stormwater pollution issues while providing greener city streets and a sustainable urban environment. A Green Street is designed with a landscape system to capture and infiltrate, or filter, stormwater runoff through a natural system. The parkway area between the roadway and the sidewalk is an ideal location for the landscape infiltration swale. As the parkway is generally located directly adjacent to the roadway, stormwater runoff can easily be directed from the streets into the parkways. The landscape parkways also provide a buffer zone between vehicular traffic in the streets and the pedestrians on the sidewalks.

Green Street parkways generally consist of depressed planters that are capable of capturing and retaining stormwater and urban runoff. They minimize the impacts of stormwater runoff on the receiving water bodies by reducing the volume of polluted stormwater that currently flows untreated into the City's storm drain system. Stormwater flow is reduced by allowing the stormwater in the infiltration swales to percolate into the ground below, or to be filtered through the soil matrix. Green Street parkways also provide adequate space for street trees to mature and develop significant canopy coverage, which improves air quality and reduces the heat island effect from urban pavements.

Identification of BMP Opportunities

The screening of parcels within high priority catchments yielded 192 regional sites and 117 distributed candidate BMP catchments in the portion of the LAR Watershed that is within the City of Los Angeles' jurisdiction (Table 3-3 and 3-4). Figures 3-7 and 3-8 show the spatial distribution of candidate regional and distributed BMPs, respectively. Many of the candidate locations for regional BMPs are along flood control or utility ROWs.

Table 3-3 Regional BMP Opportunities Identified in Los Angeles River Subwatersheds within City of Los Angeles

Subwatershed	Number of Opportunities
Aliso Canyon Wash	3
Bell Creek	1
Burbank Western Channel	10
Compton Creek	15
LA River Reach 2	26
LA River Reach 3	1
LA River Reach 4	72
LA River Reach 5	11
LA River Reach 6	32
Tujunga Wash	21
Total	192

Table 3-4. Distributed BMP Opportunity Catchments Identified in Los Angeles River Subwatersheds within City of Los Angeles

Subwatershed	Number of Opportunities
Aliso Canyon Wash	1
Bell Creek	1
Burbank Western Channel	4
Compton Creek	10
LA River Reach 1	1
LA River Reach 2	21
LA River Reach 3	7
LA River Reach 4	21
LA River Reach 5	5
LA River Reach 6	28
Tujunga Wash	18
Total	117

GIS screening of strong candidate Green Streets evaluated the current land cover within the public ROW, prioritizing bare soil or irrigated grass cover types. The basis for this analysis was detailed land cover classification conducted for the Los Angeles One Million Tree Canopy Cover Assessment (McPherson et al. 2007). The analysis yielded 39.5 miles of road with good potential for Green Street retrofits, which equals less than one percent of the roadways in the LAR Watershed (Figure 3-9). The majority of these sites are located within residential communities.

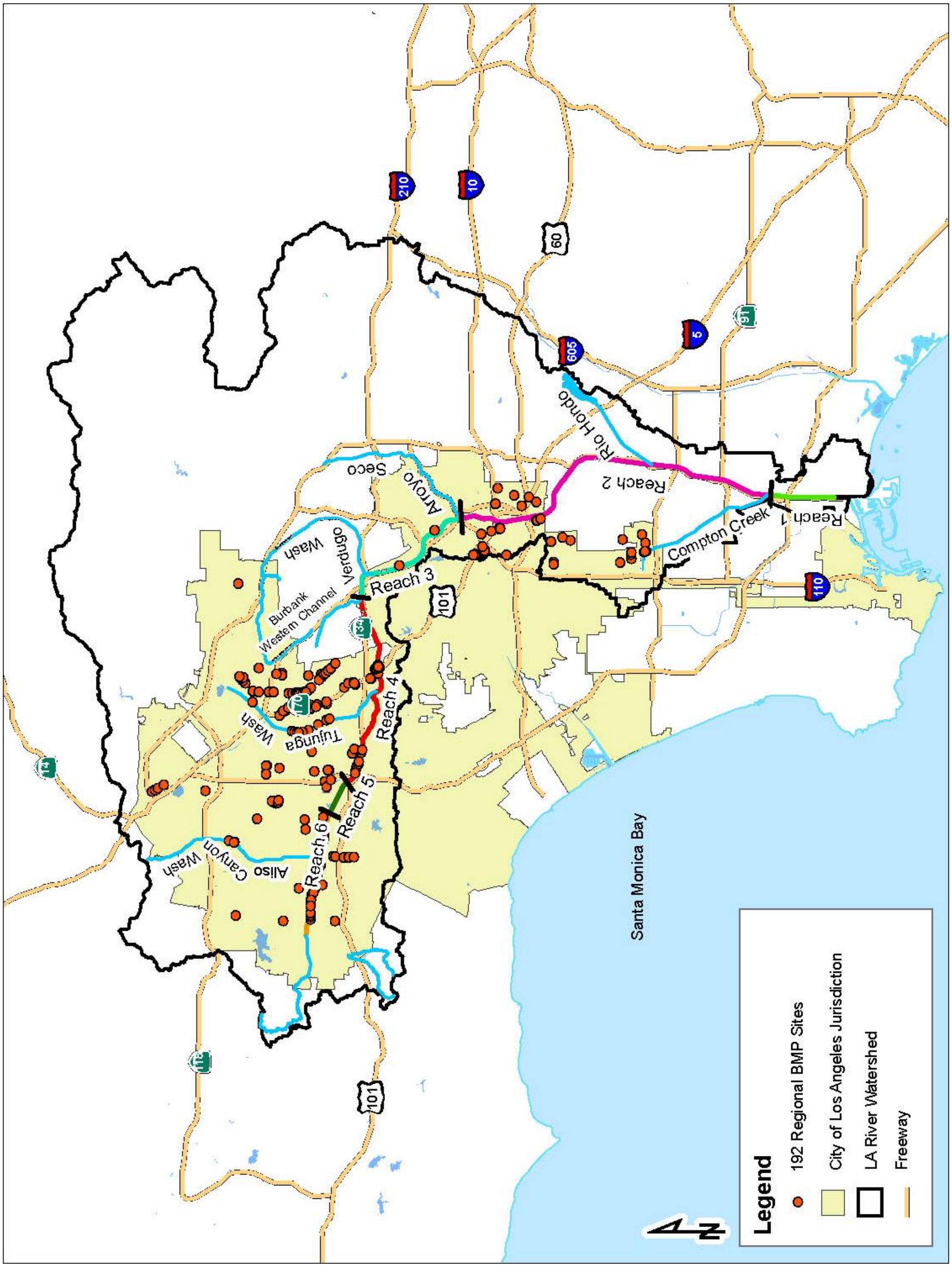

Figure 3-7
Spatial Distribution of Candidate Regional BMP Locations

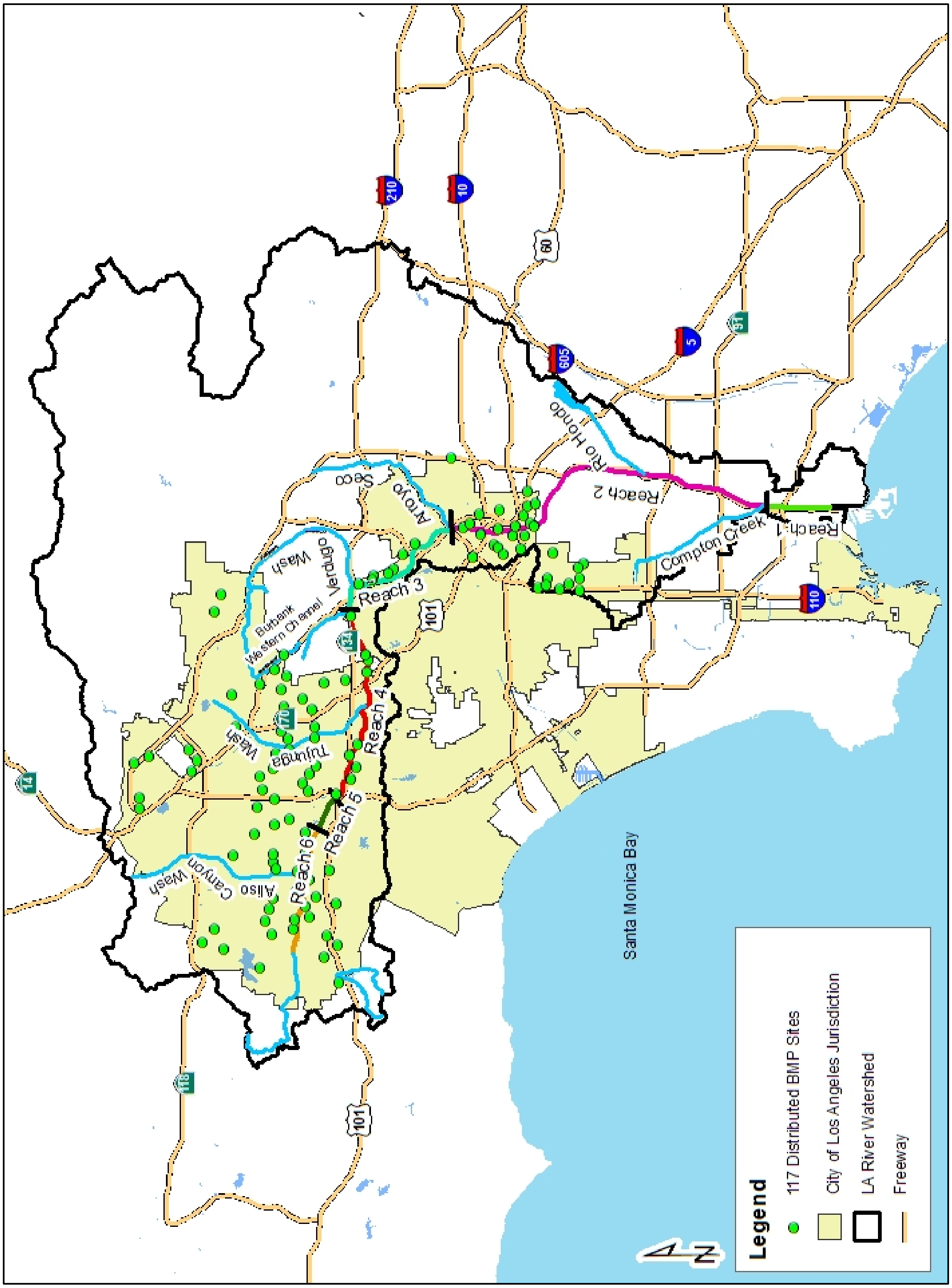

Figure 3-8
Spatial Distribution of Candidate Distributed BMP Locations

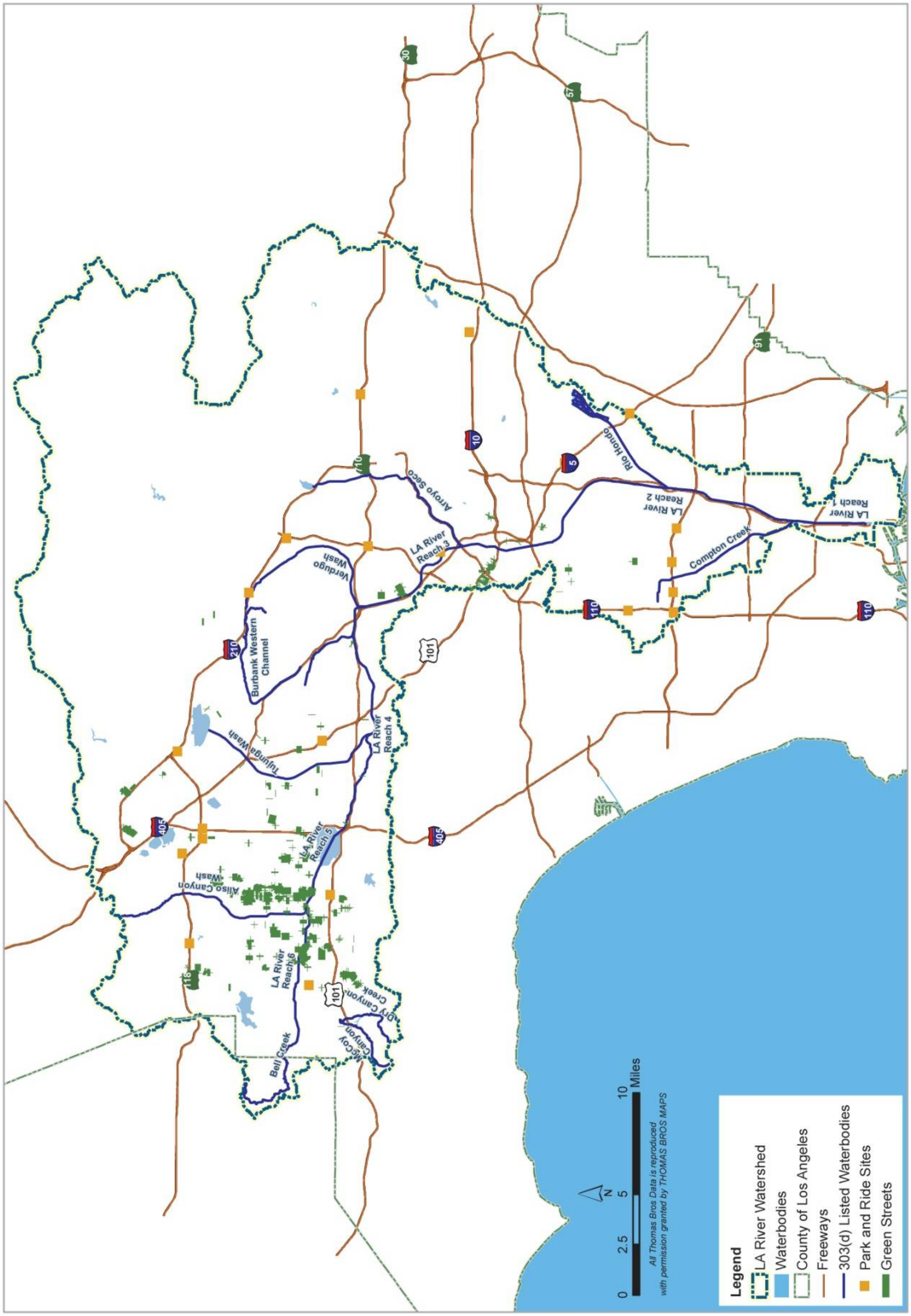

Figure 3-9
Candidiat4es locations for pervious pavement retrofit at park and ride lots and Green Street retrofits within the Los Angeles River Watershed

3.4.3 Preliminary Screening of Structural BMP Opportunities

Overview

Structural BMPs are engineered devices that capture and treat runoff, reducing the pollutant load and runoff volume draining to downstream catchments or receiving water bodies. BMPs are implemented to reduce the total volume and flow rate of urban runoff draining from a parcel of land while treating and/or removing pollutant loads within the captured runoff. The previous section identified candidate opportunity sites for structural BMPs within the City of Los Angeles' portion of the LAR Watershed. The types of distributed or regional BMPs that are most appropriate for a candidate site depend on several factors. The SBPAT preliminary screening methodology for evaluating BMP options compares four general screening categories to determine which types of structural BMPs may be most appropriate for each catchment (Geosyntec 2008a):

- Cost
- Effectiveness
- Ease of implementation
- Other environmental factors

Each of these four screening factors contains a number of sub-factors with their own weighting. SBPAT performs general, structural BMP evaluations at a catchment level; however, candidate BMP locations in the LAR Watershed for this project were identified at a parcel level. Thus, BMP-type scores for candidate BMP locations are equal for all opportunity parcels within the same catchment.

To refine the results of the general BMP assessment described above, additional analyses evaluated the feasibility of establishing infiltration basins at candidate regional BMP locations. Site requirements may limit or prevent implementing infiltration basins, which (when not sited appropriately) can potentially cause flooding, storm drain backflow, groundwater contamination, or increase the risks of landslide/liquefaction. To assess the feasibility of installing an infiltration basin at candidate regional BMP sites, five additional screening factors were evaluated:

- Adequate distance from contaminated sites
- Adequate depth to groundwater
- Minimum saturated hydraulic conductivity (K_{sat})
- Location relative to landslide and liquefaction zones

Appendix C provides additional information regarding the screening process.

Types of BMPs Screened

The following sections describe the primary types of BMPs associated with regional and distributed structural BMPs screened during this step.

Regional BMPs

Defined as centralized stormwater facilities, Regional BMPs are typically placed near the outlet of a catchment (a drainage area of approximately 40 acres) or subwatershed (a group of catchments with a common outlet) and are designed to treat urban runoff from a relatively large drainage area (drainage areas ranging from 20 acres to several hundred acres). Example BMPs include:

- *Infiltration Systems:* volume-based BMPs similar to stormwater retention systems but are constructed with a highly permeable base specifically designed to infiltrate captured runoff. Because it is usually not practical to infiltrate runoff at the same rate that it is captured, these facilities usually include both storage and drainage components. Pretreatment BMPs such as swales, filter strips, and sediment forebays/basins/manholes that minimize sediment loading to the infiltration facility are recommended to increase longevity and reduce maintenance costs.

- *Detention Basins* (also known as dry ponds and detention ponds): detention systems are BMPs designed to collect and store runoff for gradual release. Basins should have outlets designed to detain the storm runoff for 36 to 48 hours to allow sediment particles and associated pollutants to settle and be removed. These facilities may also be used to provide hydromodification and/or flood control by modifying the outlet control structure design and including additional detention storage.

- *Subsurface Wetlands with Detention*: engineered, below-ground treatment wetlands that include many of the natural treatment processes of surface flow constructed wetlands, as well as the filtration mechanisms of media filters. Water flows through a granular matrix, which typically supports the growth of emergent wetland vegetation on the surface. The matrix provides a significant surface area for the filtration of particulate bound constituents and the growth of bacterial biofilms that metabolize and degrade many pollutants including nutrients, bacteria, dissolved metals, and organic compounds. Due to the low treatment flow rates, an equalization basin is typically needed to handle peak flows and provide near constant discharge to the facility.

- *Constructed Wetlands/Wetponds*: a naturalistic retention system BMP that includes a permanent or seasonal pool of water. Aquascape facilities, such as artificial lakes, are a special form of wetpond that can incorporate innovative design elements to allow them to function as a stormwater treatment facility in addition to an aesthetic water feature. The main pollutant removal mechanism is sedimentation. Other pollutant reduction processes include dilution and biological processes such as microbially-mediated transformations and plant uptake and storage.

- *Treatment Diversion*: urban runoff may be diverted from the storm drain system to a conventional wastewater treatment facility. Additionally, there are proprietary, treatment technologies that could possibly provide runoff treatment on a small scale in localized drainage areas before discharging to receiving waters. Small packaged systems are available using traditional treatment methods such as grit removal, primary sedimentation, secondary sedimentation/filtration, and disinfection using chlorine. An equalization basin upstream of the treatment plant would typically be required to smooth the peaks of runoff events.

- *Hydrodynamic Devices*: flow-based mechanical BMPs that remove pollutants from stormwater by physical separation processes that make use of the influent flow stream energy. Removal processes include physical separation of solids and associated pollutants. Hydrodynamic separators are typically installed in line with storm drains and require regular maintenance of the filtration devices.

- *Channel Naturalization*: includes projects such as storm drain daylighting, channel revegetation, and wetland channel establishment. Natural pollutant attenuation processes can occur in these types of water systems.

Distributed BMPs

Distributed BMPs are defined as stormwater collection devices and landscaping practices dispersed throughout catchments that serve relatively small drainage areas (typically 10 acres or less). These BMPs include, for example, cisterns, bioretention, vegetated swales, green roofs, porous/permeable pavements, gross solids removal devices, media filters, and catch basin inserts.

- *Cisterns*: volume-based BMPs that collect and store runoff from storm events for use or disposal after the storm event has ended. Cisterns range in size from rain barrels to underground storage tanks.

- *Bioretention Facilities*: volume-based BMPs resembling vegetated, landscaped, shallow depressions that provide storage, infiltration, and evapotranspiration. Bioretention areas also remove pollutants by filtering stormwater through plants adapted to the local climate and soil moisture conditions, and an engineered soil mix. In bioretention areas, pore spaces, microbes, and organic material in the engineered soils help to retain water in the form of soil moisture and to promote the adsorption of pollutants, such as dissolved metals and petroleum hydrocarbons, into the soil matrix. Bioretention areas function to reduce runoff volumes by capturing and infiltrating stormwater. However, underdrains can be provided where the underlying soils have low permeability.

- *Vegetated Swales*: flow-based BMPs resembling open, shallow channels with low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. Vegetated swales provide pollutant removal through settling and filtration in the vegetation (usually grasses) lining the channels; provide the opportunity for volume reduction through infiltration and evapotranspiration; and reduce the flow velocity, in addition to conveying stormwater runoff.

- *Porous/Permeable Pavement*: area-based BMPs that include a variety of different paving methods that allow infiltration of stormwater, including pavers, porous asphalt, porous concrete, and others. Each is characterized by the ability to rapidly infiltrate water from the surface into subsurface storage for eventual infiltration. Typically, designs include an aggregate or sand reservoir below the wearing surface that accumulates water during a storm and draws down by infiltration and evaporation. Impervious surfaces may drain to permeable pavement, thereby further reducing runoff.

- *Green Roofs*: area-based BMPs that include a variety of roof-top landscaping that promote water retention and attenuation of peak runoff from roofs. Designs range from those consisting of simple layers of aggregate and soil to those including various layers of soil, synthetic retention layers, gravel, and underdrains. Each is characterized by the ability to store a portion of the water from a storm event and evapo-transpire stored water between events. Note that, as shown in Section 4, no Green Roofs are included in this Implementation Plan at this time.

- *Gross Solids Removal Devices (GSRDs):* flow-based BMPs that include a variety of proprietary BMPs to remove large solids, such as trash and litter, from stormwater by physical separation processes, making use of the influent flow energy. Removal processes include physical separation of solids and associated pollutants. GSRDs are characterized by relatively small storage volume compared to treatment flow rate, resulting in minor changes to site hydrology as a result of implementation.

- *Media Filters:* flow-based proprietary and non-proprietary BMPs that remove pollutants from stormwater by media filtration. Removal processes include physical separation (filtration of solids), sorption of some dissolved solids, and limited biological activity. Media filters are characterized by relatively small storage volume compared to filtration flow rate, resulting in minor changes to site hydrology as a result of implementation.

- *Catch Basin Inserts:* manufactured filters or fabric placed in a drop inlet to remove sediment and debris and may include sorbent media to remove floating oils and grease. There are a multitude of inserts of various shapes and configurations, typically falling into one of three groups: socks, boxes, and trays. Inserts are an easy and inexpensive retrofitting option as drain inlets are already a component of most standard drainage systems.

Preliminary Screening Results

The results of the initial BMP screening indicate that infiltration basins are the most appropriate BMP for all regional implementation sites. However, an assessment of the infiltration constraints (explained above) reduced the number of infiltration basin candidate sites within high-priority catchments of the LAR Watershed. The general BMP ranking suggests that for the remaining candidate BMP locations, the most appropriate option would be constructed surface flow wetlands. Both detention basins and channel naturalization ranked as the second best alternative to infiltration, depending upon the location characteristics.

The highest-ranking BMP options, which are effective at treating metals, have relatively low capital costs, and provide other potential benefits. Although detention basins with subsurface flow wetlands and treatment facilities have a high relative effectiveness for metals, they have relatively higher costs. Hydrodynamic devices are less effective at removing metals.

For all candidate distributed BMP locations, cisterns ranked first, vegetated swales ranked second, and pervious pavement ranked third. These distributed BMPs were the highest scoring options, primarily because of their pollutant removal effectiveness, relatively low maintenance costs, and other potential benefits. Green roofs, GSRD media filters, and catch basin inserts are less effective, more costly, or provide fewer other benefits than the higher scoring distributed BMPs.

The BMP rankings, based on technical analyses, were used to assist with the selection of the best regional and distributed BMPs (as described in the list above) for various locations in the watershed. Also considered was the opportunity to use an integrated water resources approach and implement green solution BMPs, or BMPs that provide multiple benefits (Table 3-5).

Green solution structural BMPs focus on: (1) reducing the volume of urban runoff (thereby indirectly improving water quality); (2) removing pollutants from urban runoff through natural processes; (3) providing recreational values and improving habitat quality (e.g., favorable environment for flora and fauna); and (4) reducing water demand for irrigation. Similarly, multi-benefit BMPs can provide ancillary benefits to the watershed, harvesting stormwater for multi-purpose use, infiltration for groundwater recharge, and other beneficial uses, such as improving natural settings of urban neighborhoods and creating more green open spaces. Many of the green solutions provide the added benefit of safely storing the stormwater overland or underground within the local sub-watershed, which can be utilized for plant growth after the storm event.

Table 3-5 Green Solutions and Multiple Benefit BMPs

BMP Type	Benefits					Multi-Benefits
	Treats Multi-Pollutants	Natural Process	Reduction in Irrigation Demand	Stormwater Harvesting	Other (e.g., REC uses; aesthetics)	
Regional						
Infiltration Facilities	X	X		X		**X**
Detention Basins	X	X				**X**
Subsurface Flow (SSF) Wetlands with Detention	X	X			X	**X**
Constructed Wetlands/ Wetponds	X	X			X	**X**
Treatment Facilities Hydrodynamic Devices	X					
Hydrodynamic Devices	X					
Channel Naturalization	X	X			X	**X**
Distributed/Onsite BMPs						
Cisterns	X	X	X	X		**X**
Bioretention Facilities	X	X	X		X	**X**
Vegetated Swales	X	X			X	**X**
Green Roofs	X	X			X	**X**
Porous/Permeable Pavement	X	X		X		**X**
Gross Solids Removal Devices (GSRDs)	X					
Media Filters	X	X				**X**
Catch Basin Inserts	X					

3.4.4 Site-Specific BMP Evaluation

Overview

Planning and siting of potential regional and distributed structural BMPs is particularly challenging because of the highly developed conditions in the watershed. Because the majority of structural regional BMPs will need to be retrofitted into developed areas of the watershed, the BMP analyses require significant site-specific BMP evaluations, including additional data collection and field inspections in order to screen, prioritize, and select sites.

Regional BMP Site Selection Methodology

Three technical steps were followed to conduct a site-specific analysis of BMP candidate locations for regional BMP implementation:

- GIS-level screening to screen BMPs based on data available in GIS layers

- Desktop-level screening to identify BMP opportunities and constraints based on aerial photos and any other available information (e.g., storm drain information)
- Field-level screening to ground-truth opportunities and constraints identified during the two previous screening levels, and identify any other issues

Appendix C provides additional information regarding each of these analyses.

Distributed BMP Site Selection Methodology

The overall methodology used to identify distributed BMP opportunities was similar to the approach used for selecting regional BMPs:

- GIS-level screening to screen BMPs based on data available in GIS layers. Unlike regional BMPs, distributed BMP opportunities exist throughout the watershed. Accordingly, GIS layers used to screen regional BMP sites may not screen out distributed BMP sites.
- Desktop-level screening to identify BMP opportunities and constraints based on aerial photos and any other available information (e.g., storm drain information).
- Field-level screening to ground-truth opportunities and constraints identified during the two previous screening levels, identify any other implementation issues, and provide information to support development of a phased approach.

Appendix C provides additional information regarding each of these analyses.

Final Candidate BMP Locations

Regional BMPs

Using the above mentioned criteria, a number of potential sites were eliminated from the original list of 192 sites within the City jurisdiction. Typically, one site per high-priority ranked catchment was considered for a regional BMP. Based on the desktop analysis, 157 of the 192 potential BMP opportunity sites were eliminated as inappropriate for BMP implementation. The remaining 35 sites that met the desktop-level screening criteria were included in the field screening step. Figure 3-10 shows the candidate 35 locations spatially distributed throughout the watershed within the City's jurisdiction; Table 3-6 summarizes the characteristics of each site.

The 35 sites cover most of the 303(d) listed tributary and main channel reaches. However, no regional BMP opportunity sites were available in the upper portions of Reach 2 and Reach 3 that are located within the City's jurisdiction. Opportunity sites in the upper parts of the watershed within Reaches 6, 5, and 4 were not considered because urban development in these areas is minimal, and the drainage areas for treatment are limited. In order to target the areas with the greatest potential of pollutant loadings, the sites in the lower portions of each subwatershed within developed areas are considered for implementation at this time.

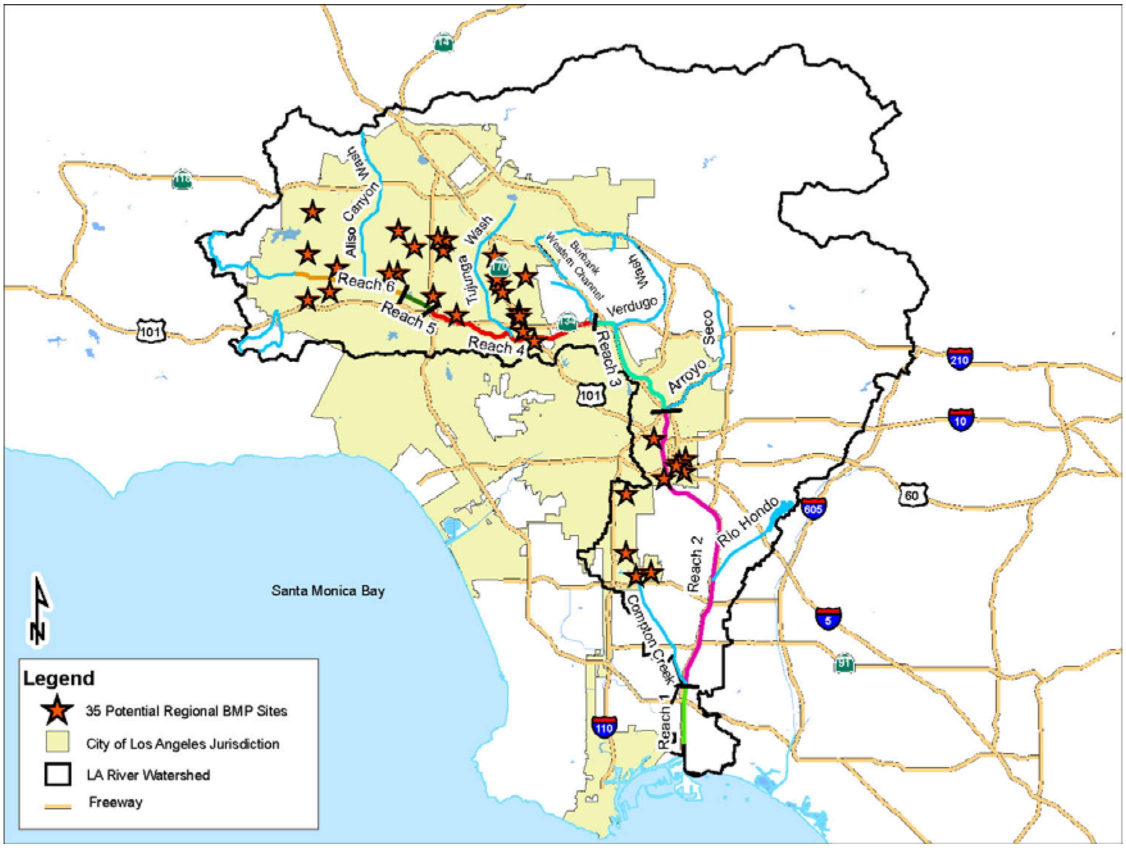

Figure 3-10
Candidate Regional BMP Sites (35) Considered for Field Investigations

The results of the field investigations of regional BMP opportunity sites provided an assessment of the regional BMP type and available open space area within each site that could be retrofitted to install a regional BMP, and any potential constraints (Table 3-6). This information was evaluated for three purposes:

- Remove sites that contain any flaws that could either impede BMP construction (e.g., site with matured trees), or reduce water quality benefits (e.g., reduced area available for siting of the BMP).
- Identify priority sites for implementation during the first phase of the Implementation Plan. The field data from these sites was coupled with other opportunities identified by stakeholders to select a priority set of BMP locations for implementation.
- An implementation percentage for each type of regional BMPs was evaluated and considered for the Implementation Plan. This information was then used to support quantitative analyses associated with the implementation of regional and distributed BMPs throughout the watershed.

From the 35 initial sites that were field-investigated, the highest ranking 17 sites were identified for potential regional BMP implementation. Rankings were developed using best professional judgment. These 17 sites were considered for inclusion as priority projects in the TMDL Implementation Plan (Table 3-7 and Figure 3-11). The selection of priority sites for incorporation into the metals TMDL Implementation Plan will be discussed in Section 4.

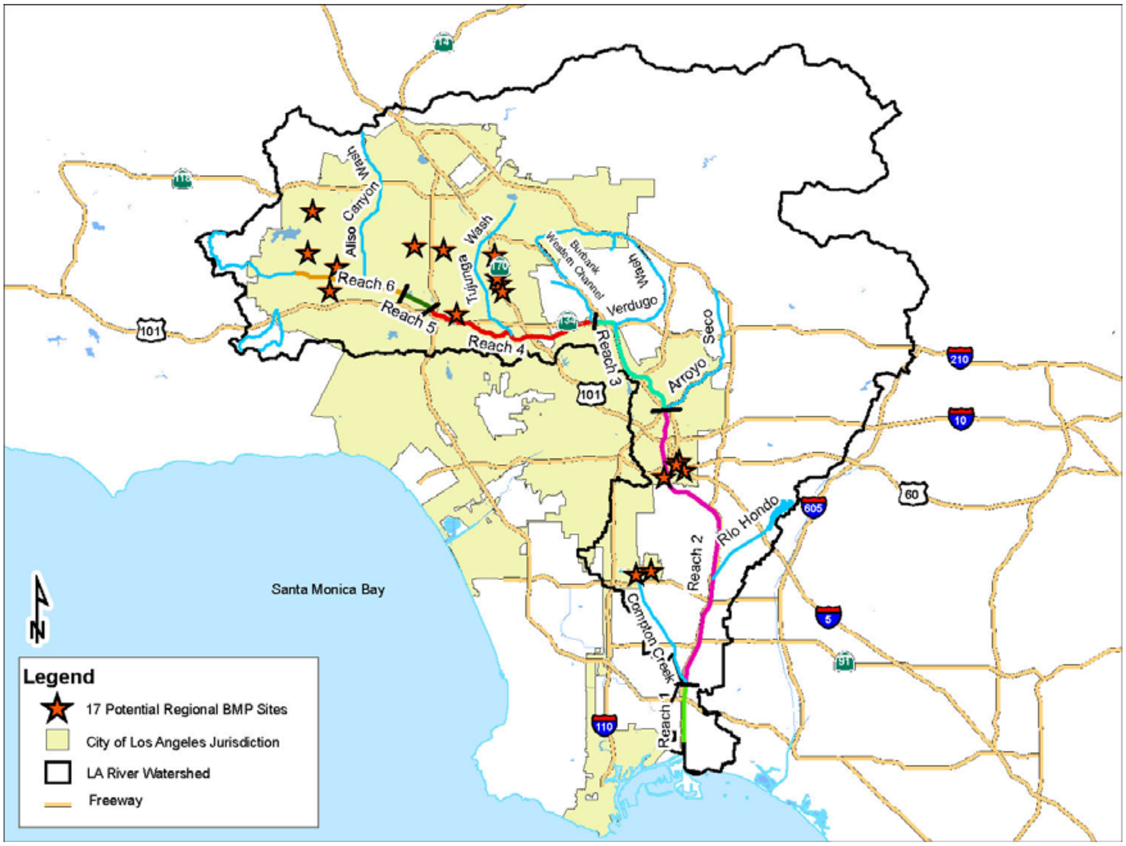

Figure 3-11
Prioritized 17 Regional BMP Opportunity Sites

Table 3-6 Characteristics of 35 Candidate Regional BMP Sites

Catchment ID	Sub-Watershed	Owner	Land Use of Parcel	Current Use of Open Space	Catchment Area (ac)	Approximate Open Space Acreage	Surrounding Land Use	Infiltration Screening
B173A-4	Compton Creek	City of Los Angeles	Park	vacant	2276	1.4	Residential/ Industrial	Non-Infiltration
CMPTN-1	Compton Creek	City of Los Angeles	Undeveloped residential/ industrial	vacant	3	9	Residential, Industrial	Non-Infiltration
EGLEN-3	Compton Creek	Community Redevelopment Agency	Park	vacant with walking path	215	2	Residential	Non-Infiltration
BI73A-2	Compton Creek	City of Los Angeles	Park	dirt soccer field	222	2.5	Residential	Non-Infiltration
BI103	LA River Reach 6	City of Los Angeles	Park	Park	1397	1.7	Residential, Industrial	Non-Infiltration
BI112	LA River Reach 6	Los Angeles Community College District	open space	Open space, agricultural, rangeland	3592	41	Residential, Industrial	Non-Infiltration
BI472-1	LA River Reach 6	City of Los Angeles	Park	Park	1446	6.7	Residential	Non-Infiltration
BI472-2	LA River Reach 6	City of Los Angeles	Park	Park	280	6.4	Residential	Non-Infiltration
BI477	LA River Reach 6	City of Los Angeles	Park	Park	134	2.0	Residential	Non-Infiltration
BROWN6	LA River Reach 6 (Brown Cyn Wash)	City of Los Angeles	Industrial	Vacant	9101	2.5	Industrial	Non-Infiltration
LA7149	LA River Reach 6	City of Los Angeles	Park	Park	1350	10.7	Residential, commercial	Non-Infiltration
BI9214	Bell Creek	City of Los Angeles	Park, with trees	Park, with trees	303	9	Residential, industrial	Non-Infiltration
BI469	LA River Reach 5	City of Los Angeles	Agriculture / Vacant	Agriculture / Vacant	1443	40	Agriculture, Industrial	Infiltration
BULL6	LA River Reach 5	US Army Corp of Engineers	Vacant	Vacant	6667	27.9	Residential	Non-Infiltration
BI39-2	LA River Reach 4	City of Los Angeles	open space	vacant	2293	27.7	industrial	Non-Infiltration
BI462	LA River Reach 4	City of Los Angeles	open space	park/ballfields	1531	34.5	com/res/fwy	Non-Infiltration
BI463	LA River Reach 4	City of Los Angeles	open space	park	444	6.5	residential/fwy	Non-Infiltration

Table 3-6 Characteristics of 35 Candidate Regional BMP Sites

Catchment ID	Sub-Watershed	Owner	Land Use of Parcel	Current Use of Open Space	Catchment Area (ac)	Approximate Open Space Acreage	Surrounding Land Use	Infiltration Screening
BI9203-2	LA River Reach 4	City of Los Angeles	open space	park/ballfields	4498	41	Residential	Non-Infiltration
LAR80	LA River Reach 4	City of Los Angeles	open space	park/vacant/ballfields	775	11.3	Residential/fwy	Non-Infiltration
MT30-2_1	LA River Reach 4	City of Los Angeles	open space	vacant, baseball fields	437	15	Residential	Infiltration
MT30-2_2	LA River Reach 4	City of Los Angeles	open space	park	1341	37	Residential/fwy	Infiltration
MT30-2_3	LA River Reach 4	City of Los Angeles	open space	open space, park	1341	10	Residential/fwy	Infiltration
MT30-2_4	LA River Reach 4	City of Los Angeles	open space	vacant	350	3	Residential/fwy	Non-Infiltration
MT30-2_5	LA River Reach 4	City of Los Angeles	open space	park	66	1.7	Commercial, Residential	Non-Infiltration
MT30-2_6	LA River Reach 4	City of Los Angeles	open space	park/ballfields	2020	7.2	Residential/fwy	Non-Infiltration
BI88	Tujunga Wash	City of Los Angeles	Open Space	Vacant	1698	1.5	Residential, Commercial	Infiltration
BI9203-1	Tujunga Wash	Los Angeles Unified School District	School/Athletic Fields	Vacant	2877	4.5	Residential	Non-Infiltration
PACW3	Tujunga Wash	City of Los Angeles	Park	Park	563	1.4	Residential	Non-Infiltration
BI5206-1?	LA River Reach 2	City of Los Angeles	open space	park	569	2	Residential	Non-Infiltration
BI67A_1	LA River Reach 2	City of Los Angeles	open space	baseball field, blacktop	464	4	Residential, school	Non-Infiltration
BI5206-2	LA River Reach 2	City of Los Angeles	open space	baseball field, park	663	3.3	Residential, school	Non-Infiltration
BI67A_3	LA River Reach 2	City of Los Angeles	open space	vacant	573	1.6	Residential, school	Non-Infiltration
BI9921	LA River Reach 2	City of Los Angeles	open space	vacant	177	12.5	Industrial	Non-Infiltration
LAR138	LA River Reach 2	City of Los Angeles	commercial	grassy area	880	1	Commercial	Non-Infiltration

Table 3-7 Characteristics of Candidate 17 Regional BMP Sites with Potential BMP Options

Catchment ID [1]	Sub-Watershed	Owner	Catchment Area (Acres)	Approximate Open Space Acreage	Comments	Potential BMP Options
CMPTN-1	Compton Creek	City of Los Angeles	7,100	9	Vacant; Adjacent to Compton Creek	Wetlands/Detention Basin
EGLEN-3	Compton Creek	Community Redevelopment Agency	215	2	Park with walking path	Wetlands/Detention Basin
BI112	LA River Reach 6	Los Angeles Community College District	1,760	39	Pierce College	Detention Basin
BI477	LA River Reach 6	City of Los Angeles	134	2	Park	Detention Basin
BROWN6	LA River Reach 6	City of Los Angeles	9,101	2.5	Next to Metrolink station	Detention Basin
MT30-2_7	LA River Reach 4	City of Los Angeles	4,360	14	North Hollywood Park	Infiltration
BI9214	Bell Creek	City of Los Angeles	303	9	Lanark Park	Detention Basin
BI469	LA River Reach 5	City of Los Angeles	1,443	40	Sod Farms	Infiltration/Detention Basin/Wetland
BI9203-2	LA River Reach 4	City of Los Angeles	1,100	30	Van Nuys Sherman Oaks Park	Detention Basin/Wetland
MT30-2_1	LA River Reach 4	City of Los Angeles	437	15	Strathern/Slavern Parks	Infiltration
MT30-2_2	LA River Reach 4	City of Los Angeles	1,341	37	Valley Plaza Park	Infiltration/Detention Basin/Wetland
MT30-2_3	LA River Reach 4	City of Los Angeles	1,341	10	Park/Ball Field	Infiltration/Detention Basin/Wetland
MT30-2_4	LA River Reach 4	City of Los Angeles	350	3	Valley Plaza Park	Detention Basin/Wetland
BI9203-1	Tujunga Wash	Los Angeles Unified School District	2,877	4.5	School/Athletic Fields	Detention Basin
BI5206-2	LA River Reach 2	City of Los Angeles	663	3.3	Baseball Field, Park/Boyle Heights	Detention Basin
BI67A_3	LA River Reach 2	City of Los Angeles	573	1.6	Hollenbeck Middle School; Boyle Heights Green Corridor Project	Detention Basin/ Wetland
BI9921	LA River Reach 2	City of Los Angeles	177	12.5	Vacant; Clean Tech Manufacturing Center	Wetland/Detention Basin

[1] Sites in this table are also shown on list of 35 field visited locations. Additional information for these sites is provided

Distributed BMPs

Potential distributed BMP opportunities are located throughout the urbanized areas of the LAR Watershed. A distributed BMP can be installed in any area where there are sources of contamination and the local topography drains to a place where space is available. It is expected that nearly all catchments will have at least some opportunities for distributed BMPs.

Opportunities to implement distributed BMPs in a particular catchment vary depending on the existing land use and other factors. However, because distributed BMPs include multiple individual small-footprint facilities requiring much less space than regional BMPs, a number of opportunities exist to retrofit distributed BMPs in most catchments.

The approach used to identify potential distributed BMP opportunities for implementation under this Plan focuses on the catchments that have a higher likelihood of pollutant loading. Prioritization results were used to focus distributed BMP implementation on high CPI scoring catchments (4 or 5) within the City of Los Angeles jurisdiction (see Section 3.4.1).

Following completion of the GIS-level screening analyses (see Section 3.4.2) only 117 high scoring catchments remained (out of the 1,018 catchments that make up the LAR Watershed). The desktop-level screening was performed to select 100 catchments for field investigation. This was done by skewing the selection toward Reach 2 and other industrial areas, where there were fewer regional BMP opportunities. As part of the desktop level screening, a smaller subcatchment (approximately 40 acres), with a similar land use distribution to that of the larger catchment, was selected for each of the 100 large (approximately 500 acre) catchments. This was done to focus the field level screening to a more reasonable area. The 100 potential distributed BMP catchments are shown in Figure 3-12.

After performing the GIS-level, desktop-level, and field-level screening, it was found that the greatest opportunity for distributed BMPs were Green Street parkways. Field investigations determined the feasibility of converting existing parkways to Green Street parkways, incorporating bioretention BMPs into parkways areas. The field investigations estimated the length and width of existing parkways as well as the tributary area. It was assumed that even if an existing parkway was converted to a treatment facility, any mature trees would remain in place. The extent of mature trees, driveways and other structures within the parkway was documented and taken into account when calculating the usable space for bioretention areas.

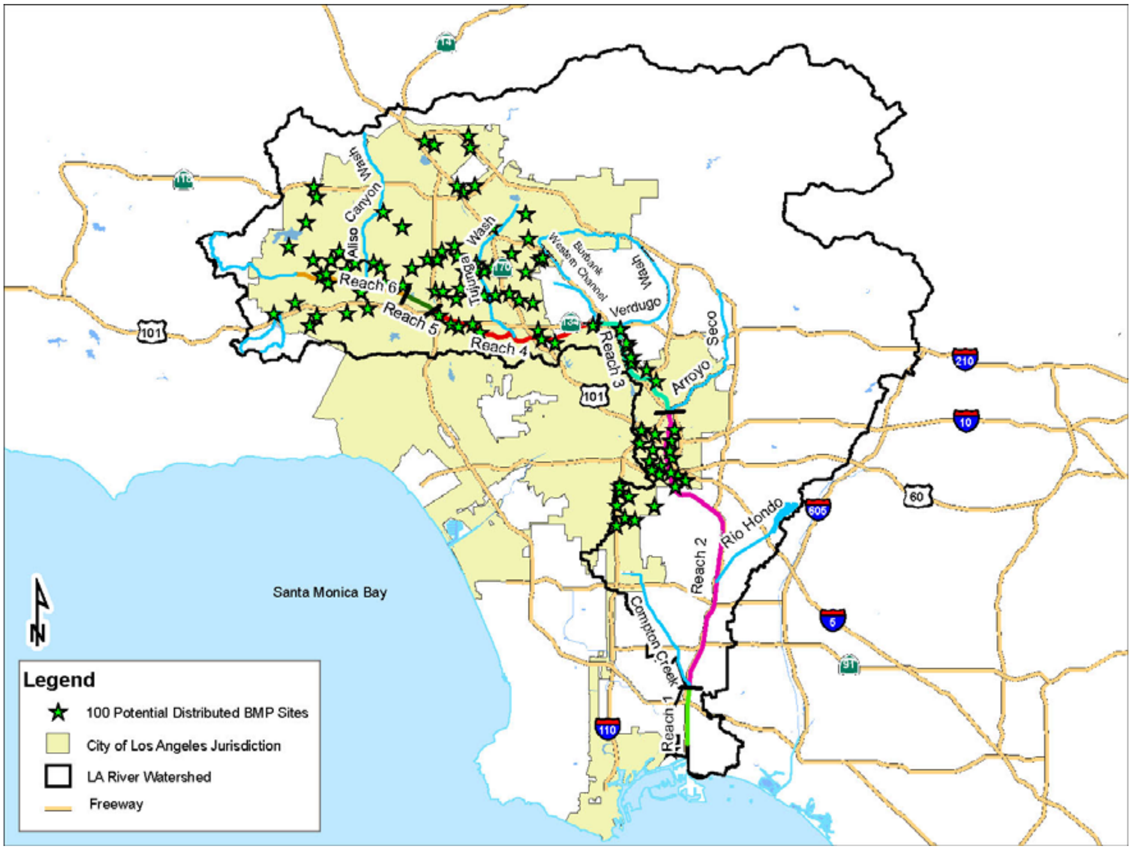

Figure 3-12
100 Potential Distributed BMP Sites

The field-level investigation activities provided valuable information on the feasibility of implementing distributed BMPs, and generated numerous field data sheets and photographs for each of the 100 sites. Table 3-8 below summarizes the field investigations for the 100 distributed BMP sites. The selection of priority sites for incorporation into the metals TMDL Implementation Plan will be discussed in Section 4.

Table 3-8 Summary Of Distributed BMP Field Investigations

Sub-catchment	Catchment ID	Waterbody	Catchment Area (ac)	Land Use (acres)						
				Agriculture	Commercial	Educational	Industrial	MF+SF Residential	Open/ Vacant	Transportation
600473	STSUS3	LA River Reach 6	34.2	0.0	0.0	0.0	11.4	12.6	0.0	10.2
600954	BROWN7	LA River Reach 6	28.4	0.0	0.0	8.0	0.0	20.4	0.0	0.0
603373	CALAB4	LA River Reach 6	66.3	0.0	0.0	21.9	0.0	44.5	0.0	0.0
603679	LAR2	LA River Reach 6	33.8	0.0	4.9	4.8	0.0	22.3	0.0	1.8
603932	BI3857	LA River Reach 6	28.3	0.0	0.0	0.0	0.0	28.2	0.0	0.0
604000	BI477	LA River Reach 6	33.5	0.0	4.9	4.0	0.0	24.6	0.0	0.0
605031	BI652	LA River Reach 6	40	10.2	0.0	7.5	0.0	20.7	0.0	1.6
605134	BI9202	LA River Reach 6	46.5	0.0	7.5	5.6	0.0	33.4	0.0	0.0
605283	BI476	LA River Reach 6	33.1	0.0	13.8	0.0	0.0	19.3	0.0	0.0
605314	LAR12	LA River Reach 6	28.9	0.0	0.0	8.9	0.0	20.0	0.0	0.0
606886	BI475	Caballero Creek	40.7	0.0	10.3	0.2	0.0	26.8	3.4	0.0
606966	BI474B	LA River Reach 6	32.6	0.0	3.9	9.7	0.0	19.1	0.0	0.0
607512	BI472	LA River Reach 6	37.9	0.0	0.0	23.7	0.0	14.2	0.0	0.0
607618	LA2327	LA River Reach 5	18	0.0	0.0	16.1	0.0	0.5	0.0	1.4
608851	BI106	LA River Reach 4	34.4	0.0	3.1	0.0	17.8	13.5	0.0	0.0
610302	BI108	LA River Reach 4	33.1	0.0	5.5	0.0	0.0	27.3	0.3	0.0
610314	LA7335	LA River Reach 4	44.7	0.0	5.5	0.0	0.0	31.5	3.1	4.6
610855	WILSN3	Tujunga Wash	39.7	0.0	25.8	0.0	0.0	13.9	0.0	0.0
610981	PACDV9	Tujunga Wash	50.4	0.0	0.7	33.6	0.0	16.1	0.0	0.0

Table 3-8 Summary Of Distributed BMP Field Investigations

Sub-catchment	Catchment ID	Waterbody	Catchment Area (ac)	Land Use (acres)						
				Agriculture	Commercial	Educational	Industrial	MF+SF Residential	Open/ Vacant	Transportation
611116	SYLMR1	Tujunga Wash	36	0.0	33.0	0.0	2.2	0.0	0.0	0.9
611118	SYLMR2	Tujunga Wash	38.9	0.0	0.2	0.0	32.7	2.0	1.8	2.2
611486	BI9203-1	Tujunga Wash	28.3	0.0	4.2	0.0	0.0	24.1	0.0	0.0
611527	BI9203-2	LA River Reach 4	30.6	0.0	11.5	4.3	0.0	14.8	0.0	0.0
611694	LAR54	LA River Reach 4	14.3	0.0	2.3	8.3	0.0	3.6	0.0	0.0
613731	BI107B	Tujunga Wash	30.6	0.0	1.5	0.0	16.0	13.1	0.0	0.0
614047	BI85-1	Tujunga Wash	36.1	0.0	21.0	0.0	11.9	3.2	0.0	0.0
614067	BI9245	Tujunga Wash	30.3	0.0	4.5	0.0	25.7	0.0	0.0	0.0
614088	TJNGA3	Tujunga Wash	43.5	0.0	13.1	0.0	0.0	30.4	0.0	0.0
614782	BI39-2	LA River Reach 4	41.8	2.5	0.0	16.3	15.3	0.0	0.0	7.6
614816	BI39-3	LA River Reach 4	29.2	0.0	3.9	4.7	0.0	20.5	0.0	0.0
614854	BI39-4	LA River Reach 4	33.8	0.0	7.3	0.0	0.0	26.4	0.0	0.0
615410	BI60A	LA River Reach 3	33.8	0.0	0.0	4.1	0.0	29.7	0.0	0.0
790701	CNTRA	Burbank Western Channel	38.8	0.0	0.1	0.0	38.6	0.1	0.0	0.0
790772	BI609B	Burbank Western Channel	40.9	0.0	2.8	7.9	18.0	8.9	0.0	3.3
800837	LAR138	LA River Reach 2	33.1	0.0	21.5	0.0	3.6	6.4	0.0	1.6
800901	B166-3	LA River Reach 2	25.4	0.0	0.0	0.0	19.3	2.1	2.6	1.4
801011	BI59-2	LA River Reach 2	34.2	0.0	1.2	1.4	0.0	18.7	0.0	12.9

Table 3-8 Summary Of Distributed BMP Field Investigations

Sub-catchment	Catchment ID	Waterbody	Catchment Area (ac)	Land Use (acres)						
				Agriculture	Commercial	Educational	Industrial	MF+SF Residential	Open/ Vacant	Transportation
801038	LAR140	LA River Reach 2	46.5	0.0	3.8	0.9	24.6	6.6	0.7	9.8
801118	BI5203	LA River Reach 2	38.6	0.0	31.0	0.0	6.0	1.5	0.0	0.0
801131	BI67A	LA River Reach 2	45.2	0.0	9.9	0.3	12.8	15.6	6.6	0.0
801255	LA4958	LA River Reach 2	42.2	0.0	0.0	4.5	37.7	0.0	0.0	0.0
801306	BI58	LA River Reach 2	39.7	0.0	2.9	0.0	36.8	0.0	0.0	0.0
801412	BI5206-2	LA River Reach 2	26.1	0.0	4.3	0.0	2.4	19.4	0.0	0.0
850062	BI73B-1	Compton Creek	44.4	0.0	10.1	0.0	5.7	28.5	0.0	0.0
850150	BI73A-3	Compton Creek	44.1	0.0	11.5	0.0	12.9	17.9	0.0	1.9
851060	HOOP-1	Compton Creek	45.1	0.0	0.0	3.3	22.3	9.0	10.5	0.0
603646	BI478B	LA River Reach 6	45.6	0.0	0.5	0.0	35.8	7.6	0.0	1.7
614161	TJNGA4	Tujunga Wash	31.5	0.0	0.0	1.2	0.0	25.6	4.7	0.0
614200	BI91	Tujunga Wash	30.7	0.0	0.0	6.8	0.0	23.9	0.0	0.0
801426	BI90	LA River Reach 2	21.2	0.0	0.0	0.0	7.0	14.2	0.0	0.0
614072	BI657	Tujunga Wash	21.2	0.0	1.4	5.1	0.0	14.7	0.0	0.0
850002	BI5201-1	Compton Creek	32	0.0	3.5	0.0	23.6	4.6	0.3	0.0
608553	BI469	LA River Reach 5	27.4	0.0	0.0	0.0	27.4	0.0	0.0	0.0
610971	PACDV8	Tujunga Wash	42	0.0	0.0	0.0	40.3	0.0	0.1	1.6
611655	LAR48	LA River Reach 4	23.5	0.0	14.5	0.0	0.0	0.5	3.4	4.9
613938	BI3853	Tujunga Wash	46	0.0	39.1	0.0	0.0	6.9	0.0	0.0

Table 3-8 Summary Of Distributed BMP Field Investigations

Sub-catchment	Catchment ID	Waterbody	Catchment Area (ac)	Land Use (acres)						
				Agriculture	Commercial	Educational	Industrial	MF+SF Residential	Open/ Vacant	Transportation
614044	BI85-2	Tujunga Wash	24.6	0.0	3.9	0.0	12.7	5.9	2.0	0.0
610393	BI36	LA River Reach 4	28.1	0.0	18.1	0.0	9.7	0.2	0.0	0.0
610443	LA3624	LA River Reach 4	33.9	0.0	17.4	0.0	0.0	16.5	0.0	0.0
614407	BI467B	LA River Reach 4	25.2	0.0	0.0	4.0	21.2	0.0	0.0	0.0
614592	BI462	LA River Reach 4	31.7	0.0	10.9	0.0	0.0	20.8	0.0	0.0
615150	LAR104	LA River Reach 3	37.3	0.0	0.0	0.0	22.3	0.0	8.5	6.5
615264	BI437	LA River Reach 3	6.8	0.0	0.0	0.0	6.8	0.0	0.0	0.0
615506	BI480A	LA River Reach 3	48.7	0.0	15.6	0.0	33.1	0.0	0.0	0.0
616394	LA3707	LA River Reach 3	38.9	0.0	9.0	0.9	21.8	6.9	0.0	0.3
790791	LCKHD	Burbank Western Channel	29.8	0.0	0.0	0.0	18.7	0.0	0.0	11.2
850462	BI73C-1	Compton Creek	41.2	0.0	0.0	0.0	41.0	0.1	0.0	0.0
801236	LA27039	LA River Reach 2	43	0.0	0.0	2.6	31.8	0.0	8.6	0.0
800818	LAR137	LA River Reach 2	43	0.0	0.0	0.0	40.3	0.0	2.7	0.0
610886	WILSN2	Tujunga Wash	28.5	0.0	2.7	0.0	0.0	22.9	2.9	0.0
615331	LA458	LA River Reach 3	27.7	0.0	18.9	0.0	0.1	8.7	0.0	0.0
602392	CHATS2	Bell Creek	52.2	0.0	0.0	0.0	48.1	4.0	0.0	0.1
603306	CALAB2	McCoy Canyon Ck	37.5	10.1	0.0	0.0	0.0	24.0	0.0	3.5
603847	LA7149	LA River Reach 6	36.1	0.0	0.0	0.0	0.0	36.1	0.0	0.0
603901	LAR3	LA River Reach 6	23.3	0.0	3.1	0.0	0.0	20.1	0.0	0.1

Table 3-8 Summary Of Distributed BMP Field Investigations

Sub-catchment	Catchment ID	Waterbody	Catchment Area (ac)	Land Use (acres)						
				Agriculture	Commercial	Educational	Industrial	MF+SF Residential	Open/ Vacant	Transportation
607171	BI474A1	LA River Reach 6	33.3	0.0	9.7	23.4	0.0	0.1	0.0	0.0
607246	LA21397	LA River Reach 6	25.3	0.0	0.0	0.0	0.0	25.3	0.0	0.0
608389	LA27595	LA River Reach 5	29.9	0.0	1.8	0.0	0.0	28.1	0.0	0.0
610151	BI5220	LA River Reach 4	39.7	0.0	0.2	0.0	0.0	36.5	1.0	2.1
614678	BI39-1	Burbank Western Channel	48.5	4.7	0.0	0.0	1.2	37.1	5.6	0.0
801272	LAR142	LA River Reach 2	19.1	0.0	0.0	0.0	19.1	0.0	0.0	0.0
850091	BI73A-1	Compton Creek	40.2	0.0	4.9	0.0	0.0	21.1	0.0	14.2
600805	BROWN6	LA River Reach 6	49.4	6.0	0.0	0.0	0.0	43.4	0.0	0.0
614421	BI38	LA River Reach 4	47.4	3.4	6.5	0.0	0.0	37.6	0.0	0.0
614493	MT30-2	LA River Reach 4	41.1	0.0	24.0	6.3	0.0	9.5	0.0	1.4
400303	BI5153	LA River Reach 1	22.8	0.0	0.0	0.0	19.3	0.0	3.3	0.2
600231	STSUS2	LA River Reach 6	15.3	0.0	0.0	0.0	0.0	2.8	1.8	10.7
801342	LAR146	LA River Reach 2	11.1	0.0	0.4	0.0	10.7	0.0	0.0	0.0
850007	BI5201-2	Compton Creek	28.8	0.0	3.3	0.0	0.0	22.9	2.7	0.0
850016	BI5201-3	Compton Creek	35.1	0.0	2.5	0.0	0.0	23.3	9.3	0.0
801282	BI9921	LA River Reach 2	41.7	0.0	1.4	0.0	30.4	0.0	9.9	0.0
801171	LA1033	LA River Reach 2	44.6	0.0	38.6	0.0	0.0	0.0	5.5	0.4
615256	BI9506A	LA River Reach 3	19.9	0.0	0.0	0.0	15.5	4.4	0.0	0.0
614926	LAR84	LA River Reach 4	41.5	0.0	1.4	0.0	19.6	17.3	3.2	0.0

Table 3-8 Summary Of Distributed BMP Field Investigations

Sub-catchment	Catchment ID	Waterbody	Catchment Area (ac)	Land Use (acres)						
				Agriculture	Commercial	Educational	Industrial	MF+SF Residential	Open/ Vacant	Transportation
615004	LAR86	LA River Reach 4	31.5	0.0	0.0	0.0	23.0	0.2	8.3	0.0
615126	LAR98	LA River Reach 4	54	0.0	0.0	0.0	1.9	0.0	41.0	11.1
611231	BI7050	Tujunga Wash	48.2	0.0	27.9	6.6	0.0	13.7	0.0	0.0
610080	LAR32	LA River Reach 4	24.3	0.0	16.2	0.0	0.0	4.5	3.2	0.4
603484	BI5229	LA River Reach 6	20.7	0.0	0.0	0.0	0.0	20.0	0.0	0.7
606937	BI96	LA River Reach 6	36.7	0.0	7.0	0.0	0.0	29.6	0.0	0.0

3.5 Stakeholder Coordination

During the development of this Implementation Plan, the City conducted a series of stakeholder workshops and held one-on-one discussions with key Non-Governmental Organizations (NGOs). The purpose of these meetings was to provide a forum for the discussion of BMP opportunities in the watershed. The following is a summary of these coordination activities.

3.5.1 Stakeholder Workshops

Three stakeholder workshops were held at the LAR Center in 2009. The meeting date and primary topic of discussion for each meeting is as follows:

- *Workshop 1:* Watershed Characterization, LAR Center, March 25, 2009
- *Workshop 2:* Identification of BMP Opportunities, LAR Center, July 1, 2009
- *Workshop 3:* Metals TMDL Implementation Plan, LAR Center, September 30, 2009

The workshops were well attended with numbers of attendees ranging from 50 to 100. Appendix D includes a copy of each of the workshop presentations. During each meeting, the City documented stakeholder questions and comments. Following the meeting, a comment response matrix was prepared and distributed to the meeting attendees as well as others on the City's mailing list (see Appendix D for a matrix prepared after each meeting).

3.5.2 Individual Stakeholder Meetings

The City met with a variety of stakeholders representing watershed, environmental, and community interests to identify opportunities for collaboration on implementing BMPs to manage urban runoff. For each meeting, the discussion focused on the following theme: What can your organization tell us about existing or proposed projects or programs that may provide an opportunity for collaborating with the City of Los Angeles to achieve TMDL goals? Meetings were held with the following organizations:

- Los Angeles and San Gabriel Rivers Watershed Council
- Los Angeles Conservation Corps
- Audubon Society, San Fernando Valley
- TreePeople
- Mujeres de la Tierra
- North East Trees
- Heal the Bay
- Friends of the Los Angeles River
- Los Angeles Department of Water and Power
- Los Angeles Equestrian Center

Common issues identified during these meetings included the following (see Appendix D for a summary of the discussion points from each meeting):

- BMPs should simultaneously focus on multiple pollutants and provide multiple local benefits (e.g., parks, stormwater harvest, street repair, correct drainage problems)
- Link Green Street retrofits schedule to regular street maintenance/upgrade activities
- Industrial areas need particular focus for BMP implementation
- Established community groups provide collaboration opportunities at the local/neighborhood level (e.g., south Los Angeles)
- Areas where multiple jurisdictions coincide increases need for collaboration among responsible agencies
- Many opportunities/strategies have been identified in watershed plans and Integrated Resource Plans

Meetings with stakeholders also identified a number of ongoing or potential stormwater BMP implementation activities ongoing in the watershed:

- Elmer Avenue green street retrofit project
- Fletcher Corridor bicycle and pedestrian connections
- Numerous ongoing Sun Valley Watershed multi-benefit projects; many additional opportunities available
- Cudahy riverfront park where stormwater will be infiltrated to support riparian plant community
- South Los Angeles projects—Jordan Downs Development, Vermont median, McKinley Square, Augustus Hawkins Park, Youth Opportunities High School
- Riverdale Avenue green street retrofit
- Existing watershed plans have numerous BMP projects already identified, e.g., Compton and Tujunga Watershed Plans

Appendix D includes a summary of the key discussion points from each meeting with stakeholders.

3.5.3 Opportunities for Stakeholder Collaboration

As a result of stakeholder input, it is clear that significant collaboration opportunities exist for implementing BMPs in coordination with the City. Collaboration may occur in several ways, including but not limited to:

- Participating in the development of policies and guidance that support urban runoff management
- Contributing to education and outreach activities by (1) assisting in the development of appropriate materials, (2) potentially serving as an extension of City staff, (3) taking a lead role in implementing education and outreach activities, (4) coordinating local BMP implementation with nearby schools to provide local educational opportunities, and (5) expanding opportunities for teacher training in integrated water and watershed concepts
- Developing cost-share opportunities that create cost-effective opportunities to resolve localized urban runoff management concerns, such as green street projects
- Assisting with the roll-out of new BMP programs by participating in efforts to educate property owners on the benefits of the programs, such as downspout disconnect, incentivized retrofits of private properties, or water conservation activities
- Supporting development of new programs or data collection efforts to evaluate the effectiveness of existing programs
- Participating in youth/young adult work programs to support BMP implementation while providing job-training benefits
- Monitoring activities to evaluate benefits from institutional or distributed BMP projects to improve program implementation or BMP design

Section 4
Implementation Plan

The Implementation Plan presented in this section provides a roadmap for achieving compliance with the targets established in the Los Angeles River Metals TMDL. This section describes the phased implementation of the selected BMPs. Section 5 provides the quantitative analyses that demonstrate compliance with interim and final targets.

4.1 Overview

The Implementation Plan is consistent with the City's WQMPUR, which established a strategy for urban runoff management, and the following four guiding principles:

- *Comprehensive Program*—Incorporates a combination of institutional and green structural BMPs
- *Integrated Water Resources Approach*—Considers potential recycled water and conservation benefits of rainwater reuse
- *Green Solutions*—Enhances other public goals, such as increased acreage of parks, greenways, and open space
- *Phased Approach*—Implements BMPs in phases while evaluating associated water quality improvements; revises BMP priorities as needed

Compliance with TMDL targets can be achieved through the implementation of a BMP program that takes into account the combined water quality benefits achieved through different BMP programs. Figure 4-1 illustrates the framework used to build this Implementation Plan.

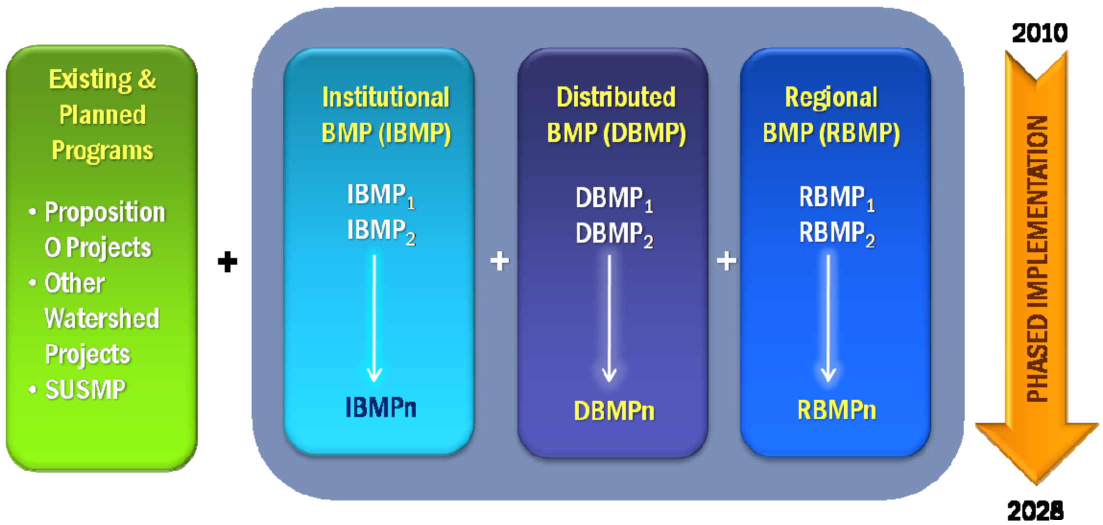

Figure 4-1
Overview of Proposed Comprehensive BMP Program for the Implementation Plan

4.2 Existing and Planned BMPs

Water quality benefits are already being achieved through implementation of MS4 permit requirements and existing and planned watershed projects. These benefits, described below, have been incorporated into this Implementation Plan.

4.2.1 Proposition O Projects

A number of major Proposition O projects will be completed prior to the metals TMDL compliance target dates (Figure 4-2). Each of these projects provides a significant water quality benefit. Additional smaller projects (e.g., Oros Green Street) also provide benefits. Table 4-1 summarizes the number of acres of tributary runoff that are expected to receive treatment as a result of the completion of each major Proposition O project.

Table 4-1 Water Quality Benefits of Major Proposition O Projects

Proposition O Project	TMDL Compliance Target Supported	Acres Tributary
Cabrito Paseo Walkway	2012	16
Cesar Chavez Recreational Complex	2012	679
Echo Park Lake Restoration	2012	356
Hansen Dam Wetlands Restoration	2012	235
LA Zoo Parking Lot	2012	33
North Atwater Park	2012	62
South Los Angeles Wetland Park	2012	525
Albion Dairy Park	2024	255
Strathern Pit Stormwater Infiltration	2028	929
Taylor Yard G2	2028	4200 (est)[1]
	Total Acres Tributary to Project	**7,290**

[1] – (est.) = tributary acres estimated as a function of approximate space available for a BMP

4.2.2 Other Watershed Projects

A number of other major watershed projects are in development stages or planned for completion prior to the metals TMDL compliance target dates (Figure 4-3). Additional smaller projects (e.g., Riverdale and Elmer Green Streets) also provide benefits. Similar to the Proposition O projects, each of these major projects provides a significant water quality benefit. Table 4-2 summarizes the number of acres of tributary runoff that are expected to receive treatment as a result of the completion of each of the major watershed projects.

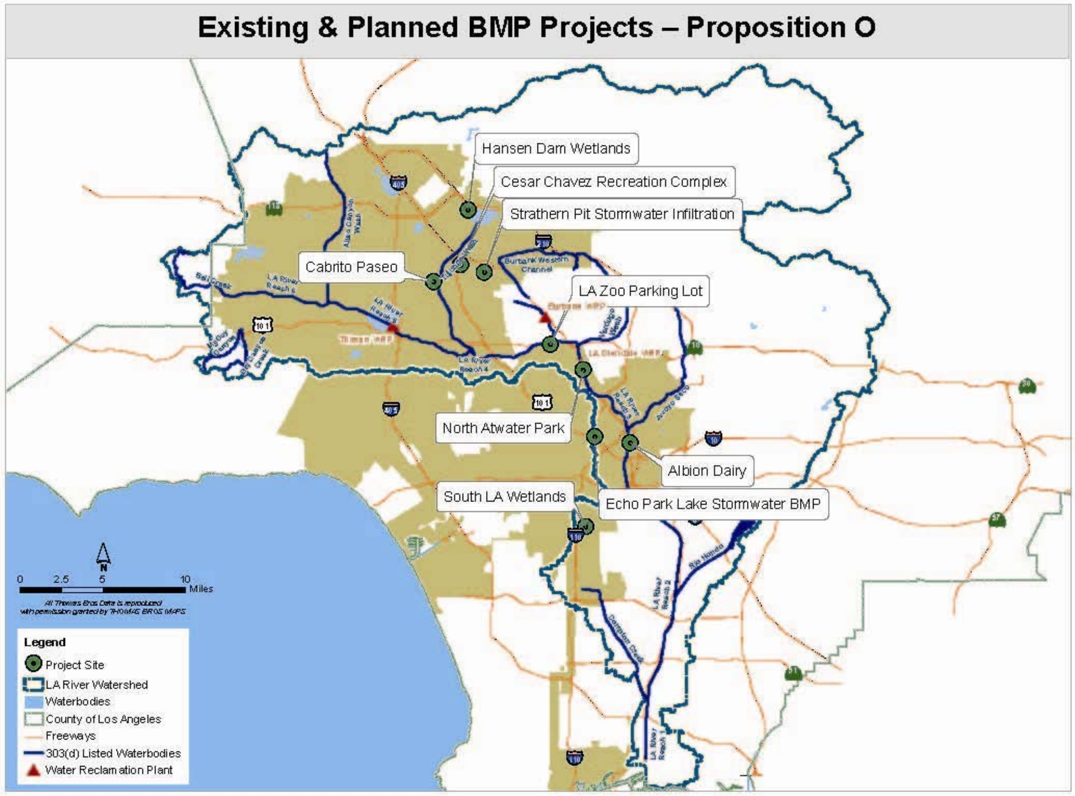

Figure 4-2
Proposition O Projects Planned for Completion by 2028

Table 4-2 Water Quality Benefits of Other Major Watershed Projects

Watershed Project	TMDL Compliance Target Supported	Acres Tributary
LADWP Whitnall Powerline Easement Stormwater Capture	2010	185
Tujunga Spreading Grounds	2012	2,840
Low Flow Diversions (7th & 8th Streets)	2012	155
Bull Creek Restoration	2012	2,800 (est.)[1]
Headworks Ecosystem Restoration	2012	4,300 (est.)[1]
LADWP Valley Generating Station Stormwater Recharge	2024	155
Cornfield-Arroyo Seco Specific Plan	2024	433
Sunnynook Park	2028	133
Aliso Creek Confluence/Reseda River Loop	2028	153 (est.)[1]
Arroyo-Seco Confluence Restoration Greenway	2028	193 (est.)[1]
Total Acres Tributary to Project		**11,347**

[1] – (est.) = tributary acres estimated as a function of approximated space available for a BMP.

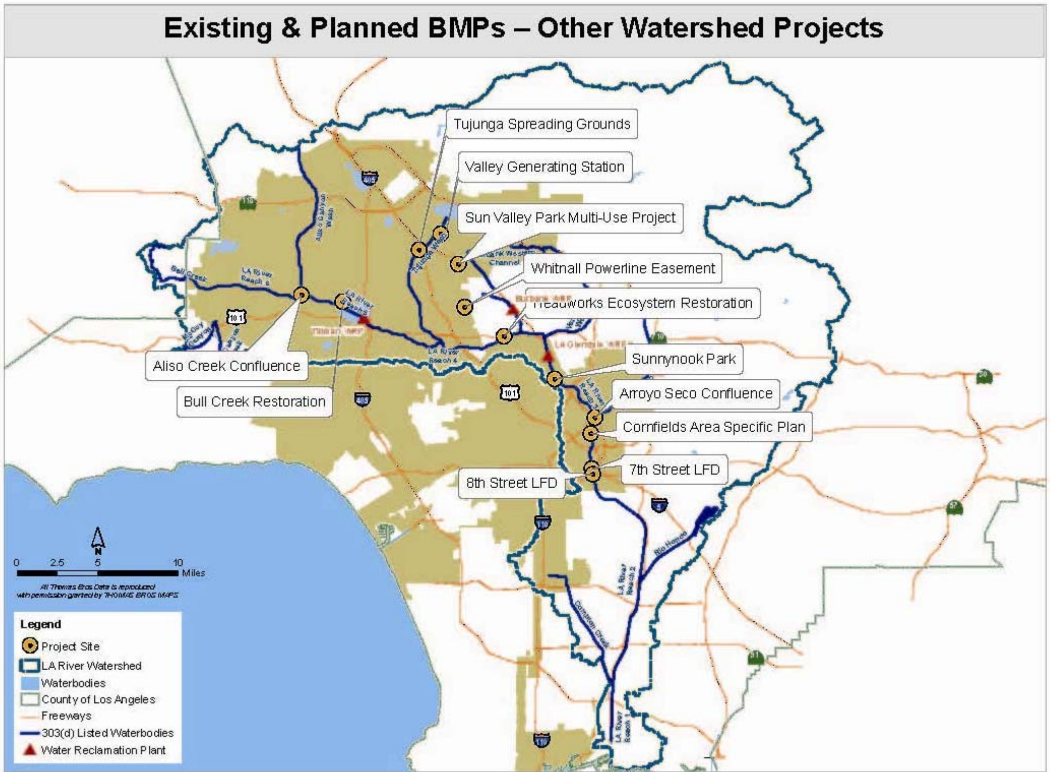

Figure 4-3
Other Watershed Projects Planned for Completion by 2028

4.3 SUSMP

Throughout the implementation of this Plan, new development and redevelopment activities will continue in the City of Los Angeles. Many of these development activities are subject to MS4 permit SUSMP requirements for managing stormwater. Where SUSMP requirements apply, the BMPs installed on-site must be able to infiltrate, capture and reuse, or treat all of the runoff from an 85th percentile storm, which is equivalent to a 3/4", 24-hour storm. New City guidelines for SUSMP approved on July 9, 2008 require developers to give top priority to BMPs that infiltrate stormwater and lowest priority to mechanical/hydrodynamic units.

A review of City development records shows that on average, approximately 250 acres of new development or redevelopment projects have been implemented across the City each year since 2001. This plan assumes that this average number of acres subject to SUSMP requirements will continue to occur in the Los Angeles River Watershed in future years.

4.4 Institutional BMPs

Institutional BMPs focus on pollution prevention and stormwater runoff volume reduction to decrease pollutant loading to the City's waters. This section describes the proposed plan for implementing watershed-wide institutional BMPs to reduce metals loadings in the Los Angeles River Watershed. While specific to this watershed, many of these BMPs are consistent with other City efforts to implement institutional BMPs in other watersheds. Because of the difficulty in implementing some BMPs related to technological, institutional, or political issues, this proposed plan recognizes that some actions can be taken immediately while others will take longer as they may require significant discussion among multiple stakeholders.

The BMPs described in this section represent the range of potential institutional BMPs being considered for implementation in the watershed. In some cases, these BMPs recognize or supplement institutional BMPs already being implemented through the City's MS4 permit program. Other BMPs are new and recommended for implementation to help address urban runoff management concerns in general, and target metals sources specifically.

To simplify the presentation of institutional BMPs planned for consideration and/or implementation, specific BMP activities have been categorized into the following four broad areas:

- *Direct Source Control*—BMPs that directly address metals sources are included in this category. Sources are addressed either through pollution prevention, such as product replacement, or activities that reduce the volume of urban runoff, e.g., downspout disconnection program.

- *Program Development*—This category addresses the need for ordinance, policy, and guidance development. Included in this area is the need to consider how to incentivize BMP implementation on properties under private ownership, especially commercial and industrial properties.

- *Education and Outreach*—Some of the BMPs in this category are already being implemented; however, they are included to document continued commitment to the BMP, or recognition that some programs may need to be evaluated and revised to create better-targeted messages addressing metals sources. This category also includes BMPs that are more programmatic in nature to help ensure that education and outreach activities receive the needed funding, are consistent across the watershed and the City, and are regularly updated to ensure that those tasked with managing urban runoff are kept updated on current policies and guidance.

- *Planning and Coordination*—Coordination will be needed both within and among agencies to successfully execute BMPs in the watershed. Such coordination can create opportunities, increase efficiency and effectiveness, and minimize the likelihood that other agencies or jurisdictions work at cross-purposes. For example, revisions or development of new education and outreach materials, development of green policies, and downspout disconnection specifications (see other BMP categories) need not be developed separately by each jurisdiction. Moreover, opportunities may exist to work collaboratively with NGOs to implement selected elements of the institutional BMPs.

4.4.1 Direct Source Control

Implementation of the institutional BMPs associated with this category result in the direct removal of pollutant sources either through removal of a metals source or by reducing urban runoff which prevents metals from being conveyed to storm drains and into the Los Angeles River.

Product Replacement

The purpose of this BMP is to reduce a significant source of metals in the environment by developing safe alternative products. To implement this BMP, the City will continue to support efforts to reduce metals in vehicle brake pads and wheel weights through pending legislation (SB 346 and SB 757, respectively). In addition, if opportunities arise to participate in studies or legislation to reduce the metal content in other products, the City will consider its potential role participating in those efforts.

Enhanced Street Sweeping

This BMP focuses on enhancing street sweeping activities to achieve a modest 5% increase in material picked up by 2028. To achieve this goal, the City will evaluate opportunities to increase the efficiency of its existing street sweeping program. This evaluation will include a pilot study to evaluate effectiveness of street sweeping by evaluating parameters such as sweeping frequency, sweeper type, location (areas with highest potential pollutant loads), need for parking regulations, material captured (type and quality), etc. Based on the study findings, the City can develop and implement program features that improve sweeping effectiveness.

Downspout Disconnection

This institutional BMP involves encouraging property owners to disconnect their roof downspouts and redirect the stormwater runoff to pervious surfaces, rain gardens, rain barrels or cisterns. Implementation of this BMP can greatly reduce the stormwater runoff volumes and reduce pollutant loading to City waterbodies.

BMP implementation in the Los Angeles River Watershed will be coordinated with ongoing efforts to develop a downspout disconnection program in the Los Angeles River Watershed. Currently, a pilot program is underway in the Ballona Creek watershed. Based on the findings from this effort and studies of other downspout disconnect programs (e.g., in cities such as Portland, OR), the City will obtain technical information to evaluate program results (e.g., volume of urban runoff from rooftops and the water quality of rooftop runoff); develop technical specifications (e.g., methods for downspout disconnections); and evaluate programmatic issues, including estimating the numbers of homeowners willing to participate, methods for encouraging property owner participation (e.g., incentive or city service), and analyzing program costs.

Based on the outcome of the pilot study, the City will consider establishing an incentive program to encourage residential, commercial, and industrial property owners to implement downspout disconnections on their own properties. Examples of this approach have been used successfully elsewhere (e.g., City of Portland[1] provides a one-time rebate on a portion of the costs incurred by property owners who disconnect downspouts on their own).

4.4.2 Program Development

The water quality benefits achievable through institutional BMP implementation are facilitated and enhanced through implementation of ordinances, policies, or programs that require or encourage a better approach to urban runoff management. A number of institutional BMPs are already being implemented in this BMP category. The City will either continue these activities or implement new activities in the following areas:

Source Control Incentive Programs—The City will consider developing incentive programs to control metals at their source, especially on commercial and industrial parcels. Specifically, the City will consider (1) adopting a stormwater credit program (e.g., City of Minneapolis, Minnesota[2], or city of Portland's Clean River Rewards Program[3]) that provides a reduction in stormwater fees based on the degree of BMP implementation that affects stormwater quality or quantity; or (2) adopting a business recognition program for facilities that implement selected BMPs (e.g., Clean Bay Business Program, City of Palo Alto, California[4]).

Green Policy/Guidance Development—Work collaboratively within and among City agencies and possibly other jurisdictions to establish revised or new policies that facilitate the implementation of urban runoff management BMPs. Policies/guidance's (which include minimum technical specifications) to be addressed include: (1) beneficial reuse of stormwater; (2) green building (including LID requirements); (3) use of permeable or porous pavement; and (3) Green Street development. An effort will be made to create as much consistency as possible across the watershed and address critical policy issues. For example, a Green Street retrofit can be limited to the street within the right-of–way, or expanded to include drainage capture from adjacent private lots. Policy development would need to consider the potential for creating public/private partnerships in these types of projects.

SUSMP Enhancement—Enhance the SUSMP requirements for new development and redeveloped properties to include LID principles to reduce property stormwater runoff. At a minimum, SUSMP enhancements will be consistent with expected LID requirements in future MS4 stormwater permits (e.g., as already defined in the

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1 http://www.portlandonline.com/Auditor/index.cfm?a=245002&c=28044
2 http://www.ci.minneapolis.mn.us/stormwater/fee/index.asp (last visited on July 23, 2009)
3 http://www.portlandonline.com/BES/index.cfm?c=41976
4 http://www.cityofpaloalto.org/business/news/details.asp?NewsID=526&TargetID=5

recently adopted Ventura County MS4 permit[5]) (See additional SUSMP discussion in Section 4.2.1).

Stream Protection Ordinance—The City will complete development of its Stream Protection Ordinance to provide a mechanism to protect lands adjacent to waterbodies. Implementing this ordinance over a long period of time will reduce pollutant loads from reaching City waterbodies.

Source Control Ordinances—The City will evaluate its existing ordinances to determine whether additional or modified city ordinances would make residents and businesses more responsive to source control measures. In addition, the City will continue its efforts to implement an integrated water resource approach to urban runoff management. This effort includes implementing BMPs to increase water conservation and stormwater reuse through projects that reduce water use or capture stormwater. Such efforts will reduce potential pollutant loading to downstream waters.

4.4.3 Education and Outreach

One of the primary keys to source control is implementing education and outreach programs to increase public understanding of urban runoff management issues. Accordingly, this BMP involves providing education on water quality impacts from controllable sources, and preventing polluted runoff from entering the storm drain system. Implementation activities include:

Urban Runoff Websites—The City will continue to manage its stormwater Website (www.lastormwater.org) to provide information on urban runoff management practices, and add specific information on Los Angeles River metals TMDL implementation.

Regulatory and Policy Education—The City will develop and implement a process to educate and provide outreach to appropriate City departments and agencies to support implementing newly developed policies, ordinances, and incentive programs.

Targeted Metals Education & Outreach—The City currently implements a comprehensive education program to reduce potential mobilization of metals into storm drains from car washing (both at home and charity car washes), hosing down driveways, improper disposal of used oil, and vehicle maintenance activities at home. The City will evaluate its existing education and outreach program to determine the need to enhance this effort to improve the effectiveness of this BMP.

Rapid Transit Promotion—The City will evaluate the potential to partner with Metrolink, Los Angeles County Metropolitan Transit Authority, and Los Angeles Department of Transportation to promote the use of rapid transit to minimize the number of vehicle miles driven in the watershed. Where partnerships are possible, the

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5 http://www.swrcb.ca.gov/rwqcb4/water_issues/programs/stormwater/municipal/ventura_ms4/09-0057/Transmittal%20Letter%20and%20MS4%20Permit%20Order%20No%2009%200057.pdf

City will evaluate with these agencies opportunities to develop and implement incentives to reduce the number of vehicle miles driven.

Education and Outreach Effectiveness Evaluation—The City will develop evaluation and monitoring methods to better understand the performance of education and outreach programs. Based on this information, prioritize educational campaigns on the basis of their effectiveness (e.g., information dissemination through brochures, public meetings, signage, school education, etc.).

Watershed-wide Education—The purpose of this ongoing BMP is to improve the consistency and efficiency of urban runoff management education efforts watershed-wide. The City will continue to collaborate with other jurisdictions, City agencies, and NGOs to develop appropriate watershed-wide educational programs.

Education and Outreach Funding—The City will work with its watershed partners to establish a long-term stable fund for supporting watershed-wide education activities that is cost-shared among jurisdictions and organizations including, but not limited to, the cities, Los Angeles County, and NGOs. Establishing this fund would include developing an agreement on the methods for governing fund expenditures.

Environmental Learning Center—The City will complete construction of the Environmental Learning Center by the end of 2010, and establish a secure funding source so that the facility is regularly open to provide environmental education.

4.4.4 Planning and Coordination

Given the need to implement a comprehensive program to reduce metals loads in the Los Angeles River Watershed, this effort would benefit from increased coordination and collaboration among responsible jurisdictions, NGOs and stakeholders. To facilitate this need, the following institutional BMP activities will be considered for implementation:

Interagency Task Force—Establish a task force that includes appropriate representation (e.g., decision-makers associated with responsible city or agency departments and NGOs). The primary purpose of this task force would be to coordinate the review and revision or adoption of new policies and ordinances in a consistent manner in the watershed. Other functions could include facilitation of BMP implementation and coordination of similar institutional BMP programs across jurisdictions.

Collaborative Watershed Projects—The NGOs often obtain funds for watershed projects from state and federal grant funding sources. When cost-shared with other entities (e.g., cities or the County), opportunities are created to fund valuable BMP projects (e.g., as identified by other planning activities or programs). Accordingly, the City will continue to work collaboratively with the NGOs where opportunities exist to cost share on the implementation of BMP projects that are consistent with the goals of this Plan.

General Plan Update—The City will work with its planning department to consider options for revising the City's General Plans to facilitate urban runoff management, particularly as redevelopment opportunities become available. The City of Los Angeles has already begun this process through the implementation of its WQCMPUR.

4.5 Green Structural BMPs

After a review of the top ranked regional and distributed BMP sites, those sites were divided into Priority 1 and Priority 2 sites. Priority 1 sites are proposed for implementation under this Implementation Plan according to the schedule described in Section 4.6[6]. Priority 2 sites are held in reserve at this time. As the TMDL implementation process moves forward, where additional regional and distributed BMP projects are needed, these Priority 2 sites serve as the pool from which new projects may be drawn. The City may also supplement these Priority 2 sites in the future where opportunities become available.

4.5.1 Regional BMP Projects

Additional screening was conducted on the 17 candidate regional BMP sites (see Section 3) based on opportunity potential, site conditions, ownership, drainage area, and geographic distribution. The screening narrowed the 17 sites to four Priority 1 sites (Table 4-3 and Figure 4-4). As Priority 1 sites, these four are recommended for the initial phases of structural BMP implementation under the Implementation Plan.

Table 4-3 Characteristics of 4 Priority 1 Regional BMP Sites with Potential BMP Options

Site Name (Catchment ID)	Owner	Sub-watershed	Figure No.	Drainage Area (ac)	Potential BMP Type	Comments	BMP Footprint (ac)
BI112	Los Angeles Community College District	LA River Reach 6	Figure 4-5; Figure 4-6	2,380	Detention Basin	Pierce College	39
BI9203-2	City of Los Angeles	LA River Reach 4	Figure 4-7; Figure 4-8	1,520	Detention Basin/Wetland	Van Nuys Sherman Oaks Park	27
MT30-2_7	City of Los Angeles	LA River Reach 4	Figure 4-9; Figure 4-10	4,360	Detention Basin/ Infiltration	North Hollywood Park	14
CMPTN-1	City of Los Angeles	Compton Creek	Figure 4-11, Figure 4-12	7,100	Wetland/ Detention Basin	Adjacent to Compton Creek	8.5

6 The City may substitute one or more of these priority projects with other regional and/or distributed BMP projects if it is determined that a project is not feasible, e.g., the land is unavailable, or a project opportunity becomes available that is functionally equivalent, i.e., provides necessary volume of treatment and/or accomplishes the goals of this TMDL Implementation Plan.

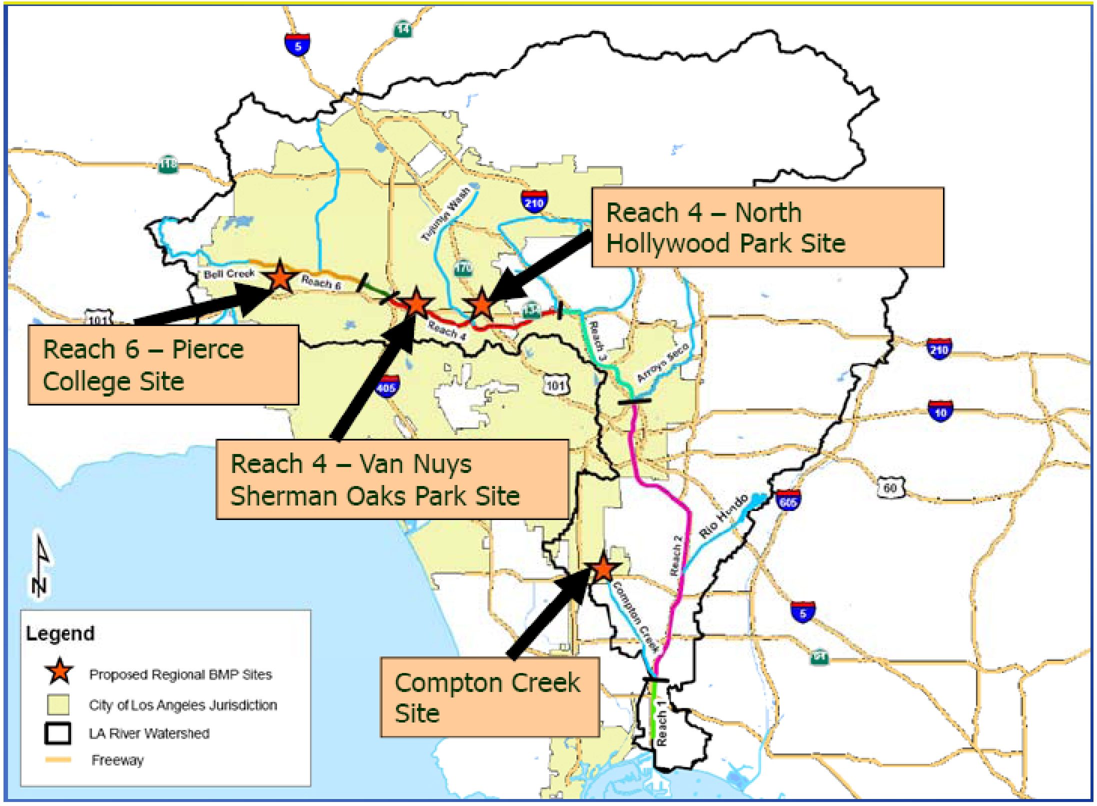

Figure 4-4
Recommended Priority 1 Regional BMP Sites

Priority 1 Regional BMP Sites

The following sections provide descriptions for each Priority 1 regional BMP site, including location, storm drain, and open space information. For each of the four recommended Priority 1 BMPs, a preliminary conceptual plan was developed and basic sizing properties were estimated for use in the simulation of runoff capture and treatment. The plan includes information on the general schematics of the BMP inflows and outflows, potential flow control devices, and flow diversions (if needed) from the waterbody and/or storm drains from where inflows are drawn for treatment. For various types of BMP options suitable for these sites, different criteria are used in developing preliminary conceptual sizing for model inputs. This section discusses those criteria as well.

The information and figures presented for the proposed Priority 1 regional BMP sites are preliminary and conceptual in nature. At this time only informal discussions with landowners have taken place and the actual availability of the land necessary to implement these regional BMP projects has not been secured. The specific infrastructure and land needs will be determined during the feasibility study and design phases of each project. Additional information that will need to be gathered includes:

- Topographic site survey of existing ground surfaces, utilities and structures;
- Analysis of as-built drawings for all existing utilities and structures;
- Geotechnical subsurface soil investigation;
- Hydraulic conductivity testing (soil permeability);
- Detailed water quality testing for process design; and
- Environmental review

If the necessary land for project implementation cannot be secured, then alternative Priority 1 projects will be considered for implementation. In addition, impacts to existing recreational uses, surrounding areas, aesthetics, wildlife and other factors will also be examined in more detail in the CEQA and/or NEPA environmental process.

Pierce College (BI112)

The Pierce College site is located within the area that drains to Reach 6 of the Los Angeles River, less than a half mile from the main channel (Figure 4-5, Table 4-4). The site includes about 39 acres of agricultural/vacant area at Pierce College. The site is located within the City of Los Angeles and is owned by the Los Angeles Community College District. The site has a tributary area of approximately 2,380 acres. The potential BMP footprint is proposed on a flat agricultural area that is a small portion of the hilly 375 acre community college property (Assessor's Parcel Number [APN] 2149007902). Potential BMP types include a detention basin or possible wetland.

There are two major storm drains located along the east and west sides of the potential BMP site, as shown in Figure 4-6. Flow from both of these storm drains could be diverted to the detention basin. The east storm drain flows through the potential BMP area, and flow could be diverted to the detention basin. Similarly, the storm drains along De Soto Avenue on the west side of the BMP could also be diverted to the detention basin.

The goal of this BMP will be to temporarily detain runoff during storm events. The site is proposed to be excavated and graded so that the BMP operates by gravity. A feasibility study and/or preliminary design will need to be performed, including a site survey to determine existing ground elevations and storm drain invert elevations to verify that gravity flow is possible. During the design phase of the project, the need for infrastructure will be determined. The feasibility of maintaining the existing agricultural use of the site will be determined. For example, the agricultural use could

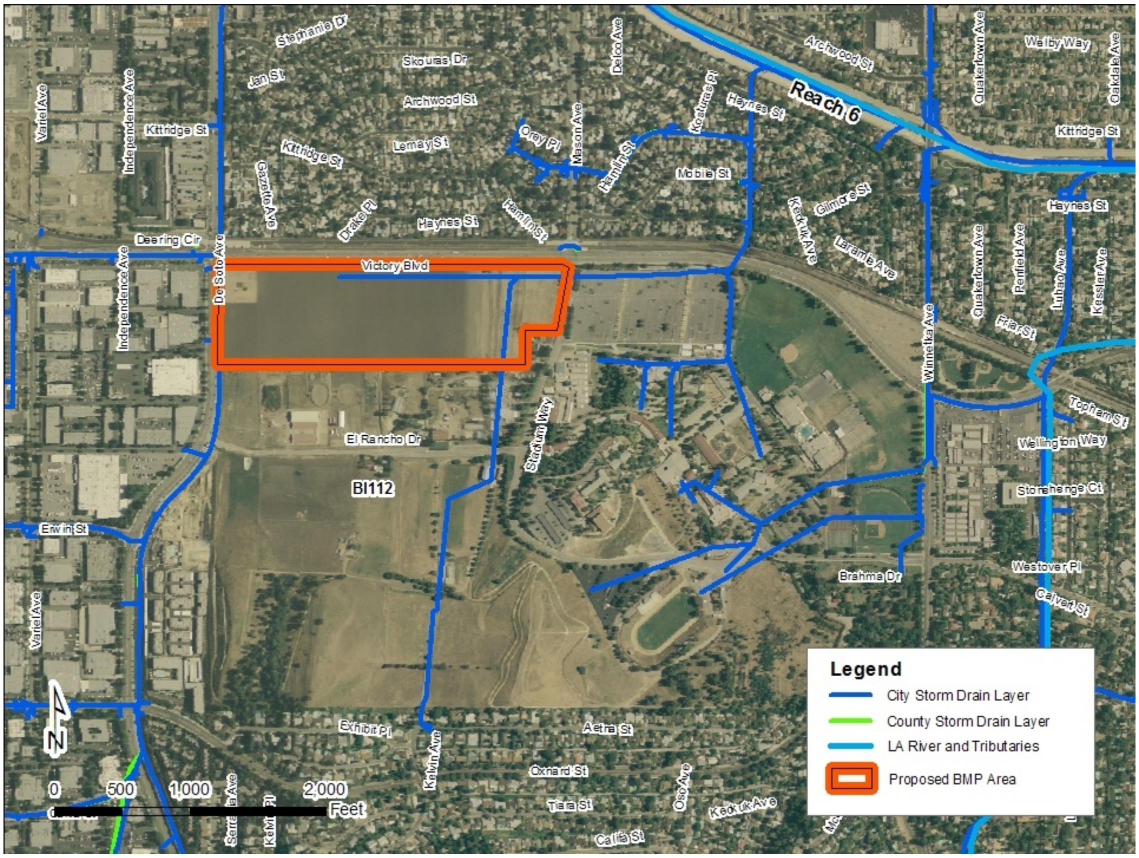

Figure 4-5
Priority 1 Regional BMP – Pierce College BI112

Table 4-4 Pierce College (BI112) Summary

Owner	Land Use	Property Area (ac)	Catchment Area (ac)	Distance from major Storm Drain (ft)	Approx Open Space (ac)	Current Use of open space	BMP Options	Comments
Los Angeles Community College District	Open space	375	2,380	0	39	Agriculture / vacant	Detention Basin, Possible wetland	Pierce College, open channel runs through site

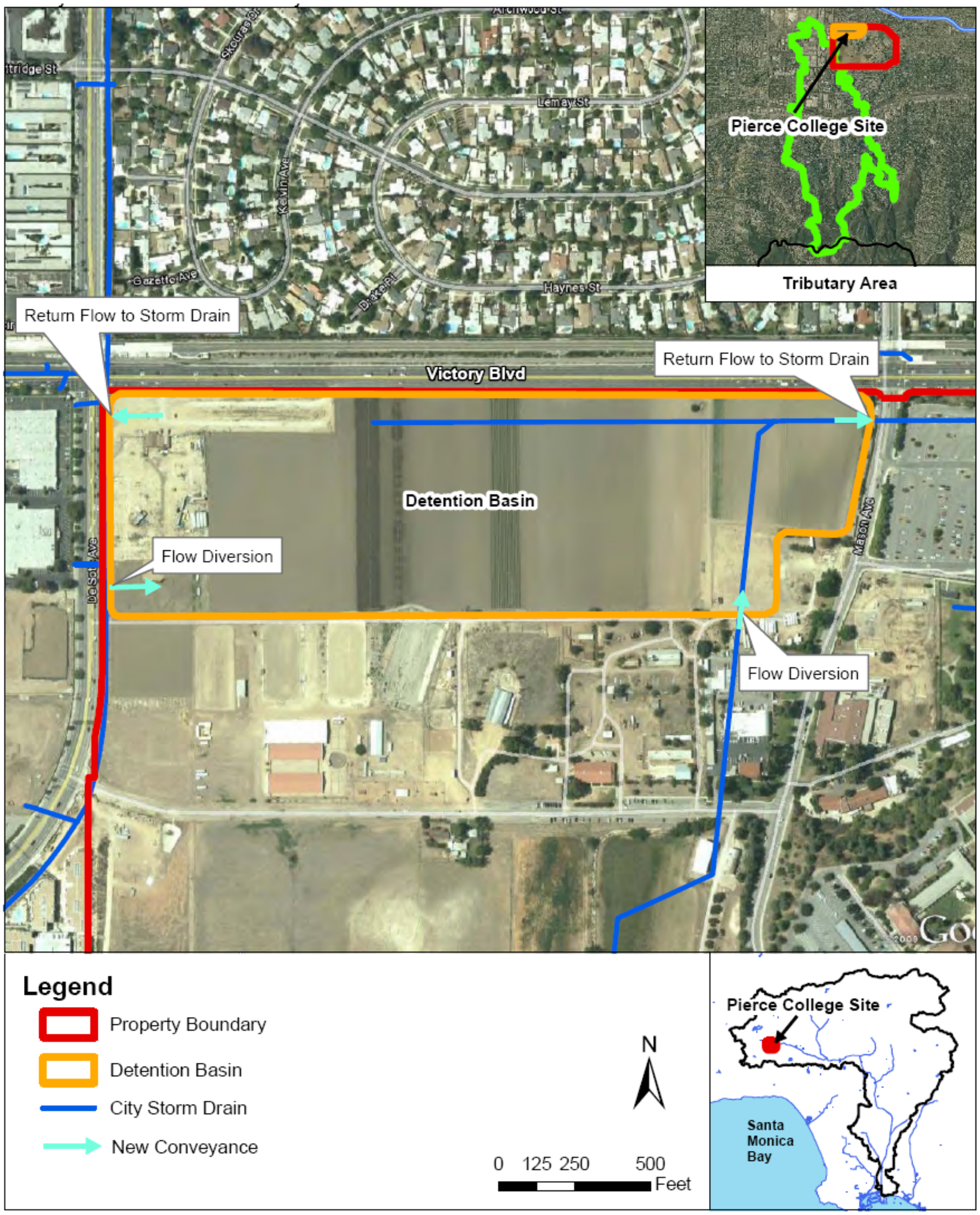

Figure 4-6
Pierce College Regional BMP Footprint (BI112)

be maintained if alternative crops are planted that tolerate flood irrigation. This project could also provide educational benefits for students and the general public.

Van Nuys Sherman Oaks Park (BI9203-2)
The Van Nuys Sherman Oaks Park site is located within the area that drains to Los Angeles River Reach 4 (Figure 4-7, Table 4-5). The site includes about 30 acres of ball fields located at the Van Nuys Sherman Oaks Park. The site is located within the City of Los Angeles jurisdiction, owned by the City of Los Angeles, and maintained by the Parks and Recreation Department.

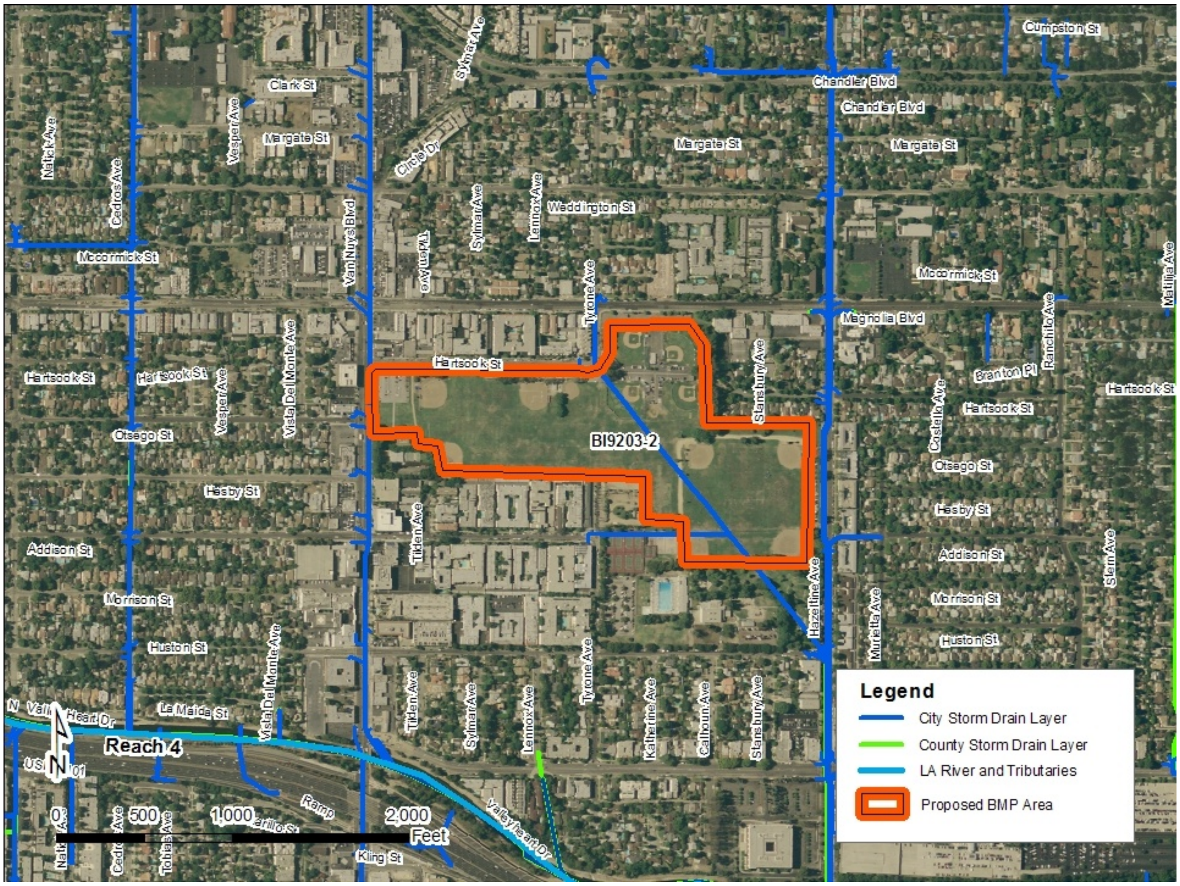

Figure 4-7
Priority 1 Regional BMP – Van Nuys Sherman Oaks Park (BI9203-2)

Table 4-5 Van Nuys Sherman Oaks Park (BI9203-2) Summary

Owner	Land Use	Property Area (ac)	Catchment Area (ac)	Distance from major Storm Drain (ft)	Approx Open Space (ac)	Current Use of open space	BMP Options	Comments
City of Los Angeles	Open Space	65.5	1,520	0	27	Ball fields	Detention Basin/ Wetland	Limited unused open space

The site has a tributary area of approximately 1,520 acres, and is located within three parcels, APN's 2248008901, 2248009901 and 22488023901. Storm drains that run through the park, and along the east and west sides of the potential BMP area (Figure 4-8), could be routed to the proposed detention basin. The detention basin could be constructed as an open basin with the ball fields at the basin invert so that they would be available for park use during dry weather. Another option is to design the basin as an underground detention basin, which would also maintain existing recreational use; however, for the purposes of preparing a cost estimate for this project, it was assumed that the detention basin would be above ground (see Section 6).

North Hollywood Park (MT30-2_7)

The North Hollywood Park site is located within the area that drains to Reach 4 of the Los Angeles River (Figure 4-9, Table 4-6). This portion of North Hollywood Park consists of 20 acres of walking trails, trees and grassy areas. The site is located within the City of Los Angeles jurisdiction, owned by the City of Los Angeles, and maintained by the Parks and Recreation Department.

The site has a tributary area of approximately 4,360 acres, and is comprised of a single parcel, APN 2353001903. The potential BMP type is proposed as an infiltration basin. Flow from the open channel along the west side of the potential BMP area (Figure 4-10) could be diverted near the northwest corner of the site for infiltration. This will require pumping because the invert of the channel is about 10 to 15 feet below the invert of the potential infiltration basin. Storage volume for an infiltration basin at North Hollywood Park is dependent upon the infiltration rate of the underlying soils.

The proposed project area is on the southern portion of North Hollywood Park. Most of the recreational use at the park occurs at the northern portion of the park (north of Magnolia Blvd), which is not considered for the siting of the infiltration basin. The primary recreational use in the southern portion is the use of dirt walking paths around and through the park. In order to maintain the existing use of the site, the walking paths can be left in place or reconstructed within the infiltration basin. The proposed infiltration basin will require that some existing landscaping (including trees) be replaced after construction. The walking paths would be usable during the dry season and between storm events.

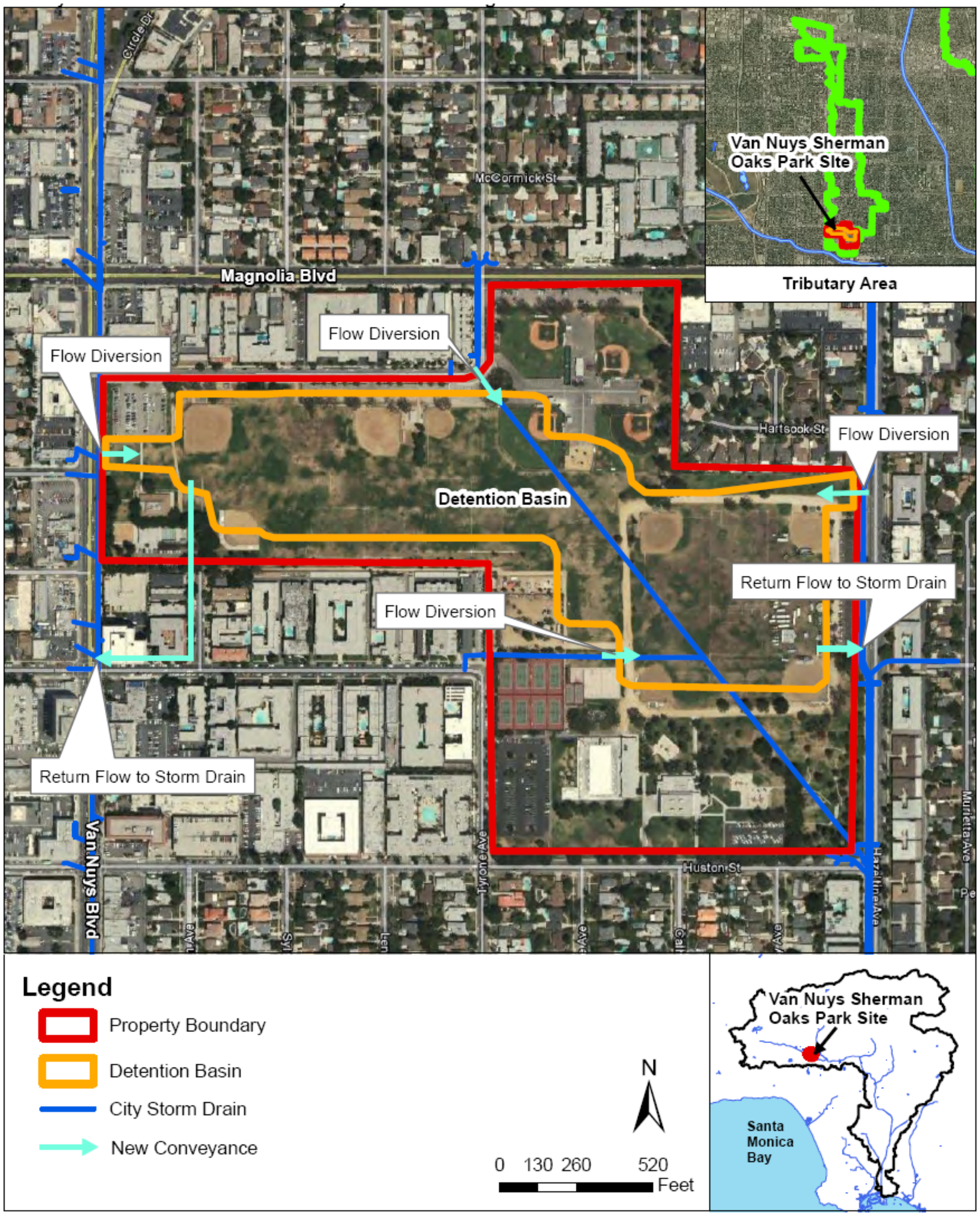

Figure 4-8
Regional BMP Footprint - Van Nuys Sherman Oaks Park (BI9203-1)

Figure 4-9
Priority 1 Regional BMP – North Hollywood Park (MT30-2_7)

Table 4-6 North Hollywood park (MT30-2_7) Summary

Owner	Land Use	Property Area (ac)	Catchment Area (ac)	Distance from major Storm Drain (ft)	Approx Open Space (ac)	Current Use of open space	Potential BMP Option	Comments
City of Los Angeles	Open Space	20.5	4,360	0	14	Park	Detention Basin/ Infiltration	Grassy areas, walking trails and mature trees.

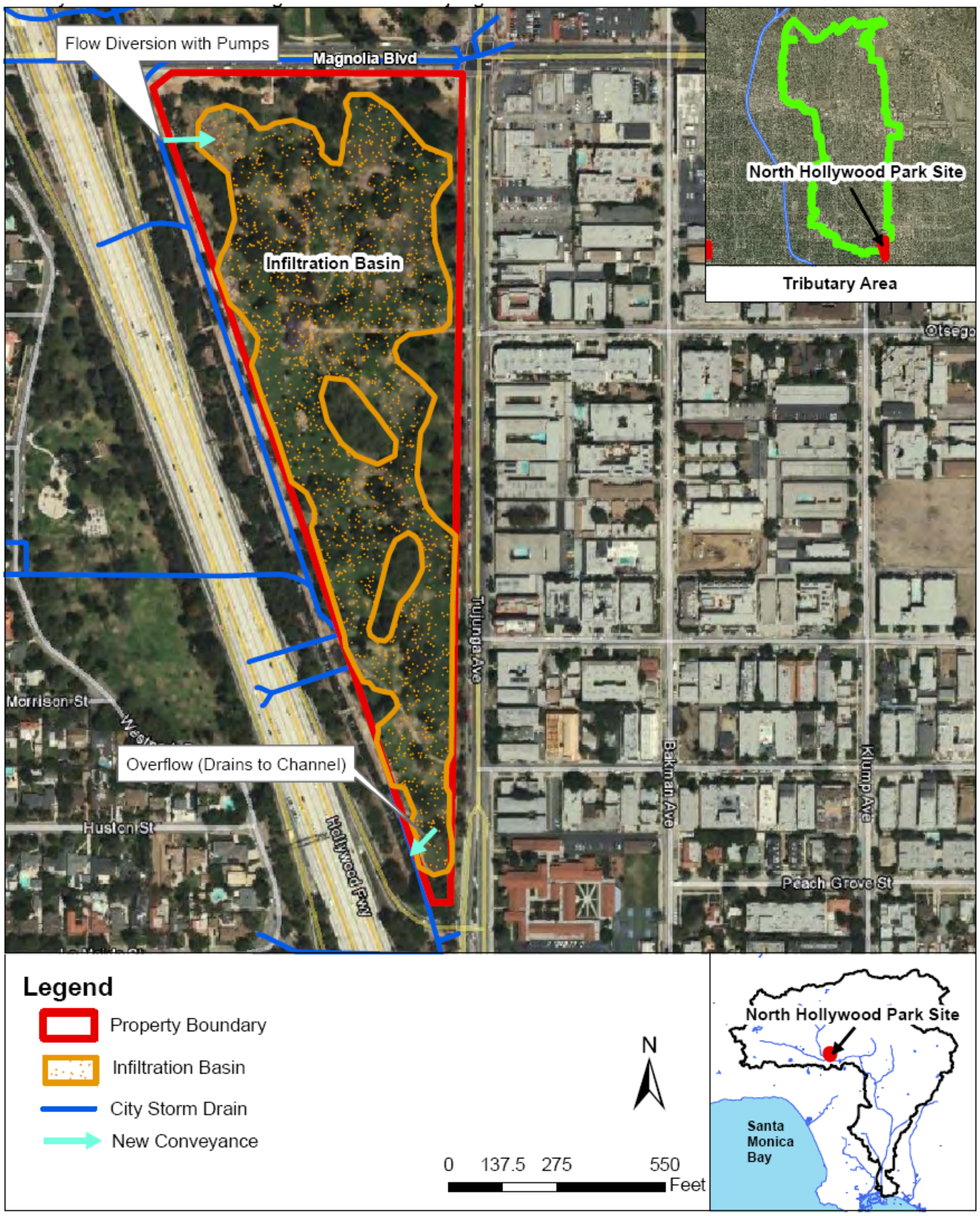

Figure 4-10
Regional BMP Footprint – North Hollywood Park (MT30-2_7)

Compton Creek (CMPTN-1))

The Compton Creek site is located within the Compton Creek subwatershed (Figure 4-11, Table 4-7). The site has about 8.5 acres of open space available immediately adjacent to the Compton Creek channel. The site is located within the City of Los Angeles jurisdiction and is owned by the City of Los Angeles. The site has a tributary area of approximately 7,100 acres, which drains to the channel adjacent to the potential BMP area. The site is comprised of several parcels (APN's 6071021908, 6071021909, 6071021910, 6071021911, 6071021912 and 6071021913). Potential BMP options include a wetland or detention basin.

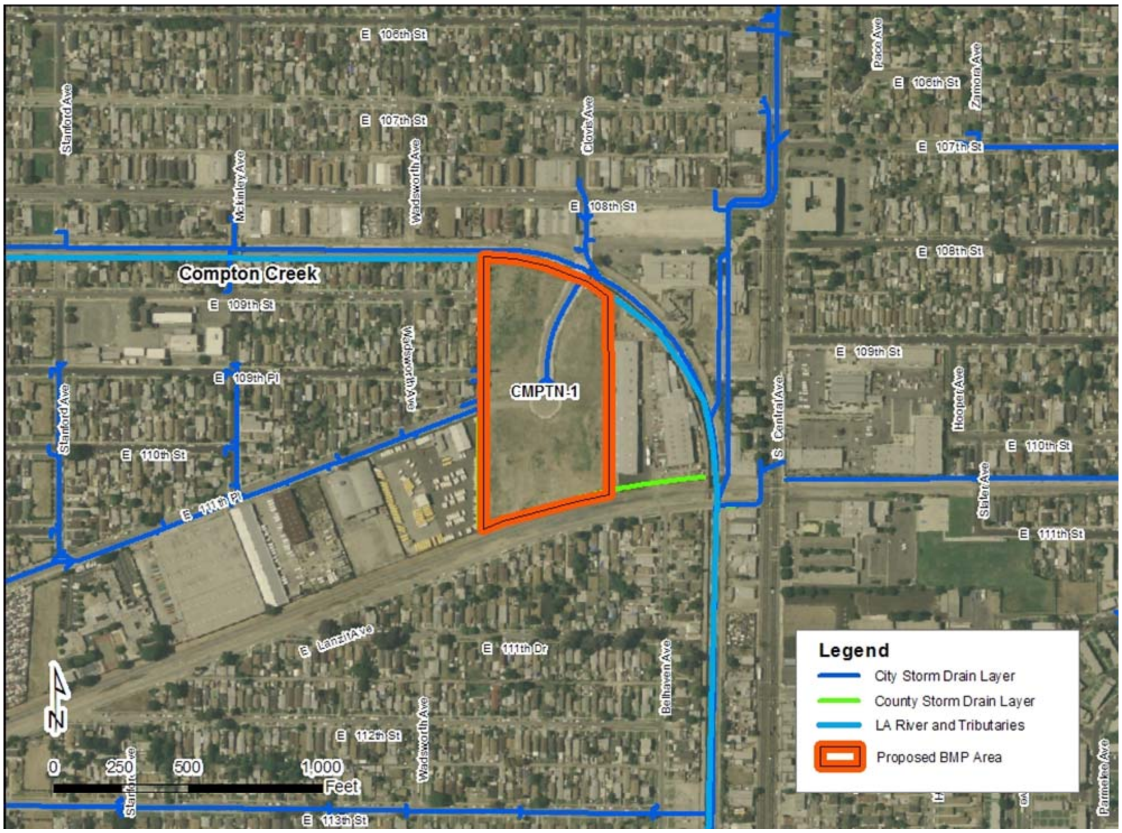

Figure 4-11
Priority 1 Regional BMP – Compton Creek (CMPTN-1)

Table 4-7 Compton Creek (CMPTN-1) Summary

Owner	Land Use	Property Area (ac)	Catchment Area (ac)	Distance from major Storm Drain (ft)	Approx Open Space (ac)	Current Use of open space	BMP Options	Comments
City of Los Angeles	Undeveloped residential/ industrial	9	7,100	50	8.5	Vacant	Wetland/ Detention Basin	Adjacent to Compton Creek

A preliminary conceptual plan for a treatment wetland BMP has been developed for this site (Figure 4-12). About 1/3 of the site has been proposed for a flow equalization basin. Flow from Compton Creek would be diverted for treatment to the wetland via the flow equalization basin. The equalization basin will be an underground storage facility upstream of the wetland. This storage facility is required to extend residence times within the system and also serve as pretreatment to capture sediment in the runoff. Pumping will be required to lift flow from the equalization basin to the wetland, due the lower invert in the basin that is needed to provide adequate storage. A traditional wetland with a mix of media, vegetation, and ponded water at grade for Compton Creek is recommended for this site.

A technical center has also been proposed at this site by the Community Redevelopment Agency (CRA). The CRA project could be located above the underground equalization basin, which would maintain the BMP's treatment capacity. The proposed wetland could also add aesthetic appeal to the CRA project. Additional configurations of storm drain connections and any infrastructure needs will be evaluated during the preliminary design phase. The existing portion of Clovis Avenue, which leads to a cul-de-sac, will be obsolete and removed (see Figure 4-12).

Priority 2 Regional BMP Sites

The Priority 1 BMPs presented above are proposed for implementation under this Metals TMDL Implementation Plan. As needed, additional regional BMP projects may be implemented comply with the TMDL targets. These Priority 2 projects will likely be drawn from other field-investigated sites (see Tables 3-6 and 3-7). However, if opportunity for a collaborative project with watershed stakeholders becomes available, the City will consider participation to meet the goals of the TMDL.

4.5.2 Distributed BMPs Sites

Priority 1 Distributed BMP Sites

Although 100 distributed BMP opportunity sites were field investigated, the specific sites and the number of sites needed for implementation was determined based on the phased compliance analysis and discussions among City staff. A screening process was used to narrow the 100 distributed BMP sites to 50 Priority 1 sites (Figure 4-13). The following factors were used for the screening process:

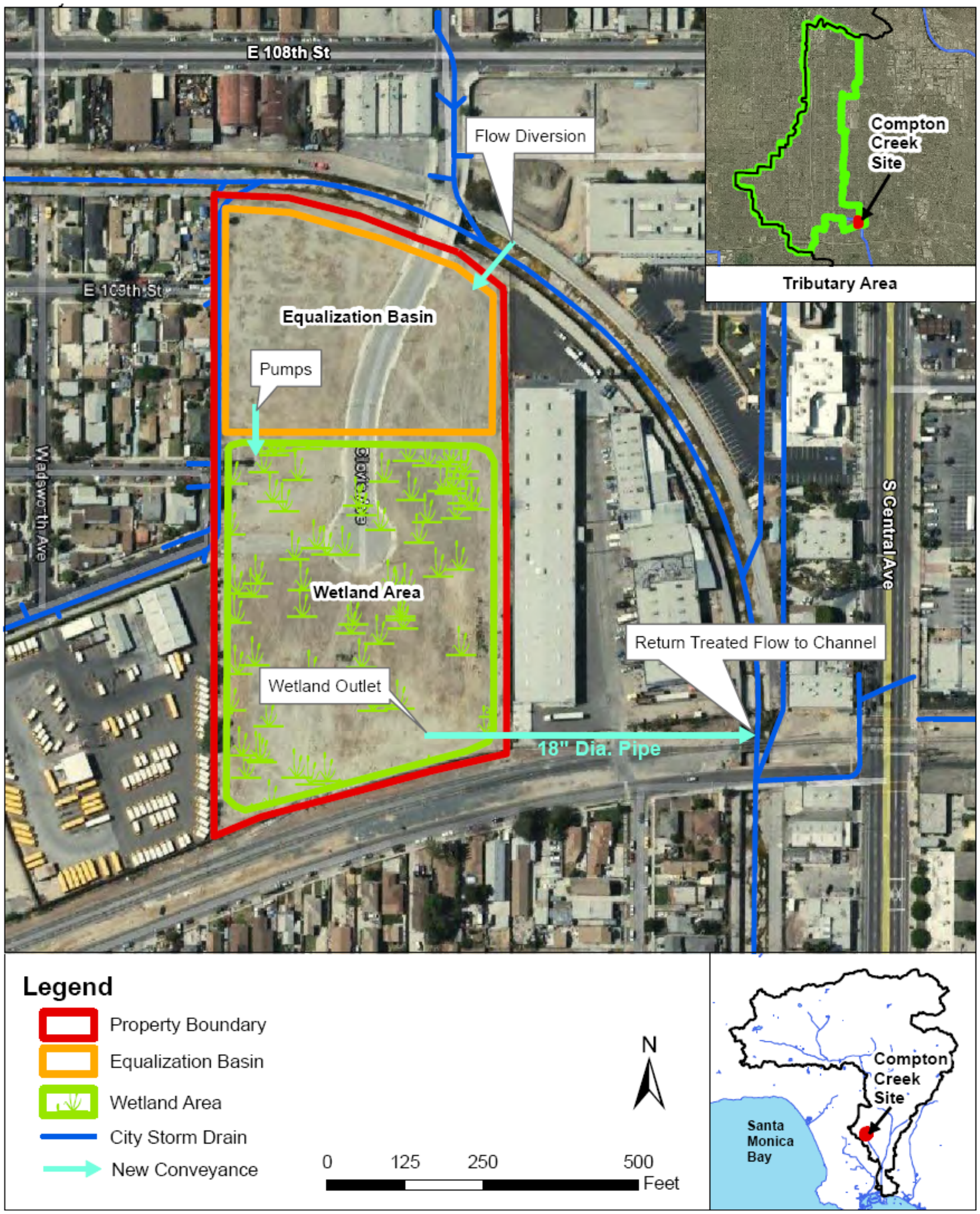

Figure 4-12
Regional BMP Footprint – Compton Creek (CMPTN-1)

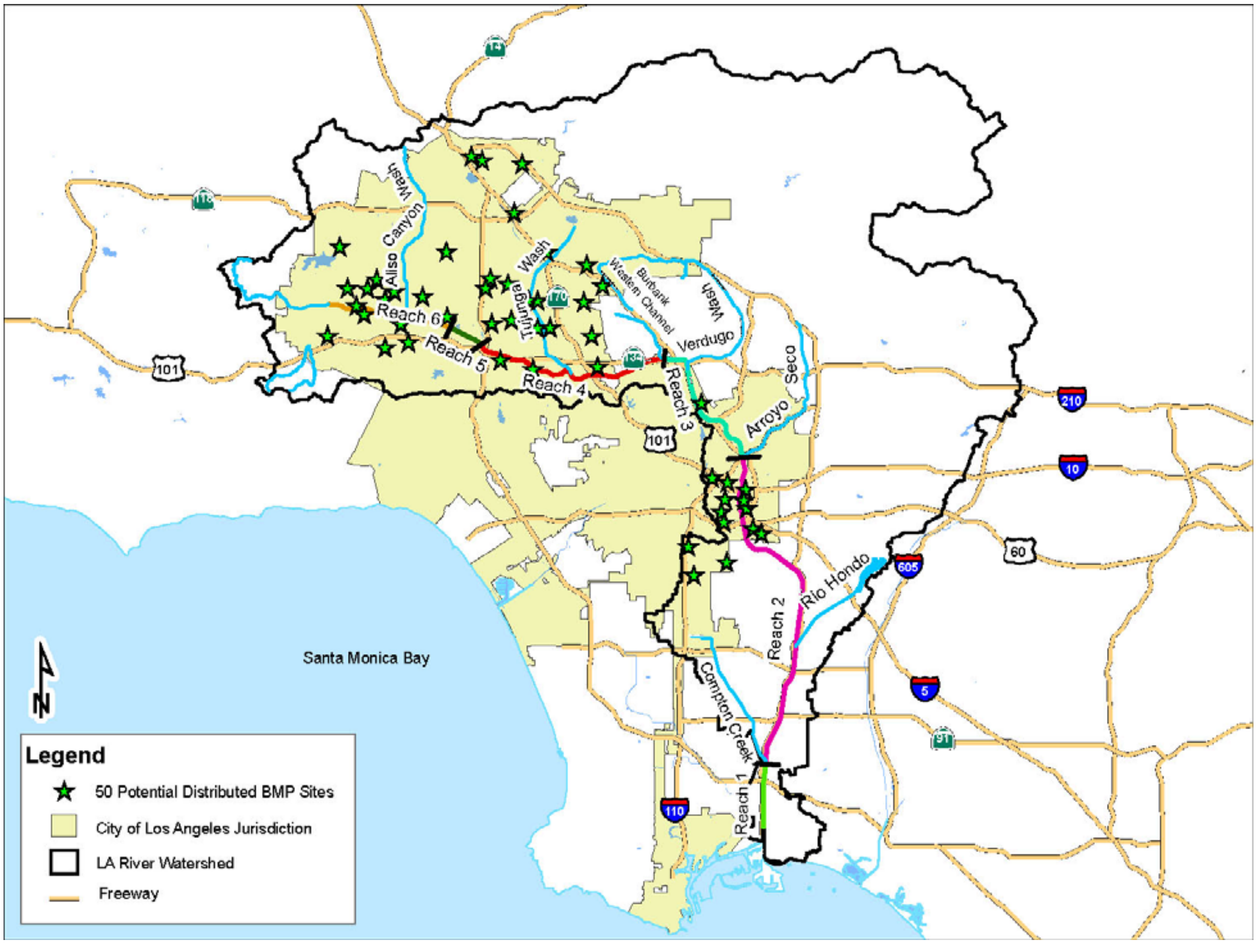

Figure 4-13
50 Potential Distributed BMP Priority 1 Sites

BMP sites within subwatersheds that have water quality impairments (estimated by previous water quality exceedances shown by water quality data) were ranked the highest in the Priority 1 list. Water quality exceedances were determined by comparing the dry weather data for metals with the water quality targets.

- Subwatersheds that did not have any regional BMP sites were considered as priority sites for the distributed BMPs. This was particularly the case for the industrial and commercial areas.
- Sites must have sufficient public right-of-way for implementing distributed BMPs. Sites with minimal or no public land available for implementation of distributed BMPs were ranked lower.
- Sites with educational land use were considered as priority sites since at least one type of distributed BMP was suitable in those areas.

The Priority 1 distributed sites with proposed BMPs are presented in Table 4-8. Specific distributed BMPs at the Priority 1 sites were determined based on availability of public right-of-way such as parkways, alleys, and public facilities for potential BMP installation, land use, field investigations, desktop analysis, ownership, and site conditions. Table 4-9 summarizes the general treatment capabilities that may be provided by the distributed BMPs described in Table 4-8.

BMP footprint maps were drawn for all the Priority 1 distributed BMP sites and are provided in Appendix E. An example distributed footprint map is presented in Figure 4-14. Each BMP footprint map includes the following information:

- Catchment boundary. In most cases, the catchment boundary (typically about 40 acres in size) is the same as the project boundary. However, in some cases, the catchment boundary was adjusted to remove the private land areas where distributed BMPs are not considered for implementation at this time.
- Waterbody
- Site name and neighborhood
- BMP footprint
- Storm drain network
- Publicly owned parcels

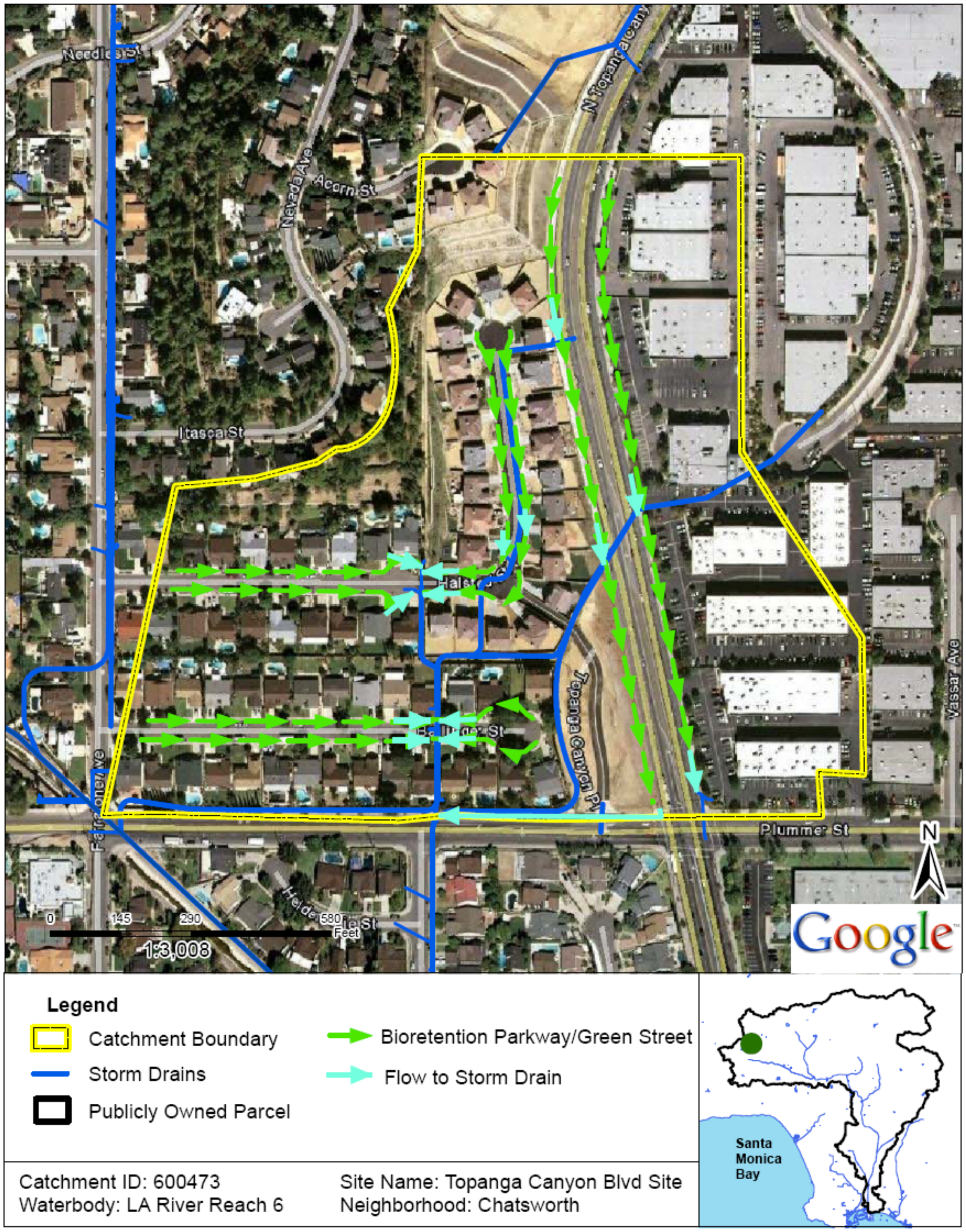

Figure 4-14
Example Distributed BMP Footprint Map for a Priority 1 Site

Table 4-8 Summary of Priority 1 Distributed BMP locations

Sub-catchment	Catchment ID	Waterbody	Site Name	Neighborhood	Bioretention Parkway/ Green Street	Permeable pavement	Cisterns
600473	STSUS3	LA River Reach 6	Topanga Canyon	Chatsworth	X	-	-
600954	BROWN7	LA River Reach 6	Sunnybrae Ave	Canoga Park	X	X	X
603373	CALAB4	LA River Reach 6	Capistrano Ave	Winnetka/ Canoga Park	X	X	X
603679	LAR2	LA River Reach 6	Hart St.	Canoga Park	X	X	X
603932	BI3857	LA River Reach 6	Archwood St	Winnetka	X	-	-
604000	BI477	LA River Reach 6	Cantara St	Winnetka	X	-	-
605031	BI652	LA River Reach 6	Collier St	Tarzana/ Woodland Hills	X	X	X
605134	BI9202	LA River Reach 6	Cantlay St	Winnetka	X	X	-
605283	BI476	LA River Reach 6	Lull St	Reseda	X	X	-
605314	LAR12	LA River Reach 6	Vanalden Ave	Reseda	X	X	X
606966	BI474B	LA River Reach 6	Valerio St	Reseda	X	X	X
607512	BI472	LA River Reach 6	Holmes Middle School	Northridge	X	X	X
603646	BI478B	LA River Reach 6	Alabama Ave	Canoga Park	X	-	-
607618	LA2327	LA River Reach 6	Haynes St.	Lake Balboa	X	X	X
608851	BI106	LA River Reach 5	Stagg st.	Van Nuys	X	-	-
610302	BI108	LA River Reach 4	Colombus Ave	Van Nuys	X	X	-
610314	LA7335	LA River Reach 4	Willis Ave	Sherman Oaks	X	-	-
611527	BI9203-2	LA River Reach 4	Tyrone Ave	Van Nuys	X	X	X
611694	LAR54	LA River Reach 4	Dixie Canyon Ave	Sherman Oaks	X	X	X
614782	BI39-2	LA River Reach 4	Sun Valley Middle School	Sun Valley/North Hollywood	X	X	X
614816	BI39-3	LA River Reach 4	Burbank Blvd	North Hollywood	X	X	X
614854	BI39-4	LA River Reach 4	Cahuenga Blvd.	Toluca Lake	X	X	-
615410	BI60A	LA River Reach 3	Dover St.	Atwater Village	X	X	X
800837	LAR138	LA River Reach 2	Hill St.	Chinatown	X	X	X
800901	B166-3	LA River Reach 2	Cesar Chavez St.	Boyle Heights	X	-	-
801011	BI59-2	LA River Reach 2	Beaudry Ave.	Downtown	X	X	-
801038	LAR140	LA River Reach 2	Utah St.	Boyle Heights	X	X	X
801118	BI5203	LA River Reach 2	Wall St.	Downtown	X	X	-
801131	BI67A	LA River Reach 2	Clarence St.	Boyle Heights	X	-	X
801255	LA4958	LA River Reach 2	Stanford Ave	Downtown	X	X	X
801306	BI58	LA River Reach 2	12th St.	Downtown	X	X	-
801412	BI5206-2	LA River Reach 2	Soto St.	Boyle Heights	X	X	X

Table 4-8 Summary of Priority 1 Distributed BMP locations

Sub-catchment	Catchment ID	Waterbody	Site Name	Neighborhood	Bioretention Parkway/ Green Street	Permeable pavement	Cisterns
801426	BI90	LA River Reach 2	Olympic Blvd	Boyle Heights	X	X	X
606886	BI475	LA River Reach 6	Crebs Ave	Tarzana	X	X	-
610855	WILSN3	Tujunga Wash	Sayre St	Sylmar	X	-	-
610981	PACDV9	Tujunga Wash	San Fernando High School	Pacoima	X	X	X
611116	SYLMR1	Tujunga Wash	Barry J. Midorf Juevenile Hall	Sylmar	X	X	X
611118	SYLMR2	Tujunga Wash	Ralston Ave	Sylmar	X	-	-
611486	BI9203-1	Tujunga Wash	Lanark St Site	Panorama City	X	-	-
613731	BI107B	Tujunga Wash	Laurel Canyon Blvd	Pacoima	X	X	-
614047	BI85-1	Tujunga Wash	Blythe St.	Panorama City	X	-	-
614067	BI9245	Tujunga Wash	Atoll Ave	Valley Glen	X	X	-
614088	TJNGA3	Tujunga Wash	Sherman Way	Van Nuys/Valley Glen	X	-	-
614161	TJNGA4	Tujunga Wash	Oxnard St.	Van Nuys	X	-	-
614200	BI91	Tujunga Wash	Bessemer St.	Valley Glen	X	X	X
790701	CNTRA	Burbank Western Channel	Tuxford St.	Sun Valley	X	X	-
790772	BI609B	Burbank Western Channel	San Fernardo Rd	Sun Valley	X	X	X
850062	BI73B-1	Compton Creek	Martin Luther King Jr Blvd	Historic South Central	X	-	-
850150	BI73A-3	Compton Creek	Slauson Ave.	South Los Angeles	X	X	-
851060	HOOP-1	Compton Creek	Holmes Ave	Central-Alameda	X	X	X

Table 4-9 Tributary Area and Runoff Treatment Capacity for Distributed BMPs in the 50 Priority 1 Catchments

Catchment ID	Permeable Pavement Tributary (acres) [1]	Cistern Tributary (acres) [1]	Bioretention				
			Average K_{sat} (in/hr)	Underdrain Needed	Parkway Length (miles) [2]	Bioretention Tributary (acres)	Runoff Treatment Capacity (in) [3]
600473	0.0	0.0	0.83	No	1.3	18.7	0.42
600954	0.9	0.2	0.57	No	1.3	27.2	0.81
603373	0.8	0.0	0.27	No	1.7	24.7	0.41
603646	0.0	0.0	0.69	No	1.4	43.8	0.44
603679	1.0	0.2	0.35	No	1.1	20.2	0.38
603932	0.0	0.0	0.39	No	1.7	28.2	0.61
604000	0.0	0.0	0.54	No	1.3	29.4	0.49
605031	0.3	0.2	0.25	Yes	0.6	19.2	0.75
605134	1.0	0.0	0.36	No	1.7	30.1	0.38
605283	0.8	0.0	0.36	No	1.6	32.3	0.45
605314	0.9	1.0	0.82	No	1.3	20.0	1.42
606886	1.1	0.0	0.33	No	2.3	36.0	0.74
606966	0.8	0.4	0.36	No	1.2	31.5	0.30
607512	0.0	0.0	0.28	Yes	0.4	6.3	0.75
607618	6.2	3.7	2.51	No	0.3	6.5	2.25
608851	0.0	0.0	0.36	No	0.7	16.6	0.24
610302	1.6	0.0	0.36	Yes	1.4	27.3	0.75
610314	0.0	0.0	0.45	No	1.3	23.0	0.55
610855	0.0	0.0	0.45	No	1.4	38.7	0.33
610981	3.3	2.7	0.56	No	0.8	16.1	1.00
611116	0.7	3.0	0.30	No	0.2	4.5	0.68
611118	0.0	0.0	0.45	No	0.9	34.9	0.45
611486	0.0	0.0	0.36	Yes	1.6	24.0	0.75
611527	0.2	0.3	0.45	No	1.2	21.0	0.38
611694	0.7	1.0	0.23	No	0.3	12.5	0.08
613731	1.4	0.0	0.67	No	1.3	29.2	0.73
614047	0.0	0.0	0.45	Yes	0.8	33.0	0.75
614067	2.0	0.0	0.72	No	0.8	27.9	0.44
614088	0.0	0.0	0.48	No	1.6	43.1	0.38
614161	0.0	0.0	0.45	No	1.5	28.0	0.45
614200	0.6	1.2	0.72	No	1.2	20.1	0.74
614782	10.3	9.4	0.72	No	0.6	15.2	0.44
614816	0.6	1.3	0.72	No	1.4	24.5	0.62
614854	1.3	0.0	0.72	No	1.5	32.5	0.89
615410	0.4	0.6	0.39	No	1.5	29.7	0.76
790701	8.4	0.0	0.72	No	0.9	30.4	0.41
790772	3.3	2.5	0.72	No	1.1	35.1	0.33

Table 4-9 Tributary Area and Runoff Treatment Capacity for Distributed BMPs in the 50 Priority 1 Catchments

Catchment ID	Permeable Pavement Tributary (acres) [1]	Cistern Tributary (acres) [1]	Bioretention				
			Average K_{sat} (in/hr)	Underdrain Needed	Parkway Length (miles) [2]	Bioretention Tributary (acres)	Runoff Treatment Capacity (in) [3]
800837	0.4	0.4	0.40	No	1.6	23.5	0.51
800901	0.0	0.0	0.45	No	1.4	22.9	0.59
801011	0.6	0.0	0.11	Yes	0.8	18.2	0.75
801038	9.4	10.1	0.35	No	1.9	15.1	0.62
801118	0.5	0.0	0.33	Yes	2.0	38.1	0.75
801131	0.0	1.4	0.43	No	0.8	12.6	0.56
801255	0.2	0.0	0.33	No	2.4	42.0	0.39
801306	4.7	0.0	0.33	No	2.1	35.0	0.40
801412	1.3	0.3	0.45	Yes	0.8	15.3	0.75
801426	0.9	2.4	0.45	No	0.7	12.1	0.38
850062	0.0	0.0	0.33	Yes	1.6	33.2	0.75
850150	3.8	0.0	0.33	No	1.2	33.2	0.21
851060	3.4	2.5	0.33	Yes	0.2	34.7	0.75
Total	**74**	**45**			**61**	**1277**	

1) Effective capture of runoff form 0.75 inch design storm is assumed
2) Parkway length is the length of bioretention area along each curb of a Green Street retrofit
3) Treatment capacity, as runoff depth, is a function of tributary area, available space in ROW for bioretention, and soil permeability.

Figure 4-14 also shows the approximate location where stormwater will enter the existing storm drain system from green street BMPs (shown with light blue arrows). The need for under drains will be determined based on the site-specific conditions. If a collector under drain pipe system is used, stormwater will enter bioretention parkways through newly constructed curb-opening inlets, percolate through the bioretention parkway soil/media, then drain into a collector pipe. The collector pipe will tie into the existing storm drain system. If the system does not need a collector pipe, stormwater that enters bioretention parkways through new curb opening inlets is retained for infiltration and evapotranspiration. For larger storms, flows that exceed the capacity of bioretention parkways may flow in the gutter, bypassing bioretention curb-opening inlets, and enter the existing storm drain system at existing inlets. The specific infrastructure needs for each project site will be determined during the design phase of each BMP project.

4.6 Other Implementation Activities

Throughout the implementation of the TMDL, the City will continue to participate, as needed, in watershed-wide monitoring activities and special studies to support compliance analyses. The following sections describe these activities.

4.6.1 Water Quality Monitoring

As noted in Sections 1 and 2, the City is participating with other jurisdictions in the LAR Watershed in the implementation of the CMP. Under this Implementation Plan the City will continue to participate in this monitoring program. However, as needed to demonstrate that the City's jurisdiction is in compliance with its requirements under the TMDL, the City will conduct additional monitoring activities. These additional monitoring activities are described in Appendix F.

4.6.2 Special Studies

The TMDL includes a provision for reconsidering the TMDL wasteload allocations and implementation schedule within five years after the TMDL effective date (i.e., by January 11, 2011). At this time, the results of any special studies that provide the basis for reconsideration of any of the TMDL's provisions are to be submitted to the LARWQCB. Under this Plan, the City will participate in studies where appropriate, e.g., atmospheric deposition, water effect ratio analyses or other potential special studies as described in the Metals TMDL (LARWQCB 2005). In addition, the City recommends that the LARWQCB reconsider the 2012 wet weather target date. As noted in Section 4.7, even with adequate funding, implementation of all structural BMPs identified as necessary to achieve compliance with this target date is infeasible in this short time frame. Table 4-10 summarizes the typical length of key project phases for regional and distributed BMPs.

Table 4-10 Typical length of time associated with implementation of key phases of City BMP projects.

Project Phase	Number of Months for Completion	
	Regional BMP	**Distributed BMP**
Pre-Design	18	6
Design	12	8
Bid & Award	6	6
Construction	18	6
Post-Construction	6	6
Total Months	**60**	**32**

4.7 Implementation Plan Schedule

The Implementation Plan schedule phases structural and institutional BMP implementation to meet the interim and final TMDL targets. Implementation of the BMPs presented in this Plan is dependent on adequate funding over the duration of the implementation period. The City is currently evaluating options for establishing a funding source for implementation of this and other TMDLs. However, even if an adequate funding source is established in the short term, the City will not be able to construct by 2012 all necessary BMPs required to comply with the 2012 wet weather target date (see Section 4.6.2 and Table 4-10 for additional information). Regardless, the City is committed to expediting the planning, design, and construction phases for each structural BMP project to the maximum extent practicable.

The metals TMDL includes separate compliance requirements for dry and wet weather (Table 4-11).

Table 4-11 Metals TMDL Compliance Targets

Flow Condition	Target Date	Compliance Target (Watershed Drainage Area)
Dry Weather	2012	50%
	2020	75%
	2024	100%
Wet Weather	2012	25%
	2024	50%
	2028	100%

Results from CMP data collected since October 2008[1] demonstrate that more than 75 percent of the City of Los Angeles drainage area within the Los Angeles River Watershed is in compliance with dry weather metals TMDL targets for copper and lead (total and dissolved) (see Section 5 for detailed analysis). Accordingly, for dry weather, the focus of BMP implementation activities will be on compliance with the 2024 target.

In contrast, CMP wet weather collected in 2009 (see footnote 7) indicate that the City is not currently in compliance with any of the total copper and total zinc metals wet weather targets (although the City was in compliance with all lead and cadmium targets). Given these results, the focus of BMP implementation under this Plan is on

1 Los Angeles River TMDL CMP Ambient Monitoring 2008-2009 submittal to the LARWQCB. September 14, 2009

the wet weather targets, in particular for total copper and total zinc. Because many of the BMPs planned for implementation will also result in dry weather load reductions, the City's focus on wet weather compliance will result in compliance with dry weather targets.

Tables 4-12 and 4-13 summarize the proposed schedule for structural and institutional BMP implementation to achieve compliance with metals TMDL wet weather targets applicable to City's portion of the Los Angeles River Watershed. The table identifies activities applicable to interim and final target dates. Quantitative analyses demonstrate that implementation of this Plan will result in the required metals load reductions within the City's jurisdiction to achieve compliance with the wet weather targets (see Section 5 for detailed analyses). The following sections describe the general implementation approach, expected water quality benefits, and relationship between implementation and TMDL target for the implementation categories summarized in Tables 4-12 and 4-13.

Table 4-12 Planned Implementation of Structural BMPs to Achieve TMDL-specific Targets

Implementation Category	BMP/Program	TMDL Target (Acres Treated)		
		2012	2024	2028
Existing & Planned Projects	Proposition O (see Table 4-1 for projects and TMDL target dates)	1,910	255	5,130
	Other Watershed Projects (see Table 4-2 for projects and TMDL target dates)	10,280	590	480
New Green Structural BMPs	Distributed BMPs (Priority 1 projects by 2012; Priority 2 plus other projects by 2028)	1,400	5,000	
	Regional BMPs (Priority 1 - Compton Creek and North Hollywood Park)	11,460	--	--
	Regional BMPs (Priority 1 – Pierce College and Van Nuys Sherman Oaks)	--	3,900	--
	Regional BMP Priority 2 projects	--	--	15,000

Table 4-13 Planned Implementation of Institutional BMPs to Achieve TMDL-specific Targets

Institutional Program	BMP Type	2012 Target	2024 Target	2028 Target
Direct Source Control	Brake Pad Replacement	6.5% average copper content	5.7% average copper content	5.0% average copper content
	Enhanced Street Sweeping	5% increase in sediment removal		
	Downspout Disconnection	2,500 downspout disconnects/year		
Development/ Redevelopment Standards	Enhanced Program	250 acres/year		
Other BMP Categories Types	Education & Outreach, Program Development, Planning & Coordination	Water quality benefits not quantified. Continuous implementation through 2028; specific goals summarized in Table 4-14		

4.7.1 Existing and Planned BMP Projects

Sections 4.2.2 and 4.2.3 identified the major Proposition O and other major watershed projects which will provide water quality benefits regarding urban runoff. The acres of runoff treated, based on the known or estimated project characteristics, and the expected completion date relative to the TMDL target dates are summarized in Table 4-12. The City will continue to monitor these projects throughout the TMDL implementation period to verify that the expected water quality benefits from each project occur.

4.7.2 Institutional BMPs

Table 4-14 provides a summary matrix and general schedule for institutional BMP implementation. Where appropriate, these activities will be implemented in conjunction with other TMDL implementation activities, e.g., the Ballona Creek Bacteria and Metals TMDL Implementation Plans. This Plan adopts quantitative targets for only the few institutional BMPs for which water quality benefits can be estimated (see Table 4-14):

- *Brake Pad Replacement*—Table 4-13 indicates the expected average copper percentage (by weight) in brake pads over the period of implementation. Existing vehicles have, on average, 6.5 percent copper in their brake pads. By 2012, it is expected that this average percentage will remain unchanged. Assuming SB 346 becomes law in 2010, it is assumed that the average copper percentage will decline to 5.7 percent by 2024, and 5 percent by 2028. These modest reductions in average copper content of brake pads takes into account the lag time expected for new brake pad products to be common on vehicles in California.

- *Enhanced Street Sweeping*—During the period of implementation, the City plans to enhance street sweeping to achieve an additional 5 percent removal of sediment. This modest increase takes into account the fact that the City already has an active street sweeping program. Thus, opportunities to increase effectiveness are limited.

- *Downspout Disconnect*—Downspout disconnection is a key element of the City's proposed Implementation Plan. This program, which is already being piloted in the Ballona Creek Watershed, will be expanded to the Los Angeles River Watershed. Throughout the period of implementation until 2028, the City plans to implement 2,500 downspout disconnections per year.

- *Enhanced SUSMP Implementation*—Since 2001, City records indicate that an average of 250 acres of projects that meet SUSMP requirements are implemented each year in the Los Angeles River Watershed. It has been assumed that this rate of implementation will continue. The City will continue to enhance the SUSMP requirements as required by MS4 permit requirements.

Table 4-14 Schedule for Implementation of Institutional BMP Program Elements

Category	Institutional BMP	Implementation Process/Schedule	Expected Benefits
Direct Source Control	Product Replacement	■ Continue to provide technical, financial and political support to adopt SB 346 and SB 757 in 2010. ■ Support implementation efforts after legislation passed, including participating pilot/monitoring studies ■ Conduct or participate in local, regional or state studies to identify product replacement opportunities to reduce metals pollutant loads to City waters.	Metals are contained in a number of consumer products the use of which increased metal loadings to the waterbodies. Replacement of metals in these products with a safer alternative will result in significant reductions of metals loadings.
	Street Sweeping Enhancement	■ By 2012, complete street sweeping effectiveness study. ■ By 2013, use findings of study to revise street program ■ By 2014, fully implement revised program (e.g., if it is determined that new equipment is needed).	Increasing the effectiveness of this program will further reduce pollutant loading during wet weather. Conducting an effectiveness study provides opportunity to evaluate new types of equipment and revised strategies.
	Downspout Disconnection	■ By 2011, implement/evaluate pilot program, develop targeted program for full implementation, and begin program implementation ■ By 2013, complete at least 2,500 downspout disconnects in the Los Angeles River Watershed ■ 2013 - 2028, implement at least 2,500 downspout disconnects/year in the Los Angeles River Watershed.	The cornerstone to compliance with wet weather targets is the implementation of a progressive, targeted downspout disconnection program. Implementation is phased so that time is allowed for developing an effective program that targets the most important areas of the watershed.
Program Development	Source Control Incentives	■ By 2013, establish and implement incentive program that encourage implementation of BMPs that reduce wet weather runoff from commercial and industrial properties.	Establishing incentives for commercial and industrial properties increases likelihood of implementation of distributed structural BMPs on these privately owned properties. This will result in reduced pollutant loads in wet weather runoff.
Program Development	SUSMP Enhancement	■ By 2012 (or sooner if required by MS4 permit), establish and implement enhanced SUSMP requirements that incorporate LID principles	Implementation of LID principles on new developments or redeveloped properties subject to SUSMP will reduce pollutant loads in wet weather runoff.
	Stream Protection Ordinance	■ By 2011, establish stream protection ordinance in the City of Los Angeles	Over the long term, this BMP provides opportunities for implementation of BMPs along waterbodies to mitigate urban runoff. Ordinance development is underway in the City of Los Angeles
	Source Control Ordinances	■ By 2011, evaluate need for additional authority in ordinances to reduce metals loads in urban runoff. ■ By 2013, adopt new or revised ordinance provisions as needed.	BMP provides opportunity to identify additional authority needed to reduce metals pollutant loads in dry and wet weather runoff.

Table 4-14 Schedule for Implementation of Institutional BMP Program Elements

Category	Institutional BMP	Implementation Process/Schedule	Expected Benefits
Program Development	Green Policy/Guidance Development	■ By 2011, establish (or revise as needed) policies and guidance for green street retrofits and green building activities (including LID requirements) ■ By 2012, establish stormwater beneficial reuse policies and guidance ■ By 2012, establish permeable pavement policies and guidance	The establishment of formal policies and guidance (including technical specifications) provides an important mechanism for ensuring implementation of appropriate BMPs to manage urban runoff throughout the area.
Education and Outreach	Urban Runoff Website	■ Continuous implementation	Provides quick, easy way to broadcast information throughout the watershed
	Regulatory and Policy Education	■ Continuous – as products from program development are developed, information and training provided, as needed.	Training of staff within each jurisdiction of new programs, procedures and policies ensures more effective implementation
Education and Outreach	Targeted Metals-Education & Public Outreach	■ By 2011, review and revise public education and public outreach activities related to activities which can reduce metals loading to storm drains, e.g., used oil disposal, car washing, vehicle maintenance	Provides mechanism for continual improvement of materials and message delivered to homeowners and organizations that promote activities such as charity car washes.
	Rapid Transit Promotion	■ By 2011, identify opportunities to establish partnerships with regional transportation agencies to implement programs to promote rapid transit as a means to improve water quality. ■ By 2012, evaluate opportunities with identified partners to create incentives to promote use of rapid transit. If appropriate, conduct pilot program prior to implementation of program throughout the watershed.	Given that vehicle tires are an important metals source in the environment, implementation of BMPs that result in reduced driving reduces the build-up of metals on roadways and metals loadings in waterbodies.
	Effectiveness Evaluation	■ By 2011, conduct evaluation of existing education and outreach materials that target metals sources to determine their effectiveness. ■ By 2012, select most effective materials and programs, update as needed and implement.	Establishing a common education and outreach message across the watershed helps ensure that a consistent message is broadcast. The effectiveness evaluations and development of watershed-wide materials should be closely coordinated
	Watershed-wide Education	■ By 2012, consolidate education and outreach programs to the extent possible to provide consistent message across the watershed.	
	Program Funding	■ By 2012, establish long-term, stable funding source for education and outreach activities.	Establishment of long-term, stable funding source for education supports efforts to provide consistent and, as needed, regularly updated message. A portion of the established funds would be dedicated to the annual operation of the ELC.
	Environmental Learning Center	■ By 2011, complete ELC construction and initiate learning activities at the Center. ■ By 2012, establish long-term, stable funding source for operation of ELC.	

Table 4-14 Schedule for Implementation of Institutional BMP Program Elements

Category	Institutional BMP	Implementation Process/Schedule	Expected Benefits
Planning & Coordination	Interagency Task Force	■ By 2011, establish Task Force and begin meeting at least quarterly	Establishment of this Task Force increases the opportunity for consistent collaborative implementation of urban runoff management strategies and site-specific BMP projects throughout the watershed.
	Watershed Collaboration	■ Continuous implementation	Occasionally state and federal grant opportunities become available for funding NGO projects which have urban runoff management benefits. By working collaboratively with the NGOs, jurisdictions have opportunities to cost-share projects.
	General Plan Update	■ By 2011, all jurisdictions evaluate opportunities to update their General Plans to incorporate urban runoff management goals. ■ By 2015, complete General Plan updates to the extent possible (as defined by the public process)	Updating General Plans provides a mechanism to establish common development goals that recognize the importance of managing urban runoff. The extent of implementation of this BMP depends on concurrence of Plan changes by many stakeholders.

Given the high uncertainty surrounding water quality benefits achievable by implementing many institutional BMPs (e.g., education and outreach), the benefits that may occur from these BMPs were not quantified for the purposes of developing this Implementation Plan. The benefits of these activities are still expected to be significant; however, by not attempting to quantify these benefits, the City has increased the margin of safety associated with its quantitative analysis.

In many cases, the City is already implementing at least a baseline program for a number of the institutional BMPs identified in this Plan. Under this Plan, these existing programs will be reviewed and, where appropriate, update or enhanced (e.g., updated education and outreach materials to target metals sources).

Implementation of some of the new institutional BMPs, e.g., downspout disconnection program, will generally follow a typical project cycle including planning, preparation of a detailed and specific BMP action plan, and development of a pilot program leading into subsequent implementation phases. Where appropriate, this development cycle will be coordinated with similar programs planned for implementation in other watersheds (e.g., Ballona Creek).

Where feasible, the pilot programs will be prioritized to target the higher priority catchments. A detailed institutional BMP action plan will be developed for each program and will focus on what each specific agency is currently doing, how resources could be shifted to target high priority catchments initially, and what can be done to enhance activities that will be ultimately implemented by the City.

As the institutional BMPs become better defined through the iterative, adaptive approach, specific, quantifiable performance measures will be identified and included in the respective program implementation plans. In addition, as water quality monitoring results are obtained from the CMP, institutional BMPs can be honed to target specific locations where high metals concentrations are found, and the implementation plan for the affected programs modified accordingly.

4.7.3 Regional Structural BMPs

Table 4-12 indicates the number of acres from which runoff is derived and targeted for treatment through the implementation of regional BMPs. These acres vary depending on the wet weather target date. Section 4.4.1 identified four priority regional BMP projects for implementation to achieve compliance with the wet weather TMDL targets. These four projects[2] have the capacity to treat stormwater from about 15,360 acres (see Table 4-3). Sufficient treatment capacity exists in the four projects to provide the approximately 11,460 acres of needed treatment by 2012 and the additional approximately 3,900 acres needed by 2024 (Table 4-11).

[2] The City may substitute one or more of these priority projects with other regional and/or distributed BMP projects if it is determined that a project is not feasible, e.g., the land is unavailable, or a project opportunity becomes available that is functionally equivalent, i.e., provides necessary volume of treatment and/or accomplishes the goals of this TMDL Implementation Plan.

The City plans to implement two of the four priority regional BMP projects by 2012 and the other two projects by 2024. Given the need to treat runoff from 11,460 acres by 2012 (Table 4-12), the two largest of the four projects (Compton Creek and North Hollywood Park) are planned for completion by 2012. The remaining two projects will be completed by 2024.

Table 4-12 indicates that the City plans to implement additional regional BMPs by 2028 that provide treatment for runoff from an additional 15,000 acres. Unless alternative opportunities become available that have not been identified to date, the City will implement selected projects from the list of potential regional BMP sites developed under this Plan (see Tables 3-6 and 3-7). While the quantitative analysis demonstrates that these projects only need to be completed by 2028, the actual timing for implementation of these projects will be determined at a later date. It is likely that the City will phase the planning, design, and construction of these projects beginning prior to 2024 with completion of all work by 2028.

The City plans to achieve multiple-objectives with each of the regional BMP projects, e.g., increased open space, recreational benefits, and compliance support for other pollutants. Accordingly, it is expected that most regional BMP projects will require extensive planning, stakeholder input, and coordination with multiple agencies. All will be subject to resolution of substantive permitting and right-of-way issues. Final project flow rates and treatment levels will depend on the available area and detailed project engineering design. The treatment volumes for projects may fall below the full treatment volumes anticipated by this Plan if necessitated by the results of detailed engineering feasibility studies.

4.7.4 Distributed Structural BMPs

Table 4-12 indicates that achieving compliance with the 2012 wet weather TMDL target requires that the runoff from 1,400 acres receives treatment from implementation of distributed BMPs. Tables 4-9 and 4-9 describe 50 Priority 1 distributed BMP opportunities[3] planned for implementation in the Los Angeles River Watershed. The treatment catchment area for these projects is variable; however, according to preliminary analyses these 50 projects have the potential to provide sufficient treatment capacity to meet the 1,400 acres treated target shown for 2012 (Table 4-12).

Between 2012 and 2028, an additional 5,000 acres of treated runoff is required to achieve the compliance goals set for 2024 and 2028. The remaining distributed BMP sites not included as Priority 1 sites could be implemented following completion of the Priority 1 projects (see Tables 3-8 and 4-9). These projects likely can provide up to an additional 25% of the treatment needs from distributed BMP projects. Additional projects will need to be developed during future years of implementation.

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3 The City may substitute one or more of these priority projects with other regional and/or distributed BMP projects if a project opportunity becomes available that is functionally equivalent, i.e., provides necessary volume of treatment and/or accomplishes the goals of this TMDL Implementation Plan.

The City expects to implement projects at a regular pace over the 16-year period from 2013 to 2028. Accordingly, the City will implement projects that provide an additional 300 to 350 acres of treatment each year. Based on the typical project size of distributed BMP projects, the City will need to implement approximately 10 distributed BMP projects per year.

Similar to the regional BMP projects, it is expected that most distributed BMP projects will require extensive planning, stakeholder input, and coordination with multiple agencies. All will be subject to the resolution of substantive permitting and right-of-way issues. Final treatment benefits associated with each project will depend on the available area and detailed project engineering design.

Section 5
Implementation Plan Compliance Analysis

The Los Angeles River Metals TMDL includes pollutant mass load allocations for MS4 Permittees in the watershed. The TMDL sets load allocations to require reduction of metals concentrations in impaired waterbodies to below California Toxics Rule (CTR) water quality standards. Load allocations differ for dry and wet weather runoff conditions, with the definition of wet-weather being any day with greater than 500 cfs at the Wardlow gauge (LARWQCB 2005). Compliance schedules also different between dry and wet weather conditions (See Section 1).

5.1 Dry Weather Compliance Analysis

5.1.1 Dry Weather Wasteload Allocation

Table 5-1 shows the allowable wasteload allocation in waterbodies downstream of City of Los Angeles MS4 drainage areas. Per the TMDL allocations for dry weather are the product of numeric concentration targets, based on chronic CTR standards for copper and lead, and median dry weather flow for each waterbody. For ungaged waterbodies or river segments, the dry weather flow is estimated by taking the difference between median dry weather flows at Wardlow (145 cfs) and combined median discharge from three wastewater treatment plants (WWTP) in the watershed (111 cfs). The remaining flow is apportioned to waterbodies based solely on the size of upstream drainage areas.

Table 5-1 Copper and Lead Dry weather wasteload allocations for stormwater in City of Los Angeles MS4 drainage areas (modified from Table 6-6 of TMDL Staff Report, LARWQCB 2005)

Waterbody	Critical Flow (cfs)	Combined MS4 Permittees		City of Los Angeles[1]	
		Copper (kg/day)	Lead (kg/day)	Copper (kg/day)	Lead (kg/day)
LAR Reach 6	7.2	0.53	0.33	0.39	0.24
LAR Reach 5	0.75	0.05	0.03	0.05	0.03
LAR Reach 4	5.13	0.32	0.12	0.29	0.11
LAR Reach 3	4.84	0.06	0.03	0.03	0.02
LAR Reach 2	3.86	0.13	0.07	0.04	0.02
LAR Reach 1	2.58	0.14	0.07	0.0003	0.0001
Bell Creek	0.79	0.06	0.04	0.03	0.02
Tujunga Wash	0.03	0.001	0.0002	0.0002	0.00005
Verdugo Wash	3.3	0.15	0.07	0.01	0.00
Burbank Western Channel	3.3	0.18	0.1	0.09	0.05
Arroyo Seco	0.25	0.01	0.01	0.001	0.001
Rio Hondo Reach 1	0.5	0.01	0.006	0.00	0.00
Compton Creek	0.9	0.04	0.02	0.02	0.01
Total	**34**	**1.7**	**0.89**	**0.96**	**0.51**

1 City of Los Angeles wasteload allocation is determined by multiplying the total waterbody-specific stormwater wasteload allocation by the fraction of drainage area within the City

The City of Los Angeles MS4 drainage area also includes the portion of the watershed draining to Aliso Canyon Creek and Reach 6 of the Los Angeles River, where there is a concentration based TMDL for selenium of 5 µg/L during dry weather. The TMDL states that the source of this pollutant is likely natural. Accordingly, this compliance analysis only focuses on cadmium, copper, lead, and zinc.

5.1.2 Dry Weather Compliance

For dry weather conditions, water quality samples collected at ten locations by the coordinated monitoring program (CMP) are available to estimate the portion of the MS4 drainage area in compliance for each sampling event (Figure 5-1). Assuming that each monitoring location represents water quality conditions within its immediate upstream drainage area, the portion of the MS4 drainage area in compliance with numeric targets in the TMDL is evaluated for each sampling event. Table 5-2 summarizes the portion of the MS4 drainage area associated with each CMP sample location. Table 5-3 shows the area in compliance for each dry weather sample event since October 2008. These results show that dry weather compliance is achieved for greater than 75 percent of the City of Los Angeles MS4 drainage area over the past year of CMP sampling. Therefore, the metals TMDL Implementation Plan for dry weather will focus on achieving 100 percent compliance for the 2024 target. Significant structural and institutional BMPs necessary for wet weather compliance will provide more than the necessary load reductions needed during dry weather conditions to achieve this milestone.

Table 5-2 Percent of City of LA MS4 Drainage Area Represented at each CMP Location

CMP Dry Weather Sample Location [1]	% of City of Los Angeles MS4 Area	Dry Weather Numeric Targets (µg/L)			
		Total Copper	Dissolved Copper	Total Lead	Dissolved Lead
LAR at White Oak Ave.	28.60%	30	29	19	11
LAR at Sepulveda Blvd.	16.45%	26	29	19	11
LAR at Tujunga Ave.	8.22%	26	19	10	6.6
LAR at Zoo Dr.	8.74%	23	22	12	7.6
LAR at Figueroa St.	6.70%	26	21	12	7.5
LAR at Washington Blvd.	9.55%	22	21	11	7.3
LAR at 710 Freeway [2]	1.89%	22	21	11	7.3
Tujunga Wash at Moorpark St. [3]	8.22%	20	19	10	6.6
Burbank Western Channel at Riverside [4]	5.26%	19	18	9.1	6.1
Compton Creek at Del Amo [5]	6.38%	19	18	8.9	6.0

1 Only Tier 1 CMP stations shown. Data from additional monitoring plan (AMP) locations, collected as necessary, will replace downstream CMP site data for the portion of the subwatershed represented
2 Additional Monitoring Program (AMP) site LAR-R2 includes 0.50% of City of LA MS4 Area (see Appendix F)
3 AMP site LAR-R4 includes 0.92% of City of LA MS4 Area
4 AMP site LAR-R3 includes 4.80% of City of LA MS4 Area
5 AMP site LAR-R1 includes 0.67% of City of LA MS4 Area

Table 5-3 Compliance with Dry Weather Numeric Targets in Metals TMDL

Sample Month	Total Copper	Dissolved Copper	Total Lead	Dissolved Lead
10/2008	87%	92%	100%	100%
11/2008	92%	92%	100%	100%
12/2008	92%	92%	100%	100%
1/2009	100%	100%	100%	100%
4/2009	92%	92%	83%	92%
5/2009	100%	100%	100%	100%
6/2009	94%	100%	100%	100%
7/2009	92%	92%	100%	100%
8/2009	100%	100%	100%	100%

5.2 Wet Weather Compliance Analyses

5.2.1 Wet Weather Wasteload Allocation

Wet weather wasteload allocations for MS4 Permittees are set for cadmium, copper, lead, and zinc in all waterbodies of the LAR Watershed. These allocations are a function of storm runoff volume, represented as load duration curves for the entire LAR Watershed (Figure 5-2). The allocation for MS4 permittees, developed watershed-wide, is the majority of the acceptable loading capacity, as shown for a 500 cfs flow condition at the Wardlow gauge (Table 5-4). These curves show the allowable pollutant load from a given storm runoff volume for cadmium, copper, lead, and zinc. The wasteload allocations shown incorporates allowable load from the minimum flow to distinguish a wet-weather condition (500 cfs at Wardlow), equivalent to the values shown in Table 5-4.

Table 5-4
Wet weather wasteload allocations for stormwater based on a daily flow of 500 cfs (from Table 6-13 of TMDL Staff Report, LARWQCB 2005)

Pollutant	General Industrial permittees (kg/day)	General Construction permittees (kg/day)	Caltrans (kg/day)	MS4 Permittees (kg/day)	Combined storm water permittees (kg/day)
Cadmium	0.089	0.036	0.036	1.6	1.8
Copper	0.50	0.20	0.20	9.1	10
Lead	3.6	1.4	1.4	65	71
Zinc	5.08	2.03	2.03	93	102

The City of Los Angeles MS4 drainage area represents approximately 50 percent of the total MS4 permittee drainage area in the LAR Watershed. According to the TMDL, the City's allocation is equal to this fraction of the combined MS4 permittee load allocation.

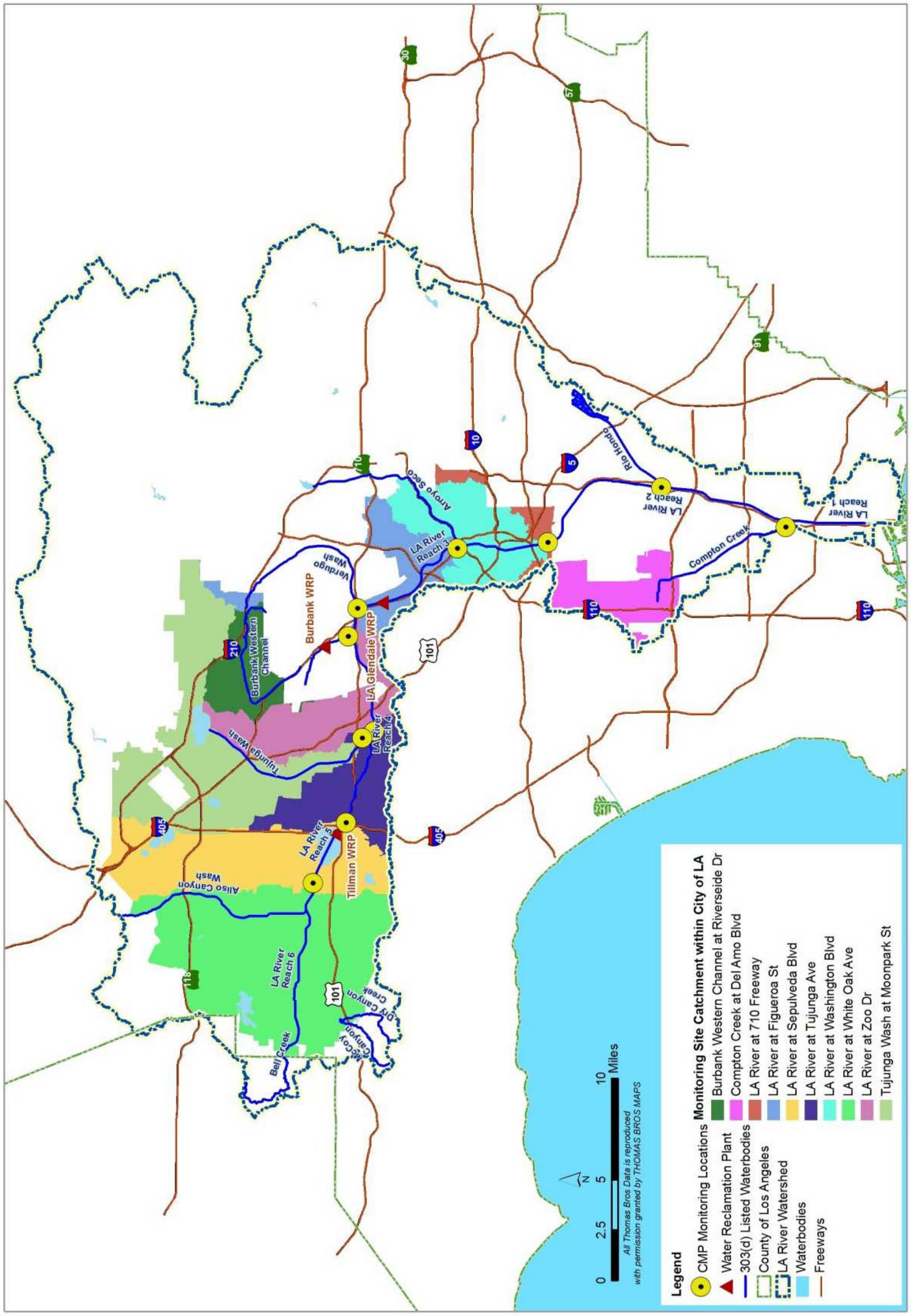

Figure 5-1
Drainage Areas to CMP Locations within the City of LA Jurisdiction

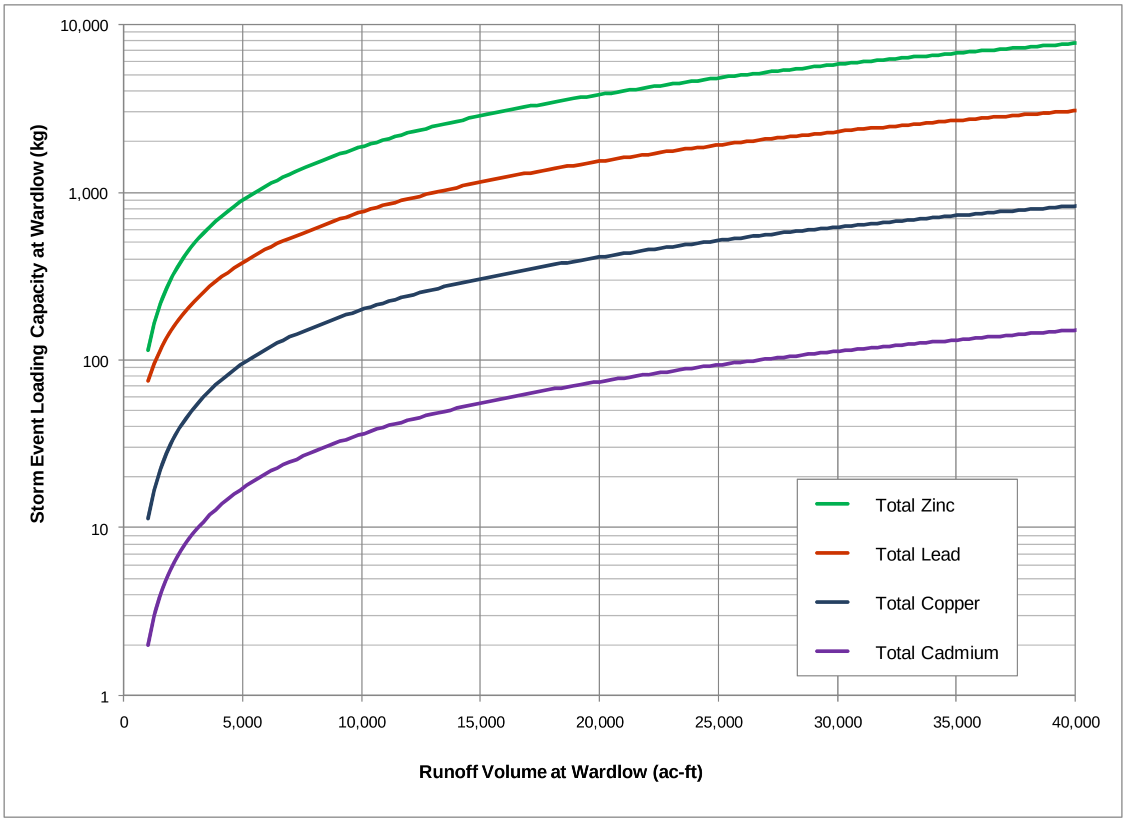

Figure 5-2
Wasteload Allocation for the City of LA MS4 Drainage Areas

5.2.2 Wet Weather Compliance

An evaluation of existing water quality conditions is necessary to determine the load reductions needed to achieve targets in the TMDL. Wasteload allocations are the allowable watershed loads for compliance at the final wet weather milestone in 2028. Interim compliance is measured differently; as the fraction of the MS4 drainage area where metals concentrations are below numeric concentration targets in the TMDL.

The availability of water quality data during dry weather conditions allowed for an assessment of current conditions in different parts of the watershed. Conversely, flow weighted wet weather composite samples within the LAR Watershed are limited to routine monitoring at the stormwater mass emission station within Reach 1 at Wardlow Street, except for three events where tributary mass emissions were monitored during the 2003-2004 wet season. Given the limited dataset to characterize metals loads during wet weather from different portions of the LAR Watershed, this compliance analysis is based upon monitoring at the Wardlow Street station.

Historical data for LAR at Wardlow showed non-compliance with several TMDL targets, most notably, total copper. Using the mass emission data for metals included in the TMDL, a trend line was fit for the loading versus runoff volume data to characterize baseline water quality throughout the LAR Watershed (Figure 5-3).Comparing this curve with the wasteload allocation for MS4 permittees approximates the load reduction needed to meet the TMDL for a given runoff event volume.

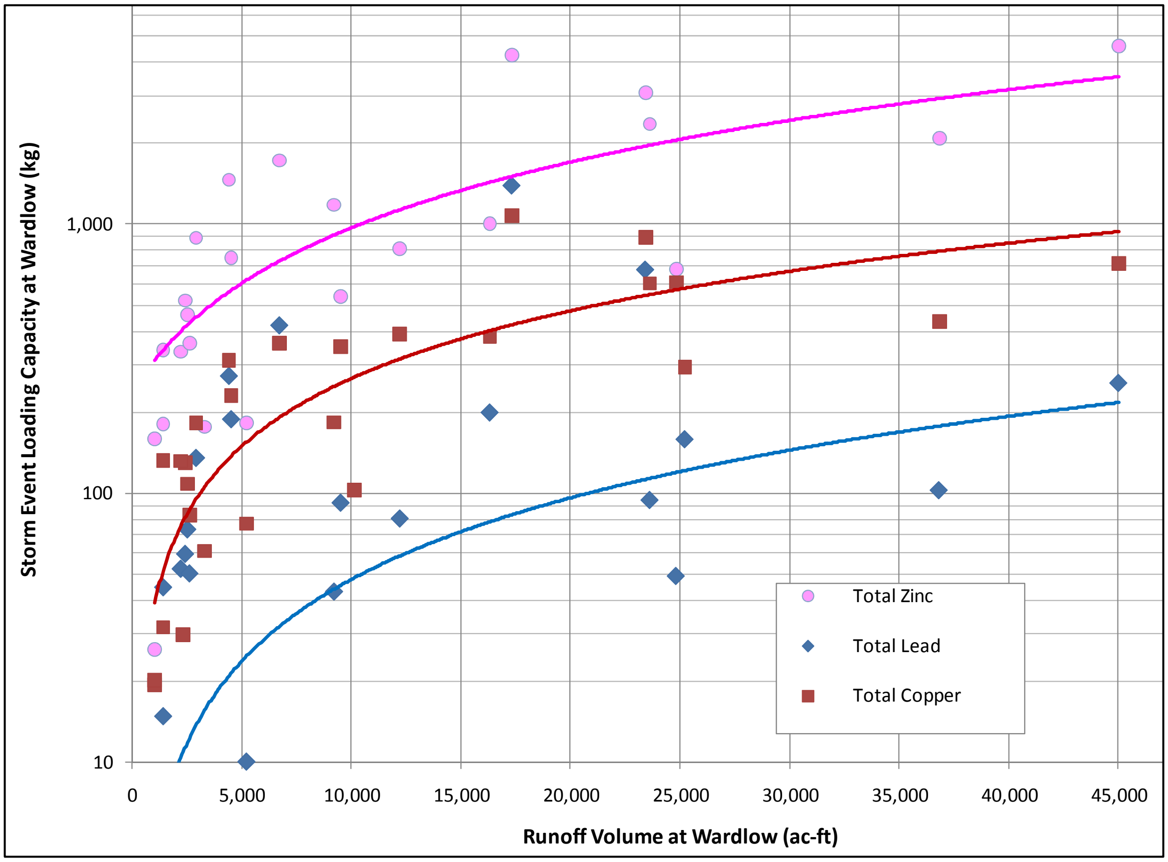

Figure 5-3
Trends to Approximate Baseline Metals Loading for the LAR Watershed

Since the relationship between runoff and load for each metal is not statistically significant, uncertainty analyses considered the full distribution of baseline metals loading in developing probabilistic results. Figure 5-4 shows comparisons of baseline water quality data and wasteload allocations for each metal in the TMDL. Total copper is the only metal where baseline water quality exceeds the loading capacity of the watershed.

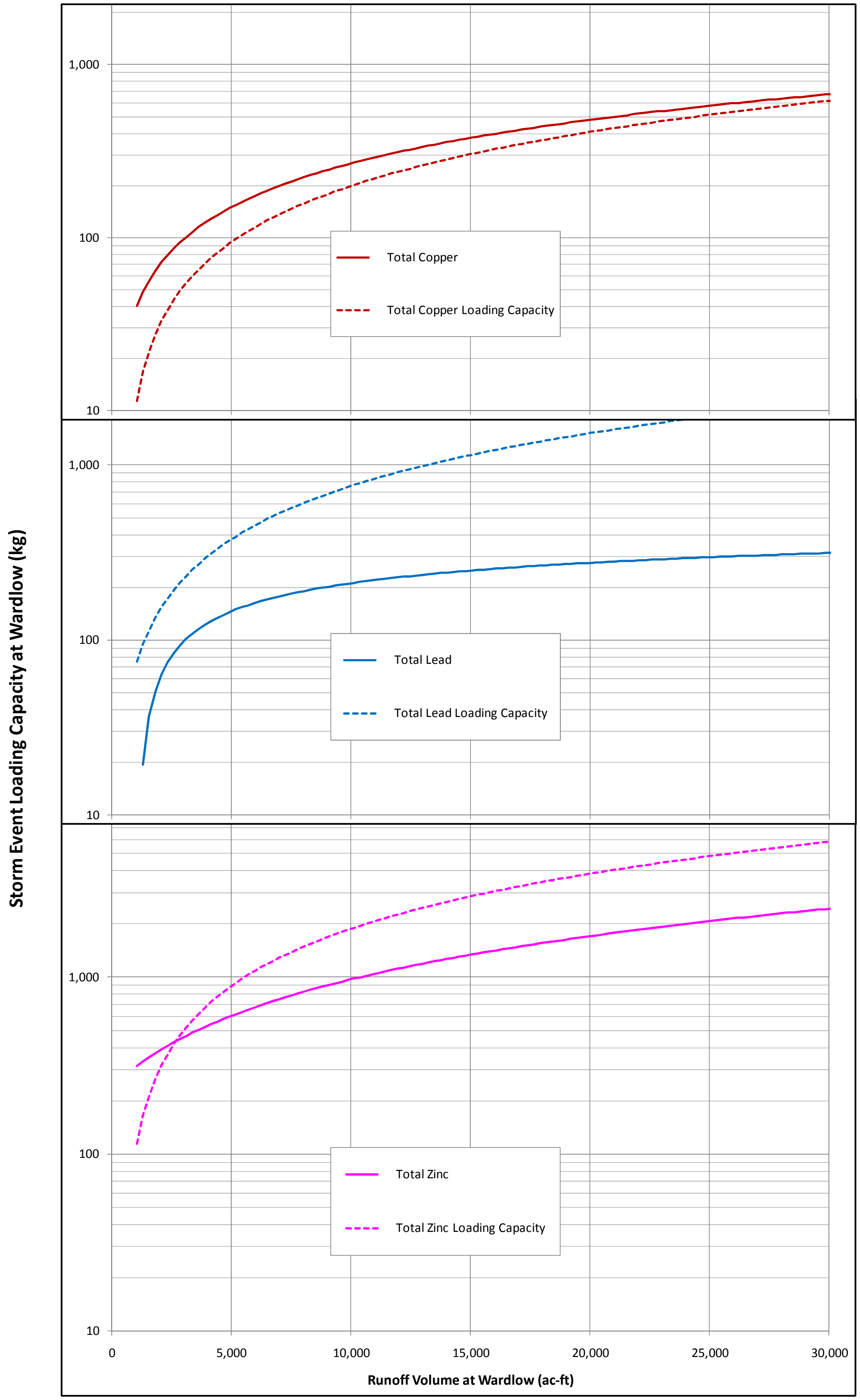

Figure 5-4
Comparison of Baseline Metals Loading Trend to Wasteload Allocation for MS4 Permittees in the LAR Watershed

Four sampling events within the Wardlow Street mass emission station period of record were excluded from the assessment of baseline water quality, because of significantly higher flow-weighted mean concentrations. Further review of these data shows that they are not outliers, but rather associated with major sediment mobilization from the watershed, due extended dry periods (i.e., first storm of wet season).

Compliance with the TMDL is driven by total copper, which has significantly greater frequency and magnitude of exceedance than total lead or total zinc. The largest deviations of baseline total copper from the wasteload allocation occur during smaller storm events, indicating that smaller storms may have higher concentrations of total copper than larger storms. During large runoff events, dilution of water quality may occur after the initial wash-off of accumulated metals in the beginning of the storm. Following a similar pattern, the trend of baseline loading for total zinc exceeded the wasteload allocation in only small to medium size storm events. The baseline trend for total lead indicates that this metal is not a significant concern.

Assuming that load reduction is proportional to MS4 drainage area compliance, compliance with interim milestones can be computed without more extensive upstream mass emission monitoring. For instance, to achieve the first milestone of 25 percent of MS4 drainage area in compliance, 25 percent of the necessary load reduction must be demonstrated. Therefore, the recommended BMP projects in the Metals TMDL Implementation Plan (see Section 4) provide sufficient treatment of urban runoff to achieve interim milestones based on the fraction of necessary load reduction achieved.

Existing stormwater management programs will be supplemented with recommendations for new or enhanced source control programs and implementation of new regional and distributed structural BMPs. The quantification of metals load reduction from implementation of BMPs in the watershed involves different approaches for wet versus dry weather, consideration of the type of BMP implemented, and the compliance milestone under consideration. Load reductions are estimated for the following categories of projects:

- Institutional BMPs
- Distributed Structural BMPs
- Regional Structural BMPs
- Existing / Planned BMPs
- SUSMP projects

The above quantitative analysis approach for wet weather assumes no in-stream processes exist that can provide some load reduction for metals (e.g., as might be the case for bacteria due to in-stream decay). Metals are typically conservative, i.e., minimal concentration change from in-stream processes is expected; however, some reductions may occur through processes such as sediment particle settling.

5.2.2.1 Load Reduction from Institutional BMPs

Quantifying the sources of metals in urban watersheds is difficult, because sources and activities that mobilize different metals are numerous and diverse. Nationwide, watershed management plans identify vehicle brake pads, tire tread, roadway sediment, used motor oil, building materials, algaecides and pesticides as significant sources of metals in urbanized watersheds. Reductions of cadmium, copper, lead, and zinc from these pollutant sources can be achieved by implementing institutional BMPs.

Institutional BMPs reduce pollutant loads by either reducing the source of a pollutant or capturing built-up pollutants before they can be washed off by stormwater into local waterbodies. Estimating the pollutant load reduction achieved through the implementation of these BMPs involves two distinct computations:

- Pollutant Buildup – Determining the relative contribution of the pollutant from a targeted source to the watershed land surface

- Pollutant Wash-off – the transport of pollutants from the watershed surface to downstream waterbodies

Quantification Methodology

Historical rainfall records were used to estimate the buildup of metals from controllable sources prior to a storm event (P_t), as a function of preceding dry days (DD). Rational method hydrologic simulations for distinct storm events in the historical rainfall record were used to estimate the wash-off of pollutant from the watershed surface (W), as a function of runoff depth (R). Numerous studies have found that pollutant buildup and wash-off are most appropriately estimated using non-linear relationships. Pollutant buildup occurs at the fastest rate in the initial days following a wash-off event, but decline as buildup approaches the maximum carrying capacity (P_{max}) for the watershed over longer dry periods (Sartor and Boyd 1972; EPA NURP Study 1983). These studies also show that the greatest amount of pollutant wash-off occurs with the first ½ inch of runoff, with lower wash-off rates associated with each increment of additional runoff. Therefore, exponential functions were used to estimate pollutant buildup and wash-off associated with specific sources of metals in the watershed;

$$P_t = P_{max} * \left[1 - e^{(-k_b * DD)}\right] + [P_{t-1} - W_{t-1}] * e^{-k_b * DD}$$

$$W_t = P_t * \left[1 - e^{(k_w * R)}\right]$$

The variables used in these exponential functions for buildup (k_b) and wash-off (k_w) were derived so that ultimate loading to receiving waterbodies is approximately 20 percent of metals accumulated on the watershed, consistent with what has been recorded from urban catchments by Pitt et al. (2004). In addition, the values used in this analysis (k_b = .23; k_w = 1.3) are within the range used in technical modeling for the development of the Los Angeles River Metals TMDL (TetraTech 2004) as well as recent models of highly urbanized subwatersheds in the Great Lakes region (Chen and Adams 2006).

Pollutant buildup and wash-off analyses were completed for specific sources of metals; including copper in brake pad wear debris, and all 303(d) listed metals in street sediment and atmospheric deposition to quantify water quality benefits associated with brake pad product replacement, enhanced street sweeping, and roof downspout disconnection, respectively. These institutional BMPs were identified as BMPs for which water quality benefits can be most reliably quantified. Figure 5-5 shows reductions in total copper buildup over the watershed that may be achievable with implementation of the recommended direct source control institutional BMPs.

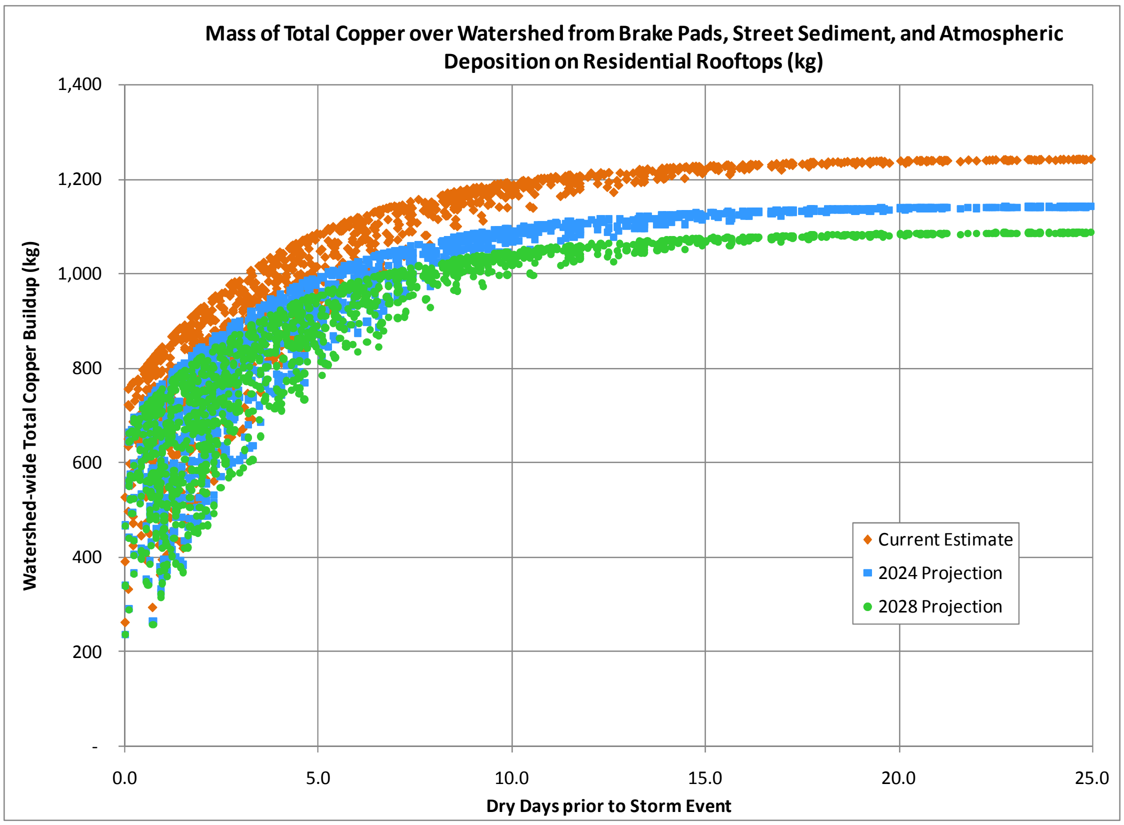

Figure 5-5
Buildup Rates of Total Copper within LAR Watershed for Current Conditions and at Long-Term Wet Weather Compliance Milestones with Implementation of Institutional BMPs

The concentration of metals in accumulated sediment is reduced by implementing institutional BMPs, therefore wash-off of accumulated sediment in the future will have a reduced associated metals loading. These institutional BMPs have a similar effect on buildup rates of cadmium, lead, and zinc.

Additional institutional BMPs included in this TMDL Implementation Plan were not quantified, yet may provide additional pollutant removal. Water quality monitoring will determine if the non-quantified BMPs provide an additional benefit, resulting in potential reduction in the need for structural BMPs to comply with later compliance milestones.

Brake Pad Replacement

Copper from vehicle brake pad wear debris accounts for a significant portion of total copper loads in urban watersheds. In subwatersheds of the San Francisco Bay, brake pad wear debris accounted for 15-50 percent of total copper loads, depending upon the land use in each subwatershed (AquaTerra 2007). The Santa Clara Valley Urban Runoff Program estimated that brake pads are responsible for 42 percent of copper loading to the San Francisco Bay (SCVURP 1997). To develop this Implementation Plan, a similar analysis for the LAR Watershed estimated the fraction of total copper loading manageable through direct source control activities related to copper content in brake pads. The mass of copper released to the watershed per vehicular kilometers traveled (VKmT) provides a basis to quantify baseline loads of total copper from brake pad wear debris. Copper loading rates per VKmT were estimated in several targeted studies conducted by the Brake Pad Partnership (Rosselot 2006). Rosselot (2006) identified a brake pad wear rate of approximately 0.5 mg per VKmT. Rosselot (2006) also evaluated the copper content in different types of vehicles within the San Francisco Bay area.

Based on the above studies, an average copper content for vehicles in the LAR Watershed was assumed to be 6.5 percent. Thus, 6.5 percent of 7.0 mg per VKmT is the rate at which copper is released to the LAR Watershed for every VKmT. Daily VKmT was estimated by taking the number of vehicles in the watershed (~3 million) with an assumed average annual driving of 16,000 kilometers. However, studies have shown equilibrium of pollutant carrying capacity occurs after approximately 20 dry days within an urban watershed (Pitt and Shawley 1982). Therefore, the maximum buildup of copper on impervious areas is estimated as the buildup over 20 dry days. In the LAR Watershed, this is approximately 500 kg of copper (7 mg/VKmT * 1E-6 kg/mg * 0.065 Cu * 20 days * 96 million VKmT/day * 57% imperviousness). The mass of accumulated sediment on a given day is an exponential function of this maximum carrying capacity, residual pollutant not washed off during the preceding runoff event, and dry days prior to the event.

If implemented, State Bill 346 would require new brake pads in the State of California to contain less than 5 percent copper by 2021 and 0.5 percent copper by 2032. Given these changes in copper content in brake pad wear debris, the mass of copper built up on the watershed, and available for wash-off, will be reduced. To account for the gradual introduction of new brake pads into the market, this compliance analysis assumed average copper content could be reduced to 5 percent by the 2028 compliance milestone (allowing for seven years – a typical length of time for consumers to purchase a new car). For the 2024 compliance milestone, an interim average copper content of 5.7 percent provides the basis for direct source control reduction.

Enhanced Street Sweeping

Removal of accumulated sediments and associated pollutants from streets is another institutional BMP that can reduce pollutant loads in runoff entering receiving waterbodies. The City's Bureau of Street Services (BSS) currently operates a street sweeping program that includes over 130 mechanical broom sweepers with a staff of over 100 operators. Citywide, BSS conducts Routine Street sweeping for 7,600 curb-km of posted streets on a weekly basis, and an additional 15,500 curb-km of non-posted or arterial streets on a monthly basis.

Several alternatives exist for BSS to enhance its program by capturing more sediment for roads within the City, including increased frequency of sweeping on non-posted roadways or replacement of aging mechanical broom sweepers within the current fleet with new more efficient types of street sweepers. The City of Dana Point doubled sediment removal by increasing street sweeping from biweekly to weekly (Dana Point 2005). Several studies comparing mechanical broom sweepers to newer high efficiency alternative equipment have shown increases in sediment removal of 35 percent (Pitt 2002), 15 to 60 percent (Minton 1998), and up to 140 percent (Schwarze Industries 2004). This TMDL Implementation Plan uses a conservative target of increasing current sediment removal by 5 percent with enhancements to street sweeping. Additional studies and potential pilot programs, working closely with BSS, will be necessary to evaluate the most effective and suitable approach to achieve this target.

Findings of local studies of accumulation rate and metals composition in street sediment provide necessary information to quantify the metals loading associated with approximately 16,000 curb-km of roads in the City's portion of the LAR Watershed. Sartor and Gaboury (1984) estimated sediment accumulation for impervious surfaces to range from 12 to 21 kg/curb-km/day. In a more recent study to support the Brake Pad Partnership in California, Rosselot (2007) measured a street sediment accumulation rate of 14 kg/curb-km/day. Using this rate of accumulation for 20 days following a washoff event, a maximum carrying capacity of sediment on streets within the City is approximately 6.7 million kg. The mass of accumulated sediment on a given day is an exponential function of this maximum carrying capacity, residual pollutant not washed off during the preceding runoff event, and dry days prior to the event.

Accumulated street sediments contain a high concentration of metals of concern in the LAR Watershed, based on finding of Lau and Stenstrom (2005) from several roadways in the neighboring Ballona Creek Watershed (Table 5-5). These values facilitate quantification of reductions in pollutant buildup for specific metals associated with additional sediment removal from current BSS street cleaning operations.

Table 5-5 Metals of Concern in Street Sediments of the LAR Watershed

Metal	Concentration in Street Sediments (mg/kg) [1]	Maximum Buildup within City of Los Angeles portion of the Watershed (kg)
Cadmium	1.7	7.7
Copper	99	446
Lead	133	599
Zinc	371	1670

[1].Average of values reported by Lau and Stenstrom (2005)

Downspout Disconnection

Rooftop runoff is another source of metals loading in the watershed, due to atmospheric deposition and leaching of building materials. Disconnection of rooftop drainage downspouts involves redirection of rooftop runoff from impervious surface runoff or gutter flow to pervious land where bioretention and infiltration can occur. Reduction in runoff from a property provides a reduction in metals loads, estimated as a function of the accumulation of metals on the roof prior to the runoff event. Due to limited information on types of roofing materials used throughout the watershed, load reductions are quantified based on atmospheric deposition alone. Therefore, estimated reductions are conservative.

Monitoring of metals deposition from the atmosphere onto the LAR Watershed during dry weather occurred during 2002-2003 at three locations spanning the lower and upper portions of the watershed (Lim et. al. 2006). Averages of measured depositional fluxes for metals addressed by this Plan, including copper, lead, and zinc were 21, 19, and 120 $\mu g/m^2/day$, respectively. Applying these fluxes to rooftop area provides an estimate of metals accumulation on roofs as a function of dry days prior to a storm event, applying the same exponential function used for brake pad wear and street sediment accumulation. Using this rate of accumulation for 20 days following a wash-off event, a maximum carrying capacity of metals on an estimated 17,000 acres of residential rooftops within the City is approximately 0.7 kg Cd, 43 kg Cu, 39 kg Pb, and 248 kg Zn. The mass of accumulated sediment on a given day is an exponential function of this maximum carrying capacity, residual pollutant not washed off during the preceding runoff event, and dry days prior to the event.

5.2.2.2 Load Reduction from Distributed BMPs

This Plan evaluated pollutant removal from distributed BMPs selected for implementation. Bioretention along public rights of way also referred to as a Green Street retrofit, is the most widespread distributed BMP selected for implementation. Siting of these BMPs within the public ROW limits potential land acquisition constraints. In addition to capturing overland flow from surrounding properties, bioretention parkways can provide pollutant removal for larger drainage areas by incorporating curb cuts to reroute gutter flow into the BMP. This Plan also includes recommendations for permeable pavement and cisterns to capture runoff from impervious surfaces on select publicly owned properties. Priority 1 distributed BMPs are recommended in 50 catchments as described in Section 4.

Quantification Methodology

Performance of the Priority 1 distributed BMPs used a long-term simulation of runoff from the upstream drainage area and estimated treatment capacity of different types of BMPs located within the catchment. Several key assumptions were necessary to simulate these different BMPs. Permeable pavement projects have sufficient capacity to capture and retain runoff from storms up to 0.75 inch of rainfall over an area twice as large as the permeable pavement footprint. Cisterns to capture rooftop runoff will be sized to capture runoff from up to 0.75 inches of rainfall for use in landscape irrigation after the storm. The tributary area to cisterns and permeable pavement is relatively small, therefore capture and treatment of the runoff from a 0.75 inch storm (equivalent to SUSMP requirements for certain new development and redevelopment projects) is achievable without significantly disrupting existing developments.

Estimation of the treatment capacity of bioretention within public ROWs required analysis of several factors, including the tributary area (A_{trib}) to the BMP, area available for siting a bioretention area ($A_{bioretention}$), and permeability of underlying soil (Pin/hr). Using a drawdown time (t) of 72 hours within the bioretention areas, depth of bioretention media (d) and allowable ponding (l); the treatment capacity, measured by the maximum depth of runoff (R_{in}) captured at a given site is:

$$R_{in} = \frac{[A_{bioretention} * t * P * (d + l)]}{A_{trib} * l}$$

This equation is equivalent to the method documented in the Los Angeles County 2009 BMP Design Manual. Tributary area to bioretention in public ROWs is a function of local topography and roadway drainage. Typically, Green Street bioretention drainage areas are larger than other distributed BMP types, because of the use of curbcuts to route gutter flow to the bioretention area. The available space for bioretention approximated from field observation at opportunity sites accounted for limitations due to other uses of the public ROW, such as for mature trees, driveways, and utilities.

The permeability of underlying soil is highly variable depending upon the location of the BMP in the LAR Watershed. For each of the 50 Priority 1 catchments, the permeability of the underlying soil was extracted by intersecting catchment and soil GIS layers to provide a better estimate of catchment specific infiltration rate for bioretention BMPs. Given all of these factors, if the estimated treatment capacity is less than 0.25 inches of runoff over the BMP tributary area, then it was assumed that underdrains would be used to route BMP effluent to the stormwater system. Table 5-6 summarizes parameters used to represent permeable pavement, cistern, and bioretention BMPs averaged across 50 Priority 1 catchments.

Table 5-6 Summary of Recommended Distributed BMPs within 50 Priority Catchments

Sizing Criteria	Permeable Pavement	Cisterns	Green Streets / Bioretention
Projects	91	247	61 curb miles
BMP Footprint (ac)	42	n/a	16.2
Tributary Area (ac)	74	45	1,277
Runoff Capture (in)	0.75	0.75	0.53 [1]

[1] Tributary weighted average of estimated runoff capture from bioretention BMPs recommended in each of the 50 priority catchments. Runoff capture at individual sites will vary.

SBPAT uses the Stormwater Management Model (SWMM) for hydrologic simulations of runoff and BMP performance. Effluent from distributed BMPs has reduced concentrations of metals for effectively captured and treated runoff. The International BMP Database provides values of effluent concentration from different BMP types, which are used to approximate performance of the recommended BMPs in this Implementation Plan (www.bmpdatabase.org).

Variability of influent and effluent water quality is characterized using SBPAT to perform Monte Carlo analyses for each recommended BMP (Geosyntec 2008a). This simulation involves numerous iterations of the tool, with each using a unique set of influent and effluent metals concentrations inputs selected from a statistical distributions of potential values. To develop sampling distributions for the Monte Carlo analysis, SBPAT uses variability measured in the LADPW 1995-2000 land use monitoring data (http://ladpw.org/wmd/NPDES/IntTC.cfm) for influent EMCs, and ranges of values found in the International BMP database for effluent concentrations (WERF 2008). The pollutant load reduction computed at numerous model iterations provides a range of potential results. To quantify the water quality benefit from distributed BMP implementation in 50 catchments, the average load reduction of all model iterations at a given runoff depth is subtracted from the baseline watershed-wide loading at the same runoff depth. Using runoff depth as opposed to runoff volume aligns BMP load reductions for relatively small tributary areas with the corresponding load over the entire watershed. Table 5-7 shows the incremental metals load reduction from the 50 Priority 1 distributed BMP catchments for different runoff depth intervals.

Table 5-7 Summary of Pollutant Load Reductions Achieved by Recommended Distributed BMPs for different Categories of Storm Event Runoff

	Permeable Pavement, Cisterns, and Bioretention (kg removal/event)		
Runoff (inches)	Total Copper	Total Lead	Total Zinc
< 0.10	0.2	0.1	2.7
0.11 - 0.25	0.5	0.2	6.2
0.26 - 0.50	1.1	0.5	12.4
0.51 - 0.75	1.5	0.7	16.9
0.76 - 1.00	1.8	0.8	20.1
1.01 - 1.50	1.9	0.8	20.5
1.51 - 2.00	2.4	0.9	26.5
> 2.00	2.9	1.1	32.2

The results from these 50 Priority 1 distributed BMP catchments are normalized by tributary acres and runoff inches to extrapolate the total tributary acreage within the City of Los Angeles MS4 in the LAR Watershed requiring a downstream distributed BMP to meet the 2024 and 2028 compliance milestones.

5.2.2.3 Load Reduction from Regional BMPs

This Plan evaluated pollutant removal from four regional BMPs selected for implementation; including detention at Pierce College and Van Nuys Sherman Oaks Park, subsurface flow (SSF) wetlands at a Community Redevelopment Authority property along Compton Creek, and infiltration at North Hollywood Park (see Section 4 for description of these opportunities). Additional regional BMP opportunity sites identified through the desktop and field evaluations may be necessary to meet long-term compliance milestones, but the regional BMP quantitative analysis was limited to the four projects recommended in this Plan (however, as noted in Section 4.5.1, these recommended projects are only preliminary and conceptual in nature).

Quantification Methodology

Performance of the four regional BMPs involved the development of a long-term simulation of runoff from the upstream watershed and capture in a storage unit (infiltration or detention) or series of storage and flow through treatment (SSF wetland with equalization). SBPAT uses the Stormwater Management Model (SWMM) for hydrologic simulations of runoff and BMP performance. Effluent from regional BMPs has reduced concentrations of metals for effectively captured and treated runoff. The International BMP Database provides values of effluent concentration from different BMP types, which are used to approximate performance of the recommended BMPs in this Implementation Plan (www.bmpdatabase.org).

Variability of influent and effluent water quality is characterized using SBPAT to perform Monte Carlo analyses for each recommended BMP (SBPAT Citation). This simulation involves numerous iterations of the tool, with each using a unique set of influent and effluent metals concentrations inputs selected from a statistical distributions of potential values. To develop sampling distributions for the Monte Carlo analysis, SBPAT uses variability measured in the LADPW 1995-2000 land use monitoring (http://ladpw.org/wmd/NPDES/IntTC.cfm) for influent EMCs, and ranges of values found in the International BMP database for effluent concentrations (WERF, 2008). The pollutant load reduction computed at numerous model iterations provides a range of potential results. To quantify the water quality benefit of each recommended regional BMP, the average load reduction of all model iterations at a given runoff depth is subtracted from the baseline watershed-wide loading at the same runoff depth. Using runoff depth as opposed to runoff volume aligns BMP load reductions for relatively small tributary areas with the corresponding load over the entire watershed.

Regional BMP Load Reduction

For each of the four recommended BMPs, a conceptual plan was developed and basic sizing properties were estimated for use in the simulation of runoff capture and treatment. Table 5-8 summarizes sizing variables used in the modeling of each regional BMP. For different BMP types, there are different criteria used in developing conceptual sizing for model inputs:

- Storage volume for an infiltration basin at North Hollywood Park is dependent upon the infiltration rate of the underlying soils, which determines the depth of water that can be stored, while allowing for a 48-hour drawdown time. The runoff capture is then a function of this storage depth and usable open space.
- Storage volume of an extended detention basin at the Pierce College and Van Nuys Sherman Oaks Park sites are a function of the depth of storage and available open space. The depth of storage is assumed to be four feet on average to reduce structural challenges and allow for continued use of the properties for agriculture and baseball fields, respectively, during the growing season. The basin outlet structure is then designed to provide a 48-hour drawdown of captured runoff.
- SSF wetlands adjacent to Compton Creek require capture of runoff in an equalization storage facility prior to being routed through the wetland treatment system. This is due to longer residence times needed as well as potential problems associated with sediment in a wetland system. The size of this equalization storage basin was estimated by comparing peak runoff with the wetland treatment capacity. A portion of the runoff hydrograph exceeding the wetland treatment capacity would requires on-site storage if it were to be routed through the wetland following the runoff event. Guidelines developed for detention sizing developed by Natural Resources Conservation Service (NRCS) provided a basis to optimize the use of available space at these locations for underground detention and wetland footprints (NRCS 1986).

Table 5-8 Summary of Sizing Criteria for Recommended Regional BMPs

Sizing Criteria	Hollywood Park Infiltration Basin	Pierce College Detention Basin	Van Nuys Sherman Oaks Park Detention Basin	Compton Creek SSF Wetland
Drainage Area (ac)	4,360	2,380	1,520	7,100
Available Open Space (ac)	14	39	27	8.5
Average Basin Depth (ft)	4	6	6	4
Treatment Volume (ac-ft)	56	234	162	28
Equalization Volume (ac-ft)	n/a	n/a	n/a	24
Equalization Footprint (acres)	n/a	n/a	n/a	1.6

Table 5-9 shows the incremental metals load reduction from the four recommended regional BMPs for different runoff depth intervals. For Compton Creek and North Hollywood Park, the load reduction achieved does not differ significantly between runoff events, indicating that these two opportunities are limited by their capacity to treat runoff from large watershed relative to the BMP footprint. The combined tributary area to these BMP opportunities is approximately 11,460 acres. One advantage of these opportunities is that during smaller runoff events the capacity of the BMP for load reduction is maximized.

Table 5-9 Summary of Pollutant Load Reductions Achieved by Recommended Regional BMPs for Different Categories of Storm Event Runoff

Runoff (inches)	Compton Creek SSF Wetland (kg removal/event)			North Hollywood Park Infiltration (kg removal/event)			Pierce College Detention (kg removal/event)			Van Nuys Sherman Oaks Park Detention (kg removal/event)		
	TCu	TPb	TZn	TCu	TPb	TZn	TCu	TPb	TZn	TCu	TPb	TZn
< 0.10	1.0	0.2	8.4	0.8	0.3	5.8	0.3	0.1	1.9	0.1	0.0	1.4
0.11 - 0.25	1.1	0.2	9.9	1.5	0.5	10.3	0.6	0.2	4.7	0.4	0.1	3.5
0.26 - 0.50	1.4	0.2	11.8	1.5	0.5	10.2	1.0	0.3	7.9	0.7	0.2	6.5
0.51 - 0.75	1.3	0.2	10.9	1.3	0.4	9.0	1.8	0.6	15.4	1.2	0.3	11.7
0.76 - 1.00	1.2	0.3	10.2	1.6	0.6	11.6	2.2	0.9	20.0	1.5	0.4	15.3
1.01 - 1.50	1.8	0.3	14.9	1.6	0.5	10.4	2.9	1.0	26.2	2.3	0.5	21.9
1.51 - 2.00	1.8	0.2	14.5	1.3	0.5	9.1	3.5	1.1	31.1	2.7	0.7	26.4
> 2.00	1.7	0.3	14.2	1.3	0.4	9.1	3.5	1.5	29.6	3.3	1.0	31.3

Load reductions for the Pierce College and Van Nuys Sherman Oaks Park detention basins are greater for larger storm events, indicating that these sites have the ability to capture and treat runoff from larger storm events in the upstream watershed. This is due to the less restrictive sizing criteria for detention basins and smaller tributary area to these sites, approximately 3,900 acres combined. The results from these four projects are normalized by tributary acres and runoff inches to extrapolate the total tributary acreage within the City's MS4 in the LAR Watershed requiring a downstream regional BMP to meet the 2024 and 2028 compliance milestones.

5.2.2.4 Load Reduction from SUSMP Projects

New development and redevelopment projects required to prepare a SUSMP including BMPs to capture and treat runoff will remove metals loads from a portion of the watershed. Most of these projects will place a large emphasis on the use of LID practices, with the basic principle of keeping runoff on-site. Distributed BMPs recommended in this Plan will be integral components of LID planning. Therefore, the load reduction from a given runoff event per unit acre of tributary area, estimated from the 50 Priority 1 distributed BMP catchments, was extrapolated to quantify metals load reduction from approximately 250 acres of SUSMP projects annually. Over time, the load reduction from new SUSMP projects increases, providing a larger benefit at the later compliance milestones (Table 5-10)

Table 5-10 Summary of Pollutant Load Reductions Estimated from Future SUSMP Projects

Runoff (inches)	2012 (kg removal/event)			2024 (kg removal/event)			2028 (kg removal/event)		
	TCu	TPb	TZn	TCu	TPb	TZn	TCu	TPb	TZn
< 0.10	0.06	0.04	1.01	0.36	0.16	4.03	0.45	0.20	5.04
0.11 - 0.25	0.6	0.08	2.01	0.60	0.31	8.03	0.77	0.38	10.4
0.26 - 0.50	0.08	0.16	4.03	1.15	0.64	16.10	1.51	0.80	20.13
0.51 - 0.75	0.08	0.24	5.51	1.54	0.96	22.05	2.03	1.20	27.57

5.2.2.5 Load Reduction from Existing and Planned BMPs

Recently completed and planned regional BMPs provide a significant extent of treated drainage area within the City's MS4 portion of the watershed, as described in Sections 3 and 4. The metals load reduction that may be associated with these projects is estimated by extrapolating the modeled load reductions, normalized from the four regional BMP simulations by tributary acres and runoff inches, recommended for implementation in this Plan. Many projects occur within the first compliance milestone of 2012, as is the case for many of the Proposition O projects, however additional projects increase the cumulative load reduction as the later compliance milestones are reached (Table 5-11).

Table 5-11 Summary of Pollutant Load Reductions Estimated from Existing and Planned Regional BMPs

Runoff (inches)	2012 (kg removal/event)			2024 (kg removal/event)			2028 (kg removal/event)		
	TCu	TPb	TZn	TCu	TPb	TZn	TCu	TPb	TZn
< 0.10	1.00	0.11	5.45	2.12	1.13	14.75	2.15	1.14	15.08
0.11 - 0.25	1.61	0.12	6.57	2.89	1.33	17.64	2.92	1.34	18.02
0.26 - 0.50	2.83	0.17	8.58	4.68	1.93	23.33	4.72	1.95	23.90
0.51 - 0.75	4.17	0.25	10.59	5.83	1.86	25.59	5.87	1.88	26.33
0.76 - 1.00	5.55	0.27	12.14	7.71	2.41	30.02	7.75	2.43	30.90
1.01 - 1.50	7.23	0.31	16.00	9.90	2.95	40.59	9.94	2.99	41.71

5.3 Compliance Analysis Results

Metals load reductions from each of the elements of the Implementation Plan scheduled for implementation prior to a compliance milestone were summed and removed from the baseline loading to demonstrate compliance with the TMDL for total copper, total lead, and total zinc, as shown in Figures 5-6 through 5-8, respectively. Total copper proved to be the driving constituent, requiring the greatest implementation of BMPs within the City to meet the TMDL compliance milestones. The findings of this analysis were used to develop the phased implementation schedule previously presented in Section 4.

5.4 Uncertainty Analysis

There are many factors considered in the wet weather compliance analysis, thus a quantitative assessment of uncertainty is an important element of this TMDL Implementation Plan. The uncertainty analysis involved a Monte Carlo simulation to evaluate the variation of the many different variables considered in computing baseline load and load reduction achieved from implementation of the various BMPs contained in the Plan. This approach evaluates the full range of possible results by comparing distributions of data rather than means. Consistent with other elements of the quantitative analysis, uncertainty was estimated only for the primary constituent of concern, total copper.

Results provide the projected range of compliance (α=0.05) for the LAR Watershed at the 2012, 2024, and 2028 milestones (Table 5-12). Based on the uncertainty analysis, the mean percent drainage area values all exceed the desired TMDL target, indicating a high expectation that implementation of this Plan will achieve the goals of the TMDL.

Table 5-12 Results of Uncertainty Analysis for Compliance with Los Angeles River Wet Weather TMDL for Total Copper

Compliance Milestone	TMDL Target (% of City of Los Angeles MS4 in Compliance)	Percent of Drainage Area in Compliance Relative to the TMDL Target		
		Mean	Worst Case	Best Case
2012	25%	38%	13%	69%
2024	50%	97%	34%	160%
2028	100%	141%	46%	224%

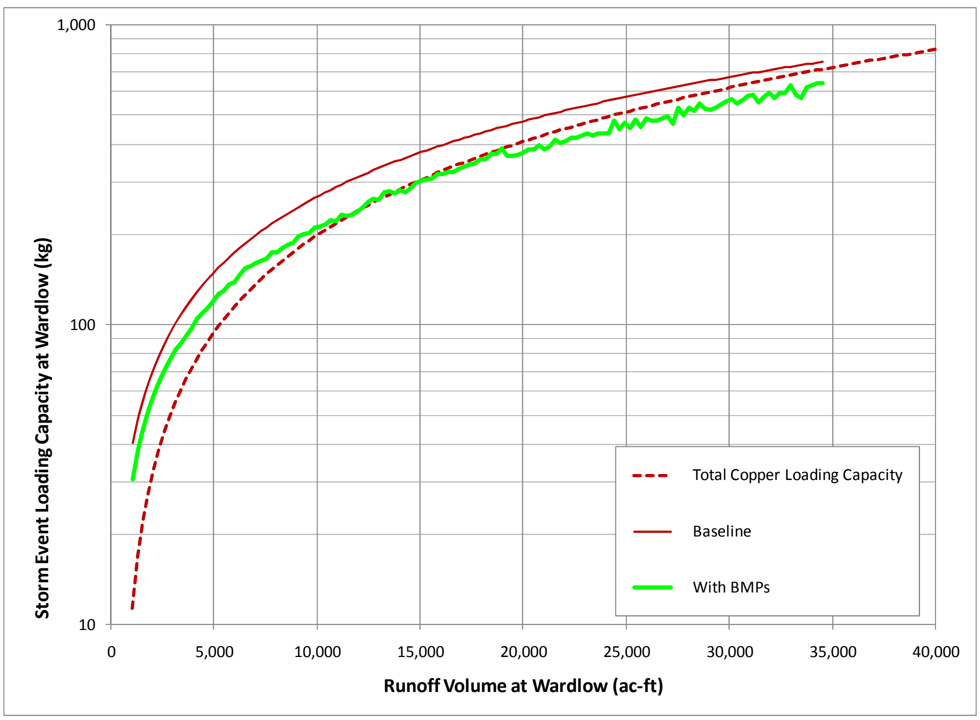

Figure 5-6
Metals Load Reduction from Quantitative Analysis Based on 2028 Compliance Target for Total Copper

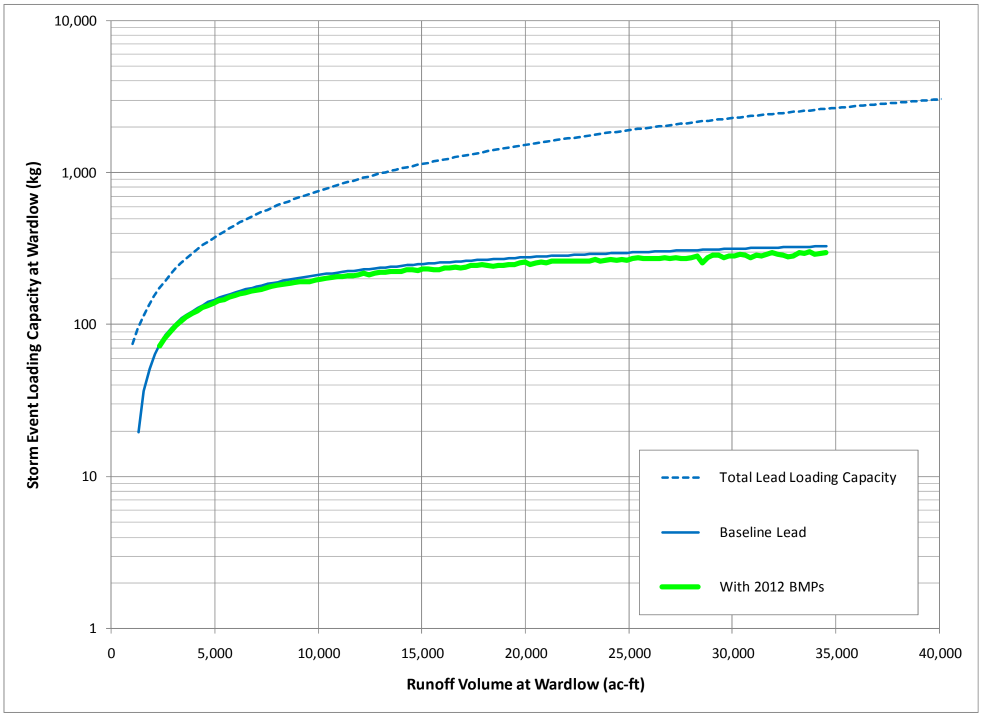

Figure 5-7
Metals Load Reduction from Quantitative Analysis Based on 2028 Compliance Target for Total Lead

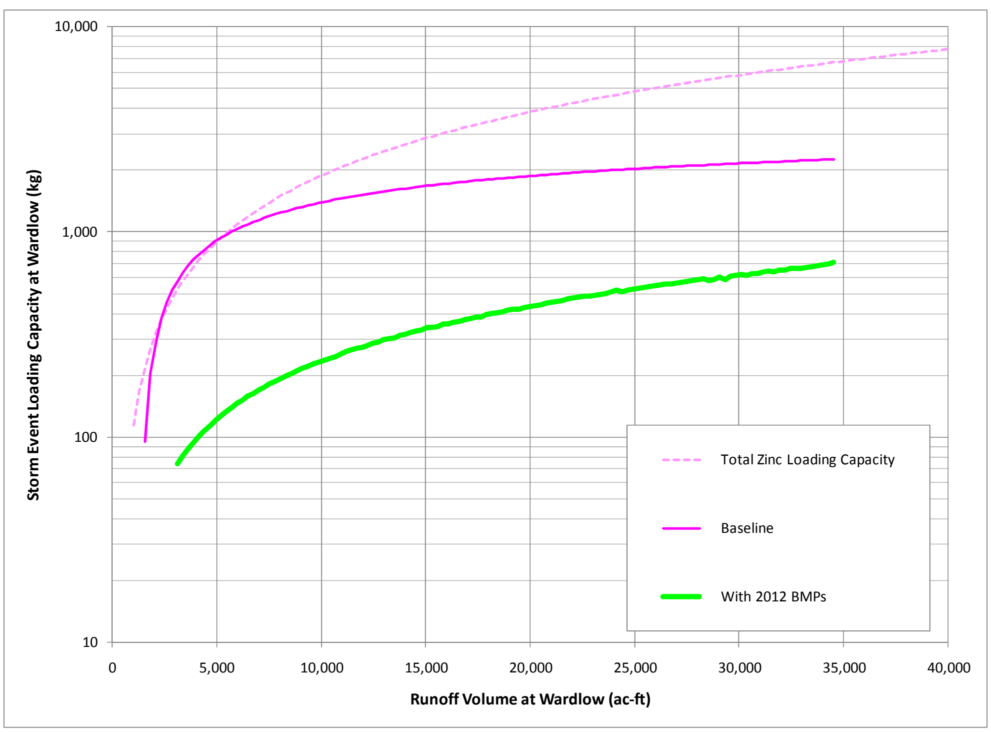

Figure 5-8
Metals Load Reduction from Quantitative Analysis Based on 2028 Compliance Target for Total Zinc

Section 6
Program Costs

6.1 Introduction

Planning-level (order-of-magnitude) capital and operations and management (O&M) cost estimates were developed based on the preliminary project and program concepts presented in Section 4. These estimates are intended to provide decision-makers with an order-of-magnitude sense of what expenditures and staff resources may be anticipated over the period of implementation (through 2028). Given the iterative and adaptive nature of this Implementation Plan and the potential for modifications of selected priority BMP projects the cost estimate should be considered planning level only and for later years should be revisited as the implementation period moves forward.

6.2 Structural BMPs

The Water Environment Research Federation (WERF) Whole Life Cycle cost spreadsheets provide the basis for developing the cost estimates for structural BMPs (www.werf.org/bmpcost). The Whole Life Cycle costing approach was applied to the four Priority 1 regional BMP sites and five representative Priority 1 distributed BMP projects. The distributed BMP cost estimates were then extrapolated to other Priority 1 distributed BMP projects based on the estimated cost per acre of runoff treated in the five cost estimated projects.

Cost estimates for construction of these facilities were prepared using construction cost data prepared for other City of Los Angeles Proposition O projects, revised as necessary from other sources (such as bid tabulations and contacts with vendors and contractors to incorporate features not previously included in Proposition O construction cost estimates). Whole life costs (regular operations and maintenance costs prorated over the expected useful life of the project) were calculated using the spreadsheet model included in the WERF report, *Performance and Whole Life Costs of Best Management Practices and Sustainable Urban Drainage Systems* (WERF 2005).

Appendix G provides the detailed results of the structural BMP cost estimates for each of the four Priority 1 regional BMPs and five representative Priority 1 distributed BMPs. The detailed cost estimates include the present value estimated for the whole life-cycle costs for a 50-year service period.

6.2.1 Structural BMP Capital Costs

Table 6-1 provides a summary of the cost estimate for each of the Priority 1 regional BMPs. Similarly, Table 6-2 summarizes the cost estimate for the representative distributed BMP projects. Total facility capital costs and annual O&M costs are provided. Both tables provide the upstream drainage area "treated" by each BMP project. The total capital and O&M costs are divided by the treated areas to provide "per acre" costs that can be extrapolated to the remainder of the watershed.

Table 6-1 Cost Estimate Summary for Priority 1 Regional BMPs

Regional BMP Site	Total Facility Capital Cost	Total Annual O&M Costs	Acres Treated
Pierce College	$39,100,000	$88,000	2,380
North Hollywood Park	$13,600,000	$155,000	4,360
Van Nuys Sherman Oaks Park	$33,150,000	$132,500	1,520
Compton Creek	$14,300,000	$686,300	7,100
Totals	**$100,150,000**	**$1,061,800**	**15,360**
Average Cost per Treated Acre	**$6,520**	**$69**	

Table 6-2 Cost Estimate Summary for Selected Priority 1 Distributed BMPs

Site #[1]	Total Facility Capital Cost	Total Annual O&M Costs	Acres Treated	Capital Cost per Treated Acre	Maintenance Cost per Treated Acre
Sunnybrae Avenue (LAR Reach 6)	$1,135,600	$44,028	29.2	$38,890	$1,508
Tyrone Avenue (Reach 4)	$447,500	$38,900	25.5	$17,549	$1,525
Laurel Canyon Blvd (Tujunga Wash)	$1,052,000	$42,000	32.4	$32,469	$1,295
Cesar Chavez St. (LAR Reach 2)	$501,000	$32,200	24.0	$20,875	$1,342
Slauson Avenue (Compton Creek)	$2,800,000	$71,500	43.0	$65,116	$1,663
		Total Acres	154.1		
			Average Cost per Treated Acre	$34,979	$1,467

[1] These five sites are intended to be representative of the 50 Priority 1 distributed BMPs. The average cost per treated acre was used to extrapolate costs to other distributed BMP projects.

The facility costs were determined through two steps. First, an assumed unit cost was applied to each estimated conceptual BMP identified for each distributed catchment or regional site in order to calculate the facility base costs. Second, the facility base costs were scaled up to account for the following additional capital costs:

- Project Management, which includes Engineering: Preliminary and Final Design, Topographic Survey, Geotechnical, and Landscape Design
- Utility Relocation
- Legal Services
- Permitting and Construction Inspection
- Contingency

Land acquisition costs (site, easements, etc.) were not included in the cost estimates because the facility sites were selected to be on public property or will be implemented as part of a public/private partnership.

Tables 6-1 and 6-2 present the average per acre capital cost for Priority 1 regional BMPs and representative distributed BMPs of $6,520/acre and $34,979/acre, respectively. These average costs were applied across the watershed to estimate overall structural BMP costs for the Implementation Plan based on the number of acres required needed for treatment by regional and distributed BMPs (see Section 4.6).

6.2.2 Structural BMP Operation and Maintenance Costs

Costs for routine maintenance activities include:

- Inspections
- Reporting and information management
- Vegetation management with trash and minor debris removal
- Vector control

Corrective and infrequent maintenance activities (e.g., unplanned and/or every 3 years or more) include:

- Intermittent facility maintenance
- Sediment removal

The routine and corrective/infrequent O&M costs were summed to calculate an average cost per treated acre. Similar to the capital costs, the average O&M costs were applied across the watershed to estimate overall structural BMP O&M cost for the Implementation Plan based on the number of acres needed for treatment by regional and distributed BMPs (see Section 4.6). Tables 6-1 and 6-2 present the average per acre capital cost for Priority 1 regional BMPs and representative distributed BMPs of $69/acre and $1,467/acre, respectively.

6.3 Institutional BMPs

New program costs were estimated only for the downspout disconnect program. All other institutional program costs are expected to be part of the regular urban runoff management program.

The Implementation Plan includes costs associated with the downspout retrofit program. Compliance is based on the implementation of 2,500 downspout disconnects each year from 2010 until 2028, i.e., for 18 years. Assuming at least 2,500 disconnects are completed each year, a total of 45,000 properties will be retrofitted by 2028. The majority of the retrofits will be on residential properties. The average roof area was estimated to be 2,100 square feet, or 0.05 acres.

Based on the cost estimate for the City WPD downspout retrofit pilot program (City of Los Angeles 2008), which involved downspout disconnection at 600 properties and had a total cost of $1 million, a unit cost per downspout disconnection is estimated to be $1,700 per property.

Based on 45,000 homes being retrofit, the total capital cost is estimated to be $76.5 million. It is assumed that there will be no operation and maintenance cost for the responsible agencies as the retrofit downspouts will be the responsibility of the property owners.

6.4 Implementation Plan Costs

Estimated Implementation costs do not include already funded Proposition O and watershed projects as described in Section 4.2. In addition it is assumed that the SUSMP program will continue at its current level of program funding. Table 6-3 provides an estimate of the new costs associated with the implementation of this Plan. As shown, the total capital cost for structural and institutional BMPs is estimated to be $498,315,600, with $11,485,600 in annual O&M costs.

Table 6-3 Draft Metals TMDL Implementation Plan Costs for Los Angeles River Watershed

Watershed BMPs	Treated Acres	Estimated Capital Cost per Treated Acre	Total Capital Cost	Estimated O&M Costs per acre	Annual O&M
Structural BMPs					
Regional BMPs					
Priority 1 Projects[a]	15,360	$6,520	$100,150,000	$69	$1,061,800
Priority 2 Projects[b]	15,000		$97,800,000		$1,035,000
Distributed BMPs					
Priority 1 Projects[c]	1,400	$34,979	$48,970,600	$1,467	$2,053,800
Priority 2 Projects[d]	5,000		$174,895,000		$7,335,000
Institutional BMPs					
Downspout Disconnection			$76,500,000		$0
Total Cost			**$498,315,600**		**$11,485,600**

[a] Treated acres and estimated costs of Priority 1 regional projects based on BMPs as conceptualized (see Section 4.5.1).

[b] Treated acres estimate based on compliance analysis (see Table 4-12); costs extrapolated from average cost per treated acre developed from Priority 1 regional BMP cost estimates.

[c] Treated acres estimate based on compliance analysis (see Table 4-12). Table 6-2 provides the basis of cost per treated acre from representative project site cost estimates.

[d] Treated acres estimate based on compliance analysis (see Table 4-12); costs extrapolated from per treated acre costs developed from Priority 1 distributed BMP cost estimates.

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