U.S. Environmental Protection Agency
Region IX

Los Cerritos Channel Total Maximum Daily Loads for Metals

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

µg/L	Micrograms per liter
ac	Acre
ACF	Acute Conversion Factor
BMPs	Best Management Practices
Caltrans	California Department of Transportation
CCF	Chronic Conversion Factor
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CTR	California Toxics Rule
CWA	Clean Water Act
DL	Detection Limit
EMC	Event Mean Concentration
g/day	Grams Per Day
gpd	Gallons Per Day
HSPF	Hydrological Simulation Program FORTRAN
kg/year	Kilograms Per Year
LA	Load Allocation
LARWQCB	Los Angeles Regional Water Quality Control Board
LID	Low Impact Development
mg/L	Milligrams Per Liter
MS4	Municipal Separate Storm Sewer System
ND	Non Detect
NPDES	National Pollutant Discharge Elimination System
REC2	Non-Contact Water Recreation
RL	Reporting Limit (same as Detection Limit)
SCCWRP	Southern California Coastal Water Research Project
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
WARM	Warm Freshwater Habitat
WDRs	Waste Discharge Requirements
WER	Water-Effect Ratio
WILD	Wildlife Habitat
WLA	Waste Load Allocation
WQOs	Water Quality Objectives

1 INTRODUCTION

This report presents the required elements of the Total Maximum Daily Loads (TMDLs) for metals in Los Cerritos Channel and summarizes the technical analyses performed by the United States Environmental Protection Agency (USEPA), Region IX, to develop the TMDLs. The goal of these TMDLs is to determine the amount of copper, zinc and lead the Los Cerritos Channel can receive and still meet water quality standards. Los Cerritos Channel (Figure 1) is located within the jurisdiction of the California Regional Water Quality Control Board, Los Angeles Region (Regional Board).

Los Cerritos Channel was included on the 1998, 2002 and 2006 California 303(d) lists as an impaired waterbody for copper, zinc, and lead. (Regional Board, 1998 and California State Water Resources Control Board, 2002 and 2006.) The Clean Water Act (CWA) requires TMDLs be set at levels necessary to achieve all applicable water quality standards in Los Cerritos Channel.

These TMDLs comply with 40 CFR 130.2 and 130.7, Section 303(d) of the CWA and USEPA guidance for developing TMDLs in California (USEPA, 2000a). This document summarizes the information used by USEPA to develop TMDLs for metals. USEPA was assisted in this effort by the Regional Board. Because an implementation plan is not considered a required element of a TMDL established by USEPA, these TMDLs do not include an implementation plan to achieve the waste load allocations (WLAs) and attain water quality objectives (WQOs); however, implementation recommendations are included. An implementation plan will be developed by the Regional Board when it incorporates these TMDLs into its Basin Plan.

1.1 REGULATORY BACKGROUND

Section 303(d) of the CWA requires 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 CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

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 the USEPA 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" (40 CFR 130.2) such that the capacity of the waterbody 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 (CWA 303(d)(1)(C) (USEPA, 2000).

States must develop water quality management plans to implement the TMDL (40 CFR 130.6). 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 State Water Resources Control Board (State Board) and the nine Regional Water Quality Control Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If USEPA disapproves a TMDL submitted by a state, it is required to establish a TMDL for that waterbody. The Regional Boards 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).

As part of its 1996 and 1998 regional water quality assessments, the Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWQCB, 1996, 1998a). These are referred to as "listed" or "303(d) listed" waterbodies or waterbody segments. A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree approved between USEPA and several environmental groups on March 22, 1999 (Heal the Bay Inc., et al. v. Browner, et al. C 98-4825 SBA).

For the purpose of scheduling TMDL development, the consent decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units. Analytical Unit 84 is for metals listings in Los Cerritos Channel. Under the consent decree, USEPA must establish those TMDLs by March 2012. Therefore, the TMDLs for Analytical Unit 84 must be adopted by 2012. The State is unlikely to complete adoption of the TMDLs for Analytical Unit 84 in time to meet the consent decree deadline; therefore, USEPA is establishing these TMDLs.

The TMDLs will establish waste load allocations (WLAs) and total maximum daily loads for copper, lead, and zinc to the water column in Los Cerritos Channel. The TMDLs meet the requirement in the consent decree to develop TMDLs for Los Cerritos Channel under Analytical Unit 84.

1.2 ENVIRONMENTAL SETTING

Los Cerritos Channel is an open channel situated within the cities of Long Beach, Lakewood, Bellflower, Paramount, Downey, Signal Hill and Cerritos, as well as a small portion of Los Angeles County. The Channel is a concrete-lined conduit for freshwater until approximately Anaheim Road, where the Channel's tidal prism[1] begins. From there it connects with Alamitos Bay through the Marine Stadium. Wetlands connect to the Channel a short distance from its lower end. The wetlands and portion of the Channel near the wetlands constitute an overwintering site for a great diversity of birds (up to 50 species). An endangered bird species, the Belding's Savannah Sparrow, may nest there and an area adjacent to the wetlands is a historic least tern colony site. One small marina is located in the Channel which is used by rowing teams and is a popular fishing area.

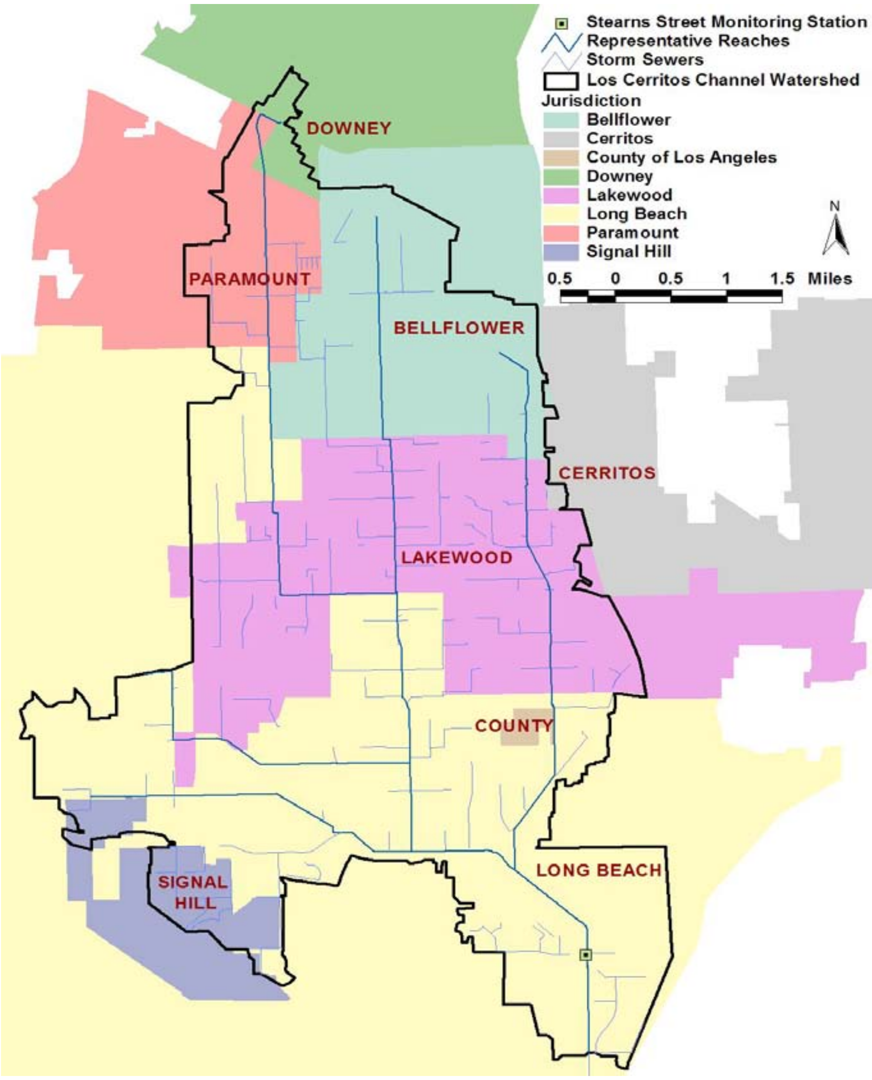
Average dry-weather flows in Los Cerritos Channel are 2.35 cubic feet per second (cfs). Storm event flows can be as high as 1,460 cfs (historical maximum). (Appendix F.) Los Cerritos Channel was structured to quickly convey stormwater to its terminus in Alamitos Bay. Therefore, the relationship between rain events in the Watershed and increased flow in the Channel is strong and immediate.

The portion of Los Cerritos Channel listed as impaired for metals that these TMDLs address is the freshwater portion above the tidal prism, 2.1 miles in length (shown in Figure 4). The Los Cerritos Channel above the tidal prism drains a relatively small (17,711 acre) densely urbanized area, hereafter referred to as the Los Cerritos Channel Freshwater Watershed (Figure 1). Geographic Information System coverage for the freshwater portion of Los Cerritos Channel

[1] Tidal prism is the volume of water drawn into the channel from the ocean through tides.

watershed was provided by the Regional Board. This watershed boundary was modified, to exclude areas draining to other watersheds, based on field reconnaissance by the City of Downey (personal communication, G. Greene, City of Downey to K. Graves, USEPA Region 9, October 26, 2009).

Figure 1. Los Cerritos Channel Freshwater Watershed



Note: A 5.05 acre area in the City of Downey drains to the Los Angeles River watershed. While this area is included in this and other maps throughout this document; it has been excluded from TMDL calculations, allocations and other tables and text (except those presenting model results) for the Los Cerritos Channel metals TMDLs.

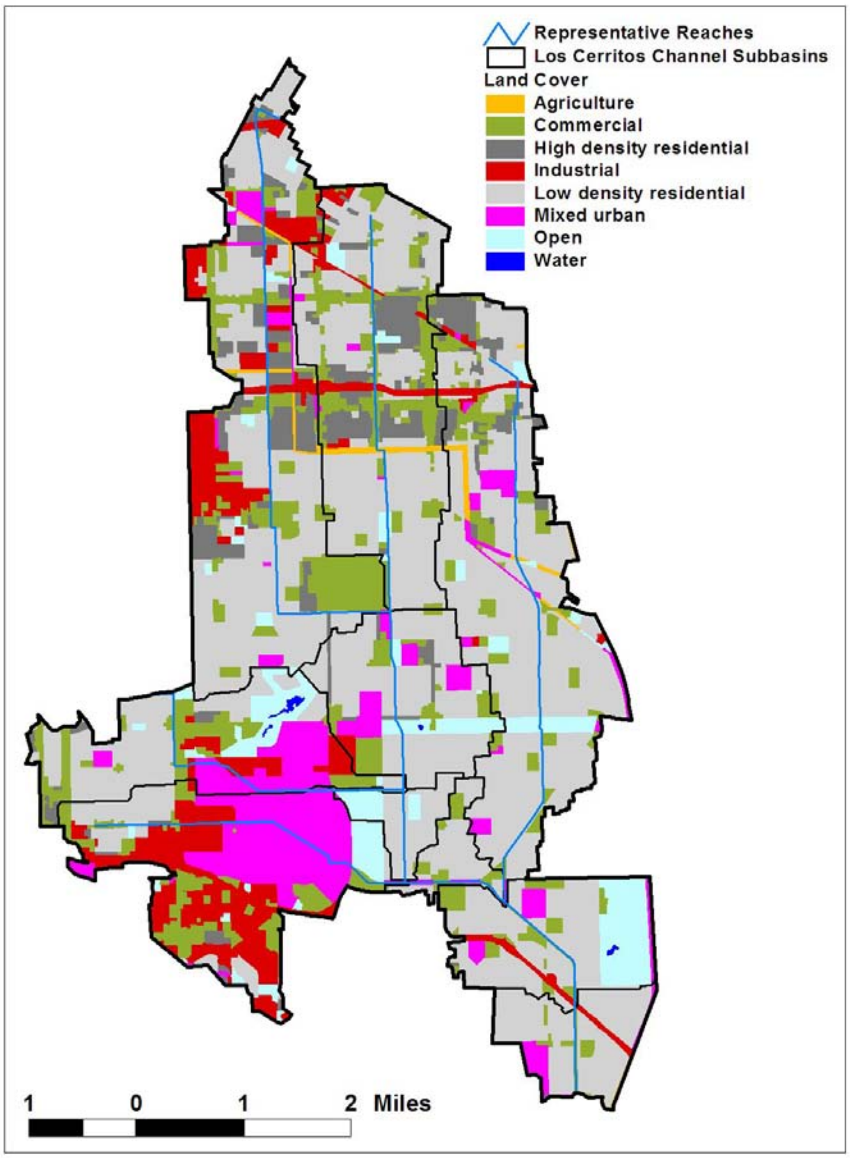
Approximately 45 percent of the Watershed is located in east Long Beach while 55 percent is located outside the City of Long Beach, in cities including Lakewood, Bellflower, Paramount, Downey, Signal Hill, and Cerritos.

Land use within the Watershed is 93% urban (approximately 59% residential, 9% mixed urban, 15% commercial, and 9% industrial). Open space accounts for 6% of land use and agriculture is <1% of land use. (Appendix E, Table 1.) Table 1-1 shows the estimated number of acres for seven land use categories in the Watershed, depicted pictorially in Figure 2.

Table 1-1. Land use types and acreage in the Los Cerritos Channel Freshwater Watershed.

Land Cover Type	No. of Acres	Percentage of Watershed
Agriculture	137.1	0.8%
Commercial	2,668.6	15.1%
High Density Residential	1,228.5	6.9%
Industrial	1,615.0	9.1%
Low Density Residential	9,278.9	52.4%
Mixed Urban	1,665.8	9.4%
Open Space	1,097.9	6.2%
Water	18.9	0.1%
Total	**17,710.7**	**100%**

Figure 2. Land use representation in the Los Cerritos Channel Freshwater Watershed



1.3 ORGANIZATION OF THIS DOCUMENT

Guidance from USEPA (1991) identifies several elements of a TMDL. Sections 2 through 8 of this document are organized such that each section describes one of the elements, with the analysis and findings of these TMDLs for that element. The elements are as follows:

- **Section 2: Problem Identification.** Describes the water quality objectives (WQOs) designed to protect beneficial uses and reviews monitoring data for the metals for which Los Cerritos Channel is listed as impaired.
- **Section 3: Numeric Targets.** Sets numeric targets based upon the WQOs described in the California Toxics Rule.
- **Section 4: Source Assessment.** Describes what is currently understood about the sources of metals impairment in the Los Cerritos Channel Freshwater Watershed and discusses the number and type of permitted sources located in the Watershed.
- **Section 5: Linkage Analysis.** Provides an analysis of the relationship between sources and in-stream water quality impairment. The linkage analysis addresses the critical conditions of stream flow, loading, and water quality parameters.
- **Section 6: TMDLs and Pollutant Allocations.** Identifies the quantitative load of metals that can be delivered to Los Cerritos Channel without causing a violation of water quality standards and apportions Waste Load Allocations to permittees and Load Allocations to nonpoint sources.
- **Section 7: Implementation.** Not considered a required element of a TMDL established by USEPA; contains recommendations to the State regarding implementation of the TMDLs.
- **Section 8: Monitoring.** Not considered a required element of a TMDL established by USEPA; contains recommendations to the State regarding monitoring related to the TMDLs.

References are included in Section 9.

2 PROBLEM IDENTIFICATION

This section provides an overview of water quality standards for Los Cerritos Channel and reviews water quality data used in the 1998 water quality assessment (WQA), the 2002 and 2004-2006 303(d) listings, and additional data used to analyze sources in these TMDLs.

2.1 WATER QUALITY STANDARDS

California state water quality standards consist of the following elements: 1) beneficial uses; 2) narrative and/or numeric water quality objectives; and 3) an antidegradation policy. In California, the Regional Boards define beneficial uses in their *Basin Plans*. Numeric and narrative objectives designed to be protective of these beneficial uses are specified in each Region's *Basin Plan*, or State Water Quality Control Plans.

For certain toxic pollutants, USEPA has established numeric criteria that serve as water quality standards for California's inland surface waters. (California Toxics Rule (CTR), 40 CFR 131.38.) In other words, if a pollutant is present in a surface waterbody at a level higher than a CTR criterion, then the surface waterbody is toxic. The federal water quality criteria established by the CTR are equivalent to state water quality objectives and they serve the same purpose. For the Los Angeles region, numeric objectives for toxics can be found in the CTR.

2.1.1 Beneficial Uses

The *Basin Plan* for the Los Angeles Regional Board (1994) defines one existing (E) and two intermittent (I) beneficial uses for Los Cerritos Channel. Metals loading to the Channel may result in impairments of the beneficial uses.

Table 2-1 Los Cerritos Channel beneficial uses.

Type of Beneficial Use	Beneficial Use	Acronym
Existing	Wildlife Habitat	WILD
Intermittent	Noncontact Water Recreation	REC2
Intermittent	Warmwater Habitat	WARM

2.1.2 Water Quality Objectives

As stated in the *Basin Plan*, water quality objectives (WQOs) are intended to protect the public health and welfare and to maintain or enhance water quality in relation to the designated existing and potential beneficial uses of the water. Narrative WQOs are specified in the 1994 Regional Board *Basin Plan*. The following narrative objective is most pertinent to the metals TMDLs.

> *All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.*

The Regional Board's narrative toxicity objective reflects and implements national policy set by Congress. The Clean Water Act states that, "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited." (33 U.S.C. 1251(a)(3).) In 2000, USEPA established numeric water quality objectives for pollutants addressed in these TMDLs in the CTR. The CTR establishes freshwater and saltwater aquatic life criteria for 23 priority toxic pollutants and numeric human health criteria for 57 priority toxic pollutants.

USEPA expressed the CTR criteria as concentrations. Therefore, whenever a pollutant is present in a surface waterbody at a concentration in excess of a CTR criterion, the criterion is considered to be exceeded, and the surface waterbody is generally considered to be toxic. USEPA did not differentiate between wet-weather conditions and dry-weather conditions in establishing the CTR. The CTR criteria therefore apply at all times to inland surface waters. This result is reached on both legal and technical grounds. Legally, the result is compelled because the CTR establishes water quality criteria (called "objectives" in California) to protect aquatic life in all of California's inland surface waters. (See, 40 CFR 131.38(a), (c)(1), and (d)(1).) There is no exception for wet-weather conditions in the CTR. Moreover, aquatic life is also present in wet-weather conditions. The CTR is legally necessary to protect these uses in wet-weather conditions. It would be illogical and illegal to conclude that the CTR does not apply in wet weather.

From a technical perspective, it would be equally inappropriate to find a wet-weather exception in the CTR. Because the CTR criteria are expressed as concentrations, the volume of water is irrelevant. The concentration-based criteria essentially account for dilution in wet-weather conditions. In high-volume, wet-weather conditions, if the concentration of a toxic pollutant in a water body exceeds the CTR criterion, the water body is toxic.

The CTR establishes short-term (acute) and long-term (chronic) aquatic life criteria for metals in both freshwater and saltwater. The acute criterion, defined in the CTR as the Criteria Maximum Concentration, equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects. The chronic criterion, defined in the CTR as the Criteria Continuous Concentration, equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. Freshwater aquatic life criteria apply to waters in which the salinity is equal to or less than 1 part per thousand (ppt) 95 percent or more of the time. Saltwater aquatic life criteria apply to waters in which salinity is equal to or greater than 10 ppt 95 percent or more of the time. For waters in which the salinity is between one and 10 ppt, the more stringent of the freshwater or saltwater aquatic life criteria apply.

CTR freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness and/or water quality characteristics that are usually correlated with hardness can reduce or increase the toxicity of some metals. Hardness is used as a surrogate for a number of water quality characteristics, which affect the toxicity of metals in a variety of ways. Increasing hardness generally has the effect of decreasing the toxicity of metals. Water quality criteria to protect aquatic life may be calculated at different concentrations of hardness measured in milligrams per liter (mg/L) as calcium carbonate ($CaCO_3$). The CTR lists freshwater aquatic life criteria based on a hardness value of 100 mg/L and provides hardness dependent equations to calculate the freshwater aquatic life metals criteria using site-specific hardness data.

In the CTR, freshwater and saltwater criteria for metals are expressed in terms of the dissolved fraction of the metal in the water column. These criteria were calculated based on methods in USEPA guidance (USEPA, 1985) developed under Section 304(a) of the CWA. This methodology is used to calculate the total recoverable fraction of metals in the water column and then appropriate conversion factors, included in the CTR, are applied to calculate the dissolved criteria.

Table 2-2 summarizes the applicable aquatic life criteria for metals in the freshwater portion of Los Cerritos Channel addressed by these TMDLs. The criteria are expressed in terms of the dissolved fraction of the metal in the water column.

Table 2-2. Water quality objectives for copper, lead, and zinc established in the CTR for the protection of aquatic life. Objectives are established for dissolved metals concentrations.

Metal	Freshwater Acute* (µg/L)	Freshwater Chronic* (µg/L)
Copper	13	9.0
Lead	65	2.5
Zinc	120	120

** Criteria are hardness-dependent. Values in the table are based on a hardness of 100 mg/L.*

The CTR allows for the adjustment of criteria through the use of a water-effect ratio (WER) to assure that the metals criteria are appropriate for the site-specific chemical conditions under which they are applied. A WER represents the ratio between metals that are measured and metals that are biologically available and toxic. A WER is a measure of the toxicity of a material in site water divided by the toxicity of the same material in laboratory dilution water. No site-specific WER has been developed for Los Cerritos Channel. Therefore, a WER default value of 1.0 is assumed.

The equations for calculating the freshwater criteria for metals are:

$$\text{Acute Criterion} = \text{WER} \times \text{ACF} \times \text{EXP}[(m_a)(\ln(\text{hardness}))+b_a]$$
$$\text{Chronic Criterion} = \text{WER} \times \text{CCF} \times \text{EXP}[(m_c)(\ln(\text{hardness}))+b_c]$$

Where:
- WER = Water-Effect Ratio (assumed to be 1)
- ACF = Acute conversion factor (to convert from the total to the dissolved fraction)
- CCF = Chronic conversion factor (to convert from the total to the dissolved fraction)
- m_a = slope factor for acute criteria
- m_c = slope factor for chronic criteria
- b_a = y intercept for acute criteria
- b_c = y intercept for chronic criteria

The coefficients needed for the calculation are provided in the CTR (Table 2-3). The conversion factor for lead in freshwater is dependent on hardness. The following equations can be used to calculate the conversion factors based on site-specific hardness data:

$$\text{Lead ACF} = 1.46203 - [(\ln\{\text{hardness}\})(0.145712)]$$
$$\text{Lead CCF} = 1.46203 - [(\ln\{\text{hardness}\})(0.145712)]$$

Table 2-3. Coefficients used in formulas for calculating CTR freshwater criteria for metals.

Metal	ACF	m_a	b_a	CCF	m_c	b_c
Copper	0.960	0.9422	-1.700	0.960	0.8545	-1.702
Lead	0.791*	1.273	-1.460	0.791*	1.273	-4.705
Zinc	0.978	0.8473	0.884	0.986	0.8473	0.884

** The ACF and CCF for lead are hardness-dependent. Conversion factors presented here are based on a hardness of 100 mg/L.*

2.1.3 Antidegradation

State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Water in California," known as the "Antidegradation Policy," protects surface and ground waters from degradation. Any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the state, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the federal Antidegradation Policy (40 CFR 131.12). The proposed TMDLs will not degrade water quality, and will in fact improve water quality as they will lead to meeting the numeric water quality standards.

2.2 WATER QUALITY DATA REVIEW

Water quality was assessed using data from the City of Long Beach stormwater program and using 5 additional samples provided by Kinnetics Laboratories, Inc., to assess both dry-weather and wet-weather conditions.

The metals data were collected from the City's Los Cerritos Channel monitoring site, located in the east central portion of Long Beach at Stearns Street (see Figure 1). The site is bound on the north, south, east, and west by Spring Street, Rendina Street, the San Gabriel River, and Bellflower Boulevard, respectively. The stormwater monitoring station was installed in a steel utility box located on the west side of the channel south of Stearns Street. (City of Long Beach Stormwater Monitoring Report, 2001-2002, pg. 17). Four of the five additional samples were collected at the Stearns Street intersection, and one was collected at East Willow Street, just upstream from Stearns Street, in the impaired segment of Los Cerritos Channel, (submitted via email from M. Stevenson, Kinnetics Laboratories, Inc., to K. Graves, USEPA Region 9, October 21, 2009).

Figure 3. City of Long Beach Stearns Street sampling site

Photo from City of Long Beach Stormwater Monitoring Report 2006/2007

The Stearns Street sampling site is above tidewater in Los Cerritos Channel, and thus represents the freshwater portion of the Channel listed for metals impairment on the California 303(d) list. The drainage pattern is to the east and south on the west side of the Los Cerritos Channel and to the west and south on the east side. Eight major storm drain systems with a total of three major storm drain lines contribute runoff into the Channel. Flow sensors and sampling tubing were installed on the bottom of the concrete-lined channel. Flow rates based upon flow velocity and channel dimensions are used to control the composite sampler, and to calculate total flow at the end of every storm event.

In order to assess the frequency of exceedances of the CTR acute and chronic criteria for copper, lead, and zinc in Los Cerritos Channel, dry-weather and wet-weather metals concentrations were compared to CTR values using actual hardness measured for each sampling event.

2.2.1 Data Summary

In dry weather, the evidence indicates water column exceedances for copper but not for lead and zinc. In wet weather, the evidence indicates water column exceedances for all three metals.

Table 2-4 summarizes dry-weather exceedances and Table 2-5 summarizes wet-weather exceedances. A detailed data assessment is provided in Appendix A (dry-weather data) and Appendix B (wet-weather data).

Table 2-4. Summary of 2001-2009 Los Cerritos Channel dry-weather metals data relative to freshwater CTR criteria. Data are based on dissolved metals concentrations.

Metal	No. of Samples	DL/RL (µg/L)	# > DL/RL	# > Acute	# > Chronic
Copper	21	0.5	21	2	9
Lead	16	0.5*	15	0	0
Zinc	16	1	16	0	0

DL/RL reported as the maximum of the detection limit (DL) or the reporting limit (RL).
* For 2001 samples, DL = 1.

Table 2-5. Summary of 2001-early 2009 Los Cerritos Channel wet-weather metals data relative to freshwater CTR criteria. Data are based on dissolved metals concentrations.

Metal	No. of Samples	DL/RL (µg/L)	# > DL/RL	# > Acute	# > Chronic
Copper	31	0.5	31	25	28
Lead**	31	0.5*	24	0	22
Zinc	31	1	31	21	21

DL/RL reported as the maximum of the detection limit (DL) or the reporting limit (RL).
* For 2001 samples, DL = 1.
** For approx. 2/3 of the samples, the CTR chronic criterion was higher than the DL.

2.2.2 Conclusions on Water Quality Assessment

This re-assessment confirms the existence of metals impairments identified in the 2004-2006 303(d) list. In dry weather, only copper exceeds the criteria (43% of all dissolved copper samples) so a dry-weather TMDL is developed for copper but not for lead or zinc.

In wet weather, all three metals exceed the criteria in the majority of samples collected, although lead exceeds only the chronic criteria and not the acute. The lead exceedances reflect generally low hardness values during wet weather which, in turn, result in low CTR chronic criteria. Approximately 81% of dissolved copper samples exceed the acute criteria and 90% exceed the chronic criteria; 71% of dissolved lead samples exceed the chronic criteria; and 68% of dissolved zinc samples exceed the acute and chronic criteria. Therefore, wet-weather TMDLs are developed for copper, lead, and zinc.

3 NUMERIC TARGETS

Numeric targets for the TMDLs have been calculated based on the numeric objectives in the CTR. By applying the CTR criteria, these TMDLs also address the narrative objective (section 2.1.2). (See 62 FR 42160, 42189, August 5, 1997.) The numeric objectives in the CTR are expressed in terms of dissolved metals (USEPA 2000a) because the dissolved forms are the most bioavailable to aquatic organisms.

USEPA and the Regional Board recognize the potential for transformation between total recoverable metals and the dissolved metals fraction. The partitioning between dissolved and particulate phases of total recoverable metals is highly dependent upon the conditions observed during the period of sampling. During dry conditions, metals are primarily in the dissolved state, which is consistent with default conversion factors defined in the CTR. For wet conditions, the partitioning between particulate and dissolved metals often does not achieve equilibrium as the metals are transported with storm flows. Conversion factors are used to convert the dissolved metal numeric targets to total recoverable metals for calculation of the WLAs in these TMDLs. The linkage analysis and pollutant allocations to meet the numeric targets (Section 5 and 6) will be based on total recoverable metals.

Separate numeric targets are developed for dry and wet weather because hardness values and flow conditions in Los Cerritos Channel differ significantly between these conditions.

Dry-weather flow is estimated to be 2.35 cfs, which is the average flow measured by the City of Long Beach for 19 dry-weather sampling events in the 2001-2009 time frame.

For the purpose of these TMDLs, wet weather is defined in terms of flow rather than rainfall. Wet weather is defined as any day when the maximum daily flow is equal to or greater than 23 cfs. (Appendix F, Table 1.) This is based on the estimated 90th percentile of daily average flows measured at the Los Cerritos Channel monitoring site from 2001 to early 2008. (Appendix F.) Since the Los Cerritos Channel monitoring site only records flows of 18.8 cfs or higher, the 90th percentile wet-weather flow is estimated by substituting the dry-weather average flow of 2.35 cfs for unrecorded flows less than 18.8 cfs.

3.1 DRY-WEATHER TMDL TARGET

As discussed in Section 2, the freshwater aquatic life criteria for metals in the CTR are expressed as a function of hardness of the receiving water. Dry-weather hardness data reported by the City of Long Beach for Los Cerritos Channel were analyzed and a median hardness value of 170 mg/L was determined. The chronic criterion is the most appropriate value for dry weather conditions, therefore, it is used as the basis for the copper dry-weather numeric target and waste load allocations.

The numeric target in Table 3-1 requires conversion to a total recoverable concentration for comparison to existing conditions for TMDL development. To evaluate the potential use of site-specific dry-weather factors for converting the chronic CTR criteria from dissolved metals concentrations to total recoverable concentrations, dry weather data collected by the City of Long Beach at the Stearns Street sampling site from 2001-2009, and data collected in 2009 by

Kinnetics Laboratories, Inc. from within the impaired, freshwater portion of Los Cerritos Channel were evaluated.

USEPA utilized its guidance on translators, *The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From A Dissolved Criterion* (USEPA, 1996), to evaluate the potential for a site-specific dry weather translator for copper. The guidance describes methods to analyze local water-body data and determine translators to convert dissolved loads into equivalent total loads. In addition to using default CTR translators, USEPA guidance describes three options for deriving a site-specific translator:

1. Direct Measurement - Assuming no Relationship to Total Suspended Solids (TSS), uses descriptive statistics and may be developed directly as the ratio of dissolved to total recoverable metal;

2. Direct Measurement - Based upon Relationship to TSS, uses regression equations to evaluate correlations and yield r^2 values, which indicate the strength of the relationship with TSS and fraction of particulate metals;

3. Partition coefficient – Based on relationship to TSS and is functionally related to the number of metal binding sites on the particulate surfaces in the water column (i.e., concentrations of TSS, TOC, or humic substances), and r^2 values also indicate the strength of the relationships and the conversion factor (fraction of particulate metals).

USEPA considered the three options, and selected Option 1, Direct Measurement Assuming no Relationship to TSS, with selection of the median value for the translator. Analysis via Options 2 and 3 revealed a very poor correlation of particulate metals fractions with TSS (r^2 values ranged from 0.345 - 0.378). Without any reliable relationship with TSS, translators derived from Options 2 and 3 were disregarded.

Direct measurement (Option 1) was selected as the preferred method to determine the copper site specific translator for dry weather in Los Cerritos watershed for two reasons. Dry weather paired metals data in Los Cerritos show dissolved to total ratios ranging from 23% - 94%; whereas the CTR conversion value for copper is 96%. Thus the local dry weather dissolved fractions do not resemble the dissolved fractions defined by CTR conversion values. For translation of chronic metals criteria, the median value was determined, which is consistent with the State's Implementation Policy (SIP) for CTR (SWRCB, 2005).

Table 3-1. Dry-weather numeric target expressed in terms of dissolved and total recoverable fraction.

Metal	Target* (µg/L) Dissolved	Site Specific Translator	Target (µg/L) Total Recoverable
Copper	14.1	0.737	19.1

** Freshwater target based on a median hardness of 170 mg/L (calculated using 21 dry weather samples).*

3.2 WET-WEATHER TMDL TARGETS

As discussed above, the freshwater aquatic life criteria for metals in the CTR are expressed as a function of hardness of the receiving water. Wet-weather hardness values reported by the City of Long Beach for Los Cerritos Channel were analyzed. These data represent 31 stormwater composite samples collected between 2001 and 2009. The median hardness value of this dataset is 27 mg/L, a value significantly lower relative to the CTR default hardness of 100 mg/L. Using the default hardness value of 100 mg/L may not be fully protective. Therefore, the median hardness of 27 mg/L is assumed to be representative of wet-weather conditions, as well as fully protective of aquatic life.

The chronic criteria are typically based on exposures, which occur over a 4-day time interval. Storms of this duration are a rare occurrence in Southern California. Most storms are of shorter duration. City of Long Beach data shows that the average duration of storms affecting Los Cerritos Channel is 1 day (ranging from 10 to 39 hours over 17 storm events evaluated). [City of Long Beach Stormwater Monitoring Reports (five reports covering 2002-2007).] Hardness values in Los Cerritos Channel are generally significantly lower in wet weather than in dry weather. Decreasing hardness has the effect of increasing the toxicity of metals such as copper, lead, and zinc, resulting in more stringent wet-weather criteria relative to dry-weather criteria. However, given the relatively short duration of storms in the area, the hardness-dependent wet-weather chronic criteria may not represent a full 4-day time interval. Furthermore, unlike pollutants such as mercury, the metals of concern here do not bioaccumulate over time in fish. The acute criteria are based on a shorter time interval and are more appropriate for setting numeric targets for wet-weather conditions.

To evaluate the potential for use of site-specific wet-weather factors for converting the acute CTR criteria from dissolved metals concentrations to total recoverable concentrations, stormwater data collected by the City of Long Beach were evaluated. Dissolved metals concentrations were compared to total recoverable metals concentrations in a regression analysis for the 31 monitored wet-weather events from January 2001 through February 2009. The regression analysis is provided in Appendix C. Table 3-2 shows the results of the regression analysis, along with the default CTR conversion factors for comparison. The CTR conversion factor for lead was calculated based on a median hardness of 27 mg/L.

Table 3-2. Wet-weather conversion factors for total recoverable metals to dissolved metals concentrations.

Metal	CTR Conversion Factor for Freshwater Acute Criteria	Wet-Weather Data (City of Long Beach)		
		No. of Samples	Conversion Factor Slope	r^{2**}
Copper	0.96	31	0.027	0.11
Lead	0.982*	31	0.006	0.11
Zinc	0.978	30	0.029	0.17

** Conversion factor is hardness-dependent, based on a hardness of 27 mg/L.*
*** r^2 is the fraction of the variance explained by the regression.*

These regressions suggest that the CTR default conversion factors overestimate the dissolved portion of metals in stormwater. This is particularly evident with respect to lead concentrations, in which the dissolved fraction of total recoverable values is 5% or smaller in all but 7 of the 31 City of Long Beach wet-weather samples. However, the low r-squared values for all three metals suggest a very weak linear relationship between actual dissolved and total recoverable values, i.e., the relationship across the dataset is scattered and difficult to predict. Therefore, the slope of the regression is not used to convert the CTR dissolved criteria to total recoverable metals targets. As with dry weather data, USEPA used the *Metals Translator guidance* (USEPA, 1996) to evaluate the potential for a site specific translator for wet weather. USEPA evaluated the analytical results after applying the same three options described above. Again, Options 2 and 3 yielded very poor to marginal correlation of particulate metals fractions with TSS (r^2 values ranged from 0.07 - 0.579). Without any reliable relationship with TSS, translators derived from Options 2 and 3 were disregarded. USEPA opted for Option 1, Direct Measurement Assuming no Relationship to TSS, and selected the 90th percentile value as designated in the CTR SIP for the translation of acute criteria.

Evaluation of the wet weather paired metals data in Los Cerritos Channel shows that dissolved to total ratios are not similar to those suggested by the CTR conversion values. For lead, the percent of total to dissolved values fell below 15% in 30 of the 31 samples evaluated (See Appendix C; this is drastically different from the CTR conversion value (97%)). For copper and zinc dissolved to total ratios range from 4% to 88%; whereas the default CTR conversion values are closer to 96% or more.

The wet-weather numeric targets used to calculate these TMDLs and allocations are provided in Table 3-3.

Table 3-3. Wet-weather numeric targets expressed as dissolved and total recoverable values.

Metal	Target* (µg/L) Dissolved	Site Specific Translator	Target (µg/L) Total Recoverable
Copper	3.9	0.400	9.8
Lead	15.1	0.071	213.2
Zinc	38.6	0.404	95.6

** Targets are based on a median hardness of 27mg/L (31 total samples).*

4 SOURCE ASSESSMENT

This section identifies the potential sources of copper, lead, and zinc that discharge into Los Cerritos Channel. In general, pollutants can enter surface waters from both point and nonpoint sources. Point sources include discharges from a discrete human-engineered outfall. These discharges are regulated through National Pollutant Discharge Elimination System (NPDES) permits. Nonpoint sources, by definition, include pollutants that reach surface waters from a number of diffuse land uses and activities that are not regulated through NPDES permits. In Los Angeles County, urban runoff to Los Cerritos Channel is regulated under stormwater NPDES permits as a point source discharge. In this section, we discuss both point source and nonpoint source contributions to metals loading in Los Cerritos Channel.

4.1 POINT SOURCES

The NPDES permits in the Los Cerritos Channel Freshwater Watershed include municipal separate storm sewer system (MS4) permits, the California Department of Transportation

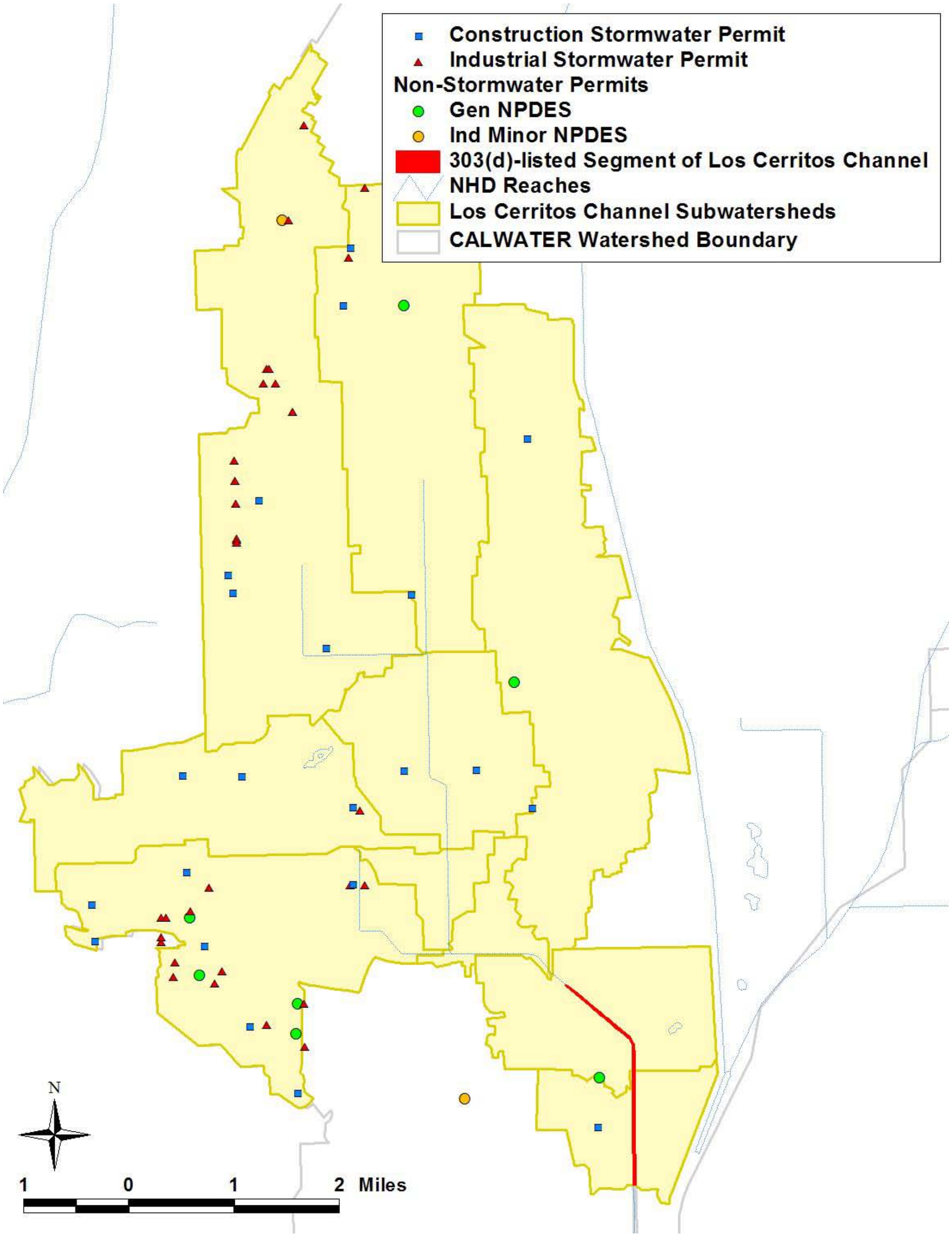
(Caltrans) stormwater permit, general construction stormwater permits, general industrial stormwater permits, minor NPDES permits, and general NPDES permits (Table 4-1).

Table 4-1. NPDES Permits in the Los Cerritos Channel Freshwater Watershed.

Type of NPDES Permit	Number of Permits
Municipal Stormwater	2
California Department of Transportation Stormwater	1
General Construction Stormwater	23
General Industrial Stormwater	33
Individual NPDES Permits (Minor)	2
General NPDES Permits:	7
Construction and Project Dewatering	2
Petroleum Fuel Cleanup Sites	1
Potable Water	2
Non-Process Wastewater	1
Hydrostatic Test Water	1
Total	**68**

The locations of discharges authorized under the general construction stormwater, general industrial stormwater, individual NPDES, and general NPDES permits are shown in Figure 4.

Figure 4. Map of point sources in the Los Cerritos Channel Freshwater Watershed



Individual sources of metals in stormwater include automobile brake pads, vehicle wear, building materials, pesticides, erosion of paint and deposition of air emissions from fuel combustion and industrial facilities.

A Southern California stormwater study conducted between 2001-2005 found that industrial land use sites contributed substantially higher fluxes[2] and event mean concentrations (EMCs)[3] of copper and zinc relative to other land use site categories (e.g., residential, commercial, etc…) (Tiefenthaler et. al, 2007, pgs. 13-29.) In contrast, the highest fluxes for lead were associated with agriculture, high density residential, and recreational land use sites, while the highest EMCs for lead related to high density residential and industrial land use sites. Industrial sites typically have >70% impervious cover as well as on-site sources of metals which may explain the higher loadings of copper and zinc from industrial land use sites observed in the study. In addition, industrial land use sites were found to contribute substantially higher fluxes of Total Suspended Solids (TSS) relative to other land uses (along with agriculture land use sites). In the Los Cerritos Channel Freshwater Watershed, industrial land use only constitutes 9% of total land use.

The contribution of automobile brake pads to copper levels in Los Cerritos Channel could be significant. Deposited onto roads by vehicles, copper from brake pad use is transported through stormwater into water bodies. The Brake Pad Partnership, a multi-stakeholder effort to understand the environmental impacts that may arise from brake pad wear debris from passenger vehicles, conducted a watershed modeling study of copper from brake pads affecting water quality in South San Francisco Bay, as an example area. The study determined that copper from brake pads accounts for up to half of the anthropogenic copper discharged from highly urbanized areas to the San Francisco Bay. (Brake Pad Partnership Update, 2007, pg. 1.) Since the Los Cerritos Channel Freshwater Watershed is highly urbanized, it is likely that brake pads are the largest single contributor to copper in stormwater runoff to the Channel.

4.1.1 Stormwater Permits

Stormwater runoff in the Los Cerritos Channel Freshwater Watershed is regulated through the City of Long Beach MS4 permit, the Los Angeles County MS4 permit, the statewide stormwater permit issued to Caltrans, the statewide Construction Activities Stormwater General Permit and the statewide Industrial Activities Stormwater General Permit. The permitting process defines these discharges as point sources because the stormwater discharges from the end of a stormwater conveyance system. Since the industrial and construction stormwater discharges are enrolled under NPDES permits, these discharges are treated as point sources in these TMDLs.

4.1.1.1 MS4 Stormwater Permits

In 1990, USEPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent pollutants from being washed by stormwater runoff into MS4s (or from being discharged directly into the MS4s) and then discharged into local waterbodies. Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement a stormwater management program as a means to control polluted discharges.

Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations, and hazardous waste treatment. Large and medium MS4 operators are

[2] Flux = the total mass loading of a storm divided by the total catchment size.
[3] EMC = the total mass load of a contaminant divided by the total runoff water volume discharged during a storm.

required to develop and implement Stormwater Management Plans that address, at a minimum, the following elements:

- Structural control maintenance
- Areas of significant development or redevelopment
- Roadway runoff management
- Flood control related to water quality issues
- Municipally owned operations such as landfills, and wastewater treatment plants
- Municipally owned hazardous waste treatment, storage, or disposal sites
- Application of pesticides, herbicides, and fertilizers
- Illicit discharge detection and elimination
- Regulation of sites classified as associated with industrial activity
- Construction site and post-construction site runoff control
- Public education and outreach

The Los Angeles County MS4 Permit was renewed in December 2001 (Regional Board Order No. 01-182) and is on a five-year renewal cycle. There are 85 co-permittees covered under this permit, including 84 incorporated cities and the County of Los Angeles. The City of Long Beach MS4 permit was renewed on June 30, 1999 as Order No. R4-99-060 and is on a five-year renewal cycle. It solely covers the City of Long Beach.

4.1.1.2 Caltrans Stormwater Permit

Caltrans is regulated by a statewide stormwater discharge permit that covers all municipal stormwater activities and construction activities (State Board Order No. 99-06-DWQ). The Caltrans stormwater permit authorizes stormwater discharges from Caltrans properties such as the state highway system, park and ride facilities, and maintenance yards.

The stormwater discharges from most of these Caltrans properties and facilities eventually end up in either a city or county storm drain. The metals loading specifically from Caltrans properties have not been determined in the Los Cerritos Channel Freshwater Watershed. However, we can estimate the quantity of acres covered by state highways in the Watershed. A conservative estimate is 140 acres, or approximately 0.79% of the Watershed. This area represents Caltrans' right-of-way that drains to the portion of Los Cerritos Channel subject to these TMDLs. This percentage does not represent all of the Watershed area that Caltrans is responsible for under its stormwater permit. For example, park and ride facilities and maintenance yards were not included in the estimate.

4.1.1.3 General Stormwater Permits

In 1990, USEPA issued regulations for controlling pollutants in stormwater discharges from industrial sites (40 Code of Federal Regulations [CFR] Parts 122, 123, and 124) equal to or greater than five acres. The regulations require dischargers of stormwater associated with industrial activity to obtain a NPDES permit and to implement Best Available Technology Economically Achievable (BAT) to reduce or prevent non-conventional and toxic pollutants, including metals, in stormwater discharges and authorized non-storm discharges. On December 8, 1999, USEPA expanded the NPDES program to include stormwater discharges from construction sites that resulted in land disturbances equal to or greater than one acre (40 CFR Parts 122, 123, and 124).

On April 17, 1997, State Board issued a statewide general NPDES permit for Discharges of Stormwater Associated with Industrial Activities Excluding Construction Activities Permit (Order No. 97-03-DWQ). This Order regulates stormwater discharges and authorized non-stormwater discharges from ten specific categories of industrial facilities, including but not limited to, manufacturing facilities, oil and gas mining facilities, landfills, and transportation facilities. As of the writing of these TMDLs, there are 33 dischargers enrolled under the general industrial stormwater permit within the Los Cerritos Channel Freshwater Watershed. Potential pollutants from an industrial site will depend on the type of facility and operations that take place at that facility. Industrial sites in the Los Cerritos Channel Freshwater Watershed with stormwater permits include trucking and warehousing, transportation equipment, fabricated metal products, petroleum and coal products, rubber and miscellaneous plastics products, oil and gas extraction, and other miscellaneous industries. There is a potential for metals loadings from these types of facilities, especially transportation and manufacturing facilities.

During wet weather, runoff from industrial sites has the potential to contribute metals loadings to the Channel. During dry weather, the potential contribution of metals loadings from industrial stormwater is low because non-stormwater discharges are prohibited or authorized by the permit only under the following circumstances: when they do not contain significant quantities of pollutants; where Best Management Practices (BMPs) are in place to minimize contact with significant materials and reduce flow; and when they are in compliance with Regional Board and local agency requirements.

On August 19, 1999, State Board issued a statewide general NPDES permit for Discharges of Stormwater Runoff Associated with Construction Activities (Order No. 99-08-DQW). As of the writing of these TMDLs, there are 23 construction sites enrolled under the general construction stormwater permit within the Los Cerritos Channel Freshwater Watershed. Sources of metals from construction sites include sediment-containing metals, construction materials, and equipment used on construction sites. In addition, in the highly urbanized Los Cerritos Channel Freshwater Watershed, re-development of former industrial sites has a higher potential to discharge sediments laden with metals. During wet weather, runoff from construction sites has the potential to contribute metals loadings to the Channel. Raskin et al. (2004) found that building materials and construction waste exposed to stormwater can leach metals and contribute metals to waterways. During dry weather, the potential contribution of metals loadings is low because discharges of non-stormwater are authorized by the permit only where they do not cause or contribute to a violation of any water quality standard and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants.

4.1.2 Other NPDES Permits

There are two types of NPDES permits: individual and general permits. An individual NPDES permit is classified as either a major or a minor permit. Other than the MS4 and Caltrans stormwater permits, there are no major individual NPDES permits in the Los Cerritos Channel Freshwater Watershed. The discharge flows associated with minor individual NPDES permits and general NPDES permits are typically less than 1 million gallons per day (MGD). General

NPDES permits often regulate episodic discharges (e.g. dewatering operations) rather than continuous flows.

4.1.2.1 Minor Individual NPDES Permits

There are 2 minor individual dischargers to Los Cerritos Channel: Paramount Petroleum Corporation and BP West Coast Products LLC, Hathaway Terminal Tank Farm. Paramount Petroleum Corporation's permitted discharge flow is a maximum of 400,000 gallons per day of treated storm water; however recent discharge data (2008) shows 20 gallons per day. Paramount Petroleum Corporation's permit effluent limitations for copper and zinc exceed the numeric targets shown in Table 3-3. BP West Coast Products' permitted discharge flow is a maximum of 50,000 gallons per day of treated storm water; however recent discharge data (2004-2009) shows 30,000 gallons per day on average. Both facilities are permitted for intermittent discharges, and discharges during dry weather are not permitted.

4.1.2.2 General NPDES Permits

Pursuant to 40 CFR parts 122 and 123, the State Board and the Regional Boards have the authority to issue general NPDES permits to regulate a category of point sources if the sources: involve the same or substantially similar types of operations; discharge the same type of waste; require the same type of effluent limitations; and require similar monitoring. The Regional Board has issued general NPDES permits for six categories of discharges: construction and project dewatering; petroleum fuel cleanup sites; volatile organic compounds (VOCs) cleanup sites; potable water; non-process wastewater; and hydrostatic test water. There are 7 facilities with General NPDES permits in the Los Cerritos Channel Freshwater Watershed. Five of the six categories apply to one or more of these facilities (there are no VOC cleanup sites in the Watershed).

The general NPDES permit for Discharges of Groundwater from Construction and Project Dewatering to Surface Waters (Order No. R4-2008-0032) covers wastewater discharges, including but not limited to, treated or untreated groundwater generated from permanent or temporary dewatering operations. Currently, there are 2 dischargers enrolled under this Order in the Los Cerritos Channel Freshwater Watershed (Note: Order No. R4-2008-0032, effective on July 5, 2008, has replaced Order R4-2003-0111 which is referenced in the two permits). The applicable effluent limitations for copper and zinc exceed the numeric targets shown in Table 3-3.

The general NPDES permit for Treated Groundwater and Other Wastewaters from Investigation and/or Cleanup of Petroleum Fuel-Contaminated Sites to Surface Waters (Order No. R4-2002-0125) covers discharges, including but not limited to, treated groundwater and other wastewaters from the investigation, dewatering, or cleanup of petroleum contamination arising from current and former leaking underground storage tanks or similar petroleum contamination. Currently, there is 1 discharger enrolled under this Order in the Los Cerritos Channel Freshwater Watershed. There are no numeric effluent limitations for copper, lead, or zinc in the permit or Order No. R4-2002-0125. However, to enroll for this permit, dischargers must demonstrate that treated groundwater does not exceed the CTR-based water quality criteria for metals. Once enrolled under the permit, dischargers must continue to demonstrate compliance with CTR-based effluent limitations for lead.

The general NPDES permit for Discharges of Groundwater from Potable Water Supply Wells to Surface Waters (Order No. R4-2003-0108) covers discharges of groundwater from potable supply wells generated during well purging, well rehabilitation and redevelopment, and well drilling, construction and development. Currently, there are 2 dischargers enrolled under this Order in the Los Cerritos Channel Freshwater Watershed. The applicable numeric effluent limitations for these facilities can be found in Order No. R4-2003-0108. The effluent limitations for copper and lead in the Order exceed the numeric targets in Table 3-3. The Order does not contain a numeric effluent limitation for zinc.

The general NPDES permit for Discharges of Nonprocess Wastewater to Surface Waters (Order No. R4-2004-0058) covers waste discharges, including but not limited to, noncontact cooling water, boiler blowdown, air conditioning condensate, water treatment plant filter backwash, filter backwash, swimming pool drainage, and/or groundwater seepage. Currently, there is 1 discharger enrolled under this Order in the Los Cerritos Channel Freshwater Watershed. The permit effluent limitations for copper and zinc exceed the numeric targets shown in Table 3-3.

The general NPDES permit for Discharges of Low Threat Hydrostatic Test Water to Surface Waters (Order No. R4-2004-0109) covers waste discharges from hydrostatic testing of pipes, tanks, and storage vessels using domestic/potable water. Currently, there is 1 discharger enrolled under this Order in the Los Cerritos Channel Freshwater Watershed. There are no numeric effluent limitations for copper, lead, or zinc in the permit or in Order No. R4-2004-0109. However, potential for exceeding the numeric targets is low since the discharge is domestic or potable water.

4.1.3 Summary of Point Sources

The total loading of metals reflects the sum of inputs from urban runoff and multiple NPDES permits within the Los Cerritos Channel Freshwater Watershed (Table 4-2). In the Watershed, stormwater discharges are regulated under the two MS4 permits, the Caltrans permit, the general industrial stormwater permit and the general construction stormwater permit. There is 1 minor NPDES permit with the potential to contribute loadings to the system. There are also 7 facilities with non-stormwater general permits that have low individual potential to contribute significant loadings to the system but may in the aggregate contribute significantly.

Table 4-2. Summary of permits in Los Cerritos Channel Freshwater Watershed.

Type of NPDES Permit	Number of Permits	Permitted Volume (gpd)	Screening for pollutants?	Permit Limits for metals?	Potential for significant contribution?
Municipal Stormwater	2	NA	Yes	No	High
Caltrans Stormwater	1	NA	Yes	No	High
General Construction Stormwater	23	NA	Yes	No	High
General Industrial Stormwater	33	NA	Yes	No	High
Individ. NPDES permit (CA0056065)	1	400,000	Yes	Yes	Medium
Individ. NPDES permit (CA0058343)	1	50,000	Yes	No	Low
Other General Permits					
Construction and Project Dewatering	2	NA	Yes	Yes	Low
Petroleum Fuel Cleanup Sites	1	NA	Yes	No	Low
Potable Water	2	NA	Yes	Yes (Cu, Pb)	Low
Non-Process Wastewater	1	NA	Yes	Yes	Low
Hydrostatic Test Water	1	NA	Yes	No	Low

4.2 QUANTIFYING POINT SOURCE RUNOFF

Urban stormwater has been recognized as a substantial source of metals (Characklis and Wiesner 1997, Davis et al. 2001, Buffleben et al. 2002). The most prevalent metals in urban stormwater (copper, lead, and zinc) are consistently associated with the suspended solids portion of sediment loads (Sansalone and Buchberger 1997, Davis et al. 2001). These metals are typically associated with fine particles in stormwater runoff (Characklis and Wiesner 1997, Liebens 2001). Metals loadings are attributable to ongoing activities in the Watershed. This is reflected in routine stormwater monitoring performed by the City of Long Beach under its MS4 permit.

4.2.1 Dry-Weather Loading

Dry-weather urban runoff is a significant source of copper loading in the Los Cerritos Channel Freshwater Watershed. During dry weather, the metals concentrations are predominantly in the dissolved phase and may be more bioavailable (SCCWRP, 2004). Dry-weather watershed flows in the Los Cerritos Channel are dominated by groundwater inflow and discharges to the stormwater conveyance system from illicit connections, excess irrigation, and other residential and commercial practices (McPherson et al., 2005; Stein and Ackerman, 2007).

Dry-weather monitoring data for the Los Cerritos Channel were analyzed to estimate existing dry weather metals loading in the freshwater portion of the watershed. Specifically, dissolved metals, total recoverable metals, and instantaneous flow collected at the Stearns site for 21 dry-weather events were used to calculate flow-weighted average concentrations for total and dissolved copper. (See Appendix D.) The flow-weighted mean concentrations are 12.54 µg/L (dissolved) and 17.74 ug/L (total). These values translate into existing dry-weather copper loads of 0.159 lbs/day (dissolved) and 0.225 lbs/day (total).

4.2.2 Wet-Weather Loading

Wet-weather sources of metals are generally associated with the accumulation and wash-off of metals on the land surface during rain events. Metals washed off the land surface are delivered to the river through creeks and stormwater collection systems. Wet-weather loading varies depending on the amount of rainfall and size of storms in a given year.

Wet-weather loads were estimated by using a model (USEPA's Loading Simulation Program C++) which is discussed in detail in Section 5.2 and Appendix E. For modeling purposes, the Los Cerritos Channel Freshwater Watershed was divided into 10 sub-basins based on sewersheds, monitoring locations, and field reconnaissance by the City of Downey (personal communication, G. Greene, City of Downey to K. Graves, USEPA Region 9, October 26, 2009). Land use in each sub-basin was categorized by the number of acres that are commercial, high density residential, industrial, etc. The urban land uses were then divided into separate pervious and impervious land units. (Appendix E, Table 1 and Figure 3.) Precipitation data from the Long Beach weather station was input into the model to estimate wet-weather flows. The model generates pollutant load estimates based on applying assumptions of sediment and metals loadings from different land uses in several modeling modules. The modeling modules include SEDMNT (simulates removal of sediment from pervious land; SOLIDS (simulates removal of sediment/solids from impervious land); SEDTRN (simulates transport, deposition, and scour of sediment in stream channels), and a water quality module to represent the metals' association with sediment.

The model's accuracy was compared to City of Long Beach flow data and observed concentrations of total recoverable metals during wet-weather events. (Appendix E, Figures 9, 11, and 13 illustrate the copper, lead, and zinc results, respectively.) The model captured the magnitude of observed data reasonably well with results within acceptable modeling ranges. Summary statistics were also calculated comparing mean metals concentrations and loads for the monitored wet-weather events to modeled predictions of concentrations and loads for these events. (Appendix E, Tables 5 and 6.) While some variation was observed, the model predicted observed flow, sediment, copper, lead, and zinc within acceptable modeling ranges. Table 4-3 shows modeled annual wet-weather loadings of copper, lead, and zinc compared to observed loadings.

Table 4-3. Typical annual wet-weather loading (lb/day) to Los Cerritos Channel.

Metal	Observed Mean	Modeled Mean	Observed Median	Modeled Median
Total Copper	72	65	51	29
Total Lead	78	49	43	21
Total Zinc	705	528	469	248

Table 4-4 shows modeled annual average loading rates by overall land use in the Watershed for copper, lead, and zinc. The high density residential land use has the highest loadings for lead, while the industrial land use has the highest loading for copper and zinc.

Table 4-4. Average annual modeled loading rates by land use.

Land Cover Category	Copper (lb/ac/yr)	Lead (lb/ac/yr)	Zinc (lb/ac/yr)
Agriculture	3.170E	5.283E-09	1.321E-07
Commercial	7.094E	7.094E-02	7.236E-01
High Density Residential	7.970E	1.063E-01	9.963E-01
Industrial	8.182E	4.091E-02	1.091E+00
Low Density Residential	4.250E	2.834E-02	1.700E-01
Mixed Urban	4.081E	1.275E-02	2.551E-01
Open	8.031E	5.354E-08	1.338E-06

4.3 NONPOINT SOURCES

A nonpoint source is a source that discharges via sheet flow or natural discharges. Nonpoint source loadings represent a diffuse form of water pollution from various natural and anthropogenic sources that accumulate in a watershed and are most often transported to the waterbody via runoff from rainfall. Examples of nonpoint sources include agricultural practices, atmospheric deposition, weathering and erosion of susceptible materials (including mine tailings and waste rock), animal wastes, and, street and urban debris.

Atmospheric deposition is a potential nonpoint source of metals to the Los Cerritos Channel Freshwater Watershed. Sabin et al. (2004) estimated the mass of dry atmospheric deposition for the Los Angeles River Watershed. For the purpose of this source assessment, the numbers for the Los Angeles River Watershed were extrapolated to the Los Cerritos Channel Freshwater Watershed based on the relative area of each watershed and the relative amount of surface water in each watershed (Table 4-5).

Direct atmospheric deposition is the amount of airborne metals deposited directly onto the surface of a water body. Direct atmospheric deposition during dry weather was quantified by multiplying the surface area of the Los Cerritos Channel (freshwater portion) times the rate of atmospheric deposition recommended by Sabin et al. These numbers are generally small because the portion of Los Cerritos Channel Freshwater Watershed that is covered by water is small, approximately 19 acres or 0.11% of the watershed. (Appendix E, Table 1.) Therefore, direct deposition of metals is insignificant relative to the annual dry-weather loading or the total annual loading. Small load allocations are established for direct air deposition in the dry and wet weather TMDLs (see Section 6).

Indirect atmospheric deposition is the amount of airborne metals deposited on land surface that may be washed into a water body during storm events. The amount of deposited metals available for transport to Los Cerritos Channel (i.e., not infiltrated) is unknown. In a separate study, Sabin et. al. found that for a small impervious catchment, atmospheric deposition could potentially account for 57-100% of the metals in storm runoff generated in the study area (Sabin et. al., 2005). This study assumes that all the metals deposited on the catchment were available for removal. However, in large, varied watersheds, not all metals deposited on the land surface may be available for removal by runoff. In any case, the loadings of metals associated with indirect atmospheric deposition are accounted for in the estimates of stormwater loading to Los Cerritos Channel. Once metals are deposited on land under the jurisdiction of a stormwater permittee, they are within a permittee's control.

Table 4-5. Estimate of direct and indirect atmospheric deposition (kg/year).

Los Angeles River Watershed	**Area (square miles)**	**% Water**	**Copper (kg/year)**	**Lead (kg/year)**	**Zinc (kg/year)**
	834	0.21%			
Indirect Deposition			16,000	12,000	80,000
Direct Deposition			3	2	10
Los Cerritos Channel Freshwater Watershed	27.7	0.11%			
Indirect Deposition			531	398	2,655
Direct Deposition			0.05	0.03	0.17

Natural background, e.g., national forest, loading of metals is another potential source. The Los Cerritos Channel Freshwater Watershed does not contain state or national parkland, therefore, no load allocations for natural background are necessary. Open space areas, e.g., golf courses or small neighborhood parks, disturbed by human activity are not considered natural background. Discharges from open space areas drain to the storm drain system before reaching the Channel, and thus are addressed in the WLAs for MS4 permittees.

5 LINKAGE ANALYSIS

Information on sources of pollutants provides one part of the TMDL equation. To determine the effects of these sources on water quality, it is also necessary to determine the assimilative capacity of the receiving water. The delivery of metals to Los Cerritos Channel and the assimilative capacity of the Channel to accommodate these loadings can be strongly affected by variations between dry and wet weather.

5.1 DRY-WEATHER ANALYSIS

Metals loadings during dry weather were estimated by calculating flow-weighted average concentrations for total and dissolved copper, lead, and zinc from City of Long Beach monitoring data. No model simulation was performed due to limited data availability. Analysis of empirical data is determined sufficient in developing a TMDL for copper during dry weather for the Los Cerritos Channel Freshwater Watershed.

5.2 WET-WEATHER MODELING ANALYSIS

To assess the link between sources of sediment, metals, and the impaired waters, a modeling system was utilized that simulates land-use based sources of sediment and associated metals loads and the hydrologic and hydraulic processes that affect delivery.

USEPA's Loading Simulation Program C++ (LSPC) (Shen et al., 2004; USEPA, 2003) was used to represent the hydrologic and water quality conditions in the Los Cerritos Channel watershed. LSPC is a component of USEPA's TMDL Modeling Toolbox (USEPA, 2003b), which has been developed through a joint effort between USEPA and Tetra Tech, Inc. It integrates a comprehensive data storage and management capability, a dynamic watershed model (a re-coded version of USEPA's Hydrological Simulation Program – FORTRAN [HSPF] [Bicknell et al., 2001]), and a data analysis/post-processing system into a convenient PC-based windows interface that dictates no software requirements.

LSPC is capable of representing loading and both flow and water quality from non-point and point sources as well as simulating in-stream processes. LSPC can simulate flow, sediment, metals, nutrients, pesticides, and other conventional pollutants for pervious and impervious lands and waterbodies. The model has been successfully applied and calibrated in Southern California for the Los Angeles River (LAR), the San Gabriel River (SGR), Dominguez Creek (DC) (original model by SCCWRP), the near-shore watersheds draining to Los Angeles/Long Beach Harbor (LA/LB Harbor), the San Jacinto River, and multiple watersheds draining to impaired beaches of the San Diego Region. For Los Cerritos Channel, LSPC was used to simulate metals (copper, lead, and zinc) for determining loads.

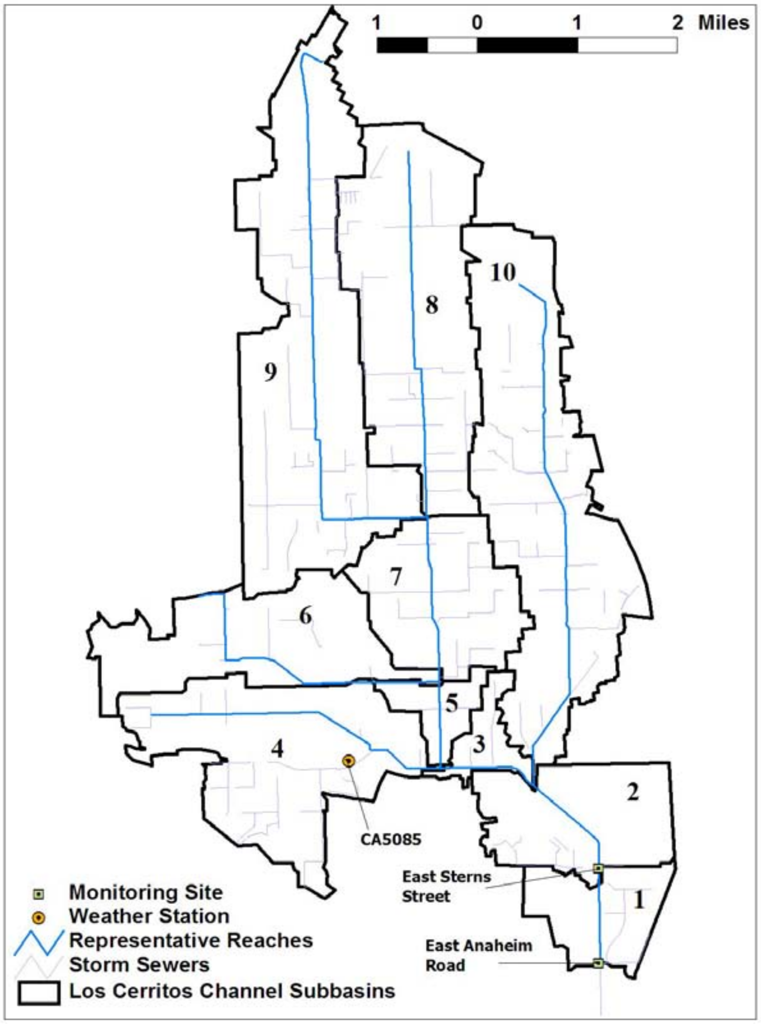
Previous wet-weather watershed modeling and TMDL efforts by Tetra Tech and SCCWRP have led to the development of a regional watershed modeling approach to simulate hydrology, sediment, and metals transport in the Los Angeles Region. The regional modeling approach assumes that metals loadings can be dynamically simulated based on hydrology and sediment transported from land uses in a watershed. Development of the approach resulted from application and testing of models for multiple small-scale land use sites and larger watersheds in the Los Angeles Region. SCCWRP developed watershed models, based on HSPF (Bicknell et al., 2001), of multiple homogeneous land use sites in the region. Sufficient stormflow and water quality data were available at these locations to facilitate calibration of land-use-specific HSPF modeling parameters. These parameters were validated in an additional HSPF model of Ballona Creek (Ackerman et al., 2005; SCCWRP, 2004), and similar models of LAR (Tetra Tech, Inc., 2004), SGR (Tetra Tech, Inc, 2005), and LA/LB Harbor (Tetra Tech, Inc, 2006) using LSPC. These models were used to calculate TMDLs for each of these waterbodies (LARWQCB, 2005a, 2005c, 2006; draft LA/LB Harbor TMDLs currently under development).

In general, the methods used for previous modeling studies of LAR, SGR, DC, and LA/LB Harbor were applied for freshwater portion of the Los Cerritos Channel watershed. The differences between the regional approach and the Los Cerritos Channel model include: modifications to the land use groupings based on stakeholder comments, changes to the designation of percent impervious, and the use of revised copper potency factors (these three changes are described in detail in Appendix E). The watershed model represented the variability of wet-weather runoff source contributions through dynamic representation of hydrology and land practices. It included all point and non-point source contributions. Key components of the watershed modeling include:

- Watershed segmentation
- Meteorological data
- Land use representation
- Soils
- Reach characteristics
- Point source discharges
- Hydrology representation
- Pollutant representation
- Flow data

These components provided the basis for the model's ability to estimate flow and pollutant loading. The model was configured for ten sub-basins of the Los Cerritos Channel Freshwater Watershed as shown in Figure 5. (Appendix E, Figure 15.)

Figure 5. Model sub-basins and monitoring stations

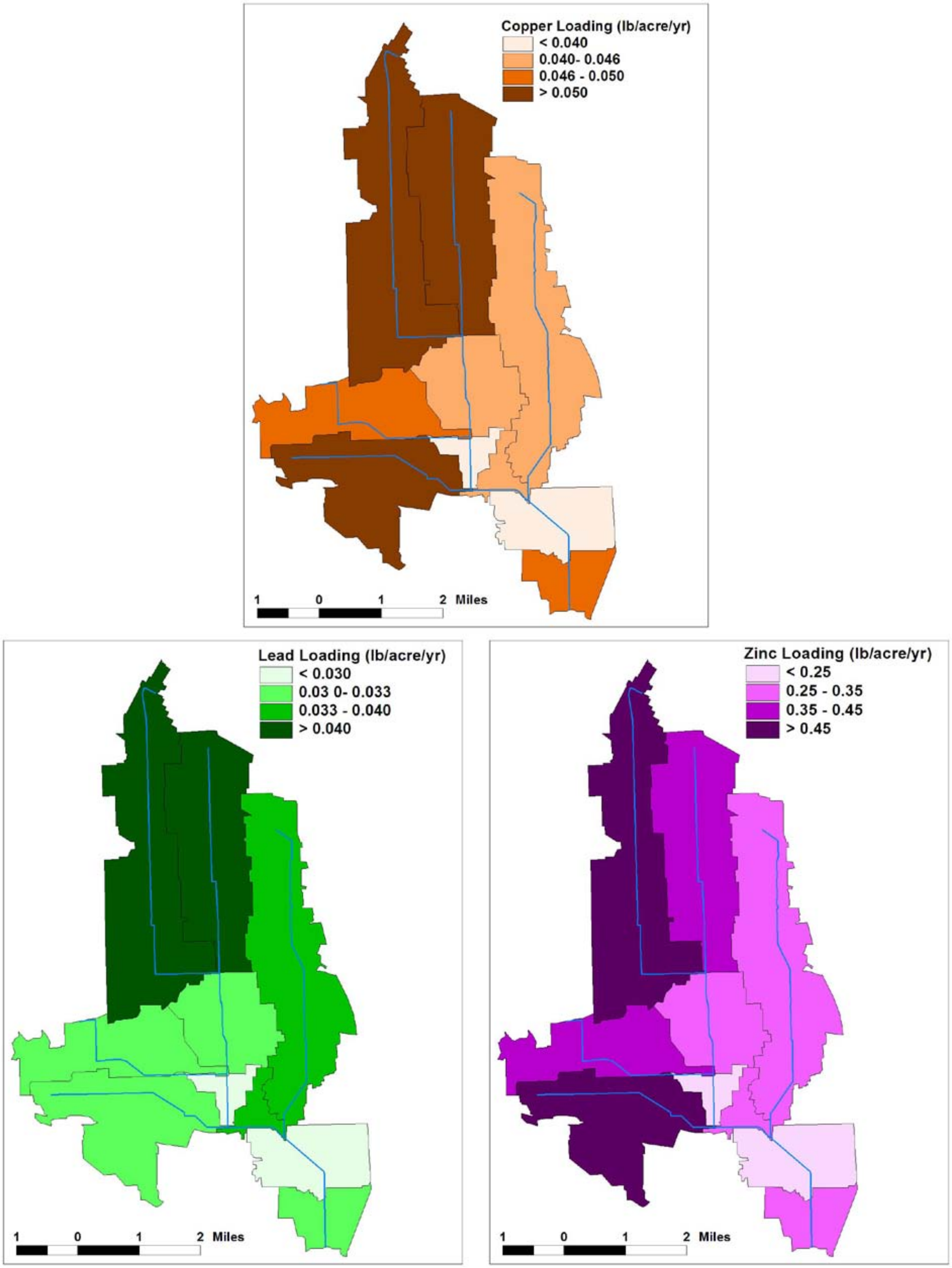


Loading processes for metals (copper, lead, and zinc) for each land use were represented through their associations with sediment. The accumulation and washoff of sediments were modeled using the SEDMNT module for pervious lands and the SOLIDS module for impervious lands. Sediments washed off by rain are delivered to the stream channel by overland flow. Processes such as transport, deposition and scour of sediments in the stream channels were modeled using the SEDTRN module. These processes depend on sediment characteristics such as particle size distribution (which define settling velocities and the critical shear stresses for deposition and re-suspension), and the bottom shear stress predicted by the model.

The model was then used to simulate the in-stream TSS concentrations. The relationships between sediment and total recoverable metals (copper, lead and zinc) were parameterized in the water quality module as potency factors developed by SCCWRP. Potency factors were defined from the regional modeling approach for copper, lead and zinc for each of seven land-uses categories (agriculture, commercial, high-density residential, industrial, low-density residential, mixed urban and open) (Ackerman et al., 2005). Copper potency factors were subsequently updated by SCCWRP (Ackerman and Weisberg, 2006) and these updated values were used in the Los Cerritos Channel model. After the model was configured, model validation was performed. This is generally a two-phase process, with hydrology calibration and validation completed before repeating the process for water quality. Model calibration was not performed since the hydrologic, sediment, and water quality parameters from the LA/LB Harbor model were applied to the Los Cerritos Channel model without further calibration. The Los Cerritos Channel model was used to further validate the previously calibrated parameters. Model validation essentially confirmed the applicability of the watershed-based parameters derived during the calibration process. However, it is important to note that there are a few differences between the regional approach and the Los Cerritos Channel model: modifications to the land use groupings based on stakeholder comments, changes to the designation of percent impervious, and the use of revised copper potency factors. A detailed description of the wet-weather watershed model developed for the Los Cerritos Channel Freshwater Watershed, including these modifications, is contained in Appendix E.

The results of the model were used to estimate copper, lead, and zinc loading rates by sub-basin in pounds per acre per year, as shown in Figure 6. (Appendix E, Figure 15.) The northernmost sub-basin (sub-basin #9 in Figure 5) has highest loading rates for copper (and is second-highest for lead and zinc). This sub-basin is primarily low density residential, commercial, high density residential, and industrial land use (presented as highest to lowest acreage). The north-central sub-basin has the highest loading rate for lead (and second-highest for copper) (sub-basin #8 in Figure 5). In this sub-basin, land use is primarily low density residential with some commercial and high density residential. The southwestern-most sub-basin, which is mostly industrial and mixed urban, has the highest loading rate for zinc (sub-basin #4 in Figure 5).

Figure 6. Estimated metals loadings by sub-basin



6 TOTAL MAXIMUM DAILY LOADS

In this section, we develop the loading capacity, pollutant allocations and margin of safety for metals in the freshwater portion of Los Cerritos Channel. USEPA regulations require that a TMDL include waste load allocations (WLAs), which identify the portion of the loading capacity allocated to existing or future point sources (40 CFR 130.2(h)) and load allocations (LAs), which identify the portion of the loading capacity allocated to nonpoint sources (40 CFR 130.2(g)) along with a margin of safety.

As discussed in previous sections, the sources of metals and the relative magnitude of the inputs vary between dry-weather and wet-weather periods. In these TMDLs, concentration-based and mass-based waste load allocations were developed for dry-weather urban runoff and mass-based waste load allocations for stormwater runoff. Concentration-based waste load allocations are developed for all other NPDES permitted discharges based on dry- and wet-weather conditions.

6.1 DRY-WEATHER LOADING CAPACITY AND TMDL FOR COPPER

Los Cerritos Channel is listed as an impaired waterbody due to metals. Based on an assessment of recent water quality data, we have determined that a dry-weather TMDL is needed for copper. The dry-weather copper loading capacity is used to establish a dry-weather TMDL.

The dry-weather copper loading capacity was derived by multiplying the hardness-adjusted dry-weather numeric target expressed as total recoverable (Table 3-1) by the critical dry-weather flow assigned to Los Cerritos Channel. The loading capacity is presented as total recoverable copper for quantification of total recoverable copper loads.

Dry-weather flow is estimated by averaging instantaneous dry-weather flows monitored by the City of Long Beach on 19 days between 2001 and 2009 (see Table 2 in Appendix D). The resulting average dry-weather flow is 2.35 cfs. This flow was used to define the critical dry-weather flow for Los Cerritos Channel. (Note: while the City of Long Beach has daily flow data records beginning in 2001, the gage at the Los Cerritos Channel monitoring site can only record flows greater than approximately 18.8 cfs. This data, therefore, does not represent low flow conditions.)

The copper dry-weather loading capacity (TMDL) for Los Cerritos Channel is 19.1 µg/L X 2.35 cfs X 0.00539 (conversion factor) = 0.242 lbs/day, which is **109.7 grams/day**, expressed as total recoverable metals.

6.2 DRY-WEATHER ALLOCATIONS

Allocations are assigned to point and nonpoint sources throughout the watershed in order to meet the copper TMDL. The following TMDL equation applies:

$$TMDL = WLA_{\text{Stormwater permittees}} + WLA_{\textbf{Other permittees}} + LA_{\text{Direct Atmospheric Deposition}} + LA_{\text{Open Space}}$$

Mass-based allocations are assigned to all of these sources except for minor NPDES permittees and general non-stormwater NPDES permittees that discharge to Los Cerritos Channel.

Concentration-based waste load allocations are applied as these point sources have intermittent flows and calculation of mass-based waste load allocations is not possible. These "other permittees" will have a minor impact on metals loadings if they are limited by concentration to the applicable CTR-based waste load allocations.

"Open Space" refers to opens space that discharges directly to Los Cerritos Channel and not through the storm drain system. In the Los Cerritos Channel Freshwater Watershed, there is no allocation for open space because the limited open space in this watershed drains to the storm drain system before reaching the Channel and is included in stormwater WLAs. Therefore, the equation for calculating mass-based dry loads becomes:

$$\text{TMDL} = \text{WLA}_{\text{Stormwater permittees}} + \text{LA}_{\text{Direct Atmospheric Deposition}}$$

Mass-based load allocations are developed for direct atmospheric deposition and stormwater permittees (Los Angeles County MS4, City of Long Beach MS4, Caltrans, General Industrial and General Construction).

6.2.1 Dry-Weather Load Allocations for Direct Atmospheric Deposition

Dry-weather load allocations for direct atmospheric deposition are based on the calculations by Sabin et al. and allocated to Los Cerritos Channel based on the percentage of the Los Cerritos Channel Freshwater Watershed covered by water. As shown in Table 4-5, direct deposition of copper expressed as total recoverable metals is estimated to be 0.05 kg/year, or **0.14 grams/day**.

6.2.2 Dry-Weather Waste Load Allocation for Stormwater Permits

A dry-weather mass-based waste load allocation for copper is developed for the stormwater permittees according to the following equation:

$$\text{TMDL} - \text{LA}_{\text{Direct Atmospheric Deposition}} = \text{WLA}_{\text{Stormwater permittees}}$$

$$109.7 \text{ grams/day} - 0.14 \text{ grams/day} = \mathbf{109.58\ grams/day}$$

For accounting purposes, it is assumed that Caltrans and the general stormwater permittees discharge entirely to the MS4 system. A zero waste load allocation is assigned to all general industrial and construction stormwater permits during dry weather. Order Nos. 97-03 DWQ and 99-08 DWQ already prohibit non-stormwater discharges with few exceptions as discussed in Section 4.1.1.3. Therefore, the entire dry-weather waste load allocation for stormwater permittees of 109.58 grams/day, expressed as total recoverable metals, is shared by the two MS4 permittees (Los Angeles County and City of Long Beach) and Caltrans.

USEPA regulation allows allocations for NPDES-regulated municipal stormwater discharges from multiple point sources to be expressed as a single categorical waste load allocation when data and information are insufficient to assign each source or outfall an individual allocation. We recognize that these municipal stormwater allocations may be rudimentary because of data limitations and variability in the system. The combined stormwater waste load allocation is partitioned among the Los Angeles County MS4 permittee (9,470 acres), City of Long Beach MS4 permittee (5,840 acres) and Caltrans (140 acres) based on an estimate of the percentage of land area covered under each permit (Table 6-6). Based on these areas, the waste load allocations for Caltrans and the MS4 permittees are presented in Table 6-1.

Table 6-1. Dry-weather mass-based waste load allocations for Caltrans and MS4 permittees expressed as total recoverable metals (grams/day).

Pollutant	Caltrans	Los Angeles County MS4 Permittee	City of Long Beach MS4 Permittee
Copper	1.0	67.2	41.4

6.2.3 Dry-Weather Waste Load Allocation for other NPDES Permits

Concentration-based waste load allocations are established for the minor NPDES permits and general non-stormwater NPDES permits that discharge to Los Cerritos Channel to ensure that these do not contribute to exceedances of the CTR limits. The concentration-based waste load allocations are equal to the 19.1 µg/L dry-weather numeric target for copper expressed as total recoverable metals as provided in Table 3-1.

Monitoring requirements will be placed on these discharges as appropriate in their respective NPDES permits. Any future minor NPDES permits or enrollees under a general non-stormwater NPDES permit will also be subject to the concentration-based waste load allocations.

6.3 WET-WEATHER LOADING CAPACITY (LOAD-DURATION CURVES) AND TMDLS FOR COPPER, LEAD AND ZINC

Based on an assessment of recent water quality data, we have determined that wet-weather TMDLs are needed for copper, lead and zinc.

During wet weather, the allowable load is a function of the volume of water in the Channel. Given the variability in wet-weather flows, the concept of a single critical flow is not justified. Instead, a load duration curve approach is used to establish the wet-weather loading capacity. In brief, a load duration curve is developed by multiplying the wet-weather flows by the in-stream numeric target. The result is a curve, which identifies the allowable load for a given flow. The wet-weather TMDLs for copper and zinc are defined by these load-duration curves. The lead TMDL is defined by the average existing load, which is lower than the allowable load.

TMDL (g/day) = loading capacity = daily storm volume (liters) X numeric target (µg/L) / 1,000,000

The LSPC model was used to simulate flows and metals concentrations in Los Cerritos Channel from 2000-2007, providing daily flow volume and estimates of existing metals loads. By including all storm flows over the 2000-2007 period, analysis of critical conditions was included. Loading capacities were calculated by multiplying the daily storm volume by the appropriate numeric water quality target or observed average concentration representing existing conditions, whichever is lower (Table 6-2). The wet-weather loading capacity applies to any day when the maximum daily flow measured at a location within the Los Cerritos Channel above the tidal prism (see Stearns Street Monitoring Station, Figure 1) is equal to or greater than 23 cfs, which is the estimated 90th percentile flow.

Identification of each metal-specific TMDL is based on a comparison of the existing loads with the loading capacity. For lead, where existing loads (based on the observed average concentration of 55.8 µg/L), are less than the loading capacity (based on the translated CTR total lead concentration of 213.2 µg/L), the TMDL and allocations are set at the existing load level (See Table 6-2 and Figure 8). USEPA is defining the lead TMDL and allocations based on the existing loads in Los Cerritos Channel in order to ensure that freshwater quality for this pollutant does not degrade below current levels, and to ensure that lead levels in downstream sediments do not increase in the future.

Table 6-2. Wet-weather load capacity (TMDLs) for metals expressed in terms of total recoverable metals.

Metal[1]	Load Capacity
Copper	Daily storm volume x 9.8 µg/L
Lead	Daily storm volume x 55.8 µg/L
Zinc	Daily storm volume x 95.6 µg/L

[1] Copper and zinc load capacities are based on the total wet weather numeric targets presented in Table 3-3. The lead load capacity is based on the observed average total concentration representing existing conditions.

These TMDLs are based on total recoverable metals concentrations. Copper and zinc targets expressed as dissolved metals concentrations were converted to total recoverable metals concentrations using site-specific translators shown in Table 3-3. While a numeric target for lead is presented in Table 3-3, the lead concentration used to calculate the loading capacity is based on the observed average total concentration (see Table 6-2), which represents existing conditions.

Based on modeling of the average annual loading capacity for each metal during wet weather (Appendix E), Table 6-3 compares the annual existing load to the allowable load using the numeric targets. (Source: Tetra Tech spreadsheet, February 5, 2010).

Table 6-3. Average annual loads and percent reduction required.

Metal	Allowable load (kg)	Existing load (kg)	Percent reduction required
Copper[1]	68	266	74.7%
Lead	1,489	212	0.0%
Zinc[1]	669	2,127	69.2%

[1] The numeric targets presented in Table 3-3 (based on CTR) were used to determine percent reductions in the watershed model.

Figures 7, 8, and 9 show the wet-weather load-duration curves for each metal, along with the 2000-2007 modeled existing load. For practical purposes of comparing stormwater data to the TMDLs, the wet-weather load for a day is calculated based on the stormwater event mean concentration (EMC) from a flow-weighted composite:

$$\text{Wet-weather load (g/day)} = \text{daily storm volume (liters)} \times \text{EMC } (\mu g/L) / 1{,}000{,}000$$

These figures illustrate the load capacity, wasteload allocations (i.e., allowable load; blue bars below the load capacity curve), and required reductions (red bars above the load capacity curve).

Model results indicated that no lead reductions are required using the translated CTR-based numeric target (Figure 8). As previously noted, to ensure that freshwater quality for this pollutant does not degrade below current levels, and to ensure that lead levels in downstream sediments do not increase in the future, the average observed concentration for total lead, representing existing conditions, was used for TMDL calculation (represented by an orange line in Figure 8). Given this is an average condition; some daily loads are expected to be above this load, while others will fall below (see Section 8.2 for a discussion of meeting wet-weather waste load allocations).

Figure 7. Modeled copper load and load capacity by daily storm volume

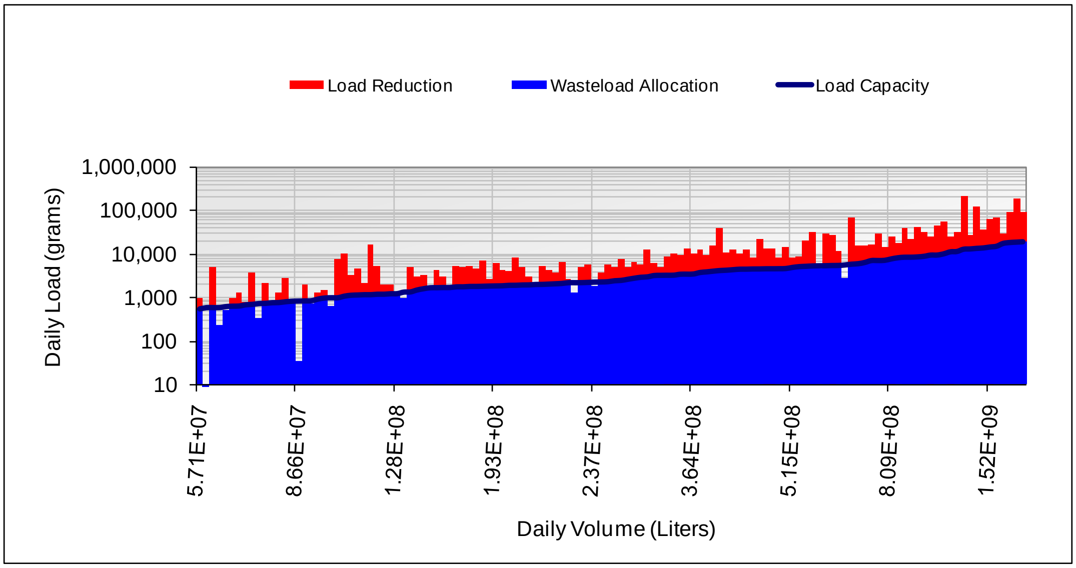
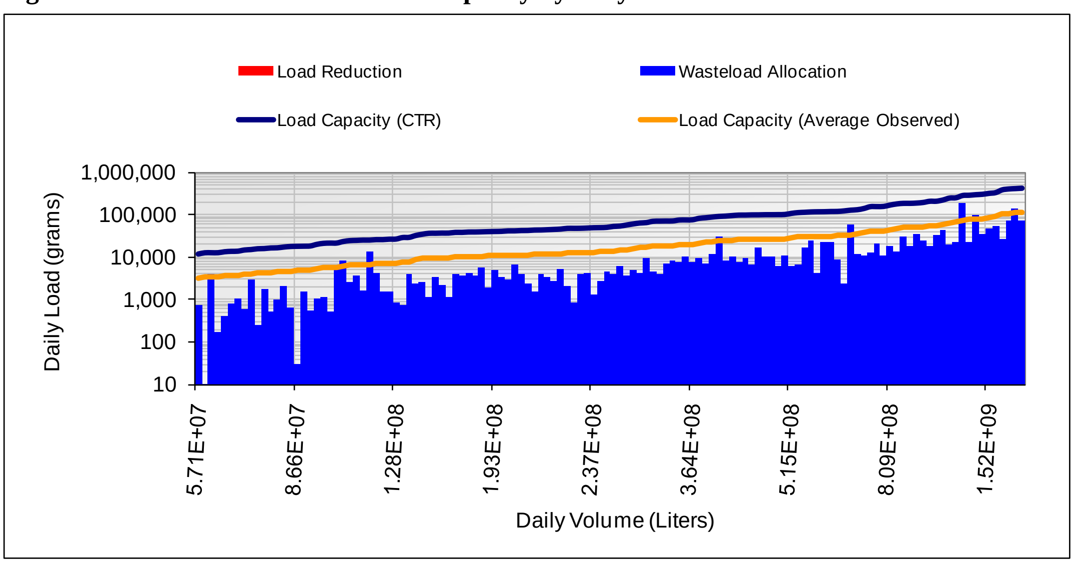
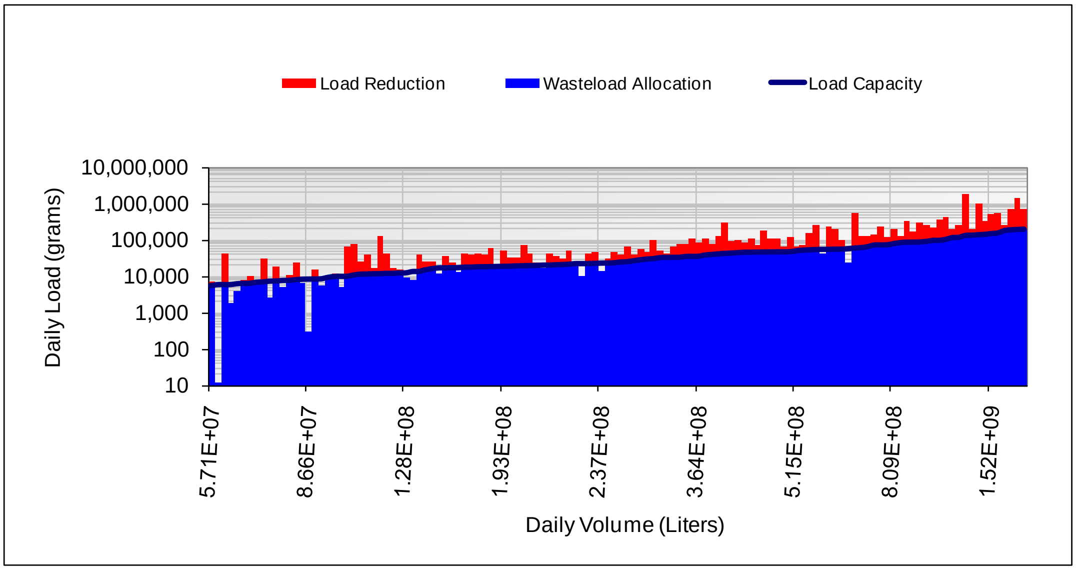


Figure 8. Modeled lead load and load capacity by daily storm volume



Note: The blue loading capacity line was based on the total recoverable lead concentration calculated from the dissolved CTR water quality criteria using a site-specific translator. The orange loading capacity line was calculated using the average observed total lead concentration, which represents existing conditions, and was used for TMDL calculations and allocations.

Figure 9. Modeled zinc load and load capacity by daily storm volume



6.4 WET-WEATHER ALLOCATIONS

Wet-weather allocations are assigned in the same manner as the dry-weather allocations, but also include a 10% explicit margin of safety. The wet-weather allocations are based on flows measured at the Stearns Street sampling site operated by the City of Long Beach.

6.4.1 Wet-Weather Load Allocations

An estimate of direct atmospheric deposition is developed based on the percent area of surface water in the watershed. Approximately 0.11% of the watershed area draining to the freshwater portion of Los Cerritos Channel is comprised of water.

The load allocation for atmospheric deposition is calculated by multiplying this percentage by the total loading capacity, according to the following equation:

$$LA_{\text{Direct Atmospheric Deposition}} = 0.0011 \text{ x TMDL}$$

The wet-weather TMDLs are shown in Table 6-2. The loadings associated with indirect deposition are included in the wet-weather stormwater waste load mass-based allocations (See Table 6-4).

6.4.2 Wet-Weather Waste Load Allocation for Stormwater Permits

Wet-weather waste load allocations for the stormwater permittees are calculated in the same manner as the dry-weather allocation. Since the direct atmospheric deposition is calculated as a percentage of the TMDL, the equation becomes:

$$WLA_{\text{Stormwater permittees}} = \text{TMDL (numeric target x daily storm volume)} - \text{MOS} - LA_{\text{Direct Atmospheric Deposition}}$$

Allocations for direct atmospheric deposition and stormwater permittees are presented in Table 6-4. For example, a daily flow of 40 cfs (daily storm volume = 9.8 x 10^7 liters) results in the allocations presented in Table 6-5.

Table 6-4. Wet-weather mass-based allocations.

Metal	10% Margin of Safety (g/day)	Direct Atmospheric Deposition (g/day)	Combined Stormwater Permittees (g/day)
Copper	0.978 µg/L * daily storm volume (L) * 10^{-6}	0.0097 µg/L * daily storm volume (L) * 10^{-6}	8.796 µg/L * daily storm volume (L) * 10^{-6}
Lead	5.58 µg/L * daily storm volume (L) * 10^{-6}	0.0552 µg/L * daily storm volume (L) * 10^{-6}	50.165 µg/L * daily storm volume (L) * 10^{-6}
Zinc	9.565 µg/L * daily storm volume (L) * 10^{-6}	0.0947 µg/L * daily storm volume (L) * 10^{-6}	85.987 µg/L * daily storm volume (L) * 10^{-6}

L = Liters

Table 6-5. Wet-weather mass-based allocations based on a daily flow equal to 40 cfs.

Metal[1]	Loading Capacity (g/day)	10% Margin of Safety (g/day)	Direct Atmospheric Deposition (g/day)	Combined Stormwater Permittees (g/day)
Copper	958.9	95.9	0.9	862.0
Lead	5,468.4	546.8	5.4	4,916.1
Zinc	9,373.3	937.3	9.3	8,426.7

[1] Copper and zinc load capacities are based on the total wet weather numeric targets presented in Table 3-3. The lead load capacity is based on the observed average total concentration representing existing conditions.

The combined stormwater waste load allocation is partitioned among the five stormwater permittees (City of Long Beach MS4, Los Angeles County MS4, Caltrans, general industrial and general construction) based on an estimate of the percentage of land area covered under each permit (Table 6-6).

Table 6-6. Areal extent of watershed and percent area covered under stormwater permits.

Category	Permit #	Area in acres	Percent area of Watershed
Los Angeles County MS4 Permit	CAS004001	9,470	53.5%
City of Long Beach MS4 Permit	CAS004003	5,840	33.0%
General Industrial Stormwater Permit	CAS000001	1,740	9.8%
General Construction Stormwater Permit	CAS000002	502	2.8%
Caltrans Stormwater Permit	State Board Order No. 99-06-DWQ	140	0.8%
Water	--	19	0.1%
Total	**--**	**17,711**	**100%**

Based on these areas (excluding the Water category), the waste load allocations for each stormwater permittee are presented in Table 6-7.

Table 6-7. Wet-weather combined stormwater allocations apportioned based on percent of watershed.

Metal	General Construction permittees (g/day)	General Industrial permittees (g/day)	Caltrans (g/day)	City of Long Beach MS4 Permittee (g/day)	Los Angeles County MS4 Permittee (g/day)
Copper	0.250 * daily storm volume (L) * 10^{-6}	0.865 * daily storm volume (L) * 10^{-6}	0.070 * daily storm volume (L) * 10^{-6}	2.904 * daily storm volume (L) * 10^{-6}	4.709 * daily storm volume (L) * 10^{-6}
Lead	1.423 * daily storm volume (L) * 10^{-6}	4.933 * daily storm volume (L) * 10^{-6}	0.397 * daily storm volume (L) * 10^{-6}	16.560 * daily storm volume (L) * 10^{-6}	26.852 * daily storm volume (L) * 10^{-6}
Zinc	2.440 * daily storm volume (L) * 10^{-6}	8.455 * daily storm volume (L) * 10^{-6}	0.680 * daily storm volume (L) * 10^{-6}	28.385 * daily storm volume (L) * 10^{-6}	46.027 * daily storm volume (L) * 10^{-6}

For example, a daily flow of 40 cfs (daily storm volume = $9.8x10^7$ liters) results in the stormwater waste load allocations presented in Table 6-8.

Table 6-8. Wet-weather waste load allocations for stormwater based on a daily flow of 40 cfs.

Metal	General Construction permittees (g/day)	General Industrial permittees (g/day)	Caltrans (g/day)	City of Long Beach MS4 Permittee (g/day)	Los Angeles County MS4 Permittee (g/day)
Copper	24.5	84.8	6.8	284.6	461.4
Lead	139.5	483.4	38.9	1,622.8	2,631.5
Zinc	239.1	828.6	66.7	2,781.7	4,510.7

Each stormwater permittee enrolled under the general construction or industrial stormwater permits will receive an individual waste load allocation per acre based on the total acreage of general permits as presented in Table 6-9.

Table 6-9. Wet-weather waste load allocations for enrollees under general construction or industrial stormwater permits (total recoverable metals).

Metal	Individual General Construction or Individual General Industrial Permittee (g/day/ac)
Copper	0.497 * 10^{-3} * daily storm volume (L)
Lead	2.835 * 10^{-3} * daily storm volume (L)
Zinc	4.860 * 10^{-3} * daily storm volume (L)

For example, a daily flow of 40 cfs (daily storm volume = $9.8x10^7$ liters) results in the general construction and industrial stormwater waste load allocations presented in Table 6-10.

Table 6-10. Wet-weather per acre waste load allocations for an individual general construction or industrial stormwater permittee (g/day/acre) based on a daily flow of 40 cfs.

Metal	Individual General Construction or Individual General Industrial Permittee (g/day/ac)
Copper	0.05
Lead	0.28
Zinc	0.48

6.4.3 Wet-Weather Waste Load Allocation for other NPDES Permits

Concentration-based waste load allocations are established for the minor NPDES permittees and general non-stormwater NPDES permittees that discharge to Los Cerritos Channel to ensure that these point sources do not contribute to exceedances of the CTR limits. The concentration-based waste load allocations are equal to the wet-weather numeric targets for copper and zinc or average daily existing concentration for lead expressed as total recoverable metals as provided in Table 6-2. Any future minor NPDES permits or enrollees under a general non-stormwater NPDES permit will also be subject to the concentration-based waste load allocations.

6.5 MARGIN OF SAFETY

The federal statute and regulations require that TMDLs include a margin of safety to account for any lack of knowledge concerning the relationships between effluent limitations and water quality. The required MOS may be provided explicitly by reserving (not allocating) a portion of available pollutant loading capacity and/or implicitly by making environmentally conservative analytical assumptions in the supporting analysis.

The dry weather TMDL includes an implicit margin of safety, while the wet weather TMDLs include both implicit and explicit margins of safety. Specifically, the TMDLs include an implicit margin of safety by evaluating dry-weather and wet-weather conditions separately and assigning allocations based on two disparate critical conditions.

To account for any additional uncertainty in the wet-weather TMDLs, USEPA has included an explicit MOS equal to 10% of the loading capacity or existing load available for wet-weather allocations. The 10% MOS was subtracted from the loading capacity or existing load, which ever is smaller. Applying an explicit margin of safety is reasonable because a number of uncertain estimates are offset by the explicit margin of safety. While the observed dissolved-to-total metals ratios are not similar to CTR default conversion values, we also note there appears to be very poor correlation between the fraction of particulate metals and TSS. There is added uncertainty of stream flow rates during wet weather conditions, when the highest metal loads occur, thus an explicit margin of safety is justified.

6.6 SUMMARY OF TMDLS

The TMDLs are based on pollutant loadings to the water column in Los Cerritos Channel above the tidal prism. For dry weather, the allowable copper load is based on the average dry-weather volume in the Channel. For wet-weather, allowable loads for copper, zinc, and lead are expressed as a function of stormwater volume using load-duration curves. An implicit margin of safety is provided through the use of conservative conversion factors for the translation of total recoverable metals to dissolved metals concentration. In addition, a 10% explicit margin of safety was assigned for the wet weather TMDLs to address any additional uncertainty. A dry-weather mass-based waste load allocation for copper has been developed for Caltrans and for the MS4 permittees. A wet-weather mass-based waste load allocation has been developed for the general industrial and construction stormwater permittees as a group, Caltrans, and the two MS4 permittees. Concentration-based WLAs will also be applied to the other non-stormwater NPDES permittees.

7 IMPLEMENTATION RECOMMENDATIONS

Implementation measures may be developed in the future by the Regional Board through an implementation plan, NPDES permits or non-point source enforcement. This section describes USEPA's recommendations to the Regional Board as to the implementation procedures and regulatory mechanisms that could be used to provide reasonable assurances that water quality standards will be met.

7.1. Nonpoint Sources

Regional Board may regulate nonpoint pollutant sources through the authority contained in sections 13263 and 13269 of the California Water Code, in conformance with the State Water Resources Control Board's Nonpoint Source Implementation and Enforcement Policy, and the Conditional Waiver for Discharges from Irrigated Lands, adopted by the Los Angeles Regional Water Quality Control Board on November 3, 2005.

7.2. Non-stormwater NPDES Permits

NPDES permit limitations will need to be consistent with the concentration-based WLAs established for non-stormwater point sources in these TMDLs. Permit limits will need to meet the water quality targets established in these TMDLs and maintain water quality standards in Los Cerritos Channel. Permit writers can translate waste load allocations into effluent limits by applying the SIP procedures or other applicable engineering practices authorized under federal regulations. For permits subject to both dry- and wet-weather WLAs, USEPA expects that permit writers will write a monthly limit based on the dry-weather WLA and two separate daily maximum limits based on dry- and wet-weather WLAs.

7.3 General Industrial Stormwater Permits

The dry-weather waste load allocation equal to zero applies to unauthorized non-stormwater flows, which are prohibited by statewide General NPDES Permit No. CAS000001. We anticipate that any dry-weather discharges (allowed under special circumstances within the existing permit issued by the LA Regional Board) will be consistent with the assumptions and requirements within these TMDLs.

Wet-weather mass-based waste load allocations for the general industrial stormwater permittees (Table 6-9) will be incorporated into the State Board general permit upon renewal or into a watershed-specific general permit developed by the Regional Board.

7.4 General Construction Stormwater Permits

Waste load allocations for the general construction stormwater permits (Table 6-9) will be incorporated into the State Board general NPDES permit No. CAS000002 upon renewal or into a watershed-specific general permit developed by the Regional Board.

7.5 MS4 and Caltrans Stormwater Permits

Dry-weather and wet-weather waste load allocations apply to the MS4s and Caltrans permits (Tables 6-1 and 6-7). These mass-based waste load allocations will be incorporated into the

Caltrans permit and all NPDES-regulated municipal stormwater discharges in the Los Cerritos Channel Freshwater Watershed, including the City of Long Beach MS4 permit and all municipalities enrolled under the Los Angeles County MS4 permit. (See Figure 1.)

7.6 TMDL Compliance

While the mass-based allocations for the stormwater NPDES permittees are expressed in grams per day (Table 6-8), USEPA recommends the allocations be incorporated into permits to protect both in-stream and down-stream uses. The concentration-based waste load allocations are established for the minor NPDES permittees and general non-stormwater NPDES permittees that discharge to Los Cerritos Channel to ensure that these point sources do not contribute to exceedances of the CTR limits. For dry weather the concentration-based waste load allocations are equal to the dry weather numeric target for copper, and for wet weather the concentration-based waste load allocations are equal to the wet-weather numeric targets for total recoverable metals as provided in Table 6-2. USEPA recommends that monitoring requirements be placed on these discharges as appropriate in their respective NPDES permits.

We anticipate that implementation for stormwater discharges will be determined by the LA Regional Board and be consistent with assumptions and requirements within these TMDLs, (see 40 C.F.R. § 122.44(d)(1)(vii)(B)). Allocations for all three metals were calculated using ambient water quality monitoring data from Stearns Street sampling site operated by the City of Long Beach (see Figure 1). We expect that the effectiveness of implementation measures to meet the targets will be assessed through evaluation of ambient water quality monitoring data for dry weather and wet weather, collected at this site.

7.7 Source Control Alternatives

A known source of copper loading in urban areas is from automobile brake pads. The use of alternative materials or reduced-copper in brake pads would help to reduce the discharge of copper into Los Cerritos Channel. The Brake Pad Partnership conducted a watershed modeling study of copper from brake pad wear and debris into the South San Francisco Bay, concluding that in highly urbanized watersheds (such as the Los Cerritos Channel Freshwater Watershed), brake pads are likely the single largest contributor to copper loadings. (Brake Pad Partnership Update, 2007.) The Brake Pad Partnership is seeking reductions in the levels of copper used in brake pads, but acknowledges that reducing copper concentrations in waterways by reducing copper in brake pads is a long-term process that may not be accomplished within 10-year TMDL compliance timeframes.

An alternative approach to reducing metals concentrations from the source is to reduce the volume of stormwater that reaches water bodies. When infiltrated into soil, stormwater is retained as groundwater rather than carried through storm drains. Stormwater captured onsite (e.g., by rooftop rain gardens or constructed vegetated swales) offers a means to prevent it from reaching paved streets or other surfaces that are sources of metals. Such techniques are generally referred to as “green infrastructure” or “low impact development” (LID). The City of Downey has already modified 215 acres using LID techniques on individual parcels and estimates they capture approximately 1% of runoff from a 0.75” rain event, thereby recycling some stormwater and reducing metal loads from entering the Los Cerritos Channel. (G. Greene, personnal communication, February 2, 2010.) USEPA encourages these approaches to reducing stormwater pollution. Information is provided on USEPA's website at: http://cfpub.epa.gov/npdes/home.cfm?program_id=298 and www.epa.gov/nps/lid/.

Green infrastructure projects adjacent to roads may be beneficial in reducing stormwater metals loads, including copper from brake pads, lead from tire weights, and zinc from tire wear. Also, green infrastructure projects could be prioritized for sub-basins within the Los Cerritos Channel Freshwater Watershed that contribute the highest wet-weather metals loadings (see Figure 6), such as the northernmost sub-basins.

The Los Angeles County Department of Public Works is currently developing a watershed management modeling system for water quality improvements that can be used for all areas covered by the Los Angeles MS4 permit and City of Long Beach MS4 permit. One of the objectives of this system is to identify cost-effective pollution reduction projects to address urban runoff and stormwater quality, making use of USEPA's watershed/Best Management Practice modeling system. The system also provides a technical framework for LID implementation by parcel- or watershed-scale planning. This will enable identification of locations in which LID retrofits could be implemented for maximum effect in reducing stormwater volumes and associated pollutant loads. Scheduled milestones for this project are in the 2010-2011 timeframe. (Y. Sim, personnal communication, November 6, 2008.)

8 MONITORING

When the Regional Board adopts metals TMDLs, they will include a monitoring plan. USEPA expects the monitoring plan to include two objectives. The first is to collect additional water quality data (e.g., hardness, flow, and background total recoverable metals and dissolved metals concentrations) to evaluate the assumptions made in the TMDL, including the frequency and extent of exceedences. The second is to collect data to assess compliance with the TMDL's waste load allocations.

8.1 AMBIENT MONITORING

USEPA recommends an ambient monitoring program in order to track trends in water quality improvements in Los Cerritos Channel. Another goal is to provide background information on hardness values and the partitioning of metals between the total recoverable and dissolved fraction to refine load and waste load allocations. The MS4 and Caltrans stormwater NPDES permittees are jointly responsible for implementing the ambient monitoring program.

The City of Long Beach currently collects water quality data in Los Cerritos Channel at the Stearns Street sampling site. The City monitors metals concentrations and hardness for two dry-weather events per year and four wet-weather events per year, on average.

8.2 TMDL EFFECTIVENESS MONITORING

TMDL effectiveness monitoring requirements should be specified in permits to determine if the waste load allocations are achieved.

Stormwater permittees should be encouraged to develop a monitoring program that will not only assess individual compliance, but will assess the effectiveness of chosen BMPs to reduce pollutant loading on an industry-wide or permit category basis. MS4 permittees and those enrolled under industrial and construction stormwater permits should be encouraged to participate in such programs. For practical purposes, effectively meeting wet-weather waste load allocations is when the measured EMC multiplied by the daily storm volume is less than or equal to the loading capacity (minus the margin of safety) for any given storm. Responsible agencies shall sample at least 4 wet weather-events where flow meets wet-weather conditions (>23 cfs in Los Cerritos Channel above the tidal prism) in a given storm season.

Typically, monitoring options to assess whether the stormwater NPDES permittees are effectively meeting their waste load allocations include: 1) if the in-stream pollutant concentration or load at the first downstream effectiveness monitoring location is equal to or less than the corresponding concentration- or load-based waste load allocation or; 2) if sampling at the storm drain outlet shows that the numeric target for the receiving water is being met.

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