Copper Site-Specific Objectives in San Francisco Bay

Proposed Basin Plan Amendment and Draft Staff Report

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Table of Contents

1 Introduction

This San Francisco Bay Regional Water Quality Control Board (Water Board) staff report provides the technical background and basis for a proposed amendment to the San Francisco Bay Region Water Quality Control Plan (Basin Plan) to replace existing marine water quality objectives for copper, a toxic pollutant, with site-specific objectives (SSOs) for San Francisco Bay segments north of the Dumbarton Bridge and proposes an implementation plan to ensure attainment of the SSOs and protection of water quality and beneficial uses. SSOs were adopted for copper and nickel for South San Francisco Bay in 2002. This proposed amendment builds on the work completed for the 2002 Basin Plan amendment. The proposed implementation plan has been adapted from the existing copper action plan for South San Francisco Bay. Changes are proposed in the existing implementation plan for South San Francisco Bay in order to create an Implementation Plan for copper that is consistent Bay-wide. The proposed Basin Plan amendment includes the adoption of specific translators, a ratio of dissolved to total metal concentrations, which will be used to compute numeric effluent limits for wastewater facilities.

To help understand the geographic distinctions used in this staff report, note that throughout the staff report, the terms “Bay”, “San Francisco Bay”, and “Bay-wide” should be understood to denote all seven San Francisco Bay segments shown in Figure 3-1. The term “South San Francisco Bay”, as shown on the same figure, is used to refer to the segment of San Francisco Bay south of the Dumbarton Bridge. The terms “San Francisco Bay north of the Dumbarton Bridge”, “Bay north of the Dumbarton Bridge”, and “Bay north of Dumbarton” are used to refer to all segments of San Francisco Bay shown on Figure 3-1 except the segment named South San Francisco Bay.

The proposed SSOs were derived using U.S. Environmental Protection Agency (U.S. EPA) -approved procedures, and they are fully protective of the Bay’s aquatic life beneficial uses. SSOs adjust water quality objectives to account for their over- and under-protectiveness. One of those procedures is the indicator species procedure which is based on the assumption that characteristics of ambient water may influence the bioavailability and toxicity of a pollutant (U.S. EPA 1994a). As part of this procedure, a water effects ratio (WER) is determined using results from toxicity tests performed in ambient water and laboratory water. A WER is the ratio of toxicity of a compound to an aquatic organism when the tests are performed using standard laboratory water versus the toxicity when the tests are performed using ambient water.

Although the proposed amendment relaxes the existing copper water quality objectives, the proposed implementation plan contains pollution prevention and source control actions designed to prevent any increases in ambient copper concentrations and thus prevent any lowering of existing water quality in the Bay segments affected by this amendment. This report demonstrates why the proposed SSOs are necessary and protective of the Bay’s most sensitive beneficial uses.

1.1 Regulatory Authority

The current copper water quality objectives that apply in the Bay were promulgated in the California Toxics Rule ("CTR", 40 CFR 131.38 et seq) by U.S. EPA in May 2000. The State Water Resources Control Board's ("State Board") Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries ("State Implementation Policy" or "SIP") allows the Water Board to adopt SSOs in lieu of the objectives in the CTR when it is appropriate to do so. The regulations promulgated under the Clean Water Act also allow states to adopt water quality criteria based on Clean Water Act Section 304(a) guidance to reflect site-specific conditions. The proposed SSOs fully comply with State and federal laws and regulations for adopting site-specific water quality objectives.

1.2 Report Organization

The report is organized into sections that present the information and analyses required by State and federal law. Sections 2, 3 and 4 present the technical basis for the proposed Basin Plan Amendment. The fifth section presents the Implementation Plan being proposed to achieve and maintain the SSOs. The sixth section presents the regulatory analysis required to adopt the amendment and establish water quality objectives under the California Water Code (CWC) Section 13241. Section 7 presents the references relied on to prepare the report. The sections are as listed below:

2. *Project Description*—defines the project, why it is necessary and its objectives.
3. *Project Background*—describes the ambient conditions, copper sources, and conceptual understanding of copper in the Bay.
4. *Technical Background for SSOs*—provides information on how the SSOs and metal translators were computed.
5. *Implementation Plan*—describes the program to achieve and maintain the SSOs including actions to control sources and monitoring.
6. *Regulatory Analyses*— provide an overview of the project's compliance with CWC requirements, peer review requirements of Health and Safety Code section 57004, California Environmental Quality Act (CEQA), and federal and State antidegradation policies.
7. *References*—lists all the information sources cited and relied upon to prepare this report.

This staff report in its entirety serves as a substitute CEQA environmental document. Language for the proposed Basin Plan amendment is included as Appendix A. The CEQA environmental checklist is included as Appendix C.

2 Project Description

2.1 Project Definition and Necessity

The project is a proposed Basin Plan amendment that will do the following: 1) establish site-specific chronic and acute water quality objectives for dissolved copper in San Francisco Bay segments north of the Dumbarton Bridge; and 2) create a Bay-wide implementation plan to achieve and maintain these site-specific water quality objectives ("SSOs"). The following are new regulatory provisions of the proposed project:

1. Acute and chronic site-specific water quality objectives for concentrations of dissolved copper in San Francisco Bay (north of the Dumbarton Bridge).
2. Numeric metal translators to be used to calculate water quality-based effluent limits for wastewater sources discharging to deepwater portions of the Bay north of the Dumbarton Bridge. Deepwater dischargers are defined as those that discharge effluent through an outfall with a diffuser, such that the wastewater receives a minimum initial dilution of at least 10:1.
3. A Bay-wide implementation strategy to ensure attainment of the copper SSOs that includes:
    a. Copper control measures for urban runoff management agencies;
    b. Copper control measures for wastewater facilities;
    c. Numeric water quality-based effluent limitations for wastewater facilities; and
    d. NPDES permit requirements to conduct or cause to be conducted technical studies to investigate urban runoff loads, possible sediment copper toxicity and sublethal effects on salmonids.

The following are non-regulatory provisions of the proposed project:

e. Copper control measures for copper-based marine antifouling coatings;
f. Copper control measures for lagoons;
g. A water quality monitoring program designed to detect small changes in ambient dissolved copper concentrations in the Bay that may trigger additional aggressive control measures; and
h. Amend portions of the Basin Plan. A Bay-wide copper management strategy will supersede what was adopted in 2002 as part of the South San Francisco Bay copper and nickel SSO project. Existing language in Chapter 7 of the Basin Plan addressing the Water Quality Attainment Strategy for copper SSOs for South San Francisco Bay will be replaced with a revised Bay-wide copper implementation strategy. Deleting the existing passages is a non-regulatory change since these passages are descriptive in nature. It is necessary to delete these non-regulatory descriptive passages and replace them with language describing the Bay-wide copper management strategy to create a consistent implementation approach for all San Francisco Bay segments.

Necessity of SSOs – Over the past two decades, substantial reductions have been achieved in copper wastewater loading to the Bay. In 1987, copper loads from point sources were estimated to be 40,000-68,000 lbs/yr (RWQCB 1993). The point source copper loads during the period 2001-2003 averaged less than 20,000 lbs/yr (CEP 2004a p.70). During the period of 1993 to 2004, there is no readily apparent trend in ambient concentrations of dissolved copper in most parts of the Bay as shown in Figure 2-1 below. The wastewater loading reductions are probably due to the success of source control and pollution prevention efforts by wastewater dischargers. However, further reductions in mass loading by wastewater dischargers may be difficult and cannot guarantee ambient water quality improvements for copper. Other sources that are difficult to manage such as urban runoff (which is affected by copper in automobile brake pads), resuspension of sediment bound copper from historical deposits of copper in the Bay sediments and natural sources of copper are among the dominant contributions to current ambient water concentrations (CEP 2004a).

An impairment assessment conducted for San Francisco Bay segments north of the Dumbarton Bridge demonstrated that copper SSOs, higher than the default national criteria, would still fully protect beneficial uses (CEP 2004a). Consequently, SSOs for dissolved copper that protect beneficial uses are needed to address the fact that wastewater sources face compliance challenges based on current water quality objectives that are lower than necessary to protect beneficial uses.

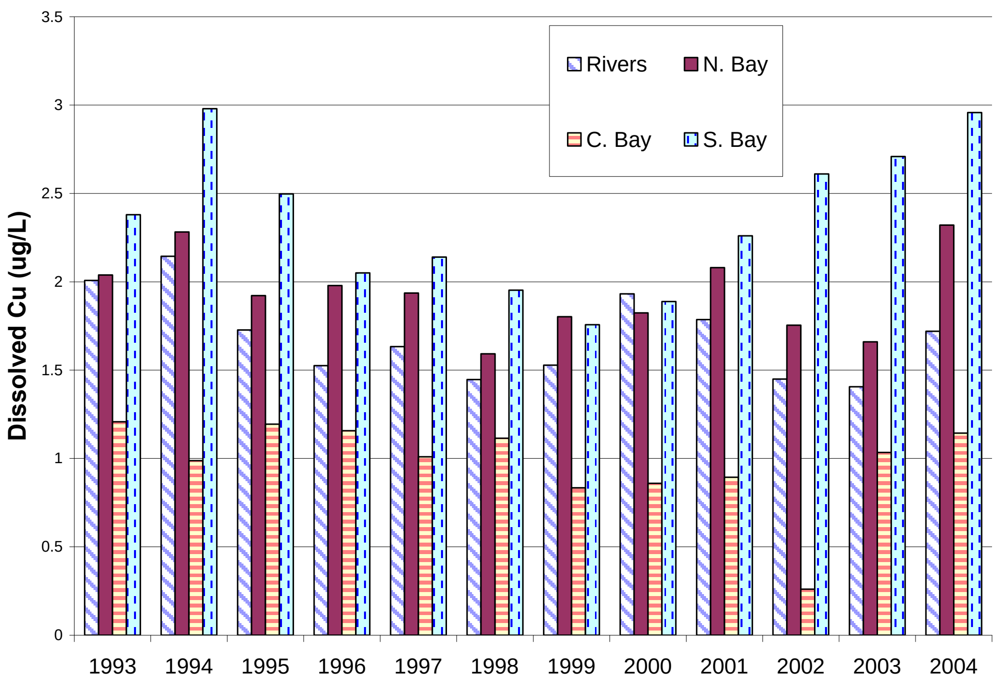

Figure 2-1 Average Dissolved Concentrations of Copper in different regions of San Francisco Bay. These data are from Regional Monitoring Program for Trace Substances (RMP) and other monitoring efforts. The raw data are available on the San Francisco Estuary Institute (SFEI) website (sfei.org).

Necessity of translators – Metal translators applicable to deep water dischargers are needed to calculate water quality-based effluent limits for wastewater sources from the proposed SSOs. Effluent limits for wastewater sources will be calculated according to the procedure outlined in the SIP when permits are reissued. This procedure calculates an Average Monthly Effluent Limit (AMEL) for the monthly average concentration of a regulated pollutant and a Maximum Daily Effluent Limit (MDEL). Both the AMEL and the MDEL are expressed as a total metal concentration. For metals like copper, the calculation requires use of a ratio of total to dissolved metal concentration called the metal translator. It is more efficient for the Water Board to define, when appropriate, metal translators for a waterbody as a whole, rather than requiring special studies to determine translators on a discharger-by-discharger basis during NPDES permit reissuance. However, for shallow-water dischargers, (defined as those wastewater discharges that have been granted an exception to the Basin Plan prohibition against wastewater discharges into non-tidal water, dead-end sloughs or at any point that wastewater does not receive dilution of at least 10:1) metal translators will need to be determined on a case-by-case basis because local conditions for such dischargers are distinct from the conditions found in the deep water portions of the Bay.

Necessity of Copper Control Measures for Urban Runoff – Urban runoff constitutes one of the largest local, controllable copper loads to the Bay. Copper control measures for copper sources contributing to urban runoff are necessary as part of a strategy to ensure that all controllable sources of copper to the Bay are being managed.

Necessity of Copper Control Measures for Wastewater Sources – Wastewater sources constitute a substantial, controllable source of copper to the Bay. Copper control measures for copper sources contributing to wastewater are necessary as part of a strategy to ensure that all controllable sources of copper to the Bay are being managed.

Mandatory copper effluent limits are proposed for all Bay wastewater dischargers. The SIP specifies a methodology for determining which priority pollutants require effluent limits. Step 7 of Section 1.3 of the SIP provides that Water Boards may find that numeric effluent limits are required for pollutants even if Steps 1 through 6 do not trigger the requirement for the water-quality based limits. Given the remaining technical uncertainties described in Section 3 of this report and to fulfill antidegradation requirements and ensure full commitment of resources from dischargers to maintain current performance and pollution prevention, mandatory numeric effluent limits for wastewater sources are needed.

Necessity of Permit Requirements to Resolve Remaining Uncertainties –The majority of available evidence supports the finding that San Francisco Bay north of the Dumbarton Bridge is not impaired by dissolved copper and that the proposed SSOs are appropriate and protective of beneficial uses. However, some uncertainty remains regarding overall loading estimates, tributary loads, wet season data, water column/sediment interactions, toxicity to benthic organisms and sublethal effects on salmonids. Those uncertainties that are not currently being investigated and require support to ensure completion are: urban runoff loading; copper sediment toxicity; and sublethal effects on salmonids. It is necessary to investigate these technical issues in order to have a greater degree of confidence that beneficial uses are being protected as the SSOs are implemented.

2.2 Project Objectives

The proposed Basin Plan amendment is intended to establish appropriate and protective site-specific water quality objectives for copper in San Francisco Bay, north of the Dumbarton Bridge, and a plan to implement those objectives that will prevent future increases in loads or ambient concentrations of copper. Specific objectives of the project are as follows:

1. Update the Basin Plan to incorporate the best available scientific information on appropriate acute and chronic water quality objectives for dissolved copper concentrations in the Bay, north of the Dumbarton Bridge, that:
    a. Fully protect San Francisco Bay beneficial uses and prevent nuisance;
    b. Fully protect the public health or welfare, enhance water quality and serve the purposes of the Clean Water Act;
    c. Are calculated based on the best and most relevant set of San Francisco Bay data and are based on sound scientific rationale;
    d. Are no higher than necessary;
    e. Are not so low that they pose unnecessary compliance challenges for wastewater sources that may compel them to perform costly upgrades to their treatment facilities that may not result in corresponding water quality improvements; and
    f. Ensure that copper sources to the Bay are being addressed now and in the future through reasonable treatment and control measures.
2. Comply with the antidegradation requirements of State Board Resolution No. 68-16 and federal antidegradation regulations (40 CRF 131.12).

3 Project Background

This chapter describes the physical setting for the project, summarizes information on copper sources and their associated loadings to the Bay, describes the chemistry and fate, and other aspects of the current conceptual understanding for copper in the Bay.

3.1 Physical Setting

San Francisco Bay is a natural embayment in the Central Coast of California. With an average depth of six meters, the Bay is broad, shallow, and turbid, which makes sediment an important factor in the fate and transport of pollutants. The movement of sediment within the Bay is driven by daily tides, the spring-neap tide cycle, and seasonally variable wind patterns.

The Bay is divided into two major hydrographic units, which are connected by the Central Bay to the Pacific Ocean. The northern reach is relatively well flushed because more than half of California's freshwater flows into the Bay through the Sacramento and San Joaquin Rivers from the Central Valley watershed. In contrast, the southern reach receives only limited flushing from the smaller streams draining these smaller local watersheds.

The San Francisco Bay system is the largest coastal embayment on the Pacific Coast of the United States (Nichols and Pamatmat 1988). The watershed encompasses about 155,000 km^2, or 40% of the land area of California (STB 2000). Its waters have a surface area of about 1220 km^2 and are divided into several segments: a small portion of the Sacramento/San Joaquin River Delta, Suisun Bay (including Grizzly and Honker Bays), Carquinez Strait, San Pablo Bay, Central Bay, Lower Bay and South Bay (Figure 3-1). As shown in Table 3-1 below, the area, depth, and volume of each of these segments varies considerably.

Table 3-1 Bathymetric Data for San Francisco Bay (CEP 2004a).

Region	Surface Area (km^2)	Mean Depth (m)	Mean Volume (acre-ft)
Suisun Bay	93	4	323,000
Carquinez Strait	31	9	223,000
San Pablo Bay	272	3	605,000
Central Bay	267	11	2,307,000
South and Lower Bay	554	3	1,507,000
Total >>>	*1217*	*5*	*4,965,000*

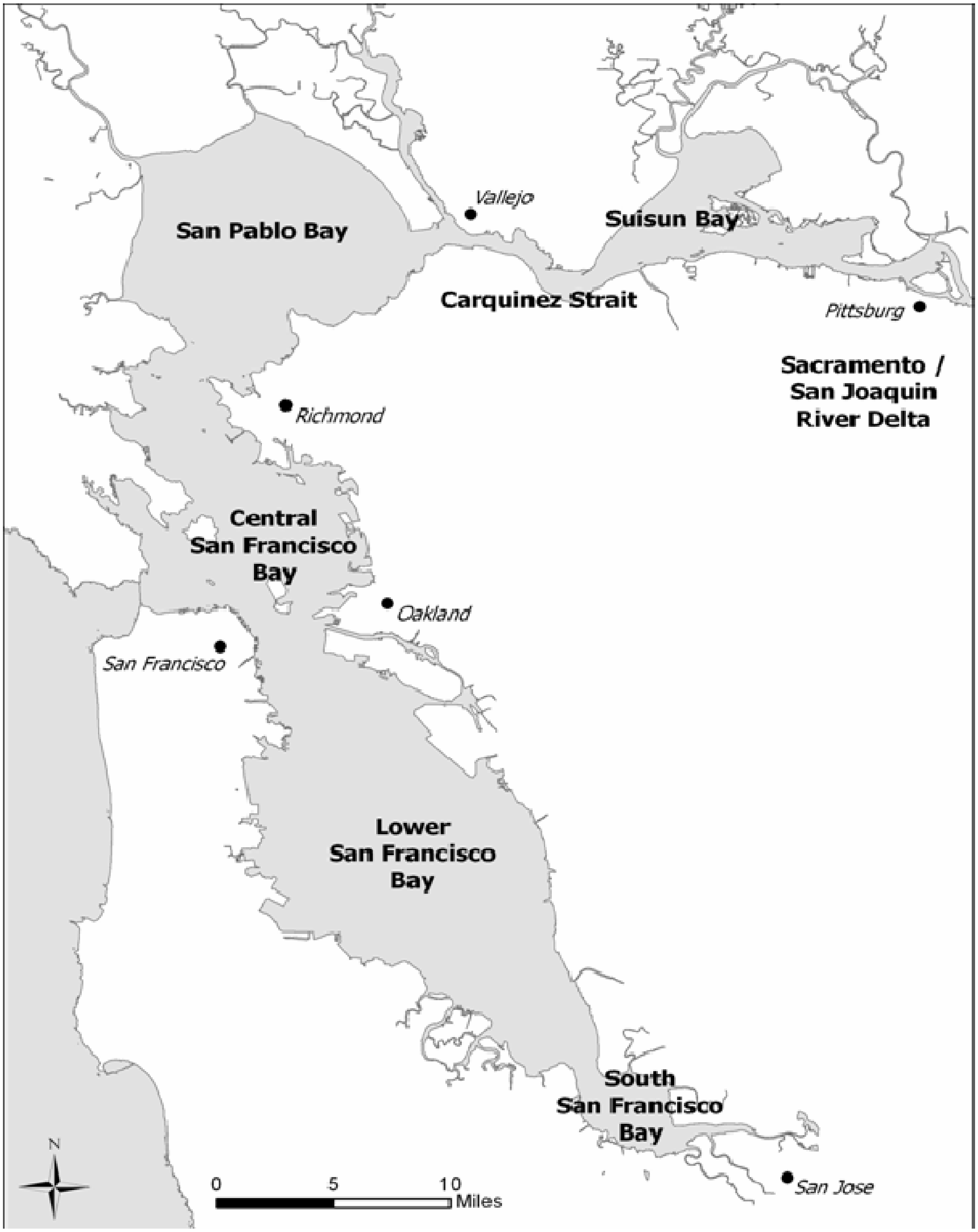

Figure 3-1 Map of San Francisco Bay
San Francisco Bay is comprised of seven unique segments: Sacramento/San Joaquin River Delta, Suisun Bay, Carquinez Strait, San Pablo Bay, Central San Francisco Bay, Lower San Francisco Bay, and South San Francisco Bay.

3.2 Copper Sources and Loads

Numerous estimates of copper loading to the Bay have been made. The largest loads are from the Central Valley rivers, local watershed sources, and from erosion of buried sediment. These loads are shown in Table 3-2 and discussed below.

Central Valley Rivers

In a September 2000 report, Davis and co-workers estimated copper loads from the Central Valley by multiplying Delta outflow volume by water column concentration data for several sampling events from two relevant RMP stations. The authors averaged these daily load values for the period 1993-1998 to obtain average daily loads and then extrapolated to an annual load of 740 kg/d (Davis *et al.* 2000).

Table 3-2 Inputs of Total Copper to SF Bay (CEP 2004a, 2004d, Tsai *et al*. 2001, TDC 2004, SFBRWQCB 2005, Davis et al. 2000.)

Source	Load (kg/d)
Sacramento & San Joaquin Rivers	740
Urban and non-urban Runoff	180
Wastewater (north of Dumbarton Bridge)	23
Industrial Wastewater	0.5
Anti-fouling Marine Coatings	25
Atmospheric Deposition (wet)	1.4
Atmospheric Deposition (dry)	2.1
Erosion of Buried Sediment	342
Totals (approximate)	**1315**

Local Watershed Sources

Urban runoff occurs year round. However, the most significant loading of most constituents, including copper, occurs during wet weather urban runoff flow events. Wet weather urban runoff is a component of stormwater runoff, which has been assessed by SFEI in a report titled *Contaminant Loads from Stormwater to Coastal Waters in the San Francisco Bay Region*, (Davis *et al*. 2000). Davis and co-workers estimated local tributary loads using a rainfall/runoff model that relies on estimates of contaminant loading from different types of landuse. Using that approach, they estimated copper loads to San Francisco Bay from stormwater runoff ranging from 100 to 300 kg/d, with a best estimate of 180 kg/d.

Mass loadings to San Pablo Bay and Lower South Bay were estimated in 1997 (Rivera-Duarte and Flegal 1997). SFEI summarized results from that same study in a 2001 report (Davis *et al.* 2001). The mass loading estimates indicated riverine loadings were an important source. See Table 3-2 for a summary of sources of total copper to the Bay. There are no comprehensive estimates of dissolved copper loads to the Bay.

Municipal & Industrial Wastewater Sources

Wastewater effluent total copper data and flows were obtained for dischargers to San Francisco Bay north of the Dumbarton Bridge. These data were used to estimate loading of copper from municipal and industrial sources. Effluent volume, typical copper concentrations and daily copper loads from municipal and industrial wastewater facilities are shown in Table 3-3 and Table 3-4 (CEP 2004d).

Table 3-3 Municipal Wastewater Copper Concentrations and Loads (2001-2003) (CEP 2004d).

Discharger	Ave. Flow MGD	Mean Cu μg/L	Cu Load kg/day
City of Benicia	3.0	6.8	0.078
Burlingame	4.0	9.8	0.15
Central Contra Costa Sanitary District	43.9	6.6	1.1
Central Marin	10.4	2.8	0.11
Delta Diablo Sanitation District	9.9	7.6	0.29
Dublin San Ramon Services District	10.5	44.2	1.8
EBDA (E-001 combined)	75.0	12.3	3.5
Castro Valley	15.4	9.7	0.57
Hayward	13.1	24.1	1.2
San Leandro	5.4	9.1	0.19
Union Sanitary District	29.1	14.3	1.6
EBMUD	73.5	9.9	2.7
Fairfield-Suisun Sewer District	16.6	4.4	2.7
Las Gallinas Valley Sanitation District	3.3	12.6	0.16
Millbrae	1.9	8.8	0.06
Mt. View Sanitary District	2.0	5.0	0.04
Novato Sanitary District	3.2	8.1	0.10
Ignacio Plant	4.5	5.2	0.088
Novato Plant	2.0	11.0	0.084
Petaluma	7.3	3.6	0.099
Pinole-Hercules	3.2	4.6	0.056
Rodeo Sanitary District	0.8	3.2	0.0091
S.F. Airport, Water Quality Control Plant	0.7	7.0	0.020
San Francisco City & County Southeast	71.2	13.7	3.7
San Francisco City & County Bayside (wet)	22.7	48.2	4.2
San Mateo	12.8	6.0	0.029
Sausalito-Marin Sanitary District	1.7	11.2	0.071
Sewerage Agency of Southern Marin	3.1	15.5	0.18
Sonoma County Water Agency	3.3	7.7	0.097
South Bayside System Authority	16.9	10.1	0.64
South San Francisco & San Bruno	9.9	10.6	0.40
Tiburon	0.7	18.2	0.049
US Navy Treasure Island Permit	0.4	12.5	0.020
Vallejo San & Flood Control District	14.0	6.4	0.34
West County/Richmond	8.9	7.4	0.25
Totals			23.4

A March 2004 report prepared by TDC Environmental presented estimates for the sources of copper in urban runoff to San Francisco Bay (TDC 2004). The significant sources of copper in urban runoff were estimated to be, in decreasing magnitude, vehicle brake pads, air emissions, copper-containing pesticides, soil erosion, architectural copper, industrial copper use, domestic water discharges, and vehicle fluid leaks. The significant sources of copper from shoreline activities were identified as marine antifouling coatings and copper-containing algaecides applied to surface waters. The table below presents the magnitude of estimated contributions to urban runoff along with a qualitative description of the estimate's uncertainty.

Table 3-4 Industrial Wastewater Copper Concentrations and Loads (2001-2003) (CEP 2004d)

Discharger	Ave. Flow MGD	Mean Cu µg/L	Cu Load kg/day
Chevron Richmond Refinery	6.3	3.5	0.083
ConocoPhillips (at Rodeo)	1.5	6.7	0.038
Dow Chemical Company Permit	0.3	8.8	0.0087
General Chemical Permit	0.3	3.7	0.0045
General Electric Company	0.05	8.3	0.0016
GWF E 3rd St (Site I) Permit	0.04	21.9	0.0036
GWF Nichols Rd (Site V) Permit	0.05	20.0	0.0036
Martinez Refining Company	6.0	5.4	0.12
Morton Permit	0.03	10.6	0.0011
Rhodia Basic Chemicals Permit	0.1	10.7	0.0044
S.F.Airport, Industrial	0.7	5.5	0.014
Tesoro Golden Eagle Refinery	4.2	4.6	0.074
USS – Posco	7.6	2.7	0.079
Valero Benicia Refinery	2.1	7.6	0.060
Totals			0.50

Table 3-5 Copper Sources in Urban Runoff and Shoreline Activities (TDC 2004)

Copper Source	Load Estimate (kg/d)	Uncertainty[a]
Vehicle brake pads	>13	High
Architectural copper	5.6	Moderate-High
Copper pesticides	<10 - <12.5	High
Industrial copper use	4.1	Moderate
Deposition of copper air emissions	11	Low to Moderate
Soil erosion	8.7	Moderate
Copper in domestic water discharged to storm drains	3.7	Moderate-High
Vehicle fluid leaks and dumping	0.75	Moderate-High
Marine antifouling coatings	25	Moderate-High

[a]Uncertainty is defined as follows: Low indicates that the estimate has an error within 50%; Moderate indicates that the estimate has an error up to 2 fold; Moderate-high indicates that the estimate has an error up to 5 fold; High indicates an error up to 10 fold.

Atmospheric Deposition

The global releases of metals into the atmosphere from combustion, industry, and natural sources result in direct atmospheric loadings to San Francisco Bay. Pollutants released hundreds or thousands of miles away can be deposited directly to the Bay or conveyed to the Bay after deposition (indirect) to the Bay's watershed. A study to measure atmospheric deposition loads to the Bay was conducted from August 1999 through August 2000 (Tsai et al. 2001). Particulates in the ambient air and precipitation samples were collected at three sites strategically located in close proximity to the Estuary. Copper load estimates from this study are presented in Table 3-6.

Table 3-6 Direct Atmospheric Deposition of Copper to North and Central San Francisco Bay (1999 – 2000) (Tsai *et al*. 2001).

Region	Dry Deposition (kg/d)	Wet Deposition (kg/d)
North Bay	1.34 (±0.77)	0.66
Central Bay	0.74 (±0.58)	0.74

Erosion of Buried Sediment

Available sediment cores indicate that copper concentrations in buried sediment are elevated compared to background levels (from sediments deposited prior to anthropogenic enrichment). Data show that natural baseline concentrations of copper in San Francisco Bay sediments (sediments deposited prior to anthropogenic enrichment) ranged from 23.7 ± 1.2 µg/g to 41.4 ± 2.4 µg/g. Maximum concentrations of copper in the cores were less than 3 times the baseline concentration (Hornberger *et al*., 1999). Surface sediment copper concentrations vary throughout San Francisco Bay with an overall average of approximately 40 µg Cu/g sediment.

When erosion of Bay sediments occurs, sediments with elevated concentrations will be exposed resulting in increased copper loading to the water column. Although sediment burial and erosion are ongoing natural processes throughout San Francisco Bay, San Pablo Bay, Suisun Bay, and Lower San Francisco Bay studies indicate that more erosion is occurring than burial (USGS 2001a,b 2004). During the 48 years from 1942 to 1990, Suisun Bay experienced a net loss of about 61,000,000 cubic meters (m^3) of sediment, averaging a net loss of 1,300,000 m^3/yr (USGS 2001b). During the 32 years from 1951 to 1983, San Pablo Bay experienced a net loss of about 7,000,000 m^3 of sediment, averaging a net loss of 220,000 m^3/yr (about one sixth of what eroded from Suisun Bay each year) (USGS 2001a). Combining these losses from Suisun Bay and San Pablo Bay, the total net loss is about 1,500,000 m^3/yr from the northern reach.

In recently published U.S. Geological Survey work describing deposition and erosion in San Francisco Bay's southern reach (i.e., Lower San Francisco Bay and South San Francisco Bay) (USGS 2004) between 1956 and 1983, a net average of about 2,600,000 m^3/yr of sediment left the southern reach. Discounting the sediment removed from borrow pits through specific historic human activities, the area's net erosion for that period is estimated to be about 1,700,000 m^3/yr.

Assuming that the eroding sediment is 50% water and 50% sediment by weight (a common assumption for dredging operations, USACE 2002), and based on the densities of water and sediment (1.03 grams per milliliter [g/ml] and 2.65 g/ml (Weast 1981; Elert 2002), there are about 740 kg dry sediment /m^3 of wet volume. The annual net sediment loss is therefore about 1,100 M kg from the northern reach and 1,300 M kg from the southern reach.

As sediment is lost from the floors of San Pablo Bay and Suisun Bay, buried sediment becomes the active sediment layer (approximately the top 0.15 meters). This newly introduced sediment likely contains higher copper concentrations. Metal concentrations are available for sediment cores from San Pablo Bay, Grizzly Bay (north of Suisun Bay), and Richardson Bay (Hornberger *et al*. 1999). Copper concentrations in buried sediment increase with depth because of anthropogenic enrichment, then decrease substantially below about 1 meter (SFRWQCB 2005a). The San Pablo Bay and Grizzly Bay sediment cores can be used to estimate the sediment copper concentrations eroding from the floor of San Pablo Bay and Suisun Bay. (The Richardson Bay core is less likely to be representative of conditions where net bed erosion is known to occur because the core was taken in a depositional environment, and it is farther away from San Pablo Bay and Suisun Bay.) A core from near the San Mateo Bridge is available to estimate the copper concentrations of eroding sediment in Lower San Francisco Bay.

The depth-weighted average copper concentration in the top 1.3 meters of San Pablo and Suisun Bay sediment (the sediment with elevated copper concentrations) is about 63 ppm (SFBRWQCB 2005). The depth-weighted concentration was calculated over the top 1.3 meters of sediment to represent a sediment copper concentration due to anthropogenic enrichment. Assuming that eroding sediment from the floor of these Bay segments contains about 63 ppm copper, and assuming that the net annual sediment loss is about 1,100 M kg/yr from this portion of the Bay, the copper load associated with newly exposed sediment is roughly 69,000 kg/yr (189 kg/d).

The depth-weighted average copper concentration in the top meter of Lower San Francisco Bay sediment (the sediment with elevated copper concentrations) is about 43 ppm (SFBRWQCB 2005). Assuming that eroding sediment from the floor of this Bay segment contains about 43 ppm copper, and assuming that the net annual sediment loss is about 1,300 M kg/yr from this Bay segment, the copper load associated with newly exposed sediment is roughly 56,000 kg/yr (153 kg/d).

3.3 Copper Transport and Transformations

Importance of Sediment

Sediment transport is important to copper cycling in the Bay because copper tends to adsorb to the sediment. The particle size of suspended sediments is generally small (silt and clay). This affects the fate and transport of adsorbed copper, since suspended sediments may be transported long distances and provide more surface area and therefore have higher pollutant concentrations. In addition, when sediments are suspended, copper may desorb releasing large quantities of dissolved copper to the water column (CEP 2004a).

Sediment Transport at Mouth of Petaluma River

An illustration of the importance of sediment transport on ambient copper concentrations can be found at the mouth of the Petaluma River. Here, the RMP has consistently measured high concentrations of contaminants (SFEI 2003a). Sediment transport between the Petaluma River and San Pablo Bay creates high suspended sediment concentrations, which largely explains the area's high concentrations of contaminants. The USGS and the University of California at Davis collected continuous hydrodynamic and suspended sediment concentration data in the Petaluma River from January 1999–August 1999, and from September 2000–March 2001 (Barad *et al*., 2001).

The geometry and tidal currents in the area create a process of sediment erosion and deposition that repeats with each tidal cycle (about every 12.4 hours). As water flows seaward on ebb tides, the tidal currents apply force to the riverbed. An upstream deposit of sediment on the bed of the Petaluma River is eroded and mixed into the water column. As this suspended sediment mass moves downstream, very high suspended sediment concentrations are present (>500 mg/L). Once the suspended sediment mass reaches San Pablo Bay, the slack tide and broad area allow sediment to drop out of the water, forming a downstream sediment deposit. As water begins flowing landward immediately after the tide turns from slack to flood, the downstream sediment deposit is re-suspended and transported upstream. This to and fro process then repeats, with the same sediment mass oscillating back and forth between the Petaluma River and San Pablo Bay. Sediment is effectively trapped within this area, except during large flows in the Petaluma River. This process accounts for the high concentrations of suspended sediment and contaminants in RMP samples collected at the mouth of the Petaluma River. As seen in Figure 3-3, site BD15 (Petaluma River station) stands out from the other sites as having higher copper concentrations.

Copper Cycling and Speciation

Copper cycling between different chemical forms is important in San Francisco Bay because it plays a major role in both the fate and toxicity of this metal in the Bay. The major chemical species of copper are the free copper ion; inorganic complexes with chlorides, hydroxides, carbonates, and sulfates; organic complexes with strong and weak ligands; and adsorbed and other particulate forms (TetraTech 1999). Speciation is very important since free copper ion and labile inorganic complexes are most closely associated with toxicity to aquatic organisms. Only a small fraction of the total copper in the water column occurs in these forms. Much of the dissolved copper is complexed with organic ligands, and particulate forms constitute a significant fraction of the total copper concentrations (TetraTech 1999). Therefore, it is important to understand the processes that control the transformations between different chemical forms of copper, since these will determine the speciation and concentrations of copper as loads or internal cycling processes change in the future.

Complexation and adsorption are the main processes that control copper speciation. Inorganic complexation reactions are fast, and can be considered as equilibrium processes (Buck and Bruland 2003). Seasonal salinity variations have the largest effect on these reactions, since salinity determines the concentrations of the inorganic ligands that complex copper. Organic complexation reactions depend on the relative concentrations of organic ligands and dissolved copper (Buck and Bruland 2003). Buck and Bruland conducted speciation studies of copper in San Francisco Bay to characterize the concentrations of important chemical forms (free ionic, strongly and weakly complexed) and the probable impact of these ambient concentrations on aquatic toxicity. Two ambient ligand classes (strong L_1 and intermediate L_2) were found to complex 99.9% of the dissolved copper in the Bay. This complexation results in very low concentrations of free Cu^{2+} ion (the form most closely associated with toxicity to aquatic life). The ligand concentrations exceeded the dissolved copper concentrations at every site.

The free ionic form of copper can be toxic to certain species of phytoplankton. However, water quality criteria for copper are not based on phytoplankton toxicity. Rather, the marine criteria are based on toxicity to mussel larvae. Further, although research indicates that free ionic copper is the toxic form of copper to aquatic life, and it is possible to measure (indirectly) free ionic copper concentrations, water quality criteria for metals like copper are expressed as dissolved concentrations. Accordingly, copper dosing in toxicity tests is measured in dissolved concentrations, and interpretation of these toxicity tests results is made with reference to the dissolved concentration present during the test. It is through the WER that we account for chelation and infer what the binding capacity must have been in the test water to provide the protective effect observed in the test organism.

During the study, no ambient free ionic copper concentrations exceeded 10^{-13}mol/L, a concentration two orders below the threshold concentration at which the viability of most phytoplankton species begins to decline (Buck and Bruland 2003). However, Buck and Bruland predicted that if dissolved copper concentrations in the Bay were to increase to 6.9 µg/L, free ionic copper concentrations may increase to those levels associated with toxicity to phytoplankton (10^{-11} mol/L).

Biological Cycling

Organisms influence biogeochemical cycling through uptake and excretion processes, incorporation into biological tissues, production of organic detrital material containing copper, and subsequent release during decomposition and mineralization. Biological uptake removes dissolved copper from the water column and incorporates it in the biota, while excretion returns the copper back to the water in soluble forms. This biological processing can change the form and bioavailability of copper. Free copper ion and weak inorganic complexes are the forms most readily assimilated from the water, while excreted forms may be complexed with organic ligands and are much less available for biological uptake. In addition, phytoplankton excrete cellular exudates that chelate copper ions, effectively reducing copper bioavailability and toxicity (Buck and Bruland 2003).

Particulate organic detrital copper is produced through food web processing. Following accumulation of copper in the biota, processes such as phytoplankton settling, plankton mortality, and egestion generate organic detrital copper that settles and deposits in the sediments. This copper can be released in a soluble form to the water column and sediment porewaters as the organic material decomposes. Solubilization of the copper by benthic animals feeding on phytoplankton and detritus could also be an important process releasing copper into the water column. Benthic bioturbation/irrigation effects could likewise release copper-containing sediment into the water column for subsequent dissolution.

Copper in the Aquatic Food Web

The amount of copper in the aquatic food web depends on uptake from two routes of exposure, water and food. The uptake and elimination rates must consider the effects of metal regulation by the organisms, at least for copper. A steady-state approach can be used to estimate total copper concentrations in different organisms and relative contributions from water and food. Alternatively, a dynamic food web model can be constructed to predict copper concentrations throughout the food web in response to changing exposure conditions, for example, from seasonal variations in the loading and cycling of copper, or to future projected conditions in the Bay. Currently, copper measurements in aquatic organisms in San Francisco Bay are limited to benthic bivalves. Copper is an essential nutrient to phytoplankton, which actively take up this metal from the water column (TetraTech 1999). However, copper bioaccumulation in the aquatic food web is not expected to occur and has not been a documented problem in the Bay (CEP 2004a).

3.4 Ambient Conditions

RMP ambient water and sediment data for copper are summarized in Figure 3-3 and Figure 3-4. These plots summarize nine years of RMP data and are therefore useful for evaluating spatial trends in the Bay. To help interpret the water quality monitoring data, a map of RMP water sampling locations along with a table describing the locations is shown in Figure 3-2.

Figure 3-3 and Figure 3-4 are box and whisker plots showing the median, the 25th percentile, the 75th percentile, extreme values and outliers. The lower and upper boundaries of the box represent the 25th and 75th percentiles, respectively. The horizontal line inside the box represents the median. Data values that are between 1.5 and 3 box-lengths from the upper or lower edge of the box are outliers and shown with circles. The largest and smallest observed values that are not outliers are also shown. Lines (referred to as whiskers) are drawn from the ends of the box to these values.

Bay Region	Station Name	Station ID
Rivers	San Joaquin River	BG30
	Sacramento River	BG20
Northern Estuary	Honker Bay	BF40
	Grizzly Bay	BF20
	Pacheco Creek	BF10
	Napa River	BD50
	Davis Point	BD40
	Pinole Point	BD30
	San Pablo Bay	BD20
	Petaluma River	BD15
Central Bay	Red Rock	BC60
	Point Isabel	BC41
	Richardson Bay	BC30
	Horseshoe Bay	NS
	Golden Gate	BC20
	Yerba Buena Island	BC10
Lower Bay	Alameda	BB70
	Oyster Point	BB30
	San Bruno Shoal	BB15
	Redwood Creek	BA40
South Bay	Dumbarton Bridge	BA30
	South Bay	BA20
	Coyote Creek	BA10

Figure 3-2 Map and Table showing RMP sampling stations

Figure 3-3 shows dissolved copper concentrations in Bay waters. The stations shown are RMP sampling stations arranged spatially with Grizzly Bay (BF20) at the left and South Bay (BA 30) on the right. The BC20 station represents the Golden Gate Bridge samples, and the lowest concentrations of dissolved copper in the Bay (ocean water). To the left of BC20 in Figure 3-3, concentrations increase somewhat steadily to Grizzly Bay (BF20), excluding BD15 and begin to decrease at the Sacramento and San Joaquin River mouths. To the right of BC20, concentrations of dissolved copper increase steadily toward the Dumbarton Bridge. Copper concentrations in Bay sediments are shown in Figure 3-4. These concentrations vary according to the size of sediment particle found in each area. For instance, coarse sands at BG20 and BG30 have less surface area for copper adsorption and have lower copper concentrations, while the fine grained (<63µm) sediments at BF40 and BF21 have high copper concentrations (Hornberger *et al*. 1999, CEP 2004a).

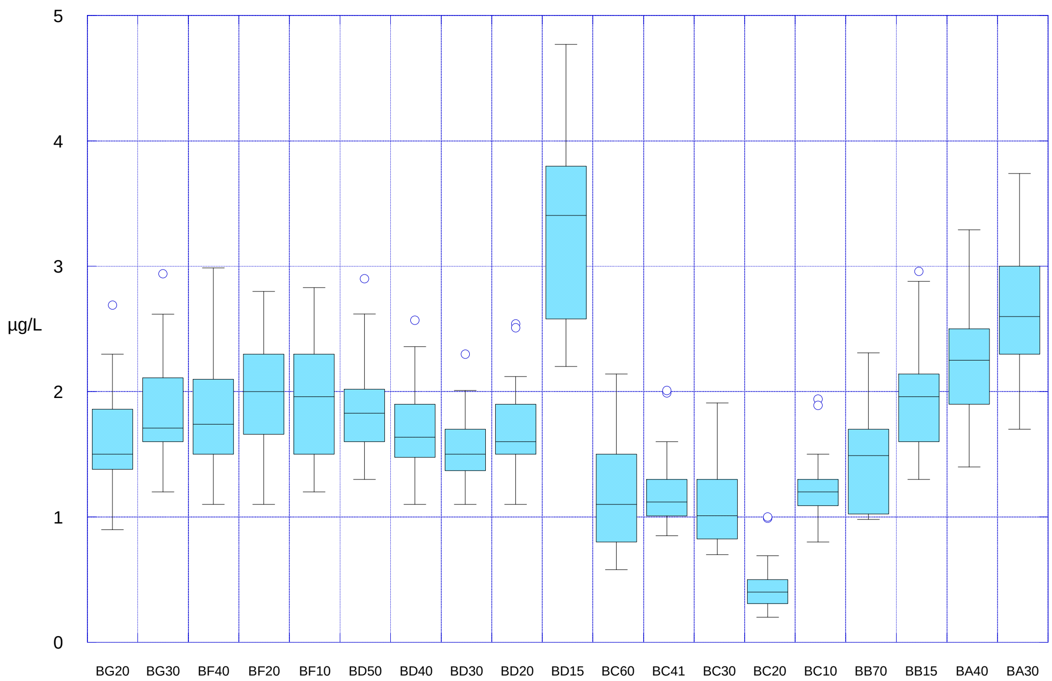

Figure 3-3 RMP Dissolved Copper in Water Column (1993-2001) in San Francisco Bay north of the Dumbarton Bridge (CEP 2004a). BD15 is the Petaluma River station.

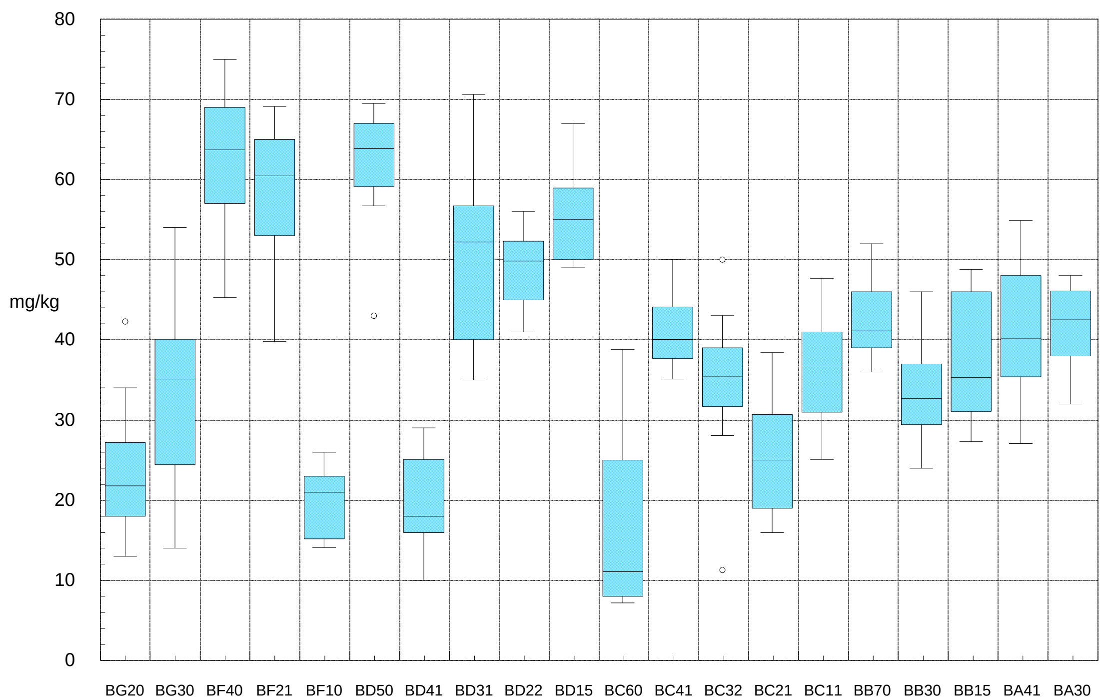

Figure 3-4 RMP Copper in Surface Sediment (1993-2001) in San Francisco Bay north of the Dumbarton Bridge (CEP 2004a).

3.5 Technical Uncertainties

The majority of available evidence supports the finding that the Bay north of Dumbarton Bridge is not impaired by dissolved copper. However, as with most complex environmental systems, there are some uncertainties. The areas of remaining uncertainty are overall loading estimates, tributary runoff loads, wet season data, water column/sediment interactions, toxicity to benthic organisms and fish olfactory effects. These uncertainties motivate the pollution prevention and other actions discussed in the chapter on implementation.

Uncertainty in Tributary Loads

Wet season tributary runoff loads are the most important of the ongoing external sources, both in terms of magnitude and potential for load reductions by watershed management or stormwater control measures. The existing load estimates have a fair amount of uncertainty associated with them, and they could be refined using more current or projected land use information, more recent and complete runoff loading data, and more advanced models than were previously available.

The Sources, Pathways and Loadings work group of the RMP, in cooperation with the Clean Estuary Partnership (CEP), is undertaking studies to improve the methodologies for estimation of wet season loadings from small and large tributaries (SFEI 2003b). This effort includes high flow monitoring studies at Mallard Island and on the Guadalupe River that may provide useful tools for estimation of wet season copper tributary loads. Additionally, the results from a modeling effort associated with an ongoing project funded through the Costa-Machado Act (Proposition 13) will assist greatly in the quantification and understanding of urban runoff loadings to the Bay. Finally, NPDES permits for urban runoff management agencies will require monitoring efforts to assess loads and loading trends for a wide variety of other pollutants of concern. The incremental cost opportunistic copper sampling during such monitoring efforts will be small compared to the obtained insights into status and trends of copper loading from this source.

Resuspension. The sediments of the Bay serve as a repository of copper from historical and ongoing external loads. The stored copper in the sediments can strongly influence concentrations of total and dissolved copper (CEP 2004a). When these sediments are resuspended, the copper attached to the sediment largely determines the total concentrations in the water column. Also, copper can desorb from the suspended sediment and contribute substantially to dissolved concentrations. This process is pronounced during the dry, windy season when resuspension rates are highest. Copper can also diffuse directly from the bed sediment and impact dissolved concentrations in the water column (TetraTech 1999). Ongoing RMP monitoring helps gain insights into this process.

Erosion. The bed erosion load estimates presented above could change drastically if additional sediment cores or more information about how different parts of the Bay floor are eroding becomes available in the future. For example, if one or more Bay segments are found to be undergoing sediment deposition instead of erosion, this internal copper source would be largely eliminated. There are ongoing RMP studies addressing this uncertainty.

Toxicity. Surface sediment samples have exhibited toxicity to test organisms at a number of sites throughout the Bay. Since 1993, the RMP has seasonally evaluated the toxicity of sediments to mussel embryos and amphipods. For each seasonal sampling period since 1993, the proportion of sediment samples that were toxic to at least one test organism ranged from 33% to 100%, with no clear overall trend, but with clear seasonal differences. As with water toxicity, sediment toxicity is more frequent in the Bay during the wet season than in the dry season, suggesting stormwater runoff may be an important source of constituents that cause sediment toxicity (CEP 2004a).

Initial analyses to identify the causes of observed sediment toxicity have yielded a variety of answers, in large part due to the complex mixtures of chemicals involved. Comparisons of the chemical data to toxicity test data indicated that amphipod mortality and reductions in normal mussel embryo development may have been related to various chemicals in San Francisco Bay sediments (Thompson *et al*. 1999; Anderson *et al*. 2001; Phillips *et al*. 2003). Additionally, research by Phillips *et al.* has shown that sediment toxicity to bivalve embryos is caused by "elevated concentrations of divalent cations….with copper as the most probable cause of toxicity" (Phillips *et al.* 2003).

Additional special studies will likely be conducted through the RMP. These studies would further examine whether water and sediment toxicity tests used in the RMP are accurate predictors of impacts on the Bay's aquatic and benthic communities. Because the amphipod (*Eohaustorius estuarius*) used in the RMP is not a resident of the Bay, there are questions regarding its ecological relevance. Sensitivity of selected resident organisms to key chemicals of concern will be compared to sensitivity of this amphipod species. Information from these experiments will confirm whether the current species employed are adequately sensitive to represent and ensure the protection of the Bay ecosystem. The proposed experimental work would include continued toxicity identification evaluations, laboratory and/or *in situ* sediment spiking and dose-response tests at concentrations shown to be associated with toxicity (SFEI 2003).

As presented in Section 1.4 above, the RMP has been monitoring sediment copper concentrations since 1993. These data show that, despite year to year variability, there is no discernible temporal trend in copper sediment concentration at any RMP station (SFEI 2007). Continued collection and analysis of these data along with the results of sediment toxicity studies will allow the Water Board to regularly evaluate copper accumulation in sediments.

Sublethal Effects of Copper on Salmonids

Copper has been implicated in affecting multiple sublethal endpoints in laboratory tests on salmonids. All these laboratory experiments have been conducted in freshwater, and this introduces uncertainty as to their applicability to marine or estuarine environments. Dissolved copper has been shown to affect sensory system function important to an array of ecologically relevant behaviors in anadromous salmonids. The precise mechanism of damage by dissolved copper remains unknown, but direct exposure to dissolved copper can impair and destroy olfactory sensory neurons.

Damage to olfaction can be experimentally quantified by a sensitive technique that measures olfactory receptor function in fish (NOAA 2006, Baldwin 2003).
The technique is called the electro-olfactogram (EOG) and is designed to monitor the effects of pollutants on the active properties of primary sensory neurons in the olfactory epithelium. The EOG is measured with an electrode positioned near the surface of the sensory epithelium. The amplitude of the EOG reflects the electrical response of olfactory receptor neurons as they bind to odor molecules in the surrounding environment. Therefore, the EOG provides a direct measure of receptor neuron function in the intact animal (Baldwin 2003).

Copper can impair and destroy salmonid sensory systems; alter behavior essential for completion of anadromous lifecycles; impair immune system functions thereby reducing disease resistance; increase susceptibility to stress; impair osmoregulation; induce liver damage; reduce growth; impair swimming ability; and weaken eggshells. Many of these effects manifest at low parts per million copper concentrations over relatively brief durations (NOAA 2006).

Two salmonid sensory systems, olfaction and the lateral line, rely on neurons with similar structures (called ciliated receptors) to detect and respond to cues in the aquatic environment. Both of these systems can be damaged by dissolved copper. These olfactory receptors detect chemical cues that are important in finding food, avoiding predators and pollution, navigating migratory routes, recognizing kin, and participating in reproduction (NOAA 2006).

Recent studies show significant reductions in olfactory receptor function at short exposures (10 min) of low (5 μg/L) dissolved copper concentrations. Further, similar measurements were observed 7 days following exposure, an indication that the olfactory system cannot adapt to, and correct for, copper exposure within that time period (NOAA 2006). Further, EOG measurements in combination with a predator avoidance assay provided evidence that impaired olfaction resulted in a direct suppression of predator avoidance behavior (alarm response) at environmentally realistic dissolved copper exposures (> 2 μg/L; 3 hour exposure, NOAA 2006). Recent research demonstrated that copper toxicity to the olfactory system is not ameliorated by alkalinity or hardness, but dissolved organic carbon appeared to reduce copper bioavailability in a dose dependent manner. These results suggest the application of a common toxicity model called the Biotic Ligand Model is not appropriate to predict the sublethal effect of copper on salmonids (NOAA 2006).

Because all known studies to date have been conducted in the laboratory in experiments intended to represent freshwater environments, a number of uncertainties need to be resolved before the results can be extended to marine or estuarine environments. First, the neurophysiological responses should be linked to behavioral responses in the natural environment. Second, no research has been conducted on possible sensory impacts of copper in marine or estuarine systems. The results of freshwater studies cannot be directly applied because of physiological differences in fish sensory function in freshwater and marine environments. Third, the mechanism of toxicity is not well-understood so the role of copper speciation in reducing the sensory impacts is unknown. The studies to date have been conducted in the laboratory in experiments intended to represent freshwater environments. Ionic copper is the primary causative agent in toxicity to phytoplankton or juvenile stages of shellfish. This toxicity is clearly ameliorated to the extent that free ionic copper concentrations are reduced due to complexation. The extent to which this same amelioration of sublethal effects on sensory function would take place in marine environments is still unknown.

4 Technical Background for SSO Development

This chapter presents the technical details underlying the proposed copper SSOs, including details about the associated water effects ratios (WERs) and metal translators needed to compute water quality based effluent limits (WQBELs) based on the SSOs. The current copper water quality objectives applicable to the Bay north of the Dumbarton Bridge are the Basin Plan's 3.1 µg/L chronic (4-day average) and 4.8 µg/L acute objective. The chapter begins with a demonstration of why SSOs are needed for the portion of San Francisco Bay north of the Dumbarton.

4.1 Need for SSOs for SF Bay North of Dumbarton

SIP Section 5.2 (3) requires submission of specific information when dischargers request that the Water Board develop and adopt SSOs. This information must demonstrate: "that the discharger cannot be assured of achieving the criterion or objective and/or effluent limitation through reasonable treatment, source control, and pollution prevention measures. This demonstration may include, but is not limited to, as determined by the Water Board: (a) an analysis of compliance and consistency with all relevant federal and State plans, policies, laws and regulations; (b) a thorough review of historical limits and compliance with those limits; (c) thorough review of current technology and technology-based limits; and (d) an economic analysis of compliance with the priority pollutant criterion or objective of concern." A report was prepared that included elements (a) through (d) for municipal wastewater facilities discharging north of the Dumbarton Bridge (CEP 2004d). The key arguments of this report are included below.

To demonstrate the need for the SSOs, three municipal agencies can serve as representative examples of the more than 40 agencies that discharge treated wastewater into the portion of San Francisco Bay north of the Dumbarton Bridge. The three agencies include: (1) a small, shallow water secondary treatment discharger (Las Gallinas Valley Sanitary District, LGVSD), (2) a medium-sized shallow water advanced secondary treatment discharger (Fairfield-Suisun Sanitary District, FSSD), and (3) a large deep water secondary treatment discharger (East Bay Municipal Utility District, EBMUD).

To demonstrate that these three dischargers are reasonably representative of other dischargers, available effluent copper data from the period 2001 through 2003 from all dischargers were compiled from the Water Board's Electronic Reporting System (ERS). The ERS database contains data for these facilities and most other municipal and industrial NPDES dischargers to San Francisco Bay. The data were grouped into secondary wastewater treatment and advanced secondary wastewater treatment categories. These data are shown graphically in Figure 4-1 as a series of box plots comparing effluent concentration data from the three case study facilities to effluent concentration data of all secondary and advanced facilities discharging to the Bay north of the Dumbarton. This figure shows that these three dischargers are reasonably representative of other dischargers in terms of effluent copper data from the period 2001 through 2003.

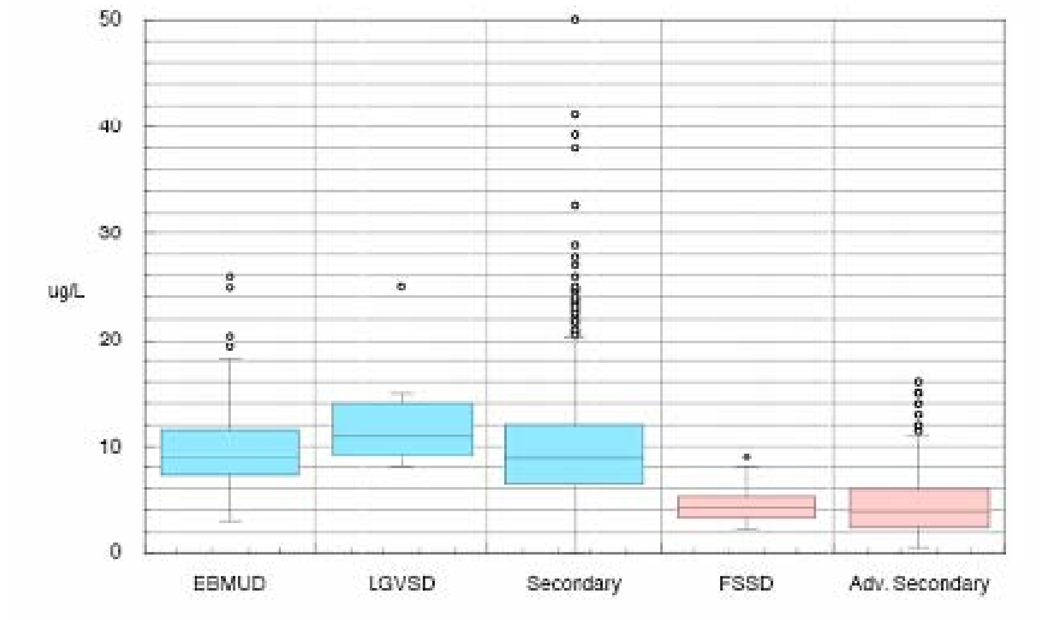

Figure 4-1 Boxplot of total copper effluent concentration data (in µg/L) for three case study facilities compared to all municipal facilities. The lower and upper boundaries of the box represent the 25th and 75th percentiles, respectively. The horizontal line inside the box represents the median. Data with values that are between 1.5 and 3 box-lengths from the upper or lower edge of the box are considered outliers and are shown with circles. The largest and smallest observed values that are not considered outliers are also shown as lines (referred to as whiskers) drawn from the ends of the box to these values.

Existing final effluent limits and potential future effluent limits for copper were calculated for each facility based on existing copper water quality objectives. Current effluent quality was compared with these effluent limits to establish the ability to comply with current effluent limits for the three representative agencies. Additionally, an overview analysis of all municipal wastewater dischargers was made to validate that the compliance assessment for the three case study facilities represented the full suite of potentially impacted agencies. More information about this analysis can be found in the supporting documentation (CEP 2004d). Ability to comply with final effluent limits is determined by comparing the calculated effluent limits to the observed maximum effluent concentration (MEC) and/or the statistically projected maximum. None of the case study facilities could consistently comply with final CTR based copper effluent limits calculated with the translators used for the latest NPDES permits. It can be estimated that LGVSD would exceed a 3.4 µg/L limit 100% of the time. FSSD would exceed its 4.8 µg/L limit about 40% of the time. EBMUD would exceed its 7.6 µg/L limit about 75% of the time. Because these facilities are representative of other facilities of the same treatment type, a large number of north of Dumbarton wastewater facilities would have similar compliance challenges for copper.

All three facilities have long-established and well performing source control and pollution prevention programs in place for copper. The majority of influent copper in these and most other systems is believed to be a function of the relative corrosivity of the potable water supply and corrosion of copper piping and plumbing fixtures. The pre-treatment and pollution prevention performance of the three case study facilities are described in detail in a separate report and summarized below (CEP 2004d).

LGVSD provides a consistent and above average level of secondary treatment. Long-term average biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations were 9.3 and 14.1 mg/L, representing 94% and 91% removals, respectively, well above the 85% removal stipulated in the federal secondary treatment regulations (CEP 2004d). LGVSD is not required to institute a Pretreatment Program because the average dry weather flow is less than 5 MGD, and because there are no categorical dischargers or dischargers generating greater than 25,000 gallons per day. Nonetheless, the District, beginning in 1993/94, developed a strong pollution prevention (P2) program regulating targeted commercial facilities, educating the public and coordinating with other local and regional programs. Copper control has been a primary focus. The District's commercial facility program includes inspecting and permitting automotive facilities, and inspecting printers, photo-processors, dentists and medical facilities. The District has also expanded its program to contact laboratories, facilities with cooling towers and dry cleaners. The District's P2 program address potential sources of copper primarily through regulation of automotive facilities (most of which are now zero-discharge) and of printers. The program's general P2 and public outreach activities (such as discouraging use of copper-based root killers) may also result in reductions in copper loading (CEP 2004d).

FSSD, an advanced treatment facility, has outstanding performance in removing TSS and BOD. Long term average effluent concentrations between 2002 and 2005 were 2 mg/L for BOD and 1.1 mg/L for TSS. In addition to its pretreatment program, which regulates 11 industries and 3 groundwater remediation sites, the District has an active pollution prevention program that has been in place since 1992.The District has identified copper as a pollutant of concern and has conducted pollution prevention targeting copper sources including corrosion of copper plumbing, root control products, vehicle service facilities, mobile surface cleaners, and metal fabricators. Pollution prevention activities have contributed to a 34% reduction in copper influent levels between 1992 (59 µg/L) and 2000 (39 µg/L). The District has conducted source control for most of the common copper sources so it is not expected that significant reduction can be achieved (CEP 2004d).

EBMUD has been a leader in Bay Area pretreatment and pollution prevention activities since 1974 and has been the recipient of the U.S. EPA National First Place Award as an outstanding pretreatment and pollution prevention program on three separate occasions (1989, 1993 and 1997). A summary of the District's recent source control activities is provided in the 2000 EBMUD Pretreatment and Pollution Prevention Report dated February 2001 (CEP 2004d). The District has conducted a number of programs aimed at the identification and reduction of copper sources and found that tap water was the major contribution to its influent. The District has monitored tap water to derive its estimates of water supply contributions of copper. The relatively high contribution from tap water is a result of the relatively corrosive nature of the District's water supply from the Sierra

Nevada Mountains. EBMUD's source water is very low in total dissolved solids since it is primarily snowmelt. The District has already implemented a wide variety of copper source reduction and pollution minimization actions including: addressing corrosion control, industrial source pretreatment, pollution prevention outreach to known sources, and education on consumer products containing copper. EBMUD estimates that since 1988,copper source control activities have resulted in a 35 percent reduction in influent loading to the treatment plant. The estimated reduction in effluent copper load from the EBMUD plant since 1988 has been about 15% (CEP 2004d).

LGVSD, FSSD, and EBMUD all provide a consistent and high level of wastewater treatment in full compliance with Federal secondary treatment requirements. As documented in their respective Infeasibility Studies, plant operations are already highly optimized and there are no known plant additional optimization methodologies that would significantly reduce effluent concentrations. All three facilities have long-established and well performing source control and pollution prevention programs in place. Potential commercial and industrial copper sources discharging to the collection have long been targeted by these programs and continue to be tracked, inspected, and monitored. There are no known significant additional sources to target that may result in the level of reductions necessary to comply with the potential final limits.

The majority of influent copper in these and most systems is believed to be a function of the relative corrosivity of the potable water supply and corrosion of copper piping and plumbing fixtures. The water purveyors in each of the three discharger's service areas have had corrosion control programs in place for years, as mandated to comply with the Safe Drinking Water Act Lead and Copper Rule. Some of this corrosion could be controlled through additional corrosion control efforts by water purveyors may result in reduced copper influent concentrations to municipal wastewater facilities. While technically feasible, the additional expense for these efforts may not be warranted because the reduced influent concentrations may not allow wastewater facilities to meet current effluent limits.

Based on available information, these three representative case study facilities, despite implementing reasonable treatment and copper source control, cannot consistently meet copper effluent limits based upon the default CTR criteria. Thus, the SIP condition for consideration of a copper SSO is met.

4.2 Copper Site-Specific Objectives and Translators

Because a national aquatic life criterion might be more or less protective than intended for the aquatic life in most bodies of water, U.S. EPA has provided guidance concerning procedures that may be used to derive a site-specific criterion (U.S. EPA 1994a).

The indicator species procedure is the method used in this project, and it is based on the assumption that characteristics of ambient water may influence the bioavailability and toxicity of a pollutant (U.S. EPA 1994a). Acute toxicity in site water and laboratory water is determined in side-by-side toxicity tests using either resident species or suitable sensitive non-resident species, which are used as surrogates for the resident species. The

Indicator Species Procedure allows for modification of the national criterion by using a site-specific multiplier that accounts for ambient water quality characteristics that may affect the bioavailability of the pollutant in question. As part of this procedure, a water effects ratio (WER) is determined using results from toxicity tests performed in ambient water and laboratory water.

A WER is the ratio of toxicity of a compound to an aquatic organism when the tests are performed using standard laboratory water versus the toxicity when the tests are performed using ambient water. A WER is expected to appropriately take into account the (a) site-specific toxicity of a compound and (b) interactions with other constituents of the site water that may either reduce or increase the toxicity of the compound in question. If the value of the water effect ratio exceeds 1.0, the pollutant is less toxic in the site water than in laboratory water. The difference in toxicity values, expressed as a WER, is used to convert a national water quality criterion for a pollutant to a site-specific water quality criterion (U.S. EPA 1994a).

Translator calculation - Required effluent limits for the wastewater sources must be calculated according to the procedures outlined in the SIP. There are two types of effluent limits, an Average Monthly Effluent Limit (AMEL) for the monthly average concentration of a regulated pollutant and a Maximum Daily Effluent Limit (MDEL). Both the AMEL and the MDEL are expressed as total metal concentration. However, water quality criteria for copper are expressed as dissolved concentrations. Therefore, the effluent limit calculation requires use of a ratio of total to dissolved metal concentration called the metal translator.

The data collected through the RMP and the special WER study (see below) to calculate copper translators reasonably represent water conditions into which deep water discharges enter the Bay. This is not the case for shallow water discharges because the local ambient conditions for shallow water dischargers can vary substantially from discharge to discharge. For this reason, the copper translators developed through this project will only be applicable to deep water discharges. Deep water dischargers may use the copper translators specified through this project or perform a special study to develop site-specific translators for their discharge location. However, translators for shallow water dischargers must be established on a discharger-by-discharger basis during NPDES permit reissuance.

The most conservative translator is a value of one (1.0), implying that all metals discharged will be present in the dissolved form in the receiving water. Effluent limits derived using translator of 1.0 simply treat the CTR dissolved criteria as total recoverable values. A less conservative option is to use the EPA's "conversion factor" (listed in the CTR) as a default translator. The federal saltwater copper criteria conversion factor is 0.83. The dissolved CTR criteria are adjusted to a total recoverable basis by dividing by these conversion factors. Effluent limits derived using the default conversion factors would be slightly higher than those based on a translator equal to 1.0. The third option is to develop a site-specific translator based on an analysis of sample data collected from the receiving water. SIP Section 1.4.1 describes the conditions under which site-specific translators may be used. This project computes translators for deep water discharges by direct measurement of the dissolved and total recoverable copper concentrations in water samples (U.S. EPA 1996). The translator can then be calculated as the ratio of dissolved to total concentrations.

4.3 North of Dumbarton Special WER Study

Beginning in 2000, a study was performed to improve the understanding of the aquatic toxicity of copper in San Francisco Bay north of the Dumbarton Bridge. The study was designed: (1) to provide scientifically defensible data; (2) to characterize chemical and toxicological conditions at various locations in the Bay; (3) to evaluate whether or not existing ambient water column levels of copper cause impairment in San Francisco Bay north of the Dumbarton Bridge; (4) to develop site specific water quality objectives for copper for San Francisco Bay north of the Dumbarton Bridge; and (5) derive translator values to us in computing NPDES permit limits.

Sampling was conducted at thirteen stations (see Table 4-1 and Figure 4-2 below). Sample site selection was based on existing RMP data, results from hydrodynamic modeling, and the need to explore shallow areas of the Bay that had not been sampled extensively through the RMP. Sample events included 8 (deep water) RMP sample sites and 5 shallow water sites sampled four different times. The shallow water sites lie on transects anchored on deep water RMP sites, in order to develop information on possible gradients extending into the shallows.

Table 4-1 Site Codes and Station Descriptions for Sampling Locations for Special Study

Site Code	Site Description
BD15	Mouth of Petaluma River
BD20	San Pablo Bay
SPB01	Shallow area between BD15 and BD20
SPB02	Shallow area in eastern San Pablo Bay, mid-point on transect
SPB03	Shallow area in eastern San Pablo Bay, near shore on transect
BF20	Grizzly Bay
BF10	Pacheco Creek
BC10	Yerba Buena Island
BB30	Oyster Point
BB15	San Bruno
BA40	Redwood Creek
LCB01	Shallow area in Central Bay, mid-point on transect
LCB02	Shallow area in Central Bay, near shore on transect

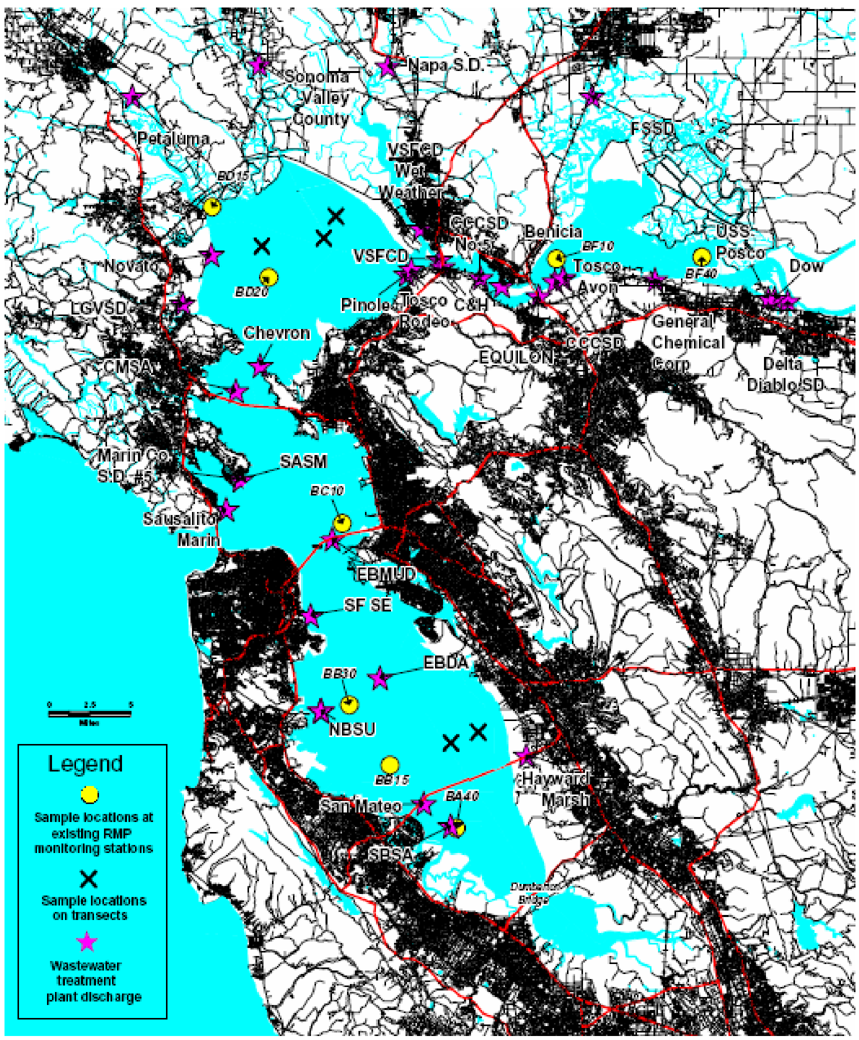

Figure 4-2 Map showing sampling locations for special study. Circles represent historical RMP stations. Stations marked with an 'X' represent sampling locations along transects in shallow water areas in San Pablo Bay (SPB01-03) and Central Bay (LCB01-02).

Two sampling events were conducted during the dry season (September 2000 and June 2001), and two sampling events were conducted during the wet season (January and March 2001). The rationale behind the sampling event selection was to capture the dominant hydrological conditions observed during the year. The selected number of events also represented a balancing of temporal coverage with the need for extensive spatial coverage to sample areas of the Bay north of Dumbarton in both deep and shallow water. The copper toxicity tests in the special study were performed on the larval form of *Mytilus edulis* (common mussel), which is an ideal organism for use in bioassays needed to determine WER values due to its sensitivity to copper.

4.4 Copper Toxicity Results and WER Calculation

The *Mytilus edulis* toxicity tests used for the WER study followed the guidelines established by the U.S. EPA manual (U.S. EPA 1995). The sampling, laboratory and quality assurance/quality control (QA/QC) procedures for this study were based in large part on the studies conducted by the City of San Jose in developing WERs for South San Francisco Bay. Detailed descriptions and information relating to sampling, laboratory and QA/QC procedures are provided in Sections 2 through 4 (and associated Appendices 2 through 4) of the WER report (BACWA 2002). There were a total of 50 valid site water EC50s (concentration that adversely affects 50% of test organisms) and eight laboratory water EC50s developed in the WER study. The site water EC50s are shown in. There were two laboratory water results developed for each event.

Table 4-2 Dissolved Copper EC50 Values (µg/L) in site water (CEP 2004b).

	Station	Event 1	Event 2	Event 3	Event 4
Central/Lower Bay	BA40	21.7	25.0	19.1	21.3
	BB15	19.4	19.3	18.9	17.0
	LCB01	20.1	27.8	17.3	16.3
	LCB02	19.4	30.9	19.6	14.7
	BB30	20.3	20.7	16.8	16.4
	BC10	17.8	15.3	16.9	12.4
North Bay	BD20	18.2	24.2	13.8	14.5
	SPB01	16.7	24.8	20.1	19.2
	BD15	22.4	50.5	23.3	22.7
	SPB02	14.2	30.3	16.5	21.1
	SPB03	14.5	23.4	18.4	19.0
	BF10	21.1	33.3	21.3	*
	BF20	14.0	30.2	11.1	*
Summary Statistics					
Number		13	13	13	11
Minimum		14.0	15.3	11.1	12.4
Maximum		22.4	50.5	23.3	22.7
Arithmetic Mean		18.4	27.4	17.9	17.7
Geometric Mean		18.2	26.3	17.6	17.4
90^{th} Percentile		21.6	32.8	21.1	21.3
5^{th} Percentile		14.1	17.7	12.7	13.5
Median		19.4	25.0	18.4	17.0
Std. deviation		2.9	8.6	3.1	3.2

* QA problems prevented computation of EC50s for the fourth event at BF10 and BF20.

Dissolved copper EC50 values were used to calculate the WERs for each station and event. The resulting WERs and relevant summary statistics are shown in Table 4-3.

$$\text{WER} = \frac{\text{Site Water EC50}}{\text{Lab Water EC50}}$$

Table 4-3 Dissolved Copper WER Summary Statistics (CEP 2004b)

	Station	Event 1	Event 2	Event 3	Event 4
Central/Lower Bay	BA40	2.7	4.2	2.7	3.1
	BB15	2.4	3.2	2.7	2.5
	LCB01	2.5	4.7	2.4	2.4
	LCB02	2.4	5.2	2.8	2.2
	BB30	2.5	3.5	2.4	2.4
	BC10	2.2	2.6	2.4	1.8
North Bay	BD20	2.2	2.6	2.0	1.5
	SPB01	2.0	2.6	2.9	2.0
	BD15	2.7	5.3	3.4	2.4
	SPB02	1.7	3.2	2.4	2.2
	SPB03	1.7	2.5	2.7	2.1
	BF10	2.5	3.5	3.1	*
	BF20	1.7	3.2	1.6	*
Summary Statistics					
Number		13	13	13	11
Minimum		1.7	2.5	1.6	1.5
Maximum		2.7	5.3	3.4	3.1
Arithmetic Mean		2.3	3.5	2.6	2.3
Geometric Mean		2.2	3.4	2.5	2.2
90th Percentile		2.7	5.1	3.1	2.5
Median		2.4	3.2	2.7	2.2
Std. deviation		0.4	1.0	0.5	0.4

* QA problems prevented computation of WERs for the fourth event at BF10 and BF20.

Results of the north of Dumbarton study are consistent with results obtained during the 1996-1997 San Jose study. The Redwood Creek station (BA40) was investigated in both studies (in 2000 – 2001 and 1996 – 1997), and results were comparable (averages of 2.75 and 2.2).

The U.S. EPA guidance suggests using geometric means for final WER (FWER) selection. The arithmetic means for the north of Dumbarton Bridge data ranged from 2.5 to 2.8 while the geometric means ranged from 2.4 to 2.7. Statistical analysis showed there to be no significant differences between results at shallow water and deep water stations so those groupings are not considered further in the SSO selection analysis. Although the measured WERs were noticeably higher during the January 2001 wet season sampling event, the WERs were consistent for the other three sampling events. Therefore, there was no clear evidence of a seasonal pattern in the WERs.

4.5 Copper SSO Calculation

Water quality criteria designed to protect aquatic organisms are generally of two types – the Criteria Continuous Concentration (CCC) and the Criteria Maximum Concentration

(CMC). The CCC are the U.S. EPA national water quality criteria recommendations for the highest ambient concentrations of a pollutant to which organisms can be exposed indefinitely without causing an unacceptable effect and thus protect against chronic toxicity. The CMC are the U.S. EPA national water quality criteria recommendations for the highest ambient concentrations of a pollutant to which organisms can be exposed for a brief period of time without causing an unacceptable effect, thus protecting against acute toxicity (CTR).

The first step in computing SSOs using the indicator species procedure is to determine, using available toxicity data, a final acute value (FAV), which is an estimate of the concentration of a pollutant that is protective of 95% of the genera represented in the toxicity data set. The FAV or acute value is the basis for both the chronic and the acute criterion. The FAV is divided by two and multiplied by the WER to calculate an acute criterion. Division by two is a safety factor to account for uncertainty. The acute value is divided by the ratio of acute to chronic toxicity (ACR) and then multiplied by the WER to produce a chronic criterion.

These calculations can be summarized as follows (from U.S. EPA 1994a):

Acute Criterion:	(acute value / 2) x WER = Acute SSO
Chronic Criterion:	(acute value / ACR) x WER = Chronic SSO

The current national saltwater copper FAV is 10.39 µg/L based on the four most sensitive species. However, U.S. EPA lowered this FAV to 9.625 µg/L, the Species Mean Acute Value (SMAV) for *M. edulis*, in order to protect this commercially important species. As a result, the current national saltwater copper CMC is 4.8 µg/L (9.625/2=4.8). The current national saltwater copper CCC is 3.1 µg/L, which is the quotient of the SMAV of 9.625 µg/L and the current U.S. EPA ACR of 3.127 (9.625/3.127=3.1). Note that the default copper WER is 1.

When the six reference toxicant test dissolved copper EC50 values from the San Jose study and data from this study were added to the U.S. EPA values, the new SMAV for *M. edulis* decreased from 9.625 µg/L to 7.776 µg/L. This resulted in a new CMC of 3.9 µg/L dissolved copper (7.776/2=3.9) and a new CCC of 2.5 µg/L dissolved copper (7.776/3.127=2.5) (CEP 2004b). The chronic copper SSOs are computed as the new CCC x WER. The acute SSOs are computed as the new CMC x WER. Particular WERs used to adjust the CCC and CMC are discussed below.

4.6 Bay Segmentation and SSO Recommendation

There are some chemical, biological, and physical differences between the portions of the Bay north and south of the Dumbarton Bridge. Generally, the portion south of the Dumbarton Bridge receives less freshwater and tidal flushing, and it drains a heavily urbanized watershed ("Silicon Valley"). Its status as a unique, water-quality-limited, hydrodynamic and biological environment is recognized in the Basin Plan. These factors result in higher concentrations of dissolved copper, but this portion of the Bay also has generally higher concentrations of natural and anthropogenic ligands that can bind copper to make less available for biological uptake. Copper toxicity to aquatic organisms is closely correlated to the concentration of the Cu^{2+}, and these ligands reduce the amount of Cu^{2+}(Buck and Bruland 2003). In contrast, the portion of the Bay north of the Dumbarton Bridge is more influenced by the ocean and freshwater inputs from the Central Valley rivers. This portion of the Bay has generally lower concentrations of dissolved copper as well as lower concentrations of organic ligands.

In view of these differences in different portions of the Bay, individual WER values from the 13 sampling sites were pooled according to specific geographic regions of the Bay. The geometric mean WERs for these regions are shown in Table 4-4. The San Bruno Shoal is the geographic feature that distinguishes the two portions of Lower San Francisco Bay (regions 3 and 4) used in this analysis. This feature is approximated by a straight line connecting Coyote Point with the Oakland Airport (see Figure 4-4). The endpoints are: Coyote Point on the San Mateo side of the Bay (longitude: 122d 15m 45s W latitude: 37d 34m 26s N), and Oakland Airport's runway 29 on the East Bay side (longitude: 122d 12m 49s W latitude: 37d 41m 57s N).

Table 4-4 WER Results by Region of the Bay. See Figure 4-3 for map of these regions.

Region of Bay	Basin Plan Segments Included	Contributing Stations	Geometric Mean WER
1	Suisun Bay, portion of Delta	BF10, BF20	2.49
2	San Pablo Bay	BD15, BD20, SPB01, SPB02, SPB03	2.40
3	Central San Francisco Bay and the portion of Lower Bay north of a line connecting Coyote Point and the Oakland Airport	BC10, BB30	2.44
4	The portion of Lower San Francisco Bay south of the line connecting Coyote Point and the Oakland Airport.	BB15, BA40, LCB01, LCB02	2.90
5	South San Francisco Bay	Data from a previous study	2.77

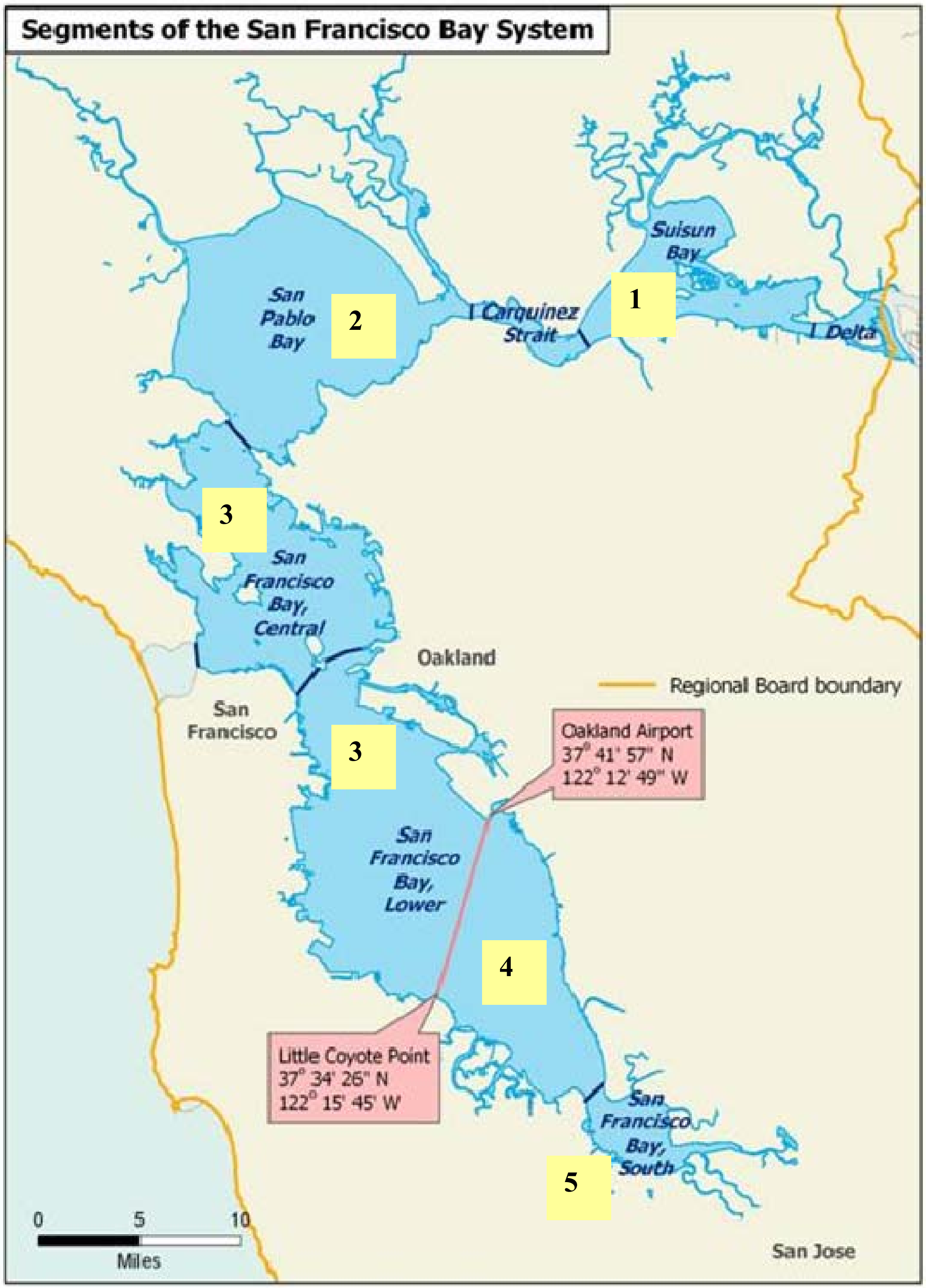

Figure 4-3 Segments of San Francisco Bay. Numeric designations shown in boxes are used in assigning WERs to specific locations in the Bay.

In viewing the results shown in Table 4-4, it is clear that the WERs of regions 1-3 are lower than those for regions 4 and 5. Accordingly, we propose two separate copper WERs for the Bay, north of Dumbarton, a single value to represent the entire Bay north of the San Bruno Shoal (regions 1-3) and a single value south of this shoal. We propose 2.40 as the WER for Regions 1-3, which is the lowest of the three geometric means for regions 1-3 (CEP 2004b). We propose 2.77 as the WER for Region 4, which is the geometric mean from South SF Bay (Region 5). This proposed WER is lower than that measured in Region 4 (2.9), but the lower Region 5 WER will be used both as a measure of protectiveness and because it is based on a larger data set than the Region 4 WER (CEP 2004b).

These proposed WERs result in dissolved copper chronic SSOs (CCC) of 6.0 µg/L for Bay Regions 1-3 and 6.9 µg/L for Bay Regions 4 and 5. This approach protects *Mytilus* sp., the most sensitive species in the U.S. EPA database. The corresponding acute copper SSOs (CMC) are 9.4 µg/L and 10.8 µg/L (see Figure 4-4).

4.7 Impairment Assessment Findings

Impairment of aquatic life uses is the primary concern related to water column copper concentrations. The impairment assessment addressed three primary indicators to assess potential impairment of aquatic organisms in San Francisco Bay: (1) site-specific water column criteria based on U.S. EPA guidance, (2) surface sediment concentrations and toxicity, and (3) phytoplankton. The conclusion from the impairment assessment is that impairment of aquatic life uses in San Francisco Bay north of Dumbarton is unlikely. The several lines of evidence supporting this finding are discussed fully in the North of Dumbarton Bridge Copper and Nickel Conceptual Model and Impairment Assessment Report (EOA/LWA, 2004a) and summarized below. More detailed information about these uncertainties as well as others relevant to this finding is presented in Section 3 of this report.

Water column criteria - The first line of evidence is a conservative screening analysis that assumed that if the aquatic species most sensitive to copper is not impacted by ambient dissolved copper concentrations, the other aquatic species less sensitive to copper will not be impacted either. Further, all beneficial uses will be fully protected if beneficial uses relating to aquatic life (uses most sensitive to copper) are protected. The water column dissolved copper concentrations do not exceed chronic toxicity values for *Mytilus edulis* (blue mussels), the most sensitive species in the national database tested for copper toxicity. The highest dissolved copper concentration measured north of the Dumbarton Bridge from 1993 to 2004 was 4.8 µg/L at the Petaluma River station in 1995 (SFEI 2005). Even this concentration is well below the recommended SSO that is protective of Bay aquatic life. Additionally, the toxicity of copper in SF Bay is reduced by the presence of dissolved organic compounds that bind the copper making it less bioavailable (BACWA, 2002).

Sediment toxicity – As discussed in Section 3, surface sediment samples have exhibited toxicity to test organisms at a number of sites throughout the Bay. Phillips and co-workers have shown that sediment toxicity to bivalve embryos is caused by “elevated concentrations of divalent cations….with copper as the most probable cause of toxicity" (Phillips et al. 2003).

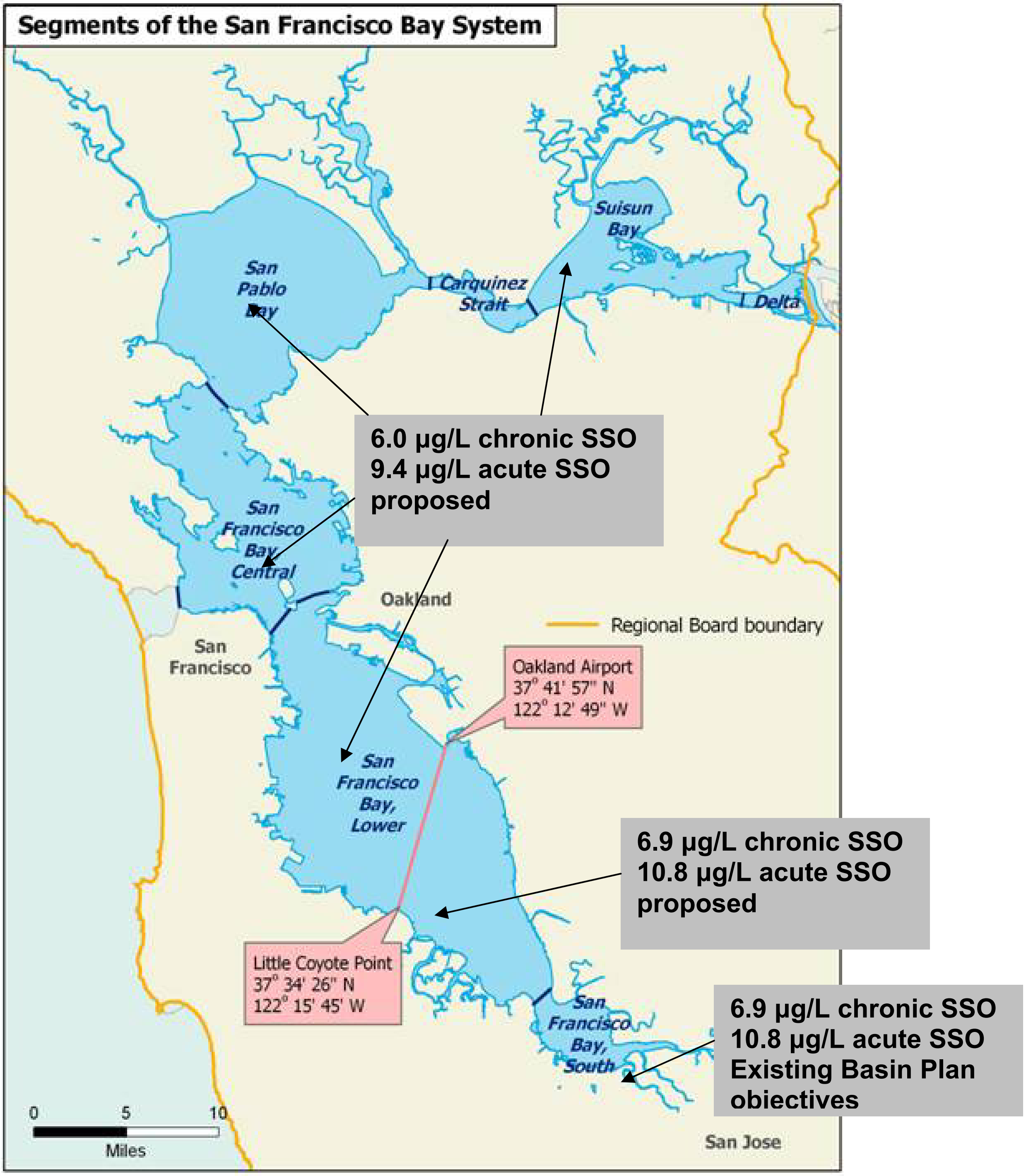

Figure 4-4 Proposed copper SSOs in San Francisco Bay segments.

Because the amphipod (Eohaustorius estuarius) used in the RMP is not a resident of the Bay, there are currently questions regarding the ecological relevance of these data. Therefore, it is not currently clear whether or not copper is impairing Bay beneficial uses via through toxicity to benthic (sediment dwelling) organisms.

Phytoplankton - Buck and Bruland (2003) conducted speciation studies of copper in San Francisco Bay to characterize the concentrations of important chemical forms (free ionic, strongly and weakly complexed) and the probable impact of these ambient concentrations on aquatic toxicity. Their results showed that very little ambient dissolved copper was in the toxic, free ionic form. During the study, no ambient copper concentrations exceeded 10^{-13} mol/liter, a concentration threshold below which copper is considered nontoxic to the phytoplankton community. Therefore, it is unlikely that copper is negatively impacting the Bay food web through impacts on phytoplankton, the base of the pelagic (open water) food web.

4.8 Translators for Deep Water Discharger Effluent Limits

The combined RMP and special study data were pooled into representative data sets to derive translators. The data were pooled using the same Bay regions described for the WERs. The copper translator and TSS summary statistics for these pooled categories are shown in Table 4-5 and Table 4-6 below. The Petaluma River sampling station (BD15) copper concentrations are considerably higher than those at any other station. However, a review of the copper translator box plots in Figure 4-5 and summary statistics in, where the BD15 results are broken out and shown separately, indicates that the translator values at BD15 fall within the range of values for the remaining North Bay stations (those in San Pablo and Suisun Bay).

Because both dissolved and total concentrations were elevated at station BD15, the impact on calculated translators was not as pronounced as would otherwise be expected. Comparing the ‘All’ grouping and the ‘All but BD15’ grouping in Table 4-5 shows that removing BD15 from dataset only slightly raised the resultant translator. The greatest relative differences in translators existed between the North Bay and Central Bay groupings of stations. This is likely explained by the greater influence of ocean flushing on the Central Bay sites. According to the SIP, the median translator is used for the calculation of AMEL, and a 90th percentile translator is used for computing MDELs. Therefore we propose two sets of translators for use by for deep water discharges – one for the North Bay and another for the Central Bay. Note that the Central Bay translators do not apply to South San Francisco Bay, which had translators defined in a separate project .

Table 4-5 Copper Translator Summary Statistics (CEP 2004c, data 1993-2003, San Jose 2006b)

Summary Statistics	Central /Lower Bay (regions 3&4)	Suisun/San Pablo Bay (regions 1&2)	All	All but BD15
Number	137	131	268	244
Minimum	0.28	0.08	0.08	0.08
Maximum	1.00	0.94	1.00	1.00
Arithmetic Mean	0.71	0.41	0.56	0.58
Geometric Mean	0.70	0.37	0.51	0.53
90^{th} percentile	0.87	0.66	0.82	0.83
Median	0.73	0.38	0.60	0.63
Standard Deviation	0.14	0.19	0.22	0.22

Table 4-6 TSS Summary Statistics in mg/L (1993-2001, CEP 2004c).

Summary Statistics	Central / Lower Bay	Suisun/San Pablo Bay	All	All but BD15
Number	112	117	229	205
Minimum	1.00	7.20	1.00	1.00
Maximum	56.0	414	414	371
Arithmetic Mean	13.0	85.9	50.3	35.9
Geometric Mean	9.10	55.9	23.0	18.8
90^{th} percentile	29.8	190	121	89.8
Median	8.40	59.2	22.4	17.6
Standard Deviation	11.8	86.6	72.2	46.0
10^{th} percentile	3.4	15	4	4.1

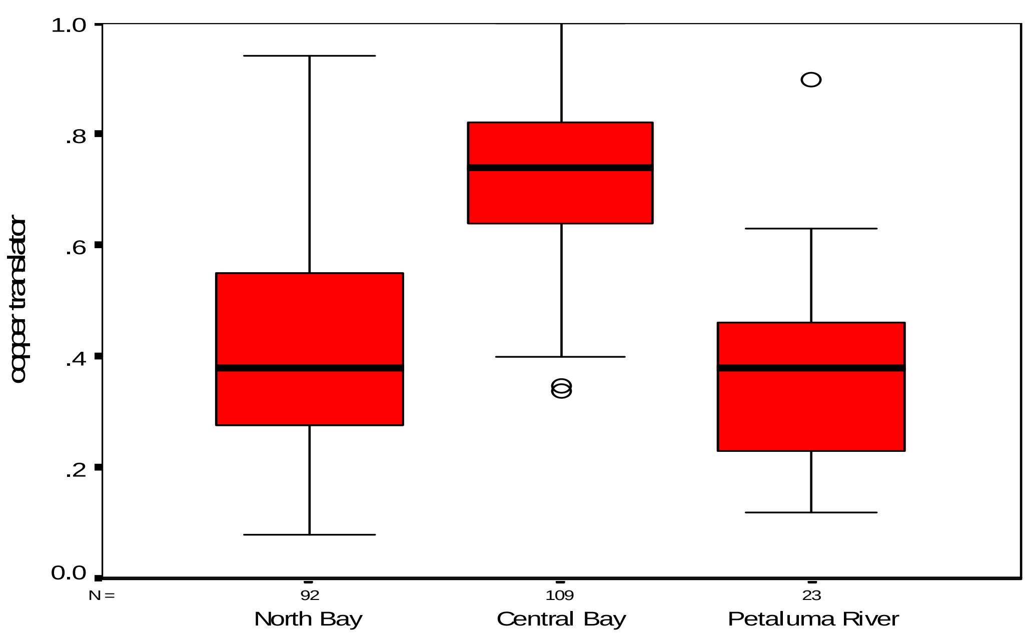

Figure 4-5 Copper Translator Box Plots for North Bay, Central Bay and Petaluma River Sampling Stations (see Figure 4-1 for explanation of box plot format).

Table 4-7 Recommended copper translators for use in computing copper effluent limits for deep water discharges North of the Dumbarton Bridge.

Bay Segment	Copper AMEL Translator	Copper MDEL Translator
Suisun Bay San Pablo Bay (Regions 1 and 2)	0.38 (median of data in regions 1 and 2)	0.66 (90th percentile of data in regions 1 and 2)
Central and Lower San Francisco Bay (Regions 3 and 4)	0.73 (median of data in regions 3 and 4)	0.87 (90th percentile of data in regions 1 and 2)

5 Implementation Plan

An implementation plan is required to ensure the achievement and ongoing maintenance of the SSOs in the entire Bay. The main purpose of the implementation plan is to prevent increases of dissolved copper concentrations in the Bay. We propose to accomplish this goal through implementing the following:

- Control measures for urban runoff management agencies
- Control measures for wastewater treatment facilities
- Copper control measures for copper-based antifouling coatings on boats
- Control measures for lagoons
- Measures to resolve remaining uncertainties
- Ambient monitoring and concentration triggers

This implementation plan will apply Bay-wide and will replace some components of the existing South San Francisco Bay implementation plan that was put in place in 2002 to support SSOs in the South Bay segment (region 5 in Figure 4-3). The following sections describe each component of the implementation plan.

5.1 Control Measures for Urban Runoff Management Agencies

The control measures for urban runoff target significant sources of copper identified in a report produced in 2004 for the Clean Estuary Partnership (TDC 2004). This report updated information on sources of copper in urban runoff, loading estimates and associated level of uncertainty, and summarized feasible control measures and priorities for further investigation. The major sources identified were: vehicle brake pads, architectural copper, copper pesticides, industrial copper use, air deposition, soil erosion, domestic supply, and vehicle fluid leaks and dumping (TDC 2004). The implementation plan calls for control measures that directly or indirectly address the largest of these sources.

One of the largest sources to urban runoff is vehicle brake pad wear debris. The Brake Pad Partnership is a project funded through Proposition 13 (Costa-Machado Act) whose participants include government regulators, brake pad manufacturers, stormwater management agencies, and environmental advocacy groups. This project is evaluating the potential effects of brake wear debris on water quality. After rigorous testing and modeling, if brake pad wear debris is found to impair water quality, industry manufactures have agreed to voluntarily introduce new products containing less copper within five years. However, this voluntary reduction is uncertain, and some aftermarket brake pads are possibly unaffected by the voluntary action. Moreover, the benefits of copper content reduction may be slowly realized because there is a great deal of wear debris already deposited on watersheds, and this wear debris will continue to be deposited as long as copper-containing brakepads are in use. Therefore, there may need to be additional measures addressing copper-containing wear debris on the part of urban stormwater management agencies.

For other sources, urban runoff management agencies can take steps to control the magnitude of copper released to watersheds. For example, all municipalities exercise permitting authority for construction so, through this process, new instances of architectural copper use can be identified so that appropriate wash water controls can be put in place. All of the urban runoff copper control measures will be implemented through NPDES permits for urban runoff management agencies. The proposed permit provisions are shown in Table 5-1 below.

Table 5-1 Proposed NPDES copper permit provisions for urban runoff management agencies

Source	Control Measure
Architectural Copper	Prevent storm drain discharges of waste solutions generated from cleaning and treating copper architectural features (e.g., patina treatments, or other corrosive cleaning solutions) both during installation and throughout the life of the feature.
Copper Pesticides	1) Prohibit pool, spa, or fountain discharge containing copper to storm drain. Require Installation of Appropriate Sewer Discharge Connections for Pools, Spas, and Fountains and that backwash be discharged to the sewer.
Vehicle Brake Pads	1) Participate in and support the Brake Pad Partnership. 2) Explore enhanced system design, operation, and maintenance to control copper releases from program areas.
Industrial Sources	Ensure compliance with best management practices for control of copper where it is used in industrial applications. This will be accomplished through industrial stormwater inspections.
Support Studies to Reduce Uncertainty	Conduct or cause to be conducted: monitoring of copper loading to the Bay at locations and frequency sufficient to track loading trends; technical studies to investigate possible copper sediment toxicity; and technical studies to investigate sublethal effects on salmonids (refer to Section 3.5 for background information on uncertainties and Section 2.1 for necessity).

NPDES permits for urban runoff management agencies prohibit discharge of copper that cause or contribute to an exceedance of the applicable copper water quality standard. If an ambient trigger concentration in any San Francisco Bay segment (see Section 5.6) is exceeded, consistent with existing permit conditions all urban runoff management agencies discharging to that segment will be required to submit a report to the Water Board that describes best management practices that are currently being implemented and additional measures, with a schedule, that will be implemented to prevent their copper discharge from causing or contributing to the exceedance. This report may include a demonstration that the discharges from the urban runoff management agency are not causing or contributing to increased ambient copper concentration.

5.2 Control Measures for Wastewater Treatment Facilities

The implementation plan for wastewater sources is intended to maintain or improve current treatment and source control performance. This goal will be achieved by requiring copper control measures and numeric water quality-based effluent limitations (WQBELs). The WQBELs will be computed from the site-specific objectives and translators presented in chapter 4 of this report using methodology described in the SIP.

Municipal and industrial wastewater facilities generally have well-developed source control programs addressing copper. As a consequence of this long experience with copper control, we know a lot about the important sources to target. A study by Palo Alto in 1999 identified major copper sources to their municipal treatment plant and concluded that the largest by far (50% of total) was corrosion of copper water pipes (EIP 1999). Other notable sources were industrial sources, water supply, stormwater inflow, infiltration, and groundwater. This information is probably applicable to other municipal facilities in the Bay area.

The management measures for wastewater treatment facilities will be implemented through individual NPDES permits and will include the following elements:

- Water quality-based effluent limits (WQBELs) computed from the SSOs
- Baseline program of pollution prevention measures (described below)
- Advanced pollution prevention program (if necessary)
- Support for studies to reduce uncertainties associated with sediment toxicity to benthos and sublethal olfactory effects (refer to Section 3.5 for background information on uncertainties and Section 2.1 for necessity).
- Monitoring and Reporting

The WQBELs will be computed from the SSOs and translators for the relevant portion of the Bay for each discharge. Shallow water dischargers will need to develop site-specific translators for their discharge location at the time of permit reissuance. The baseline pollution prevention measures are summarized in Table 5-2.

The extent of implementation will be scaled to the size and resources of the agency – with large facilities implementing the full program, and smaller facilities implementing fewer measures. The reason for this is that commercial and industrial sources are less relevant to smaller agencies and are thus not cost-effective to control. The extent to which these actions are implemented will be based on the size and resources of the agency using the following criteria:

- Municipal wastewater facilities with average dry weather design flows of 5 MGD or greater would need to implement a copper pollution prevention program that includes the industrial, commercial, and residential elements discussed in Table 5-2.
- Municipal wastewater facilities with average dry weather design flows of 1 MGD but less than 5 MGD would implement the commercial and residential elements discussed above.
- Municipal wastewater facilities with average dry weather design flows of less than 1 MGD would need to implement the residential element.

- All municipal and industrial facilities will be required to document source identification efforts and develop an implementation schedule.

Table 5-2: Proposed control measures for wastewater dischargers

Measure	Details
Source Evaluation	Evaluate or document prior evaluations of copper sources to their influent within 12 months of the Basin Plan Amendment adoption. This evaluation is conducted prior to developing a program and will aid in identifying controllable copper sources of significance (those contributing at least 10% of copper found in influent).
Industrial Pre-treatment	Municipal wastewater facilities with an industrial pretreatment program shall confirm that all industrial users meet copper local limits as defined in Federal pretreatment regulations and take appropriate enforcement if necessary.
Commercial	If corrosion is determined to be a significant copper source, work cooperatively with local water purveyors to reduce and control water corrosivity as appropriate and ensure that local plumbing contractors implement BMPs to reduce corrosion in pipes. Provide BMP education for plumbers, designers, and maintenance contractors for pools and spas. BMPs may include practices such as encouraging the reduction of copper pipe burrs; proper use of fluxes, reducing hot water temperature, careful reaming of cut ends to reduce turbulence and others (Good Plumbing Practices Protect San Francisco Bay, A Fact Sheet for Installers/Plumbers; Preventing Corrosion Protects San Francisco Bay, A Fact Sheet for Designers, http://www.sanjoseca.gov/esd/pub_res.asp#bmp)
Residential	Provide education and outreach to the public regarding plumbers' roles in reducing corrosion as well as proper pool and spa maintenance.

Each facility will evaluate their control efforts to determine if they are effective and are targeting major sources. Municipal facilities will accomplish this evaluation through their Pollution Prevention Annual report. Based on this evaluation (and Water Board concurrence during permit reissuance), it may be possible for a facility to adjust copper-related activities to insure the most resource-effective program implementation.

There may be circumstances in which a facility will have to implement control measures beyond the baseline program. There are two criteria for a facility to move to a more advanced copper pollution prevention program – exceeding an effluent limit or reaching an ambient dissolved copper trigger concentration.

If a facility exceeds its copper effluent limit due to increased influent loading, then it would be necessary to investigate the cause of the exceedance and submit for review and approval an initial report of findings within sixty (60) days of the exceedance.

The elements of the investigation shall include:
- Cause determination including source, if known.
- Impacts of the exceedance.
- Corrective actions including implementation schedule.
- Schedule for follow-up including evaluation of effectiveness.

There are three possible primary causes for an effluent copper limit exceedance; increased influent loading, plant process upset, and plant capacity limitations. Only one of these causes, increased influent concentration, would warrant additional pollution prevention activities. Plant capacity issues would require a plant capacity review and action plan and plant upset would require a review of operational procedures and implementation of safe guards, as appropriate.

Increased influent loading is defined as headworks concentration that results in an effluent limit exceedance when the plant's most recent 12 month average copper removal efficiency is mathematically applied to the influent concentration. Plant process upset as cause is defined as non-standard process function that results in copper removal efficiencies twenty-five percent (25%) below the most recent 12 month average copper removal efficiency. Plant capacity limitation as cause is defined as the most recent average dry weather flow (defined as the average of the three consecutive months with the lowest plant flow in a calendar year) exceeding eighty-five percent (85%) of plant design capacity.

A second occurrence that may compel additional control measures is that an ambient trigger concentration (see monitoring section below) is reached. In this case, all municipal and industrial wastewater facilities within that reach of the Bay will investigate effluent copper trends. Those facilities with increasing copper effluent trends over the previous 3 years will develop and implement a plan to address these increasing levels. Depending on the cause of the upward trends in effluent copper levels, additional source control or treatment process optimization may be warranted.

An annual report for municipal facilities will be produced for at least five (5) years following the adoption of the Basin Plan Amendment. Regional Board staff will review the need for continuing this compiled reporting during the fifth year. The annual report will contain the following information from each municipal facility:

- Effluent graph of facility performance over past 5 years
- Accomplishments and effectiveness evaluation of copper control measures
- Any observation of trends in indicators (lower copper discharges from sources, lower effluent levels, increase awareness, etc.)

All individual industrial facilities will be required to submit an annual summary of performance that shows influent and effluent copper concentrations and loading. Figure B-1 in Appendix B shows a suggested format for this report. The performance summaries will provide the last 5 years of plant data to illustrate that performance is not degrading over time.

5.3 Control Measures for Anti-fouling Marine Coatings

Paints applied to boats and ships to control unwanted "fouling" growth on their hulls often contain copper-based biocides. When the use of tributyltin in marine coatings was phased out in the late 1980s, copper-based biocides became the primary antifouling coating option for recreational boats. In the Bay there are major ports, industrial piers, and dozens of marinas. Boats and ships coated with copper-containing biocides may release copper directly into the Bay during storage, operation, and in-water maintenance. On-shore maintenance activities have the potential to release copper into urban runoff (TDC 2004).

Currently there are no specific control measures in place to limit copper releases from marine antifouling paint in the San Francisco Bay Area. In response to concerns raised in San Diego, the State Department of Pesticide Regulation (DPR) and the State Water Resources Control Board are working together to explore the relationship between marine antifouling paints and copper levels in surface waters. To facilitate exploration of this issue, DPR has organized a multi-disciplinary workgroup to assess the degree and geographical distribution of copper pollution caused by copper antifouling paints in California's aquatic environments and to evaluate control measures by DPR and Regional Water Quality Control Boards. The San Francisco Bay Regional Water Board is participating in this work group.

The workgroup serves as a project review committee for some elements of DPR's strategy to determine the appropriate regulatory approach to biocides in marine antifouling coatings, including copper. Key elements of the DPR strategy include completion of a monitoring study to evaluate the extent and magnitude of water quality impacts from marine antifouling paint ingredients (primarily copper in marinas) on California surface waters and sediments and to coordinate development of safer alternative fouling control practices. Alternatives to copper-based hull paints using epoxy or silicone coatings have entered the market in recent years, and education pieces for boaters about these non-toxic strategies have been produced. However, non-toxic alternatives have not been widely accepted yet in the boating industry, due to practicality and cost concerns (TDC 2004).

Pending review of the monitoring study results, DPR may initiate a regulatory process called "re-evaluation". This regulatory authority allows DPR to require specific information from makers of marine antifouling coatings. Based on information from its own monitoring, information obtained from manufacturers through re-evaluation, U.S. EPA's regulatory actions (if any), Water Board regulatory changes (if any), voluntary commitments by manufacturers (if any) and any other relevant available evidence, DPR intends to determine its appropriate regulatory action.

5.4 Control Measures for Lagoons

Many managed lagoons are hydraulically connected to the Bay. Because of their nutrient loading and stagnant conditions, excessive growth of aquatic plants and algae can cause nuisance conditions in these lagoons. In addition to mechanical harvesting, copper-based algaecides are used to control nuisance plant and algae growth. The application of these algaecides is currently permitted under a Statewide General NPDES Permit (SWRCB Water Quality Order 2004-0009) for discharges of aquatic pesticides to surface waters. To qualify for coverage under this general permit, dischargers generally must be licensed by DPR or Department of Health Services (DHS) to apply aquatic pesticides. The basic requirements of the general permit include:

i) The discharger must follow all pesticide label instructions and any Use Permits issued by a County Agricultural Commissioner.
ii) The discharger must implement best management practices.
iii) The discharger must comply with monitoring requirements.

The effluent limitations of the general permit state that the "discharge shall not cause or contribute to long-term adverse impacts on beneficial uses of waters of the United States". The discharge shall not cause or contribute to an exceedance of specific, hardness-based receiving water limitations. The implementation plan for the SSO project proposes to recognize coverage under the general permit as being sufficient to ensure that application of copper pesticides to lagoons shall not cause or contribute to violations of the water quality objectives.

U.S. EPA has recently enacted a regulation exempting application of pesticides consistent with federal pesticide law from the need to obtain an NPDES permit (SWRCB 2007). For now, the general permit will remain in place. However, in the absence of the general permit, the Water Board may exercise its authority under Porter-Cologne and consider imposing requirements similar to those now in place under the general permit.

5.5 Measures to Resolve Remaining Uncertainties

The majority of available evidence supports the assessment that the Bay north of Dumbarton Bridge is not impaired by dissolved copper. However, as is the case for most questions concerning complex environmental systems, some uncertainties remain. Three key areas of remaining uncertainty are wet season tributary loads, toxicity to benthic organisms and fish olfactory effects (described in Section 3.5). The implementation plan calls attention to planned or needed investigations specifically directed at these areas of remaining uncertainty and requires NPDES permittees to support these studies.

5.6 Ambient Monitoring and Concentration Triggers

The implementation plan establishes baseline copper control measures as well as additional measures that would be implemented if ambient dissolved concentrations increase. The implementation plan also includes an evaluation of sediment copper concentration and sediment toxicity data collected through the RMP to assess possible copper accumulation in Bay sediments and toxicity to biota. The implementation plan also includes periodic assessment of the appropriateness of copper SSOs for San Francisco Bay given ongoing changes in water and sediment management, as well as restoration activities around the Bay. Dissolved organic carbon (DOC) is a cost-effective surrogate to assess the degree to which Bay water prevents toxicity to mussel larvae because such toxicity correlates very well with DOC. Therefore, analysis of trends in DOC data collected through the RMP will determine whether or not additional toxicity tests are needed to confirm the values of the SSOs. The DOC analysis and consideration of an appropriate response will be accomplished through the triennial review of the Basin Plan.

In order to determine systematically if ambient dissolved concentrations have increased, specific copper concentration triggers are proposed for comparison to data collected through the RMP. In other words, if copper RMP data reach the trigger levels, additional action should be taken to investigate the cause of the increase and control sources if warranted. We do not expect concentrations to increase based on the decade-long pattern of consistent Bay concentrations illustrated in Figure 5-1 and Figure 2-1 However, the monitoring program will be able to detect increases if they occur.

The calculated trigger level magnitudes are inversely related to the number of samples (‘n’) that the RMP will collect. In other words, trigger levels increase as ‘n’ decreases. South San Francisco Bay dischargers have conducted intensive monthly copper sampling since 1998 at 12 monitoring stations south of the Dumbarton Bridge in order to be able to detect small ambient copper concentration changes with a high statistical power. In view of the consistent pattern of historical dissolved ambient copper concentrations in all portions of the Bay, we propose a monitoring program that has less intensive sampling but can achieve the same statistical power.

The RMP reevaluated regional definitions in the Bay and now recognizes the five regions shown in Figure 4-3 and listed in Table 5-3 (CEP 2004b). Notice that the RMP region designated “3” includes portions of two Basin Plan segments (all of Central San Francisco Bay and the northern portion of Lower San Francisco Bay). We propose an annual calculation of the three-year rolling mean copper concentrations in these five regions of the Bay annually using data collected through the RMP. These rolling mean concentrations will be compared to trigger concentration values for each segment. Trigger values were determined using a power analysis (one-sided t-test of means with an alpha value of 0.05). The ‘n’ in Table 5-3 is the number of samples that would need to be collected annually in each Bay segment to detect a change in dissolved copper concentration equivalent to the stated trigger level. For all segments, the monitoring program would be able to detect a change of about 1 μg/L from current mean concentrations.

Table 5-3 Dissolved Copper (µg/L) Trigger Levels at 99% Statistical Power (City of San Jose 2006a,b). See Figure 4-3 for map of Bay showing these regions. Data were from 1999-2003.

Bay Segment (or portion thereof)	Number of samples (n)	Trigger Level (µg/L)	Mean Concentration (µg/L)
Suisun Bay	9	2.8	1.9
San Pablo Bay	9	3.0	1.9
Central San Francisco Bay Lower San Francisco Bay (north Hayward Shoals)	9	2.2	1.3
Lower San Francisco Bay (south of Hayward Shoals)	9	3.6	2.4
South San Francisco Bay	15	4.2	3.2

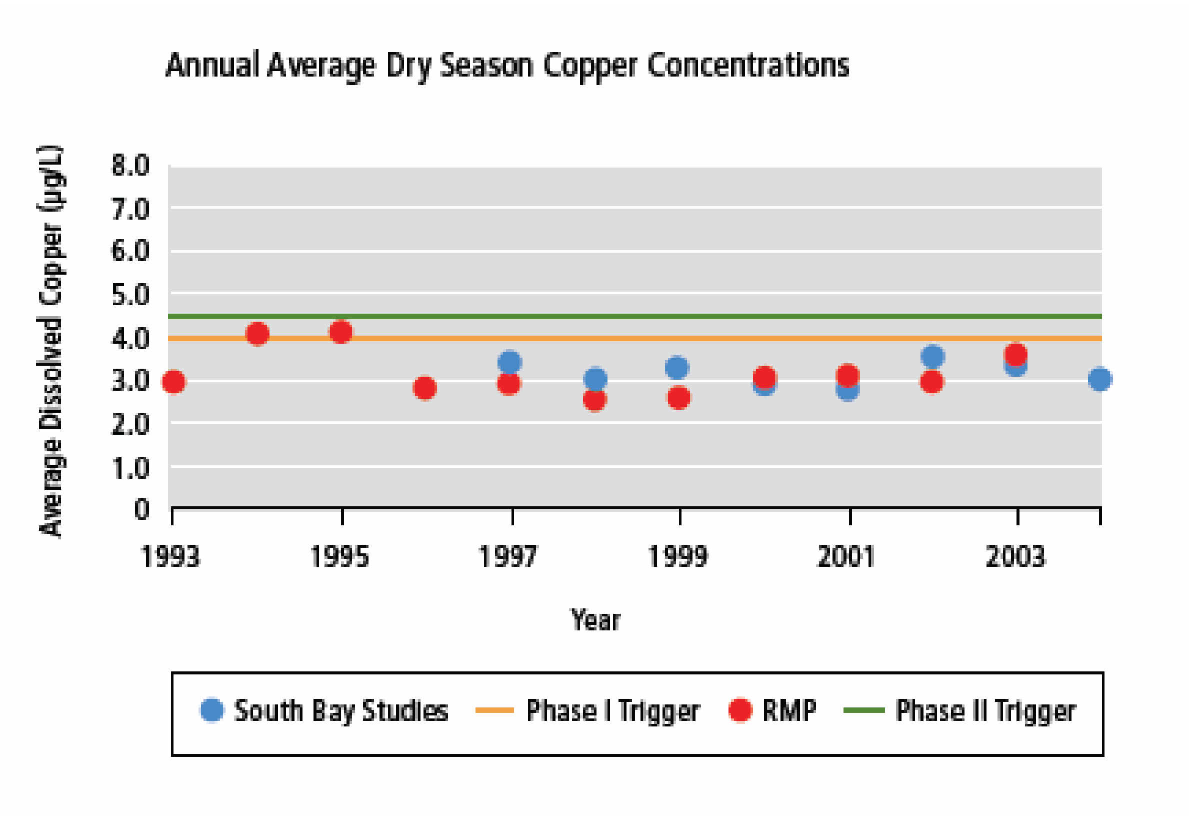

Figure 5-1 Time series of ambient copper concentrations in San Francisco Bay. Courtesy of San Francisco Estuary Institute.

5.7 Information Sources to Support Management Strategy

Pollution Prevention Clearinghouse Website (found at http://scvurppp.org/) The Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) has developed a website that provides information about 15 copper sources. The website provides links to documents and other internet sites that contain information on potential control measures for both POTWs and stormwater programs. The SCVURPPP website incorporates the latest information from, and is intended to be a complementary resource to, the P2 Menu project report (www.bacwa.org) and the Copper Sources in Urban Runoff and Shoreline Activities report (TDC 2004). The website will be supported voluntarily through collaboration among the municipal wastewater facilities and stormwater programs.

Uncertainty Reduction Studies Website: (found at http://scvurppp.org/) SCVURPPP contracted with SFEI to develop a prototype website that provides links to documents and other sites with new technical information applicable to copper in San Francisco Bay.

Indicators Reporting by Palo Alto: The City of Palo Alto has been producing a useful copper report for a number of years as a result of regulatory efforts in South SF Bay. This report contains valuable information on the condition of South Bay relative to copper as well as various indicators of copper loading to South SF Bay that help anticipate trends and identify sources for control measures. Examples of water quality indicators presented in the report include copper concentrations in water, fish tissue (clams), sediment. Examples of loading indicators include copper concentrations in water supply, copper content in pesticides and amounts of pesticide used, and copper content of automobile brake pads. The City of Palo Alto has agreed to continue producing this report and possibly expand the coverage Bay-wide.

5.8 Updating South San Francisco Bay Basin Plan Language

The Bay-wide copper management strategy described above will replace what was adopted in the Basin Plan in 2002 as part of the South San Francisco Bay copper and nickel SSO project. The copper control measures and monitoring program has a Bay-wide scope so the majority of existing Basin Plan language pertaining to the implementation of copper and nickel objectives in South San Francisco Bay must be replaced.

Chapter 7 of the Basin Plan contains a lengthy, narrative discussion of the project history for developing copper and nickel SSOs in South San Francisco Bay, the associated monitoring program, and the implementation plan for the SSOs. Nearly all of this text is unnecessary, non-regulatory language and is being deleted. Because SSOs and translators were the only regulatory elements from the South San Francisco Bay project (SFBRWQCB 2002), the only regulatory element from the existing text in Chapter 7 is the specification of copper and nickel translators that apply to wastewater discharges to South San Francisco Bay so this element will be retained. The South San Francisco Bay copper and nickel SSOs are likewise retained in Chapter 3. The deleted non-regulatory language in Chapter 7 is replaced with more efficient language describing the Bay-wide implementation strategy for copper. There is no Bay-wide implementation strategy for nickel because nickel SSOs have only been adopted for South San Francisco Bay. Chapter 4 of the Basin Plan states the implementation measures necessary to implement the South Bay nickel SSOs in the form of numeric nickel effluent limits for South Bay wastewater facilities.

6 Regulatory Analyses

This section provides the regulatory analyses required for adoption of new site-specific water quality objectives and associated implementation plan. Subsections below include an overview of the Project's compliance with California Water Code(CWC) requirements; peer review requirements of Health and Safety Code §57004; California Environmental Quality Act (CEQA); and federal and State antidegradation policies.

6.1 California Water Code §13241

CWC Section 13241 identifies six factors that must be considered when establishing a water quality objective.

- Past, present and probable beneficial uses of water;
- Environmental characteristics of the hydrographic unit under consideration; including the quality of water available thereto;
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area;
- Economic considerations;
- The need for developing housing within the region; and
- The need to develop and use recycled water

Each of these six factors is discussed below.

Beneficial Uses

The past, present and probable future beneficial uses of San Francisco Bay north of Dumbarton are commercial and sport fishing, estuarine habitat, industrial service supply, marine habitat, fish migration, navigation, industrial process supply, preservation of rare and endangered species, water contact recreation, non-contact water recreation, shellfish harvesting, fish spawning, and wildlife habitat. Beneficial uses of the Bay north of Dumbarton are currently not impaired by copper. The proposed site-specific objectives are based on the latest science pertaining to copper toxicity to aquatic organisms and, by definition, are fully protective of the most sensitive beneficial uses, those relevant to aquatic life, and are thus protective of all applicable beneficial uses listed above.

These beneficial uses adequately represent past, present and probable future uses, and they provided the basis of the impairment assessment performed as part of this project.

Environmental Characteristics of the Hydrographic Unit

The hydrographic unit for the application of SSOs consists of all San Francisco Bay segments except South San Francisco Bay. The environmental characteristics and existing conditions in San Francisco Bay are discussed in Chapter 3 of this Report.

Water Quality Conditions that Could Reasonably be Achieved

The goals of the proposed water quality objectives are to sustain current low levels of copper in the Bay waters while recognizing that existing marine water quality objectives for copper do not reflect site-specific conditions of San Francisco Bay. Although the recommended SSOs are higher than the California Toxics Rule marine copper criteria that currently apply, they better reflect existing scientific knowledge of copper toxicity and its effects on aquatic organisms specific to the Bay. The SSOs are based on site-specific toxicity data for the most sensitive species on the federal toxicity database (mussel), and this species is also commercially and recreationally important.

The derivation of new objectives is conducted using calculation procedures established by the U.S. EPA, which, in turn, result in scientifically-defensible objectives for copper (see Chapter 4 for details). Less stringent copper objectives are appropriate and still protective of water quality and all beneficial uses.

An implementation plan to support the SSOs, (Chapter 5) proposes continued efforts to control copper sources. Key elements of the implementation plan are designed to ensure that source control efforts are sustained and that water quality and beneficial uses are protected. A monitoring program is proposed that is designed to detect small changes in copper concentrations in the Bay. The implementation plan requires baseline pollution prevention activities. More aggressive pollution prevention actions will be triggered if ambient monitoring data show increases in dissolved ambient copper concentrations at trigger levels established well below the proposed site-specific objectives.

Economic considerations

The economic analysis is interpreted as requiring, at a minimum, a review of available information to determine whether:

- The proposed water quality objective is currently being attained; or if not,
- What methods are available to achieve compliance with the water quality objective and the costs of those methods of compliance (SWRCB 1990).

In addition to the CWC §13241 economic analysis requirements, CEQA requires that whenever a State or regional board adopts rules that require the installation of pollution control equipment or establish a performance standard or treatment requirement, the board must conduct an environmental analysis of the reasonably foreseeable methods of compliance [Pub. Res. Code §21159, 14 CCR 15064]. Both the CEQA analysis of reasonably foreseeable methods of compliance and CWC §13241 economic analyses of the preferred alternative are provided in this section.

There are minimal economic impacts that would result from this amendment. The proposed site-specific water quality objectives for copper are currently being met in the receiving water. Therefore, it is not foreseeable that additional treatment measures are necessary to achieve compliance with the proposed objectives. The copper wastewater effluent monitoring would be conducted absent the project as would the ambient monitoring included as part of the implementation plan. All wastewater and urban runoff programs already have existing copper source control programs so additional expense to focus attention on particular sources suggested by the project will be minimal. DPR actions relative to marine anti-fouling coatings would occur even without this proposed project as would copper control necessary for compliance under the general permit for lagoons.

In the proposed project, the copper water quality objectives are being relaxed relative to current objectives so wastewater treatment facilities will more easily be able to comply with the effluent limits computed from the proposed copper SSOs. Therefore, these facilities will be less likely compelled to fund facility upgrades resulting from compliance challenges.

For example, with the current chronic copper criterion of 3.1 µg/l dissolved, 85% of wastewater treatment facilities have recently experienced effluent concentrations that exceed projected effluent limits based on this default criterion. Only 25% of these treatment facilities have experienced a maximum effluent concentrations that exceeds projected copper effluent limits based on the SSO (CEP 2004d). Although the SSOs may not entirely eliminate the wastewater compliance challenges, they do reduce the potential for compliance challenges and, thus, reduce the potential costs associated with achieving compliance. Because compliance challenges are eased compared to the current default CTR copper objectives, no additional treatment would be required by the proposed project that would not be required absent the proposed project.

Need for Housing

The proposed water quality objectives would not restrict the development of housing in the San Francisco Bay Region because they do not result in discharge requirements that affect housing or any economic costs related to housing development.

Need to Develop and Use Recycled Water

Adopting the recommended site-specific objectives will have no impact on the quality and no impact on the quantity of wastewater available for recycling or reclamation in the region and none of the alternatives considered would restrict the development or use of recycled water.

6.2 Peer Review

Basin Plan amendments establishing new water quality objectives and related requirements necessitate scientific peer review. Health and Safety Code, Sect. 57004 requires an external peer review for work products that constitute the scientific basis for a rule "…establishing a regulatory level, standard, or other requirement for the protection of public health or the environment." State law (SB 1320) defines "scientific basis" as "the foundations of a rule that are premised upon, or derived from empirical data or other scientific findings, conclusions, or assumptions establishing a regulatory level, standard or other requirement for the protection of public health or the environment." Under SB 1320, "rule" includes any policy adopted by the State Board under the Porter-Cologne Water Quality Control Act (Division 7, commencing with Section 13000 of the Water Code) that has the effect of a regulation.

This amendment establishes SSOs for copper in San Francisco Bay, north of the Dumbarton Bridge. The scientific basis of this project is very similar to that of the project to establish SSOs for the portion of the Bay, south of the Dumbarton Bridge completed in 2002. Nonetheless, an external peer review is underway.

6.3 Environmental Analysis

CEQA requires agencies to review the potential for their actions to result in adverse environmental impacts. The water quality planning process is a certified regulatory program approved by the Secretary of Resources as exempt from CEQA's requirements for preparation of an environmental impact report or negative declaration. As part of the regulatory program, the State Water Board's regulations at 23 Cal. Code of Regs. §3720 et seq. require any standard, rule, regulation or plan proposed for board approval to be accompanied by a completed Environmental Checklist and a written report containing (1) a brief description of the proposed activity; (2) reasonable alternatives to the proposed activity and (3) mitigation measures to minimize any significant environmental impacts of the proposed activity. Upon completion of the written report, the Water Board is required to provide a Notice of Filing of the report to the public. This Staff Report including Appendix C, Environmental Checklist, meets the requirements of CEQA for adopting Basin Plan amendments and serves as a substitute environmental document.

Brief Description of the Proposed Activity

The proposed project is a Basin Plan amendment to establish chronic and acute site-specific objectives (SSOs) for dissolved copper in San Francisco Bay, north of the Dumbarton Bridge. The proposed amendment includes copper SSOs and an implementation plan to support the SSOs. This plan will be implemented Bay-wide so some components of the existing Basin Plan language for South San Francisco Bay will need to be revised. The Basin Plan amendment project includes:

- Site-specific dissolved copper objectives (SSOs) for regions of the Bay and incorporation of these SSOs into the Basin Plan. The objectives will be 6.9 μg/L chronic and 10.8 μg/L acute for the portions of the Bay south of the Hayward Shoals. The objectives will be 6.0 μg/L chronic and 9.4 μg/L acute for the portions of the Bay north of the Hayward Shoals.
- Copper translators (ratios of dissolved to total copper) for computing NPDES effluent limits for wastewater sources.
- An implementation plan to support maintenance of water quality and continued attainment of WQOs consisting of:
    - **a.** Control measures for urban runoff
    - **b.** Control measures for wastewater
    - **c.** Control measures for use of copper-based anti-fouling coatings on boats
    - **d.** Control measures for lagoons
    - **e.** Measures to resolve remaining uncertainties, specifically, permit requirements to investigate urban runoff copper loading, and to conduct or cause to be conducted technical studies to investigate possible copper sediment toxicity and sublethal effects on salmonids.

   f. Ambient monitoring and ambient copper concentration triggers
- Replacement of some basin plan language for South SF Bay copper SSO implementation based on a Bay-wide implementation strategy being proposed in the proposed Basin Plan amendment.

More information about the project can be found throughout this Staff Report. The amendment language itself is found in Appendix A. Sections 1 through 5 as well as this Section satisfy the foregoing analysis requirements for the proposed Basin Plan amendment. Appendix C contains the Environmental Checklist for the proposed activity. An explanation follows the Environmental Checklist and provides details concerning the environmental impact assessment. The analysis concludes that adopting the proposed amendment will not have any significant adverse environmental effects and no mitigation measures are proposed.

Consideration of Alternatives for the Proposed Amendment

Four alternative scenarios are considered: (1) no action (no Basin Plan Amendment), (2) proposed Basin Plan Amendment, (3) a single copper SSO for the entire Bay lower than the proposed objectives, (4) a single copper SSO higher than the proposed objectives.

No Action

Under this alternative, the Water Board would not amend the Basin Plan to adopt the proposed SSOs. No new implementation activities would be initiated. If the current copper objectives are maintained and effluent limits are derived from them, 37 of the 44 wastewater facilities surveyed would be able to comply with those effluent limits (Maximum effluent concentrations greater than the estimated Average Monthly Effluent Limit (AMEL), CEP 2004b). Therefore, this alternative would not meet all the Basin Plan Amendment's objectives, as listed in Section 2, Project Description. First, this alternative would not meet the project objective to update the Basin Plan to incorporate the best available scientific information on appropriate acute and chronic water quality objectives for dissolved concentrations of copper in the Bay that are calculated based on the best and most relevant set of data and are based on sound scientific rationale. The proposed SSOs are based on newer and more relevant data for the Bay. Second, the '*No Action*' alternative would mean that SSOs based on the best available scientific information would not be established, and this would result in unnecessarily stringent effluent limits for San Francisco Bay wastewater dischargers north of the Dumbarton Bridge. The more stringent effluent limits are not necessary to protect beneficial uses and may not result in corresponding water quality improvements.

Proposed Basin Plan Amendment

The proposed project is the adoption of the Basin Plan Amendment presented in Appendix A. The Basin Plan Amendment is based on the technical analyses described in Sections 1 through 5 of this report. The Basin Plan Amendment includes: proposed copper SSOs in the portion of the Bay north of the Dumbarton Bridge; specification of metal translators for use in computing required numeric effluent limitations for wastewater treatment plants; and an implementation program of monitoring and control measures substantial copper sources to the Bay. Because this alternative is the only one considered that meets all project objectives, it is the preferred alternative.

Single Set of Copper SSOs for Bay based on minimum WER of 1.5

Under this alternative, a single set of copper SSOs would be computed based on the minimum measured WER of 1.5. The minimum WER in the data set was 1.5 measured in San Pablo Bay (station BD 20, CEP2004b). The chronic and acute SSOs derived from this WER value are 3.6 and 5.8 μg/L (derived from acute value of 7.776 μg/L and Acute to Chronic Ratio of 3.127). This alternative is appealing in having a single set of SSOs for the entire portion of the Bay north of the Dumbarton Bridge. However, this alternative would not meet all the Basin Plan Amendment's objectives, as listed in Section 2, Project Description. First, the wastewater compliance status of most facilities would be very similar to the "no action" alternative since the chronic SSO would be very close to the default chronic objective. Thus, approximately 35 of 44 facilities would not be able to comply with effluent limits derived from these SSOs. Further, this alternative would not meet the project objective to establish SSOs that "are not so low as to compel POTWs to institute costly upgrades to their treatment facilities that do not provide corresponding water quality improvements, provided they maintain reasonably high levels of performance". Further, not using multiple SSOs would conflict with the project objective to choose SSOs that "are calculated based on the best and most relevant set of data and are based on sound scientific rationale". Using segment-specific data is more relevant than choosing a single Bay-wide SSO. There is no reason to choose lower SSOs than that necessary to protect beneficial.

Single Set of Copper SSOs for Bay based on maximum WER of 5

Under this alternative, a single set of copper SSOs would be computed based on the highest measured WER of 5. The maximum WERs in the data set were just over 5. WER values slightly greater than 5 were measured in San Pablo Bay and at the mouth of the Petaluma River (CEP2004b). The chronic and acute SSOs derived from this WER value are 12.4 and 19.4 μg/L (derived from acute value of 7.776 μg/L and Acute to Chronic Ratio of 3.127). This alternative is appealing in having a single set of SSOs for the entire portion of the Bay north of the Dumbarton Bridge. However, this alternative would not meet all the Basin Plan Amendment's objectives, as listed in Section 2, Project Description. Choosing the maximum WER raises questions as to its whether this single values represents Bay conditions both spatially and seasonally. Therefore, it is not clear that this alternative would meet the project objectives to establish SSOs that "fully protect Bay beneficial uses of and prevent nuisance", "fully protect the public health or welfare" and "enhance water quality and serve the purposes of the Clean Water Act".

Using this single set of SSOs would also conflict with the project objective to choose SSOs that "are calculated based on the best and most relevant set of data and are based on sound scientific rationale" and "are no higher than necessary to protect beneficial uses". Using segment-specific data is more relevant than choosing a single Bay-wide SSO.

Preferred Alternative

Because the proposed Basin Plan amendment will not pose any significant adverse environmental impacts, any alternatives would not avoid or lessen any significant impacts. '*No Action*' would result in the moderate economic impacts of unnecessary enforcement and the possible significant economic impacts of capital projects to produce unnecessarily low effluent concentrations of copper. The other two alternatives in which a single set of SSOs computed either from the minimum WER or maximum WER do not meet all of the project objectives. Therefore, the proposed Basin Plan amendment is the preferred alternative.

6.4 Antidegradation

The Clean Water Act and the Basin Plan require that adopted site-specific objectives comply with federal and State anti-degradation policies. Establishing site-specific copper objectives for San Francisco Bay north of the Dumbarton Bridge will not result in a lowering of water quality based on three lines of evidence – the role of the implementation plan, the consistency of ambient copper concentrations, and the nature of wastewater treatment plan effluent performance. These lines of evidence will be discussed in the following paragraphs. Following this discussion, the federal and State antidegradation requirements will be discussed and shown to be met.

Implementation Plan Protects Against Water Quality Degradation

The first line of evidence that no lowering of water quality will occur as a result of this basin plan amendment is that the amendment contains an implementation plan. The control measures and monitoring of the implementation plan described in Chapter 5 are designed to prevent any degradation of water quality due to increases in ambient concentrations in the Bay. There will be mandatory copper control measures for wastewater and urban runoff sources implemented through their NPDES permits targeting the most substantial sources of copper. The monitoring program described in Chapter 5 is designed to detect very small increases in ambient copper concentrations. If these increases do occur, the implementation plan calls for more aggressive pollution prevention actions on the part of wastewater and urban runoff sources in order to keep ambient concentrations under control and avoid further increases. Further, the Water Board always retains the latitude to impose additional requirements as necessary to protect water quality. The ambient concentration triggers are well below the proposed site-specific objectives so action could be taken well in advance of reaching the concentrations that might pose a threat to beneficial uses.

Consistency of Ambient Copper Concentrations in the Bay

The second line of evidence discussed in Chapter 5 and illustrated in Figure 5-1is that Bay ambient copper concentrations have shown a remarkable consistency since 1993. During this time, the average dissolved concentration in the Bay has varied mainly between 3 and 4 μg/L and has shown no apparent trend. Part of the reason for this consistency may be explained by the dominant role of sediments in determining dissolved copper concentrations. As discussed in Chapter 3, the sediments are a large repository of copper from natural background as well as historical and ongoing loading. When these sediments are suspended, the copper may desorb and become dissolved. In fact, such desorption was found to account for a large fraction of the dissolved ambient concentration (CEP 2004a). Because of the important role of the sediments in determining dissolved copper concentrations and because the amount copper in Bay sediments changes very slowly, the amount of copper found dissolved in the water column can be expected to follow its historical consistent pattern in the future, despite establishing SSOs that are higher than current objectives. As discussed in Chapter 5, there has been no apparent trend over the last decade in ambient copper concentrations, and ambient concentrations are well below the SSOs, and the Water Board expects ambient copper concentrations to remain well below the levels associated with water quality degradation.

Nature of Wastewater Treatment Plant Performance

The third line of evidence concerns the fact that wastewater treatment plant performance will likely continue to be as good if not better than past performance. One obvious way in which copper loads to the Bay might be supposed to increase is through the relaxation of numeric effluent limits for wastewater treatment facilities resulting from the SSOs. However, establishing the SSOs is unlikely to cause any increase in ambient copper concentrations due to increased loads if current performance by dischargers is maintained as is expected. The operation of the physical and biological treatment processes used in Bay area treatment plants is required to meet technology-based federal requirements and will not be modified by plant operators to achieve less stringent copper effluent limits. In other words, municipalities and industries have neither an incentive nor capability to "re-operate" their plants to "take advantage" of less stringent copper effluent limits. They would be unable to accomplish such independent degradation of their copper performance without simultaneously worsening performance for other constituents that would likely result in violations of effluent limitations for these other constituents. For this reason, future changes in existing copper effluent concentrations are not likely for the existing treatment facilities, with or without changes in effluent limits.

These lines of evidence demonstrate that establishing SSOs does not necessarily lead to a lowering of water quality. The state and federal antidegradation requirements can also be as will be shown in the following paragraphs.

Federal Requirements

The federal regulations covering antidegradation (40 CFR 131.12) divide waters into three categories or tiers. Tier 1 waters[1] are those that are either not meeting the federal "fishable/swimmable" goals, or that meet "fishable/swimmable"[2] goals but lack assimilative capacity to accept any more of the specific pollutant proposed for discharge. Tier 2 waters are those where the water quality is better than the minimum necessary to maintain "fishable/swimmable" uses. Tier 3 waters are outstanding national resource waters such as National and State parks and wildlife refuges or waters of exceptional

[1] According to EPA guidance, Questions and Answers on Antidegradation, 1985, Tier 1 waters are those where there is any existing use, whether it is fishable/swimmable or not.

[2] A level of water quality that provides for the protection and propagation of fish, shellfish and wildlife, and recreation in and on the water.

recreational or ecological significance. The portion of the Bay north of the Dumbarton Bridge where the proposed SSOs will apply is a Tier 2 water.

For Tier 2 waters, lowering of water quality (which could occur if a standard is relaxed) may be allowed only after satisfying public participation requirements, and if the Water Board finds that (1) the lowering of water quality is necessary to accommodate important economic or social development in the area in which the waters are located; (2) the revised water quality objective is fully protective of existing beneficial uses; and (3) the highest statutory and regulatory requirements will be imposed on all new and existing point sources and all cost-effective and reasonable best management practices will be required for nonpoint source control. Water quality will not be lowered as a result of this Basin Plan amendment. However, for completeness, each of these three conditions will now be considered in turn.

1) *The lowering of water quality is necessary to accommodate important economic or social development in the area in which the waters are located;*

As discussed above, water quality will not be lowered as a result of this Basin Plan amendment. In the future, it is expected that ambient copper concentrations in San Francisco Bay will remain similar to current levels since they have remained relatively constant for over 10 years. The combination of the proposed site-specific objectives and implementation plan will protect water quality and accommodate current and future economic activity and population growth. These two goals can be accomplished while ensuring no actual lowering of water quality will occur despite relaxing the water quality objectives for copper. Implementation of the SSOs includes vigilant ambient monitoring as well as monitoring of effluent discharge quality. If an unforeseen lowering of water quality is observed, dischargers are requires to implement corrective action. Further, the lowering of water quality would be extremely small, and beneficial uses would still be fully protected.

2) *The water quality objective is fully protective of existing beneficial uses;*

The SSOs were computed according to U.S. EPA procedures and are fully protective of beneficial uses in the Bay north of the Dumbarton Bridge.

3) The highest statutory and regulatory requirements will be imposed on all new and existing point sources and all cost-effective and reasonable best management practices will be required for nonpoint source control.

NPDES permits for wastewater dischargers will require numeric effluent limits and strong and effective pollution prevention and source control programs designed to ensure that wastewater dischargers maintain their current level of performance. The intent of the actions described in Section 5 (implementation plan) of this Report is to prevent degradation of water quality due to increases in concentrations of copper in San Francisco Bay north of Dumbarton despite the relaxation of the water quality objectives. This plan requires copper control measures for urban runoff management agencies as well as measures to control copper from other sources. Additionally, a robust ambient monitoring program will continue that will be able to detect changes in dissolved copper concentrations as small as 1 μg/L such that additional control measures can be put in place before ambient concentrations increase to the SSOs.

State Requirements

New water quality objectives must conform to State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality of Water in California." It must be demonstrated that the change in water quality owing to relaxing the water quality objective:

- Will be consistent with maximum benefits to the people of the State;
- Will not unreasonably affect present and anticipated beneficial use of such water;
- Will not result in water quality lower than that prescribed in the applicable policies; and
- Will ensure that dischargers will implement the best practicable treatment or control.

The proposed copper SSOs are based on the latest science pertaining to copper toxicity to aquatic organisms and are scientifically-defensible and protective of beneficial uses in San Francisco Bay north of Dumbarton. Proposing the water quality objectives is consistent with the maximum benefit to the people of the State because beneficial uses will be protected without requiring an unreasonable or unnecessary level of performance on the part of dischargers.

The currently applicable default copper marine criteria include the provision for adjusting the value based on site-specific water quality (adjustment of the WER). As described in Section 4, there are now ample data available to demonstrate that the default criteria are more conservative than necessary because of water chemistry characteristics of the Bay. Thus, the copper objectives in the Bay north of Dumbarton may be raised yet still protect beneficial uses. Because north of Dumbarton ambient concentrations are considerably less than the proposed SSOs, impairment of beneficial uses due to ambient copper concentrations is unlikely.

A relaxation of the copper water quality objectives is unlikely to cause any increase in ambient copper concentrations due to increased loads if current performance by area dischargers is maintained as is expected.

The reason that we expect dischargers to maintain or improve their current treatment performance is that dischargers simply do not have the ability to manipulate their processes to adjust effluent copper levels independently of other treatment parameters. In other words, in order to maintain their facilities in compliance with the wide range of effluent limits imposed on their facilities, they will maintain their performance with respect to copper, despite relaxed copper effluent limits.

Basic Concepts for Antidegradation Analysis

Key considerations in the assessment of consistency with anti-degradation policy include, at a minimum, (1) analysis of the incremental change in water quality resulting from a proposed action (e.g. the adoption and implementation of an SSO) and (2) analysis of the incremental change in mass loading resulting from the proposed action. The anti-degradation policies allow minor changes in both mass loadings and ambient concentrations, but do not allow significant adverse changes in ambient water quality.

Concern that water quality concentrations of copper in San Francisco Bay north of Dumbarton may undergo significant adverse change with the adoption and implementation of site-specific objectives that are less stringent than the current objectives is derived from the following hypothesis:

1. Changes in the copper objectives will result in less stringent effluent limits for NPDES dischargers, and
2. Effluent concentrations of copper from NPDES dischargers will increase as a result of less stringent effluent limits, with concentrations reaching the revised final effluent limits, and
3. Copper loadings to the Bay north of Dumbarton will increase as a result of increased concentrations, and
4. Increased loadings will lead to increased concentrations of copper in the Bay north of Dumbarton.

An evaluation of the likelihood that adoption of site-specific objectives will result in increased concentrations of copper in the Bay north of Dumbarton is examined below.

Changes in Copper Effluent Limits

Current copper discharges to the Bay by municipal and industrial point sources are controlled through existing NPDES permits. These NPDES regulated discharges include both treated wastewater from municipal and industrial treatment plants, and the discharge of storm water runoff. Available information indicates that municipal and industrial wastewater treatment plant effluent discharges represent a minor source of copper to the Bay (see Section 3 for details).

Review of existing NPDES permits indicates that some permits include copper effluent limits, while some do not (see Table 6-3). Those discharges without copper effluent limits do not have reasonable potential to cause or contribute to the violation of the current default copper objectives. No change in effluent concentrations would be expected for those dischargers in response to the proposed copper site-specific objectives.

Table 6-3 also shows existing interim and final effluent limits in NPDES wastewater permits and the projected (estimated) final effluent copper limits that would be incorporated into permits if the proposed SSOs are adopted. Comparison of existing interim limits with and projected final limits indicates many discharges would have less stringent final limits than their current interim or final limits after adoption of the proposed copper SSOs.

Changes in Effluent Copper Concentrations

The hypothesis that effluent copper concentrations will increase if less stringent effluent limits are established in NPDES permits is not supported by the analysis of treatment plant operations or processes. There would be essentially two ways for effluent concentrations to increase – degradation of treatment effectiveness or increased influent concentrations through relaxation of source control or pollution prevention. As argued previously, operation of the physical and biological treatment processes used in Bay area treatment plants to achieve secondary treatment is required to meet technology-based federal requirements and will not be modified by plant operators to achieve less stringent copper effluent limits. In other words, municipalities and industries have neither an incentive nor capability to "re-operate" their plants to "take advantage" of less stringent copper effluent limits. For this reason, future changes in existing copper effluent concentrations are not likely for the existing treatment facilities, with or without changes in effluent limits. To illustrate this point, Table 6-1 and Table 6-2 show summary statistics for municipal wastewater copper effluent concentrations south of the Dumbarton Bridge before and after the adoption of copper SSOs for this portion of the Bay. Notice that two of the three facilities have substantially lower effluent concentrations after adoption of the SSOs. Neither is it likely that influent concentrations to wastewater facilities would increase since the implementation plan requires ongoing maintenance of existing source control and pollution prevention activities.

Table 6-1 South San Francisco Bay POTW performance statistics for total copper prior to SSO adoption (SFBRWQCB 2002).

POTW	Min (µg/L)	Mean (µg/L)	Max (µg/L)
San Jose	1.4	3.8	8.8
Sunnyvale	Non-detect (<1 µg/L)	3.0	8.1
Palo Alto	1.9	6.5	17

Table 6-2 South San Francisco Bay POTW performance statistics for total copper after SSO adoption (SFRWQCB 2007). Data from 2003 through 2006

POTW	Min (µg/L)	Mean (µg/L)	Max (µg/L)
San Jose	1.5	3.0	6.5
Sunnyvale	Non-detect (<0.5 µg/L)	2.0	6.9
Palo Alto	5.7	7.7	12.8

Moreover, available data indicate that, for wastewater treatment plants in the Bay area, effluent copper concentrations are not entirely a function of influent concentrations (CEP 2004d). Therefore, even if influent concentrations increased, it is not likely that effluent concentrations would be substantially impacted. This can be illustrated with the case of the Fairfield-Suisun facility (whose influent and effluent concentrations are shown in Figure 6-1). This facility has typical influent copper concentrations around 40 µg/L and average effluent concentrations of about 4 µg/L. Thus, the copper concentration in influent is reduced by about 90% within the facility. If influent copper concentrations increase by 10 µg/L to 50 µg/L, that would at most result in an increased effluent concentration of only about 1 µg/L in effluent. It can also be seen from this figure that during those times when influent concentrations are high, effluent concentrations do not necessarily increase substantially.

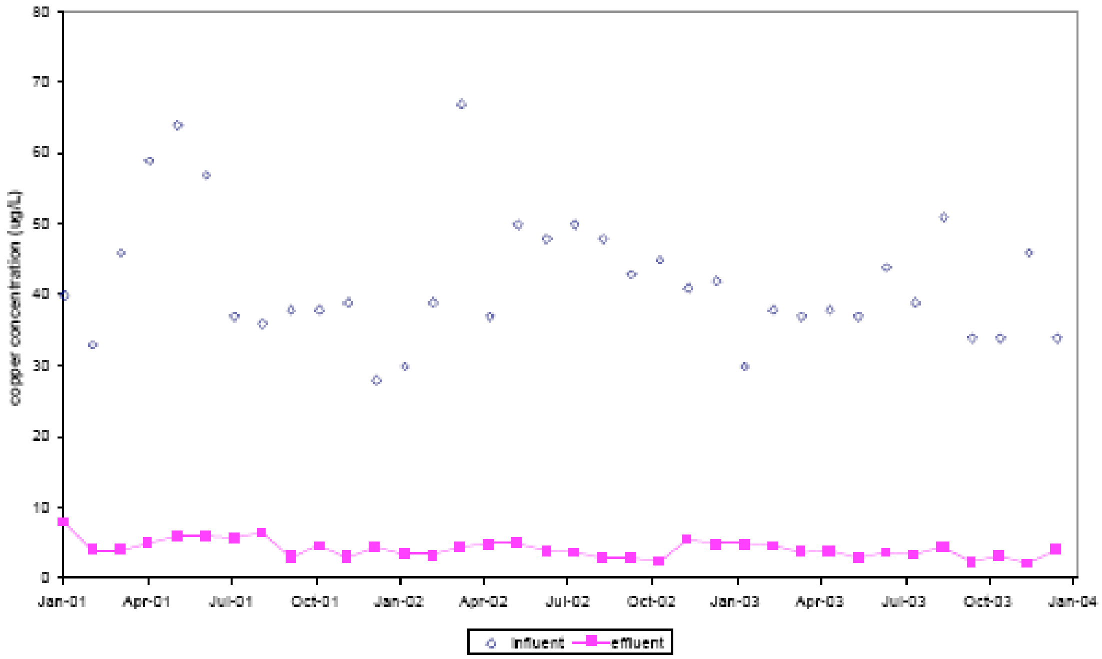

Figure 6-1 Time Series of Influent and Effluent Concentrations at Fairfield-Suisun (CEP 2004d).

Table 6-3 Municipal and Industrial Wastewater Discharger Current and Projected Copper Effluent Limits.

Discharger	Discharger Type	Type of Discharge	Projected AMEL (µg/L)	Projected MDEL (µg/L)	Interim AMEL (µg/L) * indicates final limit	Interim MDEL (µg/L) * indicates final limit
American Canyon, City of	POTW	Shallow	6.8	13.9	11.5	54.4
Benicia, City of	POTW	Deep	57.1	113.6		32
Burlingame, City of	POTW	Deep	52.9	121.3	27	
Calistoga, City of	POTW	Deep	180.5	299.8	5.4	10.4
Central Contra Costa Sanitary District	POTW	Deep	79.0	113.6		37
Contra Costa County Sanitation District #5 Port Costa	POTW	Deep	56.6	113.6		
Central Marin Sanitation Agency	POTW	Deep	79.5	115.9	13.1*	21.8*
Delta Diablo Sanitation District	POTW	Deep	77.8	113.6		16
Dublin-San Ramon Services District	POTW	Deep	74.6	121.3	71*	100*
East Bay Dischargers Authority	POTW	Deep	79.2	110.1	71*	100*
East Bay Municipal Utilities District	POTW	Deep	64.8	121.3		37
Fairfield-Suisun Sewer District	POTW	Shallow	9.0	13.9		12.3
Las Gallinas Valley Sanitary District	POTW	Shallow	8.0	13.9		17
Livermore, City of	POTW	Deep	60.5	121.3		
Marin County Sanitary District #5 Tiburon	POTW	Deep	49.8	121.3		37
Millbrae, City of	POTW	Deep	78.7	112.2	17	
Mt. View Sanitary District	POTW	Shallow	9.5	13.9	8.3*	11.4*
Napa Sanitation District	POTW	Shallow/ Deep	54.8	115.9	9.8	23.2
Novato Sanitary District	POTW	Shallow	6.9	13.9		19
Petaluma, City of	POTW	Shallow	8.8	13.9	11.8*	17.4*
Pinole-Hercules, Cities of	POTW	Deep	68.5	115.9	20*	37*
Rodeo Sanitary District	POTW	Deep	59.1	115.9	12.5	55.5
San Francisco International Airport (Municipal)	POTW	Deep	64.7	121.3		33
San Francisco, City and County of (Southeast)	POTW	Deep	77.3	117.2		37
San Mateo, City of	POTW	Deep	73.8	121.3		33.1
Sausalito-Marin City Sanitary District	POTW	Deep	81.3	102.3		28
Sewerage Agency of Southern Marin	POTW	Deep	79.3	109.8		29
Sonoma Valley County Sanitary District	POTW	Shallow	10.1	13.9	18	
South Bayside System Authority	POTW	Deep	77.8	115.5	16.4	25.4
South San Francisco-San Bruno, Cities of	POTW	Deep	65.9	121.3		37
St. Helena, City of	POTW	Deep	150.6	302.1		
U.S. Navy Treasure Island	POTW	Deep	77.1	118.3		25
Union Sanitary District, Hayward Marsh	POTW	Shallow	6.9	13.9		

Discharger	Discharger Type	Type of Discharge	Projected AMEL (µg/L)	Projected MDEL (µg/L)	Interim AMEL (µg/L) * indicates final limit	Interim MDEL (µg/L) * indicates final limit
Union Sanitary District, Wet Weather	POTW	Deep	78.3	113.8	22.2	33.0
Vallejo Sanitation & Flood Control District	POTW	Deep	81.5	115.9	110*	148*
West County Agency	POTW	Deep	78.7	112.1		17
Yountville, Town of	POTW	Deep	150.6	302.1	57.8	117.0
Chevron Richmond Refinery	Refinery	Deep	45.3	115.9	13*	25*
ConocoPhillips (Rodeo)	Refinery	Deep	57.2	115.9		37
Martinez Refining Company	Refinery	Deep	66.4	113.6	23*	13*
Tesoro Golden Eagle Refinery	Refinery	Deep	55.6	113.6	13*	24*
Valero Benicia Refinery	Refinery	Deep	68.1	113.6		36
C&H Sugar	Industrial	Deep	57.8	115.9		
Crockett Cogeneration	Industrial	Deep	57.8	115.9		
Dow Chemical Company	Industrial	Deep	73.8	113.6		37
General Chemical	Industrial	Deep	56.6	113.6		
GWF Power Systems (Site I)	Industrial	Deep	86.0	113.6		36
GWF Power Systems (Site V)	Industrial	Deep	87.0	113.6		36
Morton	Industrial	Deep	60.5	121.3		
Rhodia Basic Chemicals	Industrial	Deep	57.6	113.6		37
S.F.Airport, Industrial (Total)	Industrial	Deep	60.5	121.3		
Southern Energy California Pittsburg Power Plant	Industrial	Shallow	6.9	13.9		
Southern Energy Delta LLC Potrero Power Plant	Industrial	Deep	60.5	121.3		
US Navy Point Molate	Industrial	Deep	57.8	115.9		
USS Posco	Industrial	Shallow	8.9	13.9	3.3*	5.5*

Changes in Copper Loadings

In the unlikely event that wastewater effluent concentrations increase in response to less stringent effluent limits, copper loadings to the Bay north of Dumbarton would increase. Table B-1 in Appendix B provides a summary of the maximum incremental changes in copper loadings resulting from discharges at the projected final effluent limit concentrations.

Two loading increase increments were computed: (a) from a baseline of existing flows and loadings and (b) from a baseline of loadings at existing effluent limitations. The aggregate theoretical incremental change above existing loadings for each facility is presented in Table 1 Appendix B. Current copper loads are estimated at about 6000 kg/yr for all wastewater facilities. If facilities discharged at their current effluent limits, those loads would be approximately 23,000 kg/yr (an increase of about 17,000 kg/yr from current loads). Obviously, most facilities are performing well below their currently allowed limits. If facilities were to discharge effluent at the projected effluent limits that would be computed from the SSOs, the wastewater load would be approximately 41,000 kg/yr (an increase of about 35,000 kg/yr from current loads).

It is useful to consider the magnitude of these incremental changes in relation to current estimated copper loading of about 300,000 kg/yr. Currently, wastewater comprises about 3% of total copper load to the Bay north of Dumbarton. In the unlikely worst-case loading scenario in which all wastewater facilities degraded their performance up to the project effluent limits, wastewater would still only constitute about 14% of the total copper load. As stated above, this loading is theoretical in nature and is not expected to occur. The magnitude of the potential increase indicates the importance of reasonable source control and ongoing effluent and ambient monitoring to ensure that load increases of that magnitude do not occur.

Another way to view the relative magnitude of current and worst case wastewater loading is to compare this mass to the mass of dissolved copper in the water column of the Bay north of Dumbarton. The current average mass of dissolved copper in the water column of the Bay is estimated to be 14,300 kg based on average dissolved copper concentrations and average volumes of subregions of the Bay as shown in. On a per day basis, current wastewater copper loads are about 18 kg/day, while the worst case increased loading would be 110 kg/day. These loads are 0.2 and 0.8 percent of the existing water column mass of copper in San Francisco Bay north of Dumbarton. While these increased loads may contribute to enrichment of copper in the Bay sediments, it is unlikely that the ambient concentration would be sensitive even to the worst-case wastewater loading increase scenario.

Table 6-4 Estimates of Mass of Dissolved Copper in Water Column of San Francisco Bay (CEP 2004a). See Figure 4-3 for locations of subregions and their correspondence to Bay segments.

Bay Subregion	Volume (acre-feet)	Mean Dissolved Copper (µg/L)	Mean mass of dissolved copper (kg)
1 – Suisun Bay	323,000	2.0	780
2 – San Pablo Bay	223,000	2.5	680
3 – Central Bay	605,000	1.4	1,100
4 – South Bay	2,307,000	2.2	6,200
5 – Lower South Bay	1,507,000	3	5,600
Totals	4,960,000		14,300

Changes in Ambient Copper Concentrations

Current 95th percentile ambient concentrations of dissolved copper at RMP-monitored sites in the Bay (with the exception of the mouth of the Petaluma River) range from 0.8 to 3.5 µg/L (CEP 2004a). These 95th percentile concentrations are well below the proposed SSOs of 6.0 and 6.9 µg/L dissolved copper. These ambient concentrations reflect the current loading to the Bay at existing effluent concentrations and are not expected to change significantly with the adoption of the proposed SSOs. Given the magnitude of the maximum potential daily mass loadings as described above, significant changes in ambient copper concentrations are extremely unlikely and not anticipated.

Overall Assessment

Based on the above analysis, adoption and implementation of the proposed SSOs is not predicted to result in significant increased loadings or increased concentrations of copper in the Bay. As such, the proposed adoption of site-specific objectives would be consistent with State and federal anti-degradation policies.

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Appendix A – Basin Plan Amendment

PROPOSED BASIN PLAN AMENDMENT

Revisions indicated in single underline/strikeout represent new language. A small amount of double underlined text at the beginning of the amendment under 'Site Specific Objectives' is text that has been approved by the State Water Board and is pending approval by the State Board.

Amend the following language in Chapter 3 of the Basin Plan as follows:

Site-specific objectives have been adopted for copper in segments of San Francisco Bay shown (see Figure 7.1), for nickel, **~~adopted for~~**in South San Francisco Bay~~ south of the Dumbarton Bridge~~, (Table 3-3A) and for cyanide in all San Francisco Bay segments (Table 3-3C) **~~are listed in Table 3-3A.~~**

Table 3-3A: Water Quality Objectives for Copper and Nickel in ~~Lower South~~ San Francisco Bay segments

Compound	4-day Average (CCC)[1]	1-hr Average (CMC)[2]	Extent of Applicability
Copper	6.9	10.8	~~Marine and Estuarine Waters Contiguous to SF Bay, South of Dumbarton Bridge~~ The portion of Lower San Francisco Bay south of the line representing the Hayward Shoals shown on Figure 7.1, and South San Francisco Bay.
Copper	6.0	9.4	The portion of the delta located in the San Francisco Bay Region, Suisun Bay, Carquinez Strait, San Pablo Bay, Central San Francisco Bay, and the portion of Lower San Francisco Bay north of the line representing the Hayward Shoals on Figure 7.1.
Nickel	11.9	62.4*	~~Marine and Estuarine Waters Contiguous to SF Bay, South of Dumbarton Bridge~~ South San Francisco Bay

*Handbook of ~~WQS~~Water Quality Standards, 2nd ed. 1994 in Section 3.7.6 states that the CMC = Final AcuteValue/2; 62.4 is the Final Acute Value (resident species database)/2; so the site-specific CMC is lower than the California Toxics Rule value because we are using the resident species database instead of the National Species Database.

[1]Criteria Continuous Concentration

[2]Criteria Maximum Concentration

Amend the following language in Chapter 4 of the Basin Plan as follows:

SITE-SPECIFIC OBJECTIVES

Site-specific objectives have been adopted by the Water Board for copper in San Francisco Bay and for nickel in ~~Lower~~ South San Francisco Bay, (Table 3-3A) and for cyanide in San Francisco Bay (Table 3-3C).

7.2.~~1~~ A WATER QUALITY ATTAINMENT STRATEGY TO SUPPORT COPPER SITE-SPECIFIC OBJECTIVES FOR SAN FRANCISCO BAY AND NICKEL SITE-SPECIFIC OBJECTIVES FOR SOUTH ~~OF THE DUMBARTON BRIDGE~~SAN FRANCISCO BAY

The Water Quality Attainment Strategy (WQAS) for copper in all San Francisco Bay segments (see Figure 7.1) and nickel in South San Francisco Bay ~~south of the Dumbarton Bridge (Lower South SF Bay)~~ is designed to prevent water quality degradation and ensure attainment of the ~~ongoing~~

~~maintenance of the~~ copper and nickel site-specific objectives (SSOs). ~~both for copper and nickel in Lower South SF Bay.~~ This section describes the details of the WQAS and how the Water Board will use its regulatory authority to implement this strategy.

The four elements of the WQAS f~~or copper and nickel in Lower South SF Bay~~ are:

- ~~Current c~~Control measures/actions to minimize the discharge of copper ~~and nickel~~ ~~releases~~ ~~(~~from ~~municipal~~ wastewater treatment plants, ~~and~~ urban runoff ~~programs~~, anti-fouling boat paints, and lagoons to ensure that significant copper sources are properly managed~~)~~; ~~to Lower South SF Bay;~~
- Statistically-based water quality "triggers" and a receiving water monitoring program that would initiate additional control measures/actions if the "triggers" are exceeded ~~met~~;
- ~~A proactive framework for addressing increases to future copper and nickel concentrations in Lower South SF Bay, if they occur; and~~
- Metal translators that will be used to compute copper and nickel effluent limits for the municipal wastewater treatment plants discharging to ~~Lower~~ South ~~SF~~ San Francisco Bay.
- Metal translators that will be used to compute copper effluent limits for municipal and industrial wastewater treatment plants that discharge to deep water (see Section 4.5.2.2 for definition) north of the Dumbarton Bridge.

~~Except for the specification of metal translators, all actions and monitoring obligations described in this section have been required by the National Pollutant Discharge Elimination System (NPDES) permits for the three municipal wastewater dischargers and the municipal urban runoff (stormwater) dischargers in Lower South SF Bay since October 2000 and March 2001, respectively.~~

7.2~~1~~.1 BACKGROUND

All San Francisco Bay segments (see Figure 7.1) meet water quality objectives for copper and nickel. Since the mid-1980s, because of effective treatment and successful pollution prevention and source control efforts, substantial reductions in metal loading to San Francisco Bay segments have been achieved. Other sources that are difficult to manage such as urban runoff (which includes copper from automobile brake pads), historical deposits of copper in the Bay sediments and natural sources of copper are among the dominant contributions to current ambient water concentrations. SSOs (see Chapter 3) for dissolved copper in all Bay segments (and nickel in South San Francisco Bay) have been derived using toxicity data representing site-specific conditions in all San Francisco Bay segments, and these SSOs fully protect San Francisco Bay beneficial uses.

~~Lower South SF Bay has been listed as impaired due to point source discharges of generic metals since 1990 (Clean Water Act §304(l) listing) and most recently for copper and nickel from point and urban runoff sources in the State's 1998 list required by Clean Water Act §303(d). The primary reason for the copper and nickel impairment listings had been that ambient water concentrations of dissolved copper and nickel exceeded Basin Plan water quality objectives or US EPA national water quality criteria for the protection of aquatic life. Despite significant reductions in wastewater loadings over the past two decades, ambient concentrations at stations monitored through the San Francisco Estuary Regional Monitoring Program for Trace Substances (RMP) or the City of San Jose monitoring program still approach or exceed the previously-applicable federal criteria or water quality objectives in Lower South SF Bay. The Water Board has now adopted site-specific water quality objectives. As discussed below, it is likely that these new objectives are being attained.~~

~~*7.1.1.1 SOURCES*~~

~~The external sources of copper and nickel to Lower South SF Bay include a minor contribution from atmospheric deposition and substantial discharges from tributaries/urban runoff and municipal wastewater. The dischargers responsible for the urban runoff discharges are the Santa Clara Valley Water~~

~~District, County of Santa Clara, City of Campbell, City of Cupertino, City of Los Altos, Town of Los Altos Hills, Town of Los Gatos, City of Milpitas, City of Monte Sereno, City of Mountain View, City of Palo Alto, City of San Jose, City of Santa Clara, City of Saratoga, and City of Sunnyvale. These cities have joined together to form the Santa Clara Valley Urban Runoff Pollution Prevention Program. The municipal wastewater dischargers are the Cities of San Jose and Santa Clara, Sunnyvale, and Palo Alto. Each of these cities owns and operates a wastewater treatment plant (Publicly-Owned Treatment Works or POTW) that discharges into the Lower South Bay.~~

~~On an annual basis, about 1100 kilograms (kg) of copper and 1500 kg of nickel enters Lower South SF Bay from POTWs. From tributaries, roughly 3800 kg copper and 6000 kg nickel enters this Bay segment each year. During the dry season (June-November), POTW loading is dominant, and tributary loading is dominant during the wet season (December-May). Substantial amounts of copper (about 1.9 million kg) and nickel (about 50 million kg) already existing in the sediments of Lower South SF Bay can also contribute to water concentrations when the sediments are resuspended by waves, winds, tides, and currents. The metals deposited in the sediments consist of those deposited historically (higher than current levels) and those currently deposited metals. The historical and current external loadings have elevated the total copper and possibly the total nickel concentrations of Lower South SF Bay sediments above what they would be in the absence of anthropogenic sources.~~

~~*7.1.1.2 STAKEHOLDER INVOLVEMENT*~~

~~The stakeholder group recognized by the Water Board to assist in developing watershed-based programs to address both short and long-term water quality issues in Lower South SF Bay is the Santa Clara Basin Watershed Management Initiative (SCBWMI). The SCBWMI, formed in 1996, is a collaborative effort of representatives from business and industrial sectors, professional and trade organizations, civic, environmental, resource conservation and agricultural groups, regional and local public agencies, resource agencies, and the general public. These groups have joined forces to address all sources of pollution that threaten the water bodies draining into the Lower South Bay. A major aim of the SCBWMI is to coordinate existing watershed activities on a basin-wide scale, ensuring that environmental protection efforts are addressed efficiently and cost-effectively. The Water Board will continue to recognize and rely on the leadership of the SCBWMI to ensure the ongoing success of the WQAS.~~

~~A working subgroup of the SCBWMI, the Bay Monitoring and Modeling Subgroup, took the lead to address the water quality issues and to provide the basic strategy and information necessary to address both the water quality technical and related regulatory questions. In 1998, the Copper and Nickel TMDL Work Group (Workgroup) was formed by the SCBWMI to provide guidance for the development of the TMDLs for copper and nickel in Lower South SF Bay. A broad group of stakeholders was represented on the Workgroup including several environmental groups, local wastewater dischargers, local public agencies responsible for the urban runoff program, state and federal regulators, industry and local business representatives, and national organizations such as the Copper Development Association.~~

~~**7.1.2 OVERVIEW OF THE TMDL PROJECT FOR COPPER AND NICKEL IN LOWER SOUTH BAY**~~

~~In 1996, the State Water Board included the South San Francisco Bay on the §303(d) impaired water body list as a high priority impaired water body. In 1998, the list was updated and specifically identified copper, nickel, mercury and selenium as the metal pollutants of concern. The listing triggered the Clean Water Act §303(d) mandate for the State of California, specifically the Water Board, to establish TMDLs for these pollutants of concern. To address NPDES permit issues for its wastewater treatment plant, the City of San Jose and other local municipalities took the lead in providing funding for the development of the copper and nickel TMDLs for Lower South Bay, and other Lower South Bay communities contributed to related SCBWMI activities.~~

~~The TMDL effort focused on:~~

~~1.Conducting an Impairment Assessment to determine if ambient concentrations of copper and nickel were negatively impacting the designated beneficial uses of Lower South Bay;~~

2.Developing a range of scientifically defensible water quality objectives for copper and nickel;

3.Developing a conceptual model of copper and nickel cycling to evaluate attainment of the range of objectives; and

4.Characterizing sources and identifying pollution prevention and control actions.

The Workgroup oversaw the preparation and review of several technical reports. These reports provide the basis of the conclusions and recommendations of the Workgroup regarding the effects of ambient concentrations of copper and nickel on the beneficial uses of Lower South Bay.

7.1.3 IMPAIRMENT ASSESSMENT AND SITE-SPECIFIC OBJECTIVES

The Impairment Assessment Report was finalized in June 2000 to present new information and to re-evaluate the determination that the beneficial uses of Lower South Bay were impaired due to ambient concentrations of copper and nickel. Specifically, the goals of the assessment were to:

- Compile and evaluate data on ambient concentrations and toxicity information for copper and nickel in Lower South Bay;
- Identify, evaluate and select indicators of beneficial use impairment. The categories of parameters and criteria considered included toxicity (acute and chronic), biological (biota composition, health, abundance, and physical habitat vs. a reference site), chemical (numeric values), and physical (capacity to support uses);
- Develop endpoints for the selected indicators that can be used to assess the existence of impairment and compare these values to ambient concentrations in Lower South Bay. The intent of this assessment was to provide policy makers, regulators, and other stakeholders with the best technical laboratory and ambient information currently available to compare with known threshold impact levels on selected indicators;
- Assess the level of certainty with which it can be shown ambient concentrations of copper and nickel are or are not resulting in beneficial use impairment; and
- Recommend numeric values for site-specific objectives (SSOs) for dissolved copper and nickel in Lower South Bay in lieu of TMDL development upon finding that the Lower South Bay is not impaired due to these metals.

The final results of the impairment assessment indicated that impairment to beneficial uses of Lower South Bay due to ambient copper and nickel concentrations is unlikely. There are several lines of evidence to support the finding for each metal, and these are discussed at length in the Impairment Assessment Report. One important factor in the impairment decision was the recognition that the chemical features of Lower South Bay reduce the toxicity and bioavailability of copper and nickel. These chemical features include binding of copper and nickel by dissolved organic compounds and the abundance of dissolved metals like manganese and iron that compete with copper and nickel for receptor sites on aquatic organisms.

From the established ranges of acute and chronic values of copper and nickel site-specific objectives developed through the Impairment Assessement Report, the Water Board selected specific values for copper and nickel that it deemed protective of beneficial uses and incorporated them into Chapter 3 of this Basin Plan. The acute and chronic site-specific water quality objectives in Lower South Bay for dissolved copper are 10.8 µg/L and 6.9 µg/L, respectively. The acute and chronic site-specific water quality objectives in Lower South Bay for dissolved nickel are 62.4 µg/L and 11.9 µg/L, respectively.

While the conclusions of the Impairment Assessment Report are scientifically sound, like most statements about complex environmental systems, its conclusions on the lack of impairment have some degree of uncertainty. The existence of these uncertainties underscores the need for continued monitoring and studies that are described below. The four primary areas of uncertainty are the toxicity of copper to phytoplankton, copper and nickel cycling in Lower South Bay, sediment toxicity, and uncertainties in loading estimates.

7.21.2 4 IMPLEMENTATION PLAN AND MONITORING PROGRAM

This section discusses the actions and ambient monitoring program that will be needed taken to ensure continued attainment of maintain the copper and nickel site-specific objectives throughout San Francisco Bay and. The underlying goal of these actions is to ensure that copper sources are properly managed so ambient copper levels do not increase due to potential increases in loading of copper to San Francisco ~~and nickel to Lower South~~ Bay. The implementation plan also calls for requirements in NPDES permits to support investigations to resolve three key areas of remaining technical uncertainty regarding copper: urban tributary loads and trends; toxicity to benthic organisms; and possible effects on the olfactory system of salmonids.

~~Except for the specification of metal translators, all actions and monitoring obligations described in this section are already required in the NPDES permits for the three municipal wastewater dischargers and the municipal urban runoff (stormwater) dischargers in Lower South Bay. Other non-regulatory, collaborative actions discussed here will be implemented via the SCBWMI and its participants on a voluntary basis.~~

~~*7.1.4.1 MONITORING PROGRAM*~~

~~Fundamental to the monitoring program is the concept of a water quality indicator. An indicator is a measurable quantity that is so strongly associated with particular environmental conditions that the value of the measurable quantity can be used to indicate the existence and maintenance of these conditions. The indicators used in the monitoring program to support the site-specific objectives are dissolved copper and nickel concentrations in Lower South Bay. The monitoring program described here has been required by the NPDES permits for the three municipal wastewater dischargers since October 2000. (Order No. 00-108). The monitoring program consists of monthly dissolved copper and nickel measurements at the ten stations shown in Table 7-1. As of the adoption of this WQAS, the municipal wastewater dischargers defined dissolved metal as those metal constituents that pass through a 0.45 micron (µm) filter prior to chemical analysis. Any changes to this operational definition of dissolved metal or details of the monitoring program will be addressed through amendments to the NPDES permits.~~

~~The purpose of the monitoring component of the WQAS is to assess ambient conditions compared to the specific trigger levels described below. The ambient data collected through the WQAS monitoring program may be considered along with other ambient monitoring data to determine whether additional controls are necessary.~~

~~*7.1.4.2 TRIGGER VALUES*~~

~~The NPDES permits for municipal wastewater and stormwater dischargers contain a series of trigger values and corresponding actions that are required to be taken by the dischargers if the triggers are reached. For copper, an increase in dry season dissolved copper concentration of 0.8 µg/L can be reliably detected despite inherent variability, and this specific increase is used to define the copper trigger levels. The copper Phase I trigger is reached and copper-specific Phase I actions will be conducted if the average dry season dissolved copper concentration at stations SB3, SB4, SB5, SB7, SB8, SB9 increases from 3.2 µg/L (overall dry season mean from indicator stations during the period June 1997 to November 1998) to 4.0 µg/L. The copper Phase II trigger is reached and Phase II actions will be conducted if the dry season mean concentration of the indicator stations increases further to 4.4 µg/L. This 0.4 µg/L change can still be detected with reasonable statistical certainty to justify the more aggressive Phase II actions.~~

~~For nickel, an increase in dry season dissolved concentration of 2.0 µg/L can be reliably detected despite inherent variability, and this increase is used to define the trigger levels for nickel. The nickel Phase I trigger is reached and Phase I actions will be conducted if the average dry season dissolved nickel concentration at stations SB3, SB6, SB7, SB8, SB9, SB10 increases from 4.0 µg/L (overall dry season mean from indicator stations during the period June 1997 to November 1998) to 6.0 µg/L. The nickel Phase II trigger is reached and Phase II actions will be conducted if the dry season mean dissolved concentration from the indicator stations increases another 2.0 µg/L to 8.0 µg/L. Note that the copper and nickel Phase I and Phase II triggers are well below the site-specific objectives for these metals and reaching the triggers indicates a negative trend in water quality but not impairment of beneficial uses.~~

~~The Executive Officer will review the monitoring program results annually and determine whether the trigger values have been reached. The Executive Officer will report findings to the Water Board and will notify interested agencies and interested persons of these findings and will provide them with an opportunity to submit their views and recommendations concerning the findings either in written form or at a public hearing.~~

~~If the trigger values for ambient copper and nickel concentrations have not been exceeded, the monitoring program will continue to provide information for the next review period. The Water Board shall evaluate performance of the monitoring program during the annual review to determine if the necessary information is being provided.~~

~~*7.1.4.3 BASELINE ACTIONS*~~

~~These actions are already being implemented through the NPDES permits and will continue until the Water Board directs otherwise through the permitting process. These actions include: 1) pollution prevention and control actions by public agencies; 2) actions to conduct or track special studies that address specific technical areas of uncertainty (the toxicity of copper to phytoplankton, copper and nickel cycling in Lower South Bay, sediment toxicity, and uncertainties in loading estimates); and 3) planning-type studies to track, evaluate, and/or develop additional indicators and associated triggers (i.e., indicators for growth, development, or increased use or discharge of copper and nickel in the watershed).~~

~~*BASELINE ACTIONS CONDUCTED BY MUNICIPAL WASTEWATER DISCHARGERS*~~

~~Baseline actions applicable to municipal wastewater dischargers are actions associated with implementation of reasonable treatment, source control, and pollution prevention measures to limit discharges of copper and/or nickel.~~

~~In the consideration of the site-specific objectives for copper and nickel, the "Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California" (State Implementation Plan, or SIP) requires that dischargers demonstrate that they are implementing reasonable treatment, source control, and pollution prevention measures for these metals. The Water Board found that continuation of baseline actions satisfies this requirement as long as the copper and nickel trigger levels are not reached in Lower South Bay. Pollution prevention and minimization are a significant part of these dischargers' efforts to limit the discharges of copper and nickel. These dischargers have approved Pretreatment Programs and have established Pollution Prevention Programs under the requirements specified by the Water Board in their NPDES permits.~~

~~These findings and specific baseline actions are already being implemented through the NPDES permits for these dischargers (Order No. 00-108, October 2000). The municipal wastewater dischargers are required by their permits to maintain these baseline actions and review and report to the Water Board on their implementation on an annual basis. Modifications to the current baseline actions may be considered through the permit process, provided that these dischargers demonstrate to the Water Board that such modifications are consistent with maintaining reasonable treatment, source control, and pollution prevention measures.~~

~~*BASELINE ACTIONS CONDUCTED BY URBAN RUNOFF (MUNICIPAL STORMWATER) DISCHARGERS*~~

~~The Urban Runoff Management requirements (see Section 4.14 Urban Runoff Management) and specific copper and nickel baseline actions have been required by the NPDES permit for the Santa Clara Valley Urban Runoff Pollution Prevention Program and its dischargers since March 2001 (Order No. 01-024). These requirements include actions associated with implementation of controls to reduce copper and/or nickel in discharges to the maximum extent practicable, actions associated with prohibiting discharges other than stormwater to storm drain systems and waterways, and actions associated with monitoring to evaluate effectiveness of controls, identify sources of pollutants, and to measure or estimate pollutant concentrations and loads. On an annual basis, these dischargers are required to describe the controls that they are implementing and any additional controls that will be implemented. These dischargers are required to provide to the Water Board detailed descriptions of activities in each fiscal year in annual workplans and associated evaluations and results in annual reports. Modifications to the current baseline actions may be considered through the NPDES permit, provided that the Dischargers demonstrate to Water Board that such modifications are consistent with maintaining programs that control copper and nickel discharges to the maximum extent practicable in accordance with the requirements of the Water Board's Comprehensive Control Program for Urban Runoff Management and the Clean Water Act. As long as Lower South Bay ambient concentrations of copper and nickel remain below the established Phase I~~

~~trigger levels, the Water Board has determined that the baseline actions applicable to urban runoff (municipal stormwater) dischargers satisfy the copper- and nickel-specific requirements of the Comprehensive Control Program for Urban Runoff Management and federal regulations (40 CFR 122.26).~~

~~*BASELINE ACTIONS CONDUCTED BY SANTA CLARA BASIN WATERSHED MANAGEMENT INITIATIVE*~~

~~As described above, the SCBWMI is a collaborative, stakeholder-participation forum that seeks integration of regulatory and watershed management actions that affect Lower South SF Bay and its tributaries. In addition to the actions required in the NPDES permits for the three municipal wastewater dischargers and the municipal urban runoff dischargers, there are other non-regulatory, collaborative actions that the SCBWMI and participants have committed to implement. These collaborative actions are described in attachments to the NPDES permit for the SCVURPPP and include: establishing a forum on transportation issues and impervious surfaces and for reviewing the appropriateness of transportation control measures with a view toward reducing traffic congestion; implementing measures to improve classification and assessment of watersheds; establishing an environmental clearinghouse of information related to tracking and disseminating new scientific information related to copper toxicity, loadings, fate and transport, and impairment of aquatic ecosystems; and planning-type studies to track, evaluate, and/or develop additional indicators to use and future potential indicators and triggers (i.e., indicators for growth, development, or increased use or discharge of copper and nickel in the watershed). In addition, the SCBWMI serves as a stakeholder participation forum to track, review, and evaluate the baseline actions required by the NPDES permits.~~

~~*7.1.4.4 PHASE I ACTIONS*~~

~~Phase I actions are already specified in the NPDES permits for municipal wastewater and stormwater dischargers. These actions are implemented when the mean value of selected monitoring parameters exceeds specified Phase I water quality triggers. The exceedance of the Phase I trigger indicates a negative trend in water quality and not impairment. Phase I actions consist of both specific remedial actions and planning for implementation of future actions if the Phase II triggers are exceeded.~~

~~If the Phase I copper or nickel triggers are exceeded, the Regional Board will consider execution of Phase I and Baseline actions as satisfying both the SIP requirement that municipal wastewater dischargers are implementing reasonable treatment, source control, and pollution prevention measures for copper and nickel and the Basin Plan requirement that municipal stormwater dischargers are implementing controls to reduce copper and/or nickel in discharges to the maximum extent practicable. Within 90 days after the determination of Phase I trigger exceedance, the Regional Board expects both the municipal wastewater and municipal stormwater dischargers to submit, for Executive Officer concurrence, their proposed Phase I plans with implementation schedules to implement additional measures to limit their relative cause or contribution to the exceedance. This submittal should, at a minimum, include evaluation of the Phase I actions and development of a Phase II plan. If the submittal is not received within 90 days of the determination of Phase I trigger exceedance or is not being implemented in accordance with the dischargers' implementation schedule following the Executive Officer's concurrence, the Regional Board may consider enforcement action to enforce the terms of the dischargers' permits.~~

~~*7.1.4.5 PHASE II ACTIONS*~~

~~Phase II actions are already specified in the NPDES permits for municipal wastewater and stormwater dischargers. Phase II actions are implemented when the mean value of selected monitoring parameters exceeds specified Phase II water quality triggers. Phase II actions are intended to reduce controllable sources further to maintain compliance with the site-specific water quality objectives.~~

~~If the Phase II copper or nickel triggers are exceeded, the Regional Board will consider execution of Phase II, Phase I and Baseline actions as satisfying both the SIP requirement that municipal wastewater dischargers are implementing reasonable treatment, source control, and pollution prevention measures for copper and nickel and the Basin Plan and Clean Water Act requirement that municipal stormwater dischargers are implementing controls to reduce copper and/or nickel in discharges to the maximum extent practicable. Within 90 days after the determination of Phase II trigger exceedance, the Regional~~

Board expects the dischargers to submit, for Executive Officer concurrence, the proposed Phase II plans with implementation schedules to implement additional measures to limit their relative cause or contribution to the exceedance. If the submittal is not received within 90 days of the determination of Phase II trigger exceedance or is not being implemented in accordance with the dischargers' implementation schedule upon the Executive Officer's concurrence, the Regional Board may consider enforcement action to enforce the terms of the dischargers' permits.

An important regulatory element of the WQAS is the specification of metal translators applicable to the three Lower South SF Bay municipal wastewater dischargers. When the NPDES permits are re-issued, concentration-based effluent limits for these three facilities will be calculated from the chronic copper and nickel SSOs. Water quality objectives for copper and nickel are expressed as dissolved metal concentrations. Effluent limits for thePOTWs are expressed as total metal concentrations and must be calculated according to the procedure outlined in the SIP. Therefore, for metals like copper and nickel, the calculation of the effluent limit requires the use of a ratio of total to dissolved metal called the metal translator.

Analyses of data from 12 monitoring stations in Lower South SF Bay (Dumbarton to sloughs) collected from February 1997 to August 2000 and including dissolved and total copper and nickel, total suspended solids (TSS), and tidal data, showed a strong TSS dependence. The statistical analyses explored relationships between translator values and TSS, tide, site, and season. Linear regression with log-transformed dissolved fraction (translator) and TSS data provided the best regression fit. The best-fit regression line and its 95% confidence intervals provided the basis for translator values for copper and nickel.

U.S. EPA guidance (U.S. EPA Office of Water, June 1996. The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion. EPA 823-B-96-007) states that, when there is a relationship between the translator and TSS, regression equations should be used to develop translator values using representative TSS values the for the site under consideration. There is a fairly wide variation in TSS, and the guidance on translator development suggests using a representative TSS value. In Lower South SF Bay, a median TSS value may not account for the higher translator values and dissolved metal levels that result during high TSS episodes. For this reason, copper and nickel translators computed from 95% confidence interval TSS values were used to develop the POTW effluent limits. A copper translator of 0.53, and a nickel translator of 0.44 resulted from this procedure. Using the 95% confidence interval translator provides an additional measure of beneficial use protection in that effluent limits, expressed at total metal, will be lower using a higher value for metal translators. These translators shall be used to compute copper and nickel effluent limits for POTWs discharging to the Lower South SF Bay when NPDES permits for Lower South SF municipal wastewater dischargers are reissued.

Table 7-1: Monitoring Stations for Copper and Nickel in Lower South San Francisco Bay

SBS Site ID	Reference Location	Longitude	Latitude	RMP Site ID
SB01	Channel Marker #14	37° 30.782'	122° 8.036'	BA30
SB02	Channel Marker #16	37° 29.595'	122° 5.243'	BA20
SB03	Channel Marker #20	37° 27.437'	122° 3.033'	BA10
SB04	Coyote Creek Railroad Bridge	37° 27.600'	121° 58.540'	C-3-0
SB05	Coyote Creek at Guadalupe River confluence	37° 27.875'	122° 1.406'	NA
SB06	Between Channel Markers #17 & #18	37° 28.390'	122° 4.180'	NA
SB07	Mouth of Mowry Slough	37° 29.499'	122° 3.110'	NA
SB08	Mouth of Newark Slough	37° 30.066'	122° 5.231'	NA
SB09	North of Cooley Landing	37° 28.959'	122° 7.068'	NA
SB10	Old Palo Alto Yacht Club Channel Mouth	37° 28.087'	122° 5.846'	NA

~~SB11~~	~~Standish Dam in Coyote Creek~~	~~37° 27.150'~~	~~121° 55.501'~~	~~BW10~~
~~SB12~~	~~Alviso Yacht Club Dock~~	~~37° 25.574'~~	~~121° 58.778'~~	~~BW15~~

7.2~~1~~.2.1 Control Measures for Urban Runoff Management Agencies

The NPDES permits for urban runoff management agencies shall require the implementation of best management practices and copper control measures designed to prevent urban runoff discharges from causing or contributing to exceedances of copper water quality objectives. Requirements in each permit issued or reissued and applicable for the term of the permit shall be based on an updated assessment of control measures intended to reduce copper in stormwater runoff to the maximum extent practicable. Urban runoff management agencies must implement control measures targeting: vehicle brake pads, architectural copper, copper pesticides, and industrial copper use. Additionally, these permits shall contain requirements to conduct or cause to be conducted: monitoring of copper loading to the Bay at locations and frequency sufficient to track loading trends; and technical studies to investigate possible copper sediment toxicity and sublethal effects on salmonids.

If an ambient trigger concentration in any San Francisco Bay segment (see Section 7.2.2.5) is exceeded, all urban runoff management agencies discharging to that segment shall submit a report to the Water Board that describes best management practices that are currently being implemented and additional measures, with a schedule, that will be implemented to prevent their copper discharges from causing or contributing to the exceedance.

7.2~~1~~.2.2 Control Measures for Wastewater Treatment Facilities

The management measures for municipal and industrial wastewater treatment facilities will be implemented through their individual NPDES permits, which shall include the following elements:

- Water quality-based effluent limits (WQBELs) computed from the SSOs.
- Baseline Program of pollution prevention measures.
- Requirement to conduct or cause to be conducted technical studies to investigate possible copper sediment toxicity and sublethal effects on salmonids.
- Effluent Monitoring and Reporting.

The baseline pollution prevention measures for wastewater facilities include:

- Evaluate copper sources (all municipal and industrial facilities)
- Confirm industrial facility compliance with local pre-treatment copper limits (municipal facilities only)
- Control municipal water supply pipeline corrosion from commercial and residential sources (municipal facilities only)

More advanced, facility-specific pollution prevention measures shall be implemented by facilities that exceed a copper effluent limit due to increased copper influent loading compared to the previous year's performance. Additionally, if an ambient trigger concentration (see Section 7.2.2.5) is exceeded, each municipal and industrial wastewater facility discharging to that segment of the Bay shall evaluate the history of its facility's effluent copper concentrations. Those facilities with increasing copper effluent trends shall develop and implement plans to control these increasing levels.

METAL TRANSLATORS

An important regulatory element of the WQAS is the specification of metal translators. Water quality objectives for copper and nickel are expressed as dissolved metal concentrations. Effluent limits for the wastewater dischargers' treatment facilities are expressed as total metal concentrations and must be calculated according to the procedure outlined in the "Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California". Therefore, for metals like copper and nickel, the calculation of an effluent limit requires the use of a ratio of total to dissolved metals called the metal translator.

South San Francisco Bay copper and nickel translators were developed using a regression relationship between the translators and total suspended solids (TSS). The translators were computed by evaluating the upper 95% confidence interval regression relationship at the median TSS value for South San Francisco Bay. For this reason, there is a single translator value for each metal (Table 7.2-1). The higher translators that result from using the upper confidence level regression result in lower numeric effluent limits and provide an additional measure of protection of beneficial uses.

There is not a strong relationship between TSS and translators for the segments of the Bay north of the Dumbarton Bridge. There are geographic differences in computed translators between the northernmost segments and those in the southern segments the Bay. In such cases, median and 90th percentile translators can be computed from available data for use in computing average monthly and maximum daily effluent limits, respectively. The translators in Table 7.2-2 apply only to deepwater wastewater discharges to San Francisco Bay because the available translator data are not representative of shallow water discharge (defined as those wastewater discharges that have been granted an exception to the prohibition against wastewater discharges into non-tidal water, dead-end sloughs or at any point that wastewater does not receive dilution of at least 10:1) locations. Shallow water wastewater dischargers must develop translators applicable to the discharge location at the time of permit reissuance.

Table 7.2-1 Translators Applicable to South San Francisco Bay Municipal Wastewater Discharges for Copper and Nickel

Bay Segments	Copper Translator For Effluent Limit Calculation	Nickel Translator For Effluent Limit Calculation
South San Francisco Bay	0.53	0.44

Table 7.2-2 Translators Applicable to Other San Francisco Bay Municipal and Industrial Wastewater Deep Water Discharges for Copper

Bay Segments	Copper Translator For Average Monthly Effluent Limit Calculation	Copper Translator For Maximum Daily Effluent Limit Calculation
Suisun Bay San Pablo Bay	0.38	0.66
Central San Francisco Bay Lower San Francisco Bay	0.73	0.87

7.2.2.3 Copper From Anti-Fouling Boat Paint
Paints applied to boats and ships to control unwanted “fouling” growth on their hulls often contain copper-based biocides. In San Francisco Bay, there are major ports, industrial piers, and dozens of marinas. Boats and ships coated with copper-containing biocides may release copper directly into the Bay during storage, operation, and in-water maintenance.

The Water Board is relying on the authority of the California Department of Pesticide Regulation (DPR) to regulate the pesticidal use of copper in antifouling paints such that water quality objectives will be attained. The Water Board will work with DPR as it executes its regulatory strategy for biocides in marine antifouling coatings, which includes monitoring to evaluate water quality impacts and review of registration status.

7.2.2.4 Control Measures for Lagoons
There are many managed lagoons that are hydraulically connected to the Bay. Because of nutrient loading and stagnant conditions, excessive growth of aquatic plants and algae can cause nuisance conditions. In addition to mechanical harvesting, copper-based algaecides are used to control nuisance plant and algae growth. The application of these algaecides is permitted under the State Water Board’s Statewide General NPDES Permit (Order No. 2004-0009-DWQ) for discharges of aquatic pesticides to surface waters. The Water Board recognizes coverage under the general permit as being sufficient to ensure that application of copper pesticides to lagoons shall not cause or contribute to violations of the water quality objectives.

7.2.2.5 Ambient Monitoring Program
The implementation plan establishes copper control measures in order to prevent increases in ambient dissolved copper concentrations. Ambient concentrations of copper in the Bay have remained essentially unchanged from 1993 through 2006 and are not expected to increase in the future. In order to determine systematically if ambient concentrations have increased, specific copper concentration triggers are compared to data collected through the Regional Monitoring Program for Trace Substances (RMP). This is accomplished by calculating every year the three-year rolling mean of RMP copper concentrations in segments of the Bay. These rolling mean concentrations will be compared to trigger concentration values for each segment. The trigger concentrations (shown in Table 7.3) were calculated in order to detect a change (from 2003 concentrations) in dissolved copper concentration of about 1 μg/L with a statistical power of 99%. If the trigger concentration is exceeded in any Bay segment, the Water Board will investigate causes of the exceedance and potential control options and require wastewater and urban runoff dischargers to that segment to investigate whether they have caused or contributed to the exceedance and, if so,

to identify and submit a plan and schedule to implement controls to resolve their contribution to the exceedance.

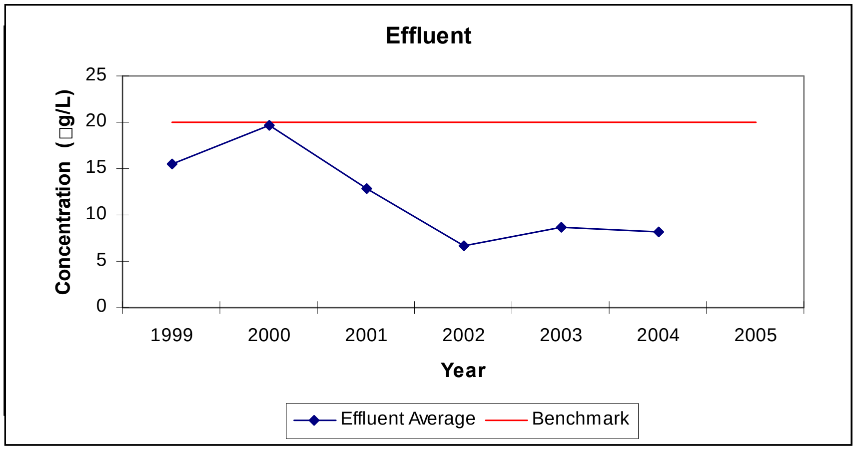
The Water Board will assess the continued appropriateness of the SSOs for San Francisco Bay should conditions change in Bay water quality. Dissolved organic carbon (DOC) will be used as a surrogate measure of the protective effect of Bay water against copper water column toxicity. An analysis and evaluation of trends in DOC data collected through the RMP will determine whether or not additional water column toxicity tests are needed to confirm that the SSOs are protective. In addition, the Water Board will evaluate sediment copper concentration and sediment toxicity data collected through the RMP to assess possible effects related to copper accumulation in Bay sediments. The need for a reevaluation of the SSOs or other regulatory actions will be established through the triennial review of the Basin Plan.

Table 7.3 Dissolved Copper (µg/L) Trigger Concentrations at 99% Statistical Power.

Bay Segment (or portion thereof)	**Trigger Level (µg/L)**
Suisun Bay	2.8
San Pablo Bay	3.0
Central San Francisco Bay Lower San Francisco Bay (north Hayward Shoals)	2.2
Lower San Francisco Bay (south of Hayward Shoals)	3.6
South San Francisco Bay	4.2

<u>Figure 7.1 Segments of San Francisco Bay showing location of Hayward Shoals as a line connecting Little Coyote Point and the Oakland Airport.</u>

Appendix B – Tables and Figures



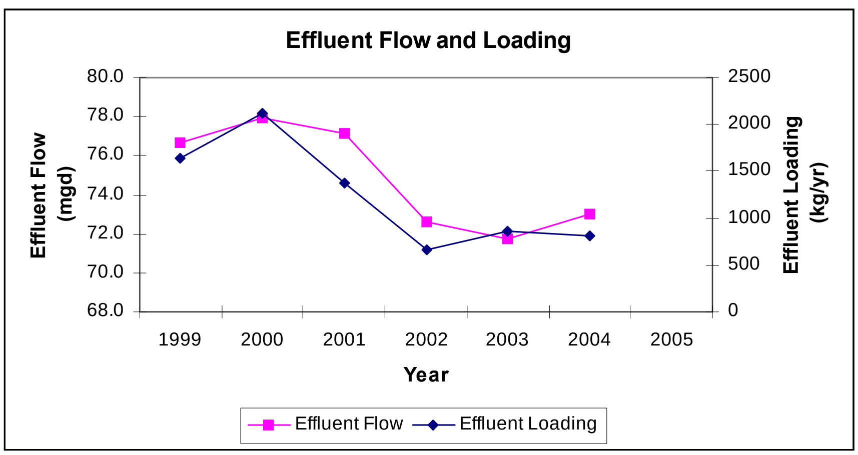


Figure B-1 Sample Figures for Wastewater Performance "Report Card"

Table B-1 Current and Projected Wastewater Loading to Bay (facilities North of Dumbarton Bridge 2001-2003 data)

Discharger	Current Annual Load (kg/yr)	Current Final AMEL (µg/L)	Current Interim AMEL (µg/L)	Load at current NPDES permit Limit (AMEL) kg/yr	Projected AMEL (µg/L)	Load at projected AMEL derived from proposed SSO for plants with RP (kg/yr)
Municipal Wastewater Facilities						
American Canyon, City of	2.8 +/- 2.9		2.5	2.9	6.8	7.9
Angel Island State Park	0.1 +/-					0.1
Benicia, City of	29.9 +/- 17.7		32.0	140.2	57.1	250.3
Burlingame, City of	56.3 +/- 45.1		27	154.5	52.9	302.9
Calistoga, City of	1.1 +/- 0.9				180.5	1.1
Central Contra Costa Sanitary District	402.3 +/- 107.0		37.0	2265.5	79.0	4837.8
Central Marin Sanitation Agency	41.8 +/- 11.7	13.1		197.7	79.5	1199.4
Delta Diablo Sanitation District	123.0 +/- 40.4		16.0	259.4	77.8	1261.8
Dublin-San Ramon Services District	652.4 +/- 246.1	71		1049.0	74.6	652.4
East Bay Dischargers Authority	1279.2 +/- 305.6	71		7365.0	79.2	8218.9
East Bay Municipal Utilities District	1026.0 +/- 531.8		37.0	3799.8	64.8	6651.9
Fairfield-Suisun Sewer District	100.7 +/- 33.5		12.3	282.8	9.0	206.0
Las Gallinas Valley Sanitary District	22.3 +/- 14.3		17.0	30.0	8.0	14.1
Livermore, City of	36.8 +/- 0.0				60.5	36.8
Marin County Sanitary District #5 Tiburon	8.7 +/- 8.0		18.5	19.0	49.8	51.1
Millbrae, City of	23.2 +/- 6.2		17.0	44.6	78.7	206.7
Mt. View Sanitary District	13.9 +/- 4.0	8.3		22.9	9.5	26.1
Napa Sanitation District	44.2 +/- 30.0		2.5	27.3	54.8	598.3
Novato Sanitary District	0.0 +/-		19.0	9.8	6.9	3.6
Petaluma, City of	16.2 +/- 5.6		7.9	35.6	8.8	39.9
Pinole-Hercules, Cities of	18.5 +/- 8.0	20		80.4	68.5	275.3
Contra Costa County Sanitation District #5 Port Costa	0.0 +/- 0.0				56.6	

Discharger	Current Annual Load (kg/yr)	Current Final AMEL (µg/L)	Current Interim AMEL (µg/L)	Load at current NPDES permit Limit (AMEL) kg/yr	Projected AMEL (µg/L)	Load at projected AMEL derived from proposed SSO for plants with RP (kg/yr)
Rodeo Sanitary District	3.5 +/- 2.0		17.0	19.0	59.1	66.0
St. Helena, City of	0.0 +/-				150.6	24.7
San Francisco International Airport (Municipal)	7.7 +/- 4.1		33.0	36.8	64.7	72.2
San Francisco, City and County of (Southeast)	1479.7 +/- 491.4		37.0	3990.8	77.3	8343.0
San Mateo, City of	105.3 +/- 40.8		33.1	579.7	73.8	1292.2
Sausalito-Marin City Sanitary District	26.2 +/- 4.6		28.0	63.7	81.3	184.8
Seafirth Estates	0.0 +/- 0.0					
Sewerage Agency of Southern Marin	70.5 +/- 16.8		29.0	131.4	79.3	359.5
Sonoma Valley County Sanitary District	23.9 +/- 6.9		18	55.9	10.1	31.4
South Bayside System Authority	253.8 +/- 77.6		14.0	353.5	77.8	1964.8
South San Francisco-San Bruno, Cities of	149.8 +/- 74.7		37.0	521.7	65.9	929.2
Treasure Island	9.4 +/- 7.7		25.0	18.9	77.1	9.4
Union Sanitary District, Wet Weather	0.5 +/- 0.1		2.5	0.1	78.3	2.5
Vallejo Sanitation & Flood Control District	134.8 +/- 36.6	110		754.8	81.5	134.8
West County Agency	125.4 +/- 32.2		17.0	288.0	78.7	1333.7
Yountville, Town of	7.8 +/- 4.5		8.5	2.4	150.6	43.3
Municipal Wastewater Total	**6298 +/-**			**22603.2**		**39634.1**
Petroleum Refineries						
Chevron Richmond Refinery	33.1 +/- 34.8	13		124.5	22.8	218.3
ConocoPhillips (Rodeo)	14.9 +/- 13.4		37.0	82.4	36.5	81.3
Martinez Refining Company	43.4 +/- 18.3	13		104.9	48.2	389.4
Tesoro Golden Eagle Refinery	27.2 +/- 17.0	13		76.8	35.3	208.3
Valero Benicia Refinery	17.0 +/- 6.7		36.0	99.5	50.3	138.9
Petroleum Refinery Total	**136 +/- 90**			**488.2**		**1036.1**
Other Industries						
C&H Sugar			18.5	621.9	37.2	1251.3
Crockett Cogeneration			126.0	0.0	37.2	0.0

Discharger	Current Annual Load (kg/yr)	Current Final AMEL (µg/L)	Current Interim AMEL (µg/L)	Load at current NPDES permit Limit (AMEL) kg/yr	Projected AMEL (µg/L)	Load at projected AMEL derived from proposed SSO for plants with RP (kg/yr)
Dow Chemical Company	2.7 +/- 1.1		37.0	12.7	57.4	19.7
General Chemical					36.5	
GWF Power Systems (Site I)	1.4 +/- 0.3		36.0	2.3	73.5	4.6
GWF Power Systems (Site V)	1.3 +/- 0.3		36.0	2.3	74.8	4.7
Hanson Aggregates (Amador Street)						
Hanson Aggregates (Olin Jones Dredge Spoils Disposal)					4.5	
Hanson Aggregates (Tidewater Avenue)					4.5	
Morton	1.3 +/- 0.5				39.0	
Pacific Gas & Electric (East Shell Pond)					36.5	
Pacific Gas & Electric (Hunters Point)					39.0	
Rhodia Basic Chemicals	1.5 +/- 0.9		37.0	5.1	37.6	5.2
S.F.Airport, Industrial (Total)	8.7 +/- 9.3		8.5	10.5	39.0	47.9
Southern Energy California Pittsburg Power Plant		20		0.0	4.5	0.0
Southern Energy Delta LLC Potrero Power Plant					39.0	
US Navy Point Molate			18.5	0.0	37.2	0.0
USS Posco	27.0 +/- 9.9	3.3		33.5	6.8	69.2
Other Industry Total	**53 +/- 40**			**688.2**		**1402.7**

Note: Facilities that are shown in this table to have a final AMEL may not be allowed to have an effluent limit derived from the SSOs according to anti-backsliding provisions of NPDES regulations. This would be the case if they are shown to be meeting their current effluent limits derived from the current copper objective. This determination will be made at the time of permit reissuance. The loads projected therefore may be somewhat overstated.

Appendix C – Environmental Checklist

1. Project Title:	Adoption of site-specific water quality objectives for copper for San Francisco Bay.
2. Lead Agency Name and Address:	California Regional Water Quality Control Board, San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, California 94612
3. Contact Person and Phone Number:	Naomi Feger (510) 622-2328 Richard Looker (510) 622-2451
4. Project Location:	San Francisco Bay
5. Project Sponsor's Name and Address:	California Regional Water Quality Control Board, San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, California 94612
6. General Plan Designation:	Not Applicable
7. Zoning:	Not Applicable

8. **Description of Project:**

   The project is a proposed Basin Plan amendment adopting new copper water quality objectives for San Francisco Bay. Additional details are provided in the attached explanation.

9. **Surrounding Land Uses and Setting:**

   San Francisco Bay is surrounded by urban areas.

10. **Other public agencies whose approval is required** (e.g., permits, financing approval, or participation agreement.)

    The California State Water Resources Control Board, the California Office of Administrative Law, and the U.S. Environmental Protection Agency must approve the proposed Basin Plan amendment.

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*

I. AESTHETICS -- Would the project:

a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☐	☒
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒

II. AGRICULTURE RESOURCES -- In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. **Would the project:**

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
III. AIR QUALITY -- Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. **Would the project:**				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☐	☒
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒
IV. BIOLOGICAL RESOURCES -- Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☒	☐

	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
IV. BIOLOGICAL RESOURCES -- (cont.):				
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	☒
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒
V. CULTURAL RESOURCES -- Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
b) Cause a substantial adverse change in the significance of a unique archaeological resource pursuant to §15064.5?	☐	☐	☐	☒
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	☒
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
VI. GEOLOGY AND SOILS -- Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c) Be located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☐	☒

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒
VII. HAZARDS AND HAZARDOUS MATERIALS -- Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
VII. HAZARDS AND HAZARDOUS MATERIALS -- (cont.):				
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒

Issues:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
VIII. HYDROLOGY AND WATER QUALITY -- Would the project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☐	☒

Issues	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion of siltation on- or off-site?	☐	☐	☐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality?	☐	☐	☐	☒
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
VIII. HYDROLOGY AND WATER QUALITY – (cont.):				
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☒

j) Inundation of seiche, tsunami, or mudflow?	☐	☐	☐	☒
IX. LAND USE AND PLANNING -- Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒
X. MINERAL RESOURCES -- Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒
XI. NOISE -- Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*

XI. NOISE – (cont.) in:

b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☒
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☒
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

XII. POPULATION AND HOUSING -- Would the project:

a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
XIII. PUBLIC SERVICES --				
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒
XIV. RECREATION --				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒
XV. TRANSPORTATION / TRAFFIC -- Would the project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume-to-capacity ratio on roads, or congestion at intersections)?	☐	☐	☐	☒
b) Exceed, either individually or cumulatively, a level of service				

standard established by the county congestion management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
XV. TRANSPORTATION / TRAFFIC – (cont.):				
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒
XVI. UTILITIES AND SERVICE SYSTEMS -- Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒

	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
XVI. UTILITIES AND SERVICE SYSTEMS – (cont.):				
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
XVII. MANDATORY FINDINGS OF SIGNIFICANCE				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒

b) Does the project have impacts that are individually limited, but cumulative considerable? ("Cumulative considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☐	☐	☒
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

EXPLANATION

Project Description
The proposed project is a Basin Plan amendment to establish chronic and acute site-specific objectives (SSOs) for dissolved copper in San Francisco Bay, north of the Dumbarton Bridge. The proposed amendment includes copper SSOs and an implementation plan to support the SSOs. This plan will be implemented Bay-wide so some components of the existing Basin Plan language for South San Francisco Bay will need to be revised. The Basin Plan amendment project includes:

- Site-specific dissolved copper objectives (SSOs) for regions of the Bay and incorporation of these SSOs into the Basin Plan. The objectives will be 6.9 µg/L chronic and 10.8 µg/L acute for the portions of the Bay south of the Hayward Shoals. The objectives will be 6.0 µg/L chronic and 9.4 µg/L acute for the portions of the Bay north of the Hayward Shoals.
- Copper translators (ratios of dissolved to total copper) for computing NPDES effluent limits for wastewater sources.
- An implementation plan to support maintenance of water quality and continued attainment of WQOs consisting of:
    - **a.** Control measures for urban runoff
    - **b.** Control measures for wastewater
    - **c.** Control measures for use of copper-based anti-fouling coatings on boats
    - **d.** Control measures for lagoons
    - **e.** Measures to resolve remaining uncertainties, specifically, permit requirement to conduct or cause to be conducted technical studies to investigate possible copper sediment toxicity and sublethal effects on salmonids.
    - **f.** Ambient monitoring and ambient copper concentration triggers

Replacement of some basin plan language for South SF Bay copper SSO implementation based on a Bay-wide implementation strategy being proposed in the proposed Basin Plan amendment.

Environmental Analysis
The proposed project will not have a significant impact on the environment. The proposed site-specific objectives are fully protective of the most sensitive beneficial uses, as fully explained throughout the Staff Report. Additionally, the implementation plan ensures that dischargers continue to maintain or improve their current good performance. As explained in the Staff Report, less stringent effluent limits derived from the relaxed site-specific objectives and the application translators are not likely to increase loadings into the San Francisco Bay (see Anti-Degradation discussion in Staff Report Section 6). In the unlikely event that effluent concentrations increase in response to less stringent effluent limits, the copper loadings from wastewater would still constitute a very small fraction of the dissolved copper in the water column.

Under this worst-case scenario, this additional loading is minor considering the assimilative capacity of the Bay for copper. In any case, even under unlikely worst-case scenario, the proposed SSOs would not be exceeded so even the most sensitive beneficial uses would continue to be protected and there would be no significant adverse impacts.

An explanation for each box checked on the environmental checklist is provided below:

I. Aesthetics

Any physical changes to the aesthetic environment as a result of the Basin Plan amendment would be small in scale. The Basin Plan amendment would not substantially affect any scenic resource or vista, or degrade the existing visual character or quality of any site or its surroundings. It would not create any new source of light or glare.

II. Agriculture Resources

The proposed Basin Plan amendment and implementation would not result in any changes to agricultural resources and would not contribute to the conversion of farmland to non-agricultural use. It would not affect agricultural zoning or any Williamson Act contract.

III. Air Quality

The proposed Basin Plan amendment will not have adverse impacts on air quality. As it would not cause any change in population or employment, it would not generate ongoing traffic-related emissions. It would also not involve the construction of any permanent emissions sources. For these reasons, no permanent change in air emissions would occur, and the Basin Plan amendment would not conflict with applicable air quality plans. It would not expose sensitive receptors to ongoing pollutant emissions and therefore would not pose health risks or create objectionable odors.

IV. Biological Resources

The Basin Plan amendment is designed to protect biological resources, including wildlife and rare and endangered species. The copper SSOs were developed using data from toxicity tests on the most sensitive saltwater aquatic organism (*Mytilus edulis*) and are thus, by definition, protective of this most sensitive species. Under the proposed Basin Plan amendment, all NPDES wastewater dischargers will continue to have water quality-based effluent limits to implement the site-specific objectives. These facilities as well as urban runoff management agencies will be required to maintain copper source control and pollution prevention effort to ensure that the copper sources are well-managed. While the SSOs clearly protect sensitive aquatic organisms dwelling in the water column, there are two additional modes of toxicity that require investigation as part of implementation.

Surface sediment samples have exhibited toxicity to test organisms at a number of sites throughout the Bay with copper as the most probable cause of toxicity. Additional RMP special studies have been proposed to further examine whether water and sediment toxicity tests used in the RMP are accurate predictors of impacts on the Bay's aquatic and benthic communities. We propose that the implementation plan will include requirements in NPDES permits for urban runoff management agencies and wastewater treatment facilities to support these special studies.

Copper has been shown to impair and destroy salmonid sensory systems. However, all such studies to date have been conducted in the laboratory in experiments modeling freshwater systems and many of them have not yet been published. A number of uncertainties need to be resolved before interpretation and extension to marine or estuarine systems can be attempted. First, in assessing the effects of copper on the ability of salmonids to avoid predation, migrate, and reproduce, it is critical that neurophysiological responses be empirically linked to behavioral responses in the natural environment and, in turn, to ecological significance at the population level. Second, there has been no research conducted on possible sensory impacts due to copper in marine or estuarine systems. The results of the freshwater investigations cannot be directly applied to marine systems because of profound physiological differences in fish sensory function in freshwater versus marine environments. Third, the mechanism of toxicity is still unknown, and the full role of copper speciation is likewise unknown. We propose that the implementation plan will include requirements in NPDES permits for urban runoff management agencies and wastewater treatment facilities to support these special studies.

V. Cultural Resources

The Basin Plan amendment and the implementation plan for copper would not directly affect cultural resources.

VI. Geology and Soils

The implementation activities resulting from the Basin Plan amendment do not involve construction, earthmoving or soil disturbing activities and therefore would not adversely impact local geology and soils.

VII. Hazards and Hazardous Materials

The proposed Basin Plan amendment and the implementation plan for copper address water quality issues and would not directly involve the handling or transport of hazards and hazardous materials. Hazardous waste management activities resulting from the Basin Plan amendment would not interfere with any emergency response plans or emergency evacuation plans and would not affect the potential for wildland fires.

VIII. Hydrology and Water Quality

The proposed project amends the Basin Plan to establish site-specific marine water quality objectives for copper that relax the current California Toxics Rule objectives of 3.1 µg/L chronic and 4.8 µg/L acute.

The results from a special study conducted in 2000-2001 and results of the Regional Monitoring Program confirm that ambient dissolved copper concentrations in the water column of San Francisco Bay are consistently low and have never exceeded 5 µg/L and have rarely exceeded 4 µg/L. The vast majority of measured concentrations are below 3 µg/L which is well below the proposed SSOs. This suggests that current measures to control copper sources from wastewater, urban runoff and other sources have been adequate to prevent degradation or water quality impairment with respect to copper. The proposed amendment will seek to maintain or enhance those controls so ambient water quality conditions should not change despite relaxing water quality objectives.

In addition, this project contains an implementation plan that describes a monitoring strategy to ensure that ambient copper concentrations in San Francisco Bay are maintained. We propose a monitoring program whereby the mean copper concentrations in several regions of the Bay are computed annually using a three-year rolling mean of data collected through the RMP. Using this approach, we will be able to detect changes in dissolved copper of no more than 1.2 µg/L from current concentration, and the trigger concentration will be well below the proposed SSOs. If a trigger concentration is reached in a Bay segment, additional control measures may be necessary for the sources discharging into that segment.

IX. Land Use and Planning

The Basin Plan amendment regulates water quality and would not conflict with any land use plan, policy, or regulation, and would not affect any habitat conservation plan or natural community conservation plan.

X. Mineral Resources

The proposed project addresses water quality and will not have any impact on mineral resources.

XI. Noise

The proposed project addresses water quality and will not directly cause an increase in noise levels.

XII. Population and Housing

The Basin Plan amendment would not affect the population of the Bay Area, Central Valley, or California. It would not induce growth through such means as constructing new housing or businesses, or by extending roads or infrastructure. The Basin Plan amendment would also not displace any existing housing or any people that would need replacement housing.

XIII. Public Services

The Basin Plan amendment would not affect populations or involve construction of substantial new government facilities. The Basin Plan amendment would not affect service ratios, response times, or other performance objectives for any public services, including fire protection, police protection, schools, or parks.

XIV. Recreation

The proposed project addresses water quality and will not directly affect recreational activities. No recreational facilities would need to be constructed or expanded.

XV. Transportation / Traffic

Because the Basin Plan amendment would not increase population or provide employment, it would not affect transportation facilities or generate any additional traffic.

XVI. Utilities and Service Systems

The project would amend the Basin Plan, which is the basis for wastewater treatment requirements in the Bay Area; therefore, the Basin Plan amendment would be consistent with such requirements.

Because the Basin Plan amendment would not affect water demands or supplies, it would not require the construction of new or expanded water or wastewater treatment facilities and storm water management facilities.

XVII. Mandatory Findings of Significance

The proposed Basin Plan amendment is intended to maintain all beneficial uses in San Francisco Bay. The proposed amendment does not have the potential to degrade the quality of the environment, substantially reduce fish or wildlife habitat, cause fish or wildlife population to drop below self-sustaining levels or threaten to eliminate a plant or animal community. The proposed amendment is based on the latest science pertaining to the toxicity of copper to aquatic organisms. Therefore, the proposed water quality objectives will fully protect beneficial uses of the Bay.

There are no potential adverse impacts that would interact in such a way as to further degrade the environment and no cumulative effects would occur. Therefore, the incremental effects of the Basin Plan amendment would be negligible when viewed in the context of the overall environmental changes foreseeable in the Bay Area as California's population grows and urban development occurs. For this reason, the Basin Plan amendment's cumulative effects would be less-than-significant, and adopting the Basin Plan amendment would require no mandatory findings of significance.

There are no direct significant impacts from the proposed project that would cause adverse effects to human beings. There are also no indirect, significant adverse impacts resulting from the proposed Basin Plan amendment and implementation plan.