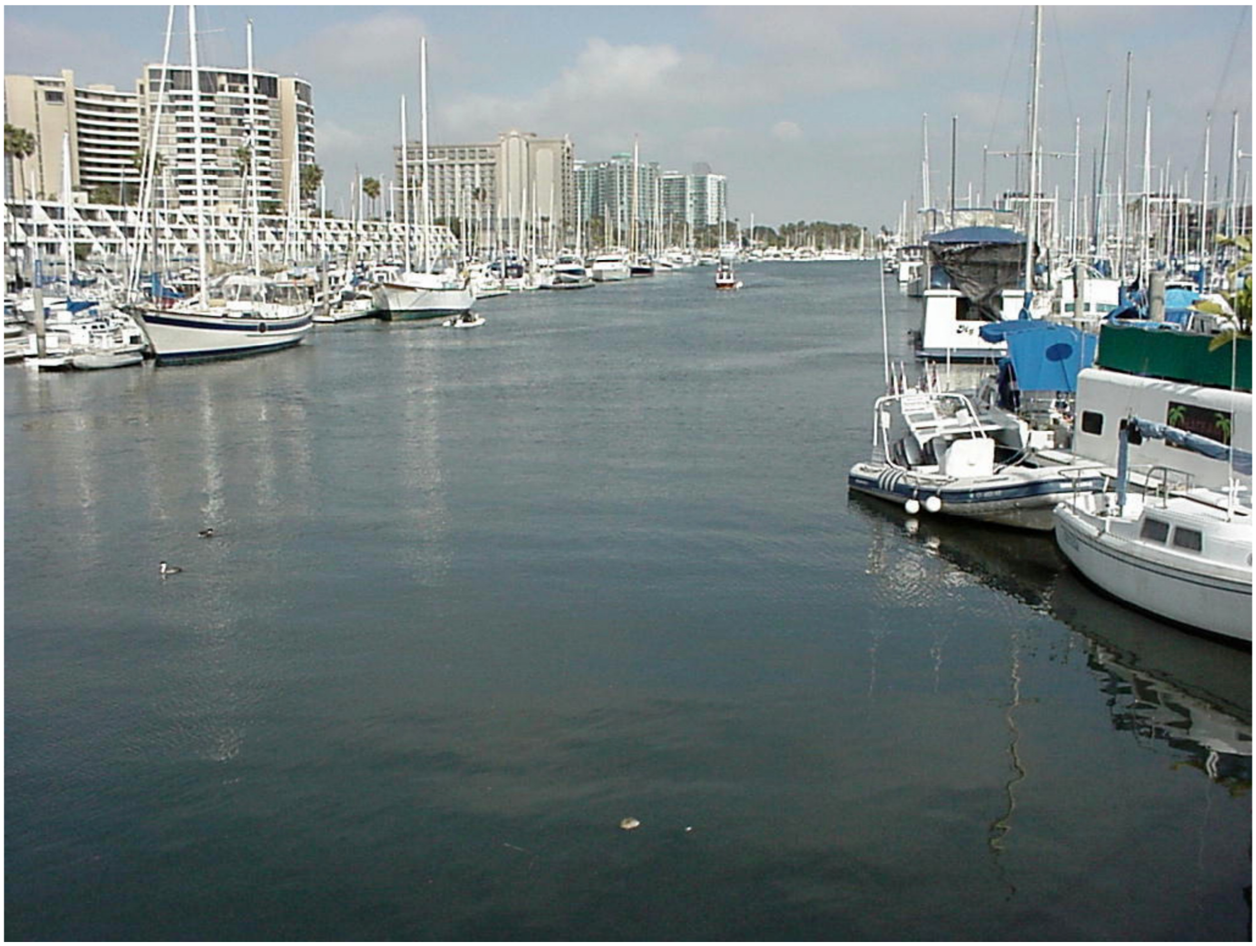
RECONSIDERATION OF THE TOTAL MAXIMUM DAILY LOAD FOR TOXIC POLLUTANTS IN MARINA DEL REY HARBOR



PREPARED BY
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

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Table of Contents

List of Tables

List of Figures

1. Introduction

This staff report presents technical analyses in support of recommendations to reconsider aspects of the Marina del Rey Harbor Toxic Pollutants TMDL established by the Los Angeles Regional Water Quality Control Board (Regional Board). The regulatory background, beneficial uses to be protected, geographical extent and complete TMDL elements along with supporting analysis are described in the original staff report and amendment to the Los Angeles Region Water Quality Control Plan (Basin Plan) (LARWQCB, 2005c) at (http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/tmdl_list.shtml) and are not repeated, herein.

While the Regional Board can amend the Basin Plan to adjust a TMDL at any time, implementation schedules for TMDLs in the Los Angeles Region have often included scheduled "reconsiderations" by the Regional Board at a specific point during implementation. Specific reconsiderations have been included so that aspects of the TMDL, or the TMDL implementation schedule, could be adjusted based on anticipated new information or methods. This approach has allowed the Regional Board to establish TMDLs with all the required elements, including numeric targets, allocations, and implementation schedules, so that responsible parties could begin implementing the TMDL to improve water quality, while acknowledging the potential benefit to refining certain technical elements of the TMDL or the implementation schedule after additional study and data collection were completed. The timeframe included in the original TMDL implementation schedule for the current reconsideration was six years after the effective date of the TMDL.

2. History and Status of the TMDL

The Marina del Rey Harbor Toxic Pollutants TMDL was adopted by the Regional Board on October 6, 2005 (Regional Board Resolution No. R05-2012), approved by the State Water Resources Control Board (State Board) on January 13, 2006 (State Board Resolution No. 2006-0006), and approved by the United States Environmental Protection Agency (U.S. EPA) on March 16, 2006. The waste load allocations (WLAs) and other associated requirements of the TMDL have been incorporated into the National Pollution Discharge Elimination System (NPDES) permits covering point source discharges within the Marina del Rey (MdR) Watershed, including the Los Angeles County Municipal Separate Storm System (MS4) Permit (Order No. R4-2012-0175) and the Caltrans MS4 Permit (Order No. 2012-0011-DWQ). Actions related to the TMDL that have occurred since adoption are listed in Tables 2-1 and 2-2. The Coordinated Monitoring Plan (CMP) was approved and two annual reports have been submitted to the Regional Board. The responsible parties have submitted two separate implementation plans: one plan from the County of Los Angeles and one plan from the City of Los Angeles, Culver City, and the California Department of Transportation (collectively the MdR Watershed Agencies). Two special studies were required by the TMDL and have been conducted: a Low Detection

Level Study and a Partitioning Coefficient Study. Two recommended studies have also been completed: the Marina del Rey Sediment Characterization Study and a BMP effectiveness study.

Table 2-1. TMDL Actions to Date

Item	Date
TMDL In Effect	March 22, 2006
Special Study: Marina del Rey Sediment Characterization Study	April 2008
Coordinated Monitoring Plan Final Approval	March 3, 2009
Special Study: BMP Effectiveness Phase I	September 9, 2010
Special Study: Low Detection Level Study	December 22, 2011
Special Study: Partitioning Coefficient Study	December 22, 2011
CMP Annual Monitoring 2010-11 Submittal	January 30, 2012
Los Angeles County Implementation Plan	August 22, 2012
CMP Annual Monitoring 2011-2012 Submittal	December 3, 2012
MdR Watershed Agencies Implementation Plan	December 10, 2012

Structural and non-structural BMPs have been instituted or are in progress in the Marina del Rey Harbor Watershed. A sampling of these BMPs is listed in Table 2-2.

Table 2-2. BMPs in Marina del Rey Harbor Watershed

	Anticipated Completion Date	Completion Date
Structural BMPs		
Bio-retention Filters (5)	--	December 2006
Low Flow Diversions (3)	--	November 2009
Oxford Basin Multi-Benefit Enhancement Project	December 2015	--
Improvement of Marina Parking Lots (5)	2017	--
Non-Structural BMPs		
Increased Frequency of Street and Parking Lot Sweeping	--	Ongoing since 2008
L.A. City and County adopted LID ordinances	--	Ongoing
Green Marinas Program	--	Ongoing
Participation in Brake Pad Partnership	--	Ongoing

2.1 Special Studies

In order to obtain necessary information to refine the TMDL and better target implementation actions, the TMDL required two special studies to be conducted and recommended three additional studies. The status of these studies and related findings are discussed below.

2.1.1 Partitioning Coefficient Study

A Partitioning Coefficient Study Report, required by the TMDL, was submitted by the County of Los Angeles Department of Public Works on behalf of the County of Los Angeles, the California Department of Transportation, and the Cities of Culver City and Los Angeles to the Regional Board on December 28, 2011 (Brown and Caldwell 2011b). Concentrations of copper and partitioning coefficients were investigated in the sediment, water column, and storm water of Marina del Rey Harbor. Some trends were evident; however, findings bear further investigation due to inherent noisiness in the data. Partitioning coefficients appear lower in the water column than in the sediment, suggesting the sediments were not acting as a source of copper to the water column during the study period. Elevated dissolved copper concentrations in the upper water column relative to the middle and lower water column suggest an input of copper to the upper water column. Possible sources of copper to the water column discussed in the study report include storm water and boats.

Analyses of lead and zinc are included in Appendix G; however, these results are not discussed in the report. While the results of the study suggest Marina del Rey Harbor sediments may not be a source of copper to the water column, potential contributions of other pollutants, including lead and zinc, to the water column from the sediment have not been investigated.

2.1.2 Low Detection Level Study

The original TMDL required a special study to "evaluate the use of low detection level techniques to determine water quality concentrations for those contaminants where standard detection limits cannot be used to assess compliance for CTR standards or are not sufficient for estimating source loadings from tributaries and storm water." A Low Detection Level Study Report was submitted by the County of Los Angeles Department of Public Works on behalf of the County of Los Angeles, the California Department of Transportation, and the Cities of Culver City and Los Angeles to the Regional Board on December 28, 2011 (Brown and Caldwell 2011b). The submitted study was a field and laboratory investigation of PCB and chlordane levels in Marina del Rey Harbor that was conducted in conjunction with the CMP. A negative chemical ionization procedure was used for concentrating the samples for some chlordane analyses. The details and logistics of the negative chemical ionization procedure are not included in the report; however, the analyses resulted in a method detection limit (MDL) of 0.028 ng/L, which is lower than the TMDL numeric target of 0.5 µg/kg (ng/L) (for comparison, the MDL for similar chlordane analyses in the CMP is 50 ng/L). The reporting limit (RL) achieved from incorporating negative chemical ionization (NCI) into laboratory procedures for chlordane was not discussed in the report. In part due to elevated PCB readings in blanks, methods utilized to analyze PCB samples did not achieve detection limits below numeric targets.

2.1.3 Storm-Borne Sediment Pilot Study

A pilot study is currently in progress to establish a sediment collection approach that will result in sufficient sediment mass for analysis and comparison to the TMDL numeric targets/waste load allocations. A single storm event was sampled for the pilot study during the 2013 storm season. Passive sediment collection devices were deployed at three locations to collect sediment from storm water for laboratory analyses. Sediments were analyzed in the laboratory for TMDL constituents, including copper, lead, zinc, chlordane, and PCBs. Preliminary results indicate all metals and chlordane concentrations measured were higher than TMDL numeric targets. PCBs were non-detectable at two of the three sites; however, at site MdR-5, near Boone-Olive Pump Station, total PCBs were measured as 1900 µg/kg (TMDL numeric target: 22.7 µg/kg). The reporting limits for both PCBs and chlordane were both greater than the TMDL numeric limit. Greater storm size and corresponding sediment volume may make it possible to attain reporting limits for organic pollutants that are lower than the TMDL numeric targets using current analytical methods. The pilot study is anticipated to resume during the 2014 storm season.

2.1.4 Multiple Lines of Evidence - Sediment Characterization Study

A Sediment Characterization Study investigated the entirety of Marina del Rey Harbor -- both the front and back basins as well as the main channel (Weston Solutions 2008). Chemistry was investigated in surface sediment grab samples as well as in the tops and bottoms of sediment cores. The report presents sediment concentrations for TMDL constituents throughout Marina del Rey Harbor, which frequently exceed ERLs and ERMs. DDTs commonly exceeded ERMs at the bottom depth of sediment cores.

In addition to sediment chemistry analyses, an SQO assessment, including toxicity and benthic community analysis, was conducted as part of the sediment characterization study. This assessment was completed based on a draft version of California's *Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality.* State SQO guidelines specify that a minimum of two toxicity tests -- one short term survival sediment toxicity test and one sublethal sediment toxicity test must be used to conduct the assessment (SWRCB 2009). The sediment characterization study incorporated only one toxicity test: a 10-day short term survival test using the amphipod *Eohaustorius estuarius*. Additionally, a line of evidence (LOE) titled "Severity of Biological Effects," which integrated toxicity and benthic condition LOEs was used in the SQO assessment. These procedures are not consistent with California's SQOs (SWRCB 2009); therefore, individual chemistry, toxicity, and benthic community analyses conducted during this study are discussed in section 4.1.1 of this report, but the SQO assessment itself is not included here.

2.1.5 BMP effectiveness

The TMDL required the construction industry to submit the results of wet-weather BMP effectiveness studies to the Regional Board for consideration by March 22, 2013. The purpose of the studies was for the Regional Board to approve BMPs that would result in attainment of wet-weather waste load allocations to be included in the construction stormwater permit. The Building Industry Association initiated a BMP study and published the results (Wu 2010). The study investigated the potential for short-term release of cadmium, copper, lead, and zinc from a first flush of 18 different BMPs. The study suggests that the release of heavy metals from BMPs can contribute to pollution. The study was not a BMP effectiveness study as required by the TMDL and the findings do not provide the necessary justification for the approval of BMPs that would result in the attainment of wet-weather waste load allocations.

3. Reconsideration Items Required by the TMDL

The implementation plan that was adopted as a part of the TMDL includes a mandatory reconsideration six years after the effective date of the TMDL to re-evaluate waste load allocations and the implementation schedule. Two specific components are required to be addressed by the Regional Board and will be discussed here in further detail: SQOs and toxicity hotspots.

3.1 Sediment Quality Objectives

The Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality (SWRCB 2009), which promulgated sediment quality objectives (SQOs), was adopted after the effective date of the Marina del Rey Harbor Toxic Pollutants TMDL. As the SQOs were in development when the Marina del Rey Harbor Toxic Pollutant TMDL was adopted, an item was included in the implementation plan of the original TMDL requiring the Regional Board to "re-assess the numeric targets and waste load allocations for consistency with the State Board adopted sediment quality objectives."

The SQOs are proposed to be incorporated into the TMDL as an alternative target and means of demonstrating attainment of the TMDL. This addition does not necessitate any changes to the original numeric targets or waste load allocations. However, new monitoring requirements and language regarding alternative means of demonstrating compliance are necessary to fully utilize the SQOs. In accordance with the State's SQOs, the alternative target enables the use of a multiple lines of evidence (MLOE) approach to demonstrate that Marina del Rey Harbor sediments fall within the categories of **Unimpacted** or **Likely Unimpacted**. These categories are considered protective of beneficial uses such that if Marina del Rey Harbor sediments meet this target, beneficial uses are considered protected even if sample data indicate that pollutant specific numeric targets are not met in sediments.

3.2 Toxicity Hotspots

The TMDL implementation plan requires the Executive Officer of the Regional Board to issue investigatory and clean up and abatement orders to address toxicity hotspots within sediments. The Sediment Characterization Study (Weston Solutions 2008) indicates that the sediment of Marina del Rey Harbor is contaminated throughout the harbor, in both front and back basins as well as the main channel, rather than being confined to hotspots.

The Regional Board has not yet issued clean up and abatement orders as removing the sediment prior to reducing contaminant loading will likely result in re-contamination and a potential need to repeat the costly dredging. In order to ensure contaminated sediments are addressed, in this reconsideration load allocations are assigned to the sediment. Los Angeles County, the responsible party for the in-situ sediment, may comply with assigned load allocations by creating a contaminated sediment management plan, which it may commit to implementing through a Memorandum of Agreement (MOA) or, in the event an MOA is not established, a clean-up and abatement order may be issued by the Regional Board. These options will be discussed in detail in section 4.10.3.

4. Proposed Changes

Based on data collected and evaluated since the adoption of the original TMDL, staff proposes several changes to the TMDL, including the extension of the geographical area of the TMDL to include the front basins (Basins A, B, C, G, and H) (see Section 4.1), the addition of a TMDL for DDT in the sediments (see Section 4.2), the addition of load allocations for the in-situ contaminated sediments (see Section 4.3), the addition of a copper water column TMDL (see Section 4.4), the revision of final water column, fish tissue, and sediment numeric targets for PCBs (see Sections 4.5-4.7), the revision of certain monitoring requirements (see Section 4.9), and the revision of the implementation plan to reflect changes to the technical elements of the TMDL (see Section 10). The proposed changes are discussed in detail below.

4.1 Geographical Extent of Impairment in Marina del Rey Harbor

Figure 4-1 shows a map of Marina del Rey Harbor. Currently all Clean Water Act Section 303(d) listings for Marina del Rey Harbor are for the back basins (Basins D, E, and F). Data collected since the adoption of the TMDL indicates that impairments are not confined to the back basins but are also present in the front basins (Basins A, B, C, G, and H). With the exception of lead, all pollutants listed in the Marina del Rey Harbor Toxic Pollutants TMDL (copper, zinc, chlordane, and PCBs) are also impairing the front basins. The data for each pollutant is discussed in detail in section 4.1.1, below.

Figure 4-1. Marina del Rey Watershed Map

Based on the analysis in section 4.1.1, and in order to ensure that the water body be treated holistically and that positive implementation actions in the back basins are not hindered by effects from the front basins, Regional Board staff recommends updating the Clean Water Act Section 303(d) listing for Marina del Rey Harbor during the next listing cycle to encompass toxic impairments throughout the harbor and addressing these impairments in this reconsideration of the Marina del Rey Harbor Toxic Pollutants TMDL.

The linkage and source analyses in the original TMDL are still appropriate and will not be repeated here. The original TMDL divided the watershed into five sub-watersheds based on the drainage patterns provided by the Los Angeles County Department of Public Works (LACDPW). These five sub-watersheds are described in the staff report of the original TMDL (LARWQCB 2005d). The proposed change in geographical area is the addition of sub-watershed Area 1B, which drains into the front basins of Marina del Rey Harbor.

4.1.1 Data Analysis Demonstrating Additional Impairments in Front Basins of Marina del Rey Harbor

The following is a review of new data available since the adoption of the TMDL, which confirm previously identified impairments and demonstrate additional impairments of the sediment by copper, zinc, chlordane and PCBs in the front basins of Marina del Rey Harbor. Each pollutant is assessed individually and for each, data are discussed separately for the back basins and then the front basins, in the discussion. Sources of data include the Coordinated Monitoring Plan, monitoring by Aquatic Bioassay & Consulting Laboratories, Bight '08, and the Sediment Characterization Study discussed in section 2.1.4.

The Regional Board has received two years of monitoring data from the Coordinated Monitoring Plan (2010-2011 and 2011-2012). The Coordinated Monitoring Plan was designed specifically to meet the monitoring requirements of the TMDL.

The County of Los Angeles Department of Beaches and Harbors contracted with Aquatic Bioassay & Consulting Laboratories, Inc. (ABC Labs) to conduct annual monitoring. Sediment chemistry data from 2004-2005, 2005-2006 and 2007-2008 is included in this evaluation. Due to budgetary issues no monitoring report is available for the 2006-2007 time period. This monitoring program concluded in 2008.

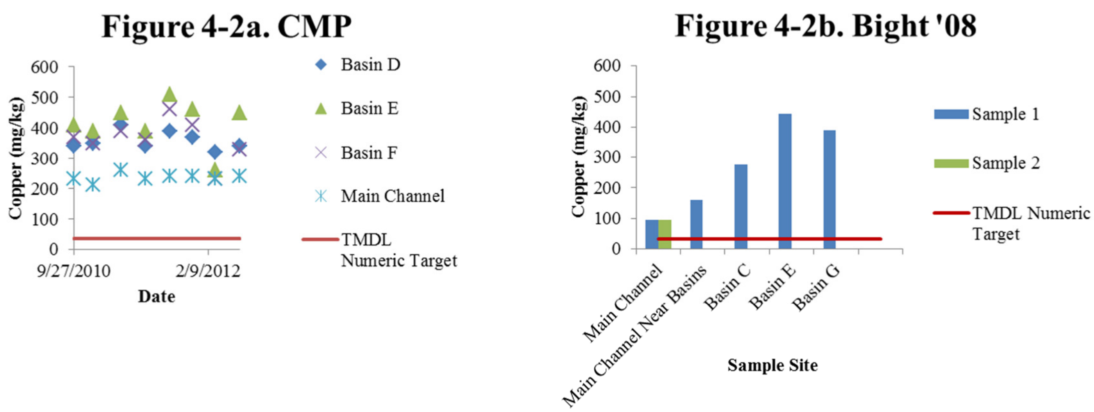
Bight '08, a collaborative regional monitoring project, studied a wide array of parameters affecting coastal ecology in the Southern California Bight. Sediment chemistry, toxicity, and benthic community data collected in Marina del Rey during Bight '08 is included in the following data review.

A sediment characterization study (Weston Solutions, 2008) included analyses of surficial samples as well as cores. Only surface data collected from Van Veen grab samplers is included for analysis in this report as it is most comparable to other studies conducted.

4.1.1.1. Copper Data for the Back Basins

The original TMDL addresses a copper impairment in the sediment. All copper measurements in the sediment collected through the Coordinated Monitoring Plan (Fig. 4-2a) and during Bight '08 (Fig. 4-2b) exceed 34 mg/kg, the TMDL numeric target for copper in sediment (County of Los Angeles Department of Public Works 2012a, County of Los Angeles Department of Public Works 2012b, Schiff et al. 2011). All measurements of copper in the sediment collected by ABC Labs (ABC Labs 2007, ABC Labs 2009) and during the Marina del Rey Harbor Sediment Characterization Study (Weston Solutions 2008) also exceed the TMDL numeric target.

Figure 4-2. Copper in Marina del Rey Harbor Sediment



4.1.1.2. Copper Data for the Front Basins

Sediment chemistry in the front basins of Marina del Rey Harbor was investigated by ABC Labs during annual sampling, during Bight '08 and as part of the Sediment Characterization Study. Five of the 24 copper samples exceed the Effects Range-Median (ERM) threshold of 270 mg/g (Table 4-1). In line with the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (303(d) listing policy) (SWRCB 2004), this is sufficient evidence for identifying copper in the sediment as an impairment in the front basins.

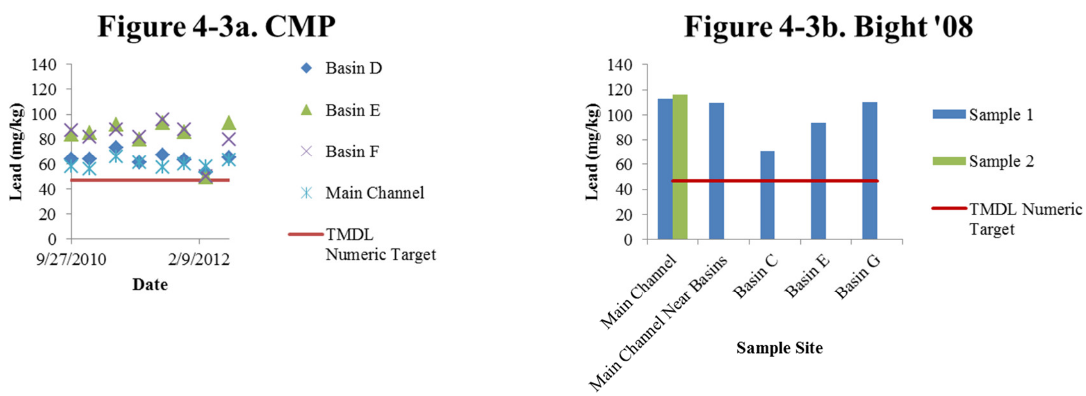
Table 4-1. Copper in the Sediment of the Marina del Rey Harbor Front Basins

	# Samples	# ERM Exceedances	Minimum # Exceedances Required to List (SWRCB 2004)
ABC Labs	11	1	2
Bight '08	4	2	2
Sed. Characterization Study	9	2	2
Total	24	5	2

4.1.1.3. Lead Data for the Back Basins

The original TMDL addresses a lead impairment in the sediment. All lead measurements in the sediment collected through the Coordinated Monitoring Plan (Fig. 4-3a) and during Bight '08 (Fig. 4-3b) exceed 46.7 mg/kg, the TMDL numeric target for lead in sediment (County of Los Angeles Department of Public Works 2012a, County of Los Angeles Department of Public Works 2012b, Schiff et al. 2011). Five out of the six samples of lead in the sediment included in each of the 2005-2006 and 2007-2008 reports from ABC Labs also exceed the TMDL numeric target (ABC Labs 2007, ABC Labs 2009). All measurements of lead in the sediment reported in the Marina del Rey Harbor Sediment Characterization Study exceed the TMDL numeric target (Weston Solutions 2008).

Figure 4-3. Lead in Marina del Rey Harbor Sediment



Lead samples in the water column measured through the Coordinated Monitoring Plan are all below CTR acute and chronic saltwater criteria (210 µg/L and 8.1 µg/L, respectively) (County of Los Angeles Department of Public Works 2012a, County of Los Angeles Department of Public Works 2012b). There is currently no 303(d) listing for lead in the water column in Marina del Rey Harbor.

4.1.1.4. Lead Data for the Front Basins

Sediment chemistry in the front basins of Marina del Rey Harbor was investigated by ABC Labs during annual sampling, during Bight '08 and as part of the Sediment Characterization Study. All measurements of lead in the front basins were below the ERM of 218 µg/g (Table 4-2).

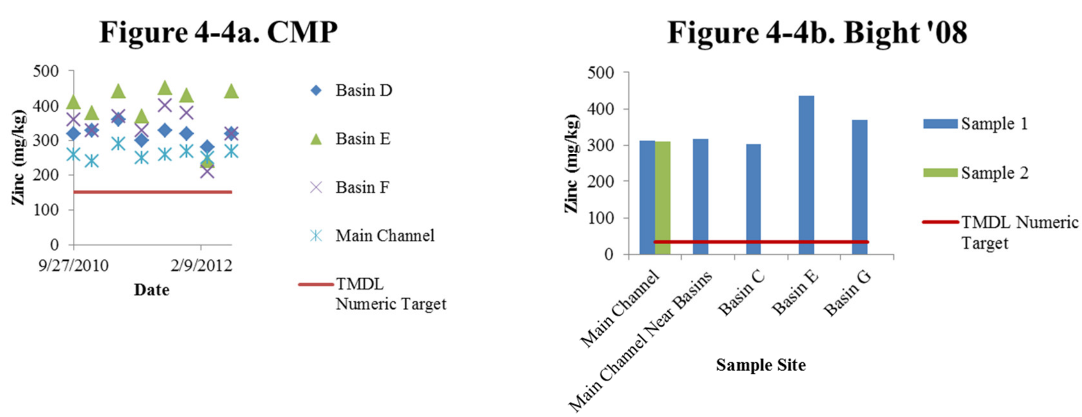
Table 4-2. Lead in Sediment in the Marina del Rey Harbor Front Basins

	# Samples	# ERM Exceedances	Minimum # Exceedances Required for 303d Listing (SWRCB 2004)
ABC Labs	11	0	2
Bight '08	4	0	2
Sed. Characterization Study	9	0	2
Total	24	0	2

4.1.1.5. Zinc Data for the Back Basins

The original TMDL addresses a zinc impairment in the sediment. All zinc measurements in the sediment from the back basins collected through the Coordinated Monitoring Plan (Fig. 4-4a) and during Bight '08 (Fig. 4-4b) exceed the TMDL numeric target for zinc in sediment of 105 mg/kg (County of Los Angeles Department of Public Works 2012a, County of Los Angeles Department of Public Works 2012b, Schiff et al. 2011). All samples of zinc in sediment reported in the 2005-2006 report, and five out of the 6 samples in the 2007-2008 report, from ABC Labs also exceed the TMDL numeric target for zinc in sediment (ABC Labs 2007, ABC Labs 2009). All measurements of zinc in the sediment reported in the Marina del Rey Harbor Sediment Characterization Study exceed the TMDL numeric target (Weston Solutions 2008).

Figure 4-4. Zinc in Sediment of the Marina del Rey Harbor Back Basins



4.1.1.6. Zinc Data for the Front Basins

Sediment chemistry in the front basins of Marina del Rey Harbor was investigated by ABC Labs during annual sampling, during Bight '08 and as part of the Sediment Characterization Study. Two samples from the monitoring by ABC Labs exceed the ERM of 218 mg/g (Table 4-3). In line with California's 303(d) listing policy, this is sufficient evidence for identifying zinc in the sediment as an impairment in the front basins.

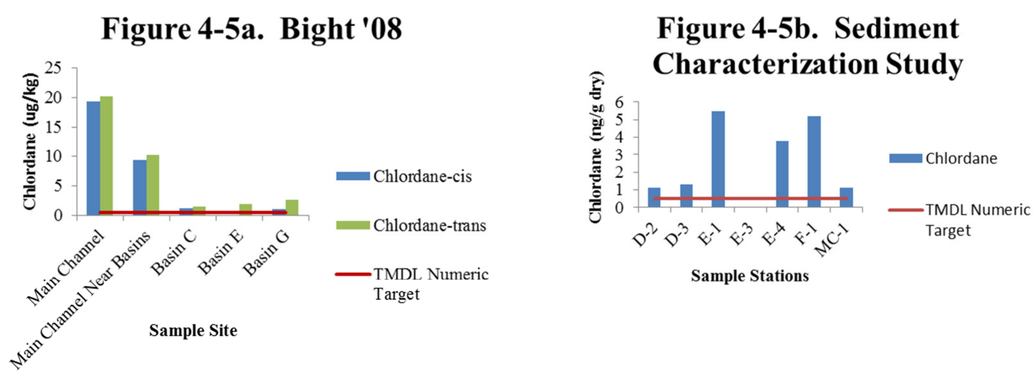
Table 4-3. Zinc in Sediment in the Marina del Rey Harbor Front Basins

	# Samples	# ERM Exceedances	Minimum # Exceedances Required for 303d Listing
ABC Labs	11	2	2
Bight '08	4	0	2
Sed. Characterization Study	9	0	2
Total	24	2	2

4.1.1.7. Chlordane Data for the Back Basins

The original TMDL addresses a chlordane impairment in the sediment. All chlordane measurements in the sediment collected through the Coordinated Monitoring Plan were non-detectable. As the TMDL numeric target for chlordane in sediment, 0.5 µg/kg, is below the current detection limit of approximately 1 µg/kg, these data are inconclusive regarding whether or not sediment quality improvements have occurred. However, measurements of chlordane in sediment collected during Bight '08 all exceed the TMDL numeric target (Fig. 4-5a) as do all but one of the back basin sites investigated in the Marina del Rey Harbor Sediment Characterization Study (Weston Solutions 2008) (Fig. 4-5b). Site E3 was recorded as non-detectable, which for the reason stated above is inconclusive regarding whether or not the chlordane concentration exceeds the TMDL numeric target.

Figure 4-5. Chlordane in Marina del Rey Harbor Sediment



Chlordane samples in the water column measured through the Coordinated Monitoring Plan are all non-detectable except for a measurement of 0.19 µg/L at sample station MdRH-B1 on October 27, 2011. There is currently no 303(d) listing for chlordane in the water column in Marina del Rey Harbor.

4.1.1.8. Chlordane Data for the Front Basins

Sediment chemistry in the front basins of Marina del Rey Harbor was investigated by ABC Labs during annual sampling, during Bight '08 and as part of the Sediment Characterization Study. Ten samples, combined from the monitoring by ABC Labs and the Sediment Characterization Study, exceed the ERM of 6 µg/g (Table 4-4). In line with California's 303(d) listing policy, this is sufficient evidence for identifying chlordane in the sediment as an impairment in the front basins.

Table 4-4. Chlordane in Marina del Rey Harbor Front Basins Sediment

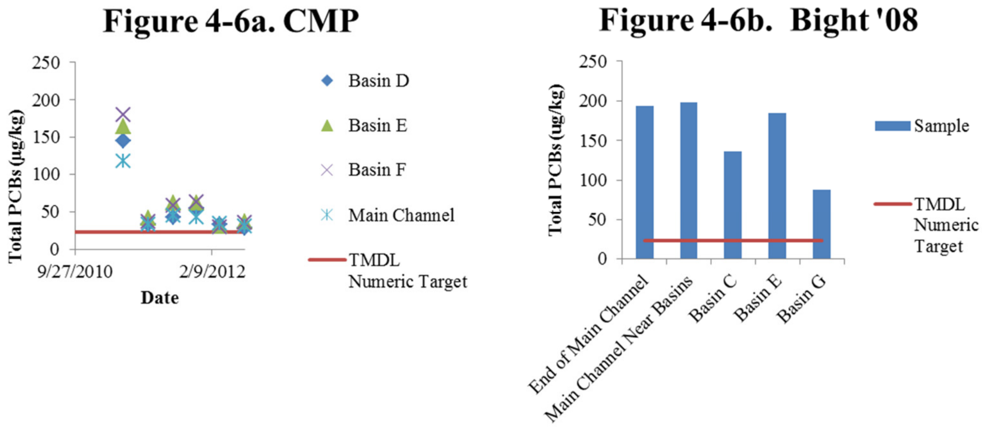
	# Samples	# ERM Exceedances	Minimum # Exceedances Required for 303d Listing
ABC Labs	11	5	2
Bight '08	4	0*	2
Sed. Characterization Study	9	5	2
Total	24	10	2

*Not measured as total chlordane, calculated as total of chlordane-cis and chlordane-trans

4.1.1.9. PCBs Data for the Back Basins

The original TMDL addresses a PCB impairment in the sediment. Some samples exceed the TMDL numeric target for PCBs in sediment, 22.7µg/kg, at every site sampled through the Coordinated Monitoring Plan (Fig. 4-6a). Remaining PCB sediment samples from the Coordinated Monitoring Plan are non-detectable. The fact that the TMDL numeric target for PCBs in sediment is below the current detection limit, and that all sites show detectable PCBs in the sediment at some point during the monitoring period indicates that the PCB impairment in the sediments continues to exist. Measurements of PCBs in sediment collected during Bight '08 all exceed the TMDL numeric target (Fig. 4-6b), confirming that the impairment still exists. One of four PCB samples analyzed in the sediment of Marina del Rey Back Basins reported in the 2005-2006 annual report and all samples in the 2007-2008 annual report from ABC Labs also exceed the TMDL numeric target for total PCBs in sediment (ABC Labs 2007, ABC Labs 2009). All Marina del Rey Harbor Back Basin measurements of total PCBs in the sediment reported in the Marina del Rey Harbor Sediment Characterization Study exceed the TMDL numeric target (Weston Solutions 2008).

Figure 4-6. PCBs in Marina del Rey Harbor Sediment



PCB samples in the water column measured through the Coordinated Monitoring Plan are all non-detectable. There is currently no 303(d) listing for PCBs in the water column in Marina del Rey Harbor.

All organisms in which bioaccumulation samples were measured through the Coordinated Monitoring Plan exceed the total PCB TMDL numeric target for fish tissue, 5.3 µg/kg in the original TMDL, at all sample sites. Consequently, fish tissue samples also exceed the Office of Environmental Health Hazard Assessment (OEHHA) Fish Contaminant Goal (FCG) of 3.6 µg/kg, the proposed new target, at all sample sites.

4.1.1.10. PCBs Data for the Front Basins

Sediment chemistry in the front basins of Marina del Rey Harbor was investigated by ABC Labs during annual sampling, during Bight '08 and as part of the Sediment Characterization Study. Two samples from Bight '08, both in the Main Channel outside the back basins, exceed the ERM of 180 µg/g (Table 4-5). In line with California's 303(d) listing policy (SWRCB 2004), this is sufficient evidence for identifying an impairment due to PCBs in the sediment in the front basins.

Table 4-5. PCBs in Marina del Rey Harbor Front Basins Sediment

	# Samples	# ERM Exceedances	Minimum # Exceedances Required for 303d Listing
ABC Labs	11	0	2
Bight '08	4	2	2
Sed. Characterization Study	9	0	2
Total	24	2	2

4.1.1.11. Comparison of Data With Sediment Quality Objectives

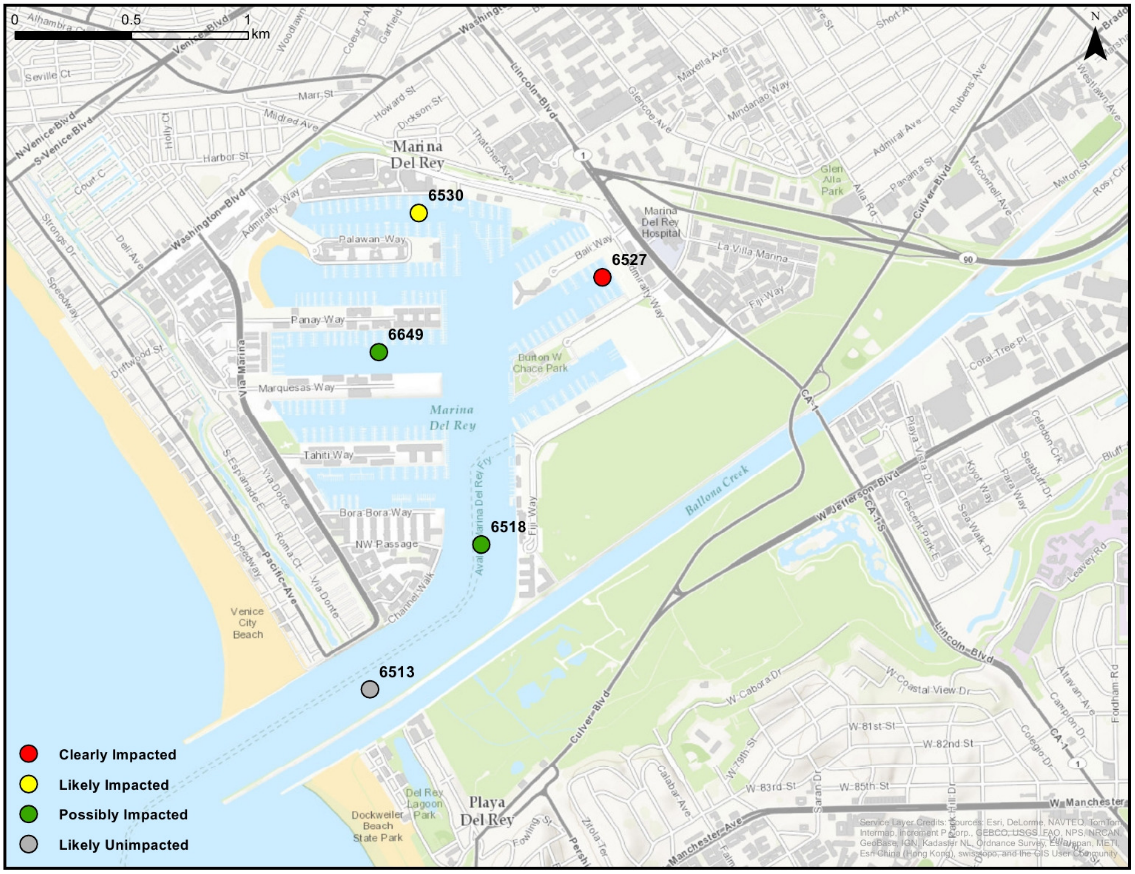
In conjunction with regional monitoring conducted through Bight ’08, researchers with SCCWRP characterized sediments in Marina del Rey Harbor to determine whether or not SQOs were being met (Schiff et al. 2011). Samples were collected and evaluations made of sediments at five sites: Basin C, Basin E, Basin G, near the front basin in the main channel, and near the outlet of the harbor. The site near the outlet of the marina was classified as likely unimpacted. Both the main channel and Basin C were classified as possibly impacted. Basin E was classified as likely impacted. Basin G was classified as clearly impacted (Table 4-6).

Table 4-6. Sediment Quality Objectives Status in Marina del Rey Harbor

Site	SQO Category	Toxicity	Chemistry	Benthic Community
Basin C	Possibly Impacted	Nontoxic	Moderate Exposure	Moderate Disturbance
Basin E	Likely Impacted	Nontoxic	High Exposure	Moderate Disturbance
Basin G	Clearly Impacted	Moderate Toxicity	High Exposure	Moderate Disturbance
Main Channel (near front basins)	Possibly Impacted	Low Toxicity	High Exposure	Low Disturbance
Main Channel (Harbor Outlet)	Likely Unimpacted	Nontoxic	High Exposure	Low Disturbance

Only the site in the forward area of the main channel, categorized as Likely Unimpacted, is considered as achieving the protective condition of the station according to the definition above. The remaining four sites are all considered degraded (Figure 4-7). This analysis of the SQO data indicates SQO impairment throughout Marina del Rey Harbor and provides additional rationale for expanding the TMDL requirements to encompass the entire harbor.

Figure 4-7. Marina del Rey Watershed Map: Bight '08 SQO Results



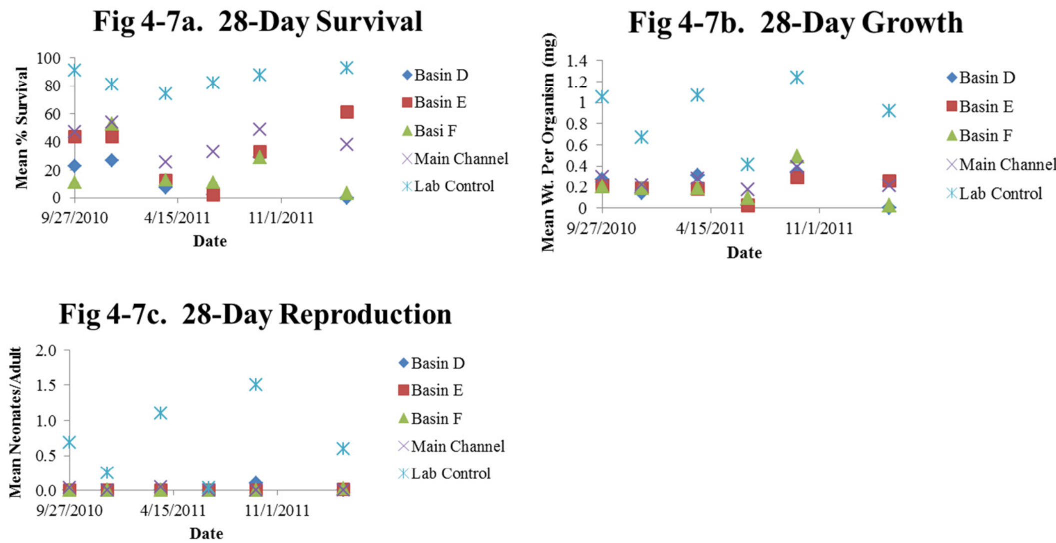
As detailed above, SQOs rely on three lines of evidence- sediment chemistry, sediment toxicity, and benthic community. Data from each of the lines of evidence provides valuable information regarding sediment quality. Sediment chemistry data has been discussed earlier in this section. Sediment toxicity and benthic community analyses are discussed below.

4.1.1.12. Sediment Toxicity Data

4.1.1.12.1. Coordinated Monitoring Plan

Toxicity testing was conducted through the Coordinated Monitoring Plan. Three types of tests were conducted utilizing the marine amphipod *Leptocheirus plumulosus*: 28-day survival, 28-day growth, and 28-day reproduction (Fig. 4-7). All three tests indicated inhibited survival, growth, and reproduction of *L. plumulosus* relative to laboratory controls.

Figure 4-8. *L. plumulosus* toxicity tests



Ten-day survival tests were carried out utilizing the amphipod *Eohaustourius estuarius.* This test is approved for use in determining the status of sediments relative to the State's Sediment Quality Objectives. All *E. estuarius* survival tests in Basin D, Basin F, and in the main channel were categorized as Nontoxic or Low Toxicity. Two of six samples from Basin E indicated Moderate Toxicity while the remaining four were categorized as Nontoxic.

Forty-eight hour embryo development tests were conducted utilizing the mussel *Mytilus galloprovincialis*. This test is approved for use in determining the status of sediments relative to the State's Sediment Quality Objectives. Results from all *M. galloprovincialis* embryo development tests were categorized as Nontoxic.

Gamete fertilization tests were conducted utilizing purple sea urchins, *Strongylocentrotus purpuratus* (Fig. 4-8). Results of *S. purpuratus* toxicity tests with Marina del Rey Harbor sediments are highly variable with results suggesting both toxicity and non-toxicity at all four sites.

Figure 4-9. 20-Minute Gamete Fertilization *Strongylocentrotus purpuratus*

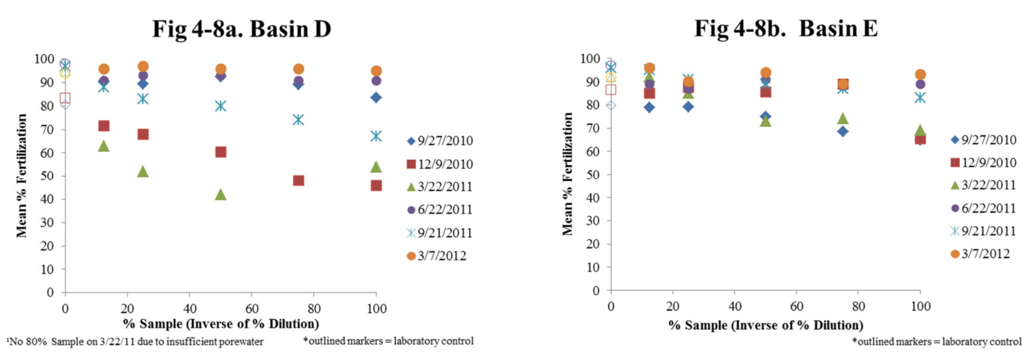


Fig 4-8c. Basin F

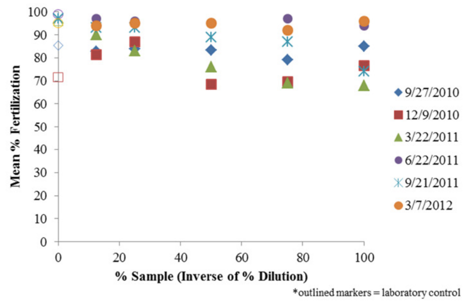
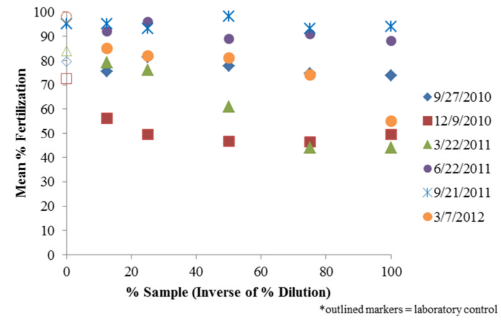


Fig 4-8d. Main Channel



As discussed above, the results of the toxicity tests conducted through the Coordinated Monitoring Plan show a great deal of variation. However, the consistent evidence of inhibited survival, growth, and reproduction of *L. plumulosus* when introduced in the laboratory to Marina del Rey Harbor Back Basin sediments indicates that these sediments are toxic.

4.1.1.12.2. Bight '08 Data

Two toxicity tests were used to characterize sediment throughout the Southern California Bight during Bight '08: a 10-day survival test using the amphipod *Eohaustorius estuarius* and a 10-day embryo development test using *Mytilus galloprovincialis* (Bay 2008). The results of the Bight '08 toxicity tests were used to classify sediments according to toxicity categories included in the State's Sediment Quality Objectives (SQOs). The categories determined for sites in Marina del Rey Harbor are listed in Table 4-7. Only one of the sites studied in Marina del Rey Harbor was in the Back Basins, station 6530 located in Basin E. On the basis of the Bight '08 data, the Marina del Rey Harbor sediments investigated were classified as Nontoxic or Low Toxicity, with the exception of Basin G, which is outside the back basin area addressed by the current TMDL. The State's EBE Plan – Part 1 Sediment Quality allows for any one of three approved survival tests to be used in determining toxicity categories. Results from the CMP toxicity testing, described above, suggest that had *Leptocheirus plumulosus* been used for the survival tests, the results of these SQO analyses may have differed from the results shown in Table 4-7.

Table 4-7. Bight '08 Sediment Toxicity Classification

Location	Bight '08 Station #	SQO Toxicity Category
End of Main Channel	6513	Nontoxic
Main Channel Near Basins	6518	Low Toxicity
Basin C	6649	Nontoxic
Basin E	6530	Nontoxic
Basin G	6527	Moderate Toxicity

4.1.1.12.3. Sediment Characterization Study

Eohaustorius estuarius survival tests were conducted throughout Marina del Rey Harbor as part of the Sediment Characterization Study (Weston Solution 2008). Thirteen of the sixteen tests conducted yielded less than 81% survival, indicating a minimum of Moderate Toxicity according to the State's SQO classification. Three tests showed less than 59% survival, placing them in the High Toxicity category used in determining whether sediments meet the State's SQOs - these tests were conducted with sediment from Basin B, Basin F, and Basin G. The three tests showing greater than 81% survival were located in Basin A, Basin H, and the Main Channel.

4.1.1.13. Benthic Community Assessment

Benthic community condition is a line of evidence incorporated in the State's SQOs. The current CMP does not include benthic community analyses. As will be discussed later, it is recommended that benthic community analyses be added to the CMP such that complete SQO evaluations can be conducted utilizing future CMP data. The following discussion includes data from both the front and back basins of Marina del Rey Harbor.

Benthic community analyses consistent with that required by the State's SQOs, were conducted by the Southern California Coastal Water Research Project (SCCWRP) during Bight '08. The results of these analyses are presented in Table 4-8 for the sites investigated in Marina del Rey Harbor. The SQO procedure calculates four different biological indices. The SQO benthic category, final column in Table 4-8, is a median of these indices. Three sites in Marina del Rey Harbor basins were investigated during Bight '08, Basins C and G of the front basins and Basin E of the back basins. The benthic community of all three sites was categorized as exhibiting "moderate disturbance." At the two sites in the main channel, the benthic community was categorized as exhibiting "low disturbance."

Table 4-8. Bight '08 Benthic Community Analysis

	RBI Score	RBI Category	IBI Score	IBI Category	BRI Score	BRI Category	RIVPACS SCORE	RIVPACS Category	SQO Benthic Category
Basin C	0.05	High Disturbance	2	Moderate Disturbance	63.60	Moderate Disturbance	0.54	Moderate Disturbance	Moderate Disturbance
Basin E	0.02	High Disturbance	1	Low Disturbance	65.71	Moderate Disturbance	0.42	Moderate Disturbance	Moderate Disturbance
Basin G	0.12	Moderate Disturbance	1	Low Disturbance	58.51	Moderate Disturbance	0.56	Moderate Disturbance	Moderate Disturbance
Main Channel (near front basins)	0.57	Reference	1	Low Disturbance	35.92	Reference	0.78	Low Disturbance	Low Disturbance
Main Channel (Harbor Outlet)	0.61	Reference	1	Low Disturbance	34.26	Reference	0.65	Moderate Disturbance	Low Disturbance

Results of the benthic community evaluation conducted as part of the Sediment Characterization Study (Weston Solutions 2008) are presented in Table 4-9. A map of the station locations can be found in the study report; however, the naming scheme includes either the basin (A, B, C, D, E, F, G, or H) or "MC," indicating the station is in the main channel of the harbor. Thirteen of the sixteen sites in Marina del Rey Harbor were categorized as exhibiting either moderate or high disturbance of the benthic community. One site in the main channel, MC-4, was categorized as a "reference" site.

Table 4-9. Sediment Characterization Study Benthic Community Analysis

Station Name	IBI Score	RBI Score	BRI Score	RIVPAC Score	SQO Benthic Category
A-2	1	0.10	43.98	0.73	Moderate Disturbance
B-2	2	0.08	46.00	0.36	Moderate Disturbance
C-2	0	0.09	55.32	0.61	Moderate Disturbance
D-2	1	0.10	52.64	0.61	Moderate Disturbance
D-3	2	0.03	47.54	0.24	High Disturbance
E-1	1	0.09	49.63	0.48	Moderate Disturbance
E-3	2	0.03	36.86	0.12	High Disturbance
E-4	2	0.04	38.46	0.36	Moderate Disturbance
F-1	0	0.10	54.95	0.61	Moderate Disturbance
G-2	1	0.07	47.81	0.61	Moderate Disturbance
H-2	0	0.38	47.04	0.73	Low Disturbance
MC-1	1	0.08	48.42	0.61	Moderate Disturbance
MC-2	1	0.10	52.38	0.48	Moderate Disturbance

MC-3	1	0.12	41.33	0.24	Moderate Disturbance
MC-4	0	0.45	36.10	0.73	Reference
MC-5	1	0.23	31.03	0.85	Low Disturbance

ABC Labs used benthic data collected during their 2007-2008 monitoring to calculate three of the benthic indices (BRI, IBI, RBI) necessary for determining the benthic component of the SQOs (ABC Labs 2009). The range of values reported for the RBI score are not consistent with those utilized for SQO evaluation (SWRCB 2009). Due to uncertainty regarding the calculation of the benthic indices, those values are not presented in this report. However, raw data included in the report from ABC Labs may be useful for potential future benthic community analyses.

4.1.2 Summary of Additional Impairments in Front Basins of Marina del Rey Harbor

In conclusion, new data available since the adoption of the TMDL demonstrate additional sediment impairments in the front basins of Marina del Rey Harbor. A TMDL revision is proposed for the additional geographic area. Sections 4.1.3 through 4.1.6 describe the elements of the revised TMDL to include the expanded area (back basins and front basins).

4.1.3 Numeric Targets for Sediment Impairments Based on Revised Geographic Area

Expansion of the area of impairment in Marina del Rey Harbor to encompass all of the basins necessitates re-evaluation of the numeric targets for these pollutants. The numeric sediment targets for the front basins in the current TMDL are set equivalent to Effects Range-Low (ERL) sediment quality guidelines derived by the National Oceanic and Atmospheric Administration. These concentration-based targets are appropriate for the front basins as well as the back basins and the application of the numeric targets should be updated to reflect the newly defined geographic boundary of the impairment.

The front basin sediments were not found to be impaired due to lead; however, it remains on the 303(d) list for the back basins and is being addressed by the current TMDL. For purposes of continuity within the TMDL as well as addressing the watershed holistically, this TMDL addresses all constituents on a watershed basis and consequently, the numeric target for lead in sediment is applied to the entirety of the area addressed by the TMDL rather than remaining confined to the back basins. The TMDL for lead in the front basins is set to maintain existing conditions. This will eliminate any necessity to deal with the back basins as an isolated component of the marina. No additional implementation actions or increased costs are anticipated as a result of aligning the extent of the lead impairment with that of all other constituents addressed through the TMDL. Table 4-10 lists the sediment numeric targets for the entire Marina del Rey Harbor.

Table 4-10. Numeric Targets for Sediment Quality in Marina del Rey

	Pollutant	Numeric Target
Metals	Copper	34 mg/kg
	Lead	46.7 mg/kg
	Zinc	150 mg/kg
Organics	Chlordane	0.5 µg/kg
	Total PCBs	3.2 µg/kg[1]

4.1.4 Loading Capacity for Sediment Impairments Based on Revised Geographic Area

The loading capacity of the sediments of Marina del Rey Harbor is based on annual average total suspended solids (TSS) loading to the harbor. TSS values were estimated from the PLOAD model prepared for U.S. EPA Region IX and included in the original TMDL (LARWQCB 2005c) (Table 4-11). Future revisions to TSS estimates from Marina del Rey Harbor may be warranted based on the results of the storm-borne sediment pilot study discussed in section 2.1.3.

Table 4-11. Average Annual TSS Loading to Marina del Rey Harbor (Front and Back Basins)

Subwatershed	TSS (lb/yr)	TSS (kg/yr)
Area 1A	21,933	9,948
Area 1B	45,074	20,,445
Area 3	7,788	3,533
Area 4	111,742	50,685
Total	186,537	84,612

Assuming fine sediments carried by storm water to be the main source of contaminated sediments to the harbor, pollutant specific loading capacity was calculated by multiplying the average annual total suspended solids load of 84,612 kg/yr discharged to the harbor by the numeric sediment targets (Table 4-10). The resultant numbers are presented in Table 4-12. The TMDL for sediment is set equal to the loading capacity.

Table 4-12. Loading Capacities for Marina del Rey Sediment Based on Revised Geographic Area

	Pollutant	Loading Capacity
Metals	Copper	2.88 kg/yr
	Lead	3.95 kg/yr
	Zinc	12.69 kg/yr
Organics	Chlordane	0.04 g/yr
	Total PCBs	1.92 g/yr

[1] Fish tissue associated sediment target, see section 4.7.

4.1.5 Updated Load Allocations for Marina del Rey Sediment Impairments Based on Revised Geographic Area

A mass-based load allocation is developed for direct atmospheric deposition (Table 4-13). An estimate of direct atmospheric deposition was based on the percent area of surface water within the watershed area, which is approximately 203 acres or 11.7% of the total watershed area according to the report on the PLOAD model prepared for U.S. EPA Region IX and included as an appendix in the original TMDL (LARWQCB 2005c). The load allocation for atmospheric deposition is calculated by multiplying this percentage by the total loading capacity, according to the following equation:

Direct Atmospheric Deposition = 0.117 x TMDL

Table 4-13. Load Allocations for Direct Atmospheric Deposition

	Pollutant	Load Allocation
Metals	Copper	0.34 kg/yr
	Lead	0.46 kg/yr
	Zinc	1.49 kg/yr
Organics	Chlordane	0.005 g/yr
	Total PCBs	0.225 g/yr

4.1.6 Waste Load Allocations for Marina del Rey Sediment Impairments

Waste load allocations are assigned for all point sources that drain to the front and back basins.

4.1.6.1. Waste Load Allocation for Storm Water

A mass-based waste load allocation (WLA), for the impairing pollutants in sediment is developed for the storm water permittees by subtracting the load allocation for direct atmospheric deposition from the TMDL according to the following equation (Table 4-14):

Combined Storm Water Sources = TMDL - Direct Atmospheric Deposition

Table 4-14. Grouped Storm Water Allocation Based on Revised Geographic Area

	Pollutant	Grouped Storm Water WLA
Metals	Copper	2.54 kg/yr
	Lead	3.49 kg/yr
	Zinc	11.20 kg/yr
Organics	Chlordane	0.04 g/yr
	Total PCBs	1.70 g/yr

The combined storm water waste load allocation (Table 4-14) is divided among the four storm water permits (MS4, Caltrans, general industrial, and general construction) based on an estimate of the percentage of land area covered under each permit (Table 4-15). The percent land area has been updated since the original TMDL based on new area draining to the front basins and a revision in the number of permittees enrolled in the general construction storm water permit. Based on these areas, the waste load allocations for each group of storm water permittees are presented in Table 4-16.

Table 4-15. Areal Extent of Watershed Land Area and Percent Area Covered by Storm Water Permits Based on Revised Geographic Area

Category	Area (acres)	Percent Area
Los Angeles County MS4 Permit	1177	~~77.1~~88.9
Caltrans Storm Water Permit	19	~~1.2~~1.4
General Construction Storm Water Permit	121	~~7.9~~9.2
General Industrial Storm Water Permit	6	~~0.4~~0.5
~~Water (for direct atmospheric deposition)~~	~~203~~	~~13.3~~
Total	~~1527~~1324	100.0

Table 4-16. Combined Storm Water Allocation Apportioned Based on Percent of Watershed based on revised geographic area Based on Revised Geographic Area

Metals	General Construction Permittees (kg/yr)	General Industrial Permittees (kg/yr)	Caltrans (kg/yr)	MS4 Permittees (kg/yr)
Copper	~~0.20~~0.23	~~0.01~~0.012	~~0.032~~0.036	~~1.96~~2.26
Lead	~~0.28~~0.32	~~0.006~~0.016	~~0.04~~0.05	~~2.69~~3.10
Zinc	~~0.89~~1.023	~~0.018~~0.053	~~0.14~~0.16	~~8.64~~9.96
Organics	**General Construction Permittees (g/yr)**	**General Industrial Permittees (g/yr)**	**Caltrans (g/yr)**	**MS4 Permittees (g/yr)**
Chlordane	~~0.0030~~0.0034	0.0002	0.0005	~~0.0288~~0.033
Total PCBs	~~0.0002~~0.16	~~0.0069~~0.0080	~~0.0001~~0.024	~~1.31~~1.51

Each storm water permittee enrolled under the general construction or industrial storm water permits will receive individual waste load allocations on a per acre basis, based on the acreage of their facility as presented in Table 4-17.

Table 4-17. Per Acre Waste Load Allocation for an Individual General Construction or Industrial Storm Water Permittee Based on Revised Geographic Area

	Pollutant	WLA
Metals		
	Copper	~~1.7~~1.9 g/yr/ac
	Lead	~~2.3~~2.6 g/yr/ac
	Zinc	~~7.3~~8.5 g/yr/ac
Organics		
	Chlordane	~~0.02~~0.03 mg/yr/ac
	Total PCBs	~~1.1~~1.3 mg/yr/ac

4.1.6.2. Waste Load Allocation for Other NPDES Permits

As was done in the original TMDL, the concentration-based sediment waste load allocations for the minor and general non-storm water NPDES permits for the front and back basins are set equal to the sediment numeric targets (Table 4-18).

Table 4-18. Concentration-Based Waste Load Allocation for Marina del Rey Sediment

	Pollutant	WLA
Metals		
	Copper	34 mg/kg
	Lead	46.7 mg/kg
	Zinc	150 mg/kg
Organics		
	Chlordane	0.5 µg/kg
	Total PCBs	3.2 µg/kg

4.2 DDT Sediment Impairment

DDT in Marina del Rey Harbor sediment was included on the 1998 303(d) list. When the Marina del Rey Harbor Toxic Pollutants TMDL (LARWQCB 2005c) was put into place in 2005 it included a finding of non-impairment for DDT in Marina del Rey Harbor sediments and the pollutant was therefore not addressed by the TMDL. New data has been collected since the adoption of the TMDL indicating that a DDT impairment does exist in Marina del Rey Harbor sediments. Consequently, it is recommended that a DDT impairment be included on the 303(d) list for Marina del Rey Harbor and addressed through this TMDL.

4.2.1 Data Supporting DDT Impairment in the Sediment in Marina del Rey Harbor

The original TMDL did not address DDT as there was a finding of non-impairment for DDT in Marina del Rey Harbor. As such, DDT data is not currently being collected through the Coordinated Monitoring Plan. DDT data has been analyzed in the front and back basin sediments of Marina del Rey Harbor through the monitoring conducted by ABC Labs (ABC Labs 2006, ABC Labs 2007, ABC Labs 2009) and as part of the

Sediment Characterization Study (Weston Solutions 2008). The Sediment Characterization Study included sample sites near the outlet of the Marina. These data are not included here as dredging of the marina outlet has occurred since this sampling.

Sediments were analyzed for total DDT as well as p,p’ DDD, p,p’ DDE, and p,p’ DDT. Only total DDT and p,p’ DDE will be discussed here as the data indicates impairment exists due to these constituents. Figure 4-9 illustrates findings for total DDT. Between the two studies, forty-two samples were analyzed for total DDT. Four of the forty-two samples exceeded the ERM of 46.1 µg/kg (Table 4-19). Figure 4-10 illustrates findings for p,p’ DDE. When the two studies are combined, eight of forty-two samples exceed the ERM of 27 µg/kg (Table 4-19). The number of exceedances for total DDT and p,p’-DDE indicate that Marina del Rey Harbor is impaired due to these constituents.

Figure 4-10. Total DDT in Marina del Rey Harbor

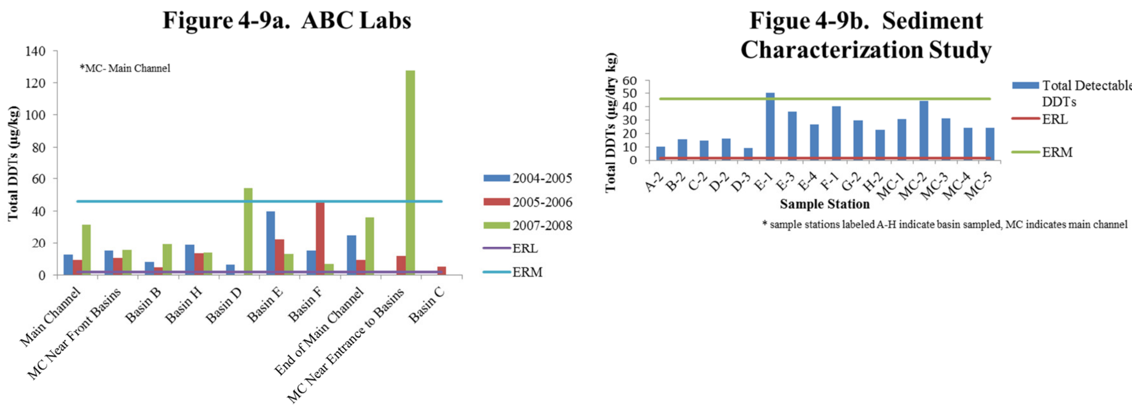


Figure 4-11. p,p’-DDE in Marina del Rey Harbor

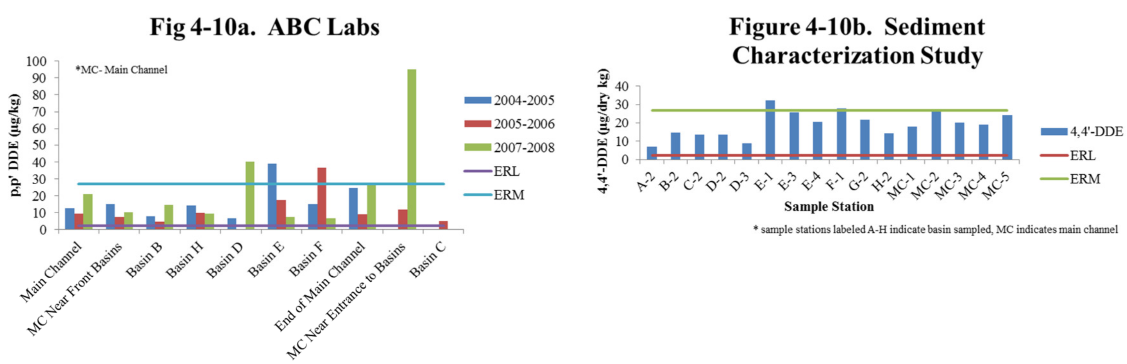


Table 4-19. Basis for Impairment Finding due to DDT in Marina del Rey Harbor

	# Samples	# Total DDT Exceedances of ERM	# p,p' DDE Exceedances of ERM	Minimum # Exceedances Required to List (SWRCB 2004)
ABC Labs	26	**3**	**5**	3
Sediment Characterization Study	16	1	**3**	2
Total	42	**4**	**8**	4

* Values in bold indicate sufficient exceedances to identify impairment per the State's listing policy.

4.2.2 303(d) Listing of DDT in Marina del Rey Harbor

The following narrative objective in the Basin Plan applies to DDTs in sediment:

No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.

For purposes of evaluating impairments, the above narrative objective can be quantitatively analyzed by using effects range-median (ERM) values found in NOAA's Sediment Quality Guidelines (NOAA 1999). This is consistent with the evaluation of other toxic pollutants in the Marina del Rey Watershed as well as throughout the region.

Available data for DDT in Marina del Rey Harbor sediments was reviewed in section 4.2.1 of this report. Forty-two samples have been collected since the adoption of the TMDL. Four of these samples exceeded the ERM for Total DDT and eight samples exceeded the ERM value for p,p' DDE (Table 4-19). The minimum number of exceedances requiring listing of a pollutant on the 303(d) list for a particular water body is dependent on the total number of samples evaluated (SCWRB 2004). When evaluating forty-two samples, four or more exceedances are required for 303(d) listing of a toxicant. Following this policy, both total DDT and p,p' DDE should be listed on California's 303(d) list for Marina del Rey Harbor.

4.2.3 Source Assessment for DDT Sediment Impairment

Dichlorodiphenyltrichloroethane, DDT, is a legacy insecticide banned from agricultural usage in the United States in 1972. DDT can still be legally manufactured in the United States for sale or use by foreign countries. According to the National Pesticide Information Center, DDT is bioaccumlative, affects the nervous system by interfering with normal nerve impulses, and has been categorized by U.S. EPA as having been shown to cause cancer in laboratory animals. The half-life of DDT in aquatic environments is approximately 150 years.

DDT impairments are prevalent throughout Los Angeles and Ventura Counties. In the area regulated by the California Regional Water Quality Control Board, Los Angeles Region, TMDLs for DDTs are in place for: Ballona Creek Estuary (LARWQCB 2005a), Calleguas Creek (LARWQCB 2005b), Colorado Lagoon (LARWQCB 2009a), McGrath Lake (LARWQCB 2009b), Machado Lake (LARWQCB 2010), Dominguez Channel

(LARWQCB 2011), Greater Los Angeles Harbor (LARWQCB 2011), Greater Long Beach Harbor (LARWQCB 2011), Oxnard Drain #3 (U.S. EPA 2011b), Santa Monica Bay (U.S. EPA 2012a), Peck Road Park Lake (U.S. EPA 2012b), and Puddingstone Reservoir (U.S. EPA 2012b).

There are fifteen NPDES permits in the Marina del Rey Watershed. The current NPDES permits are listed in Table 4-20. This is an update of Table 4-1 in the Staff Report of the original TMDL (LARWQB 2005c). These permits for existing discharges and any permits issued in the future for new discharges will be utilized by the Regional Board to implement this TMDL.

Table 4-20. NPDES Permits in the Marina del Rey Watershed

Type of NPDES Permit	Number of Permits (2013)
Phase I Municipal Separate Storm Sewer System (MS4)	1
California Department of Transportation Storm Water	1
General Construction Storm Water	8
General Industrial Storm Water	4
Total	**15**

The following beneficial uses designated in Marina del Rey Harbor are impaired by DDT contamination: water contact recreation (REC 1), marine habitat (MAR), wildlife habitat (WILD), commercial and sport fishing (COMM), and shellfish harvesting (SHELL).

The sources of DDTs in Marina del Rey Harbor are the same as those of other organic pollutants (e.g., chlordane and PCBs) causing water quality impairments in Marina del Rey Harbor. Although it is no longer used in the US, DDT persists in the environment, adhering strongly to soil particles. It is assumed that the only source of DDT in the watershed is storm water runoff carrying historically deposited DDT most likely attached to eroded sediment particles.

4.2.4 Numeric Target for DDTs Sediment Impairment

Dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyldichloroethane (DDD) are the major breakdown products of DDT in the environment as well as being components of the original DDT pesticide mixtures. Water quality guidelines are available based on total DDT (DDT+DDD+DDE) as well as for the individual compounds. As discussed in section 4.2.1, concentrations of both DDE and total DDT in Marina del Rey Harbor sediments exceed ERL (effects range low) sediment quality guidelines. Concentrations of the individual compounds DDD and DDT were below ERLs in Marina del Rey Harbor; therefore, TMDLs are necessary only for DDE as an individual compound and Total DDTs. The numeric targets in the TMDL are set equivalent to the ERLs (Table 4-21). Consistent with other TMDLs in the region, including those for organic pollutants in Marina del Rey Harbor, selection of the ERL is considered to be a conservative numeric target and thus inclusive of an implicit margin of safety.

Table 4-21. Numeric Targets for DDT Sediment Impairment

	ERL (ug/kg)
p,p' DDE	2.2
Total DDT (DDD + DDE + DDT)	1.58

As will be discussed in section 4.10.1, SQOs are proposed as an alternate means of demonstrating compliance with the sediment TMDL. This option will apply to DDTs as well as all other pollutants addressed in the Marina del Rey Harbor Toxic Pollutants TMDL. Responsible parties have an option to comply with the TMDL by demonstrating that the protective condition identified in the SQOs is met in the harbor sediments. If such evidence is provided to the Regional Board, the responsible parties will have met the TMDL requirements and would not need to demonstrate compliance with the chemistry based numeric targets or waste load allocations.

4.2.5 Loading Capacity for DDT Sediment Impairment

The p,p' DDE and total DDT loading capacity of Marina del Rey Harbor sediment was calculated by multiplying the average annual total suspended solids load of 84,612 kg/yr (Table 4-11) discharged to the harbor by the numeric sediment targets (Table 4-22). The same methodology has been used to determine the loading capacity of Marina del Rey Harbor sediment for all metal and organic pollutants addressed by this TMDL (section 4.1.3). The TMDL is set equal to the loading capacity.

Table 4-22. p,p-DDE and Total DDT Loading Capacity for Marina del Rey Harbor

Pollutant	Loading Capacity (g/yr)
p,p' DDE	0.13
Total DDT (DDD + DDE + DDT)	0.19

4.2.6 Load Allocations for Direct Atmospheric Deposition for DDT Sediment Impairment

A mass-based load allocation is developed for direct atmospheric deposition of p,p' DDE and total DDT (Table 4-23). An estimate of direct atmospheric deposition was based on the percent area of surface water within the watershed area of the harbor (front and back basins), which is approximately 203 acres or 11.7% of the total watershed area according to the report on the PLOAD model prepared for U.S. EPA Region IX and included as an appendix in the original TMDL (LARWQCB 2005c). The load allocation for atmospheric deposition is calculated by multiplying this percentage by the total loading capacity, according to the following equation:

Direct Atmospheric Deposition = 0.117 x TMDL

Table 4-23. Load Allocations for Atmospheric Deposition of DDT

Pollutant	Load Allocation (g/yr)
p,p' DDE	~~2.2~~0.022
Total DDT (DDD + DDE + DDT)	~~1.58~~0.016

4.2.7 Waste Load Allocations for DDT Sediment Impairment

Waste load allocations are assigned for all point sources that drain to the front and back basins.

4.2.7.1. Waste Load Allocation for Storm Water

Mass-based waste load allocations for total DDT (DDD+DDE+DDT) and p'p-DDE in sediment are developed for the storm water permittees by subtracting the load allocation for atmospheric deposition from the TMDL according to the following equation (Table 4-24):

Combined Storm Water Sources = TMDL - Direct Atmospheric Deposition

Table 4-24. Grouped Storm Water Allocation

Pollutant	WLA
Total DDT	0.12 g/yr
p,p'-DDE	0.16 g/yr

The combined storm water waste load allocation (Table 4-24) is divided among the four storm water permits (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 4-15 section 4.1.5.1). Based on these areas, the waste load allocations for each storm water permit are presented in Table 4-25.

Table 4-25. Combined Storm Water Allocation Apportioned Based on Percent of Watershed

	General Construction Permit (g/yr)	General Industrial Permit (g/yr)	Caltrans (g/yr)	LA County MS4 Permit (g/yr)
Total DDT	~~0.0094~~0.011	~~0.0005~~0.0006	~~00.0015~~0.0017	~~0.0910~~0.10
p,p'-DDE	~~0.0130~~0.015	~~0.0007~~0.0008	~~0.0020~~0.0024	~~0.1267~~0.15

Each storm water permittee enrolled under the general construction or industrial storm water permits will receive individual waste load allocations on a per acre basis, based on the acreage of their facility as presented in Table 4-26.

Table 4-26. Per Acre Waste Load Allocation for an Individual General Construction or Industrial Storm Water Permittee

Pollutant	WLA
Total DDT	~~0.08~~0.09 mg/yr/ac
p,p'-DDE	~~0.11~~0.12 mg/yr/ac

4.2.7.2. Waste Load Allocation for Other NPDES Permits

Concentration-based sediment waste load allocations have been developed for the minor NPDES permits and general non-storm water NPDES permits that discharge to Marina del Rey Harbor to ensure that these do not contribute loadings to the system that would cause or contribute to exceedances of water quality standards. The concentration-based waste load allocations are equal to the sediment numeric targets (Table 4-27).

Table 4-27. Concentration-Based Waste Load Allocation for Marina del Rey Sediment

	Pollutant	WLA
Metals		
	Copper	34 mg/kg
	Lead	46.7 mg/kg
	Zinc	150 mg/kg
Organics		
	Chlordane	0.5 µg/kg
	Total PCBs	3.2 µg/kg

4.3 Sediment Load Allocations

In order to ensure contaminated sediments are addressed, the proposed TMDL revision includes load allocations for the sediment in the Marina. The load allocations are set equal to the numeric targets in Tables 4-10 and 4-21. This approach has been used in other TMDLs in the region (e.g. 2005 Calleguas Creek Watershed Toxicity, Chlorpyrifos and Diazinon TMDL, 2009 McGrath Lake Pesticides and PCBs TMDL, 2010 Machado Lake Pesticides and PCBs TMDL, and 2011 Los Angeles and Long Beach Harbors Toxic and Metals TMDLs). Load allocations are assigned on a concentration basis (Table 4-28).

Table 4-28. Marina del Rey Harbor Sediment Load Allocations

Pollutant	Sediment Load Allocation
Copper	34 mg/kg
Lead	46.7 mg/kg
Zinc	150 mg/kg
Chlordane	0.5 µg/kg
4,4'-DDE	2.2 µg/kg
Total DDT	1.58 µg/kg
Total PCBs	3.2 µg/kg

4.4 Copper Water Column Impairment

A copper impairment in the water column of Marina del Rey Harbor was not addressed in the original TMDL due to insufficient data to assess the status of a potential impairment. As will be discussed in section 4.4.1, new data collected through the Coordinated Monitoring Plan shows the criterion maximum concentration (CMC) value of the saltwater copper criteria, 4.8 µg/L, established by the California Toxics Rule (CTR), was exceeded at every site investigated in Marina del Rey Harbor.

The CTR established water quality criteria for 126 priority pollutants for the protection of aquatic life and human health. Copper is one of the priority pollutants regulated through the CTR. Based on these exceedances it is recommended that Marina del Rey Harbor be listed as having a copper impairment in the water column during the next listing cycle. It is also recommended that the impairment be addressed through this TMDL by the incorporation of numeric targets, load allocations, and waste load allocations.

4.4.1 Data Supporting Impairment of Copper in the Water Column

Water column exceedances of the California Toxic Rule (CTR) acute and chronic saltwater copper criteria (4.8 µg/L and 4.1 µg/L, respectively) were measured at all sites in both the back basins (Fig. 4-11a) and front basins (Fig. 4-11b) of Marina del Rey Harbor through the Coordinated Monitoring Plan (County of Los Angeles Department of Public Works 2012a, County of Los Angeles Department of Public Works 2012b). There is currently no 303(d) listing for copper in the water column in Marina del Rey Harbor.

Figure 4-12. Copper in Marina del Rey Harbor Water Column

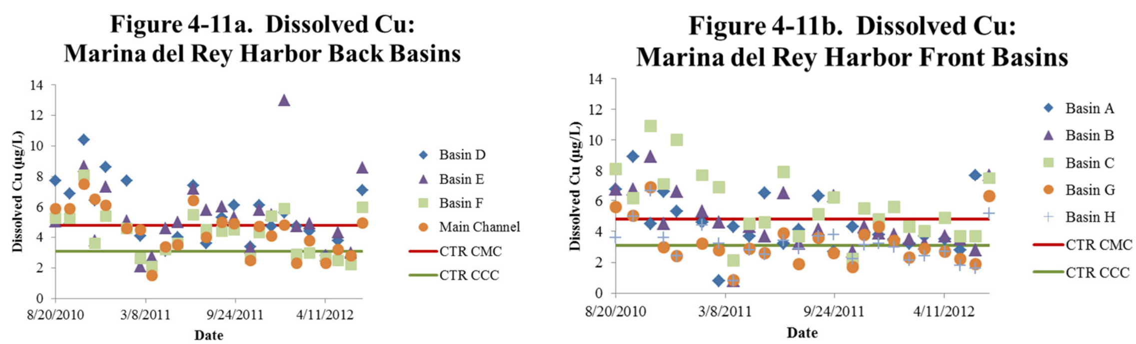


Table 4-29 lists the number of exceedances of the CTR saltwater acute criterion (i.e., Criterion Maximum Concentration, or CMC) of 4.8 µg/L, at sites sampled through the Coordinated Monitoring Plan in each basin of Marina del Rey Harbor. Dissolved copper was measured at a site in the main channel as well and those data are also summarized in Table 4-29. Based on the number of exceedances at each site as well the total number of exceedances throughout the harbor, the water column throughout the harbor is impaired by copper.

Table 4-29. Dissolved Copper in Marina del Rey Harbor

	# Samples	# Exceedances of CTR Saltwater Criteria (CMC)	Minimum # Exceedances Required for 303(d) Listing (SWRCB 2004)
Basin A	24	8	2
Basin B	24	9	2
Basin C	24	14	2
Basin D	24	12	2
Basin E	24	15	2
Basin F	24	8	2
Basin G	24	4	2
Basin H	24	3	2
Main Channel (near Back Basins)	24	9	2
Total	216	82	19

4.4.2 Numeric Target

As discussed above, the CTR established the water quality criteria for copper in both fresh and salt water (40 C.F.R. section 131.38). Numeric targets for dissolved copper in the water column are set equivalent to the CTR saltwater criteria for the protection of aquatic life:

Acute target: CTR CCC (criterion continuous concentration): 4.8 µg/L
Chronic target: CTR CMC (criterion maximum concentration): 3.1 µg/L

4.4.3 Source Assessment

According to a U.S. EPA report, copper is the primary constituent used in most biocidal anti-fouling paints (U.S. EPA 2011c). Staff has estimated the amount of copper entering Marina del Rey Harbor from copper-based hull paints using a model previously utilized in the TMDL for Dissolved Copper in Shelter Island Yacht Basin, San Diego Bay (SDRWQCB 2005) and U.S. EPA's Newport Bay Toxics TMDL (U.S. EPA 2002b). The model quantifies the annual load of copper from antifouling paint by summing the copper loads from passive leaching and hull cleaning. Results of the Marina del Rey Harbor modeling suggest antifouling paints contribute a total of 3609 kg/yr of dissolved copper to Marina del Rey Harbor, 3390 kg/yr of copper from passive leaching and 219 kg/yr of copper due to hull cleaning activity (Appendix A).

In calculating the annual copper load from hull cleaning, the same methodology was employed that was previously incorporated in the TMDL for Dissolved Copper in Shelter Island Yacht Basin, San Diego Bay (SDRWQCB 2005). This quantification is based on rates of copper released during hull cleaning quantified in Schiff (2003). The TMDL for Toxics in Newport Bay, CA (U.S. EPA 2002b), promulgated by U.S. EPA, Region IX and released prior to the publication of the report by Schiff (2003), relies on an earlier study investigating concentrations of copper in plumes created during hull cleaning (U.S.

EPA 2002b). There is a variability of more than two degrees of magnitude in these methods for quantifying copper released during hull cleaning. The methodology incorporated in the Shelter Island Yacht Basin TMDL is based on a more recent study and has been vetted during the adoption of the TMDL; therefore, this method has been used to quantify the loading to Marina del Rey Harbor. The large magnitude of difference in the two methodologies suggests that the method used in the Shelter Island Yacht Basin TMDL, and here in the Marina del Rey Harbor Toxic Pollutants TMDL, may underestimate the copper loading from hull cleaning. Further investigation regarding concentrations of copper in plumes created during hull cleaning would aid in determining the true contribution of this source of the impairment. The U.S. Navy ~~is currently conducting~~recently completed a study on the contribution of copper from antifouling paints that ~~may aid in future refinement of~~are in agreement with these calculations.

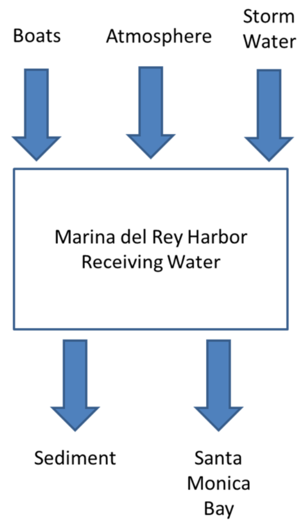
One study investigating copper loading due to hull cleaning has been completed since the adoption of the Shelter Island TMDL (AMEC 2006). The study was conducted in Shelter Island Yacht Basin and estimated an average dissolved copper emission rate of 10.0 $\mu g/cm^2$/event. When applied to the Shelter Island Yacht Basin modeling, which relied on a value of 8.5 $\mu g/cm^2$/event, the predicted annual copper load from hull cleaning increases. The model for Marina del Rey Harbor was tested for sensitivity to this leaching rate. Incorporating a leaching rate of 10.0 $\mu g/cm^2$/event results in less than 1% change in the modeled output of dissolved copper released from hull paint. This is consistent with the finding that reductions in copper inputs to the water column attainable through hull cleaning BMPs are small relative to the passive leaching of copper from antifouling paints (AMEC 2006). For purposes of this evaluation, the original Shelter Island Yacht Basin value is employed in the Marina del Rey Harbor modeling.

Conservative assumptions were employed in the modeling to ensure protection of water quality. The rates calculated in the model are based on the maximum number of ships that might occupy the marina. At the time of this report there are vacant slips in Marina del Rey Harbor; however, the TMDL is designed to be protective of water quality while the harbor is operating at its maximum capacity. It was also assumed that all boats in Marina del Rey Harbor have copper paint and are cleaned regularly while remaining in the water.

4.4.4 Linkage Analysis: Copper in the Water Column

The three known sources of copper to the receiving water of Marina del Rey Harbor are antifouling paint from boats, storm water, and atmospheric deposition (Figure 4-12). Modeling of copper loading from anti-fouling paints in Marina del Rey Harbor suggests 3609 kg/yr of dissolved copper are being released into Marina del Rey Harbor from antifouling paints (Appendix A). The contribution of copper from storm water to Marina del Rey has been evaluated through the original sediment TMDL. The TMDL implementation schedule anticipates that storm water permittees will meet a copper waste load allocation of 2.54 kg/year by 2021. Once copper waste load allocations for the sediment TMDL are met, storm water is not likely to be a significant source of copper to the water column. The amount of copper entering the receiving water (front and back basins of harbor) due to direct atmospheric deposition, 0.34 kg/yr, is also negligible relative to the contribution from antifouling paints. Given the magnitude of copper entering Marina del Rey Harbor from antifouling paint, it is recommended that this source be addressed through TMDL implementation efforts since the data and modeling indicate that antifouling paint from boats are the major source of copper to Marina del Rey Harbor.

Figure 4-13. Dissolved copper mobility in Marina del Rey Harbor



Wood preservatives utilized on pilings and other marina structures can contain copper and may also be a source to the marina. A survey of marinas in California investigating the use of wood preservatives suggested that it was unlikely that copper-treated wood has a significant direct influence on the amount of copper in the water column (Singhasemanon 2009). Based on this information, wood preservatives have not been included in this TMDL. Should new information indicate wood preservatives to be a significant source of copper to Marina del Rey Harbor, the TMDL should be adjusted to reflect this contribution.

Two primary routes are available for copper to be removed from the water column in Marina del Rey Harbor (Figure 4-12): copper migration to the sediment and through water column mixing directly to the adjacent waters of the Santa Monica Bay. The partitioning coefficient study discussed in section 2.1.1 of this report suggests that there is a greater movement of copper from the water column to the marina sediments (not vice versa) and thus the water column is a source of copper to the sediments.

4.4.4.1. Steady-State Copper Model: Marina del Rey Water Column

Modeling of copper flux in Shelter Island Yacht Basin relied on targeted field work and extensive model calibration in San Diego Bay. Given the similarities between Shelter Island Yacht Basin and Marina del Rey Harbor, for purposes of this TMDL use of the Shelter Island model is found to be valid for Marina del Rey Harbor. Refinement of the model may be necessary as efforts to reduce copper pollution in Marina del Rey Harbor proceed and our understanding of the site-specific factors affecting copper in Marina del Rey improves.

A detailed description of the model, including associated assumptions and limitations, was included in the TMDL for Dissolved Copper in Shelter Island Yacht Basin and is included as Appendix B of this report. Adjustments made to the model for its use in Marina del Rey Harbor, including inputs into the model (Table 4-30), are detailed here. The model evaluates total copper in the water column and calculates a maximum dissolved copper concentration of 547 kg/yr to be the maximum concentration that can enter the water column in Marina del Rey Harbor while enabling TMDL numeric targets to be achieved. The TMDL numeric target for copper in the water column is based on the dissolved fraction. Model results in total copper are converted to dissolved copper using a ratio of 0.83 dissolved copper to total copper (U.S. EPA 2000).

Table 4-30. Model Inputs

Variable	Definition	Value
$\mathbf{S_1}$	boundary salinity	33.75 ppt/psu
$\mathbf{S_2}$	box salinity	31.1 ppt/psu
$\mathbf{C_1}$	boundary concentration	0.7 µg/L
$\mathbf{A_c}$	cross sectional area at boundary	1463 m^2
$\mathbf{A_s}$	surface area of box	1,200,000 m^2
e	evaporation rate	0.330409 cm/d
dx	gradient length scale	1310 m
$\mathbf{V_2}$	box volume	6,400,800 m^3
$\mathbf{R_L}$	loss rate to sediment	7 %/day
$\mathbf{R_s}$	input rate to box	1.8 kg/d

$\mathbf{S_1}$: boundary salinity
A review of salinity in Marina del Rey Harbor is included in reporting by ABC Labs (ABC Labs 2007). The discussion included a finding by SCCWRP of mean salinity in ocean samples of 33.75 ppt and, within a subset of that data, ninety percent of samples in Southern California ranging from 33.57 to 33.92 ppt.

$\mathbf{S_2}$: box salinity
Salinity in Marina del Rey Harbor ranged from 33.5 to 31.1 ppt during 2007 to 2008 (ABC Labs 2007). The report with this date noted this range to be typical of previous years. The model calculation regarding salinity is based on the difference between the salinity inside the Marina (referred to as the "box" in the model description) and outside of the marina (referred to as the area outside of the box in the model description). A value of 31.1 ppt was used as a conservative value in the model as inputting the lower end of the salinity range maximizes the difference in salinity between the two areas.

$\mathbf{C_1}$: boundary concentration
The boundary concentration in Marina del Rey Harbor was set equivalent to the value used for the modeling of Shelter Island Yacht Basin as this value, 0.5 µg/L, represents the concentration of total copper in ambient seawater. The value is on based on field measurements made in San Diego Bay.

A_c: cross sectional area at boundary
The boundary of the harbor for the purpose of this box model ends in the main channel adjacent to the beginning of the front basins. The cross-sectional area at this boundary was determined by multiplying the width of the main channel by the depth of the main channel. The width of the main channel, 17.5 ft (5.334m), was determined from the Marina Del Rey nautical chart published by the National Oceanographic and Atmospheric Administration.

A_s: surface area of box
The surface area of the box, 1,200,000 m^2, was determined by GIS and was selected to encompass the area addressed by the Marina del Rey Harbor Toxic Pollutants TMDL. The box area investigated with the model included the front and back basins as well as the main channel area connecting those basins.

e: evaporation rate
The evaporation rate is set equal to the average monthly evapotranspiration rate for the Los Angeles Basin/Santa Monica for the year beginning Aug 2012 and ending July 2013. Monthly evaporation rates were obtained from the Department of Water Resources website (http://wwwcimis.water.ca.gov/cimis/data.jsp).

dx: gradient length scale
The gradient length scale is set equivalent to the length of the main channel from the end of the back basins to the beginning of the front basins, 1310m as determined by GIS.

V_2: box volume
The volume of the harbor was calculated by multiplying the surface area of the harbor, 1,200,000m, by the depth, 17.5 ft (5.334 m).

R_L: loss rate to sediment
The loss rate of copper from the water column to sediment has not been evaluated for Marina del Rey Harbor. The current model employs the R_L value quantified for Shelter Island Yacht Basin as this is believed to be an appropriate estimate of sediment loss rate in Marina del Rey Harbor due to the geographical and ecological similarities in the two harbors. As in Shelter Island Yacht Basin, loss of copper to the sediment is believed to be the dominant means of removal of copper from the water column in Marina del Rey Harbor.

R_s: input rate to box
The input rate into the box represents the amount of copper entering the water column. This value was manipulated to achieve a copper water column concentration equivalent to 3.1 µg/L, the CTR CCC. Given that all other variables in the model are fixed, adjusting the input rate of copper into the system in this manner, utilizes the model to calculate the maximum amount of copper that can enter the water column while achieving TMDL numeric targets, set equivalent to the CTR CCC, in the water

column. The CTR criterion of 3.1 µg/L is a dissolved copper criteria and was converted to total copper, 3.7 µg/L, using a ratio of 0.83 dissolved copper to total copper (U.S. EPA 2000).

Sensitivity Analysis
A sensitivity analysis of the general model is included in Appendix B. A test of the model sensitivity to changes in salinity was performed with site-specific data. Salinity manipulations of the model to encompass the range of salinities measured in Marina del Rey Harbor (ABC Labs 2007) result in a 77.4% to 84.8% required reduction of dissolved copper entering Marina del Rey Harbor to enable the TMDL numeric target to be met in the water column.

4.4.5 Load Allocations

Modeling of copper in the water column, section 4.4.4.1, estimates 547 kg/yr dissolved copper to be the maximum concentration that can enter the water column in Marina del Rey Harbor while enabling TMDL numeric targets to be achieved. This amount is set as the TMDL for dissolved copper in Marina del Rey Harbor.

As discussed in section 4.4.3, antifouling paints are the primary source of dissolved copper to the water column, contributing 3609 kg/yr of dissolved copper. In order to achieve the TMDL, an 85% reduction of copper from antifouling paints is required (Table 4-31).

Table 4-31. Load Allocation Quantification

Dissolved Copper TMDL	547 kg/yr
Current Dissolved Copper Loading from Antifouling Paint	3609 kg/yr
Required Reduction of Dissolved Copper	**85%**

A U. S. Navy research paper was released further investigating leach rates of copper from antifouling paints (Earley 2013) during the public comment period for the proposed TMDL revision (public comment period: November 5, 2013 – January 15, 2014). The study investigated life cycle loading of epoxy and ablative coatings under three scenarios: (1) no cleaning and no movement of boat, (2) cleaning of boat using BMPs, and (3) cleaning of boats without the use of BMPs. The scenario where boats are cleaned using BMPs was compared the findings of this TMDL. Assuming 50% of the boats in the marina use epoxy paints and 50% use ablative paints, the leach rate of dissolved copper for hull cleaning and passive leaching combined is 6.66 $\mu g/cm^2/day$. This value was inputted into the model for Marina del Rey Harbor described in Appendix A and resulted in an annual dissolved copper load of 3474 kg/yr from antifouling paint. For comparison, the dissolved annual copper leaching rate derived in Appendix A and utilized in this TMDL was 3608 kg/yr. The percent reduction in dissolved copper discharged from antifouling paints to meet the TMDL numeric target was also re-calculated based on the findings from Earley (2013) and indicated an 84% reduction in dissolved copper discharge from antifouling paints would be required to meet the TMDL. The calculation, based on the work of Earley, that utilizing hull cleaning BMPs throughout the marina would necessitate an 84% reduction in the amount of dissolved copper entering the marina from antifouling paints, compared to the 85% reduction calculated for this TMDL, further supports the findings of this TMDL.

4.5 Final Target for Water Column PCBs

When the TMDL was initiated, laboratory detection limits for PCBs in the water column were higher than the CTR criterion for the protection of human health from the consumption of aquatic organisms. Both a final target and interim target for PCBs in the water column were placed in the TMDL to allow time for development of more sensitive analytical techniques while acknowledging that the final CTR criterion must eventually be met in Marina del Rey Harbor. Since the effective date of the TMDL more sensitive analysis, namely EPA Method 1668, has become more prevalent. The Santa Monica Bay TMDLs for DDTs and PCBs, established in 2012 by U.S. EPA, recommend the use of Method 1668 for analysis of PCBs (U.S. EPA 2012a). It is acknowledged that employing this method will increase the cost of analysis; however, the current methodology is not sufficiently sensitive for comparison with water quality standards. EPA has validated Method 1668 and states can require permits to include analytical methods more sensitive than those within 40 C.F.R. Part 136. Regional Board Staff recommends removing the interim target for total PCBs in the water column, 0.03µg/L; thus, establishing the final target, 0.00017 µg/L, as the numeric target for total PCBs in the water column of Marina del Rey Harbor. This criterion has previously been applied as a numeric target in the Machado Lake Pesticides and PCBs TMDL.

Since the adoption of the original TMDL, the Office of Environmental Health Hazard Assessment (OEHHA) has published “Health Advisory and Safe Eating Guidelines for Fish from Coastal Areas of Southern California” (OEHHA 2009). Marina del Rey Harbor falls in the area designated by OEHHA as the red zone, between Santa Monica Beach south of Santa Monica Pier to Seal Beach (OEHHA 2009). Pollutant concentrations of fish in the red zone have resulted in reduced consumption or “do not eat” recommendations from OEHHA.

4.6 Fish Tissue Targets

The following narrative objective in the Basin Plan applies to PCBs in fish tissue:

Toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels which are harmful to aquatic life or human health.

The fish tissue target for PCBs in the original TMDL was based on the Threshold Tissue Residual Level derived from CTR human health criteria. In 2008, after the adoption of the original TMDL, the Office of Environmental Health Hazard Assessment (OEHHA) promulgated Fish Contaminant Goals (FCGs) (OEHHA 2008) based on public health considerations from consumption of fish. The FCG for PCBs in fish tissue is 3.6 µg/kg. It is recommended that OEHHA’s FCG be designated as the numeric target for PCBs in fish tissue in Marina del Rey Harbor. This number was used as the numeric target in the Los Angeles and Long Beach Harbors TMDL (Resolution R11-008).

4.7 Sediment Target for Total PCBs

Sediment targets in the original TMDL are based on NOAA's ERL values. Since the adoption of the Marina del Rey Harbor Toxic Pollutants TMDL, precedent has been set to ensure numeric targets in sediment are protective of fish tissue (LARWQCB 2011). The State's Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (EB&E Plan Part 1), which was adopted in 2009 after the original establishment of the toxics TMDL, includes (1) a narrative objective to protect benthic communities along with an evaluation approach based on integrating multiple lines of evidence (the "triad" approach) to determine whether this objective is achieved, and (2) a narrative objective to protect the human health beneficial use. Therefore, it is necessary to include fish tissue targets and associated sediment targets for the bioaccumulatives to protect the human health beneficial use and ensure that the narrative objective for indirect effects contained in the State's EB&E Plan is achieved. The requirement that a TMDL for a particular pollutant must be developed to achieve all water quality objectives for that pollutant set to protect designated beneficial uses was affirmed in a 2011 court decision, Anacostia Riverkeeper, Inc., et al. v. Lisa Jackson, US EPA. In its decision, the court affirmed that a TMDL must address all the beneficial uses and water quality objectives for a particular pollutant whether or not they are listed on the CWA Section 303(d) list.

Modeling by Gobas and Arnot (2010) yielded a bioaccumulation-based sediment concentration of 3.2 µg/kg dry weight total PCBs in sediment to reflect a cancer risk of 10^{-5} from consuming white croaker. This value has previously been applied as a numeric target in the TMDL for Toxic Pollutants in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters. Use of fish tissue targets is appropriate to account for uncertainty in the relationship between pollutant loadings and beneficial use effects (USEPA 2002) and directly addresses potential human health impacts from consumption of contaminated fish or other aquatic organisms. Table 4-32 shows a comparison of the Effects Range-Low (ERL)-based target with the bioaccumulation-based target for total PCBs. The more conservative bioaccumulation-based sediment target is recommended to replace the ERL as the numeric target for total PCBs in the Marina del Rey Harbor Toxic Pollutants TMDL.

Table 4-32. Fish Tissue Associated Sediment Objectives

	ERL (µg/kg)	Fish Tissue Associated Sediment Target (µg/kg dry wt)
Chlordane	0.5	1.3
Total PCBs	22.7	3.2
Total DDT		1.9

Should the numeric targets for total PCBs in fish tissue be met, while the concentration of total PCBs in Marina del Rey Harbor sediment continues to exceed the sediment numeric target designed to be protective of fish tissue, the TMDL should be reconsidered to include a numeric sediment target for total PCBs that is protective of the benthic community (i.e. it may be appropriate to apply the ERL as the numeric sediment target rather than the fish tissue associated sediment objective).

Fish tissue associated sediment values are also available for chlordane and total DDT (Table 4-32) based on thresholds developed by the San Francisco Estuary Institute (Greenfield 2007). These values are less protective than ERLs and thus the ERLs are the appropriate numeric sediment targets for Marina del Rey Harbor to protect the aquatic life beneficial use (direct effects).

4.8 Zinc from Boats

While there is currently not evidence of a zinc impairment in the water column of Marina del Rey Harbor, a sediment impairment is present and is included in this TMDL. Concerns have been raised regarding potential sources of zinc to Marina del Rey Harbor that were not evaluated during the adoption of the original TMDL. Those potential sources as well as an analysis of zinc in the water column are discussed below.

4.8.1 Status of Zinc in the Water Column

As discussed in sections 4.1.1.5 and 4.1.1.6, a zinc impairment persists in the sediment; however, data collected through the Coordinated Monitoring Plan indicate that there is not currently a zinc impairment in the water column. Twenty four samples were analyzed for both total recoverable zinc and dissolved zinc in the water column. Zinc samples in the water column measured below CTR acute and chronic saltwater zinc criteria (90 µg/L and 81 µg/L, respectively) with the exception of both total recoverable and dissolved zinc sampled on January 11, 2012 at site MdRH B-2 (County of Los Angeles Department of Public Works 2012a, County of Los Angeles Department of Public Works 2012b). Sample site MdRH B-2 is located in Basin E. There is currently no 303(d) listing for zinc in the water column in Marina del Rey Harbor, and the single exceedance of zinc at site MdRH B-2 is insufficient to identify Basin E as impaired due to zinc in the water column.

4.8.2 Sources of Zinc from Boats: Sacrificial Anodes

Concerns have been raised by local stakeholders that sacrificial anodes may be contributing to the zinc impairment in Marina del Rey Harbor. Sacrificial anodes are attached to boats in order to reduce the corrosion of other metals. The corroding of the sacrificial anodes releases metals into the water; however, the magnitude of their contribution to impairments in the sediment is uncertain. Zinc is commonly used as a sacrificial anode in Marina del Rey Harbor; the contribution of zinc from these sacrificial anodes to water quality impairments has not been investigated sufficiently to rule them out as a source. A study on marinas throughout California suggested sacrificial anodes to likely be the most significant source of zinc in salt marinas during dry weather (Singhasemanon 2009).

Implementation efforts to address sacrificial anodes may include measures to reduce faulty wiring on boats and docks to slow down the corrosion rates of sacrificial anodes consequently slowing their release of pollutants in the water column. Sacrificial anodes composed of aluminum alloys are becoming more widely available and can serve as replacement for zinc anodes in certain instances. Further study is warranted to quantify the contribution of various sources of zinc to the sediment impairment in Marina del Rey Harbor.

4.8.3 Sources of Zinc from Boats: Antifouling Paint

Zinc is a component of some currently applied antifouling paints (Singhasemanon 2009). There is concern that as new types of hull paint are considered for replacement of copper-based antifouling paints, that paints with higher concentrations of zinc will be employed. This potential outcome may exacerbate the zinc impairment in the sediment as well as result in a possible zinc impairment in the water column. For these reasons, it is recommended that zinc-based hull paints not be employed to replace copper-based hull paints.

4.9 Monitoring

The monitoring requirements in the original TMDL are separated into ambient and effectiveness components. Given that the ambient monitoring phase is expected to be completed before this reconsideration becomes effective, proposed changes will focus solely on effectiveness monitoring, also referred to as compliance monitoring. The ambient monitoring component of the TMDL will remain unchanged.

4.9.1 Sediment Quality Objectives

Sampling for SQOs, as specified in the EBE Plan Part 1 Sediment Quality, shall be required every five years. SQOs were analyzed in Marina del Rey Harbor during Bight '08 and four sites have been sampled in Marina del Rey Harbor as part of Bight '13. The results of these analyses may be used to meet SQO monitoring requirements of this TMDL.

Sediment Quality Objective analyses require a minimum of two toxicity tests: a short term survival test and a sublethal lethal sediment test. The current Coordinated Monitoring Plan (CMP) includes acceptable tests for both of these categories: *Eohausotrius estuarius* 10-day Survival and *Mytilus galloprovincialis* 48-hour Embryo Development. Results from neither of these test fall into the SQO category of High Toxicity; however, *Leptocheirus plumulosus* 28-day Survival, Growth, and Reproduction toxicity test conducted through the CMP all indicate toxicity. As the *L. pulumulosus* 10-day survival test is also an acceptable test for evaluating SQOs, it is recommended that this test be added to future CMP monitoring to ensure that future SQO analyses of Marina del Rey Harbor do not underestimate toxicity.

4.9.2 Toxicity Identification Evaluation

The original TMDL requires responsible parties to conduct a Toxicity Identification Evaluation (TIE) if accelerated toxicity testing results in less than 90% survival in two or more of the six required toxicity tests. To create consistency with the Sediment Quality Objectives, it is recommended that the requirement to perform a TIE be replaced with a requirement to perform stressor identification as detailed in the Water Quality Control Plan for Enclosed Bays and Estuaries (SWRCB 2009). The requirement to perform a stressor identification will be triggered based on results from Bight '08 SQO monitoring.

4.9.3 Water quality

In the original TMDL, no water quality monitoring was required during the effectiveness phase of the CMP. However, monitoring of copper in the water column is necessary to evaluate the status of the water column impairment identified in these revisions to the

TMDL. It is recommended that water quality monitoring in Marina del Rey Harbor continue into the effectiveness/compliance portion of the monitoring plan in the same manner prescribed in the ambient phase.

4.9.4 Bioaccumulation Monitoring

With the exception of total PCBs, data regarding the fish tissue concentrations of pollutants addressed in this TMDL are unavailable. Sediment impairments in Marina del Rey Harbor may be resulting in bioaccumulation of toxic pollutants in aquatic organisms. In order to ensure the TMDL is protective of aquatic life, baseline data is needed. In conjunction with the annual bioaccumulation monitoring conducted through the CMP, analyses should be conducted for bioaccumulation of chlordane and DDTs.

4.10 Implementation

4.10.1 Sediment Quality Objectives Compliance Option for MS4s and Caltrans

The Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (SWRCB 2004) was adopted prior to the Water Quality Control Plan for Enclosed Bays and Estuaries Part 1 Sediment Quality (SWRCB 2009). As such, SQOs are not currently addressed in California's listing policy. The following language from the Water Quality Control Plan for Enclosed Bays and Estuaries states that without a stressor identification having been conducted, categories designated as Possibly Impacted, Likely Impacted, and Clearly Impacted should be considered as degraded while categories designated as Unimpacted and Likely Unimpacted shall be considered as having achieved the protective condition at that station:

> *4. Relationship to the Aquatic Life – Benthic Community Protection Narrative Objective.*
>
> *a. The categories designated as **Unimpacted** and **Likely Unimpacted** shall be considered as achieving the protective condition at the station. All other categories shall be considered as degraded except as provided in b. below.*
>
> *b. The Water Board shall designate the category **Possibly Impacted** as meeting the protective condition if the studies identified in Section VII.F demonstrate that the combination of effects and exposure measures are not responding to toxic pollutants in sediments and that other factors are causing these responses within a specific reach segment or waterbody. In this situation, the Water Board will consider only the Categories Likely Impacted and Clearly Impacted as degraded when making a determination on receiving water limits and impaired water bodies described in Section VII.*

The original TMDL required that WLAs be met according to the implementation schedule in order for responsible parties to comply with the TMDL. In incorporating SQOs, the original means of compliance remains unchanged and additional compliance options should be made available as described below.

Compliance with sediment TMDLs may be demonstrated via any one of three different means:

1. Demonstrate that the sediment quality condition of Unimpacted or Likely Unimpacted via the interpretation and integration of multiple lines of evidence as defined in the EBE Plan Part 1, is met; or
2. Sediment numeric targets are met in bed sediments over a three-year averaging period; or
3. Final allocations in the discharge are met over a three-year averaging period.

In addition, the schedule for the MS4 and Caltrans Permittees draining to the front basins (Basins A, B, C, G, and H) has been extended. Interim WLAs must be met by March 22, 2019 and the final WLAs must be met by March 22, 2021.

4.10.2 Copper Load Allocation to Boats

The collaborative effort of an integrated state-wide or nation-wide approach to addressing copper antifouling paints would increase implementation options and ease the burden on individual boaters by encouraging source control and alternative paint options. Attempts are being made to address water quality impairments related to copper antifouling paints on a wider scale. Copper antifouling paints are addressed in U.S. EPA's vessel general permit adopted in 2008 and reissued in 2013 and, as discussed below, the Department of Pesticide Regulation (DPR) is currently reviewing the use of copper in antifouling paints.

Antifouling paints are considered pesticides and thus are registered in California by the Department of Pesticide Regulation (DPR). On October 5, 2013 the governor approved AB 425, which requires the Department of Pesticide Regulations to determine a leach rate for copper-based antifouling paint used on recreational vessels and to make recommendations for appropriate mitigation measures that may be implemented to address the protection of aquatic environments from the effects of exposure to that paint if it is registered as a pesticide. This legislation could inform measures to address antifouling paints as a source of copper to Marina del Rey Harbor.

DPR has previously investigated the extent of copper pollution in freshwater and saltwater marinas throughout California and the relation of this pollution to antifouling paints (Singhasemanon 2009). The study concluded that during dry weather, antifouling paints are likely the most significant source of copper in saltwater and brackish marinas. The front and back basins of Marina del Rey Harbor were included in this study and found to have the greatest frequency of CTR CCC and CMC exceedances among all marinas included in the study. Toxicity identification evaluations (TIEs) conducted as part of the study found copper to be the likely cause of toxicity in two Marina del Rey samples.

U.S. EPA, in conjunction with the Port of San Diego and the Institute for Research and Technical Assistance, conducted a study on alternatives to copper antifouling paints (U.S. EPA 2011a). Alternative paints found to be optimal through field studies were analyzed for cost effectiveness. The final report includes antifouling paint recommendations and cleaning strategies for various boat types. The Port of San Diego has also made available a guide for boaters regarding selecting alternative hull paint (Unified Port of San Diego, n.d.1) and a calculator for estimating costs of replacing hull paint (Unified Port of San Diego, n.d.2). Broader approaches to antifouling, similar to integrated pest management in terrestrial environments provide alternatives for addressing antifouling that do not rely solely on hull paint (Culver et al. 2012). Integrated pest management incorporates chemical, biological, mechanical/physical, and cultural tactics to aid in minimizing fouling.

The efforts discussed above vary in their readiness for implementation and it is uncertain what outcomes can be anticipated. Therefore the Regional Board is addressing the copper impairment in Marina del Rey Harbor as a site-specific concern. Other Regional Boards in Southern California have already begun to address copper in antifouling paints and it is hoped that addressing the issue in multiple locations throughout the region will increase implementation options by providing incentive for increasing availability of alternative paints, reducing options for non-compliance such as relocation of boats, and allowing for further collaborative efforts. The California Regional Water Quality Control Board, San Diego Region has in place a TMDL addressing copper-based antifouling paints in Shelter Island Yacht Basin. A Toxics TMDL for Newport Bay has also been promulgated by U.S.EPA, which includes a copper TMDL and determined that copper antifouling paint was the highest source of copper to Newport Bay. The metals TMDLs are currently under revision by the Santa Ana Regional Water Quality Control Board, although copper antifouling paints remain the highest source of copper to the Bay, and an implementation plan is being developed to largely address copper-based antifouling paints in Newport Bay. Work in Newport Bay has included research regarding copper concentrations and their relation to antifouling paints (Orange County Coastkeeper 2007). According to a Progress Report regarding the Shelter Island Yacht Basin TMDL, "the most successful copper reduction strategy is the conversion from copper-based anti-fouling hull coatings to "alternative" hull coatings containing little or no copper." This is confirmed by an analysis of boater surveys which concluded that "the most important policy instrument would be to require that new boats use only nontoxic coatings" (Johnson et al. 2004)

While the modeling discussed in section 4.4.3 has shown the contribution of copper from passive leaching to outweigh that from hull cleaning, abrasive hull cleaning techniques can dramatically increase the amount of copper released from hull cleaning. Communication with a professional diver in Marina del Rey Harbor indicated that hull cleaning BMPs being employed in Shelter Island Yacht Basin are not yet being widely utilized in Marina del Rey Harbor. Classes provided by the California Professional Divers Association are available in San Diego. Similar courses may be beneficial to professional divers in Marina del Rey. This would likely necessitate offering the classes in multiple languages to increase accessibility of the information.

4.10.2.1. Regulatory Mechanisms for Copper Load Allocation to Boats

The LAs for discharges of copper from boats in the Marina del Rey are assigned to the County of Los Angeles, individual anchorages, and persons owning boats moored in the Marina. The Regional Board has the authority to implement LAs ~~shall be~~

~~implemented~~ through waste discharge requirements (WDRs), waivers of WDRs, or other regulatory mechanisms in accordance with the Nonpoint Source Implementation and Enforcement Policy. The Regional Board will develop a regulatory mechanism within two years of the effective date of the TMDL to implement the LAs. Should a voluntary program be developed by responsible parties and approved by the Executive Officer within two years of the effective date of the TMDL, such a program may be reflected in the regulatory mechanism.

Compliance with LAs will be demonstrated with monitoring approved by the Executive Officer of the Regional Board through the monitoring program developed as part of the waiver, WDR, or other regulatory mechanism. Compliance may be demonstrated by monitoring receiving water in the Marina and comparing the results to the dissolved copper numeric target, demonstrating that 85% of boats in the harbor are using non-copper hull paints, or by other acceptable methods that would result in attainment of copper numeric targets in the water column (e.g. demonstrating that 100% of boats in the harbor are using hull paint that discharges 85% less copper).

4.10.2.2. Compliance Schedule for Copper Load Allocation to Boats

Discharges of copper from boats shall achieve compliance with LAs by 2024. This schedule assumes that copper-based antifouling pants are replaced with non-toxic paints over ~~an eleven~~a ten-year period and takes into account time to develop a regulatory program, outreach to boat owners, and the time and resources needed to replace paint on 85% of boats in the Marina or to implement an alternative that would result in attainment of copper numeric targets in the water column (e.g. demonstrating that 100% of boats in the harbor are using hull paint that discharges 85% less copper).

4.10.3 Load Allocations to Sediment

In addition to reducing pollutant loading to Marina del Rey Harbor sediments, the impairment in the existing sediment will need to be addressed in order to protect and restore beneficial uses. It is therefore recommended that load allocations are assigned to existing sediment in Marina del Rey Harbor.

4.10.3.1. Regulatory Mechanisms for Load Allocations to Sediment

The County of Los Angeles, the responsible party for the LA for in-situ contaminated sediment within the harbor, shall be given an opportunity within the timeline of the TMDL to develop a contaminated sediment management plan, agreed to through a Memorandum of Agreement (MOA), to address contaminated sediments in Marina del Rey Harbor. Such a MOA must be approved by the Regional Board's Executive Officer. In the event a MOA is not adopted within the time frame mandated by the TMDL, the Executive Officer will issue a cleanup and abatement or other regulatory order to ensure load allocations are met in harbor sediments.

The MOA shall meet requirements pursuant to the development of a non-regulatory implementation program as presented in the Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options (State Board Resolution 2005-0050) section 2 C ii and requirements of this TMDL. To be a valid non-regulatory implementation program adopted by the Regional Board, the MOA shall include the following requirements and conditions:

- The MOA shall direct development of a monitoring and reporting program plan that addresses the impaired waterbody as approved by the Regional Board's Executive Officer.
- The MOA shall contain conditions that require trackable progress on attaining load allocations and numeric targets. A timeline shall be included that identifies the point or points at which Regional Board regulatory intervention and oversight will be triggered if the pace of work lags or fails.
- The MOA shall contain a provision that it shall be revoked based upon findings by the Executive Officer that the program has not been adequately implemented, is not achieving its goals, or is no longer adequate to restore water quality.
- The MOA shall be consistent with the California Policy for Implementation and Enforcement of the Non-point Source Pollution Control Program, including but not limited to the "Key Elements of a Non-point Source Pollution Control Implementation Program".

Responsible parties entering into an MOA with the Regional Board shall submit and implement a contaminated sediment management plan. The plan must be approved by the Executive Officer and may be amended by Executive Officer approval, as necessary. The plan shall include a Monitoring and Reporting Program (MRP) plan to address appropriate monitoring and a clear timeline for the implementation of measures that will achieve the contaminated sediments load allocations. The contaminated sediment management plan shall include annual reporting requirements. In addition to the contaminated sediment management plan and MRP plan, a Quality Assurance Project Plan (QAPP) shall also be submitted to the Regional Board for approval by the Executive Officer to ensure data quality.

The implementation of the contaminated sediment management plan must result in attainment of the TMDL load allocations. Implementation of the MOA, contaminated sediment management plan, and progress toward the attainment of the TMDL load allocations shall be reviewed annually by the Executive Officer as part of the annual monitoring report submitted by the responsible party(ies). If the MOA and contaminated sediment management plan are not implemented such that the TMDL load allocations are achieved, the Regional Board shall revoke the MOA and the TMDL load allocations may be implemented through a CAO or other appropriate regulatory mechanism.

Described below are four potential measures to clean up the contaminated sediments in Marina del Rey.

- Sediment Capping

The objective of sediment capping is to cover contaminated sediment by a layer of clean sediment, clay, gravel, or other material. The cap reduces the mobility of the pollutants and places a physical barrier between the water column and the contaminated sediment. Capping can be an effective remediation action; however, it is most effective in large deep waterbodies under certain conditions. For example, the bottom sediments of the waterbody must be able to support the cap and the hydrologic conditions of the waterbody must not disturb the cap site. This option would require long term monitoring and maintenance to ensure that the contaminated sediments are not moving and that the cap is still in place.

- Dredging/Hydraulic Dredging

Dredging is the removal of accumulated sediments. In the case of Marina del Rey, the objective would be to remove the sediments that are contaminated with OC pesticides and PCBs. Therefore, it would be necessary to dredge to a depth that would ensure the removal of all contaminated sediments. A method of sediment removal is hydraulic dredging. A hydraulic dredge floats on the water and is approximately the size of a boat. It has a flexible pipe that siphons a mix of water and sediment from the bottom of the MArina. The flexible pipe is attached to a stationary pipe that extends to an-off site location. The sediment that is removed is pumped to a settling pond to dry prior to disposal. Hydraulic can cause damage to aquatic life, liberation of toxic pollutants, short term turbid conditions, and low dissolved oxygen. Hydraulic dredging does require careful planning and mitigation for non-target disturbances.

- Combination of Dredging and Capping

Responsible parties may consider combining the remediation measures of dredging and capping. For example, it may be possible to partially dredge and then cap either all of the Marina or particular areas of the Marina. Disposing of dredged contaminated sediment can be very expensive. The approach of combining dredging and capping may minimize the amount of dredge sediment for disposal and effectively remediate the sediments. A feasibility study would be required to determine if this approach is suitable for Marina del Rey.

- Monitored Natural Attenuation of Contaminants

Natural attenuation encompasses the physical, chemical, and biological processes that the sediment may undergo, which over time will attenuate (i.e., reduce concentration and bioavailability) the impacts of contamination. These are natural processes that will occur without other remediation actions. Monitoring would be required as part of this remediation strategy to demonstrate that contaminants are in fact attenuating and that human health and the environment are protected. A disadvantage of choosing natural attenuation as a remediation strategy is that it generally requires long periods of time to be effective given the long half lives of the pollutants of concern.

4.10.3.2. Compliance Schedule for Load Allocations to Sediment

The in-harbor sediment load allocations shall be achieved by March 22, 2029. This assumes that planning for sediment remediation activities will take place while watershed load reduction activities are being implemented, and that remediation of sediment will occur after pollutant sources to the Marina have been controlled. The timing of removal of sediments is dependent on the availability of a suitable location for disposal of dredged material. The Regional Board may reconsider the TMDL implementation schedule if necessary based on the availability of an appropriate sediment placement/disposal site.

4.10.4 Interim Compliance Determination for Stormwater Discharges

The implementation schedule in the TMDL includes interim compliance dates for the MS4 and Caltrans permittees. In the original TMDL interim compliance is determined through an area-based approach where the permittees must demonstrate a percentage of their drainage area meets the full waste load allocations. In order to increase flexibility in implementation and maintain consistency with other TMDLs, including those for Los Cerritos Channel and San Gabriel River, it is recommended that an alternative means of interim compliance be included in the TMDL. The alternative means of compliance would allow MS4 and Caltrans permittees to demonstrate compliance through a percent reduction of their full waste load allocation rather than through demonstration that a specific percentage of the watershed is meeting the final waste load allocation.

4.10.5 Integrated Water Resources Approach for Stormwater Discharges

The original TMDL offered two alternative implementation timelines for MS4 and Caltrans Permittees. The timeline options are dependent on whether or not an integrated resources approach is being applied in implementing the TMDL. Two implementation plans were submitted by MS4 and Caltrans permittees: one plan from the County of Los Angeles, one plan from the Marina del Rey Watershed Agencies (City of Los Angeles, Culver City, and Caltrans). During the process of submitting and accepting the implementation plans, the Regional Board denied requests for the optional extended timeline for applying an integrated resources approach. This decision was based on the BMPs proposed in the implementation plans. The small size of the watershed limits options for such an approach and the opportunities are further reduced by dividing the watershed into different areas between the two implementation plans. Some of the parties have subsequently submitted a Notice of Intent (NOI) to submit an Enhanced Watershed Management Program (EWMP) under the Los Angeles County MS4 permit. While it is possible an integrated resources approach may eventually be applied, it does not seem feasible that this will be evident during the timeline of this TMDL. Therefore, it is recommended that the integrated resources approach timeline be removed from the TMDL and efforts focus on meeting the timeline for a TMDL specific implementation plan.

While, for the reasons discussed above, the proposed implementation does not support an integrated resources approach, an extension of the TMDL timeline is warranted due to the increased efforts necessitated by the findings of this reconsideration. It is recommended that an additional two years be added to each the interim compliance deadline and the final compliance deadline for the MS4 and Caltrans permittees. This will extend the interim compliance date to 10 years after the effective date of the TMDL and the final compliance date to 12 years after the effective date of the TMDL (Table 4-33). The front basin compliance dates for MS4 and Caltrans Permittees, discussed in section 4.10.1, are also included in Table 4-33.

Table 4-33. Implementation Schedule for MS4 and Caltrans Permittees

	Original TMDL	Revised TMDL
Back Basins		
Interim Compliance: 50%	8 years	10 years (March 22, 2016)
Full Compliance: 100%	10 years	12 years (March 22, 2018)
Front Basins		
Interim Compliance: 50%		March 22, 2019
Full Compliance: 100%		March 22, 2021

4.10.6 Oxford Flood Control Basin

The portion of the Marina del Rey watershed that drains to the Back Basins is largely discharged through the Oxford Flood Control Basin via storm drains and then into Basin E through a tidal gate. The Oxford Basin serves as a settling basin and detention basin for the major stormwater inflows to the back harbor. Many studies suggested that the Oxford Basin may be a significant contributor of contaminants in the back basins based on the high contamination levels in the drainage basin and the correlation between back harbor and Oxford Basin concentrations during storm events (LARWQCB 2005c).

The County of Los Angeles is currently planning the Oxford Basin Enhancement Project and expects to complete the project in 2015. The project involves removal of accumulated sediment, which will increase the Basin's sediment retention capabilities, as well as provide circulation improvements, that together will likely lead to a reduction in sediment loading to the back basins of the Marina. To ensure that the Oxford Basin continues to function as a detention basin and does not itself contribute to exceedances of sediment WLAs, the proposed TMDL revision includes the addition of the County of Los Angeles Flood Control District as a responsible party for the sediment WLAs as well as ongoing monitoring in conjunction with other WLA monitoring after the completion of the Oxford Basin Enhancement Project.

5. Additional Cost Considerations for Proposed Changes to the TMDL

The proposed changes to the TMDL, specifically increasing the geographic extent of the TMDL, the addition of load allocations for contaminated Marina sediments, and the addition of load allocations for discharges from copper-based antifouling paints, could result in additional costs for implementing parties and agencies beyond what was contemplated in the original TMDL. The revision of the PCB numeric target is not expected to affect the cost estimates provided in the original TMDL staff report. The use of EPA Method 1668 to achieve lower PCB detection levels may incur additional costs, but these costs would be offset by the reduction in monitoring frequency for other constituents.

5.1 Costs of Increasing the Geographic Extent of the TMDL

The cost analysis for the original TMDL focused on achieving the grouped waste load allocation assigned to the MS4 and Caltrans storm water permittees in the urbanized portion of the watershed that drains to the back basins (1.42 square miles), which could be applied to the general industrial and construction storm water permittees as well (LARWQCB, 2005c). The original analysis assumed that most permittees would likely implement a combination of the structural and non-structural BMPs to reduce sediment transported to the Marina in order to achieve their waste load allocations. The additional analysis here applies the same approach to the urbanized portion of the watershed draining to the front basins (0.4 square miles[2]).

The original TMDL estimated costs of a combination of infiltration trenches and sand filters using estimates provided by U.S. EPA and the Federal Highway Administration (FHWA). These costs were also compared to costs estimated in a region-wide cost study prepared for the Regional Board entitled "Alternative Approaches to Storm Water Quality Control, Prepared for the Los Angeles Regional Water Quality Board" (Devinny et al. 2004). The costs estimated from the original TMDL are presented in Table 5-1.

Table 5-1. Comparison of costs for storm water compliance on a per square mile basis

	Construction Costs ($ million/square mile)
Based on U.S. EPA estimate	2.62
Based on FHWA estimate	1.91
Maximum cost calculated by Devinny et al.	1.84 –2.39

Thus, the additional costs of treating stormwater from the urbanized portion of the watershed draining to the front basins could range from $736,000 to $1,048,000.

5.2 Costs of Complying with Copper Boat Discharge Load Allocations

One reasonably foreseeable method of complying with the load allocations assigned to discharges of copper from boats is the replacement of copper-based antifouling paints with alternative coatings. Alternative, non-toxic antifouling coatings create a slick surface or hard protective layer that prevents fouling organisms from attaching to a boat's hull. Nontoxic hull coatings can be less effective at preventing the attachment of fouling organisms, so they should be used with a companion strategy to increase their efficacy. Such companion strategies may include in-water hull cleaning (to remove built-up organisms), storage in a slip liner, or storage out of water in order to control fouling organisms. Types of alternative coatings and their associated costs are presented in Table 5-2.

[2] The urbanized portion of the watershed draining to the front basins was determined by subtracting open space and water land uses from the total area of the watershed draining to the front basins (1.4 square miles) resulting in an area of 0.4 square miles.

Table 5-2. Costs of alternative antifouling coatings

Type	Cost/gal	Coverage (square feet)
Epoxy	$89 - $140	315-1,574
Ceramic-Epoxy	$98	136
Siliconized Epoxy	$189-$350	144-220
Polymer Based	$40	400

Source: Gonzalez and Johnson, 2008. Prices and other information were effective as of July 2007.

In addition to coating application costs, there are stripping costs because old copper paint must be removed from boats prior to application of alternative coatings. Non-toxic paints are most cost efficient when applied to a new boat or to an existing boat that needs to be stripped of old copper paint as part of routine maintenance. Recent studies have reported stripping costs of approximately $150 per foot (Carson 2009). Thus for an average boat length of 40 feet, it would cost an additional $6,000 compared to a boat owner who includes stripping as part of routine boat maintenance. Although non-toxic antifouling paints cost more to apply and must be cleaned more often, they are more durable and can cost less than copper-based antifouling paints over the long term (Carson 2009, U.S. EPA 2011a). In addition, costs of alternative coatings appear to have decreased over the past several years (Johnson and Gonzalez 2004b, Johnson and Gonzalez 2008).

5.3 Costs of remediating Contaminated Sediments in the Marina

In-situ capping results in the containment of contaminated sediments rather than treatment. Due to the fact the contaminants remain on-site and potentially could be exposed after the capping layer is installed, monitoring is required to verify that contaminants are not mobilizing to the water column and food web. To calculate the cost of in-situ capping, it is assumed that the entire Marina (approximately 203 acres) would be covered with a sand cap approximately one foot thick. In-situ capping would cost about $19,311,762 for installation activities (Table 5-3).

Table 5-3. Installation costs for an in-situ capping approach at Marina del Rey Harbor

Cost Component	Unit Cost	Area, ft^2	Total Cost
Capping Activities[a]	$2.15/$ft^2$	8,842,680	$19,011,762
Total			**$19,311,762**

[a] U.S. EPA, 2002c

Another potential means of remediating the contaminated sediments in Marina del Rey is dredging. According to the County of Los Angeles Department of Beaches and Harbors, sediment disposal costs are $150 to $200 per cubic yard for inland disposal and about $15 per cubic yard for slip fill disposal. Assuming the entire Marina is dredged and the sediment is dredged to a depth of one foot, it would cost approximately $147,378,000 to $196,504,000 to dredge and dispose of contaminated sediments in an inland landfill and approximately $14,737,800 to dispose of contaminated sediments in a harbor slip fill project. This may be an overestimate of the area of sediment that needs to be dredged because it is assumed that the entire Marina will be dredged. Additional sediment characterization would need to be conducted prior to a dredging project to determine the location and amount of sediment that needed to be remediated. It is possible that a combination of dredging and capping will be used to remediate the contaminated sediments and comply with the load allocations, the County of Los Angeles will propose a contaminated sediment remediation/management plan as part of the MOA they will enter into with the Regional Board to implement the load allocations.

6. References

AMEC Earth & Environmental, Inc. May 24, 2006. Copper Loading Assessment from In-water Hull Cleaning Following Natural Fouling: Shelter Island Yacht Basin, San Diego Bay, San Diego, CA.

Aquatic Bioassay & Consulting Laboratories, Inc. (ABC Labs). January 2006. The Marine Environment of Marina del Rey Harbor 2004-2005.

Aquatic Bioassay & Consulting Laboratories, Inc. (ABC Labs). January 2007. The Marine Environment of Marina del Rey Harbor 2005-2006.

Aquatic Bioassay & Consulting Laboratories, Inc. (ABC Labs). February 2009. The Marine Environment of Marina del Rey Harbor 2007-2008.

Bay, S.M., D.J. Greenstein, M. Jacobe, C. Barton, K. Sakamoto, D. Young, K.J. Ritter, and K.C. Schiff. 2011. Southern California Bight 2008 Regional Monitoring Program: I. Sediment Toxicity. Southern California Coastal Water Research Project. Costa Mesa, CA.

Brown & Caldwell. December 22, 2011a. Low Detection Level Study Report, Marina del Rey Harbor Toxic Pollutants TMDL.

Brown & Caldwell. December 22, 2011b. Partitioning Coefficient Study Report, Marina del Rey Harbor Toxic Pollutants TMDL.

Carson RT, Damon M, Johnson LT, Gonzalez JA. 2009. Conceptual Issues in Designing a Policy To Phase Out Metal-Based Antifouling Paints on Recreational Boats in San Diego Bay. *Journal of Environmental Management* 90: 2460-2468.

County of Los Angeles Department of Public Works. January 30, 2012a. Marina del Rey Harbor Toxic Pollutants Total Maximum Daily Load Coordinated Monitoring Plan Ambient Monitoring 2010-11.

County of Los Angeles Department of Public Works. 2012b. Marina del Rey Harbor Toxic Pollutants Total Maximum Daily Load Coordinated Monitoring Plan Ambient Monitoring 2011-12.

Culver, C., L. T. Johnson, and M. Lande. 2012. IPM for Boats: Integrated Pest Management for Hull Fouling in Southern California Coastal Marinas. UCCE-SD Technical Report 2012-2 California Sea Grant Report T-074

Devinny, Kamieniecki, and Stenstrom. 2004. "Alternative Approaches to Storm Water Quality Control", included as App. H to Currier et al. "NPDES Stormwater Cost Survey" (2005).

Early, P. J., B. L. Swope, K. Barbeau, R. Bundy, J. A. McDonald and I. Rivera-Duarte. November 7, 2013. Life cycle contributions of copper from vessel painting and maintenance activities. *Biofouling*. **Electronic release ahead of journal release, no vol page #s available**

Gobas F. A.P.C. and J.A. Arnot. 2010. Food web bioaccumulation model for polychlorinated biphenyls in San Francisco Bay, California, USA. *Environmental Toxicology and Chemistry* 23(6): 1385-1395.

Greenfield, B. K., A. R. Melwani, J. J. Oram, and S. M. Bay. 2007. Indicator development and framework for assessing indirect effects of sediment contaminants. SFEI Contribution #524. San Francisco Estuary Institute, Oakland, CA.

Johnson, L. T., R. Carson, J.A. Miller, and M. Damon. 2004a. Measuring Economic Incentives for Using Nontoxic Antifouling Strategies. Proceedings of The Coastal Society 19th International Conference, Newport, RI.

Johnson, L. T. and J. A. Gonzalez. 2004b. Staying Afloat with Nontoxic Antifouling Strategies for Boats. Regents of the University of California, California Sea Grant College Program Report. No. T-054: 21.

Johnson, L. T. and J. A. Gonzalez. 2008. Alternative Antifouling Strategies Sampler. Regents of the University of California, California Seat Grant College Program Report. No. T-065: 9.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2005a. Ballona Creek Estuary Toxic Pollutants TMDL. Regional Board Resolution 2005-008.

Los Angeles Regional Water Quality Control Board (LARWCB). 2005b. Total Maximum Daily Loads (TMDLs) for Organochlorine (OC) Pesticides, Polychlorinated Biphenyls (PCBs) and Siltation in Calleguas Creek, Its Tributaries, and Mugu Lagoon. Regional Board Resolution 2005-010.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2005c. Marina del Rey Harbor Toxic Pollutants TMDL. Regional Board Resolution 2005-012.

Los Angeles Regional Water Quality Control Board (LARWQCB) and U.S. EPA Region IX. 2005d. Staff Report: Total Maximum Daily Load for Toxic Pollutants in Marina del Rey Harbor. Final Report: October 6, 2005.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2009a. Total Maximum Daily Load for Organochlorine (OC) Pesticides, Polychlorinated Biphenyls (PCBs), Sediment Toxicity, Polycyclic Aromatic Hydrocarbons (PAHs), and Metals for Colorado Lagoon. Regional Board Resolution 2009-005.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2009b. Total Maximum Daily Load for PCBs, Pesticides and Sediment Toxicity in McGrath Lake. Regional Board Resolution 2009-006.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2010. Total Maximum Daily Load for Pesticides and PCBs for Machado Lake. Regional Board Resolution 2010-008.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2011. Total Maximum Daily Load for Toxic Pollutatnts in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters. Regional Board Resolution 2011-008.

NOAA. June 12, 1999. Sediment Quality Guidelines developed for the National Status and Trends Program.

Office of Environmental Health Hazard Assessment (OEHHA). June 2008. Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCbs, Selenium, and Toxaphene.

Office of Environmental Health Hazard Assessment (OEHHA). June 2009. Health Advisory and Safe Eating Guidelines for Fish From Coastal Areas of Southern California: Ventura Harbor to San Mateo Point.

Orange County Coastkeeper. July 2007. Lower Newport Bay Copper/Metals Marina Study.

Schiff K., D. Diehl, A Valkirs. June 2003. Copper emissions from antifouling paint on recreational vessels. Technical Report 405. Southern California Coastal Water Research Project. Westminster, CA.

Schiff K., R. Gossett, K. Ritter, L. Tiefenthaler, N. Dodder, W. Lao and K. Maruya. July 2011. Southern California Bight 2008 Regional Monitoring Program: III. Sediment Chemistry. Southern California Coastal Water Research Project. Costa Mesa, CA.

San Diego Regional Water Quality Control Board (SDRWQCB). February 9, 2005. Total Maximum Daily Load for Dissolved Copper in Shelter Island Yacht Basin, San Diego Bay: Basin Plan Amendment and Technical Report. Resolution No. R9-2005-0019, California Regional Water Quality Control Board, San Diego Region.

Singhasemanon, N., E. Pyatt, and J. Bacey. June 2009. Monitoring for Indicators of Antifouling Paint Pollution in California Marinas. California Department of Pesticide Regulation. California Environmental Protection Agency. Sacramento, CA.

State Water Resources Control Board (SWRCB). September 2004. Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. Resolution No. 2004-0063, State Water Resources Control Board, Sacramento, CA.

State Water Resources Control Board (SWRCB). 2009. Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality. Resolution No. 2008-0070, State Water Resources Control Board, Sacramento,CA.

Unified Port of San Diego. n.d.1. "How to Select an Alternative Hull Paint: A Boater's Guide." http://www.portofsandiego.org/environment/alternative-hull-paints.html

Unified Port of San Diego. n.d.2. "Non-Biocide Hull Paint Cost Calculator." http://www.portofsandiego.org/environment/alternative-hull-paints/alternative-hull-paint-cost-calculator.html

United States Army Corps of Engineers. September 2005. Los Angeles Regional Dredged Material Management Plan Pilot studies, Los Angeles County, California, Long-Term Evaluation of Aquatic Capping Disposal Alternative

U.S. EPA. 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. United States Environmental Protection Agency. Federal Register. Vol. 65. No. 97. May 18, 2000. Rules and Regulations.

U.S. EPA. June 14, 2002a. Total Maximum Daily Loads for Toxic Pollutants San Diego Creek and Newport Bay, California. U.S. EPA Region 9.

U.S. EPA. 2002b. Technical Support Document: Newport Bay Toxics TMDL Part E- Metals (Cadmium, Copper, Lead, and Zinc). U.S. EPA Region 9.

U.S. EPA. 2002c. Sediment Capping Pilot Study Conducted on Grasse River. Technology Innovation Program-Technology News and Trends. http://www.clu-in.org/products/newsltrs/tnandt/view.cfm?issue=0902.cfm#1 Retrieved March 16, 2009

U.S. EPA, January 2011a. Final Report: Safer Alternatives to Copper Antifouling Paints for Marine Vessels. Project NP00946501-4.

U.S. EPA, October 6, 2011b. Total Maximum Daily Loads for Pesticides, PCBs, and Sediment Toxicity in Oxnard Drain 3. U.S. EPA Region IX.

U.S. EPA, November 2011c. Underwater Ship Husbandry Discharges. EPA-800-R-11-004. Office of Wastewater Management, Washington D.C.

U.S. EPA, March 26, 2012a. Santa Monica Bay Total Maximum Daily Loads for DDTs and PCBs. U.S. EPA Region IX.

U.S. EPA, March 26, 2012b. Los Angeles Area Lakes Total Maximum Daily Loads for Nitrogen, Phosphorous, Mercury, Trash, Organochlorine Pesticides and PCBs. U.S. EPA Region IX.

Weston Solutions. April 2008. Final Report: Marina del Rey Harbor Sediment Characterization Study.

Wu, Youxian, L. Yang, F. Büyüksönmez, R. E. Beighley, Z. Gu, and M. Grey. October 2010. Evaluation of soil erosion and sediment control products for release of heavy metals. *Environmental Engineering Science*. 27(10)905-914.