HARBOR AMBIENT WATER QUALITY SUMMARY
IN SUPPORT OF THE
PORTS OF LOS ANGELES AND LONG BEACH
WATER RESOURCES ACTION PLAN
MAY 19, 2009

Prepared for:
Port of Los Angeles
425 South Palos Verdes St.
San Pedro, California 90731
and
Port of Long Beach
925 Harbor Plaza
Long Beach, California 90802

Submitted by:
AMEC Earth & Environmental, Inc.
9210 Sky Park Court, Suite 200
San Diego, California 92123
(858) 300-4300

19 May 2009

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Harbor Ambient Water Quality Summary
In Support of the
Ports of Los Angeles and Long Beach
Water Resources Action Plan
May 19, 2009

1.0 Introduction

Prior to the 1970s, elevated levels of chemical and bacterial pollutants and debris entering the Los Angeles/Long Beach Harbor complex (harbor) waters severely degraded the harbor environment. As a result of these pollutant levels, harbor waters in many locations were murky, had unpleasant odors in many locations, were littered with debris, and constituted an inhospitable environment for many types of marine life. The water quality in the harbor has improved significantly since the passage of the Clean Water Act (CWA) in 1972. Harbor water quality has improved to a point where the harbor now supports a variety of healthy and diverse biological communities. These water quality improvements were accomplished primarily by eliminating most "point-source" effluent discharges to the Dominguez Channel and harbor, while at the same time regulating and monitoring all other discharges under the National Pollutant Discharge Elimination System (NPDES) provision in the CWA.

With the harbor-wide improvements in water quality observed over the past 30 years, the focus has now shifted from point-source inputs to non-point sources. Non-point source pollutants are discharged to harbor waters from many sources, including the Dominguez Channel and Los Angeles River, storm drains, runoff from port facilities, aerial deposition, in-water vessel maintenance activities, resuspension of contaminated sediments, and others. The Ports of Los Angeles and Long Beach (POLA and POLB, respectively), along with federal, state, and local water quality agencies and other interested parties, are working together to identify the sources of pollutants that enter the harbor, the types and levels of pollutants coming from these sources, and the potential impacts of these pollutants on harbor waters, sediment, and marine life.

To evaluate chemical levels in ambient waters, California has developed numerical water standards for 64 pollutants that are designed to be protective of aquatic organisms and human health. The 64 "priority pollutants" and their numerical standards are defined under the California Toxics Rule (CTR). The water quality standards were developed by conducting numerous laboratory and field toxicity studies. For this report, the CTR standards are used for both harbors, treating the harbor complex as a single "enclosed bay."

From a regulatory standpoint, the harbor complex is listed as currently not meeting their designated beneficial uses. The U.S. Environmental Protection Agency (EPA) and California State Water Resources Control Board (SWRCB) have listed most of the harbor as impaired waterbodies under Section 303(d) of the CWA. The designation of "impaired" is based upon available data that indicates that portions of the harbor fail to meet federal water, sediment, or fish tissue standards due to elevated concentrations of particular pollutants. These pollutants include bacteria, heavy metals (such as copper and zinc), polycyclic aromatic hydrocarbons (PAHs) (chemicals found in coal and oil that are by-products of the combustion process), polychlorinated biphenyls (PCBs), and pesticides (such as DDT).

As a result of these impairment listings, the Los Angeles Regional Water Quality Control Board (RWQCB) and the EPA are working together to set Total Maximum Daily Loads (TMDLs) for the listed pollutant/waterbody combinations. The TMDL process was established under the CWA as a mechanism to address water quality problems in a comprehensive manner (such as on a watershed-wide basis). The first goal of the TMDL process is to establish the maximum amount of a pollutant (for example, pounds of copper per year) that a waterbody can receive and still be able to meet water quality standards. If a waterbody is receiving more pollutant than it can handle, the agencies will establish a pollutant load reduction goal in order to bring the waterbody back into compliance with water quality criteria and to ensure that beneficial uses are not impacted. Pollutant load reductions are accomplished through load allocations which are apportioned among all sources within the watershed.

To date, one TMDL involving Los Angeles Harbor has been established and is in the implementation phase--the Los Angeles Harbor (Inner Cabrillo Beach/Main Ship Channel) Bacteria TMDL (Bacteria TMDL). The TMDLs for these two areas within POLA were combined in one regulation but have very different implementation plans. Inner Cabrillo Beach is an isolated problem that the POLA has been studying intensively. POLA and the City of Los Angeles have undertaken structural improvements to reduce the bacteria levels at the beach. The POLA Main Ship Channel TMDL called for studies to determine if bacteria were a problem throughout the harbor. There is a compliance point at the southern end of the POLA main channel. The POLA, in conjunction with the City of Los Angeles Bureau of Sanitation (BOS), conducted a year-long special study of bacteria levels throughout the Main Channel and Inner Harbor. While a handful of stations very close to storm drains had elevated bacteria, levels were low at all open water stations (away from storm drains). The compliance point consistently met the bacteria TMDL requirements.

TMDLs for all other harbor 303(d) listings are currently under development by the RWQCB and the EPA under the Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters toxic pollutants TMDL.

Several years ago, the POLA and POLB (Ports) recognized that in order to address harbor-wide water quality issues more directly, they needed to obtain a more comprehensive understanding of the current levels of chemical pollutants in harbor waters. While monitoring of physical parameters has been conducted since the late 1960s, in 2005 the Ports initiated ambient water sampling programs that included chemical testing throughout the harbor. The results of those enhanced studies (and other limited water quality studies) are summarized below and provide the basis for spatial and temporal comparison to federal and state ambient water quality criteria.

2.0 Water Quality Studies Evaluated

The chemicals being evaluated for TMDLs were identified from numerous scientific studies of the harbor environment. The agencies evaluated these studies for water chemistry, sediment quality, and the chemical levels found in fish tissue. To date, the majority of data used to drive the 303(d) listing process for the harbor has been obtained from sediment quality studies. Prior to 2006, there was little ambient water quality chemistry available. By comparing the results from the various harbor monitoring stations to federal and/or state criteria, the agency planners have identified problem areas and pollutants of concern. Based upon this information, the harbor was divided into seven TMDL evaluation areas (Figure 1).

Listed below is a summary of the studies that were incorporated into the WRAP development to evaluate the ambient water quality in the harbor, identify chemicals of concern, and establish a water quality baseline for the harbor complex. This list contains only those studies where chemical tests were conducted on harbor water samples. Studies that solely involved the measurement of general water quality parameters (such as dissolved oxygen, water clarity, or salinity), sediments, or fish tissue were not evaluated for this water quality evaluation.

2.1 Port of Los Angeles Port-wide Water Quality Studies

In the POLA, the collection of water column chemistry data was coupled with an ongoing monthly water quality monitoring program. This ongoing monthly program, which dates back to the late 1960s, involves the evaluation of general water quality characteristics (e.g., dissolved oxygen, water clarity, temperature) at numerous locations throughout the harbor.

During seven of these routine monthly monitoring events dating back to 2005, the POLA collected mid-water column samples at a minimum of 30 locations throughout the harbor (Figure 2). These samples were analyzed for the chemicals of concern identified by the CWA 303(d) impairment listing process, as well as other chemicals of interest. These additional chemicals of interest included those typically found in industrialized harbors (e.g., butyltin – a toxic component formerly used in boat paints), as well as those of importance to the San Pedro Bay region (e.g., domoic acid).

The seven collection events were staggered to occur at different times during the year (Table 1), in order to develop a better understanding of seasonal changes in chemical levels in harbor waters. Collections were performed during dry and wet seasons as well as immediately following at least one storm event.

2.2 Port of Long Beach Port-wide Water Quality Studies

In October 2006, November 2008 and February 2009, the POLB conducted port-wide water chemistry studies similar to the POLA Study. POLB's studies involved collection of mid-water samples at 20 stations during the 2006 survey, and 10 stations during the second two studies. Samples were collected throughout the Inner, Middle, and Outer Harbor regions (Figure 1) and analyzed for a broad range of chemicals of concern, including heavy metals, PCBs, PAHs and other semivolatile organic compounds, butyltins, and pesticides.

z:\croix\sd04\aquatics\pola_wq\mxd\2008_report_boundaries.mxd

01/23/2008

amec

POLA/POLB Water Quality Stations and TMDL Areas

FIGURE

1

**Table 1. Los Angeles Harbor
Enhanced Water Quality Study Collection Events**

Event Number	Collection Date	Wet or Dry	Collection Day Characteristics
1	May 12, 2005	Wet	0.12″ rain on May 9, 67ºF, wind 16 mph
2	September 15, 2005	Dry	66ºF, wind 18 mph
3	January 12, 2006	Wet	0.97″ rain on Jan. 1 & 2, 59ºF, wind 10 mph
4	March 1, 2006	Wet	1.58″ rain on Feb. 27 & 28, 57ºF, wind 15 mph
5	January 17, 2008	Dry	52ºF, wind 7 mph
6	May 15, 2008	Dry	60ºF, wind 2 mph
7	September 11, 2008	Dry	64ºF, wind 4 mph

2.3 Surface Water Ambient Monitoring Program (SWAMP)

In 2002-2003, the RWQCB implemented a Surface Water Ambient Monitoring Program at multiple locations within the Dominguez Watershed, including the harbor area. The harbor-wide collection was performed in October 2003 and included field observations, conventional water chemistry, metals, organics, bacteriological testing and toxicity testing at the 30 harbor and San Pedro Bay stations for surface water samples. At 10 of these stations, near-bottom and bottom water samples also were analyzed for conventional water chemistry, metals, organics, and toxicity testing.

2.4 Additional Special Studies

In addition to the monitoring programs described above, the following studies were evaluated for this report.

- The Ports conducted a joint harbor-wide sediment survey in fall 2006 that included the collection of overlying water samples at 60 locations for the analysis of metals and organics.
- The POLB collected water samples at a single location within the harbor concurrent with its multi-station stormwater program. Sampling was performed from 1996 to 2005. Samples were analyzed for total metals only.
- In fall 2006, Southern California Coastal Water Research Project (SCCWRP) performed repeated water sampling at one location in Consolidated Slip, and analyzed the samples for organic contaminants (PCBs, pesticides, and PAHs).
- SCCWRP performed a study in the inner and outer harbor of San Pedro Bay using specialized equipment to measure extremely low levels of the pesticide DDE (a DDT derivative), and PCBs in surface (2 meters subsurface) and near bottom (2 meters above the bottom) samples.
- City of Los Angeles Bureau of Sanitation Terminal Island Treatment Plant water quality monitoring performed near its outfall in the outer Los Angeles harbor area.

This page intentionally left blank.

3.0 Harbor Water Quality

This section discusses the ambient water quality in the harbor based upon the findings of the studies discussed above. To assess water quality, the chemical concentrations measured in these studies have been compared to standard levels that are considered to be acceptable and protective of beneficial uses. When analyzing water chemistry results, it is important to understand that there are low background levels of many chemicals that are naturally found in harbor waters. These include metals such as copper, lead, and zinc. Therefore, the detection of low concentrations of most chemicals in harbor waters is to be expected. Concerns arise when concentrations of these naturally occurring chemicals are increased due to other pollutant sources.

As discussed above, numerical water quality standards for enclosed bays and estuaries in California have been established and are listed in the CTR. The CTR provides two water quality standards: the criterion maximum concentration (CMC) and the criterion continuous concentration (CCC). The CMC, referred to as the "acute" or short-term criterion, is a regulatory standard that equals "*the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects."* The CCC, known as the "chronic" or long-term criterion, is a regulatory standard that equals "*the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects."*

This study assessed water quality conditions in the harbor by comparing the water quality chemistry results discussed above to the acute and chronic CTR standards.

3.1 Dissolved Metals in Harbor Waters

Metal results in water samples are expressed in two ways: total and dissolved concentrations. Total metals are analyzed from whole water samples, without filtration, and include both particulate and dissolved fractions. When a sample is filtered before analysis, the particles are removed, leaving only the dissolved metals.

From a toxicological standpoint, the dissolved metal fraction is considered to be more relevant because it is more bioavailable. (Bioavailability means the chemical can more readily enter an organism's body and cause lethal or sub-lethal effects.) Consequently, California's standards for priority pollutant metals are based upon the dissolved fraction. These standards are listed in Table 2.

Table 2. CTR Water Quality Criteria for Dissolved Metals for the Protection of Aquatic Life

Metal	Saltwater CMC (µg/L)	Saltwater CCC (µg/L)
Arsenic	69	36
Cadmium[1]	40	8.8
Chromium	1,100	50
Copper	4.8	3.1
Lead	210	81
Mercury[1]	1.8	0.94
Nickel	74	8.2
Selenium	290	71
Silver	1.9	NA
Zinc	90	81

CMC = Criterion Maximum Concentration (Acute)
CCC = Criterion Continuous Concentration (Chronic)
[1]Cadmium and Mercury criteria recommended by the EPA
NA = none available

Figures 2 through 10 present dissolved metal concentrations in over 230 harbor water samples collected within the seven TMDL planning areas depicted in Figure 1. These figures show the metal analyzed, the lowest CTR standard level, and plot the results of all samples within the TMDL designated area for each station. The majority of the samples were taken at mid-depth (i.e., halfway between the water surface and harbor bottom) although during the May and September 2008 collection in the POLA, a subset of samples was also collected near the water surface and the harbor bottom. For these and all subsequent figures “n” equals to the number of samples collected for that analysis.

Overall, the results presented here indicate that dissolved metal levels in harbor waters are very low and are protective of marine life only copper is present in concentrations that exceed state criteria. In the vast majority of the samples analyzed, the dissolved metal levels were many times lower than the state standards at which negative impacts on marine life would be expected to occur. Since this assessment was based on water samples collected throughout the entire harbor complex over multiple years and during various climatic conditions, the conclusion can be drawn that in general, dissolved metal inputs from all sources (upstream discharges, stormwater runoff, in-water maintenance activities, aerial deposition, etc.) are not causing an unacceptable buildup of metals in the water column. Although dissolved metal concentrations are low in the water column, the presence of these contaminants in harbor sediments suggests that the water acts as a vehicle for the metals and becomes a concern.

In Los Angeles Harbor, slightly elevated dissolved copper concentrations were observed at two locations: Cabrillo Marina and Fish Harbor. Of the dozens of samples tested in these two locations, there were only three instances where dissolved copper exceeded the state criteria, two of them just slightly above the threshold value (Table 3). Cabrillo Marina and Fish Harbor

have several characteristics in common: they are both semi-enclosed areas with slow water circulation where multiple vessels are berthed. Therefore, the slightly elevated concentrations observed in these locations may be associated with copper anti-fouling bottom paints containing copper as a biocide, or runoff from the local storm drain inputs.

The State of California recognizes that the copper used by boaters as a biocide in bottom paints can build up in marina waters. The Department of Pesticide Regulation is currently evaluating alternatives to copper-containing bottom paints. The POLA will continue to evaluate the copper issue in these locations and monitor the progress of alternative bottom paint options.

In Long Beach Inner Harbor, dissolved copper concentrations slightly exceeded the CTR criteria at two stations (Table 3). LB-1 is located in the Cerritos Channel, and LB-3 is in Channel 3. Similar to the Los Angeles Harbor, the source of copper may be anti-fouling bottom paints or storm drain runoff both coinciding with low flushing areas.

Table 3. Dissolved Copper CCC Exceedances in Los Angeles/Long Beach Harbors

TMDL Area	Station	Date	CTR CCC Criteria (µg/L)	Sample Value (µg/L)	Depth
Fish Harbor	LA 11A	Sept 2005	3.1	3.16	Mid-depth
Cabrillo Marina	LA 06	May 2008	3.1	9.91	Surface
	LA 06	Sept 2008	3.1	3.24	Mid-depth
LB Inner Harbor	LB-1	Nov 2008	3.1	3.71	Mid-depth
LB Inner Harbor	LB-3	Nov 2008	3.1	3.38	Mid-depth

Figure 2. Dissolved Copper

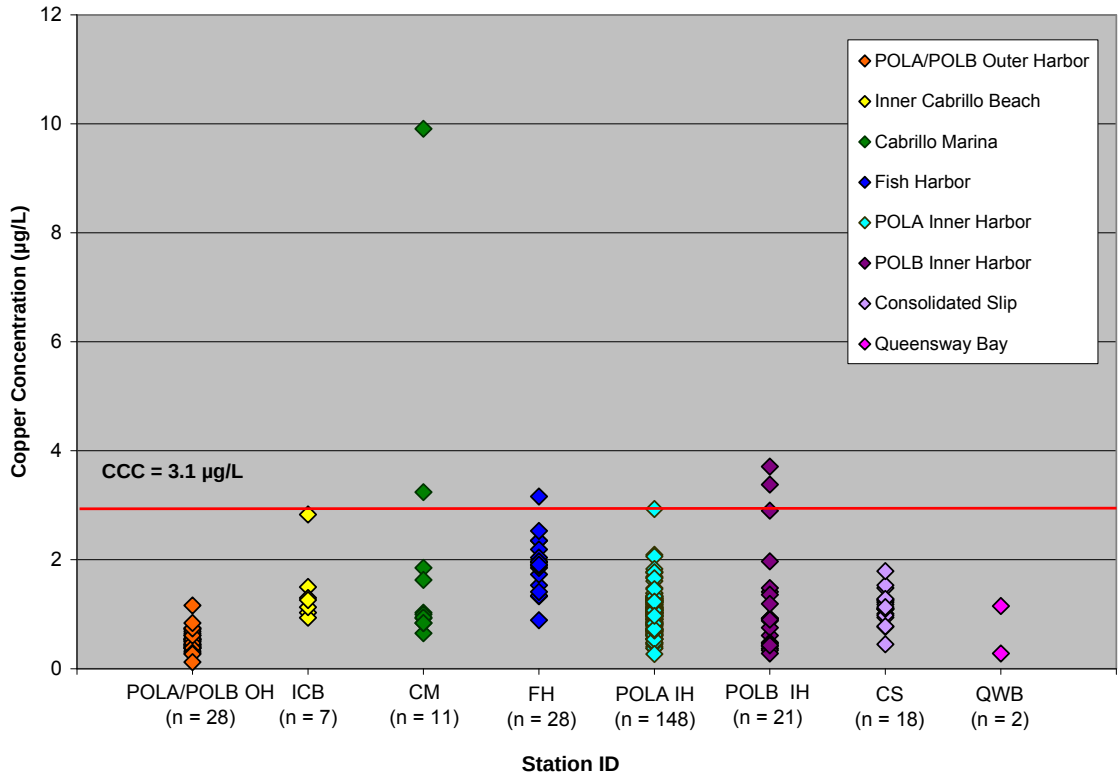


Figure 3. Dissolved Zinc

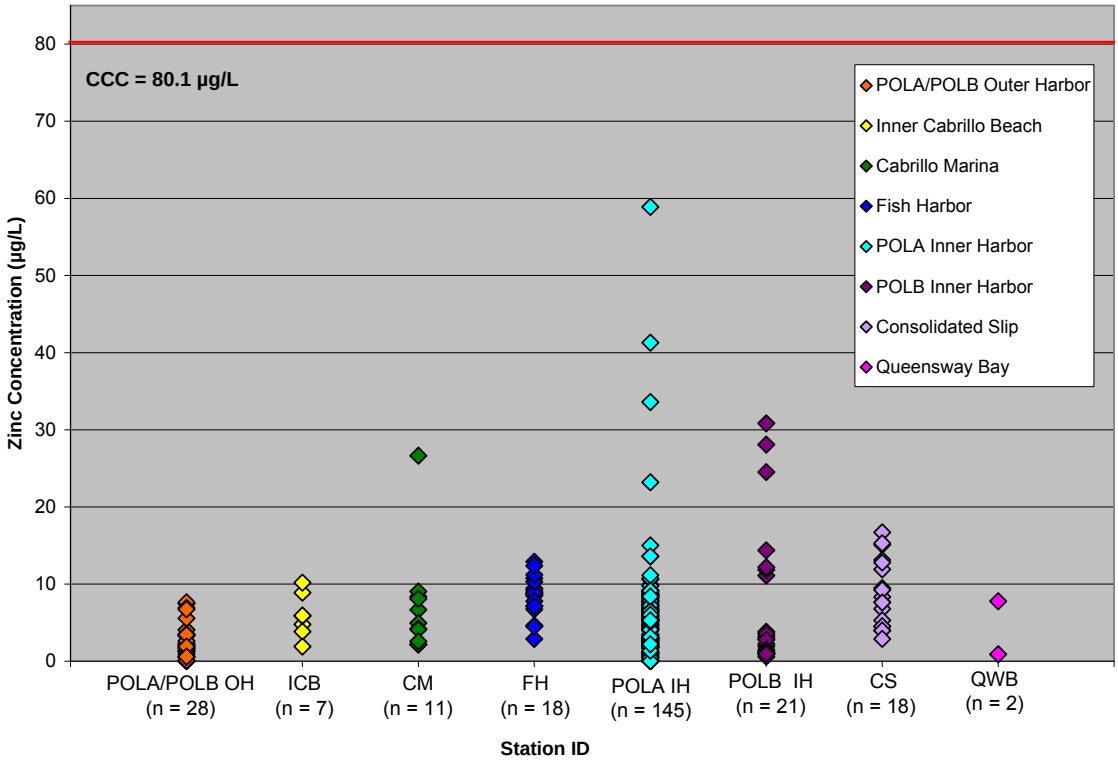


Figure 4. Dissolved Silver

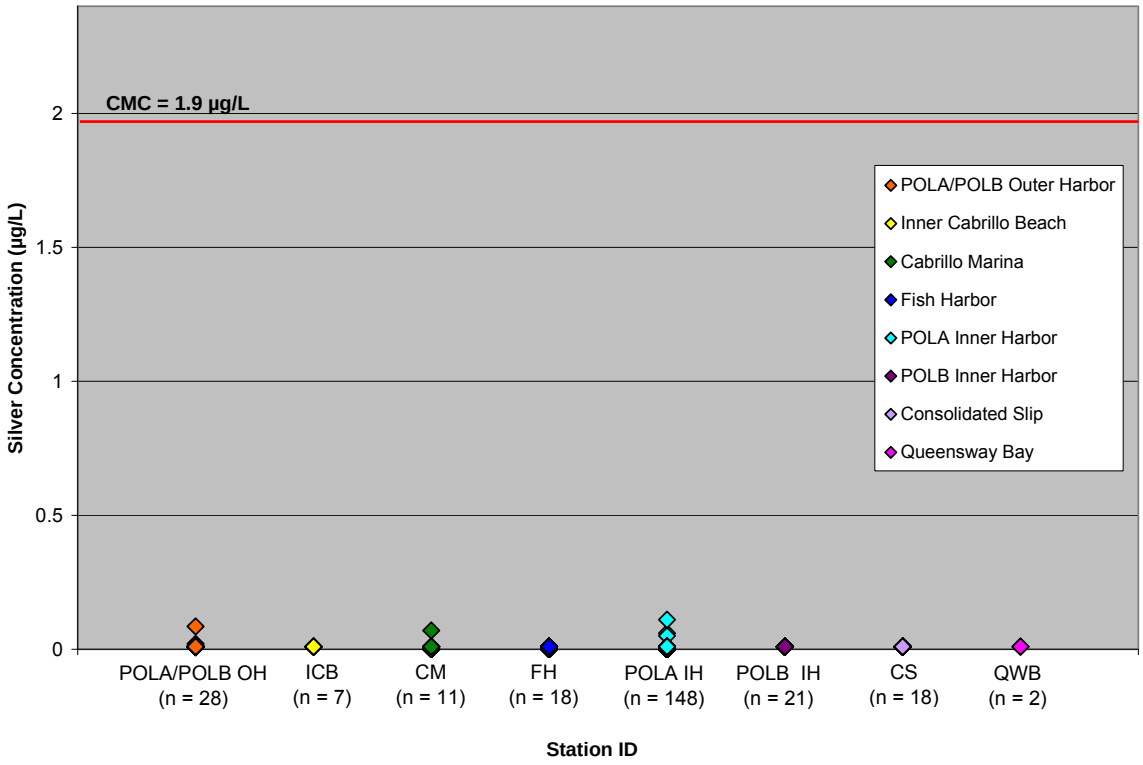


Figure 5. Dissolved Nickel

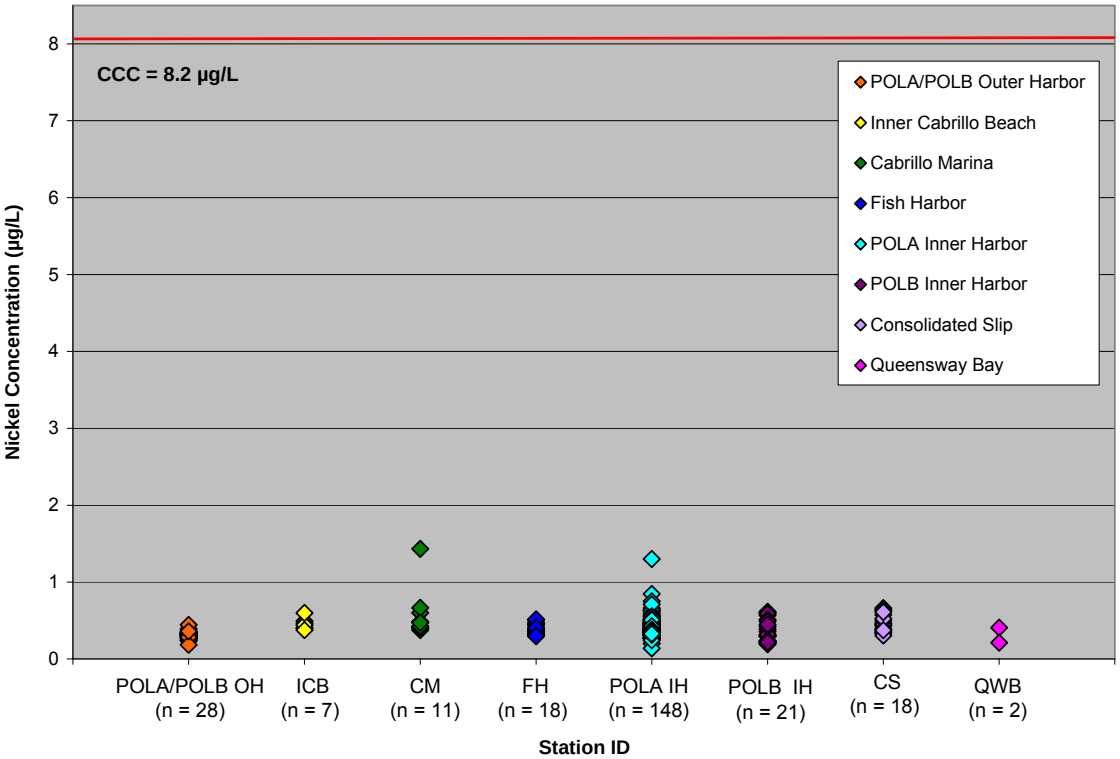


Figure 6. Dissolved Mercury

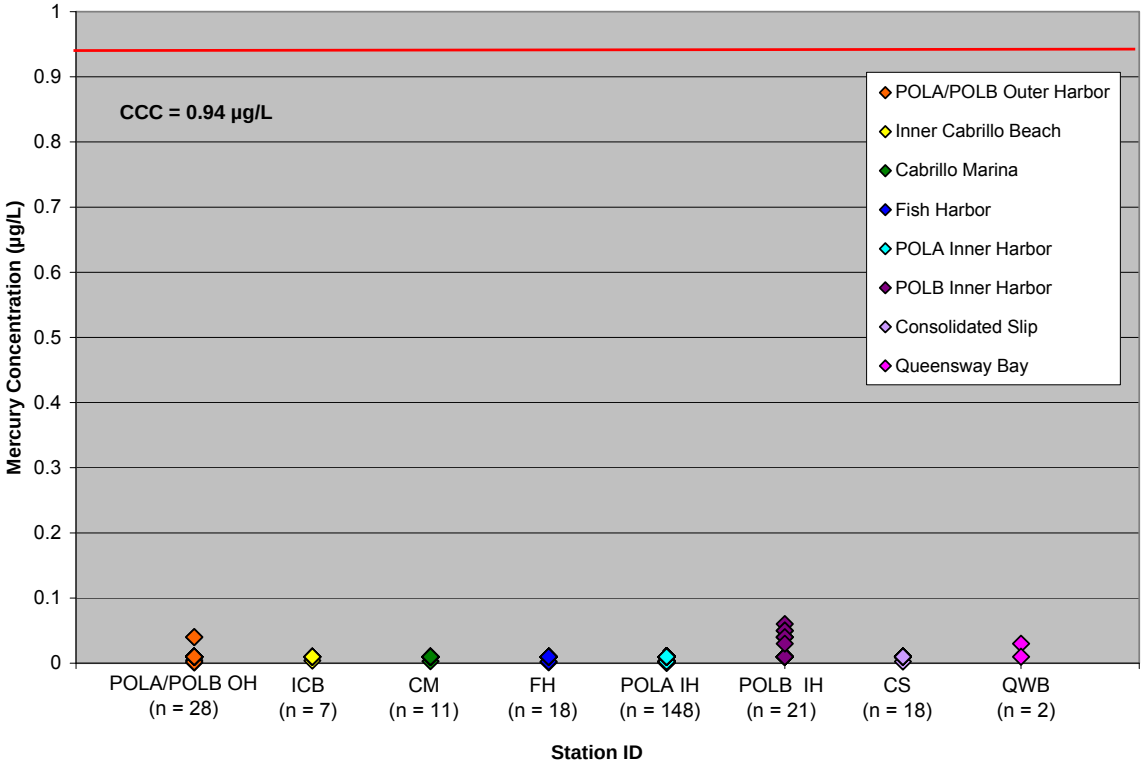


Figure 7. Dissolved Lead

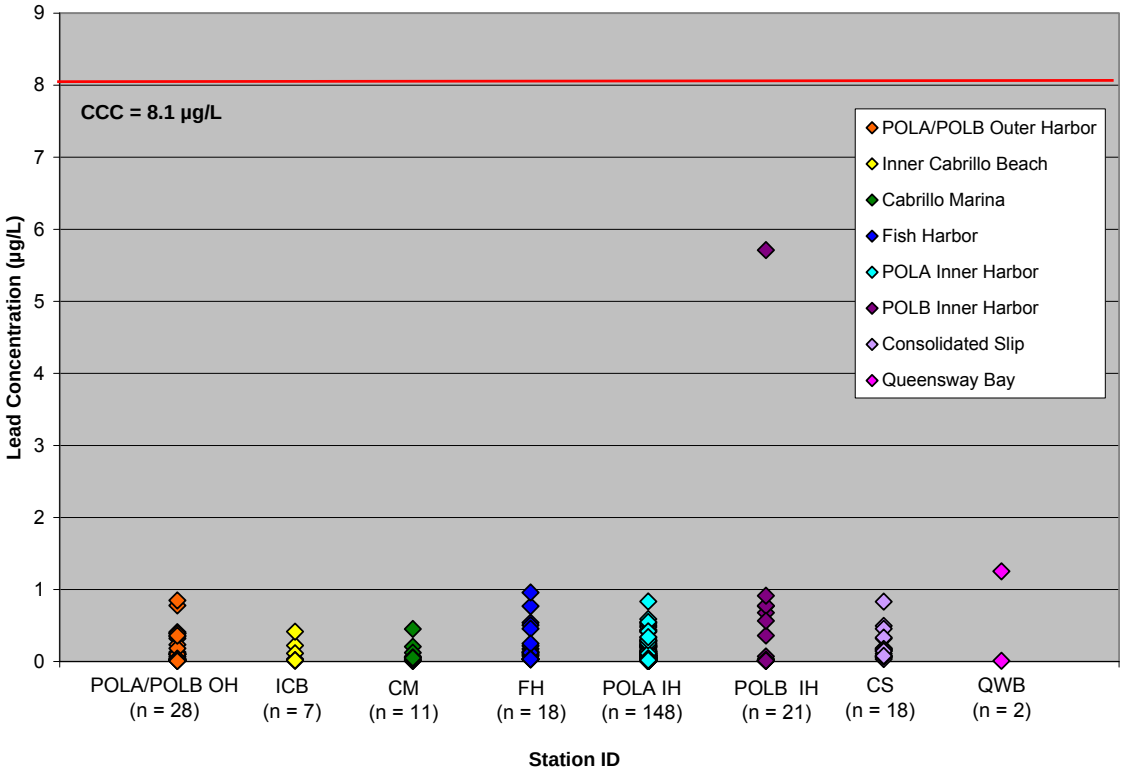


Figure 8. Dissolved Chromium

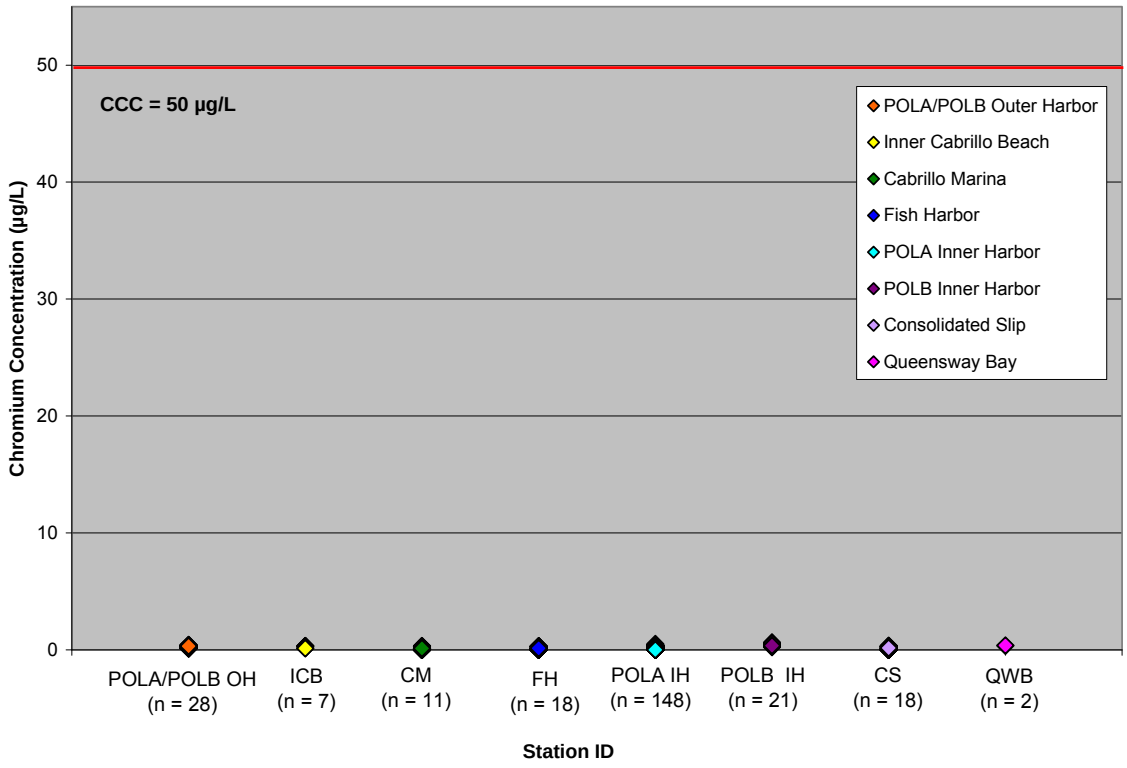


Figure 9. Dissolved Cadmium

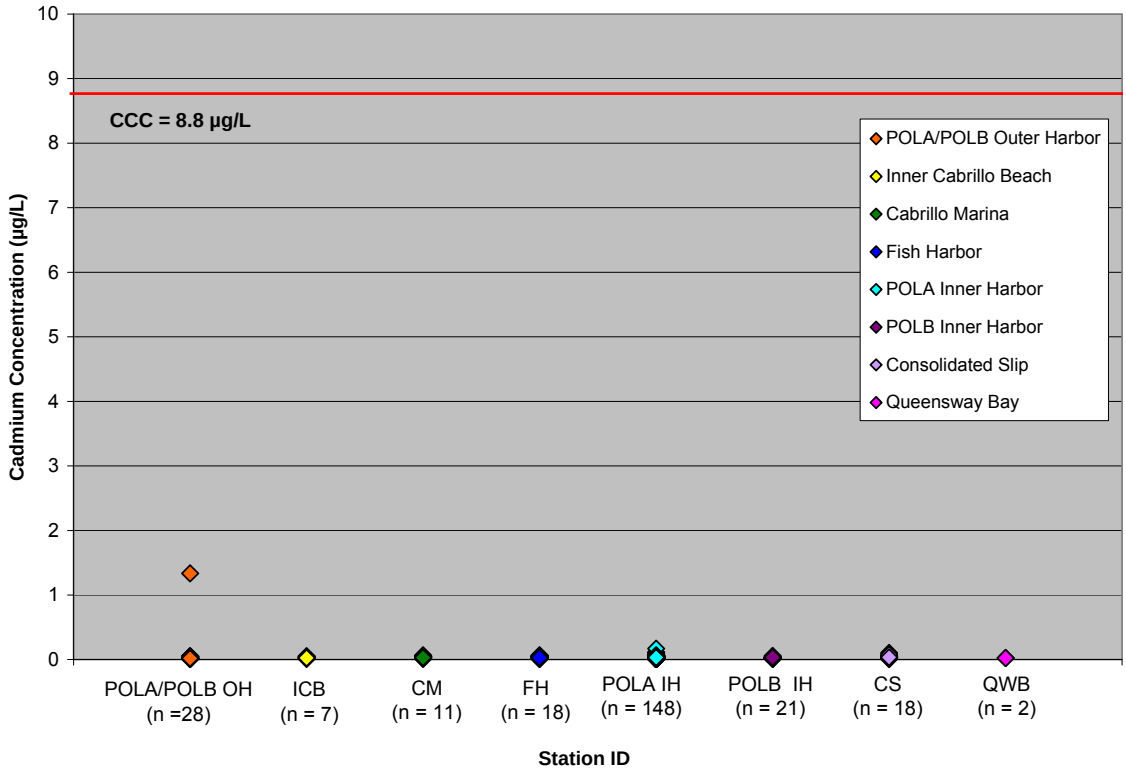
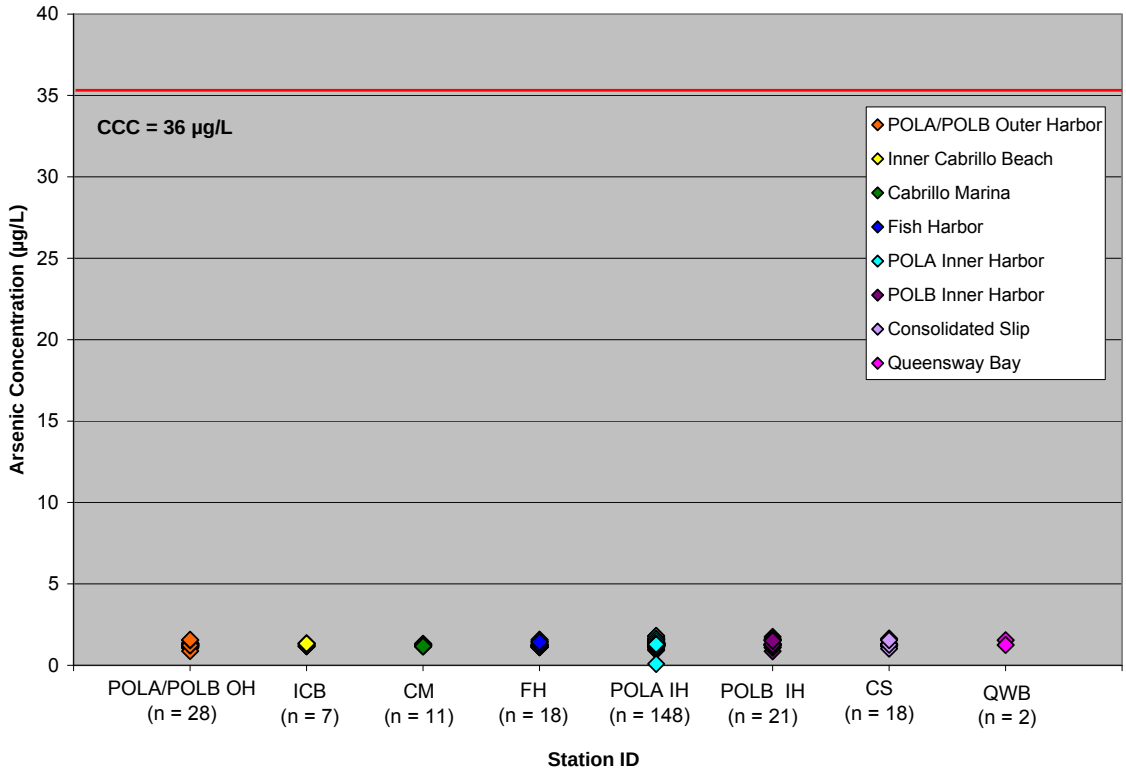


Figure 10. Dissolved Arsenic



3.2 Organics in Harbor Waters

Organic pollutants typically of concern in industrial harbors include chemicals such tributyltin (TBT), chlorinated pesticides, PCBs, PAHs, phenols, and phthalates. Each of these chemicals was analyzed as part of harbor-wide monitoring programs, although not all organic chemicals were tested during all events. In general, the concentrations of organic chemicals were found to be very low; in most cases, below detection limits (Table 4). Table 4 gives an overview of the organics results, exceedances, and number of samples taken for each analysis. The majority of analytes were not detected (ND), and there were very few exceedances. Only TBT was detected in concentrations that exceeded state water quality criteria. When detected, with few exceptions, concentrations of other organic compounds were found to be several orders of magnitude below the lowest applicable standards for chronic exposure. In the following subsections, a description of the ambient levels and possible primary sources of these organic compounds is discussed.

3.2.1 Tributyltin

Historically, TBT was used as a marine antifoulant in hull paints. In October 2001, the International Maritime Organization (IMO) approved a global treaty to prohibit the application of organotin antifouling paints by January 1, 2003, followed by a complete ban on TBT antifouling paints by January 1, 2008.

In Los Angeles Harbor, recent harbor-wide studies detected TBT during four of the seven sampling events (Figure 11). Of the 218 samples collected, sixteen samples were found to contain detectable levels of TBT - fourteen of which exceeded the CCC for TBT (CCC = 7.4 nanograms per liter [ng/L]) (Figure 12). It should be noted that the CTR does not include a

Table 4. POLA and POLB Organics Overview

	Inner Cabrillo Beach				Cabrillo Marina			
	Min	Max	exceedances	N	Min	Max	exeedances	N
Total PCBs (µg/L)	<0.005	<0.005	NA	5	<0.005	<0.005	NA	7
Total Pthalates (µg/L)	<0.01	<0.01	NA	6	<0.01	<0.01	NA	7
Total PAHs (µg/L)	<0.001	<0.001	NA	6	<0.001	<0.001	NA	7
Total Phenols (µg/L)	<0.001	<0.001	0	6	<0.001	<0.001	0	7
Total Pesticides (µg/L)	<0.0005	<0.0005	0	5	<0.0005	<0.0005	0	7
Tributyltin (TBT) (ng/L)	<1.0	<1.0	0	8	<1.0	<1.0	0	13

	Fish Harbor				Consolidated Slip			
	Min	Max	exeedances	N	Min	Max	exeedances	N
Total PCBs (µg/L)	<0.005	<0.005	NA	11	<0.005	<0.005	NA	11
Total Pthalates (µg/L)	<0.01	<0.01	NA	8	<0.01	<0.01	NA	11
Total PAHs (µg/L)	<0.001	<0.001	NA	8	<0.001	<0.001	NA	11
Total Phenols (µg/L)	<0.001	<0.001	0	8	<0.001	<0.001	0	11
Total Pesticides (µg/L)	<0.0005	<0.0005	0	11	<0.0005	<0.0005	0	11
Tributyltin (TBT) (ng/L)	<1.0	71.7	3	11	<1.0	80.7	2	17

	POLA Outer Harbor				POLA Inner Harbor			
	Min	Max	exeedances	N	Min	Max	exeedances	N
Total PCBs (µg/L)	<0.005	<0.005	NA	17	<0.005	0.07	NA	82
Total Pthalates (µg/L)	<0.01	<0.01	NA	17	<0.01	220	NA	82
Total PAHs (µg/L)	<0.001	<0.001	NA	17	<0.001	<0.001	NA	82
Total Phenols (µg/L)	<0.001	<0.001	0	17	<0.001	<0.001	0	82
Total Pesticides (µg/L)	<0.0005	<0.0005	0	17	<0.0005	0.0513	0	82
Tributyltin (TBT) (ng/L)	<1.0	<1.0	0	17	<1.0	78.3	9	139

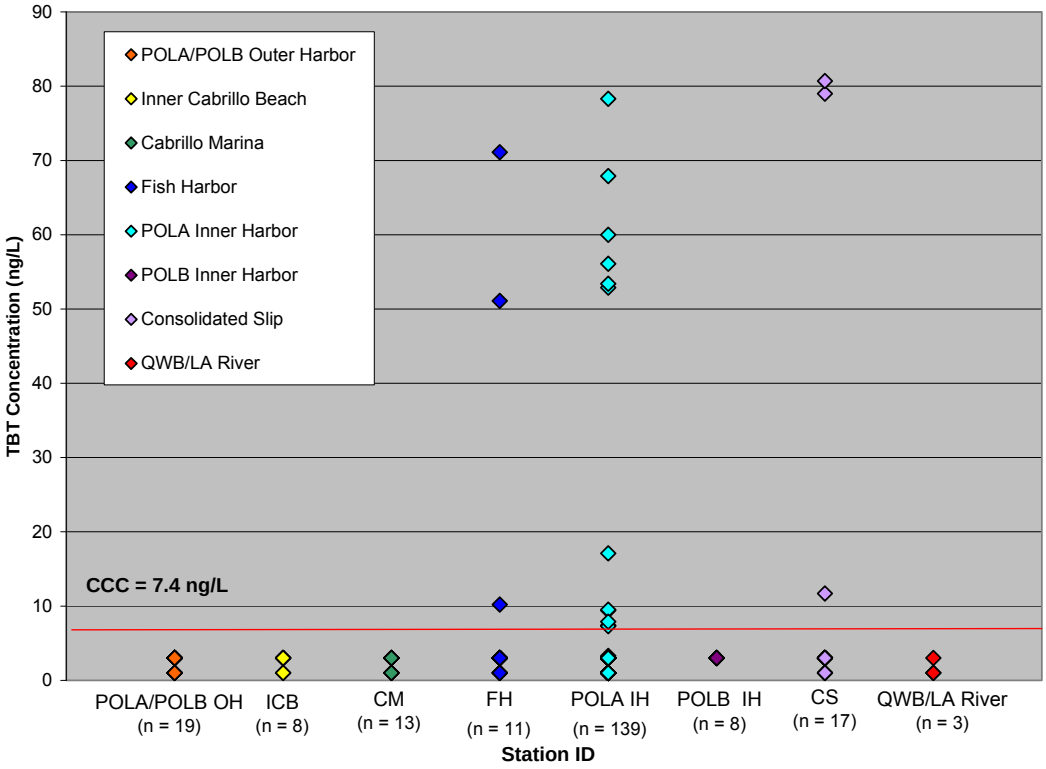
	POLB Inner Harbor				POLB Outer Harbor			
	Min	Max	exeedances	N	Min	Max	exeedances	N
Total PCBs (µg/L)	<0.001	4.2	NA	14	<0.001	<0.001	NA	2
Total Pthalates (µg/L)	<0.025	15.7	NA	14	<0.025	6.68	NA	2
Total PAHs (µg/L)	<0.001	47.8	NA	14	<0.001	0.0042	NA	2
Total Phenols (µg/L)	<0.05	<0.05	0	14	<0.05	<0.05	0	2
Total Pesticides (µg/L)	<0.001	<0.001	0	14	<0.001	<0.001	0	2
Tributyltin (TBT) (ng/L)	<1.0	<1.0	0	8	<1.0	<1.0	0	2

	Queen's Way Bay/LA River			
	Min	Max	exeedances	N
Total PCBs (µg/L)	<0.001	<0.001	NA	3
Total Pthalates (µg/L)	<0.025	8.63	NA	3
Total PAHs (µg/L)	<0.001	<0.001	NA	3
Total Phenols (µg/L)	<0.05	0.0177	0	3
Total Pesticides (µg/L)	<0.001	<0.001	0	3
Tributyltin (TBT) (ng/L)	<1.0	<1.0	0	3

NA = not applicable because currently there are no aquatic life criteria
N = number of samples analyzed

criterion value for TBT. The CCC value of 7.4 ng/L reported here is from the National Ambient Water Quality Criteria (NAWQC) list of recommended water quality criteria for non-priority pollutants. The majority of the samples that exceeded criteria levels were collected in May 2008 and were from stations throughout the Inner Harbor and Fish Harbor (Figure 11).

Figure 11. TBT Exceedances in Los Angeles Harbor



For Long Beach Harbor, samples taken in October 2006, November 2008 and February 2009 contained no TBT above detection limits.

In summary, results of TBT analyses conducted on harbor water samples indicate that a source of this chemical and its metabolites still exists. Since TBT paints have been banned, the likely source of this chemical observed in ambient water samples is harbor sediments. TBT has been found to be able to reside for decades in marine sediments where it can be resuspended during dredge operations and other activities (e.g., boat propellers). During most of the collection and testing events, water concentrations of TBT and metabolites were non-detect (Table 4); however, during May 2008, TBT was found to be elevated at multiple locations in Inner Los Angeles Harbor and Fish Harbor. Due to this inconsistency, it is not clear at this time whether water column concentrations of TBT are of concern.

3.2.2 Chlorinated Pesticides

Pesticides are substances that eliminate or otherwise control unwanted organisms. In the 1940s and 50s large quantities of pesticides were produced, especially insecticides that contained organochlorine pesticides such as DDT and derivatives. Organochlorine compounds have several notable properties: they are very stable (persist in the environment); have low solubility in water, high solubility in fat (they bioaccumulate up the food chain); are highly toxic to insects, but have low toxicity to humans. DDT was manufactured in the Dominguez Watershed upstream of the harbor. Because DDT is extremely persistent in the environment, this pesticide continues to flow into the harbor from legacy upstream sources in the Watershed.

As DDT is metabolized or degraded over decades, it breaks down into the simpler, less toxic components DDE and DDD. Of the 100+ water samples analyzed for chlorinated pesticides, only one sample showed a detectable level of any of these compounds (4,4'- DDE at a concentration of 0.05 µg/L). There are no aquatic life CTR criteria for 4,4'- DDE. These findings indicate that, in general, chlorinated pesticides are not an ambient water quality issue in the harbor.

In addition to the Port-wide study results described above, SCCWRP conducted a limited set of analyses on water samples collected at several Inner and Outer Harbor locations as well as in Consolidated Slip. SCCWRP's studies employed the use of specialized scientific equipment designed to measure organic chemical concentrations at extremely low levels. Results from four stations within Inner and Outer Harbor waters show elevated levels of DDE in comparison to CTR human health numeric criteria (0.00059 µg/L). In SCCWRP's Consolidated Slip study, average results showed elevated levels of total DDT in comparison to CTR human health criteria for consumption of organisms only. The very low levels of DDE observed in water samples in the SCCWRP study were not at levels where impacts to aquatic organisms would be expected. However, these levels are considered to be a concern to human health, due to the ability of chlorinated pesticides to biomagnify in the food chain.

3.2.3 Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) were used extensively as a coolant in electrical transformers and in the manufacture of lubricants, sealants and wiring components, among a variety of other uses. In 1970 they were banned in the United States due to their toxicity to humans, persistence in the environment, resistance to break down over time, and tendency to bioaccumulate in living systems. PCBs are analyzed as individual congeners or families of congeners called Aroclors, as determined by the amount of chlorine they contain.

The vast majority of PCB results for both harbors were non-detect. There were only three instances where PCB was detected: one in Los Angeles Harbor Main Channel and two in Long Beach Harbor Channel Two. All three samples were only slightly above the analytical detection level of 0.001 µg/L, and well below the CTR CCC criteria of 0.03 µg/L. The results of harbor monitoring for PCBs indicate that these chemicals are not of concern in the water column.

As described above, SCCWRP conducted a limited set of analyses using specialized equipment on water samples collected at several Inner and Outer Harbor locations, as well as in Consolidated Slip. Results from four stations within Inner and Outer Harbor waters show levels of PCBs that exceeded the CTR human health numeric criteria at these stations; aquatic life criteria were not exceeded. In SCCWRP's Consolidated Slip study, average results showed elevated levels of total PCBs in comparison to CTR human health criteria for consumption of organisms only.

3.2.4 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) are a product of the incomplete combustion of fuels such as oil, coal tar, forest fires, and engine exhaust. Likely sources of PAHs found in harbor waters include oil or fuel spills, or storm and dry weather runoff from upstream. Similar to PCBs in structure, they tend to persist in the environment, prefer to bind to sediments rather than dissolve in water, and can bioaccumulate.

In Los Angeles Harbor, PAHs were not generally detected in water samples in the initial four field collection events. Starting with the fifth event, however, a new, ultra low detection method was employed. Method detection limits dropped from 5.0 µg/L to 0.001 µg/L. Using this new sensitive analytical method, PAHs were detected in most samples. Although there are no CTR ambient water criteria for PAHs for aquatic life effects for comparison, the results obtained in this study were only slightly above analytical detection.

In Long Beach Harbor, PAHs were not detected in the initial October 2006 sampling. Analyses from the ultra low detection limit testing of November 2008 and February 2009 samples detected less than 1 µg/L total PAH in samples from stations scattered throughout the harbor, with the highest concentrations and number of individual PAHs showing up at two stations in the inner harbor (Channel Three and Cerritos Channel).

3.2.5 Phenols

Phenols are organic compounds with many uses, including antiseptics, herbicides, synthetic resins, and ingredients of sunscreens and cosmetics. They degrade very easily and do not last long in the environment. Typically, if phenols are found in fish tissue or water samples it indicates a current and/or chronic exposure. No phenolic compounds were detected in any of the samples taken in either harbor.

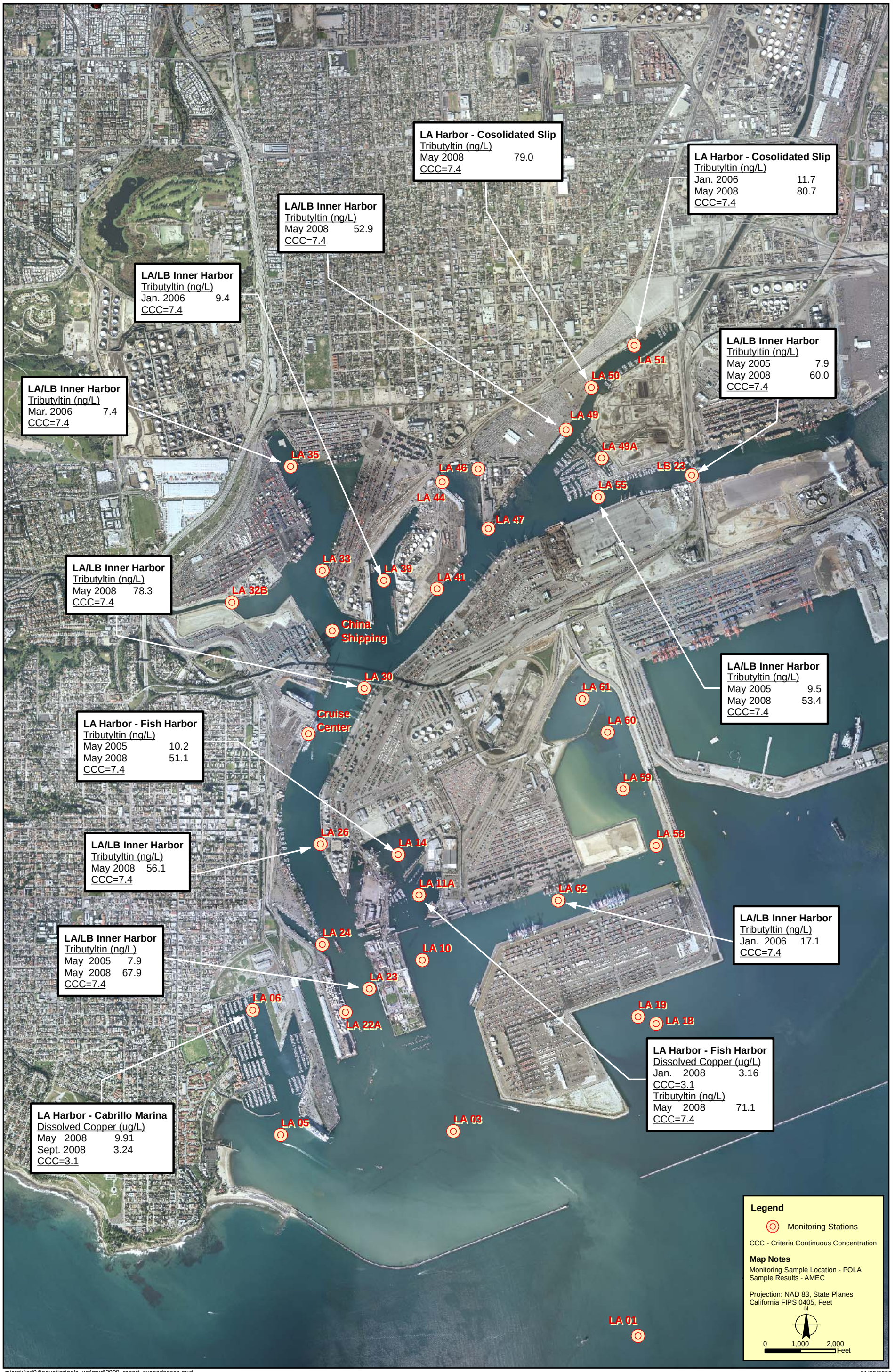
3.2.6 Phthalates

Phthalates are used to improve flexibility in many common plastic products. Their most common mode of entry into the environment is off-gassing from plastics. As the plastics de-gas, the phthalates attach to particles in the atmosphere and eventually enter marine waters via storm drains or aerial deposition. Phthalates generally biodegrade fairly quickly, tend not to bioaccumulate, and have a relatively low impact on human health.

Low levels of phthalates were found at stations throughout both harbors. The first observed multiple occurrence of phthalates in Los Angeles Harbor water samples was noted in March 2006. This sampling event occurred within 24 hours of a significant rain event (1.58” of rain). These results may be due to the transport of phthalates in stormwater to the harbor environment. Phthalates were detected at multiple locations in Los Angeles Harbor in March 2006 and January 2008, and in Long Beach Harbor in November 2008 and February 2009. The most common phthalates measured were bis (2-ethylhexyl) phthalate, butylbenzyl phthalate, and diethyl phthalate which is consistent with the wide-ranging uses of these phthalates in plastics. The levels at which phthalates cause effects on marine organisms in surface waters are not well understood, and are currently the focus of considerable scientific research. There are no aquatic life CTR criteria for phthalates in surface waters.

3.3 Metals and Organics Summary

As discussed previously, the only two pollutants to exceed state water quality criteria were copper and tributyltin. Figures 12 and 13 depict the locations at which aquatic life water quality criteria were exceeded in Los Angeles and Long Beach Harbors, respectively.



z:\croix\sd04\aquatics\pola_wq\mxd\2009_report_exceedences.mxd

01/23/2009

amec

Port of Los Angeles Monitoring Stations Exceeding Aquatic Life Water Quality Criteria

FIGURE

12

3.4 Dissolved Oxygen Levels in Harbor Waters

As discussed previously, the Port of Los Angeles began conducting harbor-wide water quality sampling in the late 1960s. The ongoing monthly monitoring involves the measurement of basic water quality parameters such as dissolved oxygen (DO), temperature, and water clarity. In the late 1960s, it was not uncommon for DO concentrations in the harbor to average 1-2 mg/L, particularly in the inner harbor area with their combination of high pollutant input from the Dominguez Channel and low tidal flushing with fresh ocean water. At such low DO concentrations, the harbor's marine life was severely degraded.

Compliance with legislation such as the Porter-Cologne Act of 1969 helped improve water quality over time, but it wasn't until the Federal Water Pollution Control Amendments of 1972 (also known as the Clean Water Act), along with the reduction of point source discharges to the harbor, that the water quality in Los Angeles Harbor reached the range of 5-6 mg/L of dissolved oxygen - the level necessary for sustaining a healthy environment for aquatic organisms.

Minimum levels of dissolved oxygen in harbor water are regulated by the RWQCB. The Los Angeles Basin Plan standard for DO in harbor waters reads as follows:

> *For that area known as the Outer Harbor area of Los Angeles-Long Beach Harbors, the mean dissolved oxygen concentrations must be 6.0 mg/L or greater, provided that no single concentration be less than 5.0 mg/L.*

For the past several decades, DO levels measured in Los Angeles Harbor waters have generally met or exceeded the 5 mg/L standard. Over the past decade the average DO from individual sample grabs has remained in the 6-8 mg/L range (Table 5). There were times when the DO concentration dropped below 5 mg/L. The number of samples below the Basin Plan Objective (5.0 mg/L) relative to the total number of samples collected is listed in Table 5. Surface and bottom DO levels are depicted graphically in Figures 14 and 15.

Table 5. Los Angeles Harbor Dissolved Oxygen (1999-2008)

Location	Surface DO (mg/L) Total					Bottom DO (mg/L) Total				
	Max	Min	Average	N	# Below BP Objective	Max	Min	Average	N	# Below BP Objective
Sta. LA-01 (outside of breakwater)	13	4.1	7.90	117	2	12.5	2.3	7.79	117	3
LA Outer Harbor	11.5	4.5	7.39	280	2	10.4	1.5	7.33	280	4
Inner Cabrillo Beach	9.1	5.1	7.19	120	1	NA	NA	NA	NA	2
Cabrillo Marina	10.4	4.7	7.29	120	0	9.2	3.9	7.21	120	0
Fish Harbor	10.8	1.1	7.17	243	9	10.4	2.9	7.12	240	4
LA Inner Harbor	10.9	0	6.68	2188	51	10.3	0	6.68	1971	25
Consolidated Slip	8.3	3.2	6.08	242	27	9.4	3.7	6.36	241	4

N = number of observations
NA = no observations conducted due to shallowness of site

BP = Basin Plan

In Long Beach Harbor, while there is no long-term historical record of ambient water quality characteristics, several recent harbor-wide water quality monitoring events starting in October 2006 found dissolved oxygen concentrations to be above the 5-6 mg/L standard at all stations (Figure 16). As in Los Angeles Harbor, average DO concentrations in Long Beach Harbor were in the 6-8 mg/L range. The only monitoring location to drop below 5.0 mg/L was in Queensway Bay, at the mouth of the Los Angeles River.

In summary, recent monitoring events in Los Angeles/Long Beach Harbors show that dissolved oxygen is generally found at concentrations that meet the Los Angeles Basin Plan water quality objectives to support a variety of biological communities.

Figure 14. POLA Dissolved Oxygen – Surface (1999-2008)

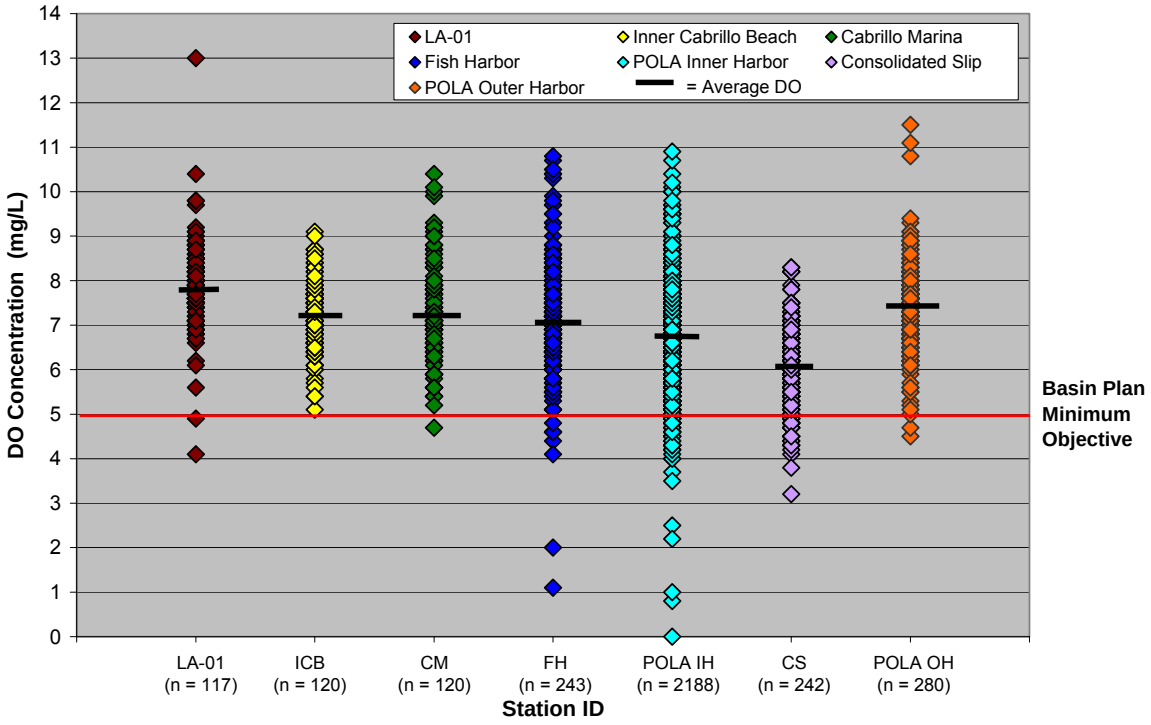


Figure 15. POLA Dissolved Oxygen – Bottom (1999-2008)

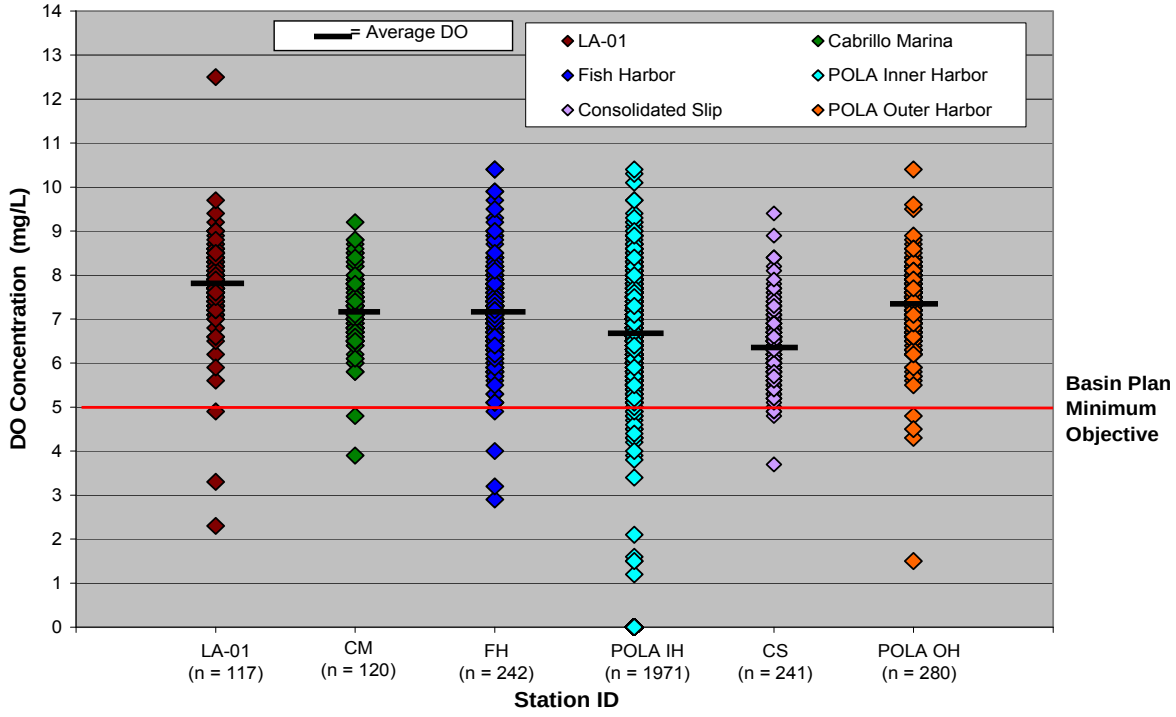
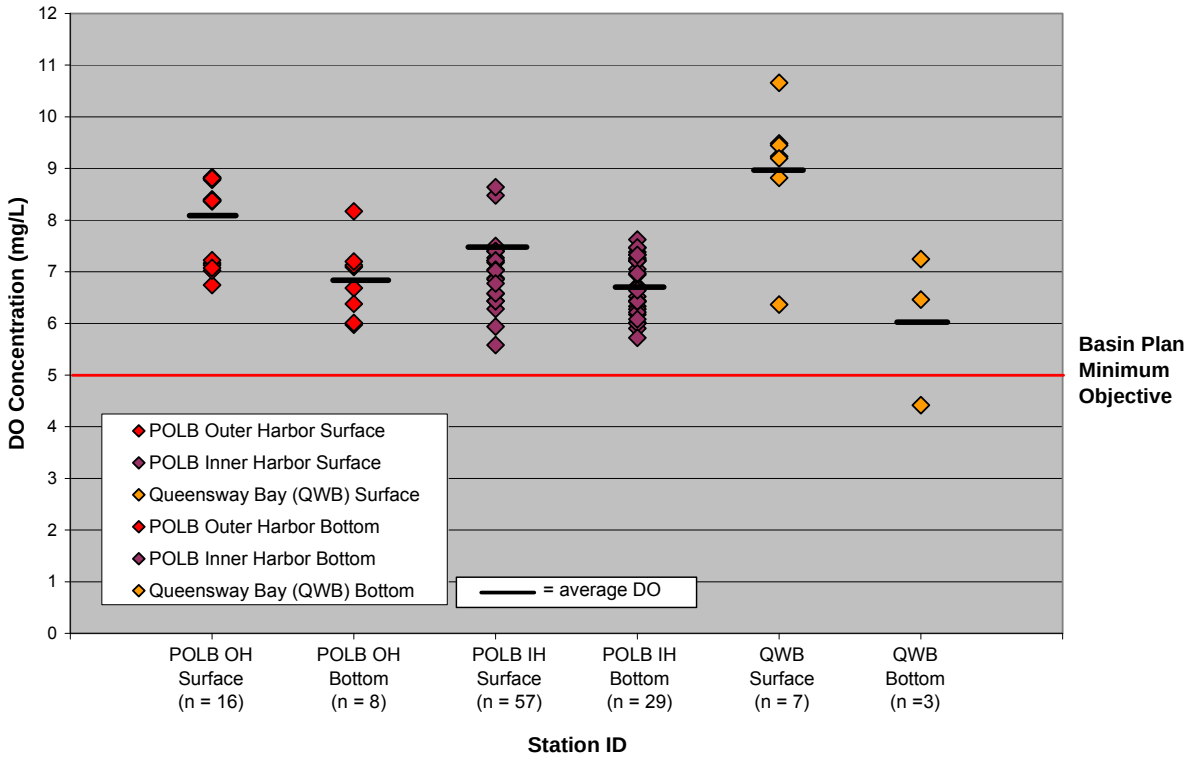


Figure 16. POLB Dissolved Oxygen (2006-2009)



3.5 Bacteria Levels in Harbor Waters

Bacteria tests are conducted on ambient water samples in order to identify total and fecal coliform bacteria and enterococcus. The concentration of these indicator bacteria determines whether a water body is safe for human contact, or should be avoided. People who swim in waters with elevated bacteria levels are more likely to contract acute infectious illnesses like gastroenteritis, upper respiratory infections, sore throats and fevers. In addition to impacting humans, high levels of bacteria in harbor waters may be an indicator of potential problems upstream (such as the illicit discharge of wastes, stormwater runoff, etc.) that need to be identified and controlled.

The California Department of Health Services has developed minimum protective bacteriological standards for the waters adjacent to public beaches and water-contact sports areas. Assembly Bill 411 (AB 411) states that the following limits should not be exceeded for bacterial indicators: 10,000 MPN/100 mL for total coliform, 400 MPN/100 mL for fecal coliform, and 104 MPN/ 100 mL for enterococcus.

This section discusses the results of bacteria testing conducted in Los Angeles Harbor, much of which has been associated with the Bacteria TMDL. In addition to the sampling conducted as part of a special study for the TMDL, bacteria tests were conducted concurrent with each of the seven enhanced monthly port-wide water quality sampling events. An additional special study was performed in the East Basin/Consolidated Slip area in conjunction with a sailing center siting study. Collection events occurred during dry and wet seasons, as well as immediately following storm events.

The Long Beach Harbor does not have a bacteria TMDL, as the harbor is designated for “non-contact water recreation” only. As result, the POLB has not conducted any bacteria testing.

Port of Los Angeles Enhanced Water Quality Study (2006-2008)

The seven Los Angeles Harbor-wide sampling events consisted of four dry events and three wet events (wet events had measurable rain within 2 weeks prior to the collection). The vast majority of the samples collected during the four dry weather events had non-detectable levels of indicator bacteria. Only one dry weather sample exceeded AB 411 criteria: Outer Harbor Station LA18 with an enterococcus level of 465 MPN/100 mL, as shown in Figure 17.

As expected, the majority of the AB 411 exceedances were observed following storm events. The magnitude of the storm, and the time lag between the storm event and the actual sample collection correlated directly to the observed concentrations of indicator bacteria. The wet event in May 2005 and January 2006 found more instances of detectable bacteria than did dry events, but only minimal exceedances of AB 411 criteria.

The March 2006 collection event took place immediately (within 48 hours) following a 1.58-inch rainfall. That study identified eight locations in the Inner Harbor and two in Consolidated Slip with enterococcus concentrations (ranging from 109 to 795 MPN/100 mL) that exceeded the AB 411 criteria level of 104 MPN/100 mL (Figure 17). Five Inner Harbor stations (ranging from 500 to 2,400 MPN/100 mL) exceeded the fecal coliform AB 411 criterion (400 MPN/100 mL, Figure 18). One station (at 16,000 MPN/100 mL) exceeded the total coliform bacteria criterion (10,000 MPN/ 100 mL, Figure 19). Bacteria exceedances following this wet event were limited

to the Inner Harbor and Consolidated Slip areas only, particularly within the East Channel, Slip 1 and Slip 5. No exceedances were found in the Outer Harbor stations.

Port of Los Angeles Marina Temporal Bacteria Study (2006)

In March/April 2006, the Port of Los Angeles conducted a focused study of bacteria concentrations in the East Basin and Consolidated Slip areas of the Inner Harbor. This location was being investigated as a potential site for a recreational sailing school for Wilmington residents. Daily samples were collected for five days immediately following a wet weather event characterized by a minimum accumulation of at least 0.25 inch of rain.

Bacteria concentrations were compared to AB 411 criteria for water contact. There were three exceedances in the initial sampling when the event began 28 March 2006. Twenty-four hours later, all stations recorded concentrations of the three indicator bacteria well above regulatory standards. On the third day of the study, 48 hours after the start of the rain event, 15 of the 21 stations (over 70 percent) exceeded regulatory standards. The concentrations of bacteria had decreased, but were still above regulatory standards at the majority of the stations. By 72 hours, the enterococci concentrations were all below regulatory standards; however, almost all stations still exceeded the fecal and total coliform standards. By hour 96, enterococci were non-detectable, total coliform bacteria were below regulatory criteria concentrations at all stations, and fecal coliform bacteria had dropped below AB 411 standards at all but two stations.

Figure 17. POLA Bacteria – Enterococcus (2005-2008)

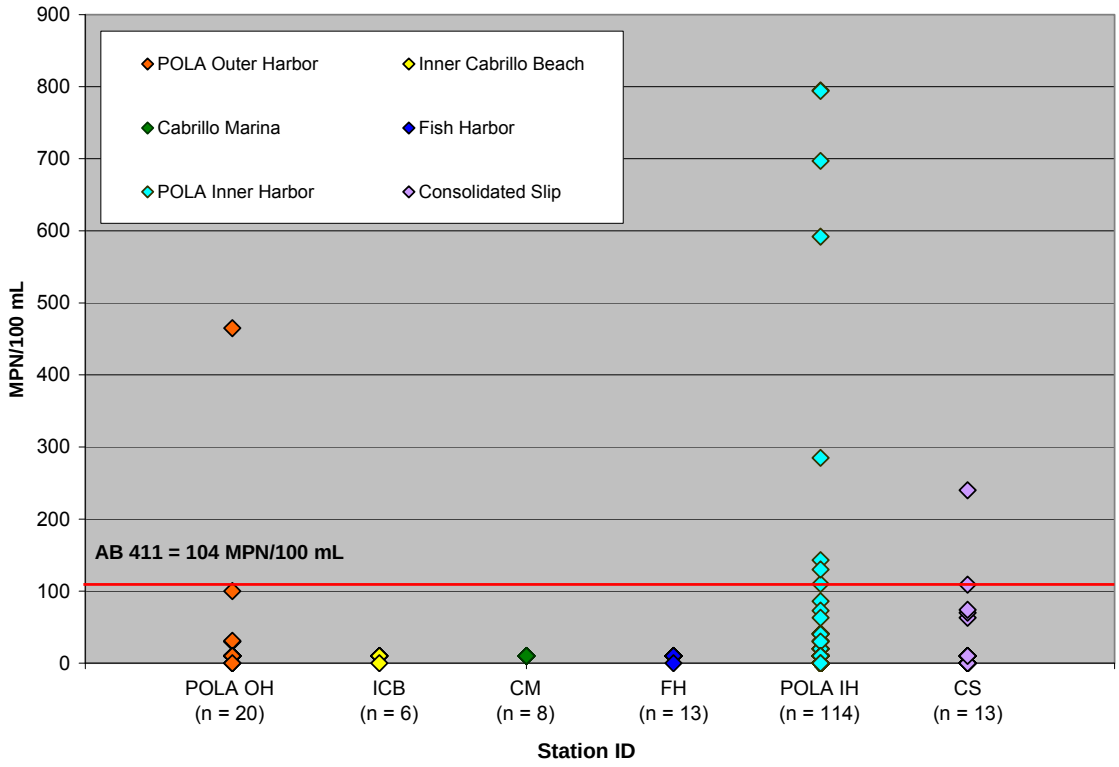


Figure 18. POLA Bacteria – Fecal Coliform (2005-2008)

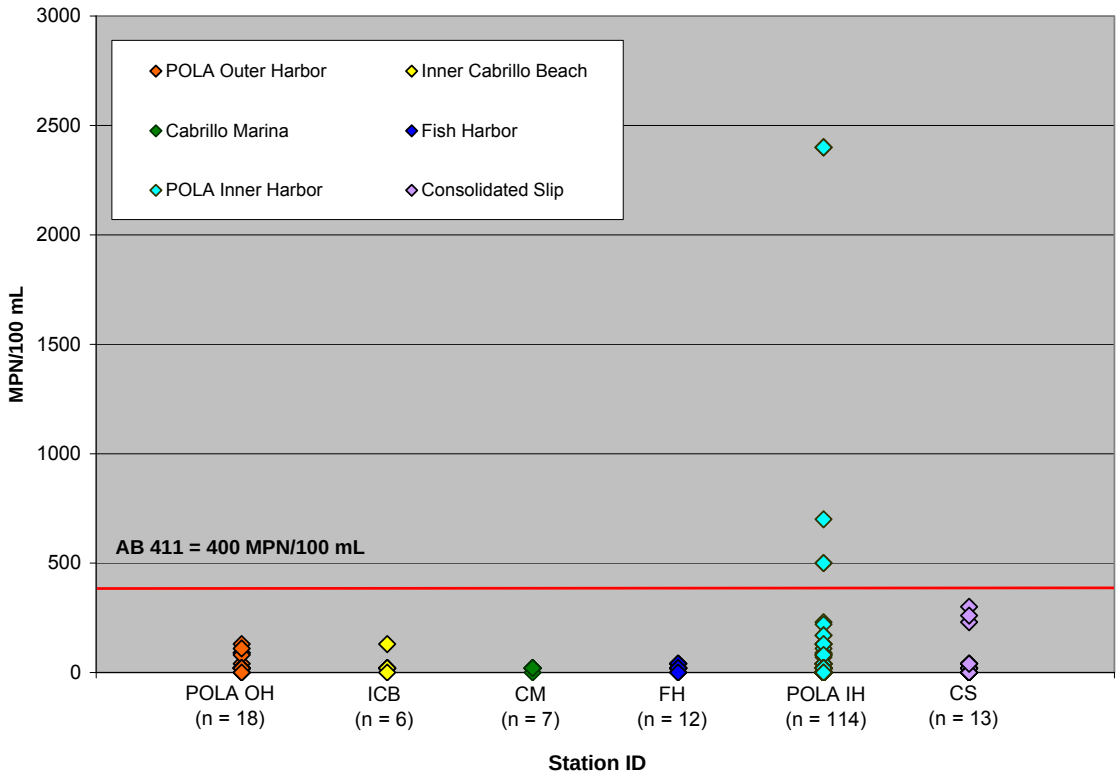
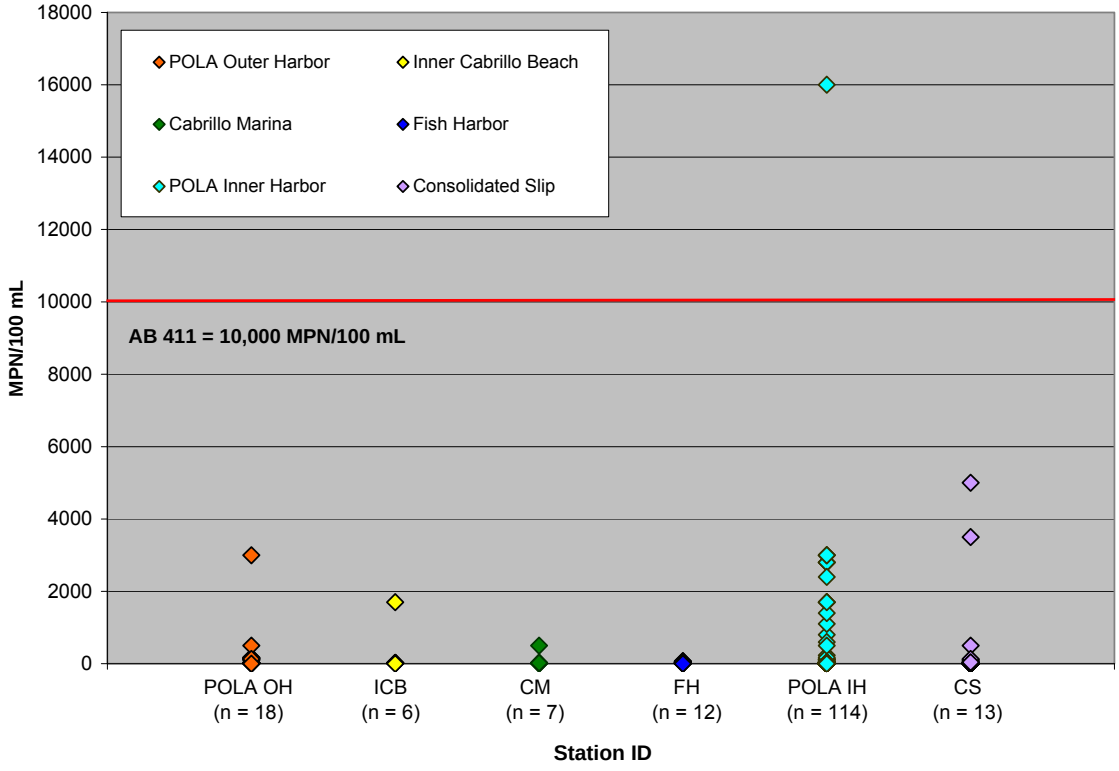


Figure 19. POLA Bacteria – Total Coliform (2005-2008)



Los Angeles Harbor Bacteria TMDL Main Ship Channel (2006-2007)

The POLA and the City and County of Los Angeles Departments of Public Works teamed to conduct a monitoring study of bacteria levels in the Los Angeles Harbor Main Ship Channel (MSC). The MSC currently has an existing REC-2 designation for water contact recreation and a potential REC-1 designation for non-water contact recreation. The MSC was designated as an impaired water body for beach closures, and a TMDL was established in 2005 that required a special study of the MSC and Inner Harbor. The study was conducted between May 2006 and April 2007, following the approved Los Angeles Harbor Main Ship Channel Bacteria TMDL study plan. The results of the study were reported in a document titled *Port of Los Angeles, Los Angeles Harbor Bacteria TMDL, Main Ship Channel, Summary Analysis, September 7, 2007*.

The year-long study focused on comparing ambient bacteria levels, taken at multiple locations throughout Los Angeles Harbor, to a TMDL compliance site referred to as HW07. The harbor-wide collection locations are depicted in Figure 20. In addition to evaluating the bacteria levels at individual sites, the study was also designed to assess the spatial and seasonal (winter dry and summer dry conditions) variability of bacteria levels in both open water and non-open water sites (near storm drains), and to assist in identifying major bacteria sources at Municipal Separate Storm Sewer System (MS4) discharges and POLA tenant facilities.

The numbers of samples analyzed and number of exceedances observed during the year-long study are summarized by station in Table 6. The results of the study indicated that the compliance site, Site HW07, did not exceed AB 411 REC-1 standards for any indicator bacteria during the monitoring period. These results meet the summer dry and winter dry TMDL requirements for this site. All other open water sites (Sites A through H and J) had no exceedance of standards for any indicator bacteria, with the exception of one site (Site H), which exceeded the Total Coliform AB 411 single sample standard one time.

Non-open water site (Sites 1 through 25) results showed that there were four localized areas that required further study: Southwest Slip (Sites 13, 14, 15, and 16), Consolidated Slip (Site 25), the Cruise Terminal (Site 12), and the Maritime Museum (Site 10). Of the 25 non-open water sites monitored in the study, seven sites had bacterial indicator standard exceedance frequencies greater than 10 percent. Of those seven sites, Sites 13, 15 and 16 had exceedance frequencies greater than 10 percent for Total Coliform, Enterococcus and E. coli. In addition, Sites 10 and 12 had frequencies of exceedance greater than 10 percent for Enterococcus, whereas Site 14 had a frequency of exceedance for both Total Coliform and Enterococcus. The only site that was found to be in exceedance for only Total Coliform and E. coli was Site 25.

Based on the study results, the report concluded that the TMDL compliance site. Site HW07, met the TMDL summer dry and winter dry requirements for the May 2006 to April 2007 time period. The nine other open water sites analyzed were also free of exceedances (with the exception of one station, H, at one sampling event). However, there were localized areas within the Los Angeles Harbor that displayed AB 411 exceedances, including the area located near the storm drains in Southwest Slip (Sites 13-16), the area located near the storm drain at Maritime Museum (Site 10), the storm drain near the Cruise Terminal (Site 12), and Consolidated Slip (Site 25).

Based upon this study, a TMDL implementation plan was developed by the POLA and its study partners, and approved by the RWQCB. The implementation plan involves conducting bacteria

monitoring at three stations; the MSC compliance point HW-07 as well as Site 10 (the Maritime Museum) and Site 12 (the Cruise Ship Terminal). Monitoring is ongoing.

Bacteria Summary

In summary, AB 411 indicator bacteria levels in Los Angeles Harbor are typically low during dry weather conditions and elevated immediately following storm events. The Inner Harbor is more susceptible to elevated bacteria levels compared to the Outer Harbor, indicating that the Dominguez Channel and other storm drains in the vicinity are the primary source of the observed bacteria.

Figure 20. Los Angeles Harbor Bacteria TMDL Study Stations (2006-2007)

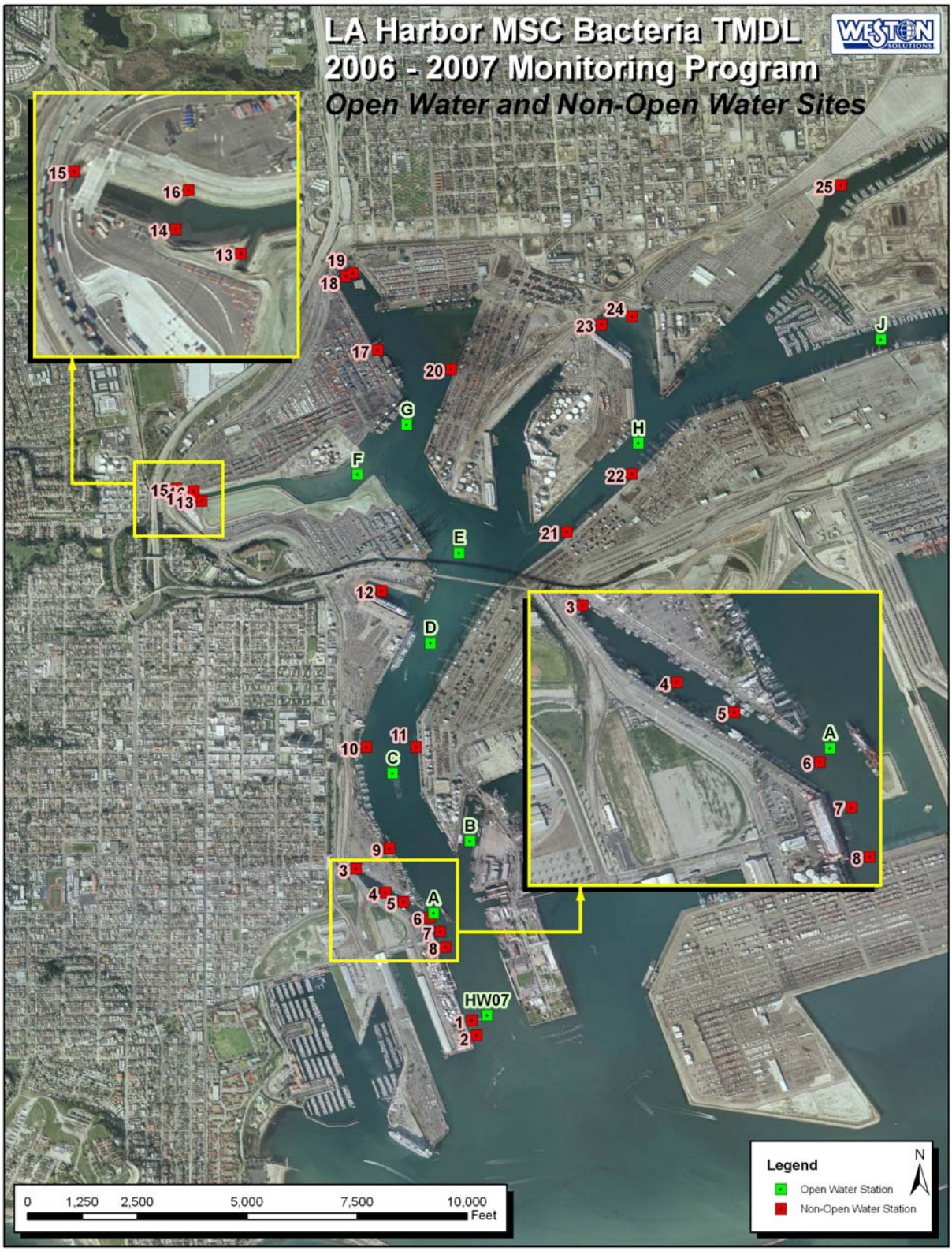


Table 6. Summary of Bacteria Exceedances from the Los Angeles Harbor Bacteria TMDL Main Ship Channel Study (2006-2007)

Sample Location		Number of Exceedances/Number of Samples Analyzed		
		E. coli	Total Coliform	Enterococcus
Open Water Sites	HW07	0/54	0/55	0/55
	A	0/21	0/21	0/21
	B	0/21	0/21	0/21
	C	0/21	0/21	0/21
	D	0/21	0/21	0/21
	E	0/20	0/20	0/20
	F	0/20	0/20	0/20
	G	0/21	0/21	0/21
	H	0/21	1/21	0/21
	J	0/21	0/21	0/21
Non-Open Water Sites	1	0/10	0/10	0/10
	2	0/10	0/10	0/10
	3	1/20	1/20	1/20
	4	0/10	0/10	0/10
	5	0/10	0/10	0/10
	6	0/10	0/10	0/10
	7	0/10	0/10	0/10
	8	0/10	0/10	0/10
	9	0/10	0/10	0/10
	10	0/20	0/20	2/20
	11	0/10	0/10	0/10
	12	1/14	0/14	2/14
	13	3/20	5/20	10/20
	14	1/19	5/19	11/19
	15	4/19	9/19	17/19
	16	4/19	7/19	10/19
	17	0/10	0/10	0/10
	18	0/10	0/10	0/10
	19	0/10	0/10	0/10
	20	0/10	0/10	0/10
	21	0/10	0/10	0/10
	22	0/10	0/10	0/10
	23	0/10	0/10	0/10
	24	0/10	0/10	0/10
	25	4/20	3/20	0/20

Highlighted cells identify locations where AB411 exceedances were observed