APPENDIX B

Staff Report

Total Maximum Daily Load

For PCBs San Francisco Bay

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Total Maximum Daily Load for PCBs in San Francisco Bay

Proposed Basin Plan Amendment
and
Staff Report

California Regional Water Quality Control Board

San Francisco Bay Region

June 22 2007

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1. Introduction

This Staff Report presents the supporting documentation for a proposed Basin Plan amendment that will be considered by the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) that establishes a Total Maximum Daily Load (TMDL) and implementation plan for Polychlorinated Biphenyls (PCBs), including PCBs with dioxin-like properties, for all of San Francisco Bay. The TMDL is based on attainment of a fish tissue target PCBs concentration protective of human health, wildlife, and aquatic life. This report contains the results of analyses of PCBs impairment assessments, sources and loadings, linkage analyses, load reductions, and implementation actions.

The Clean Water Act requires California to adopt and enforce water quality standards to protect San Francisco Bay. The Water Quality Control Plan for the San Francisco Bay Region (Basin Plan) delineates these standards, which include beneficial uses of waters in the Region, numeric and narrative water quality objectives to protect those uses, and provisions to enhance and protect existing water quality (antidegradation). Section 303(d) of the Clean Water Act requires states to compile a list of “impaired” water bodies that do not meet water quality standards and to establish a TMDL for the pollutant that causes impairment. The proposed TMDL and implementation plan are designed to resolve PCBs impairment in all segments of San Francisco Bay.

For the purpose of the report, all segments of San Francisco Bay include the portion of the Sacramento and San Joaquin Delta in the San Francisco Bay Region, and all portions and contiguous tidal zones of Suisun Bay, Carquinez Strait, San Pablo Bay, Richardson Bay, Central Bay, Lower Bay and South Bay. Throughout this report, the terms San Francisco Bay and Bay are inclusive of all these segments.

This report provides the rationale and the technical basis for the required TMDL elements and associated implementation plan. This report meets the requirements of the California Environmental Quality Act (CEQA), including the preparation of a checklist (Appendix B) for adopting Basin Plan amendments and serves in its entirety as a substitute CEQA environmental document. It builds on earlier reports on sources and loadings (June, 2000), impairment assessment (June, 2001) and a Project Report (January 2004). As with the three prior reports, this report was developed with consideration of stakeholder input, including incorporation of the comments received on the Project Report and has been updated with new information obtained since the earlier reports were released.

The process for establishing a TMDL includes compiling and considering available data and information, conducting appropriate analyses relevant to defining the impairment problem, identifying sources, and allocating responsibility for actions to resolve the impairment. This report is organized into sections that reflect background information, the key elements of the TMDL process, and regulatory analyses required to adopt the amendment.

In addition, the scientific basis of the Basin Plan amendment was subjected to external scientific peer review (Appendix C). This step is required under §57004 of the Health and Safety Code, which specifies that an external review is required for work products that serve as the basis for a rule, “…establishing a regulatory level, standard, or other requirements for the protection of public health or the environment.” The scientific basis of the PCBs TMDL, as presented in the Staff Report, was evaluated by two peer reviewers who concluded that the scientific basis of the proposed Basin Plan amendment is based on sound scientific knowledge, methods, and practices.

Section 2 presents the problem statement that the project is based on and defines the project, why it is necessary and its objectives. Section 3 presents information about the physical setting of San Francisco Bay, including climate, hydrology, geology and biology. Section 4 discusses the chemistry and historical use of PCBs. Section 5 provides a discussion of the water quality standards that are applicable to San Francisco Bay. Section 6 presents the results of the impairment assessment that identified adverse impacts to beneficial uses in the Bay.

Section 7 presents our understanding of the sources of loading of PCBs to the Bay. Sources and loading are identified as internal or external to the Bay. Internal sources reflect the current reservoir of PCBs found in sediments or the water column. External sources reflect loads coming into the Bay, for example, from urban runoff or wastewater treatment plants.

Section 8 presents the derivation of the numeric target. Section 9 presents the linkage analysis which describes the relationship between PCBs sources and the proposed target, and estimates the bay’s capacity to assimilate PCBs while still meeting the numeric fish tissue targets. Section 10 presents the proposed TMDL and the allocations of the TMDL to external sources.

Section 11 presents the Implementation Plan which includes actions and requirements deemed necessary to implement the external source allocations and actions to manage internal sources of PCBs. It specifies monitoring activities to demonstrate attainment of allocations and the numeric target. It also presents an adaptive implementation strategy to review implementation progress and to evaluate any new information generated, which may lead to improved implementation actions, and refinement of the TMDL, the numeric target or the allocations in the future.

Section 12 presents the results of CEQA analyses including an environmental impact assessment and an evaluation of alternatives to the proposed Basin Plan amendment. Chapter 13, References, lists all the information sources cited and relied upon in preparation of this report. The proposed Basin Plan amendment is contained in Appendix A.

2.Project Definition

This section presents the problem statement upon which the proposed Basin Plan amendment project is based. It also presents the project definition and objectives which form the basis of the assessment required by the CEQA.

2.1.Problem Statement

All San Francisco Bay segments were initially placed on the California 303(d) list in 1998 for total PCBs and dioxin-like PCBs due to an interim health advisory for fish consumption. The 1998 listing applies to the following Bay segments: Sacramento and San Joaquin Delta, Suisun Bay, Carquinez Strait, San Pablo Bay, Richardson Bay, Central Bay, Lower Bay and South Bay. The 303(d) list was revised in 2002 to include specific locations in the Lower Bay segment. These listing were sustained on the 2006 303(d) list version (Table 1; Figure 1). This TMDL applies to all Bay segments.

As further discussed in the Impairment Assessment in Section 6, water quality objectives that are not attained include the narrative water quality objective which states that controllable water quality factors shall not cause a detrimental increase in toxic substances found in bottom sediments or aquatic life and the numeric water quality objective of 0.00017 ug/L total PCBs in water. The associated beneficial uses that are not fully supported due to elevated PCBs levels in fish, are commercial and sport fishing, preservation of rare and endangered species, estuarine habitat, and wildlife habitat.

Table 1-San Francisco Bay Water Segments on 2006 303(d) List for PCBs

Water Body Names	Hydrologic Unit	Total Water Body Size (acres)
Sacramento/San Joaquin Delta	207.100	41,736
Suisun Bay	207.100	27,498
Carquinez Strait	207.100	5,657
San Pablo Bay	206.100	68,349
Richardson Bay	203.130	2,439
San Francisco Bay, Central	203.120	70,992
San Francisco Bay, Lower (including)	204.100	79,293
Central Basin, San Francisco	204.400	40
Mission Creek	204.400	8.5
Oakland Inner Harbor (Fruitvale site)	204.200	0.93
Oakland Inner Harbor (Pacific Dry-Dock Yard 1 site)	204.200	1.8
San Francisco Bay, South	205.100	21,669

(2006 CWA Section 303(d) list)

2.2.Project Definition

The project is the adoption of a proposed Basin Plan Amendment (see Appendix A) to establish a TMDL and an implementation plan to attain PCBs water quality standards in all segments of San Francisco Bay. The Water Board is obligated under Section 303(d) of the Clean Water Act to develop a TMDL for San Francisco Bay to address PCBs impairment. The following components form the basis of the proposed regulatory provisions and define the project:

1. Numeric target for PCBs concentrations in fish tissue.
2. Total maximum average yearly PCBs loads to San Francisco Bay.

3. Allocation of the total maximum average yearly PCBs load among the various external PCBs sources to San Francisco Bay.
4. Plan to implement the TMDL that includes actions to reduce PCBs loads to achieve external load allocations and actions to manage internal sources of PCBs in San Francisco Bay.
5. Monitoring program to evaluate progress in meeting the numeric target and load allocations.
6. Plan and schedule for studies to improve technical understanding relevant to the PCBs TMDL and implementation plan, and for reviewing progress toward meeting targets, implementing actions and evaluating continued appropriateness and effectiveness of actions.

Figure 1-San Francisco Bay Embayments

Project Objectives

The proposed Basin Plan Amendment is intended to reduce existing and future PCBs discharges to San Francisco Bay associated with controllable water quality factors. Controllable water quality factors are those resulting from human activities that can influence water quality and be reasonably controlled through prevention, mitigation, or restoration. Specific objectives of the project are as follows:

1. Attain water quality objectives established for the Bay.
2. Protect beneficial uses of San Francisco Bay related to sport fishing and wildlife habitat, including rare and endangered species habitat.
3. Set target(s) to attain relevant water quality standards in all parts of the Bay.
4. Reduce loading of PCBs to the Bay from external sources
5. Continue to make use of the experience and expertise of the Water Board and its stakeholder community regarding local watersheds and PCBs sources.
6. Initiate actions to reduce PCBs discharges, while continuing to accommodate new information on PCBs fate in the environment.
7. Establish a decision-making framework where management actions evolve to adapt to future knowledge or conditions.
8. Favor actions that have a multi-contaminant benefit and promote efficiencies in water quality regulation and resource management.
9. Avoid actions that will have unreasonable costs relative to their environmental benefits.
10. Comply with the antidegradation requirements of State Board Resolution No. 68-16 and federal antidegradation regulations (40 CRF 131.12).
11. Base decisions on readily available information on ambient conditions, PCBs loads, fish consumption patterns, and PCBs fate and effects.
12. Consider site-specific factors relating to PCBs sources, ambient conditions, watershed characteristics, and response to management actions.
13. Avoid arbitrary decisions and speculation when computing loads, setting targets, setting allocations, determining implementation actions, and defining a margin of safety.
14. When selecting from a range of options, select an environmentally protective option as a means of building an implicit margin of safety into the TMDL.
15. Consider natural, seasonal, and inter-annual variability in determining the manner of implementing the load allocations.
16. Avoid imposing regulatory requirements more stringent than necessary to meet the targets designed to attain water quality standards.
17. Provide details of an implementation plan that includes: a description of the nature of actions necessary to meet allocations and targets and thereby achieve water quality standards; a schedule for actions to be taken; and a description of monitoring to be undertaken to determine progress toward meeting allocations, targets and water quality objectives.

3.Setting

San Francisco Bay is located on the Central Coast of California and marks a natural topographic separation between the northern and southern coastal mountain ranges. The Bay functions as the only drainage outlet for waters of the Central Valley.

Because of its highly dynamic and complex environmental conditions, the Bay system supports an extraordinarily diverse and productive ecosystem. The basin's deepwater channels, tidelands, and marshlands provide a wide variety of habitats that have become increasingly vital to the survival of several plant and animal species. The basin sustains communities of crabs, clams, fish, birds and other aquatic life and serves as an important wintering site for migrating waterfowl.

3.1. Physical Setting

San Francisco Bay is a large coastal embayment receiving fresh water from Central Valley rivers via the Delta and from local small tributaries (Figure 1). The Bay is relatively shallow with an average depth of around 6 meters and a median depth of about 2 meters at mean lower low water (Conomos, 1979). Narrow channels 10 to 20 meters deep incise broad expanses of the Bay floor. Deeper sections of channels such as the Golden Gate (110 meters) and Carquinez Strait (27 meters) are topographic constrictions where depths are maintained by scouring from tidal currents. Due to the extent of shallow areas, seasonal winds cause significant sediment resuspension and movement in the Bay.

The Bay is subdivided in segments: Sacramento and San Joaquin Delta, Suisun Bay, Carquinez Strait, San Pablo Bay, Richardson Bay, Central Bay, Lower Bay and South Bay. The northern reach of the San Francisco Bay (Suisun Bay, Carquinez Strait, and San Pablo Bay) is partially to well-mixed while the South Bay (Lower and South Bay) is a tidally oscillating lagoon. The Central Bay is most influenced by water exchange with the ocean.

3.2.Climate

The climate of San Francisco Bay plays an important role in determining the environmental conditions found in the Bay. The Bay has a Xeric (Mediterranean) moisture regime characterized by cool, dry summers and mild, wet winters. The amount and timing of precipitation, air temperature, and wind patterns influence the Bay's freshwater inflow, salinity, currents, and suspended sediment concentrations.

The sun affects the Bay by promoting photosynthesis and warming the shallow areas, which in turn influences carbon dynamics in the water column and sediments. Carbon dynamics and the formation of humic substances (natural organic matter) influence the partitioning of PCBs in aquatic environments between sediments, water, and biota.

The Bay is subjected to strong southwest summer winds. These strong winds exert stress on the water surface, which generates waves. Wind-generated waves resuspend sediments creating turbid conditions and dispersing sediments throughout the Bay, thereby affecting movement of PCBs in the Bay. Waves also tend to mix and aerate the water, which also influences carbon fluxes in the Bay.

PCBs mainly partition into the organic carbon phase such as the organic matter in sediments, or into the lipid fraction of biota. A better understanding of sediment movement and organic carbon fluxes is essential to understanding distribution and long-term fate of PCBs in the Bay. Our ability to predict the fate of PCBs on a fine scale will require improved understanding of sediment movement and carbon flux throughout the Bay.

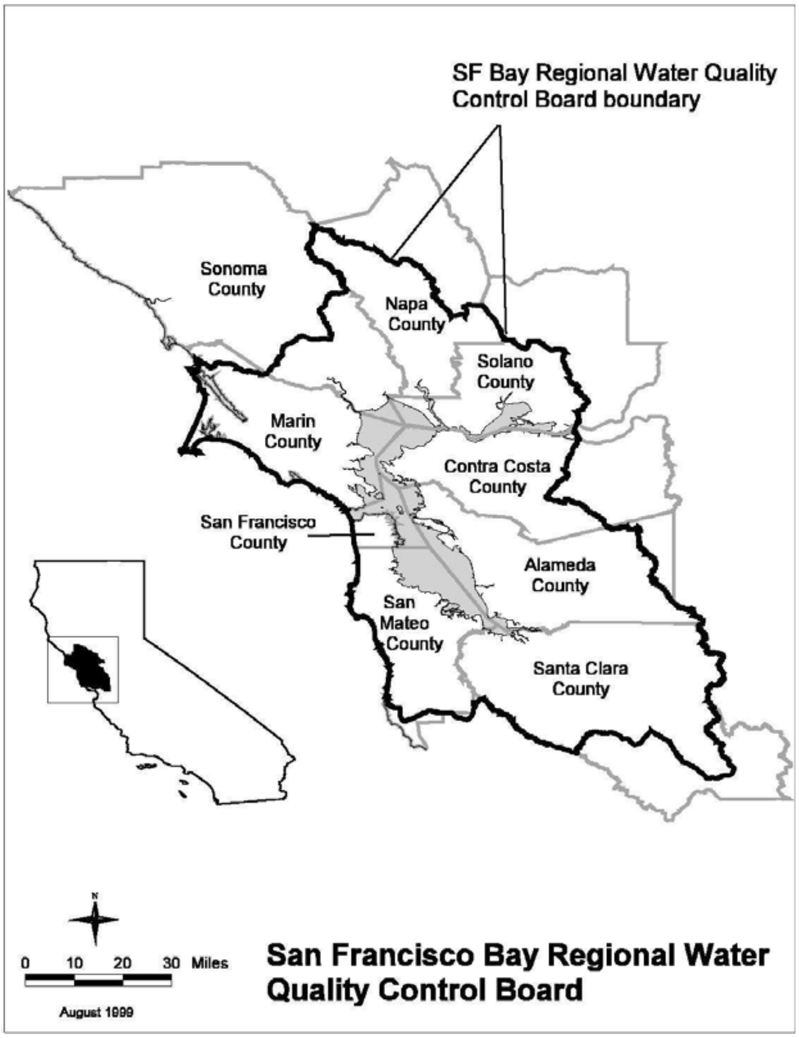

Figure 2-San Francisco Bay Region

3.3.Hydrology

Freshwater inflows, tidal mixing, and their interactions largely determine variations in the hydrology of the Bay. Hydrology has profound effects on biota that live in the Bay because it determines the salinity in different portions of the Bay.

The Bay receives 90 percent of its fresh water inflows from streams and rivers draining the Central Valley watershed and about 10 percent from local tributaries surrounding the Bay (SFEP, 1992a). The Sacramento and San Joaquin Rivers carry about 60 percent of the state runoff draining around 152,500 square kilometers (km^2) or 40 percent of California's surface area (Conomos et al., 1985). Of the fresh water flows entering the Bay from the Central Valley watershed, the Sacramento River typically accounts for 80 percent, the San Joaquin River 15 percent, and smaller rivers and streams the remainder.

The northern reach of the Bay (comprised of Suisun Bay, Carquinez Strait, and San Pablo Bay) is geographically and hydrologically distinct from the Central and South Bays. The northern reach is a partially to well-mixed waterbody (depending on the season) that is dominated by seasonally varying delta inflow. The South Bay is a tidally oscillating, lagoon-type Bay, where variations are determined by water exchange with the northern reach and the ocean. Water residence times are much longer in the South Bay than in the North Bay.

Response time of the Bay to PCBs source control will depend on the sediment hydrodynamics of the Bay, such as its rate of flushing, sediment dynamics, and the variability in inflow. The effect of these parameters over a long time scale needs to be accounted for in determining the long-term fate of PCBs in the Bay.

3.4. Geology

San Francisco Bay is located within the Coast Ranges of California. The Coast Ranges are characterized by northwest trending longitudinal mountain ranges and valleys formed by faulting and folding (Howard, 1979).

In aquatic environments, PCBs are mainly associated with sediments. Therefore, understanding past, current, and future sedimentation and sediment movement is essential for predicting the fate and transport of PCBs in the Bay.

Delta inflow from the Central Valley watershed is the major source of new sediment input into the Bay. Most new sediment (approximately 80 percent) originates in the Sacramento-San Joaquin River drainage and enters primarily as suspended load during the high winter inflows. Much of the winter sediment load from the Sacramento and San Joaquin rivers initially settles out in San Pablo Bay. During the low flow summer months, wind-generated waves and tidal currents resuspend the previously deposited sediment and redistribute it over a wider area.

The Bay’s sediment mass balance was greatly altered by the advent of hydraulic mining in the Sierras in the late 1800’s. The resulting large increase in sediment loads to the Bay due to hydraulic gold mining affected both the mudflat and sub-tidal areas (SFEP, 1992a). Deposition of fine sediments originally raised mud elevations several meters in Suisun Bay, and the elevation of mud migrated as a "mud wave" to San Pablo Bay and the Central Bay over the past century. During the time of highest PCBs production and use, the continual deposition of sediment buried PCBs being released into the Bay from land and maritime-based activities. Therefore, a large reservoir of PCBs was created in the Bay sediments.

Recent studies indicate that, in portions of the Bay, sediments are eroding (Jaffe et al., 1998). Sediments deposited during the period of Bay Area industrialization are now being uncovered due to a decrease of sediments entering the Bay from the Sacramento and San Joaquin rivers. This erosion could uncover contaminated sediments, resulting in increased availability of PCBs to the food web. Even if all current PCBs sources to the Bay are eliminated, exposure of historically contaminated sediment may turn out to be a significant PCBs source to organisms.

Sediment dynamics influence the distribution, transport and fate of PCBs in the Bay. Bathymetry is a factor affecting sediment dynamics. Broad shallows incised by narrow channels characterize San Pablo Bay, Suisun Bay, and the South Bay. These shallower areas are more prone to wind-generated currents and sediment resuspension and deposition than deeper areas, such as the Central Bay. Near-shore shallow areas are likely repositories of larger reservoirs of PCBs, due to their proximity to historical land-based industrial activities.

Currents created by tides, freshwater inflows, and winds cause erosion and transport of sediments in the Bay. Tidal currents are usually the dominant observed currents in the Bay. Generally, tides appear to have a significant influence on sediment resuspension during the more energetic spring tide when water column sediment concentrations naturally increase.

Strong seasonal winds create circulation and mixing patterns and add to tide- and river-induced current forces. It has been estimated that about 160 million cubic yards (mcy) of sediments are resuspended annually from shallow areas of the Bay by wind-generated waves (USACE, 1998), while 8 to 10 mcy enter the Bay from the Central Valley watershed and 4 to 8 mcy leave the Bay through the Golden Gate (Table 2). These estimates of sediment inputs have been updated (Schoellhamer, 2005), but these relative estimates are used to illustrate the substantial degree of sediment resuspension compared to gains and losses. These are the only estimates of sediment resuspension volumes. By comparison, between 2001 and 2005, an average of 1.8 mcy of dredged sediments was disposed in the Bay as a result of maintenance dredging activities between 2001 and 2005 (DMMO, 2006). The current estimate of the sediment budgets indicates a net loss of 2.4 mcy of sediments from the Bay (Schoellhamer, 2005).

Table 2-Sediment Movement in San Francisco Bay

Pathway	**Sediment Volume (10^6 cu yd)**
Inflow from Central Valley	6.9-8.1
Inflow from other tributaries	1.1-2.4
Outflow through the Golden Gate	4.2-8.1
Resuspension	160

(USACE, 1998)

Our understanding of sediment dynamics is based on general Bay-wide models. These models are based on Bay-wide averages and do not consider site-specific PCB-Contaminated sites in the near-shore environment.

3.5. Biology

The Bay's open water provides shallow and deep-water habitat throughout San Francisco Bay. Sediments in these areas range from clays to sand. The dominant plants are phytoplankton, green algae and blue green algae (SFEP, 1992b). Extensive phytoplankton growth in the water column occurs in Suisun, San Pablo and South Bays. Open waters also provide habitat for benthic (bottom dwelling) organisms, fish, and birds. Other important habitats include mudflats, tidal and brackish marsh, and wetlands. Large numbers of benthic organisms, such as clams, worms, mussels, shrimps, and crabs, reside in these habitats. Bay-dwelling fish, such as shiner surfperch, white croaker, and jacksmelt, are known to feed on these benthic organisms (Goals Project, 2000).

The makeup of benthic communities varies highly both spatially and over time (SFEP, 1992b; Thompson et al., 2000). A better understanding of the factors controlling benthic community composition and dynamics would further our understanding of the food web in general, and the uptake and transfer of PCBs in the food web. Benthic organisms are a large part of the diet for the Bay fish species with the highest PCBs concentration (Roberts et al., 2002). Modeling of PCBs in the food web of in the Bay has been performed providing a linkage between PCBs concentrations in sediment, water and biota (Gobas and Wilcockson, 2003; Gobas and Arnot, 2005).

4. Polychlorinated Biphenyls

PCBs are a class of organic compounds produced as complex mixtures for a variety of uses, including dielectric fluids in capacitors and transformers. PCBs were manufactured commercially by the Swann Chemical Company beginning in 1929. Monsanto acquired the process in 1935 and continued PCBs production until 1977 (Erickson, 1997).

In the United States, discovery of PCBs as ubiquitous environmental contaminants led to their initial regulation under the Toxic Substances Control Act (TSCA) in 1976. In 1978, Congress banned the manufacture, processing, and distribution in commerce of PCBs. Use of PCBs was restricted to totally enclosed applications, and non-totally enclosed applications were only allowed with the United States Environmental Protection Agency (USEPA) exemptions. In 1979, USEPA passed regulations that defined totally enclosed applications as intact, non-leaking electrical equipment. USEPA banned the manufacture and distribution in commerce of materials containing any detectable PCBs in 1984 (Erickson, 1997).

Although PCBs uses have been phased out since the ban, large quantities have remained in use, and some PCBs are still in use today (Table 3). Therefore, the potential for continued PCBs release to the environment remains. It is not known how much unreported PCBs are still being used today nor how much were used in the past in a manner such that they could be currently released to the environment.

Table 3-Self Reporting of PCBs Uses in the Bay Area (1999)

Company	City	Number of Transformers	PCBs Mass (kg)
USS-POSCO Industries	Pittsburg	65	141,494
Quebecor Printing San Jose, Inc.	San Jose	5	32,094
NASA	Moffett Field	17	7,052
Gaylord Container Corp	Antioch	2	6,078
General Chemical	Pittsburg	3	4,800
Rhodia Inc.	Martinez	4	3,356
DOT Maritime Administration Suisun Bay Reserve Fleet	Benicia	3	1,048
Macaulay Foundry, Inc.	Berkeley	1	913
Stanford Linear Accelerator Center	Menlo Park	1	1

http://www.epa.gov/opptintr/pcb/xform.htm

4.1. Chemical Structure

PCBs are a family of chlorinated organic compounds formed by two benzene rings linked by a single carbon-carbon bond (Figure 3). Various degrees of substitution of chlorine atoms for hydrogen are possible on the remaining 10 benzene carbons. There are 209 possible arrangements of chlorine atoms on the biphenyl group. Each individual arrangement or compound is called a congener. Groups of congeners with the same number of chlorine atoms are called homologs. Thirteen of the 209 congeners are known to show toxic responses similar to those caused by 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD), the most toxic dioxin compound (Van den Berg et al, 1998).

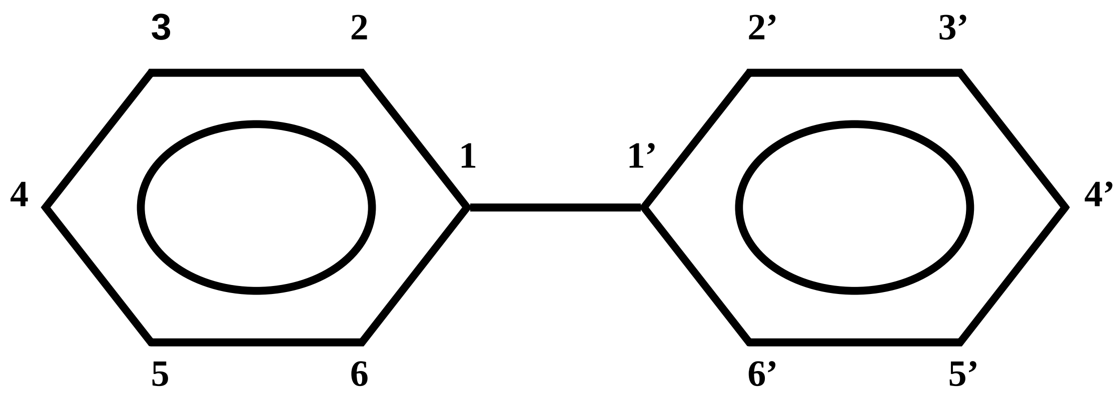

Figure 3-Structure of PCB Molecule

PCBs were mainly marketed as Aroclors in the United States. Aroclors are mixtures of congeners with varying numbers of chlorine atoms (Table 4). Aroclors were the most abundant PCBs mixtures manufactured and used in the United States. The numbering scheme for Aroclors is based on their structure and mixture: the first two digits represent the number of carbon atoms (12) while the second two numbers denote the percent chlorine by weight. Aroclor 1016 is an exception and has a chlorine weight content of 40 to 42 percent (ATSDR, 2000).

Table 4-Percentage of PCB Homolog in Aroclors

Homolog	Aroclor						
	1016	1221	1232	1242	1248	1254	1260
Biphenyl		10					
Mono-CBs	2	50	26	1	--	--	--
Di-CBs	19	35	29	13	1	--	--
Tri-CBs	57	4	24	45	21	1	--
Tetra-CBs	22	1	15	31	49	15	--
Penta-CBs	--	--	--	10	27	53	12
Hexa-CBs	--	--	--	--	2	26	42
Hepta-CBs	--	--	--	--	--	4	38
Octa-CBs	--	--	--	--	--	--	7
Nona-CBs	--	--	--	--	--	--	1
Deca-CBs	--	--	--	--	--	--	--

(ATSDR, 1997)

Although the congener compositions of manufactured Aroclors are known, the fate of the various congeners in the environment is not as well understood. Fate and stability of congeners vary with the degree and location of chlorination, making source identification of environmental PCBs difficult.

4.2. Chemical and Physical Properties

PCB congeners vary markedly in their chemical and physical properties depending on the degree and position of chlorination. Important properties such as non-flammability, low electrical conductivity, high thermal stability, and high boiling point, make PCBs highly stable and persistent in the environment. PCBs are also soluble in non-polar organic solvents and biological lipids, hence their tendency to bioaccumulate in living organisms.

PCBs are generally resistant to degradation, and are strongly resistant to acids and alkalis. PCBs have a low solubility, low volatility (small Henry's Law constant), and increasing affinity for organic matter (increasing log K_{ow}) with increasing chlorination (Table 5). Note that organic compounds with a log K_{ow} greater than 3.5 are considered to have a large potential to bioaccumulate (USEPA, 1985). Biodegradation rates of PCBs also vary greatly depending on the degree and location of chlorination, and redox conditions (ATSDR, 2000).

Table 5-Selected Properties of PCBs as Aroclors

Aroclor	Density (g/cm^3)	Solubility (mg/L)	Log K_{ow}	Henry's Law Constant ($atm\text{-}m^3/mole$)
1016	1.37	0.42	5.6	2.9×10^{-4}
1221	1.18	0.59	4.7	3.5×10^{-3}
1232	1.26	0.45	5.1	No Data
1242	1.38	0.34	5.6	5.2×10^{-4}
1248	1.44	0.06	6.2	2.8×10^{-3}
1254	1.54	0.06	6.5	2.0×10^{-3}
1260	1.62	0.08	6.8	4.6×10^{-3}
1262	1.64	0.05	No Data	No Data
1268	1.81	0.3	No Data	No Data

Kow = Octanol-water partitioning coefficient (increasing number indicates decreasing water solubility)
(ATSDR, 2000)

PCB congeners exhibit of range of properties, which affect their fate and residence time in the environment. Solubility of PCBs in water generally decreases with increased chlorination (Table 5). PCBs adsorption to sediment, denoted by increasing K_{ow}, generally increases with increasing degree of chlorination (Table 6) or increasing sediment organic carbon concentration (ATDSR, 2000). PCBs in aquatic systems are therefore usually found in much greater mass in the sediments than in the water column. Increasing log K_{ow} is accompanied by an increase in the tendency to bioaccumulate in aquatic organisms. Bioconcentration factor (BCF) increases a thousand-fold when going from monochlorobiphenyl to decachlorobiphenyl. Evaporation rates decrease with increasing degree of chlorination (Table 6). In general, the lower chlorinated PCB congeners are removed faster from the aquatic environment than the more chlorinated PCBs as the lower chlorinated congeners are not sorbed as strongly to sediments and are more readily volatilized.

Table 6-Selected Properties of PCBs as Homologs

Isomer Group	Melting Point (°C)	Vapor Pressure (Pa)	Water Solubility at 25°C (g/m^3)	log K_{ow}	Approximate BCF in Fish	Approximate Evaporation Rate at 25°C (g/m^2hour)
Biphenyl	71	4.9	9.3	4.3	1000	0.92
MonoCB	25-78	1.1	4	4.7	2500	0.25
DiCB	24-149	0.24	1.6	5.1	6300	0.065
TriCB	28-87	0.054	0.65	5.5	1.6×10^4	0.017
TetraCB	47-180	0.012	0.26	5.9	4.0×10^4	4.2×10^{-3}
PentaCB	76-124	2.6×10^{-3}	0.099	6.3	1.0×10^5	1.0×10^{-3}
HexaCB	77-150	5.8×10^{-4}	0.038	6.7	2.5×10^5	2.5×10^{-4}
HeptaCB	122-149	1.3×10^{-4}	0.014	7.1	6.3×10^5	6.2×10^{-5}
OctaCB	159-162	2.8×10^{-5}	5.5×10^{-3}	7.5	1.6×10^6	1.5×10^{-5}
NonaCB	183-206	6.3×10^{-6}	2.0×10^{-3}	7.9	4.0×10^5	3.5×10^{-6}
DecaCB	306	1.4×10^{-6}	7.6×10^{-4}	8.3	1.0×10^7	8.5×10^{-7}

(Erickson, 1997)

The biggest reservoir of PCBs in aquatic systems is sediments rather than the water column. As the tendency of PCBs to adsorb to sediments increases with increasing log K_{ow}, their persistence in surface waters increases. This property enhances the importance of bottom-dwelling organisms in the food-web transfer of PCBs. This is also the case for decreasing water solubility and decreasing volatility (decreasing vapor pressure). Many physical and chemical factors affect this persistence and transfer, ultimately limiting our ability to predict the fate and transport of PCBs in aquatic environments.

4.3. Production and Uses

PCBs were produced in very large quantities both within and outside the United States. Although their uses in capacitors and transformers are well known, PCBs were used in a wide variety of applications including some involving direct contact with the environment.

Production

In the United States, commercial PCBs production started in 1929 and continued until 1977 (ATSDR, 2000). The estimated total commercial production of PCBs in the United States ranged from 610 million to 635 million kilograms (kg). Most of domestic uses of PCBs were Aroclors produced in the U.S. with only 1.4 million kg of PCBs imported. U.S. production peaked in 1970 at 39 million kg.

PCBs mixtures were manufactured in other countries under many different trade names; these include Clophen (Germany), Fenclor (Italy), Kaneclor (Japan), Sovol (former USSR) and Phenoclor (France). Fenchlor DK is a product of interest as it is comprised solely of decachlorinated biphenyl (Congener #209) and was used in investment casting (Erickson, 1997).

The Monsanto Chemical Company produced approximately 99 percent of PCBs used by U.S. industry. Prior to ceasing production, up to 200,000 kgs of PCBs products per year were imported into the U.S. (ATSDR, 2000). Importation of PCBs continued after U.S. production was banned until January 1, 1979. However, USEPA permitted 16 companies that filed exemption petitions to continue to import and use PCBs after the ban on importation.

Between 1957 and 1977, 52 percent of the Aroclors produced consisted of Aroclor 1242 and 13 percent were its replacement, Aroclor 1016 (Table 7). Aroclor 1016 production was started in 1970, as it was believed to be less harmful to the environment than Aroclor 1242 (Erickson, 1997). Although frequently reported in environmental samples, the more chlorinated Aroclors 1248, 1254 and 1260 comprised only 7, 16 and 11 percent of the PCBs mixtures produced. This high frequency of detection of more chlorinated PCBs may be due to the preferential loss of lower chlorinated PCB congeners from the environment.

Table 7-Relative Production of Aroclors in the United States (1957-1977)

PCBs Mixture	Percent of Production
Aroclor 1016	13
Aroclor 1221	1
Aroclor 1232	<1
Aroclor 1242	52
Aroclor 1248	7
Aroclor 1254	16
Aroclor 1260	11
Aroclor 1262	1
Aroclor 1268	<1

(USEPA, 1996)

Use

PCBs mixtures were most commonly used as dielectric fluid in electrical equipment such as transformers and capacitors (EIP, 1997). PCBs uses can be divided into three different categories: completely closed systems (electrical equipment such as capacitors and transformers), nominally closed systems (e.g., vacuum pumps and hydraulic transfer systems), and open-ended applications (e.g., paints, adhesives, pesticide extenders, inks, and plasticizers). In addition, PCBs had a vast number of other uses, through their inclusion as components in products such as building materials (paints, caulks and sealants), greases, oils, carbonless copy paper, and as ballast in fluorescent lights (Table 8). For example, PCB-containing paints and building sealants were used extensively at Department of Defense (DOD) and Department of Energy (DOE) facilities (Navy, 2006; Poland et al., 2001). PCBs have also been detected in up to half the paints and sealants of buildings constructed between 1950 and 1980 in Switzerland (Kohler et al., 2005), Sweden (Astebro et al., 2000), and Australia (CFEMU no date). Based on the results of these studies, PCBs removal programs from building materials have been implemented in these countries. PCBs have been used and are still in use under in non-liquid forms in building materials (USEPA, 1999), including as aquatic paints in fish hatcheries (WDEC, 2006; Seattle Times, 2005). However, the extent of PCB-containing materials use in Bay area buildings, as well as the potential of these materials to be released and transported to the Bay, has not been determined.

Prior to 1974, PCBs were used in both closed and open-ended applications. After 1974, open-ended uses of PCBs mixtures were discontinued. One exception was the use of PCBs 209 (decachlorobiphenyl) as filler for investment casting waxes. About 200 tons of PCBs were imported from France and Italy for this use in 1974. The production of PCBs-containing capacitors and transformers ended in January 1979. The life expectancy of transformers and capacitors is decades. In-place capacitors and transformers may still remain significant potential sources of PCBs to the environment. USEPA maintains a database of current volumes of PCBs used in the United States. The database only contains uses that have been reported voluntarily. A query of this USEPA database showed significant ongoing use, almost 200,000 kg, in the San Francisco Bay Area (Table 3).

PCBs industrial use and manufacture has created on-land and in-Bay contaminated area in the San Francisco region. Remediation and control of PCBs releases from these sites may be necessary to restore the Bay's beneficial uses. In addition, the role of widespread open-ended PCBs uses needs to be addressed to ensure that the implementation actions are successful.

Table 8-Selected List of PCBs Uses

Category	Use
Electrical Uses	Transformers and Capacitors Voltage Regulator (power lines) Starting Aid (single phase motors) Power Factor Correction (rectifier, AC induction motor, furnaces) Consumer Electrical Items (refrigerators, televisions, washing machines) Water Well Pumps Lamp Ballast (fluorescent, high intensity discharge) Switch Gear Manufacturing Machinery (capacitors, transformers, associated switchgear) PCB Contaminated Mineral Oils (transformer changeout)
Non-Electrical Uses	Printing Inks and Pastes Carbonless Copy Paper Pumps Hydraulic Fluids Heat Transfer Fluids Flame Retardant Air Compressor Lubricants Plasticizer in paints, resins, synthetic rubber, surface coatings, wax, sealants, waterproofing compound, glues and adhesives Pesticides (as extenders) Cutting Oil (microscope slide oil)
PCB Contaminated Solids	Wiping Rags Safety Equipment Machinery Soil, Gravel, Asphalt, Sediment

(EIP, 1997)

Disposal

USEPA first promulgated rules in 1978 specifying that liquids containing >0.05 percent (500 mg/kg) PCBs could only be disposed of by incineration in specially permitted facilities, and all non-liquid PCBs mixtures >0.05 percent could only be disposed in specially permitted landfills. In 1979, the regulated PCBs content was lowered to 0.005 percent, or 50 mg/kg. Regulations did not apply to disposal of PCBs dielectric fluid in small capacitors (<3 lbs.) commonly found in fluorescent light ballasts due to the impracticality of regulating the one billion ballasts installed in fluorescent light fixtures throughout the U.S. Disposal and management of PCBs is further regulated under the Resource Conservation and Recovery Act (RCRA). The Clean Water Act (CWA) regulates the discharge of PCBs-laden wastewater into U.S. waters.

4.4.Quantitation

Historically, PCBs have been quantified as Aroclor mixtures by comparing environmental samples to pure unweathered Aroclor standards. This method's ability to correctly quantify PCBs has been questioned (USEPA, 1996), due to the changes (weathering) Aroclor mixtures undergo in the environment. Analytical methods are now being used to quantify individual PCB congeners (Erickson, 1997). These new methods for quantifying PCB congeners in soils and tissue matrices are performed on a relatively routine basis. Low-level analysis of PCB congeners in water at detection limits that allow comparison to USEPA criterion are still non-routine, can have poor precision (SFEI, 2002a), and are relatively expensive.

USEPA established the PCBs water quality criterion for the protection of aquatic life based on the sum of Aroclors, and for the protection of human health based on total PCBs, e.g., the sum of all congeners, or isomers or homologs or Aroclor analyses (USEPA, 2000a). In order to utilize all readily available data, in this report we define total PCBs as any of the following:

- Sum of Aroclors;
- Sum of the individual congeners routinely quantified by the Regional Monitoring Program (RMP) or a similar congener sum; or
- Sum of the National Oceanic and Atmospheric Administration (NOAA) 18 congeners converted to total Aroclors (NOAA, 1993). A comparison of the sum of 18 NOAA congeners converted to Aroclor with quantified sums of Aroclors shows relatively good correlation (Figure 4) in one study.

This is a broad designation of total PCBs that can introduce data comparability issues. However, for the purpose of estimating PCBs loads, sources and reservoirs, the introduced error will likely be small compared to the range of PCBs concentrations found in the Bay. PCBs concentrations in Bay sediments commonly vary by three to four orders of magnitude: Bay ambient sediments have about ten micrograms per kilogram (µg/kg) PCBs, while areas considered contaminated can have PCBs concentrations ranging from 1,000-10,000 µg/kg and up. In addition, PCBs concentrations in sources, reservoirs and biota vary by several orders of magnitude in the Bay. Therefore, the use of data, obtained by different methodologies, is justifiable for the purpose of this report. Where possible, water PCBs concentrations were quantified using similar analytical methods, permitting better data comparability.

All data collected for the development of this TMDL are congener based. We recommend that ongoing PCBs data collection activities in the Bay analyze for a suite of congeners. Specifically, Regional Board staff promotes the analysis of a congener list comparable to that quantified by the RMP to facilitate data comparability for long-term trend analysis. Typically, PCBs are measured as Aroclors using USEPA method 8082 or USEPA method 608 for wastewater. These are routine, relatively inexpensive, methods employed by most laboratories. However, the reporting limits for sediments (about 20 µg/kg) and water (about 0.5 µg/L) with these methods are significantly greater than current ambient concentrations in the Bay and discharged wastewater. In the last few years, more laboratories have started using USEPA method 1668 for the analysis of PCBs in sediment and water (for a list of available laboratories, see http://www.state.nj.us/drbc/PCB_lablist.htm). Using this method, reporting limits achieved for sediment (50 ng/kg) and water (100 pg/L) have environmentally significance. Therefore we use method 1668 for the monitoring of ambient conditions in San Francisco Bay.

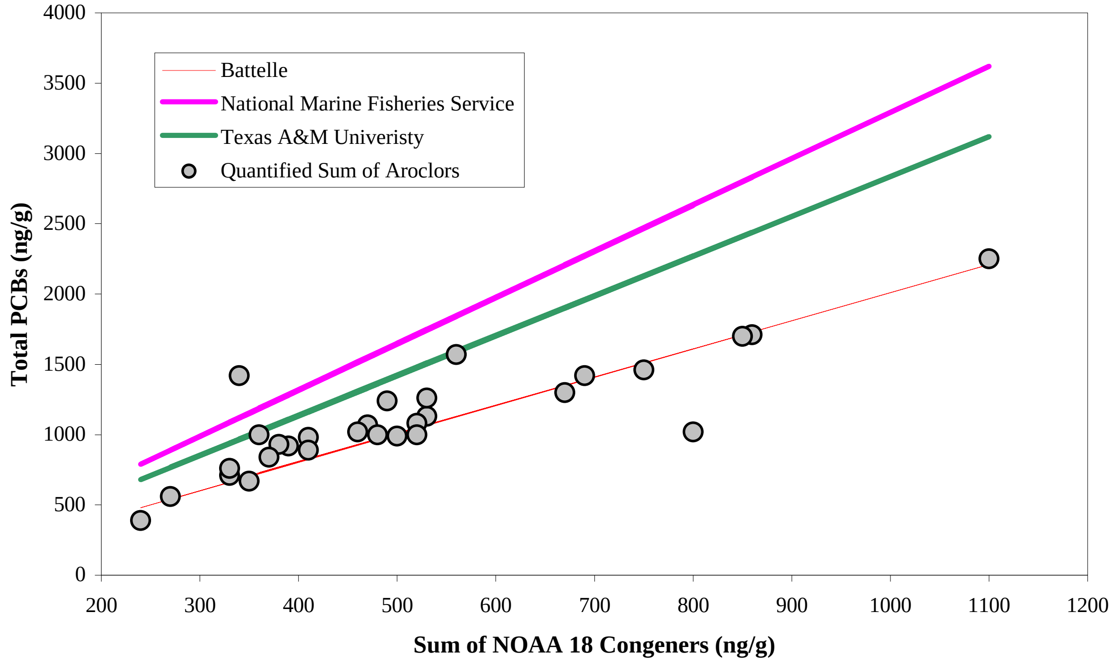

Figure 4-Correlation of PCBs Quantified as Aroclors and Aroclors Calculated from Congener Data (data from SFPUC, 2002). Regression Line Represents each Organizations Respective Methodology for Quantifying Total Aroclors from Congener Data.

5. Applicable Water Quality Standards

Section 303(d) of the Clean Water Act requires the State of California to identify waters not meeting water quality standards. Water quality standards consist of three parts: beneficial uses, water quality objectives, and antidegradation.

> **Designated or Beneficial Use** - A specific desired use appropriate to the waterbody, termed a *designated use* (beneficial use in California). A beneficial use describes the goal of the water quality standard. It is stated in a written, qualitative form, but the description is as specific as possible.
>
> **Water Quality Criterion or Objective** - A *criterion* that can be measured to establish whether the designated use is being achieved (objective in California). A water quality criterion or objective represents the condition of the waterbody that supports a designated use. The designated or beneficial use is a description of a desired endpoint for the waterbody, and the criterion or objective is a measurable or narrative indicator that is a surrogate for determining attainment of the beneficial use.
>
> **Antidegradation Policy** - An antidegradation policy (under both Federal and California regulations) ensuring that water quality will be maintained at a level protecting beneficial uses.

The beneficial uses impaired by PCBs in the Bay are described as follows:

> **Ocean, commercial, and sport fishing (COMM)**
> *Uses of water for commercial or recreational collection of fish, shellfish, or other organisms in oceans, bays, and estuaries, including, but not limited to, uses involving organisms intended for human consumption or bait purposes.*
>
> **Estuarine habitat (EST)**
> *Uses of water that support estuarine ecosystems, including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds), and the propagation, sustenance, and migration of estuarine organisms.*
>
> **Preservation of rare and endangered species (RARE)**
> *Uses of waters that support habitats necessary for the survival and successful maintenance of plant and animal species established under state and federal law as rare, threatened or endangered.*
>
> **Wildlife habitat (WILD)**
> *Uses of water that support wildlife habitats, including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl.*

The applicable water quality objectives include the narrative objective for bioaccumulative substances in San Francisco Bay. This narrative objective states: “many pollutants can accumulate on particles, in sediment, or bioaccumulate in fish and other aquatic organisms. Controllable water quality factors shall not cause a detrimental increase in toxic substances found in bottom sediments or aquatic life. Effects on aquatic organisms, wildlife, and human health will be considered." This narrative water quality objective is applicable to both total PCBs and dioxin-like PCBs.

Two applicable numeric water quality standards for total PCBs are promulgated at 40 Code of Federal Regulation Section 131.38, also known as the California Toxics Rule (CTR). These standards include the saltwater criterion continuous concentration (CCC) of 30 nanogram per liter (ng/L) for the protection of aquatic life and its uses from chronic toxicity, and the human health criterion of 170 picograms per liter (pg/L) for the protection from consumption of aquatic organisms. These criteria apply to total PCBs, defined as the sum of all Aroclors, or all congeners or homologs or isomers, and were derived to protect against adverse effects due to PCBs in water. PCBs concentration in the Bay waters are generally below the CCC water quality standard, indicating that current conditions are protective of aquatic life from chronic toxicity. We therefore propose to use the more protective human health criterion as the applicable water quality standard for the PCBs TMDL. This criterion was derived to protect the general population from an increased risk of no more than one in a million. This criterion was developed using a bioconcentration factor (BCF) approach with an upper bound potency factor reflective of high risk and persistence. However, in the development of this criterion it is explicitly recognized that it is not as protective of sub-populations that consume greater quantities of fish than the general population, and that subsistence fish consumers may only be protected from an increased risk of one in ten thousand. The CTR does not promulgate a separate numeric water quality criterion for dioxin-like PCBs.

Both the narrative and numeric water quality objectives are intended to protect beneficial uses related to human health (COMM). The narrative water quality objective is also intended to protect wildlife beneficial uses of the Bay (EST, RARE, WILD).

6. Impairment Assessment

All segments of San Francisco Bay were placed on the 303(d) list for PCBs due to an interim health advisory for fish consumption. The advisory was based on elevated PCBs concentrations in fish tissue collected in 1994 that may cause a detrimental human health effect for people consuming fish caught in the Bay. Follow-up studies in 1997 and 2000 confirmed the presence of PCBs in Bay fish tissue at concentrations that may be harmful to fish consumers. As such, the narrative water quality objective for bioaccumulative substances that is protective of these beneficial uses is not attained. This is also deemed impairment of COMM beneficial uses with regards to commercial and sport fishing in the Bay, and of EST, RARE and WILD with regards to bioaccumulation.

Consumption of PCBs-contaminated fish is considered a primary source of human exposure in locations where fish consumption (i.e. sports and subsistence fishing) and PCBs contamination are significant. A related probable exposed population is breast-fed children whose mothers consume PCBs-contaminated fish. The evaluation of the health effects of PCBs mixtures is complicated by their complex congener composition (ATSDR, 2000). There is evidence that PCB-health risks increase with increased chlorination because more highly chlorinated PCBs are retained more efficiently in fatty tissues (USEPA, 1997a). Observed effects in humans have ranged from mild reactions to serious health consequences. However, individual PCB congeners have widely varying potencies for producing a variety of adverse biological effects including hepatotoxicity, developmental toxicity, immunotoxicity, neurotoxicity, and carcinogenicity.

PCBs mixtures have been classified as probable human carcinogens (USEPA, 1997a). This is based on studies that have found liver tumors in rats exposed to Aroclors 1260, 1254, 1242, and 1016. Evaluation of the animal data indicates that PCBs with 54 percent chlorine content induces a higher yield of liver tumors in rats than other PCBs mixtures (ATSDR, 2000).

The CTR numerical criterion was derived for the protection of human health from the consumption of aquatic organisms, and as such exceedances of this criterion result in the impairment of the COMM beneficial uses. Only the narrative objective concerns the EST, RARE and WILD beneficial uses, as there is no numerical criterion for the protection of wildlife and estuarine beneficial uses. However, evidence that wildlife may be affected by PCBs exists as bird egg PCBs concentrations that have been measured at levels near the effects threshold (Schwarzbach et al., 2001).

The following sections present the data used to evaluate PCBs impairment of beneficial uses of the Bay. A review of readily available PCBs concentration data for benthic organisms and fish tissue is included, as well as water column PCBs concentrations.

6.1. Benthic Organisms

Several agencies use bivalves to measure the presence of bioaccumulative substances in the water column (NOAA, 1993; Stephenson et al., 1995). Because bivalves integrate water column concentrations of bioaccumulative substances over time, they are useful in identifying geographical areas needing further investigation.

The California Department of Fish and Game (CDFG) initiated the California Mussel Watch Program to measure bioaccumulation in bivalves placed at specific locations throughout the Bay. The long-term bivalve data shows a significant decrease of PCBs concentration in mussels deployed off Point Pinole and Treasure Island between 1977 and 1992 (Stephenson et al., 1995). The bivalve deployment program was continued and expanded by the RMP. RMP data indicate a continued decrease in PCBs concentration in bivalves placed near Yerba Buena Island from 1980 to 1996 (Gunther et al., 1999).

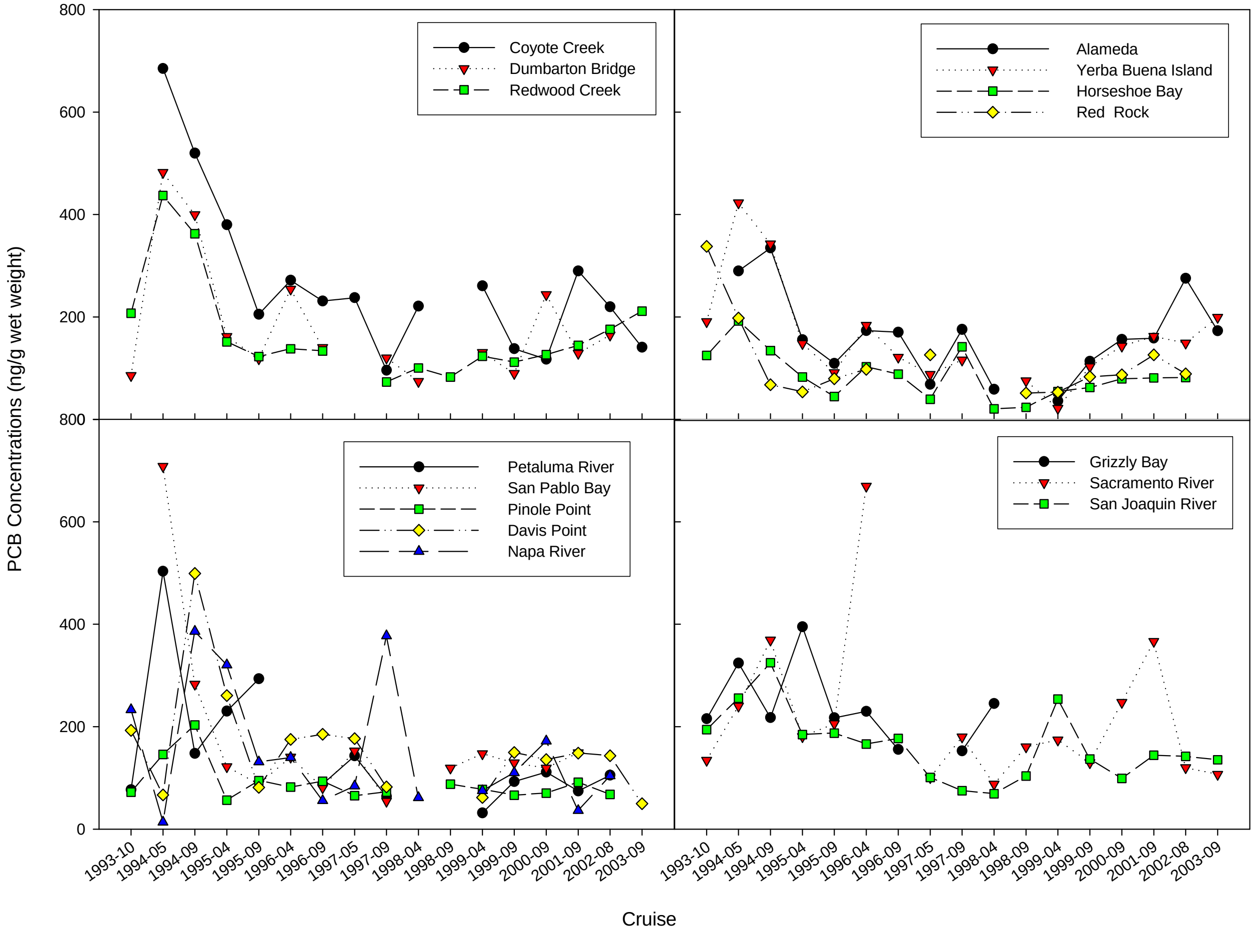

Figure 5-PCBs in Bivalves Deployed in San Francisco Bay (1993-2003)

(http://www.swrcb.ca.gov/programs/smw/index.html and http://www.sfei.org)

Over time, the frequency of deployed bivalves with tissue PCBs concentration less than the screening level of 70 nanograms per gram (ng/g) dry-weight (SFEI, 2000b) has increased (Figure 5), indicating potential improvement of the Bay relative to PCBs. Interpretation of bivalve data is limited, however, due to changing analytical procedures over time.

PCBs tissue concentrations of intertidal benthic organisms have been measured at concentrations up to 700 ng/g wet weight (PRC, 1996) near Hunter's Point Shipyard. Unfortunately, this study combined all species collected within an area and did not measure PCBs concentrations in collocated sediments. Note, however, that the maximum tissue concentration is much greater than the currently used level of concerns for fish tissue and for deployed bivalves. In a subsequent investigation at Hunter's Point Shipyard, PCBs concentrations up to 13,000 ng/g dry weight were measured in polychaete worm tissue collected in the South Basin (U.S. Navy, 2004 page 7-21). The biota were collected at a known PCBs-contaminated sites in the Bay where sediment PCBs concentrations are several orders of magnitude greater than those in ambient sediments.

PCBs concentrations seem to be declining over time in deployed bivalves, but are still measured at concentrations causing concern. Other benthic organisms, collected at contaminated sites, are often orders of magnitude greater than the screening level, and could be significant sources of PCBs to fish in the Bay.

6.2. Fish Tissue Studies

In 1994, fish were collected throughout the Bay and analyzed for a suite of contaminants including PCBs (SFBRWQCB, 1995). All fish species collected in the 1994 study had tissue PCBs concentrations exceeding the calculated screening level of 3 ng/g wet weight (SFBRWQCB, 1995). Based on these PCBs concentrations, as well as elevated concentrations of other contaminants, measured in this fish study, the Office of Environmental Health Hazard Assessment (OEHHA) issued an interim fish consumption advisory for all of San Francisco Bay (OEHHA, 1994). The OEHHA advisory is listed as interim because more information is needed about PCBs (and other contaminants) concentrations in fish in San Francisco Bay and fish PCBs concentrations that are protective of human health. Note that nationwide, there are 873 advisory listings for PCBs in surface water (USEPA, 2005). OEHHA is currently reviewing this interim health advisory (OEHHA, 1999). This review includes consideration of newly collected Bay fish PCBs concentration data (SFEI, 1999b). OEHHA will also be considering survey results of San Francisco Bay sports fish consumers and their level of fish consumption (SFEI, 2001a).

In 1997 and 2000, the RMP collected and analyzed Bay fish for contaminant concentrations (Greenfield et al., 2003; SFEI, 1999b). As part of these studies, the screening level for fish tissue PCBs concentration was recalculated based on an updated cancer slope factor of 1 (USEPA, 1997a); the resulting screening level was 23 ng/g wet-weight. We recalculated this screening level using local fish consumption habits and a cancer slope factor of 2 (SFEI, 2001a). We used a 95th percentile upper bound estimate of the local consumption rate for fish-consuming anglers of 32 grams fish per day rather than a consumption rate for the general population of the Bay area which would be smaller. This conservative estimate constitutes, in effect, a margin of safety for the TMDL, implicitly recognizing the long-term goal of increasing the viability of fish consumption and commercial harvest from the Bay. The screening level is calculated as follows:

$$SVc = [(RL / CSF) * BW] / CR \qquad \text{(Equation 1)}$$

where,

SVc = Screening value for a carcinogen in mg/kg
RL = Maximum acceptable risk level, 10^{-5} or one in 100,000
CSF = Oral cancer slope factor, upper bound estimate is 2 mg/kg-day
BW = Mean body weight of the population (70 kg)
CR = Fish consumption rate by all consumers based on a four-week recall, 32 g/day

The calculated screening level is 10 ng/g wet-weight. This screening level applies directly to the attainment of the COMM beneficial uses. As will be discussed in Section 7.2, this screening level is equivalent to a sediment PCBs concentration of 1 ng/g. The screening level is therefore also be protective of the EST, RARE, and WILD beneficial uses as USEPA (1997b) calculated a screening level for the protection of wildlife of 160 ng/g PCBs in sediment. Using the same method and assumptions, a dioxin toxic equivalent (TEQ) screening level of 0.14 pg/g dioxin is calculated for PCBs with dioxin-like properties.

Fish tissue PCBs concentrations in all white croaker and shiner perch exceeded the screening level by an order of magnitude in the three years for which data were collected (Figure 6). Three other fish species had a high frequency of screening level exceedances: sturgeon, jacksmelt and striped bass. Two other species' contaminant concentrations had a low frequency of screening level exceedances: halibut and leopard shark. In shiner surfperch and white croaker, PCBs tissue concentrations are noticeably more elevated than in the other fish species, in large part due to the higher lipid content of these fish (SFEI, 1999b).

Regional differences in fish tissue PCBs concentrations are noticeable, especially in the 1997 data. In the 1997 data, elevated fish tissue PCBs concentrations are noticeable in the Oakland inner harbor for the three fish species shown in Figure 7: jacksmelt, surfperch and white croaker. This is not unexpected as several contaminated sites are located in the Oakland inner harbor (Batelle, 1988; BPTCP, 1998). In 2000, elevated PCBs concentrations are also noticeable for surfperch in the Oakland inner harbor as well as in San Leandro Bay, another area known to have elevated sediment PCBs concentrations (Daum et al., 2000). Elevated fish tissue concentrations in certain locations may reflect a localized diet of benthic organisms residing in contaminated sediments.

PCBs concentrations in white croaker tissue collected in the Oakland Inner Harbor showed a seasonal trend (Figure 8) with higher concentrations in summer and fall and lower concentrations in winter and spring (Greenfield et al., 2003). The trend was correlated with lipid content of the white croaker, and a relation of PCBs concentrations with reproductive activity has been hypothesized (Greenfield et al., 2003). Based on these results, we consider that relying on white croaker PCBs data collected in summer is adequate for long-term trend monitoring as it reflects the season with the higher PCBs concentrations in fish. This seasonal trend will need to be verified for other fish species of concern.

Long-term trends indicate that PCBs tissue concentrations have decreased in shiner surfperch since 1965 (Risebrough, 1997). Unfortunately, data limitations make it difficult to resolve more recent trends of fish tissue PCBs concentrations. For white sturgeon, there does not appear to be a decrease in PCBs concentrations over the last 20 years (Greenfield et al., 2003).

A possible approach for estimating the risk from environmental exposure to PCBs is to use the toxic equivalency factor (TEF) method (ATSDR, 2000). This approach looks at the potency of PCBs mixtures by comparing the toxicity of a individual dioxin-like PCB congener relative to that of 2,3,7,8-tetrachlorodibenzop-dioxin (2,3,7,8-TCDD), the most toxic and studied of the dioxins. Toxicity is calculated as the ratio of the individual PCB congener to that of 2,3,7,8 TCDD that is given a toxicity of 1 (Ahlborg et al., 1994). The contribution of each congener to dioxin-like toxicity is calculated by multiplying their environmental concentrations by its toxic equivalent factor (TEF) and summing to get a dioxin toxic equivalent (TEQ).

A fish tissue screening value for TEQ of 0.14 pg/g was calculated using the same assumptions and methodology as that for total PCBs. In some cases, the TEQ was calculated using only three PCB congeners. PCBs 77, 126 and 169. However the TEQ from these three congeners usually comprises more than 80 percent of the TEQ from all PCB congeners with dioxin like toxicity. The screening value is exceeded in shiner surfperch, striped bass and white croaker (Figure 9).

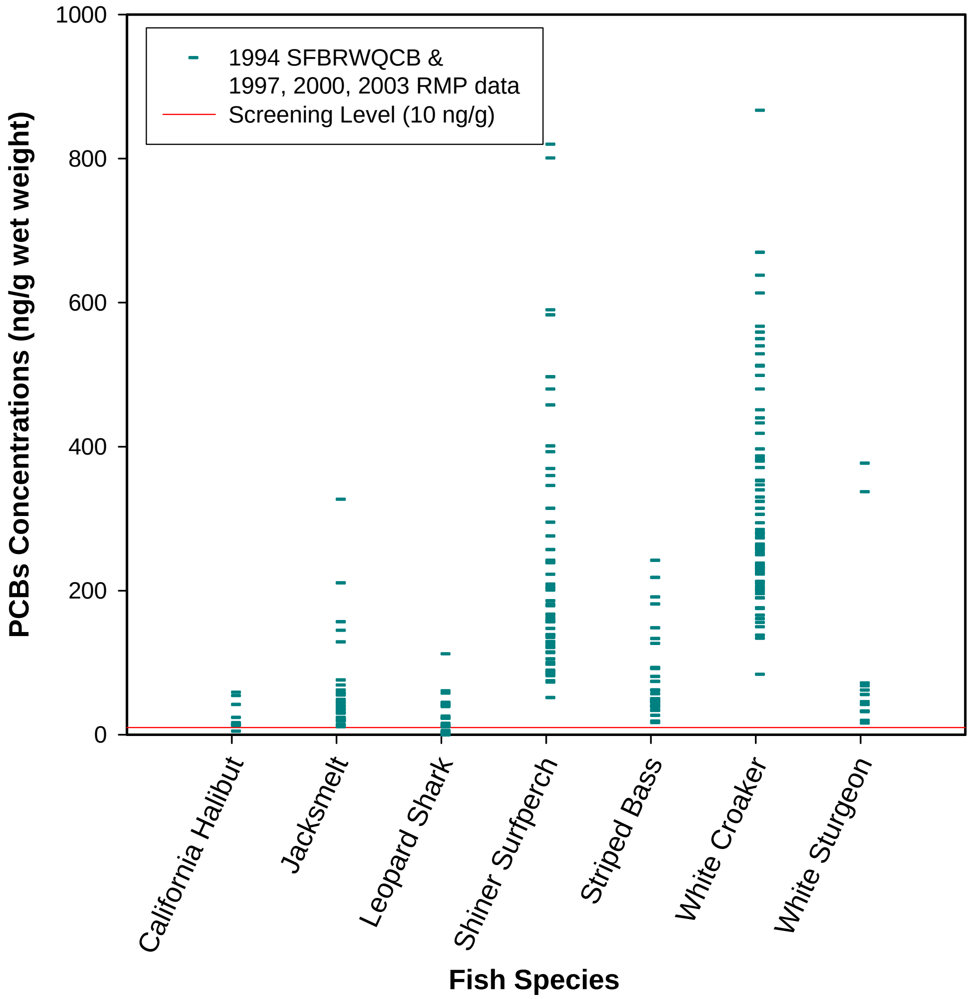

Figure 6-PCBs concentrations in San Francisco Bay Fish. (Source www.sfei.org)

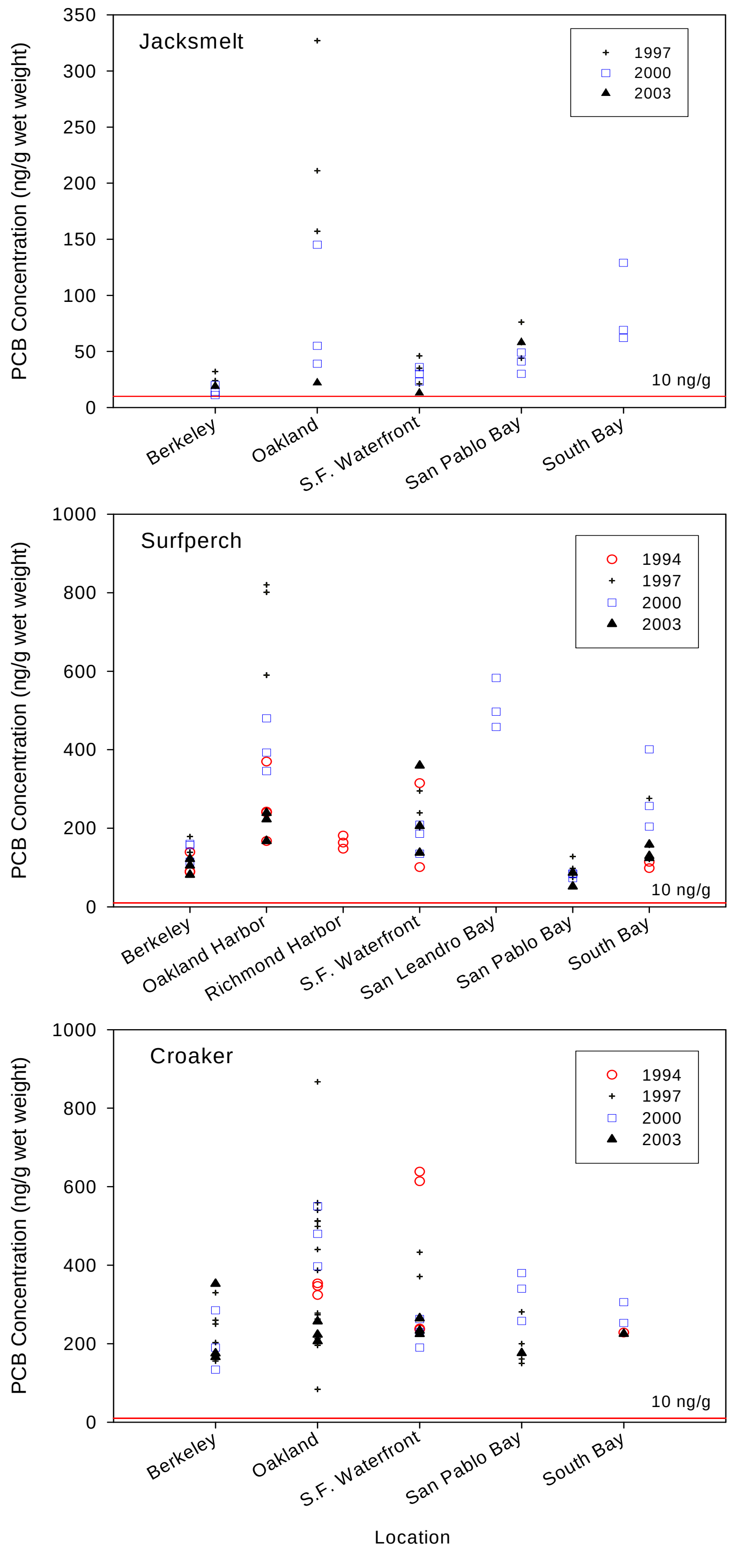

Figure 7-PCBs concentrations in Selected San Francisco Bay Fish Tissues (1994, 1997, 2000 and 2003). Screening Level is 10 ng/g wet weight. (Source www.sfei.org)

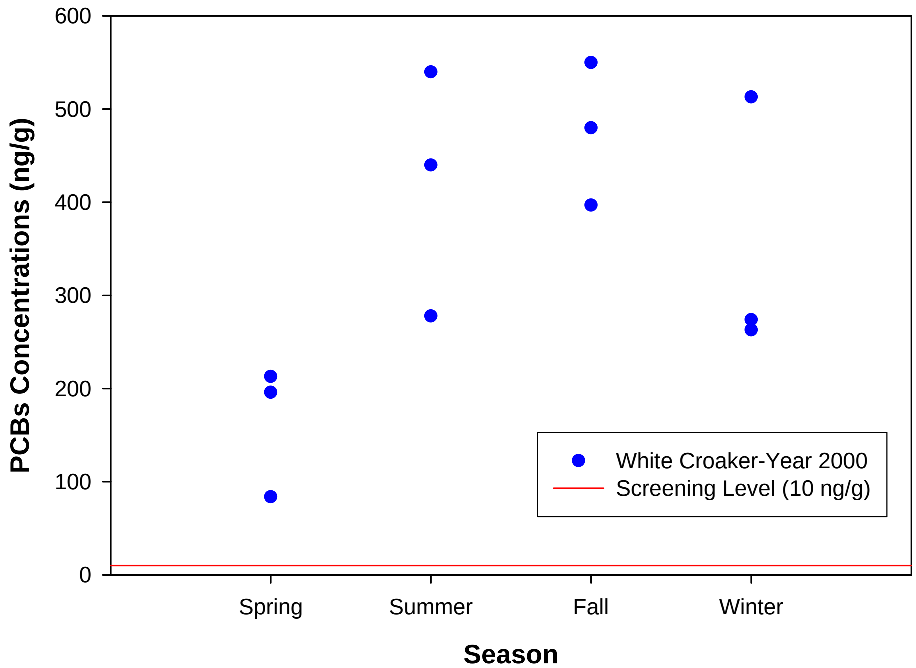

Figure 8-Seasonal Variation of PCBs concentrations in White Croaker Adapted from Greenfield et al. (2005)

Table 9-PCB Dioxin Toxic Equivalent Factors

IUPAC	NAME	TEF
PCB-77	3,3',4,4'-Tetrachlorobiphenyl	**0.0001**
PCB-81	3,4,4',5-Tetrachlorobiphenyl	**0.0001**
PCB-105	2,3,3',4,4'-Pentachlorobiphenyl	**0.0001**
PCB-114	2,3,4,4',5-Pentachlorobiphenyl	**0.0005**
PCB-118	2,3',4,4',5-Pentachlorobiphenyl	**0.0001**
PCB-123	2,3',4,4',5'-Pentachlorobiphenyl	**0.0001**
PCB-126	3,3',4,4',5-Pentachlorobiphenyl	**0.1**
PCB-156	2,3,3',4,4',5-Hexachlorobiphenyl	**0.0005**
PCB-157	2,3,3',4,4',5'-Hexachlorobiphenyl	**0.0005**
PCB-167	2,3',4,4',5,5'-Hexachlorobiphenyl	**0.00001**
PCB-169	3,3',4,4',5,5'-Hexachlorobiphenyl	**0.01**
PCB-170	2,2’,3,3’,4,4’,5-Heptachlorobiphenyl	**0.0001**
PCB-180	2,2’,3,4,4’,5,5’-Heptachlorobiphenyl	**0.00001**
PCB-189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	**0.0001**

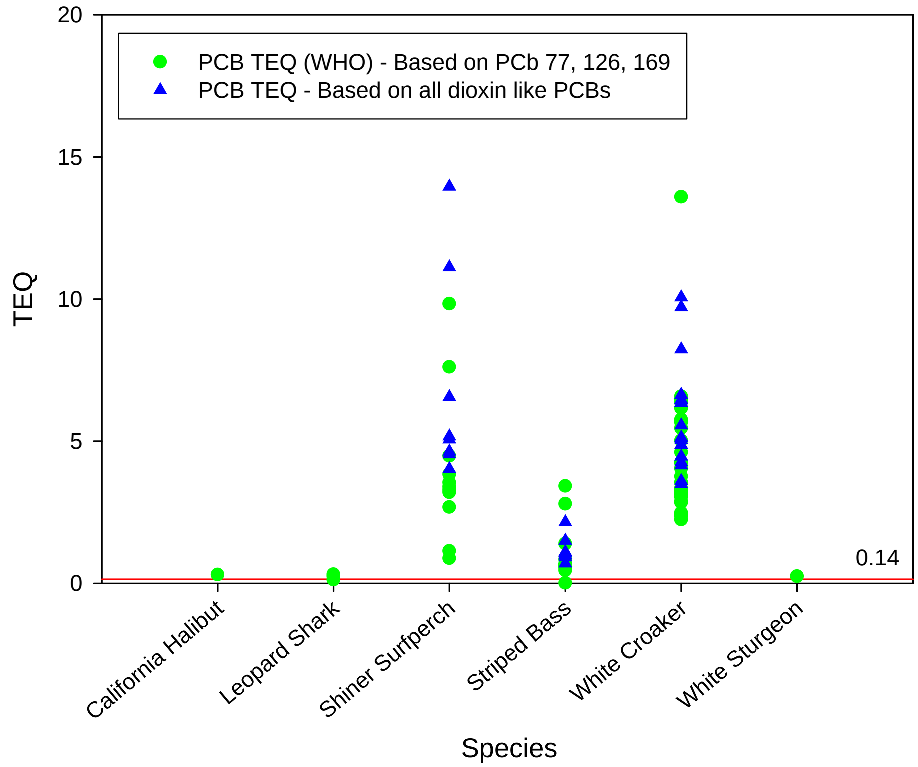

Figure 9- PCB Dioxin Toxic Equivalent (pg/g) in Selected San Francisco Bay Fish (1994, 1997, 2000) (source www.sfei.org)

6.3. Aqueous PCBs concentrations

As previously discussed, USEPA has promulgated a water quality criterion for total PCBs of 170 pg/L (USEPA, 2000a). Over a nine-year period of monitoring at San Francisco Bay monitoring stations (Figure 10), the PCBs water quality criterion was almost always exceeded (Figure 11; Figure 12). In the South Bay and the mouth of the Petaluma River, the water quality criterion was exceeded in 100 percent of the samples. Samples from all other in-Bay RMP sampling locations exceeded the criterion nearly 100 percent of the time. There are no apparent increasing or decreasing trends in water column PCBs concentrations over this time period, so the Bay can be considered at steady state with respect to PCBs concentrations.

The San Joaquin and Sacramento River monitoring stations did not exceed the criterion as often than those in-Bay locations. The criterion was exceeded fewer than 50 percent of the time at only one monitoring station: the Golden Gate located outside the Bay. Elevated in-Bay water column PCBs concentrations can therefore be attributed to Bay Area sources, whether from ongoing discharge of PCBs to the Bay or remobilization of PCBs already in Bay sediments.

There is a high frequency of water column exceedances of the PCBs water quality criterion. Yet, as was discussed in sections 6.1 and 6.2, benthic organisms and fish have elevated PCBs in areas where sediments also have elevated PCBs concentrations. In order to lower the fish tissue PCBs concentrations to the screening level, the TMDL focuses on PCBs in sediments.

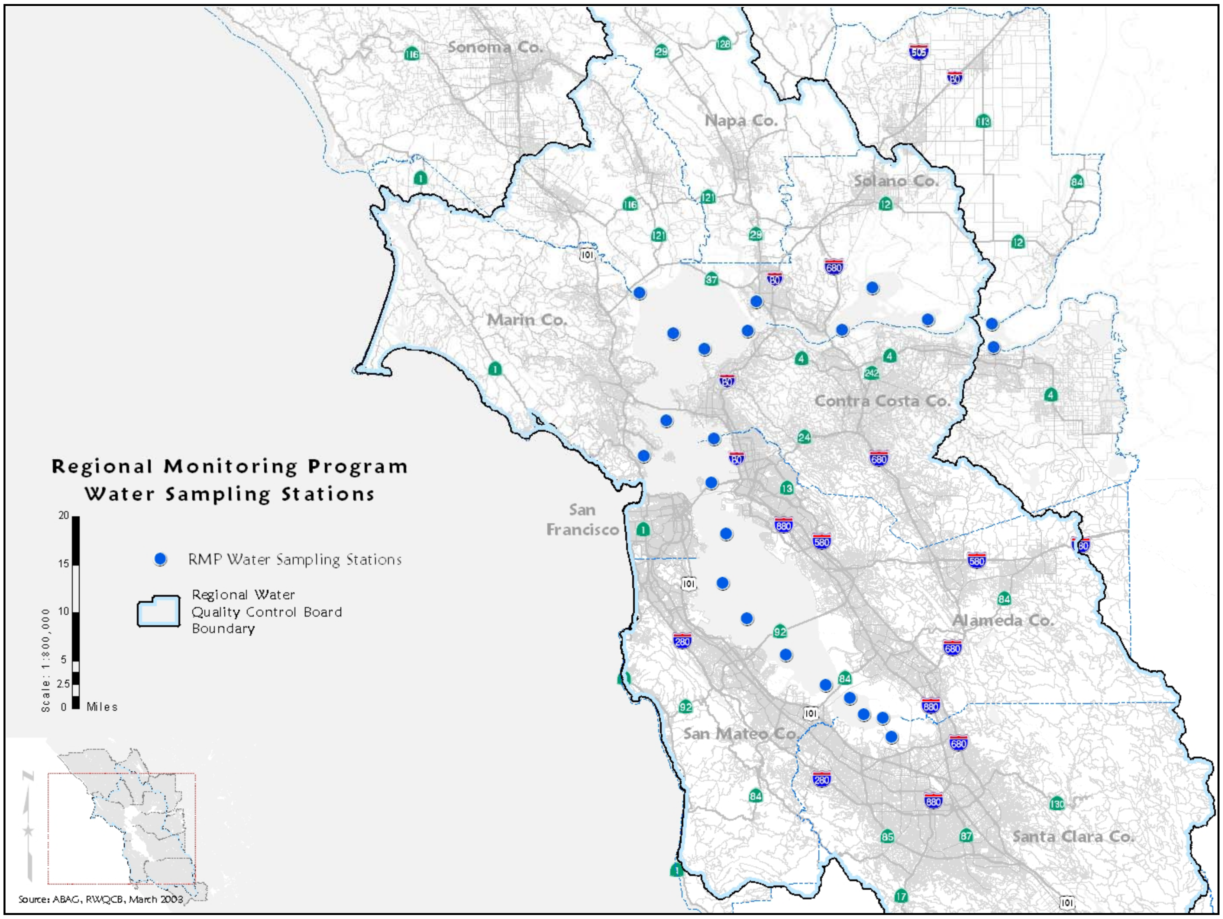

Figure 10-Regional Monitoring Program Sampling Stations (1993-2001)

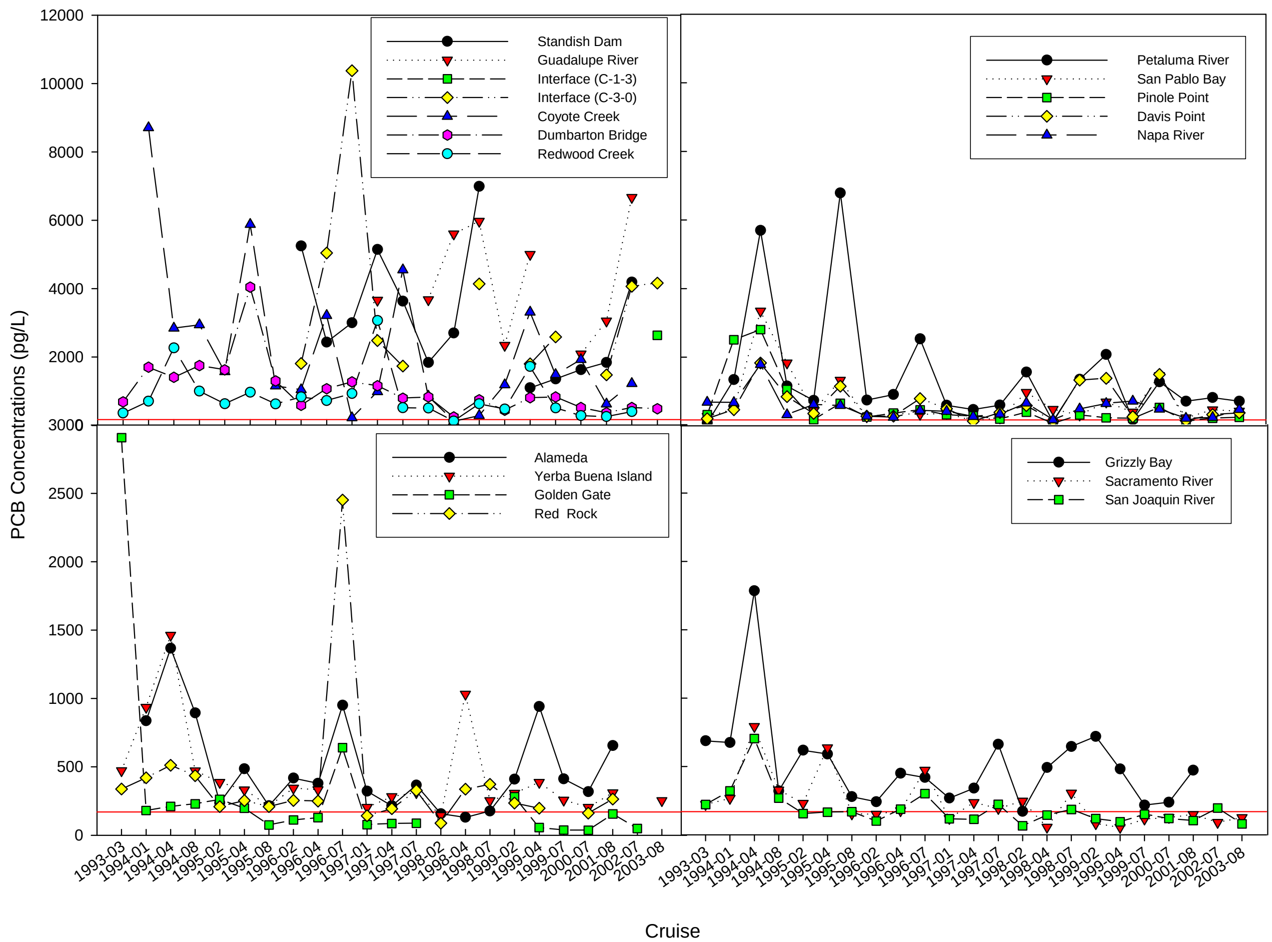

Figure 11-Water Column PCBs concentrations in San Francisco Bay fixed Stations (1993-2003)
Red line is the applicable water quality standard of 170 pg/L (based on data from http://www.sfei.org)

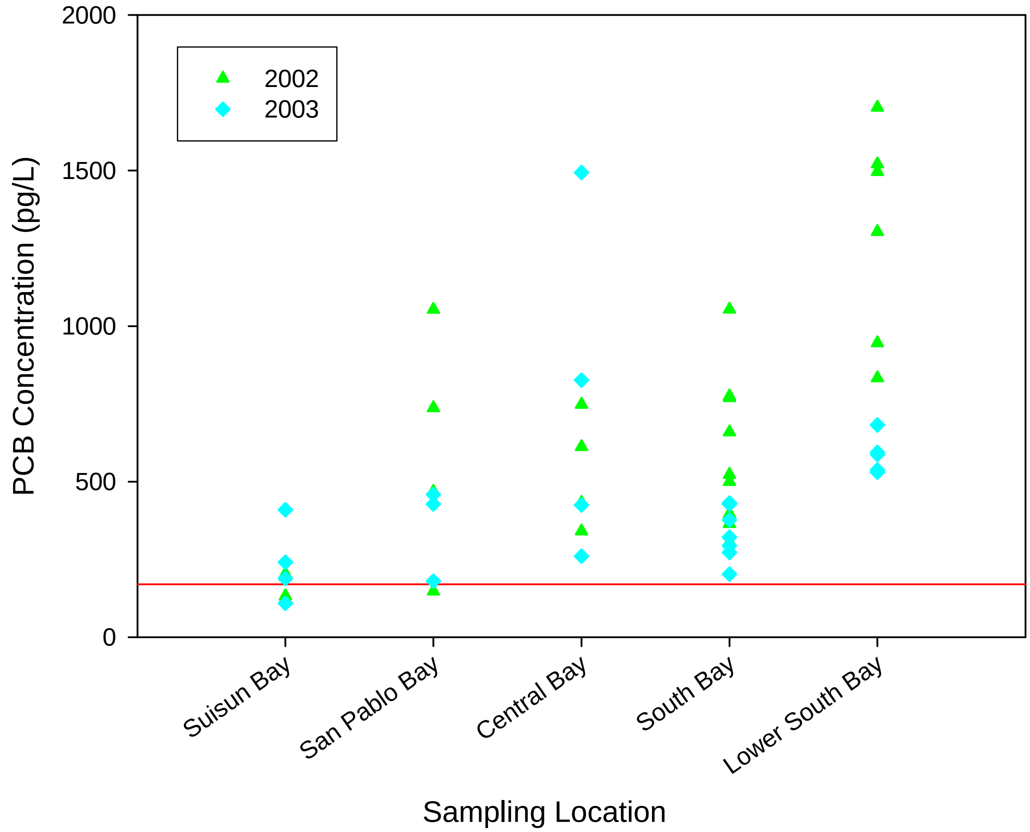

Figure 12-Water Column PCBs concentrations in San Francisco Bay-Random Design
Red line is the applicable water quality objective of 170 pg/L.

7. Reservoirs, Sources and Loads, and Movement of PCBs

Since the onset of production in 1929, PCBs have been introduced to the environment through land disposal (legal and illegal), accidental spills and leaks, incineration of PCBs or other organic materials in the presence of chlorine, pesticide applications, surface coatings such as paints and caulks, and wastewater discharge. Diffusion of PCBs from localized areas with high PCBs concentrations has resulted in widespread low-level background concentrations across the globe (Erickson, 1997).

In the following sections, we present our understanding of PCBs distribution in the Bay, along with estimates of sources and loads. We have assessed current PCBs mass in the water column and sediments, as well as the loads from direct atmospheric deposition, Central Valley watershed inputs, municipal and industrial wastewaters, and urban stormwater runoff to the Bay. We also present our understanding of in-Bay PCB-contaminated sites, but can not estimate their role as sources to the water column and biota.

7.1. Environmental Reservoirs

Due to potentially large historical releases of PCBs to the Bay, an estimate of PCBs reservoirs is needed to put current PCBs loads in perspective. Two environmental reservoirs of PCBs exist in the Bay: the water column and the sediments. As discussed below, the mass of PCBs in sediments is much greater than in the water column. However, it is important to note that a numeric criterion exists for water but not for sediments. This is important since the potential for sediments to be resuspended and supply PCBs to the water column is significant, as well as the ability for sediment to supply PCBs directly to biota.

Table 10-Estimated PCBs Mass in the Bay Water Column

Station	N	Median Concentrations (pg/L)	PCBs Mass (kg)
Coyote Creek	12	2,300	15.3
Standish Dam	9	3,600	24.0
Guadalupe River	5	3,700	24.6
San Jose	8	3,700	24.6
Dumbarton Bridge	15	1,200	8.0
Redwood Creek	15	740	4.9
Alameda	14	370	2.5
Yerba Buena Island	14	350	2.3
Golden Gate	15	130	0.9
Red Rock	14	300	2.0
Petaluma River	14	1,300	8.7
San Pablo Bay	16	430	2.9
Pinole Point	15	370	2.5
Davis Point	16	460	3.1
Napa River	14	560	3.7
Grizzly Bay	15	290	1.9
Sacramento River	16	240	1.6
San Joaquin River	14	190	1.3

(based on data from http://www.sfei.org)

Water Column

PCBs concentrations in the water column are discussed in section 6.3. Using the median water column PCBs concentrations for selected sampling locations for the years 1993 through 1998 and a water volume of 6.6 x 10^9 cubic meter (m^3) for all Bay segments (Conomos, 1979), a range of PCBs mass in the Bay water column is estimated (Table 10). PCBs mass ranges from 1 to 25 kg in the Bay, with a central tendency of 2 to 8 kg. The mid-point of this central tendency, 5 kg, is used in this report as the mass of PCBs in the water column.

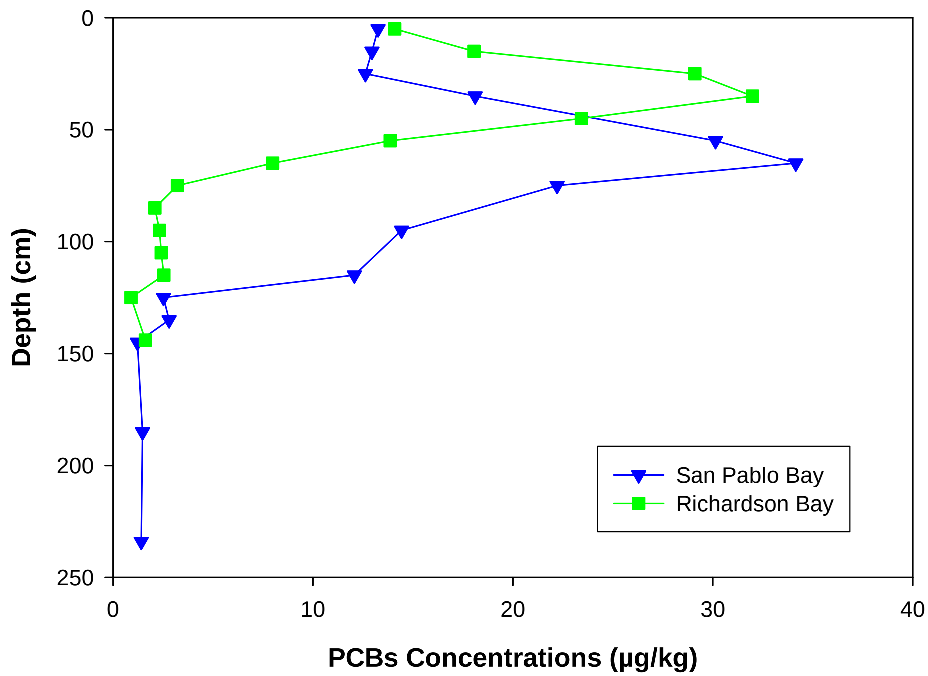

Figure 13-PCBs concentrations with Depth in Sediments from Two North Bay Locations (USGS, 1999)

Sediments

For the purposes of this report, we separated Bay sediments into two categories: ambient and contaminated. Sediments considered ambient are from locations distant from known sources of contamination and have PCBs concentrations that cannot be statistically differentiated from other sediments collected in similar environments. Sediments considered representative of contamination are usually located near-shore, close to potential sources of contamination and have concentrations often several orders of magnitude greater than ambient sediments.

In 1992, the United States Geological Survey (USGS) collected ambient sediment cores in Richardson Bay and San Pablo Bay (Fuller et al., 1999). Radioisotopes were used to determine deposition chronologies of the sediments, which were compared to the chemical concentrations as a function of depth. PCBs concentrations were relatively constant to a depth of 25 to 50 centimeters (cm), corresponding to deposition since the early 1980s. A sharp increase in PCBs concentrations was observed below those depths, with maximum concentrations corresponding to deposition in the 1970s (Figure 13).

Total masses of PCBs per unit area for the entire depth of the cores were calculated to be 1,400 nanogram per cubic centimeter (ng/cm^2) and 4,100 ng/cm^2 for Richardson Bay and San Pablo Bay respectively (Venkatesan et al, 1999). Extrapolating the core results to the entire Bay, we estimate based on an estimated surface area of 1,285 km^2 that the total PCBs mass in ambient sediments ranges from 18,000 to 52,000 kg (Table 11). This range is based on the results from sediment cores collected far from known on-land PCBs use areas, and may under-represent total PCBs in the Bay. Yet, sediments represent a PCBs reservoir four to five orders of magnitude larger than the 5 kg in the water column.

Table 11-Estimated Total PCBs Mass in Bay Sediments Based on USGS Core Data

Location	Depth (m)	Total PCBs (ng/cm2)	Total PCBs in Estuary (kg)
Richardson Bay	0.75	1,391	18,000
San Pablo Bay	1.25	4,069	52,000

Alternatively, the total mass of PCBs in ambient sediments can be estimated using the range of maximum concentrations of PCBs in sediments of 22 to 35 μg/kg (Smith and Riege, 1998). Again using an area of 1,285 km^2 for the Bay and a depth of 1 meter to cover the depth to which PCBs are usually found. Assuming that Bay sediments are 55 percent solid by weight (range from 40 to 80%), we can estimate total PCBs in sediments. Sediment volumes are converted to sediment dry mass as follows:

$$M_s = \frac{(x\rho_w)}{\left[1 + x\left(\rho_w/\rho_s - 1\right)\right]} V_t \qquad \textit{(Equation 2)}$$

where,

M_s = the dry mass of sediments in kg,
x = the percent solid per unit mass sediment,
ρ_w = the density of water (1kg/L),
ρ_s = the particle density of sediments (2.65 kg/L for aluminosilicates),
and V_t = the volume of sediments.

The dry mass of sediment is then converted to PCBs mass for a range of sediment PCBs concentrations. This gives an estimate of 12,000 to 38,000 kg of total PCBs in ambient sediments of the Bay (Table 12), which is comparable to the results based on the USGS cores.

There are specific in-Bay locations where sediment PCBs concentrations are much higher than in the rest of the Bay (BPTCP, 1998) that we refer to as PCBs-contaminated sites. Data were collected at these sites (Table 13, Figure 14) to satisfy different regulatory requirements, and are therefore not readily comparable. For example, sampling densities and methods often vary between regulatory programs. Several of the sites (e.g. Cerrito Creek) were identified under the

Bay Protection and Toxic Clean-up Program (BPTCP) and the sampling consists of one or a few surface grab samples. The Vallejo Ferry terminal site was identified during sampling and analysis for a dredging project and corresponds to one composite sample collected from several deep cores. Hunters Point Shipyard and Seaplane Lagoon at the Alameda Naval Air Station are Superfund sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). They have a much higher sampling density than most other sediment sites in the Bay. Other sites were investigated as part of scientific studies, such as in San Leandro Bay, or remedial investigations of on-land contaminated sites, such as the Emeryville crescent. At the Oyster Point site, remedial actions have already been undertaken. Regardless of the differences in methodology used for collecting these data, the listed sites have sediment PCBs concentrations several orders of magnitude greater than those considered ambient. These highly elevated PCBs concentrations could be contributing significant PCBs mass to the Bay's biota. PCBs concentrations in sediment dwelling biota can be correlated to PCBs concentrations in sediments (Figure 15). Potential contribution of PCBs to biota from these contaminated sediments needs to be further evaluated, and likely needs to be reduced to lower the fish tissue PCBs concentrations.

Table 12-Estimated Total PCBs Mass in Bay Sediments Based on Ambient PCBs concentrations

Sediment PCB Concentrations (μg/kg)	SurfaceArea (km^2)	Depth (m)	Total PCBs (kg)
11	1,285	1	12,000
22	1,285	1	24,000
35	1,285	1	38,000

Table 13-PCBs-Contaminated Sites in the Bay

Bay Segment	Location	Maximum Sediment PCBs concentrations (µg/kg)	References
Suisun Bay	Peyton Slough	>200	BPTCP (1998)
San Pablo Bay	Vallejo Ferry Terminal	>1,000	MEC (1996), Regional Board File No.2128.03
Central Bay	Richmond Harbor/Potrero Point	>10,000	Hart Crowser (1993), BPTCP (1998), Battelle (1993)
	Stege Marsh	>1,000,000	BPTCP (1998), PERL(1999), URS (2000a), URS (2002)
	Richardson Bay	>200	EDAW (1997); ABT (1998)
	Cerrito Creek	>200	BPTCP (1998)
	Cordonices Creek	>200	BPTCP (1998)
	Emeryville Crescent	>1,000	TetraTech (1993)
	Oakland Army Base	>1,000	Arcatis (2004)
	Oakland Harbor	>200	Battelle (1988), BPTCP (1998), EVS et al. (1998)
	San Leandro Bay	>1,000	BPTCP (1998), Daum et al., (2000), Regional board File No. 2199.9018A
	Alameda Naval Air Station Seaplane Lagoon	>1,000	BPTCP (1998), US Navy (1999), Battelle (2001, 2005)
	Islais Creek	>200	BPTCP (1998), SFPUC (2002)
	Mission Creek	>200	BPTCP (1998), SFPUC (2002)
	Yosemite Creek Hunters Point Shipyard	>10,000	BPTCP (1998), SFPUC (2002), PRC (1996) Navy (2002), Battelle (2004)
	Oyster Point	>1,000	MEC (1990), Treadwell and Rollo (1995), URS (2000b)
	San Francisco Airport	>1,000	BPTCP (1998), URS (1999)
South Bay	Redwood City Harbor	>1,000	MEC (1997), ABT (1997)
Lower South Bay	Moffett Federal Airfield NASA Ames	>10,000	PRC (1997)
	Guadalupe Slough San Jose	>200	ESA (1988)

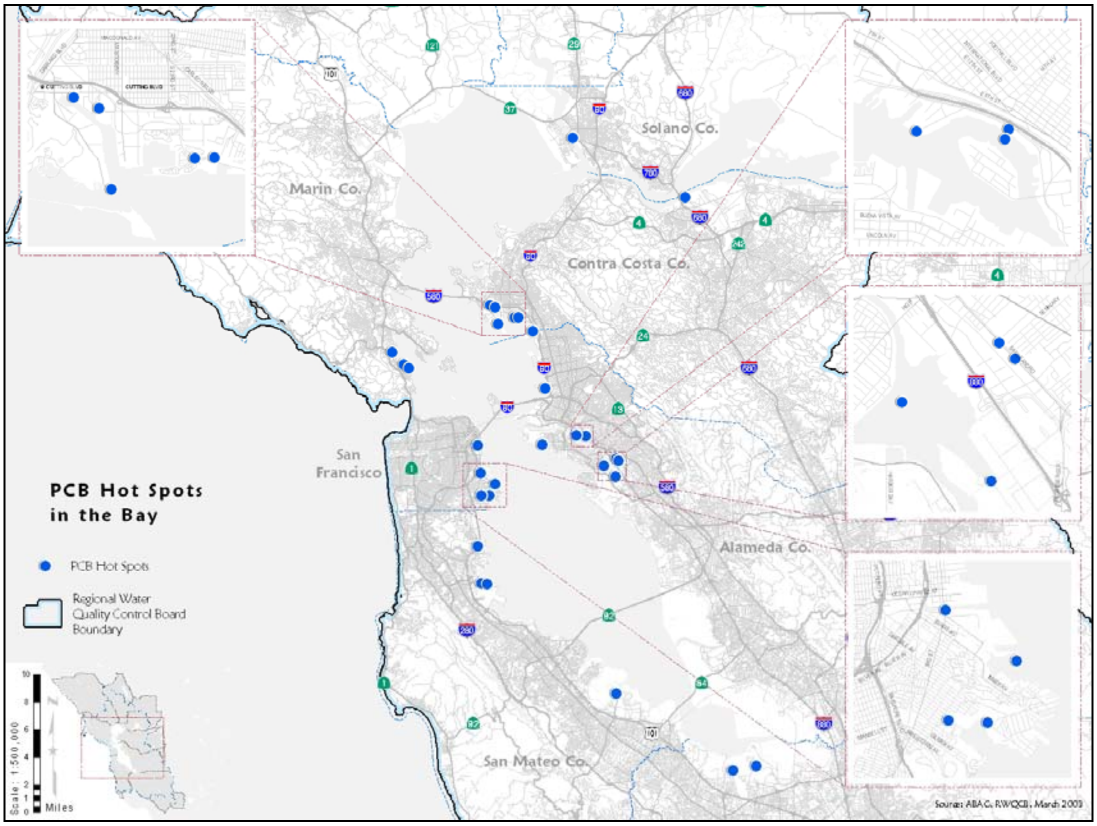

Figure 14-PCBs-Contaminated Sites in the Bay

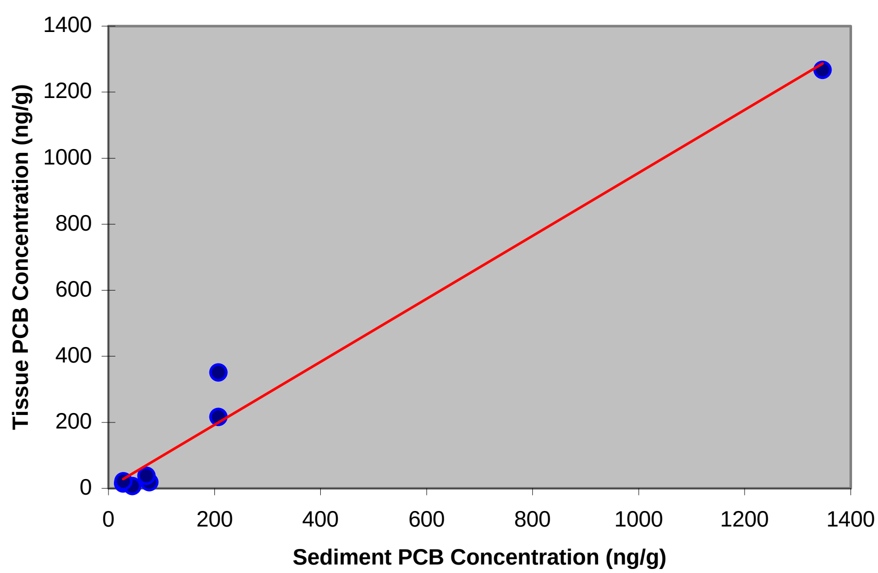

Figure 15-PCBs concentrations in Sediment and Bent-Nosed clam (Macoma nasuta) Tissue following Bioaccumulation Testing, Seaplane Lagoon, Alameda NAS

7.2. External Sources

As previously discussed, sediments are the largest PCBs reservoir in the Bay and may contribute significant PCBs mass to biota. However, these sediments correspond to only one pathway of PCBs loadings to the Bay. As part of developing this TMDL, all known and potential sources and loads of PCBs to the Bay must be considered. In this section, we present our current understanding of sources and estimates of the loads from the following sources:

- Direct atmospheric deposition
- Central Valley watershed (Sacramento and San Joaquin Rivers)
- Municipal and industrial wastewater discharges
- Runoff and local tributaries

Direct Atmospheric Deposition

PCBs have been detected in remote regions of the world, far from known areas of PCBs use, indicating that atmospheric movement and deposition of PCBs can be significant sources of PCBs to surface waters (Erickson, 1997). Conversely, PCBs can also be lost from surface waters to the atmosphere by volatilization. In some instances, loss of PCBs to the atmosphere can account for the largest removal of PCBs from surface water (Jeremiason et al., 1994).

Deposition of PCBs from the atmosphere occurs either directly to surface waters, or indirectly in the watershed. PCBs deposited in the watershed may then be transported to the Bay via urban stormwater runoff discharges. The San Francisco Estuary Institute (SFEI) has completed a study of the direct deposition of PCBs to the Bay from the atmosphere (SFEI, 2005; Tsai et al., 2002). Indirect contributions of PCBs to the Bay from the atmosphere were not quantified, but are included in the loadings estimates for urban and non-urban stormwater runoff. Direct PCBs loads to the Bay are estimated to be 0.35 kg/yr, but loss to the atmosphere is estimated at 7.4 kg/yr (Table 14). Consequently, current estimates are that about 7.0 kg of PCBs are lost from the Bay to the atmosphere yearly. A fraction of the PCBs lost by this pathway may return to the Bay via deposition in the watershed and subsequent stormwater runoff. We therefore estimate that direct atmospheric deposition does not contribute a significant load to the Bay.

Table 14-PCBs Exchange Between San Francisco Bay Water and the Atmosphere

Phase	PCBs Load (kg/year)
Gaseous	-7.4±3.0
Particulate	0.35 ±0.26
Net Load	**-7.0±3.1**

(SFEI, 2001a)

Central Valley Watershed

PCBs concentrations in the Sacramento and San Joaquin Rivers have been monitored by the RMP for over ten years. Based on the concentrations measurd by the RMP, we had previously estimated that about 40 kg of PCBs entered the Bay each year from the Central Valley (SFB-RWQCB, 2004). More recently, PCBs loads entering the Bay from the Central Valley have been estimated for the years 2002 and 2003 (Leatherbarrow et al., 2005). Annual loads of PCBs were estimated at 6.0 ± 2.0 and 23 ± 18 kg for years 2002 and 2003, respectively. The load estimates are based on measured flow-weighted mean PCBs concentrations ranging from 200 to 6,700 pg/L with a median concentration of 600 pg/L. Annual mass loadings were calculated using Central Valley water discharge data at Mallard Island from the Department of Water Resources (Interagency Ecological Program) estimated using a mass balance approach and the DAYFLOW model. These annual load estimates may be at the lower end of the range of annual loads as these years were drier years with lower sediment inflow from the Central Valley (Leatherbarrow et al., 2005). For the TMDL, we are using the mean loads of 14.5 kg/yr for these two years as the loading to the Bay from the Central Valley.

Using the measured suspended sediment concentrations and the PCBs concentrations, we calculated the PCBs concentrations on a particle weight basis assuming that all measured PCBs are associated with suspended sediments. This results in a median PCBs concentration of 9.2 g/kg on suspended sediments entering the Bay from the Central Valley.

Municipal and Industrial Wastewater Dischargers

There are a number of municipal and industrial wastewater discharges into San Francisco Bay (Figure 16 and Figure 17). Municipal wastewater discharges are located throughout the Bay (Figure 16), while the major industrial wastewater discharges take place in the north Bay segments (Figure 17) where ambient PCBs water concentrations are some of lowest in the Bay (Table 17).

Municipal and industrial wastewater discharges to surface waters are controlled through waste discharge requirements issued as federal National Pollutant Discharge Elimination System (NPDES) permits (Table 23 and Table 24). Selected municipal wastewater dischargers (Publicly Owned Treatment Works or POTWs) and petroleum refineries have quantified PCBs in their wastewaters using USEPA method 1668 to achieve lower detection limits (SFEI, 2001b; 2002a; 2002b). Wastewaters from the POTWs with secondary treatment have an average PCBs concentration of 3,600 pg/L (Table 15), while wastewaters from POTWs with advanced treatment have an average PCBs concentration of 210 pg/L (Table 16). Wastewaters from petroleum refineries in the North Bay had an average PCBs concentration of 270 pg/L (Table 17), similar to that in the POTWs with advanced treatment, while other industrial wastewater dischargers had an average concentration of 1900 pg/L.

Using average daily flows from the POTWs and industries, including refineries, and the average PCBs concentrations in wastewaters from each category, we estimate that municipal and industrial wastewater discharges annually contribute 2.3 kg and 0.035 kg of PCBs to the Bay respectively.

Urban and non-Urban Stormwater Runoff

Municipal urban stormwater runoff management agencies measured sediment PCBs concentrations within their urban and non-urban stormwater runoff conveyance systems in the summers of 2000 and 2001 (ACCWP, 2001; ACCWP 2002a, ACCWP 2002b; KLI, 2001; KLI, 2002). The purpose of these studies was to determine whether PCBs are evenly distributed and discharged from stormwater conveyance systems or whether PCBs-contaminated sites exist within watersheds. These studies also attempted to evaluate whether runoff conveyances are sources of PCBs in themselves. The studies also examined whether specific locations within watersheds are contributing to ongoing PCBs discharge to the Bay via stormwater conveyance systems due to historical or current activities at those locations. Finally, loads of PCBs from runoff to the Bay were estimated based on the sediment PCBs concentrations and estimated loadings of sediments to the Bay.

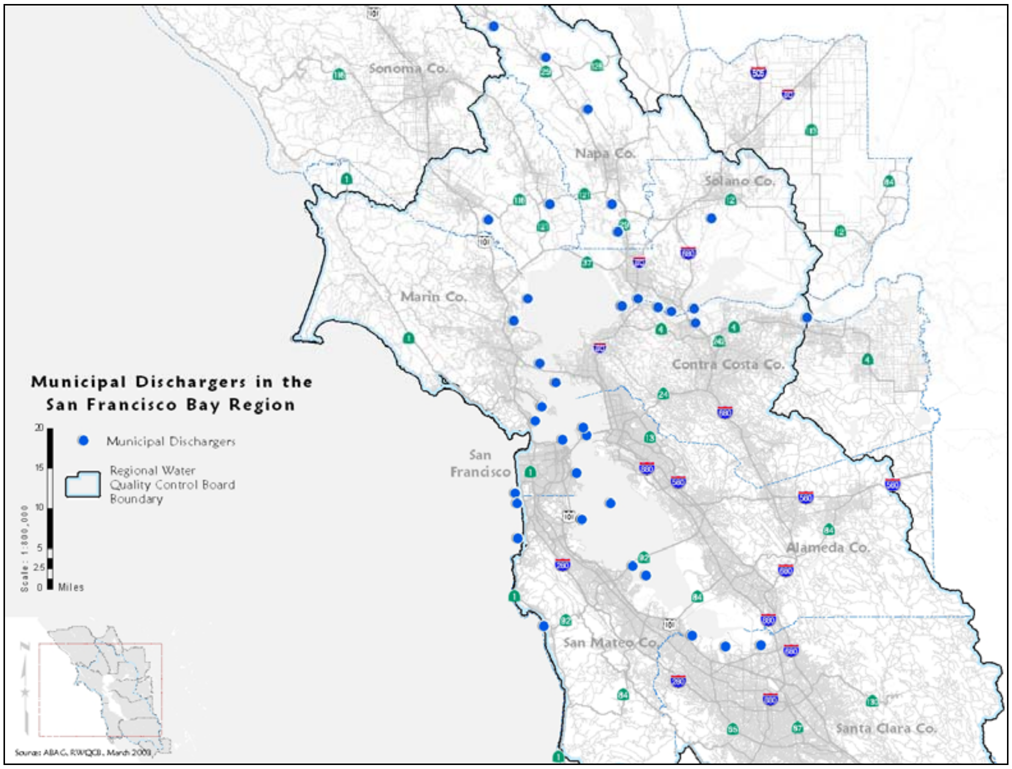

Figure 16-Municipal Wastewater Dischargers in San Francisco Bay

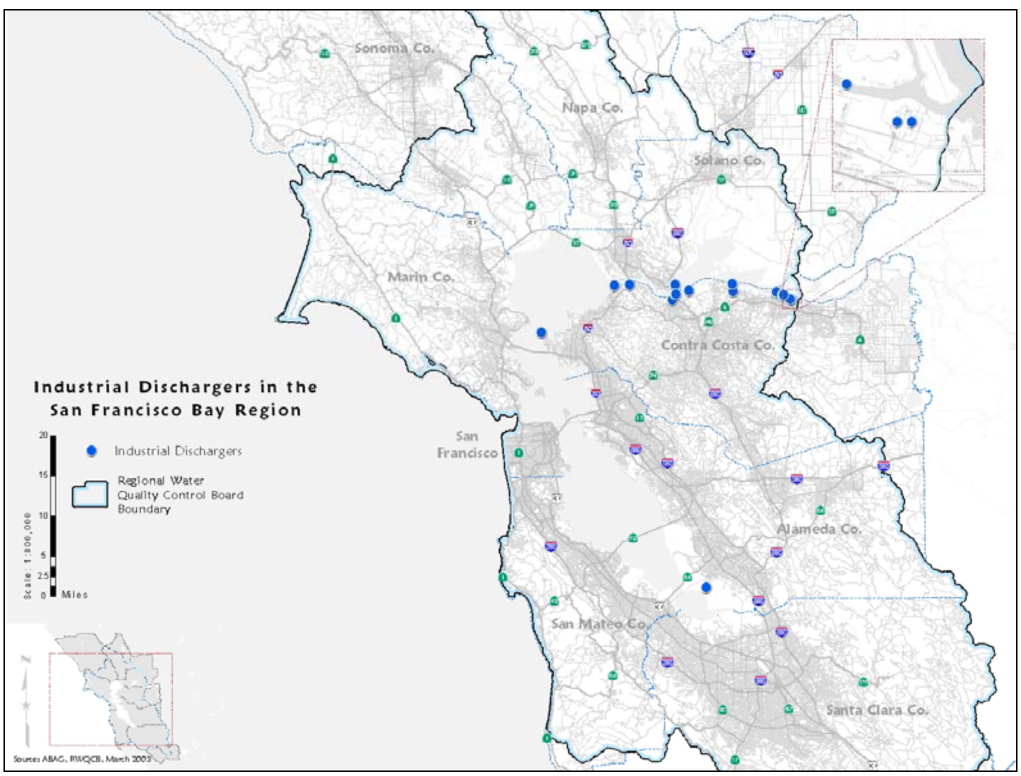

Figure 17-Selected Industrial Wastewater Dischargers in San Francisco Bay

Table 15-PCBs concentrations in Wastewater from Municipal Dischargers with Secondary Treatment

POTW	PCBs (pg/L)	
	December-00	February-01
East Bay Municipal Utility District	7,900	5,700
Central Costa Costa County Sanitary District	1,100	1,400
East Bay Dischargers Authority	4,700	3,700
City and County of San Francisco	2,200	2,700
Millbrae	NA	2,600

NA = Not Analyzed

(SFEI, 2002a)

Table 16-PCBs concentrations in Wastewater from Water Municipal Dischargers with Advanced Treatment

POTW	PCBs (pg/L)			
	November-99	February-00	April-00	July-00
Fairfield-Suisun	250	NA	130	NA
Palo Alto	310	310	320	240
San Jose/Santa Clara	190	170	170	190
Sunnyvale	200	190	120	160

(SFEI, 2001b)

Table 17-PCBs concentrations in Wastewater from Industrial Dischargers

Facility	PCBs (pg/L)
Southern Energy California LLC,	1000
Potrero Power Plant	370
	260
	130
Southern Energy California LLC,	830
Pittsburg Power Plant	72
C&H Sugar Co.	860
	3700
The DOW Chemical Co.	1800
	660
San Francisco, City and Co.,	5600
SF International Airport Industrial WTP	4300
	3400
	3400
Chevron Products Company, Richmond Refinery	650
	570
ConocoPhillips, San Francisco Refinery	170
	380
Shell Oil Products US and Martinez Refining Company,	280
Shell Martinez Refinery	150
Tesoro Refining & Marketing Co, Golden Eagle Refinery	110
	150
Valero Refining Company, Valero Benicia Refinery	170
	85

(SFEI, 2002b)

The urban and non-urban stormwater runoff study found sediment PCBs concentrations ranging from the low µg/kg level to the tens of thousands of µg/kg level. Sediment sampling locations were selected to reflect a variety of land use categories (Figure 18 and Figure 19). Sediment PCBs concentrations were statistically greater in areas of industrial, commercial and residential land use than in open space, clearly showing that PCBs were not evenly distributed across watersheds. Eleven of 209 locations had PCBs concentrations greater than 1,000 µg/kg (Figure 20), while 125 locations had PCBs concentrations greater than in-Bay ambient sediments which have PCBs concentrations of 20-35 µg/kg. Pilot studies of these urban stormwater runoff conveyance systems contaminated sites indicate that only in some cases can the PCBs be traced back to current or historical on-land activities (ACCWP, 2002a, ACCWP, 2002b; CCCWP, 2002; EOA, 2002; SMCSTPPP, 2002). Elevated PCBs concentrations in the urban and industrial landscapes were expected due to the widespread use of PCBs both in closed and open applications (Table 8), such as transformers or capacitors that may have leaked, hydraulic fluids, lubricants, and plasticizers, as well as its uses in building materials. PCBs in open space land use area were also expected due to the known role of atmospheric transport and deposition of PCBs around the world, as well as the direct application of PCBs to the environment in various processes (Section 4.3), such as pesticide extenders.

At several locations with elevated sediment PCBs concentrations, follow-up case studies were conducted to attempt to locate the source of PCBs to the stormwater conveyance system (CCCWP, 2002; EOA, 2002; SMCSPPP, 2003; SMCSPPP, 2004). These case studies were successful on only some occasions to identify a potential source of PCBs to the stormwater conveyance system. In another study (Kleinfelder, 2006), targeted sampling for PCBs in soils and sediments the public right-of-way was performed within an industrial watershed with elevated PCBs in storm drain sediments. Sampling locations were based on an analysis of current and past business, followed by inspections for compliance with the industrial general NPDES permit under which the business operate. This investigation was able to detect an number of potential sources of PCBs within the watershed at a larger frequency than in a randomly determined sampling scheme performed alongside. This study showed a need to target PCBs source and treatment controls to current and historical industrial watersheds.

Estimates of PCBs loads to the Bay from urban stormwater runoff conveyance system were generated based on the results of these studies (KLI, 2002). We propose to use these estimates as our estimates of loads from urban and non-urban stormwater runoff. Sediment PCBs concentrations were calculated for each land use based on the data collected. A simple model was used to generate runoff volumes, as well as the sediment loads, from the 17 Bay Area watersheds. The median PCBs mass loads were obtained by multiplying median PCBs concentrations by the sediment loads. Median PCBs mass loads from stormwater runoff discharge into the Bay are estimated at 40 kg per year with a range of 8.6 to 100 kg per year. More than 99 percent of the PCBs loads were attributed to stormwater runoff from urban areas. Non-urban stormwater runoff was estimated at 0.1 kg per year Runoff from non-urban watersheds is therefore not considered a significant load of PCBs to the Bay, indicating that atmospheric deposition of PCBs to the watershed and subsequent transport to the Bay is not a significant load of PCBs.

PCBs loads estimates for the Guadalupe River have been estimated from 0.7 to 1.2 kg/yr between 2003 and 2005 (McKee et al., 2005). However, extrapolation of these loads to all tributaries to the Bay is difficult, in part since the Guadalupe watershed drains both urban and non-urban lands.

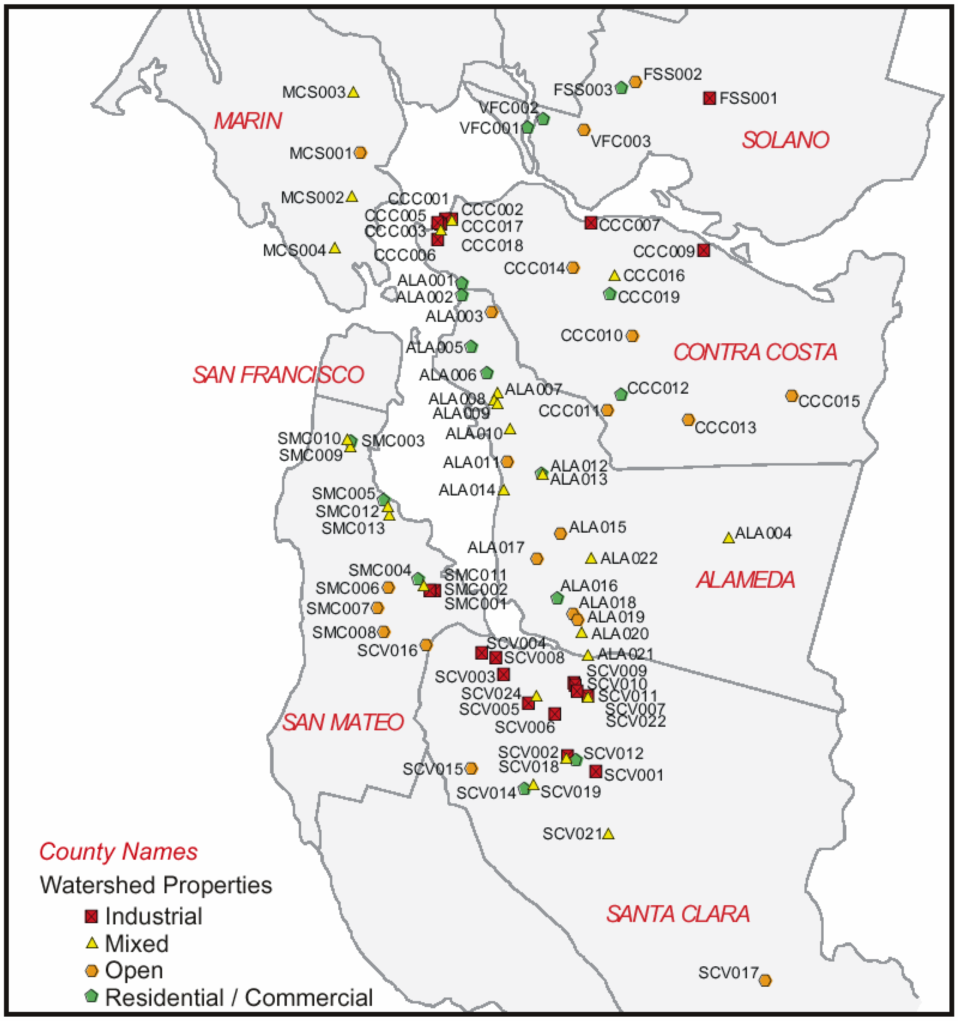

Figure 18-Sediment Sampling Locations in Stormwater Runoff Conveyance Systems (2000) (Source KLI, 2001)

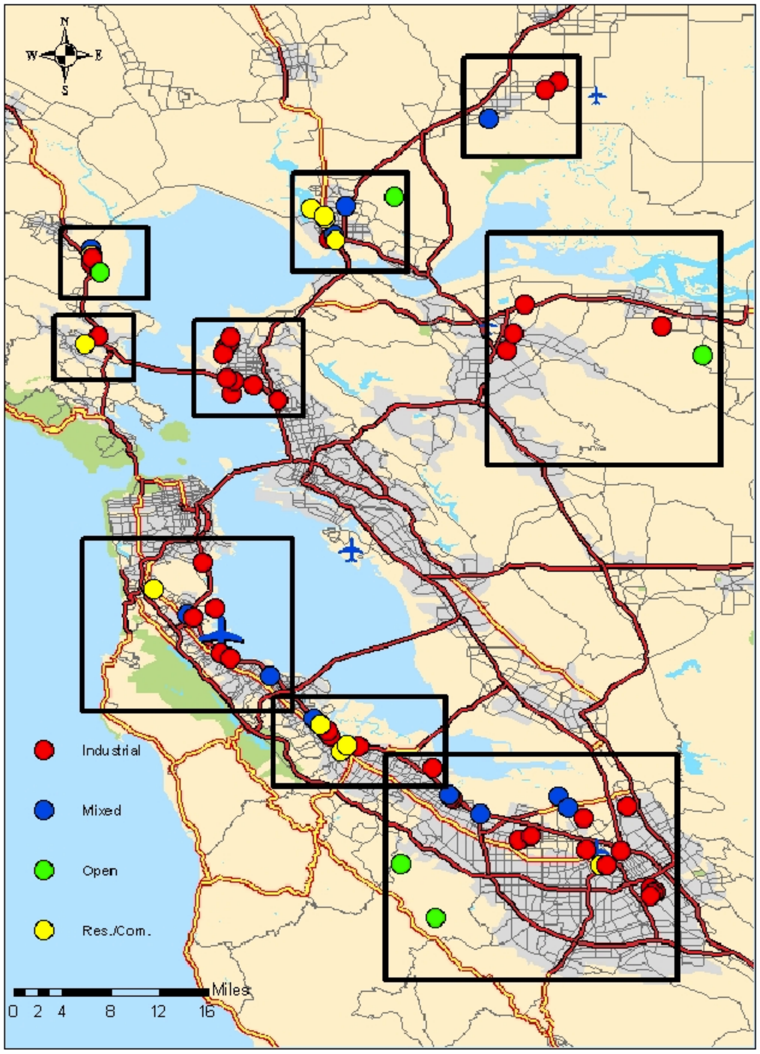

Figure 19-Sediment Sampling Locations in Stormwater Runoff Conveyance Systems (2001) (Source KLI, 2002)

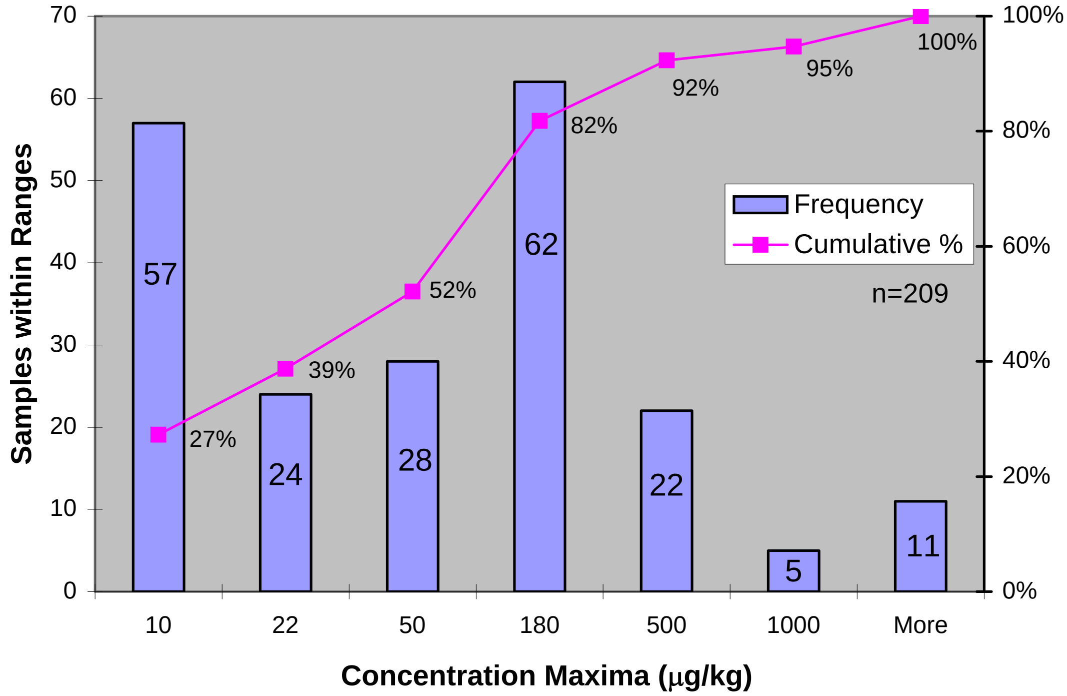

Figure 20-Sediment PCBs Concentrations Distribution in Urban Conveyance Systems (2000-2001)

7.3. Internal Sources

As discussed in section 7.1, bottom sediments are the largest environmental reservoir of PCBs in the Bay. In general, the water column PCBs mass is mostly associated with suspended sediments. Deposition of suspended sediments and re-suspension of bottom sediments are therefore important processes controlling the mass of PCBs in Bay water. Continual mixing of bottom sediments from wave action or other disturbances, such as mixing by organisms (bioturbation) or erosion of bedded sediments, can provide an ongoing supply of PCBs to the water column and biota. The large mass of PCBs in sediment denotes the importance of sediment dynamics in predicting the fate and distribution of PCBs throughout the Bay. In this section, we look at two processes affecting the bioavailability of sediment-bound PCBs. First, PCBs in the "active" sediment layer are considered because of their potential to be resuspended along with sediment and their potential for uptake by bottom dwelling aquatic organisms (bioavailability). Second, dredging activities are also considered because they can potentially cause previously buried PCBs to become bioavailable.

Active Sediment Layer

A sediment active layer can be defined many different ways based on the biophysical mechanism and reference timeframe of interest. In this report, the active layer is defined as the Bay sediments that are in contact with biota or that can be resuspended into the water column.

In one study, radioisotope dating indicated a mixing depth of about 10 cm on a timeframe of several months in Richardson Bay (Fuller et al., 1999). Biological and physical mixing within the sediment column was further substantiated by burrow worms found to a depth of 12 to 15 cm. In San Pablo Bay, the depth of the active layer was difficult to measure, as sediments at this site are believed to have undergone episodes of rapid deposition and scouring. Worms have also been observed to a depth of one to two feet in the area offshore of Hunter's Point Shipyard (U.S. Navy, 2002).

In this report, we define the active layer as the top 15 cm of sediments in the Bay to be consistent with modeling performed on the long-term fate of PCBs in the Bay. Although there is uncertainty as to the exact depth of the active layer (SFEI, 2002c), using 15 cm is appropriate to get an order of magnitude estimate of PCBs mass in the active layer because we are interested in the relative masses of PCBs in the various reservoirs and load categories. Using this depth and a mean sediment PCBs concentration of 10 µg/kg, we estimate that a PCBs mass of 1,400 kg resides in the active sediment layer of the Bay, with potentially a maximum between 3,100 and 4,900 kg (Table 18). This mass is one to two orders of magnitude greater than PCBs sources and loads discussed in section 7.2. The large mass of PCBs in the active layer, as compared to the annual loads, is likely to affect recovery of the Bay even after load reductions have been implemented.

Table 18-PCBs Mass in Sediment Active Layer in San Francisco Bay

PCBs in Sediments (µg/kg)	SurfaceArea (km^2)	Depth (m)	Total PCBs in Estuary (kg)
10	1,285	0.15	1,400
22	1,285	0.15	3,100
35	1,285	0.15	4,900

Sediment Dredging

Maintenance dredging of Bay sediments is an ongoing activity where sediment is removed from navigation channels and is disposed of at either designated in-Bay locations (Figure 21) or out of the Bay. Between 2001 and 2005, an annual average of 1.8 million cubic yards per year of dredged sediments were disposed of at in-Bay disposal sites (DMMO, 2006) while an average of about 2.4 million cubic yards of dredged sediments were removed annually from the Bay. Using five year annual averages, we can estimate the mass of PCBs disposed of in and out of the Bay (Table 19). These sediment volumes are converted to sediment dry mass as follows using the same equation as in section 7.1. Using mean ambient PCBs concentrations commonly found in the Bay (10 µg/kg), we estimate that, each year, about 10 kg/yr of PCBs are being disposed of in the Bay at dredged sediment disposal sites. During the same period, placement of dredged sediment at either upland sites or the deep ocean disposal site removes about 13 kg of PCBs per year from the Bay, resulting in a net loss of about 3 kg of PCBs each year. These are small PCBs masses compared to that in the surface layer (1,400 kg), but are on the same scale as the loads discussed in section 7.2. Note that natural processes are believed to annually resuspend much larger volumes of sediments (Table 2) and could potentially be mobilizing a significantly larger mass of PCBs.

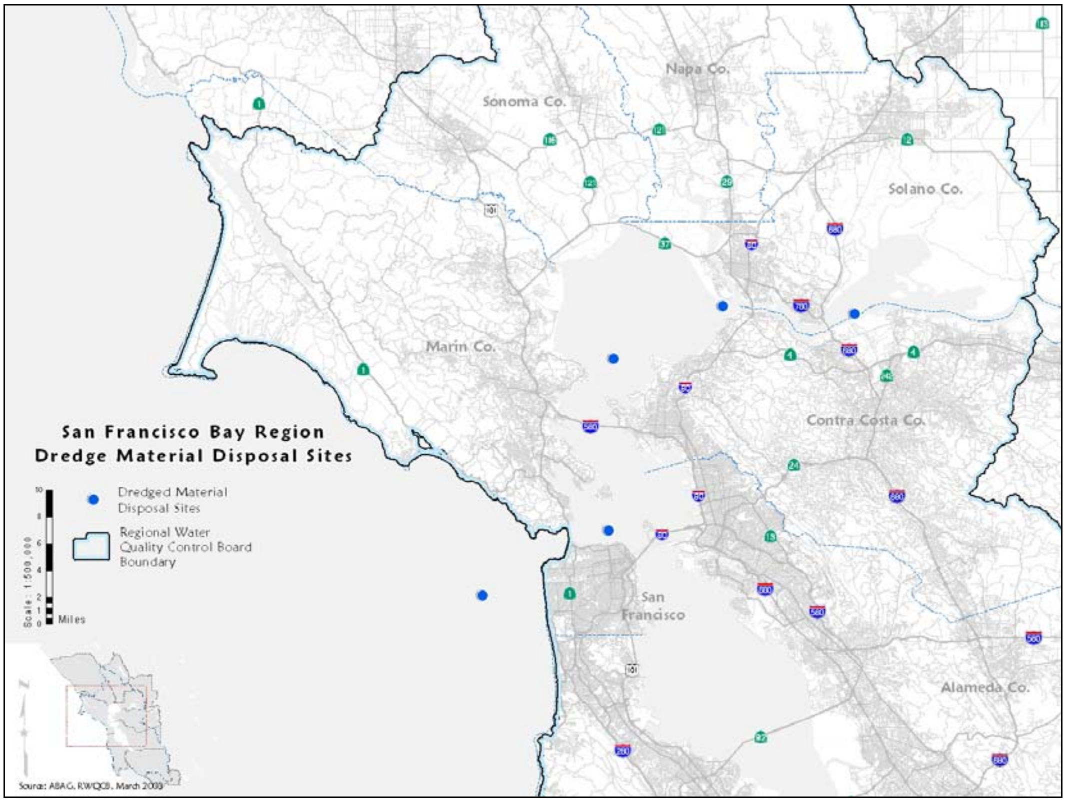

Figure 21-Dredged Sediment Disposal Sites for San Francisco Bay Region

Table 19-Estimated PCBs Mass Associated with Dredge Material Disposal (2001-2005)

Disposal Site	Total Volume 2001-2005 (cu yd)	Average Volume (cu yd/yr)	Average Annual Estimated PCB Mass (kg/yr)
In-Bay Disposal	8,900,000	1,800,000	9.9
Ocean (SF-DODS) Disposal	3,800,000	760,000	-4.2
Upland/Wetland Reuse	8,100,000	1,600,000	-9.0
Net Load			-3.3

7.4.Summary of PCBs Sources and Loads

Comparing the various load categories, excluding in-Bay sediments, the two major sources of PCBs mass to the Bay come from the Delta and urban stormwater runoff (Figure 22; Table 20) As was discussed in section 7.2, sediments from the Central Valley watershed carry a large mass of PCBs but are lower in concentrations than in-Bay sediments, potentially helping to reduce the current impact of PCBs on the Bay by burying more contaminated sediments. Therefore, implementation of the TMDL should focus primarily on reducing sediment PCBs concentrations by controlling sources in urban stormwater runoff as well as controlling the release of PCBs from contaminated sediments in the Bay.

In summary, PCBs are found mostly in the central and southern portion of the Bay (Figure 23) generally in or near areas associated with historical industrial activities. Therefore, we should focus implementation to these on land areas and the remediation of the nearby in-Bay areas most impacted by PCBs discharges.

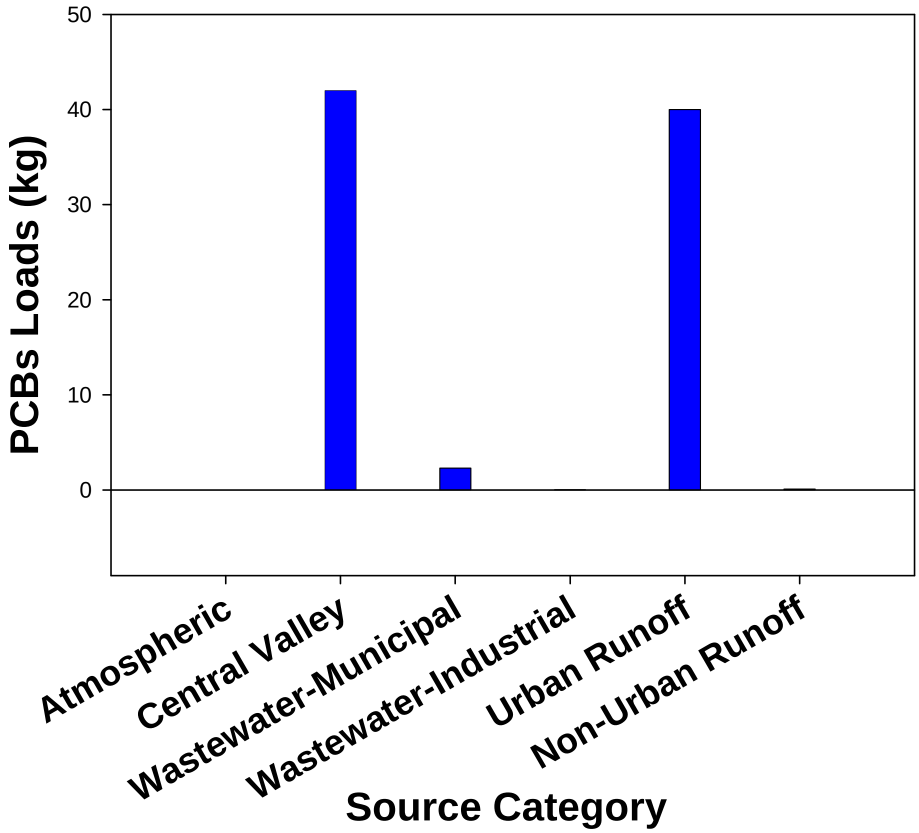

Figure 22-Sources and Loads of PCBs to San Francisco Bay

Table 20-Synopsis of PCBs loads to San Francisco Bay

Source Category	Current PCBs Loads (kg/yr)
Atmospheric	-7
Central Valley Watershed	42
Municipal Wastewater Dischargers	2.3
Industrial Wastewater Dischargers	0.035
Urban Runoff	40
Non-Urban Runoff	0.1

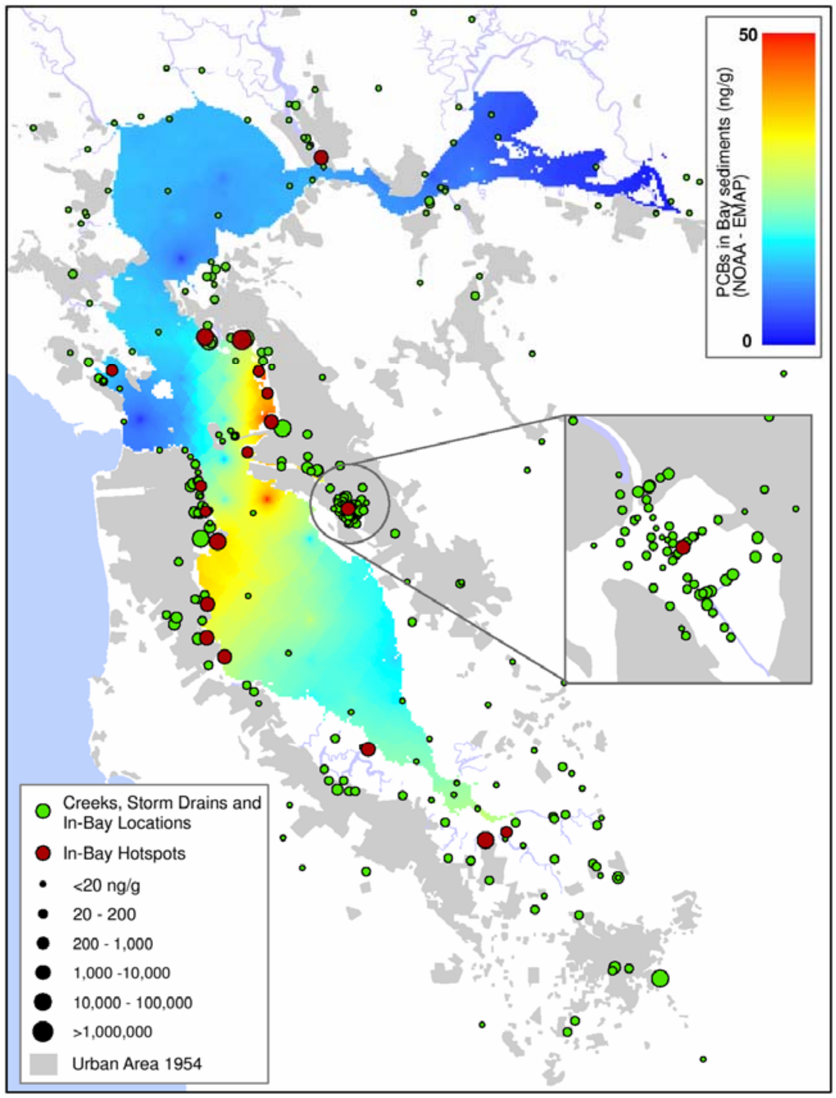

Figure 23-Overview of in-Bay and on-Land Sediment PCBs concentrations

8. Numeric Target

A numeric target is a measurable condition that demonstrates attainment of water quality standards. A numeric target can be a numeric water quality objective, a numeric interpretation of a narrative objective, or a numeric measure of some other factor necessary to meet water quality standards. In this report, we propose a fish tissue PCBs numeric target.

The fish tissue numeric target provides for the attainment of the desired conditions that support the beneficial uses currently impaired. Fish tissue PCBs concentrations are the direct cause of impairment of beneficial uses. The CTR water quality criterion for PCBs is a surrogate measure of impairment as it is derived for the protection of human health based on the risk from eating fish caught in the Bay. This PCBs TMDL focuses on fish tissue PCBs concentrations, as this is the direct measurement of impairment of commercial (COMM) beneficial uses. We expect lower bioaccumulation will also reduce the impairment of estuarine (EST) and wildlife (RARE, WILD) beneficial uses. Fish tissue PCBs concentrations are currently being monitored as part of the RMP, and therefore progress towards attaining the fish tissue numeric target is directly monitored.

8.1. Fish Tissue Target

As noted above, fish tissue PCBs concentrations are the direct cause of impairment of beneficial uses. Therefore, the proposed numeric target for the PCBs TMDL is a fish tissue PCBs concentration. The proposed fish tissue numeric target for PCBs is based on a calculated screening level developed using standard protocol (USEPA, 2000c). The screening level is defined as concentrations of PCBs in fish above which there are potential health concerns. The screening level for PCBs is calculated using Equation 2 (Section 6.2).

We calculated the screening level for a risk of one extra cancer case for an exposed population of 100,000 over a 70-year lifetime, using a mean body weight of 70 kg, a slope factor of 1 (mg/kg)/day, and a mean daily consumption rate of 0.032 kg/day. The consumption rate is the 95^{th} percentile upper bound estimate of fish intake reported by all Bay fish-consuming anglers (SFEI, 2001c). The fish tissue screening level calculated based on these numbers is 10 ng/g. This represents about a ten-fold reduction in fish tissue PCBs concentrations from current levels. This numeric fish tissue target is applicable to fish collected in summer and fall seasons, when fish tissue concentrations are most elevated (Figure 8), in consideration of seasonality.

The screening value protective of Bay sport fish consumer is calculated using the upper 95^{th} percentile consumption rate of all consumers, 32 g/day. All consumers reflect a subpopulation of Bay area residents that catch and consume sport fish which is a subset of the fisher category. The general population includes all Bay area residents, including those that do not catch or consume sport fish. As was discussed earlier about the derivation of the CTR criterion for PCBs, the water column criterion was not derived to protect subpopulations at the same risk level as the general population. We have therefore used a 10^{-5} risk level to derive the fish tissue numeric target of 0.010 mg/kg. This numeric target is also more protective than the 10^{-5} risk level since an upper bound consumption rate, rather than the mean, was used for this subpopulation. The numeric target is protective of those consuming ten times more fish, 320 g/day, at a 10^{-4} risk. This is a greater consumption rate than the maximum reported in the fish consumption study, based on a four-week recall. Finally, it is reasonable to assume that this numeric target is protective, at a 10^{-5} risk level, of the general population as only a small fraction of the overall population catch and consume fish in the Bay. Therefore, this fish tissue numeric target is protective of the general population and the most exposed population of the Bay area and is consistent with the CTR criterion. Attainment of the fish tissue target is consistent with the narrative bioaccumulation water quality objective in the Basin Plan in that it results in removal of the detrimental effects of elevated PCBs in fish.

Attainment of the fish tissue numeric target is also consistent with the CTR criterion. Bioaccumulation factors (BAFs) are the ratios of a substance's concentration in tissue of an aquatic organism to its concentration in the ambient water, where both the organism and its food are exposed and the ratio does not change substantially over time, which seems applicable to the Bay. Once developed, BAFs can be used to either predict future fish tissue concentrations based on water concentrations or inversely water column concentrations using fish tissue concentrations. We have calculated BAFs for PCBs in the entire and segments of the Bay based on current conditions (Table 21). Using these BAF values, we calculated an expected concentration of PCBs in the water column when the fish tissue numeric target is met. The model calculations predict that the CTR water quality standard will be attained upon attainment of the fish tissue numeric target for PCBs.

The CTR numeric criterion is only a surrogate measure of conditions affecting fish tissue concentration. Site-specific conditions, such as water depth and magnitude of PCBs contamination of sediments, may affect fish tissue PCBs concentrations to a larger extent than water column PCBs concentrations. Measures to attain the PCBs fish tissue numeric target will focus on reductions of pollutant mass loads and contaminated site cleanups, rather than on avoidance of exceedances of concentration-based water quality standards. A decreased input of PCBs into the Bay will result in the reduction of PCBs concentrations in sediments and a decrease in PCBs available for uptake by biota.

Attainment of the fish tissue target for PCBs in San Francisco Bay will be evaluated using white croaker (size class, 20 to 30 centimeters in length) and shiner surfperch (size class, 10 to 15 centimeters in length). These two fish species are selected as the measure of attainment of the target for three reasons. First, these two fish species have the highest PCBs concentrations of all fish monitored in the Bay (Figure 6), which is expected as they are both benthic feeders. Second, they live near shore for at least part of the year and are caught from piers and jetties. Finally, the food model predicts that attainment of the fish tissue target for white croaker and shiner surfperch will result in attainment of the target for all other fish species currently monitored in the Bay.

The average PCBs concentrations in the edible portion of these species will be used to determine attainment of the PCBs target following the methods currently in use by the RMP to ensure consistency and data comparability. The number of fish samples collected to determine compliance with the target will be based on guidance described in USEPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (EPA 823-B-00-007) and will be based on the statistical power needed to demonstrate differences over time.

Attainment of the PCBs fish tissue numeric target is also expected to result in removal of impairment of the Bay by dioxin-like PCBs. In Figure 18, we show the regression of calculated TEQ from dioxin-like PCBs to that of total PCBs in fish tissue caught in the Bay. The regression shows that a decrease of fish tissue PCBs concentrations to the fish tissue numeric target of 10 ng/g will result in a decrease of TEQ to the TEQ screening level of 0.14 pg/g.

Table 21-Bioaccumulation Factors and Estimated Water Column PCBs Concentrations upon Attainment of the Fish Tissue Target for White Croaker

Waterbody	BAF[a]	Water PCBs Concentration (pg/L)
Entire Bay	0.224	49
Central Bay	0.572	19
North Bay	0.259	43
South Bay	0.498	22

a)BAFs were calculated from pg/L in water and ng/g wet weight in fish

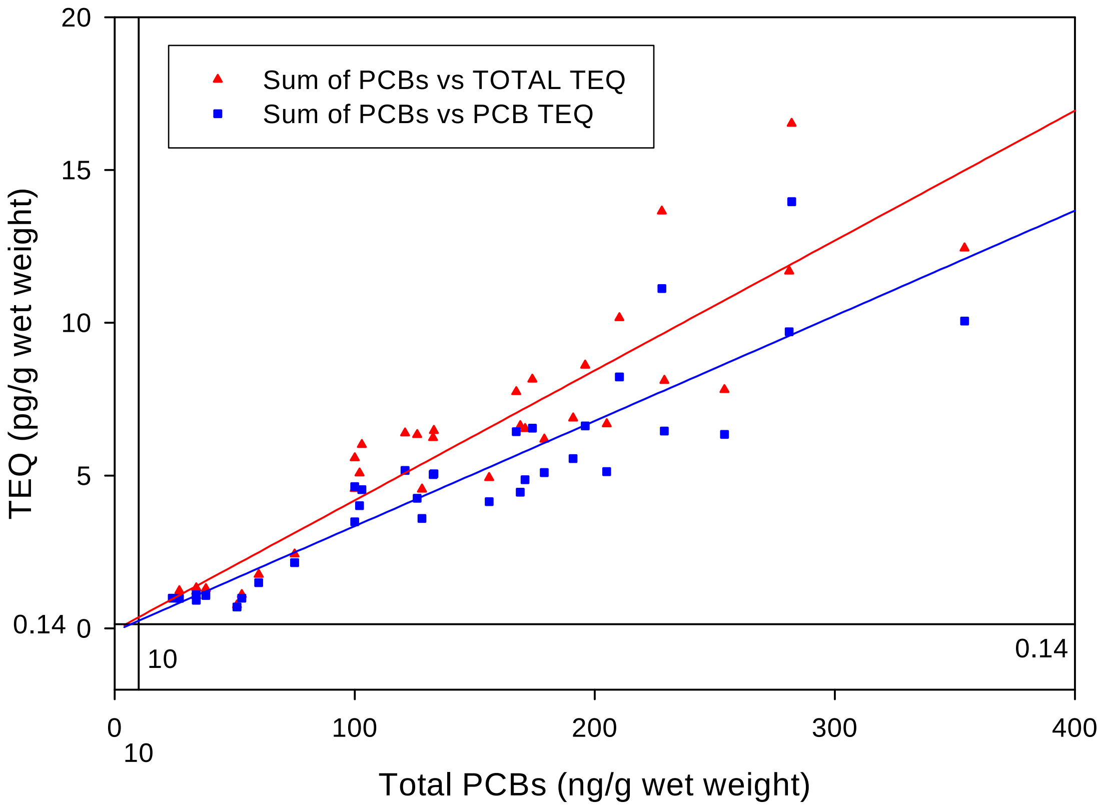

Figure 24-Regression of Dioxin-Like PCBs Total Equivalent Toxicity by Total PCBs Concentrations in Fish

8.2. Antidegradation

A numeric target must be consistent with antidegradation policies as described in 40 CFR 131.12 and SWRCB Resolution 68-16. Antidegradation policies are intended to protect beneficial uses by ensuring that water quality will be maintained at the highest levels.

The fish tissue numeric target is designed to implement the narrative water quality objective for bioaccumulation. This numeric target is intended to achieve beneficial uses of the Bay, specifically relating to the consumption of sport fish by humans. As such, it is consistent with the established numeric water quality criterion for total PCBs. Since PCBs concentrations in sediment and fish tissue currently exceed the narrative bioaccumulation objective, attaining the numeric target will improve current water quality conditions. Therefore, the numeric target is consistent with the antidegradation policies.

9. Linkage Analysis

The TMDL linkage analysis is used to connect PCBs loads to the numeric target protective of beneficial uses in the Bay. This linkage analysis can be accomplished in a variety of ways. One common approach has been to use numerical models. Water quality models for TMDL development are typically classified as either watershed (pollutant load) models or as waterbody (pollutant response) models (NRC, 2001). A watershed model relates pollutant loads to a waterbody as a function of land use and helps allocate the TMDL among sources. A waterbody model is used to predict pollutant concentrations and other responses in the waterbody as a function of the pollutant load. Other models are used to set numerical targets such as food-web models that link sources to biological receptors.

PCBs uptake by biota from sediment is well documented in the scientific literature. In a shallow bay with a large sediment PCBs reservoir, such as San Francisco Bay, this is the most important pathway for PCBs bioaccumulation in fish. Therefore, reducing PCBs concentrations in Bay sediments is the most effective means of reducing fish tissue PCBs concentrations. In this TMDL, we use a food web model to translate the fish tissue numeric target to a corresponding sediment concentration. We then use a waterbody (mass budget) model to predict the long-term fate of PCBs in the Bay and determine the external load of PCBs that will attain the sediment concentration goal resulting in attainment of the fish tissue numeric target.

The mass budget model and food web model represent the linkage between load reductions and attainment of the fish tissue numeric target, as well as between the cause of impairment and the sources of PCBs. Based on the insights provided by these two models, we first present a conceptual model of our understanding of PCBs fate and movement between environmental reservoirs (Figure 24). Figure 24 depicts the conceptual linkage between sources, reservoirs (compartments) and receptors. In this figure, we have used larger arrows and bold text to highlight the sources and processes that we consider important. The left side of Figure 24 represents the mass budget model providing the linkage between the sources, reservoirs and processes. The right side of the conceptual model highlights the food-web model providing the linkage between PCBs reservoirs and aquatic receptors. We consider urban stormwater runoff and releases from current or historical activities as the most significant sources of PCBs to the Bay. PCBs in Bay sediments are likely to function as the major source of PCBs to biota. We consider the major mechanism of PCBs uptake by fish to result from foraging on bottom dwelling organisms (benthic organisms) living in sediment.

9.1.Food Web Bioaccumulation Modeling

PCBs impairment of the Bay is related to PCBs fish tissue concentrations. In order to implement the most effective load reductions, it is critical to understand the important factors and sources causing PCBs bioaccumulation in fish. There are two general approaches for developing a linkage between PCBs concentrations in water, sediment and biota (USEPA, 2000c; USEPA, 2000d). First, there is an empirical approach where one generates data to calculate bioaccumulation factors (BAFs) and biota-sediment accumulation factors (BSAFs). BAFs are the ratios of a substance’s concentration in aquatic organisms to ambient water concentrations, taking the organism’s trophic level into consideration. BSAFs are the ratios of concentrations in aquatic organisms compared to sediment concentrations. The second approach is to develop an equilibrium or kinetic biological food web model that considers mechanistic aspects of bioaccumulation and describes the chemical reactions and physicochemical processes taking place. These two modeling approaches are complimentary as the empirical data can be used to verify, or calibrate, the food web model results.

SFEI has developed a food web model based on Gobas (1993) and Morrison et al (1997). Bay-specific data have shown that the fish species of concern have a diet consisting mainly of benthic organisms (Roberts et al., 2002), suggesting the importance of sediment PCBs as a source of PCBs to fish. This model predicts that the most sensitive endpoint is the protection of human health from the consumption of white croaker, and that attainment of conditions that result the fish tissue numeric target will be protective of wildlife. The model mathematically links the concentrations of PCBs in aquatic organisms and their prey to water and sediment PCBs concentrations via the food web as depicted in Figure 26 (Gobas and Arnot, 2005). Using this model, we can associate a specific PCBs concentration in fish to that in sediment, the main compartment of PCBs in aquatic environments, and water. Starting with the numeric fish tissue target of 10 ng/g, the model yields a corresponding concentration of 1 µg/kg PCBs in sediment. This sediment PCBs concentration goal is much lower than the sediment concentration deemed protective of wildlife of 160 µg/kg total PCBs (USEPA, 1997b), and is therefore considered to result in attainment of all beneficial uses currently impaired by PCBs. Model results validate the sediment PCBs concentration goal as protective of wildlife in San Francisco Bay.

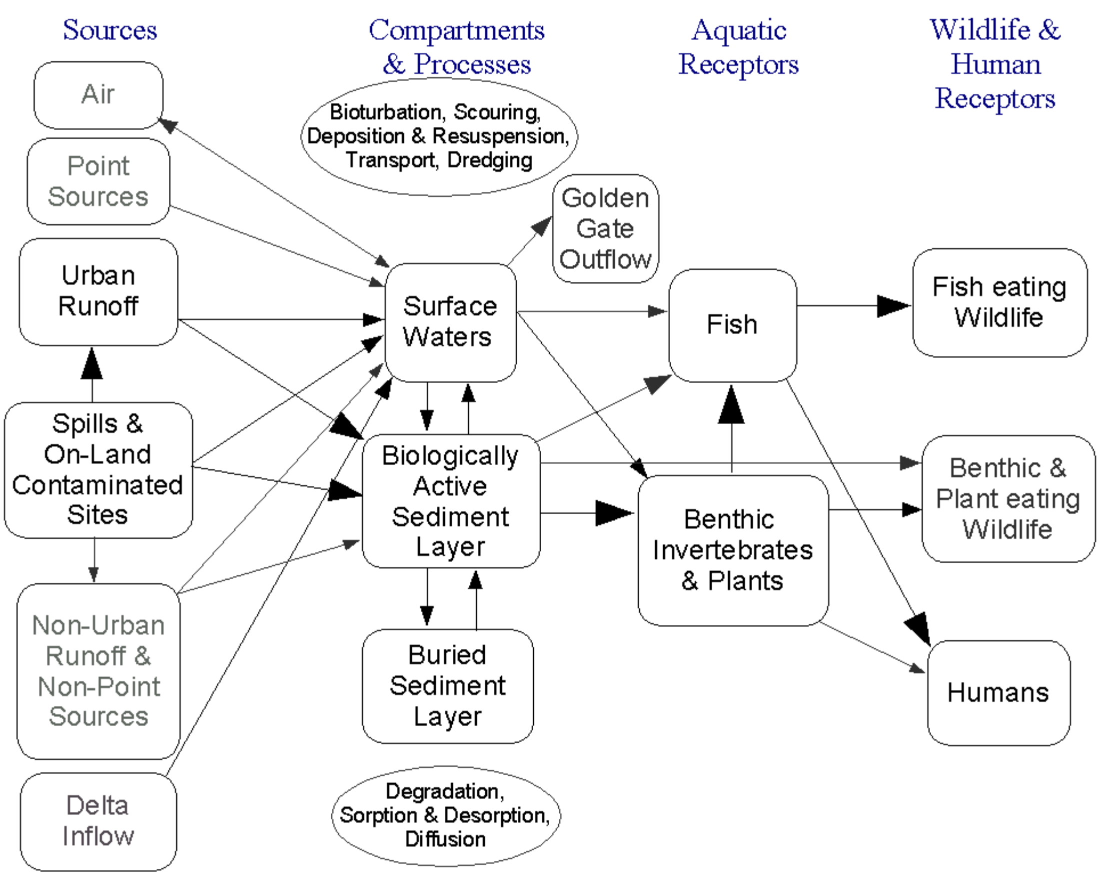

Figure 25-Conceptual Model of PCBs Movement and Fate in San Francisco Bay

This sediment goal is equivalent to reducing the total mass of PCBs in the active layer (of 0.15 m) of the entire Bay to about 160 kg. This represents a ten-fold decrease of PCBs concentrations in ambient sediments and fish tissue. The need to reduce ambient sediment PCBs concentrations by an order of magnitude to attain the 1 µg/kg sediment concentration goal is not unexpected.

Empirical models such as biota-sediment accumulation factor (BSAF) are based on a one to one relationship between sediment and fish tissue PCBs concentrations. As discussed in section 6.3, fish tissue concentrations are also an order of magnitude greater than the fish tissue numeric target for certain species. Hence the need for a ten-fold reduction in sediment to attain the fish tissue numeric target is not surprising. However, this sediment goal should not be interpreted as a clean-up goal, rather it is the long-term sediment PCBs concentration that will be attained after reduction of external loads, some targeted action on internal reservoirs of PCBs, and degradation or burial of PCBs in Bay sediments.

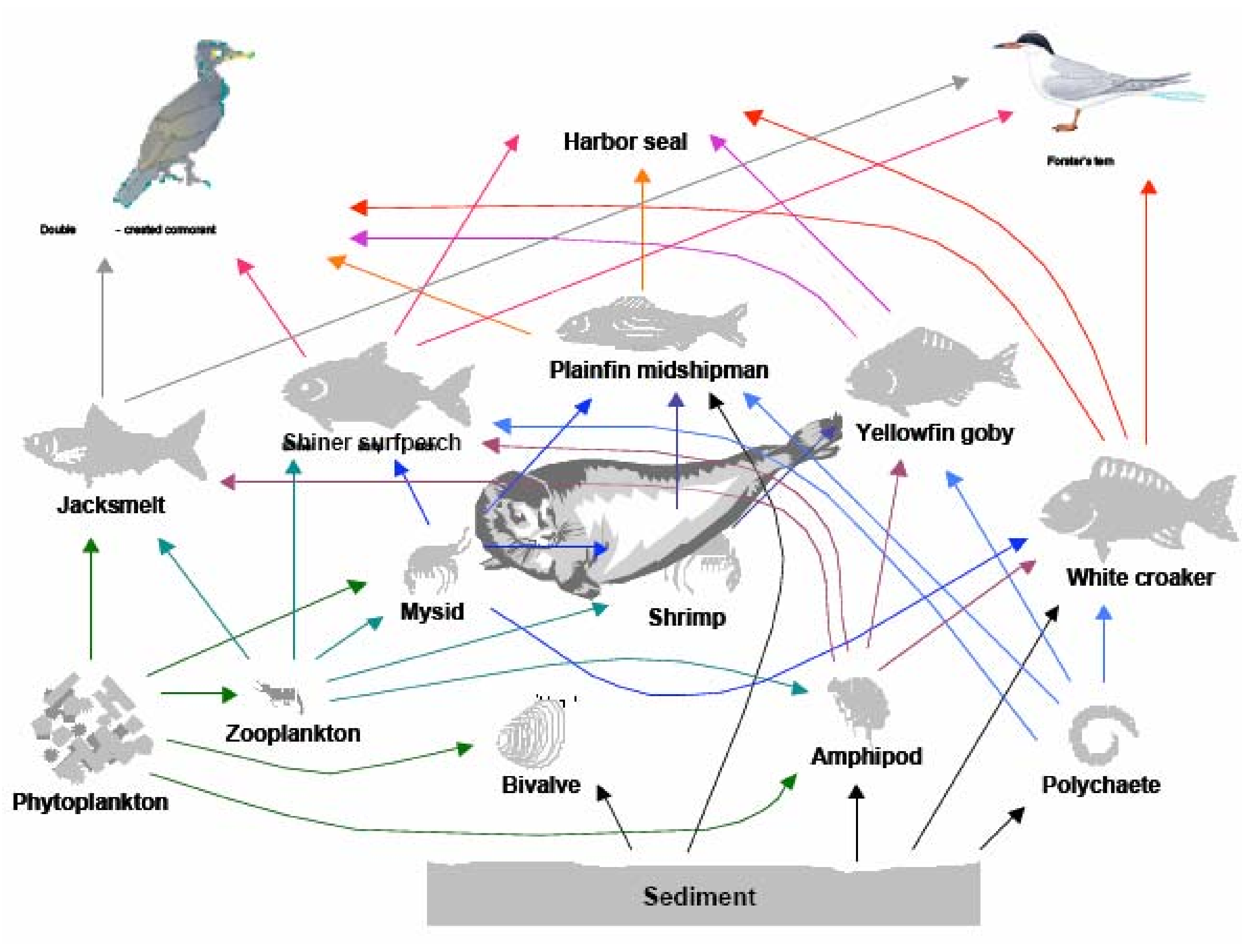

Figure 26-Food Web Model for San Francisco Bay (Gobas and Arnot, 2005)

9.2.Mass Budget Model

A mass budget model allows the exploration of different PCBs load reduction scenarios on the long-term fate of PCBs. SFEI developed a simple mass budget model for PCBs (SFEI, 2003) that treats the Bay as a single box with two environmental reservoirs: water and sediment (Figure 27). This model includes seven processes of PCBs input and loss: burial in deep sediment, degradation, external loadings, outflow to the ocean, tidal mixing, exchange with the atmosphere, and transfer between sediments and water.

The mass budget model predicts that current external PCBs loads to the Bay of about 80 kg/year will delay the reduction of the in-Bay PCBs mass and limit the reduced mass of PCBs to about 1000 kg (Figure 28). Reduction of current external loads in half to 40 kg/yr, results in a more rapid and greater reduction of PCBs in the active layer to about 500kg. Reduction of the external load to10 kg/year is needed to attain a PCBs mass in the Bay of 160 kg that is equivalent to the PCBs sediment goal of 1 µg/kg. An external load of 10 kg/yr is therefore considered the assimilative capacity of the Bay. The mass budget model predictions highlight the importance of reducing current external loads of PCBs to the Bay. Achieving these load reductions, along with cleanup of in-Bay sediment PCB-contaminated sites, will form the core of the TMDL implementation strategy.

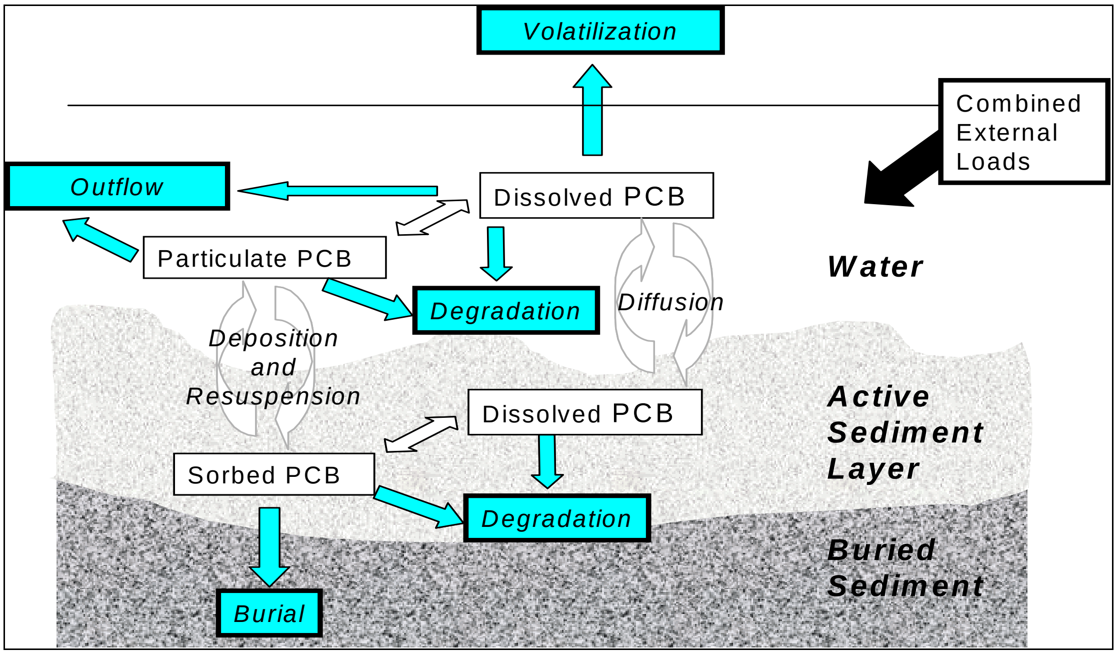

Figure 27-Mass Balance Model for PCBs in San Francisco Bay (SFEI, 2003)

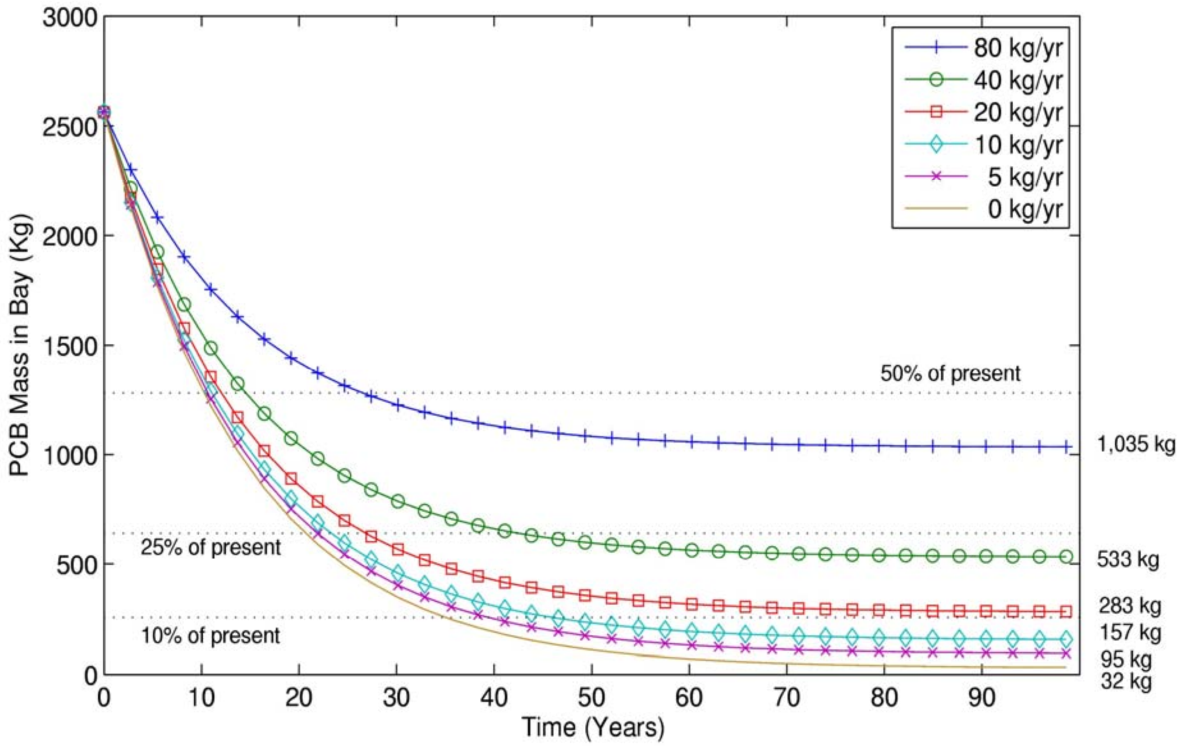

Figure 28-Predicted Long-Term Mass of PCBs in Active Sediment Layer under Different Loading Conditions (Davis et al., 2006)

10. Total Maximum Daily Load and Allocations

The total maximum daily load (TMDL) is the maximum quantity of a pollutant that can enter a waterbody and attain water quality standards. The TMDL is allocated amongst the various sources of the pollutant.

10.1. Total Maximum Daily Load

The PCBs TMDL is 10 kg/yr and represents the assimilative capacity of the Bay. This TMDL necessitates achieving a load reduction of 74 kg/yr to reduce total PCBs in the Bay active layer to 160 kg (Figure 28). This is equivalent to achieving the sediment PCBs concentration goal of 1 µg/kg, which will result in attainment of the fish tissue target of 10 µg/kg.

The TMDL is expressed as an average annual rather than as a daily load for several related reasons. First, the TMDL is derived from a mass budget model that depicts the long term (decadal) fate of PCBs. This model uses daily time steps derived by averaging annual load estimates, as the loadings data are not refined enough to provide discrete daily loads and therefore do not reflect variability in the data. Future data collection to verify attainment of the TMDL will also be collected on an annual timeframe, due to the large cost associated with these types of data. Therefore a TMDL is needed based on annual loads for comparison purposes. Also, the response of fish tissue PCBs concentrations to PCBs load reductions is not instantaneous. Even with immediate or rapid attainment of the sediment goal, there would be delay in attainment of the numeric fish tissue target, due to the time required for depuration (shedding from body) of PCBs by biota to occur. Finally, the TMDL is expressed as an average annual load because the natural variability in quantifying PCBs loads is much greater than the expected rate of load reductions. Long-term averaging of the loads is necessary to dampen out the variability in the data.

10.2. Categorical Load and Wasteload Allocations

We propose to allocate the TMDL (Table 22; Figure 29) among the existing external sources: direct atmospheric deposition, Central Valley watershed, wastewater dischargers, and urban and non-urban stormwater runoff. A portion of the TMDL is also allocated to potential future stormwater treatment by municipal wastewater dischargers. The linkage analysis shows that the fish tissue target can be achieved with reduction of external loads to the TMDL of 10 kg/yr. As such, internal sources are not assigned load allocations. However, reduction of internal loads will lead to an increased rate of recovery of beneficial uses. Sediment dredging and disposal, which results in an on-going net loss of PCBs from the Bay is expected to continue to decrease in-Bay disposal volumes and increase out-of-Bay disposal based on goals established in the "Long Term Management Strategy for the Placement of Dredged Material in The San Francisco Bay Region" (LTMS). Therefore, sediment dredging is expected to continue to remove PCBs from the Bay. In addition, remediation of in-Bay contaminated sediment is expected to decrease potential loadings from this other internal source.

The following sections present the basis of the allocation for each source category.

10.3.Wasteload Allocations

Wasteload allocations apply to all NPDES permitted discharges to the Bay, including municipal and industrial wastewater dischargers, and municipal stormwater (urban stormwater runoff) discharges.

Table 22- PCBs Load and Wasteload Allocations to San Francisco Bay

Source Category	**Allocations**
	Kilograms per year
Direct Atmospheric Deposition	0[a]
Central Valley Watershed	5
Municipal Wastewater Dischargers	2
Industrial Wastewater Dischargers	0.035
Urban Stormwater Runoff	2
Non-Urban Stormwater Runoff	0.1
Reserved for stormwater treatment by municipal wastewater dischargers	0.9
Total	***10***[b]

[a] Zero allocation reflects overall net loss to the atmosphere
[b.] Total differs from column sum due to rounding.

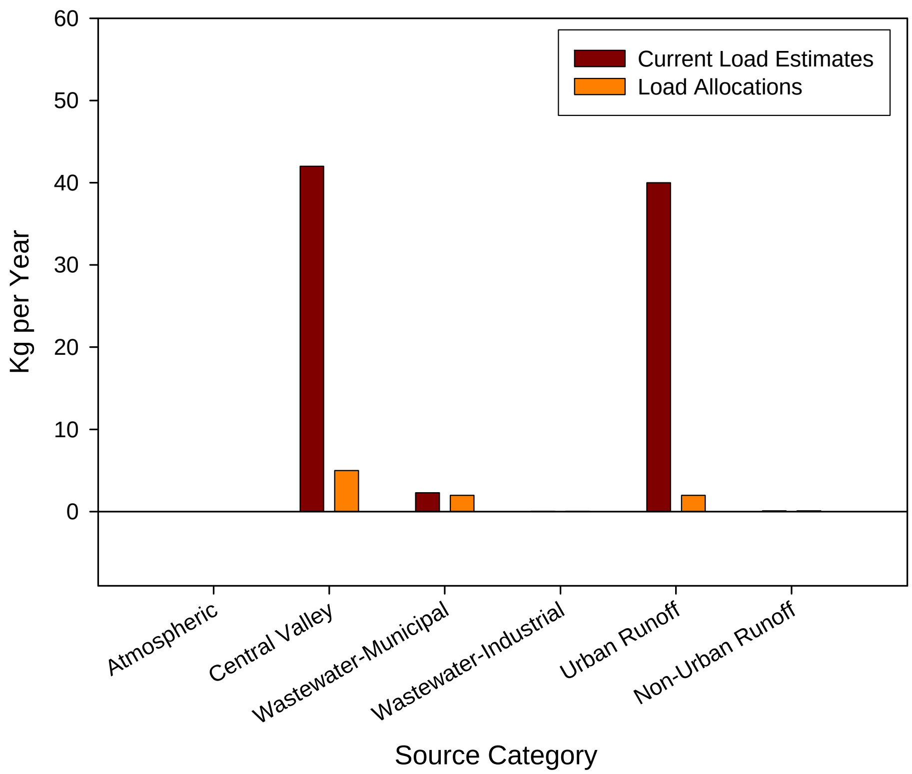

Figure 29-Loads and Allocations for PCBs to San Francisco Bay

Municipal and Industrial Wastewater Dischargers

Municipal and industrial wastewater NPDES permitted facilities (Table 23 and Table 24) discharge a small fraction of the total PCBs load to the Bay. In general, municipal and industrial wastewater dischargers operate at a high level of performance and remove PCBs via solids reduction treatment processes. The wasteload allocations for municipal wastewater dischargers total 2 kg/yr, which reflects the current estimated aggregate load of 2.3 kg/yr rounded down to one figure. The wasteload allocations for industrial facilities total 0.035 kg/yr, which reflects estimated current loads.

Individual wasteload allocations are specified for each municipal and industrial wastewater dischargers in Table 23 and Table 24, respectively. Individual load allocations are based on each facility's fraction of the total yearly wastewater discharged from this source category.

Urban Stormwater Runoff

Existing PCBs loads from urban stormwater runoff are estimated at 40 kg/yr. The proposed total wasteload allocation for urban stormwater runoff is 2 kg/yr. It reflects the resulting PCBs load when all sediment in urban stormwater runoff has a concentration of 1 µg/kg, the sediment PCBs concentration goal, assuming the sediment loads used to calculate the current PCBs load do not change. Individual county-based watershed wasteload allocations for urban stormwater runoff are presented in Table 25. This total wasteload allocation is based on the aggregate allocation of 2 kg/yr and the fraction of the Bay-side year 2000 population residing in each permitted entity (CDF, 2000; USCB, 2001). Wasteload allocations for urban stormwater runoff apply to all NPDES permitted municipal stormwater discharges (Table 25). These allocations apply to unincorporated areas and all municipalities in the county that drain to the Bay and are part of the San Francisco Bay Region. They implicitly include all current and future permitted discharges within the geographic boundaries of municipalities and unincorporated areas within each county. Examples of discharges include but are not limited to California Department of Transportation (Caltrans) roadways and non-roadway facilities and rights-of-way, atmospheric deposition, public facilities, properties proximate to stream banks, industrial facilities, and construction sites. The San Francisco allocation does not account for treatment provided by San Francisco's combined sewer system. The treatment provided by the City and County of San Francisco's Southeast Plant (NPDES permit CA0037664) will be credited toward meeting the allocation.

Urban Stormwater Runoff Treatment by Municipal Wastewater Dischargers

A potential means to reduce urban stormwater runoff PCBs loads will be to strategically intercept and route runoff to municipal wastewater treatment systems. We propose a separate wasteload allocation for discharges associated with urban stormwater runoff treatment via municipal wastewater treatment systems, since such actions will result in increased PCBs loads from municipal wastewater dischargers, and the proposed individual wasteload allocations for municipal wastewater dischargers reflect current performance levels. We propose a wasteload allocation of 0.9 kg/yr, which is the difference between the TMDL of 10 kg/yr and the sum of the other proposed wasteload and load allocations.

Table 23-Individual Municipal Wastewater Wasteload Allocations

Permitted Entity	NPDES Permit	Allocations (kilograms / year)
American Canyon, City of	CA0038768	0.002
California Department of Parks and Recreation, Angel Island State Park	CA0037401	0.00003
Benicia, City of	CA0038091	0.009
Burlingame, City of	CA0037788	0.01
Calistoga, City of	CA0037966	0.002
Central Contra Costa Sanitary District	CA0037648	0.1
Central Marin Sanitation Agency	CA0038628	0.04
Delta Diablo Sanitation District	CA0038547	0.04
East Bay Dischargers Authority	CA0037869	0.3
Dublin-San Ramon Services District (CA0037613)		
Hayward Shoreline Marsh (CA0037702)		
Livermore, City of (CA0038008)		
Union Sanitary District, Wet Weather (CA0038733)		
East Bay Municipal Utilities District	CA0037702	0.3
East Brother Light Station	CA0038806	0.0003
Fairfield-Suisun Sewer District	CA0038024	0.05
Las Gallinas Valley Sanitary District	CA0037851	0.01
Marin County Sanitary District, Paradise Cove	CA0037427	0.00003
Marin County Sanitary District, Tiburon	CA0037753	0.002
Millbrae, City of	CA0037532	0.007
Mt. View Sanitary District	CA0037770	0.007
Napa Sanitation District	CA0037575	0.04
Novato Sanitary District	CA0037958	0.02
Palo Alto, City of	CA0037834	0.09
Petaluma, City of	CA0037810	0.02
Pinole, City of	CA0037796	0.009
Contra Costa County, Port Costa Wastewater Treatment Plant	CA0037885	0.0001
Rodeo Sanitary District	CA0037826	0.002
Saint Helena, City of	CA0038016	0.001
San Francisco, City and County of, San Francisco International Airport WQCP	CA0038318	0.002
San Francisco, City and County of, Southeast Plant	CA0037664	0.3
San Jose/Santa Clara WPCP	CA0037842	0.4
San Mateo, City of	CA0037541	0.04
Sausalito-Marin City Sanitary District	CA0038067	0.005
Seafirth Estates	CA0038893	0.00001
Sewerage Agency of Southern Marin	CA0037711	0.01
Sonoma Valley County Sanitary District	CA0037800	0.01
South Bayside System Authority	CA0038369	0.06
South San Francisco/San Bruno WQCP	CA0038130	0.03
Sunnyvale, City of	CA0037621	0.05
US Naval Support Activity, Treasure Island WWTP	CA0110116	0.002
Vallejo Sanitation & Flood Control District	CA0037699	0.05
West County Agency, Combined Outfall	CA0038539	0.05
Yountville, Town of	CA0038121	0.001
Totals		***2*** [a]

[a] Total differs from column sum due to rounding.

Table 24-Individual Industrial Wasteload Allocations to San Francisco Bay

Permitted Entity	NPDES Permit	Allocations (kilograms / year)
C&H Sugar Co.	CA0005240	0.00006
Chevron Products Company	CA0005134	0.003
ConocoPhillips	CA0005053	0.0006
Crockett Cogeneration	CA0029904	0.0006
General Chemical	CA0004979	0.0009
GWF Power Systems, Site I	CA0029106	0.0001
GWF Power Systems, Site V	CA0029122	0.0001
Hanson Aggregates, Amador Street	CA0030139	0.00003
Hanson Aggregates, Olin Jones Dredge Spoils Disposal	CA0028321	0.00003
Hanson Aggregates, Tidewater Ave. Oakland	CA0030147	0.00003
Morton Salt	CA0005185	0.00008
Pacific Gas and Electric, East Shell Pond	CA0030082	0.00003
Pacific Gas and Electric, Hunters Point Power Plant	CA0005649	0.002
Rhodia, Inc.	CA0006165	0.0003
San Francisco, City and Co., SF International Airport Industrial WTP	CA0028070	0.002
Shell Oil Products US and Equilon Enterprises LLC	CA0005789	0.002
Southern Energy California, Pittsburg Power Plant	CA0004880	0.0008
Southern Energy Delta LLC, Potrero Power Plant	CA0005657	0.0003
Tesero Refining & Marketing Company	CA0004961	0.002
The Dow Chemical Company	CA0004910	0.0006
United States Navy, Point Molate	CA0030074	0.00005
USS-Posco	CA0005002	0.02
Valero Refining Company	CA0005550	0.0007
Totals		***0.035***[a]

[a] Total differs from column sum due to rounding.

10.4.Load Allocations

In this section, we present the load allocations for nonpoint source discharges of PCBs including direct atmospheric deposition, the Central Valley watershed, and non-urban stormwater runoff. Allocations focus on controllable loads of PCBs. Assessment of PCBs load reductions from sources considered uncontrollable will continue as part of the implementation of the TMDL.

Direct Atmospheric Deposition

PCBs freely exchange between the Bay and the atmosphere through both deposition and volatilization. Currently, PCBs escape to the atmosphere from the Bay at a greater rate than they are deposited from the atmosphere, resulting in a net loss of PCBs. As such, the proposed allocation to direct atmospheric deposition is zero. This load allocation is limited to PCBs that deposit directly into the Bay. Atmospheric PCBs deposited in the watershed, and indirectly washed into the Bay with runoff are not included in this source category. However, the PCBs load for non-urban stormwater runoff from open space areas is small and includes indirect loads from atmospheric deposition onto the landscape (KLI, 2002). Therefore, the indirect load from atmospheric deposition in commercial and industrial areas is also estimated to be small, contributing minimally to urban stormwater runoff discharges.

Table 25- County-Based Watershed Wasteload Allocations for Urban Stormwater Runoff

County	Population	Allocations (kilograms / year)
Alameda	1,440,000	0.5
Contra Costa	790,000	0.3
Marin	240,000	0.1
Napa	120,000	0.05
San Francisco	630,000	0.2
San Mateo	600,000	0.2
Santa Clara	1,600,000	0.5
Solano	290,000	0.1
Sonoma	110,000	0.05
Total		***2***

Central Valley Watershed

PCBs loads from the Sacramento and San Joaquin Rivers are significant. However, this load results from the large volume of sediments carried into the Bay at low sediment PCBs concentrations, although the sediment PCBs concentrations are generally greater than the sediment PCB goal. We propose to set 5 kg/yr as the Central Valley watershed load allocation, which reflects all sediments entering the Bay from the Central Valley watershed at concentrations of 1 µg/kg, the sediment PCBs concentration goal.

Non-Urban Stormwater Runoff

PCBs loads from non-urban drainages are not considered a significant load of PCBs to the Bay totaling only 0.1 kg (KLI, 2002). Sediment PCBs concentrations in open space runoff conveyances are also low with a median concentration of 0.03 µg/kg. We propose to set the allocation for non-urban stormwater runoff at the current estimated load of 0.1 kg/yr.

10.5. Margin of Safety and Seasonality

A margin of safety needs to be incorporated into the TMDL to account for uncertainty in understanding the relationship between pollutant discharges and water quality impacts (USEPA, 1991). The margin of safety can be incorporated in the TMDL either explicitly or implicitly (USEPA, 2000b). Making and documenting conservative assumptions used in the TMDL analysis provides an implicit margin of safety. The purpose of the margin of safety is to ensure, given the uncertainties in developing the TMDL, that the beneficial uses currently impaired are restored.

For the PCBs TMDL, we are incorporating an implicit margin of safety. We have used a conservative approach to derive the fish tissue numeric target. We used a high-end value, the 95th percentile consumption rate, rather than the average consumption rate allowed by USEPA

(2000c). Therefore, the fish tissue numeric target proposed in this TMDL is as protective as possible following USEPA methodology and should provide additional protection to human health from fish consumption. In addition, the wasteload allocation reserved for urban stormwater runoff treatment via municipal wastewater treatment systems is not expected to be fully utilized for several years. In the meantime, we intend to regularly review the effectiveness of implementation actions in meeting the numeric target and revise, as necessary, the proposed load and wasteload allocations. We also propose to monitor attainment of the numeric target and to reevaluate the appropriateness of the currently proposed fish tissue numeric target and associated total PCBs sediment concentration goal.

Seasonal variation also needs to be considered when developing a TMDL. As was discussed in section 6.2, PCBs concentrations in white croaker tissue collected in the Oakland Inner Harbor showed a seasonal trend with higher concentrations in summer and fall, and lower concentrations in winter and spring. This trend does not correlate with the expected higher total loading of PCBs to the Bay during the winter associated with urban stormwater and Central Valley runoff. We account for this seasonal trend by applying the fish tissue target to fish collected in the summer. In this manner, attainment of the fish tissue numeric target in the season when fish are most impacted will also be protective at other times of the year.

11. Implementation

Success of the PCBs TMDL requires an adaptive management approach to implementation actions. Adaptive implementation is a cyclical process in which TMDL plans and actions are regularly assessed for their achievement of water quality standards (NRC, 2001). Adaptive implementation simultaneously makes progress toward achieving water quality standards through implementing actions while relying on monitoring and experimentation to reduce uncertainty and refine future implementation actions.

The adaptive implementation process consists of the development of a plan that includes early implementation actions based on existing knowledge that have a reasonable probability of success and an overview of options for future actions. For PCBs in the Bay, the immediate or early implementation actions are not expected to completely eliminate the Bay impairment. Therefore, future actions must be evaluated based on continued monitoring and response to the early implementation actions, as well as based on well-designed studies used for model refinement.

This implementation plan includes three general implementation categories: control of external loadings of PCBs to the Bay, control of internal sources of PCBs within the Bay, and actions to manage risks to Bay fish consumers. In addition, the monitoring section describes monitoring required to measure attainment of the numeric target, water quality objectives and to measure implementation progress towards attainment of the load and wasteload allocations. The adaptive implementation section describes the method and schedule for evaluating and adapting the TMDL and implementation plan as needed to assure water quality standards are attained based on new information, studies to fill information gaps, and tracking and evaluation of actions.

11.1. External Sources

The following sections outline the proposed approach to adaptive implementation for mass reductions of PCBs loads from external sources.

Direct Atmospheric Deposition

There is a net removal of PCBs from the Bay through the atmosphere and consequent air-borne transport. No foreseeable actions can be taken to accelerate this loss of PCBs from the Bay. In the long-term, this loss will diminish as PCBs mass in the Bay is reduced and the numeric target is attained. A reevaluation of PCBs input and loss from the atmosphere may be needed in the future as part of reevaluation of the long term fate and transport of PCBs in the Bay, or if current implementation actions do not cause a rapid enough trend towards attainment of the target.

Central Valley Watershed

Sediments entering the Bay from the Central Valley have lower PCBs concentrations than in-Bay sediment, and major PCBs mass loading events that occur during episodic high flow events mostly flow directly out of the Bay through the Golden Gate. There are very limited locations with PCBs impairment of waters within the Central Valley watershed. The allocation will be attained through anticipated natural attenuation of PCBs in the Central Valley watershed. Verification of ongoing loads and load reductions will be a regular component of the Regional Monitoring Program.

Municipal and Industrial Wastewater Dischargers

Wasteload allocations for municipal and industrial wastewater discharges reflect current PCBs loads. Loads are expected to diminish as sources of PCBs to wastewater treatment systems diminish over time. Wasteload allocations will be implemented through NPDES permits that require implementation of best management practices (BMPs) to maintain optimum treatment performance for solids removal and to identify and manage controllable sources. Developing effluent limits for PCBs that accurately reflect treatment system performance require a substantial data set that accounts for system variability of a difficult to measure pollutant that is present at very low levels (See Section 5.2). The primary PCBs treatment mechanism is solids removal, and as such, ongoing attainment of suspended solids effluent limits provides a surrogate indicator of PCBs control. In addition to maintaining optimum solids removal performance, wastewater dischargers should evaluate whether there are any controllable sources of PCBs to their systems (e.g., industrial uses of equipment that contain PCBs).

We also propose that NPDES permits include a numeric effluent limit of 0.5 µg/L as an enforceable backstop against poor performance. This numeric effluent limit reflects the level of quantification achievable with the regulatory analytical methods promulgated under 40 CFR 136 (US EPA Method 608). NPDES permits will also require quantification of PCBs loads to the Bay every five years using a lower detection level method such as Method 1668A, in order to verify continued attainment of wasteload allocations.

We also propose a separate wasteload allocation for discharges associated with urban stormwater runoff treatment via municipal wastewater treatment systems. This allocation will be implemented through a permit that will allow municipal wastewater dischargers to apply for a portion of this reserved allocation. Although we recognize that the capacity and opportunity for existing systems to receive stormwater runoff may be limited, we expect that there will be strategic opportunities to do so.

In addition to controlling PCBs sources and discharges, municipal and industrial wastewater dischargers will be required to support actions to manage the health risks associated with the consumption of PCBs-contaminated Bay fish by people that recreationally fish, and to conduct or cause to be conducted monitoring, and studies to fill critical data needs identified in the Adaptive Implementation section.

Urban Stormwater Runoff

The urban stormwater runoff wasteload allocations shown in Table 25 will be implemented through NPDES stormwater permits issued to urban runoff management agencies. The urban stormwater runoff allocations implicitly include all current and future permitted discharges, not otherwise addressed by another allocation, and unpermitted discharges within the geographic boundaries of urban runoff management agencies including, but not limited to, California Department of Transportation (Caltrans) roadway and non-roadway facilities and rights-of-way, atmospheric deposition, public facilities, properties proximate to stream banks, industrial facilities, and construction sites.

Urban runoff management agencies can demonstrate progress toward attainment of the wasteload allocations by using one of the following methods:

1. Quantify the annual average PCBs loads reduced by implementing (a) pollution prevention activities, and (b) source and treatment controls. The Water Board will recognize such efforts as progress toward achieving the wasteload allocations and the

PCBs-related water quality standards upon which the allocations and corresponding load reductions are based. The aggregate wasteload allocation for urban stormwater runoff of 2 kg/yr represents a load reduction of 38 kg/yr from the aggregate load of 40 kg/yr, based on studies conducted in 2000 and 2001. Loads reduced as a result of actions implemented after 2001 may be used to estimate load reductions.

2. Quantify PCBs loads as a rolling five-year annual average using data on flow and water column total PCBs concentration. A five-year annual average should account for inter-annual variability.
3. Quantitatively demonstrate that the total PCBs concentration of suspended sediment that best represents sediment discharged from drainage areas is below the in-Bay surface sediment PCBs concentration goal of 1 µg/kg, which is the basis for the urban stormwater runoff wasteload allocations.

In addition to reductions due to natural attenuation, urban runoff management agencies can reduce PCBs loads by preventing PCBs sources from contaminating sediment or by reducing the amount of contaminated sediment discharged to the bay. Urban runoff management agencies can prevent contamination through various source control and pollution prevention activities, including remediation of on-land PCBs contaminated soils and control of releases of PCBs from electrical or other equipment, building materials and waste during demolition/remodeling, or other sources. In addition, urban stormwater PCBs loads can be reduced through capture, detention, and removal of highly contaminated sediment, and possibly by urban storm water treatment, including routing of PCBs contaminated runoff to wastewater treatment systems. Substantial infrastructure improvements are expected to result from implementation of construction and new development runoff permit requirements. These requirements, which promote controls such as planting vegetative buffers around impervious surfaces, may effectively control urban sediment discharges. Many of these actions also have the potential benefit of reducing other particle-associated pollutant loads in addition to PCBs.

Remediation of on-land PCBs-contaminated soils and effective PCBs prevention or removal infrastructure improvements will take several years to pilot test, evaluate, and then plan, design and implement on a scale sufficient to substantially reduce PCBs loads. As such, we propose a 20-year schedule for attaining the wasteload allocations. Requirements in each NPDES permit issued or reissued and applicable for the five-year term of the permit will be based on an updated assessment of best management practices, and control measures intended to reduce PCBs in urban runoff to the maximum extent practicable. This is consistent with the Water Board's phased approach towards attainment of water quality objectives in waters that receive stormwater discharges from urban areas described in Section 4.8 of the Basin Plan.

Specific best management practices and control measures to be considered include:

- Abatement of PCBs in runoff from areas with elevated PCBs in soils/sediments
    - Investigate and cause remediation of on-land PCBs contaminated soils and/or sediments – PCBs are a known historical contaminant in soils and sediments throughout the region, both in private and public properties, and public rights-of-ways. Although many contaminated sites have undergone remediation, it is likely that many PCBs contaminated sites remain and continue to contribute PCBs to stormwater. Urban runoff management agencies are expected to conduct or cause to be conducted by other agencies or responsible parties identification and abatement of on-land sites with PCBs contamination, such as private properties, public rights-of-ways, and stormwater conveyances.

- Improve system design, operation, and maintenance to increase fine sediment removal – PCBs are mainly transported within the stormwater conveyances attached to sediments. Many routine maintenance BMPs exist and are currently in use to control the discharge of sediments to the Bay from urban stormwater runoff, such as storm drain inlets, detention basins and street sweeping. Urban runoff management agencies are expected to implement increased routine sediment control measures within the stormwater conveyances in locations that will result in increased reduction of PCBs loads.
- Strategic runoff treatment retrofits – There are many sediment control BMPs, such as sand (or other media) filtration devices or multi-chamber treatment trains, that have not been evaluated or implemented for their ability to reduce PCBs loads in urban environments. As such, urban runoff management agencies are expected to investigate and implement as necessary new sediment treatment control measures within stormwater conveyances.
- Urban stormwater runoff treatment via municipal wastewater treatment systems – Opportunities to route dry weather and/or wet weather flows from storm drain systems to wastewater systems should be investigated, pilot tested, and implemented where feasible. This includes consideration of dry weather flows, including possible street washing flows, and wet weather flows, particularly first flush flows.

- Abatement of PCBs in runoff from all areas
  - Control/oversee removal and disposal of PCBs-containing equipment – PCBs-containing equipment remains in use with varying degrees of regulatory oversight depending on equipment type and PCBs concentration. Containment of the PCBs varies depending on equipment uses and regulatory oversight. These materials may therefore be released to the environment and enter stormwater conveyances. As such, urban runoff management agencies are expected to conduct industrial inspections to identify and replace PCBs-containing equipment remaining in the urban environment.
  - Control/manage removal and disposal of PCBs from building materials and waste during demolition/remodeling – PCBs-containing building materials remain in use with little regulatory oversight. With aging, or construction or demolition activities, these materials may be released to the environment and enter stormwater conveyances. As such, urban runoff management agencies are expected to conduct or cause to be conducted a program to manage PCBs in building materials.

In addition to controlling PCBs sources and discharges, urban stormwater management agencies will be required to develop and implement a monitoring system to quantify PCBs loads and the loads reduced through treatment, source control and other actions. The current limited monitoring of PCBs loads from local tributaries by the RMP is not sufficient to quantify PCBs loads from urban stormwater runoff and the loads reduced from urban stormwater runoff control actions. The Water Board will encourage and accept a region-wide design via augmentation of the current RMP as a means of developing and implementing the required PCBs loads monitoring.

Urban stormwater management agencies will also be required to support actions to manage the health risks of consuming PCBs-contaminated Bay fish; and conduct or cause to be conducted monitoring, and studies to fill critical data needs identified in the Adaptive Implementation section.

Urban runoff management agencies have a responsibility to oversee various discharges within the agencies' geographic boundaries. However, if it is determined that a source is substantially contributing to PCBs loads to the Bay or is outside the jurisdiction or authority of an agency the Water Board will consider a request from an urban runoff management agency which may include an allocation, load reduction, and/or other regulatory requirements for the source in question.

Urban Stormwater Runoff Treatment by Municipal Wastewater Dischargers

Routing of urban stormwater runoff through municipal wastewater treatment facilities is a means of reducing PCBs, and other particle-associated pollutant loads to the Bay. The wasteload allocation for stormwater runoff treatment via municipal wastewater treatment systems provides an incentive to implement this control measure. As described previously, proposed implementation requirements for municipal wastewater and urban stormwater runoff discharges include investigating the feasibility and PCB-removal efficiency of intercepting and routing and treating urban stormwater runoff via wastewater treatment systems, and implementing this control measure where feasible.

A wastewater discharger that accepts urban stormwater runoff will be provided an augmentation of its individual wasteload allocation that accounts for the resulting load increase. The Water Board will consider either amending individual NPDES permits or adopting a separate NPDES permit as an implementing mechanism for this wasteload allocation that would allow wastewater dischargers opportunity to apply for a portion of this wasteload allocation to account for an increase in load associated with treating urban stormwater runoff.

11.2. Internal Sources

Internal sources of PCBs have not been allocated a load. However, we expect reductions in the mass of PCBs from these source categories based on sediment removal activities or other treatment controls. Reduction of the in-Bay PCBs mass will help accelerate the recovery of the Bay from its current impairment, by driving the overall sediment PCBs concentration towards the sediment concentration goal of 1 µg/kg.

The following sections outline the proposed adaptive implementation approach to control internal sources of PCBs.

In-Bay PCB-Contaminated Sites

A number of former and current on-shore industrial and military facilities, and associated PCBs-contaminated in-Bay sediments, exist throughout the Bay. Data are not available for every site to determine whether it is currently discharging to the Bay or contributing significantly to the impairment of the Bay. While past and/or current loads of PCBs from these sites to the Bay are difficult to quantify, potentially bioavailable PCBs in off-shore sediments pose a threat to human health and the environment. As such, cleanup of these sites is a Water Board priority and many cleanups are underway. The Water Board will continue to maintain an inventory of contaminated sites (Table 13) and set priorities for investigating and remediating the sites. The Water Board will coordinate clean-up actions with U.S. EPA and the Department of Toxic Substances Control, and issue clean-up orders as necessary. Table 26 provides the status of cleanup at these sites.

The proposed approach to cleanup PCBs contaminated sites is consistent with existing efforts, wherein parties responsible for PCBs contaminated sediment sites are required to:

1. Estimate the existing and post-cleanup vertical and lateral extent of PCBs in Bay sediments;
2. Estimate the existing and post-cleanup mass of PCBs in Bay sediments;
3. Quantify rate(s) of sediment accretion, erosion or natural attenuation;
4. Implement site source control measures;
5. Evaluate, post-cleanup, the residual risks to humans and wildlife;
6. Support actions to reduce the health risks of people who consume PCBs-contaminated San Francisco Bay fish;
7. Conduct or cause to be conducted studies to fill critical data needs identified in the Adaptive Implementation section.

If not already completed, these requirements will be incorporated into individual site cleanup plans within five years of the effective date of this TMDL, with full implementation of the actions within ten years of the effective date of this TMDL or as agreed to in the individual site cleanup plan.

Table 26- In-Bay PCBs Contaminated Sites

In-Bay contaminated site remediation	Lead Agency	Status
Work Completed		
Emeryville Crescent	Water Board	Completed
Oyster Point	Water Board	Completed
Peyton Slough	Water Board	Completed
Redwood City Harbor	USACE	Completed
Former Hamilton Army Airbase – Coastal Salt Marsh	Water Board	Completed
Work In Progress		
Yosemite Slough Channel	Water Board	Site Investigation
Alameda Naval Air Station Seaplane Lagoon	U.S. EPA	Record of Decision
Hunter's Point Shipyard	U.S. EPA	Feasibility Study in preparation
Moffett Field/NASA Ames-Site 25	U.S. EPA	Feasibility Study in review
Moffett Field/NASA Ames-Northern Channel	U.S. EPA	Remediation in 2006
Oakland Army Base	DTSC	
Richmond Harbor/Potrero Point	DTSC	
Stege Marsh	DTSC	PCBs Interim Removal Action completed under Water Board lead
Work Not Started		
Cerrito Creek		
Cordonices Creek		
Guadalupe Slough		
Mission Creek		
Oakland Harbor		
Richardson Bay		
San Francisco Airport		
San Leandro Bay		
Vallejo Ferry Terminal		

Sediment Dredging

Maintenance dredging involves the removal of sediments from navigation channels and the disposal of this sediment at different permitted sites. Dredged sediment from the Bay can be disposed of at upland sites, at in-Bay disposal sites, or at a deep-ocean disposal site (USEPA/USACE, 1999a; USEPA/USACE, 1999b). The Long Term Management Strategy for the Disposal of Dredged Material in the San Francisco Bay Region (LTMS) seeks to reduce the total volume of in-Bay disposal from about 2,000,000 cubic yards per year (yd^3/yr) to approximately 1,000,000 yd^3/yr within about 10 years (USACE, 2001). The lower in-Bay dredge material disposal will result in a net removal of PCBs from the Bay.

In order to ensure that buried PCBs are not being spread out through the Bay via dredge material disposal at dispersive sites, sediments disposed of in Bay should have total PCBs concentrations no greater than that in ambient surface sediments in the Bay. To provide this assurance, we propose that the PCBs concentration in dredged material disposed of in the Bay not exceed the 99^{th} percentile total PCBs concentration of the previous 10 years of Bay surface sediment samples collected through the RMP (excluding stations outside the Bay like the Sacramento River, San Joaquin River, Guadalupe River and Standish Dam stations). Prior to disposal, the material should be sampled and analyzed according to the procedures outlined in the 2001 U.S. Army Corps of Engineers document "Guidelines for Implementing the Inland Testing Manual in the San Francisco Bay Region." All in-Bay disposal of dredged material shall comply with the Dredging and Disposal of Dredged Sediment program described in Section 4.20 of the Basin Plan and the Long Term Management Strategy for the Disposal of Dredge Material in San Francisco Bay.

In addition to controlling PCBs sources and discharges, dredged material dischargers will be required to support actions to reduce the health risks of people consuming PCBs-contaminated Bay fish, and to conduct or cause to be conducted studies to fill critical data needs identified in the Adaptive Implementation section.

11.3.Risk Management

Load reductions and consequent attainment of the numeric target to support fishing in the Bay as a beneficial use will take time to achieve. However, there are actions that should be undertaken immediately to help manage the risk to consumers of PCBs-contaminated fish. The Water Board will work with the California Office of Environmental Health Hazard Assessment, the California Department of Toxic Substances Control, the California Department of Health Services, and dischargers to pursue risk management strategies. The risk management activities will include the following:

- Investigate and implement actions to address public health impacts of PCBs in San Francisco Bay/Delta fish, including activities that reduce actual and potential exposure of and mitigate health impacts to those people and communities most likely to be affected by PCBs in San Francisco Bay caught fish, such as subsistence fishers and their families;
- Provide multilingual fish-consumption advice to the public to help reduce PCBs exposure through community outreach, broadcast and print media, and signs posted at popular fishing locations;
- Regularly inform the public about monitoring data and findings regarding hazards of eating PCBs-contaminated fish; and
- Perform special studies needed to support health risk assessment and risk communication.

11.4. Monitoring

Monitoring is needed to demonstrate progress toward attainment of allocations and the numeric target. The discharger-funded RMP currently monitors PCBs in San Francisco Bay fish, sediments, and water. The Water Board will call on dischargers to support the RMP to monitor PCBs in fish (as specified in the numeric target), in sediments and water, at a spatial scale and frequency to track trends in the decline of PCBs and to demonstrate attainment of the numeric fish tissue target and sediment concentration goal. Monitoring will provide information on the progress in attaining the TMDL target, and therefore the success of actions implemented. Long term data are needed to verify the recovery rate of the Bay, and compare this with a model predicted recovery rate. These efforts will also inform whether the actions implemented are effective in reducing PCBs to the TMDL target or whether further actions are required. A refined understanding of long term PCBs concentration trend data in water, sediment and biota could lead to a recalculation of the TMDL, and revised load and wasteload allocations.

Monitoring of load allocations to demonstrate progress towards attainment shall be conducted by municipal and industrial wastewater dischargers and by urban runoff stormwater agencies. The RMP also conducts regular monitoring of PCBs loads from the Central Valley and some limited monitoring of PCBs loads from local tributaries. The current limited monitoring of PCBs loads from local tributaries by the RMP is not sufficient to quantify PCBs loads from urban stormwater runoff or the loads reduced from urban stormwater management control actions. As described in the discussion of implementation of Central Valley allocations, the Water Board will also call on dischargers, via the RMP, to verify ongoing loads and load reductions to allow evaluation of trends in the loads of PCBs from the Central Valley watershed and to confirm that loads are being reduced due to natural attenuation.

11.5.Adaptive Implementation

Adaptive implementation entails taking immediate actions commensurate with available information, reviewing new information as it becomes available, and modifying actions as necessary based on the new information. Taking immediate action allows progress to occur while more and better information is collected, and the effectiveness of current actions is evaluated (NRC, 2001).

Periodic Review

The Water Board will adapt the TMDL to incorporate new and relevant scientific information such that effective and efficient measures can be taken to achieve the TMDL target. The Water Board will review the San Francisco Bay PCBs TMDL and evaluate new and relevant information from monitoring, special studies, and scientific literature. Any necessary modifications to the targets, allocations, or implementation plan will be incorporated into the Basin Plan. The reviews will be coordinated through the Water Board's continuing planning program and will provide opportunities for stakeholder participation.
Achievement of the allocations for Urban Stormwater Runoff is projected to take 20 years. Approximately 10 years after the effective date of the TMDL or any time thereafter, the Water Board will consider modifying the schedule for achievement of the load allocations for a source category or individual discharger provided that they have complied with all applicable permit requirements and all of the following have been accomplished relative to that source category or discharger:

- A diligent effort has been made to quantify PCBs loads and the sources of PCBs in the discharge;

- Documentation has been prepared that demonstrates that all technically and economically feasible and cost effective control measures recognized by the Water Board as applicable for that source category or discharger have been fully implemented, and evaluates and quantifies the comprehensive water quality benefit of such measures;
- A demonstration has been made that achievement of the allocation will require more than the remaining 10 years originally envisioned; and
- A plan has been prepared that includes a schedule for evaluating the effectiveness and feasibility of additional control measures and implementing additional controls as appropriate.

Critical Data Needs

Data and other information are needed to assess both the progress toward attainment of the numeric fish tissue target and to inform the adaptive implementation of the TMDL. Dischargers will therefore be required to support the following studies to fill critical data needs.

1. PCBs fate and transport modeling and food web model improvements – Model refinements are needed to improve our ability to predict recovery rates of the Bay from impairment by PCBs, and to help focus implementation actions on those with the most potential for success. Better models could lead to a recalculation of the TMDL, and revised load and wasteload allocations. The TMDL will be revised if improved models predict that the current TMDL will not result in attainment of the fish tissue target. Improved models will also help evaluate whether implemented actions are effective and sufficient, and could direct the need for different or expanded implementation actions.

2. Rate of natural attenuation of PCBs in the Bay environments – Natural attenuation is a component of the implementation of the TMDL. Attenuation rates greatly affect model prediction of recovery of the Bay from PCBs impairment. A better understanding of local rates of natural attenuation is needed in order to predict with more certainty the recovery time of the Bay, and to inform whether more implementation actions are needed. A refined understanding of the PCBs natural attenuation rate in water and sediment could lead to revised load and wasteload allocations. Specifically, load allocations to the Central Valley and dredging currently rely on natural reduction of PCBs and new findings could result in load reduction actions implementation.

12. Regulatory Analyses

This section provides the regulatory analyses required to adopt the Basin Plan amendment to establish the PCBs TMDL. It includes a discussion of the results of an environmental impact analysis and a discussion of economic considerations. The Environmental impact analysis is required under the California Environmental Quality Act (CEQA) when the Water Board adopts a Basin Plan amendment under the Water Board's certified regulatory program (California Public Resources Code § 15251 [g]). The environmental analysis also satisfies Public Resources Code § 21159 which applies when adopting rules or regulations requiring installation of pollution control equipment, compliance with a performance standard, or treatment requirement. It evaluates the reasonably foreseeable environmental impacts of the methods of compliance with the implementation plan in Section 11 and describes the reasonably foreseeable and feasible mitigation measures that could be used to reduce significant environmental impacts. The discussion of economic considerations is provided in accordance with Public Resources Code § 21159 [a] [3] [c] which requires an analysis of economic factors related to costs of implementation of the new rules or regulations. This Staff Report, including the CEQA checklist and these analyses, constitute a substitute environmental document.

The results of the assessment of environmental impacts and economic considerations show that the Basin Plan amendment is not likely to result in long-term, significant impacts and will not cause immediate, large scale expenditures by the entities required to implement the PCBs TMDL. Many of the activities related to the implementation plan for the PCBs TMDL are built on existing efforts to improve management of urban runoff, treatment of wastewater, and to remediate upland and in-Bay PCBs-contaminated sites. With regard to environmental impacts, many of the potential individual projects that may be developed to implement the Basin Plan would be required to use Best Management Practices (BMPs) and mitigation as mandatory conditions of required permits. These BMPs and other forms of mitigation, which are both feasible and already in common use as standard industry practice, are expected to reduce all potentially significant impacts to less than significant levels.

12.1. Environmental Impact Analysis: CEQA Compliance

The Water Board is the lead agency responsible for evaluating the potential environmental impacts of the proposed Basin Plan amendment to establish the PCBs TMDL and implementation plan for San Francisco Bay. To accomplish this evaluation, a standard CEQA checklist was prepared (Appendix B) along with an explanation of the results of the analysis. It includes a discussion of the potential environmental impacts as well as probable mitigation measures that could be used to eliminate or reduce the impacts. Because the Water Board cannot mandate adoption of any specific compliance method, the analysis provided here should be viewed as comparable to a programmatic or Tier 1 environmental impact review. As such, it does not and cannot present detailed analysis of project-specific impacts, since such projects have yet to be defined. Our assessment evaluates likely impacts and mitigation measures based on our best professional judgment.

Project Description and Objectives

Section 2.2 presents the project definition and objectives that provide the basis for the CEQA evaluation and are reviewed below. The project is composed of the following components:

1. Numeric target for PCBs concentrations in fish tissue;
2. Total maximum average yearly PCBs load to San Francisco Bay.
3. Allocation of the total maximum yearly PCBs load among the various external PCBs sources;
4. A plan to implement the TMDL that includes actions to reduce PCBs loads to achieve external load allocations and actions to manage internal sources of PCBs in San Francisco Bay;
5. Monitoring program to evaluate progress in meeting the numeric target and load allocations;
6. Plan and schedule for studies to improve technical understanding relevant to the PCBs TMDL and implementation plan and for reviewing progress toward meeting targets, implementing actions, and evaluating continued appropriateness and effectiveness of actions.

The basis of the TMDL is a numeric target for PCBs in fish tissue that reflects a safe level of PCBs for recreational sport fishers and wildlife. The TMDL is assigned to external sources via wasteload and load allocations which, over time, will ensure the target is reached. The primary objective of the project is to achieve the target specified by the TMDL in order to restore currently impaired beneficial uses of the Bay.

The objectives of the project which are most relevant to the analyses of environmental impacts and alternatives are listed below (the entire list is found in Section 2.2):

- Attain water quality objectives established for the Bay
- Protect beneficial uses of San Francisco Bay related to sport fishing and wildlife habitat, including rare and endangered species habitat
- Set target(s) to attain relevant water quality standards in all parts of the Bay
- Avoid imposing regulatory requirements more stringent than necessary to meet the targets designed to attain water quality standards
- Reduce loading of PCBs to the Bay from external sources

Reasonably Foreseeable Methods of Compliance

Some of the reasonably foreseeable methods of compliance with the Basin Plan amendment call for evaluation of potential actions, monitoring, participation in additional research to fill data gaps, and development of public outreach and human health risk management programs. These methods of compliance do not involve a physical change in the environment and therefore, are not subject to a CEQA review. Only implementation measures that involve a physical change in the environment are reviewed in this analysis. In addition, some actions that are described in the Implementation Plan are part of ongoing pollution reduction programs or are part of ongoing or planned remediation efforts at previously identified contaminated sites. These involve no new impacts to the environment and are also excluded from this analysis.

The following is a list of implementation measures which merit evaluation for environmental impacts:

On Land*:*

- Removal and disposal of PCBs-containing equipment
- Removal and disposal of PCBs from building materials
- Removal and disposal of PCBs residuals in sewer lines
- Remediation of contaminated soil or sediment in public rights-of-way, wastewater conveyances, and private properties
- Street cleaning (includes sweeping or washing)
- Storm drain and inlet maintenance (above and beyond normal practices)
- Construct, operate, and maintain facilities/units to intercept, divert, and treat storm water (e.g., pipelines, detention basins, wetlands, underground sand filters)

In-Bay:

- Dredge contaminated sediment with off-site disposal
- Dredge, off-site disposal and cap residual contamination in-situ

12.2. Alternatives Analysis

The discussion that follows evaluates three alternatives to the proposed Basin Plan amendment establishing a PCBs TMDL and a TMDL target in fish tissue. It presents a brief explanation of the project alternatives and demonstrates that the alternatives do not meet the objectives of the project as listed above in 12.1.

No Project Alternative

The "No-Project" alternative means that the Water Board would not adopt the Basin Plan amendment that establishes the numeric fish tissue target and associated PCBs TMDL, implementation plan, monitoring requirements, and special studies. A "No-Project" alternative would rely on natural attenuation of PCBs in the environment to attain water quality objectives and beneficial uses of the Bay.

The "No-Project" alternative does not comply with the requirement of the Clean Water Act to develop a TMDL for Section 303(d) listed impaired waters. The "No Project" alternative would not achieve the objectives of the proposed action, including attainment of water quality objectives established for the Bay, protection of the beneficial uses of San Francisco Bay related to sport fishing and wildlife habitat, including rare and endangered species habitat, set target(s) to attain relevant water quality standards in all parts of the Bay and reduction of PCBs load to the Bay from external sources.

The Project

The proposed PCBs TMDL of 10 kg/yr, including the fish tissue target, load and wasteload allocations, implementation plan and monitoring, reflects a reasonable approach for attaining the beneficial uses of San Francisco Bay with respect to PCBs impairment and meets all of the project objectives. The proposed project defines a TMDL of 10 kg/yr based on a numeric target for fish tissue protective of human health and wildlife and allocates the TMDL among the various external sources. This target is based on evaluating the lifetime incremental cancer risk of one in a 100,000 for an adult recreational sport fisher. It is derived from assuming a 70 kilogram person, consuming on average 32 grams of fish caught in San Francisco Bay per day, over a lifetime of 70 years. The fish consumption rate of 32 g/day is based on a San Francisco Bay survey (SFEI 2001c). This consumption rate represents the 95th percentile upper bound estimate of consumption for local sport fish consumers based on their four-week recall of eating Bay caught fish.

The Basin Plan amendment includes a plan to implement the TMDL, a monitoring program to evaluate progress towards achievement of the target, and a plan and schedule for additional studies. The proposed implementation schedule also provides a realistic timeframe in which to complete the tasks required by the TMDL.

Alternative Allocations

Under these alternatives, we could propose a lower or higher TMDL and lower or higher associated allocations to the various categories of dischargers.

In order to evaluate the effect of alternative TMDLs, we considered lowering the TMDL in half to 5 kg/yr and doubling the TMDL to 20 kg/yr, using the same long-term mass balance model used to set the proposed TMDL. If the TMDL were doubled to 20 kg/yr, the PCBs mass in Bay surface sediments would remain greater than 160 kg, which is the level in sediment that reflects attainment of the fish tissue target (Figure 28). This alternative therefore does not meet the project objectives including attainment of water quality objectives established for the Bay and protection of the beneficial uses of San Francisco Bay related to sport fishing.

Alternatively, if the TMDL were halved to 5 kg/yr, the PCBs mass in Bay surface sediments would be lower than 160 kg. However, the lower TMDL alternative does not meet the project objective to avoid imposing regulatory requirements that are more stringent than necessary to meet the targets designed to attain water quality standards.

Alternative Fish Tissue Target

Under this alternative, the fish tissue numeric target would be increased from the proposed 10 mg/yr to 70 mg/yr. We could have set the fish tissue numeric target using the mean concentration rate of all respondents. In the fish consumption survey, respondents included both consumers and non-consumers of Bay fish. Their mean consumption rate was 5.3 g/day, which could be used as a surrogate for the general population consumption rate. Using the same risk level of one in 100,000, we calculate a numeric fish tissue target of 70 ng/g wet weight. This is likely an underestimate of the fish tissue target for the general population as the general population of the Bay region likely consumes much less Bay caught fish than the respondents surveyed at sport fishing locations. This alternative does not meet the project objectives, including attainment of water quality objectives established for the Bay, and set target(s) to attain relevant water quality standards in all parts of the Bay.

12.3. Potential Environmental Impacts of TMDL Implementation Plan Actions

A significant impact is defined by CEQA as, “a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by a project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance," (Article 20, Section 15382). Our analysis, prepared using the CEQA checklist, identified some reasonably foreseeable methods of compliance with the Basin Plan amendment that could cause potentially significant environmental impacts in several of the categories on the CEQA checklist. The categories with potentially significant impacts *before* mitigation are:

- Air Quality
- Biological Resources
- Noise
- Utilities and Service Systems

Impacts in these categories are discussed in Section 12.5 and Table 27. In this analysis every attempt was made to anticipate projects that might reasonably be developed to implement the TMDL. However our ability to determine the extent of impacts is constrained because of the ways in which they vary by location. For example, in the case of noise, although the Federal Transit Authority has guidelines for assessing noise and vibration impacts, the significance of the impact is dependent on a number of factors, including the proximity to sensitive receptors (e.g., residential areas, schools, museums, wildlife refuges) as well other variables such as the geology of the area, construction materials of the receiving building and the presence or lack of barriers. In light of the limited information available, we took a conservative approach to evaluating impacts that was informed by our best professional judgment and experience with similar activities, such as remediation projects already carried out in the region.

12.4. Mitigation Measures

Although some potentially significant impacts have been identified, use of mitigation measures, many of which are mandatory conditions of local, state, and federal regulations and permits (i.e., mitigation requirements of the Water Board's 401 Water Quality permits) will eliminate or reduce many of these impacts to a "Less than Significant with Mitigation Incorporated" level. As used in this analysis and as defined by CEQA (Article 20, Section 15370), mitigation can be divided into four types:

1. Avoiding the impact altogether by not taking a certain action or part of an action.
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectifying or eliminating the impact over time by preservation and maintenance operations during the life of the action.
4. Compensating for the impact by replacing or providing substitute resources or environments.

It is likely that all of these mitigation strategies will be used alone or in a variety of combinations to address specific impacts associated with individual projects developed am means of compliance with the Basin Plan amendment.

It should be noted that the Water Board will not require any actions or projects to implement the PCBs TMDL that would lead to significant, permanent, negative impacts on the environment. Furthermore, we anticipate that all reasonably foreseeable potential environmental impacts will be mitigated to less-than-significant levels either through the

Water Board's regulatory and permitting authorities or under those of other agencies with jurisdiction in relevant areas, such as U.S. Environmental Protection Agency (U.S. EPA), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Occupational Health and Safety Administration (OSHA), U.S. Army Corps of Engineers (USACE), California Department of Fish and Game (CDFG), California Department of Toxic Substances Control (DTSC), and San Francisco Bay Conservation and Development Commission (BCDC).

12.5. Results of the Environmental Analysis

The CEQA checklist (Exhibit B) summarizes the results of the analysis of potential environmental impacts associated with compliance with the implementation plan in the proposed Basin Plan amendment. The standard CEQA rating system, which was used here, includes four designations of the level of significance. They are: Potentially Significant (PS), Less than Significant (LTS), Less than Significant with Mitigation Incorporated (LTSM), and No Impact (NI). Table 27 presents those environmental impacts determined to be potentially significant before mitigation and the associated mitigation measures. A discussion of the checklist environmental impact categories, impact ratings, and mitigation measures follows the summary table.

Table 27-Summary of Potentially Significant Environmental Impacts and Mitigation Measures

Environmental Impacts	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance With Mitigation
3. AIR QUALITY **IMPACT 3-B CONTRIBUTE TO AIR QUALITY VIOLATION**			
On-Land Implementation actions with potential impacts: • Construct, operate, and maintain facilities/units to intercept, divert, and treat stormwater • Remediation of PCBs-contaminated soil or sediment from public rights-of-way, storm water conveyances, and private property • Street Cleaning (washing and/or sweeping) • Storm drain and inlet maintenance Impacts: • Short-term increase in particulates (PM-10) from vehicle exhaust • Short-term increase in photo-chemical smog constituents from vehicle exhaust • Construction-related dust • Diesel exhaust (nuisance odors)	PS	On-Land Implementation of established BMPs and site-control measures to control and minimize dust include, but not limited to: • Spray down construction sites with water or soil stabilizers • Cover all hauling trucks • Maintain adequate freeboard on haul trucks • Limit vehicle speed in unpaved work areas • Suspend work during periods of high wind or air quality restrictions • Install temporary windbreaks • Use of low sulfur or emulsified diesel fuel to reduce constituents of photo-chemical smog • Use of soot traps on diesel equipment to reduce particulates Additional BMPs for removal of PCBs-containing equipment/building materials: • Use covered dust chutes for removal of material • Create a Soil Management Plan • Test and monitor on-site air quality	LTSM

Environmental Impacts	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance With Mitigation
<u>In-Bay</u> Implementation actions with potential impacts: • Dredge contaminated sediment with offsite disposal (all methods) Impacts: • Short-term increase in airborne particulates (PM-10) from barge and equipment exhaust • Short-term increase in photo-chemical smog constituents from barge and equipment exhaust	PS	<u>In-Bay</u> • Use of electric-powered excavating equipment and barges in place of diesel-fueled equipment and barges • Use of low sulfur or emulsified diesel fuel to reduce constituents of photo-chemical smog • Use of soot traps on diesel equipment to reduce particulates	LTSM
4. BIOLOGICAL RESOURCES **IMPACTS 4 C AND D: SUBSTANTIAL ADVERSE EFFECT ON FEDERALLY PROTECTED WETLANDS AND SUBSTANTIALLY INTERFERE WITH MIGRATORY FISH** <u>In Bay</u> Implementation actions with potential impacts: • Dredge contaminated sediment (all methods) Impacts: • Disturbance of near-shore tidal wetlands • Short-term habitat disturbances such as vegetation removal, noise, presence of humans	PS	<u>In-Bay</u> Mitigation measures include: • Adhere to environmental work windows outlined in Long Term Management Strategy (LTMS) (avoid seasonal migration) • Use of electric dredging equipment (noise reduction) • Use of clamshell buckets and silt screens to minimize re-suspension of sediment • Vibration dampening material on equipment • Adherence to established state and federal policies for “No Net Loss” of wetlands • Adherence to policy to avoid, minimize, mitigate for projects involving wetlands • Adherence to Water Board permit requirements, USFWS, CDFG consultation requirements • BMPs to minimize project footprint • Pre-construction survey for endangered or	LTSM

Environmental Impacts	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance With Mitigation
		sensitive species • Presence of trained on-site biological monitors • Training for construction personnel to recognize and avoid sensitive species	
11. NOISE **11-A EXPOSE PEOPLE TO NOISE IN EXCESS OF LOCAL ORDINANCES OR OTHER STANDARDS** On Land Implementation action with potential impacts: • Removal and disposal of PCBs-containing equipment • Removal and disposal of PCBs-containing building materials • Removal and disposal of PCBs residuals in sewer lines • Remediation of contaminated soil or sediment from public rights-of-way, storm water conveyances, and private property • Construct, operate, and maintain facilities/units to intercept, divert, and treat storm water Impacts: • Short-term noise related to construction activities and use of heavy equipment for all projects involving construction and removal and hauling of equipment/material from buildings	PS	On Land Mitigation measures include: • Compliance with local noise ordinances (typical standards include blackouts prohibiting use of heavy equipment on Sundays, early morning hours and evenings all week, and on holidays) • Use of noise dampening material or barriers around equipment • Engine and pneumatic exhaust controls • Locating equipment as far as practical from noise-sensitive areas • Selecting haul routes that affect the lowest number of people	LTSM

Environmental Impacts	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance With Mitigation
In-Bay • Dredge contaminated sediment (all methods) Impacts: • Use of heavy equipment during dredging and hauling activities could cause short-term, localized noise	PS	In-Bay Mitigation measures include: • Compliance with local noise ordinances (typical standards include blackouts prohibiting use of heavy equipment on Sundays, early morning hours and evenings all week, and on holidays) • Use of noise dampening material or barriers around equipment • Engine and pneumatic exhaust controls • Locating equipment as far as practical from noise-sensitive areas • Selecting haul routes that affect the lowest number of people	LTSM
11-D Substantial Temporary or Periodic Increase in Ambient Noise in Vicinity of Project On Land Implementation actions with potential impacts: • Removal and disposal of PCBs-containing equipment • Removal and disposal of PCBs-containing building materials • Removal and disposal of PCBs residuals in sewer lines • Remediation of PCBs-contaminated soil or sediment in public rights-of-way, storm water conveyances, and private property • Construct, operate, and maintain facilities/units to intercept, divert, and treat storm water	PS	On Land Mitigation measures include: • Compliance with local noise ordinances (typical standards include blackouts prohibiting use of heavy equipment on Sundays, early morning hours and evenings all week, and on holidays) • Use of noise dampening material or barriers around equipment • Engine and pneumatic exhaust controls • Locating equipment as far as practical from noise-sensitive areas • Selecting haul routes that affect the lowest number of people • Compliance with work window restrictions	LTSM

Environmental Impacts	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance With Mitigation
Impacts: • Short-term, intermittent noise from use of heavy equipment during construction or remediation activities <u>In-Bay</u> Implementation actions with potential impacts: • Dredge PCBs-contaminated sediment with off-site disposal • Dredge (partial) and cap remainder in situ Impacts: • Short-term intermittent noise from use of heavy equipment for dredging • Use of pile drivers for Installation of sheet pile walls to dewater dredge project work sites	PS	<u>In-Bay</u> Mitigation measures include: • Compliance with local noise ordinances (typical standards include blackouts prohibiting use of heavy equipment on Sundays, early morning hours and evenings all week, and on holidays) • Use of noise dampening material or barriers around equipment • Engine and pneumatic exhaust controls • Locating equipment as far as practical from noise-sensitive areas	LTSM
16. UTILITIES AND SERVICE SYSTEMS **16-B REQUIRE OR RESULT IN CONSTRUCTION OF NEW WATER OR WASTEWATER TREATMENT FACILITIES OR EXPANSION OF EXISTING FACILITIES, CONSTRUCTION OF WHICH COULD CAUSE SIGNIFICANT ENVIRONMENTAL EFFECTS** <u>On-Land</u> Implementation actions with potential impacts: • Removal and disposal of PCBs residuals in sewer lines • Construct facilities/units to intercept, divert, and treat storm water Impacts:	PS	<u>On Land</u> Mitigation measures include: • Compliance with existing, applicable zoning, land-use, permitting requirements of all agencies (local, state, and federal) • Use of standard construction BMPs to avoid and minimize environmental impacts	LTSM

Environmental Impacts	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance With Mitigation
• Projects to remove PCBs residuals from sewer lines may, in a limited number of cases, include replacement of some sections of the line • Some dischargers may strategically select sites where feasible to intercept and divert storm water to POTWs. Construction is likely to be limited to interception devices and pipelines			
16-C REQUIRE OR RESULT IN CONSTRUCTION OF NEW STORM WATER DRAINAGE FACILITIES OR EXPANSION OF EXISTING FACILITIES, THE CONSTRUCTION OF WHICH COULD CAUSE SIGNIFICANT ENVIRONMENTAL EFFECTS <u>On Land</u> Implementation actions with potential impacts: • Construction of facilities to intercept and divert urban stormwater runoff Impacts: • Impacts related to construction activities as described above	PS	<u>On Land</u> Mitigation measures include: • Compliance with existing, applicable zoning, land-use, permitting requirements of all agencies (local, state, and federal) • Use of standard construction BMPs to avoid and minimize environmental impacts	LTSM

Discussion of Environmental Impacts and Mitigation

In this section, we present the rationale for the ratings of environmental impacts listed in the CEQA checklist (Appendix B) and Table 27. The following sections are numbered to match the checklist.

1. Aesthetics

There are no known or reasonably foreseeable impacts to aesthetic values as a result of compliance with the proposed Basin Plan amendment. Significant impacts to aesthetics would involve introduction of new elements that are substantially out of character with existing land uses or would obscure or alter scenic vistas. There are no impacts of this type associated with compliance with the Basin Plan amendment.

2. Agricultural Resources

There are no known or reasonably foreseeable impacts to agricultural resources as a result of compliance with the proposed Basin Plan amendment. Significant impacts would occur if a project substantially affected agricultural lands or production processes. The reasonably foreseeable methods of compliance with Basin Plan amendment will be implemented in urban, industrial areas where there are essentially no agricultural land uses.

3. Air Quality

Project impacts to air quality in the Bay Area are assessed in relation to standards set by the Bay Area Air Quality Management District (BAAQMD) as well as compliance with federal standards under the Clean Air Act. Evaluations are based on calculations that estimate the amount of pollutants associated with a given project. Significant impact would occur if the estimates exceeded regulatory standards. In the case of implementation of the PCBs TMDL, emissions of air pollutants are primarily associated with construction activities and, therefore, they are short-term. The pollutant of greatest concern is fine particulate matter (PM_{10}), which is related to activities such as excavation, grading, vehicle travel on paved and unpaved surfaces, and vehicle and equipment emissions. Construction-related emissions of PM_{10} vary depending on a variety of factors including the level of activity, specific operations taking placing, equipment being used, and local soil and weather conditions. However, despite the variability of these influences, BAAQMD has identified feasible control measures to significantly reduce emissions of PM_{10} from construction projects. We anticipate such measures would be used as necessary for projects associated with implementation of the PCBs TMDL. Specific areas of impact and mitigation are described below. Most of the construction projects would be completed in a short time frame and therefore involve short term impacts.

Similarly, short-term impacts may be related to dredging activities to remove contaminated sediments from in-Bay sites as a result of use of dredging equipment and barges or trucks to transport dredged material to appropriate disposal sites. Only minimal contributions to air quality issues are reasonably anticipated as a result of increases in street cleaning and storm drain maintenance.

Implementation measures for the PCBs TMDL could lead to projects or other activities with impacts to air quality in the following area as listed on the CEQA checklist:

Would the project:

Impact 3- B Violate any air quality standard or contribute substantially to an existing or projected air quality violation.

These impacts are rated as potentially significant, but less than significant with mitigation incorporated.

<u>On Land</u>

Impacts: Implementation measures for the PCBs TMDL may include removal of PCB-containing equipment from buildings or other industrial facilities and disposal at appropriate offsite locations. Remediation projects may also be developed to remove contaminated soils or sediments from public rights-of-way, private property, and sewer lines. (In some rare cases, replacement of sewer lines may be necessary.) Such projects would involve the use of heavy equipment during remediation or hauling and disposal of materials.

Some dischargers responsible for urban runoff/stormwater may opt for additional street cleaning, including street sweeping and washing, or installation of new filtration systems for storm drains. Activities of this type could require more frequent operation of street cleaning machinery than under current maintenance schedules. This increase in maintenance could impact air quality on a short-term, periodic basis.

In addition, in a limited number of instances, dischargers may opt to construct facilities/units to intercept stormwater for diversion to municipal wastewater treatment facilities. This is only like to be undertaken where strategically feasible, such as in locations where municipal wastewater treatment facilities are proximate to areas with significant amounts of PCBs in urban runoff. These efforts would involve construction of pipelines connecting storm drain outlets to municipal wastewater treatment facilities.

The implementation measures for the PCBs TMDL described above could contribute to two main types of air quality impacts: increased input of PM_{10} (as described above) from dust (in construction areas) and diesel exhaust emissions as well as an increase in vehicle exhaust emissions that contain air pollutants known to contribute to photo-chemical smog, cause annoyance odors, and potentially irritate respiratory systems (particularly in sensitive individuals). The impacts would result from use of heavy equipment during construction and construction activities and from increases in street cleaning, as well. Construction-related impacts would be short-term; impacts associated with increases in street cleaning would also be short-term and minimal, but would occur on a regular basis.

Mitigation: Use of standard BMPs should reduce these impacts to less than significant levels. For particulate matter, the BMPs include, but are not limited to: spraying of construction and staging areas to control dust; covering all hauling trucks and maintaining adequate freeboard; using electric equipment when possible; ceasing construction activities during periods of high wind or episodes of poor air quality as identified by BAAQMD; using covered dust chutes for removal of building materials or equipment; developing and implementing soil management plans at all construction sites, and ongoing testing and monitoring to detect and eliminate airborne release of PCBs during remediation activities. Measures to mitigate vehicle exhaust emissions include use of construction and maintenance equipment with lower emission engines, use of soot traps or diesel particulate filters, and use of emulsified or low sulfur diesel fuel. Over time, vacuum-assisted street sweepers could be incorporated into municipal maintenance vehicle fleets, which generate less dust during operation than conventional street sweeping equipment.

In-Bay

Impacts: Remediation of PCBs-contaminated sites located along the margins of the Bay is already underway in a number of locations with additional sites scheduled for feasibility studies and potential remediation (see Section 10 of this Staff Report). These activities may involve the use of diesel powered dredging equipment and barges to transport the dredged material. On a localized, short-term basis, this equipment could contribute particulate matter as well as some of the constituents of photo-chemical smog. In addition, disposal of material from both remediation and routine maintenance dredging practices may no longer meet standards for in-Bay disposal, and would most likely be disposed of at upland facilities. (Deep-ocean disposal is also an option, although unlikely due to cost constraints.) Upland disposal could also result in increased use of diesel-fueled trucks, which would increase the release of exhaust emissions with particulates (including PM_{10}) and the constituents of photo-chemical smog.

Mitigation: Use of standard BMPs should reduce these impacts to less than significant levels. Measures to mitigate vehicle exhaust and equipment emissions include use of construction and maintenance equipment with lower emission engines, use of soot traps or diesel particulate filters, and use of emulsified or low sulfur diesel fuel. For large-scale dredging project near-shore, use of electric-powered excavating equipment and barges would significantly reduce equipment and vehicle emissions of both particulates and pollutants without a consequent loss of performance.

In addition to this review of impacts and discussion of mitigation, individual dredging projects with significant impacts would be subject to additional review pursuant to CEQA.

4. Biological Resources

Impacts to biological resources would be considered significant if the project caused substantial adverse effects directly or indirectly on a special status species (e.g., listed threatened or endangered) or candidate species. Similarly, substantial adverse impacts to sensitive natural communities, including wetlands, are considered significant impacts due to the potential presence of endangered species. Conflicts with various resource policies and plans, such as Natural Community Conservation Plans, Habitat Conservation Plans, or local tree protection ordinances, if substantial, could also be considered significant impacts.

Implementation of the TMDL for PCBs could lead to projects or activities with impacts to biological resources in three areas as listed on the CEQA checklist:

Would the project:

Impact 4-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, regional plans, policies, regulations or by California Department of Fish and Game or U.S. Fish and Wildlife Service.

Impact 4-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 the U.S. Fish and Wildlife Service.

Impact 4-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.

These impacts are rated potentially significant for in-Bay projects as explained below. There are no known reasonably foreseeable impacts to biological resources from on-land projects; this rating is also explained below.

<u>On Land</u>

There are no reasonably foreseeable impacts to biological resources from implementation of the PCBs TMDL at on-land sites. Although removal of soil and sediment could occur as part of land-based implementation activities, PCBs are normally found in highly urbanized, industrial areas where the presence of sensitive native species and habitats such as wetlands is improbable. As a result, removal of soil and sediment, PCBs-contaminated equipment and building materials, or other remediation activities at on-land sites are unlikely to disturb any rare or sensitive species or habitats. Implementation measures developed to intercept, divert, treat, and convey urban runoff to municipal wastewater treatment systems are only likely to occur at strategic locations in highly urbanized areas where urban runoff identified as a source of PCBs and wastewater treatment facilities are in close proximity, which is most likely to be in urban industrial areas. Given these factors, on-land projects have no reasonably foreseeable impacts to biological resources.

<u>In-Bay</u>

Impacts: Implementation of the PCBs TMDL at in-Bay locations could include remediation of sites with PCBs-contaminated sediments. These activities would involve dredging with offsite disposal and partial dredging combined with capping the remainder in-situ. In-Bay projects to remove PCBs-contaminated sediment would occur in near-shore areas, some of which may include sensitive tidal marsh habitat.

Dredging for remediation of in-Bay contaminated sediment could cause potential impacts to sensitive anadromous fish species such as sturgeon and coho salmon. Impacts are also possible from removal of tidal marsh vegetation and disrupting waterfowl and other wildlife that inhabit such ecosystems through short-term noise and disturbance caused by the presence of humans.

Mitigation: Use of BMPs and compliance with industry standard practices as described in the Long-term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region (LTMS), jointly developed by the Water Board, BCDC, U.S. EPA, USACE, and the State Lands Commission, and administered through the Dredged Material Management Office (DMMO), should mitigate all potentially significant impacts related to dredging of sediment contaminated by PCBs to less than significant levels. Specific mitigation measures include adherence to established work windows to time of dredging activities to avoid key seasonal activity of anadromous fish and bird species that inhabit near shore areas either seasonally or year round; use of electric dredge equipment; use of environmental (closed) clamshell buckets on dredges; and noise dampening material on equipment. Electric-powered dredging equipment has been used for San Francisco Bay dredging projects, such as in the Oakland Harbor. However, it is only feasible if the amount of material removed is very large and the site is close to shore.

Any or all of these mitigation measures could be imposed on projects through the regulatory authority of the Water Board. Therefore we anticipate that all impacts to biological resources from in-Bay dredging projects would be mitigated to less than significant levels with mitigation incorporated.

5. Cultural Resources

Cultural resources encompass archeological, traditional, and built environment resources including, buildings, other structures, objects, districts, and sites. Significant impacts to cultural resources would occur if a project caused substantial adverse changes or destroyed cultural, historical, or archeological resources or disturbed human remains.

Implementation of the PCBs TMDL could lead to projects or activities with impacts to cultural resources in two areas as listed on the CEQA checklist:

Would the project:

Impact 5-B Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5.

Impact 5-D Disturb any human remains, including those interred outside of formal cemeteries.

These impacts are rated as less than significant as explained below.

<u>On Land</u>

Impacts: Implementation measures for the PCBs TMDL could include construction of facilities/units to intercept, divert (to municipal wastewater treatment facilities where strategically feasible) and treat urban stormwater runoff; and removal of soil and sediment from PCBs-contaminated sites. Grading and excavation would affect near-surface soils in previously disturbed soils or artificial fill. Activities would not affect native soil or areas of high archeological sensitivity. Therefore these impacts are rated as less-than-significant.

<u>In Bay</u>

Impacts: Implementation of the PCBs TMDL could include dredging with offsite disposal and dredging combined with capping the remainder in-situ at sites identified as contaminated by PCBs. Such activities are most likely to be located in Bay-margin or near-shore areas adjacent to former industrial areas. It is possible, though unlikely, that dredging activities to remove PCBs-contaminated sediment in near-shore locations could uncover previously unmapped cultural resources, such as archeological sites.

6. Geology and Soils

Significant impacts to geology and soils would occur if a project exposed people or structures to potential, substantial adverse effects related to rupture of a known earthquake fault, other seismic events, or landslides. Significant impacts would also occur is a project caused substantial erosion or was located in areas with unsuitable soils or landslide-prone conditions. There are no known or reasonably foreseeable impacts to geology and soils as a result projects developed to implement the PCBs TMDL. It is unlikely that any agencies or other entities responsible for implementing this TMDL would select projects or project locations that would place people or structures at risk from seismic hazards or landslides or would develop projects requiring construction at sites with unsuitable soils.

7. Hazards and Hazardous Materials

This category refers to chemicals that have been discharged to the environment that may adversely impact the environment or human health and safety. Soil and groundwater impacted by such chemicals are also included classification. Significant impacts would occur if a project led to increased hazards to the public or environment from transport, handling, or emissions of such materials. Also included are projects located near airports and listed hazardous materials sights.

Implementation of the TMDL for PCBs could lead to projects or activities with impacts related to hazards and hazardous materials in the following three areas as listed on the CEQA checklist:

Would the project:

Impact 7-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.

Impact 7-C Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school.

Impact 7-D Be located on a site with is included on a list of hazardous materials sites complied pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment.

These impacts are rated as less than significant as explained below.

<u>On Land</u>

Impacts: Actions to implement the PCBs TMDL would include handling and transport of equipment, building materials, soil and sediment containing PCBs and other potentially hazardous material. To protect people and the environment from potential impacts from PCBs-containing material they would be handled, transported, and stored in accordance with applicable laws and regulations.

Project workers and supervisors are required to comply with applicable Occupational of Health and Safety Administration (OSHA) training requirements for site clean-up personnel. In addition, site-specific health and safety plans would be prepared in accordance with Title 8, California Code of Regulations, §5L92 and Title 29, § 1910.120 of the Federal Code of Regulations, which govern site clean-up.

<u>In-Bay</u>

Impacts: There are also on-going remediation projects at numerous sites within the Bay that have been identified as ‘hot-spots’ containing PCBs-contaminated sediment. These are also under the regulatory oversight of the Water Board, ACOE, U.S. EPA, DTSC, and BCDC. Most of the available data for PCBs contaminant levels in bay sediments indicate levels below the hazardous wasted designation level of >50 ppm.

To protect people and the environment from potential impacts from PCBs-contaminated sediment, it would be handled, transported, and stored in accordance with applicable laws and regulations.

Project workers and supervisors are required to comply with applicable Occupational of Health and Safety Administration (OSHA) training requirements for site clean-up personnel. In addition, site-specific health and safety plans would be prepared in accordance with Title 8, California

Code of Regulations, §5L92 and Title 29, § 1910.120 of the Federal Code of Regulations, which govern site clean-up.

8. Hydrology and Water Quality

Significant impacts to hydrology and water quality would occur if a project substantially alters existing drainage patterns, alters the course of a river or steam, violate water quality standards, or create or contribute to runoff that would exceed local stormwater drainage systems. Significant impacts would also occur if a project placed housing or other structures within the 100-year flood plain, or exposed people or structures to significant risks from flooding, seiches, or tsunamis. There are no known, reasonably foreseeable impacts to hydrology and water quality from the PCBs TMDL as explained below.

<u>On Land</u>

Implementation of the PCBs TMDL may include remediation projects involving removal of PCBs-contaminated soil and sediment. These projects could include activities such as excavation and backfill. They would not result in permanent changes to drainage patterns. In addition, because PCBs-contamination is most closely associated with their use in equipment such as transformers and building materials in older, highly urbanized, industrial areas, they are unlikely to occur in areas where hydrological changes or proximity to streams is of concern. Furthermore, the purpose of the PCBs TMDL and implementation plan is to attain water quality standards.

<u>In-Bay</u>

Remediation projects to remove PCBs-contaminated sediment through dredging are on-going in a number of locations along the Bay margin. Other sites are scheduled for feasibility studies and clean-up. These projects are being undertaken under regulatory programs other than the PCBs TMDL. Therefore, PCBs TMDL will not add any new impacts in this category.

9. Land Use and Planning

Significant impacts to land use and planning would occur if a project physically divided a community, conflicted with a land use plan, policy or regulation, or caused conflict with a habitat conservation plan. There are no projects related to the PCBs TMDL that would be of a type or scale to cause any impacts in this category. Projects anticipated by the PCBs TMDL implementation plan would occur on industrial sites or on the Bay margin and would not result in substantial changes to established communities or land use patterns. There are no known or reasonably foreseeable impacts to land use and planning.

10. Mineral Resources

Significant impacts to mineral resources would occur if a project resulted in the loss of a mineral resource of value locally, regionally, or statewide. There are no projects related to the PCBs TMDL that would be of a type or scale to cause any impacts in this category. None of the PCBs-contaminated sites are known to occur on land identified as a mineral resource of local, regional, or statewide significance. There are no known or reasonably foreseeable impacts to mineral resources as a result of compliance with the PCBs TMDL.

11. Noise

Significant impacts from noise would occur if a project exposed people to noise or groundborne vibration in excess of excess of established standards in a local general plan or noise ordinance or resulted in substantial permanent increase to ambient noise levels. Significant impacts can also occur if a project causes substantial temporary or periodic increases in noise or if a project is located in the vicinity of an airport and would expose people residing or working in the project area to excessive noise levels.

Reasonably foreseeable means of compliance with the PCBs TMDL at on land locations include projects for removal and disposal of PCBs-containing equipment and building materials; remediation of PCBs-contaminated soil or sediment in public rights-of-way; storm water conveyances; and private property; increased street cleaning (sweeping and washing); storm drain and inlet maintenance above what is currently done. Other possible means of compliance include projects to construct, operate, and maintain facilities/units to intercept, divert, and treat stormwater (e.g., pipelines, detention basins, underground sand filters). For in-Bay control of sources of PCBs, potential means of compliance include projects to dredge PCBs-contaminated sediment. These projects could employ a variety of methods including dredging combined with capping. A small percentage of material removed by these projects may require disposal at approve facilities at upland sites. Noise impacts related to the TMDL are primarily short-term and related to construction activities.

According to the Federal Transit Administration's guidelines for evaluation of noise and groundborne vibration associated with construction activities, assessments of noise and vibration during construction are dependent upon a number of factors. These include proximity to sensitive receptors (schools, museums, some types of parks), characteristics of the soil and rock substrate to transmit vibration, sound-proofing characteristics of buildings, and the degree of noise already present in an area. It is difficult to determine the extent of noise impacts since site-specific factors are not currently known. In addition, impacts also vary based on the type of equipment used and the number of pieces of equipment operated simultaneously. The discussion below is, therefore, general in nature. However, with implementation of industry standard mitigation, we anticipate that all noise impacts could be mitigated to less than significant levels.

Implementation of the PCBs TMDL could lead to projects or activities with impacts related to noise in three areas as listed on the CEQA checklist:

Would the project result in:

Impact 11-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?

Impact 11-B Exposure of persons to or generation of excessive groundborne vibration or groundborne noise?

Impact 11-D A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

Impacts 11-A and 11-D are rated as potentially significant, but less than significant with mitigation incorporated as explained below. Impact 11-B is less than significant and is also explained below.

On Land:

Impacts: Projects involving remediation of PCBs-contaminated sites, including removal of equipment or building materials; construction of facilities to intercept and divert stormwater; and clean PCBs-contaminated sewer lines could cause short-term, localized noise impacts.

Mitigation: Individual projects with noise impacts would be subject to applicable local permitting requirements and noise ordinances. Local agencies require implementation of standard construction BMPs to reduce noise impacts, and include, but are not limited to practices such as restrictions on operating hours and use buffer materials around/on machinery. In some cases, use of hydraulic or electric equipment could be substituted for noisier diesel equipment. Newer equipment, which emits less noise, could also be used. For particularly loud or lengthy activities, temporary noise buffers could be installed.

In-Bay:

Impacts: Dredging activities to remove PCBs-contaminated sediment from near shore or Bay margin locations could produce potentially significant noise-related impacts because they may involve the use of sheet pile to dewater work areas. Installation of sheet pile may produce short-term, potentially significant noise impacts.

Mitigation: Individual projects with noise impacts would be subject to applicable local permitting requirements and noise ordinances. Local agencies require implementation of standard construction BMPs to reduce noise impacts, such as restrictions on operating hours, for example, typical standards include blackouts prohibiting use of heavy equipment on Sundays, early mornings and evenings all week, and on holidays). Buffer materials around/on machinery and engine and pneumatic exhaust controls could be used to control noise. In some cases, use of electric powered dredging equipment may be possible as a substitute for noisier diesel machinery.

12. Population and Housing

Significant impacts to population and housing would occur if a project substantially encouraged population growth, displaced substantial numbers of people from existing housing necessitating construction of replacement housing elsewhere. There are no projects related to the PCBs TMDL that would involve construction or removal of housing or bring large numbers of people to the Bay Area. There are no known or reasonably foreseeable impacts to population and housing as a result of compliance with the PCBs TMDL.

13. Public Services

Significant impacts to public services would occur if a project resulted in substantial physical impacts as a result of requirements for increased public services such as police, fire protection, schools, or other public facilities. There are no projects related to the PCBs TMDL of a type that would increase the need for police or fire services. There are no known impacts to public services as a result of the PCBs TMDL.

14. Recreation

Significant impacts to recreation would occur if a project increased the use of existing park facilities such that physical impacts occurred of if a project included construction or expansion of park facilities leading to physical impacts. Actions to implement the PCBs TMDL would not affect use of parks or other recreational facilities or lead to physical impacts to them. There are no known impacts to recreation as a result of the PCBs TMDL.

15. Transportation and Traffic

Significant impacts to transportation and traffic would occur if a project caused a substantial increase in traffic in relation to existing traffic load/capacity of the existing street system, exceeded established level of service standards, resulted in change in air traffic patterns, lead to increases in road-related hazards, resulted in inadequate emergency access or parking.

Assessment of transportation and traffic impacts normally requires extensive study of the project area, existing traffic patterns, loads, and level of service standards. In this programmatic review, such detailed analyses are not possible, since specific projects have not yet been developed. However, Water Board staff anticipates that some reasonably foreseeable means of compliance with the PCBs TMDL could result in impacts to as identified below.

Implementation of the PCBs TMDL could lead to projects or activities with impacts to transportation and traffic in two areas as listed on the CEQA checklist:

Impact 15-A Cause an increase in traffic substantial in relation to the existing traffic load and capacity of the street system.

Impact 15-B Exceed either individually or cumulatively a level of service standard established by county congestion management agency for designated roads and highways.

These impacts are rated as less than significant as explained below.

<u>On Land</u>

Impacts: Projects to implement the TMDL could include construction of facilities to intercept, divert, treat, and convey stormwater to municipal wastewater treatment facilities. It could also result in projects for remediation or removal of PCBs-containing equipment and building materials. Remediation projects could be developed to remove soils and sediments from public rights of way, wastewater conveyances (in some limited locations), and private property. Finally, some dischargers may increase the frequency of maintenance of storm drain inlets and filtration systems as well as street cleaning (sweeping and washing).

Movement of personnel to and from work sites and hauling of equipment and materials to or from such construction or remediation sites as well as hauling of contaminated in-Bay sediments to upland disposal facilities, could potentially result in short-term impacts to traffic. Increases in the frequency of street cleaning and maintenance activities at storm drain inlets or filters could result in a minor increase in traffic.

The location, routes, and scale of such projects and activities are currently unknown. However, standard industry practices require a traffic management plan, which includes measures such as strategic route selection and carefully planned timing for haul-truck traffic, traffic impacts would be minimized. Other traffic, such as from street cleaning, would add only very small volumes of traffic that would not affect levels of service, roadway networks, or parking capacity. We anticipate that all impacts to traffic and transportation would be kept to less than significant levels.

<u>In-Bay</u>

As described above, site remediation at in-Bay locations may produce some material that does not meet new standards for in-Bay disposal. In that case, this material is most likely to be transported to appropriate on-land sites, possibly increasing traffic. However, given the small percentage of material likely to be involved and the ability to control timing and route to minimize effects, this is impacts is considered less than significant.

16. Utilities and Service Systems

Significant impacts to utilities and service systems would occur if a project exceeded wastewater treatment standards, required construction of new water or wastewater treatment facilities, new or expanded storm water drainage facilities, or a project's water needs exceeded existing resources or entitlements. Significant impacts would also occur if a project was not served by a landfill with sufficient capacity or the project failed to comply with federal, state, or local regulations for solid waste.

Implementation of the PCBs TMDL could lead to projects or activities with impacts to utilities and service systems in three areas as listed on the CEQA checklist:

Would the project:

Impact 16-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.

Impact 16-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.

These impacts are rated as potentially significant, but less than significant with mitigation incorporated as explained below.

<u>On Land</u>

Impacts: Projects to implement the PCBs TMDL could include construction of new facilities to intercept/divert and convey urban stormwater runoff to municipal wastewater facilities. Construction of any of these facilities could potentially have environmental impacts. The number and location of projects of this type is currently unknown.

Mitigation: Mitigation for these projects is linked to careful site selection. The implementation plan notes that inception and diversion of stormwater is an option that could be employed where strategically feasible, such as areas where stormwater systems and municipal treatment facilities or conveyances are close together. The benefits of this are lowered cost and lowered potential environmental impacts.

At a project-specific level, implementation actions of this type would be subject to individual review under CEQA. Individual stormwater agencies or municipal wastewater districts would be responsible for developing such projects and would serve as CEQA lead agencies. As such they would conduct project-specific environmental review and would require mitigation measures. In addition, numerous local, state, and federal permits would also be necessary, all of which would include conditions requiring mitigation for environmental impacts. The specific mitigation measures could include, but are not limited to, pre-construction BMPS, such as appropriate site selection and environmentally-friendly design; during construction, the use of standard construction BMPs appropriate to the conditions at a site; and for the project as a whole, measures appropriate to offset impacts, such as habitat restoration or enhancement, contributions to mitigation banks, etc.

<u>In-Bay</u>

This category is not applicable to in-Bay projects.

17. Mandatory Findings of Significance

The results of this analysis demonstrate that the means of compliance with TMDL for PCBs in San Francisco Bay and its Implementation Plan will not have any reasonably foreseeable potentially significant impacts on the environment that cannot be mitigated to less-than-significant levels. In addition, there are no significant cumulative impacts that are anticipated from actions to implement the PCBs TMDL.

With implementation of mitigation measures identified in the environmental checklist and required by federal, state, and local laws and regulations, impacts having a potential to degrade the environment would be reduced to less than significant levels.

Pursuant to Section 13360 of the Water Code, the Water Board cannot mandate which compliance measures responsible agencies may choose to adopt or which mitigation measures they would employ for projects to implement the PCBs TMDL that do have potentially significant impacts. However, the Water Board recommends and fully expects that appropriate compliance and mitigation measures (as needed), which are already widely in use and considered consistent with industry standards, be applied in order to avoid and reduce as well as mitigate potential environmental impacts. These measures should ensure that impacts are reduced to less than significant levels. Since the decision to perform these measures is strictly within the responsibility and jurisdiction of the individual implementing agencies, such measures can and should be adopted by these agencies (Title 14, California Code of Regulations, Section 15091 (a) (2)).

12.6. Economic Considerations Related to Potential Implementation Plan Actions

The California Environmental Quality act requires that whenever a Water Board adopts a rule that requires the installation of pollution control equipment or establishes a performance standard or treatment requirement, it must conduct an environmental analysis of reasonably foreseeable means of compliance. This analysis must take into account a reasonable range of factors, including economics. This proposed Basin Plan Amendment for the PCBs TMDL includes performance standards (e.g., targets and allocations). This part of the Staff Report discusses the reasonably anticipated costs associated with implementation methods and monitoring that might result from the proposed Basin Plan amendment.

Discussion of Costs.

The costs of implementation actions are difficult to estimate because the PCBs TMDL implementation plan applies to the entire nine-county, Bay-wide region and applies to numerous public agencies as well as individual dischargers all of which have a variety of technical needs and budgetary constraints. Thus it is difficult to anticipate which implementation measures are most likely to be adopted. Furthermore, the most costly actions will be identified and evaluated through phased pilot and feasibility studies. These assessments need to be completed before the dischargers select which action or combination of actions will be most effective and appropriate to their allocations. Also, as mentioned previously, many of the implementation measures are part of ongoing programs, and will only result in incremental increases to costs of existing programs.

These factors result in the likelihood that short-term costs will be modest. In the longer term, achieving the proposed allocations set by the TMDL may be more substantial for some dischargers. However, the implementation plan and schedule provide an opportunity to analyze alternative means of compliance and time to identify and secure adequate funding. Furthermore, because PCBs adhere to soil as do numerous other pollutants such as PBDEs, PAHs, chlorinated legacy pesticides, and heavy metals, efforts to reduce PCBs loads to the Bay will produce multi-pollutant reduction benefits.

This discussion provides an overview of the relative costs for each of the source categories that are required to implement new actions, or increased actions to attain allocations or implementation requirements. Cost information is based on similar work performed elsewhere and the best professional judgment of Water Board staff. All costs discussed below are rough estimates and only provide an order-of-magnitude characterization of costs.

Overall, the proposed urban stormwater runoff allocations will likely require the largest implementation costs. At this time, we project an upper bound to urban stormwater runoff expenditures of approximately $500 million annually. This is the current overall cost associated with municipal wastewater management. Municipal and industrial wastewater dischargers are not likely to have significant new implementation costs since their allocations reflect current treatment performance. In-Bay sources of PCBs are primarily associated with Bay-margin sites that have concentrated localized deposits of PCBs-contaminated sediment. Efforts to remediate these “hot spots” are currently underway at a number of locations and some projects have already been completed. Costs to remediate these sites may be substantial, but they are costs that would be incurred with or without the PCBs TMDL.

The following provides an overview:

<u>Municipal and Industrial Wastewater Dischargers</u>

Existing overall annual wastewater management costs exceed $500 million. These dischargers may incur incidental increases in costs associated with identifying and managing controllable sources. For municipalities, we expect this effort would be part of existing pollution prevention and source control programs and new costs would be minimal. Industrial facilities are already required to manage their use of PCBs. Use of PCBs is allowed in enclosed containers such as in transformers and capacitors. However, as this equipment ages, it must be removed and replaced with PCBs-free products. There will be some new costs associated with conducting or causing to conduct monitoring and special studies to fill critical data gaps and to participate in risk management activities (see discussion below).

<u>Urban Stormwater Runoff Dischargers</u>

The costs of attaining load reductions above and beyond natural attenuation will be substantial. We estimate Bay Area municipalities currently spend approximately $50 million per year to manage urban stormwater runoff (assuming 2.5 million households and average fees of $20 per year per household). Municipal wastewater dischargers’ current overall costs (which are ten times greater) provide a gross estimate of what it might cost to treat urban stormwater, i.e., provide an upper bound on the cost estimate to control PCBs in urban stormwater runoff.

However, a more realistic implementation scheme will be based on strategic application of numerous actions which should cost less than $500 million per year. These include:

- Removal and disposal of PCBs from building materials
- Remediation of contaminated soil or sediment in public rights-of-way, wastewater conveyances, and private property
- Street cleaning (includes sweeping or washing)
- Storm drain and inlet maintenance (above and beyond normal practices)
- Construction, operation, and maintenance of facilities/units to intercept, divert, and treat urban stormwater runoff (e.g., detention basins, wetlands, underground sand filters, swales)
- Diversion of urban storm water runoff to wastewater treatment

The proposed implementation plan and schedule provides opportunity to analyze alternative means of compliance and allows time for urban stormwater runoff agencies to secure reasonable funding. There will be some new costs associated with conducting or causing to conduct monitoring and special studies to fill critical data gaps and to participate in risk management activities (see discussion below.

<u>Sediment Dredging and Disposal</u>

The proposed sediment dredging and disposal implementation actions are based on the Long Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region (LTMS) which is already being implemented. We estimate the current annual costs of dredging and dredged sediment disposal exceeds $50 million per year. Although the LTMS is expected to result in substantial costs over time as less dredged material is disposed of in the bay and more is disposed of in the ocean or at upland sites, little or no new costs should be incurred as a result of this PCBs TMDL and implementation plan. There will be some new costs associated with conducting or causing to conduct monitoring and special studies to fill critical data gaps and to participate in risk management activities (see discussion below).

<u>In-Bay Contaminated Sediment</u>

A number of sites within the Bay have already been clean-up or are currently undergoing remediation or feasibility studies to determine the type and level of clean-up required. Costs per site vary significantly, ranging from about one million to tens of millions of dollars and up to one to four million dollars per acre. Studies alone cost hundreds of thousands of dollars. The most substantial costs are associated with dredging and disposal of contaminated sediments; depending on the degree of contamination, disposal costs range from about $10 to $100 per cubic yard. However, less costly alternatives exist, such as partial dredging and in-situ capping of residually-contaminated sediments. Also, contaminated sites usually contain numerous pollutants in addition to PCBs, such as heavy metals, petroleum hydrocarbons, and pesticides. So even though there are and will be substantial costs associated with completing existing and new clean-ups, these sites will be subjected to clean-up with or without this TMDL and little or no new costs should be incurred as a result of this TMDL.

<u>Monitoring and Special Studies</u>

The Regional Monitoring Program (RMP) conducted by the San Francisco Estuary Institute collects much of the data that are required as part of the ongoing assessment of the health of the Bay. The RMP is jointly funded by municipal and industrial wastewater dischargers, The current budget for the program is $3.4 million, which includes monitoring of PCBs in water, sediment, and fish throughout the Bay. Maintaining this effort should be sufficient to track attainment of the TMDL target and recovery of the Bay. In addition, the RMP also conducts regular monitoring of PCBs loads from the Central Valley and limited monitoring of PCBs loads from local tributaries. Additional monitoring will be necessary to sufficiently quantify loads from urban stormwater runoff and the loads reduced from urban stormwater runoff control actions. As with the control measures, this loads monitoring would also address other pollutants of concern such as heavy metals, pesticides, and petroleum hydrocarbons. This additional monitoring could cost $500 thousand to $1 million per year, but it would inform decisions to implement controls that may total upwards of $100 million per year.

There are critical data needs to improve our understanding of PCBs fate and transport, particularly PCBs in Bay sediments. Also, a better understanding of the rate of natural attenuation of PCBs in Bay environments is needed to predict with more certainty the recovery time of the Bay, and to inform whether more implementation actions are needed. We estimate these costs, which would be shared by all source category dischargers, urban stormwater dischargers, and dredgers, would total approximately $1 to 3 million, some of which would be accounted for within the existing RMP.

<u>Risk Management</u>

The risk management activities range from conducting studies to support health risk assessment and risk communication associated with eating Bay fish, providing outreach and advice to the general public and regular consumers of Bay fish, and investigating and implementing direct actions that reduce the actual and potential exposure of, and mitigate health impacts to, people and communities most likely to be consuming PCBs-contaminated fish from San Francisco Bay. Responsibility and costs associated with these activities will be shared among the California Office of Environmental Health Hazard Assessment, the California Department of Toxic Substances Control, the California Department of Health Services, dischargers, community-based organizations, and the Water Board. Although the direct risk reduction, studies, outreach efforts and mitigation actions have yet to be determined, they will likely cost in the range of $100 thousand to $1 million dollars per year.

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APPENDIX A

Proposed Basin Plan Amendment

San Francisco Bay PCBs TMDL

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Add the following language to Chapter 7, Water Quality Attainment Strategies including Total Maximum Daily Loads, of the Basin Plan:

San Francisco Bay Polychlorinated Biphenyls TMDL

The following sections establish the TMDL for total polychlorinated biphenyls including dioxin-like PCBs congeners (hereinafter referred to as PCBs) for the San Francisco Bay. The associated numeric target, allocations, and implementation plan are designed to ensure attainment of beneficial uses and water quality objectives for the San Francisco Bay.

Problem Statement

All segments of the San Francisco Bay have been identified as impaired due to elevated levels of PCBs in sport fish. Neither the narrative water quality objective, which states that controllable water quality factors shall not cause a detrimental increase in toxic substances found in bottom sediments or aquatic life, nor the numeric water quality objective of 0.00017 µg/L total PCBs in water is attained in the San Francisco Bay. Existing beneficial uses not fully supported, are commercial and sport fishing, preservation of rare and endangered species, estuarine habitat, and wildlife habitat.

This TMDL addresses impairment of San Francisco Bay segments by PCBs. In the context of this TMDL, “San Francisco Bay” refers to all of the following water bodies:

- Sacramento/San Joaquin Delta (within Region 2)
- Suisun Bay
- Carquinez Strait
- San Pablo Bay
- Richardson Bay
- San Francisco Bay, Central
- San Francisco Bay, Lower (including)
    - Central Basin, San Francisco
    - Mission Creek
    - Oakland Inner Harbor (Fruitvale site)
    - Oakland Inner Harbor (Pacific Dry-Dock Yard 1 site)
- San Francisco Bay, South

Numeric Target

The numeric target (also referred to as the TMDL target) to protect both human health and wildlife is an average fish issue concentration of 10 micrograms total PCBs per kilogram of typically consumed fish, on a wet weight basis (10 µg/kg wet weight). The targeted fish species are white croaker and shiner surfperch). Attainment of the total PCBs fish tissue numeric target will also protect human health and wildlife for dioxin-like PCBs.

Attainment of the fish tissue target for PCBs in San Francisco Bay will be evaluated in white croaker (size class, 20 to 30 centimeters in length) and shiner surfperch (size class, 10 to 15 centimeters in length). The average total PCBs concentration in the edible portion of these fish will be used to determine attainment of the PCBs target. The number of fish samples collected to determine compliance with the target will be based on guidance described in USEPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (EPA 823-B-00-007) and on the statistical power needed to demonstrate trends in total PCBs concentration over time.

Sources

Sources of PCBs to fish and the water column of San Francisco Bay fall into two categories: (1) external sources including atmospheric deposition, Central Valley inflow, municipal and industrial wastewater discharges, and urban and non-urban stormwater runoff; and (2) internal sources, including movement or release of PCBs already in San Francisco Bay sediments, specifically, dredging and in-Bay disposal of dredged sediment, erosion of bay bottom sediment containing PCBs (bed erosion), and in-Bay contaminated sediment sites. These sources and estimates of associated loads are shown in Table A-1. Decreases of PCBs in San Francisco Bay occur via out-of-Bay dredge material disposal, natural attenuation, and outflow through the Golden Gate.

Table A- 1 PCBs Sources and Current Loads to San Francisco Bay

Source Category	PCBs Loads
	Kilograms per year
External	
Direct Atmospheric Deposition	net loss
Central Valley Watershed	42
Municipal Wastewater Dischargers	2.3
Industrial Wastewater Dischargers	0.035
Urban Stormwater Runoff	40
Non-Urban Stormwater Runoff	0.1
Total	***84***[a]
Internal	
Sediment Dredging and Disposal	Net Loss
Bed Erosion	Not Quantified
In-Bay Contaminated Sediment	Not Quantified

a) Total differs from column sum due to rounding

Total Maximum Daily Load

The TMDL for PCBs in San Francisco Bay is 10 kg/year. Calculation of the TMDL is based on two models: a food-web PCBs bioaccumulation model and a long-term fate mass balance model. The model results predict that attainment of the numeric target will occur when the total PCBs concentration in surface sediments in the Bay declines to one µg/kg, which will be achieved when loads from external sources are reduced to 10 kg/year.

Load and Wasteload Allocations

Load allocations presented in Table A-2 are based on apportioning the TMDL of 10 kg/year to the external sources only. Load and wasteload allocations to Central Valley inflow, and urban and non-urban stormwater runoff are based on sustained constant sediment mass input with a sediment PCBs concentration of one µg/kg. Wasteload allocations to municipal and industrial wastewater dischargers are set at current loads. The remaining portion of the TMDL is allocated to future treatment of urban stormwater runoff by municipal wastewater dischargers.

Individual wasteload allocations for municipal wastewater dischargers and industrial wastewater dischargers are presented in Table A-3 and Table A-4. Individual wasteload allocations to county-based watersheds are presented in Table A-5.

Table A- 2 Load and Wasteload Allocations

Source Category	Allocations
	Kilograms per year
External	
Direct Atmospheric Deposition	0 [a]
Central Valley Watershed	5
Municipal Wastewater Dischargers	2
Industrial Wastewater Dischargers	0.035
Urban Stormwater Runoff	2
Non-Urban Stormwater Runoff	0.1
Urban Stormwater Runoff Treatment by POTWs	0.9
Total	***10*** [b]

a) Zero allocation reflects overall net loss to the atmosphere

b) Total differs from column sum due to rounding

Table A - 3 Individual Wasteload Allocations For Municipal Wastewater Dischargers

Permitted Entity	NPDES Permit	Allocations
		kilograms per year
American Canyon, City of	CA0038768	0.002
California Department of Parks and Recreation, Angel Island State Park	CA0037401	0.00003
Benicia, City of	CA0038091	0.009
Burlingame, City of	CA0037788	0.01
Calistoga, City of	CA0037966	0.002
Central Contra Costa Sanitary District	CA0037648	0.1
Central Marin Sanitation Agency	CA0038628	0.04
Delta Diablo Sanitation District	CA0038547	0.04
East Bay Dischargers Authority	CA0037869	0.3
Dublin-San Ramon Services District (CA0037613)		
Hayward Shoreline Marsh (CA0037702)		
Livermore, City of (CA0038008)		
Union Sanitary District, Wet Weather (CA0038733)		
East Bay Municipal Utilities District	CA0037702	0.3
East Brother Light Station	CA0038806	0.00030
Fairfield-Suisun Sewer District	CA0038024	0.05
Las Gallinas Valley Sanitary District	CA0037851	0.01
Marin County Sanitary District, Paradise Cove	CA0037427	0.00003
Marin County Sanitary District, Tiburon	CA0037753	0.002
Millbrae, City of	CA0037532	0.007
Mt. View Sanitary District	CA0037770	0.007
Napa Sanitation District	CA0037575	0.04
Novato Sanitary District	CA0037958	0.02
Palo Alto, City of	CA0037834	0.09
Petaluma, City of	CA0037810	0.02
Pinole, City of	CA0037796	0.009
Contra Costa County, Port Costa Wastewater Treatment Plant	CA0037885	0.0001
Rodeo Sanitary District	CA0037826	0.002
Saint Helena, City of	CA0038016	0.001
San Francisco, City and County of, San Francisco International Airport WQCP	CA0038318	0.002
San Francisco, City and County of, Southeast Plant	CA0037664	0.3
San Jose/Santa Clara WPCP	CA0037842	0.4
San Mateo, City of	CA0037541	0.04
Sausalito-Marin City Sanitary District	CA0038067	0.005
Seafirth Estates	CA0038893	0.00001
Sewerage Agency of Southern Marin	CA0037711	0.01
Sonoma Valley County Sanitary District	CA0037800	0.01
South Bayside System Authority	CA0038369	0.06
South San Francisco/San Bruno WQCP	CA0038130	0.03
Sunnyvale, City of	CA0037621	0.05
US Naval Support Activity, Treasure Island WWTP	CA0110116	0.002
Vallejo Sanitation & Flood Control District	CA0037699	0.05
West County Agency, Combined Outfall	CA0038539	0.05
Yountville, Town of	CA0038121	0.001
Total		***2***[a]

a) Total differs from column sum due to rounding

Table A - 4 Individual Wasteload Allocations for Industrial Wastewater Dischargers

Permitted Entity	NPDES Permit	Allocations
		kilograms per year
C&H Sugar Co.	CA0005240	0.00006
Chevron Products Company	CA0005134	0.003
ConocoPhillips	CA0005053	0.0006
Crockett Cogeneration	CA0029904	0.0006
General Chemical	CA0004979	0.0009
GWF Power Systems, Site I	CA0029106	0.0001
GWF Power Systems, Site V	CA0029122	0.0001
Hanson Aggregates, Amador Street	CA0030139	0.00003
Hanson Aggregates, Olin Jones Dredge Spoils Disposal	CA0028321	0.00003
Hanson Aggregates, Tidewater Ave. Oakland	CA0030147	0.00003
Morton Salt	CA0005185	0.00008
Pacific Gas and Electric, East Shell Pond	CA0030082	0.00003
Pacific Gas and Electric, Hunters Point Power Plant	CA0005649	0.002
Rhodia, Inc.	CA0006165	0.0003
San Francisco, City and Co., SF International Airport Industrial WTP	CA0028070	0.002
Shell Oil Products US and Equilon Enterprises LLC	CA0005789	0.002
Southern Energy California, Pittsburg Power Plant	CA0004880	0.0008
Southern Energy Delta LLC, Potrero Power Plant	CA0005657	0.0003
Tesoro Refining and Marketing Company	CA0004961	0.002
The Dow Chemical Company	CA0004910	0.0006
United States Navy, Point Molate	CA0030074	0.00005
USS-Posco	CA0005002	0.02
Valero Refining Company	CA0005550	0.0007
Total		***0.035***[a]

a) Total differs from column sum due to rounding

Table A- 5 County-Based Watershed Wasteload Allocations for Urban Stormwater Runoff

County[b]	Allocations[a] kilograms per year
Alameda	0.5
Contra Costa	0.3
Marin	0.1
Napa	0.05
San Francisco[c]	0.2
San Mateo	0.2
Santa Clara	0.5
Solano	0.1
Sonoma	0.05
Total	***2***

[a] Allocations implicitly include all current and future permitted discharges within the geographic boundaries of municipalities and unincorporated areas within the County. Examples of discharges include but are not limited to California Department of Transportation (Caltrans) roadways and non-roadway facilities and rights-of-way, atmospheric deposition, public facilities, properties proximate to stream banks, industrial facilities, and construction sites.

[b] Includes unincorporated areas and all municipalities in the county that drain to the Bay and are part of the San Francisco Bay Region.

[c] Does not account for treatment provided by San Francisco's combined sewer system. The treatment provided by the City and County of San Francisco's Southeast Plant (NPDES permit CA0037664) will be credited toward meeting the allocation and load reduction.

Implementation Plan

The implementation plan includes three general implementation categories: control of external loadings of PCBs to the Bay, control of internal sources of PCBs within the Bay, and actions to manage risks to Bay fish consumers. In addition, the plan includes monitoring to measure attainment of the numeric target and load allocations, and measuring implementation progress. Adaptive implementation, including a time schedule, is the method for evaluating and adapting the TMDL and implementation plan as needed to assure water quality standards are attained.

External Sources

This section, organized by source categories, specifies actions required to achieve allocations and implement the TMDL.

Central Valley Watershed

Sediments entering the Bay from the Central Valley have lower concentrations of PCBs than in-Bay sediment. Major mass loading events that occur during episodic high flow conditions generally flow directly out of the Bay through the Golden Gate. It is anticipated that the Central Valley allocation will be attained through natural attenuation.

Municipal and Industrial Wastewater Dischargers

Wasteload allocations shall be implemented through NPDES permits that require implementation of best management practices to maintain optimum treatment performance for solids removal and the identification and management of controllable sources. NPDES permits shall include a numeric effluent limit of 0.5 µg/L and a requirement for quantification of PCBs loads to the Bay every five years in order to determine attainment of the wasteload allocations. In addition, municipal and industrial wastewater dischargers will be required to support actions to reduce the health risks of people who eat PCBs-contaminated, San Francisco Bay fish and to conduct or cause to be conducted monitoring, and studies to fill critical data needs identified in the adaptive implementation section.

Urban Stormwater Runoff

Urban stormwater runoff wasteload allocations shall be achieved within 20 years and shall be implemented through the NPDES stormwater permits issued to urban stormwater runoff management agencies and the California Department of Transportation (Caltrans). The urban stormwater runoff wasteload allocations implicitly include all current and future permitted discharges, not otherwise addressed by another allocation, and unpermitted discharges within the geographic boundaries of urban runoff management agencies including, but not limited to, Caltrans roadway and non-roadway facilities and rights-of-way, atmospheric deposition, public facilities, properties proximate to stream banks, industrial facilities, and construction sites.

Requirements in each NPDES permit issued or reissued, shall be based on an updated assessment of best management practices and control measures intended to reduce PCBs in urban runoff. Control measures implemented by urban runoff management agencies and other entities (except construction and industrial sites) shall reduce PCBs in urban runoff to the maximum extent practicable. Control measures for construction and industrial sites shall reduce discharges based on best available technology economically achievable. All permits shall remain consistent with Section 4.8 - Stormwater Discharges.

Stormwater permittees shall demonstrate progress toward attainment of the wasteload allocations shown in Table A-5, by using one of the following methods:

1. Quantify the annual average PCBs loads reduced by implementing (a) pollution prevention activities, and (b) source and treatment controls. The Water Board will recognize such efforts as progress toward achieving the wasteload allocations and the PCBs-related water quality standards upon which the allocations and corresponding load reductions are based. Loads reduced as a result of actions implemented after 2001 may be used to estimate load reductions.
2. Quantify the PCBs loads as a rolling five-year annual average using data on flow and water column total PCBs concentration.
3. Quantitatively demonstrate that the total PCBs concentration of suspended sediment that best represents sediment discharged from drainage areas is below the in-Bay surface sediment PCBs concentration goal of 1 µg/kg, which is the basis for the urban stormwater runoff wasteload allocations.

In addition, stormwater permittees will be required to develop and implement a monitoring system to quantify PCBs urban runoff loads and the load reductions achieved through treatment, source control and other actions; support actions to reduce the health risks of people who consume PCBs-contaminated San Francisco Bay fish; and conduct or cause to be conducted monitoring, and studies to fill critical data needs identified in the adaptive implementation section.

Urban runoff management agencies have a responsibility to oversee various discharges within the agencies' geographic boundaries. However, if it is determined that a source is substantially contributing to PCBs loads to the Bay or is outside the jurisdiction or authority of an agency the Water Board will consider a request from an urban runoff management agency which may include an allocation, load reduction, and/or other regulatory requirements for the source in question.

Urban Stormwater Runoff Treatment by Municipal Wastewater Dischargers

Routing of urban stormwater runoff through municipal wastewater treatment facilities can be an efficient means of reducing PCBs, and other particle-associated contaminant loads to the Bay. This load allocation shall be implemented through a permit. Within five years of adoption of this TMDL, the Water Board will consider issuance of a permit under which municipal wastewater dischargers can apply for a portion of this reserved allocation.

Internal Sources

In-Bay PCB-Contaminated Sites

A number of former industrial and military sites adjacent to PCBs-enriched sediment are found throughout the Bay. Cleanup of these sites is a Water Board priority and many cleanups are underway. The Water Board will maintain an inventory of contaminated sites and set priorities for investigating and remediating the sites. The Water Board will coordinate clean-up actions with U.S. EPA and the Department of Toxic Substances Control, and issue clean-up orders as necessary. The Water Board will require responsible parties for each specific Bay margin contaminated site to:

1. Estimate the existing and post-cleanup vertical and lateral extent of PCBs in Bay sediments;
2. Estimate the existing and post-cleanup mass of PCBs in Bay sediments;
3. Quantify rate(s) of sediment accretion, erosion or natural attenuation;
4. Implement site source control measures;
5. Evaluate post-cleanup, the residual risks to humans and wildlife;
6. Support actions to reduce the health risks of people who consume PCBs-contaminated San Francisco Bay fish;
7. Conduct or cause to be conducted studies to fill critical data needs identified in the Adaptive Implementation section.

These requirements shall be incorporated into relevant site cleanup plans within five years of the effective date of this TMDL, and the actions shall be fully implemented within ten years of the effective date of this TMDL or as agreed to in the individual site cleanup plan.

Sediment Dredging

The PCBs concentration in dredged material disposed of in the Bay shall not exceed the 99th percentile PCBs concentration of the previous 10 years of Bay sediment samples collected through the RMP (excluding stations outside the Bay like the Sacramento River, San Joaquin River, Guadalupe River and Standish Dam stations). Prior to disposal, the material shall be sampled and analyzed according to the procedures outlined in the 2001 U.S. Army Corps of Engineers document "Guidelines for Implementing the Inland Testing Manual in the San

Francisco Bay Region." All in-Bay disposal of dredged material shall comply with Section 4.20, entitled Dredging and Disposal of Dredged Sediment, including the Long Term Management Strategy. Additionally, dredged material dischargers will be required to conduct or cause to be conducted studies to fill critical data needs identified in the Adaptive Implementation section.

Risk Management

Load reductions and attainment of the numeric target to support fishing in the Bay as a beneficial use will take time to achieve. However, there are actions that should be undertaken prior to achievement of the numeric fish tissue target to help manage the risk to consumers of PCBs-contaminated fish. The Water Board will work with the California Office of Environmental Health Hazard Assessment, the California Department of Toxic Substances Control, the California Department of Health Services, dischargers, and interested parties to pursue risk management strategies. The risk management activities will include the following:

- Investigating and implementing actions to address the public health impacts of PCBs in San Francisco Bay/Delta fish, including activities that reduce the actual and potential exposure of, and mitigate health impacts to, people and communities most likely to be consuming PCB-contaminated fish from San Francisco Bay, such as recreational and subsistence fishers and their families;
- Providing multilingual fish-consumption advice to the public to help reduce PCBs exposure through community outreach, broadcast and print media, and signs posted at popular fishing locations;
- Regularly informing the public about monitoring data and findings regarding hazards of eating PCB-contaminated fish; and
- Performing special studies needed to support health risk assessment and risk communication.

Monitoring

Monitoring to demonstrate progress toward attainment of the TMDL target shall be conducted by maintaining discharger-funded RMP monitoring of PCBs in San Francisco Bay fish, sediments, and water at a spatial scale and frequency to track trends in the decline of PCBs in the Bay. Monitoring of load allocations to demonstrate progress towards attainment shall be conducted by municipal and industrial wastewater dischargers and stormwater permittees as discussed in external sources above.

Continued regular monitoring of PCB loads from the Central Valley and other tributaries to the Bay shall be conducted by maintaining discharger-funded RMP monitoring in order to provide information on the long term decline of PCBs to the Bay and to confirm the assumption that Central Valley loads are being reduced due to natural attenuation. Monitoring of allocations to other sources, will be considered as part of the RMP special studies.

Adaptive Implementation

Adaptive implementation entails taking actions commensurate with the existing, available information, reviewing new information as it becomes available, and modifying actions as necessary based on the new information. Taking action allows progress to occur while more and better information is collected and the effectiveness of current actions is evaluated.

Periodic Review

The Water Board will adapt the PCBs TMDL to incorporate new and relevant scientific information such that effective and efficient measures can be taken to achieve the numeric fish tissue target. The Water Board will review the San Francisco Bay PCBs TMDL and evaluate new and relevant information that become available through monitoring, special studies, and the scientific literature and consider modifications to the PCBs TMDL through the Water Board's continuing Basin Planning program, which provides opportunities for stakeholder participation.

Achievement of the allocations for urban stormwater runoff is projected to take 20 years. Approximately 10 years after the effective date of the TMDL or any time thereafter, the Water Board will consider modifying the schedule for achievement of the load allocations for urban stormwater runoff provided that dischargers have complied with all applicable permit requirements and accomplished all of the following:

- A diligent effort has been made to quantify PCBs loads and the sources of PCBs in the discharge;
- Documentation has been prepared that demonstrates that all technically and economically feasible and cost-effective control measures recognized by the Water Board have been fully implemented and evaluates and quantifies the PCBs load reduction of such measures;
- A demonstration has been made that achievement of the allocation will require more than the remaining 10 years originally envisioned; and
- A plan has been prepared that includes a schedule for evaluating the effectiveness and feasibility of additional control measures and implementing additional controls as appropriate.

Critical Data Needs

Additional data and other information will be needed to assess both the progress toward attainment of the TMDL target and to evaluate the need for adaptive implementation of the PCBs TMDL. Dischargers will be required to conduct or cause to be conducted the following studies to fill critical data needs.

- PCBs fate and transport modeling and food web model improvements – Model refinements to improve our ability to predict recovery rates of the Bay from impairment by PCBs, and to help focus implementation actions on those with the most potential for success.

- Rates of natural attenuation of PCBs in the Bay environments –A better understanding of local rates of natural attenuation in order to predict with more certainty the recovery time of the Bay, and to inform whether more implementation actions are needed.

APPENDIX B

CEQA Checklist

San Francisco Bay PCBs TMDL

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1.	**Project Title:**	Proposed Basin Plan Amendment for a Total Maximum Daily Load (TMDL) for PCBs in 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:**	Fred Hetzel (510) 622-2357
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 a Total Maximum Daily Load (TMDL) and implementation plan for Polychlorinated Biphenyls (PCBs) for San Francisco Bay.

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?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

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

ENVIRONMENTAL IMPACTS:

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

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
V. CULTURAL RESOURCES -- Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
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?	☐	☐	☒	☐
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?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

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

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☒	☐
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?	☐	☐	☐	☒
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				

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
planned uses for which permits have been granted)?	☐	☐	☐	☒
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?	☐	☐	☐	☒
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?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

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

	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
construction of replacement housing elsewhere?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
c) Displace substantial numbers of people necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
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

ENVIRONMENTAL IMPACTS:

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

Issues:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
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?	☐	☒	☐	☐
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?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

XVII. MANDATORY FINDINGS OF SIGNIFICANCE

Issues:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
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?	☐	☐	☐	☒

APPENDIX C

Peer Reviewer Evaluations
San Francisco Bay PCBs TMDL

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Peer Review of the Technical Basis for the Polychlorinated Biphenyls Total Maximum daily Load in San Francisco Bay

Kevin J. Farley

27 May 2007

Specific issues to be addressed in the peer review are outlined in Attachment 2 of Mr. Fred Hetzel's March 22, 2007 letter. These issues are addressed below based on the following materials:

Appendix A: Basin Plan Amendment-Draft (March 2007)

PCBs in San Francisco Bay, Total Maximum Daily Load (TMDL), Staff Report (March 2007)

In addition, the following reports were also considered in preparing this review:

Davis, J.A. 2003. The Long-term Fate of PCBs in San Francisco Bay: SFEI Contribution 47. San Francisco Estuary Institute, Oakland, CA.

Gobas, F.A.P.C. and J. Wilcockson. 2003. San Francisco Bay PCB Food Web Model, RMP Technical Report: SFEI Contribution 90. San Francisco Estuary Institute, Oakland, CA.

Gobas, F.A.P.C. and J. Arnot. 2005. San Francisco Bay PCB Food Web Model-Final Technical Report. Prepared for the Clean Estuary Partnership.

Davis, J.A., F. Hetzel, and J. Oram. 2006. PCBs in San Francisco Bay: Impairment Assessment/Conceptual Model report. Prepared for the Clean Estuary Partnership.

Fish Tissue Numerical Target

In this Basin Plan Amendment, we propose the use of a numeric polychlorinated biphenyls (PCBs) fish tissue numeric target. We propose that the human health protection provided by the proposed objective is consistent with, and as protective of human health as the water quality criterion in the California Toxics Rule.

a) *Is our derivation of the numeric fish target based on sound scientific knowledge, methods, and practices?*

The numeric fish target is based on standard risk assessment calculations using a 70-year lifetime, a mean body weight of 70 kg, a slope factor of 1 (mg/kg)/day, and a mean daily consumption rate of 320 g/day (based on the 95th percentile upper bound estimate of fish intake reported for all Bay fish-consuming anglers), and a 10^{-5} risk level. The resulting numeric fish target for total PCBs of 10 ng/g is applied to white croaker (20-30 cm in length) and shiner surfperch (10-15 cm in length) collected in summer and fall seasons. Species selection and fish collection times are justified based on: (1) previous fish sampling studies of San Francisco Bay and food chain model results which both indicate that white croaker and shiner surfperch are expected to have higher PCB body burdens than other fish species currently monitored in the Bay, and (2) on previous fish sampling studies of San Francisco Bay which indicate that PCB body burdens were highest in the summer and fall collection seasons.

Based on field-derived BioAccumulation Factors (BAFs) in Table 21 of the Staff Report, the numeric fish target of 10 ng/g is equivalent to a water quality criterion of approximately 20-50 pg/L. For comparison, the water quality criterion in the California Toxics Rule (CTR) is given as 170 pg/L. The numeric fish target is therefore considered to be more slightly more protective of human health.

Comments/Questions:

Since the use of the 95th percentile upper bound estimate of fish intake is important in establishing the margin of safety for the TMDL, further information should be given on fish intake. For example, a log probability plot of fish intake rates would be appropriate to show in the Staff Report so that the margin of safety for other segments of the population (e.g., the 50th percentile) can be readily quantified.

The slope factor used in establishing the TEQ screening level of 0.14 pg/g for dioxin-like PCBs should be cited (e.g., on page 24 of the Staff Report).

TMDL Problem Statement

In this section of the report, we describe the basis for concluding that PCBs impair San Francisco Bay beneficial uses. High concentrations of PCBs have been found in fish consumed by sport fishers. PCB concentrations in San Francisco Bay exceed the basin Plan narrative objective for bioaccumulation and impair beneficial uses, such as sport fishing, wildlife habitat, and preservation of rare and endangered species.

b) *Is our description of the nature of the water quality problem caused by PCBs in San Francisco Bay based on sound scientific knowledge, methods, and practices?*

Water quality problems caused by PCBs in San Francisco Bay are clearly stated in Section 2 of the Staff Report. Supporting information on measured PCB concentrations for water samples, fish and benthic organisms from the Bay are presented in Section 6, and are compared to CTR water quality criterion and screening levels for fish. This information is appropriately used to demonstrate the extent of impairments due to PCB contamination.

TMDL Development

In this section of the report, we describe the sources, loads and reservoirs of PCBs. This assessment relies on available information to describe and quantify relative contributions from many sources like wastewater and storm water discharges,

atmospheric deposition, Central Valley inputs, in-bay dredge material disposal, and contaminated sediments.

c) Are the source categories clearly defined?

Source categories are clearly defined and include: (1) direct atmospheric deposition; (2) Central Valley watershed discharge; (3) municipal and industrial wastewater discharges; (4) urban and non-urban storm water runoff; (5) internal cycling from the active sediment layer; and (6) sediment dredging.

d) Are the source categories, source estimates and estimation methodologies clearly stated for each source categories?

Estimates of PCB external loads were determined as follows:

Direct atmospheric loads: The annual rates for gaseous and particulate exchange rates were taken from SFEI (2001). Details of the estimation method are not given in the Staff Report.

Central Valley watershed: The annual PCB discharge rate was taken from SFB-RWQCB (2004) based on ten years of monitoring data for the Sacramento and San Joaquin Rivers. Details of the calculation are not provided in the Staff Report.

Municipal and Industrial Wastewater Dischargers: PCB loads were determined using average daily flows from POTWs and industries, and average PCB effluent concentrations for the following categories: (1) POTWs with secondary treatment; (2) POTWs with advanced treatment; (3) petroleum refineries; and (4) other industrial wastewater dischargers.

Urban and Non-urban Stormwater Runoff: PCB loads were estimated using model-generated runoff volumes and sediment loads from the 17 Bay Area watersheds along with median PCB concentrations on sediment for urban and for non-urban runoff.

Internal Cycling from the Active Sediment Layer: The inventory of PCBs in the active sediment layer was determined from the Bay surface area, an assumed active sediment layer of 15 cm, and a Bay-wide average PCB sediment concentration of 10 μg/kg.

Sediment Dredging: An annual estimate of PCB removal from the Bay by dredging is obtained from dredging records (given as 2.4 million cubic yards per year), and a Bay-wide average PCB concentration sediment concentration of 10 μg/kg. (The bulk density of the dredged material is not stated, but results appear reasonable.) A net removal of PCB by dredging is determined based on the amount of dredged material that is disposed at in-Bay disposal sites and the amount that is disposed at either upland sites or the deep ocean disposal site.

<u>Comments/Questions</u>:

For municipal and industrial wastewater dischargers, justification should be provided for using average concentrations in estimating PCB loading rates. A probability plot, or possibly a log probability plot of measured effluent concentrations would be very helpful.

For urban and non-urban stromwater runoff, justification should be provided for using median concentrations in estimating PCB loading rates. Again, a probability plot, or possibly a log probability plot of measured effluent concentrations would be very helpful.

Part of the discussion on sediment dredging needs clarification. In particular, the sentences on page 46 stating "… we estimate that, each year, about 10 kg/yr of PCBs are being disposed in the Bay at dredged sediment disposal sites. During the same period, placement of dredged sediment at either upland sites or the deep ocean disposal site removes about 13 kg of PCBs per year from the Bay resulting in a net loss of about 3 kg of PCBs each year" do not seem right. Based on the current wording, shouldn't the net loss be the 13, not 3, kg of PCBs? Also, shouldn't sediment dredging only be considered a loss from the active sediment layer if the underlying sediments are less contaminated? Has this issue been appropriately considered in subsequent TMDL mass balance calculations?

In this section of the report, we also propose a numeric target that will achieve attainment of water quality standards. A numeric target can be a numeric water quality objective or a numeric interpretation of a narrative objective. To this TMDL, we propose to use the fish tissue total PCB concentration as the numeric target.

In this section of the report, we also present the results of a food web bioaccumulation model used to predict the sediment PCB concentration when fish tissue concentrations achieve the numeric target. A steady-state PCB fate model is then used to establish the TMDL needed to attain the predicted sediment concentration. These two models provide the linkage analysis between the numeric target and the TMDL.

e) *Are the linkages between sources and the numeric target clearly stated and based on sound scientific knowledge, methods, and practices?*

Linkage between external PCB sources and PCB concentrations in water and sediment are clearly described in the Staff Report. Details of the simple mass budget model are not provided in sufficient detail. (A general description for the simple mass budget model however is provided in SFEI, 2003. Details of the final model calculation with tidal exchange (Figure 28) are not adequately described in the Staff Report or in the cited reference (Davis et al, 2006).) The use of a Bay-wide box model to describe PCB contamination in the Bay does not appear to be consistent with observed spatial variations in PCB contamination (e.g., see map of PCB contamination in sediments (Figure 23). More detailed modeling for the long-term fate of PCBs in the Bay should therefore be given a high priority.

Linkage between PCB sediment concentrations and PCB accumulation in fish are appropriately described in the Staff Report and in the cited references. Steady-state, food web bioaccumulation model calculations for specific PCB congeners are fully described in Gobas and Wilcockson (2003), and Gobas and Arnot (2005) and are appropriately justified.

Comparison of model results and field observations are also documented, as well as the overall uncertainty associated for bioaccumulation model calculations.

Comments/Questions:

Although simple mass budget model results can be used in evaluating the "average" response for PCB contamination in the Bay, it may be reasonable to expect that sediment contamination in northern portion of the Bay may response faster due to larger incoming sediment loads from the Sacramento and San Joaquin Rivers, while the southern and more contaminated portions of the Bay may response much more slowly. Factors such as this should be acknowledged accordingly in discussions of model uncertainty.

A further explanation of PCB degradation, particularly in the active sediment layer, should be provided in the Staff Report. (This issue is not adequately addressed in Davis (2003) or Davis et al. (2006).)

For future model development, the effects of estuarine circulation, sediment transport, and organic carbon cycling should be considered in evaluating spatial and temporal responses of PCB contamination in the Bay.

Congener-specific, or at least homolog-specific, fate and bioaccumulation behavior should be considered in future model development and TMDL model evaluations.

In this section of the report, we allocate a portion of the TMDL to each source category, reserving a portion of the load as a margin of safety. A load allocation is proposed for each source category and for individual discharges in certain source categories.

f) Are the load and wasteload allocations and calculation methodologies clearly stated for each source category?

The methodologies for establishing a TMDL of 10 kg/yr are clearly stated. (The specifications of PCB tidal exchange and PCB degradation in the active sediment layer however need further clarification. See previous comments on the simple mass budget model.)

The methodologies for establishing wasteload allocations for each source category are also stated clearly.

g) Is the method of ensuring an implicit margin of safety clearly stated?

The conservative approach used in deriving the fish tissue numeric target (based on the 95th percentile upper bound estimate of fish intake reported for all Bay fish-consuming anglers) appears to be reasonable in providing an implicit margin of safety. As stated above, a log probability plot of fish intake rates, or some other information, should be provided so that the margin of safety for other segments of the population (e.g., the 50th percentile) can be readily quantified.

TMDL Implementation

The implementation plan contains proposed actions to reduce PCB loads to the bay and to reduce PCB bioaccumulation by biota. The plan also specifies a program of monitoring and special studies to address the various areas of uncertainty.

h) Are the implementation actions clearly stated?

The implementation actions are clearly stated and appear to be appropriate based on an adaptive management approach.

i) Is the proposed monitoring program adequate to evaluate progress toward achieving the fish tissue target?

The proposed monitoring program appears to provide an adequate approach for evaluating progress toward achieving the fish tissue target. In addition to monitoring of San Francisco Bay fish, sediments, and water, monitoring of external sources and in-bay PCB-contaminated sites provide important information in evaluating progress, and if necessary, in re-evaluating the TMDL.

j) Have we clearly stated the key management questions?

Issues related to long-term management plans, interim risk management actions, periodic review, and adaptive implementation are clearly described in the report.

Overarching questions

Reviewers are not limited to addressing only the specific issues presented above, and are asked to contemplate the following "big picture" questions.

k) In reading the staff report and proposed Basin Plan Amendments, are there any additional scientific issues that are part of the scientific basis of the proposed rule not described above? If so, are they based on sound scientific knowledge, methods, and practices?

None noted.

l) Taken as a whole, is the scientific portion of the proposed rules based on sound scientific knowledge, methods, and practices?

Overall, development of the San Francisco Bay TMDL for PCBs appears to be based on sound scientific knowledge, methods, and practices. Portions of the analysis; e.g., the PCB fate model, should be considered as preliminary evaluations at this time, and should be developed in more detail under the adaptive implementation management strategy.

Some editorial corrections are also listed below:

Editorial Corrections: Appendix A Basin Plan Amendment

Page A8, first sentence, first paragraph: delete "will be required agencies"

Page A8, last sentence, first paragraph: delete "to and to conduct or cause … section."

Page A9, last sentence, first paragraph: delete "to support actions"

Editorial Corrections: Staff Report

Page 10, last sentence: fix "PCb"

Page 15, five lines from bottom: delete "under"

Page 33, seven lines from bottom: "per cubic centimeter" should be "per square centimeter"

Page 39, last line, second paragraph: "g/kg" should be "μg/kg"

Page 50, third line, last paragraph: delete "in the"

Page 51, eighth line, first paragraph: fix "the entire and segment of the Bay"

Page 57, first line: "kgs" should be "kg/yr"

Page 59, last line: missing end of sentence

PEER REVIEW OF THE TECHICAL BASIS FOR THE POLYCHLORINATED BIPHENYLS TOTAL MAXIMUM DAILY LOAD IN SAN FRANCISCO BAY

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Fish Tissue Numeric Target:

1. Is our derivation of the numeric fish tissue numeric target based on sound scientific knowledge, methods, and practices?

The numeric fish tissue target is reasonable, with some qualifications, when one considers only PCBs. The screening level of 10 ng/g wet weight fish tissue falls within the risk-based consumption limit proposed by USEPA (2000) of 4 meals per month to avoid a risk of cancer beyond 1 in 100,000, or 12 meals per month to avoid excess in non-cancer health endpoints. However if one really wants to protect the public, the level for unlimited consumption given by USEPA (2000) is 1.5 ng/g (ppb) wet weight. There are certainly some sport fisherpersons, and especially some ethnic and immigrant groups who consume much more than 4 meals of fish per month. And it must be noted that the 1 in 100,000 limit is far from the 1 in 1,000,000 that is desirable. The EPA level given for unlimited consumption so as to avoid non-cancer adverse health effects is 5.9 ng/g (ppb), so even for non-cancer effects the screening level of 10 ng/g is somewhat high. Nevertheless setting this level is realistic, even if not ideal, and is consistent with other advisories throughout the country.

The bigger problem is that fish contain many other fat-soluble compounds that have carcinogenic and non-carcinogenic actions in addition to PCBs. Thus by setting the standards on the basis on consideration of only PCBs it is possible, indeed it is likely, that these standards are not protective of human health. In our study of farmed and wild salmon we found that there was a direct relationship between the levels of PCBs and those of hexachlorobenzene, lindane, heptaclor epoxide, dieldrin, endrin, trans-nanochlor, DDT, mirex, and dioxins (Huang et al., 2006). All of these substances are rated as probable human carcinogens, and all have non-cancer health effects as well. Furthermore we found that applying the EPA (2000) formula for recommended consumption rates based on consideration of all of these substances for which EPA gives cancer slope factors led to much more restrictive consumption advisories than when one considered only PCBs. Our studies also did not even consider emerging contaminants such as the polybrominated diphenyl ethers, which are also present in salmon at high concentrations (Hites et al., 2004) and are markedly rising in human breast milk in the US (Schecter et al., 2003). There are currently no confirmed cancer slope factor for the PBDEs, but they are similar in structure to PCBs and probably have similar actions. These considerations strongly suggest that the by consideration of only PCBs one is significantly underestimating the risk of consumption of fish from San Francisco Bay.

TMDL Problem Statement:

2. Is our description of the nature of the water quality problem caused by PCBs in San Francisco Bay based on sound scientific knowledge, methods, and practices?

Yes, the description of the water quality problem is sound and justified. The major problem is the large amounts of PCBs in the sediments. While PCBs are not very water soluble, they are in equilibrium with levels in the water. The report documents significant sediment contamination with PCBs, and even without additional input it will take generations before these levels decline. Removal of all of the contaminated sediments is not realistic with current technology.

I find the calculation that the direct PCB loads to the Bay are estimated at 0.35 kg/yr, but the loss due to atmospheric transport to be 7.4 kg/yr, to be very surprising and almost not believable. I have reviewed the paper by Tsai et al. (2002) and the report by Tsai and Baker (2005), and certainly don't find anything wrong in their analysis. However the input to the Bay is very much lower than that to Lake Michigan, reported to be about 3,200 kg/yr, with 330 kg coming from Chicago (Hornbuckle and Green, 2000). In their review of persistent organic pollutants in the Great Lakes, Hornbuckle et al (2006) state that "the atmosphere is the largest source of PCBs to Lake Michigan…..Atmospheric deposition (gas, dry particle, and wet deposition) is larger than inputs from resuspension of contaminated sediments and larger than inputs from direct discharge and contaminated tributaries". Kelly et al. (1991) estimated total atmospheric input to Lake Erie to be 257 kg/yr. The EPA has estimated input to Lake Ontario to be 64 kg/yr. (USEPA, 2003). Strachan and Eisenreich (1988) estimated that the atmosphere contributes about 90% of the PCBs found in Lake Superior. Hsu et al. (2003) show that between 2 and 70 kg of PCBs enter the Chicago atmosphere each day, and a significant percentage of this is deposited into Lake Michigan. Wethington and Hornbuckle (2005) report 120 kg of PCBs go into Lake Michigan just from the city of Milwaukee. I don't doubt but there is more contamination with PCBs in the Midwest and East than on the West Coast, but it is hard to believe that the input to the Bay is so small. However, the conclusion that there is more loss than input from vapor-phase PCBs is consistent with the results from the Great Lakes, and so does not alter the conclusion that there is a net loss through this route. Certainly the methods for measurement of PCBs in air used by Tsai and Baker (2005) are standard, and reports look fine. But their result is highly questionable, in my judgment. With all of the cities and waste sites around the Bay it is simply not believable that only 0.35 kg/yr enter the Bay by atmospheric transport of gas phase PCBs.

TMDL Development:

3. Are the source categories clearly defined?

Yes.

4. Are the source categories, source estimates and estimation methodologies clearly stated or each source category?

They are clearly stated, but as discussed above, I have difficulty believing that the atmospheric deposition is as small as reported here. The other estimates appear reasonable to me.

5. Are the linkages between sources and the numeric target clearly stated and based on sound scientific knowledge, methods and practices?

Yes, the linkages between sources and numeric target are clearly stated, and use of fish PCB concentration as the numeric target is appropriate. While the numeric target may not be optimally protective for those consuming excessive amounts of fish, they are reasonable and justified on the basis of target levels used throughout the country.

6. Are the load and wasteload allocations and calculation methodologies clearly stated for each source category?

The load and wasteload allocations are clearly stated for each source category. The calculation methodologies are less clearly explained, and for most of the source categories the allocation is simply given without any great discussion of how it was derived. The allocations appear reasonable, but it would have been more satisfactory to have a detailed explanation of the methodology for their derivation.

7. Is the method of ensuring an implicit margin of safety clearly stated?

Yes, the methods for ensuring a margin of safety are clearly stated and are reasonable.

TMDL Implementation:

8. Are the implementation actions clearly stated?

The implementation actions are clearly stated and are logical and appropriate. There is also a realistic time frame for implementation of these goals, which cannot be accomplished immediately because of surface contamination.

9. Is the proposed monitoring program adequate to evaluate progress toward achieving the fish tissue target?

This monitoring program is appropriate. There will be more or less continuous monitoring, followed by a more complete evaluation every five years of progress in each of the categories of input to the Bay.

10. Have we clearly stated the key management questions?

Yes, this is well done. The three major implementation categories of a) control of external loadings, b) control of internal source and c) actions to manage risks to Bay fish consumers are clearly stated and discussed. The strategy of regular monitoring is essential in order to determine whether goals are being met, and the proposed monitoring program is excellent. I do have some question as to whether the anticipated natural attenuation within the Central Valley watershed and from urban stormwater runoff is realistic, but having these as goals is appropriate. Our experience in the Great Lakes area indicates that cities are enormous reservoirs of PCBs, and that even old buildings contain significant amounts of PCBs in everything from paint, ceiling tile and caulking. The time frame for reduction from such sources is long. It is extraordinarily difficult to obtain the funds to clean up former and current industrial and especially military facilities. Dredging may only remove PCBs from one site and deposit them in another. Great care should be taken in dealing with dredged sediments.

Overarching questions:

11. In reading the staff report and proposed Basin Plan Amendments, are there any additional scientific issues that are part of the scientific basis of the proposed rule not described above? If so, are they based on sound scientific knowledge, methods, and practices?

I am rather pessimistic that the goals of this proposal will be achieved as easily as anticipated. I believe that this view would be shared by most of my colleagues who work on comparable issues around the Great Lakes. For example, Hornbuckle et al. (2006) in their recent review state "The atmosphere, especially near urban-industrial areas, is the major source to the open waters of the lakes. Other sources include contaminated tributaries and in-lake recycling of contaminated sediments. Until these remaining sources are controlled or contained, unsafe levels of PCBs will be found in the Great Lakes environment for decades to come." Part of our concern is that whereas PCB levels in Great Lakes fish declined dramatically for many years, they have now plateaued but at a level which exceeds any health-based standard. This is at least in part due to the failure to anticipate what an enormous source of PCBs urban areas are. But whether or not the goal of having fish from the Bay that are safe to eat is achieved in as rapid a time frame as proposed, the steps are all in the right direction. With load reductions and regular monitoring it will be possible at least to inform the public of the status of fish in the Bay.

12. Taken as a whole, is the scientific portion of the proposed rules based on sound scientific knowledge, methods, and practices?

Yes, the proposed rules are based on sound scientific knowledge, methods and practices. They use state-of-the-art approaches to anticipate loadings, and propose an excellent monitoring program to chart progress. While some of the problems may have been underestimated, this is an outstanding and innovative approach to regeneration of a fishery that does not pose health hazards to the public.

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