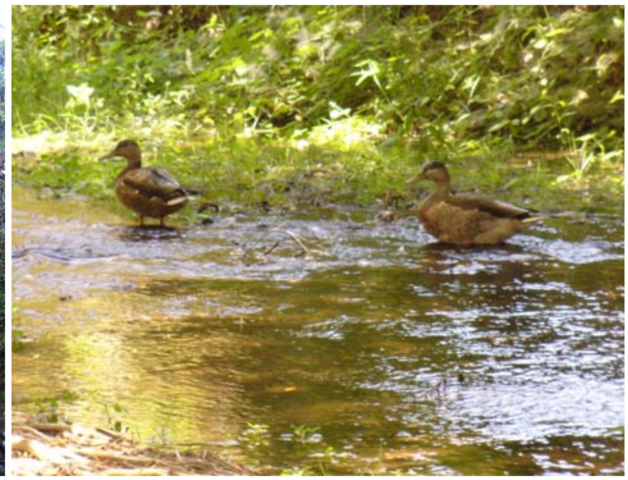
CITY of CALABASAS

Los Angeles River Watershed Metals Total Maximum Daily Load (TMDL) Implementation Plan

For Dry Canyon and McCoy Creeks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LIST OF ACRONYMS

µg/L	Microgram per Liter
BMPs	Best Management Practices
Caltrans	California Department of Transportation
CFS	Cubic Feet per Second
CMP	Coordinated Monitoring Plan
COC	Chain-of-Custody
CTR	California Toxics Rule
CWA	Clean Water Act
DMR	Discharge Monitoring Report
g/day	Gram per day
kg/day	Kilogram per day
LAR Metals TMDL	Los Angeles River and Tributaries Metals TMDL
LARWQCB	Los Angeles Regional Water Quality Control Board
LARWMC	Los Angeles River Watershed Management Committee
mg/kg	Milligram per Kilogram
mg/L	Milligram per Liter
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
QA/QC	Quality Assurance/Quality Control
SOP	Standard Operating Procedure
TC	Technical Committee
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WARM	Warm Freshwater Habitat
WEF	Water Environmental Federation
WILD	Wildlife Habitat
WLAs	Waste Load Allocations
WP	Water Pollution

EXECUTIVE SUMMARY

This Implementation Plan was prepared in response to Resolution No. R2007-014 wherein the California Water Quality Control Board, Los Angeles Region (LARWQCB), incorporated the Los Angeles River and Tributaries Metals Total Maximum Daily Load (LAR Metals TMDL) into the Water Quality Control Plan – Los Angeles Region. This Implementation Plan will focus only on those measures the City of Calabasas will undertake to meet the requirements of the LAR Metals TMDL within its jurisdictional boundary.

The Los Angeles River is one of the most polluted water bodies in Southern California. Major pollutants of concern include: trash, bacteria, metals, nutrients, oils, and trash. In accordance with the Federal Water Quality Act also known as *Federal Water Pollution Control Act*, *t*he Environmental Protection Agency (EPA) and its local executive branch (Los Angeles Regional Quality Control Board) are commissioned to identify the maximum allowable pollutant loadings for each water body and establish mandates to local jurisdictions to improve water quality within a time frame. Dry Canyon and McCoy Canyon Creeks are separately listed as impaired water bodies for several constituents, including Selenium.

The LAR Metals TMDL sets forth dry and wet-weather waste load allocations (WLAs) that 40 cities, as well as the County of Los Angeles and Caltrans, must meet over time. Approximately 5.58 square miles of the City of Calabasas lies within the Los Angeles River Watershed which represents 0.9% of the Los Angeles River Watershed. Calabasas lies in Reach 6 of Los Angeles River that is also shared by City of Calabasas, Hidden Hill, Los Angeles and County of Los Angeles and Caltrans. The City has participated and makes financial contributions towards the Metals TMDL coordinated monitoring program required by the LAR Metals TMDL.

The City's review of the dry-weather monitoring results for the relevant sampling period shows that for Reach 6, copper, lead, and zinc are well under numeric targets. If copper and lead waste load allocation exceedances occur at tier 1 and 2 monitoring stations then the city will communicate with other responsible agencies in Reach 6 to conduct sampling at Tier 3 monitoring locations this would be applicable to both dry and wet weather conditions.. Due to the high volume of traffic on 101 Freeway, City of Calabasas staff believes that a location downstream of the freeway would provide valuable data for Tier 3 monitoring.

Selenium concentrations in Reach 6 remain higher than the dry-weather numeric targets. Separate water collections samples within the 2 Calabasas creeks were conducted by City staff indicate that the level of Selenium at city boundaries (exit point) of both creeks are below detection limits. It must be noted that as indicated in the LARWQCB LAR Metals TMDL Staff Report of 2005 and the related Basin Plan Amendment, the high selenium values are due to naturally occurring elements and geological deposits.

This document will serve as a guideline for the implementation of various best management practices necessary to address listed TMDL objectives. Effective water quality monitoring and data analysis is necessary in order to properly assess the condition of the Los Angeles River and to improve water quality of the two Calabasas creeks that drain into reach 6 of the Los Angeles River. To address water quality concerns, specifically high concentration levels of selenium, an integrated approach to target these concentrations was achieved by following strict monitoring procedures that were administered at each of the outfall locations.

The City has provided general background information and water quality data results that seem to demonstrate selenium as a natural occurring element in both Dry Canyon and McCoy Creek Watersheds. Current water quality data taken from September 2009 shows less than 0.0050 microgram per liter of selenium (below detection limit) at City exit limits. The regional board is currently involved with a special study that is researching naturally occurring selenium in both watersheds.

INTRODUCTION

The City of Calabasas Implementation Plan outlines the approach that the City will take to attain the waste load allocations (WLAs) set forth in and in response to Resolution No. R2007-014, titled the *Amendment to the Water Quality Control Plan – Los Angeles Region to incorporate the Los Angeles River and Tributaries Metals TMDL* (LAR Metals TMDL) and adopted by the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) on September 6, 2007 and as effective October 29, 2008. While the goal is to protect water quality throughout the Los Angeles River and its tributaries, this Plan will focus only on areas within the City as required by the LAR Metals TMDL. This Plan outlines the current and future tasks, including timelines. The City has and will undertake to demonstrate how compliance will be achieved.

The LARWQCB developed the Los Angeles River and Tributaries Metals Total Maximum Daily Load (LAR Metals TMDL) to address impairments resulting from the concentrations of Cadmium, Copper, Lead, Selenium and Zinc occasionally exceeding the California Toxics Rule (CTR) standards. The identified beneficial use impairments include wildlife habitat (WILD), rare threatened or endangered species (RARE), warm freshwater habitat (WARM), wetlands (WET), and groundwater recharge (GWR). The Metals TMDL, which became effective on January 11, 2006, has been incorporated as an amendment to the regional Basin Plan.

Section 303(d) of the 1972 Federal Water Pollution Act (Clean Water Act or CWA) mandates that a list of impaired receiving water bodies be developed and maintained for each state. The California State Water Resources Control Board (SWRCB) adopted the 303(d) lists in 1998, 2002, 2006, and 2008. Based on a number of critical assumptions, the state may then prioritize and address these impairments through development of Total Maximum Daily Loads (TMDLs) that estimate the load of the constituent(s), which can be assimilated by the water body without inducing the impairment. The March 22, 1999 Consent Decree between Non-Governmental Organizations (NGOs) and the United States Environmental Protection Agency (USEPA), in consultation with the Los Angeles Regional Water Quality Control Board (LARWCB), was used to prioritize impaired water bodies, impairment causing constituents, and the TMDL schedule for LOS Angeles and Ventura Counties.

The City has been monitoring selenium levels in both Dry Canyon Creek and McCoy Creek watershed since 2006. In addition to the water quality monitoring and analysis done by the City, we have enlisted the research of reputable third parties including: Heal the Bay, Mountains Restoration Trust, the Las Virgenes Municipal Water District, a graduate research dissertation of a Cal State-LA geology student.

In 2006, Calabasas produced a Creeks Master Plan[1] that highlighted restoration and best management practices for all major creeks located within the City. Recent data findings along with information contained in the Creeks Master Plan have lead to several priority projects in each listed watershed. Throughout the monitoring process, the City has used the Best Management Practices (BMP's) technique which is the most efficient way to develop a comprehensive Implementation Plan.

[1] http://www.cityofcalabasas.com/pdf/creek-masterplan/creeks-master-plan.pdf

CHAPTER ONE

TOTAL MAXIMUM DAILY LOAD – TMDL

1.1 What is a TMDL?

The Federal Clean Water Act Section 303(d) requires that States identify waters that do not or are not expected to meet water quality standards (beneficial uses, water quality objectives and the antidegradation policy) with the implementation of technology-based controls. Once a waterbody has been placed on the 303(d) list of impaired waters, states are required to develop a Total Maximum Daily Load (TMDL) to address each pollutant causing impairment. A TMDL defines how much of a pollutant a waterbody can tolerate and still meet water quality standards.

Each TMDL must account for all sources of the pollutant, including: discharges from wastewater treatment facilities; runoff from homes, forested lands, agriculture, streets or highways; contaminated soils/sediments, legacy contaminants such as DDT and PCBs on-site disposal systems (septic systems) and deposits from the air. Federal regulations require that the TMDL, at a minimum, account for contributions from point sources (permitted discharges) and contributions from nonpoint sources, including natural background. In addition to accounting for past and current activities, TMDLs may consider projected growth that could increase pollutant levels. TMDLs allocate allowable pollutant loads for each source, and identify management measures that, when implemented, will assure that water quality standards are attained.

California state law (Porter-Cologne Water Quality Control Act, California Water Code Section 13000 et. seq.) requires the Regional Board to formulate and adopt water quality control plans, or Basin Plans, for all areas within its region. The Basin Plans must include an implementation plan that describes how the established water quality standards will be met. TMDLs, with their associated implementation plans, are adopted into the Basin Plans through the Basin Planning process.

1.2 TMDL Elements

A complete TMDL must contain all of the following elements:

1. Problem Statement: Describes the water body, impaired beneficial uses, and pollutant(s) causing the impairment.
2. Numeric Targets: Expresses the desired condition of the water body to protect beneficial uses. Defines indicators and associated target(s) necessary to meet numeric or narrative water quality objectives.
3. Source Analysis: Assesses the relative contributions of different pollutant sources or causes and the extent of necessary reductions/controls.
4. Linkage Analysis: Describes the relationship between numeric target(s) and sources and estimates the ability of the water body to assimilate the pollutant.
5. Allocations: Allocates responsibility for pollutant reduction. Allocations may be specific to agencies or persons (businesses), or general by source category or sector. The sum of individual allocations must equal the total allowable pollutant level.
6. Margin of Safety: Accounts for uncertainty associated with calculating pollutant loads and their impact on water quality. The margin of safety may be implicit (i.e., through use of conservative assumptions) or explicit (i.e., by assigning a specific allocation to the margin of safety).
7. Implementation Plan: Details pollution prevention, control, and restoration actions, responsible parties and schedules necessary to attain water quality standards. Identifies enforceable measures (e.g. prohibition) and triggers for Regional Board action (e.g., performance standards).
8. Monitoring/Re-evaluation: Describes the monitoring strategy that will be used to evaluate the effectiveness of the TMDL and a schedule for reviewing and, if necessary, revising the TMDL and associated implementation elements.

1.3 Los Angeles River Metals TMDL

Segments (*i.e.,* Reach 6) of the Los Angeles River and its tributaries (i.e., Dry Canyon Creek and McCoy Canyon Creek) are included on the California 303(d) list of impaired water bodies, according to the Los Angeles River Water Quality Control Board, for exceeding the water quality standards. The Clean Water Act (CWA) requires that a TMDL be developed to restore the impaired water bodies to their full beneficial uses.

1.3.a Regulatory Background

Section 303(d) of the Federal Water Pollution Control Act (FWPCA) of 1972 and its amendments require that each State “shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality objective applicable to such waters.” The FWPCA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and to establish TMDLs for such waters.

The elements of a TMDL are described in section 303(d) of the CWA, as well as in the U.S. Environmental Protection Agency guidance (USEPA, 2000a). A TMDL is defined as the “sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" such that the capacity of the water body to assimilate pollutant loads (the loading capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis.

The LAR Metals TMDL was adopted as an amendment to the Regional Water Quality Control Plan for the Los Angeles Region (Basin Plan) by the LARWQCB on June 2, 2005 (Appendix A) and approved by the USEPA on December 22, 2005 (Appendix C). This TMDL became effective January 11, 2006 with the following actions required:

- If conducted, Special Studies Results must be submitted 4 years after the effective date of the TMDL. Due date: January 11, 2010.
- A Draft Implementation Plan must be submitted 4 years after the effective date of the TMDL. Due date: January 11, 2010.
- A Final Implementation Plan must be submitted 4.5 years after the effective date of the TMDL. Due date: July 11, 2010.
- Five years after the effective date of this TMDL the LARWQCB will reconsider it, including certain provisions based on new data, some of which will be collected under this monitoring plan. Projected date: January 11, 2011.
- Responsible jurisdictions and agencies are required to achieve conformance with the Metals TMDL.

1.3.b Compliance Schedule

Responsible jurisdictions and agencies are required to achieve conformance with the Metals TMDL according to the following schedules:

- Six years after the effective date of the TMDL, the MS4 and Caltrans NPDES permittees shall demonstrate that 50% of the total drainage area served by the MS4 is effectively meeting the dry-weather WLAs and 25% of the total drainage area served by the MS4 is effectively meeting the wet-weather WLAs. Projected compliance date: January 11, 2012.
- Fourteen years after the effective date of the TMDL, the MS4 and Caltrans NPDES permittees shall demonstrate that 75% of the total drainage area served by the MS4 is effectively meeting the dry-weather WLAs. Projected compliance date: January 11, 2020.
- Eighteen years after the effective date of the TMDL, the MS4 and Caltrans NPDES permittees shall demonstrate that 100% of the total drainage area served by the MS4 is

effectively meeting the dry-weather WLAs and 50% of the total drainage area served by the MS4 is effectively meeting the wet-weather WLAs. Projected compliance date: January 11, 2024.

- Twenty-two years after the effective date of the TMDL, the MS4 and Caltrans NPDES permittees shall demonstrate that 100% of the total drainage area served by the MS4 is effectively meeting both the dry-weather and wet-weather WLAs. Projected compliance date: January 11, 2028.

1.4 Section 303 (d) of the Clean Water Act

The goal of the Clean Water Act (CWA) is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters". Under section 303(d) of the CWA, states, territories, and authorized tribes, collectively referred to in the act as "states," are required to develop lists of impaired waters. These are waters for which technology-based regulations and other required controls are not stringent enough to meet the water quality standards set by states.

The term "303(d) list" is short for the list of impaired and threatened waters (stream/river segments, lakes) that the Clean Water Act requires all states to submit for EPA approval every two years. The states identify all waters where required pollution controls are not sufficient to attain or maintain applicable water quality standards, and establish priorities for development of TMDLs based on the severity of the pollution and the sensitivity of the uses to be made of the waters, among other factors. States then provide a long-term plan for completing TMDLs within 8 to 13 years from first listing.

EPA policy allows states to remove waterbodies from the list after they have developed a TMDL or after other changes to correct water quality problems have been made. Occasionally, a waterbody can be taken off the list as a result of a change in water quality standards or removal of designated uses; however, designated uses cannot be deemed unattainable and removed until a thorough analysis clearly shows that they cannot be attained.

Regulations say states must evaluate "all existing and readily available information" in developing their 303(d) lists. Usually due to a lack of resources, most state water quality agencies are able to monitor only a small percentage of their waters consistently enough to detect water quality problems. Many state agencies use data collected from outside organizations and the public to compile their lists. There are usually requirements for data collection and submission before state agencies will consider the data.

In addition, the CWA also requires that each state report on the health of *all* its waters, not just those that are impaired. Information from this report, known as the 305(b) report or "biennial water quality report," has historically been used to develop the "threatened and impaired waters" list. Most states compile the data and findings from the 305(b) report and add information from other sources, such as the state's report of waters affected by nonpoint sources, to produce the 303(d) list. EPA recommends that states combine the threatened and impaired waters list, 303(d) report, with the 305(b) report to create an "Integrated Report," due April 1 of even-numbered years.

EPA then has 30 days to approve or disapprove the 303(d) or Category 5 lists. If EPA disapproves a state list, EPA has 30 days to develop a new list for the state; although historically, EPA has rarely established an entire list for a state. Usually EPA partially disapproves a list because some waters have been omitted and adds these few waters to the state's list.

1.5 Numeric Target and Load Allocations

Numeric Targets, also referred to a water quality targets, express the desired condition of the water body to protect restore beneficial uses and human health. These targets are indicators that are necessary to meet numeric or narrative water quality objectives. These targets may include state/federal numerical water quality standards or narrative standards, i.e. within the range of "natural" conditions. Establishing targets to restore beneficial uses is challenging and sometimes controversial. For example, the restoration of a fishery may require reducing temperatures, nutrients, sediments, and improving habitat. Necessary values for each pollutant target to restore fisheries can be uncertain. The potential for a water body to support a fishery even in a pristine state can be uncertain.

Load allocations are equally challenging as setting targets. Load allocations provide a framework for determining the relative share of natural sources and human sources of pollution. The natural background load for a pollutant may be imprecisely understood. Industrial dischargers, farmers, land developers, municipalities, natural resource agencies, and other watershed stakeholders each have a vested interest in the outcome. In addition, load allocations are responsible for pollutant reduction. Allocations may be specific to agencies or persons (businesses), or general by source category or sector. The sum of individual allocations must equal the total allowable pollutant level.

The LAR Metals TMDL dry and wet-weather numeric water quality targets are based on the numeric standards in the California Toxics Rule (CTR). The LAR Metals TMDL dry-weather numeric targets are expressed in terms of total recoverable metals in micrograms per liter (µg/L) to address the potential transformation between total recoverable and dissolved fractions of the various metals. Wet-weather targets were calculated on a mass balance method using a kilogram per day (kg/day) method. Separate targets were developed for dry and wet-weather because hardness values and flow conditions in the LA River vary significantly between dry and wet-weather.

1.6 Water Quality Targets

The purpose of water quality targets is to protect or restore beneficial uses and protect human health. These targets may include state/federal numerical water quality standards or narrative standards, i.e. within the range of "natural" conditions. Establishing targets to restore beneficial uses is challenging and sometimes controversial. For example, the restoration of a fishery may require reducing temperatures, nutrients, sediments, and improving habitat. Necessary values for each pollutant target to restore fisheries can be uncertain. The potential for a water body to support a fishery even in a pristine state can be uncertain.

1.7 Irrigation and Stormwater Runoffs

1.7.a Dry Weather Numeric Targets

Over the last decade, efforts to manage water quality have concentrated mainly on stormwater, which is perceived to be the largest source of pollutant loading. However, dry weather pollutant loadings may also constitute a significant impact to water quality in terms of both concentration and load. For instance, in six urban watersheds in the Los Angeles region, dry weather loading accounted for 20 to 50% of the total annual load of metals depending on the year's rainfall

Southern California is characterized by a dry Mediterranean climate with limited annual precipitation, the majority of rainfall occurs in the winter, with an average of only 37 rainfall days per year (Ackerman and Weisberg 2003, Nezlin and Stein 2005). Thus, dry weather flow can constitute a significant portion of total annual flow, particularly during dry years. Although concentrations of pollutants in dry weather flow might be relatively low (Mizell and French 1995, Duke *et al.* 1999), dry weather flow can be a chronic source of pollution and may impose threats to aquatic life because of its consistent contribution (Bay and Greenstein 1996, Stein and Tiefenthaler 2005, Stein and Ackerman 2007, Ackerman *et al.* 2003).

Dry-weather numeric targets are based on whichever is the most limiting of either the chronic or the acute CTR criteria. For copper and lead these are the chronic criteria, while for zinc, it is the acute criterion. The dry-weather numeric targets for copper, lead, and zinc are dependent on hardness and metals translator factors. The dry-weather numeric target for selenium is independent of hardness or conversion factors. The dry-weather numeric targets for selenium is 5 µg, apply to days when the maximum daily flow in the LA River, measured at the Wardlow Road gauge station[2] in Reach 1, is less than 500 cubic feet per second (cfs). Once flow becomes greater than 500 cfs, wet-weather targets apply.[3]

1.7.b. Wet Weather Numeric Targets

Stormwater runoff has been recognized as a major source of pollution to many of the nation's waterways (Characklis and Wiesner 1997, Davis *et al.* 2001). In southern California, pollutants

[2] The Wardlow gauge station is located in the City of Long Beach south of Wardlow Road and North of Willow Street. The site receives approximately 98% of flow from the total watershed.
[3] The 500 cfs represents the 90th percentile of average daily flow at the Wardlow gauge station during the period from 1998 to 2000.

associated with stormwater have been shown to result in significant ecological effects in local receiving waters of the Southern California Bight (Bay and Greenstein 1996, Noble *et al.* 2000, Schiff 2000). Consequently, much effort and resources have been devoted to the evaluation and management of stormwater (USEPA 1995, Wong *et al.* 1997, Ackerman and Schiff 2003, Ahn *et al.* 2005). One of the challenges associated with stormwater management is accounting for the impact of biogenic inputs, or the natural contribution from undeveloped areas (natural loadings) on overall water quality.

Unlike man-made compounds, such as Polychlorinated Biphenyls (PCBs), many constituents found in stormwater, such as metals, nutrients, and solids, can originate from natural, as well as anthropogenic, sources.[4] Therefore, high levels of these constituents may not directly indicate a water quality problem, and it may be difficult to differentiate anthropogenic effects and natural variability in the system. Existing ambient monitoring programs typically include a few reference streams in relatively undeveloped areas, but mainly focus on dry weather water quality and devote little, if any, resources for characterizing reference conditions for stormwater runoff.

To compensate for the lack of data on natural stormwater loadings, water quality standards, such as TMDLs, are often written using load allocations based on data from other parts of the country or, with anecdotal data from previous time periods. As a result, these standards may be ineffective or overly stringent. Quantification of stormwater loads from natural areas in southern California would help remedy this situation.[5]

1.8 Monitoring Requirements

The LARWQCB identified three monitoring objectives in association with Metals TMDL. The first is to collect data (e.g., hardness, flow, and background concentrations) to evaluate the uncertainties and assumptions made during development of the TMDL. The second is to collect data to assess compliance with the waste load allocations. The third is to collect data to evaluate potential management scenarios. To achieve these objectives, the LARWQCB suggested utilizing:

(1) ambient monitoring,
(2) effectiveness monitoring and
(3) special studies.

Water quality monitoring provides the data to characterize waters and identify changes or trends in water quality over time. The collection of monitoring data enables states to identify existing or emerging water quality problems and determine whether current pollution control mechanisms are effective in complying with the regulations. The Clean Water Act (CWA)

[4] Assessment of Water Quality Concentrations and Loads from Natural Landscapes. Eric Stein. SCCRP. Feb. 2007.
[5] Assessment of Water Quality Concentrations and Loads from Natural Landscapes. Eric Stein. SCCRP. Feb. 2007.

requires that each state monitor and assess the health of all their waters and report their findings every two years to EPA. This list of data and findings is called the 305(b) report or "biennial water quality report."

Under section 303(d), monitoring data as well as other information, must be used by the states to develop a list of "water-quality limited segments," i.e., waters that will not meet water quality standards for a particular pollutant even after a technology-based permit is in place. States must develop TMDLs, or Total Maximum Daily Loads, for every water body/pollutant combination on the 303(d) list.

Water quality standards are the foundation of the water-quality based control program mandated by the Clean Water Act. Water quality standards define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from pollutants. A water quality standard consists of four basic elements:

1. Designated uses of the waterbody (*e.g.* recreation, water supply, aquatic life, agriculture),
2. Water quality criteria to protect designated uses (numeric pollutant concentrations and narrative requirements),
3. An antidegradation policy to maintain and protect existing uses and high quality waters,
4. General policies addressing implementation issues (*e.g.*, low flows, variances, mixing zones).

By adopting water quality standards, states are able to determine which healthy waters need protection, which waters must be restored and how much pollutant reductions are needed. Consequently, these water quality standards set a goal for restoring and protecting a watershed over the long term.

1.9 Development History of Los Angeles River Metals TMDLs

States must develop water quality management plans to implement the TMDL. The USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the SWRCB and the nine RWQCBs are responsible for preparing lists of impaired water bodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If USEPA disapproves a TMDL submitted by a state, USEPA is required to establish a TMDL for that water body. The RWQCBs also hold regulatory authority for many of the instruments used to implement the TMDLs, such as the National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

The LARWQCB identified over 700 water body-pollutant combinations in the Los Angeles Region requiring TMDLs (LARWCQB, 1996, 1998a). These are referred to as “listed” or “303(d) listed” water bodies or water body segments. In December 1997, the Natural Resources

Defense Council (NRDC), acting as legal representative for Heal the Bay, Inc., and Santa Monica BayKeeper, Inc., filed a Notice of Intent to sue the USEPA over failure of the LARWQCB to adequately implement the 303(d)/TMDL Program. In December 1998, NRDC and BayKeeper entered into a Federal Consent Decree with the USEPA. The Consent Decree combined the more than 700 water body-pollutant combinations into 92 TMDL analytical units, which are water quality limited segments and associated pollutants for which TMDLs must be developed. A schedule for development of TMDLs in the Los Angeles Region was established in this consent decree.

This TMDL addresses Analytical Unit (AU) #13 of the Consent Decree, which consists of segments of the Los Angeles River and tributaries with impairments by metals (cadmium, copper, lead, selenium, and zinc). The Consent Decree schedule requires that this TMDL be completed by March 22, 2004. If the LARWQCB fails to develop the TMDL, USEPA must promulgate the TMDL by March 22, 2005.

USEPA and the consent decree plaintiffs agreed to extend the completion deadline to December 22, 2005, in order to enable the State to complete its adoption process and USEPA to approve the State-adopted TMDLs for this water body. The 2002 303(d) listings approved in 2003 are not required to be addressed per the Consent Decree; however, where appropriate, this TMDL addresses those listings as well. These TMDLs have not been specifically scheduled in the Consent Decree, but are required to be completed by 2012.

The Metals TMDL has been adopted as an amendment to the Regional Board's *Water Quality Control Plan for the Los Angeles Region* (Basin Plan). The Secretary of Resources has certified the basin planning process as exempt from certain requirements of the California Environmental Quality Act (CEQA), including preparation of an initial study, negative declaration, and environmental impact report. The Basin Plan amendment and supporting documents and the CEQA checklist are considered substitute documents to an initial study, negative declaration, or environmental impact report.

LARWQCB staff held a CEQA Scoping meeting on April 23, 2004 in order to receive stakeholder input on the scope and content of the TMDL documents. LARWQCB Staff presented an overview of reasonably foreseeable means of compliance with the TMDL in order to facilitate the scoping discussion and to identify possible impacts of the TMDL implementation. The TMDL was approved by the USEPA and became effective on January 11, 2006.

CHAPTER TWO

THE BASIN PLAN

Water quality standards are found in the Basin Plan. The Basin Plan is updated every two years with current water quality information. Water quality standards include various beneficial uses and objectives necessary to protect them. The Basin Plan document includes coastal watersheds for both Los Angeles and Ventura Counties.

2.1 Function

The Los Angeles Regional Board's Basin Plan is designed to preserve and enhance water quality and protect the beneficial uses of all regional waters. Specifically, the Basin Plan

(i) designates beneficial uses for surface and ground waters,

(ii) sets narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to the state's antidegradation policy, and

(iii) describes implementation programs to protect all waters in the Region.

In addition, the Basin Plan incorporates (by reference) all applicable State and Regional Board plans and policies and other pertinent water quality policies and regulations. The Basin Plan is a resource for the Regional Board and others who use water and/or discharge wastewater in the Los Angeles Region. Other agencies and organizations involved in environmental permitting and resource management activities also use the Basin Plan. Finally, the Basin Plan provides valuable information to the public about local water quality issues.

The Basin Plan can also be downloaded from the LARWQCB's website:
http://www.swrcb.ca.gov/rwqcb4/html/meetings/tmdl/Basin_plan/basin_plan.html

2.2 Amendments

Amending the Basin Plan involves the preparation of an amendment, an environmental checklist, and a staff report. Public workshops can be held to inform the public about planning issues before formal action is scheduled on the amendments. Following a public review period of at least 30 days, the Regional Board responds to public comments. Subsequently, the Regional Board can take action on the draft amendments at a public hearing. The California Environmental Quality Act (CEQA) provides that the Secretary of Resources can exempt regulatory programs of state agencies from the requirements of preparing environmental impact reports, negative declarations, and initial studies should such programs be certified as "functionally equivalent."

Following adoption by the Regional Board, Basin Plan amendments and supporting documents are submitted to the State Board for review and approval. All Basin Plan amendments approved by the State Board after June 1, 1992 must also be reviewed and approved by the State Office of Administrative Law (OAL). All amendments take effect upon approval by the OAL. In addition, the USEPA must review and approve those Basin Plan amendments that involve changes in state standards to ensure such changes do not conflict with federal regulations.

2.3 Water Resources & Quality Issues

Surface and ground waters within the Los Angeles Region have proven insufficient to support the rapidly growing population in the Los Angeles Region. Water imported from other areas now meets about 50% of fresh water demands in the Region. Restrictions on imported water as well as drought conditions have necessitated water conservation measures which, at present, are voluntary. These conservation measures have slightly lessened the use of potable water in many areas of the Region. In addition, the demand for water is being partially fulfilled by the increasing use of reclaimed water for non-potable purposes such as greenbelt irrigation and industrial processing and servicing.

2.3.a. Surface Waters:

Major surface waters of the Los Angeles Region flow from head waters in pristine mountain areas (largely in two National Forests and the Santa Monica Mountains), through urbanized foothill and valley areas, high density residential and industrial coastal areas, and terminate at highly utilized recreational beaches and harbors. Uncontrolled pollutants from nonpoint sources are believed to be the greatest threats to rivers and streams within the Region.

2.3.b. Ground Waters:

Ground water accounts for most of the Region's local (Le., non-imported) supply of fresh water.. The general quality of ground water in the Region has degraded substantially from background levels. Much of the degradation reflects land uses. For example, fertilizers and pesticides, typically used on agricultural lands, can degrade ground water when irrigation-return waters containing such substances seep into the subsurface.

In areas that are unsewered, nitrogen and pathogenic bacteria from overloaded or improperly sited septic tanks can seep into ground water and result in health risks to those who rely on ground water for domestic supply. In areas with industrial or commercial activities, aboveground and underground storage tanks contain vast quantities of hazardous substances. Thousands of these tanks in the Region have leaked or are leaking, discharging petroleum fuels, solvents, and other hazardous substances into the subsurface. These leaks as well as other discharges to the subsurface that result from inadequate handling, storage, and disposal practices can seep in the subsurface and pollute ground water.

CHAPTER THREE

THE LOS ANGELES RIVER WATERSHED

3.1 Background Information

The Los Angeles River Watershed covers an area of approximately 834 square miles (528 acres) and is located in the coastal plain of the Los Angeles Basin, and includes the San Fernando Valley, and portions of the San Gabriel Valley. The watershed includes 40 Cities, unincorporated areas of Los Angeles County, and Caltrans. Its boundaries are defined by the Santa Monica Mountains to the north and west, the San Gabriel Mountains to the north and east, and the Los Angeles Coastal Plain to the south. The Los Angeles River Watershed is divided by the LARWQCB into six jurisdictional groups based on river reach; the City of Calabasas is located in reach 6.

Map 1 – The Los Angeles River

During dry weather, most of the flow in the LA River is comprised of wastewater effluent from the Tillman, Los Angeles-Glendale and Burbank treatment plants. In the dry season, POTW mean monthly discharges totaled 70% to 100% of the monthly average flow in the LA River. The median daily flow in the LA River is 94 *mgd* (145 cfs), based on flows measured at the LACDPW Wardlow station over a 12-year period (October 1998 through December 2000). During wet weather, flow may increase by two to three orders of magnitude due to storm water runoff.

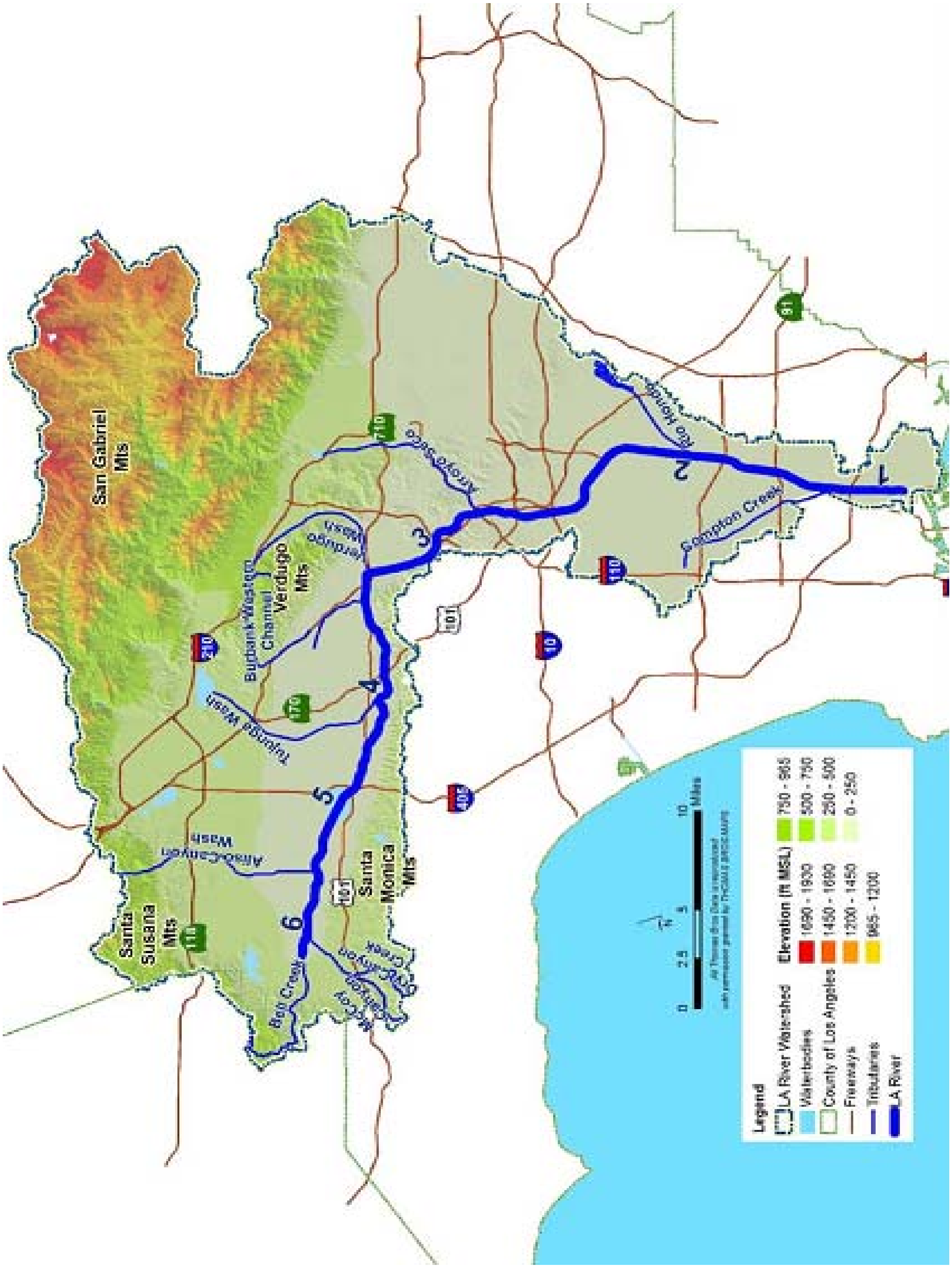
3.2 Headwaters of Los Angeles River

The headwaters of the Los Angeles River are mostly classified as forest and include the Angeles National Forest in the Santa Monica, Santa Susana, and San Gabriel Mountains, which comprise approximately 200 square miles (24%) of the watershed. In addition, the more urban uses are found in the lower portions of the watershed, where approximately 36% of the land use can be categorized as residential, 20% open or natural space, 10% as industrial, 8% as commercial, and 3% as agriculture, water and other.

The Los Angeles River begins in Canoga Park at the confluence of Bell Creek and Arroyo Calabasas. The river flows as an open channel for 55 miles from the Canoga Park neighborhood of Los Angeles through the San Fernando Valley, Burbank, Glendale, Central Los Angeles, Vernon, Maywood, Commerce, Bell, Bell Gardens, Cudahy, South Gate, Lynwood, Paramount, and Compton until it meets Queensway Bay located between the Port of Long Beach and the City of Long Beach.

Due to shifting drainage flow paths, the natural hydrology of the Los Angeles River Watershed has been altered by channelization and the construction of dams and flood control reservoirs. The Los Angeles River and many of its tributaries are lined with concrete for most or all of their lengths. However, there are two soft bottom segments of the river – a 3.1 mile stretch runs adjacent to Los Angeles and Glendale known as the “Glendale Narrows” and the 2.4 mile stretch located in the Sepulveda Basin Recreational area behind the Sepulveda Dam.

The river is fed by a complex underground network of storm drains and surface network of tributaries. Tributaries of the River include Bell Creek, Calabasas Creek, Browns Canyon Wash, Aliso Canyon Wash, Caballero Creek, Bull Creek, Tujunga Wash, Burbank Western Channel, Verdugo Wash, Sycamore Wash, Arroyo Seco, Rio Hondo, Compton Creek, and numerous other storm drains. The River meets the Estuary at Willow Street, where concrete is replaced by grouted riprap side slopes and an earth bottom.



MAP 2 - TOPOGRAPHY OF LOS ANGELES RIVER

3.3 Los Angeles River – Reach Characteristics

The LA River Watershed (LAR Watershed) covers an area of approximately 834 square miles (533,760 acres) and is located in the coastal plain of the Los Angeles Basin and includes the San Fernando Valley and portions of the San Gabriel Valley. The LAR Watershed includes 40 cities and the unincorporated areas of Los Angeles County. The boundaries are defined by the Santa Monica Mountains to the north and west, the San Gabriel Mountains to the north and east, and the Los Angeles Coastal Plain to the south. The LA River begins in Canoga Park at the confluence of Bell Creek and Arroyo Calabasas and flows as an open channel for 55 miles from Canoga Park through the Cities of Burbank, Glendale, Los Angeles, Vernon, Maywood, Commerce, Bell, Bell Gardens, Cudahy, South Gate, Lynwood, Paramount, and Compton until it meets Queensway Bay located between the Port of Long Beach and the City of Long Beach.

Due to shifting drainage flow paths, the natural hydrology of the LA River has been altered by channelization and the construction of dams and flood control reservoirs and many of its tributaries are lined with concrete for most or all of their lengths. However, there are two soft bottom segments of the LA River – a 3.1 mile stretch that runs adjacent to the City of Los Angeles and the City of Glendale known as the "Glendale Narrows" and a 2.4 mile stretch located in the Sepulveda Basin Recreational area behind the Sepulveda Dam.

A complex network of storm drains and tributaries including Bell Creek, Calabasas Creek, Browns Canyon Wash, Aliso Canyon Wash, Caballero Creek, Bull Creek, Tujunga Wash, Burbank Western Channel, Verdugo Wash, Sycamore Wash, Arroyo Seco, Rio Hondo, and Compton Creek feeds the LA River. It is also feed by natural flows and discharges from POTWs and other LARWQCB permitted sources. At its terminus, the LA River discharges into an estuary at Willow Street in the City of Long Beach where concrete is replaced by grouted riprap side slopes and an earth bottom.

Reach 6 of the LA River is geographically defined and considered as starting at the confluence of Arroyo Calabasas (which drains the northeastern portion of the Santa Monica Mountains) and Bell Creek (which drains the Simi Hills). McCoy Canyon Creek and Dry Canyon Creek are two tributaries to Arroyo Calabasas that drain through the City of Calabasas. The river flows east from its origin along the southern edge of the San Fernando Valley. The LA River also receives flow from Browns Canyon, Aliso Canyon Wash (listed for selenium) and Bull Creek which drain the Santa Susana Mountains.

The lower portions of Arroyo Calabasas and Bell Creek are channelized. Browns Canyon, Aliso Creek, and Bull Creek are completely channelized. Reach 6 land areas are divided between the responsible agencies as shown in table below:

Agency	Land Area (Acres)	Land Area (Sq. Miles)	% of Reach 6
City of Calabasas	3,573.4	5.6	5.15%
City of Hidden Hills	1,006.1	1.6	1.45%
City of Los Angeles	52,796.7	82.5	76.12%
County of Los Angeles	11,983.4	18.7	17.28%

Reach 6 Responsible Agencies' Land Areas

A major thoroughfare is U.S. Highway 101 (US 101), the primary transportation corridor in the area. There are approximately eight (8) miles of six (6) to nine (9) lanes of vehicular traffic on US 101 between White Oak Blvd. and Parkway Calabasas. According to the Caltrans Traffic Data Branch, in 2008 there was an average of approximately 244,800 cars per day traveling south and 234,000 cars per day traveling north on US 101 along this stretch.

As noted in the LARWQCB supporting Staff Report for the LAR Metals TMDL, **Reach 5** of the LA River runs through Sepulveda Basin with has no impairment listings for metals. Located in this area is the Sepulveda Basin that is a 2,150 acre open space designed to collect floodwaters during major storms.

It remains in natural or semi-natural conditions and supports a variety of low-intensity land uses. Also in this area is the D.C. Tillman Wastewater Reclamation Plant, a POTW operated by the City of Los Angeles that discharges to Reach 5 indirectly via two lakes in the Sepulveda Basin. The POTW has a treatment design capacity of 80 million gallons per day (*mgd*) and contributes a substantial flow to the LA River. Most of the POTW flow discharges directly to Reach 4 of the river just below the Sepulveda Dam.

Reach 4 of the Los Angeles River runs from Sepulveda Dam to Riverside Drive and collects flows from Pacoima Wash and Tujunga Wash that drain portions of the Angeles National Forest in the San Gabriel Mountains. The Pacoima Wash is channelized between Lopez Dam and the LA River. Tujunga Wash is channelized for the ten (10) mile reach below Hansen Dam. Some of the discharge from Hansen Dam is diverted to spreading grounds for groundwater recharge.

Reach 3 of the LA River, runs from Riverside Drive to Figueroa Street and has two major tributaries: the Burbank Western Channel and the Verdugo Channel that drain the Verdugo Mountains. Both tributaries are channelized. The Burbank Western Channel receives flow from the Burbank Water Reclamation Plant, a POTW with a design capacity of 9 *mgd*. At the eastern end of the San Fernando Valley, the LA River turns south around the Hollywood Hills and flows through Griffith Park and Elysian Park in an area known as the Glendale Narrows. This area is fed by natural springs during periods of high groundwater.

The river is channelized with concrete sides. However, the river bottom in this area is unlined because the water table is high and groundwater routinely discharges into the channel in varying volumes depending on the height of the water table. The Los Angeles-Glendale Water

Reclamation Plant, operated by the City of Los Angeles, has a design capacity of 20 *mgd* and discharges to the LA River in the Glendale Narrows.[6]

Reach 2 of the LA River runs from Figueroa Street to Carson Street. The first major tributary below the Glendale Narrows is the Arroyo Seco, which drains areas of Pasadena and portions of the Angeles National Forest in the San Gabriel Mountains. In wet periods, rising stream flows in the LA River above Arroyo Seco have been related to the increase of rising groundwater. There is up to 3,000 acre-feet of recharge from the Pollock Well Field area that adds to the rising groundwater.

The next major tributary in Reach 2 is the Rio Hondo. The Rio Hondo and its tributaries drain a large area in the eastern portion of the watershed. Flow in the Rio Hondo is managed by the Los Angeles County Department of Public Works (LACDPW). At Whittier Narrows, flow from the Rio Hondo can be diverted to the Rio Hondo Spreading Grounds. During dry weather, virtually all the water in the Rio Hondo goes to groundwater recharge, so little or no flow exits the spreading grounds to Reach 1 of the Rio Hondo. During storm events, Rio Hondo flow that is not used for spreading, reaches the LA River.

This flow is comprised of both storm water and treated wastewater effluent from the Whittier Narrows Water Reclamation Plant. Reach 1 of the Rio Hondo is listed for copper, lead, and zinc. Monrovia Canyon Creek is also listed for lead. This creek, located in the foothills of the San Gabriel Mountains in the National Forest, is a tributary to Sawpit Creek which runs into Peck Lake and ultimately to Rio Hondo Reach 2 above the spreading grounds.

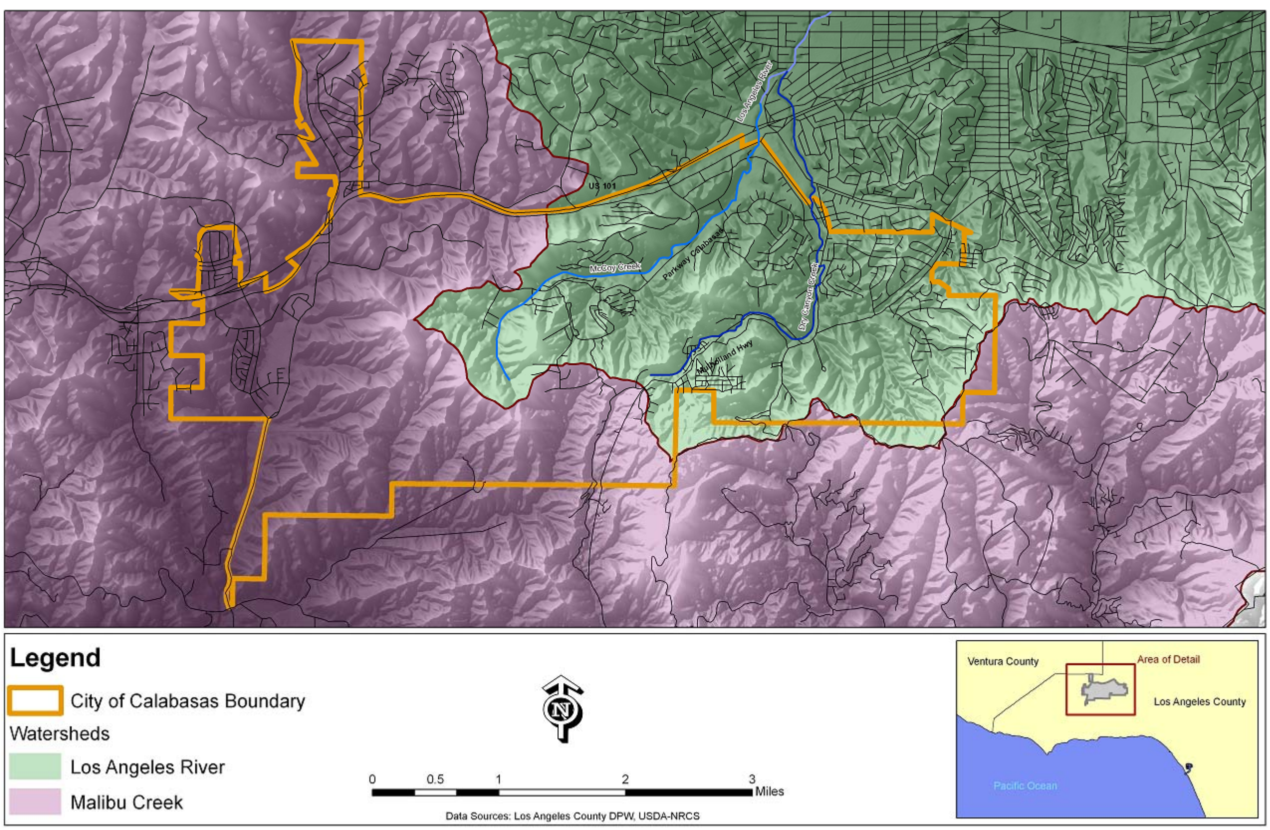
Reach 1 of the LA River, runs from Carson Street to the estuary. Compton Creek is the last large tributary to the system before the river enters the estuary. The creek is channelized for most of its 8.5 mile length. The tidal portion of the LA River begins at Willow Street and runs approximately three miles before joining with Queensway Bay located between the Port of Long Beach and the City of Long Beach. In Reach 1, the channel has a soft bottom with concrete-lined sides. Sandbars accumulate in the portion of the river where tidal influence is limited.

[6] From RWQCB Staff Report, Page 11. (Dated June 2, 2005).

CHAPTER FOUR

CITY OF CALABASAS AND THE SURROUNDING AREA

Located in the southwestern part of the San Fernando Valley, Calabasas formally became a city in 1991. The city is roughly 800 ft above sea level, and covers an area of 12.9 square miles. The city receives an average annual rainfall of 13.6 inches; temperature in the summer ranges from low 60's – high 90's, and in the winter from low 40's – high 60's. The City's official logo, depicting the red-tailed hawk flying over the Santa Monica Mountains, symbolizes a commitment to preserving the community's natural beauty and semi-rural quality of life.



Map 3 – Calabasas Creeks within the Los Angeles River Watershed

The City's official logo, depicting the red-tailed hawk flying over the Santa Monica Mountains, symbolizes a commitment to preserving the community's natural beauty and semi-rural quality of life.

4.1 Geology and Climate

4.1.a. Geology

Most of the Los Angeles Region lies within the western portion of the Transverse Ranges Geomorphic Province. The San Andreas transform fault system, forming the boundary between the North American and Pacific tectonic plates, cuts these western Transverse Ranges. This fault system, which extends northwesterly for over 700 miles from the Salton Sea in southern California to Cape Mendocino in northern California, bends in an east-west direction through the Transverse Ranges. Known as the "Big Bend," this portion of the San Andreas Fault system formed from complex movements of the Pacific Plate against the North American Plate.

Compression generated by such forces resulted in uplift of the Transverse Ranges, which have a conspicuous east-west trend (unlike other major ranges in the continental United States, which typically have a roughly north-south trend). Major mountain ranges within the Los Angeles Region include: San Gabriel Mountains, Santa Monica Mountains, Santa Susana Mountains, Simi Hills, and Santa Ynez Mountains. The San Gabriel Mountains are the most prominent range in this group.

The rock types exposed in the San Gabriel Mountains consist predominantly of Mesozoic granitic rocks (66 to 245 million years old), with minor exposures of Precambrian igneous and metamorphic rocks (prior to 570 million years old), and small stocks of Tertiary plutonic rocks (1.6 to 66 million years old). Cenozoic sedimentary beds (younger than 66 million years) are exposed only at the margins of the San Gabriel Mountains. Reflecting the recent and continuing uplift from plate tectonic activity, the San Gabriels are rugged mountains with deeply dissected canyons.

Eroded sediments from these mountains have formed and are continuing to form prominent alluvial fans in the valleys along the flanks of the range. During the Miocene Epoch (5 million to 23.5 million years ago), the sea advanced to the base of the San Gabriel Mountains, depositing fine-grained marine sediments. As the sea retreated, coarsergrained sediments, eroded from the Transverse Ranges, were deposited as alluvial fans in low-lying areas such as the San Fernando Valley, San Gabriel Valley, Oxnard Plain, and the Los Angeles Coastal Plain. These low-lying areas or basins are filled with layers of sediment. Many of these layers of sediment form aquifers that are important sources of ground water in the Region.

4.1.b. Climate

The climate of the City of Calabasas is categorized as Mediterranean with hot, dry summers and cool, moist winters with the majority of precipitation occurring between the months of November and April. The average yearly low temperature is 47° F while the average yearly high temperature is 80° F. Total yearly precipitation is approximately 18 inches with the highest monthly total occurring during February.[7]

With prevailing winds from the west and northwest, moist air from the Pacific Ocean is carried inland in the Los Angeles Region until it is forced upward by the mountains. The resulting storms, common from November through March, are followed by dry periods during summer months. Differences in topography are responsible for large variations in temperature, humidity, precipitation, and cloud cover throughout the Region. The coastal plains and islands, with mild rainy winters and warm dry summers, are noted for their subtropical "Mediterranean" climate.

The inland slopes and basins of the Transverse Ranges, on the other hand, are characterized by more extreme temperatures and little precipitation. Precipitation in the Region generally occurs as rainfall, although snowfall can occur at high elevations. Most precipitation occurs during just a few major storms. Annual rainfall in Ventura County averages 15.2 inches, although highs of almost 40inches occur around Cobblestone Mountain and Pine Mountain, and lows of around 14 inches occur on the Oxnard Plain.

Large variations also exist within Los Angeles County, as indicated by annual highs of around 42 inches at Mount Islip (along the crest of the Angeles National Forest) and annual lows of around 10 inches in the eastern Santa Clara River Valley. While an overall average is not available for Los Angeles County, annual rainfall at the Ducommun Street rain gauge in the City of Los Angeles averages 15.5 inches since measurements began in 1872.

4.2 Demographics

Calabasas' 2008 population is estimated at 23,725. This represents about a 33% increase since incorporation in 1992, when the population was 17,801. As of January 2008, the City has 8,605 dwelling units, including 6,814 single- family dwelling units, 1,538 units within multi-family buildings, and 253 mobile homes.

The Southern California Association of Governments (SCAG) estimates employment in Calabasas at 15,000 jobs. Although the City is tied to the economy of the San Fernando Valley (SFV), it differs from both the SFV and Los Angeles County in having noticeably higher proportions of resident-workers in "knowledge economy" jobs. Approximately 27 % of the

[7] Data obtained from the Canoga Park Pierce College weather station. NOAA Station ID: CA041484.

local workforce consists of self-employed, work-from-home employees. Despite a heavy reliance on these types of jobs, there are also more manufacturing, wholesaling, administrative, and food service jobs in Calabasas than residents to fill those jobs.

4.3 Land Use

4.3.a. Historic Land Use

For thousands of years Native Americans occupied the coastal California region. The Chumash is the first known tribe to inhabit the area now known as the City of Calabasas. In addition to the Chumash, the Gabrieleno/Tongva inhabited the area just south of Calabasas and then extended into the Los Angeles basin area. The mild climate and abundant flora and fauna in the area provided ample resources for hunting and gathering. Such resources enabled the Chumash to construct permanent villages, which were connected by established trails. Despite the permanence of their settlements, the Chumash lifestyle had a limited impact on the region.

The Chumash had little contact with non-Native Americans until the 18th century, when the Spanish began exploring California. Spaniards such as Gaspar de Portola and Juan de Anza journeyed along the coast via trails established by Native Americans. Shortly after the arrival of such explorers, Spanish missionaries traveled into California to convert Native Americans to Christianity. They established 21 missions on the Californian coastline from San Diego to San Francisco. *San Fernando Rey de España* and *San Gabriel Arcángel* are the two closest missions to Calabasas and are both located in Los Angeles County. The missions forever changed the way of life for Native Americans in California. The missionaries introduced livestock, exotic plants, and roads.

El Camino Real, translated as "The Royal Highway," was the main artery for moving goods and information between the missions. Today Ventura Freeway (Highway 101) runs close to the original alignment of El Camino Real. With the establishment of more missions, travel along El Camino Real intensified. The increased road use, combined with agricultural settlements, escalated impacts on the land.

While the presence of the missions changed land use patterns and cultural traditions in California, it was the arrival of the Spanish-Mexican ranchers that began to significantly impact the land. At the beginning of the 19th century, the Mexican government granted large ranches in California to Mexican citizens. The new landowners brought intensive land uses to the area. To stake their land claim, the ranchers built permanent structures, planted crops, and introduced large herds of longhorn cattle. Furthermore, they established additional infrastructure to help communication and trade between settlers and missions. Heavy grazing and clearing of trees for agriculture had a large impact on the native plants and trees. Native grasses could not compete with weeds and exotic plants brought by the Mexicans. Meadows were quickly established in grazing areas where live and valley oak once thrived.

Meanwhile, American homesteaders trying to stake their own claims in California moved into the Calabasas region in the mid-19th century. By the end of the century, Mexican and American ranches were broken into small farms. Soon, however, water ran low due to limited surface and well water in the area. Eventually this water shortage forced the ranchers to leave for more hospitable land.

The beginning of the 20th century brought new land uses to the Calabasas region. The area's proximity to the metropolis of Los Angeles made the mountainous region a desirable spot for recreation, filmmaking, and suburban residential development. The area began to grow substantially after 1958, in conjunction with the formation of the Las Virgenes Municipal Water District (LVMWD).

4.3.b. Current Land Use

Current land use within the City is outlined within the City's General Plan. As stated, the Calabasas General Plan is intended to be a "constitution" for local decision makers. The General Plan addresses immediate, mid-, and long-term issues concerning environmental sensitivity and preservation needs, public services, the economic vitality of the community, and environmental constraints. Land use and policy determinations can thus be made within a comprehensive framework that incorporates public health, safety, and "quality of life" considerations in a manner that recognizes the resource limitations and the fragility of the community's natural environment.

4.3.c. Future Land Use

Future land use is difficult to determine at this time and will depend on the actions of the City Council as well as actions taken by adjoining jurisdictions. Land use is governed by the City General Plan; however, this plan can be changed, updated, and amended at different times to allow for changes in future land use. In the Dry Canyon and McCoy Creek watersheds, land use is governed by both Calabasas and the City of Los Angeles.

It can be expected that the area in and around Calabasas will continue to develop with the resulting increase in impervious areas within the watersheds. This increase in impervious areas will increase runoff quantity and velocity unless controls are mandated on all new development with the watersheds. However, all of the contributing municipalities are subject to a National Pollutant Discharge Elimination System (NPDES) permit regulations and do impose strict urban storm water mitigation requirements on all new developments. NPDES development planning regulations focus on minimizing impervious surfaces, implementing peak flow controls, and providing structural pollution prevention devices for filtration of storm water runoff from urban development.

4.4 Reach 6 Information

While the Los Angeles River is not technically within the Calabasas city limits, two tributaries – McCoy and Dry Canyon Creek converge with Bell Canyon Creek to form the Headwaters of the Los Angeles River. Because these creeks contribute flows to the LA River, the Regional Water Quality Control Board considers the City of Calabasas to be within reach 6 of the river. Reach 6 covers an area that is approximately 7 miles. In 1992, Coliform Bacteria and Selenium were first on the 303(d) list of pollutants. The TMDL status reports that a TMDL for Coliform Bacteria is still required, and Selenium is currently being addressed through Metals TMDL.

CHAPTER FIVE

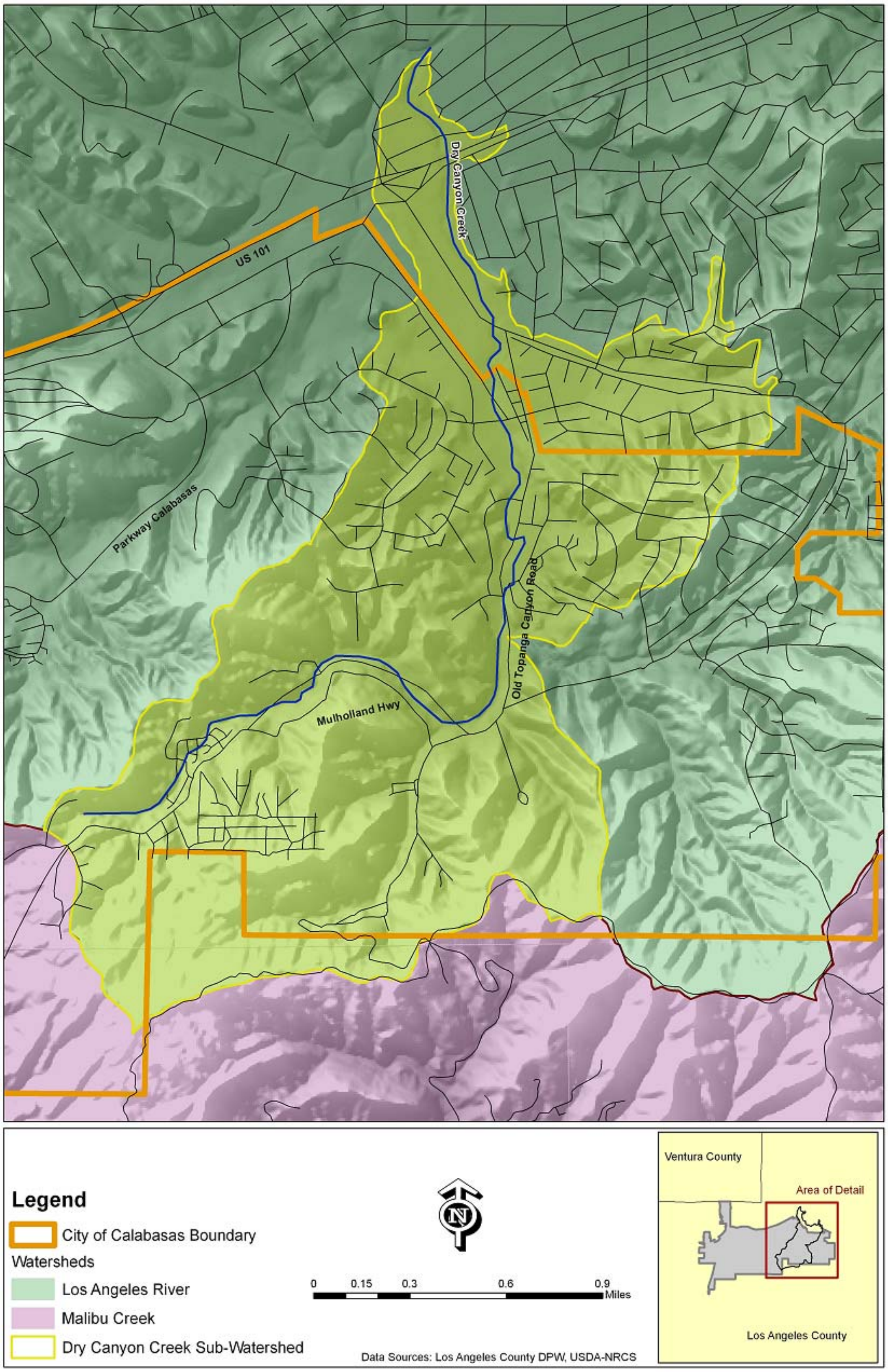
DRY CANYON CREEK WATERSHED

The Dry Canyon Creek Watershed originates in the Calabasas Highlands area and flows in a northeasterly direction generally parallel to Mulholland Highway. North of the Mulholland Highway / Old Topanga Canyon intersection, Dry Canyon Creek flows along the west side of Old Topanga Canyon Road before entering an underground culvert. The creek continues north through a concrete channel that leaves the City boundaries and passes under the 101 freeway. Near the northern border of Calabasas, Dry Canyon Creek is flanked on each side primarily by residential uses.

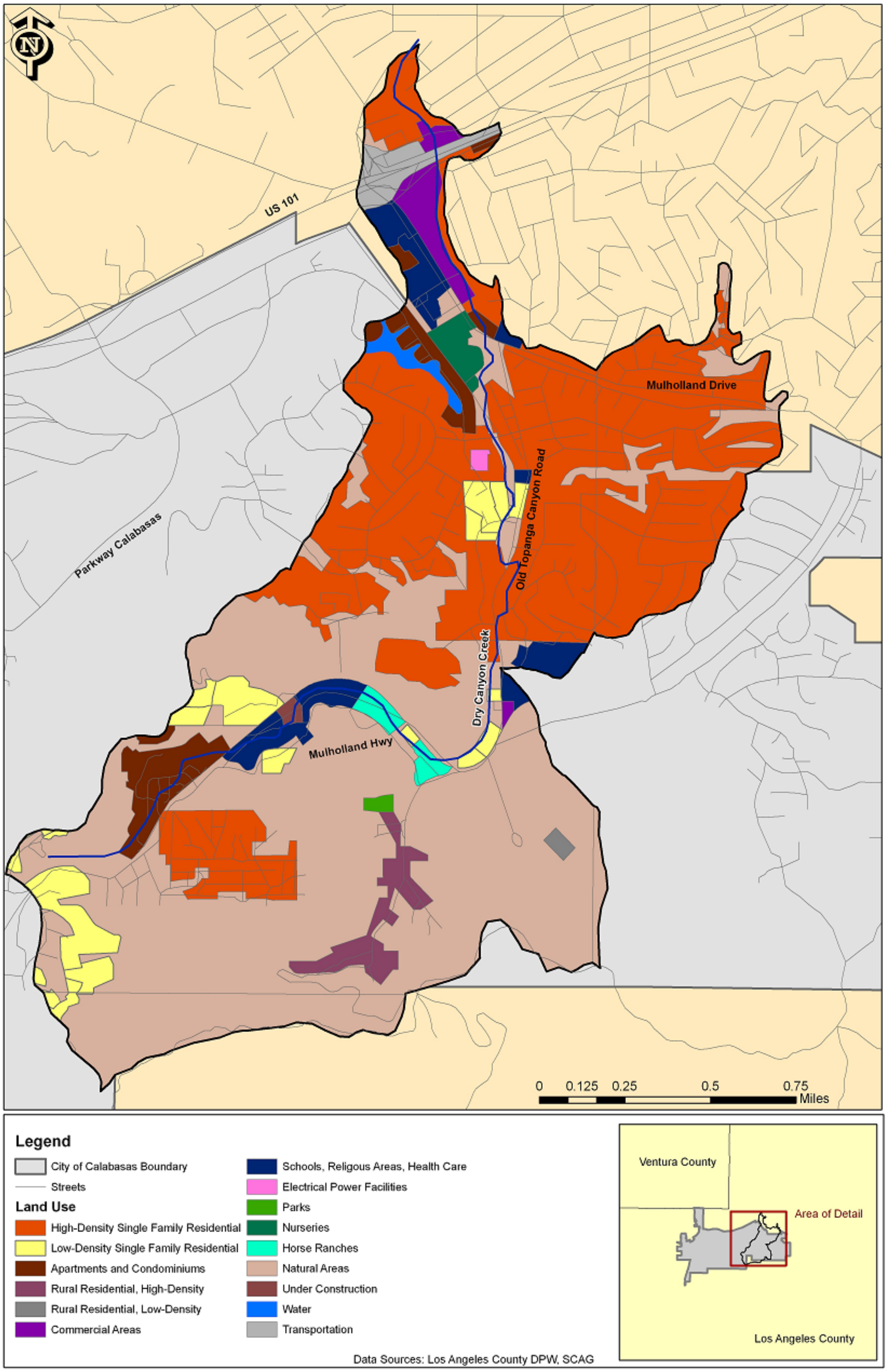
As the creek winds northeast along Mulholland Highway, it is bordered by a mix of residential uses and lands designated Hillside-Mountainous (HM). HM lands have a Maximum Land Use Intensity of one dwelling unit per 10 acres, or one dwelling unit per existing lot, whichever is greater. Because of physical constraints and safety issues on certain properties, some parcels cannot be built upon.

East and west of the intersection of Dry Canyon Cold Creek Road and Mulholland Highway, the north bank of the creek is adjacent to land designated as OS. Separated from this area by a small residential use is a second OS designation, which borders the creek for a short distance. The opposite bank of the creek in this area is bordered by HM lands.

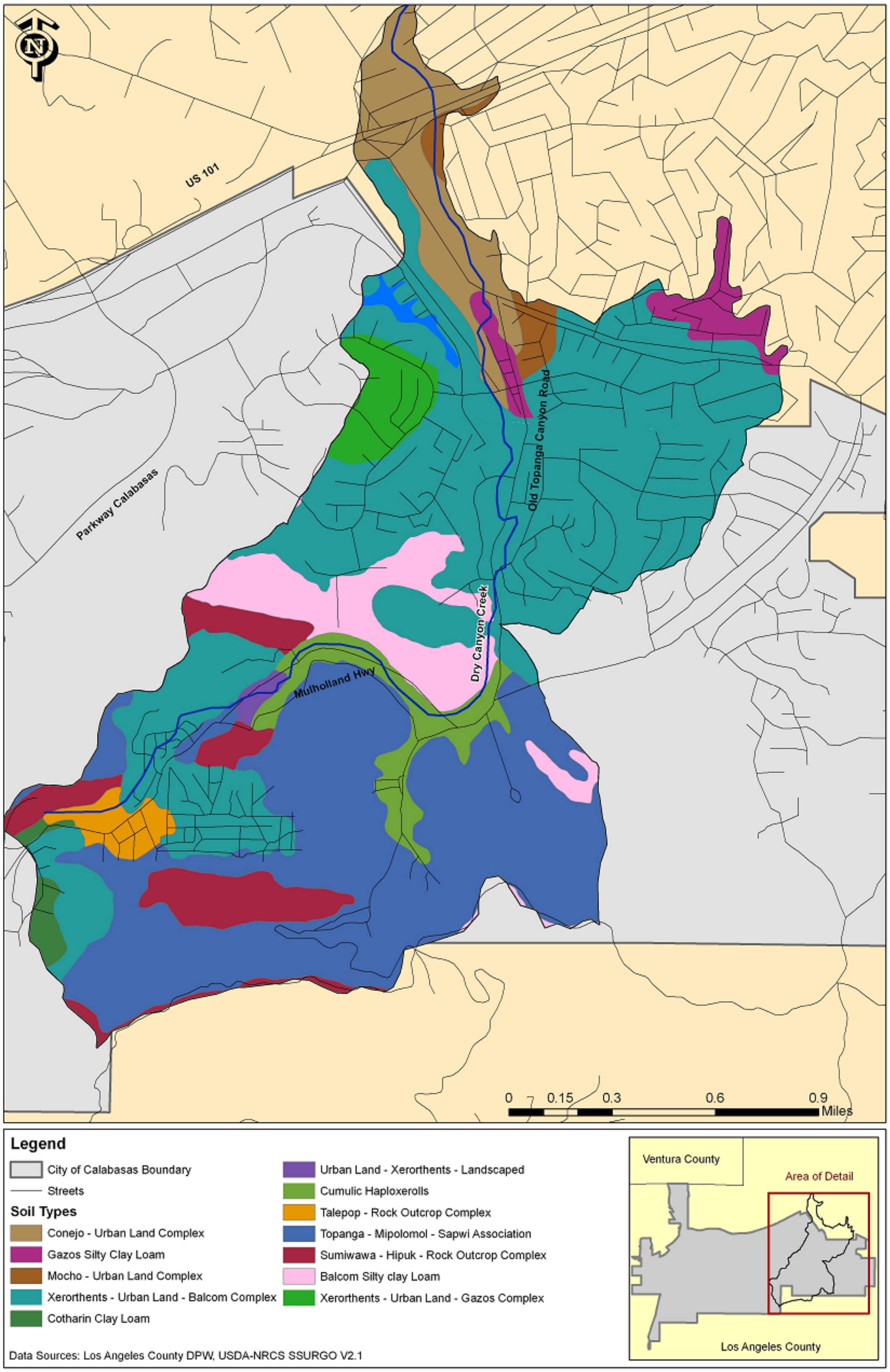
There are over 100 active septic systems within the watershed. City inspectors are currently evaluating the conditions of septic tanks and the City Council has adopted measures and regulation to extend the sewer line and ultimately eliminate all septic tanks in favor of connecting to city's sewer system. All other housing and commercial uses within the watershed are connected to the sanitary sewer system.



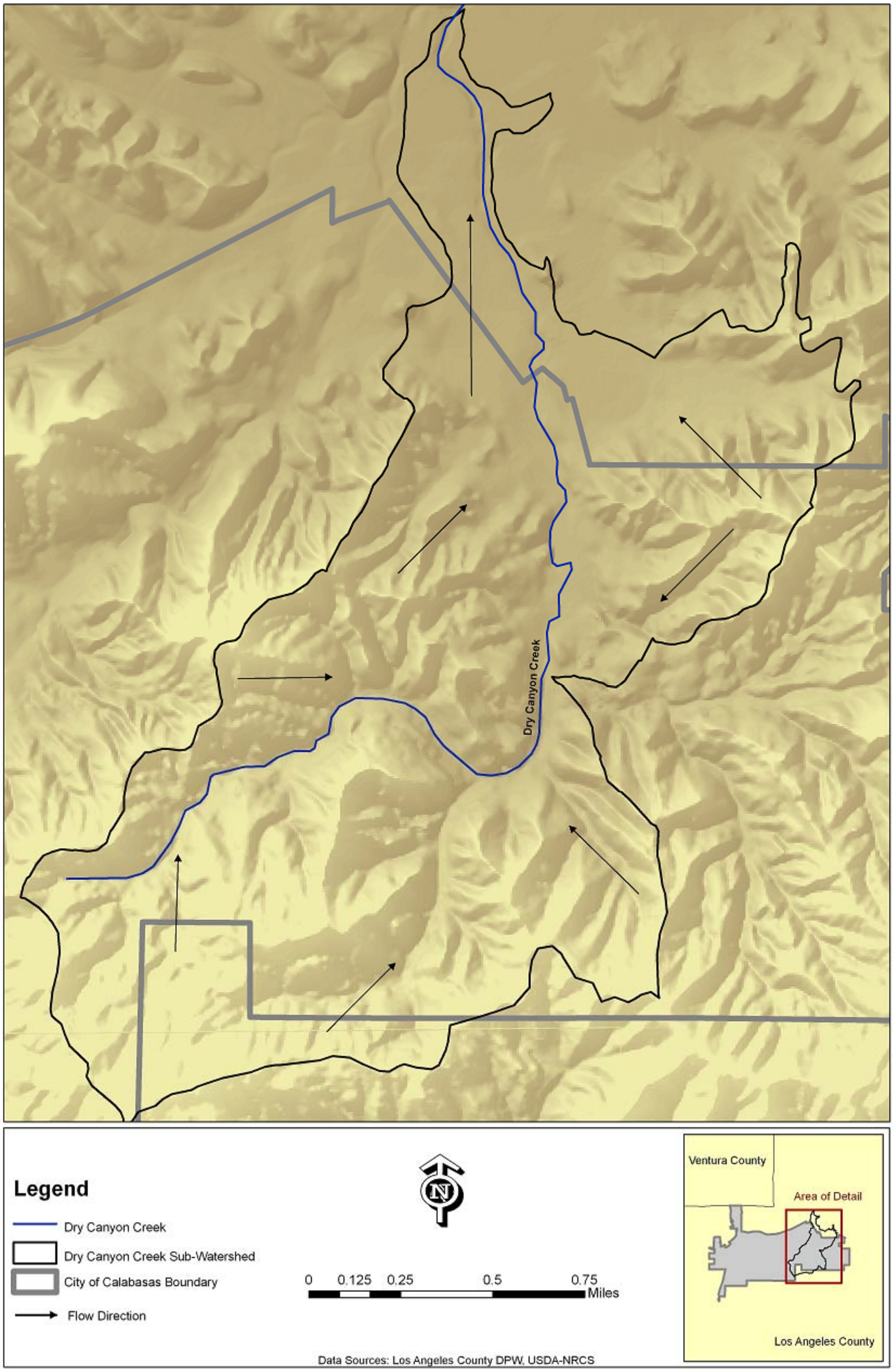
MAP 4 – Dry Canyon Creek Sub-Watershed



MAP 5 – Dry Canyon Creek Sub-Watershed Land use



MAP 6 – Dry Canyon Creek sub-Watershed Soil Types



MAP 7 – Dry Canyon creek Sub-Watershed Topography

5.1 Observation

The headwaters begin on the northeast side of Mulholland Highway flowing though a small valley that drains the adjacent hills. The first section of the creek is joined on the Viewpoint School campus by a natural tributary located behind viewpoint school that drains the hills on the southwest side of Mulholland Hwy. This first tributary is labeled DCC1.

DCC2 is a cement discharge approximately 4ft in diameter that drains Mulholland Highway into Dry Canyon Creek near the center of the Viewpoint School Campus. The third discharge point noted, DDC3 is from a small PVC pipe on a horse stable property just northwest of Viewpoint School. After the horse stable the creek crosses Mulholland Highway and is joined by another tributary DCC4. This is a cement channel that drains Mulholland Highway. The primary surrounding vegetation along this segment is oak woodland.

After being joined by DCC3 Dry Canyon Creek flows through the Headwaters Corner property owned by the City of Calabasas. On the Headwaters property the creek is joined by two tributaries: DCC5 and DCC6.

DCC5 is on the South side of the property and flows through a large cement pipe; DCC6 is on the North side of the property and has a natural streambed. At our time of observation both of these tributaries were dry. After leaving the Headwaters Corner, the creek flows along the west side of Old Topanga Canyon Rd before passing into an underground culvert south of Palm Drive.

The Creek remerges near Wrencrest Drive; this area is overgrown by invasive Arundo. Just after the Creek remerges it is joined by DCC6; a 3 by 4 ft aluminum discharge pipe. The creek exits at the border of the Creekside HOA and the Motion Picture Hospital.

5.2 Outfalls

DCC1 – Viewpoint school where Dry Canyon Creek and the tributary from the hillside meet

Observation – The upper extent of the Dry Canyon Creek watershed is located in the Calabasas Highlands area, following in a northeasterly direction parallel to Mulholland Highway. There are two metal 12 inch diameter pipes (Image 1) from the hillside that are used for residential runoff that is discharged into the creek; this is the first tributary in the creek. The creek flows southwest adjacent to Viewpoint school, where the bottom of the creek is natural and the banks have been stabilized with rock walls. The water in the creek is stagnant, and the vegetation consists of large scrubs (for example cattails).

DCC 1

DCC2 - Located on the Highway side of the creek next to the school's parking lot

Observation – The tributary discharge is approximately 4ft in diameter. Approximately half of the discharge area was covered by sediment and scrubs; runoff from Mulholland Highway

DCC 2

DCC3 – Located at the horse stables next to Wild Walnut Park

Observation – The 6 inch diameter discharge in image 4 is used for runoff from the parking lot that sits above the creek

DCC 3

DCC4 – The creek is joined by a tributary that flows north along Old Topanga Road

Observation – The discharge pipe is 3 ft in diameter and is used for runoff from Mulholland Highway. A narrow cement channel is used until it connects to the creek.

DCC 4

DCC5 – South side of the Headwaters Corner

Observation – The tributary flows underneath the highway through a large cement pipe and discharges onto the Headwaters Corner.

DCC 5

DCC6 – North side of the Headwaters Corner

Observation – This is a natural tributary lined with rocks to limit erosion it flows from the hillside openspace.

DCC 6

DCC7 – Located at the t-intersection of Old Topanga and Wrencrest Drive

Observation –Not visible when looking at the image, there is a 3 by 4 ft aluminum discharge pipe; area has large amounts of invasive Arundo plants.

DCC 7

CHAPTER SIX

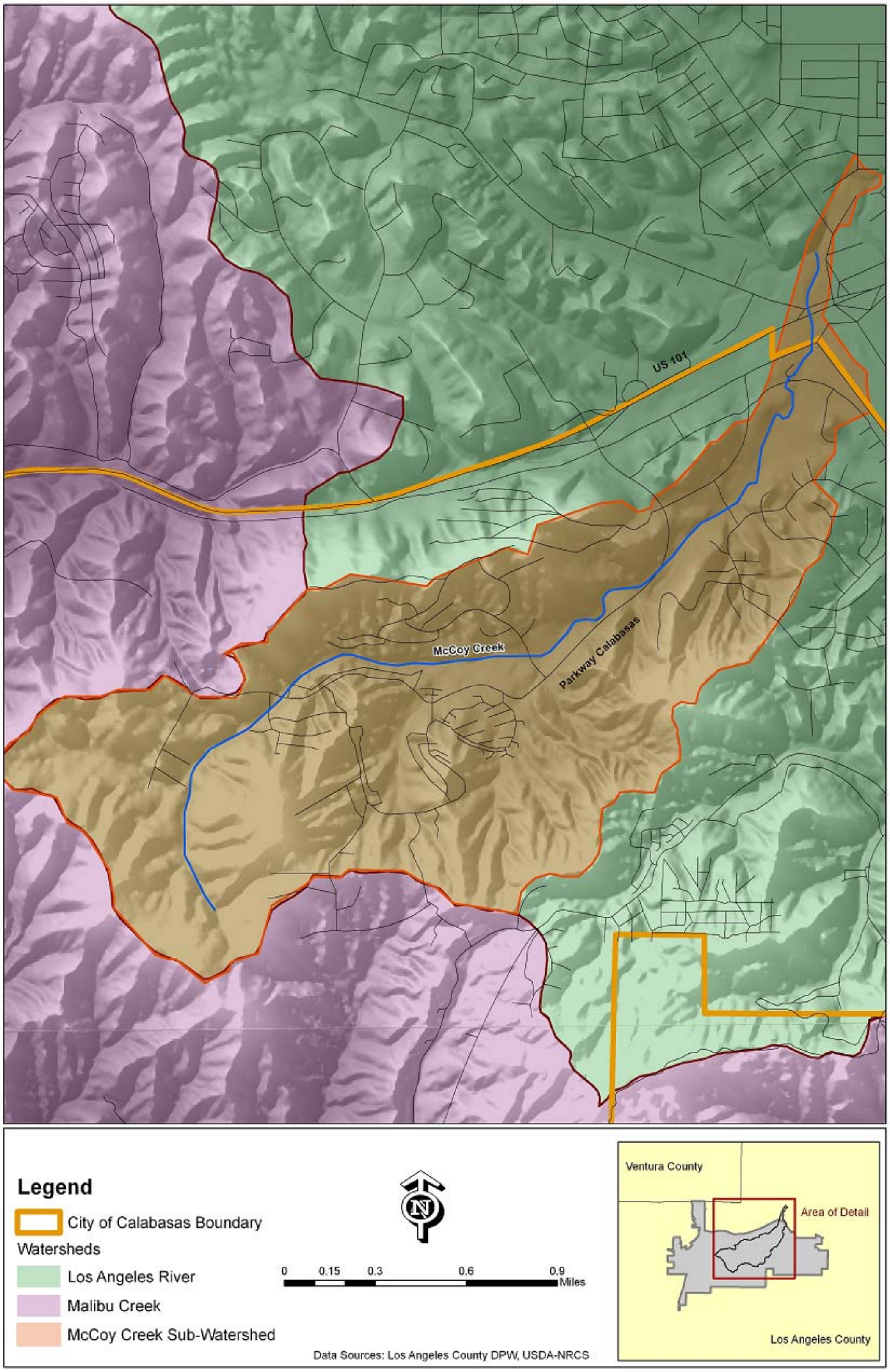
MCCOY CREEK WATERSHED

The top of McCoy Creek is located in the Calabasas Oaks development located at the end of Parkway Calabasas (above the Golf Course). The creek first daylights just before leaving the Oaks development and flows through areas of native vegetation and natural soft-bottom channel until passing through the golf course at the at the Calabasas Golf and Country Club. The creek then flows through the private grounds located behind Bank of America's corporate office, then adjacent to Lake Calabasas. Near the northern city boundary in Old Town Calabasas, the creek flows under Calabasas Road and joins Dry Canyon Creek to form the headwaters of the Los Angeles River.

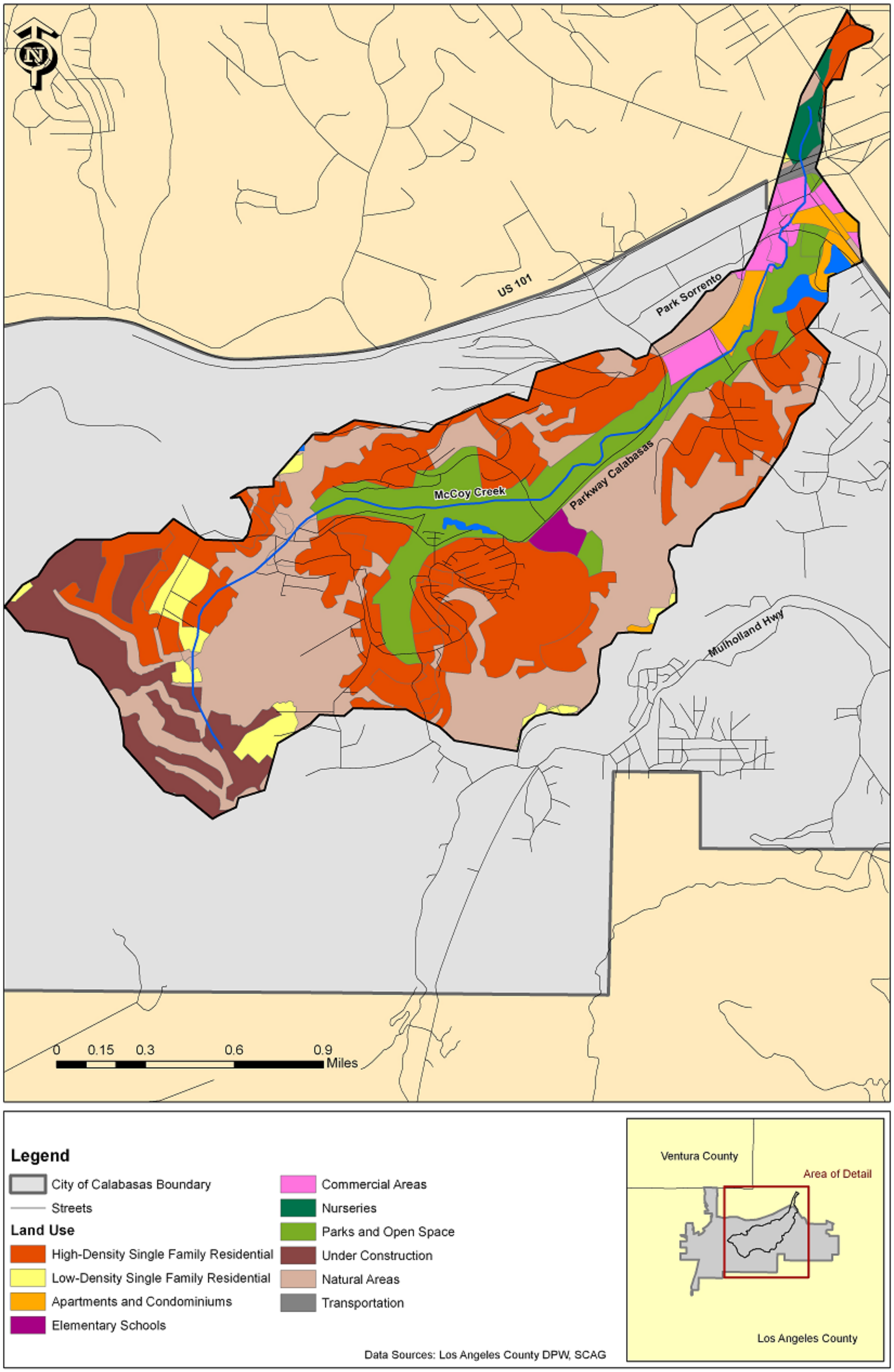
The area northwest of the golf course along McCoy Creek, designated as open space on the land use and zoning maps, is now undergoing major development based on the review of the aerial photograph. The development in this area is known as the Oaks at Calabasas.

McCoy Creek is primarily surrounded by commercial and residential land designations. A long segment of the stream flows through lands designated as OS and occupied by a golf course. A small segment of the creek located near the northern City border is adjacent to the OS land designation that includes Lake Calabasas.

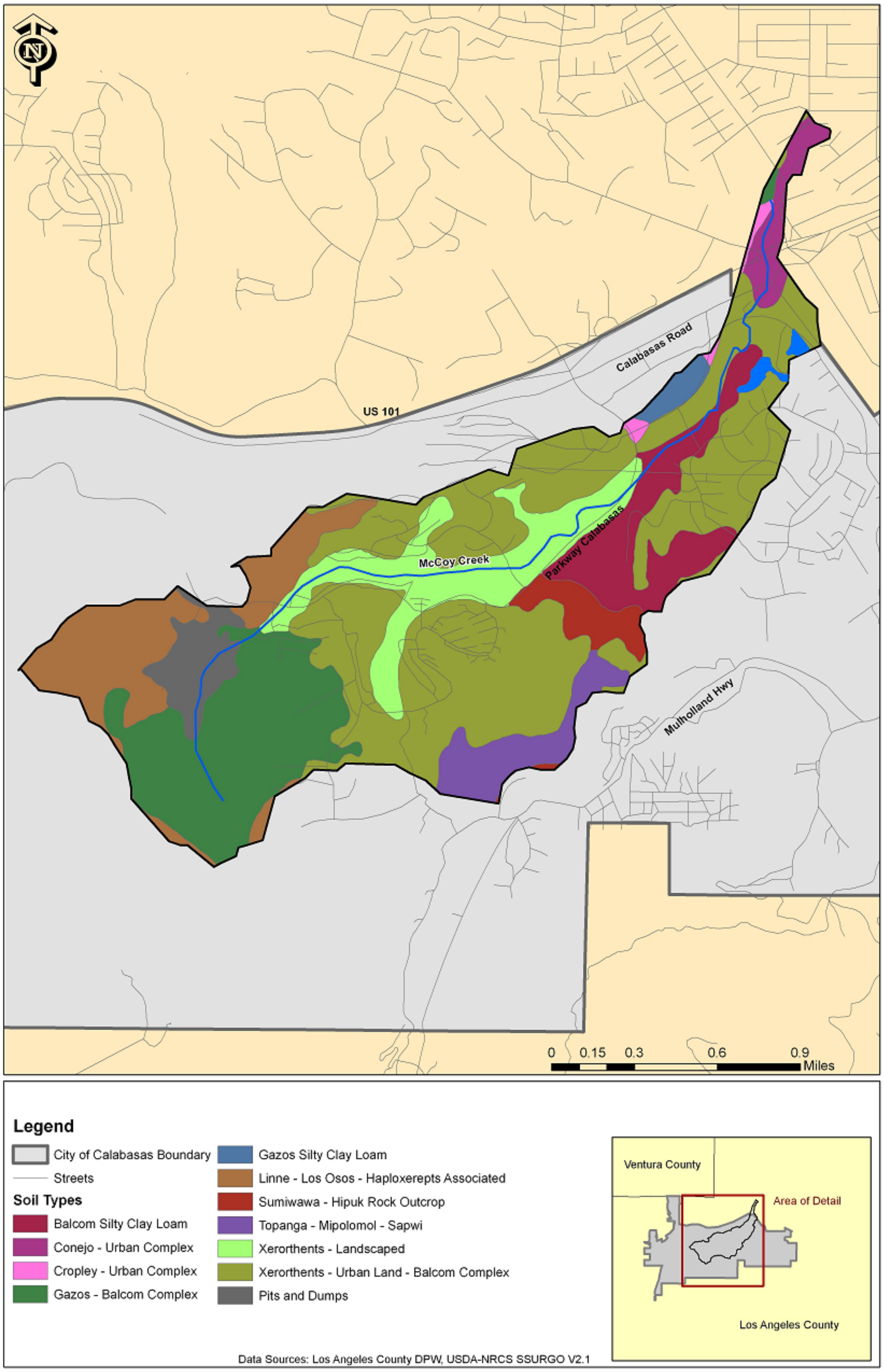
All housing and commercial areas in the watershed are connected to a sanitary sewer system. The wastewater generated by these uses are pumped to and treated by the Las Virgenes Municipal Water District.



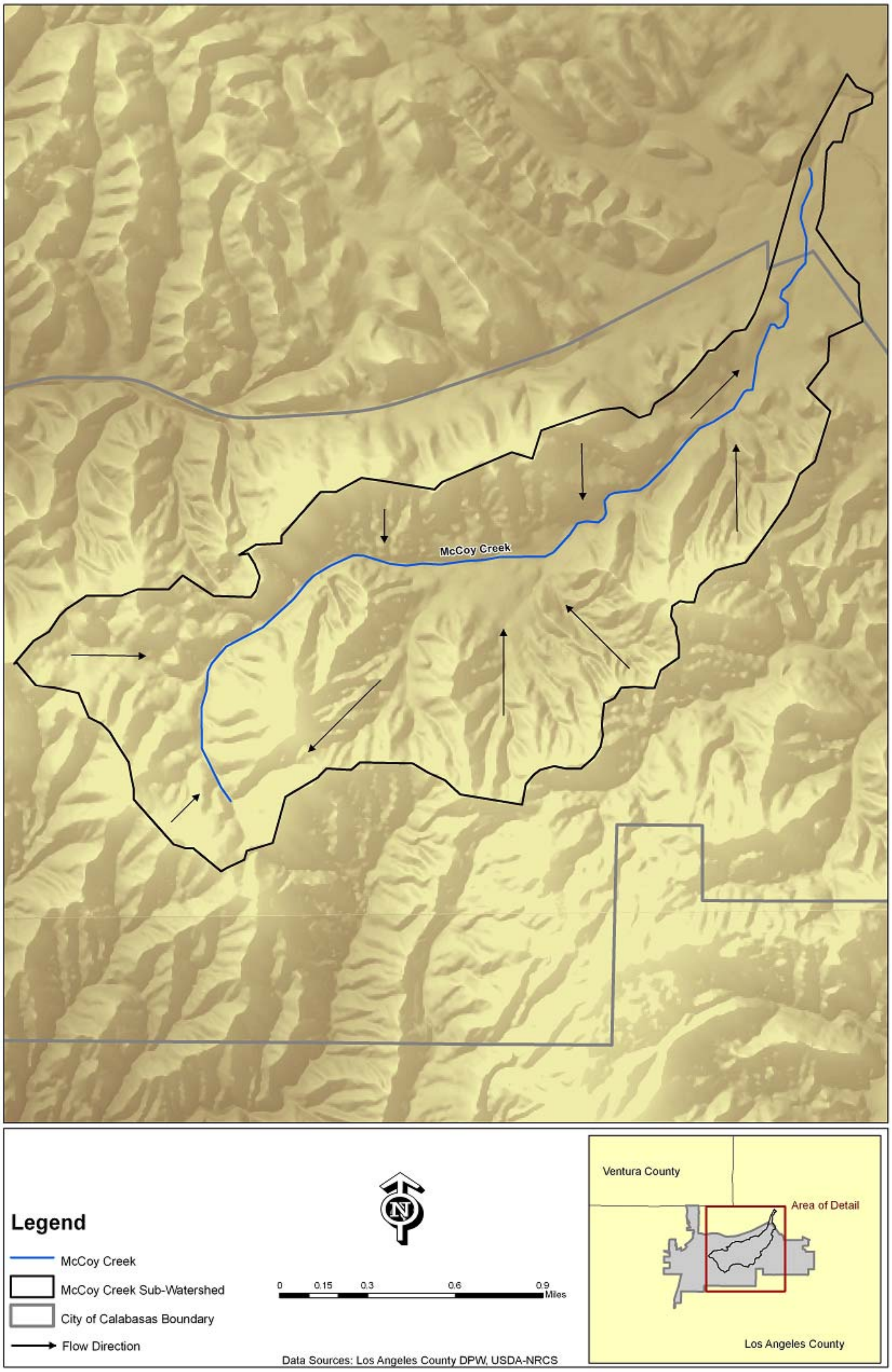
MAP 8 – McCoy Creek Sub-Watershed



MAP 9 – McCoy Creek Sub-Watershed Land Use



MAP 10 – McCoy Creek Sub-Watershed Soil Types



MAP 11 – McCoy Creek Sub-Watershed Topography

6.1 Observation

The headwaters of the creek are located inside the Oaks residential development at the end of Parkway Calabasas. It is apparent that McCoy Creek is fed by irrigation runoff from the surrounding hillside communities on both sides of Parkway Calabasas. The creek first daylights adjacent to Parkway Calabasas just before the exit gate of the Oaks. The first discharge/daylight point is a 10inch PVC pipe that we titled MCC1.

This initial discharge is joined by another higher flow rate discharge while traveling under Parkway Calabasas just before the Oaks entrance gate. This second discharge is titled MCC2. The Creek then flows though the Calabasas golf course and is joined by a tributary just west of Park Entrada that flows under Parkway Calabasas. This tributary is labeled MCC3. After leaving the golf course the creek flows under Parkway Calabasas though two box culverts onto the private grounds of Bank Of America (4500 Park Granada).

McCoy Creek then flows under Park Capri and weaves its way through the Calabasas Tennis and Swim Center. There is a concrete lake overflow structure that drains Calabasas Lake into McCoy Creek - this tributary MMC5; being peak summer this overflow structure was dry. From this point the creek flows under Park Sorrento towards Calabasas Rd. There is a 12inch cement discharge; MCC6 that drains the neighboring multifamily housing units (seen in image 21).

The creek flows north from this point past the Fins Creekside Restaurant. The Creek leaves city boundaries through a dry weather exit drain 10 yards before Park Sorrento (image 11).

6.2 Outfalls

MC 1 – Located just before exiting the surety gates at "The Oaks at Calabasas"

Observation - The creek flows underneath Parkway Calabasas within the Oaks community. The first day lighted portion of the creek, as seen in image 12, has water flowing out of a PVC pipe that is 10 inches in diameter; lots of algae bloom at the opening of the pipe.

MC 1

MC2 – Located outside of the security gates at "The Oaks" on the opposite side of the street (diagonal flow from MCC1)

Observation – At this outfall, there are two cement pipes that sit next to each other. The smaller pipe on the left-hand side measures 5ft in diameter and delivers flows from MCC1 underneath parkway Calabasas. To the right of this pipe sits a lager pipe that measures 8 ft in diameter this is the seconded outfall along McCoy Creek and is labeled MCC2

MC 2

MCC3 - Located on the Calabasas Golf and Country Club property adjacent to Parkway Calabasas.

Observation - This is a large concrete tunnel that delivers irrigation runoff underneath Parkway Calabasas. This flow discharges onto the Golf Course Property.

MC 3

MC4 – Located at the Calabasas Golf and Country Club approximately 50 yards from the entrance.

Observation – The creek is joined from the south by a tributary that crosses under Parkway Calabasas from Bay Laurel School. The segment of the creek that flows through the golf course is natural however, there are segments off the golf course property that include underground culverts and bank stabilizing structures. The storm drain tributary opening is 7 ft in diameter located at the intersection of Parkway Calabasas and Paseo Primario; rate of flow is 2 ft/sec

MC 4

MC5 – Located at the Calabasas Swim and Tennis Center where the Calabasas Lake overflow basin and the creek meet

Observation- A concrete lake overflow structure drains into the creek south of the Swim and Tennis Center, on the left-hand side of this photo. Downstream of the overflow, concrete has been used to stabilize the east and west banks of the creek.

MC 5

MC6 – Just north of Park Sorrento

Observation- 12 inch cement discharge; runoff from multi-family housing units.

MC 6

MC7 - At the City Limit just South of Calabasas Road
Observation - The Creek exits the City though a low flow channel just South of Calabasas Road. During wet weather events the creek bypasses this low flow channel and drains directly underneath Calabasas Road.

MC 7

CHAPTER SEVEN

CHEMISTRY OF SELENIUM IN NATURAL ENVIRONMENT

7.1 Selenium in the Environment

Selenium is among the rarer elements on the surface of this planet, and is rarer than silver. Selenium is present in the atmosphere as metal derivatives. Uncombined selenium is occasionally found and there are around 40 known selenium-containing minerals, some of which can have as much as 30% selenium - but all are rare and generally they occur together with sulfides of metals such as copper, zinc and lead. The main producing countries are Canada, USA, Bolivia and Russia.

Global industrial production of selenium is around 1500 tons a year and about 150 tons of selenium are recycled from industrial waste an reclaimed from old photocopiers. Selenium occurs naturally in the environment. It is released through both natural processes and human activities. Well fertilized agricultural soil generally has about 400 mg/ton since the element is naturally present in phosphate fertilizers and is often added as a trace nutrient. In its natural form as an element selenium cannot be created or destroyed, but selenium does have the ability to change form.

Selenium levels in soils and waters increase, because selenium settles from air and selenium from waste also tends to end up in the soils of disposal sites. When selenium in soils does not react with oxygen, it remains fairly immobile. Selenium that is immobile and will not dissolve in water is less of a risk for organisms. The oxygen levels in the soil and the acidity of the soil will increase mobile forms of selenium. Higher oxygen levels and increased acidity of soils is usually cause by human activities, such as industrial and agricultural processes.

When selenium is more mobile, the chances of exposure to its compounds will be greatly enhanced. Soil temperatures, moisture, concentrations of water-soluble selenium, the season of the year, organic matter content and microbial activity determine how fast selenium will move through soil. In other words, these factors determine its mobility. Agriculture cannot only increase the selenium content in soil; it can also increase selenium concentrations in surface water, as selenium is brought along in irrigation drainage water.

Low levels of selenium can end up in soils or water through weathering of rocks. It will then be taken up by plants or end up in air when it is adsorbed on fine dust particles. Selenium is most likely to enter the air through coal and oil combustion, as selenium dioxide. This substance will be converted into selenium acid in water or sweat. Selenium substances in air are usually broken down to selenium and water fairly quickly, so that they are not dangerous to the health of organisms. The behavior of selenium in the environment strongly depends upon its interactions with other compounds and the environmental conditions at a certain location at a certain time.

There is evidence selenium can accumulate in the body tissues of organisms and can then be passed up through the food chain. Usually this bio magnification of selenium starts when animals eat a lot of plants that have been absorbing large amounts of selenium, prior to digestion. Due to irrigation run-off concentrations of selenium tend to be very high in aquatic organisms in many areas. When animals absorb or accumulate extremely high concentrations of selenium it can cause reproductive failure and birth defects.

Selenium (sulē'nēum) nonmetallic chemical element; symbol Se; at. no. 34; at. wt. 78.96; m.p. 217°C; b.p. about 685°C; sp. gr. 4.81 at 20°C; valence -2, +4, or +6. Selenium is directly below sulfur in Group 16 of the periodic table. In chemical activity and physical properties it resembles sulfur and tellurium. Selenium exhibits allotropy, appearing in a number of forms, including a red amorphous powder, a red crystalline material, and a gray crystalline metallike form called "metallic" selenium.[8]

A remarkable property (discovered by Willoughby Smith in 1873) of the gray metallic form is that its electrical conductivity is greater in light than in darkness, and it increases as the illumination increases. This property has led to use of the metallic form in the junction rectifier and as a cathode in the photoelectric cell rectifier. Selenium is extensively used in the vulcanization of rubber, in the manufacture of red glass and some enamels, as a decolorizer of glass to counteract the green of iron compounds, in electronics, and in xerography. Selenium forms the oxides SeO_2 and SeO_3, the selenious (H_2SeO_3) and selenic (H_2SeO_4) acids and their respective selenite and selenate salts, a nitride, carbide, hydride, two sulfides, and various halides and oxyhalides.[9]

Selenium sometimes occurs in conjunction with sulfur deposits and often occurs as the selenide (especially of copper, lead, silver, and iron) in sulfide ores. Commercially it is obtained chiefly as a byproduct in the refining of copper. In the Great Plains region and certain other areas, selenium is absorbed from the soil by vegetation in quantities sufficient to poison livestock,

[8] http://www.infoplease.com/ce6/sci/A0844350.html
[9] http://www.infoplease.com/ce6/sci/A0844350.html

thus rendering the land useless for grazing. Nonetheless, selenium is one of the elements needed in trace amounts in the animal and human diet. Fish, meat, poultry, whole grains, and dairy products are good sources of this mineral nutrient in the human diet. The element was discovered by Berzelius in 1817.

7.1.a. Selenium in Aquatic Systems

Selenium occurs in many soil types and enters ground and surface waters through natural weathering process such as erosion, leaching and runoff. The national average concentration of selenium in nonseleniferous surface water ranges from 0.1 to 0.4 µg Se/L. Elevated levels of selenium occur in surface waters when substantial quantities of selenium enter surface waters from both natural and anthropogenic sources. It is abundant in the alkaline soils of North America from the Great Plains.

Some ground waters in California, Colorado, Kansas, Oklahoma, South Dakota and Wyoming contain elevated concentrations of selenium due to weathering of and leaching from rocks and soils. Ecological impacts have been observed where selenium is concentrated through irrigation practices in areas with seleniferous soils. Selenium also occurs in sulfide deposits of copper, lead, mercury, silver and zinc and can be released during the mining and smelting of these ores. In addition, selenium occurs naturally in coal and fuel oil and is emitted in flue gas and in fly ash during combustion. Some selenium then enters surface waters in drainage from fly-ash ponds and in runoff from fly-ash deposits on land.[10]

7.1.b. Selenium Biogeochemistry

The current understanding of the biogeochemistry of selenium has recently been reviewed by Fan et al. (2002). Their review clearly shows the extreme complexity of selenium biogeochemistry in aquatic environments. Fan et al. describe the selenium biogeochemical cycle as follows: dissolved selenium oxyanions are primarily absorbed by aquatic producers, including microphytes and bacteria, and biotransformed into organoselenium form(s) and selenium element (SeO). These, together with other particle-bound selenium sources, constitute the particulate selenium fraction of the water column, and they are poorly understood (Zawislanski and McGrath, 1998). Once accumulated in the aquatic primary and secondary producers, selenium can be transferred through various aquatic consumers into the top predators, including aquatic birds and piscivorous fish.[11]

Selenium can be further chemically transformed through the food chain transfer process. The microscopic planktonic organisms, including microphytes (cyanobacteria and phytoplankton), bacteria, protozoa, and zooplankton are major components of the particulate matter in the water column. The particulate matter, in turn, forms the basis for detrital materials which can

[10] http:// www.epa.gov/waterscience/criteria/selenium/fs.htm
[11] http:// www.epa.gov/waterscience/criteria/selenium/fs.htm

settle onto the sediment, and become the food source for sediment organisms.

Suspended particulate matter can also be mineralized in the water column. In addition to this selenium input into the sediment, waterborne selenite and selenate can be physically adsorbed onto the sediment particles, ingested, absorbed, and transformed by the sediment organisms. Sediment-bound selenate and selenite can be reduced to insoluble Se0 by anaerobic microbial activities. This and water column-derived Se0 can be reduced further to inorganic and organic selenides (-II form), and/or reoxidized to selenite and selenate by microorganisms in the sediment and/or in the digestive tracts of sediment macroinvertebrates.

Selenides can enter the food chain via absorption and/or ingestion (by chironomids or tubificid worms, for example) into sediment organisms, or be oxidized to selenite and selenate. Selenium of different oxidation states can be further biotransformed by sediment organisms and transferred up the food chain. Selenium biotransformation, bioaccumulation, and transfer through both sediment and water column foodwebs constitute the major biogeochemical pathways in aquatic ecosystems. In addition to accumulating selenium into the biomass, the aquatic producers are the main factors controlling the volatilization of selenium via the production of methylated selenides including, dimethylselenide (DMSe) and dimethyldiselenide (DMDSe). These methylated selenides can be oxidized to selenite, or can exit the water column into the atmosphere.

Selenium volatilization into the atmosphere may represent an important process responsible for significant loss of selenium in some aquatic systems. Methylated selenides can also be generated from dissolved selenium precursor(s) released by aquatic producers into the water. Moreover, other organoselenium forms can be released into the water by aquatic producers, and are reoxidized to selenite and/or reabsorbed by aquatic producers.

7.2 Narrow Margin between Sufficiency and Toxicity

Of all the priority and non-priority pollutants, selenium has the narrowest range of what is beneficial for biota and what is detrimental. Selenium is an essential element required as a mineral cofactor in the biosynthesis of glutathione peroxidases.

The major function of the glutathione peroxidases was found to involve the reduction of hydrogen peroxide to water at the expense of the oxidation of glutathione, the enzyme's cofactor. Aquatic and terrestrial organisms require 0.5 µg/g dry weight (dw) of selenium in their diet to sustain metabolic processes, whereas concentrations of selenium that are only an order of magnitude greater than the required level have been shown to be toxic to fish.[12]

Selenium deficiency has been found to affect humans, sheep and cattle, deer fish, aquatic invertebrates and algae.

[12] http:// www.epa.gov/waterscience/criteria/selenium/fs.htm

Selenium has been shown to mitigate the toxic effects of arsenic, cadmium, copper, inorganic and organic mercury, silver, ofloxacin, methyl parathion and the herbicide paraquat to biota in both aquatic and terrestrial environments.[13]

Selenium is reported to reduce the uptake of mercury by some aquatic species (, to have no effect on uptake of mercury by a mussel, and to increase the uptake of mercury by mammals and some fish. Selenium augmented accumulation of cadmium in some tissues of the shore crab, Carcinus maenas. The available data do not show whether the various inorganic and organic compounds and oxidation states of selenium are equally effective sources of selenium as a trace nutrient, or as reducing the toxic effects of various pollutants.[14]

[13] http:// www.epa.gov/waterscience/criteria/selenium/fs.htm
[14] http:// www.epa.gov/waterscience/criteria/selenium/fs.htm

CHAPTER EIGHT

CHEMISTRY OF COPPER IN NATURAL ENVIRONMENT [15]

Copper is required for the normal functioning of plants, animals and most microorganisms. In most cases, this is because copper is incorporated into a variety of organics that perform specific metabolic functions. One of the better known organometallic compounds is copper-zinc superoxide dismutase, a metalloenzyme that plays a key role in the enzymatic defense against oxygen toxicity.

Prohaska and Failla (1993) comment that "... it is more difficult to think of a system that does not depend on copper than it is to list the numerous systems that do." Copper has been used by humans for medicinal purposes for thousands of years. The Egyptians and Chinese, for example, used copper salts therapeutically more than 2000 years ago. As a malleable metal with beneficial properties, copper is widely used by humans for domestic and industrial purposes. Although copper is present in soils it is often not available for uptake by plants. Failure in the supply of adequate biologically available copper has the potential to produce copper deficiency and a variety of biochemical and physiological disorders in plants (e.g. Qin et al., 1992; Rao and Ownby, 1993; Smith and Vanden Berg, 1992a,b,c,d; Wilder and Strik, 1991).

The application of information on copper in soils does not stop with a better understanding of plant growth. Adequate nutrition of domestic animals (e.g. Compère et al., 1993; Hendricksen et al., 1992) as well as wild animals (e.g. Dierenfeld, 1993) and humans is dependent upon a suitable source of copper and that, of course, means in forage crops or plants and animals used as food.

As copper is an essential metal, a physiological response can be produced by deficiency. As a toxicant at elevated levels of biologically available metal, a physiological response can be produced by an excess of copper. Most organisms operate somewhere between these two extremes, taking up the metal from the environment or food then storing or transferring it to sites of use. There is also evidence of hyperaccumulation of some metals by some plants as a defence mechanism against ingestion by herbivores (Boyd and Martens, 1992). Some of the

[15] "THE BIOLOGICAL IMPORTANCE OF COPPER". ICA PROJECT NO. 223, June 1995. International Copper Research Association Incorporated, retrieved from http://www.copper.org/environment/ica_review/ica_review.html

uses of copper come from its ability to control the growth of organisms. This occurs when copper is biologically available and at concentrations that are detrimental. As a result, copper is used in a range of cidal agents.

The chemical nature of copper is very important in determining biological availability. Although evidence of this continues to accumulate, the potential detrimental impact of copper is still far too frequently inferred from levels of "total copper" or even the "presence" of copper. Pequegnat (1990) points out that "It is becoming increasingly difficult to convince some environmental regulators that the mere presence of a toxic chemical in marine sediments does not necessarily mean that it will adversely impact the biota". In an article entitled "Copper residues in the environment - what are we looking for?", Koldenhoven (1992) comments that "The fate of copper in the environment needs to be determined on the basis of which copper species are present and if those copper species are bioavailable".

When copper is introduced into a natural environment, or from one type of environment to another, the metal is exposed to different chemical conditions. This quite often leads to changes in metal speciation and changes in metal bioavailability. The amount of metal entering an environment and the chemical changes that occur are of importance in determining the fate of the metal as well as its biological impact. As a result, a number of studies have examined the flux of metals, including copper, as well as metal speciation [e.g. Report number 32 of the Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP)]. Monitoring programs can also provide evidence of the level of anthropogenic input as well as some indication of the source of the metals.

Areas of copper mineralization will have naturally elevated levels of soil or sediment copper; Runnells et al. (1992) point out that in aquatic situations like this, "... it may not be scientifically reasonable or technically possible to remediate the water to standards that are lower than the natural background concentrations". Wollast (1990) comments that information from surveys of the Rhone river provide evidence that "... trace metal concentrations in the Rhone are significantly lower than previous estimates and that although anthropogenic signals are present, the Rhone river is less polluted than expected". Diffuse sources of pollution have increased in importance with the strict controls on point source industrial discharges.

CHAPTER NINE

CHEMISTRY OF LEAD IN NATURAL ENVIRONMENT [16]

Lead moves into and throughout ecosystems. Atmospheric lead is deposited in vegetation, ground and water surfaces. The chemical and physical properties of lead and the biogeochemical processes within ecosystems will influence the movement of lead through ecosystems. The metal can affect all components of the environment and can move through the ecosystem until it reaches an equilibrium. Lead accumulates in the environment, but in certain chemical environments it will be transformed in such a way as to increase its solubility (e.g., the formations of lead sulfate in soils), its bioavailability or its toxicity. The effects of lead at the ecosystem level are usually seen as a form of stress (US EPA 1986).

In general, there are three known ways in which lead can adversely affect ecosystems. Populations of micro-organisms may be wiped out at soil lead concentrations of 1,000 parts per million (ppm) or more, slowing the rate of decomposition of matter. Populations of plants, micro-organisms and invertebrates may be affected by lead concentrations of 500 to 1,000 ppm, allowing more lead-tolerant populations of the same or different species to take their place. This will change the type of ecosystem present. At all ambient atmospheric concentrations of lead, the addition of lead to vegetation and animal surfaces can prevent the normal biochemical process that purifies and repurifies the calcium pool in grazing animals and decomposer organisms (UNEP 1991).

9.1 Exposure routes for lead to the environment

The main sources of lead entering an ecosystem are atmospheric lead (primarily from automobile emissions), paint chips, used ammunition, fertilisers and pesticides and lead-acid batteries or other industrial products. The transport and distribution of lead from major emission sources, both fixed and mobile, are mainly through air (UNEP 1991). While most of the lead discharged into air falls out near the source, about 20 percent is widely dispersed. Studies have demonstrated that measurements of lead in Greenland rose and fell with the rise and decline of use of alkyl-leaded petrol in the United States Eurasia and Canada over the past century (Roseman et al 1993). The size of the lead particles will govern how far they move from the source.

[16] Deni Green, Effects of Lead on the Environment, Lead Action News, Vol 1, No. 2, Winter 1993, http://www.lead.org.au/lanv1n2/lanv1n2-8.html

9.2 Effects of lead on soil

It is known that lead accumulates in the soil, particularly soil with a high organic content (US EPA 1986). Lead deposited on the ground is transferred to the upper layers of the soil surface, where it may be retained for many years (up to 2000 years). In undisturbed ecosystems, organic matter in the upper layer of soil surface retains atmospheric lead. In cultivated soils, this lead is mixed with soil to a depth of 25C1ll (i.e., within the root zone). Atmospheric lead in the soil will continue to move into the micro-organism and grazing food chains, until an equilibrium is reached.

Given the chemistry of lead in soil, the US EPA (1986) suggests that the uneven distribution of lead in ecosystems can displace other metals from the binding sites on the organic matter. It may hinder the chemical breakdown of inorganic soil fragments and lead in the soil may become more soluble, thus being more readily available to be taken up by plants.

9.3 Effects of lead on plants

Plants on land tend to absorb lead from the soil and retain most of this in their roots. There is some evidence that plant foliage may also take up lead (and it is possible that this lead is moved to other parts of the plant). The uptake of lead by the roots of the plant may be reduced with the application of calcium and phosphorus to the soil. Some species of plant have the capacity to accumulate high concentrations of lead (UNEP, WHO and ILO 1991).

The pores in a plant's leaves let in carbon dioxide needed for photosynthesis and emit oxygen. Lead pollution coats the surface of the leaf and reduces the amount of light reaching it. This results in stunting the growth or killing the plants by reducing the rate of photosynthesis, inhibiting respiration, encouraging an elongation of plant cells influencing root development 0; by causing pre-mature aging. Some evidence suggests that lead can affect population genetics. All these effects have been observed in isolated cells or in hydroponically grown plants in solutions of around 1-2 ppm of lead in soil moisture e.g., the lead levels experienced by ecosystems near smelters or roadsides).

Lead in air may be transferred to plants directly through fallout or indirectly through up-take from the soil. The pattern and degree of lead accumulation are largely influenced by the state of growth of the vegetation; i.e., active growth periods in spring as compared to low growth periods through autumn and winter.

9.4 Effects of lead on micro-organisms

Evidence exists to show that lead at the concentrations occasionally found near roadsides (i.e., 10,000 - 40,000 ppm dry weight), can wipe out populations of bacteria and fungi on leaf surfaces and in soil. This can have a significant impact, given that many of these micro-organisms are an essential part of the decomposing food chain. The micro-organism populations affected are likely to be replaced by others of the same or different species, although these may be less efficient at decomposing organic matter. Evidence also suggests that micro-organisms can make lead more soluble and hence more easily absorbed by plants. That is, bacteria exude organic acids that lower the pH in the immediate vicinity of the plant root.

9.5 Effects of lead on animals

Lead affects the central nervous system of animals and inhibits their ability to synthesize red blood cells. Lead blood concentrations of above 40 µg/dl can produce observable clinical symptoms in domestic animals. Calcium and phosphorus can reduce the intestinal absorption of lead (US EPA 1986). The US EPA report generalizes that a regular diet of 2-8 mg of lead per kilogram of body weight per day, over an extended period of time, will cause death in most animals. Grazing animals are directly affected by the consumption of forage and feed contaminated by airborne lead and somewhat indirectly by the up-take of lead through plant roots. Invertebrates may also accumulate lead at levels toxic to their predators.

Lead shot and lead weight can severely affect individual organisms and threaten ecosystems (WHO 1989). After three to ten days of waterfowl ingesting lead shot, the poison will reach the bloodstream and be carried to major organs, like the heart, liver and kidneys. By the 17th to 21st day the bird falls into a coma and dies. Following the ingestion of lead shot, lead toxicosis has been observed in Magpie geese, Black swans, several species of duck (including Black duck and Musk duck) and Hardhead species (OECD 1993).Organic lead is much more readily taken up by birds and fish (WHO 1989). Aquatic organisms take up inorganic lead through a transfer of lead from water and sediments; this is a relatively slow process. Organic lead is rapidly taken up by aquatic organisms from water and sediment. Aquatic animals are affected by lead at water concentrations lower than previously thought safe for wildlife. These concentrations occur often, but the impact of atmospheric lead on specific sites with high aquatic lead levels is not clear (US EPA 1986).

CHAPTER TEN

DATA AND MONITORING

10.1 Los Angeles River Monitoring

Several monitoring efforts have taken place within the Los Angeles River Watershed. Beginning in 2002, the City of Los Angeles, Department of Public Works, Bureau of Sanitation, Watershed Protection Division, under its Status and Trends Monitoring Program, began monthly monitoring at eight (8) locations along the main channel of Los Angeles River for bacteria, metals, and other pollutants. In 2005 this Status and Trends Program was extended to include ten (10) tributary monitoring locations.

The County of Los Angeles, as part of the Los Angeles County Municipal Stormwater Permit Core Monitoring Program, also conducts sampling within the Los Angeles River Watershed. The County's Core Monitoring Program is comprised of one permanent mass emission station within the main channel. To assess wet-weather impairments, the County has been sampling approximately three to five storms per year at the Wardlow gauging station since 1996. The County samples hardness and metals (both dissolved and total recoverable metals) from composite stormwater samples.

10.2 Los Angeles River Metals TMDL Coordinated Monitoring Plan (CMP)

The LAR Metals TMDL required the forty-two (42) responsible agencies to submit a Coordinated Monitoring Plan (CMP) within 15 months of the effective date of the LAR Metals TMDL (by April 11, 2007). The CMP was developed by an eleven (11) member technical committee (LAR TC) that included representatives from every Jurisdictional Group in the watershed. The following agencies are currently members of the LAR TC: Cities of Los Angeles, Hidden Hills, Burbank, Glendale, Pasadena, Irwindale, Downey, Signal Hill, and Long Beach; the County of Los Angeles; and Caltrans. The City of Los Angeles and Los Angeles County co-chair the TC. A similar Steering Committee, comprised of various City Managers and LARWQCB Staff, was also convened to oversee the optional special studies and funding details.

The monitoring sites for the LAR Metals TMDL CMP have been selected by the Technical Committee. As part of the evaluation process, the TC considered the current 303(d) listed reaches, future TMDLs, available data including POTW monitoring locations, and conducted site investigations to determine potential ambient and effectiveness monitoring locations. The final list of monitoring sites was selected based on professional judgment, the requirements of the TMDL and the monitoring tiers presented below; these sites are characterized in Appendix K.

The goal of the CMP was to collect ambient water quality data at key locations within the LA River as well as provide for effectiveness monitoring when and where necessary. Ambient monitoring began in October 2008 and will continue until January 11, 2012 when the LAR Metals TMDL will be reconsidered by the LARWQCB. The first LAR Metals TMDL CMP report was submitted to the LARWQCB on September 14, 2009 by the City of Los Angeles. This report detailed the results from the CMP for the period of October 2008 to June 2009.

The responsible agencies in Reach 6 must monitor copper, lead, zinc, and selenium during the first ambient monitoring phase. However, at the start of the compliance time schedule of the LAR Metals TMDL, the City must only ensure that its own MS4 discharges do not exceed the LAR Metals TMDL numeric targets for pollutants established for Reach 6 or tributaries. However, there is no specific compliance target for selenium once numeric compliance requirements are in place.[17]

10.3 Ambient and Effectiveness Monitoring

Ambient Monitoring

Dry-weather ambient monitoring for hardness as well as dissolved and total recoverable metals occurs monthly at thirteen (13) locations within the LA River. All of the monitoring locations sample for copper, lead, and zinc, and the White Oak monitoring location in Reach 6 sampling for selenium. The monitoring results for the most recent CMP year, October 2008 through June 2009, show that Reach 6, as measured at the White Oak Avenue site (LAR 1-1), is well under copper and lead numeric targets.

Selenium concentrations remain consistently high, however as indicated in the CMP monitoring report, hardness at the White Oak Avenue site remains much higher than all other parts of the LA River. For example, in October 2008, hardness in the various reaches was:

- Reach 6 was 753 mg/l;
- Reach 4, at Sepulveda Blvd., was 192 mg/l and 254 mg/l at Figueroa Street;
- Reach 2 was 251 mg/l at the 710 Freeway; and in
- Reach 1 was 199 mg/l at Wardlow Blvd.

[17] See BPA page 4, "The sources of selenium appear to be related to natural levels of selenium in soils in the upper watershed. Separate studies are underway to evaluate whether selenium levels represent a "natural condition" for this watershed." See also, BPA, Page 5, "No dry weather loading capacities are calculated for…selenium in Reach 6 or its tributaries.", and Page 8, "Storm Water Dry-weather WLAs (total recoverable metals)".

As indicated in the LARWQCB Staff Report of 2005, including the Basin Plan Amendment (BPA), all parties believe that the high selenium values are naturally occurring and due to geological deposits of ocean shale.

8.3.b Effectiveness Monitoring

Effectiveness monitoring have not yet been initiated but will begin before the January 11, 2012 deadline of the LAR Metals TMDL, which states that the Jurisdictional Group shall demonstrate that 50% of Reach 6's total drainage area served by the storm drain system is effectively meeting the dry-weather WLAs and 25% is meeting the wet-weather WLAs. Compliance with dry-weather and wet-weather WLAs in Reach 6 will be shown by meeting the assigned WLAs based on the White Oak monitoring results.

8.4 Monitoring and Water Quality

8.4.a Dry-Weather Water Quality

Dry-weather ambient water quality data from the White Oak monitoring location (Tier I) in Reach 6, compiled between October 2008 and June 2009, show that the concentrations of copper and lead are consistently lower than the numeric targets for each constituent.[18] The dry-weather ambient CMP data indicate that the concentrations of selenium have been greater than the numeric targets, however as set out in the BPA and CMP, the Reach 6 members must only monitor this metal until it is decided that the selenium levels are due to natural causes.

8.4.b Wet-Weather Water Quality

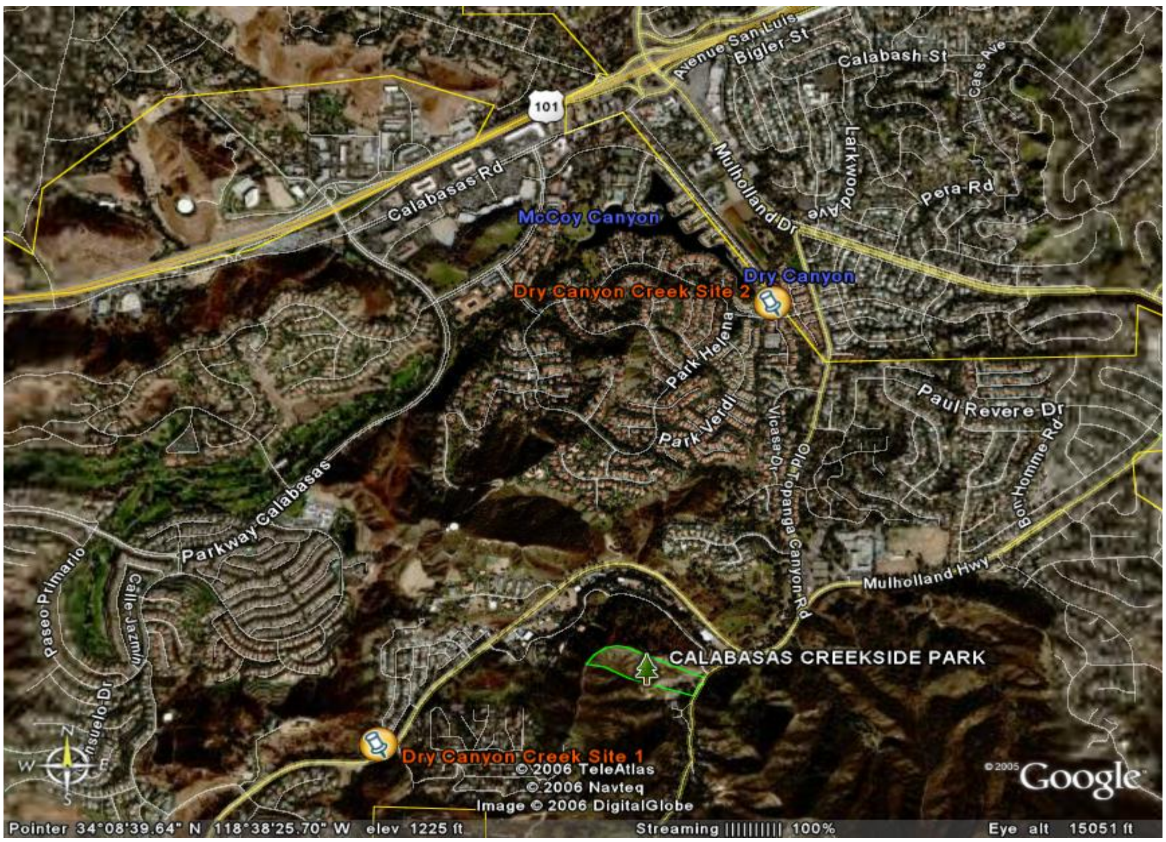
The wet-weather ambient monitoring data from the White Oak location in Reach 6 shows that the concentrations of copper and zinc may be higher than the numeric targets however, the concentrations of lead are lower than the numeric target. As reported to the LARWQCB in October 2009, the LAR TC found that the shut-off triggers for the auto-samplers was set improperly and continued to sample for several days after the two wet-weather events. The LAR TC has reported that it will correct this fault and believes that future sampling may be more accurate. The City will continue reviewing wet-weather ambient monitoring data as it becomes available to understand actual trends in copper and zinc concentrations.

8.5 Dry Canyon and McCoy Creeks Monitoring Data

The City of Calabasas has been involved with extensive water sampling in both the Dry Canyon and McCoy Creek watersheds. The first round of City monitoring was conducted from May 4th, 2006 through July 27, 2006 on a weekly basis at both creeks and at two locations per creek.

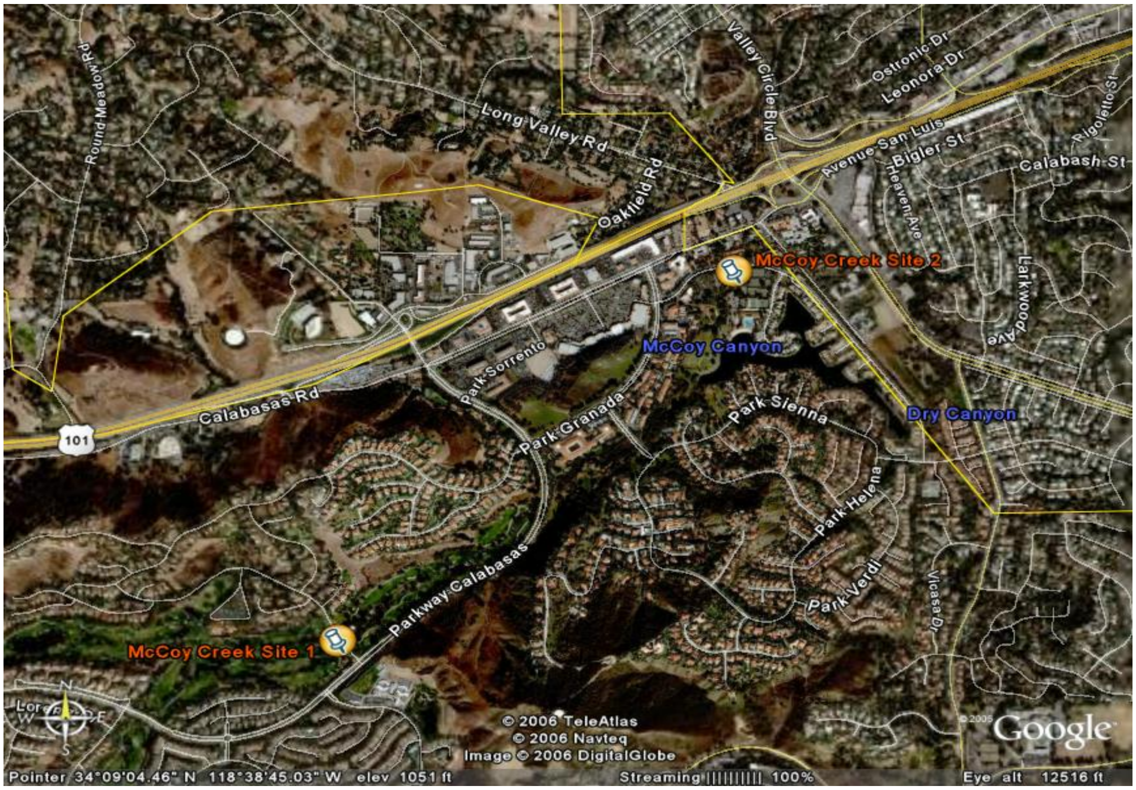
[18] LAR Metals TMDL CMP Ambient Monitoring 2008-2009 Submittal to the LARWQCB

(Please see maps below) Dry Canyon Creek was monitored for fecal coliform and selenium. McCoy Creek was monitored for fecal coliform, nitrate, nitrate as nitrogen and selenium. Thirteen monitoring events, comprising twenty-six samples per creek, were conducted between May and July 2006. Laboratory analysis was administered by American Environmental Testing Laboratory Inc. located in Burbank, California. If copper and lead waste load allocation exceedances occur at tier 1 and 2 monitoring stations then the city will communicate with other responsible agencies in Reach 6 to conduct sampling at Tier 3 monitoring location. Due to the high volume of traffic on 101 Freeway, City of Calabasas staff believes that a location downstream of the freeway would provide valuable data for Tier 3 monitoring.



Map 11 - GIS Map of Dry Canyon Creek Monitoring Sites

Two sites along Dry Canyon Creek were chosen for monitoring. The southern site, labeled Dry1 is located in the upper reach of the creek near the intersection of Mulholland Highway and Condell Road near the View Point School. The northern site, labeled Dry2 is located in the lower reach of the creek near the intersection of Park Ora Road and Park Sorrento at the boundary between the City of Calabasas and Los Angeles County.

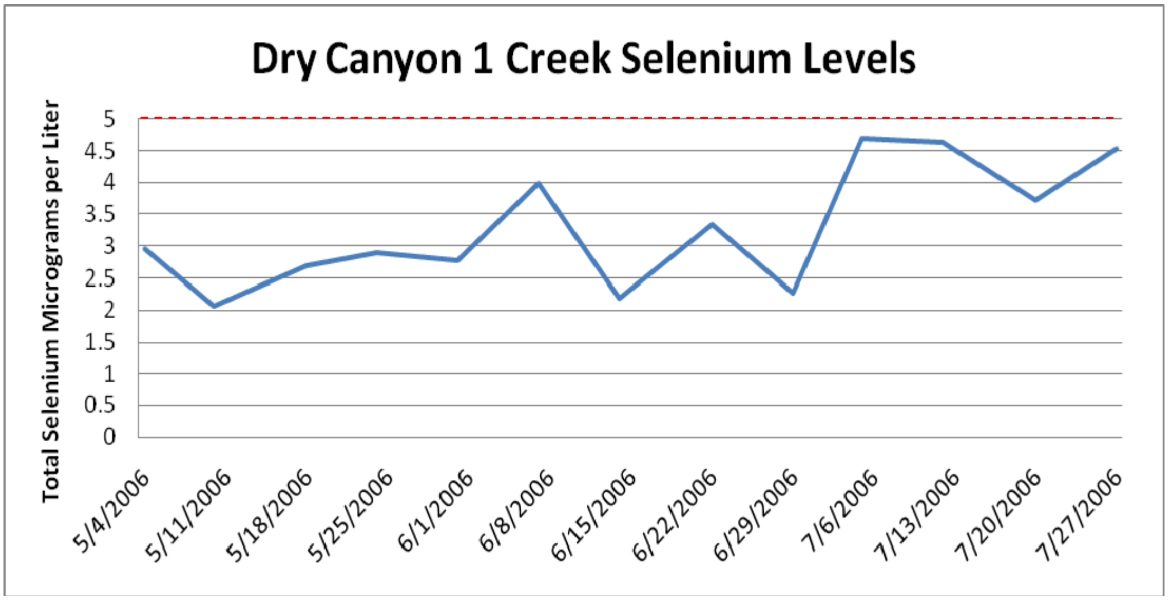


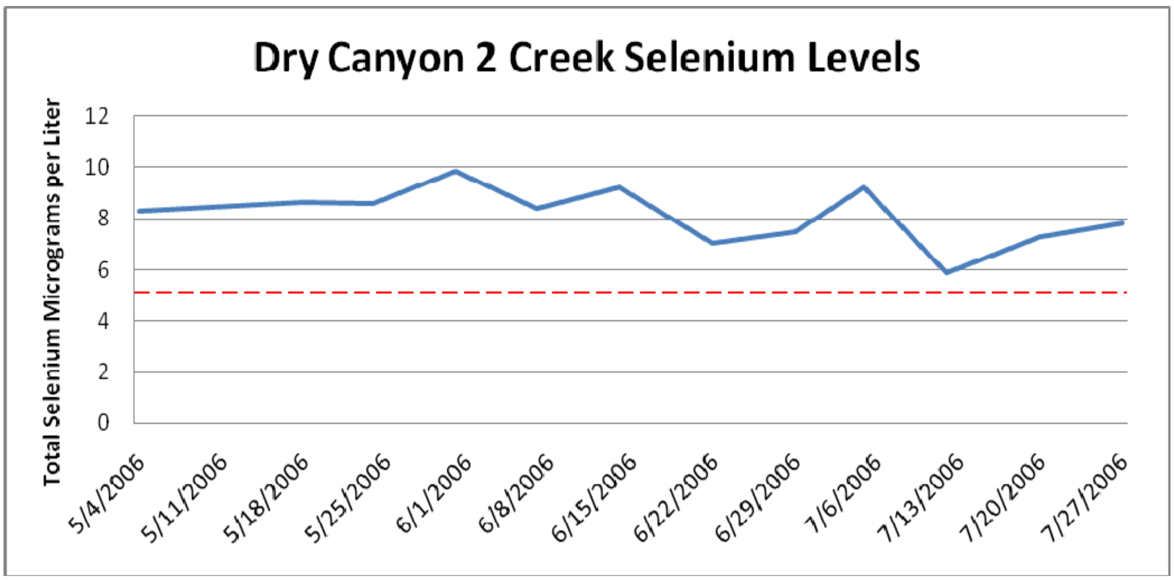
Map 12 - GIS Map of McCoy Creek Monitoring Sites

Two sites along McCoy Creek were chosen for monitoring. The southern site, labeled McCoy1 is located in the upper reach of the creek near the intersection of Parkway Calabasas and Park Entrada on the Calabasas Golf Course. The northern site, labeled McCoy2 is located in the lower reach of the creek near the intersection of Park Sorrento and the entrance to the Calabasas Tennis and Swim Club.

The following table and graphs summarize the results of the selenium sampling at Dry Canyon Creek:

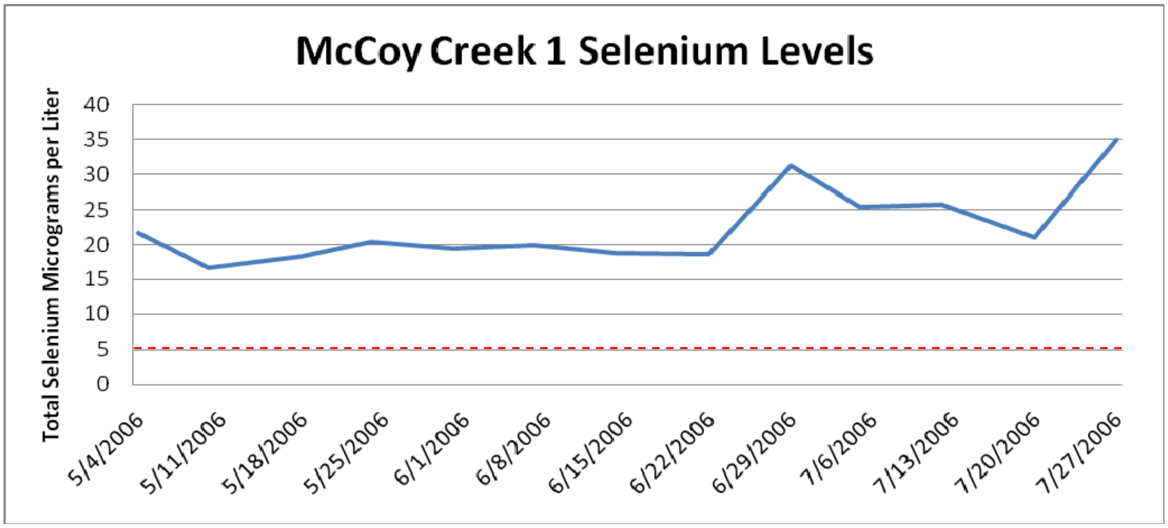
Site Name	Parameter	Analysis	Result	Units
DRY1	Selenium	Average	3.29	µg/L
DRY2	Selenium	Average	8.15	µg/L
Total				
DRY CANYON	Selenium	Average	5.72	µg/L

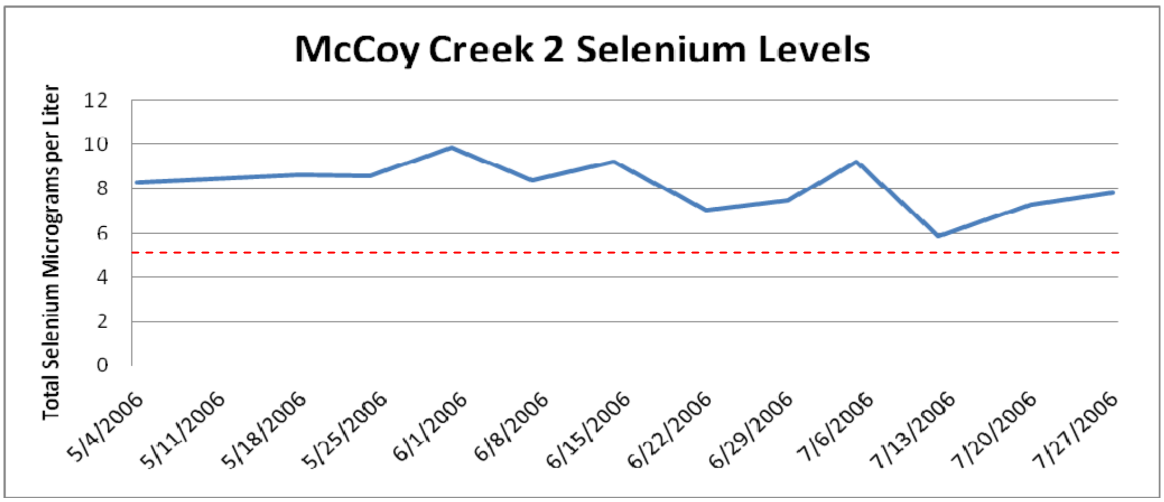




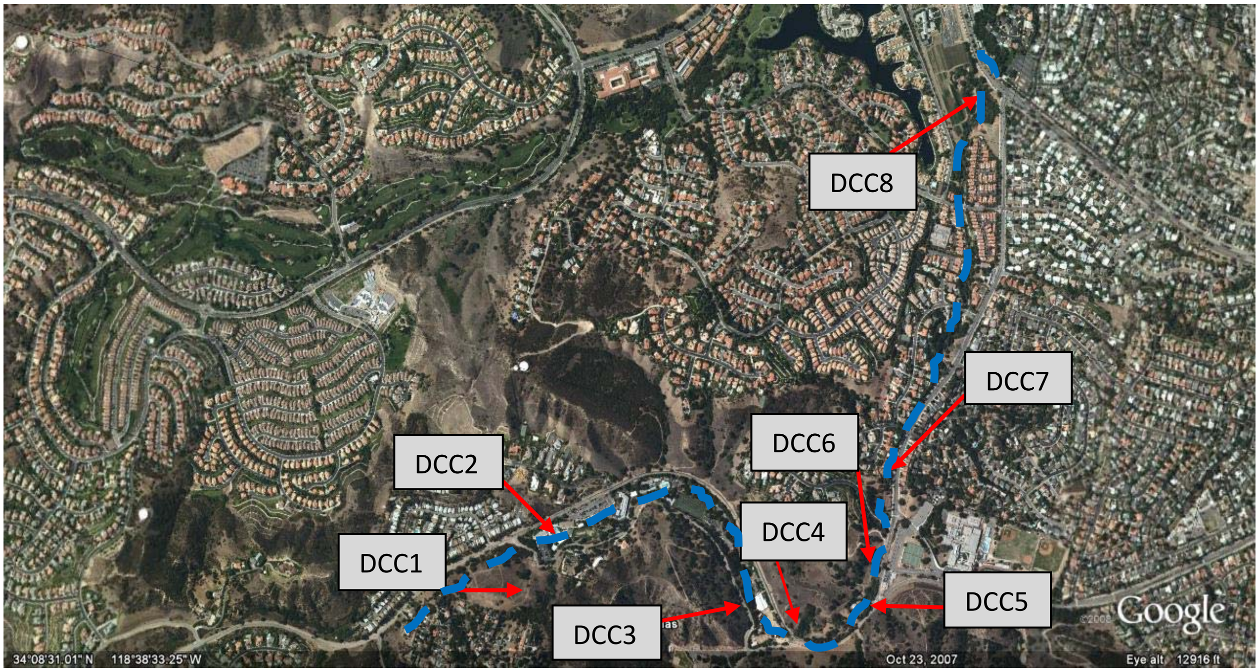
The following table and graph summarize the results of the selenium sampling at McCoy Creek:

Site	Parameter	Analysis	Result	Units
McCoy1	Selenium	Average	22.4	µg/L
McCoy2	Selenium	Average	21.4	µg/L
Total				
MCCOY CREEK	Selenium	Average	21.9	µg/L





The City of Calabasas has been involved with extensive water sampling in both the Dry Canyon and McCoy Creek watersheds. The second round of City monitoring was conducted from August 31, 2009 through September 22, 2009 on a weekly basis at both creeks; all outfalls and or tributaries with flow were sampled. A total of twenty-eight samples were collected during September 2009. Laboratory analysis was administered by American Analytics located in Chatsworth, California.

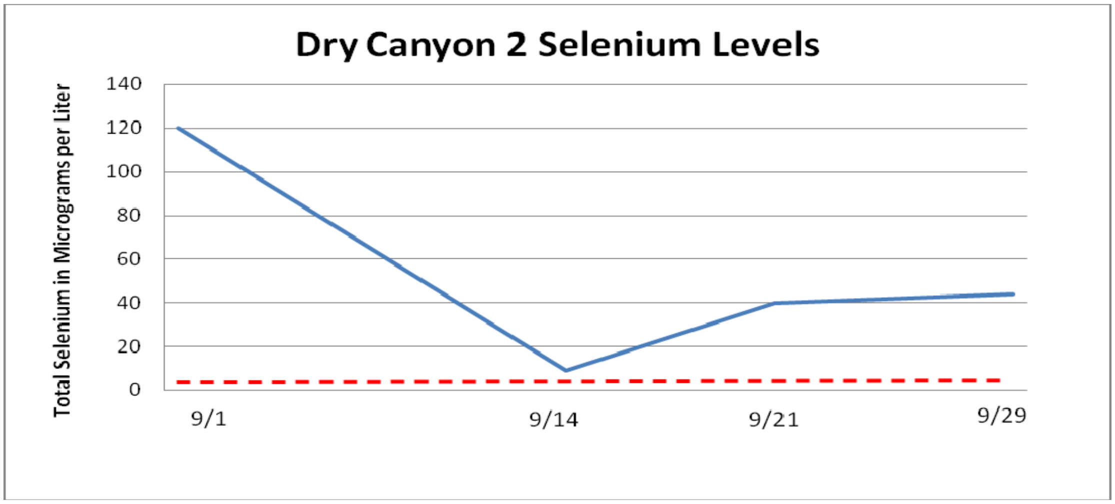


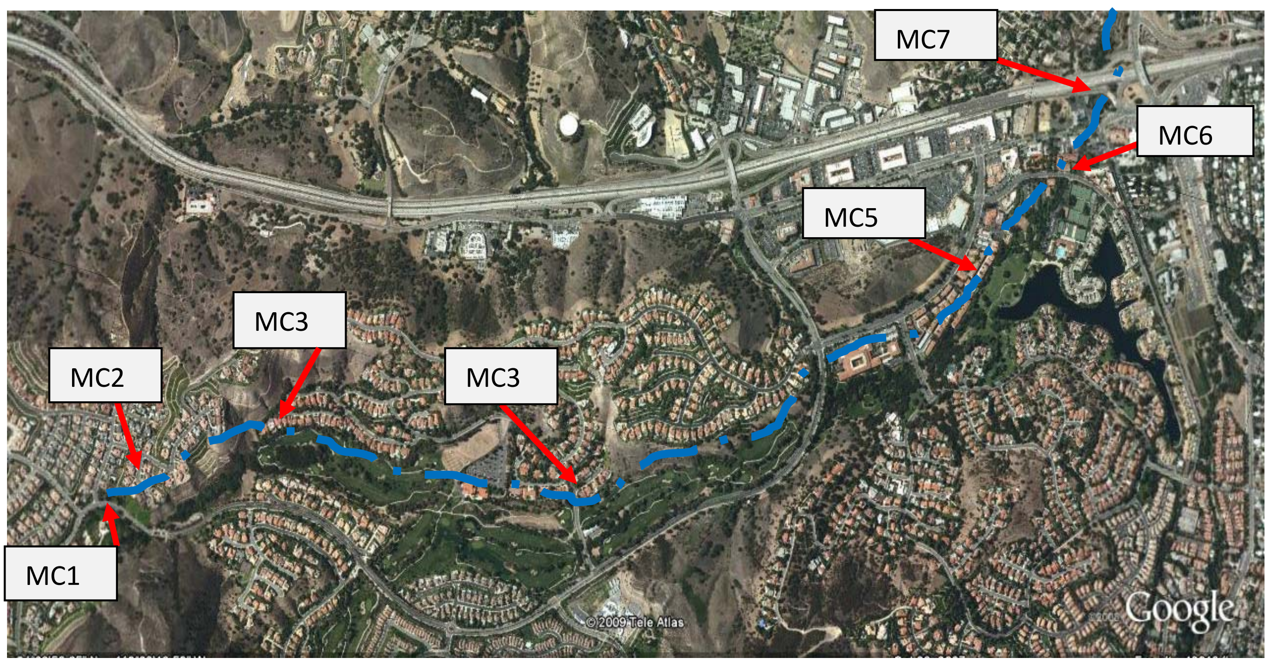
Map 13 - GIS Map of Dry Canyon Creek Monitoring Sites

For the second round of City monitoring 8 discharge/tributary convergences were selected. Site DCC1 is near the headwaters of Dry Canyon Creek and Site DCC8 is located at the City border adjacent to the Motion Picture Hospital. During the 4 weeks of monitoring only 3 sites had flows, samples were taken at DCC2; DCC7 and DCC8.

The following table and graphs summarize the results of the selenium sampling at Dry Canyon Creek:

Site	**Parameter**	**Analysis**	**Result**	**Units**
DCC2	Selenium	Average	53.2	µg/L
DCC7	Selenium	Average	1.0	µg/L
DCC8	Selenium	Average	1.0	µg/L
Totals				
	Selenium	Average	18.4	µg/L



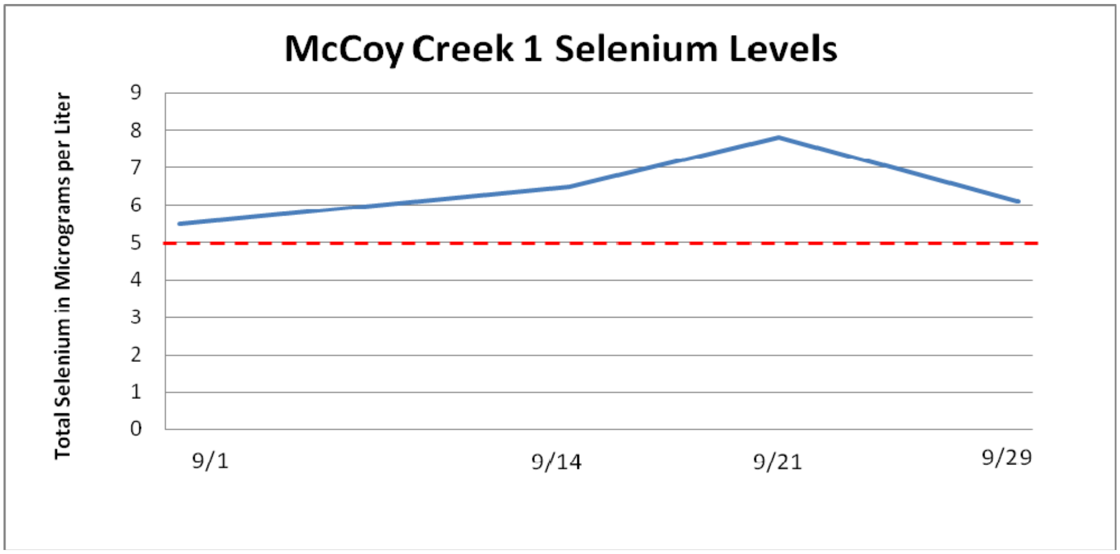


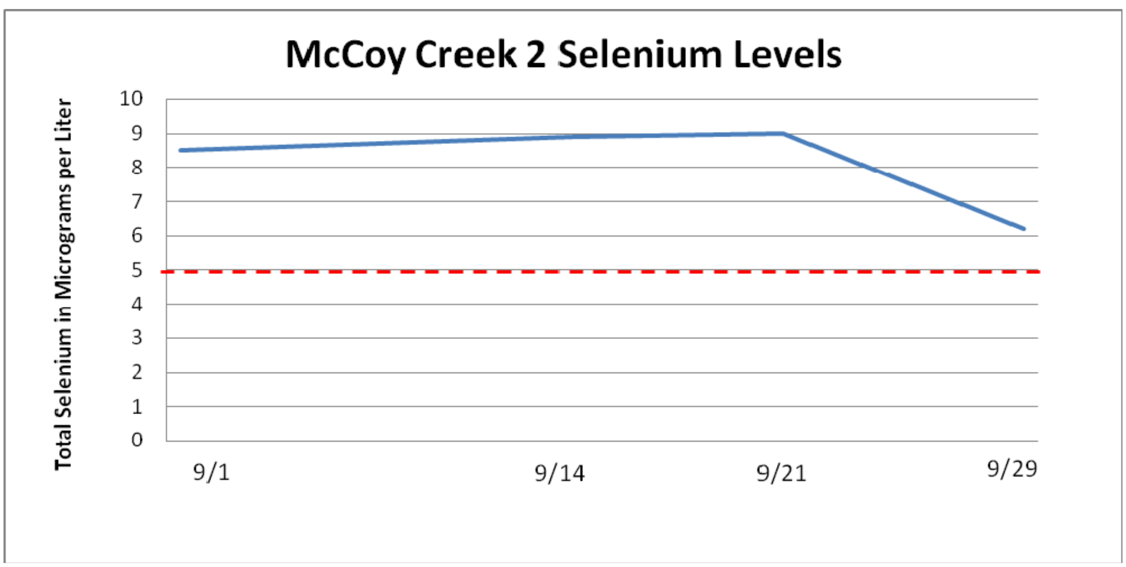
Map 14 - GIS Map of McCoy Creek Monitoring Sites

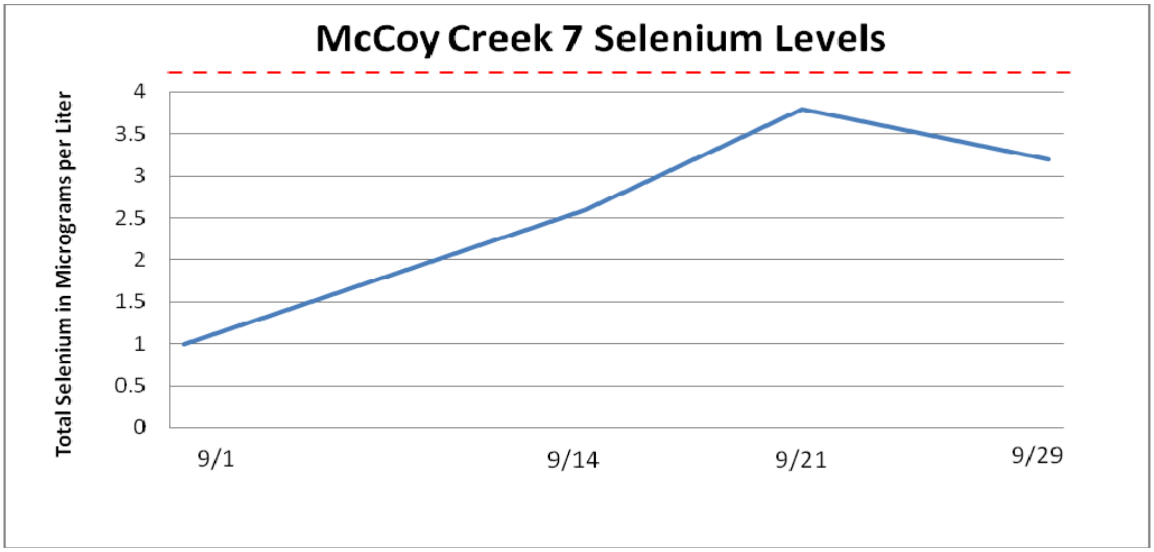
For the second round of City monitoring 7 discharge/tributary convergences were selected. Site MC1 is near the headwaters of McCoy Creek and Site MC7 is located at the City border just south of Calabasas. During the 4 weeks of monitoring only 4 sites had flows, samples were taken at MC1; MC2; MC3 and MC7.

The following table and graphs summarize the results of the selenium sampling at Dry Canyon Creek:

Site	Parameter	Analysis	Result	Units
MC1	Selenium	Average	6.5	µg/L
MC2	Selenium	Average	8.15	µg/L
MC7	Selenium	Average	2.65	µg/L
Totals				
	Selenium	Average	4.32	µg/L







8.6 Special Studies and On-Going Science Developments

The LAR Metals TMDL allows time to complete Special Studies that may be used to refine the estimated loading capacities, LAs, or WLAs. The Special Studies are not required by the LAR Metals TMDL, but may be initiated to help optimize implementation efforts (i.e. determine exact sources of pollutants if exceedances occur). Currently there are no Special Studies under way in Reach 6.

Over the last several years, the City of Calabasas has begun a monitoring program in Dry Canyon and McCoy Creeks to determine the potential natural source(s) of selenium. The City of Calabasas will be presenting their most recent findings related to these studies and investigations in their Implementation Plan. An additional study that may help clarify the naturally occurring selenium concern is one proposed by Dr. Barry Hibbs of California State University, Los Angeles. He has been investigating the hydrologic models of selenium and nitrates in the Las Virgenes Creek and aquifer system. The City will work with other Reach 6 jurisdictional members to facilitate, where possible, actual determination of these studies.

CHAPTER ELEVEN

EVALUATION OF BEST MANAGEMENT PRACTICES TO ACHIEVE APPROPRIATE TMDL

To enforce TMDLs with point sources, water quality-based effluent limitations (WQBELs) must be developed and incorporated into discharge permits for these sources. The permits are issued by EPA and state agencies under the National Pollutant Discharge Elimination System (NPDES). Nonpoint source discharges (e.g. agriculture) are generally in a voluntary compliance scenario. The TMDL implementation plan is intended to help bridge this divide and insure that watershed beneficial uses are restored and maintained. Local watershed groups play a critical role in educating stakeholders, generating funding, and implementing projects to reduce nonpoint sources of pollution.

9.1 Goals

Developing TMDLs is only the first step toward solving water quality problems. TMDLs must be implemented to ensure the restoration of water quality standards. TMDLs specify a set of actions to improve water quality that can include the following:

- Improving water quality
- Enhancing pollution prevention programs for wastewater and urban runoff.
- Cleaning up contaminated soils/sediments, legacy contaminants.
- Reducing pollution.
- Improving creek banks
- Create or revise ordinances and other policies.
- Ongoing monitoring to track water quality improvements.

Furthermore, monitoring and assessment are essential to the success of complying with the Regional Water Quality Control Board's polices. Sampling water flows at each outfall for both Dry Canyon and McCoy Creeks was a regular component for analyzing data.

Selenium is a naturally occurring element within the soils. Reducing soil erosion within can reduce sedimentation and selenium within the creeks. Numerous opportunities exist for reducing erosion. In addition to the sites within the creek corridor, erosion also occurs along the shoulders of the main roadways.

9.2 Evaluation of Best Management Practices (BMPs)

A Best Management Practice (BMP) is a technique, method, process, activity, incentive or reward that is believed to be more effective at delivering a particular outcome than any other technique, method, process, etc. The idea is that with proper processes, checks, and testing, a desired outcome can be delivered with fewer problems and unforeseen complications. BMPs can also be defined as the most efficient (least amount of effort) and effective (best results) way of accomplishing a task, based on repeatable procedures that have proven themselves over time for large numbers of people.

Despite the need to improve on processes as times change and things evolve, best-practice is considered by some as a business buzzword used to describe the process of developing and following a standard way of doing things that multiple organizations can use for management, policy, and especially software systems. As the term has become more popular, some organizations have begun using the term "best practices" to refer to what are in fact merely 'rules', causing a linguistic drift in which a new term such as "good ideas" is needed to refer to what would previously have been called "best practices."

9.3 Structural Criteria

Structural BMPs are designed to control the volume and discharge rate of runoff from both urban and rural areas and to reduce the amount of pollutants discharged. The primary pollutant removal mechanisms are settling, physical removal through filtration, percolation, chemical precipitation or flocculation, and/or biological uptake. Structural BMPs are often highly effective, but costly alternatives for reducing nonpoint source pollution.

Structural BMPs can be grouped into four general BMP categories, or “families.” The primary differentiators of these structural BMP families are the size of tributary drainage area and implementing entities. The following BMP families include:

- Structural Institutional BMPs
- Distributed BMPs
- Regional/Subregional BMPs
- Stream Enhancement Measures

The BMPs within these families work by effecting treatment of pollutants or volume reduction.

9.4 Non-Structural Criteria

Non- Structural BMPs are developed to reduce the generation of nonpoint source pollution from both urban and rural areas. Non-structural BMPs identified here focus on the reduction of: stormwater runoff from impervious areas directly connected to receiving streams and/or buffers; illegal dumping of hazardous materials within stormwater collection systems;.

BMPs from the existing MS4 NPDES Programs were reviewed to identify the baseline BMP programs currently being implemented. An evaluation of these BMPs provided the basis for identifying and evaluating new or enhanced BMP programs that can assist in meeting regulatory requirements. Five criteria were developed as a means to evaluate the enhanced and new non-structural BMPs:

- Target constituents
- Relative cost
- Risk of implementing a BMP
- Risk of not implementing a BMP
- Dry- and wet-weather applicability

In addition, for each BMP evaluated, applicable performance measures were developed to measure the success of the BMP.
BMPs included additions to the NPDES permit programs such as: public outreach, commercial facility control, development planning and development construction, public agency activity, and public agency illicit connection/illicit discharge control.

The program enhancements identified include items from the following sources:

- Existing watershed efforts and stakeholder input,
- Notable programs or BMPs being implemented in parts of the watershed, and
- Notable programs being implemented in other jurisdictions.

9.5 BMP Evaluation Criteria

Separate criteria were developed for both non-structural and structural BMPs. The criteria are described below for both non-structural and structural BMPs.

9.5.a. Effectiveness

The effectiveness criterion measures the effectiveness of a particular BMP based on a number of sub criteria. Effectiveness is impacted by the amount of flow that can be treated within the space available, as well as removal rates for pollutants.

9.5.b. Implementation

The implementability of a BMP is among the most important of the factors considered in the selection process. A strategy can appear to be the most appropriate in terms of cost and effectiveness, but if it cannot be reasonably implemented, the strategy may not be feasible. Implementation is a measure of the ability of a project to be completed. The higher the ranking the more likely a project will result in successful implementation. This criterion is divided into two main sub-criteria: implementation issues and safety of the public.

Implementation issues are further sub-divided into: engineering/siting feasibility, ownership/right of way/ jurisdictions, environmental clearance, and permitting and water rights and safety:

- Engineering/siting feasibility is a measure of the ability of a BMP to be designed to properly work given constraints, such as, but not limited to, area of land available, hydrology, and geology.

- Ownership of land, the ability to use right of ways, and jurisdictional location of BMPs is critical to the successful siting of structural BMPs. Stakeholders have indicated they are not willing to use eminent domain to site BMPs on land owned by unwilling sellers.

- Environmental clearance is necessary for all BMPs. Implementation of a BMP may be more difficult depending on environmental impacts that the project may cause. Construction in sensitive ecological areas is not permissible. BMPs may impact endangered species, aggravate groundwater quality problems, or cause erosion if not properly sited.

- Permitting and water rights issues are also key to successfully implementing a BMP. All projects must be able to obtain all permits required for construction. BMPs that impinge upon existing water rights by removing surface flows or altering ground water flows will reduce the ability of a project to be successfully implemented.

Safety of the public may impact the successful implementation of a BMP. BMPs must be adequately sited and designed to prevent dangers to the public, including but not limited to property damage, personal injuries, or death in the case of accidental drownings. BMPs that present dangers to the public are ranked lower.

9.5.c. Environment and Other Factors

The environment/other factors criteria are a measure of a BMP to create both benefits and potential impacts. Benefits and potential impacts are sub-criteria. Benefits of BMPs would include integrated resource management or beneficial reuse. Beneficial reuse would result in the reuse of runoff for irrigation or groundwater recharge, if feasible, reducing demands on imported potable water. Other potential BMPs resulting in beneficial reuse would receive higher rankings than those BMPs that do not have a reuse component. BMPs can also result in potential impacts such as the creation of vector sources.

CHAPTER TEN

IMPLEMENTATION MEASURES AND BMP OPPORTUNITIES

10.1. Dry Canyon Creek Opportunities

Along Dry Canyon Creek, habitat improvement opportunities primarily relate to erosion control (bank stabilization and revegetation of the floodplain), restoration of wetland and riparian habitat, and physical improvement of channel morphology. Six locations have been identified where stabilization or monitoring of erosion or bank incision are needed. Wetland or riparian habitat restoration would be beneficial in five locations.

The road shoulders along Mulholland Highway are cleared of vegetation to reduce the fire potential. However, once this vegetation is cleared the soil is not held in place and erodes during storm events. If another acceptable fire control option can be identified it should be implemented along the main highways. One possible option that could be evaluated for the road shoulders could be a combination of gravel and some type of porous pavement.

Revegetation of creek banks or the floodplain and bank stabilization opportunities exist along the upper reaches of Dry Canyon Creek, along Mulholland Highway, along the segment adjacent to the Viewpoint School, and at Wrencrest Drive where the creek emerges from an underground channel.

Creation or restoration of wetland or riparian habitat could be accomplished adjacent to the horse stables west of Old Topanga Canyon Road on Mulholland Highway, on the Headwaters Corner along the north side of Mulholland Highway east of the intersection with Old Topanga Canyon Road, and adjacent to Park Paloma near the northern boundary of the City.

Revegetation of creek banks or floodplains would be beneficial along the upper reaches of Dry Canyon Creek along Mulholland Highway, around the brow ditch located north of the intersection of Mulholland Highway and Old Topanga Canyon Road, within the rip-rap located at the intersection of Mulholland Highway and Old Topanga Canyon Road, and adjacent to Park Paloma.

Flow velocity could be reduced near Wrencrest Drive where the creek emerges from an underground channel and adjacent to Park Paloma. The segment near Park Paloma would also be appropriate for establishment of pool/riffle channel morphology, and an upstream reach, near the City boundary, would benefit from an addition of a channel meander.

10.2. McCoy Creek Opportunities

The largest category of opportunities for habitat improvement along McCoy Creek is related to stabilizing the creek banks to prevent or repair erosion and channel incision. Four locations would be appropriate for creating or restoring wetland and riparian habitat, physical channel improvements could be implemented in six locations, and exotic plant removal and revegetation could be performed in two locations.

Stabilization and monitoring of creek bank erosion and incision, as well as the removal of sediment, would be beneficial at a number of locations along McCoy creek. Most of the locations are just upstream of, or within the Calabasas Golf and Country Club, through which the creek flows.

Wetland creation or restoration is feasible on the tributary south of Parkway Calabasas, at two locations toward the eastern end of the golf course north of Parkway Calabasas, and riparian expansion could be accomplished along the creek west of Lake Calabasas.

Additional physical improvements to the channel within the Calabasas Golf and Country Club include improvements to culverts and replacement of existing weirs. Bank stabilization and inchannel grade control could also be implemented along the portion of the creek located on Bank of America's Corporate Office property.

10.3 Monitoring Plan

During the development of the Los Angeles River metal TMDL, all tributary agencies including the County of LA determined and agreed that their compliance efforts would be most effective if coordinated on a watershed basis. The agencies then planned to develop an implementation plan accordingly. However, in early 2009, the County of LA decided to depart from this plan and develop its own IP. Although the other agencies did try to continue their coordinated efforts, however, their efforts in continuation of watershed base did not succeed. Consequently, each participating agency including the City of Calabasas was compelled to develop its separate IP.

In response to the City of Calabasas' request for approval of its own separate IP, the RWQCB required the City to include a monitoring program which would facilitate for assessment of program effectiveness for the City's own area watersheds. In order to fulfill this requirement, the City of Calabasas is proposing to monitor the water quality at the beginning (entry) point of each of its two sub-watersheds in addition to the exit points of these as identified in the approved CMP.

The monitoring locations, pollutant and monitoring frequencies are shown in the following table:

Watershed	Monitoring Location		Monitoring Frequency
	Entry	Exit	
Dry Canyon Creek	DCC1	DCC8	Monthly
McCoy Creek	MC1	MC8	Monthly

CONCLUSION

The City notes that based upon the review of the data collected and also the existing data from the Coordinated Monitoring Program, it appears that it is currently in compliance with all non-anthropogenic standards for metals in both dry and wet weathers.

The City's Plan, based on current data, will essentially entail using an anti-degradation approach to maintain current water quality standards through current institutional controls and non-structural Best Management Practices (BMPs). The City believes this approach is justified based upon existing monitoring results. Moreover, land use within the City's jurisdictional limit is largely limited to residential lots that are unlikely to be the source of Selenium discharges, and the City is small in terms of both occupants and geographic boundaries compared to other responsible agencies in Reach 6 and to that of the overall Los Angeles River Watershed.

The City's review of the dry-weather data demonstrate that the concentration of Selenium is below the actual numeric targets set forth in the LAR Metals TMDL. Thus, the City assumes that it, as well as the other responsible agencies of Reach 6, is fully compliant with the dry-weather WLAs. The City will continue to monitor the dry-weather ambient monitoring data to determine whether further actions will be required.

Finally, the staff Report prepared by the RWQCB staff in 2004 clearly identifies the nature of Selenium in Calabasas creeks: "The Selenium issue seems to be confined to the upper reaches of the watershed and tributaries draining to Reach 6. Because there is little industrial activity in this area, we believe that the selenium in the waterbody originates from natural sources such as marine shales. (Total Maximum Daily Loads for Metals Los Angeles River and Tributaries, Page 22, June 2005)."

APPENDICES

APPENDIX A

State of California
California Regional Water Quality Control Board, Los Angeles Region

RESOLUTION NO. R05-006
June 2, 2005

Amendment to the *Water Quality Control Plan for the Los Angeles Region* to Incorporate a Total Maximum Daily Load for Metals for the Los Angeles River and its Tributaries

WHEREAS, the California Regional Water Quality Control Board, Los Angeles Region, finds that:

1. The Federal Clean Water Act (CWA) requires the California Regional Water Quality Control Board, Los Angles Region (Regional Board) to develop water quality objectives, which are sufficient to protect beneficial uses for each water body found within its region. Water bodies that do not meet water quality objectives or support beneficial uses are considered impaired.

2. A consent decree between the U.S. Environmental Protection Agency (USEPA), Heal the Bay, Inc. and BayKeeper, Inc. was approved on March 22, 1999. This court order directs the USEPA to complete Total Maximum Daily Loads (TMDLs) for all impaired waters within 13 years. A schedule was established in the consent decree for the completion of the first 29 TMDLs within 7 years, including completion of a TMDL to reduce metals in the Los Angeles River and its tributaries by USEPA by March 22, 2005. The remaining TMDLs will be scheduled by Regional Board staff within the 13-year period.

3. USEPA and the consent decree plaintiffs agreed to extend the completion deadline for the Los Angeles River Metals TMDL to December 22, 2005, in order to enable the State to complete its adoption process and USEPA to approve the State-adopted TMDL.

4. The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and section 303(d) of the CWA, as well as in USEPA guidance documents (Report No. EPA/440/4-91/001). A TMDL is defined as the sum of the individual waste load allocations for point sources, load allocations for nonpoint sources and natural background (40 CFR 130.2). Regulations further stipulate that TMDLs must be set at levels necessary to attain and maintain the applicable narrative and numeric water quality standards with seasonal variations and a margin of safety that takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality (40 CFR 130.7(c)(1)). The regulations in 40 CFR 130.7 also state that TMDLs shall take into account critical conditions for stream flow, loading and water quality parameters.

5. The numeric targets in this TMDL are not water quality objectives and do not create new bases for enforcement against dischargers apart from the existing, numeric water quality standards they translate. The targets merely establish the bases through which load allocations (LAs) and waste load allocations (WLAs) are calculated. WLAs are only enforced for a discharger's own discharges, and then only in the context of its National Pollutant Discharge Elimination System (NPDES) permit, which must contain effluent limits consistent with the assumptions and requirements of the WLA. (40 C.F.R. 122.44(d)(vii)(B).) The Regional

Board will develop permit requirements through subsequent permit actions that will allow all interested persons, including but not limited to municipal storm water dischargers, to provide comments on how the WLA will be translated into permit requirements.

6. As envisioned by Water Code section 13242, the TMDL contains a "description of surveillance to be undertaken to determine compliance with objectives." The Compliance Monitoring and Special Studies elements of the TMDL recognize that monitoring will be necessary to assess the on-going condition of the Los Angeles River and its tributaries and to assess the on-going effectiveness of efforts by dischargers to reduce metals loading to the Los Angeles River. Special studies may also be appropriate to provide further information about new data, new or alternative sources, and revised scientific assumptions. The TMDL does not establish the requirements for these monitoring programs or reports, although it does recognize the type of information that will be necessary to secure. The Regional Board's Executive Officer will issue orders to appropriate entities to develop and to submit monitoring programs and technical reports. The Executive Officer will determine the scope of these programs and reports, taking into account any legal requirements, and issue the orders to the appropriate entities.

7. Upon establishment of TMDLs by the State or USEPA, the State is required to incorporate the TMDLs along with appropriate implementation measures into the State Water Quality Management Plan (40 CFR 130.6(c)(1), 130.7). This Water Quality Control Plan for the Los Angeles Region (Basin Plan), and applicable statewide plans, serves as the State Water Quality Management Plans governing the watersheds under the jurisdiction of the Regional Board. Attachment A to this resolution contains the Basin Planning language for this TMDL.

8. The Los Angeles River flows for 55 miles from the Santa Monica Mountains at the western end of the San Fernando Valley to Queensway Bay located between the Port of Long Beach and the City of Long Beach. The Los Angeles River drains a watershed with an area of 834 square miles. The proposed TMDL addresses impairments of water quality caused by metals in several reaches and tributaries of the Los Angeles River.

9. On May 18, 2000, the U.S. EPA promulgated numeric criteria for priority pollutants for the State of California, known as the California Toxics Rule (CTR), codified as 40 CFR section 131.38. Federal water quality standards under section 303 of the Clean Water Act consist of designated uses and criteria to protect those uses. (40 C.F.R. 131.3(i).) Designated uses are beneficial uses under state law, and criteria are water quality objectives under state law. The CTR establishes the numeric water quality objectives for various toxic pollutants. These objectives apply "without exeception" to all inland surface waters within the State of California, including the Los Angeles region. (40 C.F.R. 131.38(d)(1)-(2).)

10. "[I]t is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited." (33 U.S.C. 1251(a)(3).) Water quality standards, including the CTR, reflect this express national policy of Congress. When a pollutant is present at levels in excess of the CTR numbers, then the pollutant is present in toxic amounts. In this sense, the numeric objectives in the CTR are U.S. EPA's determination of when priority pollutants are present at toxic amounts in contravention of Congress's national policy.

11. The Regional Board's goal in establishing the Los Angeles River and Tributaries Metals TMDL is to protect the aquatic life and wildlife beneficial uses of Los Angeles River and its tributaries and to achieve the numeric water quality objectives set to protect these uses as contained in the CTR.

12. Regional Board staff have prepared a detailed technical document that analyzes and describes the specific necessity and rationale for the development of this TMDL. The technical document entitled "Total Maximum Daily Load for Metals - Los Angeles River and Tributaries" is an integral part of this Regional Board action and was reviewed, considered, and accepted by the Regional Board before acting. Further, the technical document provides the detailed factual basis and analysis supporting the problem statement, numeric targets (interpretation of the narrative and numeric water quality objectives, used to calculate the pollutant allocations), source analysis, linkage analysis, waste load allocations (for point sources), load allocation (for nonpoint sources), margin of safety, and seasonal variations and critical conditions of this TMDL.

13. On June 2, 2004, prior to the Board's action on this resolution, public hearings were conducted on the Los Angeles River and Tributaries Metals TMDL. Notice of the hearings were sent to all known interested persons and published in the Los Angeles Times on March 27, 2005 in accordance with the requirements of Water Code Section 13244.

14. The public has had reasonable opportunity to participate in review of the amendment to the Basin Plan. A draft of the Los Angeles River and Tributaries Metals TMDL was originally released for public comment on July 12, 2004. The Regional Board held a workshop to receive testimony on the proposed TMDL on September 2, 2004. Regional Board staff responded to oral and written comments received from the public on the first draft and released a revised draft TMDL for public comment on March 28, 2005. A Notice of Hearing and Notice of Filing were published and circulated 45 days preceding Board action, and Regional Board staff responded to oral and written comments received from the public on the revised draft.

15. In amending the Basin Plan, the Regional Board considered the requirements set forth in Sections 13240 and 13242 of the California Water Code.

16. Because the TMDL implements existing numeric water quality objectives (i.e., the numeric water quality criteria established by USEPA in the CTR), the Regional Board has consistently maintained (along with the State Water Resources Control Board) that adopting a TMDL does not require the water boards to consider the factors of Water Code section 13241. The consideration of the Water Code section 13241 factors, by section 13241's express terms, only applies "in establishing water quality objectives." Here the Regional Board is not establishing water quality objectives, but as required by section 303(d)(1)(C) of the Clean Water Act is adopting a TMDL that will implement the previously established objectives that have not been achieved.

17. While the Regional Board is not required to consider the factors of Water Code section 13241, it, nonetheless, has developed and received significant information pertaining to the Water Code section 13241 factors and considered that information in developing and adopting this TMDL. The past, present, and probable future beneficial uses of water have been considered in that the Los Angeles River is designated for a multitude of beneficial uses in the Basin Plan. Various living organisms (including vegetation, fish, invertebrates, and wildlife) are present in, transient through, and will be present in the Los Angeles River. The fact that some flows are intermittent or, as characterized by some commenters "effluent dominated" or "nuisance flows," does not diminish this fact. The environmental characteristics of the Los Angeles River are spelled out at length in the Basin Plan and in the technical documents supporting this Basin Plan amendment, and have been considered in

developing this TMDL. Water quality conditions that reasonably could be achieved through the coordinated control of all factors which affect water quality in the area have been considered via the discussion of likely means of compliance, and studies indicating that a mix of best management practices (BMPs), rather than advanced treatment plants, would achieve the water quality criteria established in the CTR. Authorizing certain storm water dischargers to rely on BMPs in the first instances reflects the reasonableness of the action in terms of the ability to implement the requirements, as well as a belief that the water quality conditions can reasonably be achieved in any event. Establishing a plan that will ensure the Los Angeles River is not toxic is a reasonable water quality condition. However, to the extent that there would be any conflict between the consideration of the factor in Water Code section 13241 subdivision (c), if the consideration were required, and the Clean Water Act, the Clean Water Act would prevail. Notably, national policy established by Congress prohibits the discharge of toxic pollutants in toxic amounts. Economic considerations were considered throughout the development of the TMDL. Some of these economic considerations arise in the context of Public Resources Code section 21159 and are equally applicable here. The TMDL maps out a two-decade approach to implementing national policy prohibiting toxic pollutants in toxic amounts. This implementation program recognizes the economic limitations on achieving immediate compliance—especially for municipal storm water dischargers. The TMDL also authorizes the use of BMPs, to the extent authorized by law, for various storm water dischargers. Again, these recognize the economic limitations on certain storm water dischargers, while remaining faithful to the requirement to implement existing water quality standards and national policy. As part of this economic consideration, the Regional Board considered several studies pertaining to storm water (some submitted by dischargers showing costs as high as several hundred billion to implement all water quality standards in the Basin Plan through advanced treatment plants and some developed by the State Water Resources Control Board and Regional Board through economic studies prepared by professors at the University of Southern California, the University of California at Los Angeles, California State University at Sacramento showing costs of several billion dollars to implement all water quality standards in the Basin Plan using a mix of BMPs). The former studies consist of worst-case assumptions and these studies' high-end figures assume the widespread construction of treatment facilities. Based on existing policy geared toward BMPs and the latter studies, these assumptions are unrealistic. While section 13241 of the Water Code does not require a balancing of the costs and benefits, the latter studies also conclude that any costs would be outweighed by the societal and economic benefits to Los Angeles' coastal economy. Again, these "economic considerations" were all considered and are reflected in an implementation program that is flexible and allows two decades to comply with the final WLAs. The need for housing within the region has been considered, but this TMDL is unlikely to affect housing needs. Whatever housing impacts could materialize are ameliorated by the flexible nature of this TMDL and the two-decade implementation period. Finally, the TMDL is likely to facilitate the use of recycled water, as demonstrated by the City of Los Angeles' Integrated Resources Plan.

18. The amendment is consistent with the State Antidegradation Policy (State Board Resolution No. 68-16), in that it does not authorize any lowering of water quality and is designed to implement existing water quality objectives. Likewise, the amendment is consistent with the federal Antidegradation Policy (40 CFR 131.12).

19. Pursuant to Public Resources Code section 21080.5, the Resources Agency has approved the Regional Water Boards' basin planning process as a "certified regulatory program" that adequately satisfies the California Environmental Quality Act (CEQA) (Public Resources Code, Section 21000 et seq.) requirements for preparing environmental documents. (14 Cal.

Code Regs. § 15251(g); 23 Cal. Code Regs. § 3782.) As such, the Regional Water Board's basin planning documents together with an Environmental Checklist, are the "substitute documents" that contain the required environmental documentation under CEQA. (23 Cal Code Regs. § 3777.) The detailed technical report entitled "Total Maximum Daily Load for Metals - Los Angeles River and Tributaries," responses prepared by staff to address comments raised during the development of the TMDL, this resolution, and the Environmental Checklist serve as the substitute documents for this project. The project itself is the establishment of a TMDL for toxic metals in the Los Angeles River and its tributaries. While the Regional Board has no discretion to not establish a TMDL (the TMDL is required by federal law) or for determining the water quality standard to be applied (the CTR establishes the numeric water quality objectives that must be implemented), the Board does exercise discretion in assigning waste load allocations and load allocations, determining the program of implementation, and setting various milestones in achieving the numeric water quality standards established in the CTR.

20. A CEQA Scoping hearing was conducted on April 23, 2004 at the Los Angeles Regional Water Quality Control Board, 320 W. 4th Street, Los Angeles, CA 90013. A notice of the CEQA Scoping hearing was sent to interested parties including cities and/or counties with jurisdiction in or bordering the Los Angeles River watershed.

21. The lengthy implementation period allowed by the TMDL, will allow many compliance approaches to be pursued. In preparing the accompanying CEQA substitute documents, the Regional Board has considered the requirements of Public Resources Code section 21159 and California Code of Regulations, title 14, section 15187, and intends the substitute documents to serve as a tier 1 environmental review. Nearly all of the compliance obligations will be undertaken by public agencies that will have their own obligations under CEQA. Project level impacts will need to be considered in any subsequent environmental analysis performed by other public agencies, pursuant to Public Resources Code section 21159.2. If not properly mitigated at the project level, there could be adverse environmental impacts. The substitute documents for this TMDL, and in particular the Environmental Checklist and staff's responses to comments, identify broad mitigation approaches that should be considered at the project level. Consistent with CEQA, the substitute documents do not engage in speculation or conjecture and only consider the reasonably foreseeable environmental impacts of the methods of compliance, the reasonably foreseeable feasible mitigation measures, and the reasonably foreseeable alternative means of compliance, which would avoid or eliminate the identified impacts.

22. The proposed amendment could have a significant adverse effect on the environment. However, there are feasible alternatives, feasible mitigation measures, or both that would substantially lessen any significant adverse impact. The public agencies responsible for those parts of the project can and should incorporate such alternatives and mitigation into any subsequent projects or project approvals. Possible alternatives and mitigation are described in the CEQA substitute documents, specifically the TMDL technical report and the Environmental Checklist. To the extent the alternatives, mitigation measures, or both are not deemed feasible by those agencies, the necessity of implementing the federally required metals TMDL and removing the metals-related toxicity impairment from the Los Angeles River (an action required to achieve the express, national policy of the Clean Water Act) outweigh the unavoidable adverse environmental effects.

23. Health and Safety Code section 57004 requires external scientific peer review for certain water quality control policies. Prior to public notice of the draft TMDL, the Regional Board

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Page 6

submitted the scientific basis and scientific portions of the Los Angeles River Metals TMDL to the University of California for external scientific peer review. A written peer review report was received by the Regional Board. Minor modifications were made to the scientific portions of the TMDL to address concerns identified during the peer review process.

24. The regulatory action meets the "Necessity" standard of the Administrative Procedures Act, Government Code, Section 11353, Subdivision (b). As specified above, federal regulations require that TMDLs be incorporated into the water quality management plan. The Regional Board's Basin Plan is the Regional Board's component of the water quality management plan, and the Basin Plan is how the Regional Board takes quasi-legislative, planning actions. Moreover, the TMDL is a program of implementation for existing water quality objectives, and is, therefore, appropriately a component of the Basin Plan under Water Code section 13242. The necessity of developing a TMDL is established in the TMDL staff report, the section 303(d) list, and the data contained in the administrative record documenting the metals impairments of the Los Angeles River and its tributaries.

25. The Basin Plan amendment incorporating a TMDL for metals for the Los Angeles River and Tributaries must be submitted for review and approval by the State Water Resources Control Board (State Board), the State Office of Administrative Law (OAL), and the USEPA. The Basin Plan amendment will become effective upon approval by USEPA. A Notice of Decision will be filed with the Resources Agency.

26. The Regional Board has previously endorsed integrated water resources approaches to addressing Municipal Separate Storm Sewer System (MS4) implementation of TMDLs. The Regional Board believes integrated approaches require additional time for planning and development and are suitable for the 22-year implementation period discussed in this TMDL. As presently proposed, the TMDL implementation program does not distinguish between integrated and nonintegrated approaches. Further consideration of an implementation schedule incorporating and establishing incentives for an integrated water resources approach, similar to the Santa Monica Bay Beaches Bacteria TMDL, is appropriate.

THEREFORE, be it resolved that pursuant to sections 13240 and 13242 of the Water Code, the Regional Board hereby amends the Basin Plan as follows:

1. Pursuant to Sections 13240 and 13242 of the California Water Code, the Regional Board, after considering the entire record, including oral testimony at the hearing, hereby adopts the amendments to Chapter 7 of the Water Quality Control Plan for the Los Angeles Region, as set forth in Attachment A hereto, to incorporate the elements of the Los Angeles River and Tributaries Metals TMDL.

2. The Executive Officer is directed to forward copies of the Basin Plan amendment to the State Board in accordance with the requirements of section 13245 of the California Water Code.

3. The Regional Board requests that the State Board approve the Basin Plan amendment in accordance with the requirements of sections 13245 and 13246 of the California Water Code and forward it to OAL and the USEPA.

4. If during its approval process Regional Board staff, the State Board or OAL determines that minor, non-substantive corrections to the language of the amendment are needed for clarity or

consistency, the Executive Officer may make such changes, and shall inform the Board of any such changes.

5. The Executive Officer is authorized to sign a Certificate of Fee Exemption.

6. Regional Board staff are directed to explore and to propose revisions to the TMDL implementation schedule that incorporate an integrated water resources approach, similar to the implementation program in the Santa Monica Bay Beaches Bacteria TMDL. The Regional Board will consider any revisions proposed by staff, but is not committing to any particular course of action.

I, Jonathan Bishop, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a resolution adopted by the California Regional Water Quality Control Board, Los Angeles Region, on June 2, 2005.

Jonathan Bishop
Executive Officer

6/17/05
Date

APPENDIX B

STATE OF CALIFORNIA
OFFICE OF ADMINISTRATIVE LAW

In re: STATE WATER RESOURCES CONTROL BOARD	NOTICE OF APPROVAL OF REGULATORY ACTION
REGULATORY ACTION:	Government Code Section 11353
Title 23, California Code of Regulations Adopt sections 3939.19	OAL File No. 05-1027-02 S

This amendment to the Water Quality Control Plan for the Los Angeles Region (Basin Plan) establishes a Total Maximum Daily Load (TMDL) to reduce metals in the Los Angeles River and its Tributaries for dry weather (maximum daily flow in the River less than 500 cubic feet per second) and wet weather (maximum daily flow in the River equal to or greater than 500 cubic feet per second). The TMDL: (1) sets dry-and wet-weather numeric targets to achieve California Toxics Rule (CTR) numeric water quality criteria for metals; (2) establishes a dry-weather loading capacity for a single critical flow to meet the dry-weather numeric target; (3) establishes a wet-weather loading capacity that varies with flow in order to meet wet-weather numeric targets; and (4) allocates the dry-and wet-weather loading capacities among point and nonpoint sources of metals, with the majority of the dry-weather allocation to the three largest publicly owned treatment works (POTWs) and the majority of the wet-weather allocation to storm water sources.

OAL approves this regulatory action pursuant to section 11353 of the Government Code.

DATE: 12/09/05

DEBRA M. CORNEZ
Assistant Chief Counsel

for: WILLIAM L. GAUSEWITZ
Director

Original : Celeste Cantu, Executive Director
cc : Greg Frantz

APPENDIX C

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

DEC 2 2 2005

Ms. Celeste Cantú
Executive Director
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Dear Ms. Cantú:

Thank you for submitting the Basin Plan amendments containing total maximum daily loads (TMDLs) for Los Angeles River, Ballona Creek and Ballona Creek Estuary. The Los Angeles River and Ballona Creek TMDL submittal was dated December 13, 2005 and received by EPA on December 19, 2005. The Ballona Creek Estuary TMDL submittal was dated December 14, 2005 and received by EPA on December 19, 2005. The State adopted TMDLs to address the following water body-pollutant combinations on California's 2002 Clean Water Act Section 303(d) list:

- Los Angeles River Reach 1 (cadmium, copper, lead, zinc), Los Angeles River Reach 2 and 4 (lead), Rio Hondo Reach 1 (copper, lead, zinc), Compton Creek (copper, lead), Tujunga Wash (copper), Monrovia Creek (lead), Aliso Creek (selenium), Dry Canyon Creek (selenium), and McCoy Canyon Creek (selenium);
- Ballona Creek (copper, lead, selenium, zinc) and Sepulveda Canyon Channel (lead); and
- Ballona Creek Estuary (chlordane, total DDT, total PAHs, total PCBs, lead, zinc).

During the TMDL development process, the State determined the following additional water body-pollutant combinations are also water quality limited pursuant to the requirements of Section 303(d)(1), and adopted TMDLs to address these additional combinations:

- Los Angeles River Reaches 2, 3, 4, and 5 and Burbank Western Channel (copper);
- Los Angeles River Reaches 3 and 5 and Burbank Western Channel (lead);
- Los Angeles River Reach 6 (selenium);
- Sepulveda Canyon Channel (copper, selenium and zinc); and
- Ballona Creek Estuary (cadmium copper, and silver).

During the decision-making process, the State clearly identified these additional water body-pollutant combinations as water quality limited waters for which TMDLs are required. The State provided sufficient documentation to support its determination and

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provided opportunities for public review and comment on the additional water body-pollutant identifications. The State's decision to concurrently identify additional water quality limited segments and adopt TMDLs for those segments is consistent with the provisions of the Clean Water Act and federal regulations. As the State's decision to identify the additional water body-pollutant combinations is consistent with the requirements of Section 303(d) and federal regulations at 40 CFR 130.7, EPA hereby approves the identification of these additional combinations pursuant to Section 303(d)(2).

Based on EPA's review of the TMDL submittals under Clean Water Act Section 303(d)(2), I have concluded the TMDLs adequately address the pollutants of concern and, upon implementation, will result in attainment of the water quality standards adopted by the State. These TMDLs include waste load and load allocations as needed, take into consideration seasonal variations and critical conditions, and provide an adequate margin of safety.

The State provided sufficient opportunities for public review and comment on the TMDLs and demonstrated how public comments were considered in the final TMDLs. All required elements are adequately addressed; therefore, the TMDLs are hereby approved pursuant to Clean Water Act Section 303(d)(2).

The State submittals also contain detailed plans for implementing these TMDLs. Current federal regulations do not define TMDLs as containing implementation plans; therefore, EPA is not taking action on the implementation plans provided with the TMDLs. However, EPA generally concurs with the State's proposed implementation approaches.

The enclosed review discusses the basis for these decisions in greater detail. I appreciate the State and Regional Board's work to adopt these TMDLs and look forward to our continuing partnership in TMDL development. If you have questions concerning this action, please call me at (415) 972-3572 or David Smith at (415) 972-3416.

Sincerely yours,

Alexis Strauss
Director
Water Division

enclosures

✓cc: Jonathan Bishop, LARWQCB

APPENDIX D

State of California
California Regional Water Quality Control Board, Los Angeles Region

RESOLUTION NO. R2007-014

September 6, 2007

Amendment to the *Water Quality Control Plan for the Los Angeles Region* to Incorporate a Total Maximum Daily Load for Metals in Los Angeles River

WHEREAS, the California Regional Water Quality Control Board, Los Angeles Region, finds that:

1. On June 2, 2005, the Regional Board established, by Resolution No. R05-006, an amendment to the Water Quality Control Plan for the Los Angeles Region (Basin Plan) incorporating a Metals TMDL for the Los Angeles River. The TMDL was subsequently approved by the State Water Resources Control Board in Resolution No. 2005-0077 on October 20, 2005 and by the Office of Administrative Law on December 9, 2005. The USEPA approved the Los Angeles River Metals TMDL on December 22, 2005. The effective date of the TMDL is January 11, 2006, when the Certificate of Fee Exemption was filed with the California Department of Fish and Game.
2. On February 16, 2006, the Cities of Bellflower, Carson, Cerritos, Downey, Paramount, Santa Fe Springs, Signal Hill, and Whittier (Cities) filed a petition for a writ of mandate challenging many aspects of the Los Angeles River Metals TMDLs and the Ballona Creek Metals TMDLs.
3. On May 24, 2007, the Los Angeles County Superior Court adopted the third of three rulings with respect to the writ petition. Collectively, all challenges to the TMDLs were rejected, except for one CEQA claim. Specifically, the Court ruled that the State and Regional Boards (Water Boards) should have adopted and circulated an alternatives analysis that analyzed alternatives to the project, pursuant to Public Resources Code section 21080.5 and section 3777 of Title 23 of the California Code of Regulations. Together, those authorities, which are applicable to the Water Boards' certified regulatory program, require that a project not be approved if there are feasible alternatives to the project that would substantially lessen a significant adverse effect that the activity may have on the environment. (Pub. Res. C. Section 21080.5(d)(2)(A).)
4. The Water Boards alleged that no feasible alternatives to the project exist that would result in less significant impacts to the environment, but the Court ruled that the Water Boards have the burden of formulating and analyzing alternatives, and that since the Cities had identified in their briefs two "potentially feasible alternatives", the environmental documentation was deficient because the Water Boards did not conduct an adequate alternatives analysis. Accordingly, the Court issued its writ of mandate, directing the Water Boards to adopt an alternatives analysis that analyzed feasible alternatives to the TMDLs and reconsider the TMDLs accordingly. The writ was limited to that issue, and the TMDLs were affirmed in all other respects. Accordingly, an alternatives analysis has been prepared to comply with the writ of mandate, and to explain the Regional Board's conclusion that no feasible alternatives exist that would result in less significant impacts and also achieve the project's purposes.
5. On June 22, 2007, an alternatives analysis was prepared and circulated for public comment, in order to comply with the writ of mandate. The alternatives analysis examines the alternatives suggested by the Cities in the litigation, as well as analogous alternatives suggested to the Regional Board during other TMDL proceedings by these and other stakeholders. The analysis concludes that none of the alternatives are feasible alternatives that would both result in less significant impacts and achieve the project's purposes. The Regional Board has reviewed that analysis, and in consideration of the entire administrative record, the Regional Board approves and adopts the analysis. The Regional Board finds that no feasible alternatives exist that would achieve the project's purpose and also result in substantially less significant impacts to the environment than the TMDL as previously adopted.

6. Considering the alternatives analysis, the Regional Board finds that the TMDL as originally proposed and adopted is appropriate. The Regional Board further finds that nothing in the alternatives analysis, nor any of the evidence generated, presents a basis for the Regional Board to conclude that it would have acted differently when it adopted the TMDLs had the alternatives analysis been prepared and circulated at that time.

7. A revised Basin Plan amendment was circulated on June 22, 2007. The revised amendment replaces the previous implementation deadlines that were tied to "the effective date of the TMDL", with the specific dates that were set when the TMDL previously became effective.

8. Readopting the TMDL while maintaining the existing compliance schedule is warranted, and the Court's order does not justify additional time to comply with the TMDL for any and all of the following reasons:

   a. The TMDL was not stayed during the Court proceedings, and jurisdictions responsible for complying with the TMDL reasonably should have been planning to meet the existing timeline. The petitioners and other responsible jurisdictions are not required to demonstrate attainment of waste load allocations until January 11, 2012, and no showing has been made by any responsible jurisdiction that this timeframe is inappropriate as a result of the litigation or the alternatives analysis;

   b. The alternatives analysis does not change the Regional Board's conclusion that feasible alternatives do not exist to the TMDL that would achieve the project's purposes and result in less significant impacts to the environment, and therefore the original TMDL is not being altered as a result;

   c. The TMDL regulates 42 jurisdictions in the Los Angeles River Watershed, most of whom have proceeded to implement the TMDL in reliance on the existing schedule;

   d. The Cities who filed the petition challenging the Los Angeles River and Ballona Creek Metals TMDLs represent a small fraction of the cities in the Los Angeles River Watershed. Specifically, the cities of Carson, Downey, Paramount, and Signal Hill are in the Los Angeles River Watershed. None of the Cities are in the Ballona Creek Watershed. The cities of Bellflower, Cerritos, Santa Fe Springs, and Whittier are not located in either Watershed and are thus not subject to the requirements of either TMDL that was subject to the writ petition. The parties to the litigation that are not located within the Los Angeles River Watershed are not subject to the TMDL, and thus require no time to comply. Therefore, only 4 of the 42 jurisdictions subject to this TMDL are parties to the litigation, and it would be unfair to put them on unequal footing with each other. Moreover, inconsistent compliance schedules among the jurisdictions could inhibit their cooperation in generating any coordinated responses that they might otherwise find appropriate;

   e. Assuming the TMDL is temporarily vacated, the lapse in time between the issuance of the writ and the Regional Board's readoption is less than 90 days, which is insignificant in comparison to the 22-year compliance schedule;

   f. Maintaining the original time schedule is consistent with the project purpose, and with the Regional Board's mission including expeditious restoration of California's water quality. It is also in the public interest in that restoring the Los Angeles River Watershed will improve the environment and thus the quality of life of the residents in the Watershed.

9. The documents generated for this proceeding, along with the CEQA checklist dated March 25, 2005; the Los Angeles River Metals TMDL staff report dated June 2, 2005; response to comments on the June 12, 2004 and March 28, 2005 draft TMDLs; and any subsequent responses to comments, fulfill the requirements of 23 Cal Code Regulations §3777.

10. On September 6, 2007, prior to the Board's action on this resolution, public hearings were conducted on the TMDL for Metals in the Los Angeles River. Notice of the hearing for the Los Angeles River Metals TMDL was published in accordance with the requirements of Water Code section 13244. This notice was published in the Daily Commerce on June 22, 2007 and the Los Angeles Times on June 23, 2007.

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Page 3

THEREFORE, be it resolved that:

1. Pursuant to Sections 13240 and 13242 of the California Water Code, the Regional Board, after considering the entire record, including oral testimony at the hearing, hereby readopts the amendments to Chapter 7 of the Water Quality Control Plan for the Los Angeles Region as set forth in Attachment A hereto, and reaffirms the decision it took in adopting Resolution No. R05-006, to incorporate the elements of the Los Angeles River Metals TMDL. Findings paragraphs 1 through 26, and Resolved paragraphs 1 through 6 that were set forth in Resolution No. R05-006, are hereby incorporated by reference as though set forth in full. A copy of that resolution appears at Attachment B.

2. The Regional Board hereby certifies the final Addendum to CEQA Documentation as a part of the final CEQA substitute environmental documentation.

3. The Executive Officer is directed to forward copies of the Basin Plan amendment to the State Board in accordance with the requirements of section 13245 of the California Water Code.

4. The Regional Board requests that the State Board approve the Basin Plan amendment in accordance with the requirements of sections 13245 and 13246 of the California Water Code and forward it to OAL and the USEPA.

5. If during its approval process Regional Board staff, the State Board or OAL determines that minor, non-substantive corrections to the language of the amendment, this resolution, or other relevant documentation are needed for clarity or consistency, the Executive Officer may make such changes, and shall inform the Board of any such changes.

6. The Executive Officer is authorized to sign a Certificate of Fee Exemption, or pay the applicable fee as may be required by the Fish and Game Code.

7. The TMDL established by this resolution shall supersede any other Metals TMDL for the Los Angeles River that may be in effect at the time this TMDL becomes effective.

I, Deborah Smith, Interim Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a resolution adopted by the California Regional Water Quality Control Board, Los Angeles Region, on September 6, 2007.

Deborah J. Smith
Interim Executive Officer

APPENDIX E

Attachment A to Resolution No. R2007-014

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

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

Amendments:

Table of Contents
Add:

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

List of Figures, Tables and Inserts
Add:

Chapter 7. Total Maximum Daily Loads (TMDLs)
Tables
7-13 Los Angeles River and Tributaries Metals TMDL
Table 7-13.1 Los Angeles River and Tributaries Metals TMDL: Elements
Table 7-13.2 Los Angeles River and Tributaries Metals TMDL: Implementation Schedule
Table 7-13.3 Los Angeles River and Tributaries Metals TMDL: Jurisdictional Groups

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

This TMDL was adopted by

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

This TMDL was approved by:

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

The following table includes the key elements of this TMDL.

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

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

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

Dry-weather conversion factors:

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

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

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

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

Wet-weather conversion factors:

Cadmium	0.94
Copper	0.65
Lead	0.82
Zinc	0.61

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

Cd	Cu	Pb	Zn	Se
3.1	17	62	159	5

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

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

Dry-weather loading capacity (total recoverable metals)

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

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

Wet Weather

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

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

Wet-weather loading capacity (total recoverable metals)

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

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

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

Open space dry-weather LAs (total recoverable metals)

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

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

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

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

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

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

Wet Weather

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

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

Wet-weather open space LAs (total recoverable metals)

Metal — Load Allocation (kg/day)
Copper — $2.6x10^{-10}$ µg /L/day x daily storm volume(L)
Lead — $2.4x10^{-10}$ µg /L/day x daily storm volume(L)
Zinc — $1.4x10^{-9}$ µg /L/day x daily storm volume(L)

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

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

Metal — Load Allocation (kg/day)
Cadmium — $6.2x10^{-10}$ µg /L/day x daily storm volume(L)
Copper — $3.4x10^{-10}$ µg /L/day x daily storm volume(L)
Lead — $1.2x10^{-10}$ µg /L/day x daily storm volume(L)
Zinc — $3.2x10^{-9}$ µg /L/day x daily storm volume(L)

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

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

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

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

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

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

Storm water dry-weather WLAs (total recoverable metals)

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

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

Other NPDES Permits

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

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

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Element	Key Findings and Regulatory Provisions
	Other dry-weather WLAs (µg total recoverable metals/L)

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

Wet Weather

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

POTW wet-weather WLAs (total recoverable metals):

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

Element	Key Findings and Regulatory Provisions
	Wet-weather waste load allocations for the grouped storm water permittees are equal to the total loading capacity minus the load allocations for open space and direct air deposition and the waste load allocations for the POTWs. Wet-weather waste load allocations for the grouped storm water permittees apply to all reaches and tributaries. **Storm water wet-weather WLAs (total recoverable metals):** **Metal** — **Waste Load Allocation (kg/day)** Cadmium — $3.1x10^{-9}$ x daily volume(L) – 1.95 Copper — $1.7x10^{-8}$ x daily volume (L) – 10 Lead — $6.2x10^{-8}$ x daily volume (L) – 4.2 Zinc — $1.6x10^{-7}$ x daily volume (L) – 90 The combined storm water waste load allocation is apportioned between the different storm water categories by their percent area of the portion of the watershed served by storm drains. **MS4 wet-weather WLAs (total recoverable metals):** **Metal** — **Waste Load Allocation (kg/day)** Cadmium — $2.8x10^{-9}$ x daily volume(L) – 1.8 Copper — $1.5x10^{-8}$ x daily volume (L) – 9.5 Lead — $5.6x10^{-8}$ x daily volume (L) – 3.85 Zinc — $1.4x10^{-7}$ x daily volume (L) – 83 **Caltrans wet-weather WLAs (total recoverable metals):** **Metal** — **Waste Load Allocation (kg/day)** Cadmium — $5.3x10^{-11}$ x daily volume(L) – 0.03 Copper — $2.9x10^{-10}$ x daily volume (L) – 0.2 Lead — $1.06x10^{-9}$ x daily volume (L) – 0.07 Zinc — $2.7x10^{-9}$ x daily volume (L) – 1.6 **General Industrial wet-weather WLAs (total recoverable metals):** **Metal** — **Waste Load Allocation (kg/day)** Cadmium — $1.6x10^{-10}$ x daily volume(L) – 0.11 Copper — $8.8x10^{-10}$ x daily volume (L) – 0.5 Lead — $3.3x10^{-9}$ x daily volume (L) – 0.22 Zinc — $8.3x10^{-9}$ x daily volume (L) – 4.8 **General Construction wet-weather WLAs (total recoverable metals):** **Metal** — **Waste Load Allocation (kg/day)** Cadmium — $5.9x10^{-11}$ x daily volume(L) – 0.04 Copper — $3.2x10^{-10}$ x daily volume (L) – 0.2 Lead — $1.2x10^{-9}$ x daily volume (L) – 0.08 Zinc — 3.01x10-9 x daily volume (L) – 4.8 Each storm water permittee under the general industrial and construction storm water permits will receive individual waste load allocations per acre based on the total acres of their facility.

Element	Key Findings and Regulatory Provisions
	Individual General Construction or Industrial Permittees WLAs (total recoverable metals):

Metal	Waste Load Allocation (g/day/acre)
Cadmium	$7.6\text{x}10^{-12}$ x daily volume(L) – $4.8\text{x}10^{-6}$
Copper	$4.2\text{x}10^{-11}$ x daily volume (L) – $2.6\text{x}10^{-5}$
Lead	$1.5\text{x}10^{-10}$ x daily volume (L) – $1.04\text{x}10^{-5}$
Zinc	$3.9\text{x}10^{-10}$ x daily volume (L) – $2.2\text{x}10^{-4}$

Other NPDES Permits

Concentration-based wet-weather waste load allocations apply to the other NPDES permits* that discharge to all reaches of the Los Angeles River and its tributaries.

Wet-weather WLAs for other permits (total recoverable metals)

Cadmium (µg /L)	Copper (µg /L)	Lead (µg /L)	Zinc (µg /L)
3.1	17	62	159

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

Element	Key Findings and Regulatory Provisions
Margin of Safety	There is an implicit margin of safety that stems from the use of conservative values for the translation from total recoverable to the dissolved fraction during the dry and wet periods. In addition, the TMDL includes a margin of safety by evaluating wet-weather conditions separately from dry-weather conditions, which is in effect, assigning allocations for two distinct critical conditions. Furthermore, the use of the wet-weather model to calculate load allocations for open space can be applied to the margin of safety because it tends to overestimate loads from open spaces, thus reducing the available waste load allocations to the permitted discharges.
Implementation	The regulatory mechanisms used to implement the TMDL will include the Los Angeles County Municipal Storm Water NPDES Permit (MS4), the City of Long Beach MS4, the Caltrans storm water permit, major NPDES permits, minor NPDES permits, general NPDES permits, general industrial storm water NPDES permits, and general construction storm water NPDES permits. Nonpoint sources will be regulated through the authority contained in sections 13263 and 13269 of the Water Code, in conformance with the State Water Resources Control Board's Nonpoint Source Implementation and Enforcement Policy (May 2004). Each NPDES permit assigned a WLA shall be reopened or amended at reissuance, in accordance with applicable laws, to incorporate the applicable WLAs as a permit requirement. The Regional Board shall reconsider this TMDL by January 11, 2011 based on additional data obtained from special studies. Table 7-13-2 presents the implementation schedule for the responsible permittees.

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

<table>
<tr><th>Element</th><th>Key Findings and Regulatory Provisions</th></tr>
<tr><td></td><td>
<u>Wet-weather implementation</u>

General industrial storm water permittees are allowed interim wet-weather concentration-based waste load allocations based on benchmarks contained in EPA's Storm Water Multi-sector General Permit for Industrial Activities. The interim waste load allocations apply to all industry sectors and apply until no later than January 11, 2016.

Interim wet-weather WLAs for general industrial storm water permittees (total recoverable metals)*
<table>
<tr><th>Cd (µg/L)</th><th>Cu(µg/L)</th><th>Pb(µg/L)</th><th>Zn(µg/L)</th></tr>
<tr><td>15.9</td><td>63.6</td><td>81.6</td><td>117</td></tr>
</table>
*Based on USEPA benchmarks for industrial storm water sector

Until January 11, 2011, interim waste load allocations will not be interpreted as enforceable permit conditions. If monitoring demonstrates that interim waste load allocations are being exceeded, the permittee shall evaluate existing and potential BMPs, including structural BMPs, and implement any necessary BMP improvements. It is anticipated that monitoring results and any necessary BMP improvements would occur as part of an annual reporting process. After January 11, 2011, interim waste load allocations shall be translated into enforceable permit conditions. Compliance with permit conditions may be demonstrated through the installation, maintenance, and monitoring of Regional Board-approved BMPs. If this method of compliance is chosen, permit writers must provide adequate justification and documentation to demonstrate that BMPs are expected to result in attainment of interim waste load allocations.

The general industrial storm water permits shall achieve final wet-weather waste load allocations no later than January 11, 2016, which shall be expressed as NPDES water quality-based effluent limitations. Effluent limitations may be expressed as permit conditions, such as the installation, maintenance, and monitoring of Regional Board-approved BMPs if adequate justification and documentation demonstrate that BMPs are expected to result in attainment of waste load allocations.

General construction storm water permits:

Waste load allocations will be incorporated into the State Board general permit upon renewal or into a watershed-specific general permit developed by the Regional Board.

<u>Dry-weather implementation</u>

Non-storm water flows authorized by the General Permit for Storm Water Discharges Associated with Construction Activity (Water Quality Order No. 99-08 DWQ), or any successor order, are exempt from the dry-weather waste load allocation equal to zero as long as they comply with the provisions of sections C.3.and A.9 of the Order No. 99-08 DWQ, which state that these authorized non-storm discharges
</td></tr>
</table>

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

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

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

TMDL Effectiveness Monitoring

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

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

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

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

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

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

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

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

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

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

ATTACHMENT F

2007-014

RECEIVED
OCT 16 2008
SWRCB
EXECUTIVE OFFICE

State of California
Office of Administrative Law

In re: **State Water Resources Control Board**	**NOTICE OF APPROVAL OF REGULATORY ACTION**
Regulatory Action:	**Government Code Section 11353**
Title 23, California Code of Regulations	**OAL File No. 2008-0916-01 S**
Adopt sections: **Amend sections: 3939.19** **Repeal sections:**	

DWQ

RECEIVED
OCT 20 2008
DIVISION OF WATER QUALITY

On September 6, 2007, the Los Angeles Regional Water Quality Control Board adopted an amendment to the Los Angeles Water Quality Control Plan, Resolution R2007-014, which readopts a Total Maximum Daily Load ("TMDL") for metals in the Los Angeles River and its impaired tributaries. Several cities filed a petition for a writ of mandate challenging several aspects of this TMDL as well as the TMDL for Ballona Creek. On May 24, 2007, the Los Angeles County Superior Court rejected all but one of the challenges to the TMDL. According to the Los Angeles County Superior Court ruling, the State and Regional Water Boards should have adopted and circulated an alternatives analysis pursuant to Public Resources Code section 21080.5 and 23 Cal. Code of Regs. section 3777. The new administrative record includes this analysis. Both the Regional Water Quality Control Board and the State Water Resources Control Board held subsequent hearings to re-adopt the TMDL. The Los Angeles Regional Water Quality Control Board adopted Resolution No. R2007-014 on September 6, 2007. The State Water Resources Control Board adopted resolution No 2008-046 on June 17, 2008.

OAL approves this regulatory action pursuant to section 11353 of the Government Code.

Date: 10/14/2008

Holly Geneva Stout
Staff Counsel

For: SUSAN LAPSLEY
Director

APPENDIX G

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 2008-0046

APPROVING AN AMENDMENT TO THE WATER QUALITY CONTROL PLAN FOR THE LOS ANGELES REGION (BASIN PLAN) TO ESTABLISH A TOTAL MAXIMUM DAILY LOAD FOR METALS IN THE LOS ANGELES RIVER

WHEREAS:

1. On June 2, 2005, the Los Angeles Regional Water Quality Control Board (Los Angeles Water Board) adopted, by Resolution No. R05-006, an amendment to the Basin Plan establishing a metals Total Maximum Daily Load (TMDL) for the Los Angeles River. The TMDL was approved by the State Water Resources Control Board (State Water Board) by Resolution No. 2005-0077 on October 20, 2005 and by the Office of Administrative Law (OAL) on December 9, 2005. The United States Environmental Protection Agency (USEPA) approved the TMDL on December 22, 2005. The effective date of the TMDL was January 11, 2006.
2. On February 16, 2006, the Cities of Bellflower, Carson, Cerritos, Downey, Paramount,

   Santa Fe Springs, Signal Hill, and Whittier (Cities) filed a petition for a writ of mandate to the Los Angeles County Superior Court (Court) challenging many aspects of the Los Angeles River Metals TMDL and the Ballona Creek Metals TMDL.
3. On May 24, 2007, the Court issued a writ of mandate. The Court rejected all of the challenges to the TMDLs except for one claim under the California Environmental Quality Act (CEQA). Specifically, the Court ruled that the Los Angeles Water Board should have analyzed alternatives to the project, pursuant to Public Resources Code section 21080.5 and section 3777 of Title 23 of the California Code of Regulations. Those sections, which are applicable to the Water Boards' certified regulatory programs, require that an activity will not be approved or adopted as proposed if there are feasible alternatives or feasible mitigation measures available that would substantially lessen a significant adverse effect that the activity may have on the environment. (Public Resources Code section 21080.5(d)(2)(A).) Parties have filed notices of appeal from the determination of the trial Court; the Water Boards have filed a limited appeal on the issue of the Court's direction to rescind the TMDL until it completes the required alternatives analysis. The Los Angeles Water Board nonetheless performed the required analysis, and re-adopted the TMDL.
4. On June 22, 2007, the Los Angeles Water Board circulated an alternatives analysis (Attachment 1) for public comment, in order to comply with the writ of mandate. The alternatives analysis examines the alternatives suggested by the Cities in the litigation, as well as additional alternatives suggested to the Los Angeles Water Board during other TMDL proceedings by these and other stakeholders. The analysis concludes that none of the alternatives are feasible alternatives that would both result in less significant impacts and achieve the project's purposes.
5. On September 6, 2007, the Los Angeles Water Board reviewed that analysis and, in consideration of the entire administrative record, adopted Resolution No. R2007-014 (Attachment 2[1]). Considering the alternatives analysis, the Los Angeles Water Board found that the TMDL as originally proposed and adopted is appropriate. The Los Angeles Water Board further found that nothing in the alternatives analysis, nor any of the evidence generated, presents a basis for the Los Angeles Water Board to conclude that it would have acted differently when it adopted the TMDL had the alternatives analysis been prepared and circulated at that time.

[1] Attachment 2: Resolution No. R2007-014 itself has 2 attachments: Attachment A is the basin plan amendment Language; and Attachment B is Resolution No. R05-006, which this action amends.

6. The Los Angeles Water Board found that re-adopting the TMDL and maintaining the compliance schedule as originally adopted is warranted. The Court's order does not justify providing additional time to dischargers for compliance with the TMDL.

7. The Los Angeles Water Board found that the alternatives analysis generated for the writ of mandate, along with the CEQA checklist dated March 25, 2005; the staff report dated June 2, 2005; response to comments on the June 12, 2004, March 2005, and June 22, 2007 draft TMDLs, complies with the requirements of the State Water Board's certified regulatory CEQA process, as set forth in the California Code of Regulations, Title 23, section 3775 et seq.

8. The State Water Board reaffirms the finding made on October 20, 2005 that, in amending the Basin Plan to establish this TMDL, the Los Angeles Water Board complied with the requirements set forth in sections 13240, 13242, and 13269 of the California Water Code. The State Water Board also reaffirms that the TMDL is consistent with the requirements of federal Clean Water Act (CWA) section 303(d).

9. The Los Angeles Water Board reaffirmed its findings made in adopting Resolution No. R05-006 that the amendment is consistent with the State Antidegradation Policy (State Water Board Resolution No. 68-16), in that the changes to water quality objectives (i) consider maximum benefits to the people of the state, (ii) will not unreasonably affect present and anticipated beneficial use of waters, and (iii) will not result in water quality less than that prescribed in policies.

10. To the extent that pollutant loadings from indirect atmospheric deposition over land are being conveyed to stormwater discharges, these loadings are included in the stormwater waste load allocations. One study has shown that atmospheric deposition of particulates containing trace metals in the urban areas of the Los Angeles Region is an important source of metals contaminants on land surfaces. (Sabin et al., 2005)[2]. The Los Angeles Water Board met with the South Coast Air Quality Management District (SCAQMD) and the California Air Resources Board (CARB) to discuss the findings of the study. It appears that larger particulates are responsible for the highest loadings of metals in atmospheric deposition, and therefore pose the greatest risk to water quality. The two agencies have identified the need to (1) expand monitoring of larger particulates in atmospheric deposition to better gauge the impact to water quality, and (2) investigate the sources of these metals in order to design a control strategy. The Los Angeles Water Board and the State Water Board will continue to meet with the SCAQMD and CARB to pursue further studies and to assist in developing appropriate controls.

11. The State Water Board encourages local municipalities within the urban watersheds in the Los Angeles Region and Los Angeles County also to work with SCAQMD and CARB to further identify and control sources of trace metals in atmospheric deposition. If necessary, the State Water Board and Los Angeles Water Board shall enforce compliance with the adopted plans by the SCAQMD and CARB as appropriate under Water Code sections 13146 and 13247, and all other relevant statutes and regulations.

12. The Los Angeles Water Board will work with municipalities and Los Angeles County to encourage building designs and best management practices that will retain pollutants on site. This will help prevent the conveyance of pollutants from atmospheric deposition and other sources from being washed into stormwater and discharged to the Los Angeles River, Ballona Creek, and other urban watersheds.

[2] Sabin et al. "Contribution of trace metals from atmospheric deposition to stormwater runoff in small impervious urban catchment." Water Research 39 (2005) 3939-3937.

13. Nothing in this resolution shall be interpreted as suggesting that the municipal dischargers are not responsible under the CWA for the pollutants discharged from their municipal separate storm sewer systems, which is a point source subject to regulation under CWA section 402(p).

14. Los Angeles Water Board staff determined that minor, non-substantive changes to the language adopting the Basin Plan amendment were necessary to correct minor clerical errors, to improve clarity, and to ensure that the amendment is consistent with the Basin Plan update adopted under Resolution No. R2007-014. The Los Angeles Water Board's Executive Officer made these minor changes in a memorandum dated September 21, 2007 (Attachment 3).

15. A Basin Plan amendment does not become effective until approved by the State Water Board and until the regulatory provisions are approved by OAL. The TMDL must also be approved by USEPA.

THEREFORE BE IT RESOLVED THAT:

The State Water Board:

1. Approves the amendment to the Basin Plan adopted under Los Angeles Water Board Resolution No. R2007-014.

2. The Los Angeles Water Board shall consider the data generated from the TMDL special studies or any other appropriate data, and determine whether and to what extent measures by the CARB and SCAQMD are necessary or appropriate to attain Water Quality Standards and the TMDL. If such measures are appropriate, the Los Angeles Water Board shall adopt a Basin Plan amendment consistent with the atmospheric deposition findings in Whereas 10, 11, and 12 above, and take appropriate action to pursue compliance with such requirements.

3. Authorizes the Executive Director or designee to submit the amendment adopted under Los Angeles Water Board Resolution No. R2007-014 to OAL for approval of the regulatory provisions and to USEPA for approval of the TMDL.

CERTIFICATION

The undersigned Clerk to the Board does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on June 17, 2008.

AYE: Vice Chair Gary Wolff, P.E., Ph.D.
Charles R. Hoppin
Frances Spivy-Weber

NAY: None

ABSENT: Chair Tam M. Doduc
Arthur G. Baggett, Jr.

ABSTAIN: None

Dorothy Rice

Dorothy Rice, Executive Director for
Jeanine Townsend, Clerk to the Board

-3-

APPENDIX H

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

OCT 29 2008

Ms. Dorothy Rice
Executive Director
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Dear Ms. Rice:

Thank you for submitting the Basin Plan amendments containing total maximum daily loads (TMDLs) to address metals in Los Angeles River and Ballona Creek. The Los Angeles River metals TMDL submittal was dated September 17, 2008 and received September 22, 2008. The Ballona Creek metals TMDL submittal was dated October 22, 2008 and received October 23, 2008. As discussed in Regional Board Resolutions R2007-014 and R2007-015, the TMDLs now submitted to EPA are a re-adoption and reaffirmation of the TMDLs approved by EPA on December 22, 2005. EPA has reviewed the administrative record submitted by the State and has concluded that the current TMDLs are approvable for the same reasons discussed in our approval of the previous TMDLs.

California adopted these TMDLs to address the following waterbody-pollutant combinations identified on the State's 2002 Clean Water Act Section 303(d) list:

- Los Angeles River Reach 1 (cadmium, copper, lead, zinc), Los Angeles River Reach 2 and 4 (lead), Rio Hondo Reach 1 (copper, lead, zinc), Compton Creek (copper, lead), Tujunga Wash (copper), Monrovia Creek (lead), Aliso Creek (selenium), Dry Canyon Creek (selenium), and McCoy Canyon Creek (selenium);
- Ballona Creek (copper, lead, selenium, zinc) and Sepulveda Canyon Channel (lead).

During the original TMDL development process, the State determined the following additional waterbody-pollutant combinations were also water quality limited pursuant to the requirements of Section 303(d)(1), and adopted TMDLs to address these additional combinations:

- Los Angeles River Reaches 2, 3, 4, and 5 and Burbank Western Channel (copper);
- Los Angeles River Reaches 3 and 5 and Burbank Western Channel (lead);
- Los Angeles River Reach 6 (selenium);
- Sepulveda Canyon Channel (copper, selenium and zinc).

During the original decision-making process, the State clearly identified these additional waterbody-pollutant combinations as water quality limited waters for which TMDLs are required. The State provided sufficient documentation to support its determination and provided

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opportunities for public review and comment on the additional waterbody-pollutant identifications. The State's decision to concurrently identify additional water quality limited segments and adopt TMDLs for those segments was consistent with the provisions of the Clean Water Act and federal regulations. See 40 CFR 130.7. Subsequently, the State included all these segments on the "TMDLs completed" portion of the State's 2006 303(d) list, which EPA approved.

Based on EPA's review of the TMDL submittals, I have concluded the TMDLs adequately address the pollutants of concern, and will, upon implementation, result in attainment of applicable water quality standards. The TMDLs include allocations as needed, take into consideration seasonal variations and critical conditions, and provide an adequate margin of safety. The State provided adequate opportunities for the public to review and comment on the TMDLs. All required elements are adequately addressed; therefore, the TMDLs are hereby approved pursuant to Clean Water Act Section 303(d)(2).

The State's submittals also contain detailed plans for implementing the TMDLs. Current federal regulations do not define TMDLs as containing implementation plans; therefore, EPA is not taking action on the implementation plans provided with the TMDLs. However, EPA generally concurs with the State's proposed implementation approaches.

The enclosed review discusses the basis for this approval decision. We appreciate the State and Regional Boards' work to complete and adopt these TMDLs and look forward to our continuing partnership in TMDL development. If you have questions concerning this approval, please call me at (415) 972-3572 or Janet Hashimoto at (415) 972-3452.

Sincerely yours,

Nancy Woo October 29, 2008

for Alexis Strauss
Director, Water Division

Enclosure

cc: Tracy Egoscue, Los Angeles RWQCB

APPENDIX I

State of California
California Regional Water Quality Control Board, Los Angeles Region

RESOLUTION NO. R09-003

May 7, 2009

Rescinding Resolutions R05-006 and R05-007, Which Incorporated the 2005 Versions of the Los Angeles River and Ballona Creek Total Maximum Daily Loads into the *Water Quality Control Plan for the Los Angeles Region*

WHEREAS, the California Regional Water Quality Control Board, Los Angeles Region, finds that:

1. On June 2, 2005, the Regional Board established, by Resolution Nos. R05-006 and R05-007, amendments to the Water Quality Control Plan for the Los Angeles Region (Basin Plan) incorporating Metals TMDLs for the Los Angeles River and for Ballona Creek. The TMDLs were subsequently approved by the State Water Resources Control Board in Resolution Nos. 2005-0077 and 2005-0078 on October 20, 2005 and by the Office of Administrative Law on December 9, 2005. The USEPA approved the TMDLs on December 22, 2005. The effective date of the TMDLs was January 11, 2006, when the Certificate of Fee Exemption was filed with the California Department of Fish and Game.
2. On February 16, 2006, the Cities of Bellflower, Carson, Cerritos, Downey, Paramount, Santa Fe Springs, Signal Hill, and Whittier (Cities) filed a petition for a writ of mandate challenging many aspects of the Los Angeles River Metals TMDLs and the Ballona Creek Metals TMDLs. (*Cities of Bellflower et al v. State Water Resources Control Board et al* (Los Angeles Superior Court # BS101732).
3. On May 24, 2007, the Los Angeles County Superior Court adopted the third of three rulings with respect to the writ petition. Collectively, all challenges to the TMDLs were rejected, except for one CEQA claim. Specifically, the Court ruled that the State and Regional Boards (Water Boards) should have adopted and circulated an alternatives analysis that analyzed alternatives to the project, pursuant to Public Resources Code section 21080.5 and section 3777 of Title 23 of the California Code of Regulations. Together, those authorities, which are applicable to the Water Boards' certified regulatory program, require that a project not be approved if there are feasible alternatives to the project that would substantially lessen a significant adverse effect that the activity may have on the environment. (Pub. Res. C. Section 21080.5(d)(2)(A).)
4. The Water Boards alleged that no feasible alternatives to the project existed that would result in less significant impacts to the environment, and noted that the Cities had not even suggested specific alternatives to the Water Boards during its proceedings. The Cities contended it was not their obligation to suggest alternatives, but the Court allowed the Cities a limited opportunity to brief a series of suggested alternative projects so the Court could consider whether they were feasible. The Court provided the Water Boards a similar opportunity to respond. Upon review of the briefs, The Court rejected the Cities' contention that a no-project alternative was feasible, as TMDLs are required by federal law. The Court rejected others of the Cities suggestions, but ruled that two of the Cities proposals were not intuitively infeasible based on the briefing. The Court ruled that the Water Boards have the burden of formulating and analyzing alternatives, and that since the Cities had identified in their briefs two "potentially feasible alternatives", the environmental documentation was deficient because the Water Boards did not conduct an adequate alternatives analysis. Accordingly, the Court issued its writ of mandate, directing the Water Boards to adopt an alternatives analysis that analyzed feasible alternatives to the TMDLs and reconsider the TMDLs accordingly. The writ was limited to that issue, and the TMDLs were affirmed in all other respects.
5. The Water Boards complied with the writ of mandate's direction to adopt an alternatives analysis and to reconsider the TMDLs in that light. On June 22, 2007, the Regional Board circulated a draft alternatives analysis for a 45-day comment period, and commenced the process of reconsidering the Metals TMDLs. The alternatives analysis examined all the alternatives suggested by the Cities in the litigation, as well as

similar alternatives suggested to the Regional Board during other TMDL proceedings by these Cities and by other stakeholders. The alternatives analysis nevertheless concluded that none of the suggested alternatives were feasible alternatives that would both result in substantially less significant environmental impacts and would also achieve the projects' purposes.

6. Meanwhile, the Water Boards argued to the trial court that Public Resources Code section 21168.9(a)(3) gave the court discretion to allow the Water Boards to adopt an alternatives analysis, but to only void the TMDLs if it was otherwise compelled by CEQA. Specifically, the Water Boards should not be compelled to set aside the TMDLs if the alternatives analysis revealed no feasible alternatives exist that have substantially less significant impacts than the TMDLs that had already been adopted, or if the Regional Board determined that a statement of overriding considerations was appropriate. The Cities opposed the Water Boards' request. The trial judge questioned at the hearing whether he had the authority to allow the TMDLs to remain in place. On July 13, 2007, the court issued its final writ of mandate which required that the resolutions establishing the TMDLs be set aside.

7. After a public hearing, on September 6, 2007, the Regional Board reconsidered the TMDLs in view of the court's decision, the alternatives analysis that had been circulated, and the public comments received, and thereafter determined that no feasible alternatives exist that would achieve the project's purpose and also result in substantially less significant impacts to the environment than the TMDL as previously adopted. The Regional Board found that "[t]he alternatives analysis does not change the Regional Board's conclusion that feasible alternatives do not exist to the TMDL that would achieve the project's purposes and result in less significant impacts to the environment." The Regional Board further found:

   > "Considering the alternatives analysis, the Regional Board finds that the TMDL as originally proposed and adopted is appropriate. The Regional Board further finds that nothing in the alternatives analysis, nor any of the evidence generated, presents a basis for the Regional Board to conclude that it would have acted differently when it adopted the TMDLs had the alternatives analysis been prepared and circulated at that time."

   The Regional Board therefore adopted the alternatives analysis, and readopted the TMDLs in Resolution Nos. R2007-014 and R2007-015 (Attachments A and B, hereto). Resolution Nos. R2007-014 and R2007-015 expressly superseded the original TMDLs that were the subject of the writ of mandate.

8. On or about September 28, 2007, the Cities appealed every part of the trial court's decision except the one issue on which they prevailed.

9. The Water Boards filed a limited cross-appeal, which was directed solely to the trial court's decision to order the TMDLs voided, and to clarify that the trial court does have the authority to impose a lesser remedy than ordering that the regulations be revoked. In filing the cross-appeal, the Regional Board considered that numerous NPDES permits had been issued that had already incorporated the waste load allocations from the LA River and Ballona Creek Metals TMDLs, and that revocation of the original TMDLs would render uncertain the enforceability of those effluent limitations. The Regional Board also considered the waste of public resources that would be occasioned by revising numerous permits, merely to revise findings showing that the effluent limitations are based upon the 2007 TMDLs instead of the 2005 TMDLs.

10. On April 3, 2009, the Second District Court of Appeal, Division 5, issued its decision in *City of Bellflower et al v. SWRCB et al,* No. B202660, and summarily rejected all of the Cities claims. The Court stated:

    > "The Cities contend that the trial court should have found [the] Regional Board's substitute EIR failed to set forth the reasonably foreseeable environmental impacts of compliance with the metals TMDLs and the reasonably foreseeable mitigation measures. We have examined the Cities' contentions and concluded that they are without merit. Therefore, we decline to address the specific contentions." (Slip Opn., p. 20.)
    >
    > "In all cases, the sufficiency of the information contained in an EIR is reviewed in light of what is reasonably feasible. … We conclude from our review of the substitute documents prepared by the Regional Board, as did the trial court, that the documents complied with the requirement to address the reasonably foreseeable environmental impacts from methods of compliance and set forth mitigation measures to minimize any significant adverse environmental impacts. The

> environmental review adequately examined and evaluated the environmental impacts of the proposed project in all pertinent areas of consideration and mitigation measures and mitigation measures, as would a first tier environmental review prepared under CEQA. This is not a case in which the Regional Board merely offered a checklist that denied the project would have any environmental impact and obviously intended its documentation to be the functional equivalent of a negative declaration (Cf. *City of Arcadia v. State Water Resources Control Bd.* [Trash TMDL Case]) Therefore, we reject the Cities['] additional contentions concerning CEQA violations." (Slip Opn., pp. 20-21.)

11. On the cross-appeal, the Court of Appeal agreed with the Water Boards that the court may elect not to void a regulation when it has found a CEQA deficiency:

    > "Section 21168.9 thus gives trial courts the option to void the finding of the agency (§21168.9, subd. (a)(1)), or to order a lesser remedy which suspends a specific project activity which could cause an adverse change in the environment (§21168.9, subd. (a)(2)), or to order specific action needed to bring the agency's action into compliance with CEQA (§21168.9, subd. (a)(3)). The choice of a lesser remedy involves the trial court's consideration of equitable principles." (Slip Opn., p. 18.)

    The Court of Appeal, however, ruled that the trial court properly exercised its discretion, and upheld the decision to void the TMDLs.

12. The only outstanding requirement of the writ of mandate is to vacate Resolution Nos. R05-006 and R05-007.

13. A search of the Regional Board's records reveals that approximately 17 facilities (as described in Attachment C) are regulated with effluent limitations derived from the waste load allocations established by Resolution Nos. R05-006 and R05-007.

THEREFORE, be it resolved that:

1. Pursuant to the writ of mandate in the matter of *Cities of Bellflower et al v. SWRCB*, Los Angeles Superior Court No. BS101732, Resolution Nos. R05-006 and R05-007 are hereby voided and set aside.

2. Staff is hereby directed to examine the permits applicable to facilities described in Attachment C, hereto, and any other permits that have effluent limitations derived from the TMDLs established by R05-006 or R05-007, and bring back for the Regional Board's consideration such permit modifications as may be necessary to conform those permits to the requirements of the TMDLs established by Resolution Nos. R2007-014 and R2007-015.

I, Tracy J. Egoscue, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a resolution adopted by the California Regional Water Quality Control Board, Los Angeles Region, on May 7, 2009.

Tracy J. Egoscue
Executive Officer

APPENDIX J

Experiences with the Development of the Los Angeles River Metals TMDL Coordinated Monitoring Plan: The Long and Winding River

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Introduction

The Los Angeles River (LAR) is a 55 mile mostly concrete-lined channel that runs in an easterly direction through the southern San Fernando Valley section of the City of Los Angeles before turning south near the Cities of Burbank and Glendale boundary east of Griffith Park and eventually reaching the Queensway Bay in Long Beach. Three sections of the River are not lined in concrete, the Sepulveda Basin area, the Glendale Narrows area, and the estuary south of Willow Street in Long Beach.

Due to the arid Mediterranean climate of Southern California, the median River flow in dry weather is approximately 145 cfs, with approximately 70% generated from three tertiary sewage treatment plant discharges and the rest of the flow from natural groundwater seepage, upstream dam releases, and urban runoff. During storm events, the flow can increase by more than two orders of magnitude. The watershed has separate sewer and storm water collection systems, with urban runoff discharging into the River through the storm drain system.

The LAR Watershed drains an area of 834 square miles. Its headwaters in the Santa Monica, Santa Susana, and San Gabriel Mountains, including the Angeles National Forest, comprise approximately 200 square miles (24%) of the watershed. The more urban uses are found in the lower portions of the watershed, where approximately 35% of the land use can be categorized as residential, 20% open or natural space, 10% as industrial, 8% as commercial, and 3% agriculture, water and other uses. The river drains forty cities, Los Angeles County unincorporated areas, and the California Department of Transportation (Caltrans) operated freeways and roads. A municipal separate storm sewer system (MS4) permit regulates discharges to surface waters from storm water and urban runoff.

Background of the LAR Metals TMDL and its Coordinated Monitoring Plan (CMP) Requirement

Several segments of the LAR and its tributaries were identified on the 1998 and 2002 Clean Water Act (CWA) 303(d) list of impaired water bodies as impaired due to various metals. A Total Maximum Daily Load (TMDL) establishes a maximum limit for a specific pollutant that can be discharged into a water body without exceeding water quality standards and impairing beneficial uses. Those uses most likely to be impacted by metal loadings to the LAR are uses associated with aquatic life and water supply. As a result of a 1999 consent decree between three environmental organizations (Heal the Bay, Natural Resources Defense Council (NRDC), and Santa Monica Baykeeper) and the US Environmental Protection Agency (EPA), the Los Angeles Regional Water Quality Control Board (LARWQCB) was required to abide by a 13 year schedule to develop over 90 TMDLs (67 of which affect the City of Los Angeles). The consent decree required that the LAR and Tributaries Metals TMDL (LAR Metals TMDL) be completed by March 22, 2004, however that deadline was extended by mutual consent of the plaintiffs and the EPA to December 2005. The EPA approved the LAR Metals TMDL as an amendment to the regional Water Quality Control Plan for the Los Angeles Region (Basin Plan) on December 22, 2005 and the TMDL became effective January 11, 2006.

The LAR Metals TMDL organizes the six 303(d) listed reaches and tributaries of the LAR into responsible jurisdictional groups so as to isolate major tributaries and other flow sources, such as dams and publicly owned treatment works (POTWs). This TMDL addresses impairments for selenium, zinc, lead, copper, and cadmium, and even though not all reaches or tributaries were listed as impaired, metal allocations were developed for upstream reaches and tributaries that drain to impaired reaches. Selenium, most probably, leaches from natural areas with high selenium containing soils in the Santa Monica Mountains. Zinc, lead, copper and cadmium may be associated with industrial discharges to sewage treatment plants, runoff from roadways, parking lots, and other areas associated with vehicle usage, and atmospheric deposition over the entire watershed.

The LAR Metals TMDL required the 42 responsible agencies to submit a Coordinated Monitoring Plan (CMP) for each jurisdiction in the River, within 15 months of the effective date of the TMDL, or April 11, 2007. Also, sampling would need to begin within 6 months after approval of the CMP by the LARWQCB. The LARWQCB identified three monitoring objectives in association with this TMDL. The first is to collect data (e.g., hardness, flow, and background concentrations) to evaluate the uncertainties and assumptions made during development of the TMDL. The second is to collect data to assess compliance with the waste load allocations. The third is to collect data to evaluate potential management scenarios. To achieve these objectives, the LARWQCB suggested utilizing: (1) ambient monitoring, (2) effectiveness monitoring and (3) special studies. Per the TMDL language: *"An ambient monitoring program is necessary to assess water quality throughout the Los Angeles River and its tributaries. The MS4 and Caltrans NPDES permittees assigned waste load allocations in each jurisdictional group are jointly responsible for implementing the ambient monitoring program. The responsible agencies shall sample for total recoverable metals, dissolved metals, and hardness once per month at each ambient monitoring location until at least year five when the TMDL is reconsidered."*[1]

Technical and Logistical Issues That Were Encountered During CMP Formulation

At its July 17, 2006 meeting, the LAR Watershed Management Committee (LARWMC), a body composed of representatives from each city and entity within the watershed, recommended formation of a LAR Metals TMDL Technical Committee (TC) and tasked this group with preparation of the LAR Metals TMDL CMP for the entire watershed on behalf of the 42 regulated entities. To adequately represent the watershed, the 11-member TC included representatives from each jurisdiction, nominated by the LARWMC and willing to be involved, with the City and County of Los Angeles and State of California Department of Transportation (Caltrans) spanning more than one jurisdiction. The following agencies are currently members of the TC: Cities of Los Angeles, Hidden Hills, Burbank, Glendale, Pasadena, Irwindale, Downey, Signal Hill, Long Beach, County of Los Angeles, and Caltrans. The County and City of Los Angeles serve as the co-chairs of this committee and are responsible for conducting the meetings, maintaining project schedule, preparing the meeting agendas and editing the meeting minutes. A similar Steering Committee (SC), comprised of City Managers, was also convened to oversee the optional special studies and funding details.

The first meeting of the TC was held on August 15, 2006. The TC committed to meet twice a month as necessary to ensure submittal of the draft CMP to the LARWQCB by April 2007. Also decided at this meeting was that everyone would have a role in the writing of the plan, that the TC would perform quality assurance/quality control on any laboratory data that was reported to the LARWQCB, and that support staff from each representative city would be welcomed at the meeting. The following are some of the key issues and decisions in the development of the CMP.

<u>Sampling Locations</u>
As a first step in determining the sampling locations for the CMP, the TC reviewed the current sampling regimes being conducted by the City and County of Los Angeles. The County has an autosampler located at the base of the watershed (Wardlow Road) in Long Beach, which collects mass emission data that was used for development of this TMDL. The City of Los Angeles samples 8 main channel and 10 tributaries stations primarily during dry weather for hardness as well as total and dissolved metals. In addition, data from 3 POTW dischargers were reviewed.

After review of all data and sampling locations, each TC member was tasked with preparing a "wish list" of possible sampling locations for their jurisdiction. Initially, the "wish list" numbered over 20 sampling locations. Each TC member was required to justify their proposed sampling locations, field visits were conducted to verify accessibility, and GIS analysis was completed to determine drainage areas. Following lengthy discussions and TC member voting, the list was reduced to 16 sampling locations. Key factors used to influence the final selection of the sampling locations included: 1) locations that could be used for both ambient and effectiveness monitoring, 2) locations at the base of each jurisdiction so that compliance tracking is simplified, and 3) locations that could be used for future TMDLs. Since the monitoring requirements extended for at least the duration of the TMDL implementation schedule, twenty years, the TC was balancing costs with what the group wanted on their wish list; therefore, only the minimum number of locations to accomplish the above goals was chosen. Site locations were shared with the LARWQCB staff and the environmental group Heal the Bay well before a draft CMP was written.

<u>Tiered Monitoring</u>
Another important concept in this CMP was the inclusion of a tiered monitoring scheme. Since the CMP is intended to cover both the ambient and effectiveness monitoring, this method allows control of costs while also having the ability to isolate the source of an exceedance of the water quality standards during the effectiveness-monitoring period at a particular location. This method was adopted from a previously approved monitoring plan for the Santa Monica Bay Bacteria TMDL. The concept is simple; there are three tiers (Tier I, II, and III) of monitoring with samples only being taken at Tiers II or III upon exceedances of Tier I samples. Of the 16 sampling locations chosen from the original "wish list", nine sites became Tier I monitoring locations, each representing major portions of the total drainage area. The remaining seven sites were Tier II locations and represented approximately 3 – 26 % of the entire watershed. During ambient monitoring, only Tier I sites will be sampled in order to assess the water quality of the watershed. Once effectiveness monitoring is required by the TMDL, the Tier II activation and deactivation criteria will be applied to the data from the Tier I locations to determine when monitoring at the upstream Tier II locations would begin and end in order to narrow the search for the source of the exceedance(s). As initially proposed, the Tier II activation criteria was 3 consecutive exceedances of WLA(s) at a Tier I monitoring site, while the Tier II deactivation

criteria was 3 consecutive Tier II monitoring events less than the WLA(s). Tier III monitoring or investigatory sampling occurs only during the effectiveness monitoring to track the sources in the vicinity upstream of Tier II triggered locations.

Autosampling

Another issue that consumed a large amount of time for the TC was installation of the autosamplers and associated appurtenances, including flow meters. Because the wet-weather WLAs were determined using the load-duration concept, an autosampler is needed to collect samples that are representative of the entire storm and flow measurements are needed at that sampling location. TC members from the Cities of Glendale and Burbank who had previous experience with these devices volunteered to research this issue and conducted site visits for each location. The TC viewed presentations from major autosampler and flow meter vendors. Since this application is for a concrete-lined channel and not a naturally banked river, most company representatives had no prior experience in this type of installation. Many months were spent talking to the County about their autosamplers set up in the watershed channels for the MS4 required monitoring. A cost estimate of $75,000 per sampler location was used totaling $375,000 for five locations. The County pledged to procure and install the autosamplers and associated instrumentation identified by the TC. The County's standard installation is housed in a permanent steel signal box mounted on a concrete pad with electrical power and cellular telemetry with a bubbler flow meter used to measure the amount of flow.

By locating the autosamplers at the base of each jurisdiction, wet-weather compliance can more easily be determined. Since the TMDL definition of wet weather is 500 cfs of flow at the Wardlow sampling station, it was originally thought that the existing County flowmeter at Wardlow could be used to trigger the upstream samplers to start. However, since the watershed is large and differences in rainfall patterns exist between the lower watershed and upper watershed that could cause either premature or delayed triggering, the TC decided that flowmeters would need to be installed at each autosampler location. In order to properly trigger each autosampler for wet-weather, an equivalent flow was necessary for each upstream location. This required an analysis of the County's vast flow data at 3 coincident locations and a flow balance and rating table generation at the two non-County flow-gaged locations. The City of Downey gracefully volunteered to accomplish this task. But this was all for naught, as the County subsequently decided to take on the entire task of autosampler installation based on their standard setup and calculation of the autosampler trigger flows. The County has now committed to having the autosamplers installed by October 1, 2008, the start of the wet-weather season.

Sampling Frequency, Analysis, and Parameters

The sampling frequency as required in the TMDL is monthly for total recoverable and dissolved metals and hardness for both the ambient and effectiveness monitoring periods unless Tier II or III monitoring is triggered during the compliance monitoring period. The pollutants of concern to be monitored include cadmium, copper, lead, selenium, zinc, and hardness. Consistent with the TMDL, Cadmium will be tested only in Reach 1 and only during wet-weather events and likewise, selenium will only be tested during dry-weather monitoring events in Reach 6. The TC decided that dry-weather sampling would be taken by grab sampling methods and that only wet-weather sampling would be collected with expensive autosampler apparatus located at the base of each jurisdiction.

The TC received unofficial bids from local labs, including the City of Los Angeles, for both sampling and analysis costs. The cost estimates included two analytical methods for metals: EPA Method 200.7 (Inductively coupled plasma emission spectrometry- ICP), and the more expensive EPA Method 200.8 (ICP-Mass Spectrometry). After reviewing the cost estimates, the TC decided that the City of Los Angeles was the most qualified to do both the sampling and lab analysis.

Cost Sharing Agreement for CMP Implementation

From the first meeting of the SC, the Gateway Cities Council of Governments (GCCOG), a regional association of 29 cities and government entities from southeastern Los Angeles County, was tasked with the administrative and fiduciary duties for the special studies because of its links to so many cities in the watershed and its previous history with intergovernmental studies and agreements. Similarly, the TC and SC decided that the GCCOG would also be the administrative and fiduciary agent for the CMP cost sharing agreements. The GCCOG administrative costs were estimated to be $10,000 per year.

In order to share the monitoring and associated costs equitably among the CMP participants, a cost-sharing formula was developed by the SC. This formula included a base amount calculated at 21% ($500 for each of the 42 entities per $100,000 in cost) of the total cost divided evenly among the parties of this CMP. The remaining 79% of the total cost was calculated by multiplying the percentage contributing drainage area for each agency in the watershed (determined using GIS data) by the .79 * the total CMP cost. Invoicing will be conducted annually and equate to approximately $120,000 for the annual sampling and laboratory costs; the first year's invoice will include the autosampler capital costs of $375,000.

The TC and SC decided to use a cost–sharing agreement or memorandum of agreement (MOAs) to legally commit funds from all the watershed agencies. The City of Los Angeles led in drafting the MOA. The agreement spells out the duties of the GCCOG, the City and County of Los Angeles, the cost of the sampling effort, the procedures to follow in the event of a delinquent payment, and lists other general provisions.

Participation of all Regulated Entities in the Watershed

Since the CMP was being presented to the LARWQCB on behalf of all the regulated entities in the LAR Watershed, the TC decided that commitment to this TMDL-mandated effort from each agency was required before the CMP submittal. In order to gauge commitment, the TC mailed a written questionnaire to all agencies. Additionally, per the SC request, the LARWQCB sent a 13267 letter (California Water Code Section 13267) to all the regulated entities requiring the submission of the CMP by April 11, 2007. This was done to ensure that some recalcitrant cities would commit to the effort. Most cities sent back affirmative ballots, however some did not respond or responded negatively. In a coordinated effort, members of the TC, SC, County and LARWMC provided outreach and garnered support from all remaining agencies. By the April 11, 2007 deadline, the CMP was submitted to the LARWQCB and all 42 regulated entities in the watershed had committed to participating in the CMP.

Issues Raised by the LARWQCB After Reviewing the CMP

Following submission of the CMP on April 11, 2007, the LARWQCB responded with a letter dated July 20, 2007. The main issues raised included assessing waste load allocation effectiveness on a jurisdictional basis, triggers for Tier II sampling, sampling in all impaired reaches and tributaries, sampling for total and dissolved metals, inclusion of cadmium as a parameter, and required minimum levels.

Modifications of the CMP in Response to LARWQCB Comments

The issues identified in the June 20, 2007 LARWQCB letter required some changes to the CMP. The first comment, assessing waste load allocation effectiveness on a jurisdictional basis, was addressed by recalculating the sampling location drainage area from percent of total watershed to percent of urban watershed in each jurisdiction to better gauge compliance with the implementation requirements. Tier I locations were located at the base of each jurisdiction to show approximately 100% compliance for that jurisdiction, with additional Tier I monitoring locations to show interim percent compliance for jurisdictions. Data gathered at the Tier I locations will provide jurisdiction water quality at several locations and if these locations are not meeting the waste load allocations, then monitoring will begin at Tier II locations. The Tier II locations even further subdivide the watershed to demonstrate compliance. If Tier II monitoring does not identify the source of pollution and exceedances persist, then Tier III monitoring will initiate source tracking to isolate the pollutant source for remediation.

To address the triggers for Tier II sampling, the TC decided to reduce the activation criteria for monitoring at the Tier II sites from three to two consecutive exceedances. The TC chose to use two consecutive exceedance criteria versus one exceedance to avoid the possibilities of performing additional sampling to compensate for one-time events that may not be traceable for example, but not limited to, sampling error, analytical error, or illegal dumping events. The TC believes that this activation criterion for Tier II monitoring will be able to trace the persistent sources of any metal loadings for remediation and is most reasonable in relation to the intent and purpose of the TMDL.

The LARWQCB also suggested that Tier II monitoring occur prior to the first implementation deadline of the TMDL to ensure the jurisdictional groups achieve the waste load allocations. The revised CMP has added three more Tier I sampling sites and relocated one sampling site to provide a more distributed sampling program. The TC is confident that the proposed Tier I monitoring locations will be able to adequately demonstrate compliance with the first TMDL compliance milestone. However, if a jurisdiction is not confident with meeting compliance based on the results of the monitoring, then additional monitoring at Tier II sites or new locations may be pursued. In addition, the jurisdictional groups will also use the monitoring data during the development of the implementation plans and may request additional monitoring at Tier II locations to isolate any problem drainage areas in order to propose implementation strategies.

As discussed above, the draft CMP proposed 9 Tier I locations in the main channel of the LAR and 7 Tier II locations in the tributaries. However, the LARWQCB review letter reiterated the requirement to monitor in all 303d listed reaches, so several Tier II locations were changed to Tier I monitoring sites. There are now 13 Tier I and 3 Tier II sampling locations (refer to attached map). In some cases, persistent exceedances at these new Tier I sites will directly result in Tier III monitoring since there are no longer a major tributary to monitor as a Tier II site. Although selenium is listed in 3 tributaries in Reach 6, the TC and LARWQCB staff decided that additional Tier I monitoring specifically in these tributaries is not necessary at this time. Based on scientific studies, the selenium source is currently thought to be the result of the natural occurring shale in the region and the MS4s were not assigned a WLA for selenium. The CMP will monitor the selenium levels at the Tier I and Tier II sites located in the main channel to ensure that selenium levels are stabilized and not increasing.

During the formulation of the CMP, the TC was not proposing to sample for cadmium during the ambient monitoring period because of a proposed delisting made by the State Board in the 2006 303(d) list. The LARWQCB had opposed this delisting because of the detection limit for the dataset was above the CTR value. In discussions with the LARWQCB, a concern about the cadmium quantification limit of 10 μg/L in the City's lab for EPA Method 200.7 was raised. Since wet-weather WLA for cadmium is 3.1 μg/L, it was decided to cost the analysis for 200.8, but analyze by 200.7 to determine whether the 200.8 method is needed. For instance, if the initial screening by 200.7 is below the 10 μg/L quantification limit, then the lab will do the 200.8 analysis. All constituent analysis was decided to be based on this modified 200.8 method for ease of reporting and standardization. This required the monitoring costs to increase by a factor of three.

The LARWQCB also requested that both total and dissolved metals be sampled and analyzed as specified in the TMDL to understand and verify the fractionation between the two forms of metals. Based on information found in a Stormcon 2006 paper (filtering in the field was a necessity for preserving the actual dissolved fractionation in the water and automated samplers currently are not equipped with a filter option thus preventing an accurate dissolved metals quantification), the TC proposed the following special dissolved sampling study: 1) Monthly dry weather dissolved sampling at all locations for a two year period, 2) Filtering in the field with a 0.45 μm filter, and 3) Metals to be sampled include copper, lead, and zinc (selenium has no translator and cadmium is wet-weather only). The TC requested that the results from this dissolved monitoring be used to modify the default CTR translator for the fractionation between dissolved and total metals used in the Metals TMDL.

A revised CMP was resubmitted to the LARWQCB in October 2007 and conditionally approved by the LARWQCB with a letter dated January 31, 2008. The LARWQCB required the following four changes to the CMP: 1) Include Tier III monitoring in Reach 6 tributaries if the downstream Tier I or II sites show an increasing trend in selenium concentrations, 2) Include wet-weather dissolved sampling as part of the two-year dissolved metals sampling study, 3) Include the correct Basin Plan Amendment as part of the CMP, and 4) In regards to the Tier III trigger, define "consistently" as two exceedances at a downstream Tier II site.

After receipt of the conditional approval letter, discussion among the TC members quickly resulted in requesting a meeting with the LARWQCB to resolve Item 2, wet-weather dissolved sampling. All other requested changes would be made to the final CMP. The LARWQCB's position that this was required to verify that the wet-weather translator value derived at the County (mass emission) Wardlow sampling location was not site-specific to Wardlow, and could be applied to the entire river. Abiding by the original letter requirements would have entailed a total of 120 additional sampling events (24 months times 5 autosampler locations). A compromise was reached that the CMP will describe a more limited wet-weather dissolved metals sampling limited to 4 wet-weather events per year for the 2 year study period at only two locations: Wardlow and Figueroa. Figueroa was offered because it is near the middle of the watershed and not influenced by a nearby tributary flow. This will result in only 16 additional sampling events. Because the mass emission wet-weather trigger is rainfall amount based and the TMDL trigger is river flow based, a separate sample at Wardlow will be needed.

Implementation Status of the CMP

The final CMP was submitted to the LARWQCB on March 26, 2008. Upon approval of the MOA by the GCCOG Board in May, the CMP MOA will be mailed to the 42 regulated entities in the watershed for execution and budgeting. The County of Los Angeles is preparing to install the five autosamplers and associated equipment by October 1, 2008, the beginning of the wet weather season; similarly the City of Los Angeles is gearing up to start the monitoring and sampling for both dry and wet-weather upon approval of the CMP and execution of the MOAs. The City and County of Los Angeles are committed to meeting the 6-month deadline imposed by the LARWQCB.

Lessons Learned

The unwieldy size of the watershed, both in the number of entities involved and in area, caused the TC to be limited to representatives from each jurisdictional area including the County and City of Los Angeles and Caltrans. By working in a manageable group size of an 11-member TC (which represented 42 entities), discussion was manageable enabling decisions to be made at each meeting. To complete the preparation of the CMP within the 8-month timeline, the TC initially met bimonthly and later scaled it back to monthly meetings (15 meetings to complete draft CMP). Minutes and agendas were prepared for each meeting, so that members and agency management were kept abreast of the progress. Additionally, the TC was a stable group having no major personnel changes during the development of the CMP, thus avoiding any repeat discussions and having knowledgeable committee members prepared to discuss and debate the issues. The TC also invited experts on an as-needed basis to provide additional information.

From the beginning of this process, the TC had a close working relationship with the LARWQCB and environmental groups. Although not involved in day-to-day issues, the outside groups were informed of major issues and invited to comment at key milestone points. The LARWQCB staff was very responsive to questions and willing to discuss issues at any time. This collaborative effort was important to develop a good CMP within a tight time period.

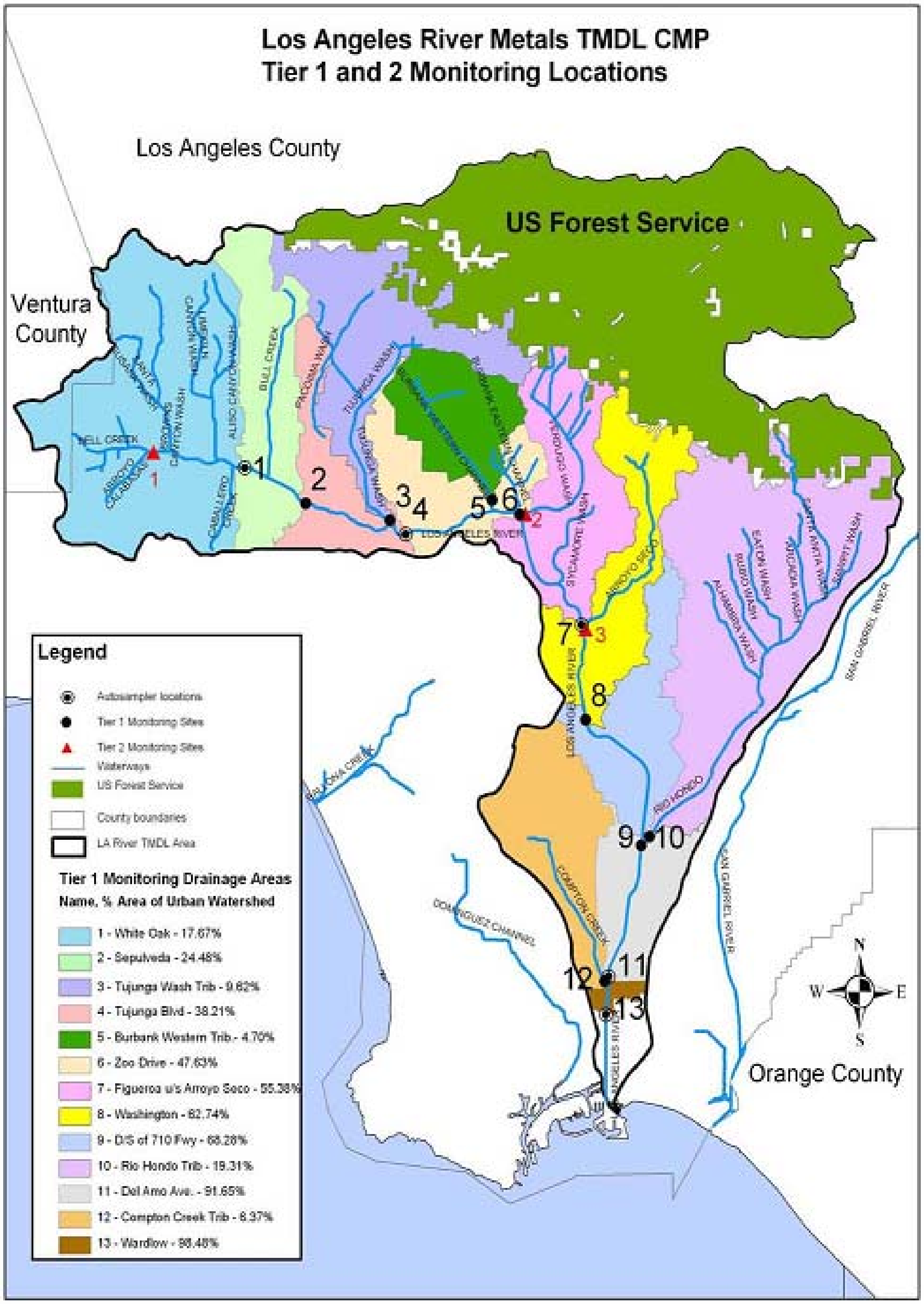
Conclusion

By working closely with a dedicated group of representatives, the TC was able to meet the deadline for CMP submittal and in a timely fashion address and modify the document in response to LARWQCB and environmental group comments.

References

1. Los Angeles Region Water Quality Control Board, "Total Maximum Daily Loads for Metals Los Angeles River and Tributaries", LARWQCB, 2005, p.78.

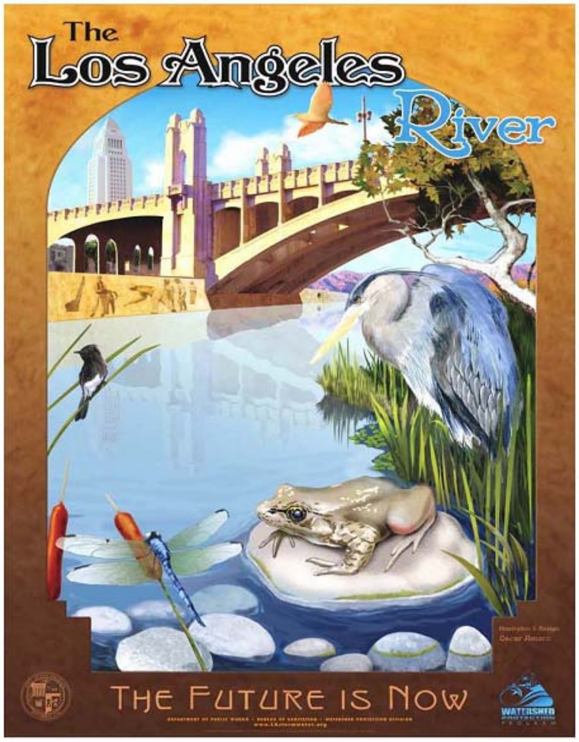
2. Tellessen, Gretchen and Scott A. de Ridder, "The Effect of Transit Time on the Ratio of Dissolved to Total Metals in Stormwater Runoff Samples", Stormcon Conference Proceedings, Forester Communications, 2006.


Los Angeles River Metals TMDL CMP
Tier 1 and 2 Monitoring Locations
Los Angeles County
Ventura County
US Forest Service
Orange County
Legend
Autosampler locations
Tier 1 Monitoring Sites
Tier 2 Monitoring Sites
Waterways
US Forest Service
County boundaries
LA River TMDL Area
Tier 1 Monitoring Drainage Areas
Name, % Area of Urban Watershed
1 - White Oak - 17.67%
2 - Sepulveda - 24.48%
3 - Tujunga Wash Trib - 9.62%
4 - Tujunga Blvd - 38.21%
5 - Burbank Western Trib - 4.70%
6 - Zoo Drive - 47.63%
7 - Figueroa u/s Arroyo Seco - 55.38%
8 - Washington - 62.74%
9 - D/S of 710 Fwy - 68.28%
10 - Rio Hondo Trib - 19.31%
11 - Del Amo Ave. - 91.65%
12 - Compton Creek Trib - 8.37%
13 - Wardlow - 98.48%
N
E
S
W

APPENDIX K

Excerpts from

LOS ANGELES RIVER METALS TMDL COORDINATED MONITORING PLAN



PREPARED BY THE LOS ANGELES RIVER METALS TMDL TECHNICAL COMMITTEE
CHAIRED BY THE CITY AND COUNTY OF LOS ANGELES

APRIL 11, 2007

APPENDIX C

Summary of Compliance Monitoring Locations

Los Angeles River Metals TMDL Water Quality Monitoring Locations

Tier I – Ambient & Effectiveness Locations

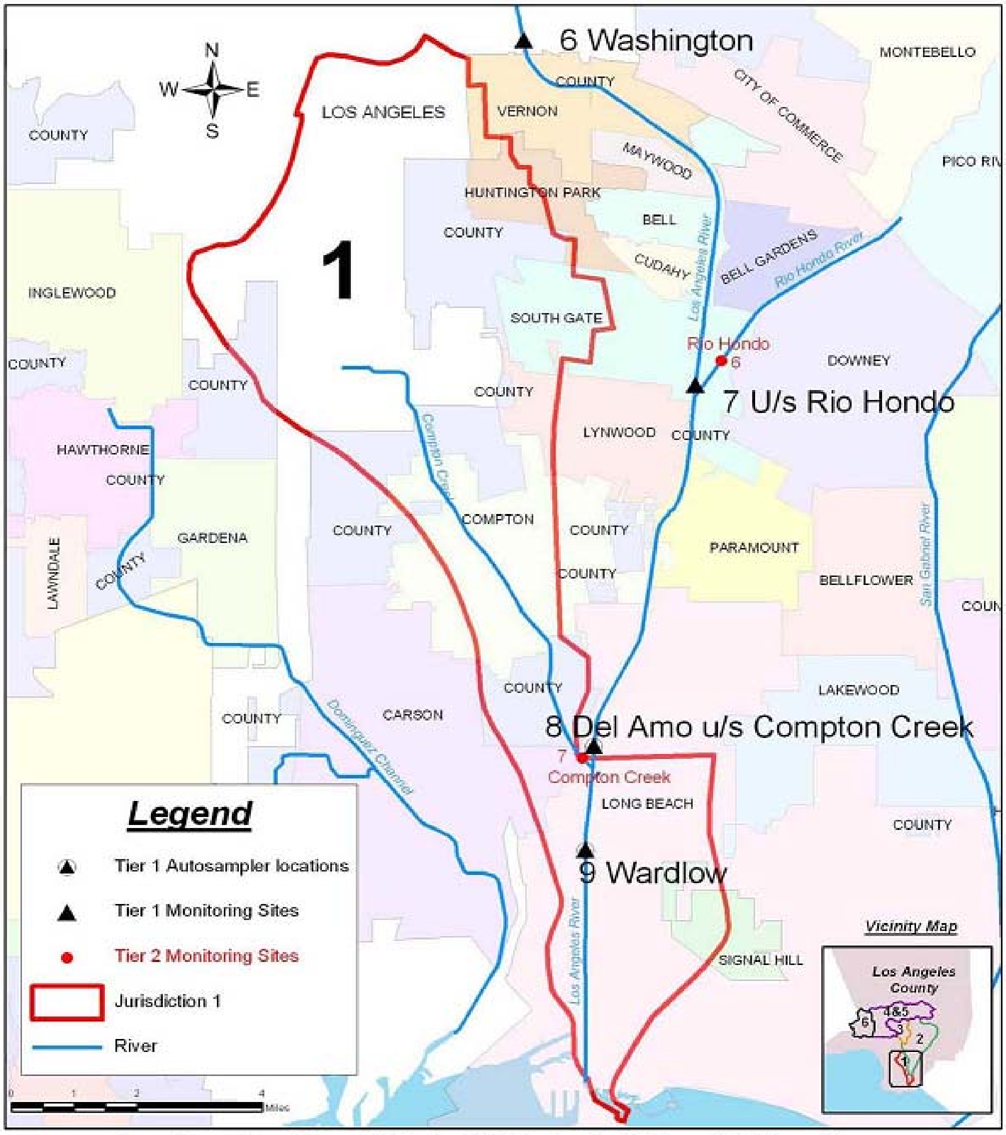
Monitoring Location	TMDL Addressed	Jurisdiction	Location	Freq	Lat.	Long.	Percentage of Watershed	TBG Map	Comments
LAR – 1	Metals	6	Main Channel	Monthly	34.185076°	-118.518735°	13.4%	531-B7	@ White Oak
LAR – 2	Metals	4/5	Main Channel	Monthly	34.161559°	-118.465969°	18.6%	561- H3	@ Sepulveda
LAR – 3	Metals	4/5	Main Channel	Monthly	34.140977°	-118.379127°	48.4%	562-J6	@ Tujunga
LAR – 4	Metals	3	Main Channel	Monthly	34.140863°	-118.276523°	59.3%	564-C5	@ Colorado
LAR – 5	Metals	3	Main Channel	Monthly	34.081249°	-118.227546°	61.4%	594-H7	@ Figueroa upstream of the Arroyo Seco
LAR – 6	Metals	2	Main Channel	Monthly	34.017325°	-118.223783°	69.3%	674-J1	@ Washington
LAR – 7	Metals	2	Main Channel	Monthly	33.934206°	-118.175479°	73.2%	705-F6	U/S Rio Hondo
LAR – 8	Metals	2	Main Channel	Monthly	33.846228°	-118.203295°	93.2%	765-C4	@ Del Amo Ave.
LAR – 9	Metals	1	Main Channel	Monthly	33.819002°	-118.205560°	98.7%	765-C7	@ Wardlow Ave.

Los Angeles River Metals TMDL Water Quality Monitoring Locations

Tier II – Upstream Locations

Monitoring Location	TMDL Addressed	Jurisdiction	Location	Freq	Lat.	Long.	Percentage of Watershed	TBG Map	Comments
LAR2 – 1	Metals	6	Main Channel D/S Confluence	As needed*	34.195135°	-118.59763°	4.8%	530-B6	@ Canoga Ave.
LAR2 – 2	Metals	4/5	Tujunga Wash	As needed*	34.150429°	-118.39312°	26.32%	562-G4	@ Moorpark Ave.
LAR2 – 3	Metals	3	Burbank Western Channel.	As needed*	34.160714°	-118.30502°	3.0%	562-J3	@ Riverside Dr
LAR2 – 4	Metals	3	Verdugo Wash	As needed*	34.156700°	-118.27115°	3.6%	564-C3	@ Concord St.
LAR2 – 5	Metals	2	Arroyo Seco	As needed*	34.080470°	-118.22496°	5.6%	594-F2	@ San Fernando Rd.
LAR2 – 6	Metals	2	Rio Hondo	As needed*	34.154869°	-118.27604°	16.7%	705-G5	@ Garfield Ave.
LAR2 – 7	Metals	1	Compton Creek.	As needed*	33.846214°	-118.20899°	5%	765-B4	@ Del Amo Blvd

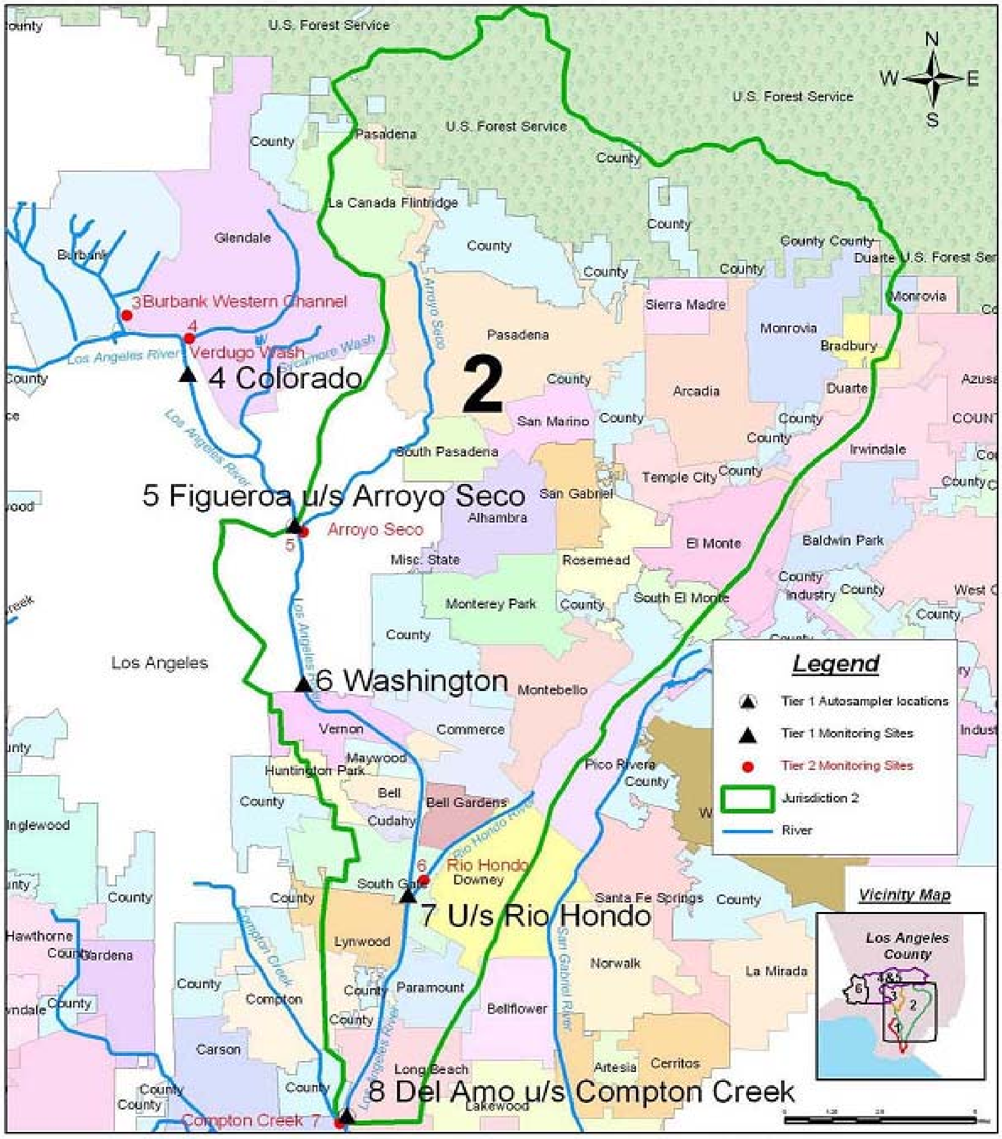
*** Tier II activation criteria is 3 consecutive exceedances of the Waste Load Allocation(s) at a Tier I monitoring site.**



Los Angeles River Metals TMDL Jurisdiction 1 Cities Map

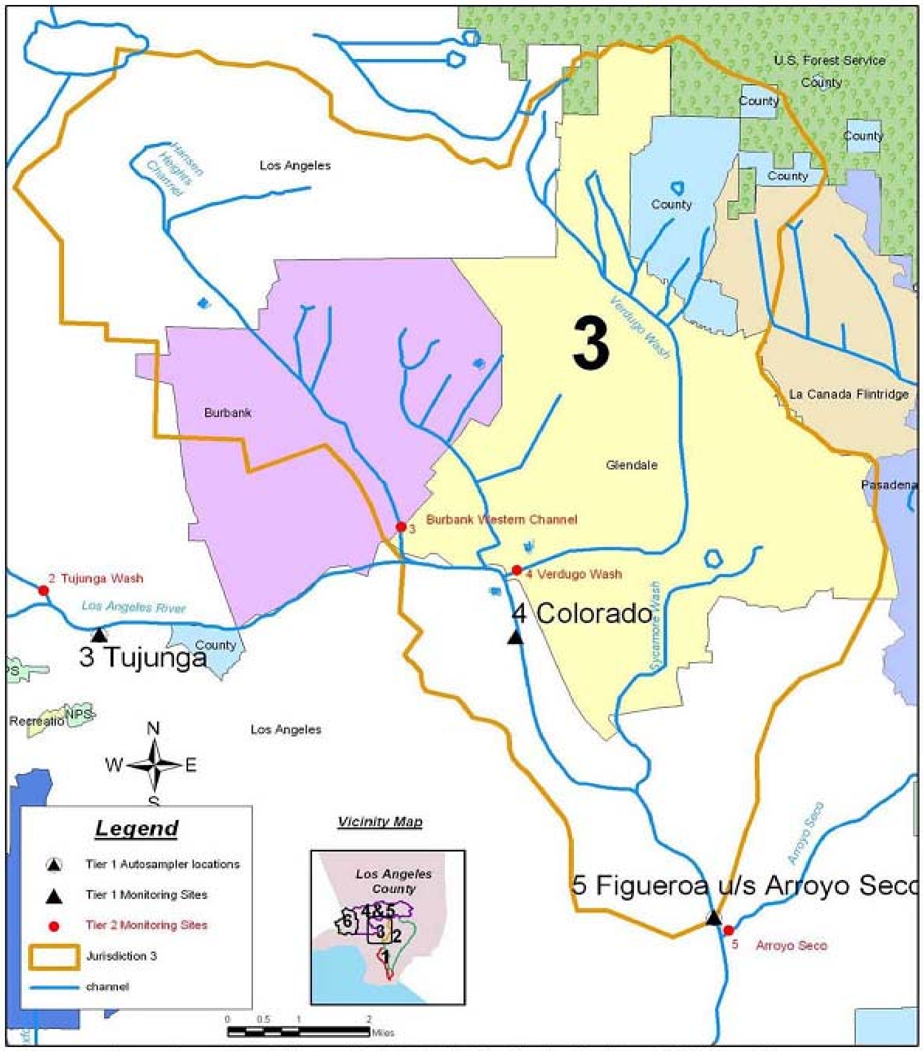
CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS | RITA L. ROBINSON DIRECTOR | DEPARTMENT OF PUBLIC WORKS | SHAHRAM KHARAGHANI PROGRAM MANAGER | WATERSHED PROTECTION

FILE-LOC F:/LARTMDL/Metals TMDL GIS | DRAWN BY: SC | CHECKED BY: PW | DATE 11/07/06 DATE REVISED 11/07/06 | This map shall not be copied or reproduced, all or any part thereof, whether for distribution or resale, without the proper written permission of the Dept. of Public Works, City of Los Angeles. Thomas Bros Data reproduced with permission granted by THOMAS BROS MAPS



Los Angeles River Metals TMDL Jurisdiction 2 Cities Map

CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS	RITA L. ROBINSON DIRECTOR	DEPARTMENT OF PUBLIC WORKS		SHAHRAM KHARAGHANI PROGRAM MANAGER	WATERSHED PROTECTION
	FILE-LOC F:/LARTMDL/Metals TMDL GIS	DRAWN BY: SC	CHECKED BY: PW	DATE 11/07/06 DATE REVISED 11/07/06	



Los Angeles River Metals TMDL Jurisdiction 3 Cities Map

CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS | RITA L. ROBINSON DIRECTOR | DEPARTMENT OF PUBLIC WORKS | SHAHRAM KHARAGHANI PROGRAM MANAGER | WATERSHED PROTECTION
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Los Angeles River Metals TMDL Jurisdiction 4 & 5 Cities Map

CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS	RITA L. ROBINSON DIRECTOR	DEPARTMENT OF PUBLIC WORKS		SHAHRAM KHARAGHANI PROGRAM MANAGER	WATERSHED PROTECTION
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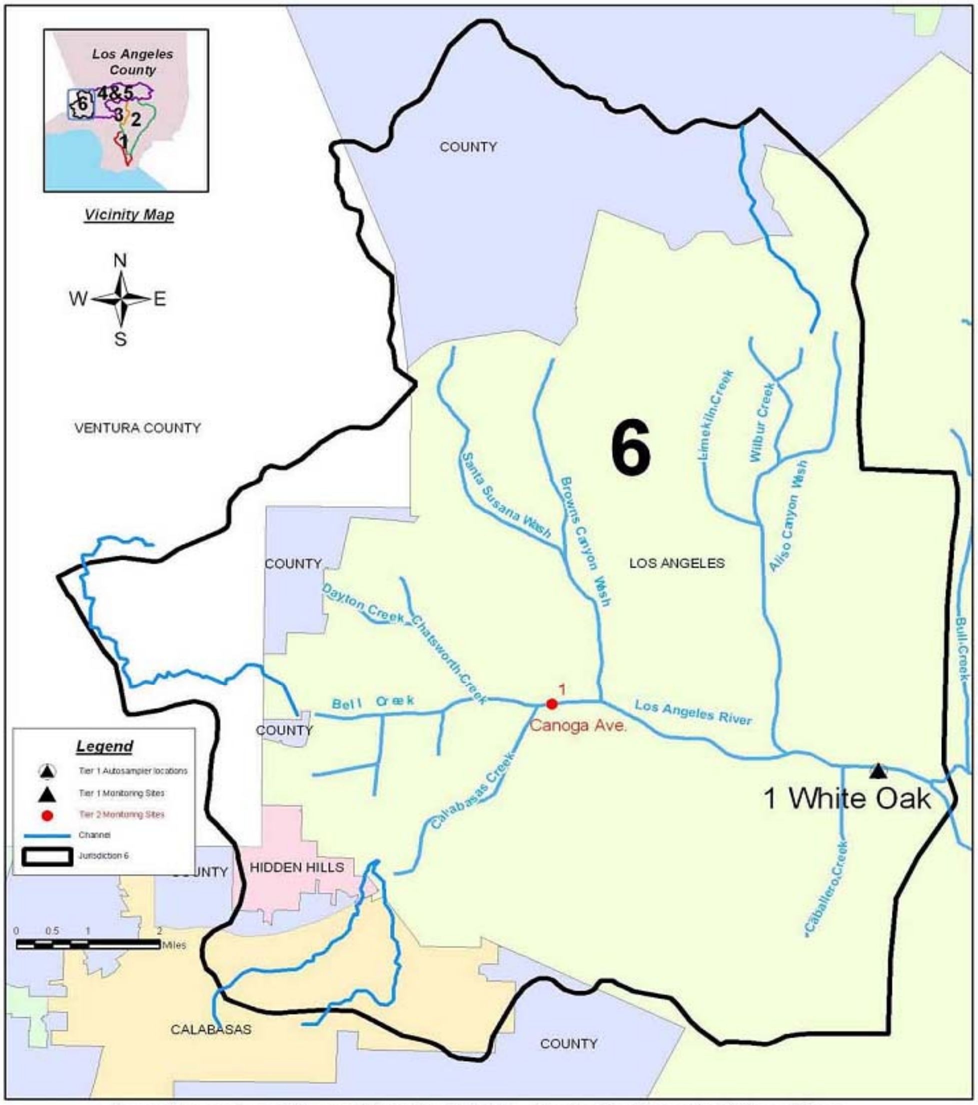

Los Angeles River Metals TMDL Jurisdiction 6 Cities Map

CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS | RITA L. ROBINSON DIRECTOR | DEPARTMENT OF PUBLIC WORKS | SHAHRAM KHARAGHANI PROGRAM MANAGER

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WATERSHED PROTECTION

APPENDIX L

J. Aquat. Plant Manage. 39: 33-36

Removal of Aqueous Selenium by Four Aquatic Plants

KATHLEEN M. CARVALHO[1] AND DEAN F. MARTIN[1]

ABSTRACT

Several aquatic species were examined as potential phytoremoval agents for selenium in aqueous solutions. Selenium was initially present in concentrations of 0-100 ppm Se (as sodium selenite) in 10% Hoagland's medium, and aquatic plants were grown in the medium for one week. Four aquatic plants were studied: Cattail (*Typha domingensis*), duckweed (*Lemna obscura*), hydrilla (*Hydrilla verticillata* Royle), and swamp lily (*Crinum americanum*). Analyses were done by atomic absorption spectrometry using hydride reduction. Four replicates were done for each analysis. Each system was examined for change in fresh weight, percent removal of selenium from solution, and accumulation of selenium in the plant. At selenium concentrations of 100 ppm or less, fairly good to excellent removal was achieved (65 to 100%), depending on the plant. Exposure to concentrations greater than 100 ppm had an inhibitory effect on plant growth, so concentrations less than 100 were studied in more detail. During a one-week period, hydrilla quantitatively removed the selenium, and the fresh weight and dry weights of the plant increased. Other plants were less effective in removal of selenium or were more adversely affected by added selenium.

Key words: phytoremediation, hydrilla, duckweed, cattail, and swamp lily.

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INTRODUCTION

The process by which aquatic plants improve water quality by transferring and accumulating metals and excessive nutrients into their biomass is known as phytoremediation. Phytoremediation is an innovative technology, which involves the use of naturally occurring plants and microorganisms to remediate contaminated sites.

The use of plants and microorganisms that can naturally volatilize the selenium and remove it from the soil or water has been studied with promising results (Pilon-Smits et al. 1999). Selenium can be removed from soils by plant uptake and accumulation (phytoaccumulation), plant volatilization (phytovolatilization), and removal in the rhizosphere (rhizodegradation) (Terry and Zayed 1998). Selenium removal by phytoaccumulation depends upon which chemical species of selenium is present in the polluted soils and water (Mikkelsen et al. 1989, Blaylock and James 1994). The oxidized forms of selenium, -selenate and selenite- are more readily available to plants because of their high solubility. The reduced forms, elemental selenium and most selenides (excluding the alkali metal selenides), are insoluble and, therefore, are unavailable. Furthermore, the uptake of selenate and organic selenium is metabolically driven, unlike the uptake of selenite, which may be passive (Ulrich and Shrift 1968, Abrams et al. 1990). Organic forms of selenium, such as dimethyl selenide, may be more readily available for uptake by plants rather than inorganic forms, such as elemental selenium (Williams and Maryland 1992).

Once the plants have successfully accumulated and stored selenium in their plant tissues, the plant tissue must be harvested, removed from the contaminated site, and disposed safely. An advantage with selenium remediation is that selenium is an essential trace element for adequate nutrition and health in mammals. One safe disposal method would involve using the selenium enriched plant material as forage for animals with low selenium levels. Another option would be to use the selenium-enriched plant material as organic selenium fertilizer and add it to forage crops. Finally, if the selenium-enriched plant material also absorbed undesired toxic elements such as mercury and arsenic at levels that exceeded the safe limits for animal consumption, the plant tissue could be used as fuel to generate electricity.

Selenium can also be removed by phytovolatilization. The concept of biological volatilization of selenium from selenium-contaminated soils is based upon interactions between the soil and microbes (Frankenberger and Karlson 1988) and plants (Duckart et al. 1992, Terry et al. 1992, Biggar and Jayaweera 1993). The idea of using plants, which are able to perform phytovolatilization of selenium, is a very attractive method of phytoremediation because the selenium is completely removed from the local ecosystem by being released to the atmosphere in relatively nontoxic volatile forms (Terry et al. 1992, Terry and Zayed 1994). Studies have shown that the addition of plants to the soil increased the rate of volatilization of selenium (Zieve and Peterson 1984, Biggar and Jayaweera 1993, Duckart et al. 1992). It has also been demonstrated that the volatile forms of selenium, released by the plant, are released directly through the plant tissues (Beath et al. 1935, Lewis et al. 1966). The volatile forms of selenium released vary between selenium accumulators and non-accumulators. Typically, plants referred to as selenium accumulators predominately release dimethyldiselenide (Evans et al. 1968), while plants referred to as non-accumulators mainly release dimethylselenide.

The last mechanism of phytoremediation that has been observed in selenium-contaminated areas is rhizodegredation. It has been observed that when the shoots of plants have been removed, increased rates of selenium volatilization result. This has been explained by the fact that when the shoots of a plant are removed, reduced carbon compounds, including free amino acids, leak into the rhizosphere thus accelerating the production of volatile selenium rhizosphere microorganisms (Terry and Zayed 1998). Studies have shown that although volatilization of selenium can occur without rhizosphere microbes, the rate of volatilization is increased in their presence (Terry and Zayed 1994, Azaizeh et al. 1997).

In our studies, *Typha domingensis, Lemna obscura, Hydrilla verticillata,* and *Crinum americanum* were individually evaluated for phytoremediation of selenium. The percent removal of selenium, amount of selenium accumulated in the plant tissue, and changes in the weight of the plants after exposure to selenium were examined. The maximum contaminate level of selenium in drinking water allowed by the EPA is a value of 0.05 ppm (United States Environmental Protection Agency, Office of Ground Water and Drinking Water). In this study, concentrations significantly higher than the maximum amount allowed were selected, in order to examine the phytoremediation potential of these selected wetland species when exposed to extremely elevated levels of selenium in the water.

MATERIALS AND METHODS

Plants and plant sources. The plants selected were aquatic species common to Florida wetlands. Cattails *(Typha domingensis)* and hydrilla (*Hydrilla verticillata* Royle) were obtained from the pond behind University Square Mall, which is adjacent to the west side of the USF Tampa campus. Duckweed (*Lemna obscura* Aust.) and swamp lily plants (*Crinum americanum* L.) were obtained from Delany Creek at the point that it crosses South 36th street in south Tampa. The plants were collected in the morning and brought back to the laboratory where they were rinsed in deionized water, and any unwanted debris was removed prior to being placed in half-strength Hoagland's medium (Steward and Elliston 1973) and kept in the Phytotron room. The medium was changed biweekly and no studies were done before a month had elapsed.

Phytoremediation studies. Several studies were conducted in order to determine if selected wetland species were capable of reducing toxic soluble forms of selenium into either an insoluble or volatile and less toxic form. All phytoremediation studies were conducted in the Phytotron room (Environmental Growth Chambers, Chagrin Falls, OH), located in room 119 of the Science Center with a photo period of 12 hours light/12 hours dark, a relative humidity of 80%, constant temperature of 26C, and light intensity of 190 μmol photon m^{-2} sec^{-1} (as measured with a LI-COR model LI-185A photometer). Sodium selenite was used in all phytoremediation experiments. A stock solution was diluted to the desired concentrations with Hoagland's medium. The wetland plants chosen were aquatic species common to Florida wetlands. All plants chosen were obtained from local sites in the Tampa Bay area. The plants used in the phytoremediation studies were cattails (*Typha domingensis*), duckweed (*Lemna obscura*), hydrilla (*Hydrilla verticillata* Royle), and swamp lily (*Crinum americanum*).

Once the wetland species were adapted to their new environment in the Phytotron room, several selenium remediation experiments were conducted using each of the specified wetland plants. In the experiments using hydrilla and duckweed, two-gram samples were placed in sterile foam-stoppered 500-mL erlenmeyer flasks with selenium solutions containing 0, 1, 2, 5, 10, 20, 50 ppm in Hoagland's medium. In the experiments using cattails and swamp lilies, higher concentrations, 100-200 ppm were used because of the larger biomass of the plants. Samples were in triplicate and were exposed to the selenium-enriched solutions for one week. After one week of exposure, a liquid aliquot was taken from each sample and refrigerated until analysis by atomic absorption.

The entire plant was removed from the solutions and prepared for digestion in the following manner. Each individual plant was weighed, cut, and blended. The initial fresh weight was compared with the fresh weight measured after exposure, and any physical differences observed were recorded. The plant was allowed to dry in the phytotron for one week. A dry weight was taken and each sample was placed in a 150-mL Teflon beaker. Next, 5 mL of nitric acid (16 *M*) and 5 mL of deionized water were added. Each sample was covered with a watch glass and warmed for 10 to15 minutes without boiling (90 to 95C). The sample was then allowed to cool, another 5 mL of nitric acid (16 *M*) was added and the sample was warmed for 30 minutes. This step was repeated, then 2 mL of deionized water and 3 mL of 30% hydrogen peroxide were added slowly, and the mixture was heated until effervescence ceased. Finally, 5 mL of hydrochloric acid (12 *M*) was added and the mixture was refluxed for 10 to 15 min. The sample was cooled to room temperature, then diluted to 100 mL with 6% (v/v) HCl. Next, the sample was vacuum filtered in an all glass filtration apparatus using a 0.45 μm Millipore membrane filter. Finally, the aliquot was diluted to 100 mL using a volumetric flask and then analyzed by hydride generation atomic absorption using a custom-built apparatus (Carvalho et al. 2000).

RESULTS AND DISCUSSION

The results from all of the experiments showed that all plants examined were able to remove selenium from the hydroponic environment. All of the plants examined accumulated selenium in their tissues, but cattails and swamp lilies seemed to tolerate higher concentrations of selenium (100, 200 ppm) better. Hydrilla and duckweed were studied at lower concentrations (<50 ppm). Cattails, swamp lilies, and duckweed decreased by 75-85% in fresh weight during the studies (whereas controls showed a 4% increase). Hydrilla showed an 56-130% increase in fresh weight over the concentration range studied during the study period.

Cattails and swamp lily plants retained the highest amounts of selenium in their tissues. However, duckweed accumulated the most selenium on a fresh-weight basis, accumulating as much as 4.95% selenium per mg of biomass. In contrast, cattails and swamp lilies accumulated only between 0.002 to 0.003% selenium per mg of dry biomass. More attention was focused on the removal effectiveness of duckweed and hydrilla over the range of 1 to 50 ppm Se (Table 1). The percent removal was essentially quantitative for hydrilla and only slightly less for duckweed (95.0 to 99.8%). The pattern was different, however, for the other two plants. Duckweed became more effective in removing selenium with increasing concentration (1-50 ppm), and at 5 to 50 ppm Se, the effectiveness was nearly quantitative (99 to 99.8%). Hydrilla, in contrast, exhibited quantitative removal at lower concentrations (1 to 10 ppm Se), but showed reduced removal effectiveness at 20 ppm (94.3% removal) and 50 ppm (92.0%). It would be tempting to ascribe the reduction to a toxic effect. A good increase in fresh weight was obtained at 0 to 20 ppm Se, then the value at 50 ppm was about the same. It is a remarkable thought that selenium would stimulate the growth of this nuisance species.

Through additional studies under confined environments (so that products of volatilization could be collected), it was verified that the main mechanism for selenium removal was phytovolatilization (Carvalho et al. 2000). All of the plants studied increased the amount of selenium volatilized, and, using gas chromatography coupled with mass spectrometry (GC-MS) analyses, it was found that the major form of selenium products produced by volatilization was some organic selenium species (Carvalho et al. 2000). This is a promising result, because organic forms of selenium are much less toxic than inorganic forms.

From these studies, we can conclude that hydrilla, duckweed, swamp lily, and cattail plants could be effective at removing selenium from the environment, and could also convert the inorganic selenium into a less toxic form. Of the

TABLE 1. PERCENTAGE OF SELENIUM REMOVAL BY AQUATIC PLANTS.

Plant	Initial solution Se conc (ppm)	Final solution Se conc (ppm)	Conc retained in Plant (ppm)	Biomass (mg)	% Se removal	% Se removal/weight
Cattails	100.3 ± 5.8	45.9 ± 2.7	50.1 ± 3.7	16300 ± 2400	54.2	0.003
Cattails	200.8 ± 4.1	62.9 ± 5.2	80.0 ± 2.8	51800 ± 7200	68.7	0.001
Swamp Lily	200.4 ± 5.2	78.0 ± 3.5	30.6 ± 4.6	27600 ± 3900	61.1	0.002
Duckweed	1.00 ± 0.05	0.05 ± 0.03	0.20 ± 0.02	50 ± 20	95.0	1.9
Duckweed	2.00 ± 0.02	0.05 ± 0.01	0.10 ± 0.04	40 ± 10	97.5	2.4
Duckweed	5.00 ± 0.78	0.05 ± 0.02	0.15 ± 0.07	40 ± 10	99.0	2.5
Duckweed	10.00 ± 1.18	0.10 ± 0.04	0.25 ± 0.06	30 ± 10	99.0	3.3
Duckweed	20.00 ± 1.82	0.10 ± 0.12	0.30 ± 0.03	20 ± 20	99.5	4.95
Duckweed	50.00 ± 2.13	0.10 ± 0.08	0.45 ± 0.12	30 ± 10	99.8	3.3
Hydrilla	1.00 ± 0.05	0.00 ± 0.08	1.10 ± 0.08	110 ± 10	100.0	0.91
Hydrilla	2.00 ± 0.02	0.00 ± 0.03	1.30 ± 0.14	130 ± 50	100.0	0.77
Hydrilla	5.00 ± 0.78	0.00 ± 0.05	0.90 ± 0.17	120 ± 10	100.0	0.83
Hydrilla	10.00 ± 1.18	0.00 ± 0.21	1.15 ± 0.06	80 ± 10	100.0	1.25
Hydrilla	20.00 ± 1.82	1.15 ± 0.22	0.85 ± 0.03	100 ± 20	94.3	0.94
Hydrilla	50.00 ± 2.13	4.00 ± 0.38	1.00 ± 0.23	150 ± 30	92.0	0.61

four plants studied, the most effective plant for removing selenium was hydrilla, but it is doubtful that anyone would advocate its use for this purpose. On the other hand, duckweed was also effective, and is an environmentally acceptable plant for phytoaccumulation of heavy metals.

ACKNOWLEDGMENTS

We would like to express thanks to the Institute for Environmental Studies, and the Department of Chemistry at the University of South Florida where this research was conducted. We are grateful to the Department of Biology for use of the Phytotron room. We would also like to thank Dr. Robert F. Benson, Dr. Maria Gallardo-Williams, Mrs. Barbara Martin, and Ms. Melissa McGettigan for helpful comments.

LITERATURE CITED

Abrams, M. M., C. Shennan, J. Zasoski and R. G. Burau. 1990. Selenomethionine uptake by wheat seedlings. Agron. J. 82: 1127-1130.
Azaizeh, H. A., S. Gowthaman and N. Terry. 1997. Microbial selenium volatilization in rhizosphere and bulk soils from a constructed wetland. J. Environ. Qual. 26: 666-672.
Beath, O. A., H. F. Eppson and C. S. Gilbert. 1935. Selenium and other toxic minerals in soils and vegetation. Wyoming Agric. Sta. Bull. 206: 1-9.
Biggar, J. W. and G. R. Jayaweera. 1993. Measurement of selenium volatilization in the field. Soil Sci. 155: 31-35.
Blaylock, M. J. and B. R. James. 1994. Redox transformations and plant uptake of Se resulting from root-soil interactions. Plant Soil 158: 1-17.
Carvalho, K. M., R. F. Benson, F. A. Booth, M. J. Collier and D. F. Martin. 2000. Analysis of commercial selenium-supplement tablets. Florida Scient. 63(1): 8-12.
Duckart, E. C., L. J. Waldron and H. E. Doner. 1992. Selenium uptake and volatilization from plants growing in soil. Soil Sci. 153: 94-99.
Evans, C. S., C. J. Asher and C. M. Johnson. 1968. Isolation of dimethyl diselenide and other volatile selenium compounds from *Astragalus racemosus* (Pursh.). Aust. J. Biol. Sci. 21: 13-20.
Frankenberger, W. T., Jr. and U. Karlson. 1988. Dissipation of soil selenium by microbial volatilization at Kesterson Reservoir. Final report submitted to U.S. Department of the Interior, Project No. 7-F.C-20-05240, November. U. S. Bureau of Reclamation, Sacramento, CA.
Lewis, B. G., C. M. Johnson and C. C. Delwiche. 1966. Release of volatile selenium compounds by plants: Collection procedures and preliminary observations. J. Agric. Food Chem. 14: 638-640.
Mikkelsen, R. L., A. L. Page and F. T. Bingham. 1989. Factors affecting selenium accumulation by agricultural crops.. In: L. W. Jacobs (ed). Selenium in Agriculture and the Environment. Soil Science Society of America Special Publication No. 23. SSSA, Madison, WI. pp. 65-94
Pilon-Smits, E. A. H., M. P. Desouza, G. Hong, A. Amni, R. C. Bravo, S. T. Payabyab and N. Terry. 1999. Selenium volatilization and accumulation by twenty aquatic species. J. Environ. Qual. 28: 1011-1018.
Steward, K. K. and R. A.Elliston. 1973. Growth of hydrilla in solution cultures at various nutrient levels. Florida Scient. 36: 228-233.
Terry, N., C. Carlson, T. K. Raab and A. M. Zayed. 1992. Rates of selenium volatilization among crop species. J. Environ. Qual. 21: 341-344.
Terry, N. and A. M. Zayed. 1994. Selenium volatilization by plants. *In:* Frankenberger, W. T., Jr. and S. Benson (eds.), Selenium in the Environment. Marcel Dekker, Inc., New York, NY. pp. 343-367.
Terry, N. and A. Zayed. 1998. Phytoremediation of selenium. *In:* Frankenberger, W. T., Jr. and R. A. Engberg (eds.), Environmental Chemistry of Selenium. Marcel Dekker, Inc. New York, NY. pp. 633-655.
Ulrich, J. M. and A. Shrift. 1968. Selenium absorption by excised *Astragalas* roots. Plant Physiol. 43: 14-19.
Williams, M. C. and H. F. Maryland. 1992. Selenium absorption by two-grooved milkvetch and western wheatgrass from selenomethionine, selenocystine, and selenite. J. Range Manage. 45: 374-378.
Zieve, R. and P. J. Peterson. 1984. The accumulation and assimilation of dimethyl selenide by four plant species. Planta 160: 180-184.