California Water Boards
Protecting California's Water

Draft Staff Report Including Draft Substitute Environmental Documentation Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Sediment Quality Provisions)

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Acronyms and Abbreviations

ARB – California Air Resources Board
ATL – Advisory Tissue Level
BMP – Best Management Practice
BAF – Bioaccumulation Factor
BOG – Bioaccumulation Oversite Group
BPJ – Best Professional Judgment
BPTCP Bay Protection and Toxic Cleanup Program
BSAF – Biota-Sediment Accumulation Factor
CAD – Confined Aquatic Disposal
CalEPA California Environmental Protection Agency’s
CCAA California Clean Air Act
CEQA California Environmental Quality Act
CERCLA – Comprehensive Environmental Response Compensation and Liability Act
CESA – California Endangered Species Act
CCLEAN – Central Coast Long Term Environmental Assessment Network
CO – Carbon Monoxide
CWA – Clean Water Act
DDD Dichlorodiphenyldichloroethane
DDE - Dichlorodiphenyldichloroethylene
DDT Dichlorodiphenyltrichloroethane
DDTs – DDD, DDE and DDT
Delta RMP – Delta Regional Monitoring Program
DFW – California Department of Fish and Wildlife
DST Decision Support Tool
DTSC Department of Toxic Substances Control
EIR – Environmental Impact Report
FCG – Fish Contaminant Goal
FDA – U.S. Food and Drug Administration
GHG – Greenhouse Gas
HR – Home Range
ISWEBE Plan – Inland Surface Waters and Enclosed Bays and Estuaries Plan
KM - Kilometer
M - Meter
MEP – Maximum Extent Practical
MLOE – Multiple Lines of Evidence
MPA Marine Protected Area
MRZ – Mineral Resource Zone
MS4 - Municipal Separate Storm Sewer System
NOAA - National Oceanic and Atmospheric Administration
NPDES – National Pollutant Discharge Elimination System
NPL – National Priorities List
NPS – Nonpoint Source

ODEQ - Oregon Department of Environmental Quality
OEHHA - Office of Environmental Health Hazard Assessment
OSHA – Occupational Health and Safety Administration
PAHs - Polycyclic aromatic hydrocarbons
PBDEs - polybrominated diphenyl ethers
PCBs – Polychlorinated Biphenyls
RCRA – Resource Conservation and Recovery Act
RHMP – Regional Harbors Monitoring Program
RMP – Regional Monitoring Program
Regional Water Board - Regional Water Quality Control Board –
SA – Site Area
SCCWRP – Southern California Coastal Water Research Project
SED - Substitute Environmental Document
Sediment Quality Provisions - Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Part 1)
SFEI – San Francisco Estuary Institute
SIP – Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California
SL – Site Linkage Factor
SQO - Sediment Quality Objective
SSC - Scientific Steering Committee
State Water Board – State Water Resources Control Board
SWAMP – Surface Water Ambient Monitoring Program
TIE – Toxicity Identification Evaluation
TMDL - Total Maximum Daily Load
TOC – Total Organic Carbon
UCL – Upper Confidence Limit
USACE – United State Army Corps of Engineers
U.S. EPA United States Environmental Protection Agency
U.S. Fish and Wildlife Services
WDRs – Waste Discharge Requirements

1 Introduction

This draft staff report represents the State Water Resources Control Board (State Water Board) formal water quality planning and substitute environmental document (SED) to support amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Part 1)[1] herein referred to as the Sediment Quality Provisions. The purpose of this document is to describe the proposed amendments, the rational and basis for the amendments, the factors considered in the development and analysis of the proposed amendments, in accordance with the California Water Code and California Environmental Quality Act. The proposed amendments are presented in Appendix A of this document.

The remainder of this document is organized as follows: Section 2 describes the project, the goals and necessity as well as the intended use and approvals required for the proposed amendments to become effective. Section 3 presents a conceptual model for sediment quality that describes the principal factors affecting fate and transport of pollutants in sediment and the receptors potentially at risk. Section 4 presents regulatory basis for the State Water Boards formal planning process and the programs dedicated to the assessment and management of sediment quality. Section 5 describes the environmental setting within the Regional Water Quality Control Boards that are potentially affected by the proposed amendments, while Section 6 discusses the project alternatives considered in the development of the proposed amendments. Analysis of environmental impacts in accordance with the California Environmental Quality Act (CEQA) and checklist are presented in Section 7, while Section 8 describes other factors considered, including those required under Section 13241 of California Water Code. Section 9 discusses antidegradation, and references are listed in Section 10.

The State Water Board intends in future to create the ISWEBE Plan. The ISWEBE Plan would incorporate what has previously been titled Water Quality Control Plan for Enclosed Bays and Estuaries of California -- Part 1: Sediment Quality. Subsequent references herein to Part 1 refer to those previously-adopted portions of the Water Quality Control Plan for Enclosed Bays and Estuaries of California addressing sediment quality, prior to the proposed amendments. The language of the proposed amendment will refer to Sediment Quality Provisions (of the future ISWEBE Plan) rather than Part 1.

2 Project

2.1 Project Description

The State Water Board is proposing the following project: The Amendment of the Sediment Quality Provisions. The amendments address the application and implementation of two narrative sediment quality objectives (SQOs) in the existing plan. The amendments associated with each SQO are summarized below.

- Application and implementation of the SQO protecting benthic communities from direct exposure to pollutants in sediment, including:
    - Revisions to the implementation requirements that would replace the existing frequency based "binomial" approach for listing and delisting of impaired water bodies and exceedance of receiving water limits with an approach based on percent area and category of impact
    - Changes to the minimum frequency required of Regional Monitoring Programs
    - Corrections to Equation 2 of Sediment Quality Provisions
    - Corrections to polycyclic aromatic hydrocarbon and three organochlorine pesticide values applied to the Chemical Index Score included in Table 6 of Sediment Quality Provisions
- Application and implementation of the SQO protecting human consumers of resident sportfish from contaminants that bioaccumulate from sediment into fish tissue, including
    - Revisions to the assessment framework and policy of implementation that would replace the existing approach with a prescriptive framework to assess risk to human consumers of resident sportfish and evaluate the linkage to contaminants in sediment.
    - Description of how this revised assessment framework shall be applied within Water Board programs including:
        - Dredged materials
        - Listing and delisting impaired waterbodies
        - Application in permits as receiving water limits for control of point source discharges
        - Development of management targets as well as some factors to consider in the potential application of targets
    - The technical tools and assessment thresholds associated with this SQO protecting human consumers of resident sportfish from contaminants that bioaccumulate from sediment into fish tissue are only applicable to organochlorine pesticides and polychlorinated biphenyls (PCBs)
    - Assessment for other contaminants of concern would rely on the existing approach to implement this SQO.

The amendments if adopted would be applicable to all enclosed bays and estuaries of California. Enclosed bays are defined in Water Code section 13391.5 as:

indentations along the coast which enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. This definition includes, but is not limited to: Humboldt Bay, Bodega Harbor, Tomales Bay, Drakes Estero, San Francisco Bay, Morro Bay, Los Angeles Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay.

Water Code section 13391.5 defines estuaries as:

waters at the mouths of streams that serve as mixing zones for fresh and ocean waters during a major portion of the year. Mouths of streams that are temporarily separated from the ocean by sandbars shall be considered as estuaries. Estuarine waters will generally be considered to extend from a bay or the open ocean to the upstream limit of tidal action but may be considered to extend seaward if significant mixing of fresh and salt water occurs in the open coastal waters. The waters described by this definition include, but are not limited to, the Sacramento-San Joaquin Delta as defined by Section 12220 of CWC, Suisun Bay, Carquinez Strait downstream to Carquinez Bridge, and appropriate areas of the Smith, Klamath, Mad, Eel, Noyo, and Russian Rivers.

If these proposed amendments are adopted, the State Water Board as well as the North Coast, San Francisco, Central Coast, Los Angeles, Central Valley, Santa Ana River, and San Diego Regional Water Quality Control Boards (Regional Water Boards) would be responsible for implementing the adopted amendments. Those regulated under the proposed amendments would include permittees or responsible parties that discharge toxic pollutants to enclosed bays and estuaries of California or rivers or streams draining into enclosed bays and estuaries. In order to assess sediment quality under the proposed amendments, permittees and responsible parties would be required to undertake the following:

- Collect samples of sediment and fish tissue from the site area
- Analyze the sediment for the constituents of concern
- Apply the results to the assessment framework and associated thresholds
- Determine if the SQO is exceeded for the site area
- Document the sample collection, analytical testing and analysis and
- Submit the report to the appropriate Regional Water Board

Those waterbodies that have Total Maximum Daily Loads (TMDLs) adopted to reduce the loads of organochlorine pesticides and PCBs would be exempted from the requirements associated with implementation of the human health SQO protecting human consumers from contaminants in fish tissue

Potential actions the Regional Water Boards would take upon adoption of these amendments include:

- No action for sites or discharges that represent little or no impact to sediment quality;

- Additional monitoring of sediment and tissue at sites or discharges where sediment is characterized as possibly impacted;
- List water bodies as impaired or delist waterbodies as unimpaired based on monitoring data collected and applied using the revised assessment framework;
- Require reduction in allowable loads or more stringent effluent limits for discharges that are causing or contributing to impacts by independent permit action or through the development of a TMDL within a waterbody;
- Require remedial action at sites that represent unacceptable risks to human consumers of resident sportfish. Such actions could include removal, in situ treatment, capping and sequestering, monitored natural recovery, or some combination of these approaches.

All of these actions would occur through the State Water Board and Regional Water Quality Control Boards' (Water Boards) implementation of existing Water Quality Control Plans and Policies that protect beneficial uses designated within enclosed bays and estuaries through other means and tools, on a site-by-site basis. Adoption of the proposed amendments would create a robust and consistent framework to specially assess and characterize the relationship between sediment quality and fish tissue.

2.2 Project Necessity

In 1989, the Legislature added chapter 5.6 to Division 7 of the California Water Code. The legislation required the State Water Board to develop SQOs as part of a comprehensive program to protect beneficial uses in enclosed bays and estuaries. The objectives are required "for toxic pollutants" that were identified in toxic hot spots or that were identified as pollutants of concern by the State Water Board or the Regional Water Boards.[2] The waters targeted for protection are enclosed bays and estuaries.

The Legislature defined a SQO as "that level of a constituent in sediment which is established with an adequate margin of safety, for the reasonable protection of the beneficial uses of water or the prevention of nuisances."[3] The SQOs must be "based on scientific information, including, but not limited to, chemical monitoring, bioassays, or established modeling procedures."[4] They must "provide adequate protection for the most sensitive aquatic organisms."[5] The State Water Board is not precluded from adopting SQOs for a pollutant even though additional research may be needed.[6]

In response to this mandate, the State Water Board adopted SQOs in 2008 (Resolution 2008-0070) and 2011 (Resolution 2011-0017) and has continued working on the development of associated assessment tools and a policy of implementation as described in this document.

2.3 Project Goals

[2] See Wat. Code sec. 13392.6. Subsequent undesignated section references are to the California Water Code.
[3] Sec. 13391.5.
[4] Sec. 13393.
[5] Section 13393.
[6] Sec. 13392.6.

The goals of the proposed project are:

1. Protect and restore those beneficial uses at risk from pollutants in sediments within California's enclosed bays and estuaries through the refinement of sediment quality assessment and interpretive tools and policy of implementation.
2. Comply with California Water Code §13393 which requires the State Water Board to adopt SQOs for toxic pollutants that have been identified in toxic hot spots as part of the Bay Protection and Toxic Cleanup Program (BPTCP) and for other toxic pollutants of concern including contaminants that may pose risk to human consumers of fish and shellfish.
3. Provide regulators, stakeholders, and interested parties with a transparent, and scientifically sound process to better assess the effects caused by pollutants in sediments within California's enclosed bays and estuaries.
4. Provide regulators, stakeholders, and interested parties with a transparent and effective process that will promote the protection of sediment quality as well as the management of sediments that do not meet the SQOs.
5. Reduce monitoring, regulatory requirements and costs while still protecting associated beneficial uses.

2.4 Intended Uses of the SED

The State CEQA Guidelines require that the project description include, among other things, a statement briefly describing the intended uses of the Environmental Impact Report (EIR) (Cal. Code Regs., tit. 14, § 15124, subd. (d)). The agencies expected to use this Staff Report in decision-making are described below.

The State Water Board will use this Staff Report in determining whether to adopt the proposed amendments. The State Water Board or any of the Regional Water Boards may use the information contained within this Staff Report for future decision making and/or permitting. Furthermore, implementation procedures have been included in the amendments and in this Staff Report in order to facilitate meeting the water quality objectives for the permitted discharges subject to the amendments. Therefore, if the amendments are approved, the following entities, where they are considered public agencies for purposes of CEQA, may be considered responsible agencies and may use the final Staff Report adopted by the State Water Board in their decision-making actions to comply with the amendments:

- Permitted non-storm water dischargers (e.g. publicly owned treatment works, industrial discharges)
- Permitted storm water dischargers
- Dischargers with Waste Discharge Requirements (WDRs) or waivers of WDRs
- Responsible parties for sediment quality related remedial action
- The Water Boards

2.5 Approvals Required in Order to Implement the Amendments

After adoption by the State Water Board, the amendments must be submitted to the California Office of Administrative Law for review and approval. Because the amendments include a revision of the assessment framework implementing an existing narrative SQO, the amendments will be submitted to U.S. EPA.

2.6 Project History

A 2001 Superior Court decision (San Francisco BayKeeper, Inc. v. State Water Resources Control Board, Sacramento Superior Court, Case No. 99CS02722, October 2001) ordered the State Water Board to adopt SQOs pursuant to California Water Code section 13393. Section 13393 requires the State Water Board to adopt SQOs for toxic pollutants that have been identified in toxic hot spots as part of the Bay Protection and Toxic Cleanup Program (BPTCP) and for other toxic pollutants of concern. Although the State Water Board had prepared a workplan to develop SQOs in 1990, SQOs were never developed, as efforts were focused on the identification of hotspots. In response to the court's decision, the State Water Board immediately initiated a phased process to develop SQOs, supporting tools, and an implementation policy.

2.6.1 Phase 1

Under Phase 1 of the SQO Program, the State Water Board made significant progress to protect sediment dwelling organisms from direct effects caused by exposure to pollutants in sediment within the major enclosed bays and harbors of California. A detailed description of Phase I can be found in the 2008 Staff Report, approved and adopted under Resolution 2008-0070. That document is available here;
http://www.swrcb.ca.gov/water_issues/programs/bptcp/docs/sediment/071808_draftstaffreport.pdf

During this first phase of SQO development, the State Water Board and technical team developed a framework that relies on multiple lines of evidence (MLOE). The MLOE consist of sediment bioassays, benthic community health, and sediment chemistry that are applied to interpret the narrative SQO contained in Section IV.A. of the Sediment Quality Provisions that states:

> *Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California. This narrative objective shall be implemented using the integration of multiple lines of evidence (MLOE) as described in Section V of Part 1.*

Sediment quality dependent aquatic life related beneficial uses intended to be protected by the SQO consists of Marine and Estuarine Uses as stated in the Sediment Quality Provisions. Implementation of this narrative objective includes requirements for monitoring and an iterative process to determine the cause of the biological effects and the responsible sources so that management actions are effective. The Sediment Quality Provisions also describes how the narrative objectives and assessment framework are applied within permits as receiving water limits, used for listing of impaired waterbodies and in setting requirements associated with navigation dredging and development of management targets. However, for some habitats, there was too little data available for developing and/or refining existing indicators for all three lines of evidence. As a result, the indicators adopted for interpreting this narrative within estuarine water bodies are less robust and rely upon best professional judgment (BPJ) to a greater extent than those applicable to enclosed bays.

During Phase 1, a narrative SQO was also proposed to protect humans from exposure to contaminants in fish tissue derived from bay or estuarine sediments. This narrative, subsequently adopted into the Sediment Quality Provisions states:

> *Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health in bays and estuaries of California. This narrative objective shall be implemented as described in Section VI.A of Part 1.*

Sediment quality dependent beneficial uses intended to be protected by this SQO consist of Commercial fishing and Sportfishing, Aquaculture, and Shellfish Harvesting Uses, as stated in the Sediment Quality Provisions. As with the interpretation of the narrative objective protecting benthic communities in estuarine waters, limited data hindered the development of a prescriptive methodology for interpreting the narrative objective protecting human health. As a result, Section VI of the Sediment Quality Provisions relies upon existing guidance and practices from U.S. EPA and CalEPA and BPJ to assess sediment quality relative to this narrative SQO:

> *The narrative human health objective in Section IV.B. of this Part 1 shall be implemented on a case-by-case basis, based upon a human health risk assessment. In conducting a risk assessment, the Water Boards shall consider any applicable and relevant information, including California Environmental Protection Agency's (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, CalEPA's Department of Toxic Substances Control (DTSC) Risk Assessment, and U.S. EPA Human Health Risk Assessment policies.*

These general requirements ensure that each assessment is based on human health risk assessment, a generic framework for assessing the potential for adverse effects to humans from exposure to contaminants in the environment. Human health risk assessment is frequently used by U.S. EPA, U.S. Army Corps of Engineers, and many state agencies to evaluate sites where elevated levels of contaminants are present in site sediments. The human health risk assessment framework consists of the following basic elements (U.S. EPA, 2000):

- Planning based on a site conceptual model that describes how potential exposures could occur through likely exposure pathways and who could be potentially be impacted,
- Hazard Identification to evaluate what potential hazards exist,
- Dose Response Assessment to understand how the dose of a chemical affects the body's physiological response,
- Exposure Assessment evaluates the actual exposure likely to occur, and

Risk Characterization utilizes all the above information to provide an evaluation of the risk posed by the exposure. Although U.S. EPA and other federal and state agencies provide extensive and detailed guidance on how to conduct risk assessments, the process is intended to be flexible to enable the investigators to respond to any situation encountered relative to the size and complexity of the site. As a result, this framework performs equally well when applied to small simple sites as it does to large complex National Priorities List (NPL) Sites. However, because this approach is based on a general framework and not a highly structured prescriptive approach, there is significant discretion and subjectivity associated with the process. Implementation of the process requires a high degree of best professional judgment and expertise in both the planning as well as the analysis. These factors negatively impact consistency in the application and outcome, as well as utility, and ease of use. In addition, because of the high degree of subjectivity involved, risk assessments require a high level of communication amongst regulators, responsible parties, and the affected population. The proposed amendments described in this report are intended to resolve these limitations by replacing the existing assessment framework with a more prescriptive approach. Phase I was completed when the State Water Board approved Resolution 2008-0070 adopting the Sediment Quality Provisions. The Sediment Quality Provisions became effective upon approval by U.S. EPA on August 25, 2009.

2.6.2 Phase 2

Phase 2 originally focused on developing a prescriptive assessment framework to support implementation of the SQO protecting human consumers of fish and shellfish. While working on this second phase of SQO development, the State Water Board prepared and circulated a CEQA scoping informational document (State Water Board, 2010) describing these efforts and held a scoping meeting in Sacramento on May 19, 2010. After review of comment letters received in response to the CEQA Scoping informational document and review of past comment letters received in the development and adoption process associated with Phase 1, State Water Board decided that greater benefit could be achieved by refocusing Phase 2 on receptors not previously considered in Phase I. As a result, this effort now consisted of a narrative objective proposed to protect wildlife and resident finfish from exposure to contaminants in sediment:

> *Pollutants shall not be present in sediment at levels that alone or in combination are toxic to wildlife and resident finfish by direct exposure or bioaccumulate in aquatic life at levels that are harmful to wildlife or resident finfish by indirect exposure in bays and estuaries of California This narrative objective shall be implemented as described in Section VI.B of Part 1.*

Sediment quality dependent beneficial uses intended to be protected by this SQO consist of Rare, Threatened and Endangered Species; Preservation of Biological Habitats of Special Concern; Wildlife Habitat and Spawning Reproduction and Early Development, as stated in the Sediment Quality Provisions. Similar to the SQO protecting human health, this objective is implemented using existing guidance and practices from U.S. EPA and Cal EPA and based on BPJ. Phase 2 was completed when the State Water Board approved Resolution No. 2011-0017 adopting the proposed amendments. To date, U.S. EPA has not approved the wildlife and resident finfish SQO and as a result is applicable only under State law.

2.6.3 Phase 3

The amendments described in this report constitute Phase 3 of SQO development. As described above, this effort was previously identified as Phase 2 from 2007 until 2011. See

Section 2.1 above for the full project description. The proposed amendments are provided in Appendix A.

2.7 Project Contacts

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2.8 Advisory and Scientific Steering Committees

Advisory Committee

The 1989 amendments to the Water Code required the State Water Board to form an advisory committee to assist in the implementation of chapter 5.6. State Water Board staff invited stakeholders and interested parties to participate in this committee, which was intended to focus on SQOs development and implementation within bays. Dr. Brock Bernstein served as Chairperson and facilitator.

Scientific Steering Committee

The Scientific Steering Committee (SSC) was formed for the purpose of independently assessing the soundness and adequacy of the technical approach and ensuring that all findings and conclusions are well supported. The SSC provided the State Water Board's technical team with a high level of expertise and experience from around the nation. The members on this committee participating in the human health assessment framework development are:

- Dr. Peter Landrum, Committee Chair: Research Chemist NOAA/Great Lakes (retired) Environmental Research Laboratory Ann Arbor, MI
- Dr. Todd Bridges, Research Biologist and Director of the Center for Contaminated Sediments, Waterways Experiment Station (WES) U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS
- Dr. Robert Burgess Research Scientist, U.S. EPA's Office of Research and Development (Atlantic Ecology Division-Narragansett)
- Dr. Charles Menzie, Exponent Inc.
- Dr. Jim Shine, Harvard School of Public Health
- Dr. Donna Vorhees, The Science Collaborative-North Shore

2.9 Technical Team

The technical team includes the following scientists

- Mr. Steve Bay, Technical Team Leader, Principal Scientist at Southern California Coastal Water Research Project
- Dr. Ben Greenfield, formerly with San Francisco Estuary Institute
- Dr. Aroon Melwani, formerly with San Francisco Estuary Institute
- Dr. Michael Connor, formerly with San Francisco Estuary Institute
- Dr. Doris Vidal Dorsch, formerly with Southern California Coastal Water Research Project
- Dr. Ashley Parks, Southern California Coastal Water Research Project
- Mr. Darrin Greenstein, Southern California Coastal Water Research Project
- Ms. Shelly Moore, Southern California Coastal Water Research Project
- Dr. Stephen Weisberg, Southern California Coastal Water Research Project

2.10 Future Incorporation into the Inland Surface Waters and Enclosed Bays and Estuaries Plan

The State Water Board intends in the future to create the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries of California (ISWEBE). The State Water Board intends to incorporate the Sediment Quality Provisions into the ISWEBE Plan, once it is created.

When the Sediment Quality provisions contained in the Enclosed Bays and Estuaries Plan are incorporated into the ISWEBE Plan, some editorial revisions may be made, including but not limited to appropriate changes to the title page, table of contents, appendices, page numbers, table and figure numbers, footnote numbers, and headers and footers. Presented in Table 2.1 is a comparison of the headings associated with the Sediment Quality Provisions within Enclosed Bays and Estuaries Plan and the same provisions incorporated into the ISWEBE. The proposed amendments are presented in the format of the ISWEBE.

Table 2.1. Conforming the Enclosed Bays and Estuaries Plan to the Inland Surface Waters, Enclosed Bays, and Estuaries Plan format. This table represents formatting changes to content from the Enclosed Bays and Estuaries Plan adopted on January 28, 2011.

Content	Enclosed Bays and Estuaries Plan	Inland Surface Waters, Enclosed Bays, and Estuaries Plan
Intent and Summary	Section I.	Chapter I.A.1.
Use and Applicability of SQOs	Section II.	Chapter III.A.2.
Beneficial Uses	Section III.	Chapter II.
Sediment Quality Objectives	Section IV.	Chapter III.A.3.
Implementation for Assessing Benthic Community Protection	Section V.	Chapter IV.A.1.
Implementation for Assessing Human Health	Section VI.	Chapter IV.A.2.
Wildlife and Resident Finfish	Section VI.	Chapter IV.A.3.
Program Specific Implementation	Section VII.	Chapter IV.A.4.
Appendices/Attachments	Appendix A.	Attachment C-3.
	Appendix B.	Attachment C-4.

3 Conceptual Model

3.1 Fate and Transport Processes

Contaminants in sediments are influenced by many physical chemical, and biological processes that ultimately determine the distribution and bioavailability of these contaminants within enclosed bays and estuaries. There are many possible sources of contaminants that can contribute to sediment contamination in embayments (Figure 3.1). Runoff and discharge from rivers, creeks, and drainage channels that carry storm water and dry weather runoff from the upland watershed are major nonpoint sources. Other nonpoint contaminant sources include atmospheric deposition and transport from groundwater into surface water bodies. Contaminants may also be discharged in effluents from point sources, such as municipal wastewater and industrial discharges located within embayments, as well as spills, leaks or accidental releases. A large portion of the contaminants from most of these sources may be associated with particles, either as suspended particles in the discharge or receiving water body. However, each of these discharges influences water and sediment quality on different spatial and temporal scales. This diversity of sources, combined with various physical mixing processes such as currents, tidal exchange, and ship traffic, can produce complex and widespread patterns of sediment contamination.

Many factors affect the fate and distribution of sediment contaminants within enclosed bays and estuaries (Figure 3.2). Upon introduction into the water body, dissolved contaminants may bind to suspended particles in the water column or particle-associated contaminants may desorb back into the water column. In brackish embayments in particular, flocculation and aggregation of small suspended particles into large agglomerates that then settle out of the water column is a primary mechanism for introduction of contaminants to surface sediments. Where river or tidal currents are present, some contaminants will be transported (advected) out of the system. The fraction that remains and eventually settles forms the sediment's surface, a layer (5-20 cm) where a variety of physical, chemical, and biological processes occur. Most of the benthic infauna resides in this surface layer. The layer of sediment below is less dynamic and contaminants that are contained in this layer generally exert little influence on organisms. However, contaminants in the deep sediment layer can affect habitat quality if they are transported to the surface by deep burrowing organisms, transformed into different chemical species under anaerobic conditions, or resuspended by physical processes such as sediment erosion or dredging. Particle-bound contaminants can move into the water column by diffusion (desorption from particles), resuspension, or from the burrowing and feeding activities of many benthic organisms (bioturbation) (Figure 3.2). Sediment particle size and composition can affect the distribution and biological availability by binding to contaminants. Sediment particles vary from coarse sand with a diameter of about 1 mm to fine silts and clays with diameters less than 0.01 mm. These finer particles generally contain higher contaminant concentrations due to a much greater surface area and greater number of chemical sorption sites. Sediments contain variable amounts and types of organic carbon, including natural plant or animal detritus, microbial films, and anthropogenic materials such as ash, soot, wood chips, oils, and tars. The partitioning of many contaminants between sediment particles, water, and biota is strongly influenced by the nature of sediment organic carbon (Figure 3.2). The predominant forms for metals (or speciation) are largely governed by the reduction-oxidation (redox) potential (or Eh) and the co-occurrence of binding constituents such as sulfides, organic material, metal oxides, and clay minerals. Microbial activities also influence the characteristics of sediment contaminants. The microbial degradation of sediment organic matter can alter the pH and oxygen content of sediments, which may in turn affect the rates of metal desorption/precipitation. Bacterial metabolism or chemical processes can also transform or degrade some contaminants to other forms. In some cases, the transformation product may have greater biological availability or toxicity, such as methyl mercury. In other cases, such as for some pesticides, degradation may alter the contaminant so that it is no longer toxic.

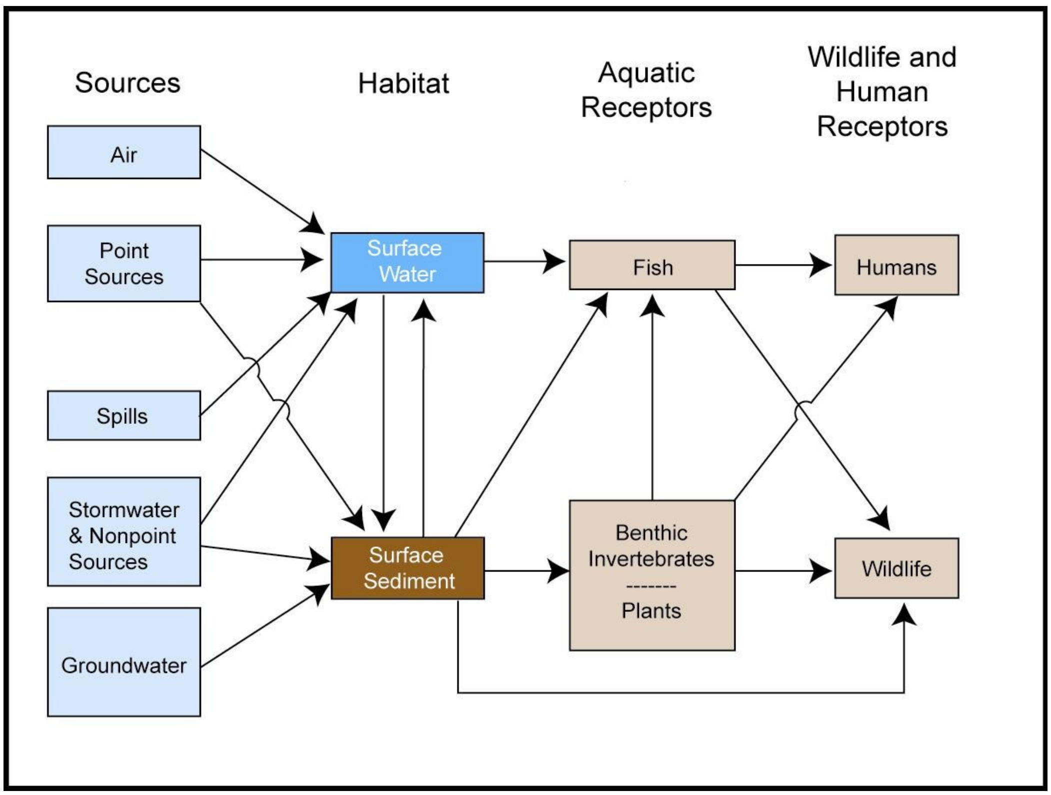


Figure 3.1. Principal Sources, Fates, and Effects of Sediment Contaminants in Enclosed Bays and Estuaries (Adapted from Bridges et al. 2005)

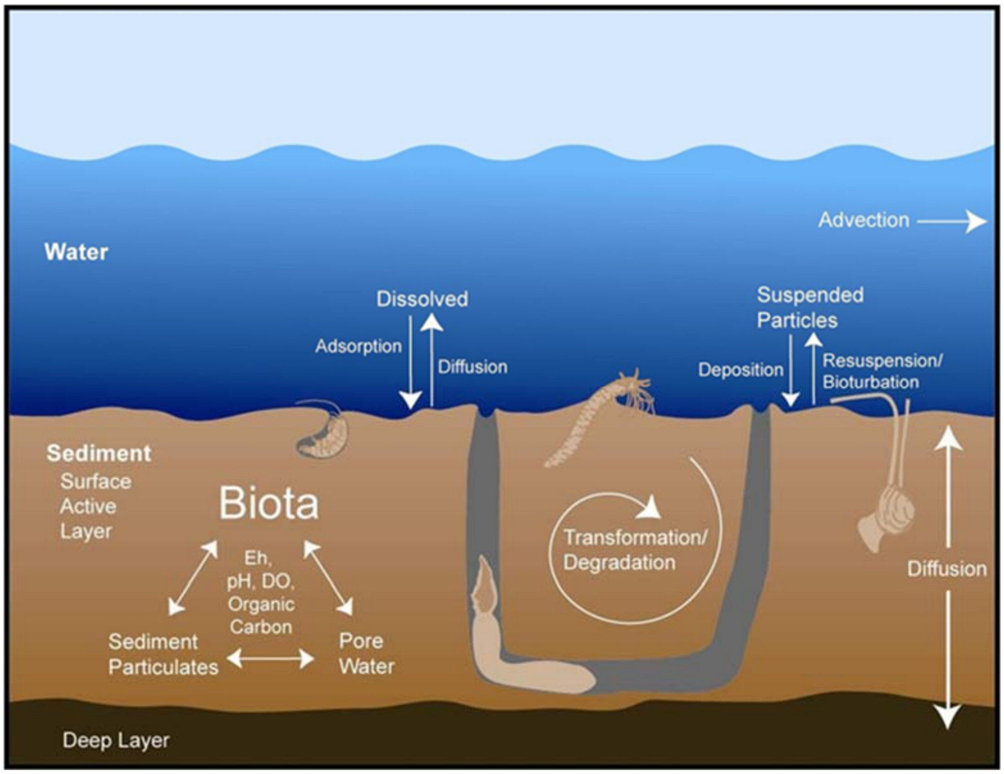


Figure 3.2. Sediment Processes Affecting the Distribution and Form of Contaminants

3.2 Receptors and Exposure Pathways

California's bays and estuaries are home to a tremendous diversity of life. As such, there are multiple routes by which these organisms can be exposed to and affected by sediment contaminants. There are two general types of contaminant exposure: direct and indirect. Most of the direct exposure results from the contact of organisms with the sediment and sediment ingestion. Organisms living in the sediment are exposed through the uptake of contaminants from the pore water, which is the water associated with the sediment particles. This process is analogous to the exposure of water column organisms from dissolved contaminants. Organisms that ingest sediments may accumulate contaminants that are desorbed by digestive processes in the gut. Indirect contaminant exposure results from the consumption of contaminated prey. Examples include fish feeding on benthic invertebrates, birds feeding on benthic invertebrates or fish, and humans consuming fish (Figure 3.3).

Direct Effects to Benthic Communities

Benthic invertebrates are generally at greatest risk for adverse effects from direct sediment contaminant exposure, because these organisms often live in continual direct contact with sediment/pore water and exhibit limited range or mobility. These invertebrates are also critical to the health of the aquatic ecosystem, because benthic invertebrates:

- Digest a significant portion of the organic detritus that settles out in bays and estuaries.
- Significantly enhance sediment mixing and oxygenate deeper sediments that stimulate bacteria-driven biogeochemical processes.

- Create habitat that enhances recruitment for other organisms.
- Provide food for most fish species that utilize bays and estuaries. Waterfowl and wetlands birds also rely on benthic invertebrates as a primary food source.

Within many habitats, a variety of taxa are present that exhibit different life histories. Species-specific differences in feeding strategies, metabolism, and contaminant uptake rates affect the amount of contaminant (or dose) accumulated by benthic organisms. Many species ingest significant quantities of sediment as a source of nutrition (Figure 3.3). The relative importance of sediment ingestion vs. sediment contact for contaminant exposure varies depending upon the life history of the species. As a result, benthic species vary in their sensitivity to sediment contamination. This in turn produces a gradation of benthic community composition change that corresponds to the magnitude of contaminant exposure. Changes in the benthic community, such as abundance and species composition, are a sensitive measure of the direct effects of sediment contamination, because these organisms live in the surface sediment layer. However, variations in sediment composition complicate this assessment because benthic organisms often have specific preferences or tolerances for variations in sediment grain size and organic content, in addition to other environmental factors such as water depth, salinity, and temperature. Consequently, the benthic community present at a site may be altered by a variety of environmental factors in addition to adverse effects from contaminants. It is necessary to understand how these environmental factors affect benthic communities before the effects of contaminants can be discerned. The tools used to determine benthic community condition (benthic indices) often must be calibrated to specific habitat types (e.g., marine bays or low salinity estuaries) in order to provide an accurate assessment of biological condition.

Laboratory toxicity tests are also useful for assessing the direct effects of sediment. These tests measure the lethal or sublethal response of a test species exposed to the sediment under controlled conditions. Toxicity tests provide a measure of the bioavailability and toxicity of sediment contaminants from direct exposure and are not affected by many of the environmental factors that confound benthic community analyses or other measurements of effect in the field.

Indirect Effects to Human Consumers of Fish
Certain types of trace metals and organic chemicals can accumulate in fish tissue from exposure to these pollutants in the water column, sediment and prey tissue. Bioaccumulation is the result of the uptake and retention of a chemical by an aquatic organism from the surrounding water, food, and sediment (Mackay and Fraser 2000). The relationships between contaminated sediments and the accumulation of pollutants in fish and shellfish tissue is influenced by many species-specific and site-specific factors, such as sediment organic content, complexity of the food web, species-specific feeding habits, home range and lipid content, factors that vary with both age and season. Some of the biological factors affecting bioaccumulation are lipid content, food web structure, diet, consumption rate and age. Contaminants such as PCBs, organochlorine pesticides, and methyl mercury have an affinity for tissue lipids. As a result bioaccumulation, contaminants may accumulate at higher trophic levels to concentrations capable of causing unacceptable risks to human consumers and biota.

Figure 3.3 illustrates the trophic transfer and contaminant flux from water and sediment into biota in a hypothetical food web for organochlorine pesticides and PCBs.

Primary productivity occurs in both the water column by phytoplankton and at the sediment water interface by algae and vascular plants attached to the sediment. Primary consumers such as zooplankton feed on primary producers. Benthic invertebrates, including crustaceans, mollusks, and polychaetes, have highly varied diets and may feed on detritus, sediment, algae, or other benthic fauna. Benthic invertebrates are consumed by resident and transient fish species (Figure 3.3). In this example, striped mullet and topsmelt predominantly consume sediment and attached algae, and shiner perch feed on both water column and benthic organisms. Many fish species consume mostly invertebrates, with some piscivory on smaller fish, including topsmelt and arrow goby. Human sport fishers catch and consume a variety of fish species within enclosed bays and estuaries. In this example of a southern California embayment or coastal lagoon, shiner perch, striped mullet, California corbina, spotted sand bass, and yellowfin croaker represent a major portion of the catch.

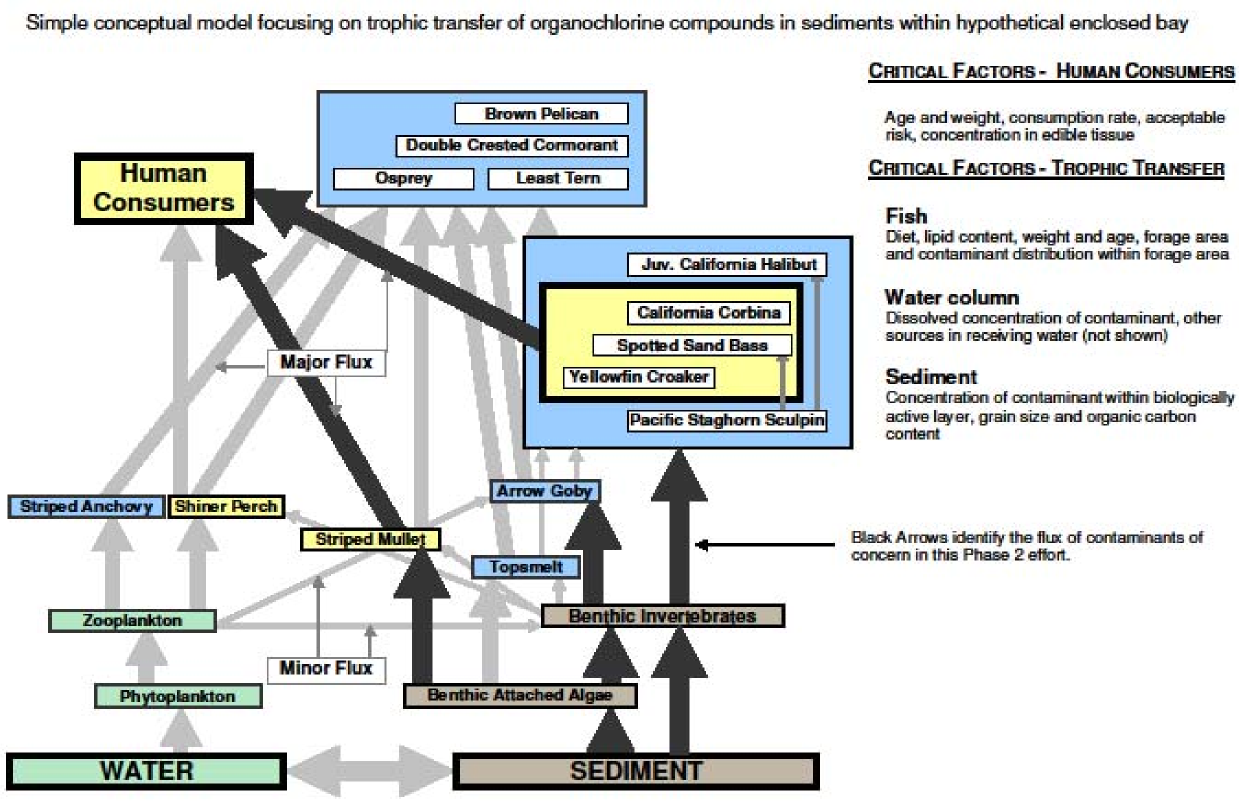


Figure 3.3 Trophic Transfer within an Enclosed Bay

Contaminant transfer between sediment and biota can occur through a variety of routes; however food-web trophic transfer (as represented by dietary uptake of invertebrates) is the most significant route of exposure for fish. The food web presented in Figure 3.3 encompasses the major transport pathways. Although the exact food web structure will vary among water bodies, the general food web components will be present in all circumstances. That is, all embayments will contain primary producers, primary consumers, and resident and transient fish and wildlife that consume some combination of these organisms. The water bodies will also be visited by higher trophic level predators (e.g., large sport fish, humans) that consume resident fish.

The spatial scale of the exposure generally increases with trophic level. Sedentary receptors such as benthic invertebrates and gobies exhibit high site fidelity ranging from less than one square meter (m^2) to 100 m^2 respectively. For receptors that exhibit high site fidelity and low trophic position, the relationship between organism exposure and contaminants in sediment can be evaluated directly with relatively simple tools and measures. Most resident fish are not sedentary and may forage over 0.5 square kilometers (km^2) to 50 km^2 or more within enclosed bays and estuaries. Over this larger area, quantifying exposure and contribution of contaminants from a specific portion of the forage area becomes difficult due to variations in contaminant distribution and bioavailability, preferential feeding in select habitats within foraging area, and variability in diet, age, and lipid content.

The contaminant concentrations in fish tissue represent the net uptake from the entire foraging area. For upper trophic level fish with large forage range, contaminants in fish tissue collected in close proximity to a site may not represent the contaminant contribution from the site sediments. A substantial portion of the tissue contamination may come from sediments outside of the area of interest. The situation is even more complex with anadromous fish, migratory birds, and marine mammals that spend a substantial portion of their lives away from the site or water body. For these types of animals, it is often difficult to determine the amount of contaminant exposure in these organisms that is due to feeding within the water body. Variations in movement and feeding behavior lead to wide variations in the strength of linkage between sediment contamination at a specific site and seafood contamination. As a result, the presence of fish at a specific site with tissue contamination that represents a human health concern is not conclusive evidence that the sediment at that site is the source of the contamination. The source of exposure may be sediments local to the site or remote from that area, depending on the life history traits of the species.

4 Regulatory Background

4.1 Water Quality Planning Requirements

4.1.1 Federal Clean Water Act

The Clean Water Act (CWA) is the primary federal water pollution control statute. The State Water Board is designated as the State Water Pollution Control Agency for all purposes under the CWA. As required under section 303(c) of the Act, the Water Boards adopt water quality standards for waters of the United States.

4.1.2 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne) is the primary water quality law in California. The California legislature has assigned the responsibility for protecting and enhancing water quality in California to the State Water Board and the nine regional water boards. Porter-Cologne addresses two primary functions: water quality control planning and waste discharge regulation. In adopting Porter-Cologne, the State Legislature directed that California's waters, "shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible." (§ 13000). Porter-Cologne is administered regionally, within a framework of statewide coordination and policy. The State Water Board provides state-level coordination of the water quality control program by establishing statewide policies and plans for the implementation of state and federal laws and regulations. The regional water boards adopt and implement Regional Water Quality Control Plans (Basin Plans) that recognize the unique characteristics of each region with regard to water quality, actual and potential beneficial uses, and water quality problems. State Water Board staff oversees and guides the regional water boards through adoption of statewide water quality control plans and policies.

The State Water Board is authorized under Water Code section 13170 to adopt Water Quality Control Plans in accordance with the provisions of Water Code section 13240 et. seq., as applicable (all further statutory references are to the Water Code unless otherwise indicated). State plans supersede Basin Plans for the same waters (Wat. Code § 13170).

The State Water Board must follow state and federal procedural requirements for public participation, including approval by the state Office of Administrative Law when amending a water quality control plan. Substantive amendments are also subject to the regulations for implementing the California Environmental Quality Act of 1970, as discussed below. Additionally, while the proposed action does not include establishing new or revised water quality objectives, the proposed assessment framework is similar enough in function that the State Water Board has determined it appropriate to consider the Porter Cologne section 13241 factors, which include:

a. Past, present, and probable future beneficial uses of water.
b. Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.

c. Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.
d. Economic considerations.
e. The need for developing housing within the region.
f. The need to develop and use recycled water.

In 1989, the Legislature enacted the Bay Protection and Toxic Cleanup Act, which amended Porter-Cologne to require the State Water Board to develop sediment quality objectives (SQOs) for toxic pollutants in toxic hot spots and for other toxic pollutants of concern, as part of a comprehensive program to protect beneficial uses in enclosed bays and estuaries. (Wat. Code, §§ 13390-13396.9). The Legislature defined a “sediment quality objective” (SQO) as “that level of a constituent in sediment which is established with an adequate margin of safety, for the reasonable protection of the beneficial uses of water or the prevention of nuisance.” (Wat. Code, § 13391.5. subd. (d)). The SQOs must “be based on scientific information, including, but not limited to, chemical monitoring, bioassays, or established modeling procedures” and “provide adequate protection for the most sensitive aquatic organisms” (Wat. Code, § 13393.). The State Water Board is not precluded from adopting SQOs for a pollutant even though additional research may be needed (Wat. Code, § 13392.6.). In addition, if there is a potential for human exposure to pollutants through the food chain, the State Water Board must base SQOs on a health risk assessment (Wat. Code, § 13393.). A health risk assessment is an analysis that evaluates and quantifies the potential human exposure to a pollutant that bioaccumulates in edible finfish, shellfish, or wildlife, and “includes an analysis of both individual and population-wide health risks associated with anticipated levels of human exposure, including potential synergistic effects of toxic pollutants and impacts on sensitive populations” (Wat. Code, § 13391.5, subd.(c)).

4.1.3 California Environmental Quality Act

The State Water Board must comply with the procedural and substantive requirements of CEQA when proposing to amend water quality control plans and policies (Pub. Resources Code. § 21000 et seq.). CEQA authorizes the Secretary for Natural Resources to certify that state regulatory programs meeting certain environmental standards are exempt from the majority of the procedural requirements of CEQA, including the preparation of a separate environmental impact report (EIR), negative declaration, or initial study (Cal. Code. Regs., tit. 14, §15250). The Secretary for Natural Resources has certified as exempt the State Water Board adoption or approval of standards, rules, regulations, or plans to be used in the Basin/208 Planning program for the protection, maintenance, and enhancement of water quality in California (Cal. Code. Regs., tit. 14, § 15251; Cal. Code Regs. tit. 23, §§ 3775 – 3781). This exemption includes the State Water Board’s process to adopt these proposed amendments. Under this exemption, the State Water Board must still comply with CEQA’s goals and policies, including the policy of avoiding significant adverse effects on the environment where feasible (Cal. Code. Regs., tit. 14, § 15250). In addition, the State Water Board must also evaluate environmental effects, including cumulative effects; consult with other agencies; conduct early public consultation and review; respond to comments on the draft environmental document; adopt CEQA findings; and provide for mitigation monitoring and reporting, as appropriate. Early consultation consisted of preparation and circulation of a CEQA scoping informational document and the May 19, 2010 scoping meeting held in Sacramento, California (State Water Board, 2010). http://www.waterboards.ca.gov/water_issues/programs/bptcp/docs/sediment/sqo_scopedoc042110.pdf

The CEQA Guidelines provide for the use of a “substitute document” by State agencies with certified Programs (Cal. Code. Regs., tit. 14, § 15252). State Water Board regulations (Cal. Code. of Regs., tit. 23, § 3777) require that Draft Substitute Environmental Documentation (SED) be prepared for a certified regulatory program. The Draft SED must include:

- A written report prepared for the board that contains a brief description and an environmental analysis of the proposed project;
- An identification of any significant, or potentially significant, adverse environmental impacts of the proposed project;
- An analysis of reasonable alternatives to the project;
- An analysis of mitigation measures that would avoid or reduce any significant, or potentially significant, adverse environmental impacts;
- An environmental analysis of the reasonably foreseeable methods of compliance;
- A completed Environmental Checklist; and
- Other documents the State Water Board may decide to include.

4.1.4 Native American Consultation

With the passage of Assembly Bill 52 (AB 52) in 2014, the California Legislature added new requirements to the California Environmental Quality Act in order to ensure that local and Tribal governments, public agencies and project proponents have information available early in the project planning process, to identify and address potential adverse impacts to tribal cultural resources. The Public Resources Code now establishes that “[a] project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment.” (Pub. Resources Code, sec. 21084.2) The State Water Board, as lead agency for CEQA, notified Tribes requesting AB 52 Consultation on January 30, 2017.

The State Water Board was contacted by Trinidad Rancheria on February 28, 2017, requesting a copy of the proposed amendments to the Sediment Quality Provisions. Telephone contact on March 6, 2017 verified Trinidad Rancheria’s interest in a copy of the proposed amendment and clarified that Trinidad was not requesting formal consultation. Thus, the State Water Board sent a letter dated April 12, 2017, notifying the Tribe of the State Water Board’s decision to move forward with public notice of the project and inviting participation during that process.

The State Water Board was contacted by Wilton Rancheria on March 29, 2017, requesting a copy of the proposed amendments to the Sediment Quality Provisions. Subsequent contacts offering to initiate consultation received no further response. Thus, the State Water Board sent a letter dated July 21, 2017, notifying the Tribe of the State Water Board’s decision to move forward with public notice of the project and inviting participation during that process.

4.1.5 California Health and Safety Code

In 1997, section 57004 was added to the California Health and Safety Code (Senate Bill 1320-Sher) which requires external scientific peer review of the scientific basis for any rule proposed by any board, office or department within CalEPA. Scientific peer review is a mechanism for ensuring that regulatory decisions and initiatives are based on sound science. Scientific peer review also helps strengthen regulatory activities, establishes credibility with stakeholders, and ensures that public resources are managed effectively. The scientific and technical information supporting the proposed amendments will be submitted for scientific peer review in Fall of 2017. Peer review comments as well as Water Board responses will be included as an appendix to this SED.

4.2 Statewide Programs to Assess and Manage Sediment Quality

Porter-Cologne also established the Water Board's authority to regulate discharges and require monitoring, assessment, and corrective action by dischargers that are causing or contributing to the degradation of water quality. Specifically, Porter-Cologne establishes a program to regulate waste discharges that could affect water quality through waste discharge requirements, conditional waivers, or prohibitions (See Wat. Code §§13243, 13263, 13269). This program is the principal way in which water quality control policies and plans are implemented. The term "waste" is broadly defined in Porter-Cologne and includes toxic pollutants, as well as other waste substances (*Id.* §13050(d)). The term "waters of the state" is similarly broadly defined to include all surface waters, including bays and estuaries, and groundwater within state boundaries (*Id.* §13050(e)).

Porter-Cologne also authorizes the Water Boards to investigate water quality and to require waste dischargers to submit monitoring and technical reports (*Id.* §13267, 13383). In addition, Porter-Cologne gives the Water Boards extensive enforcement authority to respond to unauthorized discharges, discharges in violation of applicable requirements, discharges that cause pollution or nuisance, and other matters. The enforcement options include, among others, cleanup and abatement orders, cease and desist orders, and administrative civil liability orders (*Id.* §13301, 13304, 13350). The summary below provides a description of programs plans and policies that stem from this authority as well as the CWA.

4.2.1 Policies and Procedures for the Investigation and Cleanup and Abatement of Discharges

In 1992, the State Water Board adopted Resolution No. 92-49, "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304." The resolution describes the policies and procedures that apply to the cleanup and abatement of all types of discharges subject to Water Code section 13304. These include discharges, or threatened discharges, to surface and groundwater. The Resolution requires dischargers to clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality or the best water quality that is reasonable if background levels of water quality cannot be restored, considering economic and other factors. In approving any alternative cleanup levels less stringent than background, Regional Water Boards must apply section 2550.4 of Title 23 of the California Code of Regulations. Section 2550.4 provides that a

Regional Water Board can only approve cleanup levels less stringent than background if the Regional Water Board finds that it is technologically or economically infeasible to achieve background. Resolution No. 92-49 further requires that any alternative cleanup level shall: (1) be consistent with maximum benefit to the people of the state; (2) not unreasonably affect present and anticipated beneficial uses of such water; and (3) not result in water quality less than that prescribed in the water quality control plans and policies adopted by the State and Regional Water Boards.

A Regional Water Board must apply Resolution No. 92-49 when setting cleanup levels for contaminated sediment if such sediment threatens beneficial uses of the waters of the state, and the contamination or pollution is the result of a discharge of waste. Contaminated sediment must be cleaned up to background sediment quality unless it would be technologically or economically infeasible to do so.

4.2.2 Bay Protection and Toxic Cleanup Program (BPTCP)

To address toxic hot spots, Water Code section 13392.5 required the Regional Water Boards to develop a consolidated data base that identified all known and potential toxic hot spot spots. In consultation with the State Water Board, the Regional Water Boards were directed to develop an ongoing monitoring and surveillance program that included suggested guidelines to promote standardized analytical methodologies and consistency in data reporting and identification of additional monitoring and analyses needed to complete the toxic hot spot assessment for each enclosed bay and estuary.

In addition, by January 1, 1998, the Regional Water Boards were required to complete and submit to the State Water Board a toxic hot spot cleanup plan for affected waters within their respective regions. (Wat. Code §13394.) Toxic hot spots are defined in Water Code section 13391.5 (e) as “locations…where hazardous substances have accumulated in the water or sediment to levels which (1) may pose a substantial present or potential hazard to aquatic life, wildlife, fisheries, or human health, or (2) may adversely affect the beneficial uses of the bay, estuary, or ocean waters as defined in water quality control plans, or (3) exceeds adopted water quality or sediment quality objectives”.

Each regional toxic hot spots cleanup plan was required to include:

- A priority ranking of all hot spots, including the State Water Board’s recommendations for remedial action at each toxic hot spot site.
- A description of each hot spot site including a characterization of the pollutants present at the site.
- An estimate of the total costs to implement the plan.
- An assessment of the most likely source or sources of pollutants.
- An estimate of the costs that may be recoverable from parties responsible for the discharge of pollutants that have accumulated in sediment.
- A preliminary assessment of the actions required to remedy or restore a toxic hot spot.
- A two-year expenditure schedule identifying state funds needed to implement the plan.

- A summary of actions that have been initiated by the regional board to reduce the accumulation of pollutants at existing hot spot sites and to prevent the creation of new hot spots.

The State Water Board was mandated to submit a consolidated statewide toxic hot spot cleanup plan to the Legislature by June 30, 1999. The statewide plan had to include findings and recommendations on the need for establishing a toxic hot spots cleanup program (Wat. Code § 13394.).

As part of the BPTCP, Chapter 5.6 of Division 7 of Porter Cologne further required the Regional Water Boards to revise waste discharge requirements for dischargers that discharged all or part of the pollutants that caused the toxic hot spot "to ensure compliance with water quality control plans and water quality control plan amendments,…including requirements to prevent the creation of new toxic hot spots and the maintenance or further pollution of existing toxic hot spots" (Wat. Code §13395). A Regional Water Board could determine that it was unnecessary to revise waste discharge requirements only if the Regional Water Board determined that the discharger's contribution was insignificant or that the discharger no longer conducted the practices that led to creation of the toxic hot spot. Water Code section 13396 also prohibits any person from dredging or disturbing a toxic hot spot site without first obtaining a water quality certification under Clean Water Act section 401 or waste discharge requirements.

Program Goals and Actions

The BPTCP was driven by four major goals (State Water Board, 2004): (1) protect existing and future beneficial uses of bay and estuarine waters, (2) identify and characterize toxic hot spots, (3) plan for the prevention and control of further pollution at toxic hot spots, and (4) develop plans for remedial actions of existing toxic hot spots and prevent the creation of new toxic hot spots.

The BPTCP identified benthic organisms and human health as the key targets for protection (SWRCB, 1991) and used both exposure and effects-based measurements of the sediment quality triad (sediment toxicity, benthic community structure and measures of chemical concentrations in sediments) and other measures such as biomarkers and tissue residue to identify toxic hot spots.

Consolidated Hotspots Cleanup Plan

The Consolidated Toxic Hot Spots Cleanup Plan (Consolidated Plan) identified and ranked known toxic hot spots. In addition, the Consolidated Plan presented descriptions of toxic hot spots, actions necessary to remediate sites, the benefits of remediation, and a range of remediation costs. The plan is applicable to any point and nonpoint source discharges that the Regional Water Boards reasonably determine contribute to or cause the pollution at toxic hot spots. The Consolidated Plan required Regional Water Boards to implement the remediation action to the extent that responsible parties can be identified, and funds are available and allocated for this purpose. When the Regional Water Boards cannot identify a responsible party, the Consolidated Plan indicated that they are to seek funding from available sources to remediate the site. The Regional Water Boards determined the ranking of each known toxic hot spot based on the five general criteria specified in the Consolidated Plan as shown in Table 4.1. Table 4.2 describes the rank and reason for listing each hotspot identified in the Consolidated Plan.

Table 4.1. Toxic Hot Spot Ranking Criteria

Criteria Category	High	Moderate	Low
Human Health Impacts	Human health advisory for consumption of nonmigratory aquatic life from the site	Tissue residues in aquatic organisms exceed FDA/DHS action level or U.S. EPA screening levels	None
Aquatic Life Impacts[1]	Hits in any two biological measures if associated with high chemistry	Hit in one of the measures associated with high chemistry	High sediment or water chemistry
Water Quality Objectives	Objectives exceeded regularly	Objectives occasionally exceeded	Objectives infrequently exceeded
Areal Extent of Hot Spot	More than 10 acres	1 to 10 acres	Less than 1 acre
Natural Remediation Potential	Unlikely to improve without intervention	May or may not improve without intervention	Likely to improve without intervention

Source: SWRCB (1999).

1. Site rankings are based on an analysis of the sediment chemistry, sediment toxicity, biological field assessments (including benthic community analysis), water toxicity, TIEs, and bioaccumulation.

As presented in Table 4.2 a significant number of hotspots were identified in bays and estuaries. Although the program focused on specific sites, some hotspots encompass large portions of waterbodies and support many of the 303(d) listings described in the previous section. Under the Bay Protection program, all designated hotspots regardless of priority require corrective action, management action or delisting. The Consolidated Plan provides a summary of the remedial actions and estimated costs to assess and or cleanup high priority toxic hot spots. Note that several of the remedial actions identified by the State and Regional Boards only characterize the problem at a hot spot. Thus, the costs identified for those actions do not include all actions necessary to fully remediate the toxic hot spot. Additional funds would be required for remediation after characterization studies are complete.

Additional information on the enclosed bays listed as known toxic hot spots in the Consolidated Plan, including ranking and reason for listing can be obtained from the Consolidated Hotspots Cleanup Plan available from the following link: https://www.waterboards.ca.gov/water_issues/programs/bptcp/conplan.shtml

Table 4.2. Toxic Hot Spots within Enclosed Bays and Estuaries

Rank	Site Identification	Reason for Listing	
		Definition trigger	Pollutants
High	Delta Estuary, Cache Creek watershed including Clear lake	Human health impacts	Mercury
High	Delta Estuary	Aquatic life impacts	Diazinon

Rank	Site Identification	Reason for Listing	
		Definition trigger	Pollutants
High	Delta Estuary - Morrison Creek, Mosher Slough, 5 Mile Slough, Mormon Slough & Calaveras River	Aquatic life impacts	Diazinon & Chlorpyrifos
High	Delta Estuary - Ulatis Creek, Paradise Cut, French Camp & Duck Slough	Aquatic life impacts	Chlorpyrifos
High	Humboldt Bay Eureka Waterfront H Street	Bioassay toxicity	Lead, Silver, Antimony, Zinc, Methoxychlor, PAHs
High	Los Angeles Inner Harbor Dominguez Channel, Consolidated Slip	Human health, aquatic life impacts	DDT, PCBs, PAH, Cadmium, Copper, Lead, Mercury, Zinc, Dieldrin, Chlordane
High	Los Angeles Outer Harbor Cabrillo Pier	Human health, aquatic life impacts	DDT, PCBs, Copper
High	Lower Newport Bay Rhine Channel	Sediment toxicity, exceeds objectives	Arsenic, Copper, Lead, Mercury, Zinc, DDE, PCB, TBT
High	Moss Landing Harbor and Tributaries	Sediment chemistry, toxicity, bioaccumulation, and exceedances of NAS and FDA guidelines	Pesticides, PCBs, Nickel, Chromium, TBT
High	Mugu Lagoon/ Calleguas Creek tidal prism, Eastern Arm, Main Lagoon, Western Arm	Aquatic life impacts	DDT, PCBs, metals, Chlordane, Chlorpyrifos
High	San Diego Bay Seventh St. Channel Paleta Creek, Naval Station	Sediment toxicity and benthic community impacts	Chlordane, DDT, PAHs and Total Chemistry[2]
High	San Francisco Bay Castro Cove	Aquatic life impacts	Mercury, Selenium, PAHs, Dieldrin
High	San Francisco Bay Entire Bay	Human health impacts	Mercury, PCBs, Dieldrin, Chlordane, DDT, Dioxin Site listing was based on Mercury and PCB health advisory
High	San Francisco Bay Islais Creek	Aquatic life impacts	PCBs, chlordane, dieldrin, endosulfan sulfate, PAHs, anthropogenically enriched H_2S and NH_3
High	San Francisco Bay Mission Creek	Aquatic life impacts	Silver, Chromium, Copper Mercury, Lead, Zinc, Chlordane, Chlorpyrifos, Dieldrin, Mirex, PCBs, PAHs, anthropogenically enriched H_2S and NH_3
High	San Francisco Bay Peyton Slough	Aquatic life impacts	Silver, Cadmium, Copper, Selenium, Zinc, PCBs, Chlordane, ppDDE, Pyrene
High	San Francisco Bay Point Potrero/ Richmond Harbor	Human health	Mercury, PCBs, Copper, Lead, Zinc
High	San Francisco Bay Stege Marsh	Aquatic life impacts	Arsenic, Copper, Mercury, Selenium, Zinc, chlordane, dieldrin, ppDDE, dacthal, endosulfan, endosulfan sulfate, dichlorobenzophenone, heptachlor epoxide, hexachlorobenzene, mirex, oxidiazon, toxaphene and PCBs
Moderate	Anaheim Bay, Naval Reserve	Sediment toxicity	Chlordane, DDE
Moderate	Ballona Creek Entrance Channel	Sediment toxicity	DDT, zinc, lead, Chlordane, dieldrin, chlorpyrifos
Moderate	Bodega Bay-10006 Mason's Marina	Bioassay toxicity	Cadmium, Copper, TBT, PAH

Rank	Site Identification	Reason for Listing	
		Definition trigger	Pollutants
Moderate	Bodega Bay-10028 Porto Bodega Marina	Bioassay toxicity	Copper, lead, Mercury, Zinc, TBT, DDT, PCB, PAH
Moderate	Delta Estuary Delta	Aquatic life impacts	Chlordane, Dieldrin, Lindane, Heptachlor, Total PCBs, PAH & DDT
Moderate	Delta Estuary Delta	Human health impacts	Chlordane, Dieldrin, Total DDT, PCBs, Endosulfan, Toxaphene
Moderate	Los Angeles River Estuary	Sediment toxicity	DDT, PAH, Chlordane
Moderate	Upper Newport Bay Narrows	Sediment toxicity, exceeds water quality objectives	Chlordane, Zinc, DDE
Moderate	Lower Newport Bay Newport Island	Exceeds water quality objectives	Copper, Lead, Mercury, Zinc, Chlordane, DDE, PCB, TBT
Moderate	Marina del Rey	Sediment toxicity	DDT, PCB, Copper, Mercury, Nickel, Lead, Zinc, Chlordane
Moderate	Monterey Harbor	Aquatic life impacts, sediment toxicity	PAHs, Cu, Zn, Toxaphene, PCBs, Tributyltin
Moderate	San Diego Bay Between “B” Street & Broadway Piers	Benthic community impacts	PAHs, Total Chemistry
Moderate	San Diego Bay Central Bay Switzer Creek	Sediment toxicity	Chlordane, Lindane, DDT, Total Chemistry
Moderate	San Diego Bay Chollas Creek	Benthic community impacts	Chlordane, Total Chemistry
Moderate	San Diego Bay Foot of Evans & Sampson Streets	Benthic Community Impacts	PCBs, Antimony, Copper, Total Chemistry
Moderate	San Francisco Bay Central Basin, San Francisco Bay	Aquatic life impacts	Mercury, PAHs
Moderate	San Francisco Bay Fruitvale (area in front of storm drain)	Aquatic life impacts	Chlordane, PCBs
Moderate	San Francisco Bay Oakland Estuary. Pacific Drydock #1 (in front of storm drain)	Aquatic life impacts	Copper, Lead, Mercury, Zinc, TBT, ppDDE, PCBs, PAHs, Chlorpyrifos, Chlordane, Dieldrin, Mirex
Moderate	San Francisco Bay, San Leandro Bay	Aquatic life impacts	Mercury, Lead, Selenium, Zinc, PCBs, PAHs, DDT, pesticides
Low	Huntington Harbor Upper Reach	Sediment toxicity	Chlordane, DDE, Chlorpyrifos

Depending on the source and areal extent of the known toxic hot spot, the actions to remediate the sites include: (1) institutional controls/education, (2) better characterization of the sites and problem, (3) dredging, (4) capping, (5) a combination of dredging and capping, (6) source control, (7) watershed management, and (8) implementation of a no-action alternative (natural attenuation).

The estimated total cost to implement the Consolidated Plan ranges from $72 million to $812 million. According to the plan, much of this amount is considered recoverable from responsible dischargers. The un-funded portion of the cost to implement the Consolidated Plan ranges from approximately $40 million to $529 million. Although much of the Consolidated Plan can be implemented through existing Water Code authorities, no funding was obtained to fully implement the Consolidated Plan.

Development of Sediment Quality Objectives

Sediment quality objectives were developed by the State Water Board and approved under Resolution No. 2008-070 adopting the Water Quality Control Plan for Enclosed Bays and Estuaries and Resolution No. 2011-008 adopting amendments to the plan. As described in Section 2.6, the Water Quality Control Plan for Enclosed Bays and Estuaries includes the following:

- Narrative SQOs protecting:
  - Benthic communities directly exposed to toxic pollutants in sediment;
  - Human consumers of resident sportfish from contaminants that bioaccumulate into fish tissue from sediment and;
  - Resident finfish and wildlife exposed either through direct contact with pollutants in sediment or indirectly through the trophic transfer.
- An assessment framework for each SQO.
- Program of Implementation describing how the SQOs are applied to:
  - Dredged materials;
  - National Pollution Discharge Elimination System (NPDES) permitting and receiving water limits (monitoring and frequency);
  - CWA 303(d) listings for impaired waterbodies;
  - Stressor Identification;
  - Target development and relationship to Resolution No. 92-49 for Cleanup and Abatement.

Since 2008, staff and technical team have worked to improve the assessment framework associated with the narrative SQO protecting human consumers of resident sportfish from contaminants that bioaccumulate into fish tissue from sediment. This revised assessment framework is intended to address two key questions:

1. Are contaminants in site sediments bioaccumulating into higher trophic levels such as resident sportfish?

2. Do the contaminant levels present unacceptable risk to human health?

These two questions form the basis of the State Water Boards' technical effort to build a framework for the purpose of interpreting the existing SQO protecting human consumers of resident fish. See Section 6 for a discussion of project options associated with the development of this assessment framework. The proposed amendments in Appendix A describe how the assessment is applied to assess sediment quality.

4.2.3 Impaired Waterbodies and TMDLs

Listing for Impaired Water Bodies

In 2004, the State Water Board adopted a Water Quality Control Policy for Developing California's Section 303(d) List (Listing Policy). For sediments, the Listing Policy provides that a water segment will be listed as impaired if the sediments exhibit statistically significant toxicity based on a binomial distribution of the sampling data and exceedances. When applying this methodology, if the number of measured toxicity exceedances supports rejection of the null hypothesis, the water segment is considered impaired. The policy indicates that a segment should be listed if the observed toxicity is associated with a toxicant or toxicants or for toxicity alone. If the toxicant causing or contributing to the toxicity is identified, the pollutant should be added to the 303(d) list as well. Appropriate reference and control measures must be included in the toxicity testing. Reference conditions may include a response less than 90% of the minimum significant difference for each specific test organism. Acceptable methods include, but are not limited to, those listed in water quality control plans, the methods used by Surface Water Ambient Monitoring Program, the Southern California Bight Projects of the Southern California Coastal Water Research Project, American Society for Testing and Materials, U.S. EPA, the Regional Monitoring Program of the San Francisco Estuary Institute, and the BPTCP (State Water Board, 2004b).

Association of pollutant concentrations with toxic or other biological effects should be determined by one of the following (SWRCB, 2004b):

- Sediment quality guidelines are exceeded using the binomial distribution; in addition, using rank correlation, the observed effects are correlated with measurements of chemical concentration in sediments
- An evaluation of equilibrium partitioning or other type of toxicological response that identifies the pollutant that may cause the observed impact; comparison to reference conditions within a watershed or ecoregion may be used to establish sediment impacts
- Development of an evaluation (such as a TIE) that identifies the pollutant that contributes to or caused the observed impact.

Other listing criteria include:

- Degradation of biological communities such as diminished number of species or individuals associated with water or sediment concentrations of pollutants
- Adverse biological response such as reduction in growth, reproduction, or development, associated with water or sediment concentrations of pollutants
- Bioaccumulation of pollutants in aquatic life tissue
- Fish or shellfish tissue consumption advisory or ban issued by Office of Environmental Health Hazard Assessment or Department of Health Services

In February, 2015, the State Board amended the Listing Policy through adoption of Resolution 2015-0005 to be consistent with the listing requirements included in the Water Quality Control Plan for Enclosed Bays and Estuaries. Section 6.1.3.1.A of the Listing Policy states:

> *If sediment quality objectives apply, the Regional Water Boards shall use the methods and procedures that were adopted to interpret the objective and any provisions adopted to develop the section 303(d) list.*

Specific sediment quality related listings are presented by Regional Water Board in Section 5; Environmental Setting

TMDLs

Clean Water Act section 303(d) mandates that the state develop TMDLs for its listed waters. A TMDL, in general, identifies the maximum amount of a pollutant that a waterbody can assimilate while still meeting water quality standards. The TMDL identifies pollutant sources and includes an implementation plan that describes the actions necessary to achieve standards, including a schedule and monitoring and surveillance activities to determine compliance. TMDLs have been adopted by the Regional Water Boards to address pollutants in sediment within many bay and estuarine waterbodies. TMDLs developed by the San Francisco Bay and Los Angeles Regional Water Boards illustrate application of the TMDL program to address sediment quality.

The San Francisco Bay Regional Water Board adopted a TMDL to address bay-wide exceedances of the narrative bioaccumulation objective caused by excessive methyl-mercury levels. High mercury levels in sediments are due, in large part, to legacy gold mining operations and have resulted in bay-wide fish consumption advisories. The San Francisco Bay Regional Water Board has also listed bay waters for failure to achieve the bioaccumulation narrative objective due to PCBs, another legacy contaminant found in sediments, which was used in many high voltage applications as a dielectric fluid. For both pollutants, the mechanism to restore beneficial uses is through the development of TMDLs where all sources of loading regardless of media are evaluated and controlled to the extent practical. The mercury targets were derived based upon the estimated reduction in mercury mass in tissue that would be needed to be protective of human health and wildlife (California Regional Water Quality Control Board San Francisco Bay Region, 2006). PCB targets were derived for the protection of sport fishers; however, the targets also protect consumers that consume significantly higher amounts as well as other aquatic receptors including marine mammals and birds (California Regional Water Quality Control Board San Francisco Bay Region 2009). Differences in how each target was derived can be linked to fate and transport processes. Unlike mercury, the movement of PCBs and other hydrophobic organochlorine compounds up through the food web can be predicted with food web modeling software. Such models can be used to predict the sediment concentrations that will lower prey tissue to levels that protect target receptors (San Francisco Bay Regional Water Quality Control Board, 2007).

The Los Angeles Regional Water Board adopted the Dominguez Channel and Greater Los Angeles and Long Beach Greater Harbor Waters TMDL for Toxics on May 5, 2011, which went into effect on March 23, 2012, in order to address impairments related to toxic pollutants in sediments and fish tissue. The TMDL established sediment chemistry targets to address both sediment quality and fish tissue. The toxic pollutants include copper, lead, zinc, chlordane, and total PCBs. Numeric targets for these pollutants in sediments are based on sediment quality guidelines or a categorical outcome for the SQO protecting benthic communities of Unimpacted or Likely Unimpacted. Numeric targets for sediment and fish tissue designed to protect human consumers of fish tissue from contaminants in the tissue were obtained from a variety of sources including Fish Contaminant Goals (FCGs) developed by CalEPA Office of Environmental Health Hazard Assessment (OEHHA), and the San Francisco Bay Bioaccumulation Study in support of the San Francisco Bay PCB TMDL, as well as other bioaccumulation studies (Los Angeles Regional Water Quality Control Board, 2011).

4.2.4 Regional Monitoring and Assessment Programs

In California, water and sediment quality monitoring are routinely performed by the Water Boards, U.S. EPA, other state and federal agencies, academic institutions and other public research organizations, the regulated community, environmental advocacy organizations, and stakeholders in bays and estuaries. Collaborative regional monitoring programs are best suited for assessing the health of many of these beneficial uses for several reasons:

- Monitor large areas that for many resident species represent a significant portion of the entire foraging area or habitat,
- Apply multiple indicators to develop a comprehensive understanding of the health of these beneficial uses,
- Generate high quality data that can be applied with confidence,
- Greater cost effectiveness where multiple organizations are participating in the program. Those with trawl capabilities or bioassay laboratories and other resources or expertise can provide in-kind services that other participants may be lacking.

There are several regional monitoring programs that monitor marine and estuarine waters in California. The two largest are the Southern California Bight Regional Monitoring Survey and the San Francisco Regional Monitoring Program for Trace Substances. A summary of each of these regional programs is provided below.

- **Southern California Bight Regional Monitoring Surveys** are managed by the Southern California Coastal Water Research Project to evaluate the physical, chemical and biological impacts to ocean, bay, and estuarine waters from anthropogenic inputs. These surveys encompass waters from Point Conception to the U.S. Mexico Border. These surveys are typically performed on five-year cycles. The most recent effort, "Bight 2013 Survey" included chemical analysis of bird egg, fish tissue and sediment, sediment toxicity, analysis of benthic invertebrate and fish community structure, evaluation of gross pathology in trawl caught fish in bays and coastal waters. Collaborators include storm water agencies, sanitation districts, Water Boards, U.S. EPA, U.S. Fish and Wildlife Services and other agencies.
- **San Francisco Regional Monitoring Program for Trace Substances** (RMP) is managed by the San Francisco Estuary Institute. The RMP collects data to evaluate contaminant exposure within the San Francisco Bay eco system. Specific studies conducted in 2010 aimed at fish and wildlife exposure and effects include monitoring contaminant bioaccumulation in small fish, bird shells, and assessing sensitivity of terns to polybrominated diphenyl ether (PBDEs) (SFEI, 2009). The RMP is an annual effort, though individual parameters may be monitored more or less frequently. Partners include storm water agencies, sanitation districts, San Francisco Regional Water Board and other agencies as described in Section 4.2.5.
- **SWAMP's** mission is to provide decision makers and the public with the information necessary to evaluate surface water quality throughout California. SWAMP supports the collection of high quality data in all regions for 303(d) listing and 305(b) reporting on impaired waterbodies and waters supporting beneficial uses. A more detailed

discussion of SWAMP and the collection and interpretation of fish tissue is included below.

- **Regional Harbors Monitoring Program** (RHMP) is a collaborative program initiated in response to a request for water quality information for Dana Point Oceanside, Mission and San Diego Bays made pursuant to Water Code section 13225 issued by the San Diego Regional Board. The RHMP is supported by the Port of San Diego, and the Cities of San Diego and Oceanside, and the County of Orange. RHMP's objectives include assessing the quality of water and sediment to sustain healthy biota, and the long-term trends in harbor conditions.
- **Central Coast Long-term Environmental Assessment Network** (CCLEAN), is a central coast program funded by the Cities of Santa Cruz and Watsonville, Duke Energy, Monterey Regional Water Pollution Control Agency and Carmel Area Wastewater District, under the direction of the Central Coast Regional Board. CCLEAN's goals are to assist stakeholders in maintaining, restoring, and enhancing nearshore water and sediment quality and associated beneficial uses including rare, threatened, or endangered species, water contact recreation, and wildlife habitat uses in the Central Coast Region. CCLEAN satisfies the NPDES receiving water monitoring and reporting requirements of program participants. Concerns center on elevated concentrations of persistent organic pollutants (e.g., petroleum hydrocarbons, organochlorine pesticides, polychlorinated biphenyls) in fish from the Monterey Submarine Canyon, declines in sea otter populations, diseases in sea otters related to high concentrations of persistent organic pollutants, and bird and mammal deaths due to blooms of toxic phytoplankton.
- **Delta Regional Monitoring Program** (Delta RMP) is a relatively new program initiated in 2012 by the Central Valley Regional Water Board to assess the integrity of surface waters in the Delta and vicinity. The first survey of the Delta RMP occurred in 2015. Supporters include the Regional Water Board, wastewater agencies, municipal stormwater permittees, agriculture coalitions, and state and federal water contractors. The Delta RMP is an annual effort, though individual parameters may be monitored more or less frequently. Current priorities include mercury bioaccumulation into fish tissue, current pesticides and toxicity monitoring as well as nutrients.
- **Greater Harbors Toxics Monitoring Coalition** is an outgrowth of the Los Angeles Regional Boards' Dominguez Channel and Greater Harbors Toxics TMDL that encompasses much of Los Angeles and Long Beach Harbors as well as Dominguez Channel and Los Angeles River Estuary. The monitoring required by the TMDL includes fish tissue and sediment, while additional monitoring and data collection such as measuring dissolved water column contaminant concentrations and fish tracking studies are conducted by the Ports of Los Angeles and Long Beach to assist in identifying strategies that would achieve the TMDL targets.

An outgrowth of SWAMP, the Bioaccumulation Oversite Group (BOG) collects tissue data to evaluate water quality and status of beneficial uses across the state. Where human health and exposure to contaminants in fish tissue are a concern, the Water Board typically relies on the

CalEPA's Office of Environmental Health Hazard Assessment (OEHHA) Fish Consumption Advisories and Goals to evaluate these beneficial uses. Consumers of locally caught seafood can reduce the risk associated with contaminants in fish tissue and still obtain the dietary benefits of fish consumption by following advisories developed by OEHHA. Though these advisories and goals are intended to serve the public by providing safe eating guidelines, the recommendations also support the Water Boards' mission to ensure that beneficial uses are evaluated appropriately. Advisories are generated for waterbodies or general areas based on human health risk assessment of contaminant concentrations measured in fish from the area of concern and the associated benefits of fish consumption as a source of omega-3 fatty acids. Advisories are issued on a species-by-species basis for those contaminants that have the potential to accumulate in tissue and where existing chemical and toxicological information exists to warrant the analysis. Existing advisories are developed for Chlordane, dichlorodiphenyltrichloroethane and metabolites (DDTs), Deildrin, methylmercury, polychlorinated biphenyls (PCBs), selenium, Toxaphene and polybrominated diphenyl ethers (PBDEs). Only those species with adequate data are included in each advisory. Advisories are developed based on based on Equations 1 and 2 described below, using one two or three meals per week and portion size of eight ounces, corresponding to 32, 64 and 96 grams per day consumption rates. After 2008, high consumption rates up to seven meals have been included in the calculations (OEHHA, 2011). Carcinogens and non-carcinogens are each evaluated independently and the most sensitive outcome forms the basis of the advisory. Advisory Tissue Levels develop by OEHHA for no consumption up to three meals per week are presented in Table 4.3. Waterbodies assigned consumption advisories by OEHHA are summarized by region in Section 5, Environmental Setting.

Carcinogens

RL = $\underline{TC}$ x $\underline{CR}$ x CSF x (ED/AT) x CRF / BW (Equation 1)

Non-carcinogens

HQ = $\underline{TC}$ x $\underline{CR}$ x CRF / (RfD x BW) (Equation 2)

Where:

TC = tissue concentration for appropriate seafood species monitored at site (mg/kg)

AT = averaging time (year)

BW = body weight (kg)

CR = consumption rate (kg/day)

CRF = cooking reduction factor (unitless)

CSF = cancer slope factor $(mg/kg/day)^{-1}$

ED = exposure duration (year)

HQ =hazard quotient for noncancer effects (unitless)

RfD = reference dose (mg/kg/day)

RL = cancer risk level (unitless)

Fish Consumption Advisories

Table 4.3. OEHHA Advisory thresholds (OEHHA, 2008, 2011)

Contaminant	Three meals per week - ppb wet weight	Two meals per week - ppb wet weight	One meal per week - ppb wet weight	No Consumption - ppb wet weight
Chlordane	≤190	>190-280	>280-560	>560
DDTs	≤520	>520-1,000	>1,000-2,100	>2,100
Dieldrin	≤15	>15-23	>23-46	>46
Methylmercury[1]	≤70	>70-150	>150-440	>440
Methylmercury[2]	≤220	>220-440	>440-1,310	>1,310
PCBs	≤21	>21-42	>42-120	>120
Selenium	≤2,500	>2,500-4,900	>4,900-15,000	>15,000
Toxaphene	≤200	>200-300	>300-610	>610
PBDEs	≤100	>100-210	>210-630	>630

1. Women aged 18-45 and children 1-17
2. Women over 45 and men

4.2.5 Point Source Permits

The Water Boards issue NPDES permits pursuant to section 402 of the Clean Water Act. Section 402 requires that all point source discharges of pollutants to waters of the United States be regulated under a permit. Under the NPDES permit program, discharges are regulated under permits that contain both technology-based and water quality-based effluent limits. Water quality-based effluent limits are developed to implement applicable water quality standards including those contained in basin plans and the California Toxic Rule. If a discharge is found to be causing or contributing to the degradation of beneficial uses, the Water Boards have the authority to reopen and modify or terminate the permit. In order to restore the beneficial uses, the Water Boards may include more stringent effluent limits for those pollutants causing degradation. Waste load allocations developed for TMDLs are implemented in part through NPDES permits. Once a TMDL is approved, permits are amended to include waste loads allocations as a permit condition. Within enclosed bays and estuaries, existing discharges contributing to the accumulation of pollutants in sediments are typically assigned waste load allocation through TMDLs, for a segment or waterbody, rather than through an independent permit modification.

NPDES Permits also identify applicable receiving water limitations, including narrative and numeric objectives contained in basin plans or statewide plans. An example of a narrative receiving water limitation is provided in Section V. of the San Francisco Bay Regional Board Order 2010 – 0060, which states,

> *"the discharge shall not cause the following in Central San Francisco Bay ….Toxic or other deleterious substances to be present in concentrations or quantities which will*

cause deleterious effects on wildlife, waterfowl, or other aquatic biota, or which render any of these unfit for human consumption, either at levels created in the receiving waters or as a result of biological concentration" (California Regional Water Quality Control Board, San Francisco Bay Region 2010).

As described in the 2008 Staff Report supporting the Sediment Quality Provisions (State Water Board, 2008), NPDES permittees in the San Francisco Bay may fulfill receiving water monitoring requirements by contributing and supporting the San Francisco Bay RMP (described in Section 4.2.4) in accordance with Regional Water Board Resolution R2 92-043. Several special studies focus on exposure and effects to fish and wildlife in order to assess compliance with receiving water limits. Similarly, San Francisco Bay municipal storm water agencies are provided similar flexibility under Order No. R2-2009-0074, Municipal Regional Stormwater Permit NPDES CAS612008 which also requires receiving water monitoring and participation within the RMP to assess receiving water quality. Specific provisions require monitoring of water column and sediment toxicity, benthic invertebrates (bioassessment) and sediment bound toxic pollutants DDT, PCBs, copper, mercury, selenium to assess effectiveness DDT. The City of Los Angeles Terminal Island treatment plant that discharges into the Los Angeles Long Beach Harbor complex is required, under Order R4-2010-0071 (NPDES CA0053856), to perform a number of special studies related to the protection of fish and human consumers of fish, including a local demersal finfish survey, local bioaccumulation trends survey, and participation in the Southern California Bight Regional Demersal Finfish and Invertebrate Survey and Regional Predator Risk Survey.

4.2.6 Water Quality Certifications and Waste Discharge Requirements associated with Dredge and Fill

The State and Regional Boards issue Water Quality Certifications under CWA Section 401 for federally licensed dredge and fill projects. CWA Section 401 allows States to grant or deny water quality certification for any dredge or fill activity into waters of the United States. Certification must be consistent with the requirements of the Clean Water Act, CEQA, the California Endangered Species Act (CESA), and the State Water Board's mandate to protect beneficial uses of waters of the State. State and Regional Water Boards use CWA 401 water quality certifications to protect federally designated wetlands.

Water Boards also issue waste discharge requirements (WDRs) for non-federally licensed dredge and fill actions. Porter-Cologne establishes a program to regulate waste discharges that could affect water quality through waste discharge requirements, conditional waivers, or prohibitions. (See Wat. Code, §§ 13243, 13263, 13269.) Waste discharge requirements for non-federally licensed dredge and fill projects contain similar prohibitions and requirements as described above for water quality certifications.

Water quality certifications and WDRs may include mitigation measures. The effectiveness of the mitigation measures vary depending upon site conditions, the receptors at risk and the remedial alternatives being applied. A detailed description and analysis of mitigation measures for specific remedial alternatives is presented in the State Water Resources Control Board Bay Protection and Toxic Cleanup Program's Amended Final Functional Equivalent Document

Consolidated Toxic Hot Spots Cleanup Plan (2004). Section 7 describes mitigation measures associated with sites undergoing remedial action to reduce the short-term risk and additional exposures these actions can cause while dredging, cap placement or other intrusive activity.

5 Environmental Setting

California encompasses a variety of environmental conditions ranging from the Sierra Nevada to deserts (with a huge variation in between these two extremes) to the Pacific Ocean. Specific geographical features that form basins, as well as the availability of natural resources coupled with climate and topography have created a very broad range of land use patterns and population densities throughout California. Because of these unique differences around the State, the Legislature in the Porter-Cologne Water Quality Control Act, Water Code section 13000 et seq. (Porter-Cologne) divided the State into nine different hydrologic regions or basins. These regions consist of the North Coast, San Francisco Bay, Central Coast, Los Angeles, Central Valley, Lahontan, Colorado River, Santa Ana and San Diego Regions. Though many regions share some common environmental problems, each of the regions has a unique suite of factors, such as types of discharges, pollutants, potential risks to beneficial uses and receptors.

Sediments in California's enclosed bays and estuaries are, with few exceptions, the most highly polluted sediments in the State. Historically, areas adjacent to bays and estuaries were the first heavily industrialized regions in the State and, as a result, wastes have been discharged into bays either directly as point sources, indirectly as runoff, or accidentally through releases and spills for many years. Sediment carried down rivers and creeks also contributes to the contaminant loading into bays and estuaries. Many contaminants, such as metals and pesticides, readily attach to the sediments. Through this mechanism, contaminants from inland sources can be transported long distances. Poor flushing and low current speeds allow the sediments and contaminants to settle out in the bays and estuaries before reaching the open ocean.

California's bays and estuaries are also home to a tremendous diversity of life and serve as nursery and spawning grounds and migratory routes for many important sport and bait fish species. Within bays and estuaries, sub habitats encompass shallow and deep channels, mudflats, eelgrass beds, and salt marshes with substrates that vary from rocky to muddy soft bottom. The salinity of these bays and estuaries can range from almost entirely freshwater in north coast estuaries during precipitation events up to or exceeding the salinity of ocean waters in southern California lagoons in summer months when evaporation losses are high. Species found in these waters include: California halibut, Northern anchovy, shiner perch, Starry flounder, striped mullet, steelhead (anadromous rainbow trout), spotted sand bass, and round stingray. Deeper bays such as San Francisco include a variety of rockfish, larger sharks such as Broadnose seven-gilled shark, striped bass, and green sturgeon.

Because bays and estuaries are so important for sustaining and propagating many recreational and commercial species, NOAA Fisheries has designated all bay and estuarine waters as Essential Fish Habitat for groundfish under the Magnuson-Stevens Fishery Conservation and Management Act. The California Fish and Game Commission have also designated areas in enclosed bays and estuaries as Marine Protected Areas under the Marine Life Protection Act as discussed below.

The following sections provides a brief description of the waters and land use within each region. For each region, the section includes a summary of bays and estuaries within the region that have been listed on the State Water Board's 2012 Clean Water Act section 303(d) list for impairments associated with toxic and bioaccumulative pollutants. The listings described below include water column, tissue and sediment quality impacts. Tissue listings are discussed because the food web exposure pathway frequently begins in the sediment. Water column listings are also included because the toxic pollutants eventually settle out and are deposited in the surface sediments. Many of these sediment and tissue-related listings were designated previously by the State Water Board as Toxic Hot Spots and proposed for cleanup. There are also a number of sediment quality-related 303(d) listings for waters upstream of affected bays and estuaries (see SWRCB, 2012) which are not presented here. Impaired sediments can be carried downstream and settle into bays and estuaries, contributing to existing impairments or causing new impairments. This section also includes fish tissue consumption advisories established by OEHHA for enclosed bays and estuaries of California. Though most consumption advisories issued by OEHHA are associated with specific waterbodies, OEHHA (2012) has issued guidance for migratory fish (American shad, Chinook salmon, Steelhead trout, striped bass and white sturgeon) present in all rivers estuaries and coastal waters of California. These advisories are based on mercury and PCBs.

The Lahontan and Colorado River Regions do not include enclosed bays and estuaries as described in Section 2.1 and are not considered further in this document. Descriptions of the regions were obtained from the individual water quality control plans (basin plans).

5.1 North Coast Region

The North Coast Region comprises all regional basins, including Lower Klamath Lake and Lost River Basins, draining into the Pacific Ocean from the California-Oregon state line southern boundary and includes the watershed of the Estero de San Antonio and Stemple Creek in Marin and Sonoma Counties (Figure 5.1). Two natural drainage basins, the Klamath River Basin and the North Coastal Basin, divide the Region. The Region covers all of Del Norte, Humboldt, Trinity, and Mendocino Counties, major portions of Siskiyou and Sonoma Counties, and small portions of Glenn, Lake, and Marin Counties. It encompasses a total area of approximately 19,390 square miles, including 340 miles of coastline and remote wilderness areas, as well as urbanized and agricultural areas.

Beginning at the Smith River in northern Del Norte County and heading south to the Estero de San Antonio in northern Marin County, the Region encompasses a large number of major river estuaries. Other North Coast streams and rivers with significant estuaries include the Klamath River, Redwood Creek, Little River, Mad River, Eel River, Noyo River, Navarro River, Elk Creek, Gualala River, Russian River, and Salmon Creek (this creek mouth also forms a lagoon). Northern Humboldt County coastal lagoons include Big Lagoon and Stone Lagoon. The largest enclosed bay in the North Coast Region is Humboldt Bay in Humboldt County. Another enclosed bay, Bodega Bay, is located in Sonoma County near the southern border of the Region.

Distinct temperature zones characterize the North Coast Region. Along the coast, the climate is moderate and foggy with limited temperature variation. Inland, however, seasonal temperature ranges in excess of 100°F (Fahrenheit) have been recorded. Precipitation is greater than for any other part of California, and damaging floods are a fairly frequent hazard. Particularly devastating floods occurred in the North Coast area in December 1955, December 1964, and February 1986. Ample precipitation in combination with the mild climate found over most of the North Coast Region has provided a wealth of fish, wildlife, and scenic resources. The mountainous nature of the Region, with its dense coniferous forests interspersed with grassy or chaparral covered slopes, provides shelter and food for deer, elk, bear, mountain lion, fur bearers, and many upland bird and mammal species. The numerous streams and rivers of the Region contain anadromous fish, and the reservoirs, although few in number support both cold water and warm water fish.

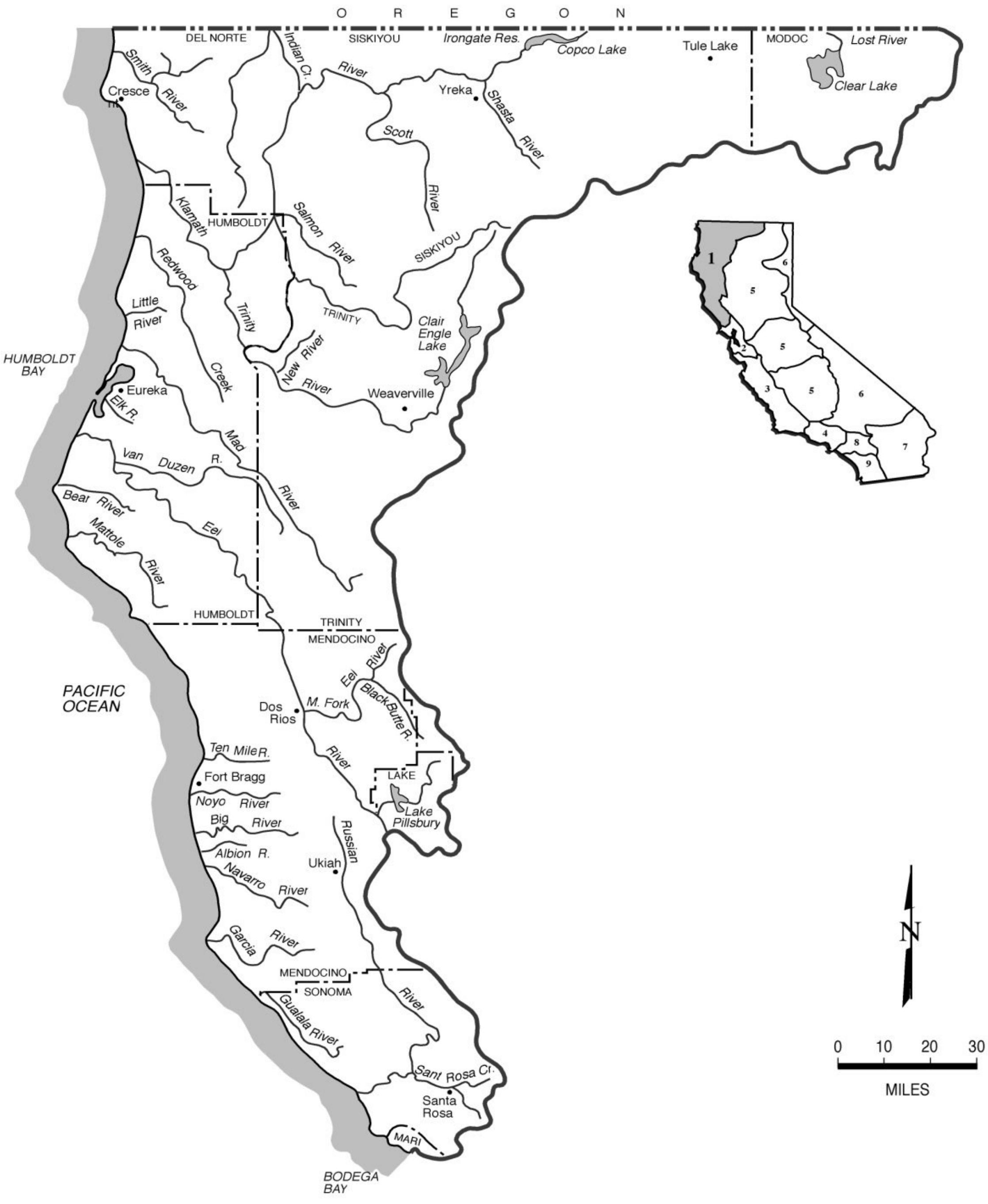
Tidelands and marshes are extremely important to many species of waterfowl and shore birds, both for feeding and nesting. Cultivated land and pasturelands also provide supplemental food for many birds, including small pheasant populations. Tideland areas along the north coast provide important habitat for marine invertebrates and nursery areas for forage fish, game fish, and crustaceans. Offshore coastal rocks are used by many species of seabirds as nesting areas. To enhance and preserve many of these unique habitats and marine resources these habitats support, the California Fish and Game Commission has designated marine protected areas in the North Coast Regions bays and estuaries including:

- South Humboldt Bay State Marine Recreational Management Area, Humboldt County
- Ten Mile Estuary State Marine Conservation Area, Mendocino County
- Big River Estuary State Marine Conservation Area, Mendocino County
- Navarro River Estuary State Marine Conservation Area, Mendocino County
- Russian River State Marine Recreational Management Area, Sonoma County
- Estero Americano State Marine Recreational Management Area, Sonoma County

Major components of the economy are tourism and recreation, logging and timber milling, aggregate mining, commercial and sport fisheries, sheep, beef and dairy production, and vineyards and wineries.

Approximately two percent of California’s total population resides in the North Coast Region. The largest urban centers are Eureka in Humboldt County and Santa Rosa in Sonoma County. The most common factors affecting beneficial uses in the North Coast Region are temperature, nutrients and sedimentation in creeks and rivers that drain the region. Few toxic pollutants have been identified at levels causing degradation of beneficial uses in the bays and estuaries of the North Coast Region. Humboldt Bay was added to the 2006 303(d) List by the State Water Board due to dioxin compounds reported in fish tissue caught from that bay. Although some lakes are impaired due to mercury, there are no other listings for toxic pollutant-related listings in bays and estuaries within the Region. Only general fish consumption advisories affecting migratory fish within rivers, estuaries and coastal waters as described above are developed for bays and estuaries within the North Coast Region. Development of Total Maximum Daily Loads within the North Coast Region have focused generally on sediment loads and temperature impairments as significant stressors affecting beneficial uses. Currently there are no TMDLs affecting bays in the North Coast Region, though many of the watersheds TMDLs encompass estuaries as well. A list of TMDLs in the North Coast Region is available at http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/

North Coast Region (1)
NORTH COAST HYDROLOGIC BASIN PLANNING AREA (NC)



Base map prepared by the Division of Water Rights, Graphics Services Unit

Figure 5.1. North Coast Region

5.2 San Francisco Bay Region

The San Francisco Bay Region comprises San Francisco Bay, Suisun Bay beginning at the Sacramento River, and San Joaquin River westerly, from a line which passes between Collinsville and Montezuma Island (Figure 5.2). The Region's boundary follows the borders common to Sacramento and Solano Counties and Sacramento and Contra Costa Counties west of the Markely Canyon watershed in Contra Costa County. All basins west of the boundary, described above, and all basins draining into the Pacific Ocean between the southern boundary of the North Coast Region and the southern boundary of the watershed of Pescadero Creek in San Mateo and Santa Cruz Counties are included in the Region.

The Region comprises most of the San Francisco Estuary to the mouth of the Sacramento-San Joaquin Delta. The San Francisco Estuary conveys the waters of the Sacramento and San Joaquin Rivers to the Pacific Ocean. As a result, the bay system functions as the only drainage outlet for waters of the Central Valley. It also marks a natural topographic separation between the northern and southern coastal mountain ranges. The Region's waterways, wetlands, and bays form the centerpiece of the fourth largest metropolitan area in the United States, including all or major portions of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.

The San Francisco Bay Regional Water Board has jurisdiction over the part of the San Francisco Estuary, which includes all of the San Francisco Bay segments extending east to the Delta (Winter Island near Pittsburg). The San Francisco Estuary sustains a highly dynamic and complex environment. Within each section of the Bay system lie deepwater areas that are adjacent to large expanses of very shallow water. Salinity levels range from hypersaline to fresh water and water temperature varies widely.

The Bay system's deepwater channels, tidelands, marshlands, fresh water streams and rivers provide a wide variety of habitats within the Region. Coastal embayments including Tomales Bay and Bolinas Lagoon are also located in this Region. The Central Valley Regional Water Board has jurisdiction over the Delta and rivers extending further eastward.

The San Francisco Estuary is made up of many different types of aquatic habitats that support a great diversity of organisms. Suisun Marsh in Suisun Bay is the largest brackish-water marsh in the United States. San Pablo Bay is a shallow embayment strongly influenced by runoff from the Sacramento and San Joaquin Rivers. The Central Bay is the portion of the Bay most influenced by oceanic conditions. The South Bay, with less freshwater inflow than the other portions of the Bay, acts more like a tidal lagoon. Together these areas sustain rich communities of aquatic life and serve as important wintering sites for migrating waterfowl and spawning areas for anadromous fish. To protect and sustain these rich communities, several marine managed areas have been designated by the California Fish and Game Commission within enclosed bays and estuaries of the San Francisco Bay Region including:

- Estero de San Antonio State Marine Recreational Management Area, Dillion Beach, Marin County
- Drakes Estero State Marine Conservation Area, Marin County

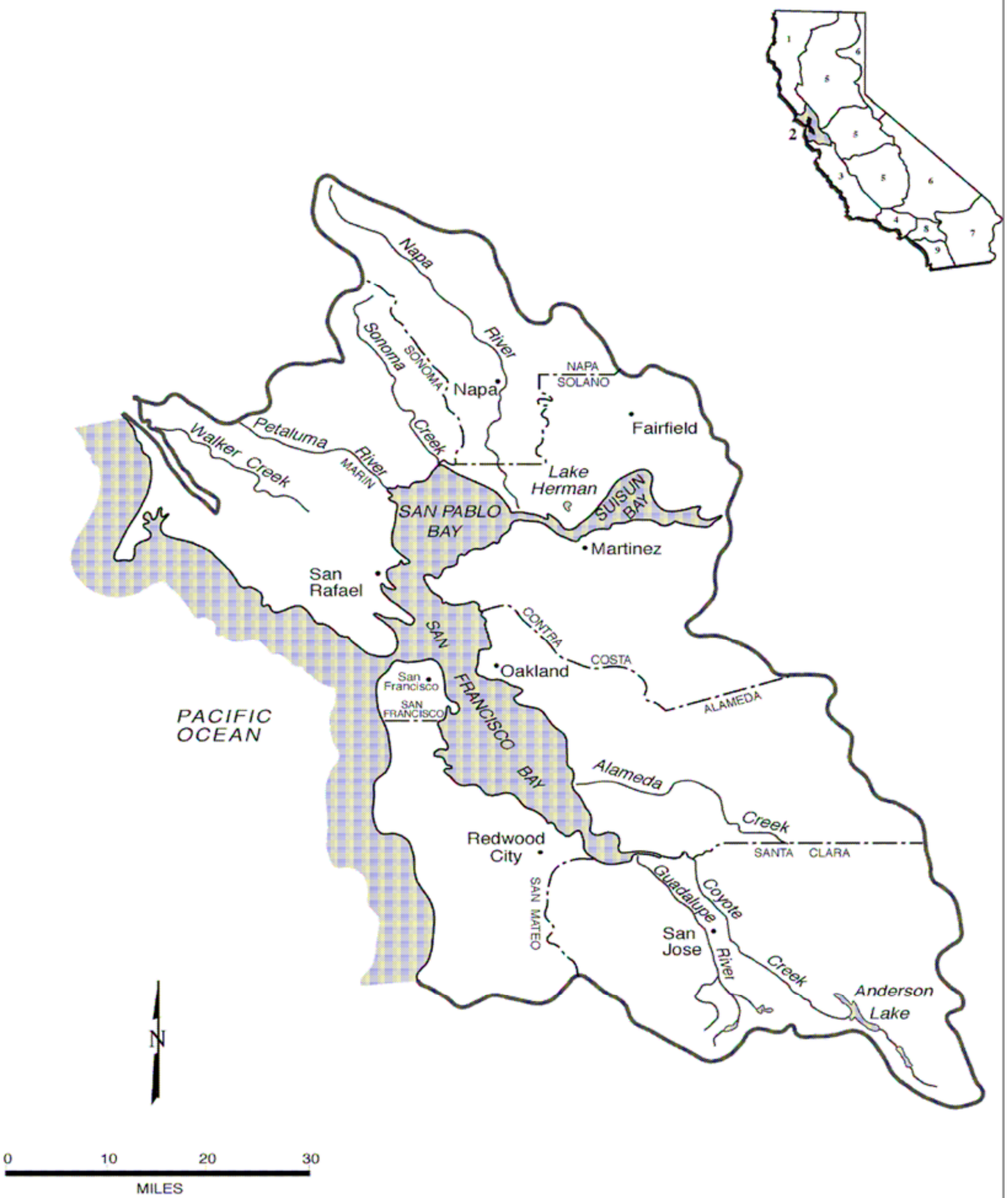
- Estero de Limantour State Marine Reserve, Marin County
- Corte Madera Marsh State Marine Park and Ecological Reserve, Marin County
- Marin Islands State Marine Park and Ecological Reserve, Marin County
- Albany Mudflats State Marine Park and Ecological Reserve, Alameda County
- Robert W. Crown State Marine Conservation Area, Alameda County
- Redwood Shores State Marine Park and Ecological Reserve, San Mateo County
- Bair Island State Marine Park and Ecological Reserve, San Mateo County

As a result of development and anthropogenic inputs, the San Francisco Bay Region encompasses many waterbodies listed as impaired. In addition, consumers of fish in several waterbodies are advised to limit consumption of select species that have accumulated contaminants in fish tissue . In response the Regional Water Board has developed and adopted many Total Maximum Daily Loads in order to improve water and sediment quality in these segments. TMDLs developed in the Region include the Guadalupe River Watershed Mercury TMDL (Resolution R2-2008-0089), North San Francisco Bay Selenium TMDL (Resolution R2-2015-0048), San Francisco Bay Mercury TMDL (Resolution R2-2006-0052), San Francisco Bay PCB TMDL (Resolution R2-2008-0012), Tomales Bay Mercury TMDL (Resolution R2-2012-0040), and the Urban Creeks Pesticide Toxicity TMDL (Resolution R2-2005-0063). A full description of the TMDLs developed by the San Francisco Bay Region can be found here: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/

Water quality impairments for toxic and bioaccumulative pollutants are summarized in Table 5.1. Fish consumption advisories developed by OEHHA are summarized in Table 5.2.

San Francisco Bay Region (2)

SAN FRANCISCO BAY HYDROLOGIC BASIN PLANNING AREA (SF)



Base map prepared by the Division of Water Rights, Graphics Services Unit

Figure 5.2. San Francisco Bay Region

Table 5.1. San Francisco Bay Region Bay and Estuarine Listings Associated with Toxic and Bioaccumulative Pollutants in Sediment, Tissue and Water Column (State Water Board, 2012)

Waterbody	Basis	Category
Carquinez Strait	Chlordane, DDT, Dieldrin, Dioxin compounds, Furan Compounds, Mercury, PCBs, Selenium	5
Castro Cove, Richmond - San Pablo Basin	Dieldrin (sediment), Mercury (sediment), PAHs (sediment), Selenium (sediment),	4b
Central Basin, San Francisco (part of SF Bay, Lower)	Chlordane, DDT, Dieldrin, Dioxin compounds, Furan Compounds, Mercury, PAHs, PCBs, Selenium	5
Islais Creek	Chlordane, Dieldrin, PAHs, Sediment Toxicity	5
Mission Creek	Chlordane, Dieldrin, Lead, Mercury, PAHs, PCBs, Silver, Zinc	5
Oakland Inner Harbor - Fruitvale Site	Chlordane, DDT, Dieldrin, Dioxin compounds, Furan Compounds, Mercury, PCBs, Sediment Toxicity, Selenium	5
Oakland Inner Harbor - Pacific Dry-dock Yard	Chlordane, Coper DDT, Dieldrin, Dioxin Compounds, Furan Compounds, Lead, Mercury, PAHs, PCBs, Selenium, Zinc	5
Richardson Bay	Chlordane, DDT, Dieldrin, Dioxin Compounds, Furan Compounds, Mercury, PCBs	5
Sacramento- San Joaquin Delta	Chlordane, DDT, Dieldrin, Dioxin Compounds, Furan Compounds, Mercury, PCBs, Selenium	5
San Francisco Bay Central	Chlordane, DDT, Dieldrin, Dioxin Compounds, Furan Compounds, Mercury, PCBs, Selenium	5
San Francisco Bay Lower	Chlordane, DDT, Dieldrin, Dioxin Compounds, Furan Compounds, Mercury, PCBs	5
San Francisco Bay South	Chlordane, DDT, Dieldrin, Dioxin Compounds, Furan Compounds, Mercury, PCBs, Selenium	5
San Leandro Bay	Chlordane, Dieldrin, Dioxin Compounds, Furan Compounds, Lead, Mercury, PAHs, Pesticides, Zinc	5
San Pablo Bay	Chlordane, DDT, Dieldrin, Dioxin Compounds, Furan Compounds, Mercury, PCBs, Selenium	5
Stege Marsh	Chlordane, Copper, Dacthal, Dieldrin, Mercury, PCBs, Zinc	4b
Suisan Bay	Chlordane, DDT, Dieldrin, Dioxin Compounds, Furan Compounds, Mercury, PCBs, Selenium	5
Suisan Slough	Diazinon	4a
Tomales Bay	Mercury	5

PCBs - Polychlorinated biphenyls
PAHs - Polyaromatic hydrocarbons
Category 5 - 303(d) list requiring the development of a TMDL
Category 4a - 303(d) list being addressed by USEPA approved TMDL
Category 4b - 303(d) list being addressed by an action other than a TMDL

Table 5.2. Consumption advisories in San Francisco Bay Region bays and estuaries

Waterbody	Fish	Basis for Advisory
Lauritzen Channel in Richmond Harbor	All fish	DDT and Dieldrin
San Francisco Bay	Brown Rockfish	Mercury
	Brown Smoothhound Shark	Mercury
	California Halibut	Mercury and PCBs
	Chinook Salmon	Mercury
	Jacksmelt	Mercury and PCBs
	Leopard Shark	Mercury
	Red Rock Crab	Mercury and PCBs
	Surf Perch General	Mercury and PCBs
	Shiner Perch	Mercury and PCBs
	Barred Surf Perch	Mercury and PCBs
	Black Perch	Mercury
	Rubberlip Seaperch	Mercury
	Walleye Surfperch	Mercury and PCBs
	Striped Bass	Mercury and PCBs
	White Croaker	Mercury and PCBs
	White Sturgeon	Mercury and PCBs
Tomalas Bay	Brown Smoothhound,	Mercury
	Leopard Shark	Mercury
	Pacific Angel shark	Mercury
	Bay Ray	Mercury
	California Halibut	Mercury
	Redtail Perch	Mercury
	Pile Perch	Mercury
	Shiner Perch	Mercury
	Red Rock Crab	Mercury
	Jacksmelt	Mercury
All bays and estuaries	American Shad	Mercury and PCBs
	Chinook (King) Salmon	Mercury and PCBs
	Striped Bass	Mercury and PCBs
	White Sturgeon	Mercury and PCBs

Sources: Health Advisory and Safe Eating Guidelines for San Francisco Bay Fish and Shellfish, (OEHHA 2011) and Health Advisory and Safe Eating Guidelines for American Shad, Chinook (King) Salmon, Steelhead Trout, Striped Bass, and White Sturgeon Caught In California Rivers, Estuaries and Coastal Waters (OEHHA, 2012)

5.3 Central Coast Region

The Central Coast Region comprises all basins (including Carrizo Plain in San Luis Obispo and Kern Counties) draining into the Pacific Ocean from the southern boundary of the Pescadero Creek watershed in San Mateo and Santa Cruz Counties; to the southeastern boundary of the Rincon Creek watershed, located in western Ventura County (Figure 5.3). The Region extends over a 300-mile long by 40-mile wide section of the State's central coast. Its geographic area encompasses all of Santa Cruz, San Benito, Monterey, San Luis Obispo, and Santa Barbara Counties as well as the southern one-third of Santa Clara County, and small portions of San

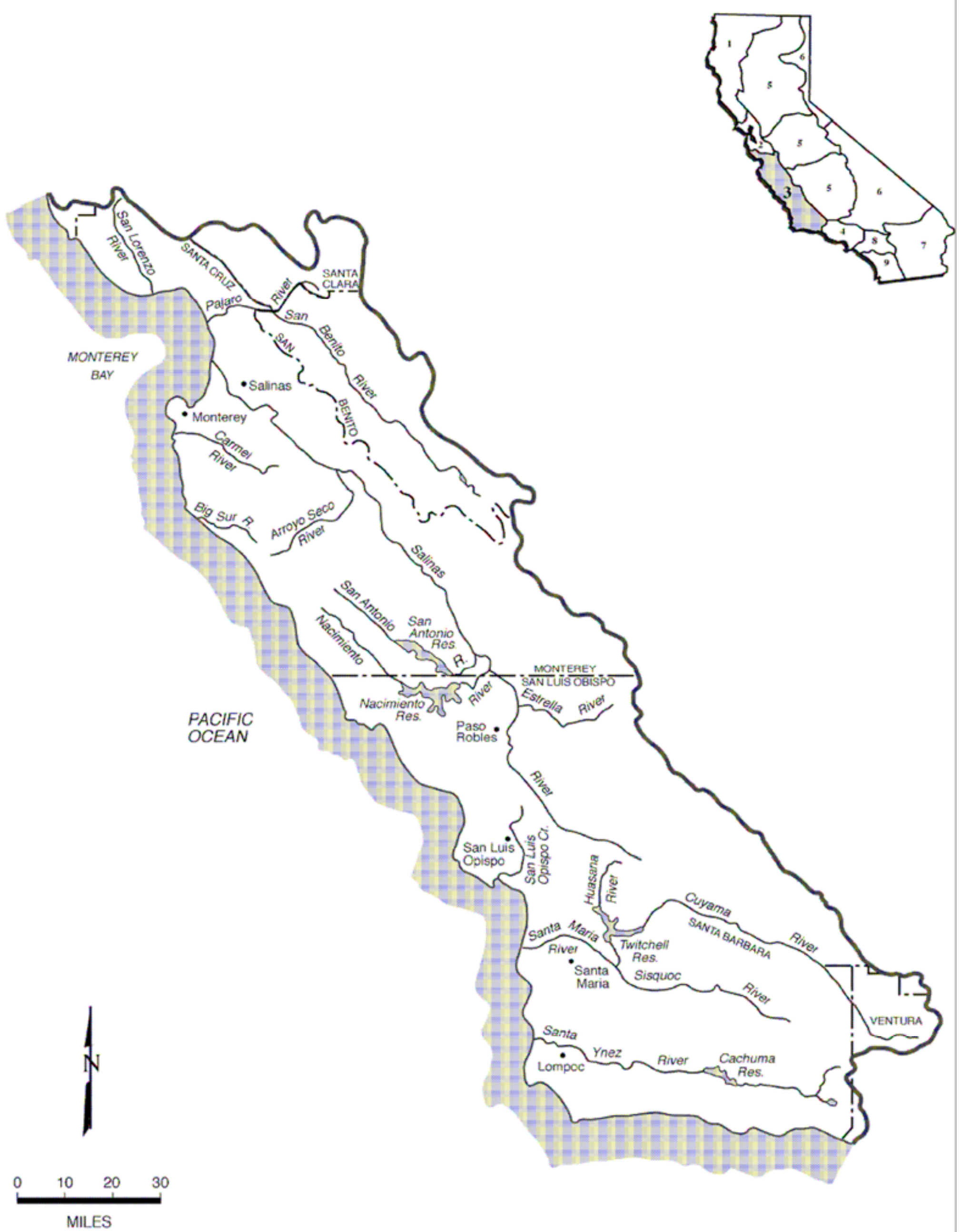
Mateo, Kern, and Ventura Counties. Included in the region are urban areas such as the Monterey Peninsula and the Santa Barbara coastal plain; prime agricultural lands such as the Salinas, Santa Maria, and Lompoc Valleys; National Forest lands; extremely wet areas such as the Santa Cruz Mountains; and arid areas such as the Carrizo Plain. Water bodies in the Central Coast Region are varied. Enclosed bays and harbors in the Region include Morro Bay, Elkhorn Slough, Tembladero Slough, Santa Cruz Harbor, Moss Landing Harbor, San Luis Harbor, and Santa Barbara Harbor. Several small estuaries also characterize the Region, including the Santa Maria River Estuary, San Lorenzo River Estuary, Big Sur River Estuary, and many others. Major rivers, streams, and lakes include San Lorenzo River, Santa Cruz River, San Benito River, Pajaro River, Salinas River, Santa Maria River, Cuyama River, EstrellaRiver and Santa Ynez River, San Antonio Reservoir, Nacimiento Reservoir, Twitchel Reservoir, and Cuchuma Reservoir. To support the health and propagation of marine resources, the following enclosed bays and estuaries have been designated as marine protected areas by the California Fish and Game Commission:

- Elkhorn Slough State Marine Reserve and Marine Conservation Area, Monterey County
- Moro Cojo Slough State Marine Reserve, Monterey County
- Morro Bay State Marine Recreational Management Area and Marine Reserve, San Luis Obispo County
- Goleta Slough Ecological Reserve, Santa Barbara County

The economic and cultural activities in the basin have been primarily agrarian. Livestock grazing persists, but has been combined with hay cultivation in the valleys. Irrigation, with pumped local groundwater, is very significant in intermountain valleys throughout the basin. Mild winters result in long growing seasons and continuous cultivation of many vegetable crops in parts of the basin.

While agriculture and related food processing activities are major industries in the Region, oil production, tourism, and manufacturing contribute heavily to its economy. The northern part of the Region has experienced a significant influx of electronic manufacturing; while offshore oil exploration and production have heavily influenced the southern part. Total population of the Region is estimated at 1.22 million people. Water quality problems frequently encountered in the Central Coastal Region include excessive salinity or hardness of local groundwaters. An increase in nitrate concentrations is a growing problem in a number of areas, in both groundwater and surface water. Surface waters suffer from bacterial contamination, nutrient enrichment, and siltation in a number of watersheds. Pesticides are a concern in agricultural areas and associated downstream water bodies. Impairments associated with toxic and bioaccumulative contaminants as well as consumption advisories are summarized in Tables 5.3 and 5.4 respectively. The Regional Water Board has developed many TMDLs to address pathogens, pesticides, nutrients for streams and rivers draining the region. Morro Bay is the only enclosed bay where TMDLs have been adopted. Those TMDLs address pathogens (Resolution No. R3-2002-0117) and Sediment (Resolution No. R3-2002-0051).

Central Coast Region (3)
CENTRAL COAST HYDROLOGIC BASIN PLANNING AREA (CC)



Base map prepared by the Division of Water Rights, Graphics Services Unit

Figure 5.3 Central Coast Region

Table 5.3 Central Coast Region Bay and Estuarine Listings Associated with Toxic and Bioaccumulative Pollutants in Sediment, Tissue and Water Column

Waterbody	Basis	Category
Carpenteria Marsh	Priority Organics	5
Elkhorn Slough	Pesticides	5
Goleta Slough/Estuary	Priority Organics	5
Monterey Harbor	Metals, Sediment Toxicity	5
Moro Cojo Slough	Pesticides	5
Moss Landing Harbor	Chlorpyrifos, Diazinon, Nickel, Pesticides, Sediment Toxicity	5
Old Salinas River	Pesticides	5
Salinas River Lagoon	Pesticides	5

Note: Category 5 - 303(d) list requiring the development of a TMDL

Table 5.4 Consumption advisories in Central Coast Region bays and estuaries

Waterbody	Fish	Basis for Advisory
Elkhorn Slough	Asian Clam	Mercury
	Bat Ray	Mercury
	Leopard Shark	Mercury
	Speckled Sanddab	Mercury
	Surfperches	Mercury and PCBs
All bays and estuaries	American Shad	Mercury and PCBs
	Chinook (King) Salmon	Mercury and PCBs
	Striped Bass	Mercury and PCBs
	White Sturgeon	Mercury and PCBs

Source: Health Advisory and Guidelines for Eating Fish from Elkhorn Slough (Monterey County), (OEHHA 2016) and Health Advisory and Safe Eating Guidelines for American Shad, Chinook (King) Salmon, Steelhead Trout, Striped Bass, and White Sturgeon Caught In California Rivers, Estuaries and Coastal Waters (OEHHA, 2012).

5.4 Los Angeles Region

The Los Angeles Region comprises all basins draining into the Pacific Ocean between the southeastern boundary of the watershed of Rincon Creek, located in western Ventura County, and a line which coincides with the southeastern boundary of Los Angeles County, from the Pacific Ocean to San Antonio Peak, and follows the divide, between the San Gabriel River and Lytle Creek drainages to the divide between Sheep Creek and San Gabriel River drainages (Figure 5.4).

The Region encompasses all coastal drainages flowing into the Pacific Ocean between Rincon Point (on the coast of western Ventura County) and the eastern Los Angeles County line, as well as the drainages of five coastal islands (Anacapa, San Nicolas, Santa Barbara, Santa Catalina and San Clemente). In addition, the Region includes all coastal waters within three miles of the continental and island coastlines.

Two large deepwater harbors (Los Angeles and Long Beach Harbors) and one smaller deepwater harbor (Port Hueneme) are contained in the Region. There are small craft marinas within the harbors, as well as tank farms, naval facilities, fish processing plants, boatyards, and container terminals. Several small-craft marinas also exist along the coast (Marina del Rey, King Harbor, Ventura Harbor); these contain boatyards, other small businesses and dense residential development.

Several large, primarily concrete-lined rivers (Los Angeles River, San Gabriel River) lead to unlined tidal prisms, which are influenced by marine waters. Salinity may be greatly reduced following rains since these rivers drain large urban areas composed of mostly impermeable surfaces. Some of these tidal prisms receive a considerable amount of freshwater throughout the year from publicly owned treatment works discharging tertiary treated effluent. Lagoons are located at the mouths of other rivers draining relatively undeveloped areas (Mugu Lagoon, Malibu Lagoon, Ventura River Estuary, and Santa Clara River Estuary). There are also a few isolated coastal brackish water bodies receiving runoff from agricultural or residential areas.

Santa Monica Bay, which includes the Palos Verdes Shelf, dominates a large portion of the open coastal water bodies in the Region. The Region's coastal water bodies also include the areas along the shoreline of Ventura County and the waters surrounding the five offshore islands in the region.

Owning to the extensive history of development, industrialization and population growth, many waterbodies and segments in the Los Angeles Region are listed as impaired. Many sportfish species are listed in consumption advisories as well. Impaired waterbody listings for toxic and bioaccumulative pollutants as well as fish consumption advisories are summarized in Tables 5.5, and 5.6. In response, the Los Angeles Regional Water Board and U.S. EPA have developed TMDLs for all major waterbodies in the region. TMDLs encompassing waters of enclosed bays and estuaries include Ballona Creek and Estuary Toxics TMDL (Resolution R13-010), Dominguez Channel and Greater Harbors Toxics TMDL (Resolution No. R11-008), Marina Del Rey Toxics TMDL (Resolution No. R14-004). A full list of TMDLs and reports are available at http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/tmdl_list.shtml

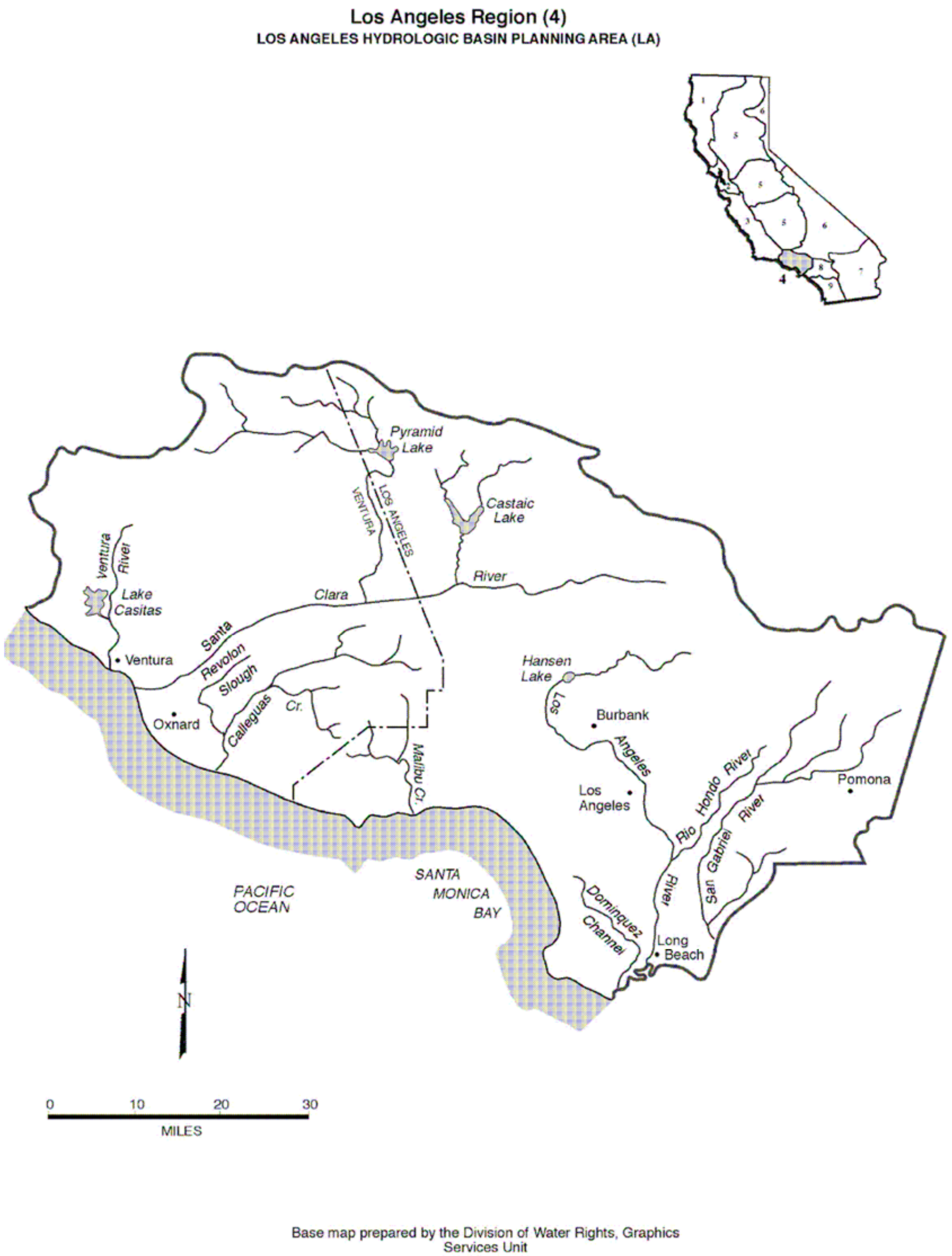


Figure 5.4. Los Angeles Region

Table 5.5. Los Angeles Region Bay and Estuarine Listings Associated with Toxic and Bioaccumulative Pollutants in Sediment, Tissue and Water Column

Waterbody	Basis	Category
Calleguas Creek - Reach 1 (formerly listed as Mugu Lagoon)	Chlordane (tissue), Copper, DDT (tissue & sediment), Dieldrin, Endosulfan (tissue), Mercury, Nickel, PCBs, Sediment Toxicity, Toxaphene, Zinc	4a
Dominguez Channel Estuary - unlined portion below Vermont Ave	Benthic Community Effects, Benzo(a)anthracene, Benzo(a)pyrene (3,4-Benzopyrene -7-d), Chlordane (tissue), Chrysene (C1-C4), DDT (tissue & sediment), Dieldrin (tissue), Lead (tissue), PCBs (Polychlorinated biphenyls), Phenanthrene, Pyrene, Sediment Toxicity, Zinc (sediment)	5
Los Angeles Harbor – Cabrillo Marina	Benzo(a)pyrene (3,4-Benzopyrene -7-d), DDT, PCBs	5
Los Angeles Harbor -Consolidated Slip	2-Methylnaphthalene, Benthic Community Effects, Benzo(a)anthracene, Benzo(a)pyrene (3,4-Benzopyrene -7-d), Cadmium (sediment), Chlordane (tissue & sediment), Chromium (sediment), Chrysene (C1-C4), Copper (sediment), DDT (tissue & sediment), Dieldrin, Lead (sediment),Mercury (sediment), PCBs (Polychlorinated biphenyls) (tissue & sediment), Phenanthrene, Pyrene, Sediment Toxicity, Toxaphene (tissue), Zinc (sediment)	5
Los Angeles Harbor - Fish Harbor	Benzo(a)anthracene, Benzo(a)pyrene (3,4-Benzopyrene -7-d), Chlordane, Chrysene (C1-C4), Copper, DDT, Dibenz[a,h]anthracene, Lead, Mercury, PAHs, PCBs, Phenanthrene, Pyrene, Sediment Toxicity, Zinc	5
Los Angeles Harbor Inner Cabrillo Beach Area	DDT, PCBs	5
Los Angeles River Estuary - Queensway Bay	Chlordane, DDT, PCBs, Sediment Toxicity	5
Los Angeles/Long Beach Outer Harbor - inside breakwater	DDT, PCBs, Sediment Toxicity	5
Marina del Rey Harbor - Back Basins	Chlordane (tissue & sediment), Copper (sediment), DDT (tissue), Dieldrin (tissue), Lead (sediment), PCBs (tissue & sediment), Sediment Toxicity, Zinc (sediment)	5
Port Hueneme Harbor - Back Basins	DDT (tissue), PCBs (tissue)	4b
Santa Clara River Estuary	Chem A, Toxaphene, Toxicity	5
Ventura Marina Jetties	DDT, PCBs	5

Note: Category 4a - 303(d) list being addressed by USEPA approved TMDL
Category 4b - 303(d) list being addressed by an action other than a TMDL
Category 5 - 303(d) list requiring the development of a TMDL

Table 5.6. Consumption advisories in Los Angeles Region bays and estuaries

Waterbody	Fish	Basis for Advisory
Ventura Harbor, Channel Islands Harbor, Port Hueneme	Barred Sand Bass	Mercury and PCBs
	Black Croaker	Mercury
	California corbina	Mercury and PCBs
	California Halibut	Mercury and PCBs
	California Scorpionfish	Mercury and PCBs
	Jacksmelt	Mercury
	Kelp Bass	Mercury and PCBs
	Opaleye	PCBs
	Pacific Barracuda	Mercury and PCBs
	Pacific Chub Mackeral	Mercury and PCBs
	Pacific Sardine	PCBs
	Queenfish	Mercury and PCBs
	Rockfishes combined	Mercury and PCBs
	Shovelnose Guitarfish	Mercury and PCBs
	Surfperches combined	Mercury and PCBs
	Topsmelt	PCBs
	White Croaker	Mercury and PCBs
	Yellowfin Croaker	PCBs
Marina Del Ray, King Harbor, Greater Los Angeles and Long Beach Harbors	Barred Sand Bass	DDT, Mercury and PCBs
	Black Croaker	Mercury
	California corbina	Mercury and PCBs
	California Halibut	Mercury and PCBs
	California Scorpionfish	Mercury and PCBs
	Jacksmelt	Mercury
	Kelp Bass	Mercury and PCBs
	Opaleye	PCBs
	Pacific Barracuda	Mercury and PCBs
	Pacific Chub Mackeral	Mercury and PCBs
	Pacific Sardine	PCBs
	Queenfish	Mercury and PCBs
	Rockfishes combined	Mercury and PCBs
	Surfperches combined	Mercury and PCBs
	Topsmelt	PCBs
	White Croaker	DDT, Mercury and PCBs
	Yellowfin Croaker	PCBs
All bays and estuaries	American Shad	Mercury and PCBs
	Chinook (King) Salmon	Mercury and PCBs
	Striped Bass	Mercury and PCBs
	White Sturgeon	Mercury and PCBs

Source: Health Advisory and Safe Eating Guidelines for Fish from Coastal Areas of Southern California: Ventura Harbor to San Mateo Point (OEHHA 2009) and Health Advisory and Safe Eating Guidelines for American Shad, Chinook (King) Salmon, Steelhead Trout, Striped Bass, and White Sturgeon Caught In California Rivers, Estuaries and Coastal Waters (OEHHA, 2012).

5.5 Central Valley Region

The Central Valley Region includes approximately 40 percent of the land in California stretching from the Oregon border to the Kern County and Los Angeles County line. The Region is divided into three basins. For planning purposes, the Sacramento River Basin and the San Joaquin River basin are covered under one Basin Plan and the Tulare Lake Basin is covered under a separate distinct one (Figures 5.5, 5.6 and 5.7).

The Sacramento River Basin covers 27,210 square miles and includes the entire area drained by the Sacramento River. The principal streams are the Sacramento River and its larger tributaries: the Pitt, Feather, Yuba, Bear, and American Rivers to the East; and Cottonwood, Stony, Cache, and Putah Creek to the west. Major reservoirs and lakes include Shasta, Oroville, Folsom, Clear Lake, and Lake Berryessa.

The San Joaquin River Basin covers 15,880 square miles and includes the entire area drained by the San Joaquin River. Principal streams in the basin are the San Joaquin River and its larger tributaries: the Consumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno Rivers. Major reservoirs and lakes include Pardee, New Hogan, Millerton, McClure, Don Pedro, and New Melones.

The Tulare Lake Basin covers approximately 16,406 square miles and comprises the drainage area of the San Joaquin Valley south of the San Joaquin River (Figure 5.7). The planning boundary between the San Joaquin River Basin and the Tulare Lake Basin is defined by the northern boundary of Little Pinoche Creek basin eastward along the channel of the San Joaquin River to Millerton Lake in the Sierra Nevada foothills, and then along the southern boundary of the San Joaquin River drainage basin. Main rivers within the basin include the King, Kaweah, Tule, and Kern Rivers, which drains the west face of the Sierra Nevada Mountains. Imported surface water supplies enter the basin through the San Luis Drain- California Aqueduct System, Friant-Kern Channel and the Delta Mendota Canal.

The two northern most basins are bound by the crests of the Sierra Nevada on the east and the Coast Range and Klamath Mountains on the west. They extend about 400 miles from the California-Oregon border southward to the headwaters of the San Joaquin River. These two river basins cover about one fourth of the total area of the State and over 30 percent of the State's irrigable land. The Sacramento and San Joaquin Rivers furnish roughly 50 percent of the State's water supply. Surface water from the two drainage basins meet and form the Delta, which ultimately drains into the San Francisco Bay. The Delta is a maze of river channels and diked islands covering roughly 1,150 square miles, including 78 square miles of water area. Two major water projects located in the South Delta, the Federal Central Valley Project and the State Water Project, deliver water from the Delta to Southern California, the San Joaquin Valley, Tulare Lake Basin, the San Francisco Bay Area, as well as within the Delta boundaries. The legal boundary of the Delta is described in Water Code section 12220.

Major issues affecting water quality include legacy mercury associated with historic mining practices, pesticides associated with urban and agricultural applications of current use and legacy pesticides, metals from various sources and selenium typically associated with flood irrigation practices.   Listings for toxic and bioaccumulative pollutants within the portion of the Delta in the Region are summarized in Table 5.7. Consumption advisories for the Delta are presented in Table 5.8. Examples of TMDLs associated with the Sacramento San Joaquin River Delta include the Sacramento-San Joaquin River Delta Diazinon and Chlopyrifos TMDL (Resolution No. R5-2006- 0061), Sacramento-San Joaquin River Delta Methylmercury TMDL (Resolution No. R5-2010-0043).   A complete list of TMDLs and associated reports are available at http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/index.shtml

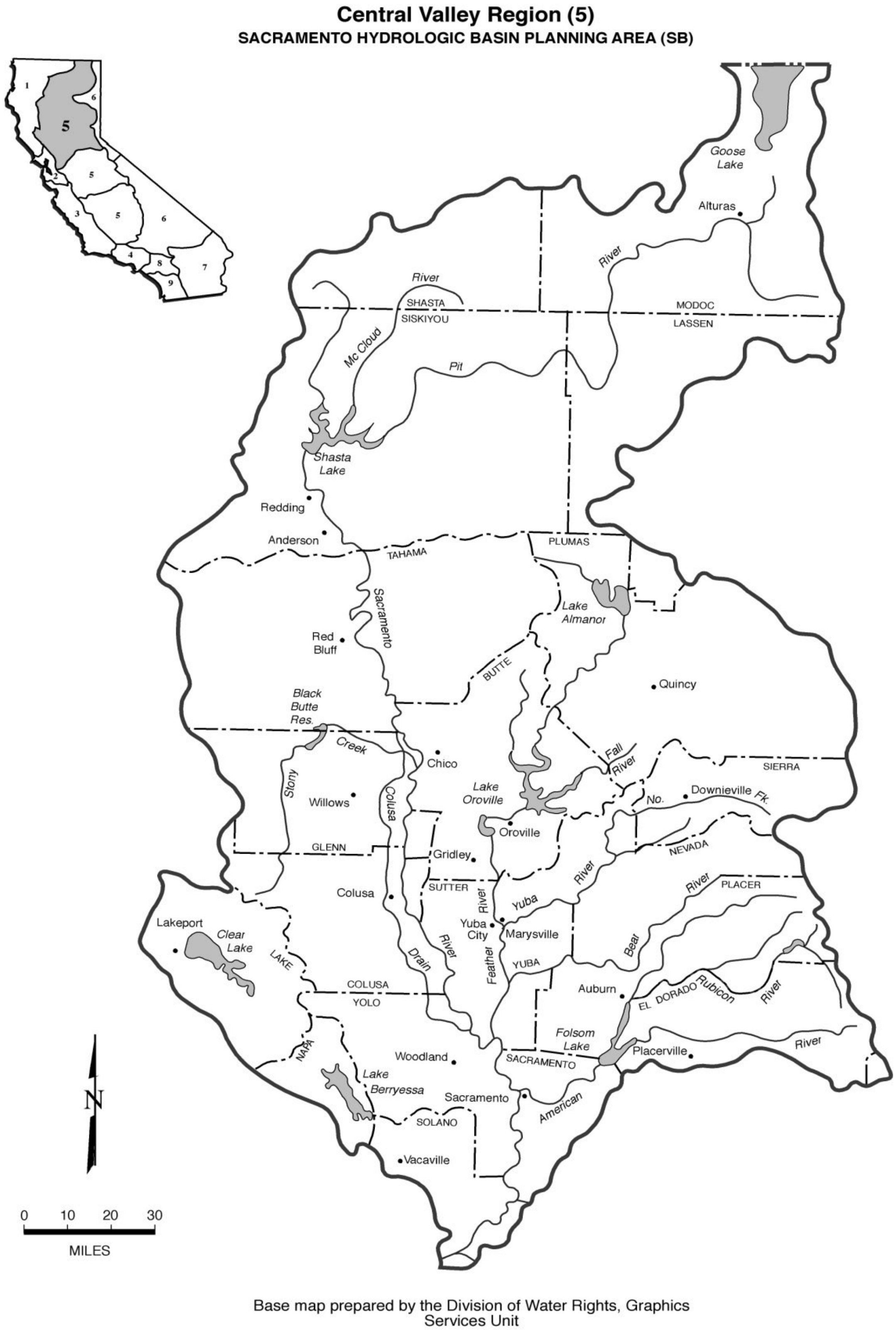


Figure 5.5. Central Valley Region Sacramento Hydrologic Basin

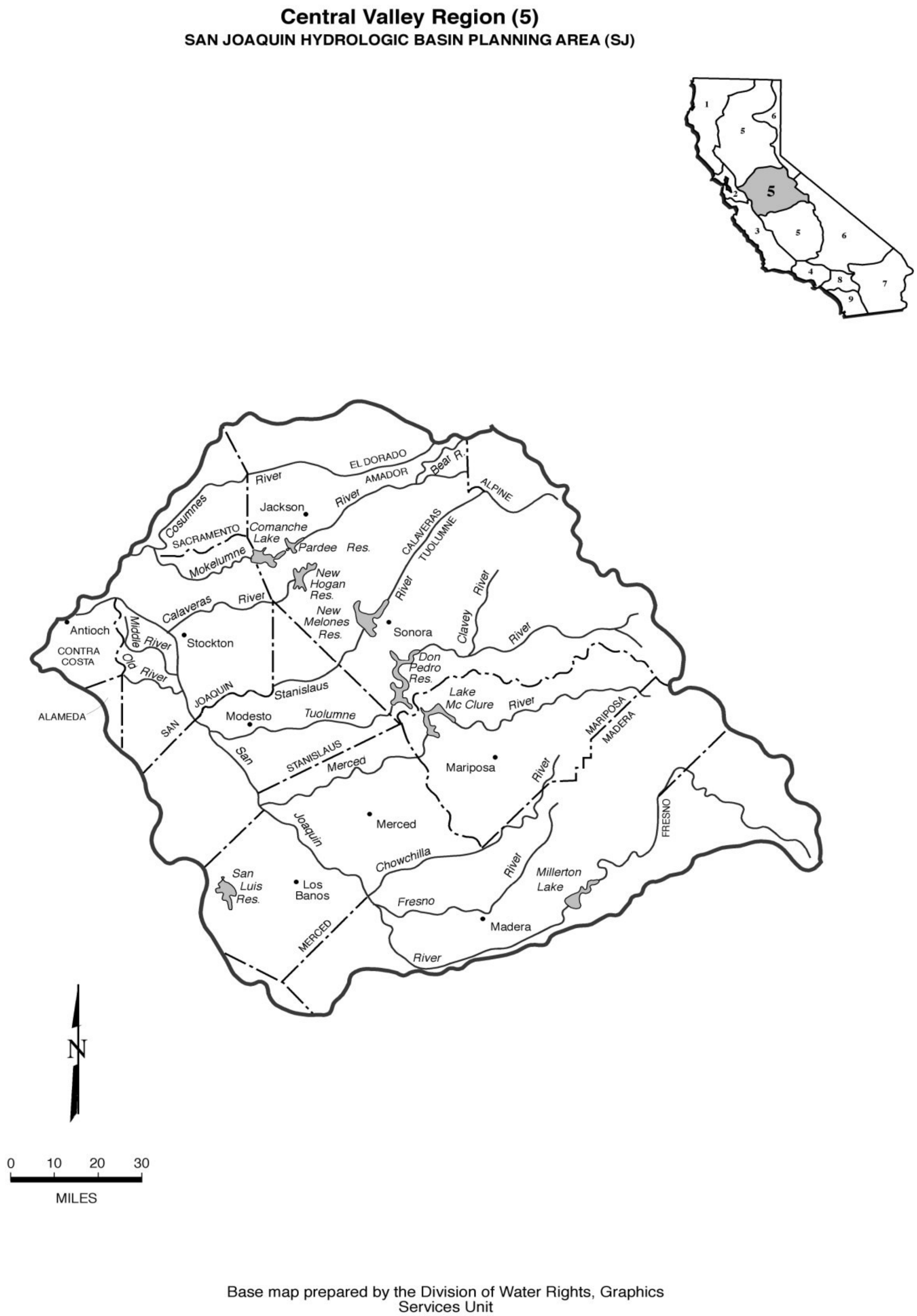


Figure 5.6. Central Valley Region San Joaquin Hydrologic Basin

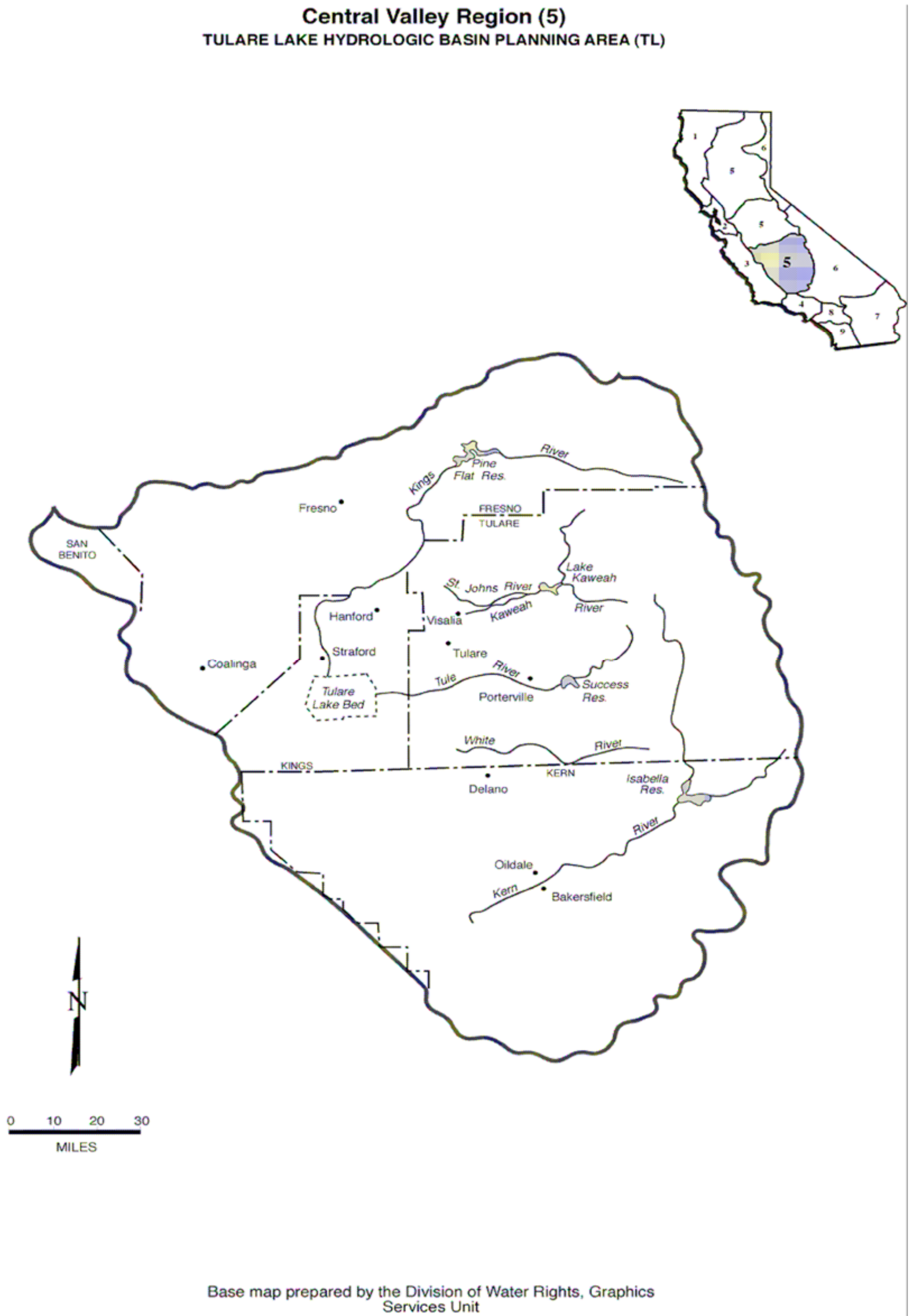


Figure5.7. Central Valley Region Tulare Lake Hydrologic Basin

Table 5.7. Central Valley Region Delta Listings Associated with Toxic and Bioaccumulative Pollutants in Sediment, Tissue and Water Column

Waterbody	Basis	Category
Delta Waterways - Stockton Ship Channel	Chlorpyrifos, DDT, Diazinon, Dioxin, Furan Compounds, Group A Pesticides, Mercury, PCBs, Unknown Toxicity	5
Delta Waterways - central portion	Chlorpyrifos, DDT, Diazinon, Group A Pesticides, Mercury, Unknown Toxicity	5
Delta Waterways - eastern portion	Chlorpyrifos, DDT, Diazinon, Group A Pesticides, Mercury, Unknown Toxicity	5
Delta Waterways - northern portion	Chlordane, Chlorpyrifos, DDT, Diazinon, Dieldrin, Group A Pesticides, Mercury, PCBs, Unknown Toxicity	5
Delta Waterways - southern portion	Chlorpyrifos, DDT, Diazinon, Group A Pesticides, Mercury, Unknown Toxicity	5

Note: Category 5 - 303(d) list requiring the development of a TMDL

Table 5.8. Consumption advisories in Central Valley Region Sacramento-San Joaquin Delta

Waterbody	Fish	Basis for Advisory
North Sacramento-San Joaquin Delta	American Shad	Mercury
	Asiatic clam	Mercury
	Carp and goldfish	Mercury
	Catfish	Mercury
	Crappie	Mercury
	Crayfish	Mercury
	Hardhead	Mercury
	Hitch	Mercury
	Largemouth Bass	Mercury
	Pikeminnow	Mercury
	Salmon	Mercury
	Striped Bass	Mercury
	Sturgeon	Mercury
	Sucker	Mercury
	Sunfish	Mercury
	Trout	Mercury
Port of Stockton	All fish and shellfish	PCBs
South Central Delta	Carp	Mercury
	Catfish	Mercury
	Clams	Mercury
	Crappie	Mercury
	Crayfish	Mercury
	Largemouth Bass	Mercury
	Smallmouth Bass	Mercury
	Spotted Bass	Mercury
	Striped Bass	Mercury
	Sucker	Mercury
	Sunfish	Mercury
Estuary	American Shad	Mercury and PCBs
	Chinook (King) Salmon	Mercury and PCBs
	Striped Bass	Mercury and PCBs
	White Sturgeon	Mercury and PCBs

Sources: Health Advisory: Draft Safe Eating Guidelines for Fish and Shellfish from the Sacramento River and North Delta (OEHHA, 2008), *2009 Update of California Sport Fish Advisories* (OEHHA 2009) and Health Advisory and Safe Eating Guidelines for American Shad, Chinook (King) Salmon, Steelhead Trout, Striped Bass, and White Sturgeon Caught In California Rivers, Estuaries and Coastal Waters (OEHHA, 2012).

5.6 Santa Ana Region

The Santa Ana Region comprises all basins draining into the Pacific Ocean between the southern boundary of the Los Angeles Region and the drainage divide between Muddy and Moro Canyons, from the ocean to the summit of San Joaquin Hills; along the divide between lands draining into Newport Bay and Laguna Canyon to Niguel Road; along Niguel Road and Los Aliso Avenue to the divide between Newport Bay and Aliso Creek drainages; and along the divide and the southeastern boundary of the Santa Ana River drainage to the divide between Baldwin Lake and Mojave Desert drainages; to the divide between the Pacific Ocean and Mojave Desert drainages (Figure 5.8). The Santa Ana Region is the smallest of the nine regions in the state (2,800 square miles) and is located in southern California, roughly between Los Angeles and San Diego.

Although small geographically, the region's four-plus million residents (1993 estimate) make it one of the most densely populated regions. The climate of the Santa Ana Region is classified as Mediterranean: generally dry in the summer with mild, wet winters. The average annual rainfall in the region is about fifteen inches, most of it occurring between November and March.

The enclosed bays in the Region include Newport Bay, Bolsa Bay (including Bolsa Chica Marsh), and Anaheim Bay. Owing to the unique character, habitat and aquatic resources supported within these waters, the California Fish and Game Commission has designated the Bolsa Chica Ecological Reserve and Bolsa Bay State Marine Conservation Area and Upper Newport Bay State Marine Conservation Area as marine protected areas. Principal Rivers include Santa Ana, San Jacinto and San Diego. Lakes and reservoirs include Big Bear, Hemet, Mathews, Canyon Lake, Lake Elsinore, Santiago Reservoir, and Perris Reservoir.

The 2012 section 303(d) list for the Santa Ana Region included nine water bodies affecting an estimated 7,886 acres (bays, estuaries, lakes, and wetlands) and 24 water bodies affecting 191 miles of rivers and shoreline. The major pollutants affecting these water bodies included nutrients, metals, pathogens, pesticides, and sediments among others (SWRCB 2003a). Both the Santa Ana Regional board and U.S. EPA have developed TMDLs for waterbodies within the region. Newport Bay is the only enclosed bay within the Region with approved TMDLs. TMDLs for Newport Bay include Diazinon and Chlorpyrifos TMDL for San Diego Creek and Upper Newport Bay (Resolution No. R8-2003-0039), Organochlorine Compounds TMDLs for San Diego Creek, Upper and Lower Newport Bay (Resolution No. R8-2011-0037). Impairments associated with toxic and bioaccumulative pollutants within bays and estuaries of the Region are summarized in Table 5.9. Tissue advisories within bays and estuaries are summarized in Table 5.10. A description of approved and adopted TMDLs as well as current

TMDL projects are presented here.
http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml#projects

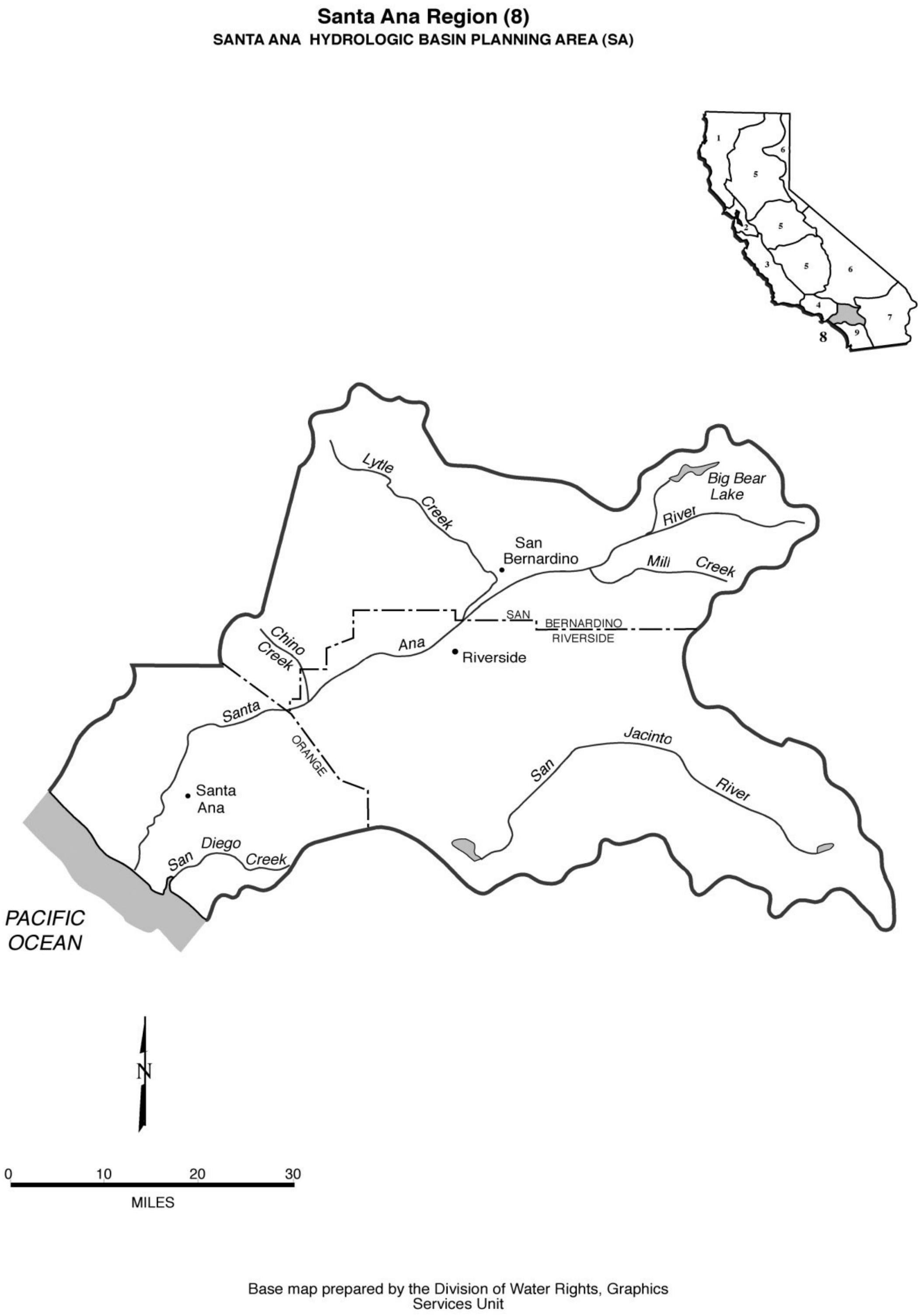


Figure 5.8. Santa Ana Region

Table 5.9. Santa Ana Region Bay and Estuarine Listings Associated with Toxic and Bioaccumulative Pollutants in Sediment, Tissue and Water Column

Waterbody	Basis	Category
Anaheim Bay	Dieldrin (tissue), Nickel, PCBs, Sediment Toxicity	5
Huntington Harbour	Chlordane, Copper, Lead, Nickel, PCBs, Sediment Toxicity	5
Newport Bay - Lower (entire lower bay, including Rhine Channel, Turning Basin and South Lido Channel to east end of H-J Moorings)	Chlordane, Copper, DDT ,PCBs, Pesticides, Sediment Toxicity	5
Newport Bay - Upper (Ecological Reserve)	Chlordane, Copper, DDT ,Metals, PCBs, Pesticides, Sediment Toxicity	5
Rhine Channel	Copper, Lead, Mercury, PCBs, Sediment Toxicity, Zinc	5

Note: Category 5 - 303(d) list requiring the development of a TMDL

Table 5.10. Consumption advisories in Santa Ana Region bays and estuaries

Waterbody	Fish	Basis for Advisory
Anaheim Bay, Huntington Harbor, Newport Harbor, Dana Point	Barred Sand Bass	Mercury and PCBs
	Black Croaker	Mercury
	California corbina	Mercury and PCBs
	California Halibut	Mercury and PCBs
	California Scorpionfish	Mercury and PCBs
	Jacksmelt	Mercury
	Kelp Bass	Mercury and PCBs
	Opaleye	PCBs
	Pacific Barracuda	Mercury and PCBs
	Pacific Chub Mackeral	Mercury and PCBs
	Pacific Sardine	PCBs
	Queenfish	Mercury and PCBs
	Rockfishes combined	Mercury and PCBs
	Shovelnose Guitarfish	Mercury and PCBs
	Surfperches combined	Mercury and PCBs
	Topsmelt	PCBs
	White Croaker	Mercury and PCBs
	Yellowfin Croaker	PCBs
Bays and Estuaries	American Shad	Mercury and PCBs
	Chinook (King) Salmon	Mercury and PCBs
	Striped Bass	Mercury and PCBs
	White Sturgeon	Mercury and PCBs

Source: Health Advisory and Safe Eating Guidelines for Fish from Coastal Areas of Southern California: Ventura Harbor to San Mateo Point (OEHHA 2009) and Health Advisory and Safe Eating Guidelines for American Shad, Chinook (King) Salmon, Steelhead Trout, Striped Bass, and White Sturgeon Caught In California Rivers, Estuaries and Coastal Waters (OEHHA, 2012).

5.7 San Diego Region

The San Diego Region comprises all basins draining into the Pacific Ocean between the southern boundary of the Santa Ana Region and the California-Mexico boundary (Figure 5.9). The San Diego Region is located along the coast of the Pacific Ocean from the Mexican border to north of Laguna Beach. The Region is rectangular in shape and extends approximately 80 miles along the coastline and 40 miles east to the crest of the mountains. The Region includes portions of San Diego, Orange, and Riverside Counties.

The population of the Region is heavily concentrated along the coastal strip. Six deepwater sewage outfalls and one across-the-beach discharge from the new border plant at the Tijuana River empty into the ocean. Two harbors, Mission Bay and San Diego Bay, support major recreational and commercial boat traffic. Coastal lagoons are found along the San Diego County coast at the mouths of creeks and rivers. Several of these lagoons have been designated as marine protected areas by the California Fish and Game Commission:

- Batiquitos Lagoon State Marine Conservation Area and Ecological Reserve, San Diego County
- San Elijo Lagoon State Marine Conservation Area and Ecological Reserve, San Diego County
- San Dieguito Lagoon State Marine Conservation Area and Ecological Reserve, San Diego County
- Famosa Slough State Marine Conservation Area, San Diego County

The 2002 section 303(d) list for the San Diego Region included 26 water bodies affecting an estimated 6,907 acres (bays, estuaries, lakes, and wetlands) and 40 water bodies, affecting 148 miles of rivers and shoreline. The major pollutants affecting these water bodies included nutrients, metals, pathogens, pesticides, and sediments among others (SWRCB, 2003a).

Weather patterns are Mediterranean in nature with an average rainfall of approximately ten inches per year occurring along the coast. Almost all the rainfall occurs during wet, cool winters. The Pacific Ocean generally has cool water temperatures due to upwelling. This nutrient-rich water supports coastal beds of giant kelp. The cities of San Diego, National City, Chula Vista, Coronado, and Imperial Beach surround San Diego Bay in the southern portion of the Region.

San Diego Bay is long and narrow, 15 miles in length and approximately one mile across. A deep-water harbor, San Diego Bay has experienced waste discharge from former sewage outfalls, industries, and urban runoff. Up to 9,000 vessels may be moored there. San Diego Bay also hosts four major U.S. Navy bases with approximately 80 surface ships and submarines. Coastal waters include bays, harbors, estuaries, beaches, and open ocean. Sediment quality-related impairments are summarized in Table 5.11. Tissue listings potentially related to pollutants in sediment are summarized in Table 5.12.

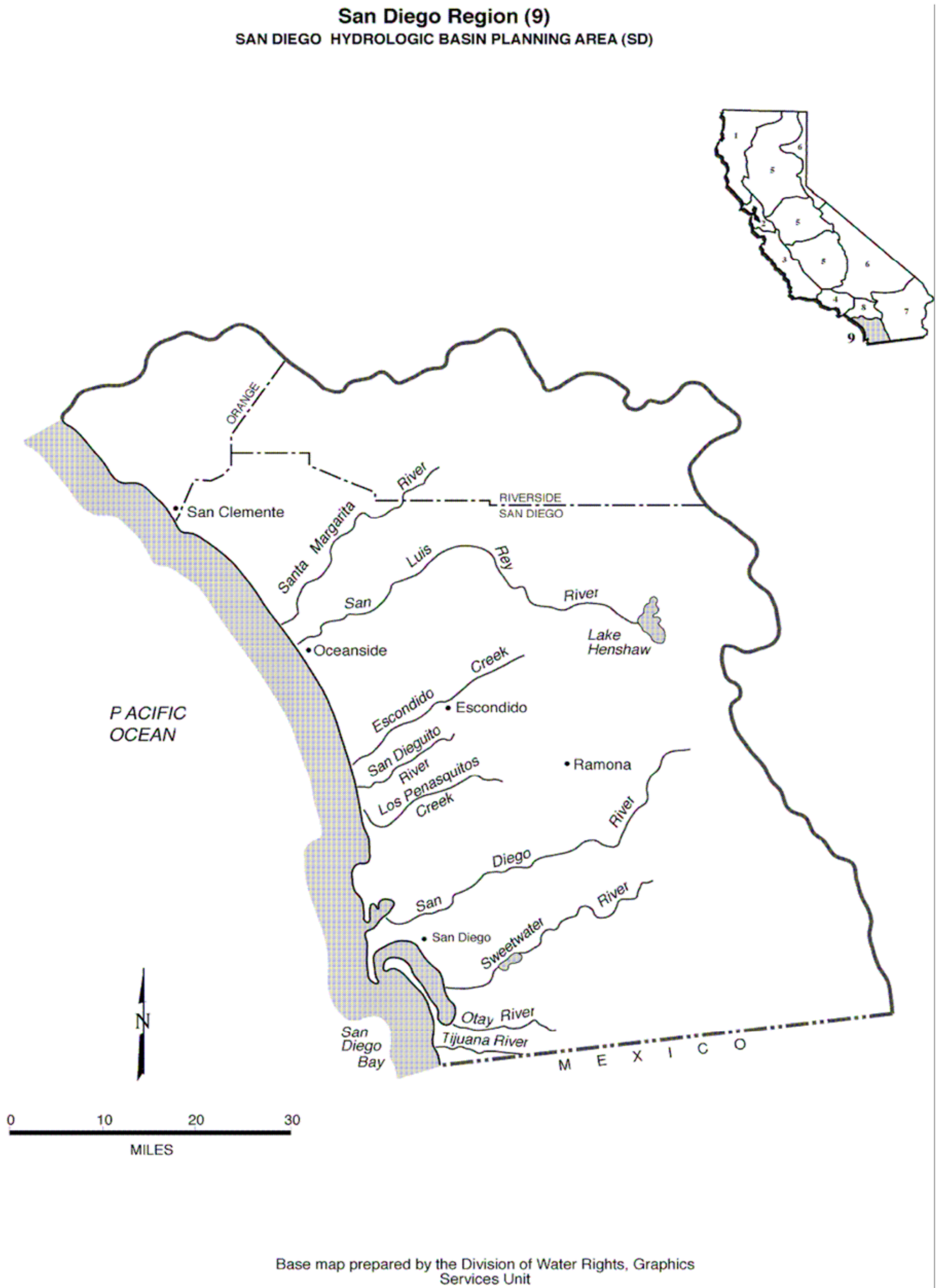


Figure 5.9. San Diego Region

Table 5.11. San Diego Region Bay and Estuarine Listings Associated with Toxic and Bioaccumulative Pollutants in Sediment, Tissue and Water Column

Waterbody	Basis	Category
Dana Point Harbor	Copper, Toxicity, Zinc	5
Mission Bay - mouth of Rose Creek	Lead	5
Mission Bay - mouth of Tecolote Creek	Lead	5
Mission Bay at Quivira Basin	Copper	5
Oceanside Harbor	Copper	5
San Diego Bay	PCBs	5
San Diego Bay, Shelter Island Yacht Basin	Dissolved Copper	4a
San Diego Bay Shoreline - 32nd Street Naval Station	Benthic Community Effects, Sediment Toxicity	5
San Diego Bay Shoreline - Chula Vista Marina	Copper	5
San Diego Bay Shoreline - Downtown Anchorage	Benthic Community Effects, Sediment Toxicity	5
San Diego Bay Shoreline - north of 24th Street Marine Terminal	Benthic Community Effects, Sediment Toxicity	5
San Diego Bay Shoreline - Seventh Street Channel	Benthic Community Effects, Sediment Toxicity	5
San Diego Bay Shoreline - vicinity of B St. and Broadway Piers	Benthic Community Effects, Sediment Toxicity	5
San Diego Bay Shoreline - Americas Cup Harbor	Copper	5
San Diego Bay Shoreline - Coronado Cays	Copper	5
San Diego Bay Shoreline - Glorietta Bay	Copper	5
San Diego Bay Shoreline - Harbor Island (East Basin)	Copper	5
San Diego Bay Shoreline at Harbor Island (West Basin)	Copper	5
San Diego Bay Shoreline at Marriott Marina	Copper	5
San Diego Bay Shoreline - Chollas Creek	Benthic Community Effects, Sediment Toxicity	5
San Diego Bay Shoreline - Coronado Bridge	Benthic Community Effects, Sediment Toxicity	5
San Diego Bay Shoreline - Sampson and 28th Streets	Copper, Mercury, PAHs, PCBs, Zinc	4b
San Diego Bay Shoreline - Switzer Creek	Chlordane, PAHs	5
San Diego Bay Shoreline - sub base	Benthic Community Effects, Sediment Toxicity, Toxicity	5
Tijuana River Estuary	Lead Nickel, Pesticides, Thallium	5

Note: Category 4a - 303(d) list being addressed by USEPA approved TMDL
Category 4b - 303(d) list being addressed by an action other than a TMDL
Category 5 - 303(d) list requiring the development of a TMDL

Consumption advisories in San Diego Bay Region bays and estuaries

Waterbody	Fish	Basis for Advisory
Mission Bay	Brown Smoothhound Shark	Mercury
	Spotted Sand Bass	Mercury
	Striped Mullet	PCBs
	Shiner Perch	PCBs
	Other Surf Perch	Mercury and PCBs
	Spotted Turbot and Diamond Turbot	Mercury and PCBs
	Yellowfin Croaker	Mercury
San Diego Bay	Spotted Sand Bass and Barred Sand Bass	Mercury and PCBs
	Spotted Turbot and Diamond Turbot	PCBs
	Shiner Perch	PCBs
	Other Surf Perch	PCBs
	Sharks	Mercury
	Shovelnose Guitar Fish and Sting Ray	Mercury
	Lizardfish, Chub Mackerel Topsmelt	PCBs
	Yellowfin Croaker	Mercury and PCBs
Bays and Estuaries	American Shad	Mercury and PCBs
	Chinook (King) Salmon	Mercury and PCBs
	Striped Bass	Mercury and PCBs
	White Sturgeon	Mercury and PCBs

Source: Health Advisory and Guidelines for Eating Fish from Mission Bay (San Diego County) (OEHHA 2013a), Health Advisory and Guidelines for Eating Fish from San Diego Bay (San Diego County) (OEHHA 2013b) and Health Advisory and Safe Eating Guidelines for American Shad, Chinook (King) Salmon, Steelhead Trout, Striped Bass, and White Sturgeon Caught In California Rivers, Estuaries and Coastal Waters (OEHHA, 2012).

6 Project Options and Rationale

6.1 Contaminant Focus Areas

6.1.1 Contaminants

The narrative SQO protecting human consumers of fish states the following:

> *Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health in bays and estuaries of California.*

The existing requirements that implement this objective states:

> *The narrative human health objective…shall be implemented on a case-by-case basis, based upon a human health risk assessment. In conducting a risk assessment, the Water Boards shall consider any applicable and relevant information, including California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, Cal/EPA's Department of Toxic Substances Control (DTSC) Risk Assessment, and U.S. EPA Human Health Risk Assessment policies.*

This general approach is applicable to the assessment of any contaminant that has the potential to bioaccumulate from sediment into tissue. Many chemicals have the potential to bioaccumulate in tissue. Examples include cadmium, chlordane, DDT, dieldrin, dioxins and furans, lead, mercury, PBDEs, PCBs, pyrene, selenium, and tributyltin.

Existing tissue monitoring data and fish tissue consumption advisories published by OEHHA for many of these compounds suggest that mercury, organochlorine pesticides and PCBs are the most prevalent in bay and estuarine seafood and present the greatest risk to beneficial uses (State Water Board, 2006). Mercury is by far the most prevalent contaminant in surface waters of California at concentrations that limit "safe" consumption for men, women of child bearing age, children. As a result, the State Water Board on May 2, 2017 adopted Resolution 2017 - 0027 approving a plan to regulate mercury in all inland surface waters and enclosed bays for a variety of beneficial uses including subsistence and cultural uses in 2017. (The mercury program page is available at this link http://www.waterboards.ca.gov/water_issues/programs/mercury/). The Resolution and link to provisions is available here; https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2017/rs2017_0027.pdf

A major difference between the bioaccumulation of organochlorine compounds and mercury is that mercury requires an intermediate process of methylation by microbes before significant bioaccumulation and trophic transfer can occur. As a result, bioaccumulation of mercury is greatest where microbiological activity is optimal for transformation to occur. This activity may or may not coincide with source areas or areas exhibiting the highest concentrations of inorganic mercury in sediment areas. Because bioaccumulation of mercury is driven by multiple processes that occur over significant spatial scales, the SSC suggested that the technical team focus on those bioaccumulative contaminants that were better understood in estuarine and marine food webs. For the past ten years, the State Water Board has focused on organochlorine pesticides and PCBs for the following reasons:

- Organochlorine pesticides and PCBs are widely distributed and pose risks to a variety of receptors, including human consumers of seafood caught within bays and estuaries of California.
- The bioaccumulation of organochlorine pesticides and PCBs is more predictable than other compounds such as mercury and selenium, which increases the probability of developing a successful assessment framework.
- The general mechanisms of bioavailability and bioaccumulation of these compounds are likely to be similar to other compounds, including PBDEs and dioxins.

Alternatives Identified

Alternative 1: No Action. Use the existing implementation provisions for all contaminants that bioaccumulate in fish tissue in bays and estuaries of California.

Alternative 2: Develop contaminant-specific assessment framework for all contaminants that bioaccumulate in fish tissue in bays and estuaries of California

Alternative 3: Develop contaminant-specific assessment framework for those contaminants where existing tools and understanding can be applied to create an assessment framework (organochlorine pesticides and PCBs) and rely upon the existing provisions for evaluating other contaminants.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.b.1)

6.1.2 Analytes and Congeners

Organochlorine pesticides and PCBs have routinely been measured in the environment for several decades. Over the years, the laboratory methods and list of analytes associated with these groups has evolved considerably based on occurrence in the environment as well as breakdown products and toxicity. For many years, PCBs were typically quantified and reported as Aroclors (trade name) which is based on the PCB mixture composition of the commercially available products. As laboratory instruments, and methods improved, so did the ability to distinguish all 209 PCB congeners and all DDT metabolites.

The summation of the concentrations of the 209 PCB congeners gives the total PCB concentration. Some PCB congeners are more toxic and cause greater environmental contamination than others. As a result, it is difficult to evaluate PCB exposure as concentration data in total PCBs, since this does not accurately reflect the risk to the environment and human health. In addition, when tissue and sediment samples are analyzed for PCBs, generally a subset of the 209 congeners are tested due to the analytical expense and time required for analysis of all 209 congeners as well as the sophistication and experience of the individual laboratories. There are five congener subsets commonly measured in California, including the

Surface Water Ambient Monitoring Program (SWAMP), the San Francisco Bay Regional Monitoring Program for Water Quality, the Southern California Bight survey, National Oceanographic and Atmospheric Administration's National Status and Trends Mussel Watch program, and SQO direct effects studies (Bay, et al, 2017). To allow for the use of measurements on a subset of congeners, it is essential to determine the total PCB burden expected.

When evaluating total PCBs, the greater number of congener's reported will be a better estimate of the true sum than estimates based on fewer congeners. For this reason, analyses conducted by Bay, et al (2017) demonstrated that the SWAMP congener subset is most consistent with the U.S. EPA National Fish Tissue Study dataset. Additionally, the SWAMP congener subset would provide for greater statewide consistency with existing monitoring conducted by SWAMP and any other monitoring program required to be SWAMP comparable.

Alternatives Identified

Alternative 1: Monitor all organochlorine pesticide and PCB congeners, metabolites and isomers.

Alternative 2: Subset based on occurrence, toxicity, feasibility as well as utility and comparability with other data sets statewide (SWAMP list).

Alternative 3: Utilize regional analyte lists.

Staff Recommendation: Alternative 2, see Appendix A, C-7.

6.2 Chemical Exposure Assessment

6.2.1 Chemical Exposure Measurement

As described in Section 3.2, assessing and evaluating chemical exposure is a critical component of sediment quality assessments. There are many different approaches that could be applied. These approaches include

- Water column chemistry
- Sediment chemistry
- Direct measurement of blood contaminant concentrations
- Epidemiological studies
- Direct measurement of the fish tissue typically consumed

Water column chemistry can be used in conjunction with California Toxics Rule criteria for organochlorine pesticides and PCBs to evaluate potential impacts; however, neither the media measured nor the standard are directly related to the exposure to human consumers of resident fish. Some programs rely on sediment chemistry which is multiplied by a bioaccumulation factor to estimate prey or sportfish tissue which coupled with consumption rate would allow direct quantification of exposure under the assumption that all contaminants in sediment bioaccumulate into the fish tissue. Other methods include direct monitoring of human blood for contaminant concentrations or epidemiology studies; both of which are highly impractical as well as infeasible for use within a state-wide sediment quality assessment program. Humans may be exposed to sources other than resident fish within bays and estuaries and epidemiology studies are resource intensive and can require years to complete. Direct measurement of fish tissue contaminant concentrations represents a relatively practical and reliable means to assess human exposure provided other important factors such as consumption are applied consistently within the framework. The advantage of this approach is that the media measured represents the true exposure point (resident sportfish caught and consumed by human sport fishers) referenced in the SQO and is not an indirect estimate based on other measurements, factors and assumptions.

Alternatives Identified

Alternative 1: Apply water column chemistry to evaluate exposure.

Alternative 2: Apply sediment chemistry and bioaccumulation factor in order to evaluate exposure.

Alternative 3: Apply fish tissue chemistry to directly evaluate chemical exposure to human consumers of fish.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.b and IV.A.2.d.3).

6.2.2 Potential Fish Species Used in Evaluation of Chemical Exposure

As discussed above, monitoring contaminants in fish tissue can provide a direct measure of chemical exposure to humans through consumption of fish tissue. However, California encompasses a variety of coastal and nearshore habitats and oceanic and climatic conditions and as a result, there are hundreds of fish species that could be found within California's enclosed bays and estuaries from the Smith River Estuary at the north end of the state to the Tijuana River Estuary along the southern boundary. Table 6.1 presents a partial list of fish caught and consumed in coastal marine and estuarine waters of California (Bay, et al, 2017). Because contaminant concentrations in fish tissue varies significantly by species, due to differences in lipid content, diet, foraging area, life history, age and size, the species selected will have a significant impact on the outcome of the assessment.

Table 6.1 Partial List of Sportfish in Nearshore Marine and Estuarine Waters of California

Common Name	Scientific Name	Common Name	Scientific Name
Albacore	*Thunnus alalunga*	Pacific barracuda	*Sphryaena argentea*
American Shad	*Alosa sapidissima*	Pacific bonita	*Sarda chiliensis*
Barred sand bass	***Paralabrax nebulifer***	Pacific chub mackerel	*Scomber japonicus*
Barred surfperch	***Amphistichus argenteus***	Pacific hake	*Merluccius productus*
Bat Ray	***Myliobatis californica***	Pacific herring	*Clupea pallasii*
Black perch	***Embiotoca jacksoni***	Pacific sanddab	*Citharichthys sordidus*
Black rockfish	***Sebastes melaops***	Pacific sardine	*Sardinops sagax caerulea*
Blacksmith	*Chromis punctipinnis*	**Pile perch**	***Rhacochilus vacca***

Bluefin Tuna	*Thunnus orientalis*	Plainfin midshipman	*Porichthys notatus*
Blue rockfish	***Sebastes mystinus***	**Queenfish**	***Seriphus politus***
Bonefish	***Albula vulpes***	**Redtail surfperch**	***Amphistichus rhodoterus***
Bocaccio	*Sebastes paucispinis*	**Rubberlip seaperch**	***Rhacochilus toxotes***
Brown rockfish	***Sebastes auriculatus***	Salema	*Xenistius californiensis*
Brown smoothhound	***Mustelus henlei***	**Sargo**	***Anisotremus davidsonii***
Cabezon	***Scorpaenichthys marmoratus***	Señorita	*Oxyjulis californica*
California corbina	*Menticirrhus undulatus*	Seven gill shark	*Notorynchus cepedianus*
California halibut	***Paralichthys californicus***	**Shiner perch**	***Cymatogaster aggregata***
California lizardfish	*Synodus luciocepsis*	Shortfin corvina	*Cynoscion parvipinnis*
California scorpionfish	*Scorpaena guttata*	Shovelnose guitarfish	*Rhinobatos productus*
California sheephead	*Semicossyphus pulcher*	Spiny dogfish	*Squalus acanthias*
Channel catfish	***Ictalurus punctatus***	**Spotfin croaker**	***Roncador stearnsii***
Chinook salmon	*Oncorhynchus tshawytscha*	**Spotted sand bass**	***Paralabrax maculatofasciatus***
Chub mackeral	*Scomber japonicus*	**Starry flounder**	***Platichthys stellatus***
Coho Salmon	*Oncorhynchus kisutch*	Steelhead trout	*Oncorhynchus mykiss*
Common carp	*Cyprinus carpio*	Striped bass	*Morone saxatilis*
Dwarf perch	***Micrometrus minimus***	**Striped mullet**	***Mugil cephalus***
English sole	*Parophrys vetulus*	**Striped seaperch**	***Embiotoca lateralis***
Fantail sole	***Xystreurys liolepis***	Thresher shark	*Alopias vulpinus*
Giant seabass	*Stereolepis gigas*	**Topsmelt**	***Atherinops affinis***
Gopher rockfish	*Sebastes carnatus*	**Walleye surfperch**	***Hyperprosopon argenteum***
Gray smoothhound	*Mustelus californicus*	**White catfish**	***Ameiurus catus***
Grass rockfish	***Sebastes rastrelliger***	**White croaker**	***Genyonemus lineatus***
Green sturgeon	*Acipenser medirostris*	**White seabass**	***Atractoscion nobilis***
Halfmoon	*Medialuna californiensis*	**White seaperch**	***Phanerodon furcatus***
Jack mackeral	*Trachurus symmetricus*	White sturgeon	*Acipenser transmontanus*
Jacksmelt	*Atherinopsis californiensis*	**Yellowfin croaker**	***Umbrina roncador***
Kelp bass	***Paralabrax clathratus***	Yellowtail	*Seriola lalandi*
Kelp rockfish	*Sebastes atrovirens*	Zebra perch	*Hermosilla azurea*
Largemouth bass	*Micropterus salmoides*		
Leopard Shark	***Triakis semifasciata***		
Lingcod	***Ophiodon elongatus***		
Monkeyface prickleback	***Cebidichthys violaceus***		
Northern Anchovy	*Engraulis mordax*		
Olive rockfish	*Sebastes serranoides*		
Opaleye	*Girella nigricans*		
Pacific angel shark	*Squatina californica*		

Note - Bolded and Underlined species represent primary species

Incorporating all of these species into the assessment framework would provide the end user with the greatest freedom and flexibility, however this approach may not adequately reflect human exposure nor site contributions and ultimately provide little value or benefit to the overall assessment. As presented in Figure 6.1, there are three traits that could be used to select species for this assessment. First, the tissue should be representative of species commonly consumed within the waterbody of interest in order to reflect human exposure associated with the waterbody of interest. Second, only species with high site fidelity (e.g. resident or species with limited home range would reflect the contaminant mass and sources within the site or waterbody of interest. Third, utilizing species that consume some proportion of their diet from benthic sources provides a stronger link to contaminants in sediment than those species that utilize a water column oriented food web. Species that share traits are bolded in Table 6.1. The analysis of these traits on species present in California coastal and estuarine waters is described in detail by Bay et al, (2017). If no guidance or limitations were placed on the selection of appropriate species, any fish that could be caught could be applied within the assessment framework regardless of whether the fish was of legal size, regularly consumed or had spent significant time in the waterbody of interest.

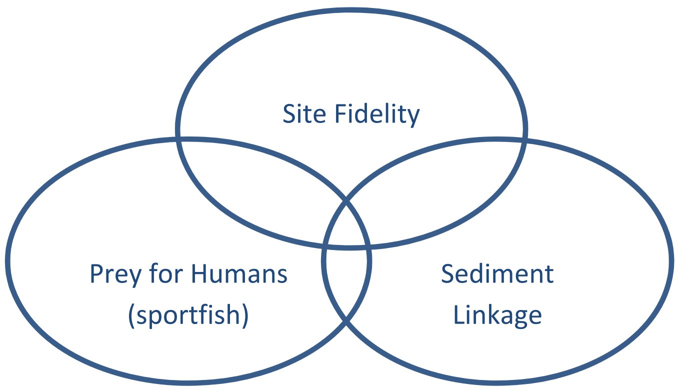


Figure 6.1. Species Traits for Assessing Chemical Exposure and Relationship to Contaminants in Sediment.

Alternatives Identified

Alternative 1: Utilize any species caught in an enclosed bay or estuary in order to evaluate chemical exposure

Alternative 2; Utilize any species of legal size and regularly consumed to evaluate chemical exposure

Alternative 3: Utilize only those species with significant site fidelity or resident to the waterbody of interest in order to evaluate chemical exposure

Alternative 4: Utilize only those species that exhibit a dietary association with sediment, either by consuming organisms that reside in the sediment or organisms that consume sediment associated prey in order to evaluate chemical exposure.

Alternative 5: Utilize only those species that meet all the criteria described in Alternatives 2, 3, 4, and summarized in Figure 6.1.

Staff Recommendation: Alternative 5, see Appendix A, Chapter IV.A.2.b.3), Chapter IV.A.2.d. and C-6.

6.2.3 Species to be Monitored and Assessed

Although the species that encompass the traits described above provide a basis for selecting fish species, there are additional factors that could provide for a more representative assessment. For example, use of a single species for the assessment of chemical exposure may not reflect the likely range of human exposures that would occur within a waterbody. Humans fishing a given waterbody are likely to consume a wide variety of species depending upon where and when they fish and the technique employed. Selecting species that are difficult to catch and or rarely caught or consumed would also provide little or no value or benefit. In order to ensure a more representative assessment, a variety of species could be applied that are commonly caught and consumed within the waterbody of interest. Another factor to consider is fish's feeding strategy. As described in Section 3, trophic transfer via the food web is a major pathway for contaminants in sediments to accumulate in fish tissue. Including fish from a variety of dietary guilds will ensure that the assessment encompasses a diversity and larger portion of the overall aquatic food web than use of a single species. A dietary guild is a group of seafood species that consume similar prey types, resulting in similar routes of exposure to sediment-associated contaminants. When trophic transfer is the predominant mechanism of contaminant movement species within the same dietary guilds should be similarly exposed all other factors being equal such as size, dietary requirements, and lipid content. However, application of dietary guilds requires detailed knowledge of a species life history. Dietary guilds identified in the proposed assessment framework as described by Bay et al (2017) consist of the following:

1. Piscivore: Diet consist mainly of fish
2. Benthic diet with piscivory: Diet regularly includes a mixture of benthic invertebrates forage fish.
3. Benthic and pelagic diet with piscivory: Diet includes a combination of benthic invertebrates, pelagic invertebrates, and forage fish.
4. Benthic diet without piscivory: Diet largely composed of small benthic invertebrates
5. Benthic and pelagic diet without piscivory: Diet includes a mixture of epibenthic and pelagic invertebrates.
6. Benthic and pelagic diet with herbivory: Diet consists of benthic and pelagic invertebrates and plant material.
7. Benthic diet with herbivory: Largely consumes benthic invertebrates, benthic algae, and aquatic plants
8. Pelagic diet with benthic herbivory: Diet includes largely pelagic invertebrates and benthic algae.

An approach incorporating a dietary guild approach would provide a more realistic indication of seafood exposure to contaminated sediments than using assumptions for a generic seafood organism. Additionally, circumstances where local species diet data are not available would be addressed by the use of diets based on representative species within the guild.

Alternatives Identified

Alternative 1: Utilize just one species to assess chemical exposure

Alternative 2; Utilize multiple species without any limitation or direction as to what species should be included in the evaluation of chemical exposure

Alternative 3: Utilize species that represent the variety of fish species consumed by humans as well as different dietary guilds.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.b.3), Chapter IV.A.2.d. and C-6. .

6.2.4 Tissue Types used to assess chemical exposure

The type of tissue utilized in the assessment of chemical exposure can significantly influence contaminant concentrations in fish tissue samples. Contaminant concentrations are generally measured for the whole body, whole body minus head and guts, and as skin-on or skin-off fillet and vary depending upon tissue type. For lipophilic contaminants, whole body analysis and skin-on fillets typically contain higher contaminant concentrations than skin-off fillets because of preferential partitioning within the organs, fatty tissue and skin relative to muscle (fillet). As a result OEHHA generally recommends that consumers of locally caught sportfish consume skin-off fillets for those fish large enough to fillet and prepare. OEHHA recognizes that some fish are simply too small to fillet and as a result are more likely consumed whole or whole, minus head and guts. All primary species identified in Table 6.1 with the exception of topsmelt and shiner perch are large enough to be evaluated as skin-off fillet. For topsmelt and shiner perch, the tissue type evaluated should consist of the whole body (e.g., skin on) with the head, tail, and guts removed. Although differences in chemical concentration between the whole body and fillet samples are not expected to be large, because the mass of muscle tissue will dominate the sample, calculation of site linkage should be based on the same tissue type for best accuracy in the results.

Alternatives Identified

Alternative 1: Allow the use of any tissue type regardless of species

Alternative 2: Analyze whole body fillet for human health effects assessment.

Alternative 3: Analyze skin-on fillet for human health effects assessment.

Alternative 4: Establish species-specific tissue type preparations, consistent with OEHHA consumption advisories and/or typical consumption practices.

Staff Recommendation: Alternative 3, see Appendix A, C-6.

6.2.5 Evaluation of Chemical Exposure

In order to provide consistent interpretation and assessment of chemical exposure, the proposed amendment should describe how the results of tissue analysis are evaluated. The most common approach applied to water quality assessments is by use of a single numeric threshold leading to a binary outcome. Examples of these outcomes include

- Pass or fail
- Un-impacted or Impacted

Another alternative is to apply multiple categories as applied in the existing Sediment Quality Provisions. Multiple categories provides several benefits over binary outcomes. Categorizing the response provides the end-user with the ability to assess scale or magnitude of result. The approach also provides greater utility when attempting to integrate the exposure response with other responses such as site linkage described in later sections. This approach has been applied to the individual lines of evidence that comprise the multiple line of evidence approach that support the benthic community protection SQO adopted by the State Water Board in 2008 under Resolution 2008-0070 (See https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2008/rs2008_0070.pdf). An example of multiple categories that could be applied are:

- Very Low
- Low
- Moderate
- High
- Very High

Alternatives Identified

Alternative 1: Do not provide a prescriptive approach for interpreting the fish tissue chemistry data for the purpose of evaluating chemical exposure.

Alternative 2: Utilize a simple binary approach for interpreting the fish tissue chemistry data for the purpose of evaluating chemical exposure.

Alternative 3: Utilize multiple categories for interpreting the fish tissue chemistry data for the purpose of evaluating chemical exposure.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.d.3) and Table 20.

6.2.6 Exposure Indices

Human exposure is evaluated by establishing a relationship between the parameter measured and the biological effects that could harm the receptor of interest. In this case, tissue concentrations can be related to the potential harm to humans using the methods applied to develop fish tissue advisories, fish tissue-related water quality criteria, and fish consumption-related TMDL targets. Two types of human health effects are evaluated in these programs: (1) the risk of developing cancer from exposure to carcinogenic chemicals; and (2) the hazard of significant adverse health effects from non-carcinogens. The equations describing the relationship between exposure and the risk or hazard are presented in Section 4.2.4. In selecting which threshold to apply for a specific situation, risk assessors will utilize the most sensitive threshold, which can vary based on consumption rate and other factors. Another approach utilized by OEHHA in the development of fish tissue consumption advisories considers the cancer risk, non-cancer hazard as well as the significant benefits associated with the consumption of fish. All three of these factors are included in the calculation of fish tissue consumption advisories for consumers of locally caught seafood in California (OEHHA, 2008). Other agencies also provide tissue thresholds derived for consumers. For example, USEPA also develops guidelines to protect consumers of fish and shellfish. In the past, US Food and Drug Administration has also prepared and published action levels. The National Academy of Sciences has also derived tissue guidelines (State Water Board, 2004). Applying the OEHHA guidelines to the assessment of tissue provides several advantages:

1. Consistency with OEHHA fish tissue advisories. Fish tissue should be evaluated consistently with the same programs that determine what and how much fish people can catch and consume.

2. The fish tissue advisories and contaminant goals are derived from human health risk assessments.

3. Transparency through the use of OEHHA tissue advisories. The methodology and approach used to derive ATLS and FCGs has been applied across many waterbodies in the state since OEHHA originally published the 2008 document (OEHHA 2009, 2010, 201, 2012, 2013a 2013b)

4. Integrate cancer risk and non-cancer hazard as well as benefits associated with fish consumption

Alternatives Identified

Alternative 1: Utilize the cancer risk threshold only for the assessment of exposure.

Alternative 2: Utilize the non-cancer hazard threshold only for the assessment of exposure

Alternative 3: Utilize both cancer and non-cancer hazard risk for the assessment of exposure

Alternative 4: Utilize the OEHHA approach based on cancer and non-cancer hazard risk as well as the benefits associated with fish consumption for the assessment of exposure

Staff Recommendation: Alternative 4, see Appendix A, Chapter IV.A.2.d.3) and Table 19.

6.2.7 Application of OEHHA Tissue Advisories and Goals

In 2008, OEHHA issued the document titled Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sportfish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium and Toxaphene (OEHHA, 2008). In that document, OEHHA utilized human health risk assessment to derive fish contaminant goals (FCGs) based on cancer risk and non-cancer hazard as long term goals. OEHHA also utilized human health risk assessment to derive advisory tissue levels (ATLs) that also consider benefits associated with fish consumption. Advisory tissue levels were developed based on one, two and three eight ounce meals per week which equates to 32, 64 and 96 grams of tissue per day (OEHHA uses the following designation: ATL 1 represents the advisory tissue level associated with the consumption of one meal per week, ATL 2 represents the advisory tissue level associated with the consumption of two meals per week and ATL 3 represents the advisory tissue level associated with consumption of three meals per week). According to OEHHA, both the FCGs and the ATLs represent no significant health risk to consumers at or less than the designated consumption rate. Only the ATLs are used in the issuance of consumption advisories. Staff could incorporate one or more of these thresholds into the assessment framework. In 2008, the State Water Board adopted multiple thresholds for each individual line of evidence used to support the aquatic life SQO assessment framework. Similarly, the State Water Board could propose a range of values to assess consumption risk based on some or all of the ATLs based on one, two and three meals per week and FCGs.

Alternatives Identified

Alternative 1: Utilize only OEHHA Advisory Tissue Levels based on one, two and three meals per week only.

Alternative 2: Utilize only OEHHA Fish Contaminant Goals

Alternative 3: Utilize both OEHHA Advisory Tissue Levels and Fish Contaminant Goals in order to provide a range of exposure categories from very low exposure up to very high exposure.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.d.3) and Table 19.

6.2.8 Exposure Indices for Subsistence Consumers

The thresholds described above address sport fishers and frequent consumers of resident seafood but not those classified as subsistence fishers. In order to incorporate thresholds protecting subsistence fisher people in the assessment, a potential approach would be to replace one (or more) of the existing exposure thresholds protecting the highest exposure; in this case, the ATL 3 with an ATL representative of subsistence consumers. In May 2017, the State Water Board adopted Resolution 2017-0027, Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions. With those amendments the State Water Board derived a Tribal Subsistence value protecting those consuming up to 142 grams per day. This consumption rate is equivalent to 4.4 eight ounce meals per week. While this value was adopted by the State Board for mercury, other values were identified ranging from 127 grams per day up to 286 grams per day (State Water Board, 2017). OEHHA does not provide an Advisory Tissue Level based on 142 grams per day; however, the mercury staff report and regulatory provisions designate either the ATL 4 or ATL 5 as equivalent. Staff could leave the actual threshold up to individual regions, based on consumption studies, though completing such studies can take significant time and resources. It is important to understand that the these alternative thresholds protecting subsistence fisher people would only be implemented in those water bodies where beneficial uses protecting those fishers have been designated by the Regional Water Board.

Alternatives Identified

Alternative 1: Do not incorporate thresholds protecting subsistence fisher people.

Alternative 2: Incorporate thresholds protecting subsistence fisher people consistent with other Water Board regulatory provisions.

Alternative 3: Utilize both OEHHA Advisory Tissue Levels and Fish Contaminant Goals in order to provide a range of exposure categories from very low exposure up to very high exposure.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.e.3).

6.3 Tiered Approach

The existing Sediment Quality Provisions includes a narrative Sediment Quality Objective (SQO) for human health, stating "Pollutants shall not be present in sediment at levels that will bioaccumulate in aquatic life to levels that are harmful to human health in enclosed bays and estuaries of California." Section VI. of the Sediment Quality Provisions sets forth the implementation provisions for the human health SQO, where implementation shall occur on a case-by-case basis and is based on a human health risk assessment. A health risk assessment is an analysis that evaluates and quantifies the potential human exposure to a pollutant that bioaccumulates in edible finfish, shellfish, or wildlife and "includes an analysis of both individual and population-wide health risks associated with anticipated levels of human exposure, including potential synergistic effects of toxic pollutants and impacts on sensitive populations." (Wat. Code, § 13391.5 subd. (c).) While the Sediment Quality Provisions provides that the State Water Resources Control Board will consider relevant and applicable information in conducting a risk assessment, it does not provide standardized and consistent implementation provisions for conducting and evaluating a human health risk assessment.

There exists a variety of approaches that have been applied to assess the contribution of contaminants from site sediments to health effects from consuming seafood. These range from relatively straight forward sediment chemical thresholds derived from large sediment and tissue databases to relatively complex and resource intensive site-specific assessments conducted under CERCLA/Superfund.

Sediment Chemistry Approach

Chemical-specific thresholds are sediment concentrations that define an acceptable human health risk from consuming seafood. These thresholds are usually created by back calculating a sediment threshold from health risk equations and assumptions regarding the bioaccumulation of the contaminant at the site (e.g., BAF). Application of simple thresholds results in a straight forward binary conclusion. Sediment concentrations can be directly compared to threshold values to determine if the sediment meets the narrative SQO.

Statewide chemical-specific sediment thresholds have been developed by the Oregon Department of Environmental Quality (ODEQ) for the regulated community to use in the evaluation of bioaccumulative compounds in sediments (ODEQ, 2007). These non-regulatory guidance thresholds were developed from existing tissue and sediment chemistry databases and are used to screen site sediments for bioaccumulation potential. If site sediments exceed the thresholds, the guidance describes additional methods and data that could be collected to better assess site-specific bioaccumulation potential. In highly urbanized waterbodies, where contamination may be present from many sources, ODEQ suggests that responsible parties consult with ODEQ staff to evaluate a site's bioaccumulation potential.

Washington also initiated the development of human health-based, chemical-specific sediment criteria or standards in the 1990's, following a tiered approach similar to that used by Oregon as guidance. Washington has not yet adopted human health-based sediment criteria.

The SQO Scientific Steering Committee voiced concerns against relying solely on a chemical threshold approach because the assumptions used in the development of statewide thresholds must be very conservative to be protective for the diverse types of conditions within California. As a result, such thresholds would likely be highly overprotective for many water bodies and limit the utility and accuracy of the assessment for subsequent management actions.

Site Specific Risk Assessment

Another option is to develop a standardized site-specific risk assessment approach. Historically, site-specific risk assessment has been used in the regulation and management of human health risks associated with consumption of seafood containing sediment-derived bioaccumulated pollutants (Greenfield et al., 2014). However, site-specific risk assessment, while warranted when costly site cleanup is required, is often a complex, expensive and lengthy process.

This approach is used by U.S. EPA, U.S. Army Corps of Engineers and many state agencies to evaluate sites where elevated levels of contaminants are present in site sediments. The risk assessment process is a framework composed of the following basic elements (U.S. EPA, 2000):

- Hazard identification;
- Dose-response assessment;
- Exposure assessment; and
- Risk characterization.

Although U.S. EPA and other federal and state agencies provide guidance on how to conduct risk assessments, the process is intended to be flexible to enable the investigators to respond to any situation encountered and to scale the resources applied to data collection relative to the size and complexity of the site. As a result, this framework performs equally well when applied to small, simple sites as it does to large complex National Priorities List (NPL) Sites. However, this process also requires a high degree of best professional judgment and expertise both in planning and analysis, which affects consistency in application, utility, and ease of use. In addition, projects involving risk assessments require a high level of communication and negotiation amongst the regulators, responsible parties, and the affected population throughout the process.

Tiered Assessment Framework

Another option is to develop a standardized tiered assessment framework. Scaling the assessment framework provides an increasing level of effort with each successive tier. The tiered assessment approach also provides flexibility for data availability, site complexity, and study objectives (Bay and Greenfield, 2015). In addition, the tiered framework approach allows for rapid screening assessment and economical use of resources. For example, Greenfield et al (2014) evaluated a tiered assessment method that evaluates whether the human health SQO is met. The assessment framework includes three tiers: screening assessment, site assessment, and refined site assessment. With this tiered assessment framework, Tier 1 and Tier 3 are optional (Figure 6.2). Tier I, screening assessment, allows for rapid site assessment and uses conservative assumptions with low data requirements. If the results from Tier 1 indicate a concern, Tier 2 assessment is required. Tier 2, site assessment, involves site-specific assumptions and parameters, and compares estimates of consumption risk and sediment contamination to classify the site condition. If Tier 2 assessment indicates a risk to human health, then either the site is classified as impacted, or Tier 3 assessment may be performed. Tier 3, refined site assessment, allows for assessment of more complex site-specific situations and is intended to be used when Tier 2 assessment is determined unreliable due to site specific conditions (Bay et al, 2017).

This tiered decision framework is intended to include the benefits associated with the chemical threshold and site-specific assessment approaches described previously while minimizing the problems associated with each. Both sediment and seafood tissue chemistry data from the site is used in conducting an assessment under the tiered approach (Figure 5.1). The tissue chemistry data is interpreted using health risk calculations based on standardized exposure parameters to determine the level of human health risk associated with consumption. The sediment chemistry data is interpreted using bioaccumulation models to estimate the human health directly associated with the site sediments. The decision framework consists of three tiers (Figure 6.2). Each tier represents an increasing level of complexity in order to enable the assessment to match variations is data availability, site complexity, and study objectives. Tier I consists of a preliminary evaluation of either tissue data or sediment data to determine whether there appears to be a potential hazard to human health. In Tier I evaluations, sediment or tissue chemical concentration data are interpreted using standardized conservative assumptions to evaluate the potential hazard to human consumers of seafood. If Tier I indicates a potential hazard exists, then the analysis would proceed to Tier II.

Tier II consists of an evaluation of both tissue data and sediment data to determine potential hazard to human health, using available site-specific information. As in Tier I, chemical concentration data are used for the evaluation. However, in Tier II, some default assumptions and parameters are replaced with more realistic parameters and assumptions that are relevant to the site characteristics. For example, variations in seafood trophic level, forage area, and sediment characteristics are incorporated into the assessment. The resulting estimates of consumption risk (from tissue data) and site sediment contribution (from sediment data) are compared to classify the site condition. If Tier II results indicate an acceptable condition, the sediment would meet the human health SQO. If Tier II results indicate an unacceptable condition (e.g., hazard), there are two alternative outcomes: (1) determine that the SQO is not met; or (2) proceed with Tier III analysis.

The Tier III assessment is intended to be used when it is determined that the Tier II assessment is unreliable due to site-specific conditions such as other sources of contamination, temporal variability, inadequate data, or the desire to investigate various management alternatives. The specifics of the Tier III assessment method are determined on a site specific basis and might require the collection of additional data and use of alternative data analysis methods. Application of a tiered decision framework requires consistency in study design and data analysis methods in order to achieve comparability in the assessment results among water bodies and user agencies. This consistency would be achieved partly through the development of a decision support tool (DST) to guide data analysis. This DST is expected to include an integrated set of data analysis tools that would apply the bioaccumulation models, health risk calculations, and assessment criteria in a consistent manner without requiring a high level of user technical expertise. Technical guidance on study design would also be developed to help achieve consistency in the assessment.

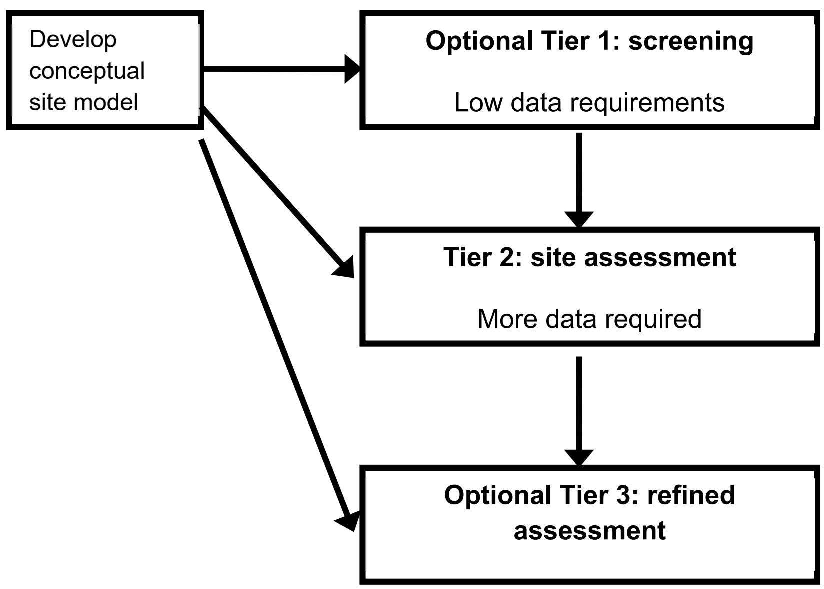


Figure 6.2. Tiered Decision Framework

Alternatives Identified

Alternative 1: No Action. Use the existing implementation provisions for human health risk assessment.

Alternative 2: Develop sediment chemistry based assessment framework

Alternative 3: Develop a site-specific risk assessment method to assess risks to human health.

Alternative 4: Develop a tiered assessment framework to assess risks to human health.

Staff Recommendation: Alternative 4, see Appendix A, Chapter IV.A.2.b.

6.4 Tier 1 Assessment

As described in Section 6.3, Tier 1 assessment allows for rapid site assessment determine if there is a potential concern of chemical exposure to consumers. In Tier 1 assessment, available sediment or tissue concentration data (or both) are interpreted using standardized conservative assumptions. If Tier 1 assessment results indicate a potentially unacceptable chemical exposure to consumers, then analysis would proceed to Tier 2. Sites found to have low potential risk in Tier 1 would be determined to meet the SQO without a requirement for further assessment.

6.4.1 Conservative Assumptions for Sediment and Tissue Based Assessment

Tier 1 assessment evaluates if there is the potential concern of chemical exposure to human consumers of fish. Conservative assumptions should be established to address uncertainty and minimize the chance of concluding unacceptable chemical exposure does not exist, when in fact it does.

One method to address uncertainty is to use an upper confidence limit (UCL) of the mean in calculating the contaminant concentration from sediment or tissue data. The Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment developed by Oregon's Department of Environmental Quality applies a 90 percent UCL when evaluating sediment screening levels (Oregon Department of Environmental Quality, 2007). However, to ensure the minimization determining a site is un-impacted when in fact it is, a more conservative approach is more appropriate. An UCL of 95 percent of the arithmetic mean is generally used as a conservative assumption in risk assessment and is suggested for Tier 1 assessment (Bay and Greenfield, 2015 and Greenfield et al, 2015).

Since Tier 1 assessment uses available data, there may be instances where a small sample size is used to calculate the contaminant concentration. In addressing the increased uncertainty associated with a small sample size (less than three samples), the maximum concentration should be used in lieu of the 95 percent UCL.

Alternatives Identified

Alternative 1: Use conservative assumption of 90 percent UCL of the mean to estimate contaminant concentration.

Alternative 2: Use conservative assumption of 95 percent UCL of the mean to estimation of the contaminant concentration.

Alternative 3: Use conservative assumption of 95 percent UCL of the mean to estimation of the contaminant concentration and in cases when the sample size is less than three use the maximum concentration.

Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.c.

6.4.2 Evaluation Based on Tissue Chemistry

In Tier 1 tissue evaluation is performed by comparing the tissue contaminant concentration to tissue screening thresholds. As described in Section 3.2, advisory tissue levels (ATL), were developed by OEHHA for various consumption rates, such as one, two, or three meals per week. ALT's are appropriate tissue screening thresholds for Tier 1 assessment. Consistent with the intent of Tier 1 to be protective, conservative assumptions of consumption rates are recommended. The assumption should consider the seafood consumer populations, fishing practices and consumption rates. One option is to determine the appropriate ATL for each site based on local fishing and consumption rates at the site. However, this is not consistent with the goal of Tier 1 assessment to use standardized conservative assumptions to provide rapid screening assessment and consistency in assessment across multiple sites. Another option is to select a standardized conservative assumption of consumption rate for application in Tier 1 assessment. An ATL based on a consumption rate of three meals per week is conservative for most consumer populations. However, a more conservative assumption of consumption rate should be applied for subsistence fishers. An ATL based on a consumption rate of four or five meals per week is appropriate for subsistence fishing consumer populations.

Alternatives Identified

Alternative 1: Determine ATL consumption rate on a site specific basis.

Alternative 2: Perform Tier 1 evaluation using ATL's based on a consumption rate of three meals per week.

Alternative 3: Perform Tier 1 evaluation using ATL's based on a consumption rate of three meals per week for all consumer populations except subsistence fishers. For subsistence fisher consumer populations perform Tier 1 evaluation using more ATL's based on a consumption rate of five meals per week

Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.c.3) and Table 16.

6.4.3 Evaluation Based on Sediment Chemistry

Tier 1 sediment evaluation is based on chemical exposure and is performed by comparing the measured contaminant concentration in sediment to the sediment thresholds. The sediment threshold is calculated by dividing the tissue threshold by the biota-sediment accumulation factor (BSAF) (Bay and Greenfield, 2015 and Greenfield et al, 2015). The BSAF is the estimated increase in concentration that occurs between sediment and seafood and is determined as a function of contaminant, fish guild, and TOC.

One approach is to calculate site-specific BSAF to establish sediment thresholds; however, this option does not align with the data and resource requirements of Tier 1. Another approach is to establish standardized BSAF or sediment thresholds. This approach was similarly implemented in Oregon's Department of Environmental Quality the Guidance for Assessing Bioaccumultive Chemicals of Concern in Sediment to establish sediment screening thresholds (Oregon Department of Environmental Quality, 2007). Developing standardized BSAF's for each contaminant in each guild, at incremental organic carbon intervals minimizes the data and resource requirements required to evaluate sediment linkage and establish sediment thresholds.

Alternatives Identified

<u>Alternative 1</u>: Calculate site-specific BSAF results to determine sediment thresholds.

<u>Alternative 2</u>: Calculate standardized Tier 1 BSAF results for each contaminant in each dietary guild, at incremental organic carbon intervals to be used in determining sediment thresholds.

Recommendation: Alternative 2, see Appendix A, Chapter IV.A.2.c.4) and Table 17.

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6.4.4 Evaluation of Impact

As stated in Section 6.4, Tier 1 assessment may be performed using either sediment or tissue data (or both), depending on available data, to determine if the site poses a potential unacceptable chemical exposure to consumers. Tier 1 assessment results in two possible categorical outcomes, not impacted or Tier 2 assessment required. If the result of either tissue or sediment evaluation, or both, exceeds the threshold for any constituent, Tier 2 evaluation is required for those constituents. However, categorizing the outcome when both sediment and tissue evaluation are conducted is more complicated.

One approach when performing tissue and sediment evaluation concurrently is to proceed to Tier 2 assessment if either tissue or sediment evaluation results in an exceedance of a threshold for any constituent (Table 6.2, Approach 1) (Bay and Greenfield, 2015 and Greenfield et al, 2015). This approach assumes equal risk to human health when one evaluation exceeds the threshold and the other does not.

Another approach considered by the Scientific Steering Committee is to consider greater risk to human health when tissue evaluation exceeds the threshold than when sediment evaluation exceeds the threshold (Table 6.2, Approach 2)(Scientific Steering Committee, 2011). This approach assumes that when sediment evaluation demonstrates a potential exceedance of the threshold, but the tissue evaluation does not, this result is sufficient to indicate that the site meets the SQO and the site would be considered not impacted.

Table 6.2. Tier 1 Assessment Interpretation

Sediment Evaluation	Tissue Evaluation	Outcome (Approach 1)	Outcome (Approach 2)
Not Impacted	No Data	Not Impacted	Not Impacted
No Data	Not Impacted	Not Impacted	Not Impacted
Not Impacted	Not Impacted	Not Impacted	Not Impacted
Potentially Impacted	No Data	Proceed to Tier II	Proceed to Tier II
No Date	Potentially Impacted	Proceed to Tier II	Proceed to Tier II

Not Impacted	Potentially Impacted	Proceed to Tier II	Proceed to Tier II
Potentially Impacted	Not Impacted	Proceed to Tier II	Not Impacted
Potentially Impacted	Potentially Impacted	Proceed to Tier II	Proceed to Tier II

Alternatives Identified

Alternative 1: Interpret Tier 1 assessment outcomes via approach 1.

Alternative 2: Interpret Tier 1 assessment outcomes via approach 2.

Recommendation: Alternative 2, see Appendix A, Chapter IV.A.2.c.5).

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6.5 Tier 2 Assessment

Tier 2 assessment is the main approach proposed for evaluating sediment quality in relation to the human health narrative SQO. As described above in Section XXX, Tier 2 consists of an evaluation of both tissue data and sediment data to determine potential hazard to human health, using available site-specific information.

6.5.1 Assessment of Site Linkage

The relationship between sediment contamination and tissue bioaccumulation is expressed by the biota-sediment accumulation factor (BSAF). The BSAF is the ratio between the tissue contaminant concentration and the sediment concentration and is either expressed on a wet/dry weight basis or normalized to tissue lipid and sediment organic carbon content (ref). BSAFs are typically based on field measurements (empirical BSAF) and thus incorporate the influence of all factors affecting bioaccumulation at the site, such as distribution of the chemical between the sediment and water column, the diet of the organisms in the food web, the benthic/pelagic connections of the food web to the water and sediment phases, the trophic level of the organism, the bioavailability of the chemical due to amounts and types of organic carbon in the ecosystem, and the metabolic transformation rates of the chemical within the food web (Burkhard et al. 2010).

Site linkage is typically evaluated by calculation of an empirical BSAF, using whatever field data are available and variable calculation methods. Empirical BSAFs represent the apparent relationship between tissue and sediment contaminant concentrations, and are useful for risk assessment screening and planning purposes. However, these values may be influenced by factors not directly related to sediment contamination at the site of interest, such as atmospheric inputs, currents, watershed runoff, and fish migration from other sites. The influence of various unknown site-specific and biological factors can be substantial. Empirical BSAFs have been shown to vary by an order of magnitude or more between sites for similar chemicals and species (Burkhard et al. 2010).

BSAFs can also be calculated based on the output of bioaccumulation models that estimate the tissue concentration based on sediment contaminant data and various constants and parameters that represent key processes affecting contaminant uptake and elimination (Arnot and Gobas 2004).

Determination of site linkage for the purposes of SQO assessment represents a special situation that may not be effectively represented by the BSAF. Since the SQO is intended to protect sediment quality at the site, it is important to distinguish the influence of site sediment contamination on the seafood from that due to other sources (e.g., off site contamination). Empirical BSAFs do not distinguish among different exposure sources and associate all bioaccumulation with site sediment contamination. For SQO assessment, a method is needed determine the relative influence of site sediment contamination on tissue burden, in comparison to other sources not associated with the site. Bioaccumulation models can theoretically be used to estimate the relative influence of site vs. offsite exposure sources on tissue burden (e.g., by comparing estimated tissue concentrations for each type of source), but modelling of offsite sources can be very complex and the needed data are rarely available.

Alternatives Identified

Alternative 1: Calculate an empirical BSAF based on available field data from the site.

Alternative 2: Use an average empirical BSAF based on literature values or a regional database.

Alternative 3: Compare bioaccumulation model estimates based on within site and off-site exposure sources

Alternative 4. Determine the proportion of seafood bioaccumulation from site sediment contamination (model-based) relative to bioaccumulation derived from all sources (field data).

Staff Recommendation: Alternative 4, see Appendix A, Chapter IV.A.2.d.4).

6.5.2 Quantification of site-related bioaccumulation

A variety of bioaccumulation models have been developed that describe the various processes of contaminant uptake and loss within food webs (e.g., Thomann et al. 1992, Arnot and Gobas 2004). Most of the models assume that bioaccumulation of contaminants by fish is the result of the balance between various processes of uptake (e.g., from water and sediment) and loss (e.g., fecal excretion and metabolism) and often take into consideration variations in fish movement, diet, and growth (Kim et al. 2016, Melwani et al. 2012). The complexity of the approaches used to estimate bioaccumulation processes also varies among models, with some basing predictions upon the net result of equilibrium partitioning and steady state assumptions, while others use a dynamic bioenergetic approach that models multiple processes associated with contaminant uptake and elimination (Barber 2008). Dynamic bioaccumulation models require detailed site-specific information on fish population structure, growth rates, diet, and movement patterns to estimate daily rates of contaminant uptake and loss among individuals.

Accuracy of the food web and other fish life history characteristics represented by the bioaccumulation model can influence the accuracy of the model outputs. A wide variety of local fish species are regularly consumed by California anglers and the diets of these species vary greatly (Figure 6.3). Accounting for variation in diet is important because most of the organochlorine hydrocarbons accumulated by fish is the result of dietary uptake from consumption organisms at different trophic levels (e.g., benthic invertebrates, plankton, or other fish). Fish movement is another important factor to consider in the quantification of site-related bioaccumulation. Knowledge of the fish species' home range (spatial area used by the adult for feeding) is also important, because fish feeding activity outside of the study site will influence the linkage of bioaccumulation to site sediments.

Applications of specific bioaccumulation models in California are currently determined on a project-specific basis. There is no standardized calculation approach and the selection of fish species, food web characteristics and key model parameters varies. Recent work on San Francisco Bay has developed a food web bioaccumulation model for PCBs (Gobas food web model) that has been peer-reviewed, calibrated and validated for several fish species relevant to assessing human health impacts (Gobas and Arnot 2010). This model has been shown to be effective in estimating PCB bioaccumulation from sediment in fish and wildlife (Figure 6.4). The structure of this model is adaptable for other species and compounds, provided compound-specific information on uptake and loss processes, as well as the diet of the species, is available.

Alternatives Identified

Alternative 1: Choice of bioaccumulation model approach is made on a project-specific basis and thus may vary among programs.

Alternative 2: Develop a site-specific dynamic bioenergetics-based model for each site.

Alternative 3: Adapt the Gobas and Arnot steady state food web model for San Francisco Bay for use in other California enclosed bays and estuaries.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.d.4). and C-8.

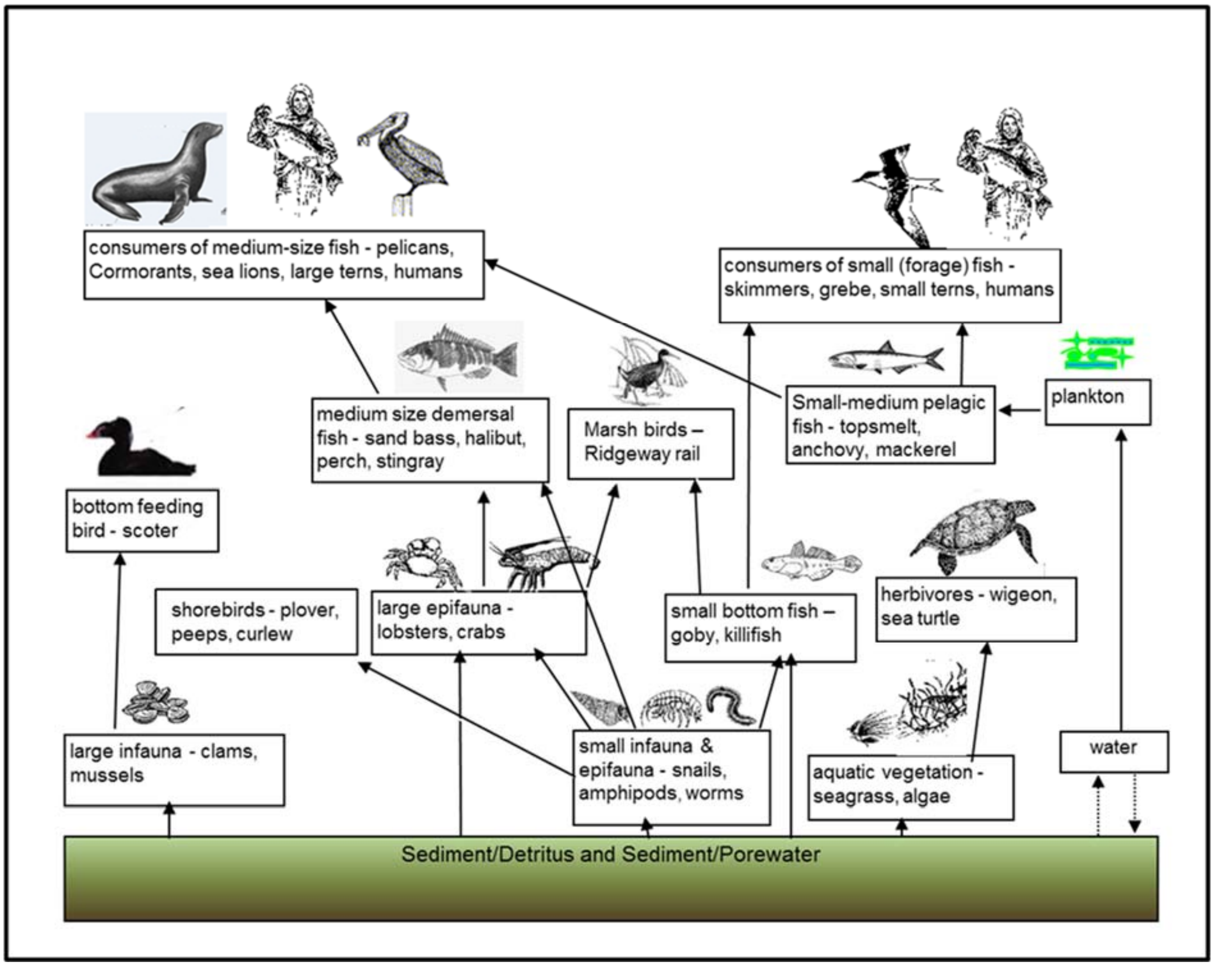

Figure 6.3 Conceptual model of sediment contamination transfer through an embayment food web (Bay et al. 2016; SCCWRP TR 953)

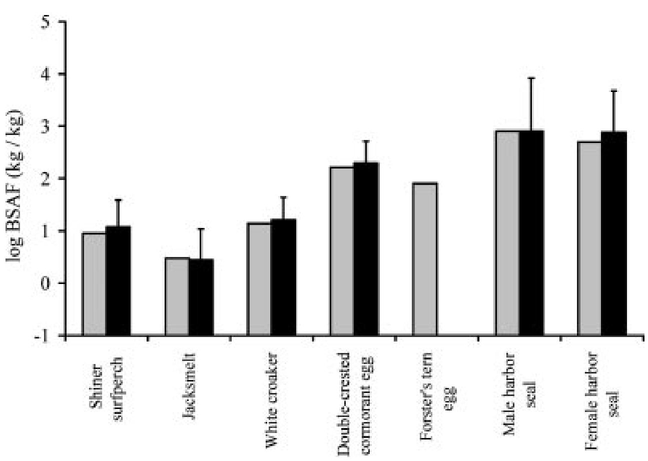

Figure 6.4. Model-predicted (gray columns) and observed (black columns) mean biota–sediment bioaccumulation factors (BSAFs in kg dry sediment/kg wet wt organism) of total PCBs in several species in San Francisco Bay, California, USA. Error bars represent 95% confidence intervals (from Gobas and Arnot 2010).

6.5.3 Consideration of Food Web Variation

The evaluation of measured and modeled tissue contaminant concentrations is central to the human health SQO assessment framework. Biology of the local seafood organisms will influence contamination because contaminant exposure will vary with organism diet and movement. The primary sportfish species identified for assessment of chemical exposure represent eight different dietary guilds, with each guild consisting of a group of seafood species that consume similar prey types, resulting in similar routes of food web exposure to sediment-associated contaminants (Bay et al. 2017). The guilds vary among each other in the types and proportion of organisms consumed (Tables 6.3 and 6.4), resulting in differences in the amount of feeding on sediment-associated prey (benthivory) that have direct exposure to sediment associated contaminants. Evaluation of chemical exposure in the assessment framework addresses dietary variation among sportfish by evaluating multiple species that are representative of different dietary guilds.

Evaluation of sediment linkage through bioaccumulation modeling should also to take into consideration dietary variation among species, as such variation will influence the strength of linkage to site sediment. Furthermore, the accuracy of the calculation of the sediment linkage will be improved if the bioaccumulation model used to estimate site sediment-derived bioaccumulation is representative of the diet of the species analyzed from the field to represent actual bioaccumulation at the site. Several options are available to address dietary variation among fish in the bioaccumulation model. These include use of a generic fish diet representative of average conditions throughout the state; in this case, a single bioaccumulation model result would be used for comparison to field bioaccumulation data for each of the fish species used for evaluation of chemical exposure, likely increasing errors in the calculation of sediment linkage. Another approach would be to conduct bioaccumulation modeling using only a single dietary guild, such as one with the greatest potential sediment linkage (e.g., highest benthivory). Use of this approach would provide an conservative estimate of sediment linkage, but would not represent variation in linkage among the various species selected for assessment of chemical exposure. A third option for modeling is to apply multiple bioaccumulation models, each representing a different dietary guild of relevance to the assessment. This final approach would require a more complex data analysis effort, but would result in a more accurate assessment of sediment linkage for each species.

Alternatives Identified

Alternative 1: Use a single generalized food web matrix for bioaccumulation modeling

Alternative 2: Use a bioaccumulation model based on the dietary guild expected to have the greatest expected sediment linkage.

Alternative 3: Use multiple bioaccumulation models to estimate bioaccumulation from site sediment, with each model representative of the species monitored and used for chemical exposure assessment.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.d.4). and C-8.

Table 6.3. Invertebrate food-web properties. Values indicate the proportion of each diet component (Bay et al. 2017).

		P	M	I1	I2	I3	I4	I5	I6	I7	I8	I9
Diet component	S	---	---	---	0.9	0.9	0.3	0.15	0.1	0.3	0.44	---
	P	---	---	1	0.05	0.05	0.35	0.65	0.45	0.65	0.01	0.3
	M	---	---	---	---	---	---	---	---	---	0.1	---
	I1	---	---	---	0.05	0.05	0.35	0.2	0.45	0.05	0.1	0.3
	I2	---	---	---	---	---	---	---	---	---	---	---
	I3	---	---	---	---	---	---	---	---	---	---	---
	I4	---	---	---	---	---	---	---	---	---	0.2	---
	I5	---	---	---	---	---	---	---	---	---	0.15	---
	I6	---	---	---	---	---	---	---	---	---	---	0.4
	I7	---	---	---	---	---	---	---	---	---	---	---
	I8	---	---	---	---	---	---	---	---	---	---	---
	I9	---	---	---	---	---	---	---	---	---	---	---
	F1	---	---	---	---	---	---	---	---	---	---	---
	F2	---	---	---	---	---	---	---	---	---	---	---
	F3	---	---	---	---	---	---	---	---	---	---	---
	F4	---	---	---	---	---	---	---	---	---	---	---
	F5	---	---	---	---	---	---	---	---	---	---	---
	F6	---	---	---	---	---	---	---	---	---	---	---
Physical properties	PW Respir. (mp)	0	0	0	0.05	0.05	0	0	0	0.05	0.05	0
	Lipid (%)	0.12	0.38	1.00	0.75	0.75	1.00	1.00	1.00	0.86	1.25	2.00
	Mass (kg)	---	---	7.10E-08	1.00E-07	1.10E-04	3.13E-06	5.00E-06	1.50E-05	1.12E-02	5.00E-03	3.72E-04

S = sediment; P = phytoplankton; M = macrophytes; I1 = zooplankton; I2 = small polychaete; I3 = large polychaete; I4 = amphipod; I5 = cumacean; I6 = mysid; I7 = bivalve mollusk; I8 = decapod crab; I9 = crangon shrimp; F1 = forage fish-herbivore (juvenile jacksmelt; F2 = forage fish-planktivore (northern anchovy); F3 = forage fish-primarily benthivore (juvenile white croaker); F4 = forage fish-benthivore (yellowfin goby); F5 = forage fish-mixed diet I (juvenile shiner perch); F6 = forage fish-mixed diet II (plainfin midshipman)); PW Respir. = porewater respiration proportion

Table 6.4. Fish food-web properties. Values indicate the proportion of each diet component (Bay et al. 2017).

		F1	F2	F3	F4	F5	F6	SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8
Diet component	S	---	---	0.05	---	0.05	0.05	---	---	---	0.05	0.05	0.29	0.05	0.3
	P	0.8	0.2	0.05	---	0.1	---	---	0.01	---	---	0.1	0.04	0.2	0.1
	M	---	---	---	---	---	---	---	---	---	---	---	0.2	0.2	0.35
	I1	0.2	0.35	0.2	---	0.2	---	---	---	---	---	0.1	0.11	0.08	0.1
	I2	---	---	0.15	0.2	0.05	0.05	---	---	0.06	0.2	0.1	---	---	---
	I3	---	---	0.15	0.2	0.05	0.1	---	---	0.05	0.2	0.1	0.01	0.01	---
	I4	---	0.2	0.1	0.15	0.25	0.15	---	0.01	0.12	0.2	0.2	0.1	0.4	0.03
	I5	---	0.15	0.1	0.15	0.25	0.15	---	---	0.02	0.2	0.2	0	0.01	---
	I6	---	0.1	0.1	---	0.05	0.2	0.01	---	0.24	0.1	0.15	0.06	0.05	0.02
	I7	---	---	---	---	---	---	---	0.28	---	---	---	0.14	---	0.1
	I8	---	---	---	---	---	---	---	0.35	---	---	---	0.04	---	---
	I9	---	---	0.1	0.25	---	0.2	0.01	---	0.03	0.05	---	---	---	---
	F1	---	---	---	---	---	---	0.08	---	---	---	---	---	---	---
	F2	---	---	---	---	---	0.05	0.45	0.1	0.48	---	---	---	---	---
	F3	---	---	---	---	---	---	0.25	---	---	---	---	---	---	---
	F4	---	---	---	---	---	---	0.1	0.15	---	---	---	0.01	---	---
	F5	---	---	---	0.05	---	0.05		---	---	---	---	---	---	---
	F6	---	---	---	---	---	---	0.1	0.1	---	---	---	---	---	---
Physical properties	PW Respir (mp)	0	0	0	0	0	0.05	0	0	0	0	0	0	0	0
	Lipid (%)	1.20	2.50	1.80	3.00	2.00	3.00	m	m	m	m	m	m	m	m
	Mass (kg)	4.00E-03	2.15E-02	1.50E-02	3.00E-02	1.31E-03	1.30E-01	1.46	0.60	0.05	0.37	0.05	2.00	0.02	1.23

SP1 = piscivore (California halibut); SP2 = benthic diet with piscivory (spotted sand bass); SP3 = benthic and pelagic with piscivory (queenfish); SP4 = benthic without piscivory (white croaker); SP5 = benthic and pelagic without piscivory (shiner perch); SP6 = benthic with herbivory (common carp); SP7 = benthic and pelagic with herbivory (topsmelt); SP8 = pelagic with benthic herbivory (striped mullet)

6.5.4 Consideration of Fish Movement

Exposure of fish to sediment contamination within the assessment site has a major influence on the strength of the linkage between site sediment contamination and bioaccumulation. The home range (HR, area over which a species' activities occur) may be smaller than the site, such that all of the exposure is related to site sediment contamination. In other cases, a fish's movements and foraging area (area over which food is sought) may extend beyond the site, resulting in exposure to contaminants that are not associated with the site and thus not the focus of the SQO assessment. Two other spatial factors in addition to movement interact to influence the exposure of fish to sediment contamination: variability in sediment chemical concentration (e.g., heterogeneity, gradients, or hotspots), and differences in habitat quality that influence foraging activity. The interaction of these three factors determines the proportion of the fish's contaminant burden that is derived from site sediment contamination. Numerous field studies have documented a wide range of variability bioaccumulation factors for nonpolar organics in aquatic organisms, with variations in organism movement and contaminant heterogeneity among the factors responsible (Kim et al. 2016).

The home range of the primary fish species recommended for Tier 2 assessment vary widely (Table 6.5). For example, the shiner perch has a small home range (1,200 m2), while the California halibut and striped mullet are not known to have a defined home range and forage over long distances (28 km). The strength of the relationship between site area and bioaccumulation may also vary among locations as a result of regional differences in foraging behavior of sediment contamination gradients (Melwani et al. 2009).

The size of the area selected for assessment is another factor that can influence the site linkage result. Expanding the site area (SA) of the assessment to provide confidence that the fish's home range is included may also include substantial areas with low sediment contamination and thus reduce the sensitivity of the assessment to detect significant site linkage. Conversely, restricting the assessment to just a small hotspot of contamination that represents a small fraction of the area of fish foraging and occurrence may not accurately describe the exposure conditions and result in an over- or underestimate of site linkage, depending upon how fish movement outside of the site is accounted for.

Risk assessors have used several strategies to address wildlife movement and other spatial factors (Wickwire et al. 2011). The traditional and most commonly used approaches are to either assume that the entire site represents a species' home range or to apply a site use factor (SA/HR). Alternatively, spatially explicit exposure models have been developed that relate spatial variability in animal movement to spatial variability in habitat quality for foraging and chemical concentrations. Spatially explicit exposure models usually represent the area of interest as a two- or three-dimensional grid ranging from a few cells to over a million cells, with each cell requiring characterization in terms of factors such as forage activity, habitat quality, and contaminant concentration. These models can be complex, and their parameterization often requires detailed site-specific data on organism behavior, habitat quality, and contamination patterns. Detailed information on fish species' life history and spatial variability in foraging habitat quality and contaminant concentrations is unavailable for most enclosed bays and estuaries in California, however. Outputs of spatially explicit exposure models may include daily or annual estimates of bioaccumulation that are expressed for individuals or the population. These model outputs are valuable for development of site remediation options, where their potential improved accuracy enables the benefits of various management options to be evaluated along with costs, technical feasibility, and other impacts.

Alternatives Identified

Alternative 1: Do not consider fish home range, site size, or spatial heterogeneity in site linkage determination (e.g., assume exposure only occurs solely within site).

Alternative 2: Adjust site linkage calculation for offsite foraging through use of a site use factor and consider fish movement and sediment contamination heterogeneity in selection of site boundaries.

Alternative 3: Develop and apply a spatially explicit exposure model to calculate site linkage.

Staff Recommendation: Alternative 2, see Appendix A, Chapter IV.A.2.d.4). and C-8.

Table 6.5. Movement range estimates for guild indicator species (adapted from Bay et al. 2017).

Species	Median	Mean	SD	Basis for Estimate and Additional Movement Information
California halibut	12,858 m	29,300 m	60,000	Tag recapture studies on adults and acoustic telemetry study of juvenile (sublegal) halibut in Huntington Beach wetlands. Fish are associated with eelgrass, high water flow areas, and other areas of high prey abundance.
Spotted sand bass	4950 m^2	7100 m^2	7300	Home range expected to be larger than for kelp bass and smaller than barred sand bass, based on expert recommendation. Data were fit to have SD = mean, similar to barred sand bass.
White catfish	4200 m	6920 m	9600	Tag recapture studies using angler information from Sacramento-San Joaquin Delta.
Queenfish	1,617,000 m^2	3,000,000 m^2	4,689,000	Assumed to be similar to white croaker, given similar life histories and diets.
White croaker	1,617,000 m^2	3,000,000 m^2	4,689,000	Home range estimate based on telemetry results in Palo Verdes shelf. Ocean whitefish and California sheephead were used as proxies to estimate variability (i.e., coefficient of variation), as they are both roving predators like white croaker.
Shiner perch	1000 m^2	1200 m^2	804	Expected to exhibit limited movement due to diet, association with structure, and avoidance of predation. Average and variation selected based on expert recommendation.
Common carp	7347 m	-	-	Telemetry studies of movement in rivers. Gamma distribution parameters are shape parameter [k] = 1.05; scale parameter [θ, theta] = 9904.
Topsmelt	1000 m^2	1200 m^2	804	Selected to be same as shiner surfperch. Species likely does not have a home range. Contaminant monitoring results indicate significant differences among adjacent sites, suggesting limited movement ranges.
Striped mullet		28,200 m	80,340	Tag recapture studies on adults. Species likely does not have a home range, but forages nearshore throughout estuary. Offshore migration of great distances sometimes occur, supporting use of high coefficient of variation.

6.5.5 Evaluation of Site Linkage

The result of the sediment linkage is a ratio that represents the proportion of the observed tissue contamination in sport fish (field data) that is estimated to result from exposure to site sediment as a result of food web transfer.

Site Linkage factor = CEst/CTis (Equation 3)

Where

CEst = estimated tissue contaminant concentration

CTis = observed tissue contaminant concentration

The estimated tissue contaminant concentration is calculated using data on site sediment contamination, bioaccumulation, and fish movement (Greenfield et al. 2015).

CEst= Σ CSed x BSAF x SA / HR. (Equation 4)

Where:

Σ CSed = measured sum contaminant concentration (sum PCBs, sum DDTs, sum chlordanes, or dieldrin) in sediment from the site

BSAF = biota-sediment accumulation factor for species

SA = site area or length across the site

HR = sportfish home range or linear movement distance

The site linkage factor (SL) is a continuous value that can range from 0 (no bioaccumulation related to site) to 1 (site bioaccumulation equivalent to observed concentration in field) to greater than 1 (estimated site bioaccumulation exceeds observed value). The value of SL is expected to vary because there is variability or uncertainty associated with each of the parameters used to calculate SL.

The approach used to evaluate sediment linkage should satisfy two needs. First, a numeric threshold is needed to support statistical evaluation of the results. Second, the evaluation approach should take into consideration variability within and among sites and provide information useful for understanding the relative importance of site sediment contamination.

The linkage threshold should indicate the extent to which sediment contamination at the site is responsible for the level of chemical exposure represented by the sportfish evaluated in the assessment. One option is to use a low SL threshold that represents the presence of any fish exposure due to site sediment contamination, such as exceedance of a SL value of 0.05. A disadvantage of using a presence/absence type of threshold is that little information is provided regarding the relative significance of the site sediment linkage, it could be minor and represent very little of what is accumulated by the fish or it could be represent the dominant source of bioaccumulation. Because of the presence of low levels of background contamination in all sites, use of such a low threshold will likely identify all sites as having significant linkage and thus would provide little value in prioritizing or placing the site in context relative to other locations. Another option is to use a higher site linkage threshold that represents a substantial influence of site sediment contamination relative to overall bioaccumulation in the fish. Use of a SL threshold of 0.5 or greater would identify cases of relatively strong site linkage that accounts for the majority of the bioaccumulation in the fish and have value in differentiating sites where bioaccumulation from sources other than site sediments is important.

Use of a single threshold to produce a binary interpretation of site linkage (e.g., above threshold or below threshold) is easy to implement, but conveys little information regarding the magnitude of the result in relation to other sites or in consideration of data uncertainty. Other elements of the SQO assessment frameworks for aquatic life protection or human health protection make use of a multiple category evaluation to assist in data interpretation.

Alternatives Identified

Alternative 1: Establish a low SL threshold that represents the presence/absence of any detectable site linkage.

Alternative 2: Use a threshold of 0.5 to distinguish between presence/absence of substantial site linkage.

Alternative 3: Establish thresholds and/or other criteria to classify site linkage into multiple categories that is consistent with the design of other elements of SQO assessment frameworks.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.d.4) – 7) and Table 21.

6.5.6 Addressing Uncertainty and Variability in Data

The site linkage is calculated using the field monitoring and bioaccumulation model results as the ratio of the estimated sportfish tissue concentration (from bioaccumulation model) to the observed concentration (from monitoring data). The calculations include several parameters that contain uncertainty or variability:

- Measured site sediment and sportfish tissue contaminant concentrations. Spatial heterogeneity or gradients in sediment contamination are common in enclosed bays and estuaries, where proximity to stormwater discharges and localized commercial/industrial activities contribute to variability in sediment contamination. Fish tissue contamination varies among individuals due to difference in age, reproductive status, diet preference, and forage location. Variability in these measurements is typically represented by the standard deviation of the mean.
- BSAF calculated from bioaccumulation model. The BSAF is calculated for each fish dietary guild using a food web bioaccumulation model. The model contains dozens of parameters, each with a component of uncertainty. In some cases, a species-specific

measurement of the parameter is not available and the value is based on an assumption or data from a related species. The overall uncertainty of the BSAF cannot be calculated based on the individual components because reliable estimates of uncertainty are frequently unavailable and their joint effect is difficult to calculate. An alternative method to estimate BSAF uncertainty is to calculate a standard deviation based on empirical BSAF measurements from different locations or species. Empirical BSAFs incorporate variability in all of the bioaccumulation processes included in the bioaccumulation model, such as diet variation, age, and movement. Such data are available from monitoring and assessment studies throughout the United States (Burkhard et al. 2010).

- Fish home range. Measurements of fish movement and foraging behavior are frequently based on tagging studies conducted at one or a few locations. Variation in methods between studies, limited sample size, and geographic differences in movement patterns contribute to the uncertainty in this parameter. While a standard deviation can be calculated for the available data, such values are likely to be site-specific and thus their accuracy for other locations is uncertain.

Two approaches are commonly applied to address variability and uncertainty in risk assessments. The simplest approach is deterministic in nature, and involves using conservative point estimates of key parameter values (e.g., upper 95th percentile of sediment contamination; high BSAF value) so that the chance of underestimating site linkage is low. This approach has the risk of being overly conservative (producing high estimate of site linkage) due to the compounding of multiple conservative assumptions. The second approach (stochastic) is to use the estimates of variability and uncertainty to calculate a probability distribution of potential site linkage values. Use of a probabilistic approach is recommended to improve risk assessment communication (Thompson and Graham 1996). Monte Carlo simulation is frequently used to combine estimates of variability and uncertainty into risk assessment calculations; this approach integrates randomly selected values for each parameter (based on the data characteristics) and generates a probability distribution of potential site linkage values that is based on many iterations of random samples.

The SQO Scientific Steering Committee reviewed the site linkage calculation approaches in 2010 and 2011 and recommended the use of percentiles or a probability distribution for expressing the results. A provisional classification approach for site linkage that is based on a probability distribution and Monte Carlo simulation of variability and uncertainty in chemical measurements, BSAF, and home range was developed in consultation with the SSC and stakeholders. This approach classifies site linkage into four categories (Very Low, Low, Moderate, and High) based on the percentile of the distribution exceeding a site linkage value of 0.5 (Table 6.6, Bay et al. 2017, Greenfield et al. 2015).

Table 6.6. Site sediment linkage categories for Tier 2 evaluation (adapted from Bay et al. 2017).

Cumulative % of sediment linkage distribution	Linkage threshold	Outcome
75%	<0.5	1. Very Low

50%	<0.5	2. Low
25%	<0.5	3. Moderate
25%	≥0.5	4. High

Alternatives Identified

Alternative 1: Evaluate site linkage based on average parameter values, without consideration of variability and uncertainty.

Alternative 2: Calculate site linkage using a deterministic approach and conservative estimates of parameter values. Classification result is binary (above or below threshold) and highly conservative.

Alternative 3: Classify site linkage based on a probability distribution calculated using Monte Carlo Simulation and exceedance of a threshold correspond to substantial sediment linkage (0.5).

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.d.4) thru 7) and Table 21.

6.5.7 Integration of indicators

The Human Health SQO assessment framework generates two indicators relevant to evaluation of impacted sediments: chemical exposure and site linkage. A standardized method for integrating and interpreting the indicator results is needed to ensure comparability of assessments among different sites. Each indicator is classified into multiple categories (five chemical exposure categories and four site linkage categories) resulting in 20 possible combinations of indicators.

The approach for integration of the indicators and determination of the assessment outcome could be determined on a site-specific basis by the regulatory agency and responsible party. However, such an approach is likely to be contentious, result in delays in making a final assessment decision, and will not be comparable among sites or regions. Another alternative is to associate each of the 20 indicator combinations with one of two possible outcomes: impacted or not impacted. Such an approach is simple to apply, but would not convey information regarding differences in relative magnitude of impact.

Interpretation of the Aquatic Life SQO assessment framework faced a similar challenge. This framework used three lines of evidence, resulting in 64 possible combinations. A logic matrix, based upon SSC recommendations was developed to interpret each combination with respect to five site assessment outcomes: Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted, and Clearly Impacted. Each assessment outcome included a narrative description relating to the magnitude and certainty of sediment contamination impact and the framework was validated using expert judgement (Bay and Weisberg 2012). A similar draft logic matrix approach was developed for the Human Health SQO, based on SSC and stakeholder input, and subjected to peer review (Greenfield et al. 2015). The matrix associates each possible indicator combination with an assessment category, utilizing the same categories as established for the Aquatic Life SQO for consistency in communication (Table 6.7). Application of this draft matrix to monitoring data from California bays and estuaries produced assessment outcomes consistent with other assessment methods and expectations (Bay et al. 2017).

Table 6.7. Site Assessment Matrix.

		Chemical Exposure				
		Very Low	Low	Moderate	High	Very High
Site Sediment Linkage	Very Low	Unimpacted	Unimpacted	Likely Unimpacted	Likely Unimpacted	Likely Unimpacted
	Low	Unimpacted	Unimpacted	Likely Unimpacted	Possibly Impacted	Likely Impacted
	Mod	Unimpacted	Likely Unimpacted	Likely Impacted	Likely Impacted	Clearly Impacted
	High	Unimpacted	Likely Unimpacted	Likely Impacted	Clearly Impacted	Clearly Impacted

Alternatives Identified

Alternative 1: Determine site assessment outcome on a case-by-case basis.

Alternative 2: Associate each combination of indicators with a binary outcome: Impacted or Not Impacted.

Alternative 3: Use logic matrix to provide a standardized interpretation of each indicator combination relating to multiple categories of impact.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.d.8) and Table 22.

6.5.8 Protective Condition

As described above, multiple categories provides several benefits in the interpretation of the results and in the management of sediment quality within specific sites and waterbodies. However many Water Board programs rely upon binary or pass/fail-type results to assess compliance with standards. The categories Unimpacted and Likely Unimpacted are designated by the State Water Board to represent the protected condition for the interpretation of the SQO protecting aquatic life from direct effects. These categories were chosen because Section 13391.5(d) of Porter Cologne required that the SQOs be established with an adequate margin of safety for the reasonable protection of the beneficial uses of water. At the time of adoption, some commenters had requested that the category Possibly Impacted be included under the protective condition (State Water Board 2008). For consistency, the proposed amendments rely on the same delineation of impact that is applied in the approach used to evaluate direct effects.

Alternatives Identified

Alternative 1: Allow the Regions to determine what categories meet the protective condition

Alternative 2: Designate Unimpacted, Likely Unimpacted and Possibly Impacted as categories meeting the protective condition.

Alternative 3: Designate Unimpacted and Likely Unimpacted as the only two categories that meet the protective condition.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.d.8) and Table 22.

6.6 Tier 3 assessment

Tier 3 assessment is intended to provide flexibility in the assessment approach to address special circumstances or complex situations where the standardized Tier 2 assessment is not able to provide an accurate result. As a Tier 3 assessment uses nonstandard methods for determining chemical exposure and/or site linkage, such an assessment may require substantially more time and cost to implement. Also, the results may not be comparable with assessments based on the Tier 2 approach, resulting in difficulty in comparing conditions among sites and prioritizing the need for management actions. These complications can be minimized by developing guidance and processes for the initiation and interpretation of Tier 3 assessments.

6.6.1 Qualifying conditions

Not all situations require a Tier 3 assessment. The decision to conduct a Tier 3 assessment will increase the cost and time required to conduct an assessment. Therefore, consideration of the need and benefit associated with a Tier 3 analysis should be considered on a case-by-case basis. Evaluation of chemical exposure and site linkage have three types of applications in sediment quality assessment: 1) determining whether or not current conditions meet the SQO, 2) evaluating cleanup scenarios as part of developing and selecting management actions to restore sediment quality, and 3) assessing effectiveness of management actions as part of compliance monitoring. Determination of whether to use a Tier 2 or 3 assessment approach is relevant only for application types 1 & 3 (assessment of condition). It is anticipated that the methods for developing management alternatives may require additional information and more sophisticated analytical methods than those established for Tier 2 assessment. Development of management is not part of the SQO assessment approach and a separate process should be used to determine the methods to use. While the same Tier 2 or 3 assessment method may be sufficient to development of management actions, it is not required that the same methods be applied. This section only pertains to defining the conditions that indicate that a Tier 3 approach is justified for making a site condition assessment.

Determination of whether a Tier 3 assessment is appropriate should be made by the regulatory agency on a case-by-case basis. Because of the potential for negative impacts associated with a Tier 3 assessment (e.g., greater cost, delay in completing assessment, less comparability with other sites), the expected benefits of conducting the assessment should be considered. A Tier 3 assessment should be considered when site conditions are more complex or variable than can be accurately represented by the Tier 2 approach. Such situations include:

- Differences in the relationship between geochemical characteristics and contaminant bioavailability
- Differences in physiological processes affecting bioaccumulation model performance, such as growth rate or assimilation efficiency
- Measured average sediment concentrations are not representative of actual fish forage area due to spatial or temporal variations in sediment contaminant distribution, fate, or transport
- Differences in food web or forage range of target species
- Need to use an alternate sportfish species other than those specified for Tier 2

A Tier 3 approach may also be warranted when factors affecting chemical exposure to humans differ substantially from those used in Tier 2. Examples include differences in consumption rate or differences in the proportion of target sportfish species consumed.

Alternatives Identified

Alternative 1: No requirement to demonstrate need for Tier 3 assessment, decision is made by regulated party.

Alternative 2: Statistically significant difference in site conditions or model parameters, relative to Tier 2, is present. Effect of difference on assessment outcome not necessarily considered.

Alternative 3: Demonstration that site conditions or use of results would likely result in incorrect or imprecise assessment if Tier 2 approach is used.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.e.2).

6.6.2 Study Design and Approval

Tier 3 assessment can encompass a wide range of modifications, relative to Tier 2. The alternative assessment may include use of different bioaccumulation model parameters, or may consist of use of an entirely different bioaccumulation modeling approach. Guidance is needed ensure that the approach used in Tier 3 is appropriate to the situation and will provide a comparable level of protection of beneficial uses.

Alternatives Identified

Alternative 1: Tier 3 methods and approach are determined by regulated party.

Alternative 2: Tier 3 study design and methods specified by regulatory agency.

Alternative 3: Tier 3 study design and workplan is developed in coordination with regulatory agency and must be approved before implementation.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.e.1).

6.6.3 Constraints

The flexibility inherent in Tier 3 carries a risk that the assessment results will not be comparable to other assessments and will not provide the desired level of beneficial use protection. An evaluation process or constraints on the approach are needed to ensure that the intent of the SQO assessment is accomplished. Such comparability can be achieved in several ways. One approach would be to establish a scientific review panel to evaluate each Tier 3 study design and determine if it is consistent with the SQO program. Such a review process would likely be cumbersome and might still result in inconsistent assessments if the panel composition changes over time. A second approach would be to require a certain core level of consistency in the Tier 3 approach, such that comparability with Tier 2 assessments is preserved. An example of this approach would be to require the evaluation of the same types of indicators (i.e., chemical exposure and site linkage) and similar method of indicator integration and final site assessment.

Alternatives Identified

Alternative 1: Establish no constraints on Tier 3 approach, delegate responsibility to regulatory agency to determine that Tier 3 approach is appropriate.

Alternative 2: Require scientific peer review of each Tier 3 study plan.

Alternative 3: Require Tier 3 assessment use the same indicator types, thresholds, and integration approach that is equivalent to the Tier 2 approach.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.e.3).

6.6.4 Site linkage evaluation methods

There are many options regarding how bioaccumulation modeling is conducted for evaluation of site sediment linkage. Different models may produce outputs on a different time or spatial scale relative to Tier 2 and it may be difficult for regulators to adequately review and interpret the results. The need for comparability and relevance to the SQO should be balanced with the opportunity for flexibility and improved accuracy in the assessment.

Alternatives Identified

Alternative 1: No constraint on methods used for bioaccumulation modeling or data interpretation.

Alternative 2: Use of alternative bioaccumulation models are limited to variants of the same Gobas food web model specified for Tier 2, see Appendix A, Section XXXX.

Alternative 3: Various types of bioaccumulation models may be used, subject to approval by regulatory agency. However, site linkage evaluation must use same thresholds as specified for Tier 2.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.e.3).

6.6.5 Alternative Species and Exposure Factors

Sportfish consumption rates and patterns are poorly documented for most enclosed bays and estuaries. Most data on consumption rates are based on older studies with limited geographic extent. Demonstration that the SQO assessment is effective for protection of subsistence fishers is an important issue in many areas. Limited data and anticipated regional variation in consumption patterns may limit the effectiveness of Tier 2 assessment to protect some consumer groups. The Tier 2 chemical exposure assessment is based upon OEHHA tissue advisory levels for consumption rates up to 3 meals per week, which may not be protective for consumer groups having higher consumption rates (e.g., subsistence fishers).

Alternatives Identified

Alternative 1: Do not allow modification of chemical exposure evaluation method to address differences in consumption rate or other exposure factors.

Alternative 2: Select exposure factors that are appropriate for study objectives and approved by regulatory agency.

Alternative 3: Use alternative chemical exposure thresholds based on OEHHA Advisory Tissue Levels corresponding to higher consumption rates, in consultation with OEHHA.

Staff Recommendation: Alternatives 2 and 3, see Appendix A, Chapter IV.A.2.e.3).

6.6.6 Impact Evaluation

Use of alternative methods for evaluating site linkage and/or chemical exposure may produce results that differ in scale or type, relative to those produced by Tier 2. Comparability of the site assessment may be diminished if the results are not communicated or interpreted in a manner consistent with the Tier 2 assessment. Use of different endpoints may also make it more difficult for the regulatory agency or regulated party to demonstrate that the SQO has been attained.

Lack of comparability could be addressed by utilizing a technical advisory committee to review the Tier 3 results and make the final site assessment decision. Such an approach may be difficult to implement and may not provide the desired level of comparability if the composition of the advisory committee varies among programs. Use of a consistent data interpretation framework is another approach to achieve comparability in the final site assessment. Such an approach would allow flexibility in the data analysis methods, but provide a consistent approach for the final site assessment and communication of results.

Alternatives Identified

Alternative 1: Method for site impact evaluation is described and justified in the study report.

Alternative 2: Impact evaluation is based on review of results by technical advisory committee.

Alternative 3: Site impact evaluation is conducted using same logic matrix, indicators and categories as described for Tier 2.

Staff Recommendation: Alternative 3, see Appendix A, Chapter IV.A.2.e.3).

6.7 Water Board Implementation associated with Specific Programs

6.7.1 Application to 303(d) Listings and Exceedance of Receiving Water Limitations

As described in Section 4.2.3, the existing approach adopted to apply the SQO protecting benthic communities from pollutants in sediment relies on the binomial statistic to assess whether sediment quality is impaired and whether an exceedance of the receiving water limit has occurred. Though not a focus of this discussion, there is one important difference between the two applications: implementation of the receiving water limitation requires that the degradation must be linked with the discharge (be causing or contributing). The focus of this discussion is limited to the use of the binomial statistics.

Table 6.8 below describes the total number of exceedances and the number of exceedances required for listing purposes for the existing approach. In this case, the number of stations categorized as Possibly, Likely or Clearly Impacted equates to the number of exceedances. The total number of stations within the waterbody represents the sample size. For a case where two stations are categorized as Possibly, Likely or Clearly Impacted within a single waterbody or segment that has two to twenty-four sediment quality stations monitored, a listing would be required. For delisting a waterbody or segment, the minimum number stations required is twenty-eight stations with a maximum of two stations categorized as Possibly, Likely or Clearly Impacted.

A frequency-based approach is appropriate when sampling water quality at a single station or stations, as contaminants in the water column can vary significantly over time scales of minutes and hours for several important parameters including bacteria (EPA, 2010). However, the processes governing contaminant effects in sediment occur over much greater time scales. Sediment quality is driven not just by fate and transport processes in the water column but by contaminant deposition and buildup over time within low energy bay and estuarine environments. Time scales associated with these processes are highly variable depending on climate, sediment and pollutant sources but can occur over much greater scales on the order of months, years or tens of years. Another important issue with the binomial approach is that the outcome is binary, based on number of exceedances only and does not consider the extent or size of area degraded, nor does it account for the severity of the impact. These two characteristics are the most important when deciding whether a site segment or waterbody warrants corrective action.

Table 6.8. Number of exceedances required for listing using binomial statistic approach.

Sample Size	List If the Number of Exceedances Equals or Is Greater Than	Maximum Number of Exceedances Allowed to Remove or Delist
2 – 24	2*	Requires larger sample size
25 – 36	3	2 (Min. sample size of 28)
37 – 47	4	3

48 – 59	5	4
60 – 71	6	5
72 – 82	7	6
83 – 94	8	7
95 – 106	9	8
107 – 117	10	9
118 – 129	11	10

Alternatively, an approach could be developed that considers the extent of the area degraded and accounts for the severity of the impact (Clearly Impacted, Possibly Impacted, and Likely Impacted). For this approach, water segments would be listed if any station within this site is assessed as Clearly Impacted; however, water segments with stations assessed as Possibly Impacted and/or Likely Impacted would be listed based on a percentage of the site area that is impacted over the duration of a listing cycle. The State Water Board considered the critical exceedance rates proposed by the U.S. EPA when determining what percentage of area impacted would be appropriate for listing purposes. Table 6.9 below depicts the critical exceedance rates from less than 1 percent to as high as 25 percent proposed by the U.S. EPA that would trigger the listing of a water body on the section 303(d) list (State Water Board, 2004). The U.S. EPA noted that a critical exceedance rate of <10 percent fully supports the beneficial uses for conventional pollutants and a critical exceedance rate >10 percent and <25 percent partially supports beneficial uses for conventional pollutants. Listing a water segment if the total percent area is categorized as Possibly Impacted and/or Likely Impacted that equals or exceeds 15 percent of the site area is appropriate and protective of the beneficial uses as supported by the U.S. EPA. Furthermore, this approach leads to listing water segments more consistently than the binomial approach for assessment using a small sample size. For example, using the binomial approach when there are 2 to 24 samples, the number of exceedances required to trigger listing a water segment is 2. In this case, anywhere from 8 percent to 100 percent of samples must exceed the narrative objective in order to list. Sample sizes in this range represent the range of sizes for most small to medium size segments or reaches.

Table 6.9. Critical Exceedance Rates Proposed by the U.S. EPA

Critical Exceedance Rate	Source	Notes
≤1-in-3 years	U.S. EPA, 1997c	Fully supports beneficial uses for acute criteria
0.09% (1 out of 1,095)	U.S. EPA, 2002a	Using hypergeometric distribution equivalent to a 1-in-3 year exceedance frequency for acute criteria

0.36% (1 out of 274)	U.S. EPA, 2002a	Using hypergeometric distribution equivalent to a 1-in-3 year exceedance frequency (4-day average) for chronic criteria
>1-in-3 years to <10%	U.S. EPA, 1997c	Partially supports beneficial uses for acute criteria
5% (plus a 15% effect size)	U.S. EPA, 2002a	For toxicant criteria, equivalent to a 1-in-3 year exceedance frequency
<10%	U.S. EPA, 1997c; U.S. EPA, 2002a	For bacteria criteria
<10%	U.S. EPA, 1997c; U.S. EPA, 2002a	Fully supports beneficial uses for conventional pollutants
10%	U.S. EPA, 2003	For chronic criteria For acute criteria (if justified) For conventional pollutants (if justified) using either binomial or "raw score" tests
>10%	U.S. EPA, 1997c	For acute criteria No support of beneficial uses Measurement error should be accounted for
>10% (plus a 15% effect size)	U.S. EPA, 2002a	For conventional pollutants
>10% to <25%	U.S. EPA, 1997c; U.S. EPA 2002a	Partially supports beneficial uses for conventional pollutants
>25%	U.S. EPA, 1997c; U.S. EPA 2002a	For conventional pollutants does not support beneficial uses

Alternatives Identified

Alternative 1: No Action, Retain the existing approach based on the binomial statistic.

Alternative 2: Develop an approach based on size of area impacted and severity of impact.

Recommendation: Alternative 2, see Appendix A, Chapter IV.A.4.c.2).

6.7.2 Addressing Waters with Existing TMDLs

As described in Section 4.3.1, TMDLs have been adopted to control or reduce the loading of organochlorine pesticides and/or PCBs in several waterbodies. These TMDLs are frequently based on site specific studies, models and other analyses for the waterbody of interest. Those discharges that discharge contaminants causing or contributing to the impairment are allotted waste load allocations for point sources and load allocations for nonpoint sources which get implemented in permits as effluent limits. Because these waste load allocations are typically more stringent than existing requirements, additional controls or treatment strategies are required, which can take years or even decades for full implementation. The adoption of the proposed amendments could cause the Regional Water Boards to reassess those waterbodies under existing TMDLs, which may jeopardize ongoing efforts to control please pollutants. To alleviate this concern, water bodies with existing TMDLs could be grandfathered in, meaning that the Regional Water Board would not be required to reassess those waterbodies in accordance with the proposed provisions. In these cases the proposed amendments would only be applied if the applicable Regional Water Board chose to implement the amendments. For those waterbodies without TMDLs, the proposed amendments would be fully and unequivocally effective if adopted.

Alternatives Identified

Alternative 1: Do not include a clause that would grandfather those waterbodies with adopted TMDLs.

Alternative 2: Incorporate a grandfathering clause for waterbodies with adopted TMDLs for organochlorine pesticides and/or PCBs.

Recommendation: Alternative 2, see Appendix A, Chapter III.A.1.b.4).

6.7.3 Monitoring Frequency

The Sediment Quality Provisions currently requires large municipal stormwater permittees and major dischargers to monitor the receiving water twice over each permit cycle (5 years). Minor discharges are required to monitoring the receiving water once each permit cycle. Sampling frequencies associated with sediment are typically much longer than the sampling frequencies associated with water because sediments integrate conditions and exposures over longer time scales. Where water samples can be analyzed to identify pulses or slugs of contaminants or toxicity in the water column, sediments represent an average accumulation of solids and contaminants that settle out over time and thus are not good indicators of rapid changes in the overlying water quality. As described in the 2008 staff report (State Water Board, 2008) staff were able to utilize findings from San Francisco Bay that demonstrated consistent sediment toxicity results a year to year basis (State Water Board, 2008). As described in that document, studies from the Southern California Coastal Water Research Project suggest that sediment quality monitoring frequency should range from no more frequently than annually (once every year) to no less than once every five years. Since then, SCCWRP and others have conducted several studies that evaluated temporal variability that can be informative. These include the following:

- Applying Sediment Quality Objective Assessments to San Francisco Bay Samples from 2008-2012. Final Report. Contribution No. 702. San Francisco Estuary Institute, Richmond, California. (Willis-Norton et al, 2013)
- Temporal Assessment of Chemistry, Toxicity and Benthic Communities in Sediments at the Mouths of Chollas Creek and Paleta Creek, San Diego Bay *Southern California Coastal Water Research Project Technical Report 668 (Brown, Jeffrey and Steven Bay, 2011)*
- Southern California Bight 2013 Regional Monitoring Program: Volume VIII. Contaminant Impact Assessment Synthesis Report, SCCWRP Technical Report 973 (Bight '13 Contaminant Impact Assessment Planning Committee, 2016)
- Final Report Marina Del Rey Harbor Sediment Stressor Identification (Bay, et al 2016)

The data from 2008 to 2012 monitoring stations within San Francisco Bay is presented in Table 6.10 (Willis-Norton et al, 2013). These data are presented because the set encompasses the full five-year period of concern. As shown in Table 6.10, individual lines of evidence (chemical exposure, sediment toxicity and benthic disturbance) exhibit variable response over the five year period, whereas the station categories are more stable over the same period, as would be expected in a multiple line of evidence approach. In most cases, the station assessment varies by a single category over the five-year period and stations tended to be either consistently classified as impacted (possibly, likely impacted) or unimpacted (unimpacted, likely unimpacted). These results represent only individual stations. However, similar results were also realized when evaluating subwaterbodies using a percent area impact analysis. In the San Francisco Bay study, San Pablo Bay consistently provided the least impacted sediment quality on an area-wide basis annually which resulted in 80 percent of the area classified as unimpacted over the five year study period. Similar result were reported in Marina Del Ray. Individual lines of evidence exhibited some variability as did the station categories, however the overall percent area impacted changed little in the five years between monitoring studies (Bay, et al 2016). Data collected from the mouth of Chollas and Paleta Creek from August and November of 2001 and February, June and October of 2002, was variable within the individual lines of evidence analyzed, while station categories over the same period changed little. These data suggest that a change from monitoring twice every five years to once every five years is unlikely to harm the Water Boards' ability to assess beneficial uses. The Southern California Bight Regional Monitoring program has been evaluating trends in sediment quality since 1998 (Bight '13 Contaminant Impact Assessment Planning Committee, 2016). This monitoring program has demonstrated the ability to detect changes within southern California embayments based on five-year monitoring cycles.

Table 6.10. Temporal Variation in San Francisco Sediment Categories from Willis-Norton et al, 2013

Year	Chemical Exposure	Sediment Toxicity	Benthic Disturbance	Station Assessment
Station	BA10			
2008	Low	Low	Reference	Unimpacted
2009	Low	Moderate	Low	Possibly Impacted
2010	Nontoxic	Moderate	Low	Likely Unimpacted
2011	Low	Low	Reference	Unimpacted
2012	Minimal	Moderate	Low	Likely Unimpacted
Station	BA41			
2008	Low	High	Low	Possibly Impacted
2009	Low	High	Moderate	Likely Impacted
2010	Low	Low	High	Possibly Impacted
2011	Low	Moderate	Low	Possibly Impacted
2012	Low	Moderate	Low	Possibly Impacted
Station	BC11			
2008	Low	Moderate	Reference	Likely Unimpacted
2009	Low	Low	Reference	Unimpacted
2010	Low	Moderate	Reference	Likely Unimpacted
2011	Low	Moderate	Low	Possibly Impacted
2012	Low	Moderate	Low	Possibly Impacted
Station	BD31			
2008	Low	High	Low	Possibly Impacted
2009	Low	Nontoxic	Low	Unimpacted
2010	Low	Low	Reference	Unimpacted
2011	Low	Low	Low	Likely Unimpacted
2012	Low	Nontoxic	Low	Unimpacted
Station	BF21			

2008	Low	High	High	Likely Impacted
2009	Low	High	Low	Possibly Impacted
2010	Low	High	Moderate	Likely Impacted
2011	Low	High	Low	Possibly Impacted
2012	Low	Low	Moderate	Possibly Impacted

Alternatives Identified

Alternative 1: No Action, Retain the existing approach based on a frequency of two events over five years.

Alternative 2: Adopt an approach establishing the minimum frequency of once every five years.

Recommendation: Alternative 2, see Appendix A, Chapter IV.A.4.d.7).

7 Analysis of Environmental Effects and Alternatives

This section contains the principal environmental analysis of the proposed amendments as required by the State Water Board's Regulations for Implementation of the California Environmental Quality Act (CEQA regulations; California Code of Regulations, title 23, sections 3720-3782). Specifically, the State Water Board's CEQA regulations (Cal. Code Regs., Tit. 23, §3777) require that any water quality control plan must include or be accompanied by substitute environmental documentation that shall include, at a minimum, the following information:

(1) A brief description of the Amendment;

(2) An identification of any significant or potentially significant adverse environmental impacts of the Amendment;

(3) An analysis of reasonable alternatives to the Amendment and mitigation measures to avoid or reduce any significant or potentially significant adverse environmental impacts; and

(4) An environmental analysis of the reasonably foreseeable methods of compliance.

The project description is briefly summarized in Section 2.1 and is included in its entirety in Appendix A. In consideration of (2) above, adoption of the amendment by the State Water Board in of itself will not result in adverse environmental impacts. Only when the amendments are implemented through permits or orders by the Water Board is there the potential for impacts to occur through actions by the regulated community to comply. The reasonable foreseeable methods of compliance related to the proposed amendments are described in Section 7.1. Analysis of environmental impacts that could result from the reasonable foreseeable methods of compliance are described in Section 7.2. An analysis of alternatives is described in Section 7.3 but not analyzed in detail within the reasonable range of alternatives, either because they do not achieve the underlying project objectives or are not potentially feasible, reasonable, or within the authority of this proposed rule-making action.

7.1 Reasonably Foreseeable Methods of Compliance

As described above, the adoption of the proposed amendments by the State Water Board alone would not result in environmental impacts. Only through a physical change to the environment are such impacts possible. For the potential for environmental impacts to occur through this project, the Water Boards would have to implement the amendments (once adopted) through a Board-issued permit or order that requires some form of physical compliance action by the regulated entity. These actions that could be utilized by a regulated entity to comply with a permit or order consist of reasonably foreseeable methods of compliance.

The number of reasonably foreseeable actions that permittees or responsible parties could implement to comply with the proposed amendments is unlimited. Potential alternatives can be categorized by controls that are applicable to the quality of water associated with existing discharges and remedial actions that are applied to reduce the risk associated with the pollutants already in the sediment (State Water Board, 2008). Some of these controls and remedial alternatives are described below:

Non-Structural Controls

- Public Education—Education to promote pollution awareness on the proper use and proper disposal of products containing toxic pollutants, pollution prevention and minimization, and environmental stewardship
- Training—Training programs can be used to support effective use of BMPs
- Water Conservation—Water conservation reduces dry weather runoff that may carry sediment and pollutants directly into enclosed bays and estuaries or rivers draining into these waterbodies.
- Street cleaning (includes sweeping or washing)—Frequent or more effective street sweeping or washing can reduce both sediment and pollutant runoff.
- Source investigation to identify those areas contributing the greatest pollutant loads into stormwater conveyance systems

Structural Controls

- Detention Basins/Retention Ponds—Ponds and basins can reduce the volume of suspended sediment and pollutants in stormwater by allowing suspended solids to settle out and reduce hydraulic load on the conveyance system.
- Stormwater Diversions—Stormwater diversions have been constructed to divert dry season flows to wastewater treatment plants.
- Vegetated Swales/Buffer Strips—Well-maintained buffer strips constructed along roadsides and in medians can reduce the volume of sediment carried to storm drains.
- Removal and Disposal of Polluted Soils—Soil containing toxic pollutant residuals may be removed from sewer lines and excavated out of stormwater channels or conveyances or public rights-of-way.
- Treatment process optimization—Measures wastewater treatment plants can implement to modify or adjust the operating efficiency of the existing wastewater treatment process.
- Pretreatment Program Assessment—Wastewater treatment plants can evaluate the effectiveness of the pretreatment programs and require upstream sources to reduce pollutant loading into the plant influent.
- Treatment Plant Upgrades. Treatment plants may be upgraded to reduce pollutant concentrations in effluent.

- Outfall Modifications—Treatment plants may relocate or redesign an outfall to reduce the potential impacts associated with the discharge of effluent. Redesign may include construction of a multi-port diffuser to increase dilution or relocation of the discharge into a location close to the ocean.

Remedial actions within a waterbody are implemented to restore beneficial uses by reducing the risk of exposure to pollutants in sediment. The types of remedial action, potential environmental impacts and mitigation and relative costs are described in the Consolidated Toxic Hotspots Cleanup Plan Amended Final Functional Equivalent Document (State Water Board, 2004). Potential actions include:

- Removal Action - Polluted sediments may be dredged from the water body for offsite disposal or remediation

- Confined Aquatic Disposal (CAD) /Sequestering of Polluted Sediments -

- Monitored Natural Attenuation

- In-situ Remediation.

- Some combination of approaches described above.

Removal action or dredging involves the use of machinery with scooping or suction devices to remove sediment. Typical dredging methods include mechanical or hydraulic dredging. Mechanical dredging removes sediments through direct application of mechanical force and excavates the material at almost in situ densities. Sediments removed by a mechanical dredge are placed into a barge or boat for transport to the disposal site or land side staging area. Mechanical dredging typically produces sediments low in water content. Hydraulic dredging uses centrifugal pumps to remove sediments in the form of slurry. Although less sediment may be resuspended at the removal site, sediment slurries contain a high percentage of water at the end of the pipe. The slurry is transported by pipeline to a disposal area. Removal and consolidation can involve a diked or containment structure which retains the dredged material and assures that pollutants do not migrate. Large portable settling tanks can also be used to consolidate sediment. After consolidation, disposal to an off-site location may include either upland (landfill) or containment. Considerations once the material has been dredged shall be (1) staging or holding structures or settling ponds, (2) dewatering issues including treatment and discharge of wastewater, (3) transportation of dredged material, (i.e., pipeline, barge, rail, truck), or (4) regulatory constraints.

If the polluted sediments are not limiting navigation and risk minimization is the objective, a well-engineered cap can reduce the mass of pollutants available for uptake or exposure. Capping involves coverage of polluted sediments to contain the toxic waste at the site. The evaluation process for a CAD project includes selection of an appropriate site, characterization of both polluted and capping sediments, selection of equipment and placement techniques, prediction of material dispersion during placement, determination of the required cap thickness, and evaluation of cap stability against erosion and bioturbation, and development of a monitoring program to assess the effectiveness of the capping project.

Monitored natural recovery may be selected when significant and natural recovery processes are reducing the contaminant bioavailability, source control has been effective at reducing pollutant loading, there is little potential for erosion/remobilization, and exposure to important receptors is limited during the recovery period. Monitored natural recovery is viable only if resources are available for continued monitoring of the progress and effectiveness and the data indicates improvement in sediment quality.

Multiple remedial strategies may be selected for a given site in order to achieve the project objectives as well as water and sediment quality objectives. For example, areas where contaminant concentrations are greatest may benefit from removal action or capping whereas other areas with lower contaminant concentrations and lower associated risk may benefit from natural recovery if studies demonstrate recovery is occurring.

Selection of Reasonable and Foreseeable Compliance Methods and Strategies

The Water Boards do not specify a manner of compliance and accordingly, the actual compliance strategies would be selected by the local agencies and other permittees. Although the Water Boards do not mandate the manner of compliance, the State Water Board’s SED for a proposed project is required to include an analysis of the reasonably foreseeable methods of compliance with the project (see Cal. Code Regs., tit.23, § 3777; Pub. Resources Code, § 21159). Several of the reasonably foreseeable methods of compliance are well-known methods to control pollutants reaching the receiving waters and settling out into bedded sediments or through the remediation of contaminated sediments within bays and estuaries.

In terms of reasonably foreseeable methods of compliance, it is not reasonably foreseeable that a project proponent would propose, or that the Regional Water Board would approve, dredging and disposal of sediment from an entire waterbody if sediment in the waterbody fails to meet the proposed SQO. Dredging of this magnitude would be environmentally and economically infeasible and thus violate Resolution 92-49 as described in Section 4.2.1. In the existing TMDL program, even legacy pollutants—those that are no longer in regular use or production, such as DDT, PCBs and mercury are being controlled through means other than waterbody-wide dredging. Nor would staff anticipate a need for new wastewater treatment plants. The Clean Water Act requires all POTWs to meet secondary treatment standards, and many inland dischargers have or are in the process of upgrading to tertiary treatment. In addition, POTWs that discharge to bays and estuaries must comply with stringent CTR toxic pollutant criteria, which are implemented under the State Water Board’s Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (SIP), and must meet U.S. EPA’s existing pretreatment program requirements and the Water Quality Control Policy for Enclosed Bays and Estuaries. It is, therefore, unlikely that major modifications to existing POTWs or new POTWs would have to be constructed to meet the SQOs.

A direct consequence of the proposed amendments, if adopted, would be increased monitoring of sediment and sportfish tissue collected from trawls, seine, hook and line or by hand by permittees that discharge into bays and estuaries of California where those monitoring activities are already occurring or occurring at a lower frequency than proposed.

As stated previously, the proposed amendments do not mandate additional methods of compliance or corrective action for simply failing to meet the SQOs. Typically, a Regional Board will require the responsible party to assess and characterize the extent and magnitude of the problem as well as the source or sources before contemplating a decision in regards to corrective action. Alternatively, where no responsible party is identified, the Regional Board can assess, manage and even remediate a site through the State Water Board's Cleanup and Abatement Account. The Water Boards have extensive authority to issue and revise waste discharge requirements, and to issue and implement enforcement actions such as Cleanup and Abatement Orders that require corrective action at these sites. The proposed amendments do not make any changes to these programs or processes.

7.2 Agencies with Relevant Authorities and Discretionary Approvals

The potential universe of reasonably foreseeable means of compliance described above may include modification to waste discharge requirements/NPDES permits, waiver or issuance of Cleanup and Abatement Order, or other enforcement action initiated by the Water Boards. At the project level, other state and federal agencies may require permits, or consultations that that can reduce project-specific effects through avoidance, alternatives and mitigation. Agencies with jurisdiction in relevant areas include:

- U.S. Environmental Protection Agency (U.S. EPA) implements hazardous waste cleanup under CERCLA and RCRA and water quality programs and permits under CWA.
- U.S. Army Corps of Engineers (U.S. ACE) permits federally licensed dredge and fill activities under CWA Section 404 and Section 10 of the Rivers and Harbors Act.
- U.S. Fish and Wildlife Service (USFWS) Resource Trustee to implement the federal Endangered Species Act by protecting and restoring federally listed threatened or endangered species and preventing losses from habitat loss and degradation, contaminants or unauthorized take.
- NOAA National Marine Fisheries Service (NOAA Fisheries) Resource Trustee implements the federal Endangered Species Act and Marine Mammals Act by protecting and restoring threatened and endangered marine and anadromous fish, marine mammals and turtles. NOAA fisheries establishes essential fish habitat to maintain and restore fisheries.
- U.S. Coast Guard – Enforces environmental laws and regulations in federal waters and certifies vessels and pilots, maintains navigation aids and responds to emergencies at sea.

- Occupational Health and Safety Administration (OSHA) and Cal OSHA.
- California Department of Fish and Wildlife (DFW) – Resource Trustee responsible for implementing the California Endangered Species Act and protecting state biological resources. Provides emergency response in state waters to spills and releases.
- California Department of Toxic Substances Control (DTSC) Resources Trustee is responsible for implementing the states hazardous waste cleanup and disposal laws.
- California Coastal Commission implements the California Coastal Act and the federal Coastal Zone Management Act to ensure that land uses and resources are protected, and requires mitigation on projects that could potentially affect marine resources in the coastal zone.
- State Lands Commission is responsible for managing State lands, including submerged lands and leases.
- San Francisco Bay Conservation and Development Commission is responsible for planning and protecting marine resources in San Francisco Bay.
- California Air Resources Board (CARB) develops air quality standards for mobile sources statewide.
- Air Quality Management District's implement the CARB standards and develops district standards for other sources and can require mitigation to reduce emissions of toxics and greenhouse gasses.
- Local agencies with ordinances regulating land use, noise pollution, water quality, traffic and public services.

7.3 Effects Analysis

In conducting the environmental analysis, the State Water Board is not required to engage in speculation or conjecture. Actual environmental impacts will depend upon the specific details of the location, requirements imposed by the Regional Water Board and the compliance strategies selected by each individual project permittee. Corrective actions proposed in California will require discretionary authorizations from public agencies, and detailed environmental analyses associated with individual projects will be described in project-specific CEQA documents. Although this amendment does not authorize or approve any particular project, the State Water Board's CEQA Regulations require the State Water Board to evaluate potential environmental impacts associated with the adoption of this amendment to a water quality control plan. This analysis describes the potential environmental effects that result from the reasonably foreseeable methods of compliance associated with the proposed amendments relative to the existing environmental conditions that have resulted from current Water Board plans and policies (including the existing Sediment Quality Provisions). Specifically this analysis address the following questions:

1. Would the proposed amendments if adopted lead to more frequent compliance actions?
2. Would the proposed amendments if adopted lead to larger compliance actions?

If the response is yes to either, significant environmental impacts could potentially occur to one or more of the resource areas:

- Aesthetics
- Agriculture and Forest Resources
- Air Quality
- Biological Resources
- Cultural Resources
- Geology and Soils
- Greenhouse Gas Emissions
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Land Use Planning
- Mineral Resources
- Noise
- Population and Housing
- Public Services
- Recreation
- Transportation/Traffic
- Utilities and Service Systems

Where mitigation measures may be required, examples are described below under each resource area. A comprehensive list of mitigation measures would be difficult to assemble given all the potential environmental factors, site-specific conditions and potential project-related actions that could occur. Mitigation measures will be tailored for individual projects in the project-level CEQA analysis.

In formulating the basis for this analysis, it is important to note that the existing approach does not provide an explicit, direct and consistent means to determine whether sediment at a site meets the SQO protecting human consumers of sportfish. The approach being proposed provides a consistent, transparent and reliable classification scheme that leads to a deterministic outcome, that the sediment meet or do not meet the SQO. As a result, a direct comparison of outcomes cannot be presented. Furthermore, the existing approach does not describe how the SQO protecting human consumers of sportfish should be applied in permits or other programs.

The analysis presented below focuses only on the comparison of the existing and proposed human health assessment framework, associated program of implementation and the impacts to the physical environment resulting from the need to implement reasonably foreseeable methods of compliance. Proposed amendments to aquatic life listing and delisting methodology are not expected to have any environmental impacts. Understanding how these factors influence the outcome, whether sediment are meeting the SQO or not, is critical for the environmental effects analysis because a comparison of potential outcomes relates directly to the frequency and magnitude of actions the Regional Boards must take in response to these exceedance as well as the reasonably foreseeable methods of compliance a permittee or responsible party could select in order to comply with the Regional Boards order.

In formulating this analysis, it is important to understand that the existing approach which is presented in Section 2.6 does not provide an explicit direct and consistent means to determine whether sediment at a site meets the SQO protecting human consumers of sportfish. Nor does the existing approach describe how the SQO protecting human consumers of sportfish would be applied in permits or other programmatic applications such as 303(d) Listings as a result of direct quantitative comparison of outcomes. The existing Sediment Quality Provisions that implement the human health narrative objective state rely upon site-specific human health risk assessment and are based on information from California Environmental Protection Agency's (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, CalEPA's Department of Toxic Substances Control (DTSC) Risk Assessment, and U.S. EPA Human Health Risk Assessment policies.

As described in Section 2.6.4, human health risk assessment provides a general *framework* for assessing the potential for adverse effects to humans from exposure to contaminants in the environment. Human health risk assessment has been applied to evaluate risk from pesticides for applicators or others potentially exposed, applied in the derivation of human health risk based remedial goals for contaminated sites, or those air and water quality standards that are based on human exposure (USEPA, 2014). The framework consists of five key elements:

- Planning based on development of site conceptual model,
- Hazard Identification to evaluate what potential hazards exist,
- Dose Response Assessment to understand how the dose of a chemical affects the body's physiological response
- Exposure Assessment evaluates the actual exposure likely to occur
- Risk Characterization utilizes all the above information to provide an evaluation of the risk posed by the exposure.

Because risk assessment provides an overall framework applicable to any exposure scenario, each assessment must be planned and designed to address the specific situation and exposure pathway of interest. In addition, specific expertise in a variety fields including aquatic contaminant fate and transport, aquatic food webs, fish biology and life history and aquatic toxicology as well as human health risk assessment may be needed to successfully complete the assessment.

Considerable guidance is available through U.S. EPA on exposure factors and other human health risk parameters, as well as guidance for collecting and evaluating data and information to characterize the site in order to complete the overall assessment (USEPA 1989, 1991, 2011, 2014). Other sources of information include guidance from USEPA's Office of Water related to the development of water quality criteria for human health and development of fish consumption advisories (USEPA, 2000a and 2000b). CalEPA Office of Environmental Health Hazard Assessment also provides relevant information related to contaminants in fish tissue in their document titled "Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene (OEHHA, 2008).

In order to assess the risk to human consumers of fish from contaminants that bioaccumulate from sediment into fish tissue, the assessment must address the following three elements:

- Contaminant concentration in site sediments based on site area, boundaries and size,

- Contaminant transfer from sediment into fish tissue based on target sportfish species, tissue type and species-specific bioaccumulation factors
- Risk associated with contaminants in the tissue based on consumer demographics and consumption rates, fractional uptake from site, exposure duration and averaging time as well as information to assess chemical exposure including cancer slope factor, excess cancer risk, and chronic reference dose.

Differences in how any of these elements are addressed could result in very different outcomes. Table 7.1 identifies both the site assessment as well as the human health risk factors that would be applied to assess sediment quality in relation to the SQO regardless of framework employed. Also included in this table is the effect the factor has on the assessment outcome as well as a comparison between the variables and values applied under the existing framework versus the proposed framework designated as Tier 2. The last column in Table 7.1 summarizes how these differences in the existing approach versus the proposed approach could influence the outcome. For the existing approach, a large range of values may be applied for factors such as acceptable cancer risk or consumption rate (Table 7.1). For other factors, significant variability may occur due to the type and nature of the data analyzed, for example contaminant concentrations in tissue and/or sediment.

Even if individual factors do not differ significantly between the application of the existing and the proposed approaches; small differences in multiple factors can cumulatively affect the outcome creating highly disparate results or conversely, may offset those differences so the final results are similar or comparable. Based on this qualitative comparison of factors for a given site, the outcome associated with the proposed approach is likely to fall within the expected range of outcomes associated with the existing approach. However, it is possible that in some cases more compliance actions will be required or the extent of the compliance action will be greater. This possibility serves as the basis for the effects analyses presented in the following sections (7.3.1-7.3.17).

Table 7.1 Site Assessment and Human Health Risk Factors Comparison

Parameter	Effect	Existing Approach	Proposed Amendment	Potential Influence on Outcome
Site Size	Size of study area determines the proportion of fish contaminant exposure that associated with the site sediment.	Variable	Min site size of 1 km^2	Existing approach could designate some contaminated sites as very low risk if the site size is too small to accurately represent the foraging activities of the sportfish species used in the assessment.
Characterization of contaminants in site sediments	Data must be representative to accurately characterize site as a potential source of contaminants to the food web.	Variable	Statistically-based probabilistic sampling design that reflects spatial distribution of sediment contamination.	Existing approach could over or underestimate contaminant contribution from site if nonrepresentative data is used in analysis
Bioaccumulation	The bioaccumulation factor indicates the magnitude of influence that site sediment contamination has on sportfish tissue contamination.	Variable, estimate obtained from empirical data or site specific model derived values	Model derived values	Use of empirically derived values under existing approach could over estimate impact of site sediments if sportfish contamination is caused by other sources or media
Fish Species Measured	Lower or higher estimate of risk if species measured are not sportfish caught in area or exposed to contaminants at site	Variable, selection criteria may include fish consumed from site and vicinity or surrogate species or available data	Specific species linked to sediment, resident, and consumed regularly based on public surveys	Existing approach could identify health impacts unrelated to site if exposure occurs elsewhere
Type of tissue (whole fish, fillet)	Tissue residues (and associated health risks) vary depending on tissue measured and lipid content of tissue	Variable, or based on available data	Standardized requirements depend on species and how fish is prepared and consumed	Existing approach could over estimate risk if whole body residues is measured for species commonly consumed as fillets
Consumer Demographics	Risk varies depending upon consumer demographics however adults and children have similar sensitivities to organochlorine compounds	Variable, determined by study objectives	Consumer population as specified by OEHHA	Existing approach could use the same or more sensitive populations in analysis
Consumption rate	Consumption rate is a major factor in the assessment of human exposure if low value used, risks will be underestimated or not fully protect beneficial use	Variable, may include local estimates of mean or median consumption rate and high estimates	Variable consumption rates based on 1, 2 and 3 meals per week and higher thresholds if assessment of subsistence fishers is warranted	Existing approach could use mean or median values less than those applied in proposed approach

Fractional uptake from Site	Ratio of sportfish consumers intake from site versus intake from offsite fish affects overall chemical exposure	Variable, estimated for site, values of $\leq$ 1 based on understanding of where fishers spend time on water	Always 1	Existing approach could use the same or lower value which would lower the risk associated with the site.
Excess Cancer Risk Threshold	For carcinogens, choice of thresholds can alter risk characterization by factor of 10 or more.	1 x10^{-6} to 1 x 10^{-4}	1 x10^{-6} to 1 x 10^{-4}	Existing approach could rely on the same values or values that or more or less conservative.
Exposure Duration/Averag ing Time	Shorter exposure duration reduces risk	Variable	30 years/70 years	Existing approach could rely on the same values or values that or consider lower exposure duration resulting in less conservative estimate of risk.
Cancer Slope Factor	Relates to the carcinogenicity of the contaminant of concern	U.S. EPA and OEHHA	OEHHA	Existing approach could rely on U.S EPA value however differences would likely be small
Chronic Reference Dose	Relates to the noncancer effects over lifetime	U.S. EPA and OEHHA	OEHHA	Existing approach could rely on U.S EPA value however differences would likely be small

7.3.1 Aesthetics

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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?	❒	❒	❒	☒

Aesthetic impacts comprise the adverse effects a project might have on the scenic quality and visual characteristics of public recreation areas, historically significant sites, or scenic highways. This may also include a significant degradation of the existing visual attributes that are closely linked to a facility's surroundings and topography by introducing prominent structures or features. The potential impact that a project might have on overall visual quality is evaluated against a particular setting's attractiveness, coherence and the presence of unique and popular vistas of geological, topographical or biological resources. Consideration is also given to the designated uses of the immediate vicinity and local zoning laws, ordinances, regulations, and standards.

Monitoring sediment quality would require the use of vessels sized appropriately to navigate shallow coastal bays and lagoons to larger open waters of San Francisco Bay, typically sized from approximately 15 to 70 feet in length to collect sediment and fish tissue samples. In general, the vessel performing a sediment grab will stay on station for 30 to 60 minutes in order to collect and process the sediment grab sample before moving on to the next location. When trawling, the vessel would be moving at a constant rate of 1-2 knots with the trawl submerged for 5- 10 minutes. If fishing with hook and line, the vessel may stay on station longer in order to catch the species of interest. None of these methodologies would require permanent structures and after the fish and tissue samples are collected within the waterbody, additional monitoring surveys may not be required for several years.

Although the proposed amendments do not mandate additional methods of compliance or corrective action for failing to meet the objectives, the Water Boards have the authority to issue and revise waste discharge requirements, and issue and implement enforcement actions such as Cleanup and Abatement Orders that require corrective action at these sites. Failure to meet the objective could potentially result in construction activities associated with the installation of structural controls, implementation of non-structural controls or implementation of remedial actions such as those identified above in Section 7.1. Thus, reasonably foreseeable short-term impacts could occur during construction related activities to scenic vistas, or degrade the scenic character of the environment; however, these impacts are not considered significant because any visual degradation is short term transient and not permanent.

7.3.2 Agriculture and Forest 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. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment Project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Boards.

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
AGRICULTURE AND FOREST RESOURCES: Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	❐	❐	❐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	❐	❐	❐	☒
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	❐	❐	❐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	❐	❐	❐	☒
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	❐	❐	❐	☒

There are no known or reasonably foreseeable impacts to agricultural resources due to the proposed adoption of the proposed amendments. Adoption of the proposed amendments would not result in the conversion of prime farmland, alter land use designations currently zoned for farming, agriculture or timber harvesting or result in the loss of land for these uses. Monitoring of bay and estuarine sediments would not have any direct impact on landside activities. Undeveloped forest land is unlikely to represent a significant source of toxic or bioaccumulative contaminants and require implementation of structural controls. Furthermore, the proposed amendments make no change to the existing requirement that relies upon on the Regional Water Boards' Irrigated Lands Programs to determine how the SQOs will be implemented for those specific agricultural discharges that drain into bays and estuaries.

7.3.3 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.

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
AIR QUALITY. 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?	☒	❐	❐	❐

Sources, Constituents and Basis for Analysis

Due to the large number and types of sources, air pollution can be a significant problem in densely populated urban areas. However, air pollution can affect less densely populated areas as well. In coastal areas, air pollution is typically transported inland by onshore winds until it reaches a barrier, such as mountains or inversion layers that in combination minimize further dispersion. Where mountains exist close to the coast, air pollution is typically localized. However, where coastal plains extend inland, a gradual degradation of air quality occurs from the mountains coastward, creating large areas that do not meet air quality standards. Air quality impacts may cause adverse effects on the health and welfare of all people living, working or visiting the area affected by the project.

The U.S. EPA oversees state and local implementation of federal Clean Air Act requirements. The Clean Air Act requires U.S. EPA to develop national air quality standards and approve State Implementation Plans to meet and/or maintain the national ambient standards. Within the state, the CARB is the agency responsible for coordinating both State and federal air pollution control programs. In 1988, the State legislature adopted the California Clean Air Act (CCAA), which established a statewide air pollution control program. The CCAA's requirements include annual emission reductions, increased development and use of low emission vehicles, and submittal of air quality attainment plans by air districts. The CCAA also requires CARB to establish ambient air quality standards for the state. Ambient air quality standards define clean air, and are established to protect even the most sensitive individuals in our communities. An air quality standard defines the maximum amount of a pollutant that can be present in outdoor air without harm to the public's health. Both federal and State standards have been adopted for a number of constituents. These standards are presented in Table 7.2. Sources and effects associated with common airborne constituents are summarized below.

Carbon monoxide (CO) is a colorless and odorless gas, reduces the oxygen-carrying capacity of the blood, and therefore can cause dizziness and fatigue, impair central nervous system functions, and induce angina in persons with serious heart disease. Carbon monoxide is emitted almost exclusively from the incomplete combustion of fossil fuels. Sources in urban areas include motor vehicles, power plants, refineries, industrial boilers, ships, aircraft, and trains. Motor vehicle exhaust releases most of the carbon monoxide in urban areas. Carbon monoxide is a non-reactive air pollutant that dissipates relatively quickly. As a result, ambient carbon monoxide concentrations generally follow the spatial and temporal distributions of vehicular traffic. Carbon monoxide concentrations are influenced by local meteorological conditions; primarily wind speed, topography, and atmospheric stability.

Ozone (O_3) in the upper atmosphere (stratosphere) reduces potentially harmful ultraviolet radiation. However when it reaches elevated concentrations in the lower atmosphere, it can be harmful to human and to sensitive species of plants. Short-term ozone exposure can reduce lung function and increase an individual's susceptibility to respiratory infection while long-term exposure can impair lung function leading to emphysema and/or chronic bronchitis. Sensitivity to ozone varies among individuals with exercising children being particularly vulnerable. Ozone is formed in the atmosphere by a complex chemical reactions with sunlight and oxides of nitrogen and reactive organic compounds. Oxides of nitrogen and reactive organic compounds are emitted from a variety of stationary and mobile sources. Ozone is the chief component of urban smog and the damaging effects of photochemical smog generally relate to the concentration of ozone. Meteorology and terrain play major roles in ozone formation.

Nitric oxide (NO) and nitrogen dioxide (NO_2) are collectively called oxides of nitrogen and are major contributors to ozone formation and designated collectively as NO_X. Nitrogen dioxide exposure increases the risk of acute and chronic respiratory disease and is formed typically through a rapid reaction between nitric oxide and atmospheric oxygen. Nitrogen dioxide also contributes to the formation of respirable particulate matter through the formation of nitrate compounds.

Suflur dioxide (SO_2) exposure can result in respiratory disease which may cause wheezing, chest tightness, and shortness of breath. Sulfur dioxide can also react with water in the atmosphere to form acids or acid rain. The main source of sulfur dioxide is coal and fuel oil combustion in power plants and industries, as well as diesel fuel combustion in motor vehicles. Generally, the highest levels of sulfur dioxide are found near large industrial complexes. In recent years, sulfur dioxide concentrations have been reduced by the increasingly stringent controls placed on stationary source emissions of sulfur dioxide and by limiting the sulfur content in fuel.

Particulate matter pollution consists of very small liquid and solid particles in the air, which can include smoke, soot, dust, salts, acids, and metals. Particulate matter also forms when gases emitted from industries and motor vehicles undergo chemical reactions in the atmosphere. Particulate matter is regulated as respirable particulate matter (inhalable particulate matter less than ten micrometers in diameter) designated PM_{10} as and fine respirable particulate matter, less than 2.5 micrometers in diameter desginated $PM_{2.5}$. Major sources of respirable particulate matter include crushing operations; dust from vehicles traveling on roads; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; windblown dust from open lands; and atmospheric chemical and photochemical reactions. Fine particulate matter results from fuel combustion (e.g., from motor vehicles, power generation, and industrial facilities), residential fireplaces, and wood stoves. Fine particulate matter can also be formed in the atmosphere from gases such as sulfur dioxide, oxides of nitrogen, reactive organic compounds, and ammonia, and elemental carbon. The health effects from long-term exposure can contribute to increased risk of chronic respiratory disease like asthma and altered lung function in children. Particles with 2.5 to 10 microns in diameter tend to collect in the upper portion of the respiratory system. Particles that are 2.5 microns or less penetrate deeper into the lungs and damage lung tissues. These substances can be absorbed into the bloodstream and cause damage elsewhere in the body.

Air pollution emissions and air quality standards are reported in different units depending on purpose. Daily emissions signify the quantity of pollutant released into the air and have a unit of pounds per day (lbs/day). The term "concentrations" means the amount of pollutant material per volumetric unit of air, typically reported in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Averaging periods may range from as short as one hour to an annual arithmetic mean.

Table 7.2 State and federal ambient air quality standards

Pollutant	Averaging Time	California	Federal Primary	Federal Secondary
Ozone (O_3)	I hr	0.09 ppm (180 $\mu g/m^3$)		Same as Federal Primary

Pollutant	Averaging Time	California	Federal Primary	Federal Secondary
	8 hrs	0.070 ppm (137 µg/m³)	0.075 ppm (147 µg/m³)	
Respirable Particulate Matter (PM_{10})	24 hrs	50 µg/m³	150 µg/m³	Same as Federal Primary
	Ann. Arith. Mean	20 µg/m³		
Fine Particulate Matter ($PM_{2.5}$)	24 hrs		35 µg/m³	Same as Federal Primary
	Ann. Arith. Mean	12 µg/m³	15 µg/m³	
Carbon Monoxide (CO)	I hr	20 ppm(23 µg/m³)	35 ppm (40 µg/m³)	
	8 hrs	9 ppm (10 µg/m³)	9 ppm (10 µg/m³)	
Nitrogen Dioxide (NO_2)	I hr	0.18 ppm (339 µg/m³	100 ppb (188 µg/m³)	
	Ann. Arith. Mean	0.030 ppm (57 µg/m³)	0.053 ppm (100 µg/m³)	Same as Federal Primary
Sulfur Dioxide (SO_2)	I hr	0.25 ppm (655 µg/m³)	0.75 ppm (196 µg/m³)	
	3 hrs			0.5 ppm (1300µg/m³)
	24 hrs	0.04 ppm (105 µg/m³)	0.14 ppm (for certain areas)	
	Ann. Arith. Mean		0.030 ppm (for certain areas)	
Lead (Pb)	30 day ave.	1.5 µg/m³		
	Calendar Quarter		1.5 µg/m³(for certain areas)	Same as Federal Primary
	Rolling 3 month ave.		0.15 µg/m³	
VRP	8 hrs	Extinction of 0.23 per km		
Sulfates	24 hrs	25 µg/m³		
Hydrogen Sulfide (H_2S)	1 hr	0.03 ppm (42 µg/m³)		
Vinyl Chloride	24 hrs	0.01 ppm (26 µg/m³)		

hr	hour	ave	Average
hrs	hours	ppm	parts per million
VRP	Visibility reducing particulates	µg/m³	Micrograms per cubic meter
Ann	Annual		
Arith	Arithmetic		

CARB and local air districts are tasked with identifying areas that meet or do not meet ambient air quality standards. When monitored pollutant concentrations are lower than ambient air quality standards, these areas are designated as “attainment areas” on a pollutant-by-pollutant basis. Areas that exceed ambient standards are designated as “nonattainment areas.” Areas that recently exceeded ambient standards, but are now in attainment, are designated as a “maintenance areas.” Classifications determine the applicability and minimum stringency of pollution control requirements. State designated attainment and nonattainment zones encompassing marine and estuarine waters of California are identified in Table 7.3. Attainment Zones and Nonattainment Zones relative to National Air Quality Standards are presented in Table 7.3. After an area is designated as a nonattainment zone, the CARB and local air districts are responsible for developing clean air plans to demonstrate how and when nonattainment zones will attain air quality standards established under both federal and CCAA. To support the improvement of air quality, local air districts can establish guidelines for assessing a project's potential air quality impact in accordance with CEQA. Local lead agencies will typically rely on air quality standards (Table 12-2) and local air district management strategies and plans or develop thresholds of significance specific to the district for such analyses. Some districts may also rely upon screening criteria to screen projects that will have no significant impact on air quality from intensive air quality studies. Screening criteria are not included.

Table 7.3 2015 Attainment and Nonattainment Zones relative to State Ambient Air Quality Standards – Zones encompassing enclosed bays and estuaries

Local Air District	O_3	PM_{10}	$PM_{2.5}$	CO	NO_2	SO_2	Pb	Sulf.	H_2S	VRP
North Coast Unified	A	N	A	A	A	A	A	A	A	U
Mendocino	A	N	A	A	A	A	A	A	U	U
Northern Sonoma	N	A	A	U	A	A	A	A	U	U
San Francisco Bay Area	N	N	N	A	A	A	A	A	U	U
Monterey Bay Unified	N	N	A	A	A	A	A	A	U	U
San Luis Obispo	N	N	A	A	A	A	A	A	A	U
Santa Barbara	N	N	U	A	A	A	A	A	A	U
Ventura	N	N	A	A	A	A	A	A	U	U
South Coast	N	N	N	A	A	A	A	A	U	U
San Diego	N	N	N	A	A	A	A	A	U	U

A	Attainment	CO	Carbon Monoxide
N	Nonattainment	NO_2	Nitrogen Dioxide
U	Unclassified	SO_2	Sulfur Dioxide
O_3	Ozone (I hour)	Pb	Lead
PM_{10}	Respirable Particulate Matter	Sulf	Sulfates
$PM_{2.5}$	Fine Particulate Matter	H_2S	Hydrogen Sulfide
VRP	Visibility Reducing Particulates	NT	Nonattainment – transitional

https://www.arb.ca.gov/desig/adm/adm.htm accessed 2/19/17

Table 7.4 2015 Attainment and Nonattainment Zones relative to National Ambient Air Quality Standards – Zones encompassing enclosed bays and estuaries

Local Air District	O_3	PM_{10}	$PM_{2.5}$	CO	NO_2	SO_2	Pb
North Coast Unified	U	U	U	U	U	U	U
Mendocino	U	U	U	U	U	U	U
Northern Sonoma	U	U	U	U	U	U	U
San Francisco Bay Area	N	U	N	U	U	A	U
Monterey Bay Unified	A	U	U	U	U	U	U
San Luis Obispo	AN	U	U	U	U	U	U
Santa Barbara	AN	U	U	U	U	U	U
Ventura	N	U	U	U	U	A	U
South Coast	N	A	N	U	U	A	N
San Diego	N	U	U	U	U	A	U

A	Attainment	CO	Carbon Monoxide
N	Nonattainment	NO_2	Nitrogen Dioxide
U	Unclassified	SO_2	Sulfur Dioxide

O_3	Ozone (I hour)	Pb	Lead
PM_{10}	Respirable Particulate Matter	Sulf	Sulfates
$PM_{2.5}$	Fine Particulate Matter	H_2S	Hydrogen Sulfide
VRP	Visibility Reducing Particulates	NT	

https://www.arb.ca.gov/desig/adm/adm.htm accessed 2/19/17

Analysis

Monitoring sediment quality would require the use of gasoline or diesel powered vessels sized appropriately to navigate shallow coastal bays and lagoons to larger open waters of San Francisco Bay. Vessels currently used to monitoring water sediment and tissue in bay and estuaries by public agencies, subcontractors or other organizations could perform the monitoring associated with the proposed amendments. These vessels generally range from approximately 15 to 70 feet in length to collect sediment and fish tissue samples depending upon the depth of water, sea state and work space and sampling equipment requirements. In general, the vessel performing a sediment grab will stay on station for 30 to 60 minutes in order to collect and process the sediment grab sample before moving on to the next location. When trawling, the vessel would be moving at a constant rate of 1-2 knots with the trawl submerged for 5- 10 minutes. If fishing with hook and line, the vessel may stay on station longer in order to catch the species of interest. The minimum frequency of monitoring required under these amendments by permittees is one survey per five-year permit cycle, though a regional water board may request additional monitoring if data or information suggests that sediment quality is impacted. As described in Section 4.2.4, existing monitoring programs already collect sediment and tissue samples from the larger ports and recreational bays in California including San Francisco, Los Angeles, Long Beach, Huntington Harbor, Newport Harbor, Dana Point, Oceanside, Mission Bay and San Diego Harbor. With few changes, much of the data collected from ongoing programs is anticipated to be directly applicable to the framework presented in the proposed amendments. As a result, the additional monitoring required is not expected to conflict or obstruct any applicable air quality plan, violate any air quality standard, cumulatively increase any criteria pollutants, expose sensitive receptors to substantial concentrations or result in objectionable odors. Therefore, monitoring associated with the proposed framework is not expected to result in significant impacts to air quality.

Although the proposed amendments do not mandate additional methods of compliance or corrective action for failing to meet the objectives, the Water Boards have the authority to issue and revise waste discharge requirements, and to issue and implement enforcement actions such as Cleanup and Abatement Orders that could require corrective action at these sites. Failure to meet the objectives could potentially result in construction activities associated with the installation of structural controls, implementation of non-structural controls or implementation of sediment remedial actions. These activities could result in air quality impacts. Potential impacts associated with corrective action could occur from two types of sources: fugitive dust from surface disturbance activities (particularly as $PM_{2.5}$) and exhaust emissions from mobile sources resulting from the use of vessel-based dredging, construction and earthmoving equipment, haul trucks or rail transportation, as well as construction worker commute vehicles. Constituents associated with mobile source combustion include NOx, SOx, and CO, as well as volatile organic compounds. State Water Board cannot speculate on extent and magnitude of projects undertaken in the future as a response to the proposed amendments or the potential effects to air quality associated with the equipment, vehicles and vessels necessary and the number and length trips required to complete the project and the offloading handling and loading of material prior to disposal. Projects may be small, encompassing less than a quarter acre, utilizing two to four vehicles and equipment lasting two weeks to complete; while other projects may encompass many tens of acres and require several different pieces of heavy equipment, trucks, barges and other vessels in combination to complete the project. In order to evaluate the effects to air quality associated with these actions, the specific project must be scoped to identify the types and numbers of equipment that will be used to complete the project, the location and estimated duration of the project. With this information, emissions from the equipment must be quantified and evaluated in the context of the existing local air quality for the project and local climate and meteorology. Emissions may be directly compared to air quality standards and local air district planning thresholds if available or evaluated directly using human health risk assessment for exposure to airborne contaminants. Because the Water Board cannot speculate on the number and type of equipment, or the duration of use, there is the potential for some large scale projects to violate air quality standards, result in cumulatively net increase of criteria pollutants in the region, or expose sensitive receptors. However all these impacts may be mitigated to less than significant as described below.

Subaqueous material has the potential to create objectionable odors (e.g., hydrogen sulfide), when brought to the surface and adversely impact air quality at the site where dredged materials are temporarily or dried or loaded onto to truck or rail car for transport and disposal. In addition, objectionable odors may occur during dredging. Whether the odor is considered to be significant is a function of the location of the site and whether a substantial number of people are affected. Because the Water Board cannot speculate on the size of the projects or the location with respect to sensitive receptors, there is the potential for some large scale projects to be located near population centers that could expose people to objectionable odors. Odor related impacts can be mitigated as described below

Mitigation

Mitigation for construction related activities may include:

- Maintain all vehicles in accordance with manufactures guidelines for optimal performance including
    - Regularly check tire pressure and fill as needed to maintain maximum fuel economy and minimize tire wear
    - Regularly check all fluid levels and top off as needed. Change out at specific intervals
    - Ensure that emission controls are fully functioning at all times.

- To minimize emissions from all internal combustion engines:
    - Where feasible, use equipment powered by sources that have the lowest emissions, or are powered by electricity
    - Utilize equipment with the smallest engine size capable of completing project goals to reduce overall emissions
    - Minimize idling time and unnecessary operation of internal combustion engine powered equipment
    - Where feasible, use local suppliers for materials necessary to complete the project and encourage car pools and public transportation to reduce emissions to and from project site
- For diesel powered equipment:
    - Utilize diesel powered equipment meeting Tier 2 or higher emissions standards to the maximum extent feasible.
    - Utilize portable construction equipment registered with the State's Portable Equipment Registration Program
    - Utilize low sulfur diesel fuel and minimize idle time
    - Ensure all heavy duty diesel powered vehicles comply with state and federal standards applicable at time of purchase.
    - Utilize diesel oxidation catalyst and catalyzed diesel particulate filters or other approved emission reduction retrofit devices installed on applicable construction equipment used during individual projects.
- To control dust emissions:
    - 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
    - Install temporary windbreaks
    - Use street sweeping to remove dust from paved roads during earth work
- To control odors:

- Stockpile dredged materials away from residential areas or areas where public is present.
    - Reuse and disposal facilities must be located and designed to avoid generating nuisance odors that will adversely affect surrounding areas
    - Cover stockpiles to reduce odors
    - Minimize dredging during warm periods to reduce odor causing biological activity

- Monitor on-site air quality in relation to local agency and Air District standards and mitigate impacts

Conclusion

Because it is not possible to evaluate the entire range of emissions associated with all reasonable foreseeable means of compliance, there is the probability that some remedial action projects resulting from the proposed amendments would potentially conflict with the implementation of the applicable air quality plan or violate an air quality standard or create objectionable odors. Because the location and duration of these projects are unknown, there is also the possibility that sensitive receptors are exposed under these conditions. Implementation of these projects discussed above will require discretionary authorizations and approvals from public agencies. Detailed environmental analysis associated with individual projects will be described in the project-specific CEQA documents prepared at that time. There are reasonably foreseeable mitigation measures as described above, as well as those required by federal, state, and local laws and regulations, that the lead agency responsible for the project level environmental review can and should adopt. These mitigation measures should mitigate any potential adverse impacts at the project level to less than-significant levels.

7.3.4 Biological Resources

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
BIOLOGICAL RESOURCES -- Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	■	❒	❒	❒

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 US 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 Plan or other approved local, or state habitat conservation plan?	❒	❒	❒	■

Sensitive Species Habitats and Basis

California's bay and estuarine ecosystem are biologically diverse and encompass many sensitive habitats including soft bottom, kelp beds, eelgrass beds, and rocky substrate as well as emergent coastal wetlands and mudflats which are subject to tidal fluctuations and changing salinity conditions. These bays and estuaries support an extensive food chain and provide refuge, spawning, and rearing habitat for many commercially important marine and anadromous fish species. Eelgrass beds provide foraging habitat and shelter from predation for many species, including; California spiny lobster, California halibut, sand basses and other recreationally valuable species. Subtidal and intertidal mudflats contain an abundance of invertebrates like clams, snails, and worms that burrow into the benthic sediment that provide food for sculpin, starry flounder, leopard shark, and California skate. Many common coastal birds, such as the long-billed curlew, marbled godwit, black-necked stilt, oyster catcher, and gulls forage and nest in these areas, in addition to endangered and threatened birds like the western snowy plover, Belding's savannah sparrow, California least tern, and light-footed clapper rail. Kelp beds are common in areas just inside rock jetties and breakwaters that provide unique structurally complex habitat that supports a diversity and abundance of invertebrates, fish, and mammals similar to rocky reefs. Due to the complexity and richness of these habitats, many federal and State listed threatened and endangered species occur within or near enclosed bays and estuaries of California. See Tables 7.5, 7.6 7.7 and 7.8 Below.

Under the federal Endangered Species Act, a permit is required for any federal action that could harass, harm, kill or capture a listed species, or result in the modification or degradation of habitat where such activity results in death or injury by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. The U. S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration (NOAA) Fisheries Service administer the Endangered Species Act jointly and are also authorized to identify and designate critical habitat for the recovery of listed species. NOAA Fisheries also implements the federal Marine Mammal Protection Act that prohibits the take of all marine mammals with specific exemptions. Under the Marine Mammal Protection Act, “take” includes harassment, annoyance, and torment as well as disruption of behavior patterns including migration, breeding, feeding, nursing or sheltering on land or in water.

The Magnuson-Stevens Fishery Conservation and Management Act requires NOAA fisheries in conjunction with regional fishery management councils to develop conservation and management plans for the nation’s fishery resources through the preparation and implementation of fishery management plans. In development of the fishery management plans, NOAA fisheries must identify Essential Fish Habitat and habitat areas of special concern. In response, NOAA Fisheries has issued the Pacific Coast Groundfish and Coastal Pelagic Species Fisheries Management Plans that designate enclosed bays and estuaries as essential fish habitat for a variety of groundfish and coastal pelagic species. NOAA Fisheries has also identified all enclosed bays and estuaries north of Point Conception as essential fish habitat for Pacific Coast Salmon. Eel grass beds and estuaries have also been designated as Habitat Areas of Special Concern, a designation used to denote habitat at greater risk of destruction, a greater resource value for spawning, rearing, or recruitment that could potentially require more stringent management and protection than the general Essential Fish Habitat designation. .

Any entity applying for a federal permit that could adversely affect areas designated as Essential Fish Habitat is required to consult with regional fishery management councils and NOAA fisheries to minimize loss of habitat. In 2014, NOAA Fisheries West Coast Region released the California Eelgrass Mitigation Policy and Implementing Guidelines to ensure harm to eelgrass beds and Essential Fish Habitats is minimized.

Under the California Endangered Species Act, a permit from the California Department of Fish and Wildlife is required for projects that could result in the take of a plant or animal species that is state listed as threatened or endangered. Authorization for take of state-listed species can be obtained through a California Fish and Game Code section 2080.1 consistency determinations or a section 2081 incidental take permit. Under the California Endangered Species Act, a permit from the California Department of Fish and Wildlife is required for projects that could result in the take of a plant or animal species that is state listed as threatened or endangered. Authorization for take of state-listed species can be obtained through a California Fish and Wildlife Code section 2080.1 consistency determination or a section 2081 incidental take permit.

In California waters, all field collecting or take of biological resources for scientific research purposes is regulated by the California Department of Fish and Wildlife (DFW), under Fish and Game Code section 1002 and California Code of Regulations title 14 sections 650 and 670.7. Each supervising field biologist would be required to obtain a Scientific Collecting Permit that includes the location, species and number of organisms proposed for collection accompanied by plans and procedures proposed for collection and prevention of incidental take of non-target and threatened and endangered species. Collecting in Marine Protected Areas (MPAs) requires additional authorizations from the MPA Regional Manager. Prior to each collection, the permittee must also notify all parties at least 24 hours before field work begins so that agencies can notify the appropriate DFW warden. If the approach used to collect sportfish tissue complies with all California sport-fishing provisions, that the collectors would comply with all fishing area closures, as well as season, bag, size limits, and method of take, a sport fishing license may also be used.

Table 7.5 List of threatened and endangered fish inhabiting coastal waters of California (CDFW Biogeographic Data Branch State and Federally Listed Endangered and Threatened Animals of California January 2017)

Common Name	Scientific Name	Primary Habitat	Listing
Green sturgeon	*Acipenser medirostris*	Ocean Waters from Oregon Border to Monterey	Federally listed as threatened
Pacific eulachon	*Thaleichthys pacificus*	Anadromous	Federally listed as threatened
Coho salmon	*Oncorhynchus kisutch*	Anadromous, Central California north	State and Federally Listed
Steelhead	*Oncorhynchus mykiss*	Anadromous,	State and Federally Listed
Chinook salmon	*Oncorhynchus tshawytscha*	Anadromous, Central California north	State and Federally Listed
Tidewater Goby	*Eucyclogobius newberryi*	Polyhaline/marine	Federally listed as endangered
Delta smelt	*Hypomesus transpacificus*	Euryhaline	State and Federally Listed as endangered
Longfin smelt	*Spirinchus thaleichthys*	Anadromous	State Threatened

Table 7.6 List of threatened and endangered reptiles inhabiting coastal areas and waters of California (CDFW Biogeographic Data Branch State and Federally Listed Endangered and Threatened Animals of California January 2017)

Common Name	Scientific Name	Primary Habitat	Listing
Green sea turtle	*Chelonia mydas*	San Diego Bay and coastal waters	Federally listed as threatened
Loggerhead sea turtle	*Caretta caretta*	Coastal waters from Point Conception, south	Federally listed as endangered

Olive ridley sea turtle	*Lepidochelys olivacea*	Coastal waters	Federally listed as threatened
Leatherback sea turtle	*Dermochelys coriacea*	Point Arena to Point Arguello	Federally listed as endangered

Table 7.7 List of threatened and endangered birds inhabiting coastal areas and waters of California (CDFW Biogeographic Data Branch State and Federally Listed Endangered and Threatened Animals of California January 2017)

Common Name	Scientific Name	Primary Habitat	Listing
Short-tailed albatross	*Phoebastria albatrus*		Federally listed as endangered
California condor	*Gymnogyps californianus*	Coastal areas from Los Angeles to Monterey including islands	State and Federally listed as endangered
Bald eagle	*Haliaeetus leucocephalus*	Coastal areas and islands	State listed as endangered
California black rail	*Laterallus jamaicensis coturniculus*	Localized populations occur from Bodega Bay to Seal Beach	State listed as threatened
California clapper rail	*Rallus longirostris obsoletus*	Bay area salt marshes	State and Federally listed as endangered
Light-footed clapper rail	*Rallus longirostris levipes*	Salt marshes from Ventura County south	State and Federally listed as endangered
Western snowy plover	*Charadrius alexandrinus nivosus*	Coastal sandy beaches and adjacent estuaries	Federally listed as threatened
California least tern	*Sterna antillarum browni*	Coastal areas from San Diego to San Francisco and islands	State and Federally listed as endangered
Marbled murrelet	*Brachyramphus marmoratus*	Coast typically from Santa Barbara north	State listed as endangered, Federally listed as threatened
Willow flycatcher	*Empidonax traillii*	Localized populations in Southern California coastal riparian corridors	State listed as endangered
Belding's savannah sparrow	*Passerculus sandwichensis beldingi*	Coastal salt marshes of southern California	State listed as endangered

Table 7.8 List of threatened and endangered mammals inhabiting coastal areas and waters of California (CDFW Biogeographic Data Branch State and Federally Listed Endangered and Threatened Animals of California January 2017)

Common Name	Scientific Name	Primary Habitat	Listing
Morro Bay kangaroo rat	*Dipodomys heermanni morroensis*	Adjacent lands along perimeter of Morro Bay, San Luis Obispo County	

Common Name	Scientific Name	Primary Habitat	Listing
Guadalupe fur seal	*Arctocephalus townsendi*	Coastal waters from Sonoma County south	State and Federally listed as threatened
Southern sea otter	*Enhydra lutris nereis*	Coastal waters from San Mateo Co. to Santa Barbara Co.	
Humpback whale	*Megaptera novaeangliae*	Coastal Waters (occasional visitor to San Francisco Bay)	Federally listed as endangered

Analysis

As described in Section 4.2.4, existing monitoring programs already collect significant sediment and tissue samples from the larger ports and recreational bays in California, including San Francisco, Los Angeles, Long Beach, Huntington Harbor, Newport Harbor, Dana Point, Oceanside, Mission Bay and San Diego Harbor. With few changes, much of the fish tissue data collected from ongoing programs is anticipated to be directly applicable to the framework presented in the proposed amendments. Further scientific collecting under a California Fish and Wildlife scientific collecting permit or sportfishing license ensure that the collected methodology applied and species caught will not cause significant impacts to the health of the aquatic resources or damage habitat. As a result, the additional monitoring required under the proposed amendments is not expected to cause a substantial adverse effect, through habitat modifications, on any species identified as a candidate, sensitive, or special status species, cause substantial adverse effects on riparian habitat or other sensitive natural community or federally protected wetlands, 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.

On land, there are no reasonably foreseeable impacts to biological resources from adoption of the proposed amendments. The removal of soil could occur as part of land-based corrective action and control activities; however, many toxic pollutants found in sediments are typically found in highly urbanized, industrial areas where the presence of sensitive native species and habitats are improbable. Measures designed to intercept, divert, treat, and convey urban runoff to municipal wastewater treatment systems is only likely to occur at strategic locations in highly urbanized areas where the runoff requires additional controls.

Although sediment-related remedial action should provide long term benefits to all biological resources through reduced exposure to contaminants in the environment, dredging, disposal, and capping all have the potential to cause short-term adverse effects to biological resources in several ways (USACE/USEPA, 2009):

- Direct removal of seagrass, benthic invertebrates, fish and eggs in bucket or suction dredge while dredging
- Injury to gill and reduced oxygen uptake due to contact with suspended sediments
- Smothering of seagrasses, beds, eggs or larvae by residuals, bucket losses or turbidity

- Reduced foraging success, due to visual impairment, loss of prey abundance and habitat
- Reduced light penetration inhibiting photosynthesis for seagrasses and phytoplankton
- Avoidance and displacement of sensitive species do to suspended sediments and physical disturbance
    - impede anadromous fish
- Remobilization of contaminants into the water column
    - Increase potential for exposure and trophic transfer
- Potential changes to the bioavailability of contaminants that remain in bedded sediment
- Mobilization of nutrients in to the water column
- Changes to bathymetry that alter currents and flow patterns

Mitigation

Mitigation for subaqueous remedial actions may include

- Perform biological survey of marine and terrestrial receptors and habitats
- If avoidance does not meet the project objectives, replace and mitigate resources lost or harmed in accordance with local or regional plans policies or guidance
- Move or modify projects to maintain adequate buffer zones for sensitive receptors
- Establish work windows to minimize projects impact associated with migration, nesting and spawning seasons.
- Evaluate risks associated with new surface layer prior to dredging through sampling and assessment
- Reduce vessel speed in areas where marine mammals are present
- When working in shallow habitats reduce impacts of prop wash on seagrass beds.
- Develop water quality monitoring and contingency plan and monitor water quality over duration of project
- Install physical barrier (silt curtains, cofferdam or sheet pile enclosure) adequate for the currents and conditions anticipated at the site
- Use dredging equipment that minimizes the direct take or entrainment of biota
- Use of dredging equipment that minimizes the discharge or release of dredged material (e.g., use of clam shell dredger, etc.) or apply best practices to minimize loss of material from bucket in water column (minimize unnecessary bucket movement and reduce velocity of bucket).
- Evaluate risks associated with new surface layer prior to dredging through sampling and assessment
- Use noise and vibration dampening material on equipment.
- Retain existing bathymetry and hydrodynamics where existing receptors and habitats depend upon those conditions
- Ensure design is adequate to protect resources in the future (e.g. ensure capping layer is adequate to protect from burrowing shrimp and clam, tidal scour, anchoring, prop wash)

- Implementation of other miscellaneous actions to reduce potential impacts; e.g., requiring that construction or operations employees be given orientation and training regarding the sensitive species, their habitats, and actions to be taken to minimize or avoid impact.

Mitigation for Landside earthwork and construction related actions

- Protect wetlands from accidental spills or discharges
- Protect vegetation and restore as needed to mimic pre-construction habitat.
- Use only clean material to back fill excavations.

Mitigation related to water quality protection is described in Section 7.3.9.

Conclusion

Direct effects associated with compliance monitoring under the proposed amendments are not expected or anticipated. Remedial actions intended to reduce exposure to contaminants in the environment may result in short-term impacts. Because of the diverse range of technologies employed, the media involved and location of the project site and potential biological resources affected, it is not possible to evaluate the entire range of impacts to potential threatened or endangered species' critical habitats, or to sensitive habitats designated to protect marine aquatic resources. However, given the range of projects, there is the probability that some remedial action projects potentially could have a substantial adverse effect, either directly or through habitat modifications, on candidate, sensitive, or special status species in local or sensitive natural community identified in local or regional plans or policies; or to adversely affect protected wetlands or interfere substantially with the movement of any native resident or migratory fish.

Implementation of corrective action or remedial action projects discussed above will require discretionary authorizations and approvals from public agencies. Detailed environmental analysis associated with individual projects will be described in the project-specific CEQA documents prepared at that time. There are reasonably foreseeable mitigation measures as described above, as well as those required by federal, state, and local laws and regulations, that the lead agency responsible for the project level environmental review can and should adopt. These mitigation measures should mitigate any potential adverse impacts at the project level to less than-significant levels.

7.3.5 Cultural Resources

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
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 an 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?	☒	❐	❐	❐

A historical resource includes a resource listed in or eligible for listing in the California Register of Historical Resources. The California Register includes resources on the National Register of Historic Places, as well as California State Landmarks and Points of Historical Interest. Properties that meet the criteria for listing also include districts which reflect California's history and culture, or properties which represent an important period or work of an individual, or yield important historical information. Properties of local significance that have been designated under a local preservation ordinance (local landmarks or landmark districts) or that have been identified as local historical resources are also included in the California Register. (California Office of Historical Preservation 2006.) An archeological site may be considered an historical resource if it is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military or cultural annals of California. (Pub. Resources Code § 5020.1(j)) or if it meets the criteria for listing on the California Register (Cal. Code. of Regs. tit. 14, § 4850) The State of California does not maintain a database or maps identifying unique paleontological and geological resources. In lieu of these resources, agencies frequently rely on the Society of Vertebrate Paleontology document titled "*Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources"* (2010) or **"***Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontological Resources: Standard Guidelines" (1995)*.

Potential impacts to known identified cultural resources may be avoidable through records search surveys and consultations with local experts. However, impacts to unknown cultural resources are difficult to estimate.

Analysis

Adoption of the proposed amendments would not in itself directly cause impacts to cultural resources. Indirectly, however, implementation of the proposed amendments by a Regional Water Board through the permitting process or Board order could result in the need for construction or shallow excavation activities associated with structural stormwater BMPs such as detention ponds, infiltration basins and other treatment works on land and well as remedial action such as dredging and capping within the waterbody. As a result, the reasonably foreseeable impacts to cultural resources are limited to these types of activities. Because these areas are likely to result in shallow excavations in already highly developed and urbanized areas, it is unlikely that their implementation would cause a substantial adverse change to historical or archeological resources, destroy paleontological resources, or disturb human remains. However, depending on the final location of the BMPs or treatments works and associated facilities, potential impacts to cultural resources could occur. Paleontological resources can be found in areas containing fossil-bearing formations. Archaeological resources have been found within urbanized areas. Historic and architectural resources have also been found within urbanized areas. The site-specific presence or absence of these resources is unknown because the specific locations for all potential projects will be determined by responsible agencies at the project level. To minimize potential impacts to cultural resources, individual project proponents should complete a detailed investigation of potential impacts through consultation with Native American tribes, to make an accurate assessment of the potential to affect historic, archaeological, or architectural resources or to impact any human remains. If potential impacts are identified, measures to reduce impact could include project redesign, such as the relocation of facilities outside the boundaries of archeological or historical sites. According to the California Office of Historic Preservation, avoidance and preservation in place are the preferable forms of mitigation for archeological sites. When avoidance is infeasible, a data recovery plan should be prepared which adequately provides for recovering scientifically consequential information from the site. Studies and reports resulting from excavations must be deposited with the California Historical Resources Regional Information Center. No impact is anticipated after these measures are taken.

It is unlikely that unknown cultural resources are present beneath subtidal sediments in bays and estuaries, given the age of waterbodies and extent of development and disturbance that has already occurred. However, our lack of awareness does not preclude the possibility of previously unmapped cultural resources in near-shore or landside locations that could be impacted by activities in response to exceedance of the narrative SQOs. As a result, any future actions that could impact cultural resources would be subject to CEQA on an individual case-by-case basis, and evaluated at that time.

7.3.6 Tribal Cultural Resources

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
CULTURAL RESOURCES -- Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resource Code section 2107 as either a site, feature, place cultural landscape that is geographically defined in terms of size and scope of landscape sacred place or objective with cultural value to California Native American Tribe that is :				
a) Listed or eligible for listing in California	■	❒	❒	❒

Register of Historical Resources or in a local register of historical resources as defined in Public Resources Code section 5020.1(k)				
b) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to the California Native American Tribe.	■	❒	❒	❒

AB 52 (Gatto, 2014) established a new category of resources in CEQA called Tribal Cultural Resources. (Pub. Resources Code, § 21074.) "'Tribal cultural resources' are either of the following: (1) Sites, features, places, cultural landscapes, sacred places, and objects with cultural value to a California Native American tribe that are either of the following: (A) Included or determined to be eligible for inclusion in the California Register of Historical Resources. (B) Included in a local register of historical resources as defined in subdivision (k) of Section 5020.1. (2) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Section 5024.1. In applying the criteria set forth in subdivision (c) of Section 5024.1 for the purposes of this paragraph, the lead agency shall consider the significance of the resource to a California Native American tribe." (Ibid.) Consultation with a California Native American Tribe that has requested such consultation may assist a lead agency in determining whether the project may adversely affect tribal cultural resources, and if so, how such effects may be avoided or mitigated. Whether or not consultation has been requested (no such consultation was requested for the State Water Board's development of the Provisions, see Section 4.1.4), the lead agency evaluates whether the project may cause a substantial adverse change in a site, feature, place, cultural landscape, sacred place, or object, with cultural value to a California Native American Tribe.

Analysis

Adoption of the proposed amendments would not in itself directly cause impacts to tribal cultural resources. Indirectly, however, implementation of the proposed amendments by a Regional Water Board through the permitting process or Board order could result in the need for construction or shallow excavation activities associated with structural stormwater BMPs such as detention ponds, infiltration basins and other treatment works on land and well as remedial action such as dredging and capping within the waterbody. As a result, the reasonably foreseeable impacts to cultural resources are limited to these types of activities. Because the areas required for stormwater controls are typically densely developed urban areas (retrofit), it is unlikely that their implementation would cause a substantial adverse change to cultural resources, cultural landscape or sacred space or disturb human remains. However, as the location of the BMPs or treatments works and associated facilities is unknown, potential impacts to cultural resources could occur. To minimize potential impacts to cultural resources, individual project proponents should complete a detailed investigation of potential impacts through consultation with Native American tribes, to make an accurate assessment of the potential to affect historic, archaeological, or architectural resources or to impact any human remains. If potential impacts are identified, measures to reduce impact could include project redesign, such as the relocation of facilities outside the boundaries of archeological or historical sites. According to the California Office of Historic Preservation, avoidance and preservation in place are the preferable forms of mitigation for archeological sites. When avoidance is infeasible, a data recovery plan should be prepared which adequately provides for recovering scientifically consequential information from the site. Studies and reports resulting from excavations must be deposited with the California Historical Resources Regional Information Center. No impact is anticipated after these measures are taken.

It is unlikely that unknown tribal cultural resources are present beneath subtidal sediments in bays and estuaries, given the age of waterbodies and extent of development and disturbance that has already occurred. However, our lack of awareness does not preclude the possibility of previously unmapped tribal cultural resources in near-shore or landside locations that could be impacted by activities in response to exceedance of the narrative SQOs. As a result, any future actions that could impact cultural resources would be subject to CEQA on an individual case-by-case basis, and evaluated at that time.

7.3.7 Geology and Soils

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
GEOLOGY AND SOILS -- Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	❐	❐	❐	■
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	❐	❐	❐	■
ii) Strong seismic ground shaking?	❐	❐	❐	■
iii) Seismic-related ground failure, including liquefaction	❐	❐	❐	■

iv) Landslides?	■	❒	❒	❒
b) Result in substantial soil erosion or the loss of topsoil?	❒	❒	❒	■
c) Be located on a 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 waste water disposal systems where sewers are not available for the disposal of waste water?	❒	❒	❒	■

Existing Conditions and Basis

The geology of coastal California is highly variable, in part a function of the large geographic extent of the state. Coastal bedrock and surface deposits are comprised of Precambrian crystalline basement rocks, Paleozoic igneous and sedimentary formations, Tertiary accretionary prism/marine sediments, Pliocene to Quaternary marine terraces, Quaternary to Holocene coastal sediments such as dunes, beaches, and other alluvium, and heavily re-worked Anthropocene deposits. The California Geological Survey has published geologic maps for the state that highlight local geologic deposits. (Gutierrez et al. 2010)

California is located along an active tectonic plate margin, where the Pacific plate interacts with the North American and Juan de Fuca plates. There are hundreds of known faults, both active and inactive, throughout the state. The San Andreas Fault is the largest in California and is one of the largest lateral transform faults in the world, running for more than 700 miles through both coastal and inland areas. As a consequence of the tectonic activity in the region, there are significant seismic hazards along the California coast. Faulting can also weaken the strength of formations along the fault zone. Depending on location, the interaction of geology and environment can result in additional hazards to humans and the environment. Weathering of loosely consolidated sediments can result in coastal hazards including ground failure, landslides, subsidence, or collapse. Soil composition can adversely affect the stability of key structures through expansion/contraction. Heavy surf and accompanying rainfall can result in significant coastal erosion in some locations causing loss of structures, scenic vistas and highways. Sea level rise can further exacerbate coastal erosion.

Seismicity in the Central and Southern California coasts is largely driven by the San Andreas Fault and related transform fault activity (although normal and reverse faults are not uncommon). The presence of a subduction zone north of Point Arena increases seismic risks along the Northern California coast. Active faults are mapped by the California Geologic Survey in response to the Alquist-Priolo Earthquake Fault Zoning Act of 1972, which required the State Geologist to establish Earthquake Fault Zones around the surface traces of active faults. (Bryant and Hart 2007) The maps identify fault zones that are subject to construction requirements in order to mitigate the effects of seismicity on certain types of structures. Specifically, the Act prohibits construction of buildings used for human occupancy over the surface trace of active faults. Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings will not be constructed across active faults. Other earthquake associated hazards such as seismically induced liquefaction and landslides, not addressed in Alquist-Priolo Earthquake Fault Zoning Act, were the subject of the Seismic Hazards Mapping Act of 1990. The Seismic Hazards Mapping Act of 1990 addresses non-surface fault rupture earthquake hazards. Under the Seismic Hazards Mapping Act, the California Geological Survey prepares seismic hazard zone maps to local governments that delineate hazard zones, specific areas susceptible to liquefaction, earthquake-induced landslides or other ground failures. The Seismic Hazards Mapping Act requires local governments and planning agencies to require geotechnical studies for projects proposed within seismic Hazard zones. Under the Coastal Zone Act, section 30253 requires that new development minimize risks to life and property associated with geologic hazard and neither creates nor contributes to erosion or geologic instability. Minimum building requirements to address geological hazards are also set forth in the Uniform Building Code and the California Building Code. Frequently, local agencies (Cities and Counties) adopt ordinances to mitigate hazards associated with locally known or identified geological hazards and subsurface conditions.

Adoption of the proposed amendments would not increase risks associated with surface rupture or ground shaking or ground failure resulting from seismic motion. Reasonably foreseeable methods of compliance could include the need for construction or shallow excavation activities associated with structural stormwater BMPs such as detention ponds, infiltration basins and other treatment works on land. Dredging activities have the potential to destabilize channel slopes and undermine pilings and seawalls. Standard engineering practices that account for the geologic conditions and properties of soil and sediment onsite, and practices such as installation of sheet pile walls at the toe of the shore slope, would reduce or avoid this impact. Following standard engineering practices and by complying with local state and federal laws and appropriate mitigation measures, potentially significant impacts from slope instability or landslides can be reduced to less than significant with mitigation. Failure associated with expansive soils can also be mitigated to less than significant impacts by excavating and replacing the material with engineered fill, or other measure appropriate based on site conditions and forces acting on the material. Mitigation measures will depend upon the geologic features, physical properties of the earth materials and the types of buildings or infrastructure in the immediate vicinity of the site. These factors and appropriate mitigation would be determined for each individual action during the project CEQA review.

7.3.8 Greenhouse Gas Emissions

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
GREENHOUSE GAS EMISSIONS -- Would the project:				
a) Generate Greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	■	❒	❒	❒
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	■	❒	❒	❒

Greenhouse gases trap heat in the atmosphere, which in turn heats the surface of the Earth. Some greenhouse gases occur naturally and are emitted to the atmosphere through natural processes, while others are created and emitted solely through human activities. The emission of greenhouse gases through the combustion of fossil fuels (i.e., fuels containing carbon) in conjunction with other human activities, appears to be closely associated with global warming.

In 2006, Assembly Bill 32 (California Global Warming Solutions Act) was approved, mandating a reduction of greenhouse gas emissions to 1990 levels by 2020. In 2016, the Legislature passed Senate Bill 32, which codifies a 2030 GHG emissions reduction target of 40 percent below 1990 levels. With SB 32, the Legislature passed companion legislation AB 197, which provides additional direction for developing the Scoping Plan. ARB is moving forward with a second update to the Scoping Plan to reflect the 2030 target set by Executive Order B-30-15 and codified by SB 32.

Senate Bill 97 (Chapter 185, Statutes of 2007) amends the CEQA statute to clearly establish that greenhouse gas emissions and the effects of these emissions are appropriate subjects for CEQA analysis. It directs the Office of Planning and Research to develop draft CEQA Guidelines "for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions" by July 1, 2009 and directs the Natural Resources Agency to certify and adopt the CEQA Guidelines by January 1, 2010. The amended CEQA guidelines became effective on March 18, 2010.

Climate change refers to any significant change in measures of climate, such as average temperature, precipitation, or wind patterns over a period of time. Climate change may result from natural factors, natural processes, and human activities that change the composition of the atmosphere and alter the surface and features of the land. Significant changes in global climate patterns have recently been associated with global warming, including an average increase in the temperature of the atmosphere near the Earth's surface, attributed to accumulation of greenhouse gas emissions in the atmosphere. State law defines greenhouse gases to include the following: CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (Health and Safety Code, §38505(g).) The most common greenhouse gases that results from human activity is CO_2, followed by CH_4 and nitrous oxide. Few coastal air districts have adopted thresholds of significance in order to evaluate the potential for a project to contribute significant GHG emissions. Established thresholds are presented in Table 7.9.

Table 7.9. GHG Thresholds of Significance for Operational Emissions Impacts

Local Air District	Pollutant	Threshold
Mendocino	GHGs – Projects other than Stationary Sources	Compliance with Qualified GHG Reduction Strategy OR 1,100 MT of CO2e/yr OR 4.6 MT CO2e/SP/yr (residents+employees)
	GHGs – Stationary Sources	10,000 MT/yr
San Luis Obispo	Greenhouse Gases (CO2, CH4, N20, HFC, CFC, F6S)	Consistency with a Qualified GHG Reduction Plan OR 1,150 MT CO2e/year OR 4.9 CO2e/SP/year (residents + employees)
South Coast	**GHG**	10,000 MT/yr CO2e for industrial facilities

Carbon Dioxide Equivalent (CO2e) - A metric used to compare emissions of various greenhouse gases. It is the mass of carbon dioxide that would produce the same estimated radiative forcing as a given mass of another greenhouse gas. Carbon dioxide equivalents are computed by multiplying the mass of the gas emitted by its global warming potential.
Greenhouse Gas - Greenhouse gases include; carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrochlorofluorocarbons (HCFCs), ozone (O3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).

As discussed in Section 7.3.3, monitoring sediment quality would require the use of gasoline or diesel powered vessels sized appropriately to navigate shallow coastal bays and lagoons to larger open waters of San Francisco Bay, which would contribute to GHG emissions. However much of the data collected from ongoing programs is anticipated to be directly applicable to the framework presented in the proposed amendments. As a result, the additional monitoring required is not expected to contribute significant GHG emissions.

Although the proposed amendments do not mandate additional methods of compliance or corrective action for failing to meet the objectives, the Water Boards have the authority to issue and revise waste discharge requirements, and issue and implement enforcement actions such as cleanup and abatement orders that could require corrective action at these sites. Failure to meet the objectives could potentially result in construction activities associated with the installation of structural controls, implementation of non-structural controls or implementation of sediment remedial actions. All of these activities could result in GHG emissions, primarily through the use internal combustion engines powering vessels, dredging equipment, heavy equipment, trucks and other vehicles. As a result, many of the mitigation measures identified in Section 7.3.3 for internal combustion engines would also reduce GHG emissions.

Implementation of corrective action or remedial action projects discussed above will require discretionary authorizations and approvals from public agencies. Detailed environmental analysis associated with individual projects will be described in the project-specific CEQA documents prepared at that time. There are reasonably foreseeable mitigation measures above, as well as those required by federal, state, and local laws and regulations, that the lead agency responsible for the project level environmental review can and should adopt. These mitigation measures should mitigate any potential adverse impacts at the project level to less than-significant levels.

7.3.9 Hazards and Hazardous Materials

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
HAZARDS AND HAZARDOUS MATERIAL -- 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 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?	❒	❒	❒	■

Sources, Media and Basis

Spills or releases of hazardous material may pose multiple threats. Such releases may cause toxicity through inhalation or dermal exposure, ignite creating an immediate and acutely hazard conditions or create long-term environmental problems associated with contaminated soil, groundwater and surface waters. Contaminants in the environment can result in long-term exposure and human health and ecological risks associated with inhalation of contaminant vapors, through contaminated drinking water, or if released or spilled, contaminants enter the food chain resulting in dietary exposure. Airports also present a unique hazard associated with low flying aircraft. Wildlands and undeveloped areas are susceptible to forest and grass fires. Where urban development encroaches on these areas, forest and grass fires can cause significant loss of life and property. There is also the potential for human health hazards associated with construction. Use of heavy equipment during construction can increase the risk of accidents to workers or others present on or near the work area.

The transport, storage and use of hazardous materials is strictly regulated by both state and federal agencies. The Resource Conservation and Recovery Act (RCRA) provides the authority for EPA to regulate hazardous materials from cradle to grave. Under California Code of Regulation Title 22, the Department of Toxic Substances Control (DTSC) is responsible for permitting facilities that generate, transport, treat, store and disposal of hazardous waste, the local agencies may be delegated primary enforcement authority by DTSC. The California Health and Safety Code requires facilities that use or store hazardous materials prepare and maintain an inventory of hazardous materials that includes the type, quantity, and storage location of materials, prepare an emergency response plan, and train employees to safely and appropriately inspect and handle hazardous materials and the appropriate response in emergency situations.

The California Health and Safety Code also contains specific requirements on leak prevention detection and monitoring and reporting requirements. The intent of the California Occupational Safety and Health Act is to maintain a safe workplace for all employees, including safety training, safety equipment and communication including labels and signs on all hazardous materials. Cleanup of hazardous waste sites is addressed in RCRA and in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and 1988 Superfund Amendments and Reauthorization Act (SARA) amendments. Through CERCLA, EPA created a national policy and procedures to identify and cleanup sites contaminated by releases of hazardous substances known as Superfund. EPA manages the restoration and cleanup of Superfund sites. Other sites were releases of hazardous materials have occurred may fall under the jurisdiction of DTSC, the Regional Water Quality Control Board or local environmental health officials or fire departments. EPA and state agencies, DTSC and Water Boards maintain searchable databases that can be used to locate known sites were contaminants have been released into the soil, groundwater and surface waters.

Routine monitoring of surficial sediments within bays and estuaries is unlikely to result in the release of hazardous materials in quantities that would pose risk to the public or the environment. However the reasonably foreseeable methods of compliance could include the need for construction or excavation activities associated with structural stormwater BMPs such as detention ponds, infiltration basins and other treatment works on land as well as remedial actions such as dredging and capping directly within the waterbody. The locations of these future activities is unknown. As a result these activities could potentially be located within one half mile of an existing or proposed school or in the vicinity of a public or private airstrip or be located at a site recorded as a hazardous materials site. The risk associated with these actions can be minimized through mitigation described below.

Mitigation

- Utilize pollution prevention technology when possible (e.g., automatic sensors and shut-off valves, pressure and vacuum relief valves, secondary containment, air pollution control devices, double walled tanks and piping), access restrictions, fire controls, emergency power supplies, where hazardous materials and hazardous waste are stored onsite.
- Perform due diligence on those work areas where historical information on past ownership and land use practices is unknown.
- Develop, document and maintain onsite contingency plans for cleanup of spills and releases,
- Ensure all workers have pollution prevention training to ensure that the potential for accidental spills and releases are minimized and that contingency plans can be implemented.
- Avoid trucking hazardous wastes through residential areas
- Wash all vehicles and equipment before leaving site. Store and test wash water prior to disposal. Treat if required. Discharge only under permit
- Stockpile contaminated material on impervious surface, cover and berm to reduce erosion off site.

- Develop materials characterization plan to ensure excavated materials is disposed of in accordance with state and federal regulations
- Develop procedures and requirements for loading and unloading polluted sediments to eliminate potential for spillage.
- Ensure all workers and supervisors comply with applicable Occupational of Health and Safety Administration (OSHA) training requirements for site clean-up personnel.
- Prepare site-specific health and safety plans would be prepared in accordance with California Code of Regulations, title 8, section 5192 and 29 C.F.R. section 1910.120, which govern site clean-up.
- Obtain appropriate permits from federal state and local agencies

Conclusion

Implementation of corrective action or remedial action projects discussed above will require discretionary authorizations and approvals from public agencies. Detailed environmental analysis associated with individual projects will be described in the project-specific CEQA documents prepared at that time. There are reasonably foreseeable mitigation measures described above, and others, as well as those required by federal, state, and local laws and regulations that the lead agency responsible for the project level environmental review can and should adopt. These mitigation measures should mitigate any potential adverse impacts at the project level to less than-significant levels.

7.3.10 Hydrology and Water Quality

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

Water Quality Protection and Basis for Analysis

Water quality in enclosed bays and estuaries may be impacted by discharges within the waterbody or by discharges into rivers or creeks that drain into the waterbody. These discharges may include wastewater from publicly owned treatments works, urban stormwater from municipal stormwater systems, or discharges from industrial facilities or construction sites or nonpoint discharges from agriculture or other land use. Some pollutants associated with these discharges can bind to particulates in the water column and accumulate on the floor in quiescent periods. Where pollutants are accumulating from existing sources, Regional Water Boards can investigate, amend permits or take enforcement actions to ensure that a discharge is not causing or contributing to water quality degradation. Where pollutants have accumulated in sediments that are toxic to aquatic life or pose risk to other receptors, the Regional Boards can investigate, assess and take enforcement action that requires corrective action by responsible parties. Water quality objectives for surface waters within enclosed bays and estuaries have been developed and adopted by the Regional Water Boards. These water quality objectives reside within the applicable water quality control plans developed for each basin. The basin plans applicable to enclosed bays and estuaries are:

- Water Quality Control Plan for the North Coast Region
  http://www.waterboards.ca.gov/northcoast/water_issues/programs/basin_plan/083105-bp/basin_plan.pdf
- Water Quality Control Plan for the San Francisco Bay Basin
  http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/basinplan/web/docs/BP_all_chapters.pdf
- Water Quality Control Plan for the Central Coastal Basin
  http://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/current_version/2016_basin_plan_r3_complete.pdf
- Water Quality Control Plan for the Los Angeles Region (Coastal Watersheds of Los Angeles and Ventura Counties)
  http://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/basin_plan_documentation.shtml
- Water Quality Control Plan for the Sacramento and San Joaquin Rivers
  http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/2016july_1994_sacsjr_bpas.pdf
- Water Quality Control Plan – Santa Ana River Basin
  http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/2016/Basin_Plan_Table_of_Contents_Feb_2016.pdf
- Water Quality Control Plan for the San Diego Basin
  http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/index.shtml

Water and sediment quality objectives have also been adopted by the State Water Board into statewide or regional water quality control plans including:

- Water Quality Control Plan for the San Francisco Bay/ Sacramento-San Joaquin Delta
  http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/docs/2006_plan_final.pdf
- Water Quality Control Plan for Enclosed Bays and Estuaries
  http://www.waterboards.ca.gov/water_issues/programs/bptcp/sediment.shtml

USEPA has also promulgated water criteria for priority toxic pollutants applicable to federal waters in California through the National Toxics Rule (See 40 CFR sec. 131.36), promulgated on December 22, 1992 and amended on May 4, 1995) and through the California Toxics Rule promulgated May 18, 2000 (See 40 CFR sec.131.38).

Water quality objectives are implemented through permits issued by the State and Regional Water Boards. Permits issued by the State and Regional Water Boards include the following:

National Pollutant Discharge Elimination System Permits Regulated under CWA §402

Under the Clean Water Act, all point source discharges of pollutants to waters of the United States must be regulated under a permit. Thus, all point source discharges of toxic pollutants to enclosed bays and estuaries must be regulated under a National Pollutant Discharge Elimination System (NPDES) permit. Under the NPDES permit program, discharges are regulated under permits that contain both technology-based and water quality-based effluent limits. Water quality-based effluent limits are developed to implement applicable water quality standards. Applicable water quality standards for toxic pollutants include narrative and numeric objectives and CTR criteria. Typical discharges that are regulated under NPDES permits include discharges from publicly-owned treatment works and industrial facilities. In addition, storm water discharges are regulated under the NPDES permit program as summarized below.

- Municipal Stormwater Permits regulate storm water discharges from municipal separate storm sewer systems (MS4s). Large (Phase I) and small (Phase II) MS4s implement best management practices (BMPs) to comply under the program. BMPs include both source controls and treatment measures. The Clean Water Act and implementing federal regulations require MS4s subject to NPDES permits to reduce pollutants in storm water to the maximum extent practicable (MEP). The regulations require implementation of BMPs to meet the MEP discharge standard. In California, MS4 permits also require permittees to reduce the discharge of pollutants so that water quality standards are met. This is usually accomplished under a storm water management plan (SWMP).
- Industrial General Stormwater Permit regulates discharges associated with ten broad categories of industrial activities. This general permit requires the implementation of management measures that will achieve the performance standard of best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT) and achieve compliance with the water quality standards. The permit also requires that dischargers develop a Storm Water Pollution Prevention Plan (SWPPP) and a monitoring plan.
- Construction General Stormwater Permit requires dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres to obtain coverage under the general permit for discharges of storm water associated with construction activity. The construction general permit requires the development and implementation of a SWPPP that lists BMPs the discharger will use to control storm water runoff and the placement of those BMPs.

<u>Water Quality Certifications</u>

Clean Water Act section 401 allows states to deny or grant water quality certification for any activity which may result in a discharge to waters of the United States and which requires a federal permit or license. Certification requires a finding by the State that the activities permitted will comply with all water quality standards over the term of the permit. Certification must be consistent with the requirements of the Clean Water Act, CEQA, the California Endangered Species Act (CESA), and the State Water Board’s mandate to protect beneficial uses of waters of the State. The State Water Board considers issuance of water quality certifications for the discharge of dredged and fill materials. Clean Water Act section 401 allows the State to grant or deny water quality certification for any activity which may result in a discharge to navigable waters and which requires a federal permit. State Water Board regulations (Cal. Code Regs., tit. 23, §3830 et seq.) provide the regulatory framework under which the State Water Board issues water quality certifications. The Corps may not issue a Section 404 permit if the State denies water quality certification. In order to certify a project, the State Water Board must certify that the proposed discharge will comply with all of the applicable requirements of Clean Water Act sections 301, 302, 303, 306, and 307 (42 U.S.C. §§ 1311, 1312, 1313, 1316, and 1317). Essentially, the State Water Board must find that there is reasonable assurance that the certified activity will not violate water quality standards. In California, wetlands are also regulated through under Clean Water Act section 401.

Waste Discharge Requirements

Water Boards also issue waste discharge requirements for non-federally licensed dredge and fill actions. Porter-Cologne establishes a program to regulate waste discharges that could affect water quality through waste discharge requirements, conditional waivers, or prohibitions. (See Wat. Code, §§ 13243, 13263, 13269.) Waste discharge requirements for non-federally licensed dredge and fill projects contain similar prohibitions and requirements as described above for water quality certifications.

Nonpoint Source Control

Under Porter-Cologne, all waste discharges that could affect water quality must be regulated, including nonpoint source discharges of pollution. NPS pollution may originate from several sources, including agricultural runoff, forestry operations, urban runoff, boating and marinas, active and historical mining operations, atmospheric deposition, and wetlands.
Nonpoint sources in California must be regulated under waste discharge requirements (WDRs), conditional waivers of WDRs, or basin plan prohibitions. However, WDRs need not necessarily contain numeric effluent limits.

Analysis

The collection of sediment and tissue samples for monitoring purposes is unlikely to cause effects to hydrology or water quality. Although the proposed amendments do not mandate additional methods of compliance or corrective action for failing to meet the objectives, the Water Boards have the authority to issue and revise waste discharge requirements, and to issue and implement enforcement actions such as cleanup and abatement orders that could require corrective action at these sites. Failure to meet the objectives could potentially result in the need to construct stormwater BMPs, modify wastewater treatment facilities or implement sediment remedial actions. Structural controls such as detention, retention and infiltration basins attenuate runoff from impervious surfaces and reduce contaminant loading into the receiving waters. These structures can reduce impacts associated with small to moderate storms by reducing peak flows as well as sediment and sediment-bound pollutant loads. For large storms, structural controls within drainage basins must adhere to local design standards and accommodate the entire upstream watershed to ensure flood protection and safety for downstream development and infrastructure. Where soils are permeable, infiltration basins can capture urban runoff for ground water recharge and potentially restore base flow in nearby streams and creeks.

Although the proposed amendments do not mandate corrective action for failing to meet the objectives, the Water Boards have the authority to issue and implement enforcement actions such as Cleanup and Abatement Orders that could require remediation at these sites. Dredging involves the use of machinery with scooping or suction devices to remove sediment. Typical dredging methods include mechanical or hydraulic dredging. Mechanical dredging removes sediments through direct application of mechanical force to excavate the material at almost in situ densities. Sediments removed by a mechanical dredge are placed into a barge or boat for direct transport to the disposal site or staging area for drying and transfer truck or railcar for transport and ultimate disposal. Sediments can be resuspended by the impact of the bucket, by the removal of the bucket, and by leakage of the bucket. Mechanical dredging typically produces sediments low in water content while hydraulic dredging uses centrifugal pumps to remove sediments in the form of a slurry. Although less sediment may be resuspended at the removal site, sediment slurries contain a high percentage of water at the end of the pipe. The slurry is transported by pipeline to a disposal area. Removal and consolidation can involve a diked or containment structure which retains the dredged material and assures that pollutants do not migrate. Large portable settling tanks can also be used to consolidate sediment. After consolidation, disposal to an off-site location may include either upland (landfill) or containment. Considerations once the material has been dredged include (1) staging or holding structures or settling ponds, (2) dewatering issues including treatment and discharge of wastewater, (3) transportation of dredged material, (i.e., pipeline, barge, rail, truck), or (4) regulatory constraints. Capping involves subaqueous coverage of polluted sediments to contain the toxic waste at the site. Capping or Confined Aquatic Disposal (CAD) generally refers to capping polluted sediments but can also include nearshore fill or wetland creation projects where polluted sediments are not used as cover material. The evaluation process for a CAD project includes selection of an appropriate site, characterization of both polluted and capping sediments, selection of equipment and placement techniques, prediction of material dispersion during placement, determination of the required cap thickness, and evaluation of cap stability against erosion and bioturbation, and development of a monitoring program to assess the effectiveness of the capping project.

Mitigation

Mitigation measures described in Section in Section 7.3.4 Biological Resources and 7.3.8 Hazards and Hazardous Materials could mitigate the effects described above to less than significant.

Effects

Direct effects associated with compliance monitoring under the proposed amendments are not expected or anticipated. Remedial action intended to reduce exposure to contaminants in the environment, may result in short term impacts. Because of the diverse range of technologies employed, the media involved and location of the project site, it is not possible to evaluate the entire range of impacts to water quality. However, there is the probability that some remedial action projects could violate water quality standards or discharge requirements or substantially degrade water quality. Implementation of each corrective action or remedial action project discussed above will require discretionary authorizations and approvals from public agencies. Detailed environmental analysis associated with individual projects will be described in the project-specific CEQA documents prepared at that time. There are reasonably foreseeable mitigation measures described above, and others, as well as those required by federal, state, and local laws and regulations that the lead agency responsible for the project level environmental review can and should adopt. These mitigation measures should mitigate any potential adverse impacts at the project level to less than-significant levels.

7.3.11 Land Use and Planning

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
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?	❒	❒	❒	■

The California Coastal Act of 1976 provides broad authority to the California Coastal Commission to protect terrestrial and marine habitat and regulate development within the Coastal Zone. Land use planning functions are also carried out by local jurisdictions in accordance with general plans (Gov. Code § 65300 et seq.) and state zoning law (Gov. Code § 65800 et seq.). None of the reasonably foreseeable methods of compliance associated with the proposed amendments as described in Section 7.1 are expected to physically divide a community, conflict with an applicable land use plan or applicable habitat conservation or natural community plan.

7.3.12 Mineral Resources

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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?	❒	❒	❒	■

The California coastal environment is rich in mineral resources, including sand and gravel mining for construction materials, mining for industrial materials (diatomite, clay, quartz, and dimension stone) and metallic minerals (chromite, placer gold, manganese, mercury, platinum, and silver) in addition to fossil fuel deposits (oil and natural gas). The Surface Mining and Reclamation Act of 1975 establishes policies for conservation and development of mineral lands. The Act contains specific provisions for the classification of mineral lands by the State Mining and Geology Board and requires local planning agencies to incorporate the designated mineral resource zones into their general plans to ensure adequate protection for future needs. The designated mineral resource zones (MRZ) are defined below.

- MRZ1 : areas where adequate information indicates that no significant mineral deposits are present or where it is judged that little likelihood exists for their presence;
- MRZ 2: areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists;
- MRZ 3: areas containing mineral deposits, the significance of which cannot be evaluated from available data;
- MRZ 4: areas where available information is inadequate for assignment to any other MRZ.

Only land-based resources are evaluated for mineral resource zones. Though thresholds of significance vary among local planning agencies, development occurring with an area designated MRZ2 is frequently considered a significant impact. County resources consulted include the following:

- San Diego County General Plan, August 3, 2011 - http://www.sdcounty.ca.gov/pds/generalplan.html
- County of Orange General Plan updated March 22, 2011 http://ocplanning.net/planning/generalplan2005
- Revised Draft October 2013 Los Angeles County Draft General Plan 2035 – http://planning.lacounty.gov/generalplan/draft2013

- Ventura County General Plan RESOURCES APPENDIX – 06-28-11 Edition - http://www.ventura.org/rma/planning/pdf/plans/General-Plan-Resources-Appendix-6-28-11.pdf
- Santa Barbara Comprehensive Plan Environmental Resource Management Element Adopted 1980, republished May 2009 – http://sbcountyplanning.org/PDF/maps/COMP%20Plan%20Maps/Environmental%20Resource%20Management%20Element%20(ERME)/ERME2_Southcoast.pdf
- California Department of Conservation Division of Mines and Geology 1989. Mineral Land Classification Portland Cement Concrete Aggregate and Active Mines of all other Mineral Commodities in the San Luis Obispo- Santa Barbara Production Consumption Region, Special Report 162. https://archive.org/stream/minerallandclass162dupr#page/n54/mode/1up
- Sonoma County Permit and Resource Management Department - http://www.sonoma-county.org/prmd/activemap/index.htm.

Land designated as MRZ2 by the California Geological Survey or land actively mined represented a very small fraction of undeveloped coastal land from the Oregon border to the international border at San Ysidro. Only within select areas of San Diego and San Luis Obispo counties is mining actively occurring. Mining aggregate from river beds and channels is the main resource extracted. Sand and aggregate mining is known to occur within San Francisco Bay. As described previously sediment-related remedial actions could require removal action such as dredging of contaminated sediments. Contaminants are typically associated with fine grain silt and clay with relatively high organic carbon content that provide little value as a resource commodity for building roadways or other engineered need. There may be situations where corrective action is required in or near a location where sand is mined. However it is unlikely a removal action would result in the dredging of significant volume of sand, gravel or aggregate. As a result, it is unlikely that the reasonably foreseeable means of compliance described in Section 7.1 would 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 or 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.

7.3.13 Noise

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
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?				
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 in 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 in or working in the project area to excessive noise levels?	❒	❒	❒	■

The California Health and Safety Code section 46022 defines noise as "excessive undesirable sound, including that produced by persons, pets and livestock, industrial equipment, construction, motor vehicles, boats, aircraft, home appliances, electric motors, combustion engines, and any other noise producing objects." Significant impacts would occur if exposure to noise levels exceeded local standards, resulted in the generation of excessive groundborne vibration or groundborne noise levels, or significantly increased ambient noise levels in the project vicinity above existing levels. Though guidelines and thresholds have been developed by EPA and California Department of Health Services (CDHS), noise levels with few exceptions are regulated at the local level (counties, cities) through ordinances and land use planning and zoning laws.

Table 7.10. Levels of environmental noise requisite to protect public health (U.S. EPA, 1974)

Effect	Level	Area
Hearing Loss	$L_{eq(24)} \leq$ 70dB	All areas

Effect	Level	Area
Outdoor activity interference and annoyance	*$L_{dn} \leq 55$ dB*	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use
Outdoor activity interference and annoyance	$L_{eq(24)} \leq 55$ dB	*Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.*
Indoor activity interference and annoyance	*$L_{dn} \leq 45$ dB*	Indoor residential areas
Indoor activity interference and annoyance	*$L_{eq(24)} \leq 45$ dB*	Other indoor areas with human activities such as schools, etc.

$L_{eq(24)}$ represents the sound energy averaged over a 24-hour period while
L_{dn} represents the L_{eq} with a 10 dB nighttime weighting.
The hearing loss level identified here represents annual averages of the daily level over a period of forty years.

Table 7.11. California Department of Health Services Office of Noise Control Guidelines

Land Use	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
Single Family, Duplex, Mobile Homes	50 - 60	55 - 70	70 - 75	> 70
Multi-Family Homes	50 - 65	60 - 70	70 - 75	> 70
Schools, Libraries, Churches, Hospitals, Nursing Homes	50 - 70	60 - 70	70 - 80	>80
Transient Lodging - Motels, Hotels	50 - 65	60 - 70	70 - 80	>80
Auditoriums, Concert Halls, Amphitheaters		50-70		>65
Sports Arena, Outdoor Spectator Sports		50-75		>70
Playgrounds, Neighborhood Parks	50-70		67-75	>72
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50-75		70-80	>80

Land Use	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
Office Buildings, Business and Professional Commercial	50-70	67-77	>75	
Industrial, Manufacturing, Utilities, Agriculture	50-75	70-80	>75	

Category Definitions

Normally Acceptable: Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction without any special noise insulation requirements.

Conditionally Acceptable: New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Normally Unacceptable: New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

Clearly Unacceptable: New construction or development should generally not be undertaken

Guidelines such as these are used by local agencies for land use planning and provide the basis for local noise thresholds. Frequently, local agencies include additional criteria to address specific activities, duration, and specific periods and days of the week when certain noise generating activities are permitted. Other mitigation measure can include the following:

1. All construction equipment, fixed or mobile, shall be equipped with properly operating and maintained mufflers consistent with manufacturers' standards.
2. All stationary construction equipment shall be placed so that emitted noise is directed away from sensitive receptors nearest the project site.
3. All equipment staging shall be located to create the greatest distance between construction-related noise sources and noise-sensitive receptors nearest the project site.
4. Where the above measures are not successful at mitigating noise related impacts during construction, incorporate temporary acoustic barriers and baffles where necessary to alleviate noise impacts.
5. Avoid noise generating activities (e.g. jackhammering, truck loading and unloading, mobile generators) associated with construction at night within residential neighborhoods
6. Notify local residents living within 500 feet of construction site prior to significant noise generating activities and designate a noise disturbance coordinator with adequate authority to address noise complaints by implementing corrective action.

Adoption of the proposed amendments would not directly result in increased exposure to noise or ground borne vibrations. However, the reasonably foreseeable methods of compliance could include the need for construction or excavation activities associated with structural stormwater BMPs such as detention ponds, infiltration basins and other treatment works on land as well as remedial actions such as dredging and capping directly within the waterbody. These actions could potentially expose persons to noise levels in excess of standards established in the local general plan or noise ordinance or result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project. However these impacts may be mitigated to less than significant through the application of the measures described above. Construction for structural BMPs or implementation of remedial action project will require discretionary authorizations from public agencies. Detailed environmental analysis associated with individual projects will be described in the project-specific CEQA documents prepared at that time. There are reasonably foreseeable mitigation measures above, as well as those required by federal, state, and local laws and regulations, that the lead agency responsible for the project level environmental review can and should adopt. These mitigation measures should mitigate any potential adverse impacts at the project level to less than-significant levels.

7.3.14 Population and Housing

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
POPULATION AND HOUSING -- Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	❐	❐	❐	■
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	❐	❐	❐	■
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	❐	❐	❐	■

The proposed amendments address the assessment and management of subtidal sediments within enclosed bays and estuaries of California. The reasonably foreseeable methods of compliance described in Section 7.1 are unlikely to induce substantial population growth, or to displace substantial housing or people.

7.3.15 Public Services

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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	❐	❐	❐	■

The proposed amendments address the assessment and management of subtidal sediments within enclosed bays and estuaries of California. The reasonably foreseeable methods of compliance described in Section 7.1 are unlikely to result in substantial adverse physical impacts to police, fire, schools parks or other public facilities or result in the need for new or expanded facilities.

7.3.16 Recreation

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
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?	❒	❒	❒	■

The proposed amendments address the assessment and management of subtidal sediments within enclosed bays and estuaries of California. The reasonably foreseeable methods of compliance described in Section 7.1 would not result in the increased use of neighborhood or regional parks or lead to the construction of new facilities or the expansion of existing facilities.

7.3.17 Transportation and Traffic

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
TRANSPORTATION/TRAFFIC -- Would the project:				
a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including, but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?	❒	❒	❒	■
b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards 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) Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?	❒	❒	❒	■

Adoption of the proposed amendments will not directly influence ground air or vessel transportation. However, the reasonably foreseeable methods of compliance could include the need for construction or shallow excavation activities associated with structural stormwater BMPs such as detention ponds, infiltration basins and other treatment works on land as well as remedial actions such as dredging and capping directly within the waterbody. Both ground and vessel traffic may be impacted over the duration of these construction activities.

Movement of dredge material and transport of equipment to and from a site as well as construction activities associated with work on stormwater infrastructure and treatment systems may impact traffic on local roadways or within the right-of-ways that could result in significant delays that may not be avoidable. Many coastal communities are densely populated and rely on a few highways such as Pacific Coast Highway to connect coastal towns and cities. As these roads are already highly affected by traffic during much of the year, any disruption even short term can cause significant delays and traffic issues that extend far beyond the immediate site out into the community. Therefore, it is possible that significant transportation and traffic impacts may occur with implementation of a particular desalination facility, triggering the need to impose mitigation measures. It is possible that some of these impacts could be significant and unavoidable.

Ground transportation mitigation measures can include the following:

- Prepare traffic control traffic management plan in accordance with state and local agency standards.
  - Ensure emergency vehicles and evacuation routes are fully accessibly at all times
  - Provide signage, warning lights, flagger and pavement striping as necessary to ensure safe merging of construction traffic
- Notify emergency and safety service providers of construction activities, duration and timing and affected roads and highways, as well as identification of alternative routes
- Notify public through news print, television and social media describing the duration and timing and affected roads and highways, as well as identification of alternative routes
- Provide rideshare opportunities for construction workers or adequate off street parking to reduce localized parking impacts.
- Where trucks are used to transport excavated materials or dredge materials, limit vehicle trips during peak traffic hour. Consider performing loading and trucking operations at night in nonresidential areas.

- If trucking hazardous material prepare and implement a hazardous materials transportation spill and safety plan

Vessel transportation mitigation measures can include the following

- Notify Coast Guard, Harbor Master, local law enforcement and fire department of project related activities and schedules. Update agencies on daily basis with changes to schedule and work area locations.

Implementation of corrective action or remedial action projects discussed above will require discretionary authorizations and approvals from public agencies. Detailed environmental analysis associated with individual projects will be described in the project-specific CEQA documents prepared at that time. There are reasonably foreseeable mitigation measures above, as well as those required by federal, state, and local laws and regulations, that the lead agency responsible for the project level environmental review can and should adopt. These mitigation measures should mitigate any potential adverse impacts at the project level to less than-significant levels.

7.3.18 Utilities and Service Systems

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
UTILITIES AND SERVICE SYSTEMS -- Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	■	❒	❒	❒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	■	❒	❒	❒
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	■	❒	❒	❒
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?	■	❐	❐	❐

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 or 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.

Although the proposed amendments do not mandate the construction of wastewater treatment facilities, failure to meet the objectives within the assessment framework could potentially result in additional controls and treatment to reduce the discharge of pollutants into waterbodies. Discharge reductions can be accomplished through (1) treatment process optimization (measures facilities can implement to modify or adjust the operating efficiency of the existing wastewater treatment process - such measures usually involve engineering analysis of the existing treatment process to identify adjustments to enhance pollutant removal or reduce chemical additional); (2) waste minimization/pollution prevention costs (conducting a facility waste minimization or pollution prevention study); (3) pretreatment (conducting study of sources and reducing inflow from indirect discharges); or (4) new or additional treatment systems. As stated previously in Section 7.1, it is unlikely that treatment plants that comply with the CWA, the Water Code, the toxic pollutant criteria in the CTR, the implementation provisions in the SIP, and basin plans will cause exceedances of the SQOs as implemented through the proposed assessment framework.

Where dry weather capacity exists within the wastewater plant and system, stormwater dry weather flow is frequently diverted to the sanitary sewer to minimize the pollutant loading to the receiving water associated with urban dry weather runoff. This measure is only implemented during dry weather and only where capacity exists to treat the flows. These flows are typically a small fraction of the overall plant capacity and influent flow.

In some cases, the cleanup of sites may generate significant amounts of waste materials that could be disposed in an appropriately designated solid waste disposal site. This could create increased demand for landfill capacity. In order to assess the potential effect to landfills, the areal extent and volume of sediment should be characterized. Once this is done, project impact to landfill capacity can be evaluated. If estimates exceed capacities, plans for alternative sites or other alternative means of disposal to remove impact should be evaluated (e.g., land based confined disposal facilities, capping confined aquatic disposal, wetland restoration, levee reuse). Alternatively, the material could be treated onsite or in a staging areas to reduce the concentrations of contaminants in sediment to levels that would allow more disposal options to be considered. With more disposal options, available reliance on landfills with little or no capacity to handle the project in addition to normal or routine solid waste as well as future projects would be unnecessary and additional mitigation would be unnecessary. Solid waste disposal measures would be identified on a case-by-case basis during the project specific CEQA review.

7.4 Mandatory Findings of Significance

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
MANDATORY FINDINGS OF SIGNIFICANCE -- Would the project:				
a) 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 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 cumulatively considerable? ("Cumulatively means that 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 probably future projects)?	❐	❐	❐	■
c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly?	■	❐	❐	❐

The proposed amendments do not mandate any actions or projects that would lead to significant, permanent, negative impacts on the environment. As described in previous sections, significant adverse environmental impacts are unlikely to result from the requirements for sampling, testing, and sediment quality assessment.

If, however, permittees or responsible parties are required to institute additional controls or initiate corrective actions because the assessment outcome results in impacted or degraded sediment quality, these actions could result in potentially significant environmental impacts.

There are reasonably foreseeable mitigation measures identified in Sections 7.3.1 thru 7.3.17 above, as well as those required by federal, state, and local laws and regulations, that the lead agency responsible for the project level environmental review can and should adopt. These mitigation measures should mitigate any potential adverse impacts at the project level to less than-significant levels.

The project is unlikely to result in cumulative impacts. Where the project addresses pollutants in waterbodies that are already addressed through a TMDL, those waterbodies would not be affected by the proposed provisions.

7.5 Preliminary Staff Determination

PRELIMINARY STAFF DETERMINATION:	
The proposed project **COULD NOT** have a significant effect on the environment and therefore no alternatives or mitigation measures are proposed	☐
The proposed project **MAY** have a significant or potentially significant effect on the environment, and therefore alternatives and mitigation measures have been identified	■

7.6 Alternative Analysis

State Water Board certified regulatory programs require that the Staff Report contain “An analysis of reasonable alternatives to the project and mitigation measures to avoid or reduce any significant or potentially significant adverse environmental impacts” (Cal. Code Regs., tit. 23, § 3777, subd. (b)(3)). The alternatives should feasibly meet the project objectives (stated in Section 2.2), but avoid or substantially reduce any potentially significant adverse environmental impacts (Cal. Code Regs., tit. 14, § 15126.6 (a)).

Alternative 1 – No Project

CEQA requires that the State Water Board consider the “No-Project” alternative. The no project alternative would leave the discretion to the Regional Water Boards to determine how sediment quality would be assessed in relation to the SQO protecting human consumers of resident sportfish. As described in Section 2.6, the existing requirements require that the narrative SQO be implemented on a case-by-case basis based on human health risk assessment in accordance with existing guidance and information from OEHHA, DTSC, or U.S. EPA. As explained in Section 7.3, a case-by-case approach relies on significant best professional judgment and provides little consistency across waterbodies or regions. Because of the many different factors that affect food web bioaccumulation and human health risk assessment, the “no project” case-by-case approach could result in assessments that result in more sediment exceeding the SQO protecting human consumers of resident sportfish on an area basis, or less in comparison to the proposed project depending upon how the particular assessment was performed, fish and consumer population of interest and other factors (Section 7.3). This in turn would affect outcomes associated with the program-specific implementation of receiving water limits, listings and delistings for impaired waters, development of TMDLs and associated targets as well as remedial action. This alternative would not meet project goals Nos. 3 and 4 as defined in Section 2.3. Further, because of the inherent subjectivity of the case-by-case approach, this alternative may not always meet Nos.1 and 2. A qualitative comparison of the outcomes associated with the existing approach (no project alternative) in comparison to the outcomes associated with the proposed approach is described in Section 7.3. As stated in that Section 7.3, there may be some scenarios or outcomes where the implementation of the proposed amendments require more frequent compliance actions or larger compliance actions (more extensive remediation of sediment within a waterbody) in comparison to the no project alternative. As described in Sections 7.3.1 -7.3.17, effects to the environment could be caused by these compliance actions.

Alternative 2 – Numeric Contaminant Specific Chemical Thresholds for Sediment

Under this alternative, the Water Board could adopt sediment chemistry thresholds to implement the SQO protecting human consumers of resident sportfish. Under this approach values could be derived by back-calculating sediment thresholds using the tissue thresholds and BSAFs. The equation is included as Equation 4 of the Appendix A. As these thresholds are derived from the human health risk assessment conducted by OEHHA, the statutory requirements of Wat. Code, § 13393 as described in Section 4.1.2 would be met.

Numeric concentration based thresholds are routinely used in water quality and relatively straightforward to implement. However numeric sediment thresholds developed to protect higher trophic levels exposed via trophic transfer are not considered reliable because bioavailability and bioaccumulation are complex processes that are driven by many physical, chemical and biological processes as described in Section 3. State Water Board staff are unaware of any numeric sediment quality objectives, criteria or standards adopted in regulation that were developed to protect higher trophic levels from the bioaccumulation of contaminants in sediment and into the food chain. Oregon Department of Environmental Quality developed numeric screening levels in 2007 (Oregon Department of Environmental Quality, 2007) for human and a variety of wildlife classes. However, those values are intended only to be used for screening level purposes and do not constitute rule-making by the state’s Environmental Quality Commission. New York State Department of Environmental Conservation Division of Fish, Wildlife and Marine Resources Bureau of Habitat has also developed bioaccumulation-based sediment guidance values (New York State Department of Environmental Conservation, 2014).

As described in Section 3, and further described by Moore, et al (2014), sediment chemistry thresholds intended to protect high trophic levels from bioaccumulation of contaminants in sediment are used as screening tools in specific cases but have greater uncertainty and variability than thresholds intended to protect aquatic life from direct exposure bioassay type studies. Further, these sediment-derived values do not provide any information on the actual exposure that human consumers of resident sport fish may be receiving. This alternative would not meet project goals Nos. 3 and 4 as defined in Section 2.3. In those cases where the fish tissue chemistry does not exceed human health risk consumption thresholds but sediment chemistry exceed the numeric threshold, corrective action could be required by a Regional Water Board under this alternative where none would really be necessary under the staff recommended alternative. In these cases, the environmental impacts to air quality, biological resources, hazardous materials and water quality would be greater than the staff recommended alternative.

Alternative 3 – Numeric Contaminant Specific Chemical Thresholds for Tissue

Under this alternative, the Water Board could adopt tissue chemistry thresholds to implement the SQO protecting human consumers of resident sportfish, such as those tissue thresholds based on OEHHA Advisory Tissue Levels or Fish Contaminant Goals that provide the basis for the exposure assessment in Tier 1 and Tier 2 (Table 4.2). These thresholds are based on a human health risk assessment conducted by OEHHA and thus, would also meet the statutory requirements of Wat. Code, § 13393 as described in Section 4.1.2. Although such an approach may serve to protect human consumers from contaminants in fish, an approach based only on fish tissue does not address the site linkage. As described in Sections 6.5.1 thru 6.5.5, site linkage establishes a relationship between contaminants at the site and those in the fish tissue. Without site linkage, there would be little value added to the SQO assessment. This alternative would not meet project goals Nos. 3 and 4 as defined in Section 2.3. Further, in those cases where the fish tissue chemistry exceeds human health risk consumption thresholds but sediment chemistry falls below thresholds indicative of site contribution, corrective action could be required by a Regional Water Board under this alternative where none would really be necessary under the staff recommended alternative. In these cases, the environmental impacts to air quality, biological resources, hazardous materials and water quality would be greater than the staff recommended alternative.

7.7 Findings

Although the proposed amendments could result in significant environmental effects related to reasonable means of compliance, these effects are expected to be less than the alternatives described above. Further, unlike the alternatives described above, the recommended alternative fulfills all the project goals as described in Section 2.3.

8 CWC Section 13241 and Antidegradation

The State Water Board must analyze the factors described in section 13241 of the Water Code when establishing water quality objectives. Chapter 5.6 requires that the State Water Board adopt SQOs “pursuant to the procedures established by [Division 7] for adopting or amending water quality control plans.” (Wat. Code §13393(b).) While the State Water Board is not proposing to adopt or amend an objective and is therefore not statutorily required to comply with the substantive requirements for adoption of water quality objectives, the State Water Board has, nevertheless, considered the section 13241 factors. In addition, the State Water Board must ensure that its actions are consistent with Resolution No. 68-16, the state’s antidegradation policy.

8.1 Past, Present, and Probable Future Beneficial Uses of Water

Adoption of the proposed amendments will better protect sediment quality for all of the beneficial uses that focus on protecting humans from exposure to contaminants through consumption of fish tissue from bays and estuaries of California. The proposed amendments will compliment and support the Water Boards’ existing water quality control plans and policies, and provide greater consistency and level of protection across the regions.

8.2 Environmental Characteristics of the Hydrographic Unit

The proposed amendments to implement the SQOs account for the characteristics within each hydrographic unit. The proposed framework is intended to address waterbody specific characteristics including differences in the bioavailability of contaminants based upon the physical, chemical and microbiological processes affecting contaminants in sediments and water column, bioaccumulation and trophic transfer associated with the predator-prey relationships of interest, and the contribution of contaminants over the forage area. Both the existing language and proposed amendments provide direction on how the proposed SQO shall be implemented within the regions. However, the Regional Water Board retains the authority and flexibility to apply the SQO in the appropriate regulatory program. Neither the existing language nor amendments describe how a particular site should be corrected or remediated. Selection of corrective action can be addressed only after many site-specific factors are considered such as:

- The hydrodynamics and flow regime in the area of concern
- The specific pollutant that is causing the degradation or impairment
- The receptors at risk due to the presence of the pollutants at the levels observed within the area of concern.
- The aerial extent
- Presence of existing sources or legacy releases
- Types of controls in place and feasibility of additional controls.

8.3 Water Quality Conditions that could Reasonably be Achieved

This section describes the water quality conditions that could reasonably be achieved through the coordinated control of all the factors that affect water quality in the area.

Wastes have been discharged into bays and estuaries either directly as point sources, indirectly as runoff, or accidentally through releases and spills since the growth of industry first occurred in and adjacent to bays and estuaries of California over a century ago. As described in Section 3, many contaminants readily attach to the sediments and organic carbon and are carried down rivers and creeks contributing to the contaminant loading into bays from upstream sources. Once these sediments reach the bays and estuaries, poor flushing and low current speeds allow the sediments and contaminants to settle before reaching the open ocean. The State and Regional Water Boards are required to ensure that all discharges, regardless of type, comply with all water quality control plans and policies. If the proposed amendments are adopted into a permit as a receiving water limitation, the discharge must meet the limits or, if the limits are is not being met, the permittee would be required under existing authority to control the pollutant to the extent practical through BMPs or additional treatment. This same approach would occur if multiple discharges are contributing to the pollutant's accumulation as well. Where the proposed amendments are used to support a Regional Water Boards decision to issue a Cleanup and Abatement Order, the proposed amendments could be used to support and inform the development of cleanup goals in order to improve sediment and water quality. As described in Section 4.2.1, State Water Board Resolution 92-49 provides the basis for developing cleanup levels.

8.4 Economic Considerations

Incremental economic impacts of the proposed amendments if adopted include the costs of activities above and beyond those that would be necessary in the absence of the amendments under baseline conditions, as well as any cost savings associated with actions that will no longer need to occur (e.g., through more accurate assessment procedures). Assessments of impairment, controls, and sediment cleanups to reduce pollution in waters impaired under baseline conditions would continue in the absence of the Plan amendments and as a result, are not incremental impacts associated with the proposed SQO amendments. Three significant amendments in the proposed Plan can have an incremental impact on the current Policy. These include

- Revised approach to interpret human health objectives for organochlorine pesticides and PCBs. The proposed amendments introduce a tiered framework to assess the level of detrimental effect that a contaminated sportfish can pose to human consumers. If adopted, this new approach is likely to result in an additional cost.
- Changes to 303(d) listing and delisting process, the proposed modification in the existing 303(d) listing and delisting process may also cause an additional cost.
- Change in regional sediment quality monitoring frequency. The change in regional sediment monitoring frequency is likely to result in reduced cost.

A detailed economic analysis describing the impact these factors have on incremental economic impacts is provided in Appendix B. While the proposed amendments would require additional monitoring of fish tissue and sediment chemistry, the overall reduction in sampling frequency could result in decreased costs. However, these changes establish a minimum frequency for sampling, meaning a Regional Water Board can require more frequent monitoring in those waterbodies where that information is critical to the management of the site or segment within the water body. As a result, actual cost reductions may not be realized. In addition, many of the waterbodies affected by the proposed amendments are under existing TMDLs and as a result would not be applicable in those waterbodies (e.g. Greater Los Angeles and Long Beach Harbors and San Francisco Bay). As described in Section 7, the proposed amendments do not require corrective action once an exceedance of an SQO is reported. Rather, the Regional Water Boards determine what actions are necessary and those possible actions vary significantly in terms of costs. As a result, it would be speculative to estimate incremental economic impacts associated with corrective action.

8.5 Need for Developing Housing within the Region

The adoption of the proposed amendments is not expected to increase the need for housing in the areas surrounding enclosed bays and estuaries of California. The proposed amendments apply only to the protection of subtidal sediments within specific surface types of waters; enclosed bays and estuaries.

8.6 Need to Develop and Use Recycled Water

The adoption of the proposed amendments to the Sediment Quality Provisions are not expected to increase the need to develop and use recycled water. The proposed amendments apply only to the protection of subtidal sediments within enclosed bays and estuaries.

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9 Antidegradation

In 1986, the State Water Board adopted Resolution No. 68-16, entitled “Statement of Policy with Respect to Maintaining High Quality of Waters in California.” The policy expresses the State Water Board’s intent that the quality of existing high quality waters be maintained to the maximum extent possible. Lowering of water quality is allowed only if the lowering is consistent with the maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial uses of waters, and will not result in water quality less than that prescribed in applicable policies. Resolution No. 68-16 has been interpreted to incorporate the provisions of the federal antidegradation policy as well, where the federal policy applies.

The federal policy, in 40 C.F.R. §131.12, establishes three tiers of water quality protection and, like Resolution No. 68-16, allows a lowering of water quality for high quality waters only if certain conditions are met. The state and federal antidegradation policies must be considered for a variety of actions, including water quality standards actions.

The State Water Board does not anticipate any lowering of water quality as a result of the adoption of proposed amendments to Part I. By adopting these amendments the state will have a sediment quality objective protecting human consumers of resident fish that will finally be supported by a prescriptive, reliable and consistent framework applicable to enclosed bays and estuaries of California. Furthermore, by incorporating standards thresholds for the human health risk component of the assessment based on OEHHA consumption guidance and providing a consistent foodweb based approach to evaluate site contribution, staff believes the proposed assessment framework will be more precise resulting in fewer mischaracterized sites as described in Section 7.3 and greater consistency in determinations from one region to the next. As a result, the proposed assessment framework is likely to be more protective, vis-à-vis sediment quality, than the current approach based on best professional judgment.

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Appendix A: Draft Amendments

Appendix B: Economic Analysis