California Water Boards

Protecting California's Water

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

JUNE 5, 2018

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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 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 No. 2008-0070) and 2011 (Resolution No. 2011-0017) and has continued working on the development of associated assessment tools and a policy of implementation as described in this document.

[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.

2.3 Project Goals

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 No. 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

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 CalEPA 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.

2.11 Public and Peer Review Comments

On October 24, 2017 the availability of the draft Staff Report and proposed amendments for review and public comment were noticed and documents posted on the State Water Board's website. Presentations by staff technical team and end users as well as oral comments on the proposed amendments were heard at the December 5, 2017 Public Hearing held in Sacramento California. Written comments were accepted by the Clerk to the State Water Board until the close of the comment period on December 14, 2017.

The State Water Board held a public hearing on December 5, 2017, at which only one speaker commented on the proposed amendments. A representative of San Francisco Baykeeper opposed the "grandfathering" language, which limits applicability of implementation provisions for the human health SQO for chlorinated pesticides and polychlorinated biphenyls (PCBs) to water bodies for which a Total Maximum Daily Load (TMDL) has been established on or before the effective date of the proposed amendments, citing the need to reevaluate the assessment and conceptual model that served as the basis for existing TMDLs for San Francisco Bay.

The State Water Board received eleven comment letters by December 14, 2017. (See comment letters posted here: https://www.waterboards.ca.gov/water_issues/programs/bptcp/comments20171214.html)

Written responses to public comments are provided in Appendix C. Common issues included:

1. Support for the Proposed Assessment Framework – A few letters supported the proposed assessment framework for human health and use of OEHHA based tissue thresholds.
2. TMDL Grandfathering - Grandfathering waterbodies with existing TMDLs from reassessment with the new SQO framework was opposed by multiple organizations. As currently written, the proposed amendments allow each affected Regional Water Board to determine if reevaluation of a waterbody with existing TMDL with the proposed assessment framework is warranted. Staff does not support the requested change and recommend retaining the proposed provisions grandfathering all waterbodies with existing TMDLS for organochlorine pesticides and PCBs.
3. Application of Possibly Impacted Site and Station Category - Designating Possibly Impacted sites or stations as unimpacted, and not applying those results to 303(d) listings or in the evaluation of receiving water limitations. Staff does not support this request as the basis for this language is consistent with existing provisions adopted in 2008.
4. Clarification of Site Linkage Thresholds – The Site Linkage Table was difficult to interpret, and as a result the table was revised to present ranges of distribution exceeding the threshold. Staff supported the request for clarification.
5. Benthic SQO Proposal to Apply a Spatial Extent Threshold of 15% by Area - Multiple letters opposed the use of a threshold of 15% extent by area for implementation of the direct effects assessment and some suggested that the majority of a segment reach or waterbody should be degraded before listing or before management action is required. Staff does not support this request, as that approach would not be protective of the environment and the implementation of the proposed provisions would be similar in outcome to the existing provisions adopted in 2008

Peer review was completed March 22, 2018. The reviewers consisted of:

- Gary A. Buchanan, Ph.D. New Jersey Department of Environmental Protection Division of Science, Research and Environmental Health, Trenton, NJ
- Elaine M. Faustman, Ph.D. Professor, Dept. of Env. & Occ. Health Sciences School of Public Health University of Washington, Seattle, WA 98105
- Valery E. Forbes, Ph.D. Dean, College of Biological Sciences University of Minnesota St. Paul, MN
- Robert J. Letcher, Ph.D. Adjunct Research Professor Departments of Biology and Chemistry, Carleton University, Ottawa, ON Canada

Each reviewer was asked to review specific conclusions that provide the scientific basis and underpinnings for the proposed provisions based on education and experience. In general, each reviewer agreed with the specific scientific conclusion asked to address. The two common issues were: 1) the limited group of contaminants addressed within the assessment framework and 2) the use of the maximum concentration when less than three samples are used to characterize a site. While the list of contaminants could only be expanded in future phases as resources are made available, the provision applying the maximum concentration for sample sizes less than three samples has been removed. Now the provisions state that samples size of less than three samples cannot be used. In several instances, the commenters requested clarification and/or additional explanation on details of the assessment framework. As a result, additional edits were made to this staff report and proposed provisions (Appendix A). Responses to peer review comments are included in Appendix C.

2.12 Post-Hearing Issues identified by Staff and Technical Team

In reviewing the proposed Sediment Quality Provisions, staff and the technical team identified some errors and omissions. Staff had inadvertently omitted biota-sediment accumulation factors for white catfish in the benthic piscivory guild in Table 17 for Tier 1 as well as the home range in Table A-8.6 of the proposed amendments presented in Appendix A. As white catfish is an important species for assessments within estuaries, these values are critical for those waterbodies as only one other species (carp) is included in the framework.

The second change was the identification of clerical errors in the bioaccumulation model parameters. The version of the bioaccumulation model applied to the October 23, 2017 amendment contained incorrect values for four parameters related to digestive efficiency in plankton and fish (alpha and beta). These values were published in Gobas et al. 2010, the publication describing the development and validation of the San Francisco Bay PCB bioaccumulation model that was adapted for use as the SQO model. However, staff did not notice that the publication contained two versions of these parameters. In confirming the accuracy of our SQO model with the San Francisco Bay model described in Gobas et al 2010, this issue was discovered and the technical team determined that the values originally selected for use in the SQO model did not match those used in the SF Bay model. Subsequent investigation determined that the alternate set of model values matched those originally used in the SF Bay model. Confirmation that the revised values are correct was demonstrated by obtaining the same output for both models when the same set of input data was analyzed. This oversight also has an impact on the Tier 1 BSAF table, as those values were calculated prior to discovering this discrepancy. Use of the revised alpha and beta values affects all the BSAF results (higher) because these terms are used multiple times for each dietary guild. All BSAF values have been recalculated and are included in the revised Table 17.

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.

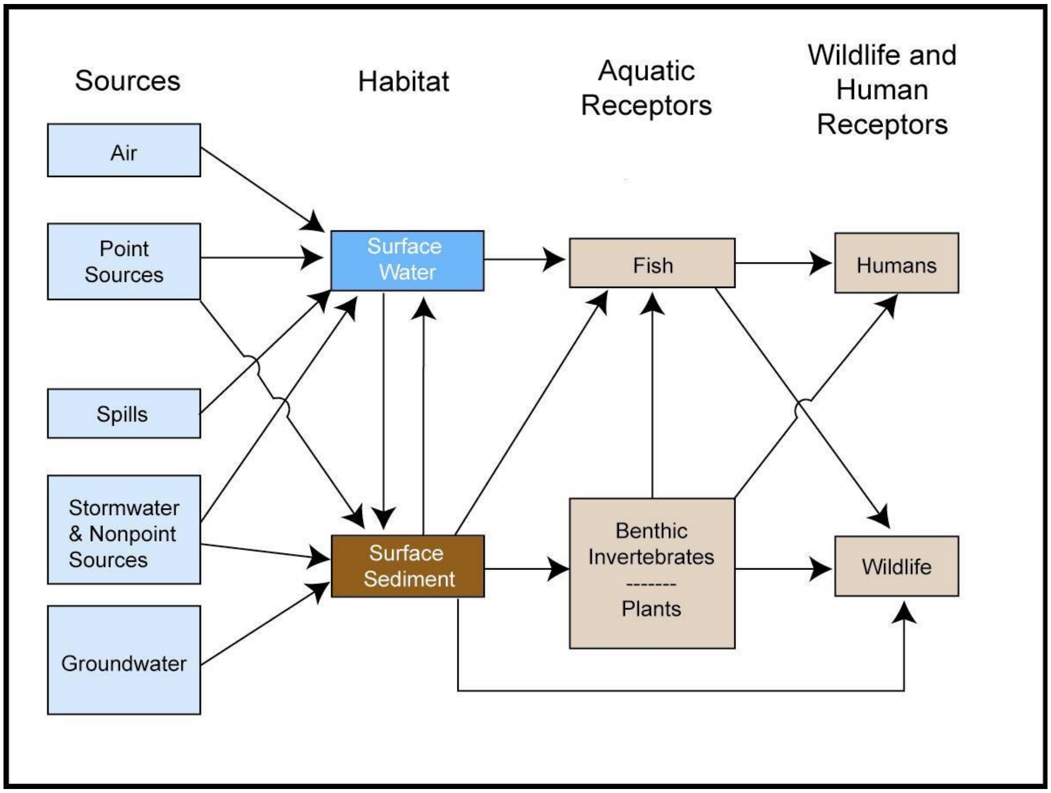


Figure 3.1. Principal Sources, Fates, and Effects of Sediment Contaminants in Enclosed Bays and Estuaries (Adapted from Bridges et al. 2005)

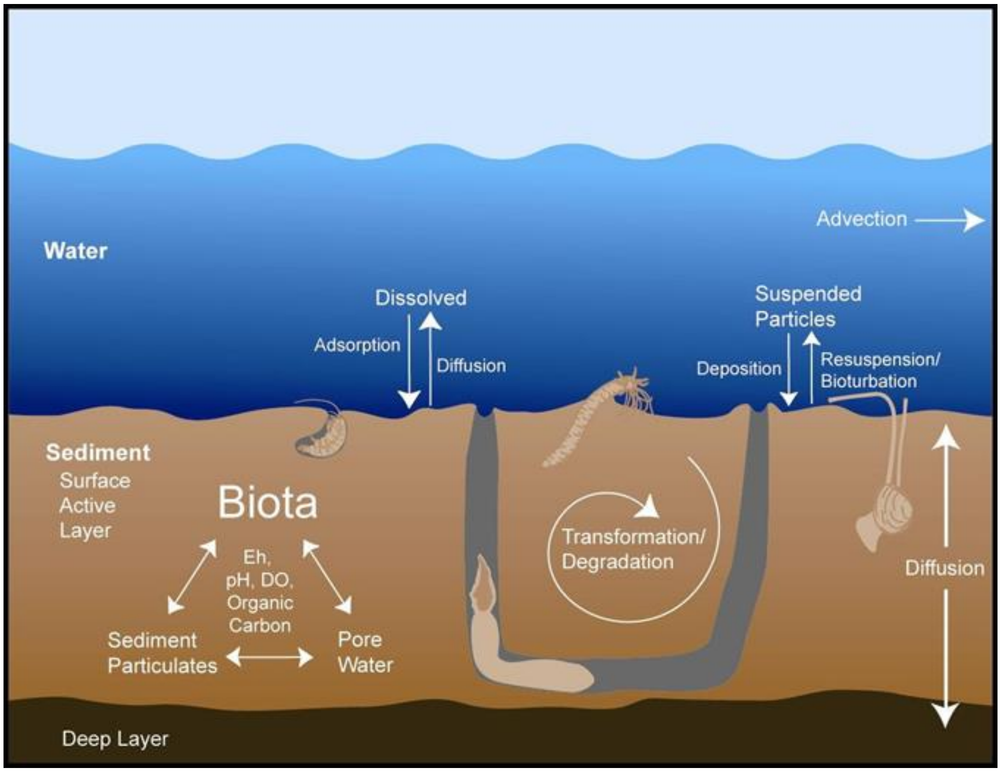


Figure 3.2. Sediment Processes Affecting the Distribution and Form of Contaminants

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 and organochlorine pesticides 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.

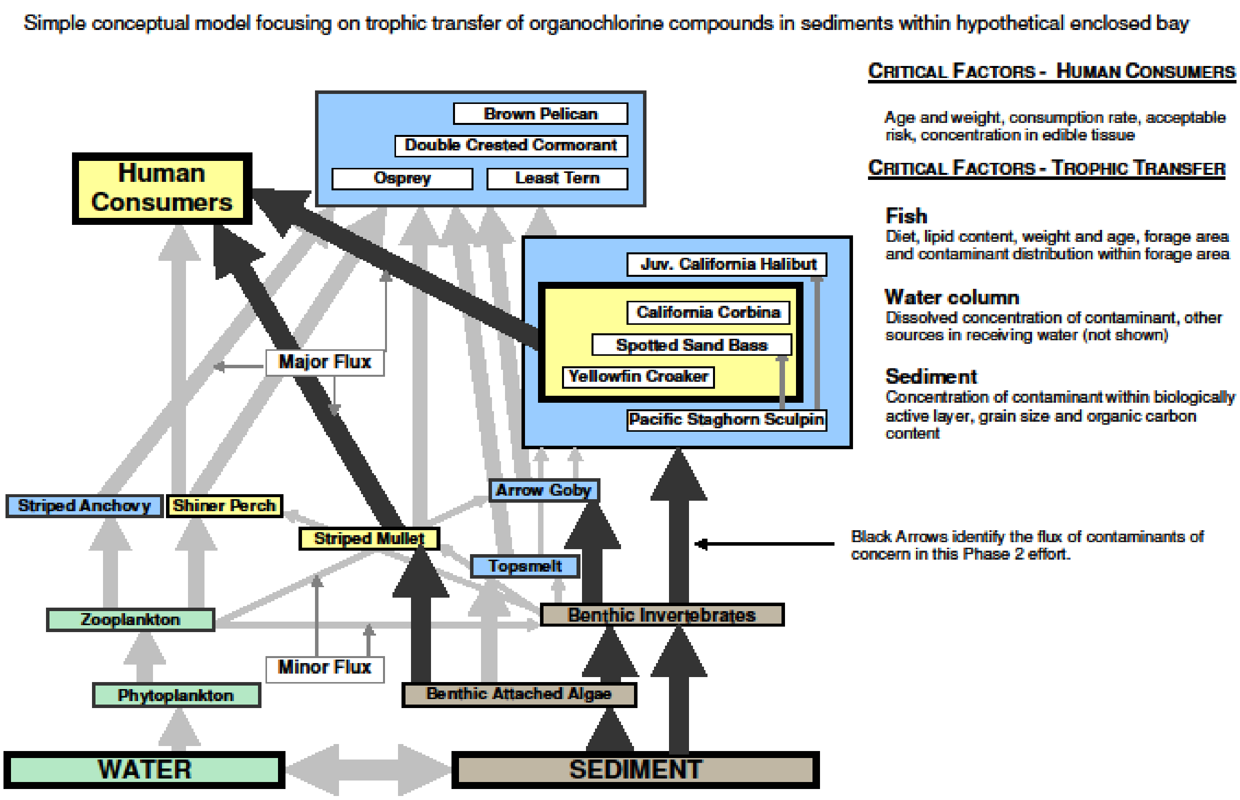


Figure 3.3 Trophic Transfer within an Enclosed Bay

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. See http://www.sccwrp.org/ResearchAreas/RegionalMonitoring.aspx
- **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. See http://www.sfei.org/rmp

- **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. See https://www.waterboards.ca.gov/water_issues/programs/swamp/
- **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. See https://www.portofsandiego.org/environment/environmental-downloads/regional-harbor-monitoring-program.html
- **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. See http://www.cclean.org
- **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. See https://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/delta_regional_monitoring/
- **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 = <u>TC</u> x <u>CR</u> x CSF x (ED/AT) x CRF / BW (Equation 1)

Non-carcinogens

HQ = <u>TC</u> x <u>CR</u> 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.

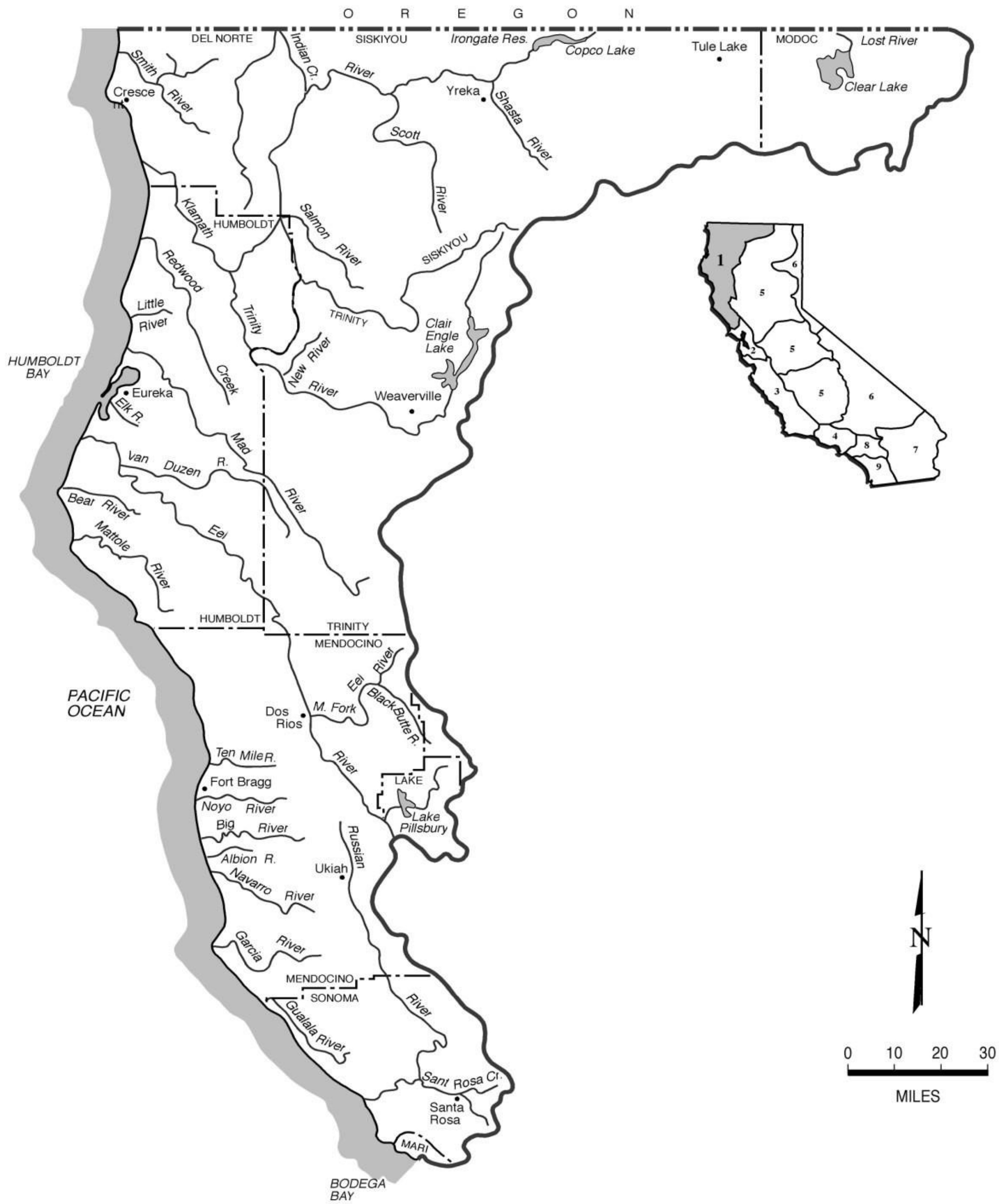
Tidelands and marshes are extremely important to many species of waterfowl and shore birds, both for feeding and nesting. Cultivated land and pasturelands also provide supplemental food for many birds, including small pheasant populations. Tideland areas along the north coast provide important habitat 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.

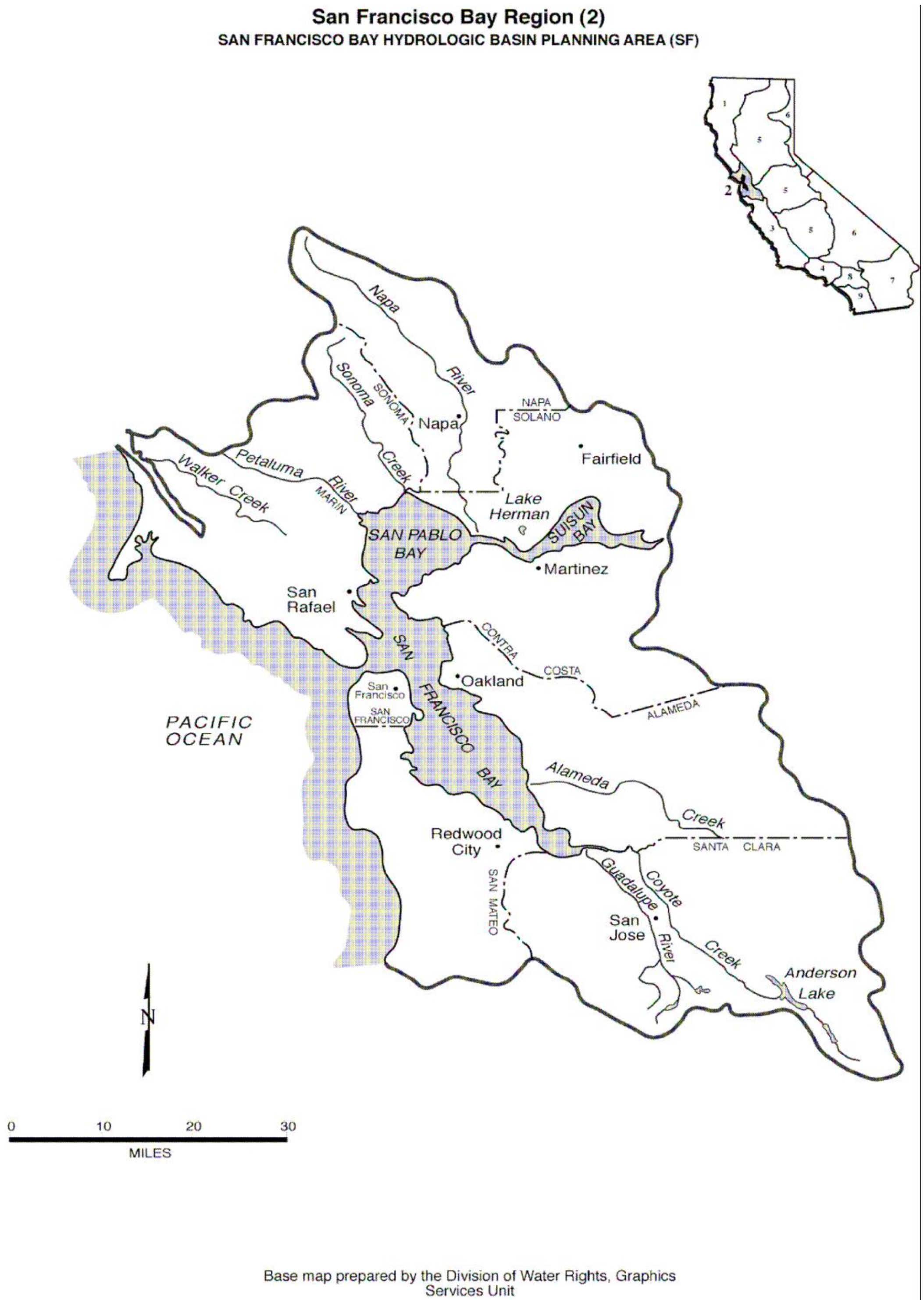


Figure 5.2. San Francisco Bay Region

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 U.S. EPA 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).

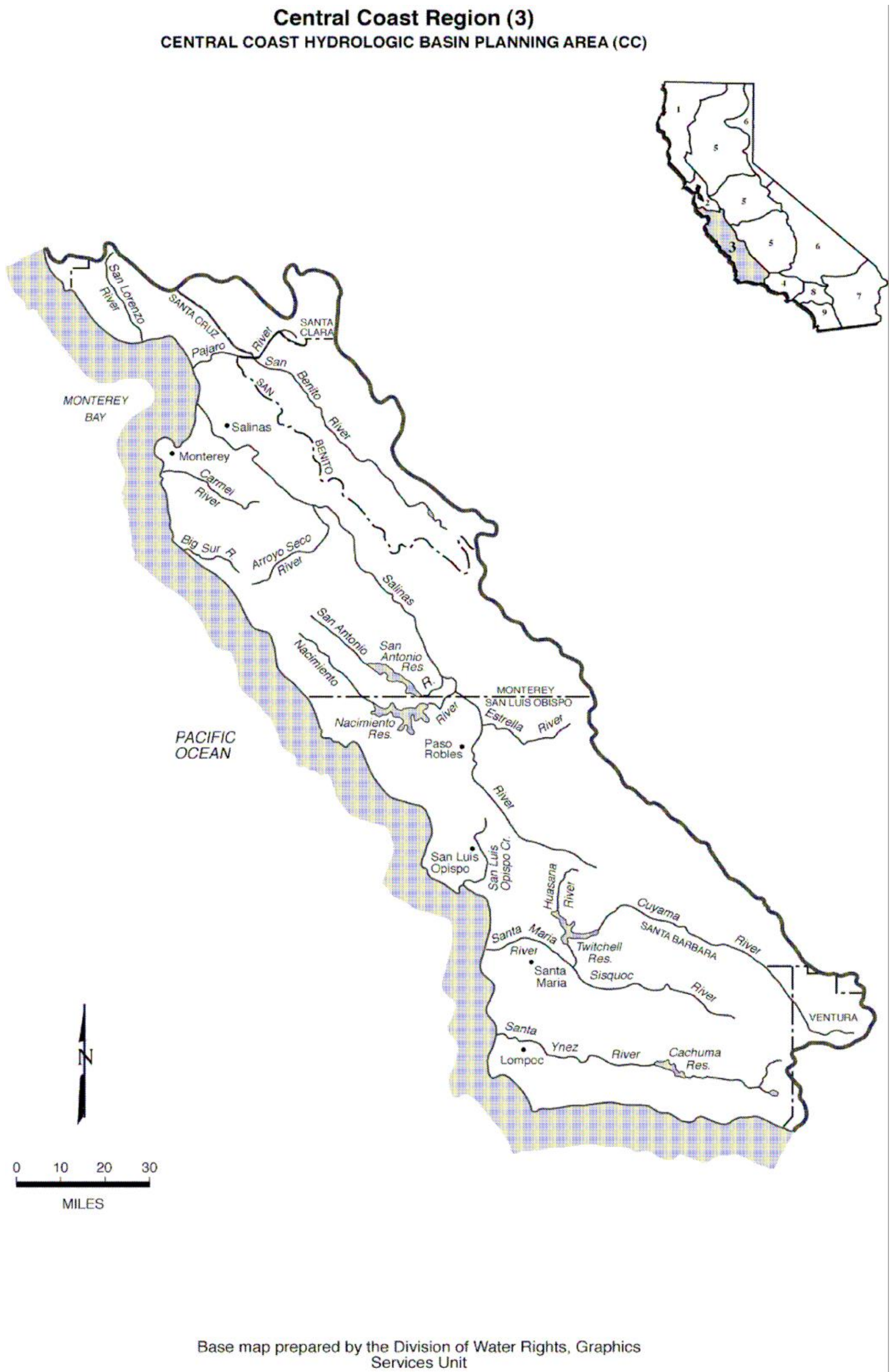


Figure 5.3 Central Coast Region

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

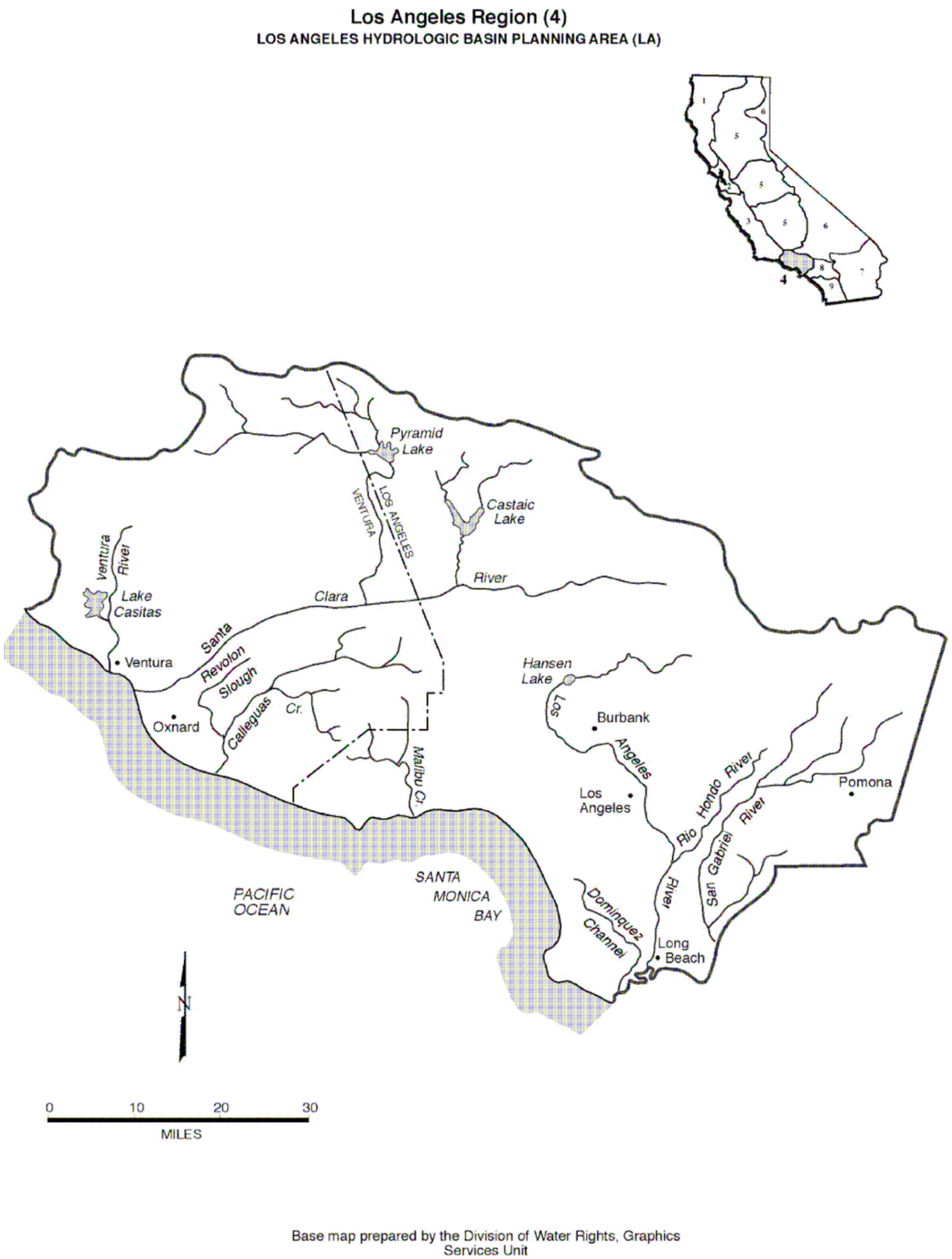


Figure 5.4. Los Angeles Region

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 U.S. EPA 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

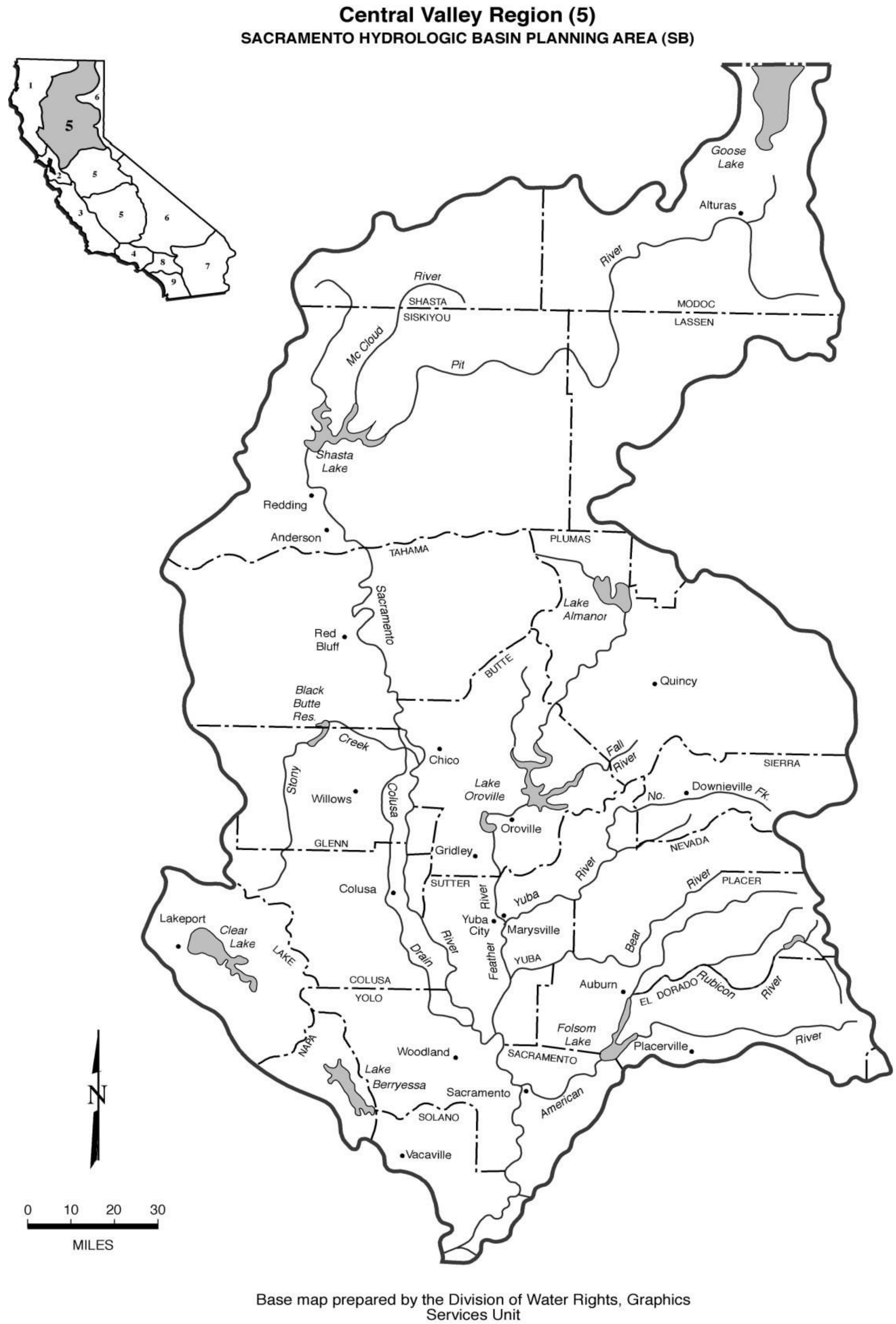
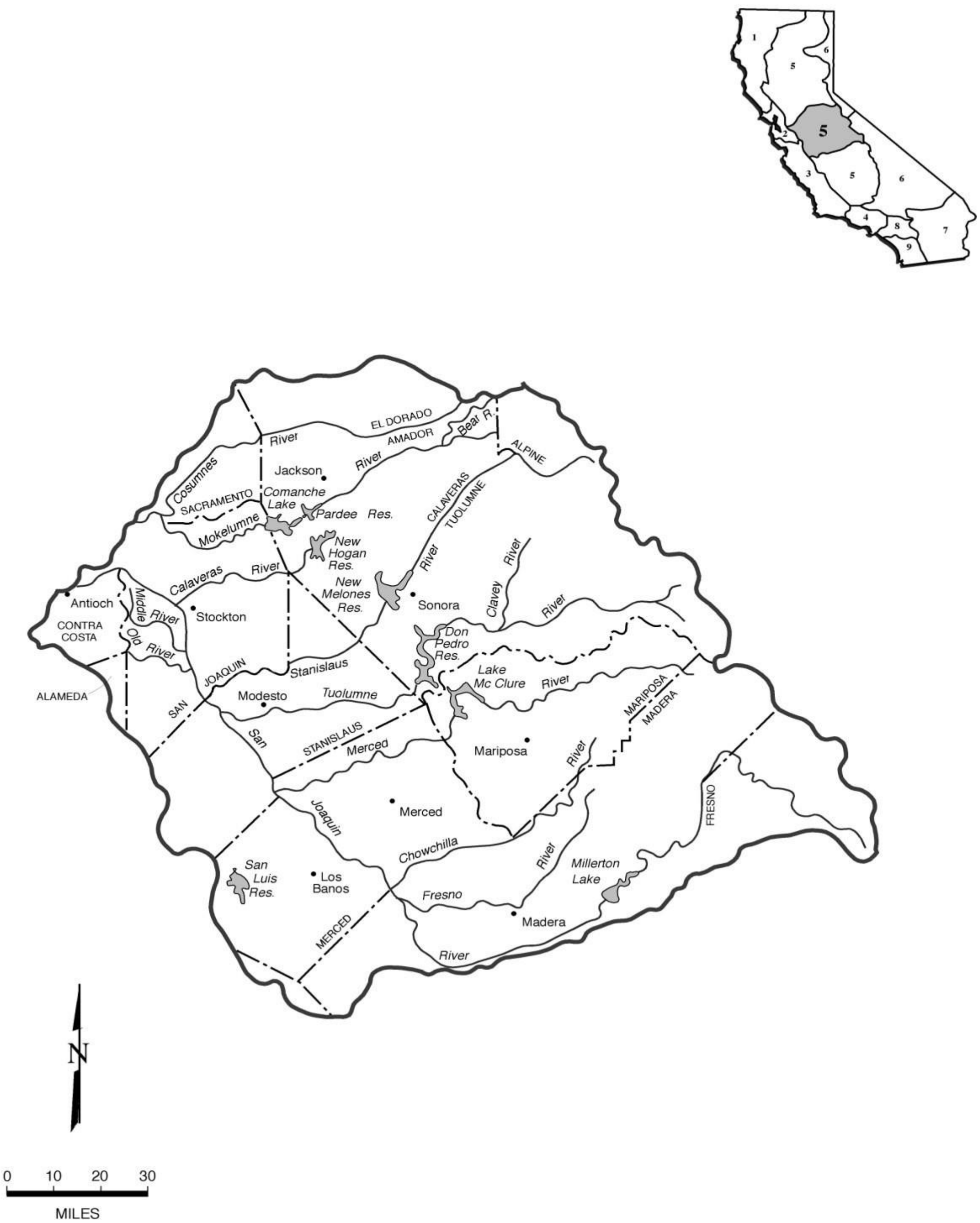


Figure 5.5. Central Valley Region Sacramento Hydrologic Basin

Central Valley Region (5)
SAN JOAQUIN HYDROLOGIC BASIN PLANNING AREA (SJ)



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

Figure 5.6. Central Valley Region San Joaquin Hydrologic Basin

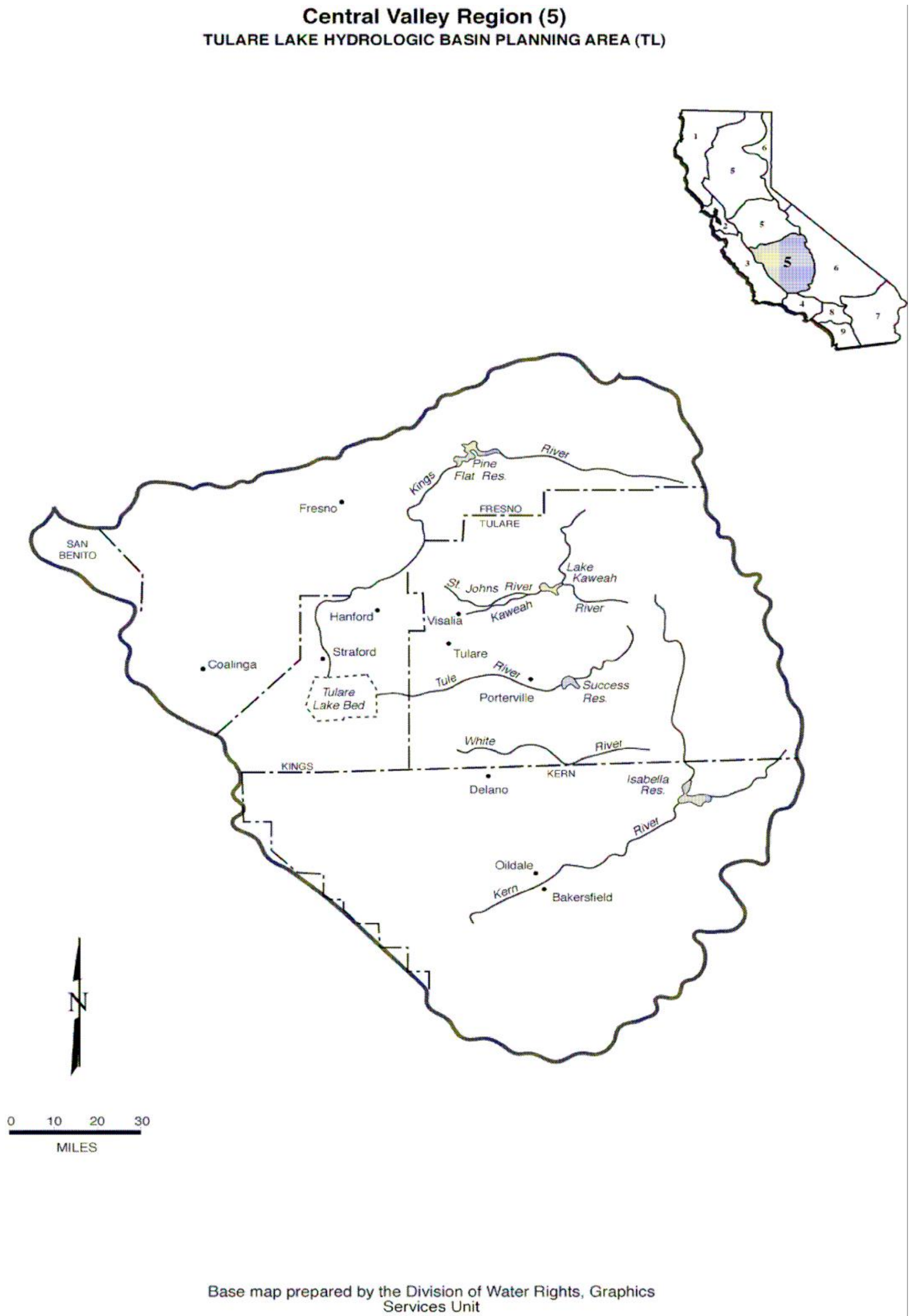


Figure5.7. Central Valley Region Tulare Lake Hydrologic Basin

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

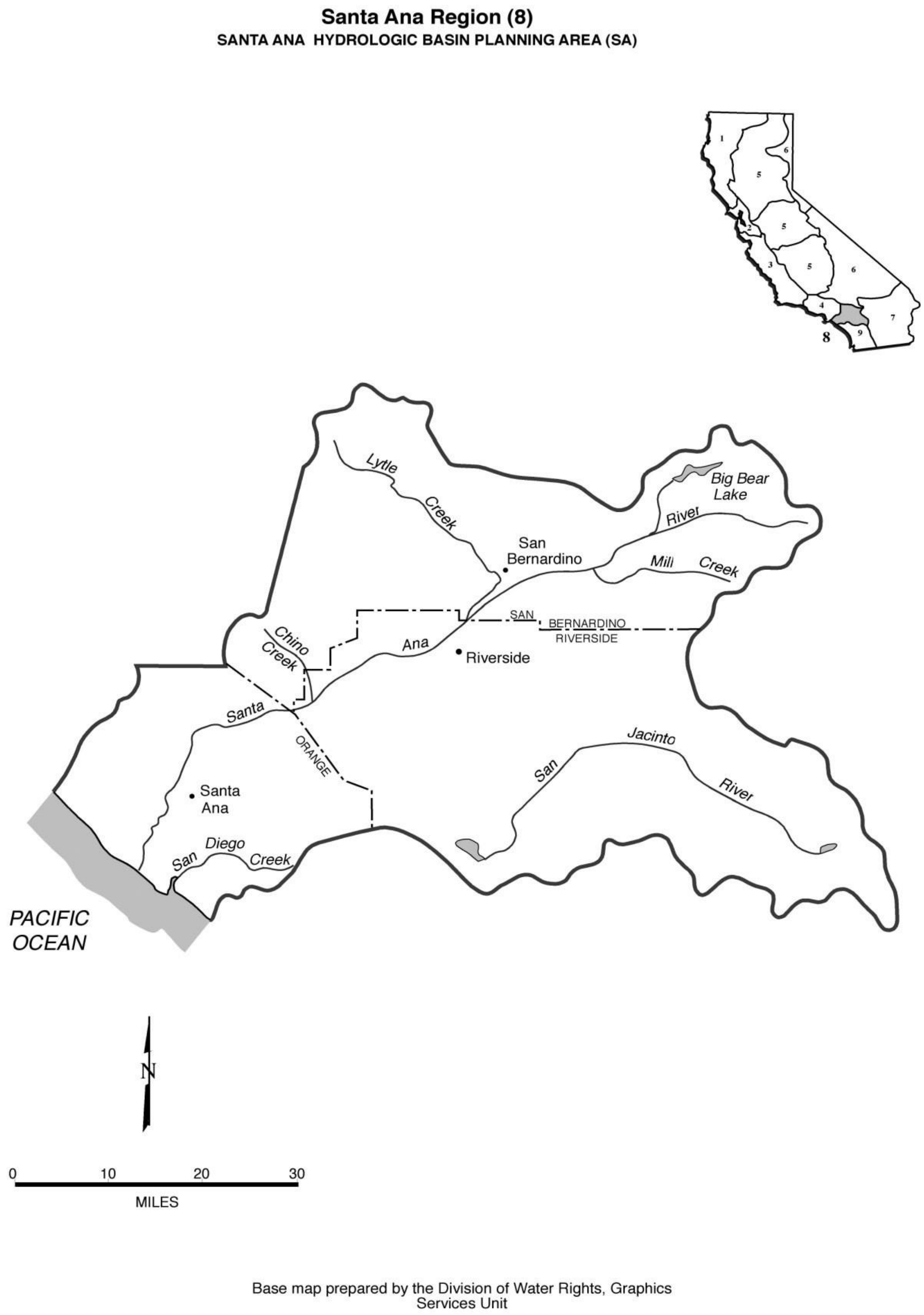


Figure 5.8. Santa Ana Region

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.

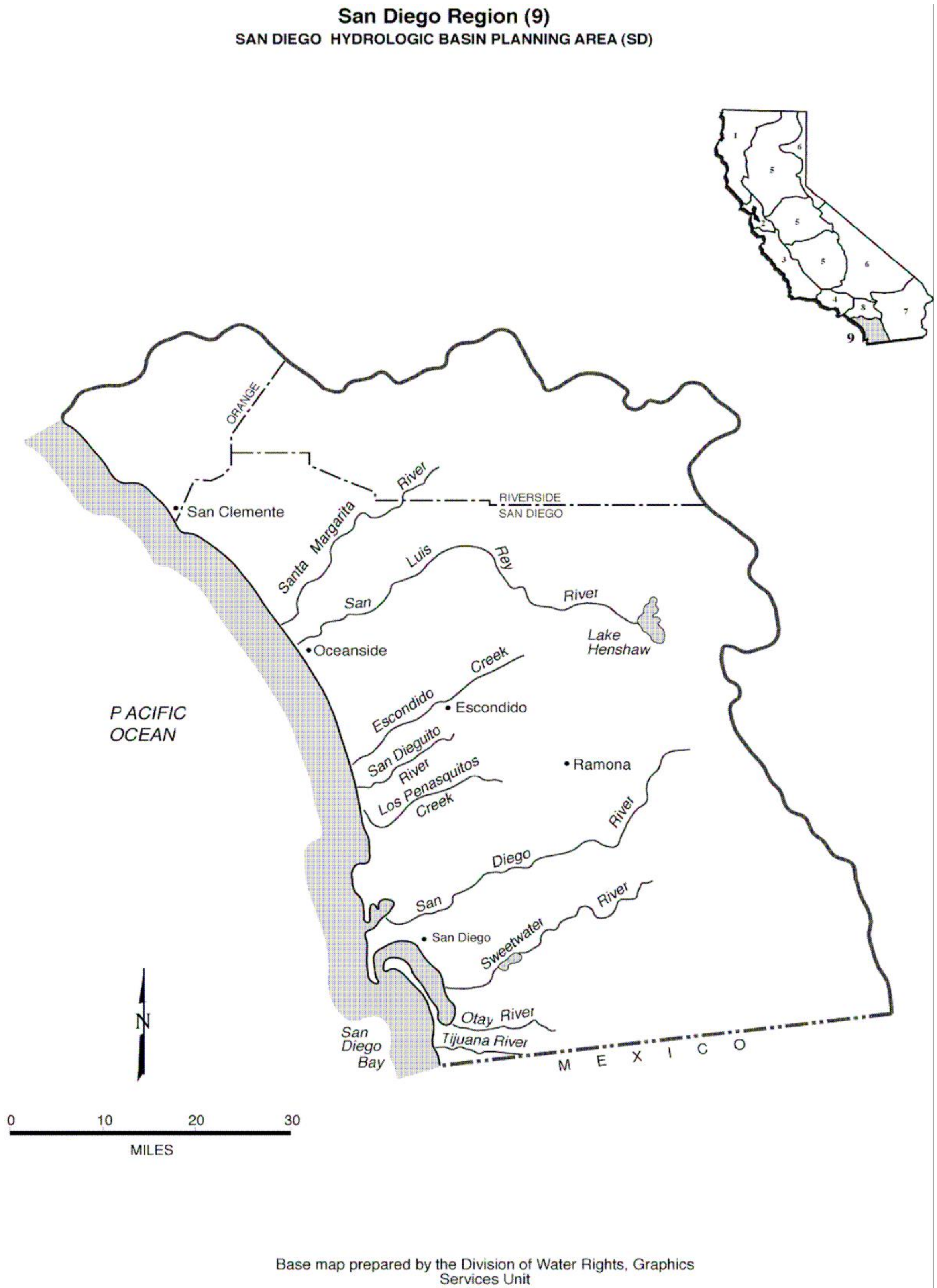


Figure 5.9. San Diego Region

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 U.S. EPA 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.

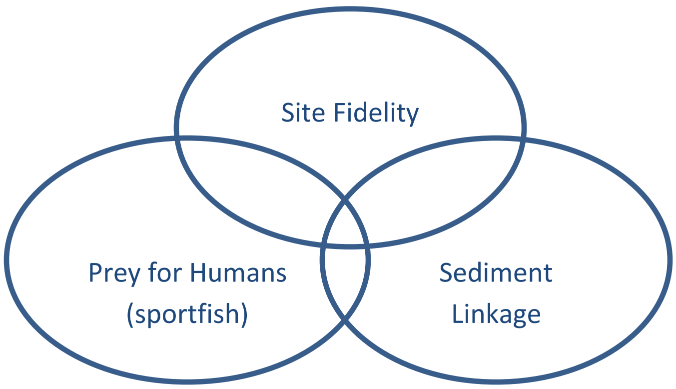


Figure 6.1. Species Traits for Assessing Chemical Exposure and Relationship to Contaminants in Sediment.

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 4, see Appendix A-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, U.S. EPA 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 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 based on OEHHA's ATL 4 or ATL 5.

Staff Recommendation: Alternative 2, 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., 2015). 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 et al, 2017). In addition, the tiered framework approach allows for rapid screening assessment and economical use of resources. For example, Greenfield et al (2015) 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 1, 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. 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 1 consists of a preliminary evaluation of either tissue data or sediment data (or both) to determine whether there appears to be a potential hazard to human health. In Tier 1 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 1 indicates a potential hazard exists, then the analysis would proceed to Tier 2.

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. As in Tier 1, chemical concentration data are used for the evaluation. However, in Tier 2, 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 2 results indicate an acceptable condition, the sediment would meet the human health SQO. If Tier 2 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 3 analysis.

The Tier 3 assessment is intended to be used when it is determined that the Tier 2 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 3 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.

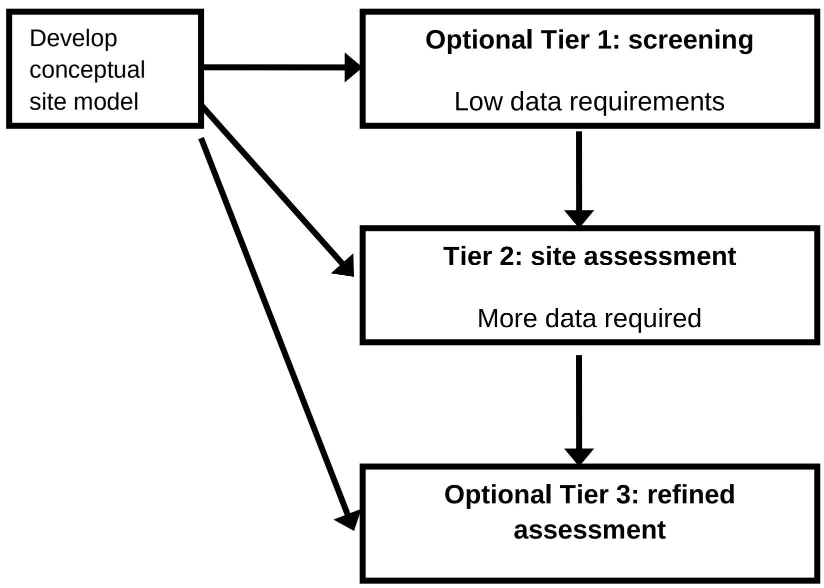


Figure 6.2. Tiered Decision Framework

Alternatives Identified

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

<u>Alternative 2</u>: Develop sediment chemistry based assessment framework

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

<u>Alternative 4</u>: 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 et al, 2017 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 could 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 2, 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 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 et al, 2017 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. The BSAF can be expressed as the concentration in tissue (wet weight) divided by the concentration in sediment (dry weight) or as normalized to percent lipid and percent organic carbon (Gobas et al, 2000). This document uses the former.

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 et al 2017 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 2	Proceed to Tier 2
No Date	Potentially Impacted	Proceed to Tier 2	Proceed to Tier 2
Not Impacted	Potentially Impacted	Proceed to Tier 2	Proceed to Tier 2
Potentially Impacted	Not Impacted	Proceed to Tier 2	Not Impacted
Potentially Impacted	Potentially Impacted	Proceed to Tier 2	Proceed to Tier 2

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 6.3, 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 (Gobas et al, 2000). 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.

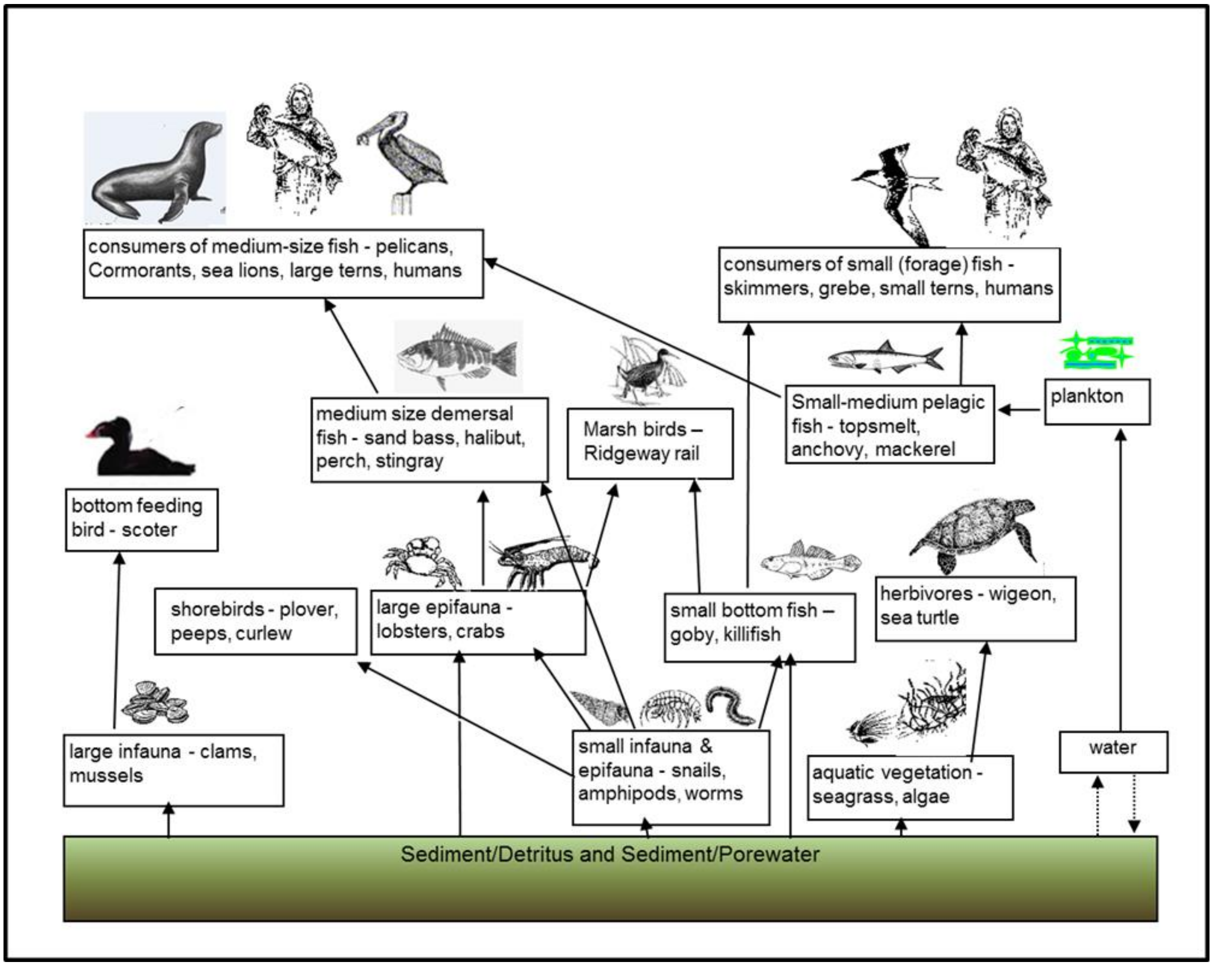

Figure 6.3 Conceptual model of sediment contamination transfer through an embayment food web (Bay et al. 2016; SCCWRP TR 953)

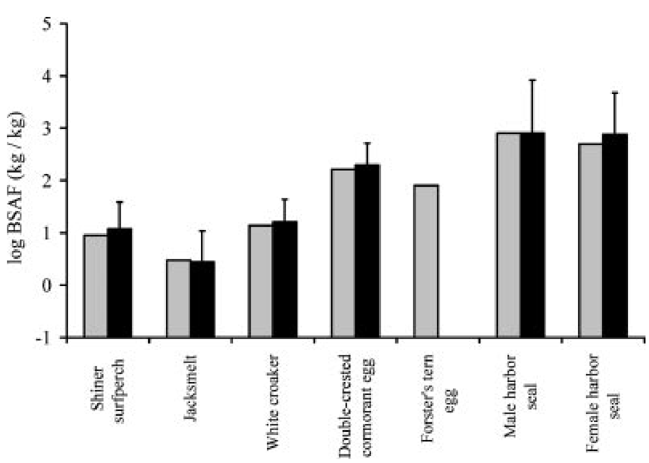

Figure 6.4. Model-predicted (gray columns) and observed (black columns) mean biota–sediment bioaccumulation factors (BSAFs in kg dry sediment/kg wet wt organism) of total PCBs in several species in San Francisco Bay, California, USA. Error bars represent 95% confidence intervals (from Gobas and Arnot 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 a 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, parameterized for each 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 bioaccumulation model parameterized for each different dietary guild of relevance to estimate bioaccumulation from site sediment, 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); m = measured value

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

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

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

<u>Alternative 3</u>: 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 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 IV.A.2.e.

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 (U.S. EPA, 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 (U.S. EPA 1989, 1991, 2011, 2014). Other sources of information include guidance from U.S. EPA's Office of Water related to the development of water quality criteria for human health and development of fish consumption advisories (U.S. EPA, 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 designated $PM_{2.5}$. 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/m^3)	0.075 ppm (147 µg/m^3)	
Respirable Particulate Matter (PM_{10})	24 hrs	50 µg/m^3	150 µg/m^3	Same as Federal Primary
	Ann. Arith. Mean	20 µg/m^3		
Fine Particulate Matter ($PM_{2.5}$)	24 hrs		35 µg/m^3	Same as Federal Primary
	Ann. Arith. Mean	12 µg/m^3	15 µg/m^3	
Carbon Monoxide (CO)	I hr	20 ppm(23 µg/m^3)	35 ppm (40 µg/m^3)	
	8 hrs	9 ppm (10 µg/m^3)	9 ppm (10 µg/m^3)	
Nitrogen Dioxide (NO_2)	I hr	0.18 ppm (339 µg/m^3	100 ppb (188 µg/m^3)	
	Ann. Arith. Mean	0.030 ppm (57 µg/m^3)	0.053 ppm (100 µg/m^3)	Same as Federal Primary
Sulfur Dioxide (SO_2)	I hr	0.25 ppm (655 µg/m^3)	0.75 ppm (196 µg/m^3)	
	3 hrs			0.5 ppm (1300µg/m^3)
	24 hrs	0.04 ppm (105 µg/m^3)	0.14 ppm (for certain areas)	
	Ann. Arith. Mean		0.030 ppm (for certain areas)	
Lead (Pb)	30 day ave.	1.5 µg/m^3		
	Calendar Quarter		1.5 µg/m^3(for certain areas)	Same as Federal Primary
	Rolling 3 month ave.		0.15 µg/m^3	
VRP	8 hrs	Extinction of 0.23 per km		
Sulfates	24 hrs	25 µg/m^3		
Hydrogen Sulfide (H_2S)	1 hr	0.03 ppm (42 µg/m^3)		
Vinyl Chloride	24 hrs	0.01 ppm (26 µg/m^3)		

hr	hour	Ave	Average
hrs	hours	Ppm	parts per million
VRP	Visibility reducing particulates	µg/m^3	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.

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	
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.	

Common Name	Scientific Name	Primary Habitat	Listing
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/U.S. EPA, 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).
- 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

U.S. EPA 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.

Water Quality Certifications

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
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.

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.

10 References

Arnot, J.A. and F.A.P.C. Gobas. 2004. A food web bioaccumulation model for organic chemicals in aquatic ecosystems. *Environmental Toxicology and Chemistry* 23:2343-2355.

Barber, M. C. 2008. Dietary uptake models used for modeling the bioaccumulation of organic contaminants in fish. Environmental Toxicology and Chemistry **27**:755-777.

Bay,S.M. and S.B.Weisberg. 2012. Framework for Interpreting Sediment Quality Triad Data. *Integrated Environmental Assessment and Management* 8:589-596

Bay, S.M, B. Greenfield, and A.N. Parks. 2017. Development of a Sediment Quality Assessment Framework for Human Health Effects. Technical Report. Southern California Coastal Water Research Project. Costa Mesa, CA.

Bay, Steven M, Darrin J. Greenstein, Ashley Parks, David Gillett and Shelly Anghera, 2016, Final Report Marina Del Ray Harbor Sediment Stressor Identification Study

Bight '13 Contaminant Impact Assessment Planning Committee, Southern California Bight 2013 Regional Monitoring Program: Volume VIII. Contaminant Impact Assessment Synthesis Report, SCCWRP Technical Report 973

Brown, Jeffrey and Steven Bay, 2011 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*

Burkhard, L.P., P.M. Cook, and M.T. Lukasewycz. 2010. Direct application of biota-sediment accumulation factors. *Environmental Toxicology and Chemistry* 29:230-236.

Greenfield, B.,A. Melwani, and S.M. Bay. 2015. A tiered evaluation framework to evaluate the human health risk of contaminated sediment. Integrated Environmental Assessment and management, 11:459-473.

Gobas, A.P.C and Heather Morrison, 2000. Bioconcentration and Biomagnification in the Aquatic Environment, Pp 191-227 in: Robert S. Boethling and Donald Mackay (eds.) Handbook of Property Estimation Methods for Chemicals Environmental Health and Sciences. Lewis Publishers (CRC Press), Baca Raton, Florida.

Gobas, F.A.P.C. and J. Arnot. 2010. Food web bioaccumulation model for polychlorinated biphenyls in San Francisco Bay, California, USA. *Environmental Toxicology and Chemistry* 29:1385-1395.

Kim, J., F.A.P.C Gobas, J.A. Arnot, D.E. Powell, R.M. Seston, and K.B. Woodburn. 2016. Evaluating the roles of biotransformation, spatial concentration differences, organism home range, and field sampling design on trophic magnification factors. Science of the Total Environment 551-552:438-451.

Los Angeles Regional Water Quality Control Board, 2011. Final Staff Report - Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants Total Maximum Daily Loads.
http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/66_New/11_0630/03%20Final%20Staff%20Report%2006%2030%2011.pdf

Mackay, D., and A. Fraser. 2000. Bioaccumulation of persistent organic chemicals: mechanisms and models. Environmental Pollution 110:375-391

Melwani A.R., B.K. Greenfield, and E.R. Byron. 2009. Empirical estimation of biota exposure range for calculation of bioaccumulation parameters. *Integrated Environmental Assessment and Management* 5:138–149.

Melwani, A.R., Greenfield, B.K., Yee, D. and Davis, J.A. 2012. Conceptual Foundations for Modeling Bioaccumulation in San Francisco Bay. RMP Technical Report. Contribution No. 676. San Francisco Estuary Institute, Richmond, California.

Moore D.W., Baudo R, Conder J.M., Landrum P.F., McFarland V.A., Meador J.P. and Word J.Q. 2005. Bioaccumulation in the assessment of sediment quality: uncertainty and potential application. In: Use of Sediment Quality Guidelines and Related Tools for the Assessment of Contaminated Sediments. Wenning R, Batley G, Ingersoll C and Moore D (Eds). SETAC Press, Pensacola FL USA, pp 429-495.

Office of Environmental Health Hazard Assessment . 2008a. Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. June 2008. Authors Susan Klasing and Robert Broadberg.

Office of Environmental Health Hazard Assessment. 2008b. Health Advisory: Draft Safe Eating Guidelines for Fish and Shellfish from the Sacramento River and North Delta.
http://oehha.ca.gov/media/downloads/advisories/srnddraftadvisoryreport041108a.pdf

Office of Environmental Health Hazard Assessment. 2009a*. 2009 Update of California Sport Fish Advisories* *http://oehha.ca.gov/media/downloads/advisories/discadvyupdates031309_9.pdf*

Office of Environmental Health Hazard Assessment. 2009b. Health Advisory and Safe Eating Guidelines for Fish from Coastal Areas of Southern California: Ventura Harbor to San Mateo Point. http://oehha.ca.gov/media/downloads/advisories/socaladvisoryl61809.pdf

Office of Environmental Health Hazard Assessment. 2011. Health Advisory and Safe Eating Guidelines for San Francisco Bay Fish and Shellfish.
http://oehha.ca.gov/media/downloads/advisories/sfbayadvisory21may2011.pdf

Office of Environmental Health Hazard Assessment. 2012. 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
http://oehha.ca.gov/media/downloads/advisories/anadromoussppadvisory.pdf

Office of Environmental Health Hazard Assessment. 2013a. Health Advisory and Guidelines for Eating Fish from Mission Bay (San Diego County). http://oehha.ca.gov/media/downloads/advisories/missionbay102213.pdf

Office of Environmental Health Hazard Assessment. 2013b. Health Advisory and Guidelines for Eating Fish from San Diego Bay (San Diego County). http://oehha.ca.gov/media/downloads/advisories/sandiegoadvisory102213.pdf

Oregon Department of Environmental Quality. 2007. Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment. https://semspub.epa.gov/work/10/500011406.pdf

San Francisco Bay Regional Water Quality Control Board, 2008. Total Maximum Daily Load for PCBs in San Francisco Bay Staff Report for Proposed Basin Plan Amendment. http://www.waterboards.ca.gov/sanfranciscobay/board_info/agendas/2008/february/tmdl/appc_pcbs_staffrept.pdf

SQO Scientific Steering Committee. SSC Discussion and Recommendations from March 2011 SQO Meeting. 2011. http://ftp.sccwrp.org/pub/download/PROJECTS/SedContaminationEffectsHumansWildlife/SQO_SSCMtgSummary_March2011.pdf

State Water Board, 2004a. Final Functional Equivalent Document, Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. http://www.waterboards.ca.gov/water_issues/programs/tmdl/docs/ffed_093004.pdf

State Water Resources Control Board. 2004b. Amended Final Functional Equivalent Document Consolidated Toxic Hot Spots Cleanup Plan.http://www.waterboards.ca.gov/bptcp/index.html

State Water Board, 2010. Staff CEQA Scoping Informational Document, Phase II Sediment Quality Objectives for Enclosed Bays and Estuaries of California http://www.waterboards.ca.gov/water_issues/programs/bptcp/docs/sediment/sqo_scopedoc042110.pdf

State Water Board Staff Final 2012 California Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report). http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml

State Water Board, 2017. Final Staff Report, 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. http://www.waterboards.ca.gov/water_issues/programs/mercury/docs/hg_SR_final.pdf

Thomann, R.V., J.P. Connolly and T.F. Parkerton. 1992. An equilibrium model of organic chemical accumulation in aquatic food webs with sediment interaction. *Environmental Toxicology and Chemistry* 11:615-629.

Thompson KM, Graham JD. 1996. Going beyond the single number: Using probabilistic risk assessment to improve risk management. Hum Ecol Risk Assess 2:1008–1034.

Wickwire T., M.S. Johnson, B.K. Hope, and M.S. Greenberg. 2011. Spatially explicit ecological exposure models: A rationale for and path toward their increased acceptance and use. *Integrated Environmental Assessment and Management* 7:158–168.

Willis-Norton, E.,Ranasinghe,J. A., Greenstein, D. and Bay, S. (2013). Applying Sediment Quality Objective Assessments to San Francisco Bay Samples from 2008-2012. Final Report. Contribution No. 702. San Francisco Estuary Institute, Richmond, California. http://www.sfei.org/sites/default/files/biblio_files/702_SQO_Assessments_2008-2012.pdf

USACE/U.S. EPA, 2009. Programmatic Essential Fish Habitat (EFH) Assessment for the Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region.
http://www.spn.usace.army.mil/Portals/68/docs/Dredging/LMTS/SF%20Bay%20LTMS%20EFH%20Assessment-Final%20Jul%2015%202009.pdf

U.S. EPA, 1989. Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) Interim Final https://www.epa.gov/sites/production/files/2015-09/documents/rags_a.pdf

U.S. EPA. 2000a. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health, Office of Science and Technology and Office of Water https://nepis.epa.gov/Exe/ZyPDF.cgi/20003D2R.PDF?Dockey=20003D2R.PDF

U.S. EPA, 2000b. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 1 Fish Sampling and Analysis Third Edition EPA-823-B-00-007. https://nepis.epa.gov/Exe/ZyPDF.cgi/20003OMP.PDF?Dockey=20003OMP.PDF

U.S. EPA. 2001. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) Final Publication 9285.7-47 December 2001 https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-d

U.S. EPA. 2009. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000) - Technical Support Document Volume 3: Development of Site-Specific Bioaccumulation Factors EPA-822-R-09-008 https://nepis.epa.gov/Exe/ZyPDF.cgi/P1005CAF.PDF?Dockey=P1005CAF.PDF

U.S. EPA, 2010. Sampling and Consideration of Variability (Temporal and Spatial) For Monitoring of Recreational Waters. Office of Water. EPA-823-R-10-005 https://www.epa.gov/sites/production/files/2015-11/documents/sampling-consideration-recreational-waters.pdf

U.S. EPA. 2011, Exposure Factors Handbook 2011 Edition (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F, 2011. https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252

U.S. EPA, 2014 Framework for Human Health Risk Assessment to Inform Decision Making **U.S.** Office of the Science Advisor Risk Assessment Forum EPA/100/R-14/001. https://www.epa.gov/sites/production/files/2014-12/documents/hhra-framework-final-2014.pdf

Appendix A: Amendments

AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA

Sediment Quality Provisions

June 5, 2018

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I. INTRODUCTION

A. SEDIMENT

1. Intent of the Sediment Quality Provisions of the Water Quality Control Plan for Enclosed Bays and Estuaries of California

It is the goal of the State Water Resources Control Board (State Water Board) to comply with the legislative directive in Water Code section 13393 to adopt sediment quality objectives (SQOs). The Sediment Quality Provisions integrates chemical and biological measures to determine if the sediment-dependent biota are protected or degraded as a result of exposure to toxic pollutants* in sediment in order to protect benthic* communities in enclosed bays* and estuaries*, human health, wildlife, and resident finfish. The Sediment Quality Provisions are not intended to address low dissolved oxygen, pathogens or nutrients including ammonia. The State Water Board will continue to refine benthic community protection indicators for estuarine waters and improve the approach to address sediment quality related human health risk associated with consumption of fish tissue.

2. Summary of the Sediment Quality Provisions

The Sediment Quality Provisions include**:**

- Narrative SQO for the protection of aquatic life.
- Narrative SQO for the protection of human health.
- Narrative SQO for the protection of wildlife* and resident finfish*.
- Identification of the beneficial uses that these SQOs are intended to protect.
- A program of implementation for each SQO that contains:
    - Specific indicators, tools and implementation provisions to determine if the sediment quality at a station or multiple stations meets the narrative objectives;
    - A description of appropriate monitoring programs; and
    - A sequential series of actions that shall be initiated when a sediment quality objective is not met, including stressor identification and evaluation of appropriate targets.
- A glossary that defines all terms denoted by an asterisk.

II. BENEFICIAL USES

A. SEDIMENT

Beneficial uses of waters protected by the Sediment Quality Provisions and corresponding target receptors are identified in Table 1.

Table 1. Beneficial Uses and Target Receptors

Beneficial Uses*	Target Receptors
Estuarine Habitat	Benthic Community/finfish/wildlife
Marine Habitat	Benthic Community/ finfish/wildlife
Commercial and Sport Fishing	Human Health
Aquaculture	Human Health
Shellfish Harvesting	Human Health
Tribal tradition and Culture	Human Health
Tribal Subsistence Fishing	Human Health
Subsistence Fishing	Human Health
Rare, Threatened, or Endangered Species	finfish/wildlife
Preservation of Biological Habitats of Special Significance	finfish/wildlife
Wildlife Habitat	Wildlife
Spawning Reproduction and Early Development	Finfish

*Only applicable to those waters where the beneficial use is assigned within a Basin Plan.

III. WATER QUALITY OBJECTIVES

A. SEDIMENT

1. Use and Applicability of SQOS

a. Ambient Sediment Quality

The SQOs and supporting tools shall be utilized to assess ambient sediment quality.

b. Relationship to Other Narrative Objectives and Total Maximum Daily Loads

1) Except as provided in paragraph 3) below, the Sediment Quality Provisions supersede all applicable narrative water quality objectives and related implementation provisions in water quality control plans (basin plans), to the extent that the objectives and provisions are applied to protect bay or estuarine benthic communities from toxic pollutants in sediments.

2) Except as provided in paragraph 3) below, the Sediment Quality Provisions also supersede all applicable narrative water quality objectives and related implementation provisions in basin plans, to the extent that the objectives and provisions are applied to protect wildlife and resident finfish from toxic pollutants in sediments, unless the State Water Board approves amendments to a basin plan to incorporate new, more stringent, narrative water quality objectives or implementation provisions.

3) The supersession provisions in paragraphs 1) and 2) above do not apply to existing sediment cleanup activities where a site assessment was completed and submitted to the Regional Water Quality Control Board (Regional Water Board) by February 19, 2008.

4) Implementation provisions described in Chapter IV.A.2. and applicable provisions in Chapter IV.A.4. implementing the objective set forth in Chapter III.A.2.b. below do not apply to dischargers that discharge to receiving waters for which a total maximum daily load (TMDL) has been established, on or before the effective date of the Sediment Quality Provisions, to address the bioaccumulation of organochlorine pesticide or polychlorinated biphenyls from sediment into sportfish tissue within enclosed bays and estuaries unless a TMDL is reconsidered pursuant to its terms, or the applicable Regional Water Board approves the application of such provisions.

c. Applicable Waters

The Sediment Quality Provisions apply to enclosed bays[1] and estuaries[2] only. The Sediment Quality Provisions do not apply to ocean waters* including Monterey Bay and Santa Monica Bay, or inland surface waters*.

d. Applicable Sediments

The Sediment Quality Provisions apply to subtidal surficial sediments* that have been deposited or emplaced seaward of the intertidal zone. The Sediment Quality Provisions do not apply to:

1) Sediments characterized by less than five percent of fines (sum of percent silt and percent clay) or substrates composed of gravels, cobbles, or consolidated rock.

2) Sediment as the physical pollutant that causes adverse biological response or community degradation related to burial, deposition, or sedimentation.

e. Applicable Discharges

The Sediment Quality Provisions are applicable in their entirety to point source* discharges. Nonpoint sources* of toxic pollutants are subject to Chapters II.A., III.A., IV.A.1., IV.A.2., and IV.A.3. of the Sediment Quality Provisions.

2. Sediment Quality Objectives

a. Aquatic Life* - Benthic Community Protection

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 Chapter IV.A.1.

b. Human Health

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 Chapter IV.A.2.

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[1] ENCLOSED BAYS are 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.

[2] ESTUARIES AND COASTAL LAGOONS are 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.

c. Wildlife and Resident Finfish

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 Chapter IV.A.3.

IV. IMPLEMENTATION OF WATER QUALITY OBJECTIVES

A. SEDIMENT

1. Implementation for Assessing Benthic Community Protection

a. MLOE Approach to Interpret the Narrative Objective

The methods and procedures described below shall be used to interpret the Narrative Objective described in Chapter III.A.2.a. These tools are intended to assess the condition of benthic communities relative to potential for exposure to toxic pollutants in sediments. Exposure to toxic pollutants at harmful levels will result in some combination of a degraded benthic community, presence of toxicity, and elevated concentrations of pollutants in sediment. The assessment of sediment quality shall consist of the measurement and integration of three lines of evidence (LOE). The LOE are:

- ***Sediment Toxicity***—Sediment toxicity is a measure of the response of invertebrates exposed to surficial sediments under controlled laboratory conditions. The sediment toxicity LOE is used to assess both pollutant related biological effects and exposure. Sediment toxicity tests are of short durations and may not duplicate exposure conditions in natural systems. This LOE provides a measure of exposure to all pollutants present, including non-traditional or unmeasured chemicals.
- ***Benthic Community Condition***—Benthic community condition is a measure of the species composition, abundance and diversity of the sediment-dwelling invertebrates inhabiting surficial sediments*. The benthic community LOE is used to assess impacts to the primary receptors targeted for protection under Chapter III.A.2.a. Benthic community composition is a measure of the biological effects of both natural and anthropogenic stressors.
- ***Sediment Chemistry***—Sediment chemistry is the measurement of the concentration of chemicals of concern* in surficial sediments. The chemistry LOE is used to assess the potential risk to benthic organisms from toxic pollutants in surficial sediments. The sediment chemistry LOE is intended only to evaluate overall exposure risk from chemical pollutants. This LOE does not establish causality associated with specific chemicals.

b. Limitations

None of the individual LOE is sufficiently reliable when used alone to assess sediment quality impacts due to toxic pollutants. Within a given site, the LOEs applied to assess exposure as described in Chapter IV.A.1.a. may underestimate or overestimate the risk to benthic communities and do not indicate causality of specific chemicals. The LOEs applied to assess biological effects can respond to stresses associated with natural or physical factors, such as sediment grain size, physical disturbance, or organic enrichment.

Each LOE produces specific information that, when integrated with the other LOEs, provides a more confident assessment of sediment quality relative to the narrative objective. When the exposure and effects tools are integrated, the approach can quantify protection through effects measures and also provide predictive capability through the exposure assessment.

c. Water Bodies

1) The tools described in the Chapters IV.A.1.d. through IV.A.1.i. are applicable to Euhaline* Bays and Coastal Lagoons* south of Point Conception and Polyhaline* San Francisco Bay that includes the Central and South Bay Areas defined in general by waters south and west of the San Rafael Bridge and north of the Dumbarton Bridge.

2) For all other bays and estuaries where LOE measurement tools are unavailable, station assessment will follow the procedure described in Chapter IV.A.1.j.

d. Field Procedures

1) All samples shall be collected using a grab sampler.

2) Benthic samples shall be screened through:

   a. A 0.5 millimeter (mm)-mesh screen in San Francisco Bay and the Sacramento-San Joaquin Delta.

   b. A 1.0 mm-mesh screen in all other locations.

3) Surface sediment from within the upper 5 cm shall be collected for chemistry and toxicity analysis.

4) The entire contents of the grab sample, with a minimum penetration depth of 5 cm, shall be collected for benthic community analysis.

5) Bulk sediment chemical analysis will include at a minimum the pollutants identified in Appendix A-3.

e. Laboratory Testing

All samples will be tested in accordance with U.S. Environmental Protection Agency (USEPA) or American Society for Testing and Materials (ASTM) methodologies where such methods exist. Where no EPA or ASTM methods exist, the State Water Board or Regional Water Boards (collectively Water Boards) shall approve the use of other methods. Analytical tests shall be conducted by laboratories certified by the State Water Board's Environmental Laboratory Accreditation Program (ELAP) in accordance with Water Code Section 13176.

f. Sediment Toxicity

1) Short-Term Survival Tests - A minimum of one short-term survival test shall be performed on sediment collected from each station. Acceptable test organisms and methods are summarized in Table 2.

Table 2. Acceptable Short-Term Survival Sediment Toxicity Test Methods

Test Organism	Exposure Type	Duration	Endpoint*
Eohaustorius estuarius	Whole Sediment	10 days	Survival
Leptocheirus plumulosus	Whole Sediment	10 days	Survival
Rhepoxynius abronius	Whole Sediment	10 days	Survival

2) Sublethal Tests—A minimum of one sublethal test shall be performed on sediment collected from each station. Acceptable test organisms and methods are summarized in Table 3.

Table 3. Acceptable Sublethal Sediment Toxicity Test Methods

Test Organism	Exposure Type	Duration	Endpoint
Neanthes arenaceodentata	Whole Sediment	28 days	Growth
Mytilus galloprovincialis	Sediment-water Interface	48 hour	Embryo Development

3) Assessment of Sediment Toxicity—Each sediment toxicity test result shall be compared and categorized according to responses in Table 4. The response categories are:

a. Nontoxic—Response not substantially different from that expected in sediments that are uncontaminated and have optimum characteristics for the test species (e.g., control sediments).

b. Low toxicity—A response that is of relatively low magnitude; the response may not be greater than test variability.

c. Moderate toxicity—High confidence that a statistically significant toxic effect is present.

d. High toxicity—High confidence that a toxic effect is present and the magnitude of response includes the strongest effects observed for the test.

Table 4. Sediment Toxicity Categorization Values

Test Species/ Endpoint	Statistical Significance	Nontoxic (Percent)	Low Toxicity (Percent of Control)	Moderate Toxicity (Percent of Control)	High Toxicity (Percent of Control)
Eohaustorius Survival	Significant	90 to 100	82 to 89	59 to 81	< 59
Eohaustorius Survival	Not Significant	82 to 100	59 to 81		<59
Leptocheirus Survival	Significant	90 to 100	78 to 89	56 to 77	<56
Leptocheirus Survival	Not Significant	78 to 100	56 to 77		<56
Rhepoxynius Survival	Significant	90 to 100	83 to 89	70 to 82	< 70
Rhepoxynius Survival	Not Significant	83 to 100	70 to 82		< 70
Neanthes Growth	Significant	90 to 100*	68 to 90	46 to 67	<46
Neanthes Growth	Not Significant	68 to 100	46 to 67		<46
Mytilus Normal	Significant	80 to 100	77 to 79	42 to 76	< 42
Mytilus Normal	Not Significant	77 to 79	42 to 76		< 42

* Expressed as a percentage of the control.

4) Integration of Sediment Toxicity Categories—The average of all test response categories shall determine the final toxicity LOE category. If the average falls midway between categories it shall be rounded up to the next higher response category.

g. Benthic Community Condition

1) General Requirements.

a. All benthic invertebrates in the screened sample shall be identified to the lowest possible taxon and counted.

b. Taxonomic nomenclature shall follow current conventions established by local monitoring programs and professional organizations (e.g., master species list).

2) Benthic Indices—The benthic condition shall be assessed using the following methods:

a. Benthic Response Index (BRI), which was originally developed for the southern California mainland shelf and extended into California's bays and estuaries. The BRI is the abundance-weighted average pollution* tolerance score of organisms occurring in a sample.

b. Index of Biotic Integrity (IBI), which was developed for freshwater streams and adapted for California's bays and estuaries. The IBI identifies community measures that have values outside a reference range.

c. Relative Benthic Index (RBI), which was developed for embayments in California's Bay Protection and Toxic Cleanup Program. The RBI is the weighted sum of: (a) several community parameters (total number of species, number of crustacean species, number of crustacean individuals, and number of mollusc species), and abundances of (b) three positive, and (c) two negative indicator species.

d. River Invertebrate Prediction and Classification System (RIVPACS), which was originally developed for British freshwater streams and adapted for California's bays and estuaries. The approach compares the assemblage at a site with an expected species composition determined by a multivariate predictive model that is based on species relationships to habitat gradients.

3) Assessment of Benthic Community Condition—Each benthic index result shall be categorized according to disturbance as described in Table 5. The disturbance categories are:

a. Reference—A community composition equivalent to a least affected or unaffected site.

b. Low disturbance— A community that shows some indication of stress, but could be within measurement error of unaffected condition.

c. Moderate disturbance—Confident that the community shows evidence of physical, chemical, natural, or anthropogenic stress.

d. High disturbance—The magnitude of stress is high.

4) Integration of Benthic Community Categories—The median of all benthic index response categories shall determine the benthic condition LOE category. If the median falls between categories it shall be rounded up to the next higher effect category.

Table 5. Benthic Index Categorization Values

Index	Reference	Low Disturbance	Moderate Disturbance	High Disturbance
Southern California Marine Bays				
BRI	< 39.96	39.96 to 49.14	49.15 to 73.26	> 73.26
IBI	0	1	2	3 or 4
RBI	> 0.27	0.17 to 0.27	0.09 to 0.16	< 0.09
RIVPACS	> 0.90 to < 1.10	0.75 to 0.90 or 1.10 to 1.25	0.33 to 0.74 or > 1.25	< 0.33
Polyhaline Central San Francisco Bay				
BRI	< 22.28	22.28 to 33.37	33.38 to 82.08	> 82.08
IBI	0 or 1	2	3	4
RBI	> 0.43	0.30 to 0.43	0.20 to 0.29	< 0.20
RIVPACS	> 0.68 to < 1.32	0.33 to 0.68 or 1.32 to 1.67	0.16 to 0.32 or > 1.67	< 0.16

h. Sediment Chemistry

1) All samples shall be tested for the analytes identified in Appendix A-3. This list represents the minimum analytes required to assess exposure. In water bodies where other toxic pollutants are believed to pose risk to benthic communities, those toxic pollutants shall be included in the analysis. Inclusion of additional analytes cannot be used in the exposure assessment described below. However, the data can be used to conduct more effective stressor identification studies as described in Chapter IV.A.4.f.

2) Sediment Chemistry Guidelines—The sediment chemistry exposure shall be assessed using the following two methods:

a. Chemical Score Index (CSI), that uses a series of empirical thresholds to predict the benthic community disturbance category (score) associated with the concentration of various chemicals (Table 6). The CSI is the weighted sum of the individual scores (Equation 1).

Equation 1. $CSI = \Sigma(w_i \times cat_i)/\Sigma w$

Where: cat_i = predicted benthic disturbance category for chemical I;
w_i = weight factor for chemical I;
Σw = sum of all weights.

b. California Logistic Regression Model (CA LRM), that uses logistic regression models to predict the probability of sediment toxicity associated with the concentration of various chemicals (Table 7 and Equation 2). The CA LRM exposure value is the maximum probability of toxicity from the individual models (P_{max})

Equation 2. $p = e^{B0+B1\,(x)} / (1 + e^{B0+B1\,(x)})$

Where: p = probability of observing a toxic effect;
B0 = intercept parameter;
B1 = slope parameter; and
x = Log (concentration of the chemical).

Table 6. Category Score Concentration Ranges and Weighting Factors for the CSI

Chemical	Units	Weight	Score (Disturbance Category)			
			1 Reference	2 Low	3 Moderate	4 High
Copper	mg/kg	100	≤52.8	> 52.8 to 96.5	> 96.5 to 406	> 406
Lead	mg/kg	88	≤ 26.4	> 26.4 to 60.8	> 60.8 to 154	> 154
Mercury	mg/kg	30	≤ 0.09	> 0.09 to 0.45	> 0.45 to 2.18	> 2.18
Zinc	mg/kg	98	≤ 113	> 113 to 201	> 201 to 629	> 629
PAHs, total high MW	µg/kg	16	≤ 313	> 313 to 1325	> 1325 to 9320	>9320
PAHs, total low MW	µg/kg	5	≤ 85.4	> 85.4 to 312	> 312 to 2471	> 2471
Chlordane, alpha-	µg/kg	55	≤ 0.50	> 0.50 to 1.23	> 1.23 to 11.1	>11.1
Chlordane, gamma-	µg/kg	58	≤ 0.54	> 0.54 to 1.45	> 1.45 to 14.5	> 14.5

DDDs, total	µg/kg	45	≤ 0.77	> 0.77 to 3.56	> 3.56 to 26.37	> 26.37
DDEs, total	µg/kg	33	≤ 1.19	>1.19 to 6.01	> 6.01 to 45.84	>45.84
DDTs, total	µg/kg	20	≤ 0.61	> 0.61 to 2.79	> 2.79 to 34.27	> 34.27
PCBs, total	µg/kg	55	≤11.9	> 11.9 to 24.7	> 24.7 to 288	> 288

Table 7. CA LRM Regression Parameters

Chemical	Units	B0	B1
Cadmium	mg/kg	0.29	3.18
Copper	mg/kg	-5.59	2.59
Lead	mg/kg	-4.72	2.84
Mercury	mg/kg	-0.06	2.68
Zinc	mg/kg	-5.13	2.42
PAHs, total high MW	µg/kg	-8.19	2.00
PAHs, total low MW	µg/kg	-6.81	1.88
Chlordane, alpha	µg/kg	-3.41	4.46
Dieldrin	µg/kg	-1.83	2.59
Trans nonachlor	µg/kg	-4.26	5.31
PCBs, total	µg/kg	-4.41	1.48
p,p' DDT	µg/kg	-3.55	3.26

3) Assessment of Sediment Chemistry Exposure—Each sediment chemistry guideline result shall be categorized according to exposure as described in Table 8. The exposure categories are:

a. Minimal exposure—Sediment-associated contamination* may be present, but exposure is unlikely to result in effects.

b. Low exposure—Small increase in pollutant exposure that may be associated with increased effects, but magnitude or frequency of occurrence of biological impacts is low.

c. Moderate exposure—Clear evidence of sediment pollutant exposure that is likely to result in biological effects; an intermediate category.

d. High exposure—Pollutant exposure highly likely to result in possibly severe biological effects; generally present in a small percentage of the samples.

Table 8. Sediment Chemistry Guideline Categorization Values

Guideline	Minimal Exposure	Low Exposure	Moderate Exposure	High Exposure
CSI	< 1.69	1.69 to 2.33	2.34 to 2.99	>2.99
CA LRM	< 0.33	0.33 to 0.49	0.50 to 0.66	> 0.66

4) Integration of Sediment Chemistry Categories—The average of all chemistry exposure categories shall determine the final

sediment chemistry LOE category. If the average falls midway between categories it shall be rounded up to the next higher exposure category.

i. Interpretation and Integration of MLOE

Assessment as to whether the aquatic life sediment quality objective has been attained at a station is accomplished by the interpretation and integration of MLOE. The categories assigned to the three LOE, sediment toxicity, benthic community condition and sediment chemistry are evaluated to determine the station level assessment. The assessment category represented by each of the possible MLOE combinations reflects the presence and severity of two characteristics of the sample: severity of biological effects, and potential for chemically-mediated effects.

1) Severity of Biological Effects—The severity of biological effects present at a site shall be determined by the integration of the toxicity LOE and benthic condition LOE categories using the decision matrix presented in Table 9.

2) Potential for Chemically-Mediated Effects—The potential for effects to be chemically-mediated shall be determined by the integration of the toxicity LOE and chemistry LOE categories using the decision matrix presented in Table 10.

Table 9. Severity of Biological Effects Matrix

		Toxicity LOE Category			
		Nontoxic	**Low Toxicity**	**Moderate Toxicity**	**High Toxicity**
Benthic Condition LOE Category	Reference	Unaffected	Unaffected	Unaffected	Low Effect
	Low Disturbance	Unaffected	Low Effect	Low Effect	Low Effect
	Moderate Disturbance	Moderate Effect	Moderate Effect	Moderate Effect	Moderate Effect
	High Disturbance	Moderate Effect	High Effect	High Effect	High Effect

Table 10. Potential for Chemically-Mediated Effects Matrix

		Toxicity LOE Category			
		Nontoxic	**Low Toxicity**	**Moderate Toxicity**	**High Toxicity**
Sediment Chemistry LOE Category	Minimal Exposure	Minimal Potential	Minimal Potential	Low Potential	Moderate Potential
	Low Exposure	Minimal Potential	Low Potential	Moderate Potential	Moderate Potential
	Moderate Exposure	Low Potential	Moderate Potential	Moderate Potential	Moderate Potential
	High Exposure	Moderate Potential	Moderate Potential	High Potential	High Potential

3) Station Level Assessment—The station level assessment shall be determined using the decision matrix presented in Table 11. This assessment combines the intermediate classifications for severity of biological effect and potential for chemically-mediated effect to result in six categories of impact at the station level:

a. Unimpacted—Confident that sediment contamination is not causing significant adverse impacts to aquatic life living in the sediment at the site.

b. Likely Unimpacted—Sediment contamination at the site is not expected to cause adverse impacts to aquatic life, but some disagreement among the LOE reduces certainty in classifying the site as unimpacted.

c. Possibly Impacted—Sediment contamination at the site may be causing adverse impacts to aquatic life, but these impacts are either small or uncertain because of disagreement among LOE.

d. Likely Impacted—Evidence for a contaminant-related impact to aquatic life at the site is persuasive, even if there is some disagreement among LOE.

e. Clearly Impacted—Sediment contamination at the site is causing clear and severe adverse impacts to aquatic life.

f. Inconclusive—Disagreement among the LOE suggests that either the data are suspect or that additional information is needed before a classification can be made.

Table 11. Station Assessment Matrix

		Severity of Effect			
		Unaffected	**Low Effect**	**Moderate Effect**	**High Effect**
Potential For Chemically-Mediated Effects	Minimal Potential	Unimpacted	Likely Unimpacted	Likely Unimpacted	Inconclusive
	Low Potential	Unimpacted	Likely Unimpacted	Possibly Impacted	Possibly Impacted
	Moderate Potential	Likely Unimpacted	Possibly Impacted or Inconclusive[1]	Likely Impacted	Likely Impacted
	High Potential	Inconclusive	Likely Impacted	Clearly Impacted	Clearly Impacted

[1] Inconclusive category when chemistry is classified as minimal exposure, benthic response is classified as reference, and toxicity response is classified as high.

The station assessment resulting from each possible combination of the three LOEs is shown in Appendix A-4. As an alternative to Tables 9, 10 and 11, each LOE category can be applied to Appendix A-4 to determine the overall condition of the station. The results will be the same regardless of the tables used.

4) Relationship to the Aquatic Life – Benthic Community Protection Narrative Objective.

a. The categories designated as **Unimpacted** and **Likely Unimpacted** shall be considered as achieving the protective condition at the station. All other categories shall be considered as degraded except as provided in b. below.

b. The Water Board shall designate the category **Possibly Impacted** as meeting the protective condition if the studies identified in Chapter IV.A.4.f. demonstrate that the combination of effects and exposure measures are not responding to toxic pollutants in sediments and that other factors are causing these responses within a specific reach segment or waterbody. In this situation, the Water Board will consider only the Categories **Likely Impacted** and **Clearly Impacted** as degraded when making a determination on receiving water limits and impaired water bodies described in Chapter IV.A.4.

j. MLOE Approach to Interpret the Narrative Objective in Other Bays and Estuaries

Station assessments for waterbodies identified in Chapter IV.A.1.c.2. will be conducted using the same conceptual approach and similar tools to those described in Chapters IV.A.1.d. through IV.A.1.h. Each LOE will be evaluated by measuring a set of readily available indicators in accordance with Tables 12 and 13.

1) Station assessment shall be consistent with the following key principles of the assessment approach described in Chapters IV.A.1.d. through IV.A.1.i.:

a. Results for a single LOE shall not be used as the basis for an assessment.

b. Evidence of both elevated chemical exposure and biological effects must be present to indicate pollutant-associated impacts.

c. The categorization of each LOE shall be based on numeric values or a statistical comparison.

2) Lines of Evidence and Measurement Tools—Sediment chemistry, toxicity, and benthic community condition shall be measured at each station. Table 12 lists the required tools for evaluation of each LOE. Each measurement shall be conducted using standardized methods (e.g., EPA or ASTM guidance) where available.

3) Categorization of LOEs—Determination of the presence of an LOE effect (i.e., biologically significant chemical exposure, toxicity, or benthic community disturbance) shall be based on a comparison to a numeric response value or a statistical comparison to reference stations. The numeric values or

statistical comparisons (e.g., confidence interval) used to classify a LOE as Effected shall be comparable to those specified in Chapters IV.A.1.f. through IV.A.1.h. to indicate High Chemical Exposure, High Toxicity, or High Disturbance. Reference stations shall be located in an area expected to be uninfluenced by the discharge or pollutants of concern in the assessment area and shall be representative of other habitat characteristics of the assessment area (e.g., salinity, grain size). Comparison to reference shall be accomplished by compiling data for appropriate regional reference sites and determining the reference envelope using statistical methods (e.g., tolerance interval).

Table 12. Tools for Use in Evaluation of LOEs

LOE	Tools	Metrics
Chemistry	Bulk sediment chemistry to include existing list (Appendix A-3) plus other chemicals of concern	CA LRM P_{max} Concentration on a dry weight basis
Sediment Toxicity	10-Day amphipod survival using a species tolerant of the sample salinity and grain size characteristics. e.g., *Hyalella azteca* or *Eohaustorius estuarius*	Percent of control survival
Benthic Community Condition	Invertebrate species identification and abundance	Species richness* Presence of sensitive indicator taxa Dominance by tolerant indicator taxa Presence of diverse functional and feeding groups Total abundance

Table 13. Numeric Values and Comparison Methods for LOE Categorization

Metric	Threshold value or Comparison
CA LRM	Pmax > 0.66
Chemical Concentration	Greater than reference range or interval
Percent of Control Survival	*E. estuarius*: < 59 *H. azteca*: < 62 or SWAMP criterion
Species Richness	Less than reference range or interval
Abundance of Sensitive Indicator Taxa	Less than reference range or interval
Abundance of Tolerant Indicator Taxa	Greater than reference range or interval
Total Abundance	Outside of reference range or interval

4) Station Level Assessment—The station level assessment shall be determined using the decision matrix presented in Table 14. This assessment combines the classifications for each LOE to result in two categories of impact at the station level:

a. Unimpacted—No conclusive evidence of both high pollutant exposure and high biological effects present at the site. Evidence of chemical exposure and biological effects may be within natural variability or measurement error.

b. Impacted—Confident that sediment contamination present at the site is causing adverse direct impacts to aquatic life.

Table 14. Station Assessment Matrix for Other Bays and Estuaries

Chemistry LOE Category	Toxicity LOE Category		Benthic Condition LOE Category	Station Assessment
No effect	No effect		No effect	Unimpacted
No effect	No effect		Effect	Unimpacted
No effect	Effect		No effect	Unimpacted
No effect	Effect		Effect	Impacted
Effect	No effect		No effect	Unimpacted
Effect	No effect		Effect	Impacted
Effect	Effect		No effect	Impacted
Effect	Effect		Effect	Impacted

5) Relationship to the Aquatic Life – Benthic Community Protection Narrative Objective—The category designated as **Unimpacted** shall be considered as achieving the protective condition at the station.

2. Implementation for Assessing Human Health

a. Approach to Interpret Objective for Contaminants Other than Chlorinated Pesticides and PCBs

The narrative human health objective in Chapter III.A.2.b. 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.

b. Approach to Interpret Objective for Chlorinated Pesticides and PCBs

The methods and procedures described below shall be used to interpret the narrative objective described in Chapter III.A.2.b. protecting human consumers of locally caught sportfish. These tools and associated assessment framework are intended to address the two components of the sediment quality objective protecting human consumers;

- Assess whether pollutant concentrations in sportfish pose unacceptable chemical exposure to human consumers and
- Assess whether sediment contamination at a site is a significant contributor to the sportfish contamination.

This framework relies on two indicators to address these components; **Chemical exposure indicator** compares sportfish contamination measurements from the site to consumption advisory thresholds. **Site Linkage indicator** compares sportfish contamination measurements to estimated sportfish concentrations that would result from site exposure. Integration of the results from both indicators produces a site assessment, which is a categorical description of the likelihood and magnitude of chemical exposure associated with sediment contamination within the site. The site assessment results are obtained using a categorical decision matrix to integrate the chemical exposure and site linkage indicators.

These indicators are applied within a tiered assessment framework. This assessment framework consists of three tiers:

Tier 1 is an optional screening assessment to address whether contaminants in sediments at a site pose a potential chemical exposure that warrants further evaluation. For contaminants in site sediments that pose such a potential, a Tier 2 evaluation is performed. Tier 1 requires fewer data relative to Tiers 2 and 3.

Tier 2 is a complete site assessment to assess sediment quality relative to the sediment quality objective protecting human consumers of locally caught sportfish. Tier 2 requires site specific information and data, including sediment and sportfish tissue chemistry, sediment organic carbon and percent lipid in tissue. The data are used to calculate average chemical exposure from consumption and the probability distribution of linkage between contaminants in sediment and sportfish.

Tier 3 is a more complex and site-specific assessment intended to supplement the Tier 2 evaluation. Greater flexibility is provided to address unique site conditions, confounding factors or other chemical exposure factors. Tier 3 may be employed only after meeting the conditions described in Chapter IV.A.2.e.2).

1) Limitations

Each indicator is intended to provide specific information for use in the tiered assessment framework. This assessment framework applies only to specific nonpolar chlorinated hydrocarbons: total DDTs, total PCBs, total chlordanes and Dieldrin. The framework may be applied to assess either the entire water body or a portion, provided that the site area is at least 1 km^2. For small site areas, limitations on the allowable fish species apply as described in Appendix A-5.

2) Routine Monitoring

This assessment framework and tools are applicable to all enclosed bays and estuaries of California.

3) Field Procedures

All studies shall adhere to the following:

a. All sediment samples shall be collected using a grab sampler.
b. Surface sediment from within the upper 5 cm shall be collected for chemistry analyses.
c. Water samples shall be collected using passive samplers, high volume filtration, or bulk collection.
d. Fish tissue shall be collected from the species identified in Appendix A-6. Secondary species may only be used if primary species cannot be collected from the site.
e. Fish shall be collected by any legal method of take.
f. Fish shall meet sportfish angling size requirements, or, if not possible, as close to the size requirement as practical.

g. Fish shall be collected from within the site boundaries, or, if not possible, as close to the site as practical. Fish collected outside the waterbody of interest shall not be used in this assessment.
h. Specific tissue types (e.g. fillet or whole fish) required for each species are identified in Appendix A-6.
i. Sediment and tissue chemical analysis shall include the constituents identified in Appendix A-7.

Before commencing with sample collection, a study design and workplan must be developed and be approved by the Regional Board. Study design considerations are described in Appendix A-5. The conceptual site model (CSM) shall serve as the basis for the study design, define the site boundaries, guide selection of sportfish species to evaluate, and identify appropriate sediment contamination data.

4) Laboratory Testing

All samples will be tested in accordance with U.S. Environmental Protection Agency (USEPA) or American Society for Testing and Materials (ASTM) methodologies where such methods exist. Where no EPA or ASTM methods exist, the Water Boards shall approve the use of other methods. Analytical tests shall be conducted by laboratories certified by the State Water Board's ELAP in accordance with Water Code Section 13176.

Table 15. Laboratory Testing Requirements by Tier

Tier	Organochlorine Pest/PCBs in Sediment[3]	Total Organic Carbon	Organochlorine Pest/PCBs in Tissue[3]	Percent Lipid	Organochlorine Pest/PCBs in Water[3]
1	Yes[1]	Yes[1]	Yes[2]	No	No
2	Yes	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	Yes	Yes

1. Necessary if using sediment data for the Tier 1 assessment.
2. Necessary if using tissue for the Tier 1 assessment.
3. Complete list of constituents is included in Appendix A-7

5) Tiered Assessment Framework

The assessment framework is intended for use in conjunction with high quality data representative of site specific conditions and factors. A CSM and study design as described in Chapter IV.A.4.d.5) must be developed prior to data analysis. Sediment and tissue data shall not be used to assess sediments in accordance with this plan, unless they are consistent with the CSM. A well-designed study is necessary to ensure that the relationship between the contaminants in site sediment and fish tissue is assessed appropriately and that conclusions can be made with confidence (see Chapter IV.A.4.d. and Appendix A-5 for study design considerations).

c. Tier 1 Screening Evaluation

1) Purpose

Tier 1 is an optional screening evaluation that uses standardized conservative methods to evaluate the potential chemical exposure to human consumers of sportfish. The purpose of this tier is to determine whether site sediments pose a sufficient risk to warrant a complete (i.e., Tier 2) site assessment. If potential chemical exposure is below this level, sediments are unimpacted and there is no reason to perform more detailed assessment (either Tier 2 or Tier 3). Tier 1 utilizes conservative assumptions to address uncertainty and reduce the chance of concluding unacceptable chemical exposure does not exist when in fact it does.

A Tier 1 assessment may be performed using either sportfish tissue contaminant concentrations or sediment contaminant concentrations and total organic carbon, depending on what data are available. If both sediment and tissue contamination data are available, the Tier 1 assessment is performed using both data types.

2) Tier 1 Data Requirements

Tier 1 chemical exposure evaluation is obtained using all data that meet the following criteria:

a. Existing sediment and tissue data shall be no more than 6 years old at the time of the assessment and collected within site boundaries.
b. Sediment data must include matching total organic carbon content for site, or an estimate based on other data.
c. Sediment and tissue chemistry must include the constituents identified in Appendix A-7.
d. Only tissue from those primary or secondary species listed in Appendix A-6 shall be used in the analysis.

3) Tissue Evaluation

The tissue-based chemical exposure evaluation is performed by comparing measured tissue concentration to screening thresholds. This comparison shall be based on tissue data from all the species identified in the CSM.

The Tier 1 tissue concentration (C_{Tis95}) is equal to the mean of the 95% upper confidence limit (UCL) of the mean tissue concentration for each species.

Equation 3 $C_{Tis95} = [\Sigma\ C_{Tis95}]/n$

Where

C_{Tis95i} = 95%UCL of the mean tissue concentration for sportfish species i (ng/g ww)

Σ is the sum across all species, and n is the number of species.

The minimum number of tissue samples required for Tier 1 assessment is 3.

To assess chemical exposure, the Tier 1 tissue concentration shall be compared to the tissue screening thresholds in Table 16. If the tissue concentration is greater than any tissue screening threshold in Table 16, there is the potential for unacceptable chemical exposure and a Tier 2 evaluation is required. If the tissue concentration is equal to or less than the tissue screening threshold, the chemical exposure is acceptable. Tier 1 assessment of subsistence fishers may be accomplished by applying thresholds based on Office of Environmental Health Hazard Assessment (OEHHA) Advisory Tissue Levels based on five-day consumption rate as described in the OEHHA 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 dated June 2008 (OEHHA, 2008), in lieu of those provided in Table 16. Use of subsistence thresholds shall only be applied to those waters where the Tribal Beneficial Uses or Tribal Subsistence Beneficial Uses have been designated by the applicable Regional Water Board.

Table 16. Tier 1 Tissue Screening Thresholds

Parameter	Total DDTs (ng/g ww)	Total PCBs (ng/g ww)	Total Chlordanes (ng/g ww)	Dieldrin (ng/g ww)
Tier 1 Threshold[a]	>520	>21	>190	>15

[a] Advisory Tissue Level based on three servings per week (OEHHA 2008).

4) Sediment Evaluation

Tier 1 sediment evaluation is also based on chemical exposure. The Tier 1 sediment evaluation is performed by comparing site sediment concentration to sediment screening thresholds. Sediment screening thresholds are calculated for each contaminant evaluated at the site. To conduct the sediment evaluation, compare the 95% UCL of the mean concentration for site sediment to the threshold. The minimum number of sediment samples required for Tier 1 assessment is three.

The sediment threshold is calculated as the tissue threshold divided by a biota-sediment accumulation factor (BSAF):

Equation 4 $T_{Sed} = (T_{Tis})/(BSAF)$

Where

T_{Sed} = sediment screening threshold (ng/g dw)

T_{Tis} = tissue screening threshold in nanograms per gram wet weight (ng/g ww)

BSAF = biota-sediment accumulation factor (BSAF) defined as wet weight chemical concentration in biota divided by dry weight chemical concentration in sediment

The highest BSAF for the dietary guilds identified in the CSM shall be used in calculating the sediment screening threshold. Tissue screening thresholds are provided in Table 16. The biota-sediment accumulation factors (BSAFs) based on the contaminant, fish guild, and site total organic carbon are included in Table 17.

5) Tier 1 Interpretation

The Tier 1 screening evaluation is only applied to assess whether sediment is unimpacted in relation to the sediment quality objective or if a more detailed analysis is required by conducting a Tier 2 assessment. Possible outcomes of the Tier 1 screening are described below.

If only tissue or only sediment is applied in Tier 1 and the result exceeds the threshold for any constituent, Tier 2 is required for those constituents. If both tissue and sediment are applied the possible outcomes are as follows:

a. If both tissue and sediment results fall below the threshold, the sediment quality is **unimpacted**.
b. If tissue results fall below the threshold and sediment equals or exceeds the threshold, the sediment quality is **unimpacted.**
c. If sediment results fall below the threshold and tissue equals or exceeds the threshold, a Tier 2 **assessment is required** for those constituents above Tier 1 thresholds.

d. If both sediment and tissue results equal or exceed the threshold, a Tier 2 **assessment is required** for those constituents above Tier 1 thresholds.

Table 17. Tier 1 Biota Sediment Accumulation Factors (BSAF) calculated for Percent Total Organic Carbon

	1. Piscivore				2a. Benthic with Piscivory				2b. Benthic with Piscivory (White catfish only)			
TOC (%)	Chlor	DDTs	Diel	PCBs	Chlor	DDTs	Diel	PCBs	Chlor	DDTs	Diel	PCBs
0.1	65.8	83.1	28.1	79.0	68.6	90.8	28.5	86.8	86.6	118.3	34.1	113.6
0.2	33.7	43.6	14.2	41.8	35.7	48.5	14.5	46.9	44.9	63.2	17.3	61.4
0.3	23.0	30.4	9.5	29.4	24.7	34.4	9.8	33.6	31.0	44.8	11.6	43.9
0.4	17.6	23.7	7.2	23.1	19.2	27.3	7.5	26.8	24.0	35.5	8.8	35.1
0.6	12.2	17.0	4.8	16.8	13.7	20.1	5.2	20.0	17.0	26.1	6.0	26.1
0.8	9.5	13.6	3.7	13.5	10.9	16.4	4.0	16.5	13.5	21.3	4.6	21.5
1.0	7.9	11.5	3.0	11.6	9.3	14.2	3.3	14.3	11.4	18.4	3.8	18.6
1.2	6.8	10.1	2.5	10.2	8.1	12.7	2.8	12.9	9.9	16.3	3.2	16.7
1.4	6.0	9.1	2.2	9.2	7.3	11.5	2.5	11.8	8.9	14.8	2.8	15.2
1.6	5.4	8.3	1.9	8.4	6.7	10.7	2.2	10.9	8.1	13.7	2.5	14.1
1.8	5.0	7.7	1.7	7.8	6.2	10.0	2.0	10.2	7.5	12.8	2.3	13.2
2.0	4.6	7.2	1.6	7.3	5.8	9.4	1.9	9.7	7.0	12.0	2.1	12.4
2.5	3.9	6.2	1.3	6.4	5.1	8.3	1.6	8.6	6.1	10.6	1.7	11.0
3.0	3.4	5.6	1.1	5.7	4.6	7.5	1.4	7.8	5.5	9.6	1.5	10.0
3.5	3.1	5.1	1.0	5.2	4.2	7.0	1.3	7.2	5.0	8.8	1.3	9.2
4.0	2.8	4.7	0.9	4.8	3.9	6.5	1.2	6.7	4.6	8.2	1.2	8.6

Chlor – Total Chlordanes; Diel – Dieldrin; DDTs – Total DDTs; PCBs – Total PCBs

Table 17. Tier 1 Biota Sediment Accumulation Factors (BSAF) calculated for percent Total Organic Carbon continued

	3.Benthic and Pelagic with Piscivory				4. Benthic without Piscivory				5. Benthic and Pelagic without Piscivory			
TOC (%)	Chlor	DDTs	Diel	PCBs	Chlor	DDTs	Diel	PCBs	Chlor	DDTs	Diel	PCBs
0.1	89.0	110.6	37.2	103.9	71.7	85.6	42.7	82.4	27.6	32.9	15.9	31.6
0.2	45.1	56.7	18.7	53.6	37.9	47.3	21.8	46.2	14.3	17.6	8.0	17.2
0.3	30.4	38.7	12.5	36.8	26.6	34.4	14.8	34.0	9.9	12.5	5.4	12.3
0.4	23.1	29.7	9.4	28.3	20.9	27.9	11.3	27.9	7.6	9.9	4.1	9.8
0.6	15.8	20.7	6.3	19.9	15.2	21.2	7.8	21.5	5.4	7.3	2.8	7.3
0.8	12.1	16.2	4.8	15.6	12.3	17.7	6.1	18.1	4.3	6.0	2.2	6.1
1.0	9.9	13.5	3.9	13.1	10.6	15.6	5.0	16.0	3.6	5.1	1.8	5.3
1.2	8.5	11.6	3.2	11.4	9.4	14.1	4.3	14.5	3.2	4.6	1.5	4.7
1.4	7.4	10.3	2.8	10.1	8.5	12.9	3.8	13.4	2.8	4.2	1.3	4.3
1.6	6.6	9.3	2.5	9.2	7.8	12.0	3.5	12.5	2.6	3.8	1.2	4.0
1.8	6.0	8.5	2.2	8.4	7.3	11.3	3.2	11.8	2.4	3.6	1.1	3.7
2.0	5.5	7.9	2.0	7.8	6.9	10.7	2.9	11.2	2.2	3.4	1.0	3.5
2.5	4.6	6.8	1.6	6.7	6.1	9.5	2.5	9.9	1.9	3.0	0.8	3.1
3.0	4.0	6.0	1.4	6.0	5.5	8.7	2.2	9.1	1.7	2.7	0.7	2.8
3.5	3.6	5.4	1.2	5.5	5.1	8.0	2.0	8.3	1.6	2.5	0.6	2.6
4.0	3.2	5.0	1.1	5.0	4.7	7.4	1.8	7.8	1.5	2.3	0.6	2.4

Chlor – Total Chlordanes; Diel – Dieldrin; DDTs – Total DDTs; PCBs – Total PCBs

Table 17. Tier 1 Biota Sediment Accumulation Factors (BSAF) calculated for Percent Total Organic Carbon continued

	6 Benthic with Herbivory				7. Benthic and Pelagic with Herbivory				8. Pelagic with Benthic Herbivory			
TOC (%)	Chlor	DDTs	Diel	PCBs	Chlor	DDTs	Diel	PCBs	Chlor	DDTs	Diel	PCBs
0.1	62.0	63.7	43.3	59.2	20.7	22.3	14.0	21.0	44.3	36.9	40.7	33.4
0.2	32.6	34.1	22.5	32.0	10.6	11.6	7.0	11.0	23.3	19.7	21.1	18.0
0.3	22.7	24.2	15.6	22.9	7.2	8.0	4.7	7.6	16.3	14.0	14.6	12.9
0.4	17.8	19.2	12.1	18.3	5.5	6.2	3.6	5.9	12.7	11.1	11.3	10.3
0.6	12.8	14.2	8.6	13.6	3.8	4.4	2.4	4.2	9.2	8.2	8.1	7.7
0.8	10.3	11.6	6.8	11.2	2.9	3.5	1.8	3.4	7.4	6.8	6.4	6.4
1.0	8.8	10.0	5.8	9.8	2.4	2.9	1.5	2.9	6.3	5.9	5.4	5.6
1.2	7.8	8.9	5.1	8.8	2.1	2.6	1.3	2.5	5.6	5.3	4.8	5.0
1.4	7.0	8.2	4.6	8.0	1.8	2.3	1.1	2.3	5.1	4.8	4.3	4.6
1.6	6.5	7.5	4.2	7.4	1.7	2.1	1.0	2.1	4.7	4.5	3.9	4.3
1.8	6.0	7.0	3.9	7.0	1.5	1.9	0.9	1.9	4.4	4.2	3.6	4.1
2.0	5.6	6.6	3.6	6.6	1.4	1.8	0.8	1.8	4.1	4.0	3.4	3.9
2.5	4.9	5.9	3.2	5.8	1.2	1.6	0.7	1.6	3.7	3.6	3.0	3.5
3.0	4.5	5.3	2.9	5.3	1.1	1.4	0.6	1.4	3.3	3.3	2.7	3.3
3.5	4.1	4.9	2.6	4.9	1.0	1.3	0.5	1.3	3.1	3.1	2.5	3.0
4.0	3.8	4.5	2.5	4.5	0.9	1.2	0.5	1.2	2.9	2.9	2.3	2.9

Chlor – Total Chlordanes; Diel – Dieldrin; DDTs – Total DDTs; PCBs – Total PCBs

d. Tier 2 Assessment

1) Purpose

The purpose of the Tier 2 assessment is to determine if site sediments meet the sediment quality objective described in Chapter III.A.2.b. that protects human consumers of resident sportfish from bioaccumulative contaminants in sediment. Tier 2 is based on an evaluation of tissue data and sediment data to assess both chemical exposure to human consumers and the link to contaminants in sediment associated with the site. Chemical exposure is evaluated based on comparison to thresholds established by OEHHA. Evaluation of sediment linkage utilizes a mechanistic food web model to estimate tissue concentrations derived from measured sediment concentrations.

2) Tier 2 Data and Computational Requirements

Tier 2 utilizes a combination of site-specific variables presented in Table 18 and fixed model input parameters. Both types are needed to complete the assessment.

Table 18. Tier 2 Site-Specific Information

Category	Variable	Quantity
Required	Tissue contaminant concentrations	Minimum of three samples per species, preferably composites; minimum of two species, each representing a different dietary guild, included in assessment
Required	Tissue lipid content (%)	One from each tissue composite analyzed above
Required	Sediment contaminant concentrations	Minimum of five samples per site
Required	Sediment total organic carbon	One from each sediment sample analyzed
Required	Site area and length	One measurement
Required	Water column contaminant concentrations	Site average or one estimate for site (min)
Optional	Total suspended sediment concentration, organic carbon concentration of suspended sediment, dissolved oxygen concentration, dissolved organic carbon concentration	Site average or one estimate for site (min)
Optional	Temperature	Site average or one estimate for site
Optional	Salinity	Site average or one estimate for site

Values for optional variables may be based on site measurements (average), or estimated values based on a model (water column concentration) or regional monitoring data.

The fixed or constrained model input parameters consist of the following:

- Proportion of sportfish species consumed
- Sportfish characteristics

- o Diet
  - o Home range
- Contaminant characteristics
  - o Octanol water partitioning coefficient
- The bioaccumulation model constants listed in Appendix A-8

None of the parameters listed above may be changed in the Tier 2 assessment.

Tier 2 chemical exposure evaluation is obtained using all data that meets the following criteria:

a. Consistent with CSM as described in Chapter IV.A.4.d. and Appendix A-5.

b. Sediment and tissue chemistry must include the appropriate constituents identified in Appendix A-7.

c. Tissue obtained from among the primary species representing the dietary guilds, which are:

1. California halibut
2a. Spotted sand bass
2b. White catfish
3. Queenfish
4. White croaker
5. Shiner perch
6. Common carp
7. Topsmelt
8. Striped mullet

Secondary species shall only be used as surrogate if the primary species cannot be obtained from the site. Tier 2 model calculations shall be based on primary species parameters when tissue from a secondary species is used. Weighting of species shall be based on equal proportions of each species unless justification for other proportions is provided that is based upon state angling surveys conducted by the California Department of Fish and Wildlife. Primary and secondary species and dietary guilds are presented in Appendix A-6.

3) Chemical Exposure Evaluation

Chemical exposure is assessed by comparing average tissue contaminant concentration to thresholds. The tissue thresholds are based on serving of one, two and three 8-ounce servings over the course of a week. Tissue thresholds are presented in Table 19. Tissue categories and outcomes are presented in Table 20.

Table 19. Tier 2 Tissue Contaminant Thresholds

	Tier 2 Contaminant Threshold			
Parameter	FCG[1] (ng/g ww)	ATL3[2] (ng/g ww)	ATL2[3] (ng/g ww)	ATL1[4] (ng/g ww)
Total Chlordanes	5.6	190	280	560
Total DDTs	21	520	1,000	2100
Dieldrin	0.46	15	23	46

Total PCBs	3.6	21	42	120

1. FCG - Fish Contaminant Goal based on one 8-ounce serving per week
2. ATL3 - Tissue Advisory Level based on consumption of three 8-ounce servings per week
3. ATL2 - Tissue Advisory Level based on two 8-ounce servings per week
4. ATL1 - Tissue Advisory Level based on one 8-ounce serving per week

Table 20. Tier 2 Chemical Exposure Categories

Tissue Contaminant Concentration	Threshold	Outcome
Average	< FCG	1. Very Low
Average	< ATL3	2. Low
Average	< ATL2	3. Moderate
Average	< ATL1	4. High
Average	> ATL1	5. Very High

4) Site Linkage Determination

A site linkage factor is calculated by comparing tissue concentrations estimated from site sediments to the observed tissue contaminant concentration for the same species used in the chemical exposure evaluation. Site linkage determination is performed separately for each contaminant class. A Monte Carlo simulation is used to generate a cumulative distribution of the site linkage factor. Percentiles are then compared to thresholds presented in Table 21 to categorize the site linkage for the site. The ratio of the sportfish tissue estimated due to sediment contamination at the site compared to the observed contamination in sportfish tissue serves as the basis for this determination as described in the following equation.

Equation 5 C_{Est}/C_{Tis} = Site Linkage Factor

Where

C_{Est} = Weighted average estimated tissue contaminant concentration based on the proportion of the human diet for each guild (ng/g).

C_{Tis} = Weighted average observed tissue concentration

Estimated tissue concentrations are calculated from measured sediment contaminant concentrations based on the following equation.

Equation 6 $C_{Est\,i} = \Sigma\, C_{Sed} \times BSAF_i \times SUF_i$.

Where:

$C_{Est\,i}$ = estimated tissue contaminant concentration in species i contributed from site sediments

$\Sigma\, C_{Sed}$ = measured average sum contaminant concentration (sum PCBs, sum DDTs, sum chlordanes, or dieldrin) in sediment from the site, spatially weighted if appropriate.

$BSAF_i$ = biota-sediment accumulation factor for species i

SUF_i = site use factor for species i = SA/HR_i

SA = site area (km^2) or length across the site (km)

HR_i = sportfish home range (km^2) or linear movement distance (km) for species i

If significant contaminant heterogeneity or gradients are suspected in site sediments, area weighted averaging may be used to provide a representative mean.

5) Calculation of BSAF

Tier 2 employs the Arnot and Gobas food web model (2004), modified by Gobas and Arnot (2010), to calculate the BSAF for each of the fish guild species. The Arnot and Gobas model is structured to depict contaminant concentration in biota as the mass balance of key uptake and loss processes as described in the following equation:

Equation 7 Biota contaminant concentration = [(Respiratory Uptake x Water Concentration) + (Dietary Uptake x Prey Concentration)] / (Elimination + Fecal Egestion + Growth + Metabolism)

Where water concentration includes freely dissolved porewater and dissolved surface water concentrations, the proportions of which are dependent on the specific environment of each organism in the food web.

The dietary uptake for an organism is represented as:

Equation 8 $k_D*\Sigma(P_i*C_{D,i})$

Where:

k_D = dietary uptake rate constant

P_i = proportion by mass of prey item *i* in the total diet

$C_{D,I}$ = contaminant concentration in prey item *i*

The Arnot and Gobas model, like other food web models, includes numeric inputs that are site-specific and additional parameters that are constants. Site-specific model inputs (e.g., sportfish lipid content, sediment organic carbon, and water quality parameters), are obtained locally and modified in each unique application of the model. Site-specific inputs and food web model constants are tabulated in Appendix A-8. The model structure is specific to each fish species reflecting dietary and food web positions.

A biota contaminant concentration is calculated for each component of the food web. A BSAF is obtained for each sportfish species based on the following equation

Equation 9 BSAF = biota contaminant concentration (wet weight)/ sediment contaminant concentration (dry weight)

BSAF is the ratio of the wet weight contaminant concentration in biota to the average dry weight contaminant concentration in sediment. BSAF is calculated separately for each guild.

6) Calculation of Site Linkage Distribution

Monte Carlo simulation is used to calculate the distribution of the site linkage factor based on variability or uncertainty in average measured sediment concentration data, average measured fish tissue concentration data, average fish home range and the estimated BSAF values. Variability and uncertainty in the sediment and fish tissue concentration data is represented by the standard error of the average. Uncertainty in the estimated BSAF is based on literature values.

The Monte Carlo simulation is conducted using 10,000 random subsamples of the concentration and BSAF distributions on a log-normal basis. Site linkage is calculated for each set of subsamples. See Appendix A-8 for additional details of the calculation.

7) Site Linkage Evaluation

The results of the simulations are compiled to calculate a cumulative probability distribution of sediment linkage. The portion of the distribution less than the sediment linkage threshold is used to determine the site linkage category.

Table 21. Site Linkage Categories for Tier 2 Evaluation

Cumulative % of sediment linkage distribution above threshold	Linkage threshold	Outcome
0-25%	0.5	1. Very Low
26-50%	0.5	2. Low
51-75%	0.5	3. Moderate
76-100%	0.5	4. High

8) Site Assessment

The overall site assessment category is determined using the decision matrix presented in Table 22. Site sediments categorized as Unimpacted or Likely Unimpacted meet the sediment quality objective protecting human consumers for the specific contaminant evaluated. Site sediments categorized as Possibly Impacted, Likely Impacted or Clearly Impacted do not meet the sediment quality objective. This evaluation is performed separately for each chemical contaminant group.

Table 22. 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

e. Tier 3 Assessment

1) Purpose

A Tier 3 assessment may be performed to address unique situations or evaluate additional factors affecting the assessment not considered in Tier 2. Tier 3 may be performed to

- Improve accuracy and precision of the Tier 2 assessment
- Evaluate different risk related assumptions
- Incorporate spatial and temporal factors into the assessment
- Evaluate specific subareas, contaminant gradients or potential hotspots

Tier 3 may be performed at any time, provided that Tier 2 is completed at the same time. A change in any parameter or model from that used in Tier 2 must be justified based on site conditions in comparison to Tier 2 assumptions and values, and approved by the Regional Water Board prior to performing the analysis.

2) Tier 3 Triggering Criteria

In order to proceed with Tier 3 assessment, a site must meet one of the following conditions:

a. Variation in factors or processes are present that affect contaminant bioaccumulation from sediment, resulting in a difference in the sediment linkage category. Examples of the factors include the following:

   i. Differences in the relationship between geochemical characteristics and contaminant bioavailability.
   ii. Differences in physiological processes affecting bioaccumulation model performance, such as growth rate or assimilation efficiency.
   iii. Measured sediment concentrations are not representative of actual fish forage area due to spatial or temporal variations in sediment contaminant distribution, fate, or transport.
   iv. Differences in food web or forage range of target species.
   v. Use of alternate sportfish species other than those in Appendix A-6.
   vi. Changes in exposure factors that result in a difference in chemical exposure category.
   vii. Consumption rate.
   viii. Proportion of each sportfish species consumed by humans.

3) Site Assessment

Tier 3 assessments shall utilize the same framework indicators and decision criteria described in in Tier 2 and presented in Tables 20, 21, and 22, with exception of assessment of substance consumers.

Tier 3 assessments for subsistence consumers may be accomplished by adjusting the chemical exposure thresholds to provide an equivalent level of health protection as described in OEHHA 2008. If chemical exposure assessment requires evaluation of subsistence fishers, thresholds based on Office of Environmental Health Hazard Assessment (OEHHA) Advisory Tissue Level based on four- or five-day consumption rate shall be applied in lieu of those provided in Table 16, in consultation with OEHHA to ensure representative characterization of exposure. Use of subsistence thresholds shall only be applied to those waters where the Tribal Beneficial Uses or Tribal Subsistence Beneficial Uses have been designated by the applicable Regional Water Board.

3. Implementation for Assessing Wildlife and Resident Finfish

The narrative wildlife* and resident finfish* objective in Chapter III.A.2.c. shall be implemented on a case-by-case basis, based upon an ecological risk assessment. In conducting an ecological risk assessment, the Water Boards shall consider any applicable and relevant ecological risk information, including policies and guidance from the following sources:

- California Environmental Protection Agency's (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA)
- CalEPA's Department of Toxic Substances Control (DTSC)
- California Department of Fish and Game
- U.S. Environmental Protection Agency
- National Oceanographic Atmospheric Administration
- U.S. Fish and Wildlife Service

When threatened or endangered species are present in enclosed bays and estuaries, the Water Boards shall consult with State and/or Federal Resource Trustee agencies to ensure that these species are adequately protected.

4. Program Specific Implementation

a. Implementation of Sediment Quality Objectives

Implementation of the Sediment Quality Provisions shall be conducted in accordance with the following provisions and consistent with the process shown in Appendix A-1 and A-2.

Each sediment quality objective is evaluated independently using the applicable methods described in Chapters IV.A.1. through IV.A.3. Because each objective addresses a different receptor and/or exposure pathway, sediments that meet one objective may not meet the other objective. As a result, each determination is also independent. An important difference is the spatial scale of the assessment. Compliance with aquatic life objective is determined based on the individual assessment of two or more stations within a site. Compliance with the sportfish objective is based on an overall assessment of a site that encompasses multiple sediment and tissue samples from the site. As a result, assessment of sediment quality relative to each objective may require a unique study design; however, this does not imply that the same sediment chemistry samples and other data cannot be applied to both aquatic life and sportfish-based assessment frameworks.

b. Dredge Materials

1) The Sediment Quality Provisions shall not apply to dredge material suitability determinations.

2) The Water Boards shall not approve a dredging project that involves the dredging of sediment that exceeds the objectives in the Sediment Quality Provisions, unless the Water Boards determine that:

   a. The polluted sediment is removed in a manner that prevents or minimizes water quality degradation.

   b. The polluted sediment is not deposited in a location that may cause significant adverse effects to aquatic life, fish, shellfish, or wildlife or may harm the beneficial uses of the receiving waters, or does not create maximum benefit to the people of the State.

   c. The activity will not cause significant adverse impacts upon a federal sanctuary, recreational area, or other waters of significant national importance.

c. NPDES Permits

1) Receiving Water and Effluent Limits for SQOs

   a. If a Water Board determines that discharge of a toxic or bioaccumulative pollutant to bay or estuarine waters has the reasonable potential to cause or contribute to an exceedance of the SQOs, the Water Board shall apply the objectives as receiving water limits.

   b. The Permittee shall be in violation of such limits if it is demonstrated that the discharge is causing or contributing to the SQO exceedance as defined in Chapter IV.A.4.c.2).

   c. Receiving water monitoring required by an NPDES permit may be satisfied by a Permitee's participation in a regional SQO monitoring program described in Chapter IV.A.4.d.

   d. The sediment chemistry guidelines presented in Tables 6 and 7 shall not be translated into or applied as effluent limits. Effluent limits established to protect or restore sediment quality shall be developed only after the following:

      i. A clear relationship has been established linking the discharge to the degradation,

      ii. The pollutants causing or contributing to the degradation have been identified, and

      iii. Appropriate loading studies have been completed to estimate the reductions in pollutant loading that will restore sediment quality.

These actions are described further in Chapters IV.A.4.f. and IV.A.4.g. Nothing in this chapter shall limit a Water Board's authority to develop and implement waste* load allocations* for Total Maximum Daily Loads. However, it is recommended that the Water Boards develop TMDL allocations using the methodology described herein, wherever possible.

2) Exceedance of Receiving Water Limit

a. Exceedance of a receiving water limit to protect aquatic life as described in Chapter III.A.2.a. is demonstrated when:

   i. Any station within the site is assessed as Clearly Impacted as defined in Chapter IV.A.1.i. and IV.A.1.j. or

   ii. The total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a permit cycle. Calculation of percent area shall be based on data from spatially representative samples selected using a randomized study design or equivalent spatial analysis. Where impacted stations consist entirely of Possibly Impacted, confirmation monitoring may be conducted to further evaluate the spatial extent of the impacts or confirm the impact is present at the existing stations. The most recent monitoring data from each station will be used for the categorization, and

   iii. It is demonstrated that the discharge is causing or contributing to the SQO exceedance, following the completion of the stressor identification studies described in Chapter IV.A.4.f.

   iv. If studies by the Permittee demonstrate that other sources may also be contributing to the degradation of sediment quality, the Regional Water Board shall, as appropriate, require the other sources to initiate studies to assess the extent to which these sources are a contributing factor.

b. Exceedance of the receiving water limit to protect human consumers of sportfish as described in Chapter III.A.2.b. is demonstrated when:

   i. The site sediments are categorized as Possibly Impacted, Likely Impacted or Clearly Impacted over the duration of a permit cycle. When the site is categorized as Possibly Impacted, confirmation monitoring may be conducted to further evaluate the spatial extent of the impacts or confirm the impact is present at the existing site. The most recent monitoring data for the site will be used for the categorization; and

   ii. It is demonstrated that the discharge is causing or contributing to the SQO exceedance.

Exceedance will require the Permittee to perform additional studies as described in Chapters IV.A.4.f.

3) Receiving Water Limits Monitoring Frequency

a. Phase I Stormwater Discharges and Major Discharges—Sediment Monitoring shall not be required less frequently than once per permit cycle. For stations that are consistently classified as Unimpacted or Likely Unimpacted the frequency may be reduced to once per permit cycle. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase I Stormwater Permittees.

b. Phase II Stormwater and Minor Discharges—Sediment Monitoring shall not be required more often than twice per permit cycle or less than once per permit cycle. For stations that are consistently classified as Unimpacted or Likely Unimpacted, the number of stations monitored may be reduced at the discretion of the Water Board. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase II Stormwater Permittees.

c. Other Regulated Discharges and Waivers—The frequency of the monitoring for receiving water limits for other regulated discharges and waivers will be determined by the Water Board.

d. Sediment Monitoring and Assessment

1) Objective—Bedded sediments in bays contain an accumulation of pollutants from a wide variety of past and present sources discharged either directly into the bay or indirectly into waters draining into the bay. Embayments also represent highly disturbed or altered habitats as a result of dredging and physical disturbance caused by construction and maintenance of harbor works, boat and ship traffic, and development of adjacent lands. Due to the multitude of stressors and the complexity of the environment, a well-designed monitoring program is necessary to ensure that the data collected adequately characterizes the condition of sediment in these water bodies.

2) Permitted Discharges—Monitoring may be performed by individual Permittees to assess compliance with receiving water limits, or through participation in a regional or water body monitoring coalition as described under Chapter IV.A.4.d., or both as determined by the Water Board.

3) Monitoring Coalitions—To achieve maximum efficiency and economy of resources, the State Water Board encourages the regulated community in coordination with the Regional Water Boards to establish water body-monitoring coalitions. Monitoring coalitions enable the sharing of technical resources, trained personnel, and associated costs and create an integrated sediment-monitoring program within each major water body. Focusing resources on regional issues and developing a broader understanding of pollutants effects in these water bodies enables

the development of more rapid and efficient response strategies and facilitates better management of sediment quality.

a. If a regional monitoring coalition is established, the coalition shall be responsible for sediment quality assessment within the designated water body and for ensuring that appropriate studies are completed in a timely manner.

b. The Water Board shall provide oversight to ensure that coalition participants are proactive and responsive to potential sediment quality related issues as they arise during monitoring and assessment.

c. Each regional monitoring coalition shall prepare a workplan that describes the monitoring, a map of the stations, participants and a schedule that shall be submitted to the Water Board for approval.

4) Methods—Sediments and tissues collected from each station or site shall be tested and assessed using the methods and metrics described in Chapter IV.A.1. through VI.A.3.

5) Design.

a. The design of sediment monitoring programs, whether site-specific or region wide, shall be based upon a conceptual model. A conceptual model is useful for identifying the physical and chemical factors that control the fate and transport of pollutants and receptors that could be exposed to pollutants in the sediment. See Appendix A-5 for detailed explanation and direction. The conceptual model serves as the basis for assessing the appropriateness of a study design. The detail and complexity of the conceptual model is dependent upon the scope and scale of the monitoring program or tiered assessment. A conceptual model may consider the following:

– Points of discharge into the segment of the waterbody or region of interest
– Tidal flow and/or direction of predominant currents
– Historic and or legacy conditions in the vicinity
– Nearby land and marine uses or actions
– Beneficial uses
– Potential receptors of concern
– Changes in grain size salinity water depth and organic matter
– Other sources or discharges in the immediate vicinity.
– Site boundaries and site size
– Sportfish consumer population characteristics (e.g. consumption rate)
– Sportfish species to be monitored

– Food web associated with sportfish species to be monitored

– Site-specific modifications to the bioaccumulation model parameters (e.g. sportfish movement range or diet) as needed.

A definition of the site boundaries and site size is needed to aid in data collection and data reduction, in addition to being a key input for the sediment linkage indicator as described in Appendix A-5. Selection of sportfish species of interest should, to the extent the information is available, be based on the fishing and consumption practices of local consumers as well as species known to reside in the site, and representing predominant dietary guilds.

b. Sediment monitoring programs shall be designed to ensure that the aggregate stations are spatially representative of the sediment within the water body.

c. The design shall take into consideration existing data and information of appropriate quality.

d. Stratified random design shall be used where resources permit to assess conditions throughout a water body.

e. Identification of appropriate strata shall consider characteristics of the water body including sediment transport, hydrodynamics, depth, salinity, land uses, inputs (both natural and anthropogenic) and other factors that could affect the physical, chemical, or biological condition of the sediment.

f. Targeted designs shall be applied to those Permittees that are required to meet receiving water limits as described in Chapter IV.A.4.c.2).

6) Index Period—All stations shall be sampled between the months of June through September to be consistent with the benthic community condition index period.

7) Regional Monitoring Schedule and Frequency.

a. Regional sediment quality monitoring will occur at a minimum of once every five years.

b. Sediments identified as exceeding the narrative objective must be evaluated more frequently.

8) Confirmation Monitoring – Repeat monitoring conducted at the same and/or additional stations to confirm the categorization of a site or multiple stations as Possibly Impacted. Monitoring methods are the same as those used in the prior assessment.

e. Evaluating Waters for Placement on the Section 303(d) List

1) Aquatic Life – Benthic Community Protection

In California, water segments are placed on the section 303(d) list for sediment toxicity based either on toxicity alone or toxicity that is associated with a pollutant. The listing criteria are contained in the State Water Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (Listing Policy). The Sediment Quality Provisions adds an additional listing criterion that applies only to listings for exceedances of the narrative sediment quality objective for aquatic life protection in Chapter III.A.2.a. The criterion under the Sediment Quality Provisions is described in subchapter a. below and the relationship between the sediment toxicity listing criteria under the Listing Policy and the criterion under the Sediment Quality Provisions is described in subchapter c. and d., below.

a. Water segments shall be placed on the section 303(d) list for exceedance of the narrative sediment quality objective for aquatic life protection in Chapter III.A.2.a. of the Sediment Quality Provisions only if either the following occurs:
   i. Any station within the site is assessed as Clearly Impacted as defined in Chapter IV. A.1.i. and IV.A.1.j., or
   ii. The total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a listing cycle. Calculation of percent area shall be based on data from multiple spatially representative samples selected using a randomized study design or equivalent spatial analysis. Where impacted stations consist entirely of Possibly Impacted, confirmation monitoring may be conducted to further evaluate the spatial extent of the impacts or confirm the impact is present at the existing stations. The most recent monitoring data from each station will be used for the categorization.
b. Data to be evaluated shall include all relevant data collected from monitoring programs conducted over the duration of the listing cycle (6 years).
c. Water segments that exhibit sediment toxicity but that are not listed for an exceedance of the narrative sediment quality objective for aquatic life protection in Chapter III.A.2.a. shall continue to be listed in accordance with Section 3.6 of the Listing Policy.
d. If a water segment is listed under Section 3.6 of the Listing Policy and the Regional Water Board later determines that the applicable water quality standard that is impaired consists of the sediment quality objective in Chapter III.A.2.a. of the Sediment Quality Provisions and a bay or estuarine habitat beneficial use, the Regional Water Board shall reevaluate the listing in accordance with Chapters IV.A.1.i. and IV.A.1.j. If the Regional Water Board reevaluates the listing and determines that the water segment does not

meet the criteria in Chapter IV.A.4.e.1) a. above, the Regional Water Board shall delist the water segment.

2) Human Health - Water segments shall be placed on the section 303(d) list for exceedance of the narrative sediment quality objective for human health protection in Chapter III.A.2.b. of the Sediment Quality Provisions if sediments from a site are categorized as Possibly Impacted, Likely Impacted or Clearly Impacted over the duration of the listing cycle (6 years). When the segment is categorized as Possibly Impacted, confirmation monitoring may be conducted to further evaluate the spatial extent of the impacts or confirm the impact is present at the existing site. The most recent monitoring data for the site will be used for the categorization.

3) Segment evaluation for Chapters IV.A.4.e.1) and IV.A.4.e.2) above shall use the methods described in Chapters IV.A.4.d.4) through IV.A.4.d.7) and meet the following requirements:
   a. Data used in the evaluation must be obtained from multiple spatially representative stations.
   b. Data used in the evaluation must be obtained from multiple surveys over a span of at least one year.

4) Water segments shall be removed from the section 303(d) list if the listing thresholds are not exceeded over the duration of the listing cycle and satisfy the requirements under Chapter IV.A.4.e.3) above.

f. Stressor Identification

If sediments fail to meet the narrative SQOs in accordance with Chapters IV.A.1. through IV.A.3., the Water Boards shall direct the regional monitoring coalitions or Permittees to conduct stressor identification.

The Water Boards shall assign the highest priority for stressor identification to those segments or reaches with the highest percentage of sites designated as Clearly Impacted and Likely Impacted.

Where segments or reaches contain Possibly Impacted but no Clearly or Likely Impacted sites, confirmation monitoring shall be conducted prior to initiating stressor identification.

The stressor identification approach consists of development and implementation of a work plan to seek confirmation and characterization of pollutant-related impacts, pollutant identification, and source identification. The workplan shall be submitted to the Water Board for approval. Stressor identification consists of the following studies:

1) Confirmation and Characterization of Pollutant Related Impacts—Exceedance of the aquatic life direct effects SQO at a site indicates that pollutants in the sediment are the likely cause but does not identify the specific pollutant responsible. The MLOE assessment establishes a linkage to sediment pollutants; however, the lack of confounding factors (e.g., physical disturbance, non-pollutant constituents) must be confirmed. There are two generic stressors that are not related to toxic pollutants that may cause the narrative to be exceeded:

a. Physical Alteration—Examples of physical stressors include reduced salinity, impacts from dredging, very fine or coarse grain size, and prop wash from passing ships. These types of stressors may produce a non-reference condition* in the benthic community that is similar to that caused by pollutants. If impacts to a site are purely due to physical disturbance, the LOE characteristics will likely show a degraded benthic community with little or no toxicity and low chemical concentrations.

b. Other Pollutant Related Stressors—These constituents, which include elevated total organic carbon, ammonia, nutrients and pathogens, may have sources similar to chemical pollutants. Chemical and microbiological analysis will be necessary to determine if these constituents are present. The LOE characteristics for this type of stressor would likely be a degraded benthic community with possibly an indication of toxicity, and low chemical concentrations.

2) To further assess a site that is impacted by toxic pollutants, there are several lines of investigation that may be pursued, depending on site-specific conditions. These studies may be considered and evaluated in the work plan for the confirmation effort:

a. Evaluate the spatial extent of the Area of Concern. This information can be used to evaluate the potential risk associated with the sediment, distinguish areas of known physical disturbance or pollution and evaluate the proximity to anthropogenic source gradient from such inputs as outfalls, storm drains, and industrial and agricultural activities.

b. Body burden data may be examined from animals exposed to the site's sediment to indicate if pollutants are being accumulated and to what degree.

c. Chemical specific mechanistic benchmarks* may be applied to interpret sediment chemistry concentrations.

d. Chemistry and biology data from the site should be examined to determine if there is a correlation between the two LOE.

e. Alternate biological effects data may be pursued, such as bioaccumulation* experiments and pore water toxicity or chemical analysis.

f. Other investigations that may commonly be performed as part of a Phase 1 Toxicity Identification Evaluation* (TIE).

If there is compelling evidence that the SQO exceedances contributing to a receiving water limit exceedance are not due to toxic pollutants, then the assessment area shall be designated as having achieved the receiving water limit.

3) Pollutant Identification—Methods to help determine cause may be statistical, biological, chemical or a combination. Pollutant identification studies should be structured to address site-specific conditions, and may be based upon the following:

a. Statistical methods—Correlations between individual chemicals and biological endpoints (toxicity and benthic community).

b. Gradient analysis—Comparisons are made between different samples taken at various distances from a chemical hotspot to examine patterns in chemical concentrations and biological responses. The concentrations of causative agents should decrease as biological effects decrease.

c. Additional Toxicity Identification Evaluation efforts—A toxicological method for determining the cause of impairments is the use of toxicity identification evaluations (TIE). Sediment samples are manipulated chemically or physically to remove classes of chemicals or render them biologically unavailable. Following the manipulations, biological tests are performed to determine if toxicity has been removed. TIEs should be conducted at a limited number of stations, preferably those with strong biological or toxicological effects.

d. Bioavailability*—Chemical pollutants may be present in the sediment but not biologically available to cause toxicity or degradation of the benthic community. There are several measures of bioavailability that can be made. Chemical and toxicological measurements can be made on pore water to determine the availability of sediment pollutants. Metal compounds may be naturally bound up in the sediment and rendered unavailable by the presence of sulfides. Measurement of acid volatile sulfides and simultaneously extracted metals analysis can be conducted to determine if sufficient sulfides are present to bind the observed metals. Similarly, organic compounds can be tightly bound to sediments. Measurements of sediment organic carbon and other binding phases can be conducted to determine the bioavailable fraction of organic compounds. Solid phase microextraction (SPME) or laboratory desorption experiments can also be used to identify which organics are bioavailable to benthic organisms.

e. Verification—After specific chemicals are identified as likely causes of impairment, analysis should be performed to verify the results. Sediments can be spiked with the suspected chemicals to verify that they are indeed toxic at the concentrations observed in the field. Alternately, animals can be transplanted to suspected sites for *in situ* toxicity and bioaccumulation testing.

When stressor Identification yields inconclusive results for sites classified as Possibly Impacted, the Water Board shall require the Permittee or regional monitoring coalition to perform a one-time augmentation to that study or, alternatively, the Water Board may suspend further stressor identification studies pending the results of future routine SQO monitoring.

4) Sources Identification and Management Actions.

a. Determine if the sources are ongoing or legacy sources.

b. Determine the number and nature of ongoing sources.

c. If a single discharger is found to be responsible for discharging the stressor pollutant at a loading rate that is significant, the Regional Water Board shall require the discharger to take all necessary and appropriate steps to address exceedance of the SQO, including but not limited to reducing the pollutant loading into the sediment.

d. When multiple sources are present in the water body that discharge the stressor pollutant at a loading rate that is significant, the Regional Water Board shall require the sources to take all necessary and appropriate steps to address exceedance of the SQO. If appropriate, the Regional Water Board may adopt a TMDL to ensure attainment of the sediment standard.

g. Cleanup and Abatement

Cleanup and abatement actions covered by Water Code section 13304 for sediments that exceed the objectives in Chapter IV shall comply with Resolution No. 92-49 (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304), Cal. Code Regs., tit. 23, §§ 2907, 2911. In addition, all cleanup and abatement actions must comply with California Environmental Quality Act (CEQA), Public Resources Code §21000 et seq.

h. Development of Site-Specific Sediment Management Guidelines

The Regional Water Boards may develop site-specific sediment management guidelines where appropriate, for example, where toxic stressors have been identified and controllable sources of these stressors exist or remedial goals are desired.

Development of site-specific sediment management guidelines is the process to estimate the level of the stressor pollutant that will meet the narrative sediment quality objective. The guideline can serve as the basis for cleanup goals or revision of effluent limits described in Chapter IV.A.4.b.4) above, depending upon the situation or sources. All guidelines when applied for cleanup, must comply with Resolution No. 92-49.

1) Aquatic Life Benthic Community Protection - Guideline development should only be initiated after the stressor has been identified. The goal is to establish a relationship between the

organism's exposure and the biological effect. Once this relationship is established, a pollutant specific guideline may be designated that corresponds with minimum biological effects. The following approaches can be applied to establish these relationships:

a. Correspondence with sediment chemistry. An effective guideline can best be derived based upon the site-specific, or reach-specific relationship between the stressor pollutant exposure and biological response. Therefore the correspondence between the bulk sediment stressor concentration and biological effects should be examined.

b. Correspondence with bioavailable pollutant concentration. The concentration of the bioavailable fraction of the stressor pollutants is likely to show a less variable relationship to biological effects than bulk sediment chemistry. Interstitial water analysis, SPME, desorption experiments, selective extractions, or mechanistic models may indicate the bioavailable pollutant concentration. The correspondence between the bioavailable stressor concentration and biological effects should be examined.

c. Correspondence with tissue residue. The concentration of the stressor accumulated by a target organism may provide a measure of the stressor dose for some chemicals (e.g., those that are not rapidly metabolized). The tissue residue threshold concentration associated with unacceptable biological effects can be combined with a biota-sediment accumulation factor or model to estimate the loading or sediment concentration guideline.

d. Literature review. If site-specific analyses are ambiguous or unable to determine a guideline, then the results of similar development efforts for other areas should be reviewed. Scientifically credible values from other studies can be combined with mechanistic or empirical models of bioavailability, toxic potency, and organism sensitivity to estimate guidelines for the area of interest.

e. The chemistry LOE of Chapter IV.A.1.h.2), including the threshold values (e.g. CSI and CALRM), shall not be used for setting cleanup levels or numeric values for technical TMDLs.

2) Human Health Protection - Development of management guidelines for human health should be based upon site-specific biota-sediment accumulation factors for sportfish derived using bioaccumulation modeling. The goal is to determine a sediment contaminant concentration that will result in acceptable levels of

tissue contamination in site sportfish. The following approach can be applied to develop these guidelines:

a. Calculation of sediment concentration (Cs) corresponding to attainment of acceptable sportfish contaminant concentration based on biota-sediment accumulation factor ($BSAF_{95}$).

Equation 10 Cs = Ctt/BSAF95 where:

Cs = sediment management concentration (ng/g dry wt);

Ctt = tissue threshold (ng/g wet wt) corresponding to OEHHA ATL3

$BSAF_{95}$ = highest upper 95th percentile of BSAF derived from bioaccumulation model for species used in the assessment

b. Empirical BSAFs derived from site tissue and sediment data may be used when appropriate model-based BSAFs are not available

c. Calculation of sediment guidelines according to a. and b. (above) are based on the assumption that site sediment contamination is the primary determinant of tissue contamination. In situations where other contamination sources are important, such as water column contamination from offsite areas or watershed inputs, these approaches may not achieve the desired tissue contaminant levels. In such situations, the contributions from these additional sources should be accounted for when deriving management guidelines.

d. Regional background contamination should be taken into account when establishing management guidelines or actions. Regional background is defined as the concentration of contaminant that is primarily attributable to diffuse sources, not attributable to a specific source or release. It is not feasible to establish management guidelines for a site that are below regional background, as they cannot be expected to be attained within a defined timeframe. Instead, such values should be regarded as management goals to inform watershed-based management plans.

3) The assessment categorical results of Unimpacted and Likely Unimpacted may be used as alternative sediment management guidelines in lieu of numeric targets.

V. GLOSSARY

ADVISORY TISSUE LEVEL (ATL): Developed by CalEPA Office of Environmental Health Hazard Assessment that serve as the basis for consumption advice for consumption of fish in California.

AQUATIC LIFE: For the purpose of the Sediment Quality Provisions, aquatic life refers to benthic invertebrates, shellfish sport fish and finfish.

BAYS: For the purpose of the Sediment Quality Provisions, bays are defined as enclosed bays*.

BENTHIC: Living on or in bottom of the ocean, bays, and estuaries, or in the streambed.

BIOACCUMULATION: A process in which an organism's body burden of a pollutant exceeds that in its surrounding environment as a result of chemical uptake through all routes of chemical exposure; dietary and dermal absorption and transport across the respiratory surface.

BIOAVAILABILITY: The fraction of a pollutant that an organism is exposed to that is available for uptake through biological membranes (gut, gills).

BIOTA-SEDIMENT ACCUMULATION FACTOR (BSAF): wet weight chemical concentration in biota (ng/g) divided by dry weight chemical concentration in sediment (ng/g).

CHEMICALS OF CONCERN (COCS): Pollutants that occur in environmental media at levels that pose a risk to ecological receptors or human health.

CONTAMINATION: An impairment of the quality of the waters of the State by waste to a degree that creates a hazard to the public health through poisoning or through the spread of disease. "Contamination" includes any equivalent effect resulting from the disposal of waste whether or not waters of the State are affected (CWC section 13050(k)).

EFFECT SIZE: The maximum magnitude of exceedance frequency that is tolerated.

ENCLOSED BAYS: Indentations along the coast that 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.

ENDPOINT: A measured response of a receptor to a stressor. An endpoint can be measured in a toxicity test or in a field survey.

ESTUARIES AND COASTAL LAGOONS: 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 the California Water Code, Suisun Bay, Carquinez Strait downstream to Carquinez Bridge, and appropriate areas of the Smith, Klamath, Mad, Eel, Noyo, and Russian Rivers.

EUHALINE: Waters ranging in salinity from 25–32 practical salinity units (psu).

FISH CONTAMINANT GOAL (FCG): Developed by CalEPA Office of Environmental Health Hazard Assessment to provide fish tissue goal for pollution mitigation or elimination.

INLAND SURFACE WATERS: All surface waters of the State that do not include the ocean, enclosed bays, or estuaries.

LOAD ALLOCATION (LA): The portion of a receiving water's total maximum daily load that is allocated to one of its nonpoint sources of pollution or to natural background sources.

MECHANISTIC BENCHMARKS: Chemical guidelines developed based upon theoretical processes governing bioavailability and the relationship to biological effects.

MIXING ZONE: A limited zone within a receiving water that is allocated for mixing with a wastewater discharge where water quality criteria can be exceeded without causing adverse effects to the overall water body.

NONPOINT SOURCES: Sources that do not meet the definition of a point source as defined below.

NULL HYPOTHESIS: A statement used in statistical testing that has been put forward either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved.

OCEAN WATERS: Territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. Discharges to ocean waters are regulated in accordance with the State Water Board's California Ocean Plan.

POINT SOURCE: Any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

POLLUTANT: Defined in section 502(6) of the CWA as "dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water."

POLLUTION: Defined in section 502(19) of the CWA as the "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water." *Pollution* is also defined in CWC section 13050(1) as an alternation of the quality of the waters of the State by waste to a degree that unreasonably affects either the waters for beneficial uses or the facilities that serve these beneficial uses.

POLYHALINE: Waters ranging in salinity from 18–25 psu.

REFERENCE CONDITION: The characteristics of water body segments least impaired by human activities. As such, reference conditions can be used to describe attainable biological or habitat conditions for water body segments with common watershed/catchment characteristics within defined geographical regions.

RESIDENT FINFISH: Any species of bony fish or cartilaginous fish (sharks, skates and rays) whose home range occupies all or part of the water body but does not extend into other water bodies.

SPECIES RICHNESS: The number of species in a sample.

SURFICIAL SEDIMENTS: Those sediments representing recent depositional materials and containing the majority of the benthic invertebrate community.

STATISTICAL SIGNIFICANCE: When it can be demonstrated that the probability of obtaining a difference by chance only is relatively low.

TOTAL CHLORDANES: SUM of alpha Chlordane, gamma Chlordane, cis-Nonachlor, trans-Nonachlor, and Oxychlordane.

TOTAL DDTS: Sum of o,p'-DDE, o,p'-DDD, o,p'-DDT, p,p'-DDD, p'p'-DDE, and p,p'-DDT.

TOTAL PCBS: Sum of all PCB congeners listed in Table A-7.

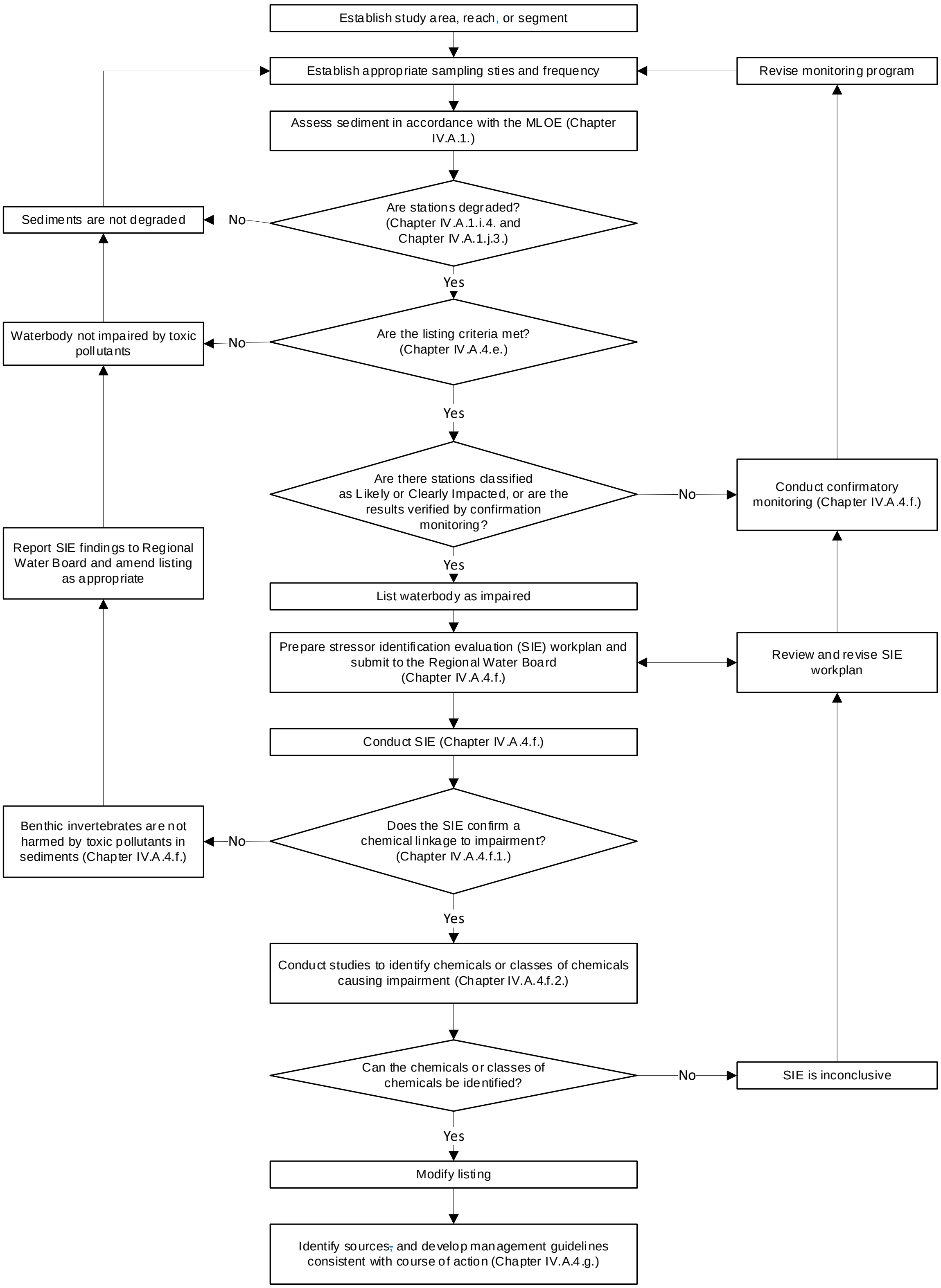
TOXICITY IDENTIFICATION EVALUATION (TIE): Techniques used to identify the unexplained cause(s) of toxic events. TIE involves selectively removing classes of chemicals through a series of sample manipulations, effectively reducing complex mixtures of chemicals in natural waters to simple components for analysis. Following each manipulation the toxicity of the sample is assessed to see whether the toxicant class removed was responsible for the toxicity.

WASTE: As used in this document, waste includes a discharger's total discharge, of whatever origin, i.e., gross, not net, discharge.

WILDLIFE: All tetrapod vertebrates, including amphibians, reptiles, birds and mammals, inclusive of marine mammals.

APPENDICIES

APPENDIX A-1: FIGURE OF WATERBODY ASSESSMENT PROCESS FOR BENTHIC COMMUNITY PROTECTION



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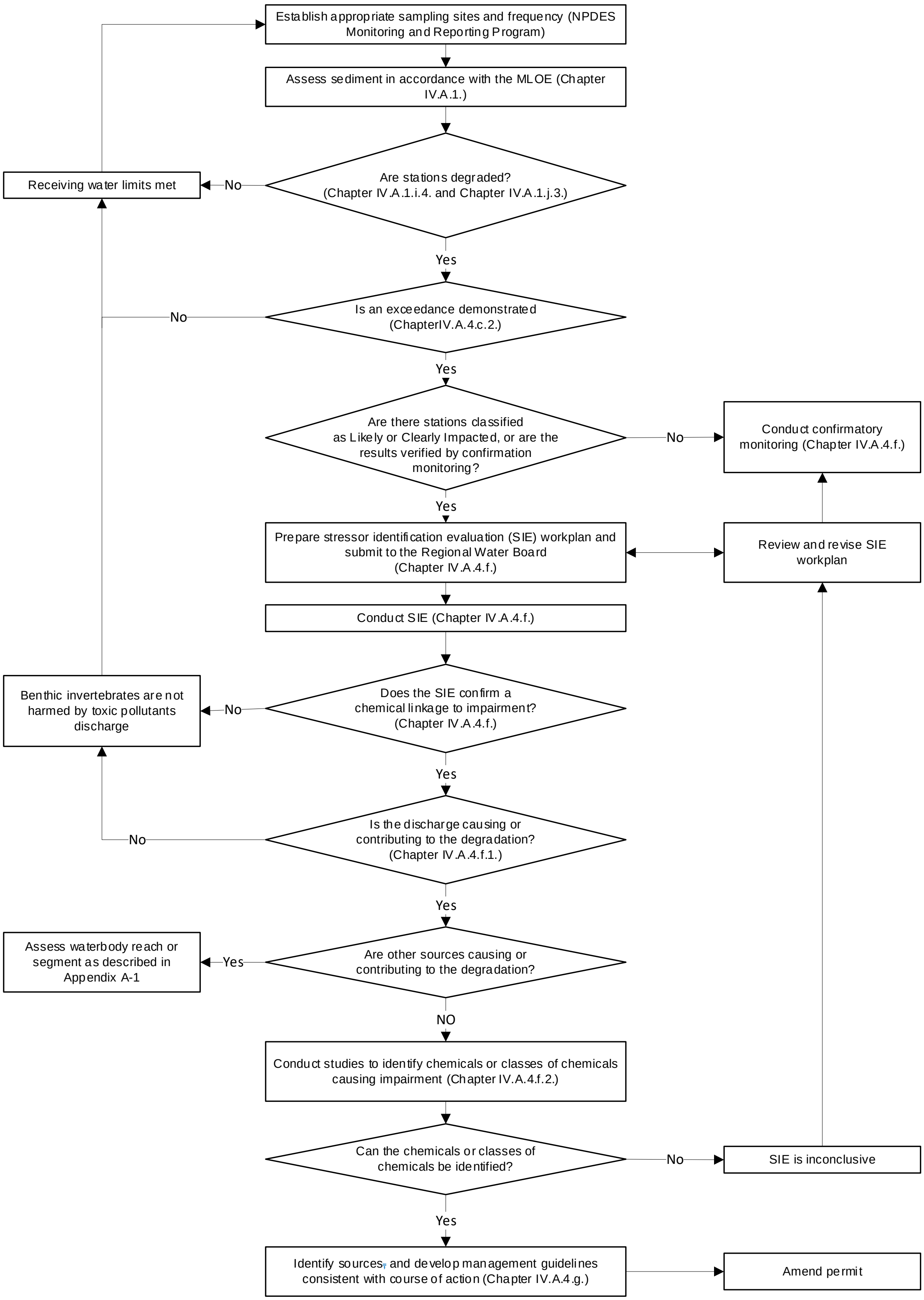
APPENDIX A-2: FIGURE OF POINT SOURCE ASSESSMENT PROCESS FOR BENTHIC COMMUNITY PROTECTION



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APPENDIX A-3: LIST OF CHEMICAL ANALYTES NEEDED TO CHARACTERIZE SEDIMENT CONTAMINATION EXPOSURE AND EFFECT FOR BENTHIC COMMUNITY PROTECTION

Chemical Name	Chemical Group	Chemical Name	Chemical Group
Total Organic Carbon	General	Alpha Chlordane	Pesticide
Percent Fines	General	Gamma Chlordane	Pesticide
		Trans Nonachlor	Pesticide
Cadmium	Metal	Dieldrin	Pesticide
Copper	Metal	o,p'-DDE	Pesticide
Lead	Metal	o,p'-DDD	Pesticide
Mercury	Metal	o,p'-DDT	Pesticide
Zinc	Metal	p,p'-DDD	Pesticide
		p,p'-DDE	Pesticide
		p,p'-DDT	Pesticide
Acenaphthene (L)	PAH	2,4'-Dichlorobiphenyl(PCB8)	PCB congener
Anthracene (L)	PAH	2,2',5-Trichlorobiphenyl(PCB18)	PCB congener
Biphenyl (L)	PAH	2,4,4'-Trichlorobiphenyl(PCB28)	PCB congener
Naphthalene (L)	PAH	2,2',3,5'-Tetrachlorobiphenyl(PCB44)	PCB congener
2,6-dimethylnaphthalene (L)	PAH	2,2',5,5'-Tetrachlorobiphenyl(PCB52)	PCB congener
Fluorene (L)	PAH	2,3',4,4'-Tetrachlorobiphenyl(PCB66)	PCB congener
1-methylnaphthalene (L)	PAH	2,2',4,5,5'-Pentachlorobiphenyl(PCB101)	PCB congener
2-methylnaphthalene (L)	PAH	2,3,3',4,4'-Pentachlorobiphenyl(PCB105)	PCB congener
1-methylphenanthrene (L)	PAH	2,3,3',4',6-Pentachlorobiphenyl (PCB110)	PCB congener
Phenanthrene (L)	PAH	2,3',4,4',5-Pentachlorobiphenyl(PCB118)	PCB congener
Benzo(a)anthracene (H)	PAH	2,2',3,3',4,4'-Hexachlorobiphenyl(PCB128)	PCB congener
Benzo(a)pyrene (H)	PAH	2,2',3,4,4',5'-Hexachlorobiphenyl(PCB138)	PCB congener
Benzo(e)pyrene (H)	PAH	2,2',4,4',5,5'-Hexachlorobiphenyl(PCB153)	PCB congener
Chrysene (H)	PAH		
Dibenz(a,h)anthracene (H)	PAH	2,2',3,4,4',5,5'-Heptachlorobiphenyl(PCB180)	PCB congener
Fluoranthene (H)	PAH	2,2',3,4',5,5',6-Heptachlorobiphenyl(PCB187)	PCB congener
Perylene (H)	PAH	2,2',3,3',4,4',5,6-Octachlorobiphenyl(PCB195)	PCB congener
Pyrene (H)	PAH		

(L) = Low molecular weight PAH
(H) = High molecular weight PAH

APPENDIX A-4: STATION ASSESSMENT CATEGORY RESULTING FROM EACH POSSIBLE MLOE COMBINATION

LOE Category Combination	Sediment Chemistry Exposure	Benthic Community Condition	Sediment Toxicity	Station Assessment
1	Minimal	Reference	Nontoxic	Unimpacted
2	Minimal	Reference	Low	Unimpacted
3	Minimal	Reference	Moderate	Unimpacted
4	Minimal	Reference	High	Inconclusive
5	Minimal	Low	Nontoxic	Unimpacted
6	Minimal	Low	Low	Likely unimpacted
7	Minimal	Low	Moderate	Likely unimpacted
8	Minimal	Low	High	Possibly impacted
9	Minimal	Moderate	Nontoxic	Likely unimpacted
10	Minimal	Moderate	Low	Likely unimpacted
11	Minimal	Moderate	Moderate	Possibly impacted
12	Minimal	Moderate	High	Likely impacted
13	Minimal	High	Nontoxic	Likely unimpacted
14	Minimal	High	Low	Inconclusive
15	Minimal	High	Moderate	Possibly impacted
16	Minimal	High	High	Likely impacted
17	Low	Reference	Nontoxic	Unimpacted
18	Low	Reference	Low	Unimpacted
19	Low	Reference	Moderate	Likely unimpacted
20	Low	Reference	High	Possibly impacted
21	Low	Low	Nontoxic	Unimpacted
22	Low	Low	Low	Likely unimpacted
23	Low	Low	Moderate	Possibly impacted
24	Low	Low	High	Possibly impacted
25	Low	Moderate	Nontoxic	Likely unimpacted
26	Low	Moderate	Low	Possibly impacted
27	Low	Moderate	Moderate	Likely impacted
28	Low	Moderate	High	Likely impacted
29	Low	High	Nontoxic	Likely unimpacted
30	Low	High	Low	Possibly impacted
31	Low	High	Moderate	Likely impacted
32	Low	High	High	Likely impacted
33	Moderate	Reference	Nontoxic	Unimpacted
34	Moderate	Reference	Low	Likely unimpacted
35	Moderate	Reference	Moderate	Likely unimpacted
36	Moderate	Reference	High	Possibly impacted
37	Moderate	Low	Nontoxic	Unimpacted
38	Moderate	Low	Low	Possibly impacted
39	Moderate	Low	Moderate	Possibly impacted
40	Moderate	Low	High	Possibly impacted
41	Moderate	Moderate	Nontoxic	Possibly impacted
42	Moderate	Moderate	Low	Likely impacted
43	Moderate	Moderate	Moderate	Likely impacted
44	Moderate	Moderate	High	Likely impacted

LOE Category Combination	Sediment Chemistry Exposure	Benthic Community Condition	Sediment Toxicity	Station Assessment
45	Moderate	High	Nontoxic	Possibly impacted
46	Moderate	High	Low	Likely impacted
47	Moderate	High	Moderate	Likely impacted
48	Moderate	High	High	Likely impacted
49	High	Reference	Nontoxic	Likely unimpacted
50	High	Reference	Low	Likely unimpacted
51	High	Reference	Moderate	Inconclusive
52	High	Reference	High	Likely impacted
53	High	Low	Nontoxic	Likely unimpacted
54	High	Low	Low	Possibly impacted
55	High	Low	Moderate	Likely impacted
56	High	Low	High	Likely impacted
57	High	Moderate	Nontoxic	Likely impacted
58	High	Moderate	Low	Likely impacted
59	High	Moderate	Moderate	Clearly impacted
60	High	Moderate	High	Clearly impacted
61	High	High	Nontoxic	Likely impacted
62	High	High	Low	Likely impacted
63	High	High	Moderate	Clearly impacted
64	High	High	High	Clearly impacted

APPENDIX A-5: DESIGN CONSIDERATIONS FOR HUMAN HEALTH SQO ASSESSMENT

The first step in site assessment for the human health SQO is to develop a conceptual site model (CSM) that describes the specific site or waterbody characteristics, contaminants, receptors, and sources that are important to the study design. This is needed to determine key assessment design elements, such as site size, sportfish species to monitor, and number of samples to collect. A CSM generally includes a written description of the specific issues associated with a site, as well as a graphical depiction of contaminant sources, processes, and receptors (i.e., target species). The graphical depiction aids in beginning to identify potential linkages, as well as sources of uncertainty, such as what types of anglers capture and consume fish from the site, how frequently does fishing activity occur, and what seafood species occur on the site. The detail and complexity of the conceptual model is dependent upon the scope and scale of the assessment. For Tier 1, a limited CSM that focuses primarily on site boundaries, historical data availability, and basis for the selection of fish species may be appropriate.

The CSM should be based on local information and expertise, and developed in a collaborative process that includes local environmental managers, stakeholders, and scientists. The CSM can be informed by prior and ongoing scientific activities, including literature, prior field data collection, anecdotal evidence, and modeling activities. This information should be documented as part of CSM development. Issues to be considered and addressed include: model assumptions; key processes; spatial and temporal scales of interest; system characteristics and behaviors; available data sources and collection programs; and data gaps. The CSM should be written in clear language with a minimum of jargon.

The CSM should identify water body characteristics, key exposure pathways, and areas of uncertainty. For the human health SQO, exposure pathways are defined, a priori, as human consumption of contaminated sportfish. However, there are site-specific aspects of consumption that should be addressed in the CSM. Specifically, the CSM should contain information needed to determine the following study design parameters:

- Site boundaries and site size
- Sportfish consumer population characteristics (e.g., consumption rate)
- Fish species to be monitored
- Food web associated with target sportfish species
- Site-specific modification to other parameters (e.g., sportfish movement range or diet) as needed
- Sediment contaminant sources
- Contaminant fate and transport mechanisms

A definition of the site boundaries and site size is needed to aid in data collection and data reduction, in addition to being a key input for the sediment contribution indicator. A site for SQO assessment is defined as an area of sufficient size to encompass key elements of the food web responsible for fish tissue contamination. The site should be large enough to include most of the foraging activities of the target sportfish, but not so large as to obscure linkages between sediment and tissue contamination. Site boundaries may be defined based on geomorphic and hydrologic boundaries, fish movement patterns, areas of management concern, previous boundary definitions (e.g., water body segments), and other local considerations.

Site size (area or length) may influence the accuracy of the site linkage indicator. The bioaccumulation modeling approach used in the assessment framework incorporates a site use factor that represents the proportion of sportfish foraging activity that occurs within the site. Use of a site that is substantially smaller than the forage area of the target sportfish will reduce the apparent linkage of the site sediment to fish bioaccumulation and may result in an underestimate of the site linkage. Selection of a very large site for assessment may also result in an underestimate of site linkage because of spatial variation in sediment contamination or foraging activity within the site. For example, the average sediment contaminant concentration over a large area may not accurately represent the concentration in subareas of the site that represent the main forage area or the fish. A minimum site area of 1 km^2 is required for Tier 2 assessment, as this area encompasses a large portion of the forage range for most of the primary sportfish species for assessment. Application of the Tier 2 methodology to smaller sites is likely to provide an inaccurate site linkage evaluation because uptake from foraging activities outside of the site is not specifically considered. Assessment of sites <1km^2 may require a Tier 3 assessment and use of an alternative bioaccumulation model. For sites of 1 to 10 km^2, California halibut or striped mullet should not be included as target species because their forage range is much larger than the site.

Another consideration is the spatial distribution of sediment contamination within a site. Some sites may contain specific areas of elevated contamination ("hotspots"), and it may be worthwhile to perform the assessment at multiple scales, including the hotspots, as well as less contaminated areas, to determine whether the assessment outcome would be different. During the CSM development, it would be useful to compile existing data on contamination in sportfish and sediment, and plot the results to examine the spatial distribution of contamination. Similarly, journal publications and technical reports describing contaminant sources and spatial patterns should be summarized, and local experts consulted, to identify potential hotspot areas.

The seafood consumer population is chosen based on what is known about fishing practices and consumption rates at the site. Selection of an appropriate consumer population will aid in identifying available information on local consumption rates. Surveys from other California water bodies may be employed to determine consumption rates if local data are not available. Selection of seafood species of interest will be based on the fishing and consumption practices of local consumers, as well as species known to reside in the site, and representing predominant dietary guilds. Influence of existing advisories on consumption rates should also be considered.

Additionally, the CSM can describe the broader environmental processes and pathways that affect human exposure to contaminated seafood at the site. This can include a depiction of the historic and current sources and processes that potentially result in elevated or reduced site sediment contamination. Examples of potential sources are legacy contaminated sites, agricultural or urban areas in which the contaminants were historically used. Processes that change site sediment contamination may include erosion or deposition events, or management activities that contribute to or reduce food web exposure to sediment contamination. The CSM may also include a description of other environmental matrices or areas outside the site that could result in food web contaminant exposure (e.g., known hotspots outside the site; ongoing external sources such as tributaries or storm basins). More complex contaminant fate and process information may be incorporated into a Tier 3 assessment, if deemed necessary.

CSM development is a dynamic process. As additional data and information becomes available, they are used to refine the CSM, by adding additional sources, pathways, or targets, or modifying existing linkages. Periodic refinement of the CSM may be needed to address site characteristics impacted by climate change, including changes to the food web or foraging behavior and range. As proposed in this framework an initial CSM is developed prior to Tier 1 assessment, and there is the opportunity to revisit the CSM prior to Tiers 2 and 3, if the later Tiers are conducted.

APPENDIX A-6: PRIMARY AND SECONDARY SPECIES AND ASSOCIATED DIETARY GUILD CATEGORIES USED FOR CHEMICAL EXPOSURE AND SITE LINKAGE EVALUATIONS. TISSUE TYPE DENOTED BY F (SKIN OFF FILLET) OR W (WHOLE FISH, WITHOUT HEAD OR INTERNAL ORGANS)

Dietary Guild	***Description***	***Primary Guild Species***	***Secondary Guild Species***
Piscivory	The majority of the diet is fish. Large predatory invertebrates (e.g., cephalopods, decapod crustaceans, and echinoderms) are also consumed to some degree.	California halibut (F)	Pacific angel shark (F) Lingcod(F)
Benthic diet with piscivory	Diet regularly includes a mixture of benthic invertebrates and forage fish. The most diverse category. Includes two estuarine species: white catfish and channel catfish, each of which is commonly targeted by recreational anglers in the Sacramento-San Joaquin Delta (Shilling et al. 2010).	Spotted sand bass (F) White catfish (F)	Leopard shark(F) Barred sand bass(F) Bat Ray(F) Yellowfin croaker(F) Bonefish White seabass(F) Brown rockfish(F) Brown smoothhound(F) Redtail surfperch(F) Pacific sanddab(F) Grass rockfish(F) Starry flounder(F) Cabezon (F) English sole(F) Channel catfish(F)
Benthic and pelagic diet with piscivory	Diet includes a combination of benthic invertebrates, pelagic invertebrates (e.g., zooplankton, shrimp, and mysidae), and forage fish.	Queenfish(F)	Black rockfish(F) Kelp bass(F) Blue rockfish(F)
Benthic diet without piscivory	Diet largely composed of small benthic invertebrates, such as amphipods and other crustaceans, bivalve mollusks, and polychaete worms.	White croaker(F)	Spotfin croaker(F) Sargo(F) Striped seaperch(W) White seaperch(W) Pile perch(W) Walleye surfperch(W) Rubberlip seaperch(W) Barred surfperch(W) Fantail sole(F)
Benthic and pelagic diet without piscivory	Diet includes a mixture of epibenthic and pelagic invertebrates (e.g., zooplankton, shrimp, and mysids).	Shiner perch(W)	Black perch(W) Dwarf perch(W)
Benthic diet with herbivory	Largely consumes benthic invertebrates, benthic algae, and aquatic plants. Includes common carp, an estuarine species captured in the Delta	Common carp(F)	Monkeyface prickleback(F) Señorita(W)
Benthic and pelagic diet with herbivory	Diet consists of benthic and pelagic invertebrates and plant material, including benthic algae and phytoplankton.	Topsmelt(W)	
Pelagic diet with benthic herbivory	Diet includes largely pelagic invertebrates and benthic algae. This includes a substantial component of benthic algae and attached plants, likely as floating detritus. These benthic plants constitute a potential dietary association with sediment.	Striped mullet(F)	

APPENDIX A-7: LIST OF CHEMICAL ANALYTES FOR SEDIMENT, TISSUE, AND WATER SAMPLES NEEDED TO CHARACTERIZE SEDIMENT CONTAMINATION EXPOSURE AND EFFECT FOR HUMAN HEALTH

Chemical Name	Chemical Group	Chemical Name	Chemical Group
Total Organic Carbon[1]	General	PCB 095	PCB congener
Percent lipids[2]	General	PCB 097	PCB congener
		PCB 099	PCB congener
alpha Chlordane	Pesticide	PCB 101	PCB congener
gamma Chlordane	Pesticide	PCB 105	PCB congener
cis-Nonachlor	Pesticide	PCB 110	PCB congener
trans-Nonachlor	Pesticide	PCB 114	PCB congener
Oxychlordane	Pesticide	PCB 118	PCB congener
		PCB 126	PCB congener
Dieldrin	Pesticide	PCB 128	PCB congener
		PCB 137	PCB congener
o,p'-DDE	Pesticide	PCB 138	PCB congener
o,p'-DDD	Pesticide	PCB 141	PCB congener
o,p'-DDT	Pesticide	PCB 146	PCB congener
p,p'-DDD	Pesticide	PCB 149	PCB congener
p,p'-DDE	Pesticide	PCB 151	PCB congener
p,p'-DDT	Pesticide	PCB 153	PCB congener
		PCB 156	PCB congener
PCB 008	PCB congener	PCB 157	PCB congener
PCB 018	PCB congener	PCB 158	PCB congener
PCB 027	PCB congener	PCB 169	PCB congener
PCB 028	PCB congener	PCB 170	PCB congener
PCB 029	PCB congener	PCB 174	PCB congener
PCB 031	PCB congener	PCB 177	PCB congener
PCB 033	PCB congener	PCB 180	PCB congener
PCB 044	PCB congener	PCB 183	PCB congener
PCB 049	PCB congener	PCB 187	PCB congener
PCB 052	PCB congener	PCB 189	PCB congener
PCB 056	PCB congener	PCB 194	PCB congener
PCB 060	PCB congener	PCB 195	PCB congener
PCB 064	PCB congener	PCB 198	PCB congener
PCB 066	PCB congener	PCB 199	PCB congener
PCB 070	PCB congener	PCB 200	PCB congener
PCB 074	PCB congener	PCB 201	PCB congener
PCB 077	PCB congener	PCB 203	PCB congener
PCB 087	PCB congener	PCB 206	PCB congener
		PCB 209	PCB congener

1. Sediment only
2. Tissue only

APPENDIX A-8: BIOACCUMULATION MODEL COMPONENTS

Bioaccumulation Model Equations

This assessment framework employs the Arnot and Gobas food web model (2004), modified by Gobas and Arnot (2010), to calculate the biota-sediment accumulation factors (BSAFs) for each of the fish guild species. This is a mechanistic bioaccumulation model which has limited complexity to increase ease of application while accurately depicting the primary bioaccumulation processes (Burkhard 1998, Arnot and Gobas 2004). The Arnot and Gobas model is structured to depict contaminant concentration in biota as the mass balance of key uptake and loss processes. The model equation structure accounts for uptake by diet and respiration; loss by egestion, metabolism, and respiratory elimination; and growth dilution:

Biota Concentration (C_{Biota})=
(Respiratory Uptake*Water Concentration+ Dietary Uptake*Prey Concentration) /
(Elimination + Fecal Egestion + Growth + Metabolism)

The model equations presented here are used to calculate biota concentration and BSAF for each model species. All model equations and assumptions have been presented in detail elsewhere (Gobas 1993, Arnot and Gobas 2004, Gobas and Arnot 2005, Gobas and Arnot 2010).

A few minor modifications were made to the Gobas and Arnot model equations for this framework. The first change was to modify the list of PCB congeners to match multiple California regional monitoring programs, as well as the addition of three classes of chlorinated pesticides: chlordanes, dieldrin, and DDTs. The second modification consists of basing temperature and salinity corrected K_{OW} values for each congener on site-specific measurements. Finally, the food-web structure was modified to be more inclusive of the diverse types of sportfish. This included the addition of several sportfish, including the California halibut, spotted sand bass, queenfish, common carp, topsmelt, and striped mullet. Appropriate prey items were also added such as macrophytes and the decapod crab.

This appendix depicts all equations included in the model. Abiotic input parameters and calculations describe key abiotic processes, such as contaminant partitioning between sediment and the water column, and between dissolved and particulate form. This is followed by biotic input parameters and calculations, which are organized separately for primary producers (phytoplankton and macrophytes) and animals (prey organisms and seafood). The primary producer calculations describe net uptake from the water column into phytoplankton and macrophytes at the base of the food web. The animal calculations are performed for each animal taxa, resulting in food web uptake, and ultimately bioaccumulation in the modeled seafood organisms. The model uses a food web structure and dietary proportions specific for each organism (Tables A-8.1 and A-8.2). For each organism, calculations are performed on a congener-specific basis and later summed to provide total contaminant concentration and BSAF values (i.e., total DDTs).

Table A-8.1. Invertebrate food-web properties. Values indicate the proportion of each diet component.

		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 A-8.2. Fish food-web properties. Values indicate the proportion of each diet component.

		F1	F2	F3	F4	F5	F6	SP1	SP2a	SP2b	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	0.2	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	---	0.06	0.24	0.1	0.15	0.06	0.05	0.02
	I7	---	---	---	---	---	---	---	0.28	0.08	---	---	---	0.14	---	0.1
	I8	---	---	---	---	---	---	---	0.35	0.11	---	---	---	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	0.25	---	---	---	0.01	---	---
	F5	---	---	---	0.05	---	0.05		---	0.3	---	---	---	---	---	---
	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	0
	Lipid (%)	1.20	2.50	1.80	3.00	2.00	3.00	m	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	1.00	0.05	0.37	0.05	2.00	0.02	1.23

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)
SP1-piscivore (California halibut)
SP2-benthic diet with piscivory (a:Spotted sand bass, b:White catfish)
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)
PW Respir.-porewater respiration proportion

Model Constants

The Arnot and Gobas model, like other food web models, includes numeric inputs that are site specific and additional numeric inputs that are generic constants. Site specific model inputs (e.g., seafood lipid content, sediment organic carbon, and water quality parameters), are obtained locally and modified in each unique application of the model. In contrast, model constants (Table A-8.3) are standard constants based on physical principles, not locally available or measured. The model utilizes constants assembled by the model authors (Arnot and Gobas 2004, Gobas and Arnot 2010) based on fitting model equations to datasets developed in global literature reviews. An exception is octanol-water partitioning coefficient (K_{OW}) for pesticides and some PCBs, which was not included in prior model documentation. Methods for K_{OW} development are documented below.

Octanol-water partitioning coefficient (K_{OW})

The octanol-water partitioning coefficient governs compound partitioning between tissue lipids versus water, and between sediment and porewater. PCB K_{OW} values used in the assessment framework were obtained from Gobas and Arnot (2005). For those PCBs not evaluated in Gobas and Arnot, K_{OW} values were the median of results combined from five published sources: Li *et al.* (2003), Mackay *et al.* (2000), Beyer *et al.* (2002), Hansen *et al.* (1999), and Hawker and Connell (1988). Pesticide K_{OW} values were taken from Shen and Wania (2005), or Leatherbarrow *et al.* (2006), which compiled K_{OW}s from Mackay *et al.* (2000).

Literature K_{OW}s are generally calculated at temperatures of 25°C, which is higher than many California bays and estuaries. Therefore, PCB K_{OW}s are temperature corrected to correspond to the water body temperature, based on the site-specific data. Following Gobas and Arnot (2005, 2010), and references cited therein, the K_{OW} values were temperature corrected using the following equation (Li *et al.* 2003):

$$\log K_{OW}E_T = \log K_{OW}D_T - \frac{\Delta U_{ow}}{\ln(10)*R} * \left(\frac{1}{E_T} - \frac{1}{D_T}\right)$$

Where:

E_T = the environmental temperature (Kelvin)

D_T = the data collection temperature (Kelvin)

ΔU_{OW} = the internal energy of octanol-water phase transfer

R = the gas law constant (0.0083145 kJ/mol K)

Empirically-derived ΔU_{OW} were unavailable for some congeners, and were estimated to be -28 kJ/mol, the median of empirical ΔU_{OW} data for other PCB congeners, and -25 kJ/mol for the pesticides.

Following Gobas and Arnot (2005, 2010), and references cited therein, K_{OW} values are also salinity corrected to correspond to the measured water body average salinity. Salinity corrections followed Xie *et al.*(1997):

$$K_{OW}S = K_{OW}T \times 10^{(SPC \cdot Vh \cdot MCS \cdot Sal / 35)}$$

Where:

SPC = the Setschenow proportionality constant (0.0018 L/cm^3)

Vh = the LeBas molar volume (cm^3/mol) of the chemical (calculated following Tucker and Nelken 1982)

MCS = the molar concentration of seawater at 35 practical salinity units (0.5)

Sal = the salinity for the system of interest (psu)

Summary tables of the PCB and pesticide physical-chemical parameters (Vh, ΔU_{OW}, and $LogK_{OW}$ values) are listed in tables A-8.4 and A-8.5, respectively.

Table A-8.3. Constant values used for bioaccumulation model calculations.

Bioaccumulation Parameters and Constants	Parameter Name	Value	Units
Density of lipid	dLipid	0.9	kg/L
Disequilibrium factor for particulate organic carbon (POC) partitioning	dPOC	1	unitless
Disequilibrium factor for dissolved organic carbon (DOC) partitioning	dDOC	1	unitless
Proportionality constant describing phase partitioning of POC	alphaPOC	0.35	unitless
Proportionality constant describing phase partitioning of DOC	alphaDOC	0.08	unitless
Non-lipid organic carbon (NLOC) proportionality constant	lipcf	0.35	unitless
Non-lipid organic matter (NLOM) proportionality constant	lipcfp	0.035	unitless
NLOC for plants	NLOC	6.00	%
NLOM for animals	NLOM	20.00	%
NLOM for bivalves	NLOM/2	10.00	%
Metabolic rate constant	kM	0	1/day
Constant for phytoplankton aqueous uptake rate	pA	6.0E-5	1/day
Constant for phytoplankton aqueous uptake rate	pB	5.5	1/day
Growth rate for phytoplankton	kGp	0.080	1/day
Growth rate for macrophytes	kGm	0.125	1/day
Invertebrate Growth Rate Coefficient	IGR	3.5E-4	unitless
Fish Growth Rate Coefficient	FGR	7E-4	unitless
Particle scavenging efficiency for filter feeders	scav	100	%
Invertebrate Lipid Digestion Efficiency (alpha)	alphaI	0.75	Unitless
Invertebrate NLOM Digestion Efficiency (beta)	betaI	0.75	unitless
Invertebrate Water Digestion Efficiency (chi)	chiI	0.55	unitless
Zooplankton Lipid Digestion Efficiency (alpha)	alphaZ	0.75	unitless
Zooplankton NLOM Digestion Efficiency (beta)	betaZ	0.75	unitless
Zooplankton Water Digestion Efficiency (chi)	chiZ	0.55	unitless
Fish Lipid Digestion Efficiency (alpha)	alphaF	0.92	unitless
Fish NLOM Digestion Efficiency (beta)	betaF	0.6	unitless
Fish Water Digestion Efficiency (chi)	chiF	0.55	unitless
Ed - Constant A - Invertebrates and Fish	A	8.50E-8	Unitless
Ed - Constant B - Invertebrates and Fish	B	2	unitless

Table A-8.4. PCB congener list with physical-chemical property values.

PCB Congener	LeBas molar volume (Mackay 2006)	ΔUow at 25 °C (kJ/mol)	Log K_{OW} at 25 °C
PCB 8	226.4	-22.7	5.12
PCB 11*	226.4	-28	5.27
PCB 18	247.3	-25	5.3
PCB 27	247.3	-28	5.4
PCB 28	247.3	-26.3	5.66
PCB 29	247.3	-28	5.6
PCB 31	247.3	-25.9	5.78
PCB 33	247.3	-26	5.65
PCB 37*	247.3	-28	5.78
PCB 44	268.2	-26	5.82
PCB 49	268.2	-27	5.95
PCB 52	268.2	-27.3	5.91
PCB 56	268.2	-30	6.02
PCB 60	268.2	-30	6.12
PCB 64	268.2	-28	5.79
PCB 66	268.2	-28	6.01
PCB 70	268.2	-28	6.1
PCB 74	268.2	-28	6.11
PCB 77	268.2	-28	6.26
PCB 81*	268.2	-28	6.25
PCB 87	289.1	-28	6.35
PCB 95	289.1	-28	6.06
PCB 97	289.1	-28	6.27
PCB 99	289.1	-28	6.36
PCB 101	289.1	-23.8	6.33
PCB 105	289.1	-28.6	6.82
PCB 110	289.1	-28	6.31
PCB 114	289.1	-28	6.65
PCB 118	289.1	-28.5	6.69
PCB 119*	289.1	-28	6.4
PCB 123*	289.1	-28	6.64
PCB 126	289.1	-28	6.77
PCB 128	310	-28	6.79
PCB 132*	310	-25	6.54
PCB 137	310	-28	6.83
PCB 138	310	-25	7.22
PCB 141	310	-25	6.77
PCB 146	310	-28	6.87

Table A-8.4. Continued

PCB Congener	LeBas molar volume (Mackay 2006)	ΔUow at 25 °C (kJ/mol)	Log Kow at 25 °C
PCB 149	310	-25	6.62
PCB 151	310	-25	6.6
PCB 153	310	-31.1	6.87
PCB 156	310	-23	7.01
PCB 157	310	-28	7.18
PCB 158	310	-23	6.87
PCB 167*	310	-28	7.28
PCB 168*	310	-28	7.11
PCB 169	310	-28	7.42
PCB 170	330.9	-25	7.18
PCB 174	330.9	-28	7.03
PCB 177	330.9	-28	7.01
PCB 180	330.9	-29.1	7.16
PCB 183	330.9	-28	7.12
PCB 187	330.9	-28	7.09
PCB 189	330.9	-28	7.3
PCB 194	351.8	-28	7.76
PCB 195	351.8	-28	7.45
PCB 198	351.8	-28	7.43
PCB 199	351.8	-28	7.2
PCB 200	351.8	-28	7.27
PCB 201	351.8	-28	7.51
PCB 203	351.8	-28	7.53
PCB 206	372.7	-28	7.8
PCB 209	393.6	-28	8.18

*Optional, not required (See Appendix A-7)

Table A-8.5. Pesticide congener list with physical-chemical property values.

PCB Congener	LeBas molar volume (Mackay 2006)	ΔUow at 25 °C (kJ/mol)	Log Kow at 25 °C
cis-Chlordane	340.5	-25	6.20
trans-Chlordane	340.5	-25	6.27
cis-Nonachlor	361.4	-25	5.70
trans-Nonachlor	361.4	-25	5.70
Oxychlordane	250	-25	2.60
Dieldrin	332.2	-25	5.48
op-DDD	312.6	-25	5.34
op-DDE	305.2	-25	5.63
op-DDT	333.5	-25	5.70
pp-DDD	312.6	-25	6.33
pp-DDE	305.2	-25	6.93
pp-DDT	333.5	-25	6.39

Abiotic site-specific input parameters

TOC = organic carbon proportion in sediment (%)

DOCw = DOC concentration in H_2O (kg/L)

POCw = POC concentration in H_2O (kg/L)

T = mean water temperature (°C)

Sal = water salinity (PSU)

DO = dissolved oxygen concentration (mg O_2/L)

SSC = concentration of suspended solids (kg/L)

Congener-specific abiotic parameters

$K_{OW}T$ = octanol-water partitioning coefficient (temperature corrected)

$K_{OW}S$ = octanol-water partitioning coefficient (corrected for temperature and salinity)

K_{OC} = octanol-organic carbon partitioning coefficient (uses the $K_{OW}S$ value)

csed = contaminant concentration in sediment (ng/g dry weight)

cpw = dissolved contaminant concentration in porewater (ng/mL)

cwatD = dissolved contaminant concentration in surface water (ng/mL)

cwat = total contaminant concentration in surface water (ng/mL)

phi = ratio of dissolved contaminant concentration to total contaminant concentration in surface water (unitless)

Congener-specific abiotic calculations

$\log K_{OW}T = \log K_{OW}D_T - \frac{\Delta U_{ow}}{\ln(10)*R} * \left(\frac{1}{T} - \frac{1}{D_T}\right)$

Where:

$\log K_{OW}D_T$ = $\log K_{OW}$ at 25 °C or 298K in Tables A-8.4 and A-8.5.

$\log K_{OW}T$ = temperature corrected $\log K_{OW}$ at the site-specific temperature (T)

$K_{OW}S = K_{OW}T \times 10^{(SPC \cdot Vh \cdot MCS \cdot Sal / 35)}$

$K_{OC} = 0.35*K_{OW}S$

cpw = csed/(TOC*K_{OC})

cwatD = measured dissolved water concentration or estimated from total concentration as:

cwatD = phi*cwat

phi = 1/(1 + POCw*dPOC*alphapoc*$K_{OW}S$ + DOCw*dDOC*alphadoc*$K_{OW}S$)

The model compares measured surface water concentration to that estimated from site sediment concentration in order to minimize the influence of off-site sources on bioaccumulation. This estimation is based on the organic carbon partitioning used in the calculation of porewater concentration. Empirical data were used to determine the relationship between calculated porewater concentrations and measured dissolved surface water concentrations of the contaminants used in the model. This resulted in a median dilution factor of eight, as presented in the equation below:

Estimated cwatD = csed/(TOC*K_{OC}*8)

The lowest value (measured or estimated) for each congener is used as cwatD in the model calculations.

Organism-specific parameters

Wb = body weight (kg)

Gv = gill ventilation rate (L/day)

lipid = tissue lipid content (%)

wc = tissue water content (kg water/kg organism ww)= 1-lipid-NLOM (animals), 1-lipid-NLOC (phytoplankton and macrophytes), 1-lipid-(NLOM/2) (bivalves)

Gd = feeding rate (kg food/day)

kG = organism growth rate (1/day)

vld = proportion of diet that is lipid (calculated based on diet proportion of prey and prey lipid content, unitless)

vcd = proportion of diet that is non-lipid organic carbon (calculated based on diet proportion of prey and prey NLOC content, unitless)

vnd = proportion of diet that is non-lipid organic matter (calculated based on diet proportion of prey and prey NLOM content, unitless)

vwd = proportion of diet that is water (calculated based on diet proportion of prey and prey water content, unitless)

vlg = lipid fraction of gut (kg lipid/kg organism ww)

vcg = NLOC fraction of gut (kg NLOC/kg organism ww)

vng = NLOM fraction of gut (kg NLOM/kg organism ww)

vwg = water fraction of gut (kg water/kg organism ww)

mp = proportion of respiration or transpiration due to porewater (Tables A-8.1 and A-8.2, unitless)

mo = proportion of respiration or transpiration due to overlying water column (unitless)

Contaminant-specific model variables

Ew = contaminant-specific gill chemical uptake efficiency (unitless)

Ed = contaminant-specific dietary chemical transfer efficiency (also called gut uptake efficiency, unitless)

k1 = aqueous uptake rate constant (L/kg·day)

kbw = biota-water partition coefficient (i.e., bioconcentration factor, L/kg organism ww)

k2 = elimination rate constant (1/day)

kd = dietary uptake rate constant (kg food/kg organism·day)kG = growth rate (1/day)

Gf = fecal egestion rate (kg feces/kg organism·day)

kgb = gut-biota partition coefficient (unitless)

ke = fecal egestion rate constant (1/day)

p_i = proportion of diet by mass that is prey item i (unitless)

p_s = proportion of diet by mass that is sediment (unitless)

cD = contaminant concentration in diet (weighted average across all prey items, ng/g ww)

$cbiota_i$ = contaminant concentration in biota organism i (ng/g organism ww)

BSAF = biota-sediment accumulation factor (unitless)

Calculations for phytoplankton and aquatic macrophytes

$k1 = 1/(pA + pB/K_{OW}S)$

$kbw = (lipid*K_{OW}S/dLipid + nloc*lipcf*K_{OW}S + wc)$

$k2 = k1/kbw$

$cbiota=k1*(cwatD)/ (k2 + kGp^*)$ [*kGp for phytoplankton and kGm for macrophyte]

BSAF = cbiota/csed

Calculations for animals (prey organisms and seafood)

$Ew = 1/(1.85+155/K_{OW}S)$

$Ed = 1/(A*K_{OW}T + B)$

$Gv = (1400*Wb^{0.65})/DO$

$k1 = Ew*Gv/Wb$

$kbw = K_{OW}S *(lipid/dLipid + nlom*lipcfp) + wc$

$k2 = k1/kbw$

$Gd = 0.022 * (Wb^{0.85}) * e^{0.06*T}$ [For fish and nonfilter feeding invertebrates]

Gd = Gv*SSC*scav [For filter feeding invertebrates]

kd = Ed*Gd/Wb

kG = IGR * $Wb^{-0.2}$ [For invertebrates]

kG = FGR * $Wb^{-0.2}$ [For fishes]

vld= $\sum_{i=1}^{n} p_i * lipid_i$; vcd= $\sum_{i=1}^{n} p_i * nloc_i$; vnd= $\sum_{i=1}^{n} p_i * nlom_i$; vwd= $\sum_{i=1}^{n} p_i * water_i$

where i = [1…n] represent individual prey taxa

Gf=Gd*((1-alpha)*vld+ (1-beta)*(vcd + vnd)+ (1-chi)*vwd)

vlg= (1-alpha)*vld/ ((1-alpha)*vld+ (1-beta)*(vcd + vnd)+ (1-chi)*vwd)

vcg= (1-beta)*vcd/ ((1-alpha)*vld+ (1-beta)*(vcd + vnd)+ (1-chi)*vwd)

vng= (1-beta)*vnd/ ((1-alpha)*vld+ (1-beta)*(vcd + vnd)+ (1-chi)*vwd)

vwg= (1-chi)*vwd/ ((1-alpha)*vld+ (1-beta)*(vcd + vnd)+ (1-chi)*vwd)

kgb=((vlg/dLipid + vng*lipcf + vcg*lipcfp)*K_{OW}T + vwg)/ ((lipid/dLipid + nlom*lipcfp)*K_{OW}T + wc)

ke = Gf*Ed*kgb/Wb

mo = 1 – mp

cD = $p_s * csed + \sum_{i=1}^{n} p_i * cbiota_i$

where i = [1…n] represent individual prey taxa

cbiota = (k1*(mo*cwatD + mp*cpw)+ kd*cD) / (k2 + ke + kG + kM)

BSAF = cbiota/csed

Site Assessment Calculations

Chemical Exposure Evaluation

Calculate the weighted average observed tissue concentration based on the diet proportion for each fish species represented and measured tissue concentration for total chlordanes, Dieldrin, total DDTs, and total PCBs. Compare this weighted average to the chemical exposure thresholds in Table 16 for Tier 1 evaluation and Table 19 for Tier 2 evaluation.

Site Linkage Determination

In evaluation of the site linkage, Monte-Carlo Simulation (MCS) is used to incorporate the variability of both the measured sediment and tissue concentrations, the fish guild home range (HR), and the estimated BSAF values. For this analysis, a lognormal distribution is used for BSAF and sediment concentrations, and the appropriate distributions for each home range is indicated in Table A-8.6. A total of 10,000 iterations should be used for the simulation.

Site linkage = C_{Est}/C_{Tis}

C_{Est} = weighted average estimated tissue concentration based on the proportion of the human diet for each guild (ng/g).

Calculate the average estimated tissue concentration for each guild, i, and contaminant class (i.e., total DDTs) using the following equation:

$C_{Est,i} = \Sigma C_{Sed} \times SUF_i \times BSAF_i$

ΣC_{Sed} = lognormal distribution of sediment concentration using the measured mean and standard error

SUF_i = site use factor for species i = SA/HR_i. SA is the area or length of site depending on the basis of the HR. HR distribution is calculated using the HR mean and HR standard deviation (SD) listed in Table A-8.6. If the calculated SUF is less than 1, use the calculated value. If the SUF is equal to or greater than 1, use the value of 1.

$BSAF_i$ = lognormal distribution of the mean BSAF for guild, i, from the model prediction and the calculated BSAF SD.

BSAF SD = CVBSAF*BSAF

CVBSAF = 0.782

The CVBSAF was estimated from empirical data using the following equations:

$$SD = \sqrt{(m^2)(e^{\sigma^2} - 1)}$$

$$CV = \frac{\sqrt{(m^2)(e^{\sigma^2} - 1)}}{m} = \sqrt{(e^{\sigma^2} - 1)}$$

Where σ = lognormal standard deviation

m = mean (this value cancels out)

CV = coefficient of variation

C_{Tis} = weighted average observed tissue concentration

Use a lognormal distribution for measured mean tissue data and standard error for each guild for total chlordanes, total dieldrin, total DDTs, and total PCBs.

Calculate the weighted average for each contaminant class based on the proportion of the human diet for each guild (ng/g).

Table A-8.6. Home range parameters for each sportfish guild.

Species	Guild	HR Basis	HR Mean	HR SD	HR Distribution
California halibut	Piscivore	Site length (km)	29.3	60	Lognormal distribution
Spotted sand bass	Benthic diet with piscivory	Site area (km^2)	0.0071	0.0073	Lognormal distribution
White Catfish	Benthic diet with piscivory	Site length (km)	6.9	9.6	Lognormal distribution
Queenfish	Benthic and pelagic with piscivory	Site area (km^2)	3	4.689	Lognormal distribution
White croaker	Benthic without piscivory	Site area (km^2)	3	4.689	Lognormal distribution
Shiner perch	Benthic and pelagic without piscivory	Site area (km^2)	0.0012	0.000804	Lognormal distribution
Common carp	Benthic with herbivory	Site length*1000 (km)	1.05	9904	Inverse gamma cumulative distribution*
Topsmelt	Benthic and pelagic with herbivory	Site area (km^2)	0.0012	0.000804	Lognormal distribution
Striped mullet	Pelagic with benthic herbivory	Site length (km)	28.2	80.34	Lognormal distribution

HR mean = mean home range of seafood species under consideration (km or km^2, depending on taxa).

HR SD = standard deviation of home range of seafood species

*Inverse gamma cumulative distribution requires 3 terms:

Probability= a random number uniformly distributed over $0 \leq x < 1$

Alpha= HR mean value (shape parameter)

Beta= HR SD value (scale parameter)

References

Arnot, J.A. and F.A.P.C. Gobas. 2004. A food web bioaccumulation model for organic chemicals in aquatic ecosystems. *Environmental Toxicology and Chemistry* 23:2343-2355.

Beyer, A., F. Wania, T. Gouin, D. Mackay and M. Matthies. 2002. Selecting internally consistent physicochemical properties of organic compounds. *Environmental Toxicology and Chemistry* 21:941-953.

Burkhard, L.P. 1998. Comparison of two models for predicting bioaccumulation of hydrophobic organic chemicals in a Great Lakes food web. *Environmental Toxicology and Chemistry* 17:383-393.

Gobas, F.A.P.C. 1993. A model for predicting the bioaccumulation of hydrophobic organic chemicals in aquatic food-webs: application to Lake Ontario. *Ecological Modelling* 69:1-17.

Gobas, F.A.P.C. and J. Arnot. 2005. San Francisco Bay PCB food-web bioaccumulation model. Simon Fraser University. Vancouver, BC.

Gobas, F.A.P.C. and J. Arnot. 2010. Food web bioaccumulation model for polychlorinated biphenyls in San Francisco Bay, California, USA. *Environmental Toxicology and Chemistry* 29:1385-1395.

Hansen, B.G., A.B. Paya-Perez, M. Rahman and B.R. Larsen. 1999. QSARs for Kow and Koc of PCB congeners: A critical examination of data, assumptions and statistical approaches. *Chemosphere* 39:2209-2228.

Hawker, D.W. and D.W. Connell. 1988. Octanol-water partition coefficients of polychlorinated biphenyl congeners. *Environmental Science and Technology* 22:382-387.

Leatherbarrow, J.E., N. David, B.K. Greenfield, J.J. Oram and J.A. Davis. 2006. Organochlorine pesticide fate in San Francisco Bay. 433. San Francisco Estuary Institute. Oakland, CA.

Li, N., F. Wania, Y. Lei and G. Daly. 2003. A comprehensive and critical compilation, evaluation, and selection of physical-chemical property data for selected polychlorinated biphenyls. *Journal of Physical and Chemical Reference Data* 32:1545-1590.

Mackay, D., W.Y. Shiu and K.C. Ma. 2000. Physical-Chemical Properties and Environmental Fate Handbook. Chapman & Hall. Boca Raton, FL.

Shen, L. and F. Wania. 2005. Compilation, evaluation and selection of physical-chemical property data for organochlorine pesticides. *Journal of Chemical and Engineering Data* 50:742 - 768.

Xie, W.H., W.Y. Shiu and e. al. 1997. A review of the effect of salts on the solubility of organic compounds in seawater. *Marine Environmental Research* 4.

Appendix B: Economic Analysis

Appendix B

Draft Economic Analysis of Proposed Sediment Quality Objectives in the State of California

July 2017

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Table of Contents

List of Exhibits

Abbreviations

AMEL	Average monthly effluent limit
BAF	Bioaccumulation factor
BAT	Best available technology economically achievable
BCT	Best conventional pollutant control technology
BLS CPI	Bureau of Labor Statistics Consumer Price Index
BMP	Best management practice
Caltrans	California Department of Transportation
CEDEN	California Environmental Data Exchange Network
CIWQS	California's Integrated Water Quality System
cm	centimeter
cy	cubic yard
CTR	California Toxics Rule
CWA	Clean Water Act
EBMUD	East Bay Municipal Utilities District
ECA	Effluent concentration allowance
ENR CCI	Engineering News-Record Construction Cost Index
FTE	Full-time equivalent
FTO	Fish tissue objective
GIS	Geographic information systems
Hg	Inorganic mercury
ICIS-NPDES	Integrated Compliance Information System-National Pollutant Discharge Elimination System
lbs/yr	pounds per year
LID	Low impact development
MDEL	Maximum daily effluent limit
MEC	Maximum effluent concentration
MeHg	Methylmercury
MEP	Maximum extent practicable
mg	milligrams
mg/kg	milligrams per kilogram
mgd	million gallons per day
mm	millimeters
MM	Management measures
MS4	Municipal separate storm sewer system
ng/L	nanograms per liter
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
OMR	Office of Mine Reclamation

P2	Pollution prevention
RP	Reasonable potential
RWQCP	Regional Water Quality Control Plant
SD	Sanitation District
SIP	Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California
SWMP	Stormwater management Plan
SWPPP	Stormwater Pollution Prevention Plan
TL	Trophic level
TMDL	Total maximum daily load
µg/L	micrograms per liter
U.S. EPA	United States Environmental Protection Agency
USFS	United States Forest Service
WDR	Waste discharge requirements
WLA	Wasteload allocation
WQBEL	Water quality based effluent limit
WWTP	Wastewater treatment Plant

Executive Summary

The California State Water Resources Control Board (State Water Board) is proposing an amendment to the state's Water Quality Control Plan for Enclosed Bays and Estuaries: Part 1 Sediment Quality. This report contains an economic analysis of the proposed amendment of the sediment quality objectives Plan (hereinafter Plan) for the protection of aquatic life, human health, wildlife, and finfish. Under contract with the United States Environmental Protection Agency (U.S. EPA), Abt Associates provided the State Water Board with an analysis of economic factors related to the proposal, including compliance with the Sediment Quality Objectives (SQO) options, available methods to achieve compliance with these options, and the costs of those methods.

Baseline and Proposed Policy

In 2008, the State Water Board adopted SQOs and an implementation Plan for bays and estuaries in the state (Part 1). An amendment of Part 1 – Sediment Quality was proposed in 2011. Part 1 integrates chemical and biological measures to determine if the sediment dependent biota are protected or degraded as a result of exposure to toxic pollutants in sediment and to protect the benthic community, human health, and wildlife. Part 1 includes narrative SQOs for the protection of aquatic life, human health, wildlife and finfish; identification of the beneficial uses that these objectives are intended to protect; and a program of implementation that contains specific indicators, tools, and implementation provisions to determine if the sediment quality at a station or multiple stations meet the narrative objectives, description of appropriate monitoring programs, and a sequential series of actions that shall be initiated when a sediment quality objective is not met, including stressor identification and evaluation of appropriate targets.

The State Water Board is proposing amendments to the Plan to incorporate additional implementation Policy for the protection of human health, modification in 303(d) listing and delisting procedure for the 303(d) list, and change in regional monitoring frequency. In establishing water quality objectives, the State Water Board considers economic factors, among others. Specifically, these economic factors include whether the objectives and alternatives under consideration are currently being attained, the methods available to achieve compliance and the costs of those methods. The available compliance methods and costs depend on the sources of the pollutants bioaccumulating in sediments in bays and estuaries, which could include municipal and industrial wastewater and stormwater, agriculture, boats, and legacy sources. Baseline conditions include current SQOs (e.g., benthic community, human health, wildlife and finfish SQOs, and narrative Basin Plan criteria), water quality objectives and policies regulating activities and pollutant discharges that affect sediment quality (e.g., CTR, Basin Plans, waste discharge requirements, and other policies), ongoing cleanup and remediation activities, and planned or anticipated cleanup and remediation actions that have not yet been completed [e.g., total maximum daily load development (TMDL) and implementation schedules]. Currently, Regional Water Boards have listed 45 bays and estuaries as impaired for toxic pollutants in sediments or fish tissue and another 124 bays and estuaries as impaired for toxic pollutants for which the effects from sediment are uncertain. There are also some impairments of fish and wildlife beneficial uses that Regional Water Boards have not yet identified the source of the pollutants and which could be attributable, at least in part, to pollutant concentrations in sediments.

Incrementally Impaired Waters

Under the current Plan, for narrative sediment quality objectives, a water segment is identified as impaired if the tissue pollutant levels in organism samples exceed a pollutant-specific evaluation guideline using binomial distribution. However, according to the proposed Plan, a water segment will be placed on the impaired list if any station within the site is assessed as Clearly Impacted and the total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a listing cycle. The determination of the impact category is dependent on the MLOE approach. Once the Plan is adopted, the new implementation approach would be used to determine impairments and assess human health criteria.

Incremental Impacts of Proposed Amendments

The incremental economic impacts of the Plan include the costs of activities above and beyond those that would be necessary in the absence of the Plan 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). Note that 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. Thus, these existing impairments 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: a new approach to interpret human health objectives, a change in 303(d) listing and delisting process, and a change in regional sediment quality monitoring frequency. For interpreting human health objectives the proposed Plan introduces a tiered framework to assess the level of detrimental effect that a contaminated sportfish can pose to human consumers. This new approach is likely to result in an additional cost. The proposed modification in the existing 303(d) listing and delisting process may also cause an additional cost. The change in regional sediment monitoring frequency is likely to result in reduced cost. Further detail on incremental cost is discussed in the following section.

Monitoring and Assessment Cost

Comprehensive compliance and assessment activities are ongoing to support the baseline framework which will continue in the absence of the Plan. Additional efforts will be undertaken under the proposed Plan, which includes assessing compliance with the proposed Plan. A sufficient amount of data is needed to determine whether the sediments are meeting existing objectives. Additionally, if the toxic substances in sediments exceed SQOs under baseline or proposed Policy, further evaluation is required to identify source, linkage and remediation of this impairment. These activities, which can include developing a work Plan/project management, collecting additional data, conducting Ecological Risk Assessment (ERA)s or Toxicity Identification Evaluations (TIEs), surface water modeling, and other analyses, may be conducted as part of developing a TMDL (SCCWRP, 2005; Parsons, et al., 2002, as cited in WSPA, 2007, SWRCB (2011)). These compliance activities will incur associated costs. While insufficient data exists to estimate costs associated with all activities, this document focuses on incremental cost (April-2017 dollars) associated with changes in monitoring requirements. Where available, information on other assessment and compliance costs is provided.

Monitoring is one component of compliance costs. The SWRCB (2008) and SWRCB (2011) provided unit costs for monitoring to assess the SQOs to protect the benthic community, human health, wildlife and finfish (direct effects). Monitoring efforts for ERAs to assess indirect effects on wildlife and finfish beyond the monitoring necessary to assess water quality criteria and the SQOs for direct effects could involve collecting finfish and documenting the presence of deformities, irregularities in size, or population effects, and collection and analysis of wildlife tissue or bird eggs. Sample collection costs may vary based on factors such as water depth, abundance of fish species, sediment characteristics (may cause unsuccessful grabs that need to be repeated), and distance between stations. Although data for some parameters may not be needed at each sampling site, the total costs per sampling event could be in the range of $10,820 to $17,040.

Under the proposed Plan, a substantial amount of cost savings are associated with the change in monitoring frequency in the regional monitoring program. The sediment quality monitoring frequency in the regional monitoring program is reduced from the frequency of "once per three years" to "once per five years" which leads to a significant amount of cost reduction in monitoring activities. The number of stations needed to assess attainment of the SQO for bays and estuaries will vary based on site-specific factors. Based on 5 to 30 sites per water body, depending on the area, the State Water Board estimates that statewide monitoring costs to assess attainment of the proposed SQO will be reduced by $0.33 million to $0.51 million each year. For convenience, all costs used in this analysis are represented as an annual cost.

The proposed amendments to 303(d) listing procedures may result in identification of more or less impairments. For bays and estuaries not currently on the 303(d) list for sediment toxicity that would exceed the SQO under the proposed Plan amendments, the next step under the Plan would be a sequential approach to manage the sediment appropriately, including developing and implementing a work plan to confirm and characterize pollutant-related impacts, identify pollutants, and identify sources and management actions (including adopting a TMDL, if appropriate). The cost of this sequential approach will vary depending on a number of factors, including the extent of baseline efforts and studies underway to address other impairment issues, and the number of potential stressors to the area. Note that in the absence of the Plan amendments, Regional Water Boards could identify these waters as exceeding the narrative objectives, and thus incremental impacts associated with TMDL development and pollution controls would be zero.

The State Water Board (2001) estimates that development of complex TMDLs (including an implementation Plan) may cost over $1 million. In addition, SWRCB (2003a) indicates that TMDL development and mercury reduction strategy cost for the San Francisco Bay could range from $10 million to $20 million. These estimates provide some indication of incremental costs that could be associated with sequential approaches to managing designated use impairments. Thus, the estimates provide an approximation of costs incurred on a per TMDL basis.

The proposed Policy will supersede the implementation requirements in existing applicable TMDLs except for some TMDLs that are specifically identified in the proposed Plan. This analysis demonstrates that a substantial amount of cost savings could be achieved under the implementation of the proposed Plan.

The annual cost savings associated with changing the monitoring requirements of TMDLs ranged between approximately $0.13 million to $0.21 million. However, as information regarding the number of sampling locations per TMDL is uncertain, it was assumed that each site contains at least one sampling station. In reality, TMDLs typically include more than one sample location, so the real cost savings would be higher than this estimate.

Cleanup and Control Costs

Various remediation actions as well as pollution source control programs will be needed to achieve SQO attainment of those water bodies that are identified as impaired by the Regional Water Board. Many bays and estuaries are already listed for sediment impairments or are exceeding the benthic community, human health, or wildlife SQOs and, therefore, would require controls under baseline conditions. When the controls implemented under baseline Policy are identical to the ones that would be implemented under proposed Policy, there is no incremental cost or cost savings associated with the Plan amendments. When the baseline controls differ, there is potential for either incremental costs or cost-savings associated with the Plan amendments.

Because strategies to meet current objectives at many impaired sites are still in the Planning stages and the overall effects of implementation strategies are unknown, estimates of incremental costs would be highly speculative. For incremental sediment remediation and/or cleanup activities to be required under the Plan, monitoring data would have to indicate adverse impacts to all communities attributable to sediments in areas that would not be designated for cleanup under existing objectives. However, it is likely that most sites with sediment conditions that would require cleanup and remediation under the Plan amendments would also exceed current objectives. To the extent that results differ, it is possible that the additional assessment activities under the Plan amendments could lead to cleanup strategies that are more cost effective compared to baseline activities. In addition, based on the implementation Plans for existing TMDLs, Regional Water Boards are likely to pursue source controls for ongoing sources and only require remediation activities for historical pollutants with no known, ongoing sources.

If incremental remediation activities are necessary, costs are likely to be very specific to the particular site and project. Sediment remediation and cleanup costs may range from less than

$1/cy to over $1000/cy for various alternatives with different feasibility and practicality considerations (SWRCB, 1998). Preliminary estimates for dredging sediments in San Diego Bay suggest that unit costs may range from $100/cy to $200/cy, depending on the volume of sediment removed (SDRWQCB, 2007b; SWRCB, 2011).

Incremental costs for controls may result from the identification of additional chemical stressors that are not included in the Phase I SQOs, Basin Plans, or CTR. Since many practices that may be employed under existing TMDLs are applicable for controlling the mobilization of pollutants in general, this situation is also difficult to estimate. For example, the TMDL for pesticides and PCBs in the Calleguas Creek watershed indicates that the BMPs needed to achieve the nutrient and toxicity TMDLs for the watershed would likely reduce pesticides and PCBs to necessary levels as well (LARWQCB, 2005c). Thus, without being able to identify the particular pollutants causing toxic effects to wildlife and finfish, and the development of discharge concentrations needed to achieve the objectives, the needed cleanups and/or controls to achieve those concentrations are site- and pollutant-specific, and therefore, difficult to estimate.

The proposed Plan may result in situations where point sources are specifically required to control toxic pollutants to levels that are lower than what would be necessary in the absence of the Plan. In these instances, it is likely that these facilities would implement source control to eliminate the pollutant from entering their treatment Plant or industrial process, or pursue regulatory relief (e.g., a variance), rather than install costly end-of-pipe treatment. However, it is uncertain whether such a situation would arise as a result of the Plan amendments.

For agriculture, Regional Water Boards regulate farmers primarily through conditional WDR waivers that require compliance with water quality standards. Regional Water Boards may also require farmers to meet more stringent criteria for specific pollutants where necessary (e.g., to meet a TMDL, site-specific objectives). All of the affected Regional Water Boards have narrative objectives that specifically prohibit the discharge of pesticides and/or toxic pollutants that cause detrimental effects in aquatic life or to animals and humans. Thus, even in the absence of the Plan amendments, farmers would be prohibited from causing or contributing to toxicity to wildlife and finfish. Potential means of compliance for stormwater sources include increased or additional nonstructural BMPs (e.g., institutional, educational, or pollution prevention practices designed to limit generation of runoff or reduce the pollutants load of runoff); and structural controls (e.g., engineered and constructed systems designed to provide water quantity or quality control). Improving the effectiveness of nonstructural BMPs could be on the order of $26 per household (CSU Sacramento, 2005). Caltrans (2001) reports a range of costs for structural controls based construction costs from several transportation departments and jurisdictions. For example, average detention basin costs are approximately $7,000 and wetlands are $13,000. However, Delaware sand filter costs are approximately $118,000, on average (Caltrans, 2001; SWRCB, 2011).

For marinas and boating activities, potential means of compliance may include use of less toxic paint on boats; performing all boat maintenance activities above the waterline or in a lined channel to prevent debris from entering the water; removing boats from the water and cleaning in a specified location equipped to trap debris and collect wastewater; prohibiting hull scraping or any process that removes paint from the boat hull from being conducted in the water; and developing a collection system for toxic materials at harbors. For example, one marina spent $14,500 on a pollution prevention program in 1999 (MBNEP, 2000), and Carson, et al. (2002) estimated the cost of remaining life hull maintenance for 40 foot length, 11 foot width boats to range from a savings of $1,354 (new boat with nontoxic coating, good performance, and lower prices) to a cost of $6,251 (2.5 year old boat requiring stripping, fair performance, and higher prices). In addition, the cost of a unit that collects water that may contain toxic materials from boating maintenance operations so that it may be sent to the sanitary sewer system could cost between $3,200 to $4,500 (Pressure Power Systems, 2007).

Wetland controls may include aeration, channelization, revegetation, sediment removal, levees, or a combination of these practices. The extent of controls needed and the types of controls are unknown. The Central Valley Regional Water Board (2005b) provides one example of the cost of efforts underway in Anderson Marsh wetland on Cache Creek. Capital costs for controlling methylmercury export from Anderson March may range from $200,000 to $1 million, and O&M costs from $20,000 to $100,000 per year (CVRWQCB, 2005b; SWRCB, 2011).

Summary

Exhibit ES-1 summarizes the estimated total annual decremental costs statewide under the proposed Policy. At this time, data limitations make it is infeasible to quantify costs for all discharge types included in the Policy.

Exhibit ES-1. Estimated Total Annual Decremental Compliance (monitoring) Cost under Proposed Policy Options in California Bays and Estuaries (April-2017$ per year)[1]

Monitoring Cost	Criteria Policy		Cost Reduction (%)
	Baseline	Proposed	
Low	$937,000	$612,000	34%
High	$1,475,000	$963,000	34%

Notes:
1 All costs presented in April-2017$ and annualized based on a 5% interest rate and 20 year expected project life.

Exhibit ES-2. Estimated Total Annual Decremental Monitoring Cost under Proposed Policy Options in Applicable TMDLs (April-2017$ per year)[1]

Monitoring Cost	Criteria Policy		Cost Reduction (%)
	Baseline	Proposed	
Low	$246,000	$111,000	55%
High	$387,000	$174,000	55%

Notes:
1 All costs presented in April-2017$ and annualized based on a 5% interest rate and 20 year expected project life.

There are a number of uncertainties and limitations associated with the data and methods used to estimate the potential incremental costs of the proposed Policy. Data limitations or lack of data altogether resulted in the largest uncertainties. For example, all TMDL sites are assumed to have at least one sampling location and costs associated with TMDL monitoring were determined based on this assumption, while in reality, a waterbody subjected to a TMDL contains multiple monitoring locations. This assumption and associated data limitation could potentially result in an underestimation of costs.

1 Introduction

The California State Water Resources Control Board (State Water Board) is proposing amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality (hereinafter Plan) for the protection of aquatic life, human health, wildlife, and finfish. The proposed amendment includes implementation procedures for the human health objectives and modification in program specific implementation procedure. This report presents an analysis of economic factors related to the amendment proposal, including compliance with the sediment quality objectives (SQO) options, available methods to achieve compliance with these options, and the costs of those methods.

1.1 Need for the Proposed Rule

Under the Clean Water Act (CWA), states have primary authority for establishing designated uses for water bodies, and developing sediment quality criteria to protect those designated uses. In 1989, California amended the Porter-Cologne Water Quality Control Act (Porter-Cologne) which requires the State Water Board to develop SQOs as part of a comprehensive program to protect existing and future beneficial uses within enclosed bays and estuaries (Section 13393). The State Water Board prepared a Work Plan for the development of SQOs for enclosed bays and estuaries in 1991 which included a schedule and specific tasks to develop direct effects tools that would protect benthic communities, and an element to assess the human and ecological risk in bays and estuaries from pollutants in sediments (indirect effects).

However, due to significant delays of adopting proposed SQOs, in 1999, petitioners filed a lawsuit against the State Water Board. As a result, the Superior Court ordered the State Water Board to develop SQOs for toxic pollutants as part of the Bay Protection and Toxic Cleanup Program pursuant to California Water Code (CWC) Section 13393 in accordance with a compliance schedule. In 2008, the State Water Board adopted SQOs and an implementation Policy for bays and estuaries in the state (Part I of the Plan; hereafter referred to as the Plan). In 2011, several amendments were proposed for addition to Part 1, including a narrative sediment quality objective for wildlife and finfish, a proposed process for implementing these narrative objectives, and proposed definitions added to the glossary in support of the narrative objectives. These amendments were adopted by the Porter-Cologne Act.

Part 1 -

- integrates chemical and biological measures to determine the impacts on sediment dependent biota as a result of exposing to toxic pollutants in sediment.
- includes narrative SQOs for the protection of aquatic life, human health, wildlife, and finfish.
- identifies the beneficial uses that these objectives are intended to protect.
- includes an implementation program containing specific indicators, tools, and implementation provisions to determine compliance.

- includes description of appropriate monitoring programs and sequential series of actions that shall be initiated when a sediment quality objective is not met, including stressor identification and evaluation of appropriate targets.

Recently, U.S. EPA suggested that it is more appropriate to amend the existing implementation approach by introducing a tiered framework for the protection of human health criteria that can provide a disciplined framework to assess SQO objectives accurately. U.S. EPA also recommended several amendments to address adjustment to the 303(d) listing and delisting process and monitoring requirements in the regional sediment quality monitoring program. Thus, the State Water Board staff is developing sediment quality objectives consistent with the U.S. EPA's recommendation. The Policy also establishes procedures for implementing the objectives. The State Water Board is proposing amendments to the Plan to incorporate additional sections with detailed discussion in interpreting the objectives for the protection of aquatic health, human health, and implementation Policy.

1.2 Scope of the Analysis

The Porter-Cologne Water Quality Act requires the Regional Water Boards to take "economic considerations," among other factors, into account when they establish water quality objectives. The other factors include the past, present, and probable future beneficial uses of water; environmental characteristics of the hydrographic unit under consideration; water quality conditions that could reasonably be achieved through the coordinated control of all factors affecting water quality in the area; the need for housing; and the need to develop and use recycled water. The objectives must ensure the reasonable protection of beneficial uses, and the prevention of nuisance.

To meet the economic considerations requirement, the State Water Board (1999; 1994) concluded that, at a minimum, the Regional Water Boards must analyze:

- Whether the proposed objective is currently being attained;
- If not, what methods are available to achieve compliance; and
- The cost of those methods.

If the economic consequences of adoption are potentially significant, the Regional Water Boards must explain why adoption is necessary to ensure reasonable protection of beneficial uses or prevent nuisance. The Boards can adopt objectives despite significant economic consequences; there is no requirement for a formal cost-benefit analysis.[1]

[1] Water quality objectives establish concentrations protective of beneficial uses and the fishable/swimmable goals of the CWA, and thus are based on science and not economics. Economics can play a role in establishing water quality standards through the analysis of use attainability [removal of a beneficial use which is not an existing use under 40 CFR 131.10(g)]. However, the applicable economic criterion in such an analysis is not efficiency (i.e., maximizing net benefits, based on cost-benefit analysis) but distributional impacts [a determination of whether there will be substantial and widespread economic and social impacts from implementing controls more stringent than those required by sections 301(b) and 306 of the CWA]. This criterion may also be employed at the local level in the evaluation of temporary variances.

Economic factors are often considered and assessed when an environmental Plan is amended. Economic factors include, but are not limited to, the attainability of the newly proposed rule/ Plan, whether the objectives and proposed alternatives are currently being attained, assessing the appropriate method to achieve compliance, and the costs related to the compliance method. The California State Water Board is considering the same economic factors to analyze the economic impact of the SQO objectives amendment. This report will demonstrate and address whether the SQOs are currently being attained, the incremental economic impact of the amendment implementation, the preventive and remedial measures available to achieve compliance with amended SQOs, and the related cost of compliance. The outcome of this analysis could be positive or negative. The cost may decrease if the pollutant sources are accurately identified. The choice of compliance methods solely depends on the source type that may be affected by the proposed SQOs. Potentially affected sources could include industries and municipal facilities discharging wastewater and stormwater to surface waters (i.e., point sources). Compliance cost also includes monitoring cost and assessment cost.

Under a contract with the U.S. EPA, Abt Associates provided the State Water Board with an analysis of economic considerations. Specifically, Abt Associates identified baseline requirements, incremental impacts under proposed Plan, likely incremental compliance actions, and costs for these entities under the proposed Policy.

1.3 Organization of this Report

This report is organized as follows:

- Chapter 2 – describes the current applicable objectives and requirements that provide the baseline for the analysis of the incremental impact of the Policy.
- Chapter 3 – describes the amendments in the proposed Policy.
- Chapter 4 – identifies whether the proposed objectives are currently being met and whether there are any incremental impacts of meeting the objectives.
- Chapter 5 – describes the compliance costs.
- Chapter 6 – provides estimates of potential incremental statewide costs of the proposed Plan.

Appendices provide detailed information on current narrative objectives applicable to sediment quality, current water quality objectives, nonpoint source Plan management measures, detailed compliance analysis, toxic hot spots for bays and estuaries, and control costs.

2 Baseline for the Analysis

This section describes the applicable baseline for identifying the potential economic impact of incremental costs incurred by the proposed Policy options. Baseline conditions include existing sediment objectives and plans, potential sources of sediment, pollutant discharges that affect sediment quality, current level of sediment impairment of inland surface waters, enclosed bays, and estuaries in California, ongoing cleanup and remediation activities, and Planned or anticipated cleanup and remediation actions that have not yet been completed [e.g., total maximum daily load development (TMDL) and implementation schedules].

2.1 Previous Sediment Quality Objectives

The 2009 Policy was amended under Resolution 2011-0017, which was approved and only applicable under the action of Porter-Cologne Act. In this economic analysis, 2011 Policy is used as a baseline scenario to capture the incremental impact of the proposed Policy. Prior to the 2011 Policy amendments, SQO Policy was adopted by the regional boards and EPA in 2009. At first, there were no specific sediment quality objectives except the narrative objectives where individual basin Plans of the nine Regional Water Quality Control Boards established sediment water quality objectives to protect ambient sediment quality. Although they have individual sediment quality objectives, none of them are numeric sediment quality objectives. The existing sediment quality objectives for the nine Regional Water Quality Control Boards are listed in Appendix A. These criteria apply to all enclosed bays and estuaries in the state, except in water bodies where site-specific objectives have been established or where a TMDL applies. This list excludes Region 6 and Region 7, as they do not contain any enclosed bays or estuaries. Therefore, these two regions are out of the scope of this economic analysis.

2.2 Sediment Quality Objectives Beneficial Uses

The existing 2011 Plan is applicable to following beneficial uses: Estuarine Habitat, Marine Habitat, Commercial and Sport fishing, Aquaculture, Shellfish Harvesting, Rare or Endangered Species, Preservation of Biological Habitats of Special Significance, Wildlife Habitat, and Spawning Reproduction and Early Development for the protection of benthic community, Human Health, wildlife and finfish.

2.3 Sediment Quality Objectives Applicability

In accordance with existing sediment Policy, proposed Part 1 applies to enclosed bays[2] and estuaries[3] only. It does not apply to ocean waters including Monterey Bay and Santa Monica

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[2] ENCLOSED BAYS are 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.

Bay, or inland surface waters. Part 1 applies to subtidal surficial sediments that have been deposited or emplaced seaward of the intertidal zone. Part 1 is also applicable in its entirety to point source discharges.

2.4 Sediment Quality Objectives

Sediment quality objectives in the existing Plan are described as follows:

- Aquatic Life – Benthic Community Protection: Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries implemented using the integration of multiple lines of evidence (MLOE).
- Human Health: Pollutants shall not be present in sediments at levels that bioaccumulate in aquatic life to levels that are harmful to human health.
- Wildlife and Resident Finfish: 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.

Also, the California Toxics Rule (CTR) contains criteria for toxic pollutants applicable to inland surface waters, enclosed bays, and estuaries in the state. However, Regional Water Boards may adopt more stringent criteria for specific pollutants where necessary (e.g., to meet a TMDL, site-specific objectives). **Appendix B** shows the CTR criteria, and indicates where a Regional Water Board may have more stringent criteria in its Basin Plan. Implementation Process

2.5 Implementation Process

The State Water Board considered adopting procedures for implementing the objectives, including general procedures for all enclosed bays and estuaries. The implementation options will supersede the implementation Plans of any existing TMDL with few exceptions.

[3] ESTUARIES AND COASTAL LAGOONS are 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.

2.5.1 Assessing Sediment Quality Objectives

2.5.1.1 Aquatic Life – Benthic Community Protection for Applicable Bays and Coastal Lagoons[4]

The Plan utilizes MLOE approach to interpret narrative objectives and assess compliance for the protection of Aquatic life - Benthic community. Multiple tools are used to assess the benthic community's condition relative to the potential exposure to sediment toxicity. When a benthic community is exposed to toxic pollutants in sediments, it results in a presence of sediment contamination, degradation in the benthic community, and elevated concentrations of pollutants in sediment. Therefore, sediment quality assessment is necessary. This assessment consists of measurement and synchronization of three lines of evidence (LOE). The LOE are sediment toxicity, benthic community condition, and sediment chemistry.

- Sediment toxicity is a measure of the invertebrate's response when exposed to surficial sediments under controlled laboratory conditions. Sediment toxicity tests (i.e., short-term lethal and sub lethal tests) are conducted to estimate LOE that is used to assess both pollutant related biological effects and exposure.
- Benthic community condition is a measure of the species composition, abundance, and diversity of the sediment-dwelling invertebrates inhabiting surficial sediments. Benthic Indices (e.g., Benthic Response Index (BRI), Index of Biotic Integrity (IBI), Relative Benthic Index (RBI), and River Invertebrate Prediction and Classification System (RIVPACS)) are calculated to estimate LOE that is used to assess impacts to the primary receptors targeted for protection.
- Sediment chemistry is the measurement of the concentration of chemicals of concern in surficial sediments. The chemistry LOE is used to assess the potential risk to benthic organisms from toxic pollutants in surficial sediments. The sediment chemistry LOE is intended only to evaluate overall exposure risk from chemical pollutants. This LOE does not establish causality associated with specific chemicals.

For compliance assessment of the aquatic life SQO, all test results from sediment toxicity are compared and classified according to the sediment toxicity categorization values. The final toxicity LOE is calculated by taking the average of all response categories (nontoxic, low, moderate, and high toxicity). Next, to calculate LOE for benthic community condition, four benthic indices are calculated and categorized according to the disturbance categories (reference, low disturbance, and moderate disturbance). Finally, all categories are integrated by taking the median of all categories to determine benthic condition LOE.

[4] Estuaries and Coastal Lagoons are 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.

In the case of sediment chemistry LOE calculation, all samples are tested for certain analytes to assess associated exposure. Sediment chemistry exposure is assessed by two methods: 1) Chemical Score Index (CSI) and 2) California Logistic Integration Model (CA LRM). Each sediment chemistry guideline method is categorized according to the exposure category (minimal exposure, low, moderate, and high exposure) and all results are integrated to determine the final LOE for sediment chemistry.

The attainment of sediment quality objectives in a particular site or station is assessed by interpretation and integration of MLOE. Different combinations of MLOE are derived in this assessment framework. These MLOE combinations reflect the presence and severity of two characteristics: severity of biological effects and potential of chemically-mediated effects. The severity of biological effect is determined from the benthos and toxicity test results, where benthos is given greater weight for determining effects. Evidence of chemical exposure, or the potential that effects are chemically mediated, is determined from the sediment chemistry and toxicity test results. Note that benthos is not used to assess chemical exposure because benthic disturbance can be caused by nontoxic-related factors, such as grain size, temperature, and recruitment. The combination of intermediate classification for severity of biological effect and potential for chemically-mediated effect can be assessed by six categories of impact at the station level.

The framework for evaluating the MLOE classifies each site into one of the six categories of impact as described in **Exhibit 2-1** as follows:

Exhibit 2-1. Categories of Impact at the Station Level

Assessment Category	Description
Unimpacted	Confident that sediment contamination is not causing significant adverse impacts to aquatic life living in the sediment at the site.
Likely Unimpacted	Sediment contamination at the site is not expected to cause adverse impacts to aquatic life, but some disagreement among the LOE reduces certainty in classifying the site as unimpacted.
Possibly Impacted	Sediment contamination at the site may be causing adverse impacts to aquatic life, but these impacts are either small or uncertain because of disagreement among LOE.
Likely Impacted	Evidence for a contaminant-related impact to aquatic life at the site is persuasive, even if there is some disagreement among LOE.
Clearly Impacted	Sediment contamination at the site is causing clear and severe adverse impacts to aquatic life.
Inconclusive	Disagreement among the LOE suggests that either the data are suspect or that additional information is needed before a classification can be made.

The station assessment resulting from each possible combination of the three LOEs is shown in **Exhibit 2-2** as follows:

Exhibit 2-2. Station Assessment Category Resulting from each Possible MLOE Combination

LOE Category Combination	Sediment Chemistry Exposure	Benthic Community Condition	Sediment Toxicity	Station Assessment
1	Minimal	Reference	Nontoxic	Unimpacted
2	Minimal	Reference	Low	Unimpacted
3	Minimal	Reference	Moderate	Unimpacted
4	Minimal	Reference	High	Inconclusive
5	Minimal	Low	Nontoxic	Unimpacted
6	Minimal	Low	Low	Likely unimpacted
7	Minimal	Low	Moderate	Likely unimpacted
8	Minimal	Low	High	Possibly impacted
9	Minimal	Moderate	Nontoxic	Likely unimpacted
10	Minimal	Moderate	Low	Likely unimpacted
11	Minimal	Moderate	Moderate	Possibly impacted
12	Minimal	Moderate	High	Likely impacted
13	Minimal	High	Nontoxic	Likely unimpacted
14	Minimal	High	Low	Inconclusive
15	Minimal	High	Moderate	Possibly impacted
16	Minimal	High	High	Likely impacted

LOE Category Combination	Sediment Chemistry Exposure	Benthic Community Condition	Sediment Toxicity	Station Assessment
17	Low	Reference	Nontoxic	Unimpacted
18	Low	Reference	Low	Unimpacted
19	Low	Reference	Moderate	Likely unimpacted
20	Low	Reference	High	Possibly impacted
21	Low	Low	Nontoxic	Unimpacted
22	Low	Low	Low	Likely unimpacted
23	Low	Low	Moderate	Possibly impacted
24	Low	Low	High	Possibly impacted
25	Low	Moderate	Nontoxic	Likely unimpacted
26	Low	Moderate	Low	Possibly impacted
27	Low	Moderate	Moderate	Likely impacted
28	Low	Moderate	High	Likely impacted
29	Low	High	Nontoxic	Likely unimpacted
30	Low	High	Low	Possibly impacted
31	Low	High	Moderate	Likely impacted
32	Low	High	High	Likely impacted
33	Moderate	Reference	Nontoxic	Unimpacted
34	Moderate	Reference	Low	Likely unimpacted
35	Moderate	Reference	Moderate	Likely unimpacted
36	Moderate	Reference	High	Possibly impacted
37	Moderate	Low	Nontoxic	Unimpacted
38	Moderate	Low	Low	Possibly impacted
39	Moderate	Low	Moderate	Possibly impacted
40	Moderate	Low	High	Possibly impacted
41	Moderate	Moderate	Nontoxic	Possibly impacted
42	Moderate	Moderate	Low	Likely impacted
43	Moderate	Moderate	Moderate	Likely impacted
44	Moderate	Moderate	High	Likely impacted
45	Moderate	High	Nontoxic	Possibly impacted
46	Moderate	High	Low	Likely impacted
47	Moderate	High	Moderate	Likely impacted
48	Moderate	High	High	Likely impacted
49	High	Reference	Nontoxic	Likely unimpacted
50	High	Reference	Low	Likely unimpacted
51	High	Reference	Moderate	Inconclusive
52	High	Reference	High	Likely impacted
53	High	Low	Nontoxic	Likely unimpacted
54	High	Low	Low	Possibly impacted
55	High	Low	Moderate	Likely impacted
56	High	Low	High	Likely impacted
57	High	Moderate	Nontoxic	Likely impacted

LOE Category Combination	Sediment Chemistry Exposure	Benthic Community Condition	Sediment Toxicity	Station Assessment
58	High	Moderate	Low	Likely impacted
59	High	Moderate	Moderate	Clearly impacted
60	High	Moderate	High	Clearly impacted
61	High	High	Nontoxic	Likely impacted
62	High	High	Low	Likely impacted
63	High	High	Moderate	Clearly impacted
64	High	High	High	Clearly impacted

The Plan specifies that sites which possess categories designated as Unimpacted and Likely Unimpacted sediments, shall be considered as achieving the SQO, whereas sites with Clearly Impacted, Likely Impacted, and Possibly Impacted sediments exceed the SQO. In addition, a Regional Water Board shall designate the Possibly Impacted category as meeting the protective condition if studies demonstrate that the combination of effects and exposure measures are not responding to toxic pollutants in sediments and that other factors are causing these responses within a specific reach segment or water body. In this situation, the Regional and State Board will only consider the Likely Impacted and Clearly Impacted categories as degraded when making a determination on receiving water limits or impaired water bodies.

2.5.1.2 Aquatic Life – Benthic Community Protection for Other Bays[5] and Estuaries

Station assessments for other bays and estuaries will be conducted using same conceptual approach and similar tools that are used for assessing SQOs in applicable bays and estuaries. There must be evidence of both elevated chemical exposure and biological effects, and the categorization of each LOE should be based on numeric values or a statistical comparison. However, the categorization of each LOE will be based on a reference condition rather than an established index or score. Reference sites should be located in an area uninfluenced by the dischargers or pollutants of concern, and should be representative of other habitat characteristics of the assessment area (e.g., salinity, grain size). Sites are classified in only two impact categories:

- Unimpacted – no conclusive evidence of both high pollutant exposure and high biological effects present at the site; evidence of chemical exposure and biological effects may be within natural variability or measurement error.
- Impacted – confident that sediment contamination present at the site is causing adverse direct impacts to aquatic life.

2.5.1.3 Human Health Protection

Compliance with the human health narrative sediment quality objective will be assessed based on a human health risk assessment in accordance with the California Environmental Protection

[5] Other bays and estuaries include all bays and estuaries except Euhaline Bays and Coastal Lagoons south of Point Conception and Polyhaline San Francisco Bay that includes the Central and South Bay Areas defined in general by waters south and west of the San Rafael Bridge and north of the Dumbarton Bridge

Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, Cal/EPA's DTSC Risk Assessment, and U.S. EPA Human Health Risk Assessment policies.

2.5.1.4 Wildlife and Resident Finfish Protection

Compliance with the wildlife and resident finfish objective will be assessed on a case-by-case basis. Compliance will be based upon an ecological risk assessment considering any applicable and relevant ecological risk information, including policies and guidance from different sources such as OEHHA, DTSC, California Department of Fish and Game, U.S. Environmental Protection Agency, National Oceanographic Atmospheric Administration, and U.S. Fish and Wildlife Service. When threatened or endangered species are present in enclosed bays and estuaries, the Water Boards shall consult with State and/or Federal Resource Trustee agencies to ensure that these species are adequately protected.

2.5.2 Program Specific Implementation

2.5.2.1 Dredge Material

Existing baseline sediment quality objectives shall not be applied for dredging material suitability determination. Also, an approval of dredging projects that might involve dredging the sediment and exceeding the sediment objectives is not allowed. However there is some exception to this rule, including consideration of a method to remove dredging material that would prevent or minimize water quality degradation, or if the polluted sediment is removed in a manner that prevents or minimizes water quality degradation.

Furthermore, only those dredging projects are approved by the Regional Water Board where the polluted sediment is not deposited in a location that may cause significant adverse effects to living species or beneficial uses of the receiving waters. Also, the polluted sediment should not be deposited in a location that does not create maximum benefit to the people of the State, or, will not cause significant adverse impacts upon a federal sanctuary, recreational area, or other waters of significant national importance.

2.5.2.2 NPDES Receiving Water and Effluent Limit

SQOs will be implemented as receiving water limits in NPDES permits where a Regional Water Board believes there is potential for the discharge to be causing or contributing to an exceedance of an applicable SQO based on the results of stressor identification studies.

Receiving water monitoring requirements in NPDES permits may be satisfied by a Permittee's participation in a regional SQO monitoring program. Effluent limits established to protect or restore sediment quality shall be developed only after the establishment of a clear relationship linking the discharge to the degradation, identification of a contributor pollutant, and appropriate loading studies.

According to the existing Plan, nothing in the Plan will limit a Water Board's authority to develop and implement waste load allocations for TMDLs. However, it is recommended that the Water Boards develop TMDL allocations using the methodology described herein, wherever possible.

2.5.2.3 Exceedance of Receiving Water Limit

The receiving water limit to protect aquatic life or human consumers of sportfish would be considered as exceeded when a binomial distribution demonstrates that the total number of stations are not meeting the protective condition; therefore, rejecting the null hypothesis (**Exhibit 2-3**). The stations included in this analysis will be those that are located in the vicinity of the discharge and identified in the permit. After identifying the discharge causing an exceedance, a stressor identification study is usually conducted. If studies by the Permittee demonstrate that other sources are also contributing to the degradation of sediment quality, the Regional Water Board shall, as appropriate, require the Discharger to initiate studies to assess the extent to which these sources are a contributing factor.

Exhibit 2-3. Minimum Number of Measured Exceedances Needed to Exceed the Direct Effects SQO as a Receiving Water Limit

Sample Size	List If the Number of Exceedances Equals or Is Greater Than
2 – 24	2*
25 – 36	3
37 – 47	4
48 – 59	5
60 – 71	6
72 – 82	7
83 – 94	8
95 – 106	9
107 – 117	10
118 – 129	11

Note:

[1] Null Hypothesis: Actual exceedance proportion ≤ 3 percent.
Alternate Hypothesis: Actual exceedance proportion > 18 percent.
The minimum effect size is 15 percent.

[2] Application of the binomial test requires a minimum sample size of 16. The number of exceedances required using the binomial test at a sample size of 16 is extended to smaller sample sizes

To determine compliance with receiving water limits, Phase I Stormwater Discharges and Major Discharges are required to do sediment monitoring not less frequently than twice per permit cycle. For stations that are consistently classified as Unimpacted or Likely Unimpacted the frequency may be reduced to once per permit cycle. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase I Stormwater Permittees. Similarly, sediment monitoring shall not be required more often than twice per permit cycle or less than once per permit cycle for Phase II Stormwater and Minor Discharges. For stations that are consistently classified as Unimpacted or Likely Unimpacted, the number of stations monitored may be reduced at the discretion of the Water Board. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase II Stormwater Permitees. The frequency of the monitoring for receiving water limits for other regulated discharges and waivers will be determined by the Water Board.

2.5.2.4 Sediment Monitoring

The objective of the sediment monitoring program is to ensure the data appropriately characterizes the water body which may be contaminated by the accumulation of pollutants from varied sources. The existing Plan directs Regional Water Boards to require permittees to monitor sediments if they discharge toxic or priority pollutants that may accumulate in sediments at levels that will cause, have the reasonable potential to cause, or contribute to an exceedance of applicable SQOs. The monitoring frequency required in the existing plan is not less than once every three years, prior to the issuance or re-issuance of a permit.

Monitoring may be performed by individual Permitees to assess compliance with receiving water limits, or through participation in a regional or water body monitoring coalition or both as determined by the Water Board. The Permittee is encouraged to participate in the regional monitoring program. Regional monitoring program is a coalition of the regulated community that supports to achieve maximum efficiency and economy of resources through sharing of technical resources, trained personal, and associated costs within each major waterbody. Sediment monitoring programs shall be designed to ensure that the aggregate stations are spatially representative of the sediment within the water body.

The design of sediment monitoring programs, whether site-specific or region-wide, shall be based upon a conceptual model that could be useful for identifying the physical and chemical factors that control the fate and transport of pollutants and receptors that could be exposed to pollutants in the sediment. The conceptual model serves as the basis for assessing the appropriateness of a study design. A design of a conceptual model considers different factors, such as points of discharge into the segment of the water body or region of interest, tidal flow and/or direction of predominant currents, historic and/or legacy conditions in the vicinity, nearby land and marine uses or action, beneficial uses, potential receptors of concern, etc. Sampling events at sampling stations should be conducted between the months of June and September, and need to be consistent with the benthic community condition index period.

2.5.2.5 Evaluate Waters for 303(d) Listing

Under the existing sediment quality Plan, the water segments are designated as “impaired’ for sediment toxicity and placed on a section 303(d) list based on toxicity alone or toxicity that is associated with a pollutant. Water segments shall be placed on the section 303(d) list for exceedance of the narrative sediment quality objective for aquatic life protection only if the number of stations designated as not achieving the protective condition supports rejection of the null hypothesis. Also, water segments that exhibit sediment toxicity but are not listed for an exceedance of the narrative sediment quality objective for aquatic life protection shall continue to be listed according to the State Water Board’s Water Quality Control Policy for Developing California’s Clean Water Act Section 303(d) List (2004) (Listing Policy). If a water segment is listed under the Listing Policy and the Regional Water Board later determines that the applicable water quality standard consists of the sediment quality objective of Part 1 and a bay or estuarine habitat beneficial use, the Regional Water Board shall re-evaluate the listing. Upon re-revaluation, if the Regional Water Board determines that the water segment does not meet the criteria in IV.4.e.i.a of the Plan, the Regional Water Board shall delist the water segment.

2.5.3 Stressor Identification

Where water bodies or segments contain sites with degraded sediments, confirmatory monitoring shall be conducted to determine whether the results are a response to toxic pollutants in sediments or due to other factors. If MLOE or confirmatory monitoring results leads to an exceedance of the narrative SQOs, the Plan requires a sequential approach to manage the sediment appropriately. The sequential approach consists of development and implementation of a work plan (i.e., stressor identification) to seek confirmation and characterization of pollutant-related impacts, pollutant identification, and source identification. The Plan directs Regional Water Boards to prioritize segments or reaches with the highest percentage of sites designated as Clearly Impacted and Likely Impacted for stressor identification. The Water Boards shall assign the highest priority for stressor identification to those segments or reaches with the highest percentage of sites designated as Clearly Impacted and Likely Impacted.

Where segments or reaches contain Possibly Impacted but no Clearly or Likely Impacted sites, confirmation monitoring shall be conducted prior to initiating stressor identification. The stressor identification work plan shall be submitted to the Regional Water Board for approval. Stressor identification consists of the studies described below:

Confirmation and Characterization of Pollutant Related Impacts – Exceedance of the direct effects SQO at a site indicates that pollutants in the sediment are the cause, but does not identify the specific contaminants responsible or rule out confounding factors (e.g., physical disturbance). Physical alterations such as reduced salinity, impacts from dredging, very fine or course grain size, and propeller wash from passing ships may produce a condition in the benthic community similar to that caused by toxic pollutants. If impacts to a site are purely due to physical disturbance, the LOE characteristics will likely show a degraded benthic community with little or no toxicity and low chemical concentrations. Other nontoxic pollutant related stressors include elevated levels of total organic carbon, nutrients, and pathogens. Chemical and microbiological analysis will be necessary to determine if these constituents are present. The LOE characteristics for this type of stressor would likely be a degraded benthic community with a possible indication of toxicity and low chemical concentrations.

To further assess a site that is impacted by toxic pollutants, the Plan allows for several studies to be considered and evaluated in the work Plan for the confirmation effort:

- Evaluate the spatial extent of the area of concern;
- Examination of body burden data from animals exposed to the site's sediment to indicate if pollutants are being accumulated and to what degree;
- Application of chemical-specific mechanistic benchmarks to interpret sediment chemistry concentrations;
- Examination of chemistry and biology data from the site to determine if there is a correlation between the two lines of evidence;
- Gather alternative biological effects data such as bioaccumulation experiments and pore water toxicity or chemical analysis; and

- Conduct other investigations commonly performed as part of a Phase I TIE.

If there is compelling evidence that the SQO exceedances contributing to a receiving water limit exceedance are not due to toxic pollutants, then the Plan indicates that the assessment area shall be designated as having achieved the receiving water limit.

Pollutant Identification Studies – Pollutant identification studies to identify the cause of the observed effects may be based on the following:

- Statistical methods: Correlations between individual chemicals and biological endpoints (toxicity and benthic community).
- Gradient analysis: Comparisons between samples taken at various distances from a chemical hotspot determine patterns in chemical concentrations and biological responses.
- Toxicity Identification Evaluation (TIE): Sediment samples are manipulated chemically or physically to remove classes of chemicals or render them biologically unavailable. Following the manipulations, biological tests determine if toxicity has been removed. TIEs should be conducted at a limited number of stations, and preferably those with strong biological effects.
- Bioavailability: Chemical and toxicological measurements on pore water may determine the availability of sediment contaminants. Measurement of acid volatile sulfides and extracted metals analysis determine if sufficient sulfides are present to bind metals. Solid phase micro extraction (SPME) or laboratory desorption experiments can be used to identify which organics are available to animals.
- Verification: Compare body burden measurements on animals exposed to the sediment to established toxicity thresholds. Spike sediments with the suspected chemicals to verify that they are toxic at the concentrations observed in the field. Alternately, transplant unaffected animals to suspected sites for in-situ toxicity and bioaccumulation testing.

To address source identification and management actions, the Plan requires:

- Determining if sources are ongoing or legacy;
- Determining the number and nature of ongoing sources;
- If a single discharger is found to be responsible for discharging the stressor pollutant at a loading rate that is significant, requiring the discharger to take all necessary and appropriate steps to address exceedances, including, but not limited to, reducing the pollutant loading into the sediment; and
- When multiple sources are present in the water body and the stressor pollutant is discharged at a loading rate that is significant, requiring the sources to take all necessary and appropriate steps to address exceedances, including adopting a TMDL, if appropriate.

2.5.4 Cleanup and Abatement

Cleanup and abatement actions are covered by Water Code section 13304 for sediments that exceed the sediment quality objectives. It shall comply with Resolution No. 92-49 (Policies and

Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304), Cal. Code Regs., tit. 23, §§ 2907, 2911.

2.5.5 Development of Site-specific Sediment Management Guide

Site-specific sediment management guidelines may be developed by the Regional Water Boards where appropriate. Development of site-specific sediment management guidelines is the process to estimate the level of the stressor pollutant that will meet the narrative sediment quality objective. The guidelines can serve as the basis for cleanup goals or revision of effluent limits.

Guidelines should be developed only under the scenario when the stressor causing the sediment impairment in a specific water body is identified. The specific intention of site-specific sediment management guidelines is to link organism exposure and the biological effect. Once the relationship is established, a pollutant specific guideline may be designated that corresponds with minimum biological effects. The following approaches can be applied to establish these relationships:

- Correspondence with sediment chemistry. An effective guideline can best be derived based upon the site-specific or reach-specific relationship between the stressor pollutant exposure and biological response. Therefore, the correspondence between the bulk sediment stressor concentration and biological effects should be examined.
- Correspondence with bioavailable pollutant concentration. The concentration of the bioavailable fraction of the stressor pollutants is likely to show a less variable relationship to biological effects that bulk sediment chemistry. Interstitial water analysis, SPME, desorption experiments, selective extractions, or mechanistic models may indicate the bioavailable pollutant concentration. The correspondence between the bioavailable stressor concentration and biological effects should be examined.
- Correspondence with tissue residue. The concentration of the stressor accumulated by a target organism may provide a measure of the stressor dose for some chemicals (e.g., those that are not rapidly metabolized). The tissue residue threshold concentration associated with unacceptable biological effects can be combined with a bioaccumulation factor or model to estimate the loading or sediment concentration guideline.
- Literature review. If site-specific analyses are ambiguous or unable to determine a guideline, then the results of similar development efforts for other areas should be reviewed. Scientifically credible values from other studies can be combined with mechanistic or empirical models of bioavailability, toxic potency, and organism sensitivity to estimate guidelines for the area of interest.

The chemistry LOE, including the threshold values (e.g. CSI and CALRM), shall not be used for setting cleanup levels or numeric values for technical TMDLs.

2.6 Regional Monitoring Program

There is a broad range of sediment monitoring programs under the existing Policy and SQOs. These programs help Regional Water Boards, dischargers, and other organizations to characterize effluent, ambient water, and sediment quality, and fish and wildlife health. These efforts include regional and coordinated programs, as well as discharger monitoring requirements. Regional programs include:

1. **Southern California Bight Regional Monitoring Survey:** This is the largest water quality monitoring program in the South Coast. The Bight program is a collaborative, integrated regional monitoring program with over 100 participating agencies, including locally-regulated agencies, state and federal regulatory agencies, and non-governmental and academic institutions. This survey is managed by the Southern California Coastal Water Research Project to assess the physical, chemical, and biological impacts to ocean waters, bays, and estuaries from Ventura to San Diego. The most recent project is "Bight 13 Regional Monitoring" which includes "Bight 13 Sediment Chemistry Assessment" which aims to determine (1) the extent and magnitude of direct impact from sediment contaminants; (2) the trend in extent and magnitude of direct impacts from sediment contaminants; and (3) the indirect risk of sediment contaminants to seabirds.
2. **San Francisco Bay Regional Monitoring Program (SFBRMP)**: The Regional Monitoring Program (RMP) is San Francisco Estuary Institute (SFEI)'s largest program and monitors contamination in the estuary providing water quality regulators with information they need to manage the estuary effectively. The RMP is an innovative collaborative effort between SFEI, the Regional Water Board, and the regulated discharger community. Monitoring performed in the RMP determines spatial patterns and long-term trends in contamination through sampling of water, sediment, bivalves, bird eggs, and fish, and evaluates toxic effects on sensitive organisms and chemical loading to the Bay. RMP has been collecting archive samples during each sampling event for sediment, bivalve, fish and birds since the early 1990's. These samples are available to SFEI researchers with RMP Program Manager Approval, and can be requested directly from the Contaminant Data Display and Download (CD3) tool. The RMP is an annual effort, though individual parameters may be monitored more or less frequently.
3. **Surface Water Ambient Monitoring Program (SWAMP): This** State Water Board program provides 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 water bodies and waters supporting beneficial uses. SWAMP is a statewide monitoring effort designed to assess the conditions of surface waters throughout the State of California. The SWAMP program was first established in 2000 by the State Water Board. For the purposes of SWAMP, "ambient" monitoring refers to any activity in which information about the status of the physical, chemical, and/or biological characteristics of the environment is collected to answer specific questions about the status and trends in water quality and/or beneficial uses of water.

   One of the funded projects of SWAMP is the Stream Pollution Trends Monitoring Program (SPoT), which was initiated to monitor trends in sediment toxicity and sediment contaminant concentrations in selected large rivers throughout California, and relates contaminant concentrations and toxicity to watershed land uses. The overall goal of this long-term trends assessment is to detect meaningful change in the concentrations of contaminants and their biological effects in large watersheds at time scales appropriate to management decision making. Sediment toxicity and a suite of pesticides, trace metals, and industrial compounds have been analyzed from 100 sites annually since 2008. The program design was revised in 2015 to reflect observed trends in stream contaminants and toxicity. This will allow for monitoring of additional chemicals of emerging concern and toxicity indicator species appropriate for these chemicals.

4. **Mussel Watch Program**: National Oceanic and Atmospheric Administration program of national status and trends is the longest running contaminant monitoring program in the United States. Contaminant concentrations in mussel tissue are a direct measure of exposure for all similar filter feeders in those habitats where found, and are an indicator of dietary exposure for biota that feed on these filter feeders.

5. **Regional Harbors Monitoring Program (RHMP):** RHMP is a collaborative program initiated in response to a Regional Water Board request pursuant to CWC 13255 for water quality information for Dana Point Oceanside, Mission Bay, and San Diego Bay. The objectives of this program include assessing water and sediment quality to sustain healthy biota, and the long-term trends in harbor conditions (Weston, 2008). The Regional Harbor Monitoring Program was developed by the Port of San Diego, City of San Diego, City of Oceanside, and County of Orange to understand the general water quality and condition of marine life in San Diego Bay, Mission Bay, Oceanside Harbor, and Dana Point Harbor. The RHMP assesses the spatial distribution of pollutants and their impacts, the safety of the waters for human contact, the safety of fish for human consumption, the abilities of the waters and sediments to sustain healthy biota, and the long-term trends in the conditions in each of the harbors. This core monitoring program occurs every five years to assess the conditions found in the harbors.

6. **Central Coast Long-term Environmental Assessment Network (CCLEAN)**: 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, chlorinated 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.

   The CCLEAN is a cooperative long-term monitoring program that satisfies the NPDES receiving water monitoring and reporting requirements of five entities including the Cities of Santa Cruz and Watsonville, Duke Energy, the Monterey Regional Water Pollution Control Agency, and the Carmel Area Wastewater District. In addition to meeting permit requirements, this collaborative meets objectives contained in a 1992 Memorandum of Agreement that established the Monterey Bay National Marine Sanctuary's Water Quality Protection Program and subsequent Action Plan entitled Monitoring, Data Access, and Interagency Coordination. Within the framework of CCAMP (Central Coast Ambient

Monitoring Program), the goal of the CCLEAN program is to assist stakeholders in maintaining, restoring, and enhancing nearshore water and sediment quality and associated beneficial uses in the Central Coast Region. A few of the specific objectives of the program are as follows:

- Obtain high-quality data describing the status and long-term trends in the quality of nearshore waters, sediments, and associated beneficial uses;
- Determine whether nearshore waters and sediments are in compliance with the Ocean Plan;
- Determine sources of contaminants to nearshore waters;
- Provide legally defensible data on the effects of wastewater discharges in nearshore waters; and
- Develop a long-term database on trends in the quality of nearshore waters, sediments and associated beneficial uses.

7. **Western Environmental Monitoring and Assessment Program (WEMAP) and the National Coastal Condition Assessment (NCCA):** These projects aim to assess near-coastal ecosystem health of the West Coast (Alaska, Washington, Oregon, California, and Hawai'i) according to methods and procedures developed under U.S. EPA Environmental Monitoring and Assessment Program (EMAP). In California, a four-year multi-agency cooperative study is managed by the Southern California Coastal Water Research Project (SCCWRP) and includes partners from the State Water Board, the San Francisco Estuary Institute (SFEI), Marine Pollution Studies Laboratory (MPSL), Moss Landing Marine Laboratories (MLML), Department of Fish and Game (DFG), and University of California, Davis. Under this project, a special study was conducted in Morro Bay in late 2003 under which water, sediment, and fish tissue samples were collected. In 2004, another round of WEMAP sampling was conducted in California's bays and estuaries with water and sediment samples collected at 49 stations and trawling for fish occurring at 31 of those stations. Funds were allocated to conduct additional sampling in bays and estuaries in 2005 and 2006. Water and sediment samples (n=32) were collected each year with trawling for flatfish species conducted at each station. MPSL-MLML provided field and logistical support for the California surveys in 2010 and lead the field effort in 2015.

2.7 Municipal and Industrial Facilities

Under the supervision of the National Pollutant Discharge and Elimination System (NPDES) permit program, the State Water Board regulates toxic pollutants in the effluents of municipal and industrial wastewater treatment facilities. The NPDES permits are issued pursuant to section 402 of the Clean Water Act, which requires that all point source discharges of pollutants to waters of the United States be regulated under a permit. Both technology-based and water quality based effluent limits are included in an NPDES permit. Water quality based effluent limits (WQBELs) reflect applicable water quality standards, including those contained in Basin Plans and the California Toxics Rule. NPDES permits also reflect narrative objectives contained in Basin Plans. The NPDES permittees may contribute to and support the RMP through special studies to assess compliance with the receiving water limits. These studies often focus on exposure and effects to fish and wildlife.

There are approximately 460 NPDES permitted municipal and industrial dischargers in the state and, of these, more than half are expected to fall within the scope of the proposed Policy. Of the potentially affected permittees, 147 are municipal dischargers, 151 are industrial dischargers, and 10 are federally-owned dischargers which primarily discharge treated sanitary waste. **Exhibit 2-4** provides a summary of these California dischargers by discharge type.

Exhibit 2-4. Municipal Wastewater Treatment Plants and Industrial Discharges to Inland Surface Waters, Enclosed Bays, and Estuaries in California

Treatment Facility Type	Major Facilities	Minor Facilities	Total
Municipal	92	55	147
Industrial	23	128	151
Federal	3	7	10
Total	**118**	**190**	**308**

Source: SWRCB (2016)

2.8 Stormwater Discharges

Regional Water Boards regulate most stormwater discharges under general permits. General permits often require compliance with standards through an iterative approach based on stormwater management Plans (SWMP), rather than through the use of numeric effluent limits. In other words, permittees implement best management practices (BMPs) identified in their SWMPs. Then, if those BMPs do not result in attainment of water quality standards, Regional Water Boards would require additional practices until pollutants are reduced to the appropriate levels. This iterative approach increases requirements until water quality objectives are met. As such, this is an ongoing process and current levels of implementation may not reflect the maximum level of control required to meet existing standards (CSU Sacramento, 2005). The State Water Board has four existing programs for controlling pollutants in stormwater runoff to surface waters: municipal, industrial, construction, and California Department of Transportation (Caltrans). Municipal, Caltrans, and industrial stormwater dischargers may have requirements specific to sediment.

2.8.1 Municipal Discharges

Stormwater discharges from municipal facilities are regulated under Municipal Separate Storm Sewer Systems (MS4s). The MS4 permits require the discharger to develop and implement a SWMP, with the goal of reducing the discharge of pollutants to the maximum extent practicable (MEP). MEP is the performance standard specified in section 402(p) of the CWA under which the management programs specify the BMPs that will be used to address public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping for municipal operations. Usually, large or medium municipal facilities are required to conduct chemical monitoring while small facilities are excluded from the requirement.

These permits can include actions addressing sediment quality. For example, the Contra Costa Clean Water Program (CA0029912 and CA0083313) requires the permittees to pursue a mass emission strategy to reduce pollutant discharges from point and nonpoint sources and address accumulation of pollutants in organisms and sediments (SFRWQCB, 1999). In addition, there are 209 small MS4s that have submitted SWMPs to Regional Water Boards or the State Water Board for approval. However, it is not clear how many of those MS4s discharge to enclosed bays and estuaries.

There are 22 NPDES Phase I MS4 permits for large MS4s in California that discharge, at least in part, to inland surface waters, enclosed bays, or estuaries. However, Phase I and Phase II MS4 permits do not specify particular controls for mercury and methylmercury and, instead, rely on implementation of programmatic requirements. Chapter 5 includes a detailed description on California's SWAMP activities.

In addition, there are 235 small MS4s required to reduce the discharge of pollutants and comply with any TMDL requirements. In California, typical permit requirements that are now being included in all Phase I MS4 permits and the Phase II General Permit include:

- Specific thresholds for "Priority Projects" that must include both source and treatment control BMPs in the completed projects;
- A list of source control (both nonstructural and structural) BMPs and treatment control BMPs to be included or considered;
- Specific water quality design volume and/or water quality design flow rate for treatment control BMPs;
- A requirement for flow control BMPs when there is potential for downstream erosion; and
- Adopt a standard model or template for identifying and documenting BMPs including a Plan for long-term operations and maintenance of BMPs.

2.8.2 Industrial Discharges

Under the industrial program, the State Water Board issues a general NPDES permit that 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 (BAT) economically achievable and best conventional pollutant control technology (BCT). The permit also requires that dischargers develop a Stormwater Pollution Prevention Plan (SWPPP) and a monitoring Plan. Through the SWPPP, dischargers must identify sources of pollutants, and describe the means to manage the sources to reduce stormwater pollution. For the monitoring Plan, facility operators may participate in group monitoring programs to reduce costs and resources.

2.8.3 Construction

The construction program involves those dischargers of stormwater whose project disturbs 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. These facilities are required to obtain coverage under the general permit for discharges of stormwater associated with construction activity.

The construction general permit involves the development and implementation of a SWPPP that lists BMPs that a discharger will use to control pollutants in stormwater runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program, a chemical monitoring program for nonvisible pollutants to be implemented if there is a failure of BMPs, and a sediment monitoring plan if the site discharges directly to a water body impaired for sediment.

2.8.4 Caltrans

In 1996, Caltrans requested that the State Water Board consider adopting a single NPDES permit for stormwater discharges from all Caltrans properties, facilities, and activities that would cover both the MS4 requirements and the statewide construction general permit requirements. The State Water Board issued the Caltrans General Permit in 1999 and a renewed permit in 2012. The permit requires Caltrans to control pollutant discharges to the MEP and implement a stormwater program designed to achieve compliance with water quality standards, over time through an iterative approach. If discharges are found to be causing or contributing to an exceedance of an applicable objective, Caltrans is required to revise its BMPs (including use of additional and more effective BMPs).

2.9 Nonpoint Sources

Nonpoint source pollution, unlike pollution from industrial and sewage treatment Plants, comes from many different sources. Some nonpoint source pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, depositing them into lakes, rivers, wetlands, coastal waters, and groundwater. Nonpoint source pollution may originate from several sources including agricultural operations, forestry operations, urban areas, boating and marinas, active and historical mining operations, atmospheric deposition, and wetlands. Note that, in many cases, discharges from these sources can be regulated as point sources (i.e., discernible, confined, and discrete conveyances).

In 1999, California implemented its Fifteen-Year Program Strategy for the Nonpoint Source Pollution Control Program, as delineated in the Plan for California’s Nonpoint Source Pollution Control Program (NPS Program Plan). The legal foundation for the NPS Program Plan is the Clean Water Act (CWA) and the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) (SWRCB, 2000). The agencies primarily responsible for the development and implementation of the NPS Program Plan are the State Water Board, the nine Regional Water Boards, and the California Coastal Commission (CCC). Various other federal, state, and local agencies have significant roles in the implementation of the NPS Program Plan. Federal approval and funding of the NPS Program Plan required assurance that the state had legal authority to implement and enforce the Plan. The state’s Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Policy) provides guidance regarding the implementation and enforcement of the NPS Program Plan. As stated in the NPS Policy, the Porter-Cologne Act provides the legal authority of the State Water Board and Regional Water Boards to regulate nonpoint sources in California under waste discharge requirements (WDRs), conditional waivers of WDRs, or basin Plan prohibitions or amendments (SWRCB, 2004b). However, all WDRs need not contain numeric effluent limits. The Regional Water Boards do not usually assign nonpoint sources numeric effluent limits; rather they primarily rely on implementation of BMPs to reduce pollution. The NPS Program Plan specifies management measures (MMs) and the corresponding management practices or BMPs for each of six source categories. MMs should be implemented where needed by 2013 using a combination of nonregulatory activities and enforceable policies and mechanisms (SWRCB, 2003a). **Appendix C** describes the MMs for each source category applicable to sediment toxicity reductions.

2.9.1 Agriculture

Agricultural activity may significantly impact sediment quality in various ways. These impacts can be caused by:

- Farming activities or style which involves excessive erosion;
- Improper and excessive usage of pesticides and fertilizers; or
- Over application of irrigation water resulting in runoff of sediments and pesticides (SWRCB, 2006b).

California Regional Water Boards have historically regulated discharges from irrigated land including stormwater runoff, irrigation tail water, and tile drainage through a discharge waiver. These waivers are authorized by CWC Section 13269, which allows Regional Water Boards to waive WDRs if it is in the public interest.

Although the majority of historical discharge waivers require that discharges not cause violations of water quality objectives; these waivers also do not require water quality monitoring, which may lead to a significant impairment of water quality through agricultural runoff. In 1999, Senate Bill 390 amended CWC section 13269 and required Regional Water Boards to review and renew their waivers, or replace them with WDRs. If Regional Water Boards did not reissue the waivers by January 1, 2003, they expired. The Central Coast, Los Angeles, Central Valley, and San Diego Regional Water Boards have established conditional waivers for agricultural discharges. The Santa Ana Regional Water Board is in the process of developing a conditional waiver for discharges from irrigated agricultural lands. While the North Coast and San Francisco Bay Regional Water Boards have no immediate Plans to adopt waivers for agricultural discharges, they may do so in the future in the context of TMDLs.

Regional Water Boards regulate agricultural discharges from cropland under nonpoint source programs concurrently with the conditional waivers that rely on BMPs to protect water quality. For instance, the State Water Board and the CCC oversee agricultural control programs, with assistance from the Department of Pesticide Regulation (DPR) for pesticide pollution and the Department of Water Resources for irrigation water management (SWRCB, 2006b). The pesticide MM 1D is likely to have the greatest impact on sediment toxicity. This MM reduces contamination of surface water and ground water from pesticides through procedures, strategies, practices, and other controls. Another management system is Integrated Pest Management (IPM), which is an effective and environmentally sensitive approach to pest management. IPM helps to reduce harmful impact of pest through:

- Set action threshold of pest control;
- Monitoring and identifying pest to adopt appropriate control decisions in conjunction with action threshold;
- Adopting different effective and cost efficient prevention methods; and
- Evaluating different control methods.

IPM strategies include evaluating pest problems in relation to cropping history and previous pest control measures, and applying pesticides only when an economic benefit will be achieved. Pesticides should be selected based on their effectiveness to control target pests and their potential environmental impacts such as persistence, toxicity, and leaching potential (SWRCB, 2006b).

There are many planned, on-going, and completed activities related to management of pesticides. However, as reported in the most recent NPS Program Plan progress report (SWRCB, 2004a), efforts to improve water quality impaired by agriculture activities are highly challenging because of the different perspectives that exist between the regulatory community and the agricultural community. As of 2003, the SWRCB (2004a) reports the following progress:

- 16 watershed working groups are actively developing farm water quality plans, with 19 new groups being formed;
- Of the over 90 farmers that attended a Farm Water Quality Course, half have developed comprehensive water quality plans for more than 10,700 acres of irrigated crops; and
- Over 750 farmers have attended 35 workshops designed to train farmers in specific conservation practices.

2.9.2 Forestry

Timber harvesting and associated activities can result in the discharge of chemical pollutants and petroleum products, in addition to other conventional pollutants. Pollutants can be discharged through runoff and drift. Potential sources of pollutants in runoff include roads that have been treated with oils or other dust suppressing materials and herbicide applications. Forest chemical management focuses on reducing pesticides that are occasionally used for pest management to reduce mortality of desired tree species, and improve forest production. Pesticide use on state or private forestry land is regulated by DPR. However, a large proportion of California's forested lands are owned or regulated by the federal government (SWQCB, 2004a) in which pesticide use is controlled by the USDA Forest Service Region 5. In addition to the NPS Program Plan MMs, forestry activities are also controlled through WDRs and conditional waivers. Recently, Regional Water Boards have adopted waivers for timber harvesting activities, provided that the activities comply with the general conditions listed in each waiver, including compliance with applicable requirements contained in each Region's Basin Plan.

The DPR regulates the sale and use of pesticides and, through county agricultural commissioners (CACs), enforces laws pertaining to pesticide use. CACs inspect pesticide applications to forests and ensure that applications do not violate pesticide laws and regulations. Landowners must also submit timber harvest plans (THPs) to the California Department of Forestry (CDF) outlining what timber will be harvested, how it will be harvested, and the steps that will be taken to prevent damage to the environment. CDF will only approve those THPs that comply with all applicable federal and state laws. The Forest Practices Act provides a conditional exemption from WDRs for timber operations (article 1. section 4514.3). The Forest Practice Rules establish responsible forest resource management practices which serve the demand for timber and other forest products, while giving consideration to the public's need for watershed protection, as well as fisheries, wildlife and recreational opportunities.

2.9.3 Air Emissions

Coal-burning power Plants are the largest human-caused source of mercury emissions to the air in the United States, accounting for over 50% of all domestic human-caused mercury emissions based on the 2005 National Emissions Inventory. U.S. EPA has estimated that about one quarter of U.S. emissions from coal-burning power plants are deposited within the contiguous United States and the remainder enters the global cycle. Burning hazardous wastes, producing chlorine, and breaking mercury products can also release mercury into the environment. Significant mercury emissions also come from international sources. However, because the State Water Board does not have authority to directly regulate air emissions, we do not include them in the analysis.

2.10 Impaired Waters

A 2011 Policy established a structured regulatory procedure to determine those water segments that are impaired due to sediment toxicity. For narrative objectives based on the bioaccumulation of pollutants in tissue, or, in a water segment is impaired if the tissue pollutant levels in organisms exceed a pollutant-specific evaluation guideline using binomial distribution. Regional Water Boards may select evaluation guidelines published by U.S. EPA or OEHHA.

Under the CWA, section 303(d), states are required to develop a list of water quality limited segments, establish priority rankings for the segments, and develop action plans, or TMDLs, to improve water quality. The listing Policy identifies the factors and information that shall be used by the State and Regional Water Boards to list and delist a water body. The 2012 303(d) list for impaired bays and estuaries and applicable TMDLs are described in **Exhibit 2-5** and **Exhibit 2-6** as follows:

Exhibit 2-5. 2012 303(d) Listings for Bays and Estuaries in California

Water Body	2012 303(d) list
Region 1	
Eureka Plain HU, Humboldt Bay	Other organics: PCBs Other organics: Dioxin Toxics Equivalent
Bodega HU, Bodega Harbor HA	Miscellaneous: Invasive species
Region 2	
San Francisco Bay, Central Basin	Sediment: Mercury, PAHs Water: Chlordane, Dieldrin, DDT
San Francisco Bay, Oakland Inner Harbor	Sediment: Chlordane, Lead, Zinc, Copper, PCBs, PAHs, Dieldrin, Mercury, Sediment Toxicity Water: Chlordane, DDT, Dieldrin Tissue: Mercury, PCBs, Selenium
San Francisco Bay, Richardson Bay	Water: Chlordane, Dieldrin, DDT Tissue: Mercury, PCBs
San Francisco Bay, Lower	Water: Chlordane, DDT, Dieldrin Tissue: Mercury, PCBs
San Francisco Bay, South	Water: Chlordane, DDT, Dieldrin Tissue: Mercury, PCBs, Selenium
San Francisco Bay, San Leonardo Bay	Sediment: Lead, Mercury, PAHs, Pesticides, Zinc Water: Chlordane, Dieldrin, Mercury Tissue: Mercury
San Francisco Bay , San Pablo Bay	Water: Chlordane, DDT, Dieldrin Tissue: Mercury, PCBs, Selenium
Suisun Bay	Water: Chlordane, DDT, Dieldrin Tissue: Mercury, PCBs, Selenium
Tomales Bay	Sediment: Sedimentation Tissue: Mercury
Carquinez Strait	Water: Chlordane, DDT, Dieldrin Tissue: Mercury, PCBs, Selenium
Castro Cove, Richmond (San Pablo Basin)	Sediment: Mercury, Dieldrin, Selenium, PAHs
Islais Creek	Sediment: Chlordane, Dieldrin, PAHs, Sediment Toxicity
Mission Creek	Sediment: Chlordane, Dieldrin, Lead, Mercury, PCBs, Silver, Zinc Water: PAHs
Sacramento San Joaquin Delta	Water: Chlordane, DDT, Dieldrin Tissue: Mercury, PCBs, Selenium
Stege Marsh	Water: Chlordane, Dacthal, Dieldrin Tissue: Mercury, PCBs, Zinc, Copper
Suisun Slough	Water: Diazinon
Region 3	
Carpinteria Marsh (El Estero Marsh)	Water: Priority Organics
Elkhorn Slough	Sediment: Sedimentation/Siltation Water: Pesticides
Goleta Slough/Estuary	Water: Priority Organics
Monterey Harbor	Sediment: Sediment Toxicity Water: Metals
Moro Cojo Slough	Sediment: Sedimentation/Siltation Water: Pesticides
Morro Bay	Sediment: Sedimentation/Siltation
Moss Landing Harbor	Sediment: Sedimentation/Siltation, Toxicity Water: Pesticides, Diazinon, Chlorpyrifos, Nickel

Water Body	2012 303(d) list
Old Salinas River Estuary	Water: Pesticides
Salinas River Lagoon (North)	Water: Pesticides
Salinas River Refuge Lagoon (South)	Sediment: Turbidity
Soquel Lagoon	Sediment: Sedimentation/Siltation
Region 4	
Calleguas Creek Reach 1 (was Mugu Lagoon on 1998 303(d) list)	Sediment: DDT, Sedimentation, Siltation Water: Dieldrin, Toxaphene, Copper, Mercury, Nickel, Zinc Tissue: Chlordane, DDT, Endosulfan, PCBs
Dominguez Channel Estuary (unlined portion below Vermont Ave)	Sediment: DDT, Toxicity, Zinc, Benthic Community Effects Water: Benzo(a)anthracene, Benzo(a)pyrene (3,4-Benzopyrene -7-d), Chrysene (C1-C4), Phenanthrene, Pyrene Tissue: Chlordane, DDT, Dieldrin, Lead, PCBs (Polychlorinated biphenyls)
Los Angeles Harbor - Cabrillo Marina	Water: DDT, PCBs, Benzo(a)pyrene (3,4-Benzopyrene -7-d Tissue: PCBs
Los Angeles Harbor - Consolidated Slip	Sediment: Benthic Community Effects, Chlordane, Chromium, Copper, Cadmium, DDT, Lead, Mercury, PCBs, Zinc, Sediment toxicity Water: 2-Methylnaphthalene, Benzo(a)anthracene, Chrysene (C1-C4), Benzo(a)pyrene (3,4-Benzopyrene -7-d), Dieldrin, Phenanthrene, Pyrene Tissue: Chlordane, DDT,PCBs, Toxaphene
Los Angeles Harbor - Fish Harbor	Sediment: Toxicity, Copper, Lead, Mercury, PAHs, Zinc Water: Chlordane, DDT, PCBs
Los Angeles Harbor - Inner Cabrillo Beach Area	Water: DDT, PCBs
Los Angeles River Estuary (Queensway Bay)	Sediment: Chlordane, DDT, PCBs, Toxicity
Los Angeles/Long Beach Inner Harbor	Sediment: Toxicity, Benthic Community Effects Water: DDT, Copper, Zinc, PCBs
Los Angeles/Long Beach Outer Harbor (inside breakwater)	Sediment: Toxicity Water: DDT, PCBs
Malibu Lagoon	Sediment: Benthic Community Effects
Marina del Rey Harbor - Back Basins	Sediment: Toxicity, Zinc, PCBs, Lead, Copper, Chlordane Tissue: Chlordane, DDT, Dieldrin, PCBs
Port Hueneme Harbor (Back Basins)	Tissue: DDT, PCBs
San Pedro Bay Near/Off Shore Zones	Sediment: DDT, toxicity Water: Chlordane, PCBs Tissue: DDT
Santa Clara River Estuary	Water: Toxaphene, ChemA, Toxicity
Santa Monica Bay Offshore/Nearshore	Sediment: DDT, PCBs, Toxicity Tissue: DDT, PCBs
Region 5	
Delta Waterways (Stockton Ship Channel)	Water: Chlorpyrifos, DDT, Diazinon, Group A Pesticides, Toxicity, PCBs, Dioxin, Furans, Tissue: Mercury, PCBs
Delta Waterways	Water: Chlorpyrifos, Chlordane, DDT, Diazinon, Dieldrin, Group A Pesticides, Toxicity Tissue: Mercury, PCBs

Water Body	2012 303(d) list
Region 8	
Anaheim Bay	Sediment: Toxicity Water: Nickel Tissue: Dieldrin, PCBs
Huntington Harbour	Sediment: Toxicity Water: Chlordane, Copper, Lead, Nickel Tissue: PCBs
Newport Bay, Lower (entire lower bay, including Rhine Channel, Turning Basin and South Lido Channel to east end of H-J Moorings)	Sediment: Toxicity Water: Chlordane, Copper, DDT, PCBs, Pesticides
Newport Bay, Upper (Ecological Reserve)	Sediment: Sedimentation, Toxicity, Water: Chlordane, Copper, DDT, Metals, PCBs, Pesticides,
Rhine Channel	Sediment: Toxicity Water: Copper, Lead, Mercury, Zinc, PCBs
Region 9	
Buena Vista Lagoon	Sediment: Sedimentation
Dana Point Harbor	Water: Copper, Zinc, Toxicity
Los Penasquitos Lagoon	Sediment: Sedimentation
Mission Bay	Water: Lead, Copper
Oceanside Harbor	Water: Copper
San Diego Bay Shoreline, 32nd St San Diego Naval Station	Sediment: Toxicity, Benthic Community Effects
San Diego Bay Shoreline, Downtown Anchorage	Sediment: Toxicity, Benthic Community Effects
San Diego Bay Shoreline, North of 24th Street Marine Terminal	Sediment: Toxicity, Benthic Community Effects
San Diego Bay Shoreline, Seventh Street Channel	Sediment: Toxicity, Benthic Community Effects
San Diego Bay Shoreline, Vicinity of B St and Broadway Piers	Sediment: Toxicity, Benthic Community Effects
San Diego Bay Shoreline, at Americas Cup Harbor	Water: Copper
San Diego Bay Shoreline, at Coronado Cays	Water: Copper
San Diego Bay Shoreline, at Glorietta Bay	Water: Copper
San Diego Bay Shoreline, at Harbor Island (East Basin)	Water: Copper
San Diego Bay Shoreline, at Marriott Marina	Water: Copper
San Diego Bay Shoreline, between Sampson and 28th Streets	Water: Copper, Mercury, PAHs, PCBs, Zinc
San Diego Bay Shoreline, near Chollas Creek	Sediment: Toxicity, Benthic Community Effects
San Diego Bay Shoreline, near Coronado Bridge	Sediment: Toxicity, Benthic Community Effects
San Diego Bay Shoreline, near Switzer Creek	Water: Chlordane, PAHs
San Diego Bay Shoreline, near sub base	Sediment: Toxicity, Benthic Community Effects
San Diego Bay, Shelter Island Yacht Basin	Water: Copper
San Elijo Lagoon	Sediment: Sedimentation

Water Body	2012 303(d) list
Tijuana River Estuary	Sediment: Turbidity Water: Thallium, Nickel, Pesticides, Lead

Source: 2012 303 (d) list.

Exhibit 2-6. Summary of Toxics TMDLs in California Bays and Estuaries

TMDL	Numeric Basis for TMDL	Objective or Target
Region 2		
San Francisco Bay Mercury TMDL	Objective	Fish tissue: 0.2 mg/kg Hg, TL3 and TL4 fish (size specified for certain species) 0.03 mg/kg Hg, 3-5 cm fish Water: 0.025 µg/L Hg (4-d average), marine and freshwater 2.1 µg/L Hg (1-hr average), marine 2.4 µg/L Hg (1-hr average), freshwater
San Francisco Bay PCBs TMDL	Targets	Fish Tissue 22 ng PCBs/g Sediment: 2.5 µg PCBs/kg
Tomales Bay Mercury TMDL	Targets	Fish tissue: 0.2 mg/kg MeHg, legal halibut (55 cm) 0.05 mg/kg MeHg, 5-15 cm TL3 fish
North San Francisco Bay Selenium TMDL	Targets	Fish tissue: 8.0 µg/g whole-body dry weight, fish tissue 11.3 µg/g muscle tissue dry weight, fish tissue Water: 0.5 µg/L dissolved total selenium
Region 3		
Lake Nacimiento and Las Tablas Creek (not approved by State Water Board or U.S.EPA)	Targets	Water: 0.050 µg/L total Hg Sediment: 0.486 mg/kg Hg
Arroyo Paredon Watershed Diazinon and Additive Toxicity TMDL	Targets	Water: 0.16 ppb, CMC, Diazinon 0.10 ppb, CCC, Diazinon
Region 4		
Ballona Creek Estuary Toxics TMDL	Targets	Sediment: 0.5 µg/kg Chlordane 1.58 µg/kg DDT 22.7 µg/kg PCBs 4,022 µg/kg PAHs 1.2 mg/kg Cadmium 34 mg/kg Copper 46.7 mg/kg Lead 1.0 mg/kg Silver 15 mg/kg Zinc

TMDL	Numeric Basis for TMDL	Objective or Target
Calleguas Creek Watershed Metals and Selenium TMDL	Targets	Dry Weather Water: Dissolved Copper 3.1 ×WER Dissolved Nickel 8.2 µg/L Total Mercury 0.051 µg/L Wet Weather Water: Dissolved Copper 4.8 ×WER Dissolved Nickel 74 µg/L Total Mercury 0.051 µg/L Sediment: Copper 34,000 µg /kg Nickel 20,900 µg /kg Fish Tissue: Methylmercury 0.3 mg/kg (human health) Methylmercury Trophic Level 3 <50 mm 0.03 mg/kg Methylmercury Trophic Level 3 50-150 mm 0.05 mg/kg Methylmercury Trophic Level 3 150-350 mm 0.1 mg/kg Bird Egg: Mercury 0.5 mg/kg
Calleguas Creek Watershed OC Pesticides and PCBs TMDL	Targets	Fish Tissue: Chlordane 0.83 µg /kg DDT 32 µg /kg Dieldrin 0.65 µg /kg PCBs 5.3 µg /kg; Toxaphene 9.8 µg /kg Sediment: Chlordane 0.5 µg /kg DDT 1 µg /kg Dieldrin 20 ng/kg PCBs 23 µg /kg Water: Chlordane 4 ng/L DDT 1 ng/L Dieldrin 1.9 ng/L PCBs 30 ng/L Toxaphene 0.2 ng/L
Calleguas Creek Watershed Mugu Lagoon Metals	Targets	Fish Tissue: 0.3 mg/kg MeHg 0.1 mg/kg MeHg, 15-35 cm TL3 fish 0.05 mg/kg MeHg, 5-15 cm TL3 fish 0.03 mg/kg MeHg, fish < 5 cm < 0.5 mg/kg Hg, bird eggs Water: 0.050 µg/L total Hg

TMDL	Numeric Basis for TMDL	Objective or Target
Marina Del Rey Harbor Toxics TMDL	Targets	Fish Tissue: PCBs 5.3 µg/kg Sediment: Chlordane 0.5 µg/kg PCBs 22.7 µg/kg Copper 34 mg/kg Lead 46.7 mg/kg Zinc 150mg/kg Water: PCBs 0.17 ng/L (interim) PCBs 30 ng/L (final)
Santa Monica Bay DDTs and PCBs	Targets	Fish tissue (based on a consumption rate of 116g/d and exposure risk of 10^{-5}): Total DDT 40 ng/g Total PCBs 7 ng/g Water: Total DDT 0.17 ng/L Total PCBs 0.019 ng/L Sediment (normalized for organic carbon): Total DDT 2.3 µg /g OC Total PCBs 0.7 ng/g µg /g OC
Machado Lake Pesticides and PCB Domoniquez channel	Targets	Fish Tissue (ng/g wet weight): Total PCBs 3.6 DDT (all congeners) no target DDE (all congeners) no target DDD (all congeners) no target Total DDT 21.0 Chlordane 5.6 Dieldrin 0.46 Water Column: Total PCBs 0.00017 µg/L 4,4' DDT 0.00059 µg/L 4,4' DDE 0.00059 µg/L 4,4' DDD 0.00084 µg/L Chlordane 0.00059 µg/L Dieldrin 0.00014 µg/L Sediment(µg/kg dry weight): Total PCBs 59.8 DDT (all congeners) 4.16 DDE (all congeners) 3.16 DDD (all congeners) 4.88 Total DDT 5.28 Chlordane 3.24 Dieldrin 1.9

TMDL	Numeric Basis for TMDL	Objective or Target
Dominguez Channel and Greater Los Angeles and Long Beach Harbor Toxics	Targets	Fish tissue (µg/kg wet): Chlordane 5.6 Dieldrin 0.46 n/a Total DDT 21 Total PCBs 3.6 PAHs – total 5.47 Toxaphene 6.1 Sediment (mg/kg): Cadmium 1.2 Chromium 81 Copper 34 Lead 46.7 Mercury 0.15 Zinc 150 Sediment (µg/kg): Chlordane, total 0.5 Dieldrin 0.02 Toxaphene 0.10 Total PCBs 22.7 Benzo[a]anthracene 261 Benzo[a]pyrene 430 Chrysene 384 Pyrene 665 2-methylnaphthalene 201 Dibenz[a,h]anthracene 260 Phenanthrene 240 Hi MW PAHs 1700 Lo MW PAHs 552 Total PAHs 4,022 Total DDT 1.58 Birds (tissue residues): Total DDT n/a 0.3 ug/g lipid Total PCBs 2.2 ug/g in
Region 5		
Cache Creek and Bear Creek TMDL for Methylmercury	Objective	Fish tissue: 0.23 mg/kg MeHg, 25-35 cm TL4 fish 0.12 mg/kg MeHg, 25-35 cm TL3 fish
Sacramento – San Joaquin Delta Estuary TMDL for Methylmercury	Objective	Fish tissue: 0.24 mg/kg MeHg, 15-50 cm TL4 fish 0.08 mg/kg MeHg, 15-50 cm TL3 fish 0.03 mg/kg MeHg, fish <5 cm
Region 8		
Toxic Pollutants San Diego Creek and Newport Bay	Targets	Fish tissue: 0.3 mg/kg MeHg Sediment: 0.13 ppm dry weight Hg

TMDL	Numeric Basis for TMDL	Objective or Target
Upper and Lower Newport Bay (including Rhine Channel) Metals TMDL	Targets	Fish Tissue: Mercury 0.3 mg/kg Chromium 0.2 mg/kg Water (Acute): Cadmium 42 µg/L Copper 4.8 µg/L Lead 210 µg/L Zinc 90 µg/ Water (Chronic): Cadmium 9.3 µg/L Copper 3.1 µg/L Lead 8.1 µg/L Zinc 81 µg/L Sediment: Cadmium 0.67 mg/kg Copper 18.7 mg/kg Lead 30.2 mg/kg Zinc 124 mg/kg Mercury 0.13 mg/kg Chromium 52 mg/kg
Upper and Lower Newport Bay Organochlorine Compounds TMDL	Targets	Fish Tissue: Chlordane 30 µg/kg DDT 50 µg/kg PCBs 20 µg/kg Water Chlordane 0.59 ng/L DDT 0.59 ng/L PCBs 0.17 ng/L Sediment: Chlordane 2.26 µg/kg DDT 3.89 µg/kg PCBs 21.5 µg/kg
Newport Bay Copper TMDL	Targets	Water(CTR Saltwater criteria) Acute 4.8 µg/L Copper Chronic 3.1 µg/L Copper Sediment: 34 µg/g, effects range low, ERL sediment guidelines
Region 9		
Shelter Island Yacht Basin Copper TMDL	Targets	Water (Acute): 4.8 µg/L Copper Water (Chronic): 3.1µg/L Copper

Note:

Source: SWRCB (2016)

cm = centimeter
NA = not applicable
Hg = Inorganic mercury
MeHg = methylmercury
mm = millimeters
TL = trophic level
mg/kg = milligram per kilogram
µg/kg = microgram per kilogram

3 Description of the Amendments

This chapter describes the February 2017 draft proposed amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries. It discusses the applicability of the regulation, beneficial uses, and implementation procedures including monitoring requirements.

3.1 Sediment Quality Objectives Beneficial Uses

There are no proposed amendments of sediment quality objectives beneficial uses in the proposed Policy.

3.2 Sediment Quality Objectives Applicability

As in the existing sediment Policy, proposed Part 1 applies to enclosed bays and estuaries only. It does not apply to the ocean waters including Monterey Bay and Santa Monica Bay, or inland surface waters. There are no proposed amendments to applicable waters, sediments, or discharges in the Plan.

3.3 Sediment Quality Objectives

There are no proposed amendments to the sediment quality objectives of the Plan.

3.4 Implementation Procedures

The State Water Board is considering adoption of a new approach to implement the sediment quality objectives to protect human health. While the approach to implement aquatic life criteria and wildlife & finfish criteria remains unchanged from the existing Plan, the proposed revised implementation procedures associated with the human health SQO are based on a tiered regulatory framework. The amendments are described as follows:

3.4.1 Assessing Human Health Protection SQOs

In the proposed Plan, the SQO for the protection of human health is interpreted based on two contaminant categories: chlorinated pesticides and PCBs, and contaminants other than the chlorinated pesticides and PCBs. Procedures to assess the latter category have not changed from the existing plan. For all contaminants except chlorinated pesticides and PCBs, human health risk assessment judgement on a specific case-by-case basis will be employed to implement the narrative human health objective. While conducting a risk assessment process, the Water Boards shall consider any applicable and relevant information, including OEHHA policies for fish consumption and risk assessment, DTSC Risk Assessment, and U.S. EPA Human Health Risk Assessment policies.

For chlorinated pesticides and PCBs, the State Water Board introduced a sequential approach that shall be used to interpret the sediment quality narrative objective protecting human consumers of locally caught sportfish. The purpose of this assessment framework is to evaluate the acceptability of pollutant concentrations in fish tissue which is exposed to human consumers and assess the contribution of site-specific sediment contamination of sportfish. Two indicators play a vital role in this framework: 1) chemical exposure indicator comparing the contamination exposure levels at the site with advisory thresholds and 2) site linkage indicator comparing sportfish contamination measurements to estimated sportfish concentrations that would result from site exposure. A site assessment framework is established by using a categorical decision matrix to integrate the chemical exposure and site linkage indicators. The assessment framework consists of three tiers:

Tier 1 is a screening assessment to address whether contaminants in sediments at a site pose a potential chemical exposure that warrants further evaluation. For contaminants that pose such a potential in site sediments, a Tier 2 evaluation is required.

Tier 2 is a complete site assessment to assess sediment quality relative to the sediment quality objective protecting human consumers of locally caught sportfish. Tier 2 requires site-specific information and data, including sediment and sportfish tissue chemistry, sediment organic carbon, and percent lipid in tissue. The data are used to calculate average chemical exposure from consumption and the probability distribution of linkage between contaminants in sediment and sportfish.

Tier 3 is a more complex and site-specific assessment intended to supplement the Tier 2 evaluation. Greater flexibility is provided to address unique site conditions, confounding factors, or other chemical exposure factors. Tier 3 may be employed only after the completion of Tier 2.

The Tiered assessment framework is focused on linking high quality data to the site-specific conditions and factors. A prerequisite of this framework data analysis is developing a conceptual site model (CSM). A study design and both sediment and tissue data must be consistent with the CSM.

This assessment framework applies only to specific nonpolar chlorinated hydrocarbons: DDTs, PCBs, chlordane and dieldrin. The framework may be applied to assess either the entire water body or a portion, provided that the site area is at least 1 km^2. A Tiered Assessment Framework also requires some additional testing to evaluate the level of chemical exposure and contribution of sites for the estimated contamination in sediment. Laboratory testing requirements by Tier is listed in following **Exhibit 3-1**:

Exhibit 3-1. Laboratory Testing Requirements by Tier

Tier	Organochlorine Pest/PCBs in Sediment[3]	Total Organic Carbon	Organochlorine Pest/PCBs in Tissue	Percent Lipid	Organochlorine Pest/PCBs in Water
1	Yes[1]	Yes[1]	Yes[2]	No	No
2	Yes	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	Yes	Yes

Note:

1 Necessary if using sediment data for the Tier 1 assessment.

2 Necessary if using tissue for the Tier 1 assessment.

3.4.1.1 Tier 1 Screening Evaluation

Tier 1 is an optional screening assessment that utilizes conservative assumptions to evaluate potential chemical exposure to human consumers of sportfish. If the outcome of Tier 1 evaluation is below the threshold level, sediments are considered as not degraded and no more Tier evaluation (i.e., Tier 2 and Tier 3) is required. A Tier 1 assessment is comprised of two evaluation classes: sediment-based and tissue-based. The assessment may be performed using either sportfish tissue or sediment contaminant concentrations data and matching total organic carbon data, depending on data availability. Data for either type of assessment must be no older than 6 years. If both sediment and tissue contamination data are available, the Tier I assessment is performed using both data types.

The tissue-based or sediment-based chemical exposure evaluation is performed by comparing measured tissue or sediment concentration to screening thresholds. This comparison shall be based on tissue data from all the species identified in the CSM. Tissue concentration in sportfish species and sediment concentration can be calculated using a prescribed equation at Section IV.A.2.g of proposed Policy. Sediment screening thresholds are calculated for each contaminant evaluated at the site using the biota sediment accumulation factors (BSAFs) based on the contaminant, fish guild, and site total organic carbon. The exceedance of tissue screening thresholds or sediment screening thresholds indicates the potential for unacceptable chemical exposure and requires a Tier 2 evaluation.

Tier 1 assessment of subsistence fishers may be accomplished by applying thresholds based on OEHHA Advisory Tissue Levels based on 5-day consumption rate in lieu of those provided in **Exhibit 3-2**.

Exhibit 3-2. Tier 1 Tissue Screening Thresholds

Parameter	DDT (ng/g ww)	PCB (ng/g ww)	Chlordane (ng/g ww)	Dieldrin (ng/g ww)
Tier 1 Threshold[1]	>520	>21	>190	>15

Note:
[1] Advisory Tissue Level based on three servings per week (OEHHA 2008).

If either tissue or sediment is applied in Tier 1 and the result exceeds the threshold for any constituent, Tier 2 is required for those constituents. If both tissue and sediment are applied, the possible decision criteria and potential outcomes are decided as follows:

Exhibit 3-3. Decision Criteria for Tier 1

Decision Criteria	Decision
Both tissue and sediment result falls below the threshold	Not Impacted
Tissue results fall below the threshold and sediment equals or exceeds the threshold	Not Impacted
Sediment results fall below the threshold and tissue equals or exceeds the threshold	Tier 2 assessment is required
Both sediment and tissue results equal or exceed the threshold	Tier 2 assessment is required

3.4.1.2 Tier 2 Assessment

Tier 2 assessment is focused on determining if the site-specific sediments meet SQOs to protect human consumers of resident sportfish from bioaccumulative contaminants in sediment. Both tissue concentration data and sediment data are required for Tier 2 analysis to assess chemical exposure. The results of Tier 2 evaluation are compared with the thresholds established by OEHHA.

Tier 2 utilizes a mechanical food web model to combine multiple site-specific fixed and optional variables with a varying sampling frequency. The fixed or constrained model parameters include proportion of sportfish species consumed, sportfish characteristics, contaminant characteristics and the bioaccumulation model constants. Chemical exposure is assessed by comparing average tissue contaminant concentration to thresholds that are based on different meal consumption frequencies over the course of a week. Tissue contaminant thresholds and potential chemical exposure categories are described in **Exhibit 3-4** and **Exhibit 3-5** as follows:

Exhibit 3-4. Tier 2 Tissue Contaminant Thresholds

Parameter	Tier 2 Contaminant Threshold			
	FCG[1] (ng/g ww)	ATL3[2] (ng/g ww)	ATL2[3] (ng/g ww)	ATL1[4] (ng/g ww)
Chlordane	5.6	190	280	560
DDTs	21	520	1,000	2100
Dieldrin	0.46	15	23	46
PCBs	3.6	21	42	120

Note:
1 FCG - Fish Contaminant Goal based on 1 meal per week
2 ATL3 - Tissue Advisory Level based on consumption of 3 meals per week
3 ATL2 - Tissue Advisory Level based on 2 meals per week
4 ATL1 - Tissue Advisory Level based on 1 meal per week

Exhibit 3-5. Tier 2 Chemical Exposure Categories

Tissue Contaminant Concentration	Threshold	Outcome
Average	< FCG	1. Very Low
Average	< ATL3	2. Low
Average	< ATL2	3. Moderate
Average	< ATL1	4. High
Average	> ATL1	5. Very High

Tissue contaminant concentration in species related to site sediments can be calculated using the measured sum contaminant concentration (sum PCBs, sum DDTs, sum chlordanes, or dieldrin) in sediment from the site, biota-sediment accumulation factor for species ($BSAF_i$), site area (km^2) or length across the site (km), and sportfish home range (km^2) or linear movement distance (km) for species (HR_i). BSAF is the ratio of the wet weight contaminant concentration in biota to dry weight contaminant concentration in sediment. Arnot and Gobas food web model (2004), modified by Gobas and Arnot (2010), is used to calculate the BSAF for each of the fish guild species. Using estimated and observed tissue contaminant concentration, the site linkage factor can be determined.

After calculating the site linkage factor, a Monte Carlo simulation is used to estimate the sediment linkage factor distribution to capture the variability and uncertainty in sediment concentration data, as well as the BSAF calculation. The Monte Carlo simulation is conducted using 10,000 random subsamples of the concentration and BSAF distributions on a log normal basis. Site sediment linkage is calculated for each set of subsamples. The results of the simulations are compiled to calculate a cumulative probability distribution of sediment linkage. The portion of the distribution less than the sediment linkage threshold is used to determine the site linkage category. **Exhibit 3-7** demonstrates the site linkage categories for Tier 2 evaluation.

Exhibit 3-7. Site Sediment Linkage Categories for Tier 2 Evaluation

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

The overall site assessment category is determined using the decision matrix presented in **Exhibit 3-8**. Site sediments categorized as Unimpacted or Likely Unimpacted meet the SQO protecting human consumers for the specific contaminant evaluated. Site sediments categorized as Possibly Impacted, Likely Impacted, or Clearly Impacted do not meet the SQO. This evaluation is performed separately for each chemical contaminant group.

Exhibit 3-8. 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
	Moderate	Unimpacted	Likely Unimpacted	Likely Impacted	Likely Impacted	Clearly Impacted
	High	Unimpacted	Likely Unimpacted	Likely Impacted	Clearly Impacted	Clearly Impacted

3.4.1.3 Tier 3 Assessment

A Tier 3 assessment is conducted when Tier 1 and Tier 2 assessment is incapable of providing a complete evaluation of a site. Tier 3 is performed to improve accuracy and precision of the Tier 2 assessment, evaluate different risk-related assumptions, incorporate spatial and temporal factors into the assessment, and evaluate specific subareas, contaminant gradients or potential hotspots. Tier 3 utilizes the same framework, indicators, and decision criteria described in Tier 2, but is performed only after the Tier 2 assessment is completed and with concurrence from the Regional Water Board.

Presence of variability in factor or process, or changes in exposure factors that affect contamination bioaccumulation in sediment may trigger Tier 3 assessment for a site. These factors include but are not limited to:

- differences in the relationship between geochemical characteristics and contaminant bioavailability;
- differences in physiological processes affecting bioaccumulation model performance;
- measured sediment concentrations that 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; and
- use of selected alternate sportfish species.

Tier 3 assessment for subsistence consumers may be accomplished by adjusting the chemical exposure thresholds to provide an equivalent level of health protection as described in OEHHA 2008. If chemical exposure assessment requires evaluation of subsistence fishers, thresholds based on OEHHA Advisory Tissue Level for 4- or 5-day consumption rates shall be applied in lieu of those provided in Table 16, in consultation with OEHHA to ensure representative characterization of exposure. With approval of the Regional Board, a decision to conduct a Tier 3 evaluation may be made at any stage of the program. A change in any parameter or model from that used in Tier 2 must be justified based on site conditions, in comparison to Tier 2 assumptions and values, and approved by the Regional Water Board prior to performing the analysis.

3.4.2 Program Specific Implementation

3.4.2.1 Implementation of Sediment Quality Objectives

Implementation of Part 1 shall be conducted in accordance with the following provisions and must be consistent with the schematic process illustrated in **Exhibit G-1** and **G-2 (Appendix G)** of this document. Due to the difference in receptors, as well as pathways, sediments that meet one objective may not meet another objective. Therefore, each SQO is evaluated independently. The new policy proposes to determine compliance with the aquatic life objective based on the assessment of two or more stations within a site. However, compliance associated with the sportfish consumer objective is assessed on a site-by-site basis that encompasses multiple sediment and tissue samples from the site. As a result, a unique study design is required for the assessment of sediment quality relative to each objective; however, this does not imply that the same sediment chemistry samples and other data cannot be applied to both aquatic life and sportfish-based assessment frameworks.

3.4.2.2 Dredge Materials

There are no amendments associated with dredge materials implementation proposed in the SQO Plan.

3.4.2.3 NPDES Permit

3.4.2.3.1 Receiving Water and Effluent Limits for SQOs

The Water Board shall apply the objectives as receiving water limits if the discharge to bay or estuarine water poses a reasonable potential to cause or contribute to an exceedance. The proposed Plan is applicable for both toxic and bioaccumulative discharge.

3.4.2.3.2 Exceedance of Receiving Water Limits

An exceedance of receiving water limits is based on a few decisive criteria, which have been revised from the existing Policy. The proposed policy adds two new factors to determine exceedance of receiving water limits: Under the proposed plan a receiving water limit for the protection of aquatic life will be determined to be exceeded when:

- Any station within the site is assessed as Clearly Impacted; and
- The total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a permit cycle. Calculation of percent area shall be based on data from spatially representative samples selected using a randomized study design or equivalent spatial analysis;

These factors are in addition to the factors in the existing plan described below:

- Stressor identification study should be followed, if the discharge demonstrates a reasonable potential for SQO exceedance.
- If studies by the Permittee demonstrate that other sources may also be contributing to the degradation of sediment quality, the Regional Water Board shall, as appropriate, require the other sources to initiate studies to assess the extent to which these sources are a contributing factor.

The proposed plan adds new procedures to determine exceedance of the receiving water limit to protect human consumers. Under the proposed plan, an exceedance is demonstrated if:

- The site sediments are categorized as Possibly Impacted, Likely Impacted or Clearly Impacted over the duration of a permit cycle;
- It is demonstrated that the discharge is causing or contributing to the SQO exceedance.

Upon exceedance of a receiving water limit the Permittee must perform stressor identification studies.

3.4.2.3.3 Receiving Water Limits Monitoring Frequency

The monitoring frequency for receiving water limits remains unchanged from the existing Plan. All dischargers (i.e., major and minor), including Phase I and II stormwater dischargers and other regulated dischargers and waivers, will have similar sediment monitoring frequency as described in the existing Plan.

3.4.2.4 Sediment Monitoring and Assessment

All components of the sediment monitoring program in the existing Policy remain unchanged except the additional consideration for conceptual model design, change in sampling method, and regional monitoring frequency.

- **Method:** Under the proposed Plan, fish tissue samples will be collected along with sediment samples from each station (or site), and will be tested and assessed utilizing the existing methods and metrics.
- **Design:** Both in the existing and proposed SQO Plan, the sediment monitoring program will be operated utilizing a conceptual model that serves as the basis for assessing the appropriateness of a study design. Besides general consideration prescribed in the existing Policy, additional considerations in design are proposed to be added for the sediment monitoring program. These considerations include:
  - Site boundaries and site size;
  - Sportfish consumer population characteristics (e.g. consumption rate);
  - Sportfish species to be monitored;
  - Food web associated with sportfish species to be monitored; and
  - Site-specific modifications to the bioaccumulation model parameters (e.g. sportfish movement range or diet), as needed.

  A definition of the site boundaries and site size is needed to aid in data collection and data reduction, in addition to being a key input for the sediment linkage indicator. Selection of sportfish species of interest should be based on the fishing and consumption practices of local consumers, as well as species known to reside in the site and representing predominant dietary guilds.
- **Regional Monitoring Frequency:** Under the new Policy, regional sediment quality monitoring is proposed to be conducted at a minimum of once every five years. This is one of the major changes from the existing Policy that will incur a significant reduction in monitoring cost.

3.4.2.5 Evaluating Waters for Placement on the Section 303(d) List

In the proposed amendments, sediment toxicity listing criteria for the protection of benthic communities are prescribed based on the categorization of impact posed by site area. Water segments shall be placed on the section 303(d) list for exceedance of the narrative SQO for aquatic life protection only if:

- Any station within the site is assessed as Clearly Impacted; or
- The total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a listing cycle. Calculation of percent area shall be based on data from multiple spatially representative samples selected using a randomized study design or equivalent spatial analysis.

Data to be evaluated shall include all relevant data collected from monitoring programs conducted over the duration of the listing cycle (6 years).

Similarly, water segments shall be placed on the section 303(d) list for exceedance of the narrative SQO for human health protection of Part 1 if:

- The site sediments are categorized as Possibly Impacted, Likely Impacted or Clearly Impacted over the duration of the listing cycle (6 years);

Site sediment evaluation shall use the methods and meet the following requirements:

- Data used in the evaluation must be obtained from multiple spatially representative stations.
- Data used in the evaluation must be obtained from multiple surveys over a span of at least one year.

Water segments shall be removed from the section 303(d) list if the listing thresholds are not exceeded over the duration of the listing cycle and satisfy the requirements.

3.4.2.6 Stressor Identification

There is no amendment to the stressor identification guideline language in the proposed Plan.

3.4.2.7 Development of Site-Specific Sediment Management Guidelines

The new proposed SQO Policy includes management guidelines for human health which are based on site-specific bioaccumulation factors for sportfish and are derived by utilizing bioaccumulation modeling. The overall goal behind these management guidelines is to determine contaminant concentration in site sediment that will result in acceptable contaminant levels in sportfish tissue.

The approach involves developing the guidelines by calculating sediment concentration (Cs) corresponding to attainment of acceptable sportfish contaminant concentration based on the biota-sediment accumulation factor ($BSAF_{95}$), where $BSAF_{95}$ is the highest upper 95th percentile of BSAF derived from bioaccumulation model for species used in the assessment.

Calculation of sediment guidelines is based on the assumption that site sediment contamination is the primary determinant of tissue contamination. However, in situations where other contamination sources are important, such as water column contamination from offsite areas or watershed inputs, these approaches may not achieve the desired tissue contaminant levels. In such situations, these additional sources should be considered in deriving management guidelines. Regional background contamination should be taken into account when establishing management guidelines or actions. Regional background contamination is defined as the concentration of contaminant that is primarily attributable to diffuse sources, not attributable to a specific source or release. It is not feasible to establish management guidelines for a site that is below regional background contamination of surrounding water, as objectives cannot be met within a defined timeframe. Instead, the objectives should be regarded as management goals to inform watershed-based management Plans. The assessment categorical results of Unimpacted and Likely Unimpacted may be used as alternative sediment management guidelines in lieu of numeric targets.

4 Incremental Impact of the Plan

This section contains an evaluation of compliance with the SQOs based on available discharge data and the potential impacts to dischargers of sediment toxicity.

4.1 Incrementally Impaired Waters

There is not enough information available at this time to predict changes in impairment status that would result from proposed changes to the Plan. Therefore it is not feasible at this time to estimate the associated compliance costs.

4.2 List of Bays and Estuaries in California

The list of applicable enclosed bays and estuaries that will be covered under the proposed Policy has not changed due to proposed amendments. **Exhibits 4-1** and **4-2** list the enclosed bays and estuaries covered under both plans. Apart from this list, there are hundreds of additional small estuaries, draining coastal streams, and small rivers that are not identified; however, most of these are in undeveloped or sparsely developed areas.

Exhibit 4-1. List of Enclosed Bays in California Covered under Proposed Policy

Name of the Bay/Harbor	Size (Acres)
Regional Board 1	
Crescent City Harbor	374
Humboldt Bay	16,000
Bodega Harbor	822
Regional Board 2	
Tomales Bay	1240
Drakes Estero Bay	12,780
San Francisco Bay, Richardson Bay	2,439
Half Moon Bay	355
Regional Board 3	
Moss Landing Harbor	79
Monterey Harbor	76
Morro Bay	6,605
Santa Barbara Harbor	266
Regional Board 4	
Ventura Harbor	179
Channel Islands Harbor	166
Port Hueneme	65
Marina del Rey	931
King Harbor	105
Alamitos Bay	499
Los Angeles and Long Beach Harbors consolidated slip	36
Dominguez Channel Estuary	70,400
Los Angeles and Long Beach Harbors Cabrillo beach	156
Regional Board 8	
Anaheim Bay	248
Bolsa Bay	116

Name of the Bay/Harbor	Size (Acres)
Newport Bay	1,853
Regional Board 9	
Mission Bay	2,032
San Diego Bay, Shoreline, at Marriott Marina	32
San Diego Bay, Shoreline, Chula Vista Marina	49

Source: SWRCB (2016)

Exhibit 4-2. List of Enclosed Estuaries in California Covered under Proposed Policy

Name of the Bay/Harbor[1]	Size (Acres)
Regional Board 1	
Lake Earl and Lake Tolowa Lagoons	2,191
Stone Lagoons	896
Big Lagoons	1,470
Mad River Estuary	3,18,080
Regional Board 2	
Bolinas Lagoon	988
Carqinez Strait	1,415
Regional Board 3	
Elkhorn Slough Estuary	741
Regional Board 9	
Los Penasquitos Lagoon	37

Note:
1 There are more estuaries in the state of California. Due to lack of available data, those estuaries are not listed in this table.

4.3 Identifying Incremental Impact

There is a variety of pollution control, cleanup, and remediation activities currently in place to protect bays and estuaries from further impairment due to sediment toxicity. These activities are assumed to be continued in the absence of Plan. Therefore, this analysis is focused on those potential changes or costs that are likely to occur under the proposed Plan.

All Regional Water Boards currently follow SQOs defined and described in the Water Quality Control Plan for Enclosed Bays and Estuaries-Part 1 Sediment Quality. A water body could be listed as impaired for toxic substances for multiple reasons. Under the baseline (existing) Plan, Regional Water Boards would list sediment as exceeding the objectives only if multiple lines of evidence (with sufficient data) indicate impairment. In the proposed Plan, the MLOE approach is still implemented to assess impairment, but more diligently and accurately. The proposed amendments could potentially increase or decrease the number of water bodies that would be incorrectly listed as impaired for toxic substances, however it is infeasible to predict. Potential costs or cost savings associated with implementing the SQOs depends on the relative stringency of the objectives.

A few proposed amendments in monitoring requirements and the implementation procedure may lead to additional cost or cost reduction. The amendments are found in the following sections:

1. Regional Sediment Quality Monitoring Requirement Frequency
2. Listing/Delisting Policy of the 303(d) List
3. Implementation Method for Assessing Human Health Criteria

The lines of evidence, tools for assessing impairment, monitoring methods, inflation factors, stressor thresholds, and thus, potential costs vary for the aquatic life, human health, and wildlife SQOs for bays and estuaries. However, the possible outcomes based on a comparison of existing objectives and implementation of the Plan are similar. **Exhibit 4-3** indicates the possible outcomes.

Exhibit 4-3. Potential Incremental Impacts Associated with the Proposed Plan Amendments

Assessment of Attainment of Existing Beneficial Uses under Existing Plans	Assessment under Proposed SQO	
	Impairment not attributable to sediments	**Impairment attributable to sediments**
Impairment not attributable to sediments	• No change in sediment quality. • Potential incremental assessment costs	• Sediment quality improvement. • Potential incremental assessment and control costs.
Impairment attributable to sediments	• Sediment quality remains the same, which may be lower than under implementation of baseline narrative objective. • Potential incremental assessment costs, but will avoid unnecessary control costs.	• Change in sediment quality if better data lead to change in control strategies • Potential incremental assessment costs; potential incremental costs or cost-savings depending on differences in control strategies

Source: SWRCB (2011)

4.3.1 Sediment Monitoring and Assessment

Significant modification of sediment quality monitoring frequency and design considerations are included in the proposed Plan. A sediment monitoring program is designed based on a conceptual model which has certain requirements, such as model parameter or input. The conceptual model is used for identifying the physical and chemical factors that control the fate and transport of pollutants and receptors. The proposed Policy modifies the current model requirement and adds some new components to input parameters, including:

- Site boundaries and site size;
- Sportfish consumer population characteristics (e.g. consumption rate);
- Sportfish species to be monitored;
- Food web associated with sportfish species to be monitored; and
- Site-specific modifications to the bioaccumulation model parameters (e.g. sportfish movement range or diet) as needed.

Additional costs can be incurred from collection of information/data regarding site boundaries size, surveying the site and consumers, monitoring for sportfish species and food web associated with the sportfish, etc. Information on costs associated with collecting this additional information is not readily available, therefore, the cost associated with model evaluation is not included in this study.

The amendment of the sediment Policy proposes a change in the regional monitoring program's monitoring frequencies listed in **Exhibit 4-4**, below.

Exhibit 4-4. Sediment Monitoring Frequency in Current and Proposed Plan

Sediment Monitoring Frequency	
Existing Policy	**Proposed Policy**
Minimum once every three years	Minimum once every five year

The new sediment monitoring requirement under the regional sediment quality monitoring program will lead to a reduction of monitoring costs in applicable bays and estuaries. This is the only compliance cost that can be reasonably estimated at this time and is the focus of this cost analysis.

4.3.2 Evaluating Waters for Placement on the Section 303(d) List

Under the existing Plan, the decision of placing a water segment on the section 303(d) list was dependent on null hypothesis testing. However, in the proposed Policy, the decision criteria has been changed. Water segments will be declared as impaired for aquatic life criteria and human health criteria when any station within the site is assessed as Clearly Impacted, Possibly Impacted, or Likely Impacted (in case of human health criteria). The assessment will be conducted based on the total percentage area classified as Clearly, Likely or Possibly Impacted.

The entire assessment framework for identifying segments impaired by sediment toxicity involves multiple costs, including monitoring cost, evaluation cost, and compliance cost. However, adequate information and data is not available to estimate these costs.

4.3.3 Implementation Framework for Assessing Human Health

Under the existing Plan, the narrative human health objective in section IV.B. of Part 1 shall be implemented on a case-by-case basis, based upon a human health risk assessment where the Water Boards shall consider any applicable and relevant information, including OEHHA policies for fish consumption and risk assessment, DTSC Risk Assessment, and U.S. EPA Human Health Risk Assessment policies.

According to the proposed Plan, implementation procedures for assessing human health criteria are divided in to two classes of contaminants:

- Chlorinated pesticides and PCBs; and
- Contaminants other than chlorinated pesticides and PCBs.

Contaminants other than chlorinated pesticides and PCBs will follow the existing implementation Plan guideline for assessing human health criteria. However, for chlorinated pesticides and PCBs, the methods and procedures associated with the Tiered Assessment Framework shall be used to interpret the narrative objective to protect human consumers of locally caught sportfish. This framework utilizes available sportfish data and involves field sampling, laboratory testing, Tiered (1, 2, and 3) Assessment Framework, Tier screening evaluation, and site linkage analysis. Although the proposed Policy contains procedures to perform this regulatory assessment, we do not have sufficient information to predict whether this would result in more or less stringent implementation of objectives. Therefore, the cost associated with human health criteria compliance assessment cannot be estimated in this analysis.

4.3.4 Exceedance of Receiving Water Limit

The existing sediment quality Policy utilizes a categorized binomial distribution and minimum number of measured exceedances to demonstrate the potential of exceeding receiving water limits. In the proposed Plan, existing criteria used to identify exceedance are modified and proposed based on the total percent area categorized as different level of impact. In protection of human health, exceedance of receiving water limits is demonstrated based on the category of site sediments (Possibly Impacted, Likely Impacted, Clearly Impacted) over the duration of a permit cycle. Currently, not enough information is available to estimate changes in the frequency of exceedance of receiving water limits under proposed Policy. As follows, cost estimates associated with new procedures for determining exceedance of receiving water limits are not performed at this time.

4.3.5 TMDL Monitoring Cost

Under the proposed Plan, nothing shall limit a Water Board's authority to develop and implement waste load allocations for Total Maximum Daily Loads. However, it is recommended that the Water Boards develop TMDL allocations using the methodology described herein, wherever possible. Sediment monitoring requirements for the TMDL will be superseded by the monitoring requirement described in the proposed Policy. **Exhibit 4-5** presents the list of applicable TMDLs associated with Enclosed Bays and Estuaries of California:

Exhibit 4-5. Applicable TMDLs Associated with Sediment Toxicity Impairment in Enclosed Bays and Estuaries of California

Regional Board	Name of the TMDL
2	North San Francisco Bay Selenium
	SF Bay Mercury
	SF Bay PCB
	Tomales Bay Mercury TMDL
3	Diazinon and Additive Toxicity in Arroyo Paredon Watershed
4	Ballona Creek Estuary Toxics TMDL
	Marina Del Rey Toxics TMDL
	Calleguas creek watershed pesticides and PCB TMDL
	Santa Monica Bay DDTs and PCBs
	Machado lake pesticides and PCB Domoniquez channel

	Dominguez Channel and Greater Harbors Toxics TMDL
5	Sacramento – San Joaquin Delta Estuary TMDL for Methylmercury
	Cache creek mercury TMDL
8	Copper-metal TMDLs for Newport bay
	Organochlorine Compounds TMDLs for San Diego Creek, Upper and Lower Newport Bay
9	San Diego Bay - Shelter Island Yacht Basin Total Maximum Daily Load

Source: SWRCB (2016)

However, in some water bodies TMDLs would take precedence over the SQO amendments. This includes:

- San Francisco Bay Region - San Francisco Bay PCB TMDL
- Los Angeles Region - Ballona Creek and Estuary Toxics TMDL
- Los Angeles Region - Dominguez Channel and Greater Harbors Toxics TMDL
- Los Angeles Region - Marina Del Rey Toxics TMDL
- Santa Ana Region - Organochlorine Compounds TMDLs for San Diego Creek, Upper and Lower Newport Bay.

5 Compliance Costs

5.1 Compliance Assessment

Under the proposed Plan, changes in methods to assess objectives and carry out implementation procedures may result in either increased or decreased instances where further regulatory action (e.g., addition of receiving water limits, additions/deletions to the 303(d) list, etc.) is required. Until actual site sediment and tissue data are monitored and assessed according to the proposed Plan, it is impracticable to predict associated compliance costs. In addition, for individual dischargers, reasonable potential for exceeding objectives or receiving water limits cannot be determined in this analysis because there is insufficient data available to predict the incremental differences in SQO exceedances that would occur. As a result, costs associated with assessing objectives and implementation procedures have not been estimated. In order to provide an indication of potential compliance costs, this Section presents unit costs associated with potential control measures and activities that may be necessary for compliance with fish tissue and water quality objectives. For the cost estimation under proposed policy, all 2011 costs were converted to April-2017 dollars using the Engineering News Record (ENR) and Construction Cost Index (CCI).

The proposed Plan includes changes in monitoring requirements. As these tend to be static and predictable, they easily translate into cost estimates. Additionally, monitoring cost data from previous rulemaking and ongoing monitoring efforts is readily available. This section therefore focuses on the estimated costs associated with changes in monitoring requirements.

5.1.1 Monitoring and Assessment for Bays

Monitoring is an important part of the compliance assessment of baseline regulatory framework. Under baseline regulatory framework, extensive monitoring and assessment activities are in operation. In the absence of the proposed Plan, these activities will continue, and additional efforts will be undertaken (e.g., as Regional Boards assess compliance with existing objectives for sediment toxicity, and address sites currently impaired for sediment toxicity). However, a significant amount of data is needed to determine whether sediments are in compliance with existing narrative objectives for sediment toxicity related to aquatic life, human health, and wildlife. Similarly, in instances in which sediments exceed baseline objectives for sediment toxicity, assessment of the causes and sources will be needed in order to identify means of compliance with the objectives. These activities, which can include developing a work Plan/project management, collecting additional data, conducting Ecological Risk Assessments (ERAs) or toxicity identification evaluations (TIEs), surface water modeling, and other analysis, may be conducted as part of developing a TMDL (SCCWRP, 2005; Parsons, et al., 2002, as cited in WSPA, 2007).

The objective of ERA is to evaluate the potential for biological effects to occur as a result of exposure to one or more stressors in the environment. ERA is a flexible iterative process that can be used for any site segment or water body either prospectively to assess future conditions or retrospectively to assess risk associated with spills or releases, or existing degradation (U.S.

EPA, 1998). ERAs may be relatively simple or extremely complex depending upon the site conditions, number of pollutants, exposure pathways, and receptors. In all cases, a variety of expertise is needed to ensure that the results of the ERA are relevant for the species exposure pathways and pollutants associated with the site segment or water body.

SWRCB (2008) and SWRCB (2011) provided unit costs for monitoring to assess the SQOs to protect the benthic community, human health, wildlife, and finfish. The costs are presented as a unit cost for per sampling event which includes from survey, sample collection, laboratory testing, and any activities that are associated with preparing the samples for transport to the analysis laboratory. A unit sampling event cost for a bay or estuary was estimated by calculating the number of sampling station per sites and multiplying it with a unit sampling cost per station. Finally the annual monitoring cost under a baseline sediment Plan was obtained by multiplying the unit sampling event cost per bay with an annual regional monitoring frequency under baseline Plan. Similarly, the annual monitoring cost under proposed Plan can be calculated by multiplying the unit sampling event cost per bay with an annual regional monitoring frequency under baseline Plan. However, to calculate potential monitoring cost under proposed Plan, the 2011 unit costs are escalated to April-2017 dollar to reflect the current economy.

Monitoring efforts for ERAs to assess indirect effects to wildlife and finfish beyond the monitoring necessary to assess water quality criteria and the SQOs for direct effects could involve collecting finfish and documenting the presence of deformities, irregularities in size, or population effects, and collection and analysis of wildlife tissue or bird eggs. **Exhibit 5-1** provides unit costs for these types of analyses. Sample collection costs may vary based on factors such as water depth, abundance of fish species, sediment characteristics (may cause unsuccessful grabs that need to be repeated), and distance between stations. Although data for some parameters may not be needed at each sampling site, the total costs per sampling event could be in the range of $10,820 to $17,040.

Exhibit 5-1. Unit Cost for Sampling Event[1]

Parameter	Unit Cost	Number per Event	Total Cost
Sediment and fish collection (for sampling or observation)	$1,500 - $1,800 per site	1	$1,500 - $1,800
Benthic Survey	$800 - $1,200 per site	1	$800 - $1,200
Metals suite (tissue)	$175 - $225 per sample	6	$1,050 - $1,350
Metal Suite (Sediment and Water)	$175 - $225 per sample	1	$175 - $225
Mercury (tissue)	$30 - $80 per sample	6	$180 - $480
Total Mercury	$65 - $135 per sample	1	$65 - $135
PAH Suite	$400	1	$400
Chlorinate pesticides (tissue)	$200 - $575 per sample	6	$1,200 - $3,450
Chlorinate pesticides (Sediment and Water sample)	$200 - $575 per sample	1	$200 - $575
Sediment toxicity (acute lethal)	$800 per sample	1	$800
Sediment toxicity (sublethal)	$800-$1400 per sample	1	$800 - $1,400
PCBs suite (tissue)	$575 - $775 per sample	6	$3,450 - $4,650
PCB cogeners (not coplanar)	$200 - $575 per sample	1	$200 - $575
Total Cost per Sampling Event	**NA**	**NA**	**$10,820 - $17,040**

Note:

Source: SCCWRP (2011), SWRCB (2011a), Source: SWRCB (2011)

[1] Incremental to sampling requirements to assess attainment of SQOs for direct effects in bays and estuaries, SWRCB(2008)
[2] Includes boat, materials, and labor for observing fish communities or collecting fish for sampling.
[3] Three fish per species and two species per site are considered for this estimation.
[4] The unit cost are the sampling cost for 2011. These values are converted to April-2017 dollars for the calculation under proposed Plan.

To assess attainment of the proposed SQO, the number of stations from which data should be collected will vary based on water body-specific factors including:

- Area;
- Tidal flow and/or direction of predominant currents;
- Historic and or legacy conditions in the vicinity of the water body;
- Nearby land and marine uses or actions;
- Beneficial uses;
- Potential receptors of concern;
- Changes in grain size, salinity, water depth, and organic matter; and
- Other sources or discharges in the immediate vicinity of the water body.

Exhibit 5-2. Number of Sampling Locations Based on the Bay Size

Bay Size (acres)	Number of Sites
<500	5
500-5000	12
>5000	30

Exhibit 5-3 shows a range of potential costs to obtain data for the bays for which no or insufficient data are available for assessing SQO compliance. These estimates represent the product of the potential number of samples (**Exhibit 5-2**) and the cost per sample of $10,820 to $17,040 (**Exhibit 5-1**).

Exhibit 5-3. Potential Compliance (monitoring) Cost Reduction under the Proposed Plan

Regional Board	Water Body	Size (Acres)	Number of Samples	Total Monitoring Costs Reduction (Low)	Total Monitoring Costs Reduction (High)
1	Crescent City Harbor	374	5	$6,253	$9,848
	Humboldt Bay	16,000	30	$37,519	$59,088
	Bodega Harbor	822	12	$15,008	$23,635
2	Tomales Bay	9,600	30	$37,519	$59,088
	Drakes Estero Bay	12,780	30	$37,519	$59,088
	San Francisco Bay, Richardson Bay	2,439	12	$15,008	$23,635
	Half moon Bay	355	5	$6,253	$9,848
3	Moss Landing Harbor	79	5	$6,253	$9,848
	Monterey Harbor	76	5	$6,253	$9,848
	Morro Bay	6,605	30	$37,519	$59,088

Regional Board	Water Body	Size (Acres)	Number of Samples	Total Monitoring Costs Reduction (Low)	Total Monitoring Costs Reduction (High)
	Santa Barbara Harbor	266	5	$6,253	$9,848
4	Ventura Harbor	179	5	$6,253	$9,848
	Channel Islands Harbor	166	5	$6,253	$9,848
	Port Hueneme	65	5	$6,253	$9,848
	Marina del Rey	931	12	$15,008	$23,635
	King Harbor	105	5	$6,253	$9,848
	Alamitos Bay	499	5	$6,253	$9,848
	Los Angeles and Long Beach Harbors consolidated slip	36	5	$6,253	$9,848
	Los Angeles and Long Beach Harbors Cabrillo beach	156	5	$6,253	$9,848
8	Anaheim Bay	248	5	$6,253	$9,848
	Bolsa Bay	116	5	$6,253	$9,848
	Newport Bay	1853	12	$15,008	$23,635
	Mission Bay	2032	12	$15,008	$23,635
	San Diego Bay San Diego Bay, Shoreline, at Marriott Marina	32	5	$6,253	$9,848
	San Diego Bay, Shoreline, Chula Vista Marina	49	5	$6,253	$9,848
Total	--	--	--	**$325,168**	**$512,094**

Notes:

[1] Costs are represented as annual monitoring cost.

In addition to the need for monitoring to conduct MLOE for segments with no data or insufficient data, confirmatory monitoring would also be required in instances where existing data indicate Possibly Impacted sites with no Clearly or Likely Impacted results. Due to lack of data to predict the number of these instances, cost associated with confirmatory monitoring could not be estimated.

5.1.2 Costs Associated With TMDLs

The proposed changes to the Plan may result in new 303(d) listings and/or delisting's. In turn, costs may be incurred for new TMDL requirements or costs savings may result where a lowered impairment status obviates a TMDL requirement. There is insufficient data to predict the overall effect of proposed Plan changes on the number of 303(d) category 5 listings; however information on the cost of TMDLs is available from the 2011 rulemaking. The State Water Board (2001) estimates that development of complex TMDLs (including an Implementation Plan) may cost over $1 million. In addition, SWRCB (2003a) indicated that TMDL development and mercury reduction strategy costs for the San Francisco Bay could range from $10 million to $20 million. These estimates provide some indication of costs that can be associated with sequential approaches to managing designated use impairments. Thus, the estimates provide an approximation of the potential magnitude of both costs associated with new or elevated listings and cost savings where additional information to accurately identify the cause of the impairment leads to downgrading or delisting. Assuming monitoring cost is the only cost associated with the TMDL and there is no new TMDL development is required under proposed policy, there could be a potential savings of $0.13 million to $0.21 million in TMDL monitoring COST under the proposed policy. Thus, assuming that assessments of SQOs would be based on the number of sites per water body, the net decremental cost associated with compliance with the Plan could range from approximately $0.13 million to $0.21 million. For the cost estimation under proposed Plan, all 2011 costs were converted to April-2017 dollars using the Engineering News Record (ENR) and Construction Cost Index (CCI).

5.1.3 Monitoring and Assessment for Estuaries

The State Water Board is collecting estuary data throughout California as a part of the Phase II effort. The focus of Phase II of the National Estuary Program is to gather and summarize the existing knowledge concerning the state of the estuary as well as the physical, chemical, and biological factors controlling spatial and temporal changes. According to the program, data will be collected to develop appropriate tools for implementing SQOs for estuaries in California. These data can also be used to assess compliance with the final SQO. Thus, additional monitoring might be required for estuarine water bodies that are not already considered under this effort. However, costs of these monitoring efforts cannot be estimated until the data collection effort is complete. Otherwise, the sampling efforts already underway could be double counted.

5.1.4 Monitoring and Assessment for TMDLs

The proposed Policy would supersede implementation Plans of existing TMDLs except for the few water bodies where existing monitoring requirements associated with TMDLs will remain unchanged.

Those water bodies include:

- San Francisco Bay Region - San Francisco Bay PCB TMDL
- Los Angeles Region - Ballona Creek and Estuary Toxics TMDL
- Los Angeles Region - Dominguez Channel and Greater Harbors Toxics
- Los Angeles Region - Marina Del Rey Toxics TMDL
- Santa Ana Region - Organochlorine Compounds TMDLs for San Diego Creek, Upper and Lower Newport Bay

Exhibit 5-4 shows the existing applicable TMDLs associated with enclosed bays and estuaries of California. The number of stations per TMDL sites varies, but for illustrative purposes and simplicity, the costs are presented on a per station basis.

Exhibit 5-4. Potential Monitoring Cost Reduction (low) in Existing Applicable TMDLs Associated with Enclosed Bays and Estuaries

Regional Board	Name of the TMDL	Annual existing monitoring cost (low)[1,2]	Monitoring cost under proposed Plan (low)	Change in cost
2	North San Francisco Bay Selenium	$11,762	$2,352	$9,410
	SF Bay Mercury	$11,762	$2,352	$9,410
	SF Bay PCB[3]	$11,762	$11,762	$0
	Tomales Bay Mercury TMDL	$2,352	$2,352	$0
3	Diazinon and Additive Toxicity in Arroyo Paredon Watershed	$11,762	$2,352	$9,410
4	Ballona Creek Estuary Toxics TMDL[3]	$23,524	$23,524	$0
	Marina Del Rey Toxics TMDL[3]	$23,524	$23,524	$0
	Calleguas creek watershed pesticides and PCB TMDL	$23,524	$2,352	$21,172
	Santa Monica Bay DDTs and PCBs	$2,352	$2,352	$0
	Machado lake pesticides and PCB Dominguez Channel	$3,529	$2,352	$1,176
	Dominguez Channel and Greater Harbors Toxics TMDL[3]	$2,352	$2,352	$0
5	Sacramento – San Joaquin Delta Estuary TMDL for Methylmercury	$47,048	$2,352	$44,696
	Cache creek mercury TMDL	$11,762	$2,352	$9,410
8	Copper-metal TMDLs for Newport bay	$23,524	$2,352	$21,172
	Organochlorine Compounds TMDLs for San Diego Creek, Upper and Lower Newport Bay[3]	$23,524	$23,524	$0
9	San Diego Bay - Shelter Island Yacht Basin Total Maximum Daily Load	$11,762	$2,352	$9,410
Total Cost	--	--	--	**$135,264**

Note:

1 Only low costs are presented in the table.

2 The number of stations per TMDL sites varies, but for illustrative purposes and simplicity, the costs are presented on a per station basis.

3 Total Maximum Daily Loads would take precedence over the SQO amendments in these waterbodies.

Assuming all existing applicable TMDLs will conduct monitoring under the monitoring requirements specified in proposed Policy amendment, there could be a potential cost savings ranging from approximately $135,000 to $213,000.

5.2 Potential Controls

The next step under the proposed Plan would be to manage impaired sediment appropriately, which includes establishing a regulatory framework to identify pollutants of concern, source identification, assessing level of impacts associated with impaired sediment, management actions, etc. Different factors can affect potential management and control cost, including other efforts and studies to assess impairment issues and number of potential stressors in the area. It is important to note that, if the Regional Water Board is already addressing the impairment issue under a different study or project, or as a result of other regulatory measures then incremental costs associated with pollution controls will be zero.

Remedial management actions are required to achieve compliance when a sediment sample or water segment is declared as impaired due to failure to meet SQO objectives. Although there are three different SQO objectives to meet (i.e., aquatic, human health and wildlife), baseline controls could be identical for each scenario. If there is already an established baseline control assigned to evaluate compliance for an objective, and controls identified as appropriate to meet the other objectives are identical to these, there will be no incremental costs with the Plan amendments.

Plan amendments may result in incremental pollution control cost associated with new instances of nonattainment of SQOs. An increase in potential control cost may also arise from the identification of additional chemical stressors that are not included in the CTR or Basin Plans. For example, in Ballona Creek, the Regional Water Board identified pyrethoid pesticides as the cause of sediment toxicity, and not metals and other toxic pollutants for which CTR criteria and sediment TMDL targets already existed (City of Los Angeles WPD, 2010). Since many practices that may be employed under existing TMDLs are applicable for controlling the mobilization of pollutants in general, pollutant specific costs are difficult to differentiate. Another example is from the TMDL for pesticides and PCBs in the Calleguas Creek Watershed. The TMDL indicates that the BMPs needed to achieve the nutrient and toxicity TMDLs for the watershed would likely reduce pesticides and PCBs to necessary levels as well (LARWQCB, 2005c).

In this particular analysis, the identification of the pollutants that cause toxicity to aquatic life and humans could not be performed due to the data uncertainty, which leads to an inability to develop discharge concentrations needed to achieve the objectives. Therefore, the required controls to achieve those concentrations are difficult to identify. The following sections discuss these issues with respect to the program areas of municipal and industrial wastewater, NPDES stormwater, Caltrans, industrial stormwater, marinas and boating activities, cleanup and remediation activities, wetlands, and dredging activities. **Appendix F** provides additional information on unit costs.

5.2.1 Municipal and Industrial Wastewater

Municipal and Industrial dischargers affected by Plan amendments would be regulated through the general statewide program implementation procedures (general permits) or individual NPDES permit program. For sediment objectives, the permit writer may assign an effluent limit only if conditions described in Section IV.4.c.i of the proposed Policy are met. In some cases, effluent limits necessary to achieve water column water quality objectives may also be necessary or may already be in place. A well planned and designed pollution control measure can address both types of limits if the focus is to identify the source and eliminate the pollutant from entering their treatment plant or industrial process. Alternatively, the Discharger may pursue regulatory relief (e.g., a variance). For the Discharger these approaches may be preferable to installing costly end-of-pipe treatment. Currently, it is challenging to assess whether the Plan amendments would result in additional controls beyond those necessary to meet effluent limits protective of the water column. Therefore, incremental cost associated with additional controls cannot be estimated at this time.

5.2.2 NPDES Stormwater

For stormwater sources, an incremental cost associated with new controls may or may not be required to achieve compliance with proposed Policy. As in the case for municipal and industrial wastewater, controls protective of water column objectives may also provide sufficient protection of sediment objectives. If Plan amendments do result in additional requirements to reduce pollutants in stormwater then additional control measures might include:

- Increased or additional non-structural BMPs – institutional, education, or pollution prevention practices designed to limit generation of runoff or reduce the pollutant load in runoff; and
- Structural controls – engineered and constructed systems designed to provide water quantity or quality control.

While there is insufficient information to predict how often additional controls would be required due to the Plan amendments, a brief discussion on different pollution control structures and their associated cost are discussed below.

5.2.2.1 Non-Structural BMPs

Non-structural BMPs can be very effective in controlling pollution generation at the source, which in turn can reduce or eliminate the need for costly end-of-pipe treatment or structural controls. They are designed to reduce the amount of stormwater runoff or pollutants that can be generated in a watershed. Usually most municipal stormwater monitoring programs implement non-structural BMPs to meet existing permit requirements. Additional compliance factors can necessitate modification or expansion of existing BMPs. For example, additional cost may come from expanding an existing outreach and education program to a larger or new target audience, refocusing source control efforts on pollutants and sources of concern (e.g., pesticide/herbicide use or integrated pest management program). Similarly, incremental costs may result from increasing program compliance efforts, and increasing frequency, duration, or efficiency of maintenance practices, such as street sweeping.

Costs are not easily quantified for the non-structural BMPs primarily because there are no design standards for these practices (SWRCB, 2006c). Also, many have been education-oriented with high up-front costs to develop outreach materials. Non-structural BMPs include public education and outreach, illicit discharge detection and elimination, construction site stormwater runoff control, post construction stormwater management in new development and redevelopment, and pollution prevention and good housekeeping for municipal operations, such as street sweeping. CSU Sacramento (2005), estimates that the aforementioned requirements, when implemented through a SWMP, cost $26 per household per year. The establishment of a public education program might seem expensive depending on the baseline program, the incremental activities, municipality size, and degree of coordination with other municipalities, but once a baseline program is established, expanding the program to other regions would not be as costly as starting a similar program from scratch. **Appendix F** provides additional examples of non-structural BMP cost estimates.

5.2.2.2 Structural BMPs

There are a variety of structural means to control the quantity and quality of stormwater runoff, including infiltration systems, detention systems, retention systems, constructed wetlands, filtration systems, and vegetated systems. There are also types of structural BMPs that rely upon natural systems, including vegetation and soils. The cost for any particular structure depends on the type of control, the quantity of water treated, and site-specific factors such as land cost. Incremental costs or cost-savings associated with the Plan amendments cannot be estimated without information on differences, if any, in structural control strategies between baseline and Plan conditions. The focus of structural BMPs is not meant to replace the use of non-structural BMPs, but rather to work in tandem with these Planning and design-based approaches to minimize unavoidable impacts. Appendix F provides examples of cost estimates for individual structures.

5.2.2.3 MS4s

Under the Policy, the State Water Board and Regional Water Boards must include permit provisions requiring Phase I and Phase II MS4s to implement monitoring requirements for dischargers to waters subject to the proposed Policy. In addition, MS4s would be required to implement pollution prevention measures.

If the Phase I and Phase II MS4s were required to augment their existing pollution prevention programs we would expect them to incur significant costs. However, this likely represents a substantial overestimate since the actual number of Phase II MS4s with existing sediment toxicity control programs are unknown. In addition, there may already be controls required but not fully implemented under an existing NPDES MS4 permit, which would also reduce sediment toxicity. This could negate the need for enhanced controls under the proposed Policy. The monitoring requirements for MS4 permits under the proposed Plan remain unchanged from the 2011 SQOs Plan that states:

"Phase I Stormwater Discharges and Major Discharges—Sediment Monitoring shall not be required less frequently than twice per permit cycle. For Stations that are consistently classified as Unimpacted or Likely Unimpacted the frequency may be reduced to once per permit cycle. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase I Stormwater Permitees [sic].

Phase II Stormwater and Minor Discharges—Sediment Monitoring shall not be required more often than twice per permit cycle or less than once per permit cycle. For stations that are consistently classified as Unimpacted or Likely Unimpacted, the number of stations monitored may be reduced at the discretion of the Water Board. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase II Stormwater Permitees [sic]."

As shown in **Exhibit 5-5**, there are already six large MS4s with requirements to implement sediment source control programs. Thus, municipalities in the remaining large MS4 permits (all of which discharge at least in part to inland surface waters, enclosed bays, and estuaries) may incur incremental costs associated with implementing a sediment source control program under the proposed Policy.

Exhibit 5-5. Permit Requirements and SWMP Activities Specific to Sediment for Large MS4s in California

MS4 Name (NPDES No.)	Affected Water Bodies	Permit Requirements and SWMP Activities
Region 2 – Municipal Regional Stormwater Permit (CAS612008)	San Francisco Bay; Suisun Bay and Suisun Marsh	• Monitor Toxicity in bedded sediment (fine grained) a total of one sample per year during April-June coordinated with surface water ambient monitoring program (SWAMP). • Develop and implement programs to prevent pollution of the Estuary by other harmful pollutants like sediments, and nutrients • The Permittees shall implement and require contractors to implement BMPs for erosion and sediment control during and after construction for maintenance activities on rural roads, particularly in or adjacent to stream channels or wetlands. • Develop a strong estimate of the amount of sediment entering the Bay from local tributaries and urban drainages. By July 1, 2011, Permittees shall develop a design for a robust sediment delivery estimate/sediment budget in local tributaries and urban drainages. • Evaluate the effectiveness of the control measures implemented, evaluate attainment of pesticide concentration and toxicity targets for water and sediment from monitoring data and identify improvements to existing control measures and/or additional control measures, if needed, to attain targets with an implementation time schedule. • The Permittees shall implement appropriate BMPs for erosion and sediment controls for all
Region 4 – Ventura County (CAS004002)	Ventura River, Santa Clara River, Calleguas Creek, Malibu Creek	• Meet interim sediment concentration (WLAs) ranging from 1.1 ng/g to 25,700 ng/g depending on constituent, location and flow. • Conduct a source control study, develop, and submit an Urban Water

Exhibit 5-5. Permit Requirements and SWMP Activities Specific to Sediment for Large MS4s in California

MS4 Name (NPDES No.)	Affected Water Bodies	Permit Requirements and SWMP Activities
Region 5 - Sacramento County (CAS082597)	Sacramento-San Joaquin Delta	• Require BMP to control sediment • Sediment toxicity is monitored regularly in coordination with SWAMP program
Region 5 – East Contra Costa (CAS083313)	Sacramento-San Joaquin Delta	• Implement pollution prevention measures and BMPs to minimize sediment discharges
Region 5 – City of Stockton and San Joaquin County (CAS083470)	Sacramento-San Joaquin Delta	• Develop and implement a sediment quality monitoring program that includes components of the 2009 SWAMP • Identification, development, implementation and assessment of BMPs to address controllable discharges of sediment-bound contaminants that may be linked to sediment toxicity to the MEP.
Region 5 - Port Stockton (CAS0084077)	Central Delta and San Joaquin River	• The Central Valley Regional Water Board is currently developing a Delta Regional Monitoring Program ("RMP") for the Sacramento-San Joaquin Delta, which will involve collection of data on pollutants and toxicity in sediment.
Region 8 – San Bernardino County (CAS618036)	Big Bear Lake	• Participate in the development and implementation of monitoring programs and control measures, including any BMPs that the City is currently implementing or proposing to implement.
Region 8 – Orange County (CAS618030)	Rhine Channel	• Participate in the development and implementation of monitoring programs and control measures, including any BMPs that the City is currently implementing or proposing to implement.

Notes:
BMP = best management practice
Hg = Inorganic mercury
MeHg = methylmercury
WLA = wasteload allocation
TMDL = total maximum daily load

5.2.3 Caltrans

Under the proposed Policy, all NPDES permits are subjected to implementation requirements. Therefore, Caltrans are expected to experience incremental impacts or incur incremental costs as a consequence of the proposed Plan.

5.2.4 Industrial Stormwater

Under the proposed Plan, industrial stormwater may experience incremental or decremental impacts in costs as a consequence of the proposed Plan, but it is infeasible to predict it due to data unavailability. For industrial storm water discharges with existing sediment monitoring requirements, the cost might decrease due to the change in required monitoring frequency. The proposed Plan may result in requirements for the Permittee to implement additional structural and non-structural controls, similar to those discussed in Section 5.2.2. In some instances, the Permittee may provide new or additional treatment technologies. Due to the site-specific nature of stormwater control and treatment, we are unable to develop specific cost estimates associated with the incremental control activities.

5.2.5 Marinas and Boating Activities

Marinas and boating activities are a significant source of toxic pollutants which can cause significant impairment in sediment. Control measures that address toxic pollutants from marinas and boating activities include:

- Use of biocide-free paint on boats or more frequent boat hull cleaning to prevent leaching of toxic paints;
- Performing above waterline boat maintenance activities in a lined channel to prevent debris from entering the water;
- Performing below waterline boat maintenance on land in area with runoff (and dust) controls; and
- Developing a collection system for toxic materials at harbors.

Although water quality controls for marinas are less common than controls for urban stormwater, information on TMDL and toxic hotspot cleanups indicates that they may be included in baseline strategies for impaired sites. However, there may also be incremental costs or cost savings at these sites as a result of the Plan amendments. Sites that are not exceeding current objectives, but would experience the proposed changes in human health objectives implementation methods could incur incremental control costs. Also, Incremental costs or cost savings will depend on the pollutants of concern, the types of activities undertaken, and, in some cases, the number of boats affected. **Appendix F** provides examples of the types of activities that may be included in incremental costs (or cost savings if baseline activities are not necessary).

5.2.6 Cleanup and Remediation Activities

Due to data unavailability, it is difficult to determine whether incremental cleanup and remediation activities will be required as a result of the Plan amendments. Additionally, according to the implementation plans of existing TMDLs, Regional Water Boards conduct remedial activities only for those pollutants that are historically present in the water body with an unknown and unidentified source. However, the possibility of implementing different cleanup and remedial activities depend on the feasibility of different strategies (e.g., capping, removal and disposal, removal and treatment and disposal), the proximity of source material (for capping) or to appropriate treatment and disposal facilities, whether disposal facilities exist or whether new facilities must be built, as well as other factors. Costs for any sediment remediation actions necessary as a result of the Plan could be similar to those estimated by the Regional Water Board for hot spot cleanup. **Appendix F** provides additional discussion regarding potential costs.

5.2.7 Wetlands

Wetlands may be used to control pollutants in wastewater and/or storm water. To achieve compliance with proposed SQOs, incremental improvements in wetland controls may or may not be necessary. Moreover, the location and extent of any controls needed and the types of controls are unknown at this time. Possible wetland control factors might include aeration, channelization, revegetation, sediment removal, levees, or a combination of these practices. Wetland protection measures might also include land use planning, land conservation, erosion and sediment control, stormwater treatment, watershed stewardship, etc.

One example of wetland control efforts underway is the Tulare Lake, drainage district, California. A flow-through experimental wetland system has been under investigation since 1996 to remove selenium (Se) from agricultural drainage water in the Tulare Lake Drainage District at Corcoran, California. In 1999, the wetland cells reduced Se from inflow water by 32 to 65% in concentration and 43 to 89% in mass. Additional controls mentioned above can be implemented to further reduce the concentration of selenium. Another example of wetland pollution control is Anderson Marsh wetland on Cache Creek. This wetland is located within a 1,000-acre park comprising oak woodlands and riparian areas. Various management practices have been implemented in this wetland to reduce the concentration of methylmercury, and other practices may reduce the downstream transport of methylmercury formed in the wetland. The extent of new wetland controls and costs that would stem from the proposed Plan amendments is currently unknown; however, the Central Valley Regional Water Board (2005b) provides capital cost estimates for controlling methylmercury export from Anderson March ranging from $200,000 to $1 million, and O&M costs ranging from $20,000 to $100,000 per year.

5.2.8 Dredging Activities

The existing and proposed Plan does not apply to dredge material suitability determinations. According to the existing and proposed Plan, the Water Boards shall not approve a dredging project that involves the dredging of sediment that exceeds the objectives in Part 1, unless the Water Boards determine that:

- The polluted sediment is removed in a manner that prevents or minimizes water quality degradation;
- The polluted sediment is not deposited in a location that may cause significant adverse effects to aquatic life, fish, shellfish, or wildlife or may harm the beneficial uses of the receiving waters, or does not create maximum benefit to the people of the State; and/or
- The activity will not cause significant adverse impacts upon a federal sanctuary, recreational area, or other waters of significant national importance.

Changes to SQO implementation procedures may affect Regional Water Board determinations of whether a sediment proposed for removal exceeds human health objectives. The impact on the number of permitting dredging project approvals or requirements associated with the dredging projects cannot be estimated at this time due to lack of data.

6 Statewide Costs

This section provides descriptions of the methods used to estimate incremental statewide costs associated with the proposed Policy options and results.

6.1 Sediment Quality and Costs in the Absence of Plan

The State's 2012 303(d) list currently has 127 segments of bays and estuaries impaired for toxic pollutants among which 88 segments are listed for sediment quality and 48 sites are known as toxic hot spots according to the State Water Board's BPTCP. There are an additional 8 bays that might be impaired based on the direct effect on aquatic life. These impaired segments need significant attention, and efforts should be made to control this impairment. Substantial resources are required to be spent over the next decades for additional monitoring, pollution control, pollution prevention, source identification, sediment cleanup and remediation activities. These resources include an estimated $87.6 million to $1.03 billion for cleanup and remediation of toxic hot spots that are of high priority (SWRCB, 2003b; SWRCB, 2011). These conditions require substantial resources to be spent over the next decades for monitoring, assessment, TMDL development, pollution controls, and sediment cleanup and remediation. These resources include an estimated $87.6 million to $1.03 billion for cleanup and remediation of toxic hot spots that are of high priority (SWRCB, 2003b; SWRCB, 2011).

In the absence of SQOs, all Regional Water Boards currently have narrative objectives for toxic substances, toxicity, bioaccumulation, pesticides, or a combination of these categories in their respective Basin Plan. Although these narrative objectives are subject to interpretation and are implemented according to each Regional Water Board’s Policy, sediments can be impaired for adverse physiological responses in animal and aquatic life, bioaccumulation in biota or fish resulting in adverse effects to aquatic life and wildlife, sediment toxicity, or high concentrations of toxic substances (especially pesticides) in sediments. However, it is not certain whether the developed or development of TMDLs would help to restore beneficial uses. Indeed, TMDLs are often phased such that evaluation of early actions can result in changes or redirection of future actions. Thus, cost might be reduced in the future due to the decreased frequency of the sediment quality monitoring program.

6.2 Sediment Quality and Costs under the Proposed Plan

As shown in the section 5.1.1, $0.32 million to $0.51 million in monitoring costs could be reduced due to the decreased monitoring frequency in the sediment quality monitoring program in California Bays and Estuaries. Although this cost only includes reduction associated with the decreased sediment quality monitoring, there might be an additional cost associated with ERA evaluation, TMDL development, implementation costs, and remedial actions.

These actions could also occur in the absence of the Plan based on existing monitoring and assessment practices. For example, Anchor Environmental (2006) performed an ERA for the Rhine Channel sediment remediation feasibility study. The Rhine Channel is a toxic hotspot under the Water Boards Bay Protection Program and on the 303(d) list for copper, pesticides, chlordane, DDT, PCBs, and sediment toxicity in lower Newport Bay. The ERA focused on risks associated with bioaccumulation and trophic transfer from sediment into fish and wildlife (including benthic and pelagic forage fish and higher trophic level species such as California halibut, harbor seal, and brown pelican) for copper, mercury, selenium, DDE, and PCBs. The purpose of the ERA was to assess and characterize existing risks to aquatic life and biota associated with contaminants in sediment. Anchor Environmental (2006) used the results to evaluate potential management actions. There are an unknown number of efforts such as this that already reflect requirements of the Proposed Plan. Thus, incremental costs associated with the proposed Plan amendments are highly uncertain.

The annual reduction in monitoring costs under the proposed Plan is approximately $0.32 million to $0.51 million per year for all the dischargers in applicable bays and estuaries. These costs are included in the costs summarized for the Policy in **Exhibit 6-1**. Reasonable potential for exceeding SQOs based on the modified implementation procedure cannot be assessed due to unavailable data. Therefore, cost associated with additional monitoring resulting from exceedances, associated control cost, and pollution prevention cost cannot be estimated. Additionally, costs to stormwater dischargers, dischargers of abandoned mines, dredging, wetlands, and other nonpoint sources cannot be estimated at this time due to data limitations. These costs would be in addition to the costs summarized for the Policy in **Exhibit 6-1**. **Exhibit 6-1** shows the detailed estimated cost for each discharger needing reductions under the proposed Plan.

Exhibit 6-1. Estimated Total Annual Decremental Compliance (monitoring) Cost under Proposed Policy for California Bays

Monitoring cost	Criteria Policy		Cost reduction (%)
	Baseline	Proposed	
Low	$936,795.60	$611,627	34%
High	$1,475,323.20	$963,228	34%
1. All costs presented in April-2017$ and annualized based on a 5% interest rate and 20 year expected project life.			

Notes:
[1] All costs presented in April-2017$ and annualized based on a 5% interest rate and 20 year expected project life.

Similarly, the annual reduction in monitoring costs under the proposed Plan is approximately $0.13 million to $0.21 million per year for all TMDLs applicable to proposed SQO amendments. These costs are summarized for the Policy in **Exhibit 6-2**.

Exhibit 6-2. Estimated Total Annual Decremental Monitoring Cost under Proposed Plan for Applicable TMDLs (April-2017$ per year)[1]

Monitoring Cost	Criteria Policy		Cost Reduction (%)
	Baseline	Proposed	
Low	$245,827	$110,563	55%
High	$387,143	$174,122	55%

6.3 Limitations and Uncertainties

The lack of data precludes estimation of potential costs associated with compliance assessment in the proposed Plan amendments. Additionally, uncertainties in the baseline scenario also may affect the cost analysis of proposed amendments of the Plan. For example, existing TMDLs and hot spot cleanup and remediation actions are planned, but have yet to be fully implemented, and the sediment quality that would result without the Plan is unknown. Baseline control scenarios are relevant because many practices can reduce loadings for a wide variety of pollutants. For example, the TMDL for pesticides and PCBs in the Calleguas Creek watershed indicates that the BMPs needed to achieve the nutrient and toxicity TMDLs for the watershed would likely reduce pesticides and PCBs to necessary levels as well (LARWQCB, 2005c). Thus, controls to address existing impairments (for water or sediment) could alter the assessment of compliance with the objectives.

There are a number of uncertainties and limitations associated with the data and methods we used to estimate the potential incremental costs of the proposed Policy. **Exhibit 6-2** provides a summary of these uncertainties and the potential impact on the cost estimates.

Exhibit 6-3. Summary of Limitations and Uncertainties of the Analysis

Assumption/Uncertainty	Potential Impact on Costs	Explanation
Unable to assess reasonable potential of sediment toxicity present in an existing water body under the proposed Plan amendments.	?	Sediment toxicity data was not available or accessible for the period of concern. Therefore, it is difficult to decide whether the dischargers discharging to applicable bays and estuaries are able to comply with newly proposed Plan amendments of the SQO.
Unable to assign additional monitoring cost based on compliance with amendments.	-	At this time, insufficient information exists regarding which water bodies will be exceeding SQO under proposed Policy.
Assumed and calculated monitoring frequency annually or "per year" basis. Therefore, all the costs are represented as annual monitoring cost.	-	The monitoring frequency for regional sediment quality control program is described as "once every five year" or "once every three year" term. to make the cost estimation associated with monitoring convenient, all monitoring frequencies are calculated as annual instead of three or five year term.
Based urban stormwater, - and industrial stormwater unit costs on a range of potential BMPs.	?	The mix of stormwater controls that would be needed for compliance is site-specific. The incremental level of control needed also depends on existing permit requirements and level of existing BMP implementation.
Assumed a lack of existing stormwater controls despite a prevalence of existing pollution prevention programs at MS4s	+	Due to a lack of site-specific data, incremental estimates are likely a substantial overestimate since many of the costed controls are already being implemented.
Did not estimate the incremental cost associated with the shift in abandoned mine clean-ups.	?	Lack of sufficient data for the location of abandoned mines from which to identify those potentially affecting impaired waters.

Exhibit 6-3. Summary of Limitations and Uncertainties of the Analysis

Assumption/Uncertainty	Potential Impact on Costs	Explanation
Unable to estimate cost associated with dredging, wetlands, and other nonpoint sources.	?	Lack of sufficient data on the number of sites where requirements might increase costs.

Notes:

Key:

"+" = potential costs likely overestimated

"-" = potential costs likely underestimated

"?" = impact on cost unknown

7 References

Alameda. 2003. Alameda Countywide Clean Water Program: Stormwater Quality Management Plan July 2001 – June 2008.

Anchor Environmental. 2006. Feasibility Study and Alternatives Evaluation: Rhine Channel Sediment Remediation Newport Bay, California. January.

California Coastal Commission (CCC). 2004. California Clean Marina Toolkit. May.

California Environmental Protection Agency (CA EPA). 1996. Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities, Part A: Overview. Department of Toxic Substances Control, Human Ecological Risk Division.

California State University (CSU) Sacramento. 2005. NPDES Stormwater Cost Survey. Prepared for State Water Resources Control Board.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2007. Basin Plan Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Sacramento and Feather Rivers: Final Staff Report. May.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2006. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Sacramento-San Joaquin Delta: Final Staff Report. June.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2005a. Sacramento-San Joaquin Delta Estuary TMDL for Methyl and Total Mercury. Draft Staff Report, August. Sacramento, CA.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2005b. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Mercury in Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch: Staff Report. October. Rancho Cordova,CA.

Central Valley Regional Water Quality Control Board (CVRWQCB). 2005c. Amendments tothe Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River: Final Staff Report. October.

City of Los Angeles Watershed Protection Division (WPD). 2010. Ballona Creek Estuary Toxics Total Maximum Daily Load (TMDL) Implementation Plan (IP). Ballona Creek TMDL IP Stakeholder Workshop 3. September 21, 2010.

Contaminated Sediment Task Force (CSTF). 2005. Long Term Management Study.

Dana Point. 2003. City of Dana Point Standard Urban Stormwater Mitigation Plan (SUSMP), Also Known as The City’s Water Quality Management Plan (WQMP).

Department of Conservation (DOC). 2000. California's Abandoned Mines: A Report on the Magnitude and Scope of the Issue in the State. June.

Hunt, B. and B. Doll. 2007. Management Practices for Marina: A Guide for Operators. February.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2005a. Total Maximum Daily Loads for Toxic Pollutants in Ballona Creek Estuary. July 7, 2005.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2005b. Total Maximum Daily Load for Toxic Pollutants in Marina del Rey Harbor. Draft: August 3, 2005.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2005c. Calleguas Creek Watershed OC Pesticides and PCBs TMDL Technical Report. April.

Orange County. 2003. Orange County Stormwater Program 2003 Drainage Area Management Plan (DAMP).

Parsons et al. 2002. Assessment of sediment toxicity and quality in Patrick Bayou, Segment 1006, Harri County, Texas. Prepared for Patrick Bayou TMDL Lead Organization, For Submission to Texas Natural Resource Conservation Commission.

Sabina, L.D., J.H. Limb, K.D. Stolzenbachb, K.C. Schiffa. 2005. Contribution of Trace Metals from Atmospheric Deposition to Stormwater Runoff in a Small Impervious Urban Catchment. Water Research. July.

San Diego Regional Water Quality Control Board (SDRWQCB). 2007. Fact Sheet/Technical Report for Tentative Order No. R9-2007-0002 NPDES No. CAS0108740 Waste Discharge Requirements for of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of Orange, the Incorporated Cities of Orange County, and the Orange County Flood Control District within the San Diego Region, July 6, 2007.

San Diego Regional Water Quality Control Board (SDRWQCB). 2005. Total Maximum Daily Load for Dissolved Copper in Shelter Island Yacht Basin, San Diego Bay. February.

San Francisco Bay Regional Water Quality Control Board (SFRWQCB). 2010. Order No. R2-2010-0060 NPDES No. CA0037702 Water Quality Control Plan San Francisco Bay Region.

San Francisco Bay Regional Water Quality Control Board (SFRWQCB). 2008. Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment. February 13.

San Francisco Bay Regional Water Quality Control Board (SFRWQCB). 2007. Waste Discharge

Requirements for Municipal and Industrial Wastewater Discharges of Mercury to San Francisco Bay.

San Francisco Bay Regional Water Quality Control Board (SFRWQCB). 2006. Mercury in San Francisco Bay Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL) and Proposed Mercury Water Quality Objectives. August 1.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 1999. Reissuing Waste Discharge Requirements for Order No. 99-058 NPDES Permit No. CA0029912.

San Francisco Estuary Institute. 2009. Regional Monitoring Program 2010 Detailed WorkPlan FINAL December 22.

Southern California Coastal Water Research Project (SCCWRP). 2011. Personal communication with Steve Bay, Principal Scientist. January.

Southern California Coastal Water Research Project (SCCWRP). 2007. Personal communication with Steve Bay, Principal Scientist. June.

Southern California Coastal Water Research Project (SCCWRP). 2005. Southern California Bight 2003 Regional Monitoring Program: I. Sediment Toxicity. May.

State Water Resources Control Board (SWRCB). 2011a. Personal communication with Chris Beegan, Engineering Geologist. January.

State Water Resources Control Board (SWRCB). 2011b. California Integrated Water Quality System Project (CIWQS): Regulated Facilities Report. Generated January 17, 2011.

State Water Resources Control Board (SWRCB). 2010. 2010 Clean Water Act Section 303(d) List of Water Quality Limited Segments.

State Water Resources Control Board. 2008. Final Staff Report – Water Quality Control Plan for Enclosed Bays and Estuaries Part 1 Sediment Quality, September 2008.

State Water Resources Control Board (SWRCB). 2006a. CEQA Scoping Meeting Informational Document: Development of Sediment Quality Objectives for Enclosed Bays and Estuaries. August.

State Water Resources Control Board (SWRCB). 2006b. California Nonpoint Source Encyclopedia. May.

State Water Resources Control Board (SWRCB). 2006c. Staff Report: Revision of the Clean Water Act Section 303(d) List of Water Quality Limited Segments. Volumes I, II, and III.

State Water Resources Control Board (SWRCB). 2006d. Informational Document: Public Scoping Meeting for Proposed Methylmercury Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries in California. December.

State Water Resources Control Board (SWRCB). 2004a. Nonpoint Source Biennial Progress Report: June 2001 through June 2003. May.

State Water Resources Control Board (SWRCB). 2004b. Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program. May, 20.

State Water Resources Control Board (SWRCB). 2004c. Stormwater Public Education Program Resident Population Telephone Survey - 2004 Evaluation and Next Steps.

State Water Resources Control Board (SWRCB). 2003a. Nonpoint Source Program Five-Year

Implementation Plan, July 2003 through June 2008. December.

State Water Resources Control Board (SWRCB). 2003b. Consolidated Toxic Hot Spots Cleanup Plan: Volumes I and II. August.

State Water Resources Control Board (SWRCB). 2001. Total Maximum Daily Loads (TMDL), Questions & Answers. Online at http://www.waterboards.ca.gov/tmdl/docs/tmdl_factsheet.pdf.

State Water Resources Control Board (SWRCB). 2000. Nonpoint Source Program Strategy and Implementation Plan, 1998-2013. January.

United States Environmental Protection Agency (U.S. EPA). 2001. Water Quality Criterion for the Protection of Human Health: Methylmercury. Office of Science and Technology, Office of Water. EPA- 823-R-01-001.

United States Environmental Protection Agency (U.S. EPA). 1998. Guidelines for Ecological Risk Assessment. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC, EPA/630/R095/002F.

Ventura County. 2001. Ventura Countywide Stormwater Quality Management Program Stormwater Quality Management Plan.

Weisberg, S. and S. Bay. 2007. The Development of a Multiple Line of Evidence Framework for the Integration of Sediment Quality Data

Appendix A. Current Narrative Objectives Applicable to Sediment Quality

This Appendix lists the current narrative Regional Water Board Basin Plan objectives that relate to sediment quality.

North Coast Regional Water Board (Region 1)

- Toxicity – All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, Plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the Regional Water Board.
- Pesticides – No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no bioaccumulation of pesticide concentrations found in bottom sediments or aquatic life.

San Francisco Bay Regional Water Board (Region 2)

- Bioaccumulation – Many pollutants can accumulate on particles, in sediment, or bioaccumulate in fish and other aquatic organisms. Controllable water quality factors shall not cause a detrimental increase in concentrations of toxic substances found in bottom sediments or aquatic life. Effects on aquatic organisms, wildlife, and human health will be considered.
- Toxicity – All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms. Detrimental responses include, but are not limited to, decreased growth rate and decreased reproductive success of resident or indicator species. There shall be no acute toxicity in ambient waters. There shall be no chronic toxicity in ambient waters.

The health and life history characteristics of aquatic organisms in waters affected by controllable water quality factors shall not differ significantly from those for the same waters in areas unaffected by controllable water quality factors.

Central Coast Regional Water Board (Region 3)

- Toxicity – All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, Plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, toxicity bioassays of appropriate duration, or other appropriate methods as specified by the Regional Water Board.

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

Los Angeles Regional Water Board (Region 4)

- Pesticides – No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.
- Bioaccumulation – Toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels which are harmful to aquatic life or human health. Toxicity – All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, Plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the Regional Water Board.

Central Valley Regional Water Board (Region 5)

- No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses; discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses; total identifiable persistent chlorinated hydrocarbon pesticides shall not be present in the water column at concentrations detectable within the accuracy of analytical methods approved by EPA or the Executive Officer; and pesticide concentrations shall not exceed the lowest levels technically and economically achievable.
- All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, Plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests of appropriate duration or other methods as specified by the Regional Water Board.

Santa Ana Regional Water Board (Region 8)

- Toxic Substances – Toxic substances shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health. The concentrations of toxic substances in the water column, sediments or biota shall not adversely affect beneficial uses.

San Diego Regional Water Board (Region 9)

- Pesticides – No individual pesticide or combination of pesticides shall be present in the water column, sediments or biota at concentrations that adversely affect beneficial uses. Pesticides shall not be present at levels which will bioaccumulate in aquatic organisms to levels which are harmful to human health, wildlife, or aquatic organisms.
- Toxicity – All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, Plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the Regional Water Board.

Appendix B. Current Water Quality Objectives

This Appendix lists the current water quality objectives for toxic pollutants under the California Toxics Rule (CTR).

Exhibit B-1. CTR Priority Toxic Pollutant Criteria (concentrations in µg/L)

Pollutant	Freshwater		Saltwater		Human Health for consumption of:	
	Acute	Chronic	Acute	Chronic	Water & Organisms	Organisms Only
Antimony					14	4300
Arsenic	340	150	69	36		
Beryllium						
Cadmium	4.3	2.2	42	9.3		
Chromium (III)	550	180				
Chromium (VI)	16	11	1100	50		
Copper	13	139.0	4.8	3.1	1300	
Lead	65	652.5	210	8.1		
Mercury (303d listed)					0.05	0.051
Nickel	470	47052	74	8.2	610	4600
Selenium (303d listed)		5.0	290	71		
Silver	3.4	3.4	1.9			
Thallium					1.7	6.3
Zinc	120	120	90	81		
Cyanide	22	5.2	1	1	700	220000
Asbestos					7,000,000	
2,3,7,8-TCDD (Dioxin) (303d listed)					0.000000013	0.000000014
Acrolein					320	780
Acrylonitrile					0.059	0.66
Benzene					1.2	71
Bromoform					4.3	360
Carbon Tetrachloride					0.25	4.4
Chlorobenzene					680	21000
Chlorodibromomethane					0.401	34

Pollutant	Freshwater		Saltwater		Human Health for consumption of:	
	Acute	Chronic	Acute	Chronic	Water & Organisms	Organisms Only
Chloroethane						
2-Chloroethylvinyl Ether						
Chloroform						
Dichlorobromomethane					0.56	46
1,1-Dichloroethane						
1,2-Dichloroethane					0.38	99
1,1-Dichloroethylene					0.057	3.2
1,2-Dichloropropane					0.52	39
1,3-Dichloropropylene					10	1700
Ethylbenzene					3100	29000
Methyl Bromide					48	4000
Methyl Chloride						
Methylene Chloride (Dichloromethane)					4.7	1600
1,1,2,2-Tetrachloroethane					0.17	11
Tetrachloroethylene					0.8	8.85
Toluene					6800	200000
1,2-Trans-Dichloroethylene					700	140,000
1,1,1-Trichloroethane						
1,1,2-Trichloroethane					0.60	42
Trichloroethylene					2.7	81
Vinyl Chloride					2	525
Chlorophenol					120	400
2,4-Dichlorophenol					93	790
2,4-Dimethylphenol					540	2300
2-Methyl-4,6-Dinitrophenol					13.4	765
2,4-Dinitrophenol					70	14000
2-Nitrophenol						
4-Nitrophenol						
3-Methyl-4-Chlorophenol						
Pentachlorophenol					0.28	8.2
Phenol					21000	4600000
2,4,6-Trichlorophenol					2.1	6.5

Pollutant	Freshwater		Saltwater		Human Health for consumption of:	
	Acute	Chronic	Acute	Chronic	Water & Organisms	Organisms Only
Acenaphthene					1200	2700
Acenaphthylene						
Anthracene					9600	110000
Benzidine					0.00012	0.00054
Benzo(a)Anthracene					0.0044	0.049
Benzo(a)Pyrene					0.0044	0.049
Benzo(b)Fluoranthene					0.0044	0.049
Benzo(ghi)Perylene						
Benzo(k)Fluoranthene					0.0044	0.049
Bis(2-Chloroethoxy)Methane						
Bis(2-Chloroethyl)Ether					0.031	1.4
Bis(2-Chloroisopropyl)Ether					1400	170000
Bis(2-Ethylhexyl)Phthalate					1.8	5.9
4-Bromophenyl Phenyl Ether						
Butylbenzyl Phthalate					3000	5200
2-Chloronaphthalene					1700	4300
4-Chlorophenyl Phenyl Ether						
Chrysene					0.0044	0.049
Dibenzo(a,h)Anthracene					0.0044	0.049
1,2-Dichlorobenzene					2700	17000
1,3-Dichlorobenzene					400	2600
1,4-Dichlorobenzene					400	2600
3,3-Dichlorobenzidine					0.04	0.077
Diethyl Phthalate					23000	120000
Dimethyl Phthalate					313000	2900000
Di-n-Butyl Phthalate					2700	12000
2,4-Dinitrotoluene					0.11	9.1
2,6-Dinitrotoluene						
Di-n-Octyl Phthalate						
1,2-Diphenylhydrazine					0.040	0.54
Fluoranthene					300	370
Fluorene					1300	14000

Pollutant	Freshwater		Saltwater		Human Health for consumption of:	
	Acute	Chronic	Acute	Chronic	Water & Organisms	Organisms Only
Hexachlorobenzene					0.00075	0.00077
Hexachlorobutadiene					0.44	50
Hexachlorocyclopentadiene					240	17000
Hexachloroethane					1.9	8.9
Indeno(1,2,3-cd) Pyrene					0.0044	0.049
Isophorone					8.4	600
Naphthalene						
Nitrobenzene					17	1900
N-Nitrosodimethylamine					0.00069	8.1
N-Nitrosodi-n-Propylamine					0.005	1.4
N-Nitrosodiphenylamine					5.0	16
Phenanthrene						
Pyrene					960	11,000
1,2,4-Trichlorobenzene						
Aldrin	3		1.3		0.00013	0.00014
alpha-BHC					0.0039	0.013
beta-BHC					0.014	0.046
gamma-BHC (Lindane)	0.95		0.16		0.019	0.063
delta-BHC	2.4					
Chlordane (303d listed)	1.1	0.0043	0.09	0.004	0.00057	0.00059
4,4-DDT (303d listed)		0.001	0.13	0.001	0.00059	0.00059
4,4-DDE					0.00059	0.00059
4,4-DDD	0.24				0.00083	0.00084
Dieldrin (303d listed)	0.22	0.056	0.71	0.0019	0.00014	0.00014
alpha-Endosulfan	0.22	0.056	0.034	0.0087	110	240
beta-Endosulfan		0.056	0.034	0.0087	110	240
Endosulfan Sulfate					110	240
Endrin	0.086	0.036	0.037	0.0023	0.76	0.81
Endrin Aldehyde	0.52				0.76	0.81
Heptachlor	0.52	0.0038	0.053	0.0036	0.00021	0.00021
Heptachlor Epoxide		0.0038	0.053	0.0036	0.00010	0.00011
PCBs sum (303d listed)	0.73	0.014		0.03	0.00017	0.00017

Pollutant	Freshwater		Saltwater		Human Health for consumption of:	
	Acute	Chronic	Acute	Chronic	Water & Organisms	Organisms Only
Toxaphene		0.0002	0.21	0.0002	0.00073	0.00075

Appendix C. Nonpoint Source Plan Management Measures

This appendix provides a description of the management measures (MMs) applicable to sediment toxicity control from California's Nonpoint Source Management Program Plan. There are five MMs in the NPS Program Plan relevant to sediment toxicity control for agriculture (Exhibit C-1).

Exhibit C-1. Agricultural Management Measures

MM Code	Agriculture MM Title	Description
1A	Erosion and Sediment Control	Where erosion and sedimentation from agricultural lands affects coastal waters and/or water bodies listed as impaired by sediment, landowners must design and install or apply a combination of practices to reduce solids and associated pollutants in runoff during all but the larger storms. Alternatively, landowners may apply the erosion component of a Resource Management System as defined in the U.S. Department of Agriculture Natural Resources Conservation Service Field Office Technical Guide.
1D	Pesticide Management	Implementation will occur through cooperation with the Department of Pesticide Regulation by development and adoption of reduced risk management strategies (including reductions in pesticide use); evaluation of pest, crop, and field factors; use of Integrated Pest Management (IPM); consideration of environmental impacts in choice of pesticides; calibration of equipment; and use of anti-backflow devices. IPM strategies are key and include evaluating pest problems in relation to cropping history and previous pest control measures, and applying pesticides only when an economic benefit will be achieved. Pesticides should be selected based on their effectiveness to control target pests and environmental impacts such as their persistence, toxicity, and leaching

MM Code	Agriculture MM Title	Description
		potential.
1F	Irrigation Water Management	Irrigation water would be applied uniformly based on an accurate measurement of crop water needs and the volume of irrigation water applied, considering limitations raised by such issues as water rights, pollutant concentrations, water delivery restrictions, salt control, wetland, water supply, and frost/freeze temperature management. Additional precautions would apply when chemicals are applied through irrigation.
1G	Education/Outreach	Implement pollution prevention and education programs such as: activities that cause erosion and loss of sediment on agricultural land; activities that cause discharge from confined animal facilities (excluding Concentrated Animal Feeding Operations) to surface water; activities that cause excess delivery of nutrients and/or leaching of nutrients; activities that cause contamination of surface water and ground water from pesticides; grazing activities that cause physical disturbance to sensitive areas and the discharge of sediment, animal waste, nutrients, and chemicals to surface and ground waters; irrigation activities that cause nonpoint source pollution of surface waters.

Source: SWRCB (2000), SWRCB (2011)

There are 11 MMs that address the various forestry operations and practices (**Exhibit C-2**). The Forest Practice Rules (FPRs) also closely reflect these silvicultural MMs.

Exhibit C-2. Forestry Management Measures

MM Code	Forestry MM Title	Description
2A	Pre-Harvest Planning	Silvicultural activities should be planned to reduce potential delivery of pollutants to surface waters by addressing the timing, location, and design of harvesting and road construction; site preparation;

MM Code	Forestry MM Title	Description
		identification of sensitive or high-erosion risk areas; and the potential for cumulative water quality impacts.
2B	Streamside Management Areas (SMAs)	Protect against soil disturbance and reduce sediment and nutrient delivery to waters from upland activities. Intended to safeguard vegetated buffer areas along surface waters to protect the water quality of adjacent streams.
2C	Road Construction/Reconstruction	Road construction/reconstruction should be conducted so as to reduce sediment generation and delivery by following preharvest plan layouts and designs for road systems, incorporating adequate drainage structures, properly installing stream crossings, avoiding road construction in SMAs, removing debris from streams, and stabilizing areas of disturbed soil such as road fills.
2D	Road Management	Management of roads to prevent sedimentation, minimize erosion, maintain stability, and reduce the risk that drainage structures and stream crossings will fail or become less effective. Implementation includes inspections and maintenance actions to prevent erosion of road surfaces and to ensure the effectiveness of stream-crossing structures. Also address appropriate methods for closing roads that are no longer in use.
2E	Timber Harvesting	Addresses skid trail location and drainage, management of debris and petroleum, and proper harvesting in SMAs. Timber harvesting practices that protect water quality and soil productivity also have economic benefits by reducing the length of roads and skid trails, reducing equipment and road maintenance costs, and providing better road protection.
2F	Site Preparation and Forest Regeneration	Impacts of mechanical site preparation and regeneration operations— particularly in areas that

MM Code	Forestry MM Title	Description
		have steep slopes or highly erodible soils, or where the site is located in close proximity to a water body—can be reduced by confining runoff onsite. This measure addresses keeping slash material out of drainage ways, operating machinery on contours, timing of activities, and protecting ground cover in ephemeral drainage areas and SMAs. Careful regeneration of harvested forestlands is important in protecting water quality from disturbed soils.
2H	Revegetation of Disturbed Areas	Addresses the rapid revegetation of areas disturbed during timber harvesting and road construction—particularly areas within harvest units or road systems where mineral soil is exposed or agitated (e.g., road cuts, fill slopes, landing surfaces, cable corridors, or skid trails) with special priority for SMAs and steep slopes near drainage ways.
2I	Forest Chemical Management	Application of pesticides, fertilizers, and other chemicals used in forest management should not lead to surface water contamination. Pesticides must be properly mixed, transported, loaded, and applied, and their containers disposed of properly. Fertilizers must also be properly handled and applied since they also may be toxic depending on concentration and exposure. Includes applications by skilled workers according to label instructions, careful prescription of the type and amount of chemical to be applied, use of buffer areas for surface waters to prevent direct application or deposition, and spill contingency Planning.
2J	Wetlands Forest Management	Forested wetlands provide many beneficial water quality functions and provide habitat for aquatic life. Activities in wetland forests should be conducted to protect the aquatic functions of forested wetlands.

MM Code	Forestry MM Title	Description
2K	Postharvest Evaluation	Incorporate postharvest monitoring, including (a) implementation monitoring to determine whether the operation was conducted according to specifications, and (b) effectiveness monitoring after at least one winter period to determine whether the specified operation prevented or minimized discharges.
2L	Education/Outreach	Implement pollution prevention and education programs to reduce NPS pollutants generated by applicable silvicultural activities.

Source: SWRCB (2000), SWRCB (2011)

California's 15 urban MMs (**Exhibit C-3**) are organized to parallel the land use development process to address the prevention and treatment of pollution during all phases of urbanization; this strategy relies primarily on pollution prevention or source reduction practices.

Exhibit C-3. Urban Management Measures

MM Code	Urban MM Title	Description
3.1 A	Developing Areas – Watershed Protection	Encourage land use and development Planning on a watershed scale that takes into consideration sensitive areas that, by being protected, will maintain or improve water quality.
3.1B	Developing Areas – Site Development	Aims to protect areas that provide important water quality benefits and limit land disturbance.
3.1C	Developing Areas – New Development	Addresses increased pollutant loads associated with developed lands, and the hydrologic alterations resulting from development that affects runoff volume and timing. Developers can use innovative site planning techniques or incorporate runoff management practices to reduce the hydrologic impact of development on receiving waters.
3.2A	Construction Sites – Construction Site Erosion and Sediment Control	Aims to reduce erosion through implementation of erosion and sediment control practices.

MM Code	Urban MM Title	Description
3.2B	Construction Sites – Chemical Control	Implement a chemical control plan to: limit application, generation, and migration of toxic substances; ensure proper storage and disposal of toxic materials; and apply nutrients to establish and maintain vegetation.
3.3A	Existing Development	Includes the implementation of nonstructural controls to reduce pollutant loads and volume of stormwater runoff.
3.4A	On-site Disposal Systems (OSDS) – New OSDSs	Includes comprehensive Planning by the regulatory authority, including measures to protect sensitive areas, such as nutrient-limited waters and shellfish harvest areas. Measures might include prohibitions, setbacks, or requirements for the use of innovative treatment systems to effect greater treatment of sewage. Also includes performance-based requirements for the siting, design, and installation of systems, and inspection of newly installed systems.
3.4B	On-site Disposal Systems (OSDS) – Operating OSDSs	Addresses the programmatic aspects of OWTS management to ensure that systems that are installed as designed are inspected and maintained regularly to prevent failures. Public education about proper sewage treatment system use and maintenance is an important part of this measure, as is development and enforcement of policies to prevent or minimize the impacts of OWTS failures.
3.5A	Transportation Development Planning, Siting, and Developing Roads and Highways	Aims to protect areas that provide important water quality benefits and limit land disturbance.
3.5B	Transportation Development – Bridges	Aims to design bridges to minimize damage to riparian or wetland habitats and treating runoff from bridge decks before it is allowed to enter watercourses. Bridge maintenance activities should be conducted using containment practices

MM Code	Urban MM Title	Description
		to prevent pollutants from entering the water or riparian habitat below. Restoration of damaged riparian or instream habitats should be done after bridge construction, maintenance, and demolition.
3.5C	Transportation Development – Construction Projects	Implement a chemical control Plan to: limit application, generation, and migration of toxic substances; ensure proper storage and disposal of toxic materials; and apply nutrients to establish and maintain vegetation.
3.5D	Transportation Development – Chemical Control	Implement a chemical control Plan to: limit application, generation, and migration of toxic substances; ensure proper storage and disposal of toxic materials; and apply nutrients to establish and maintain vegetation.
3.5E	Transportation Development – Operation and Maintenance	Incorporate pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loadings to surface waters.
3.5F	Transportation Development – Road, Highway, and Bridge Runoff Systems	Acknowledges the fact that roads built in the past may not have the same level of runoff control and treatment that is expected today, and these older roads may be contributing to pollution problems in receiving waters. Municipalities responsible for road and bridge rights-of-way should undertake an assessment of the roads' and bridges' contribution to surface waters and identify opportunities for installing new treatment practices. Based on water quality priorities and the availability of staff and funding resources, a schedule should be devised to implement these practices.
3.6A	Education/Outreach – Pollution Prevention: General Sources	Used to reduce the amount of pollutants generated or allowed to be exposed to runoff.

Source: SWRCB (2000), SWRCB (2011)

There are 16 MMs to address marina and boating sources of nonpoint pollution (**Exhibit C-4**). Effective implementation of these MMs can ensure appropriate operation and maintenance practices and encourage the development and use of effective pollution control and education efforts. The MMs cover the following operations and facilities:

- Any facility that contains 10 or more slips, piers where 10 or more boats may tie up, or any facility where a boat for hire is docked
- Any residential or Planned community marina with 10 or more slips
- Any mooring field where 10 or more boats are moored
- Public or commercial boat ramps
- Boat maintenance or repair yards on or adjacent to the water (typically, boat yards are separate entities from marinas and are regulated under NPDES stormwater permits).

Exhibit C-4. Marinas and Boating Management Measures

MM Code	Marinas MM Title	Description
4.1A	Assessment, Siting and Design – Marina Flushing	Provides for maximum flushing and circulation of surface waters through marina siting and designs. These practices can reduce the potential for water stagnation, maintain biological productivity, and reduce the potential for toxic accumulation in bottom sediment.
4.1D	Assessment, Siting and Design – Shoreline Stabilization	Use of vegetative stabilization methods is preferred over the use of structural stabilization methods where shoreline erosion is a pollution problem.
4.1E	Assessment, Siting and Design – Stormwater Runoff	Involves implementing runoff control strategies to remove at least 80 percent of suspended solids from stormwater runoff coming from boat maintenance areas (some boat yards may conform to this provision through NPDES permits).
4.1F	Assessment, Siting and Design – Fueling Station Design	Requires that fueling stations be located and designed to contain accidental fuel spills in a limited area, and that fuel containment equipment and spill contingency Plans be provided to ensure quick spill response.

MM Code	Marinas MM Title	Description
4.1H	Assessment, Siting and Design – Waste Management Facilities	Requires that facilities be installed at new and expanding marinas where needed for the proper recycling or disposal of solid wastes (e.g., oil filters, lead acid batteries, used absorbent pads, spent zinc anodes, and fish waste as applicable) and liquid materials (e.g., fuel, oil, solvents, antifreeze, and paints).
4.2A	Operation and Maintenance – Solid Waste Control	Involves properly disposing of solid wastes produced by the operation, cleaning, maintenance, and repair of boats to limit entry of these wastes to surface waters.
4.2C	Operation and Maintenance – Liquid Material Control	Promotes sound fish waste management through a combination of fish cleaning restrictions, education, and proper disposal.
4.2D	Operation and Maintenance – Petroleum Control	Requires provision and maintenance of the appropriate storage, transfer, containment, and disposal facilities for liquid materials commonly used in boat maintenance, as well as encouraging the recycling of these materials.
4.2E	Operation and Maintenance – Boat Cleaning and Maintenance	Aimed at reducing the amount of fuel and oil that leaks from fuel tanks and tank air vents during the refueling and operation of boats.
4.2G	Operation and Maintenance – Boat Operation	Involves prevention of turbidity and physical destruction of shallow-water habitat resulting from boat wakes and prop wash.
4.3A	Education and Outreach – Public Education	Requires that public education, outreach, and training programs be instituted to prevent and control improper disposal of pollutants into State waters.

Source: SWRCB (2000), SWRCB (2011)

State Water Resources Control Board (SWRCB). 2000. Nonpoint Source Program Strategy and Implementation Plan, 1998-2013. January.

Appendix D. Municipal and Industrial Discharger Estimated Compliance Costs

Exhibit D-1: Estimated Compliance Cost (low) with Proposed Policy by Water Body (California Bays)

Regional Board	Name of Bay/Harbor	Size (Acres)	Number of Stations (active)	Regional Sediment Quality Monitoring Frequency (2011) (per year)[1]	Low monitoring cost under baseline	Low monitoring cost under proposed Plan	Change in cost (Reduction)
1	Crescent City Harbor	374	5	0.333	$18,015.30	$11,762.07	$6,253
	Humboldt Bay	16000	30	0.333	$108,091.80	$70,572.41	$37,519
	Bodega Harbor	822	12	0.333	$43,236.72	$28,228.96	$15,008
2	Tomales Bay	9,600	30	0.333	$108,091.80	$70,572.41	$37,519
	Drakes Estero Bay	12780	30	0.333	$108,091.80	$70,572.41	$37,519
	San Francisco Bay, Richardson Bay	2439	12	0.333	$43,236.72	$28,228.96	$15,008
	Half moon Bay	355	5	0.333	$18,015.30	$11,762.07	$6,253
3	Moss Landing Harbor	79	5	0.333	$18,015.30	$11,762.07	$6,253
	Monterey Harbor	76	5	0.333	$18,015.30	$11,762.07	$6,253
	Morro Bay	6605	30	0.333	$108,091.80	$70,572.41	$37,519
	Santa Barbara Harbor	266	5	0.333	$18,015.30	$11,762.07	$6,253
4	Ventura Harbor	179	5	0.333	$18,015.30	$11,762.07	$6,253
	Channel Islands Harbor	166	5	0.333	$18,015.30	$11,762.07	$6,253
	Port Hueneme	65	5	0.333	$18,015.30	$11,762.07	$6,253
	Marina del Rey	931	12	0.333	$43,236.72	$28,228.96	$15,008
	King Harbor	105	5	0.333	$18,015.30	$11,762.07	$6,253
	Alamitos Bay	499	5	0.333	$18,015.30	$11,762.07	$6,253
	Los Angeles and Long Beach Harbors consolidated slip	36	5	0.333	$18,015.30	$11,762.07	$6,253
	Los Angeles and Long Beach Harbors Cabrillo beach	156	5	0.333	$18,015.30	$11,762.07	$6,253
8	Anaheim Bay	248	5	0.333	$18,015.30	$11,762.07	$6,253
	Bolsa Bay	116	5	0.333	$18,015.30	$11,762.07	$6,253
	Newport Bay	1853	12	0.333	$43,236.72	$28,228.96	$15,008

9	Mission Bay	2032	12	0.333	$43,236.72	$28,228.96	$15,008
	San Diego Bay San Diego Bay, Shoreline, at Marriott Marina	32	5	0.333	$18,015.30	$11,762.07	$6,253
	San Diego Bay, Shoreline, Chula Vista Marina	49	5	0.333	$18,015.30	$11,762.07	$6,253
Total Monitoring Cost		--	--	--	**$936,795.60**	**$611,627.51**	**$325,168.09**

Notes:
1 Under 2011 SQO Policy, Regional sediment quality monitoring will occur once every three year.

Exhibit D-2: Estimated Compliance Cost (high) with Proposed Policy by Water Body (California Bays)

Regional Board	Name of Bay/Harbor	Size (Acres)	Number of Stations (active)	Regional Sediment Quality Monitoring Frequency (2011) (per year)[1]	High monitoring cost under baseline	High monitoring cost under proposed Plan	Change in cost (Reduction)
1	Crescent City Harbor	374	5	0.333	$28,371.60	$18,523.63	$9,848
	Humboldt Bay	16000	30	0.333	$170,229.60	$111,141.76	$59,088
	Bodega Harbor	822	12	0.333	$68,091.84	$44,456.70	$23,635
2	Tomales Bay	9,600	30	0.333	$170,229.60	$111,141.76	$59,088
	Drakes Estero Bay	12780	30	0.333	$170,229.60	$111,141.76	$59,088
	San Francisco Bay, Richardson Bay	2439	12	0.333	$68,091.84	$44,456.70	$23,635
	Half moon Bay	355	5	0.333	$28,371.60	$18,523.63	$9,848
3	Moss Landing Harbor	79	5	0.333	$28,371.60	$18,523.63	$9,848
	Monterey Harbor	76	5	0.333	$28,371.60	$18,523.63	$9,848
	Morro Bay	6605	30	0.333	$170,229.60	$111,141.76	$59,088
	Santa Barbara Harbor	266	5	0.333	$28,371.60	$18,523.63	$9,848
4	Ventura Harbor	179	5	0.333	$28,371.60	$18,523.63	$9,848
	Channel Islands Harbor	166	5	0.333	$28,371.60	$18,523.63	$9,848
	Port Hueneme	65	5	0.333	$28,371.60	$18,523.63	$9,848
	Marina del Rey	931	12	0.333	$68,091.84	$44,456.70	$23,635
	King Harbor	105	5	0.333	$28,371.60	$18,523.63	$9,848

	Alamitos Bay	499	5	0.333	$28,371.60	$18,523.63	$9,848
	Los Angeles and Long Beach Harbors consolidated slip	36	5	0.333	$28,371.60	$18,523.63	$9,848
	Los Angeles and Long Beach Harbors Cabrillo beach	156	5	0.333	$28,371.60	$18,523.63	$9,848
8	Anaheim Bay	248	5	0.333	$28,371.60	$18,523.63	$9,848
	Bolsa Bay	116	5	0.333	$28,371.60	$18,523.63	$9,848
	Newport Bay	1853	12	0.333	$68,091.84	$44,456.70	$23,635
9	Mission Bay	2032	12	0.333	$68,091.84	$44,456.70	$23,635
	San Diego Bay San Diego Bay, Shoreline, at Marriott Marina	32	5	0.333	$28,371.60	$18,523.63	$9,848
	San Diego Bay, Shoreline, Chula Vista Marina	49	5	0.333	$28,371.60	$18,523.63	$9,848
Total Monitoring Cost		--	--	--	**$1,475,323.20**	**$963,228.54**	**$512,094.66**

Notes:
[1] Under 2011 SQO Policy, Regional sediment quality monitoring will occur once every three year.

Exhibit D-3: Monitoring Cost Summary under Baseline and Proposed Policy

Monitoring Cost	Criteria	Baseline Policy	Proposed Policy	Cost Reduction	Cost Reduction (%)
	Low	$936,795.60	$611,627.51	**$325,168.09**	**34.71%**
	High	$1,475,323.20	$963,228.54	**$512,094.66**	**34.71%**

Exhibit D-4: TMDL Monitoring Cost Summary under Baseline and Proposed Policy

Name of the TMDL	Cost Reduction (Low)	Cost Reduction (High)
North San Francisco Bay Selenium	$9,410	$14,818.90
SF Bay Mercury	$9,410	$14,818.90
SF Bay PCB	No change in cost	No change in cost
Tomales Bay Mercury TMDL	No change in cost	No change in cost
Diazinon and Additive Toxicity in Arroyo Paredon Watershed	$9,410	$14,818.90
Ballona Creek Estuary Toxics TMDL	No change in cost	No change in cost
Marina Del Rey Toxics TMDL	No change in cost	No change in cost

Name of the TMDL	Cost Reduction (Low)	Cost Reduction (High)
Callegua creek watershed pesticides and PCB TMDL	$21,172	$33,342.53
Santa Monica Bay DDTs and PCBs	No change in cost	No change in cost
Machado lake pesticides and PCB Domoniquez channel	$1,176	$1,852.36
Dominguez Channel and Greater Harbors Toxics TMDL	No change in cost	No change in cost
Sacramento – San Joaquin Delta Estuary TMDL for Methylmercury	$44,696	$70,389.78
Cache creek mercury TMDL	$9,410	$14,818.90
Copper-metal TMDLs for Newport bay	$21,172	$33,342.53
Organochlorine Compounds TMDLs for San Diego Creek, Upper and Lower Newport Bay	No change in cost	No change in cost
San Diego Bay - Shelter Island Yacht Basin Total Maximum Daily Load	$9,410	$14,818.90
Total Cost Reduction under Proposed Policy	**$135,264**	**$213,022**

Notes:

1. Monitoring requirements under proposed policy will not supersede the existing monitoring plan of TMDLs.

Appendix E. Toxic Hot Spots for Bays and Estuaries

This appendix provides additional information on the enclosed bays listed as known toxic hot spots in the Consolidated Plan. **Exhibit E-1** summarizes the information in the Consolidation Plan for bays.

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
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	Aquatic life & human health concerns – Sediment chemistry, Toxicity, Bioaccumulation and exceedances of NAS and or 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 benthics community impacts	Chlordane, DDT, PAHs and Total Chemistry
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 H2S and NH3
High	San Francisco Bay Mission Creek	Aquatic life impacts	Silver, Chromium, Copper Mercury, Lead, Zinc, Chlordane, Chlorpyrifos, Dieldrin, Mirex, PCBs, PAHs, anthropogenically enriched H2S and NH3

Rank	Site Identification	Reason for Listing	
		Definition Trigger	Pollutants
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 impacts	Mercury, PCBs, Copper, Lead, Zinc
High	San Francisco Bay Stege Marsh	Aquatic life impacts	Arsenic, Copper, Mercury, Selenium, Zinc, Chlordane, Dieldrin, ppDDE, Dacthal, Endosulfan 1, Endosulfan sulfate, Dichlorobenzophenone, Heptachlor epoxide, Hexachlorobenzene, Mirex, Oxidiazon, Toxaphene,PCBs
High	San Joaquin River at City of Stockton	Exceedances of water quality objective	Dissolved oxygen
High	Santa Monica Bay Palos Verdes Shelf	Human health, aquatic life impacts	DDT, 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
Moderate	Bodega Bay-10028 Porto Bodega Marina	Bioassay toxicity	Copper, Lead, Mercury, Zinc, TBT, DDT, PCB, PAH
Moderate	Bodega Bay-10007 Spud Point Marina	Bioassay toxicity	NA
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

Rank	Site Identification	Reason for Listing	
		Definition Trigger	Pollutants
Moderate	San Francisco Bay Oakland Estuary. Pacific Drydock #1 (area in front of stormdrain)	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	Bolsa Chica Ecological Reserve	Sediment toxicity	DDE
Low	Huntington Harbor Upper Reach	Sediment toxicity	Chlordane, DDE, Chlorpyrifos

Source: SWRCB (2003).

State Water Resources Control Board (SWRCB). 2003. Consolidated Toxic Hot Spots Cleanup Plan: Volumes I and II. August.

Appendix F. Control Cost

This appendix provides a description of the types of control costs that might be incurred as incremental costs of the Plan amendments should entities need to implement controls that would not be necessary in the absence of the Plan.

F.1 Stormwater Nonstructural BMP

One of the most expensive nonstructural BMP programs is the street sweeping program that accounts for approximately 11% to 64% of SWMP costs incurred by municipalities responding to a recent survey (CSU Sacramento, 2005). More intensive sweeping could include incremental costs for equipment purchase and operation. The type and operation of the equipment, sweeping frequency and number of passes, and climate determines the efficiency of street sweeping (FHWA, 2002). Thus, increasing the frequency of sweeping or changing the type of sweeper used may result in decreases in pollutant loads.

California State University (CSU) Sacramento conducted a stormwater cost survey for the State Water Board to document costs incurred by select municipalities in implementing SWMPs as part of their MS4 NPDES permits. **Exhibit F-1** shows street sweeping costs for several California municipalities, with costs ranging from $12 to $61 per curb mile. Incremental costs for more extensive sweeping would depend on a municipality's current sweeping practices and the extent of the increase needed to reduce toxic loadings (e.g., the incremental curb miles and whether new sweepers need to be purchased).

Exhibit F.1: Examples of Street Sweeping Costs

Municipality	Street Sweeping Costs ($)[1]	Annual Curb Miles Swept	Costs per Curb Mile Swept ($/curb mile)	Estimated Annual Frequency
Fremont	$1,915,000	31,405	$61	12
Sacramento	$1,322,748	26,450	$50	12
Encinitas	$117,962	5,832	$20	12
Corona	$414,215	20,877	$20	26
Fresno-Clovis	$2,193,296	142,411	$15	12
Santa Clarita	$557,443	46,800	$12	50

Notes:
Source: CSU Sacramento (2005); SWRCB (2011)
[1] Costs are in 2002/2003 fiscal year dollars

Most municipalities use mechanical/brush model sweepers (Minton, 2007), which are generally only half as effective as vacuum sweepers with respect to pollutant loading reduction. Vacuum sweepers are much more effective at removing fine sediments, silts and clays where much of the pollution resides. There are two types of vacuum sweepers: wet and dry. The dry vacuum sweepers remove a greater percentage of small particulates and sediments than the wet vacuum sweepers. Thus, depending on the load reductions needed, switching to either a wet or dry vacuum sweeper could increase pollutant load reductions to surface waters.

Conventional mechanical sweepers cost approximately $69,000 (1995 dollars), whereas wet vacuum sweepers cost around $127,000 (1995 dollars) (FHWA, 2002). The useful life span of these sweepers is between 4 and 7 years, and the operating cost associated with these sweepers is about $70 per hour (1996 dollars) (FHWA, 2002). The capital cost of vacuum-assisted dry sweepers is on the order of $170,000 (1996 dollars) with a projected useful life span of about 8 years, and operating costs of approximately $35 per hour (1996 dollars) (FHWA, 2002).

F.2 Stormwater Structural Controls

There are a variety of structural means to control the quantity and quality of stormwater runoff including infiltration systems, detention systems, retention systems, constructed wetlands, filtration systems, and vegetated systems. The cost of constructing stormwater controls depends on site conditions and drainage area. Furthermore, there are often economies of scale, making it difficult to develop a unit construction cost.

Caltrans conducted a stormwater control retrofit pilot program to acquire experience in the installation and operation of a wide range of structural controls and to evaluate the performance and costs of these devices (Caltrans, 2004). As part of this program, Caltrans compared the construction costs incurred during the program to costs collected from several other transportation departments and jurisdictions (Caltrans, 2001). Caltrans obtained cost data from the following entities: Maryland State Highway Administration, Texas Department of Transportation, City of Austin (Texas), King County (Washington), Florida Department of Environmental Quality, Maryland and Virginia BMP data collected by the Center for Watershed Protection, and City of Santa Monica (California). **Exhibit F-2** presents Caltrans' unit cost estimates for these municipalities.

Exhibit F.2: Unit Cost Estimate by Municipality

Control Type	Number of Projects	Approximate Unit Cost ($/acre)			
		Median	Average	Max	Min
Detention Basin	23	$4,901	$6,983	$32,336	$470
Retention Basin (Wet Pond)	23	$8,287	$13,122	$55,883	$1,625
Wetland	25	$4,807	$7,859	$37,641	$271
Infiltration Trench	8	$15,395	$24,626	$65,737	$7,127
Austin Sand Filter	15	$24,307	$40,737	$171,438	$1,828
Delaware Sand Filter	4	$118,933	$117,938	$193,484	$40,404
Bio retention	2	$60,498	$60,498	$95,582	$25,414

Notes:
Source: Caltrans (2001); SWRCB (2011), escalated to 2007 dollars (from 1999 dollars) using the CCI.
1 Does not include Caltrans pilot program costs. Caltrans adjusted all costs for difference in regional economics and date of construction using RS Means Heavy Construction Cost Data and the CCI, respectively.

However, the costs incurred by Caltrans for BMPs constructed during their retrofit program are, in general, substantially higher than costs reported by the other entities Caltrans used for comparison. Caltrans (2001) indicated several reasons for these higher costs, including:

- Experience and efficiency in Planning and design can contribute significantly to savings; Caltrans had relatively little experience and a relatively short Planning horizon;
- BMP retrofit work was not combined with any ongoing construction projects; and
- Pilot program did not reflect lowest cost technology for a given site.

Caltrans estimated that the retrofit program costs could be lowered by between 41% and 76%. Therefore, although the retrofit program provides valuable information related to stormwater controls, the costs are likely to overstate those that would be incurred by other entities for the same practices.

The Westside Water Quality Improvement (WWQI) Project is an example of a structural stormwater control project designed and constructed in California. The WWQI Project is a system designed to treat, to the maximum extent possible, dry weather and stormwater runoff from eastern parts of Santa Monica and parts of west Los Angeles. The system is capable of treating dry weather runoff up to 3 cubic feet per second (cfs) and stormwater runoff up to 33 cfs in a 24-hour period. The runoff comes from approximately 220 acres within Santa Monica's Centinela Sub-Watershed area and 2,280 acres from parts of west Los Angeles (CSM, No Date).

The facility utilizes three separate processes to treat and improve the quality of runoff: screening, sedimentation, and direct filtration. Direct filtration takes place in the Contech Stormwater Management StormFilter® unit which removes oil and grease, dissolved heavy metals, herbicides and pesticides. Removal of trash and other floatables, and suspended particulates by sedimentation occurs in the StormFilter, Bio Clean Nutrient Separating Baffle Box™, and at the transverse diversion weir (CSM, No Date). The facility operates totally on a gravity flow basis. Isolation gate valves may be closed for maintenance or to protect the system from being overloaded during heavy storm events (typically once or twice in a season) (CSM, No Date). The estimated cost of this project was approximately $2 million (ACC, 2007).

F.3 Controls for Marinas

Coastal Boat works in Morro Bay, California completed a pollution prevention project in 1999 to reduce the amount of heavy metals and toxic pollutants that reached the bay from the marina. In addition to distributing 500 pamphlets to various agencies and organizations promoting pollution prevention along the waterfront, the facility also purchased new cleaning equipment including dustless sanders and a Vacu-boom system (used to prevent runoff from washing operations) for boaters to use during maintenance operations (MBNEP, 2000). The marina spent approximately $14,500 on the program (includes $5,400 in funding from the MBNEP) (MBNEP, 2000).

The Vacu-boom system is a hollow, flexible tube placed directly on a hard surface to form a downslope side dam or to completely encircle the wash or containment area. During use, the boom is connected by a portable wet vacuum recovery unit (Pressure Power Systems, 2007). When the wet vacuum system is turned on, the Vacu-Boom tightly seals itself to the surface to form an impervious liquid barrier and water is extracted into the boom into the vacuum unit (Pressure Power Systems, 2007). The water is discharged from the vacuum unit through a discharge hose into a holding tank, filter unit, or sanitary sewer (Pressure Power Systems, 2007). **Exhibit F-3** shows costs for various size units.

Exhibit F-3: Capital Costs for Vacu-Boom System (2007 dollars)

Tube Size	Capital Cost
20 feet	$3,200
25 feet	$3,350
30 feet	$3,600
40 feet	$4,100
50 feet	$4,500

Source: SWRCB (2011)

The Los Angeles Regional Water Board, among others, has identified copper-based antifouling paints as a source of copper pollution in marinas and bays (LARWQCB, 2005a; 2005b). Reduction or elimination of this pollution may require the transition to alternatives. Few, if any, areas in California have begun the transition to less toxic alternatives. The San Diego Regional Water Board (2005) provides information on the potential costs associated with the use of nontoxic paints on boats, based on findings in Carson, et al. (2002). **Exhibit F-4** provides a comparison between copper-based antifouling paints and nontoxic epoxy coatings. Boat owners may save small amounts of money on nontoxic hull coatings and maintenance over the life of the boat. In some situations, individual boat owners could spend slightly more money on nontoxic coating maintenance but the amount will be small compared to hull maintenance cost over the life of the boat (SDRWQCB, 2005).

Exhibit F.4: Comparison between Copper-based Antifouling Paint and Nontoxic Epoxy Coating

Copper-based Antifouling Paints	Nontoxic Epoxy Coatings
Initially less expensive to apply ($30 per foot)	Initially more expensive to apply ($30 - $50 per foot)
Not needed to be clean as often (14 times per year)	Needed to be cleaned more often (22 times per year)
Needed to be reapplied more often (every 2.5 years)	Not needed to be re-applied very often (every 5 years to 10 years)
Needed to be stripped about 6th application (every 15 years if paint reapplied every 2.5 years)	Do not need to be stripped (in first 30-60 years)

Source: SDRWQCB (2005); SWRCB (2011)

1. Based on a typical stylized 40-foot long boat with 11-foot beam width and 375 square feet of wetted hull surface.

Variability in costs from this transition depends primarily on whether stripping for a boat is required prior to application of the nontoxic alternative. Stripping is not needed for new, unpainted boats. For older boats (approximately 15 years old), stripping is required for both application of nontoxic epoxy coatings, and continued application of copper-based paints. Thus, only boats less than 15 years old would have the option of stripping prior to applying the new paint. Stripping costs are approximated at $120/foot (Carson, et al., 2002). Long term cost estimates for transitioning from copper-based antifouling paints to nontoxic coatings also vary depending on assumptions regarding the performance of the nontoxic coatings and their price (SDRWQCB, 2005).

For example, Carson, et al. (2002) estimated the cost of remaining life hull maintenance for 40 foot length, 11 foot width boats to range from a savings of $1,354 (new boat with nontoxic coating, good performance, and lower prices) to a cost of $6,251 (2.5 year old boat requiring stripping, fair performance, and higher prices). Carson, et al. (2002) estimated that the least costly alternative for the transition to nontoxic paint (i.e., allowing boat owners to convert when the epoxy-copper cost differential is most favorable) would cost the boating community (about 7,000 boats) in San Diego Bay approximately $1.5 million over 15 years (2002 year dollars). If all boat owners were required to convert to nontoxic paints immediately, costs to boaters would be approximately $33.8 million (Carson, et al., 2002).

F.4 Sediment Remediation and Cleanup

There are a number of limitations associated with estimates of unit costs for sediment remediation and cleanup. Unit costs are generally only applicable to the conditions and constraints of the site remediated (Myers, 2005). Factors such as project scale, beneficial use opportunities, and the need for land are highly site-specific and greatly influence project costs (Myers, 2005). Myers (2005) also points out that unit costs for a one time remediation job will generally be greater than unit costs of a long term project in which a specific amount of sediment is treated each year over many years, due to economies of scale.

The types of remedial or cleanup activities implemented and their effectiveness are also highly site-specific. For example, sediment capping may be feasible in a deep water area but not feasible in a shallower area through which large ships have to pass. Also, dredging may be cost-effective where only the top layer of sediment is contaminated. However, where contamination exists beneath the top layer of sediment, dredging may not be feasible or cost-effective. Thus, information on the extent of contamination and water body uses is important in determining feasible cleanup options.

Another limitation to most unit cost estimates is a lack of detail on how the costs were derived. Tetra Tech and Averett (1994) (as cited in Myers, 2005) estimate that unit costs for a thermal gas phase reduction process range from $426/cy to $506/cy. This estimate reflects the buildup of costs in a number of categories, including site preparation, permitting, capital equipment, pretreatment, labor, consumables, supplies, and utilities, effluent treatment and disposal, monitoring, maintenance, site demobilization and cleanup, dredging, construction of and transportation to temporary storage facility, land leases, and disposal of residual material. However, due to site-specific conditions in another area (e.g., lack of available space to construct a temporary storage facility), these particular estimates may not be applicable. If documentation regarding the buildup of costs for each category is available, the estimates could potentially be modified to take site-specific conditions into account.

In 1997, the National Academy of Sciences (NAS) published comparison unit cost and cost-effectiveness information for a number of remediation strategies (**Exhibit F-5**). NAS (1997) ranked the alternatives based on feasibility, effectiveness, practicality, and cost (<$1/cy to $1,000/cy). The lowest cost option (natural recovery) does not rank high in feasibility or practicality. In comparison, the highest cost option (thermal ex situ treatment) ranks high in feasibility, effectiveness, and practicality.

Exhibit F-5. Cost-Effectiveness of Sediment Remediation Approaches

Approach	Feasibility	Effective	Practicality	Cost
Interim Control				
Administrative	0	4	2	4
Technological	1	3	1	3
In Situ Treatment				
Natural Recovery	0	4	1	4
Capping	2	3	3	3
Treatment	1	1	2	2
Sediment Removal and Transport	2	4	3	2
Ex Situ Treatment				
Physical	1	4	4	1
Chemical	1	2	4	1
Thermal	4	4	3	0

Biological	0	1	4	1
Ex Situ Containment	2	4	2	2
Scoring	Feasibility	Effective	Practicality	Cost
0	<90%	Concept	Not acceptable, very uncertain	$1,000/cy
1	90%	Bench		$100/cy
2	99%	Pilot		$10/cy
3	99.9%	Field		$1/cy
4	99.99%	Commercial	Acceptable, certain	<$1/cy

Notes:
Source: SWRCB (1998), SWRCB (2011), as adapted from and reprinted with permission from Contaminated Sediments in Ports and Waterways Cleanup Strategies and Technologies. Copyright 1997 by the National Academy of Sciences. Courtesy of the National Academy Press, Washington, D.C.

Comparable to the NAS estimates from 1997, USACE (2001) indicates that sediment treatment costs can range from around $50/cubic meter ($65/cy) for a process such as stabilization to over $1,000/cubic meter ($1,300/cy) for high temperature thermal processes. These estimates are based on project costs throughout the United States. However, preliminary estimates from USACE (1999) for capping sediments in the Palos Verdes Shelf in California range from $1.79/cy to $5.06/cy, which is greater than the $1/cy estimate in the exhibit.

As part of a cleanup and abatement order, the San Diego Regional Water Board developed unit cost estimates for dredging contaminated sediments in the San Diego Bay based on preliminary cost estimates from Exponent (2003). **Exhibit F-6** shows these unit costs. All of the estimates are for dredging with a mechanical dredge and do not include the sediment volume from areas beneath piers or within 10 feet of structures because of stability concerns.

Exhibit F.6: Unit Cost Estimates for Dredging Contaminated Sediments in San Diego Bay

Cleanup Alternative	Approximate Dredge Volume (cubic yards)	Approximate Total Cost	Approximate Cost per Cubic Yard
LAET	75,000	$15,000,000	$200
5x Background	754,000	$88,000,000	$117
Background	1,200,000	$120,000,000	$102

Notes:
Sources: SDRQWCB (2007)
LAET = lowest apparent effects threshold

F.5 References

American City and County (ACC). 2007. Taking Trash Out of Runoff. February.

California Department of Transportation (Caltrans). 2004. BMP Retrofit Pilot Program – Final Report. January.

California Department of Transportation (Caltrans). 2004. BMP Retrofit Pilot Program – Final Report. January.

California Department of Transportation (Caltrans). 2001. Third Party Best Management Practice Retrofit Pilot Study Cost Review. May.

California State University (CSU) Sacramento. 2005. NPDES Stormwater Cost Survey. Prepared for State Water Resources Control Board.

Carson, R., M. Damon, L. Johnson, and J. Miller. 2002. Transitioning to Non-Metal Antifouling Paints on Marine Recreational Boats in San Diego Bay.

City of Santa Monica (CSM). No Date. Westside Water Quality Improvement Project – SAC.

Exponent. 2003. NASSCO and Southwest Marine Detailed Sediment Investigation. Volume I.

Federal Highway Administration (FHWA). 2002. Stormwater Best Management Practices in an Ultra- Urban Setting: Selection and Monitoring. May.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2005a. Total Maximum Daily Loads for Toxic Pollutants in Ballona Creek Estuary. July 7, 2005.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2005b. Total Maximum Daily Load for Toxic Pollutants in Marina del Rey Harbor. Draft: August 3, 2005.

Minton, Gary. 2007. The Street Sweep. Online at http://www.stormwaterauthority.org/library/view_article.aspx?id=872.

Morro Bay National Estuary Program (MBNEP). 2000. Turning the Tide: Comprehensive Conservation and Management Plan.

Myers, T. E. 2005. Cost estimating for contaminated sediment treatment – A summary of the state of the practice. DOER Technical Notes Collection (ERDC TN-DOER-R8). U.S. Army Engineer Research and Development Center. Vicksburg, MS.

National Academy of Sciences (NAS). 1997. Contaminated Sediments in Ports and Waterways: Cleanup Strategies and Technologies.

Pressure Power Systems, Inc. 2007. Vacu-Boom System. Online at http://www.vacuboom.com/.

San Diego Regional Water Quality Control Board (SDRWQCB). 2007. California Regional Water Quality Control Board San Diego Region Resolution No. R9-2007-0104 Amendment to the Water Quality Control Plan for the San Diego Basin (9) to Incorporate the Revised Conditional Waivers of Waste Discharge Requirements for Specific Types of Discharge within the San Diego Region. Online at

https://www.waterboards.ca.gov/sandiego/board_decisions/adopted_orders/2007/2007_0104.pdf

San Diego Regional Water Quality Control Board (SDRWQCB). 2005. Total Maximum Daily Load for Dissolved Copper in Shelter Island Yacht Basin, San Diego Bay. February.

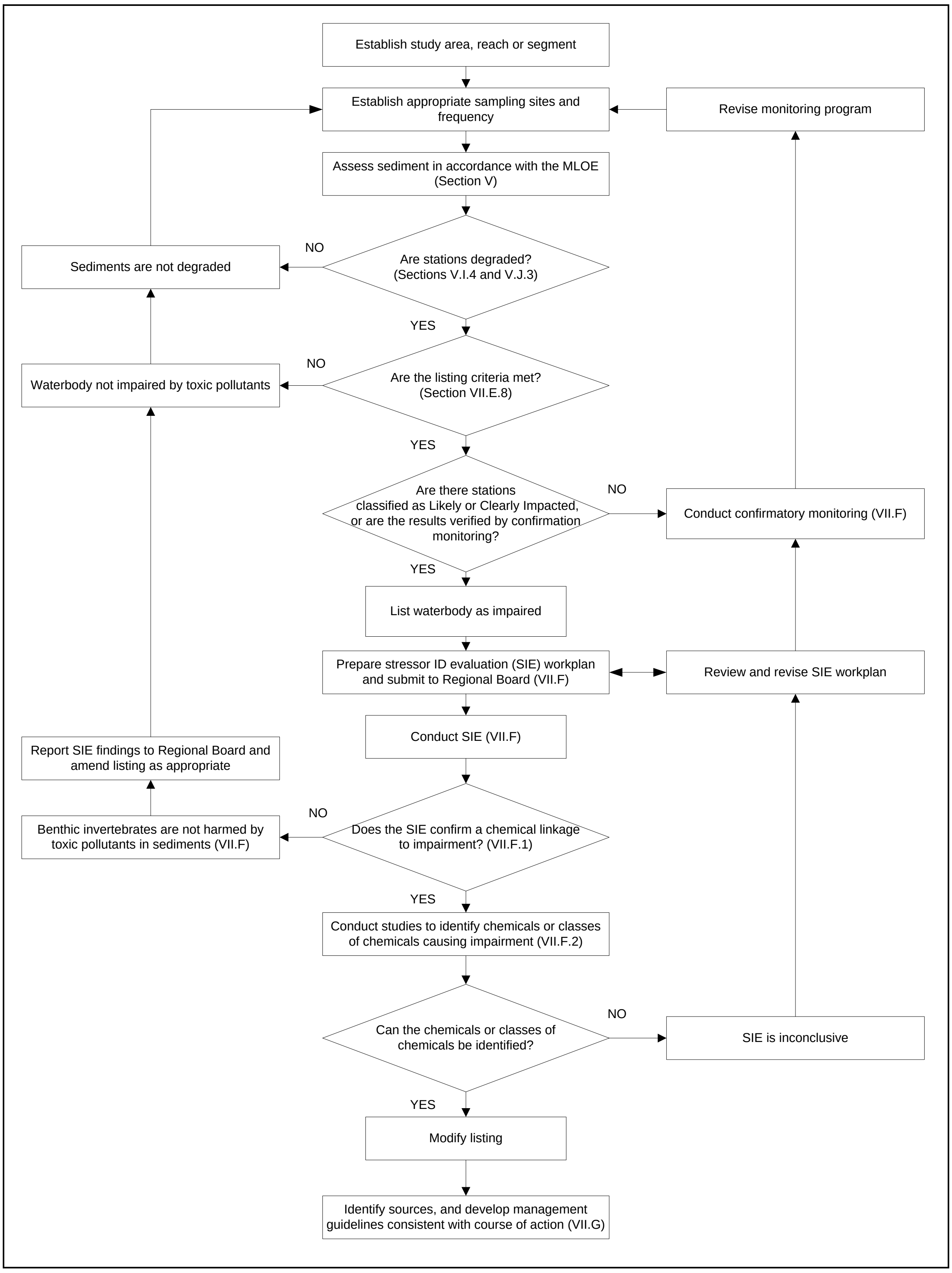
State Water Resources Control Board. 1998. Water Quality Control Policy for Guidance on Development of Regional Toxic Hot Spot Cleanup Plans. State Water Resources Control Board Resolution No. 98 – 090.

United States Army Corps of Engineers (USACE). 2001. A State of the Art Overview of Contaminated Sediment Remediation in the United States. International Conference on Remediation of Contaminated Sediments, 10-12 October 2001, Venice, Italy.

United States Army Corps of Engineers (USACE). 1999. Options for In Situ Capping of Palos Verdes Shelf Contaminated Sediments. By Michael Palermo, Paul Schroeder, Yilda Rivera, Carlos Ruiz, Doug Clarke, Joe Gailani, James Clausner, Mary Hynes, Thomas Fredette, Barbara Tardy, Linda Peyman-Dove, and Anthony Risko.

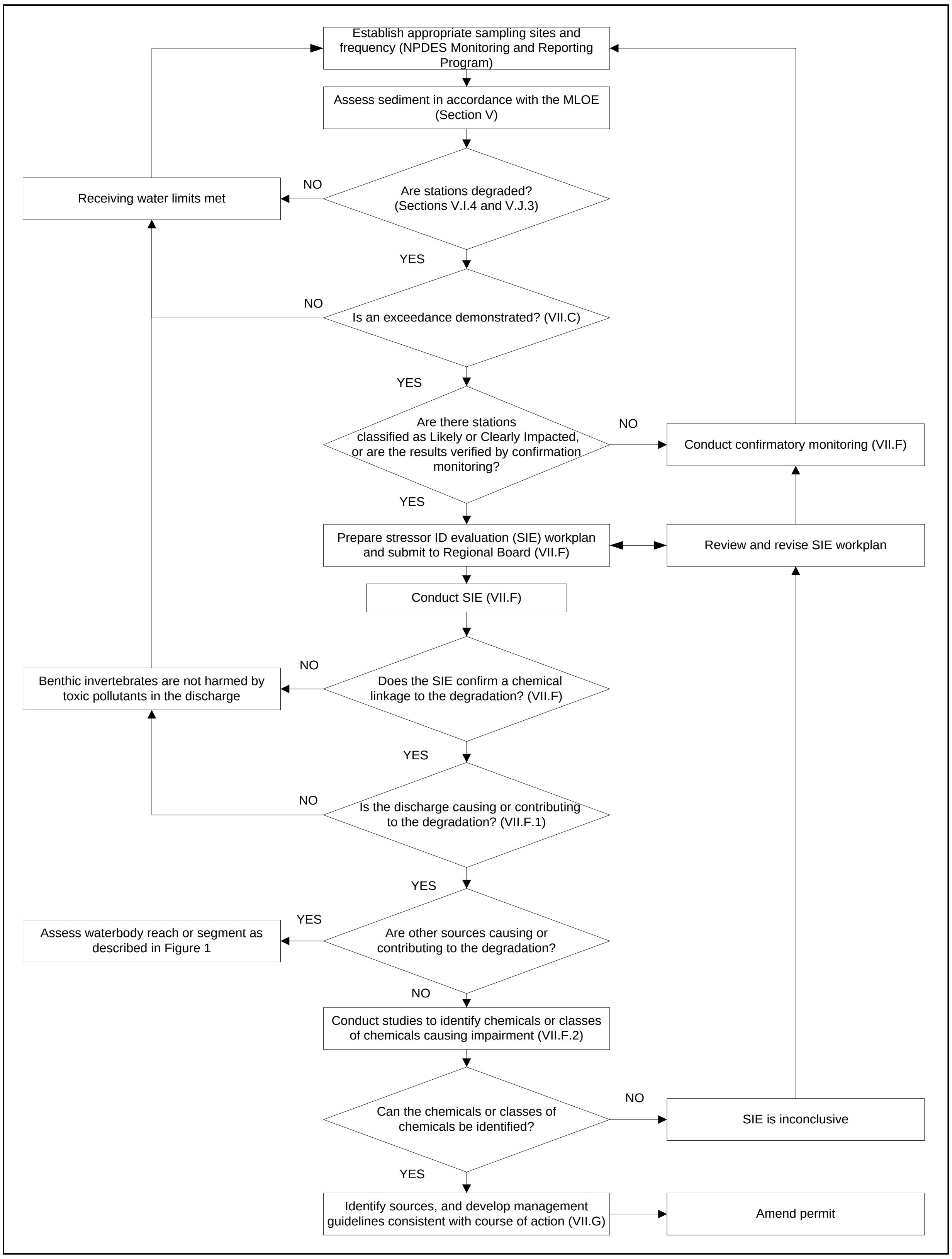
United States Environmental Protection Agency (U.S. EPA). 1999. Preliminary Data Summary of Urban Stormwater Best Management Practices. August

Exhibit G-1. Waterbody Assessment Process



Source: SWRCB (2011)

Exhibit G-2. Point Source Assessment Process



Source: SWRCB (2011)

G.1 References

State Water Resources Control Board. 2011. Draft proposed Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries Plan Part 1: Sediment Quality. State Water Resources Control Board Appendix A.

Appendix C: Responses to Comments

Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries of California:

Sediment Quality Provisions

Responses to Public Comments

Comment Letter No.	Author	Organization
1.	Jill Bicknell	California Stormwater Quality Association (CASQA)
2.	Lucia McGovern	Calleguas Creek Watershed Management Plan
3.	Todd E. Snyder	County of San Diego Department of Public Works
4.	Kay Mercer	KMI
5.	Enrique C. Zaldivar	City of Los Angeles Sanitation
6.	Kelly Richardson	Latham & Watkins on behalf of General Dynamics Corporation and Montrose Chemical Corporation of California
7.	Heather Tomley, Christopher Cannon	Port of Long Beach and Port of Los Angeles
8.	Karen Holman	San Diego Unified Port District
9.	Ian Wren	San Francisco Baykeeper
10.	Steven C. Nadeau	Sediment Management Work Group (SMWG)
11.	Kevin Buchan, (Susan Paulsen and Susan Kane Driscoll)	Western States Petroleum Association, Exponent

Comment letters are posted at: https://www.waterboards.ca.gov/water_issues/programs/bptcp/comments20171214.html

Note: A few commenters requested that their previous comment letters be incorporated by reference, these past comment letters as well as the responses are posted at: https://www.waterboards.ca.gov/water_issues/programs/bptcp/sqo_historical.html

The comments tabulated in the following pages are numbered according to comment letter.

No.	Comment	Response	Revision[1]
1.1	CASQA commends the efforts by the State Water Board in developing the updates to the Sediment Quality Objectives (SQOs) to address human health and believes these objectives incorporate much needed improvements to the science and requirements linking sediment and fish tissue for chlorinated pesticides and PCBs.	Comment noted.	No
1.2	In particular, CASQA would like to support the State Water Board's use of Office of Environmental Health Hazard Assessment (OEHHA) Advisory Tissue Levels for the Tier 1 Assessment in the Proposed Amendments.	Comment noted.	No
1.3	While CASQA supports the overall approach to the SQOs provided in the Proposed Amendments, there are a number of clarifications and modifications that are recommended to support the application of the Proposed Amendments throughout California	Comment noted. See response to comment 1.36.	No
1.4	General Comment: Implementation of Proposed Amendments appears resource intensive. As agencies responsible for implementation of regulatory initiatives like the Proposed Amendments, our assessment is the implementation of the Proposed Amendments is likely to be quite resource intensive. And while we recognize and appreciate the State Water Board making some changes that will reduce the burden (e.g., reducing the frequency of monitoring from every three years to every five years), we request that the State Water Board continue to look for ways to make implementation of the Proposed Amendments less resource intensive wherever possible. Some of our specific comments below provide suggestions for reducing the implementation burden.	Tier 1 was intended to reduce the resources necessary for monitoring by allowing for the use of existing data, where such data is available and applicable to the site in question. Existing monitoring data collected from regional monitoring programs is available in many waterbodies for contaminants in the primary species tissue and sediment. In those situations, a desktop study may be performed that would satisfy Tier 1 requirements. Additionally, see responses to comments 1.5 and 1.6.	No

[1] Revision pertains to a change made to the Proposed Final Staff Report and/or the Proposed Final Sediment Quality Provisions. A revision will be marked "Yes" only in the first instance the revision is described in the responses to comments.

1.5	The Proposed Amendments are unclear as to the procedures and minimum requirements for fish species monitoring. The Proposed Amendments make frequent references to fish species, fish size requirements, dietary guilds, and primary and secondary guild species, without additional clarification for the procedures and criteria required for groups to select fish species to monitor. The Proposed Amendments need to clearly specify the minimum number of fish species that need to be monitored and any requirements for selecting those species. If the fish species selection is solely based on the conceptual site model (CSM), the Proposed Amendments should clearly state that and remove other requirements and inconsistencies in the discussion. For example, Table 18 states that a minimum of two species shall be included in the assessment. Then bullet b under the Tier 2 chemical assessment that follows the table states that "Tissue from the primary species from each dietary guild should be used in the analysis". This text implies that at a site with multiple dietary guilds may need to collect up to nine species to conduct the assessment. This requirement could place a significant burden on fish tissue monitoring programs if they are mandated to collect species from each dietary guild as compared to identifying two primary species for monitoring.	The proposed amendments to the Sediment Quality Provisions in the Enclosed Bays and Estuaries Plan (proposed Provisions) require monitoring a minimum of one species each from two different dietary guilds. Table 18 in the proposed Provisions was edited to clarify this requirement. Chapter IV.A.2.d.2) c. was also edited to state that "tissue obtained from among the primary species representing the dietary guilds which are," followed by the list of primary species. The goal is to ensure that end users select primary species that meet the requirements described in Table 18, Chapter IV.A.2.b.3), and Chapter IV.A.2.d.2). Appendix A-6 and the conceptual site model (CSM) are used to select the specific species that meet these requirements.	Yes
1.6	Additionally, the provisions do not adequately address sites that may have limited fish species or restricted fishing requirements, such as those estuaries located on Naval bases in Southern California. For example, although Provision IV.A.2.b.3.4.b specifies that "Fish shall meet sportfish angling size requirements," the Proposed Amendments do not specify how a group should proceed if these size requirements cannot be met. Additionally, it is unclear how monitoring should be conducted if primary and secondary species cannot be collected at a site. One potential solution for limited fish species that has been used in Newport Bay is the identification and use of surrogate species where no	Field procedures in Chapter IV.A. 2.b.3) and Tier 2 data requirements in Chapter IV.A.2.d.2).c. have been revised to provide an alternative if it is not feasible to catch fish of legal size and to clarify conditions supporting the use of secondary species. The use of alternative species (not primary or secondary species) is already addressed in Tier 3, see Chapter IV. 2.e.2)a. in the proposed Provisions. The Provisions do not use the approach described in the Newport Bay example.	Yes

	primary or secondary species could be collected. Surrogate species need to have a clear linkage to the site and be approved by the Regional Water Board Executive Officer. Surrogate species were only to be used for informational purposes; information on surrogate species by itself could not be used to make decisions.		
1.7	Revisions to the Proposed Amendment, including Provision IV.A.2.b.3 and Appendix A-6, should be made to reflect these needed clarifications and provide more flexibility for sites with limited fish species and fishing restrictions.	See responses to comments 1.5 and 1.6. Changes were not made to Appendix A-6 based on this comment.	No
1.8	CASQA Recommendation: Modify the Proposed Amendments to clearly state that only two fish species are required for monitoring, though more could be selected based on the CSM. The selected fish species should represent dietary guilds identified in the CSM and be from the primary species list where possible. However, if primary species are not available at the site, secondary species can be used. Where neither primary nor secondary species are available, surrogate species may be used for informational purposes – information on surrogate species by itself could not be used to make decisions. Surrogate species need to have a clear linkage to the site and be approved by the Regional Water Board Executive Officer.	See responses to comments 1.5 and 1.6.	No
1.9	Include language throughout the Proposed Amendments, including but not limited to Provision IV.A.2.b.3 and Appendix A-6, clarifying procedures and criteria for selecting fish species to monitor in waterbodies under conditions with limited fish species or other restrictions on fish monitoring (e.g., sportfish size, sportfishing prohibitions).	See responses to comments 1.5 and 1.6. Changes were not made to Appendix A-6 based on this comment.	No
1.10	Comment #2: Consideration of Historic Data for Tier 1 Assessments Provision IV.A.2.b.5 of the Proposed Amendments specifies that, “A conceptual site model (CSM) and study design as described in Chapter IV.A.4.d.5) must be developed prior to data analysis. Sediment and tissue data shall not be used to assess	Use of existing or historical data is allowed in Tier 1. The monitoring program design guidance in Chapter IV.A.4.d.5) was revised to provide flexibility in CSM development. In addition, Appendix A-5 was revised to state that the level of development and sophistication of the CSM depends on the Tier (1, 2 and 3) and complexity	Yes

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	sediments in accordance with this plan, unless they are consistent with the CSM." CASQA requests consideration of modifications that would allow a Tier 1 Screening Evaluation to be conducted using existing historical data without the development of a CSM. In cases where fish tissue data are not available, the Proposed Amendments could be revised to reduce the requirements for CSM development for sites where qualifying historical sediment data are available.	of the site being assessed. Some form of CSM is still required to inform study design or data analysis decisions. As described, the only requirements for Tier 1 are site boundaries, historical data availability and selection of fish species based on the waterbody. Collating this data and information would not require significant resources and is expected to guide the end-user and the applicable Regional Water Quality Control Board (Regional Water Board) on the appropriateness of the study and design.	
1.11	Some areas in California have been collecting data on fish tissue and sediment for many years. Modifying the requirements would allow use of these data for the initial Tier 1 assessment prior to investing in the development of a CSM. Because the Tier 1 assessments are intended to be conservative, if the thresholds are being met based on historic data that has been collected to characterize the site, there should be minimal risk that the SQOs are not being attained. If the Tier 1 assessment thresholds are not met, then a Tier 2 assessment is required and a CSM would be developed at that time.	Some form of CSM is required regardless of tier to ensure proper design and to inform the Regional Water Board of the decisions and assumptions used to guide the assessment. See response to comment 1.10.	No
1.12	Additionally, the Tier 1 assessment should provide some flexibility to include other available data that are relevant to the site to meet some of the Tier 1 assessment requirements. As discussed in the previous comment, there are sites were the primary and secondary fish species may not be present. The Tier 1 assessment should include allowances for sites where the data specified in the Proposed Amendments are not collected, despite efforts to do so.	Tier 1 assessment allows the use of sediment chemistry data only, fish tissue chemistry data only, or both fish tissue and sediment chemistry together. If appropriate fish tissue chemistry data are not available when planning a Tier 1 assessment, the end user should consider using available sediment chemistry data.	No
1.13	CASQA Recommendation: *Remove requirement to do a full CSM before Tier 1 assessment where fish tissue data exist that meet the Tier 1 data requirements or allow for a modified, lower level CSM for Tier 1 assessment of sediment data.*	See responses to comments 1.10, 1.11, and 1.12.	No
1.14	*Modify Provision* IV.A.2.b.5.2 as follows: *b. Sediment data must include matching total organic carbon content. If total organic carbon data are not available, an estimate may be proposed in the CSM. d. Only*	The Provisions have been revised to allow for an estimate to be used in Tier 1. See responses to comments 1.10, 1.11, and 1.12.	Yes

	tissue from those species listed in Appendix A-6 shall be used in the analysis. Secondary species or an alternative list of species based on site specific factors may only be used if primary species are not collected from the site, despite efforts to do so.		
1.14.a.	*Comment #3: Clarification of Interpretation of Tier 1 Assessment Results As currently drafted, the proposed amendments are not clear on how to interpret the results of the Tier 1 Evaluation. Provision IV.A.2.c.5 states, "If either tissue or sediment is applied in Tier 1 and the result exceeds the threshold for any constituent, Tier 2 is required for those constituents." This statement should be clarified so that a Tier 2 Assessment only applies if only one of the two media is assessed. However, as currently drafted, this requirement is unclear and could be interpreted to mean that even if both media are assessed, if either one exceeds the threshold for any constituent, Tier 2 is required, in contradiction to both the sentence and bullets that follow (Provisions IV.A.2.c.5.a-d).*	The text in Chapter IV.A.2.c.5) of the proposed Provisions has been revised to clarify the potential outcome (unimpacted or proceed to Tier 2) when either tissue or sediment are applied in Tier 1 or when both are applied. Provisions have been revised to clarify the potential outcome.	Yes
1.15	In addition to the clarification detailed above, the purpose of the Tier 1 assessment should also include a determination that sediments are not impacted and are meeting the SQOs if a complete site assessment is not warranted. Currently the language states that sediments not requiring a Tier 2 determination are "not degraded" and "not impacted", but the determination of meeting the SQOs under Tier 2 uses the terminology "unimpacted". The language should be consistent throughout the document so it is clear that sediments not requiring a Tier 2 assessment are considered "unimpacted" and thereby attain the SQOs.	See response to comment 1.14.a. Provisions have been revised to use the term "unimpacted"	No
1.15.a.	CASQA Recommendation: Revise the second paragraph of Provision IV.A.2.c.5. *If either <u>only</u> tissue or <u>only</u> sediment is applied in evaluated in Tier 1 and the result is above the threshold for any constituent, Tier 2 is required for those <u>the</u> constituents <u>above Tier 1 thresholds</u>.*	Text was revised as requested.	Yes

1.16	Revise the first paragraph of Provision IV.A.2.c.1. *If potential chemical exposure is below this level, sediments are ~~not degraded~~ unimpacted and there is no reason to perform more detailed assessment (either Tier 2 or Tier 3).*	Chapter IV.A.2.c.1) of the proposed Provisions has been revised to use the term "unimpacted."	Yes.
1.17	Revise bullets a-d of Provision IV.A.2.c.5. *a. If both tissue and sediment result ~~falls~~ are equal to or below the threshold, the chemical exposure associated with the sediment and tissue is acceptable and the sediment quality is ~~not impacted~~ unimpacted.* *b. If tissue results fall below the threshold and sediment ~~equals or exceeds~~ is above the threshold, the chemical exposure is acceptable and the sediment quality is ~~not impacted~~ unimpacted.* *c. If sediment results ~~fall~~ are equal to or below the threshold and tissue equals or ~~exceeds~~ is above the threshold, a Tier 2 assessment is required.* *d. If both sediment and tissue results ~~equal or exceed~~ are above the threshold, ~~the chemical exposure to consumers is unacceptable and~~ a Tier 2 assessment is required.*	See response to comment 1.14.a., 1.15 and 1.16.	No
1.18	Comment #4: Consideration of Tier 3 Evaluation Approvals. The second paragraph of Provision IV.A.2.e states that *"Tier 3 may be performed at any time with approval from the Regional Water Board provided that Tier 2 is completed at the same time."* CASQA feels that approval from the Regional Water Board should not be required to conduct Tier 3 analysis. A Tier 3 assessment is a more complex and site-specific assessment, and one that should be pursued if a group sees it fit to do so. Although it is appropriate to solicit Regional Water Board involvement and concurrence on study design of a Tier 3 assessment and for the Regional Water Board to retain its ability to accept or reject the results of a Tier 3 assessment, CASQA contends that any group should be able to pursue a Tier 3 analysis if they meet the triggering criteria in Provision IV.A.2.e. 2.	The language has been amended to allow responsible parties to collect data and proceed with Tier 3 without approval from the Regional Water Board. The Regional Water Board retains the authority to approve and accept Tier 3 study results.	Yes
1.19	*CASQA Recommendation: Revise the second paragraph of Provision IV.A.2.e as follows: Tier 3 may*	See response to comment 1.18. Chapter IV.A.2.e. of the proposed Provisions have been revised as suggested.	No

	be performed at any time ~~with approval from the Regional Board~~ provided that Tier 2 is completed at the same time. A change in any parameter or model from that used in Tier 2 must be justified based on site conditions in comparison to Tier 2 assumptions and values, and approved by the Regional Water Board prior to performing the analysis.	However, approval of the values, assumptions, and rationale supporting the use of Tier 3 is still required.	
1.20	Comment #5: Consideration of Subsistence Fishing Beneficial Uses Designations Provision IV.A.2.e.3 allows for the use of a different OEHHA guideline, one with high frequency of fish consumption, when considering subsistence fishers and their exposure to human health risks. While use of the higher fish consumption thresholds may be appropriate for a site with subsistence fishing, the Proposed Amendments should be clear on when the higher fish consumption rates can be used in the SQO assessments. CASQA recommends that the use of the higher consumption rates be limited to waterbodies with beneficial use designations for subsistence fishing or tribal subsistence fishing. The State Water Board recently adopted new beneficial uses for subsistence fishing, but have not assessed the designation for most waters. Designation should be required before the higher consumption frequency OEHHA rates are used to ensure the beneficial use is present.	The intent of the proposed Provisions was to apply the subsistence and tribal subsistence related thresholds only within those waters where the applicable Regional Water Board has designated those uses. Chapters IV.A.2.c.3) and IV.A.2.e.3) of the proposed Provisions have been revised to clarify when subsistence and tribal subsistence thresholds apply.	Yes
1.21	CASQA Recommendation: *Clarify higher OEHHA fish consumption thresholds for subsistence fishing should only be assessments if a waterbody has a designated subsistence fishing or tribal subsistence fishing beneficial use designation.*	See response to comment 1.20.	No
1.22	*Comment #6: Clarification on Implementation of Sediment Quality Objectives to Determine Exceedance of Receiving Water Limits According to Provision IV.A.4.c.2.a (Exceedance of Receiving Water Limit to protect aquatic life), an exceedance occurs when "any station within the site is assessed as Clearly Impacted…or if the total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site*	The term "Possibly Impacted" is used to describe those situations where there is some evidence of impact, though greater uncertainty exists. Chapters IV.A.4.d.8), IV.A.4.e.1)a.ii., and IV.A.4.e.2) have been revised to recommend use of confirmation monitoring to increase confidence in data interpretation. However, "Possibly Impacted" remains a category of impact that is not considered as protecting sediment dependent beneficial uses. The category is applied consistent with the use of	Yes

	area over the duration of a permit cycle." According to Provision IV.A.4.c.2.b (Exceedance of Receiving Water Limit to protect human consumers of sportfish), an exceedance occurs when "the site sediments are characterized as Possibly Impacted, Likely Impacted or Clearly Impacted." While we support the inclusion of "any station that is Clearly Impacted", we request that the term "Possibly Impacted" be removed from these provisions. "Possibly Impacted" does not clearly demonstrate impacts or the likelihood of impacts and therefore should not be used to establish an exceedance of a receiving water limit.	the same category in the "direct effects" or benthic community assessment framework. Furthermore, for receiving water limits, an exceedance cannot occur until a relationship has been established between an effluent and the observed impacts. This relationship requires understanding the stressors causing the degradation, as well as the quality of and constituents in the effluent.	
1.23	*Additionally, we request that the "15 percent" areal criterion for Possibly Impacted and/or Likely Impacted determinations from Provision IV.A.4.c.2.a be modified to a criterion that better reflects that the majority of the site is impacted. Fifteen percent is a small area and could represent local sources or impacts, making it inappropriate to determine a receiving water "exceedance" for all dischargers to a site.*	The intent of the proposed Provisions is to support sediment dependent beneficial uses throughout the entire site and not to delay until the majority of the waterbody is degraded. Additionally, see response to comment 11.15.	No
1.24	*CASQA Recommendation: Remove "Possibly Impacted" from this provision.*	See responses to comments 1.23, 11.13, 11.14, and 11.15.	No
1.25	*Modify the 15% percent areal criterion for Likely Impacted sites to be the majority of sites for the waterbody.*	See responses to comments 1.23 and 11.15.	No
1.26	*Comment #7: Clarification on Implementation of Sediment Quality Objectives for Evaluating Waters for Placement on the Section 303(d) List. Provision IV.A.4.e.1.a. and IV.A.4.e.1.b. include provisions for listing waterbodies that are "Clearly Impacted", "Likely Impacted", and "Possibly Impacted" per the SQO assessment requirements. While we support the inclusion of waterbodies with "Clearly Impacted" and "Likely Impacted" sites on the 303(d) list, we request that the term "Possibly Impacted" be removed from this provision. "Possibly Impacted" does not clearly demonstrate that waters are degraded and additional monitoring should be conducted prior to designating these waters as impaired and placing them on the 303(d) list (Category 5 of the California 303(d)/305(b)*	See response to comment 1.22.	No

	Integrated Report). Rather, these waterbodies should be placed in Category 3 of the Integrated Report. Category 3 contains waters for which there are insufficient data to make a use support decision. The designation of "Possibly Impacted" indicates that additional monitoring and information is needed to identify if impacts are occurring at the site. Therefore, it would be appropriate to place these waterbodies into Category 3 rather than making a determination that the site is impaired and placing it on the 303(d) list.		
1.27	*Additionally, we support the provision specifying the use of data from the most recent 303(d) listing cycle for the SQO site assessments and the requirements for data to be collected from multiple spatially representative stations and multiple surveys over the span of at least one year to make listing decisions.*	Comment noted.	No
1.28	*CASQA Recommendation: Place "Possibly Impacted" sites in Category 3 of the Integrated Report rather than on the 303(d) list.*	The Possibly Impacted category requires evidence of response for at least two of the three lines of evidence. The category Possibly Impacted still represents degradation and as such should be included in the list of impaired waters.	No
1.29	*Comment #8: Clarification of the technical procedure for site linkage determination The technical procedure for site linkage determination contains a number of inconsistencies that should be clarified to ensure consistent application of the Proposed Amendments. Additionally, the Proposed Amendments do not include necessary guidance, such as how to address nondetects that is needed to complete the calculations. The following are suggested modifications to clarify and reduce inconsistencies in the site linkage assessment procedures.*	See responses to comments 1.30, 1.31, 1.32, 1.33, 1.34, and 1.35.	No
1.30	*CASQA Recommendation: Add subscript i to C_{EST} and C_{Tis} in the linkage factor equation (Equation 8 and also in Appendix A-8).*	In reviewing the equations, an error in the numbering was identified. There were no equations numbered 5 and 6. As a result, equations 7, 8, 9, 10 and 11 were renumbered 5,6,7,8 and 9. In addition, the last equation was not numbered and is now equation 10. However, all the responses to the comments follow the previous numbering and appear in double strike out. Equation 8 is the calculation of the estimated tissue contaminant	Yes

		concentration in species, i, contributed from site sediments and is denoted as C_{Esti}. The linkage factor equation is Equation 7 in the proposed Provisions and is calculated by dividing C_{Est} by C_{Tis}. C_{Est} is calculated as the weighted average estimated tissue concentration based on the proportion of the human diet for each guild, C_{Esti}. C_{Tis} is calculated as the weighted average observed tissue concentration for each contaminant class based on the proportion of the human diet for each guild. These weighted averages, C_{Est} and C_{Tis}, used to calculate the site linkage are not the value for a specific guild and therefore should not be denoted with subscript i. No change will be made to Equation 7, Equation 8 or Appendix-8. However, the definition of C_{Est} was enhanced to clarify that it is the weighted mean of C_{Esti} from equation 8, as was the definition of C_{Tis} to clarify that it is also the weighted average of observed tissue concentration.	
1.31	*C_{EST} and C_{Tis} definitions in Equation 8 and in Appendix A-8 are slightly different. Consider using a consistent terminology.*	The use of Site Area (SA), Site Use Factor (SUF) and Home Range (HR) have been standardized so that Equation 8 is consistent with Appendix A-8.	Yes
1.32	*Clarify summation procedure for calculation of sum contaminant concentration in Equation 8 for sets with and without detected congeners.*	There are various methods available for summation, each with different data requirements and effort. The data available should be considered when determining a specific method to be used.	No
1.33	*Consider changing “BSAF calculation” to “the estimated BSAF values” on page 28 under Calculation of site sediment linkage to be consistent with Appendix A-8.*	“BSAF calculation” in Chapter IV.A.2.d.6) has been corrected to “the estimated BSAF values” to be consistent with Appendix A-8. Additionally, Chapter IV.A.2.d.6) has been revised to clarify uncertainty in the *estimated* BSAF is based on literature values.	Yes
1.34	*Clarify differences between Equation 8 and the equation used in Appendix A-8 to calculate C_{EST} from Monte-Carlo simulation. Apparently in the latter equation SA/HR is replaced by SUFi which is coming from probability density functions for home range.*	Chapter IV.A.2.d.6) in the proposed Provisions has been revised to clarify that the Monte Carlo simulation is used to calculate the *distribution of the* sediment linkage factor based on the variability and uncertainty in measured sediment concentration data, measured fish tissue concentration data, fish home range, and BSAF. Additionally, see response to comment 1.31.	Yes

1.35	*Review cumulative % of sediment linkage distribution and linkage threshold values in Table 21. The fourth outcome (i.e. high) occurs when probability of calculated site linkage factor being equal or greater than 0.5 is 25% or in mathematical terms: $p(X \geq 0.5) = 0.25$. On the other hand, the first outcome (i.e. very low) is defined as: $p(X < 0.5) = 0.75$ which is equivalent to $p(X \geq 0.5) = 1-0.75 = 0.25$ and is technically similar to the definition of outcome four.*	Table 21 in the proposed Provisions has been revised for clarity. The revision was to the way the values were presented; the values themselves did not change. Additionally, see response to comment 11.23.	No
1.36	*Comment #9: Document Clarity and Editing, In addition to the more substantive comments listed above, CASQA respectfully requests the State Water Board address and correct the numerous typographical errors and unclear or inconsistent references found throughout the document. Examples within the Proposed Amendments are as follows:* *The headers in Table 17 are incorrect (i.e. DDT is repeated twice in #3).* *Chapter IV.A.2.b.7 does not exist (page 18 under Tier 3). The triggering criteria for Tier 3, are defined in Chapter IV.A. 2.e.2.* *In Section IV.A.4.e.1.d, reference to "subchapter i above…" should be revised to "Section IV.A.4.e.1.a.i, above…" for clarity.* *The figure of Waterbody Assessment Process in Appendix A-1 and Figure of Point Source Assessment Process in Appendix A-2 need to be updated according to the modified Section and Subsection numbers (i.e. Section VII.E.8 is now IV.A.4.e, Section VII.C is now IV.A.4.c.2, Section VII.F is now IV.A.4.f, and Section VII.G is now IV.A.4.g, etc.).* *CASQA Recommendation: Edit and correct typographical errors, incorrect or unclear section references, and inconsistencies throughout the Proposed Amendments.*	The headers of Table 17 in the proposed Provisions have been corrected. The Chapter reference for the Tier 3 triggering criteria in Chapter IV.A.2.b. of the proposed Provisions has been corrected to Chapter IV.A.2.e.2). The subchapter reference in Chapter IV.A.4.e.1)d. has been modified to IV.A.4.e.1)a. for clarity. Additionally, the subchapter reference in Chapter IV.A.4.e.1) has been corrected to state "subchapter a below." Appendix A-1 and Appendix A-2 of the proposed Provisions have been revised to show the correct Chapter references, and to correct references in the flowchart.	Yes

2.1	*Comment #1: Require Modifications for TMDLs with Provisions to Consider SQOs. The Proposed Amendments, as drafted, exempt waterbodies with existing TMDLs for the reduction of organochlorine pesticides and PCBs from the requirements associated with the implementation of the human health Sediment Quality Objectives (SQOs) protecting human consumers from contaminants in fish tissue. The Calleguas Creek Watershed is subject to TMDLs for Organochlorine (OC) Pesticides, Polychlorinated Biphenyls (PCBs) and Siltation which includes sediment and fish tissue targets. The TMDL was based on a presumption of a relationship between sediment quality and fish tissue concentrations using information available at the time of TMDL development. However, the TMDL recognized that additional science was being developed and included an explicit discussion about the potential need to update the TMDL based on the development of sediment quality criteria: "the development of sediment quality criteria and other water quality criteria revisions may require the reevaluation of this TMDL." The current state of science used to develop the proposed SQOs far exceeds that of the general screening criteria used as the basis of the CCW OC TMDL development. For TMDLs that included specific discussions of the sediment quality objectives or reopeners based on the development of these objectives, TMDLs should be updated within a certain period of time to be consistent with the SQOs. The Stakeholders respectfully request for the Proposed Amendment Provisions to include a requirement for Regional Water Quality Control Boards (RWQCBs) to update TMDLs for consistency with SQOs within 2 years for all TMDLs that have a provision that discusses updating the TMDL based on SQOs. Recommendation: Modify Provision III.A.1.b.4. to include requirements for RWQCBs to update TMDLs using SQOs when the TMDL includes reevaluation or*	The application of the aquatic life and human health SQO frameworks to inform Total Maximum Daily Load (TMDL) target development was evaluated in Los Angeles and Long Beach Harbors as a test case. While no final decisions by the Regional Water Board have been made, the application was considered successful by the parties involved in the studies. However, reevaluation of each TMDL requires significant time and resources from the applicable Regional Water Board, as well as the regulated community and other stakeholders. The example above required five years and several million dollars, frequent meetings to coordinate, plan, and collect the appropriate data and information for the TMDL reopener and that effort is yet to be completed. The existing language that provides the Regional Water Boards discretion to implement the SQOs in those waterbodies with TMDLs allows the flexibility to address the issue as resources become available.	No

	other provisions that reference modifying the TMDL in response to updates to the SQOs.		
2.2	*Comment #2: Clarification of Procedures for Fish Species Monitoring and Selection. The Stakeholders request modifications to the Proposed Amendment to clarify the procedures and monitoring criteria for the selection of fish species for waterbodies with limited fish species or other monitoring restrictions. The Proposed Amendments make frequent references to fish species, fish size requirements, dietary guilds, and primary and secondary guild species, without additional clarification for the procedures and criteria required for groups to select fish species to monitor should these groups monitor waterbodies with limited fish, both in size and species, or waterbodies with restrictions or prohibitions on sportfishing. For example, although Provision IV.A.2.b.3.4.b specifies that "Fish shall meet sportfish angling size requirements," the Proposed Amendments do not specify how a group should proceed if these size requirements cannot be met. Revisions to the Proposed Amendment, including Provision IV.A.2.b.3 and Appendix A-6, should be made to reflect these needed clarifications. Recommendation: Include language throughout the Proposed Amendments, including but not limited to Provision IV.A.2.b.3 and Appendix A-6, clarifying procedures and criteria for selecting fish species to monitor in waterbodies under conditions with limited fish species or other restrictions on fish monitoring (eg. sportfish size, sportfishing prohibitions). The Stakeholders recommend providing clear direction that two fish species be selected for monitoring, that represent dietary guilds identified in the CSM. The selected fish species should be from the primary species list where possible, but if primary species are not available at the site, secondary species or other species that provide a clear linkage to the site, can be used.*	See responses to comments 1.6, 1.7, 1.8, and 1.9.	No
2.3	***Comment #3: Allow Historic Data to be Used for Tier 1 Assessments Without a Conceptual Site***	See responses to comments 1.10, 1.11, 1.12, and 1.13.	No

	Model. *Provision IV.A.2.b.5 of the Proposed Amendments specifies that, "A conceptual site model (CSM) and study design as described in Chapter IV.A.4.d.5) must be developed prior to data analysis. Sediment and tissue data shall not be used to assess sediments in accordance with this plan, unless they are consistent with the CSM." The Stakeholders respectfully request for the State Board's consideration for the allowance of a Tier 1 Screening Evaluation to be conducted using existing historical data without the development of a CSM. In addition, the Stakeholders request for the Proposed Amendments to be revised such that there are reduced requirements for CSM development for sites where qualifying historical sediment data are available. Some Estuaries in California, such as Mugu Lagoon within the CCW, have been collecting data on fish tissue and sediment for many years. The Stakeholders would appreciate the opportunity to use this data to conduct the initial Tier 1 assessment prior to investing in the development of a CSM. Because the Tier 1 assessments are intended to be conservative, if the thresholds are being met based on historic data that has been collected to characterize the site, there should be minimal risk that the SQOs are not being attained. If the Tier 1 assessment thresholds are not met, then a Tier 2 assessment is required and a CSM would be developed at that time. Recommendation: Remove requirement to do a full CSM before Tier 1 assessment where fish tissue data exist that meet the Tier 1 data requirements or allow for a modified, lower level CSM for Tier 1 assessment of sediment data.*		
2.4	***Comment #4: Clarify Meaning of Tier 1 Assessment Results.*** *The Stakeholders respectfully request modification of the Proposed Amendments to clarify the language regarding the interpretation of Tier 1 Evaluation results. As currently drafted, the Proposed Amendments are not clear on how to interpret the results of the Tier 1 Evaluation. Provision IV.A.2.c.5 states, "If either tissue or sediment is*	Though either sediment or tissue can be used alone, the intent is to state that tissue takes precedence over sediment when both are used in Tier 1. That is, if tissue passes, and sediment fails, sediment quality is unimpacted. If tissue fails then Tier 2 is required, even if the sediment passes. See responses to comments 1.14, 1.15, 1.16, and 1.17.	No

	applied in Tier 1 and the result exceeds the threshold for any constituent, Tier 2 is required for those constituents." The Stakeholders request for this statement to be clarified such that a Tier 2 Assessment only applies if only one of the two media are assessed. However, as currently drafted, this requirement is unclear and could be interpreted to mean that even if both media are assessed, if either one exceeds the threshold for any constituent, Tier 2 is required, in contradiction to both the sentence and bullets that follow (Provisions IV.A.2.c.5.a-d).		
2.5	*In addition to the clarification detailed above, the purpose of the Tier 1 assessment should also include a determination that sediments are not impacted and are meeting the SQOs if a complete site assessment is not warranted. Currently the language states that sediments not requiring a Tier 2 determination are "not degraded" and "not impacted", but the determination of meeting the SQOs under Tier 2 uses the terminology "unimpacted". The language should be consistent throughout the document so it is clear that sediments not requiring a Tier 2 assessment because the are less than or equal to the Tier 1 thresholds are considered "unimpacted" and thereby attain the SQOs.*	See responses to comments 1.14, 1.15, 1.16, and 1.17.	No
2.6	*Recommendation: Revise the second paragraph of Provision IV.A.2.c.5. If ~~either~~ only tissue or only sediment is ~~applied in~~ evaluated in Tier 1 and the result is above the threshold for any constituent, Tier 2 is required for ~~those~~ the constituents above Tier 1 thresholds.*	See responses to comments 1.14, 1.15, 1.16, and 1.17	No
2.7	*Revise the first paragraph of Provision IV.A.2.c.1. If potential chemical exposure is below this level, sediments are ~~not degraded~~ unimpacted and there is no reason to perform more detailed assessment (either Tier 2 or Tier 3).*	See responses to comments 1.14, 1.15, 1.16, and 1.17.	No
2.8	*Revise bullets a-d of Provision IV.A.2.c.5. a. If both tissue and sediment result ~~falls~~ are equal to or below the threshold, the chemical exposure associated with the sediment and tissue is acceptable and the sediment quality is ~~not impacted~~ unimpacted. b. If*	See responses to comments 1.14, 1.15, 1.16, and 1.17.	No

	tissue results fall below the threshold and sediment equals or exceeds is above the threshold, the chemical exposure is acceptable and the sediment quality is not impacted unimpacted. c. If sediment results fall are equal to or below the threshold and tissue equals or exceeds is above the threshold, a Tier 2 assessment is required. d. If both sediment and tissue results equal or exceed are above the threshold, the chemical exposure to consumers is unacceptable and a Tier 2 assessment is required.		
2.9	***Comment #5: Remove Requirement for Regional Board Approval to Conduct Tier 3 Assessment.*** *The second paragraph of Provision IV.A.2.e states that "Tier 3 may be performed at any time with approval from the Regional Board provided that Tier 2 is completed at the same time." The Stakeholders believe that approval of Regional Board should not be required to conduct Tier 3 analysis. A Tier 3 assessment is a more complex and site-specific assessment, and one that should be pursued if a group sees it fit to do so. Although it is appropriate to solicit Regional Board involvement and concurrence on study design of a Tier 3 assessment and for the Regional Board to retain its ability to accept or reject the results of a Tier 3 assessment, the Stakeholders believe that any group should be able to pursue a Tier 3 analysis if so desired and meet triggering criteria in Provision IV.A.2.e. 2.*	See response to comment 1.19.	No
2.10	*Recommendation: Revise the second paragraph of Provision IV.A.2.e as follows: Tier 3 may be performed at any time ~~with approval from the Regional Board~~ provided that Tier 2 is completed at the same time. A change in any parameter or model from that used in Tier 2 must be justified based on site conditions in comparison to Tier 2 assumptions and values, and approved by the Regional Board prior to performing the analysis.*	See response to comment 1.19.	No
2.11	***Comment #6: Clarify that higher fish consumption guidelines shall only be used in areas with designated subsistence beneficial uses.*** *The*	The proposed Provisions have been revised to state that the use of subsistence and tribal subsistence thresholds shall only be applied to those waters designated to	No

	Stakeholders respect the State Board's use of a different OEHHA guideline, one with high frequency of fish consumption, when considering subsistence fishers and their exposure to human health risks (Provision IV.A.2.e.3). However, the Stakeholders think the use of these higher frequencies should be applicable only for waterbodies with beneficial use designations for subsistence fishing. The State Board recently adopted new beneficial use of subsistence fishing, but have not assessed the designation for most waters. Designation should be required before the higher consumption frequency OEHHA rates are used to ensure the beneficial use is present.	support Subsistence and/or Tribal Subsistence Uses. See response to comment 1.20.	
2.12	*Recommendation: Clarify higher OEHHA fish consumption thresholds for subsistence fishing should only be applicable if a waterbody has a designated subsistence fishing or tribal subsistence fishing beneficial use designation.*	The proposed Provisions have been revised to state that the use of subsistence thresholds shall only be applied to those waters designated to support Subsistence and/or Tribal Subsistence Uses. See response to comment 1.20.	No
2.13	**Comment #7: Modify Provisions on Implementation of Sediment Quality Objectives to Determine Exceedance of Receiving Water Limits.** According to Provision IV.A.4.c.2.a (Exceedance of Receiving Water Limit to protect aquatic life), an exceedance occurs when "any station within the site is assessed as Clearly Impacted…or if the total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a permit cycle." According to Provision IV.A.4.c.2.b (Exceedance of Receiving Water Limit to protect human consumers of sportfish), an exceedance occurs when "the site sediments are characterized as Possibly Impacted, Likely Impacted or Clearly Impacted." While we support the inclusion of "any station that is Clearly Impacted", we request that the term "Possibly Impacted" be removed from these provisions. "Possibly Impacted" does not clearly demonstrate impacts or the likelihood of impacts and therefore should not be used to establish a violation of a receiving water limit.	See response to comment 1.22.	No

2.14	*Additionally, we request that the "15 percent" areal criterion for Possibly Impacted and/or Likely Impacted determinations from Provision IV.A.4.c.2.a be modified to criterion that better reflects that the majority of the site is impacted. 15% is a small area and could represent local sources or impacts, making it inappropriate to determine a receiving water "exceedance" for all dischargers to a site.*	See response to comment 1.23.	No
2.15	*Recommendations: Remove "Possibly Impacted" from this provision. Modify the 15% percent areal criterion for Likely Impacted sites to be the majority of sites for the waterbody.*	See responses to comments 1.22 and 1.23.	No
2.16	***Comment #8: Modify Provisions on Implementation of Sediment Quality Objectives for Evaluating Waters for Placement on the Section 303(d) List.*** *Provision IV.A.4.e.1.a. and IV.A.4.e.1.b. include provisions for listing waterbodies that are "Clearly Impacted", "Likely Impacted", and "Possibly Impacted" per the SQO assessment requirements. While we support the inclusion of waterbodies with "Clearly Impacted" and "Likely Impacted" sites on the 303(d) list, we request that the term "Possibly Impacted" be removed from this provision. "Possibly Impacted" does not clearly demonstrate that waters are degraded and additional monitoring should be conducted prior to designating these waters as impaired and placing them on the 303(d) list (Category 5 of the California 303(d)/305(b) Integrated Report). Rather, these waterbodies should be placed in Category 3 of the Integrated Report. Category 3 contains waters for which there is insufficient data to make a use support decision. The designation of "Possibly Impacted" indicates that additional monitoring and information is needed to identify if impacts are occurring at the site. Therefore, it would be appropriate to place these waterbodies into Category 3 rather than making a determination that the site is impaired and placing it on the 303(d) list.*	See responses to comments 1.22, 1.24, 1.26, 1.28, 11.13, 11.14, and 11.15.	No.
2.17	*We support the provision specifying the use of data from the most recent 303(d) listing cycle for the SQO*	Comment noted.	No

	site assessments and the requirements for data to be collected from multiple spatially representative stations and multiple surveys over the span of at least one year to make listing decisions.		
2.18	*Recommendations: Place “Possibly Impacted” sites in Category 3 of the Integrated Report rather than on the 303(d) list.*	See responses to comments 1.22, 1.24, 1.26, 1.28, 11.13, 11.14, and 11.15.	No
2.19	*In Section IV.A.4.e.1.d, reference to “subchapter i above…” should be revised to “Section IV.A.4.e.1.a.i, above…” for clarity.*	See response to comment 1.36.	No
2.20	Finally, the Stakeholders support the State Board’s use of Office of Environmental Health Hazard Assessment (OEHHA) Advisory Tissue Levels within the Proposed Amendments. Advisory Tissue Levels (ATLs) correspond to the range of contaminant concentrations found in fish and are used to provide consumption advices taking into account the average daily reference dose for non-carcinogens and a risk level of no more than one additional cancer case in 10,000 people consuming fish over a life-time. ATLs are designed to encourage consumption of fish that are likely to provide significant health benefits, while discouraging consumption of fish that is likely to pose a hazard for human health. ATLs are used as part of the process to develop traditional health advisories (which focus on fish whose consumption should be avoided) as well as the newer “safe eating guidelines,” which inform consumers of fish with low contaminant levels considered safe to eat frequently. OEHHA’s advisories have also been identified as a metric in California’s Water Quality Control Policy.	Comment noted.	No
3.1	The provisions are well presented, researched and documented in both documents. Care was taken to explain the rationale and process for selection of numerous decisions, each required to develop sediment quality objectives for human health.	Comment noted.	No
3.2	**1. Receiving Water Limits Monitoring Frequency** In Section 6.7.3., the Staff Report recommends reducing the monitoring frequency from a minimum of twice per Permit cycle (5 year cycle) to once.	The requested change was made consistent with the staff report recommendation. See Chapter IV. A.4.c.3) a of the proposed Provisions	Yes

	However, the Provisions still require sampling twice per permit cycle (IV.A.4.c.2.a). Please correct this inconsistency. ***Recommendation 1:*** Modifying existing language in Staff Report Section 6. 7 .3 as follows: Phase I Stormwater Discharges and Major Discharges - Sediment Monitoring shall not be required less than once per permit cycle.		
3.3	2. Protective Condition The State Water Board defines the Protective Condition for the direct effect SQQs as categories Unimpacted or Likely Unimpacted. Additionally, Possibly Impacted may also be considered as meeting the Protective Condition based on the result of stressor identification studies (Provisions, Section IV.A.1. i.4). However, the indirect effect SQQ site assessment (Provisions, Section IV.A.2. d.8) states that only the Unimpacted and Likely Unimpacted categories meet the Protective Condition. The Protective Condition when implementing the direct effects SQQs has been defined by the State Water Board as categories Unimpacted or Likely Unimpacted. Section 6.5.8, Page 100 of the Staff Report, final sentence, states that "for consistency, the proposed amendments rely on the same delineation of impact that is applied in the approach used to evaluate direct effects." Please provide additional justification as to why the Possibly Impacted category is not included as a protective condition for the human health SQQs, which would be consistent with the direct effects SQQs. Recommendation 2: Recommend that the Possibly Impacted category for human health SQQs should be treated as in the existing direct effects SQQ, and require follow-up actions to determine if an impairment is present or not prior to determining that the site is not protective of beneficial uses.	Section 6.5.8 of the Staff Report states "*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."* The first sentence clearly states that Unimpacted and Likely Unimpacted were designated by the State Water Board to represent the protective condition for interpretation of aquatic life. The State Water Board made this decision in 2008 at the time the aquatic life SQO was adopted. The category Possibly Impacted is not included in that definition. The existing provisions for direct effects SQO do allow a Regional Water Board to make a finding that stations categorized as Possibly Impacted are unimpacted if the body of evidence indicates that other stressors (e.g. not resulting from exposure to toxic pollutants) are causing the biological effects. For the human health assessment framework, the framework does not require stressor identification as the contaminant of concern is present in tissue and sediment. The framework does provide flexibility to proceed to Tier 3 is a permittee or responsible party has reason to believe a more site-	No

		specific approach is necessary to better assess the sediment quality at a particular site.	
3.4	**3. Sediment Category Concentration Scores for the CSI (Direct Effects SQQ)** Provisions page 11, Table 6 includes the concentrations ranges and weights to score the disturbance category for sediment chemistry. The concentrations ranges have been modified in several instances, particularly for DDDs, DDEs, and DDTs. Please provide justification for the change in ranges, as some ranges have become more restricted while others are broader.	Prior to adoption of the amendment to the Enclosed Bays and Estuaries Plan in 2011, Resolution No. 2011-0017, errors in Table 6 were identified that consisted of incorrect concentration ranges and weighting factors for several constituents: zinc, high molecular weight PAHs, DDDs, DDEs, and DDTs. These errors were identified as a result of a reanalysis by the Southern California Coastal Water Research Project (SCCWRP) of a subset of data used in the development and evaluation of the chemical score index (CSI). The data analyst was unable to replicate the exact results for the chemistry Lines of Evidence (LOE) score, and subsequent investigation revealed that the calculated values for the CSI varied between the two sets of results. Further investigation revealed that the source of variation was associated with calculation of category scores for DDDs, DDEs, and DDTs. This finding prompted a thorough review by SCCWRP of the derivation and calculation of the CSI index. This review identified the source of the error was due to a mistake in calculating the sum of DDDs, sum of DDEs, and sum of DDTs in the data set used for index development. The mistake involved the use of incorrect computer programming code in calculating these sums in an early stage of development of the data set. This error was not detected during the course of index development because all subsequent checks of the calculations used the incorrect data set as a reference. Resolution of the error in the CSI index development consisted of developing a corrected chemistry data set and repeating all of the data analyses used to develop the category score concentration ranges and weighting factors used to calculate the final CSI value. This reanalysis used the same data and same statistical methods used in the original derivation of the CSI parameters. These analyses produced the revised concentration ranges and weighting factors for DDDs, DDEs, and DDTs shown in Table 6 of the 2011 Staff Report for the amendment to the Enclosed Bays and	No.

		Estuaries Plan. Concentration ranges and weights were also recalculated for other chemical constituents, and these values were the same as those adopted by the State Water Board in 2009. However, in the course of double-checking all values in Table 6, minor variations in the ranges for zinc and high molecular weight PAHs were found that were likely the result of variations in the method used for rounding numbers. These small corrections were also included in the revised version of Table 6 to provide the highest level of consistency with the data analysis results. The changes to the CSI chemical concentration ranges have the potential to impact the station assessment results, as values for multiple components of the index were changed. To document the actual impact, station assessment results were compared using the original and revised CSI parameters for a large number of stations that were used in previous evaluations of the SQO assessment framework. These data were compiled from multiple regional monitoring surveys. The results of the comparison are summarized in Table 1 at the end of this document. Station assessment results varied for 1% (three stations) of the 277 samples analyzed and showed no consistent trend. These results indicate that the effect of the changes to the CSI parameters are minor with respect to other sources of variation associated with sediment quality assessment. These changes were first proposed in January of 2011; however, these changes were not carried through in the final draft considered and adopted by the State Water Board. https://www.waterboards.ca.gov/water_issues/programs/bptcp/docs/sediment/012811app_a.pdf	
3.5	**4. Fish Home Range Comments** 4.1 The fish home range assumptions and requirements for both the Tier 1 and Tier 2 human health SQOs are specific for the primary species for each fish dietary guild. However, Table 17 in Section IV.A.2.c.4 of the Provisions and the associated text do not explicitly state that the guilds should be used for secondary fish species during an estimate of the	The secondary species tissue would only be applied as surrogates for the primary species tissue. Species names have been removed from Table 17 except for white catfish to minimize confusion regarding applicability to secondary species. All model based assumptions are predicated on the primary species and the food web associated with that species.	No

	sediment evaluation. The inclusion of the primary fish species in the headers of the table is also confusing, leading the reader to assume that the biota sediment accumulation factors (BSAFs) included in the table apply only to the primary fish species. Please clarify the intent and use of secondary fish species.		
3.6	***Recommendation 4.1:*** The Staff Report, Table 6.5 includes the estimated home range for the primary species from each guild. Please explain how the use of secondary species home range will be addressed. If the primary species information will be used to represent the guild, and the user has information specific to the home range of a secondary species, is it allowable to update the model with that information, instead of relying on the primary species home range?	See response to comment 3.5. Additionally, food web and home range are based on primary species. Secondary species are expected to have similar exposure associated with trophic transfer because of similar feeding preferences (same dietary guild). If the user desires to model the secondary species as an alternative to the primary species, then a Tier 3 assessment results and alternative home range information may be used with approval of the Regional Water Board.	No
3.7	**5. Site Size Requirements** The identification of the site size is an important' consideration in the development of the conceptual site model (CSM) and in conducting the human health effects SQQ assessment. Page 119 of the Staff Report and Page 54 of the Provisions indicate that a minimum site size of 1 km2 is required. However, limited justification for this requirement is included in the text. Additionally, it is quite likely that sites less than 1 km2 may be required, especially at the mouths of small rivers that have an estuary or marine beneficial use, along with commercial fishing, shellfish, or aquaculture beneficial uses.	The standardized Tier 2 assessment performs best when the majority of foraging activity occurs within the site. The 1 km^2 requirement is intended to ensure this situation is present by limiting minimum site size to an area similar to or greater than most primary species foraging area. Assessment of smaller sites requires a different bioaccumulation model as part of Tier 3. This supporting information was included in Appendix A-5.	Yes
3.8	***Recommendation 5.1:*** Please include additional justification for the establishment of a 1 km^2 minimum site area in both the Staff Report and Provisions (Page 119, before Table 7.1 and Appendix A-5, respectively).	See response to comment 3.7.	No
3.9	***Recommendation 5.2:*** Please include the following suggested language in the Provisions (Page 54, Appendix A-5); A minimum site area of 1km^2 is recommended for Tier 2 assessment, as this area encompasses a large portion of the forage range for most of the primary sportfish species for the assessment. However, a smaller site may be identified	See response to comment 3.7.	No

	based on site specific characteristics and with the approval of the local Regional Board.		
3.10	**6. Site Assessment and Human Health Risk Factors** In Table 7.1 of the Staff Report (Page 119) the fractional uptake from the site is noted as 1. This assumption essentially assumes that each angler or consumer of fish consumes all of their fish or seafood from that site. This assumption is highly conservative. Is a Tier 3 human health SQQ required to modify this ratio? If existing data are available to justify a revised ratio (angler study or similar) can a lower ratio be used in a Tier 2 assessment? Please provide additional justification for this assumption in the Staff Report and provide the flexibility to use a lower ratio based on justifications that are approved by the local Regional Board.	The assumption is inappropriate for Tier 2 when there is no basis or data to support a fractional uptake value of less than 1.0.	No
3.11	**7. Tissue Types used to Assess Chemical Exposures** On Page 74, Section 6.2.4 of the Staff Report, there appears to be a typo; Alternative 3 is selected as the staff recommendation. However, the associated text and Appendix A, Table A-6 include fish species with the designation of "F" or skin off and also some whole fish analyses, which matches Alternative 4, not Alternative 3.	Section 6.2.4 of the Staff Report has been corrected to accurately reflect staff recommendation of Alternative 4.	Yes
3.12	***Recommendation 7.1:*** Revise Staff Recommendation to Alternative 4.	See response to comment 3.11.	No
3.13	***Recommendation 7.2:*** Address the typo in the reference of the staff recommendation in Section 6.2.4, it should reference Appendix A, A-6, not C-6.	The Appendix reference in Section 6.2.4 of the Staff Report has been corrected to Appendix A-6.	Yes
3.14	**8. Conservative Assumptions for Sediment and Tissue Based Assessment** Section 6.4.1 of the Staff Report recommends the use of the 95th percent upper confidence limit (UCL) as a conservative measure of either sediment or tissue data for use in comparison with sediment and/or tissue thresholds in a Tier 1 assessment. The use of the 95th percent UCL is poorly supported, particularly as the methodology for the state of Oregon is referenced as	Tier 1 is intended to be conservative and protective by requiring a Tier 2 assessment when there is any potential for impact in Tier 1. The 95th percent upper confidence limit (UCL) is commonly used in regulatory programs to provide a conservative margin of safety. The State Water Boards' California Ocean Plan requires 95th percent UCL for reasonable potential analysis, as does the Department of Toxic Substances Control in the Preliminary Endangerment Assessment (PEA) Guidance Manual.	No

	an existing and effective program that utilizes the 90th percent UCL.	From a national perspective, United States Environmental Protection Agency (U.S.EPA) applies the 95th percentile UCL as default value for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site cleanups and in their statistical software ProUCL. Other states also use the 95th percentile as a default value. See references below for details: 2015 California Ocean Plan https://www.waterboards.ca.gov/water_issues/programs/ocean/docs/cop2015.pdfhttps://www.waterboards.ca.gov/water_issues/programs/ocean/docs/cop2015.pdf California Department of Toxic Substances Control (1994, Revised October 2015) Preliminary Endangerment Assessment (PEA) Guidance Manual https://www.dtsc.ca.gov/PublicationsForms/upload/PEA_Guidance_Manual.pdfhttps://www.dtsc.ca.gov/PublicationsForms/upload/PEA_Guidance_Manual.pdf USEPA, 1992 Supplemental Guidance to RAGS: Calculating the Concentration Term https://semspub.epa.gov/work/05/168975.pdfhttps://semspub.epa.gov/work/05/168975.pdf USEPA (2015) ProUCL Version 5.1 Technical Guide Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-guide.pdfhttps://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-guide.pdf State of Connecticut Department of Energy and Environmental Protection (2014) Guidance for Calculating the 95% Upper Confidence Level for Demonstrating Compliance with the Remediation Standard Regulations http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/95ucl_guidance.pdfhttp://www.ct.gov/deep/li	

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3.15	***Recommendation 8:*** Please expand the justification for why a more conservative approach than the 90th percent UCL utilized by the state of Oregon is appropriate. Also, please include procedures to allow for the proper analysis of sediment data for outliers, data distribution, and high variability. These factors should be included and assessed prior to the estimation of the UCL, as the assumption of a normal distribution may result in incorrect estimates of risk.	See response to comment 3.14 regarding the use of the 95^{th} percent UCL. There is the possibility that data will not be normally distributed or that outliers will be present in the data set. There are a variety of nonparametric methods and methods to test for outliers that can be applied to the data prior to completing the Tier 1 analysis. The ProUCL software described in the previous response is just one example of software that could perform these functions. Selection of methods and use of software are left to the discretion of the end user.	No
3.16	The following language is proposed to supplement Section 6.4.1: The 90th (or 95th) percent UCL shall be used to conduct the Tier 1 assessment, after the data have been examined and tested for statistical outliers and tested to determine if the dataset is normally distributed. If the data are not normally distributed, the data may be log transformed and tested for normality. If the data are not log-normally distributed, non-parametric measures of the UCL may be adopted as the basis for comparison with the sediment and/or tissue thresholds.	See response to comments 3.14 and 3.15. These analyses may be conducted but are not included as a requirement to complete Tier 1.	No
4.1	First, how will it be determined whether an upstream source may be impairing an estuary and/or enclosed bay?	The SQO would be used to assess sediment quality within enclosed bays and estuaries. If sediment quality is monitored and found to exceed the SQO, the Regional Water Board will initiate an assessment of all probable sources. That evaluation will typically begin within the waterbody itself. If the evidence points to upstream sources, then the Regional Water Board has the authority to initiate an assessment of potential upstream sources. The determination would be made based on the loads that all sources are contributing. Where only one or two sources are contributing, the water quality may be improved by amending the permits associated with the sources. Where many sources are contributing, a TMDL may be developed to better address all sources and provide waste load allocations and load allocations.	No

4.2	From my understanding, source designation and allocations will be based upon a model. How will the model's resolution be verified? Often, on the Central Coast, we find that model resolution is too simplistic for our diverse conditions. What if the model does not reflect the subtleties of a highly nuanced ecosystem? Is the model, then, improved? Or does this mean that policy, and subsequent regulations, will be based upon a model, regardless of its sufficiency? Is potential mischaracterization inherently built into this policy?	The framework is only intended to determine if in-place bedded sediments are exceeding the SQO. Identifying sources and allocating loads requires additional studies that the proposed framework is not intended to address. See response to comment 4.1.	No
4.3	Finally, what is the "obligation point of compliance" for an upstream non-point source? It is unclear. This issue is critical for a policy that applies to one area through nexus to another area. As written, the policy leaves regulatory staff with interpretative leeway and the regulated community with great uncertainty.	Upstream sources would not be affected or required to monitor, unless the Regional Water Board found that sediment quality is impacted and that sources upstream may be contributing to the degradation of sediment quality.	No
5.1	1. Proposed amendments to the Sediment Quality Provisions draft document (Page 3, III.A.1.b.1) Proposed provisions supersedes all applicable narrative water quality objectives and related implementation.	Correct, the proposed Provisions supersedes all applicable narrative water quality objectives and related implementation.	No
5.2	LASAN request clarification on the impact the proposed amendment would have on the existing Terminal Island Water Reclamation Plant (TIWRP) NPDES permit.	If the Regional Water Board finds that the discharge has the reasonable potential to cause or contribute, the SQOs shall be incorporated as receiving water limits. All sampling, analysis, and assessment would have to comply with the proposed Provisions.	No
5.3	LASAN seeks to clarify the anticipated timeline for the implementation of the proposed amendment and whether this will impact the existing provision in the current NPDES permit.	National Pollution Discharge Elimination System (NPDES) Permits are typically updated during the regularly scheduled renewal. At that time the applicable Regional Water Board would make a determination described in response to comment 5.2 and to incorporate any applicable measures included in the proposed Provisions.	No
5.4	2. Proposed amendments to the Sediment Quality Provisions draft document (Page 7, IV. A. e. and Page 19, b.3.4) LASAN suggests replacing "California Department of Health Services" with SWRCB-Environmental	Chapters IV.A.1.e and IV.A.2.b.4) of the proposed Provisions have been changed to appropriately reflect that the Environmental Laboratory Program is a part of the State Water Board.	Yes

	Laboratory Accreditation Program (ELAP) in accordance with Water Code Section 13176.		
5.5	3. Proposed amendments to the Sediment Quality Provisions draft document (Pages 11-12, h. Tables 6-7) Definition of 'PAHs,' total high MW,' 'PAHs,' and 'total low MW' Tables 6 and 7, in the Proposed amendments to the Sediment Quality Provisions draft document, categorizes PAHs as 'total high MW' and 'total low MW,' but a clear definition as to which of the 18 PAHs in Appendix A-3 constitute each class is not provided. Typically, PAHs with 3 or fewer rings are described as low MW.	The table in Appendix A-3 of the proposed Provisions has been revised to clarify the low and high molecular weight PAHs.	Yes
5.6	LASAN notes that it would be best to explicitly state which of the PAHs constitute each "total," and seeks clarification on which of the PAHs constitute each class. LASAN further suggests that a clear definition be provided in the glossary and perhaps a notation be made in Appendix A-3.	See response to comment 5.5.	No
5.7	4. Proposed amendments to the Sediment Quality Provisions draft document (Page 13, 2.b.3) Sampling Procedure The language in this section notes that "Surface sediment from within the upper 5 cm shall be collected for chemistry analyses." However, the Proposed amendments to the Sediment Quality Provisions direct that sediments samples should be collected concurrently with fish collection for DDTs, PCBs, chlordane, and Dieldrin analysis. LASAN notes that the field sample collection suggested will be extremely difficult and requests either a clarification or be removed.	The proposed Provisions do not require that sediment and fish tissue sampling be conducted concurrently. However, the sediment and tissue sampling should be conducted over the same time of the year and preferably during the same monitoring cycle. The reference on page 13 could not be found and a word search for "concurrently" in the proposed Provisions was unsuccessful.	No
5.8	5. Proposed amendments to the Sediment Quality Provisions draft document (Page 16, Tables 12 and 13) Sublethal effects In the Proposed amendments to the Sediment Quality Provisions draft document, sublethal toxicity methods	The sublethal sediment toxicity testing is an important component of the multiple line of evidence approach adopted in the Enclosed Bays and Estuaries Plan in 2008 for marine bays (see Chapter IV.A.1.f.). Chapter IV.A.1.i of the proposed Provisions describes the tools and indicators that are applicable to lower salinity waters and	No

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	are not included in tools for use in the evaluation of LOEs; yet, it is listed as a LOE in IV.A.f.2 (page 8). LASAN suggests removing sublethal test methods as a requirement since sublethal methods are not used as LOE.	those habitats where benthic tool development were hampered by limited data. For those waters, only acute (survival) testing is required using the two species listed in Table 12 of the Provisions. These Provisions were adopted in 2008 and the commenter may refer to that State Water Board action and associated documents for a detailed description of the rationale and basis.	
5.9	6. Proposed amendments to the Sediment Quality Provisions draft document (Pages 18, 20, 26, 57, and 67) Definition of chlordane, 'sum chlordane,' and 'sum PCB' LASAN notes that 'chlordane,' 'sum chlordane,' and 'sum PCB' that are some of the nonpolar chlorinated hydrocarbons, have been used without being defined. LASAN seeks clarification and suggests definitions in either a footnote or in the glossary (e.g., sum chlordane to mean the sum of five chlordanes: alphachlordane, gamma-chlordane, etc.; sum of PCB means the sum of 54 PCB congeners).	These terms have been standardized in the text and have been defined in the Glossary (Chapter V of the proposed Provisions).	Yes.
5.10	7. Proposed amendments to the Sediment Quality Provisions draft document (Page 19, Page 19, 5, and Page 53, Appendix A-5, paragraph 1) Study design, work plan, and conceptual site model The Proposed amendments to the Sediment Quality Provisions note that "Before commencing with sample collection, a study design and work plan must be developed and approved by the Regional Board…" In part 5, it further directs that "A conceptual site model (CSM) and study design must be developed…" LASAN seeks to clarify the anticipated timeline for the implementation of the proposed amendment and whether to commence developing the plans, designs, and model for LA Outer Harbor.	While the proposed Provisions would become effective upon approval from U.S. EPA, the Regional Water Boards typically amend permits to include changes to Water Quality Control Plans during the regularly scheduled permit renewal, which occurs in five-year cycles.	No
5.11	8. Proposed amendments to the Sediment Quality Provisions draft document (Page 26, d.2.c) Tissue Analysis	See response to comment 1.5. A minimum of one species each from a minimum of two dietary guilds is required. End users are not required to collect and sample all	No

	The Proposed amendments to the Sediment Quality Provisions note that "*Tissue from the primary species for each dietary guild shall be used in the analysis*" and the Primary species are listed including the *White Catfish* and *Common Carp*. LASAN is concerned that the *White Catfish* and *Common Carps* species are rare to nonexistent in LA Outer Harbor. Moreover, it will be difficult to achieve the remaining dietary guild primary species needed for minimum number of individuals per composite.	primary species. The primary species list encompasses sportfish species from enclosed bays and estuaries throughout California including some freshwater species that may not occur in marine bays or lagoons, but are present in lower salinity estuaries. If the species is not present in the waterbody, then that species would not be considered for analysis.	
5.12	In relation, LASAN suggests that the two species be removed from the list and clarification be provided.	See response to comment 5.11. White Catfish and Common Carps have not been removed from the primary species list. While these species may be rare, they may be present in some waterbodies being assessed. Only those species present in the waterbody should be considered for analysis.	No
5.13	9. Proposed amendments to the Sediment Quality Provisions draft document (Page 50, Appendix A-3) Percent Fines Among the list of chemical analytes needed to characterize sediment contamination exposure and effect provided in the table on the Proposed amendments to the Sediment Quality Provision draft document (Appendix A-3) is 'Percent Fines.' LASAN seeks clarification and clear direction on a specific procedure[s] to determine 'Percent Fines.'	The term "percent fines" describes the percent of clay and silt fraction by weight in an aggregate sample, where the remaining material in the sample is the size of sand and gravel. The higher the percentage of fines in a sample, the more likely the sample will contain organic carbon and contaminants. Standard analytical methods are widely available and should be specified by the regulatory agency. The "percent fines" has been clarified in Chapter III.A.1.d.1) of the proposed Provisions.	Yes
5.14	10. Proposed amendments to the Sediment Quality Provisions draft document (Page 2, II.A. Table 1; Page 5, III.A.2.c; Page 7, f.1; Page 8, f.1. ; Page 13, Table 10 (caption) Typo LASAN suggests considering using one word "Sportfishing" instead of "Sport fishing." Compare to "sportfish tissue" in III, A., 1, b, 4 (last paragraph)	In order to be consistent with recent State Water Board decisions, the term "Sport fishing" will remain two words. However, the proposed Provisions have been revised to correct the following terms: "wildlife," "short-term," and "chemically-meditated" in Chapter III.A.2.c., Chapter IV.A.1.f., Table 2, and Table 10.	Yes

	LASAN suggests considering using one word, “Wildlife.” LASAN suggests considering using one hyphenated word, “Short-Term.” LASAN suggests considering using one hyphenated word, “Chemically-Mediated.”		
6.1	Part 1 of the SQO guidance, adopted by the Board in 2008, was limited to a narrative SQO for protection of benthic communities and associated implementation guidance. The subject amendments make limited modifications to this existing guidance, add a significant new narrative SQO and implementation guidance for protection of human health, and provide program specific implementation guidance for the resulting combined benthic community and human health assessment. The new implementation guidance is far-reaching, with applications in dredge material management, NPDES permitting, sediment monitoring and site assessment, and evaluation of waters for listing as impaired under the State’s Clean Water Act Section 303(d) list.	The proposed Provisions continue to address the same program areas as previous SQOs adopted by the State Water Board and are intended to parallel the existing SQO Provisions as much as possible.	No
6.2	**Existing problems with benthic SQOs have not been addressed and have been made more problematic by the proposed amendments and new guidance.** There were already a number of serious technical flaws and deficiencies in the metrics and methods of the multiple line of evidence approach used to assess potential impacts to benthic macroinvertebrate (BMI) communities under the existing Part 1 SQO guidance. Generally speaking, these have not been addressed by the proposed revisions. Furthermore, the potential negative implications of these flaws have been made more severe by additions to guidance that stipulate uses of SQO BMI community station scores for specific regulatory purposes, including Clean Water Act 303(d) impairment listing, and assessment of possible permitted discharge limit exceedances.	This comment is outside of the scope of the proposed Provisions. The benthic community tools in the Provisions were adopted through a previous State Water Board action, Resolution 2008-0070. However, in accordance with the Federal Clean Water Act Section 303(c) and Water Code section 13240, all Water Quality Control Plans must undergo a triennial review. The commenter may submit these comments during the triennial review of the Water Quality Control Plan containing the Sediment Quality Provisions.	No
6.3	These technical flaws include:	See response to comment 6.2.	No

	• Reliance on categorical chemical concentration thresholds that lack a sound scientific or statistical basis to characterize the sediment chemistry leg of the BMI triad assessment. • Lack of provision for incorporating empirical measures of bioavailability into the sediment chemistry line of evidence (e.g., equilibrium partitioning models, passive samplers). • Lack of consideration of site-specific background levels to characterize the chemistry line of evidence using the default numeric response values. • Use of four complex numerical metrics of benthic community disturbance to characterize the community structure leg of the BMI triad assessment, without interpretation or inclusion of traditional community structure endpoints (e.g., species richness, diversity, individual taxa abundances). All of these metrics rely on internal categorical threshold comparisons rather than comparison to site specific reference conditions.		
6.4	Failure to consider or even acknowledge comparison to site-specific reference conditions as a necessary component of the community structure line of evidence, when using the default numeric response values. • Lack of requirement for replication or statistical analysis of variability between replicate benthic community samples at a station or between stations. • Lack of site-specific reference comparisons in laboratory toxicity bioassays used to characterize the sediment toxicity leg of the BMI triad assessment. Under the method guidance, test sample results are compared only to negative controls, not reference sample results. • Non-standard statistical comparisons between test sample results and negative controls. Under this guidance, tested samples can be classified as “toxic”, even when the results are NOT significantly different from controls. • Biased methods used to combine multiple metrics for all three sediment triad assessment lines of evidence	See response to comment 6.2.	No

	that overstate the actual metric findings (i.e., rounding up of all categorical metric means or medians in a given line of evidence). • Inability to consider non-chemical stressors in the interpretation of station scores (i.e., presumption of chemical causation). • Failure to appropriately acknowledge or characterize the high levels of uncertainty in constituent metric of SQO lines of evidence, let alone the multiple line of evidence station scores.		
6.5	Details on these and other technical deficiencies have been well documented, and have been known to the Board since well before Part 1 SQO adoption (see CA Chambers of Commerce 2007), and are not fully replicated here. However the stipulation of use of Part 1 SQO station scores as 303(d) listing criteria thresholds and NPDES receiving water limits makes these known deficiencies more problematic (see implementation comments below).	See response to comment 6.2.	No
6.6	To a significant degree, uncertainties and technical deficiencies associated with the benthic SQO assessment process are problematic because the guidance is so rigid, without allowance for consideration of unique Site-specific factors.	See response to comment 6.2. The existing Provisions include flexibility to account for site-specific factors in the benthic SQO assessment process. The benthic SQO relies on multiple lines of evidence to make a determination of sediment quality. Once sediments are designated as impacted, a site-specific study is required to determine the stressors causing the toxicity or community degradation. This rationale is well documented in the proceedings for the 2008 adoption of the Enclosed Bays and Estuaries Plan.	No
6.7	In development of the new human health SQO process, the Board has recognized the need for integration of Site-specific considerations through incorporation of a tiered assessment process, whereby rapid, default methods may be modified at higher tiers of assessment to address unique Site-specific conditions, which may result in exposures different from the default assumptions. Incorporation of similar options to develop a higher tier of benthic community	Site-specific analysis would allow greater flexibility; however, the benthic tools have all been peer reviewed and calibrated for the specific environments where they are being applied. The rationale and basis for these tools is well documented in the proceedings for the 2008 amendment to the Enclosed Bays and Estuaries Plan.	No

	assessment would enhance and improve the reliability of the current benthic SQO framework.		
6.8	For example, use of alternative Site-specific reference comparisons for benthic community metrics at Sites that have highly modified benthic environments would be helpful in understanding the role that sediment chemistry does or does not play in apparent community disturbance, or when community metrics disagree.	As described in response to comment 6.6, the study, or comparisons, suggested are consistent with the types of studies that could be conducted for stressor identification. Stressor identification is necessary to ensure that the stressors causing biological effects are identified and prioritized for effective management. The important role of stressor identification is well documented in the proceedings for the 2008 amendment to the Enclosed Bays and Estuaries Plan. See Chapter IV.A.4.f.	No
6.9	Recommendation: The existing SQO metrics and multiple line of evidence paradigm should be critically reviewed and documented scientific weaknesses should be addressed. Due to uncertainty, unreliability, and conservative bias, the current form of the benthic SQO station scores are useful only as an advisory line of evidence, not as automatic regulatory action levels.	This comment is outside of the scope of the proposed Provisions. However, in accordance with the Federal Clean Water Act Section 303(c) and Water Code section 13240, all Water Quality Control Plans must undergo a triennial review. The commenter may raise similar comments during the triennial review of the Water Quality Control Plan containing the Sediment Quality Provisions.	No
6.10	The Board should expand the flexibility that is explicitly included in the new human health SQO guidance (i.e., the tiered approach) to apply to benthic SQOs.	See response to comment 6.6.	No
6.11	2. The reference envelope option for benthic SQO determination should be clarified and guidance expanded. Both the proposed Provisions and existing Part 1 guidance allows for use of a “reference envelope” approach as an alternative to the prescriptive calculation and combination of numerical metrics that comprises the SQO multiple line of evidence process. Under this option, lines of evidence are assessed by statistical comparison to reference conditions, a traditional approach to sediment triad assessment that has been used for decades: “Categorization of LOEs—Determination of the presence of an LOE effect (i.e., biologically significant chemical exposure, toxicity, or benthic community disturbance) shall be based on a comparison to a numeric response value or a statistical comparison to reference stations. The	The reference envelope described in the existing Provisions was and still is only intended for use in those waterbodies where benthic tools have not been developed. There are no proposed changes to that language. See Chapter IV.A.1.j titled MLOE Approach to Interpret the Narrative Objective in Other Bays and Estuaries. The reference envelope was not intended as an alternative approach for those waters where benthic tools have been developed. With that said, guidance on development of reference envelope could be considered; however, that would be appropriate for consideration during a triennial review of the Water Quality Control Plan.	No

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	numeric values or statistical comparisons (e.g., confidence interval) used to classify a LOE as Effected shall be comparable to those specified in Chapters IV.A.1.f through IV.A.1.hSections V.F-H. to indicate High Chemical Exposure, High Toxicity, or High Disturbance. Reference stations shall be located in an area expected to be uninfluenced by the discharge or pollutants of concern in the assessment area and shall be representative of other habitat characteristics of the assessment area (e.g., salinity, grain size). Comparison to reference shall be accomplished by compiling data for appropriate regional reference sites and determining the reference envelope using statistical methods (e.g., tolerance interval).” (Provisions, Section IV.A.1.j, p.15-16).		
6.12	This option is poorly described by the Provisions. Both the accompanying staff report and the SCCWRP Sediment Quality Assessment Manual (SCCWRP 2009) provide no guidance on conducting a reference envelope assessment. In practice, the Regional Boards appear to be unaware of or unwilling to endorse this approach. The tiered approach of the new human health SQO guidance explicitly recognizes the increased value and reliability that expanded use of site specific data provides. A similar structure should be added to the benthic SQO guidance, explicitly recognizing that site-specific sediment conditions will often confound use of the default numeric response values, and that these can be addressed using the reference envelope approach. Additional guidance on key considerations and decision points involved in implementing a reference envelope assessment would be helpful, including guidelines for reference site selection, number of stations required for statistical comparisons, and appropriate statistical methods for comparison of chemical and biological data.	See response to comment 6.11.	No
6.13	Recommendation: Clarify Provisions to state that reference envelope benthic triad assessment is an acceptable alternative to the default numeric response	See response to comment 6.11.	No

	value approach, and that it offers significant benefits (at significant cost of additional data collection) when confronted with unique site-specific conditions, including the presence of non-chemical stressors. Develop additional guidance and technical resources to aid in implementation of reference envelope assessments.		
6.14	**Comments on SQOs for Protection of Human Health** **1. The rules and language regarding the tiered assessment framework are unclear.** The proposed Provisions concerning the limitations and progression between tiers of human health risk assessment for bioaccumulative chlorinated organics are unclear in several ways. Tiering is a well-established risk assessment approach designed to facilitate rapid “screening out” of sites or exposure pathways that fall clearly below a specified level of regulatory concern. Higher tiers of assessment make use of more site-specific information and data, thus resulting in a more reliable risk assessment, at the cost of more effort and data acquisition (see USEPA 2001). The proposed guidance and amendments make use of this approach, but do so in an unnecessarily restrictive manner: “Tier 3 may be performed at any time with approval from the Regional Board provided that Tier 2 is completed at the same time. A change in any parameter or model from that used in Tier must be justified based on site conditions in comparison to Tier 2 assumptions and values, and approved by the Regional Board prior to performing the analysis.” (Provisions, Section IV.A.2.e, p.30). Many sites under investigative orders, with known site-related organochlorine release histories are unlikely to be cleared by Tier 1 or even Tier 2 assessments, as described by the Provisions. A responsible party should have the option to proceed directly to Tier 3 in such cases. A Tier 3 assessment, though more expensive and time-consuming, would be more	Chapter IV.A.2.b. of the proposed Provisions has been revised to clarify that Tier 1 is optional and that Tier 3 can be conducted to supplement Tier 2 if certain conditions are met. Additionally, see responses to comments 1.18, 1.19, 2.9 and 2.10. The purpose of the tiered assessment framework is not to simply remove as many sites as possible from consideration of management actions but to delineate sites that pose no risk or low risk from sites that are contributing contaminants to the tissue burden in sportfish. Tier 2 is the standardized assessment that is required to implement the SQO. Tier 3 is only performed if assumptions associated with the Tier 2 assessment framework are inappropriate based on-site conditions or some other unique factor is present that requires an alternative assessment. However, Tier 2 is still necessary to justify the need for Tier 3.	No

	reliable. Tier 3 findings should always supersede findings of lower assessment tiers. Furthermore, the conditions under which a Regional Board would approve site-specific Tier 3 exposure assumptions are unclear. What standards would be used to evaluate evidence that site-specific exposure parameters exist and can be estimated? *Recommendation: Eliminate requirement for Tier 2 assessment in cases where site meets Tier 3 triggering criteria and the responsible party elects to go directly to Tier 3. Clarify factors and conditions upon which Board approval for Tier 3 would be contingent. Clarify that the triggering criteria list in the Provisions (Section IV.A.2.e, p.30) are examples, not an inclusive list.*		
6.15	2. Empirical measurements of sediment contaminant bioavailability should be allowed The source study for the bioaccumulation modeling technique specified for Tier 2 and 3 assessments, Gobas and Arnot (2010), states that concentrations of freely dissolved contaminants in surface water and porewater should be used in calculating BSAF. The proposed guidance does not require or discuss the collection of such data, nor the use of tissue data from prey species to parameterize Gobas food web models. When practicable, collection of these types of site-specific data in a Tier 3 assessment would produce more reliable estimates of human exposure and risk than obtained from modeling bioaccumulation using bulk sediment concentrations alone. Recommendation: The guidance should explicitly recognize the value of site-specific empirical data in parameterizing bioaccumulation models, and allow the use of devices such as passive samplers to measure pore water concentrations and the use of prey tissue data to replace modeled tissue concentrations in Tier 3 Gobas models.	The proposed Provisions do not contain language that would disallow the use of empirical measurements in the food web or porewater in Tier 3. The Tier 3 triggering criteria encompass a broad range of factors that could encompass a variety of site-specific measures that are aimed at addressing a unique site. It is not reasonable to assume that all the potential measures employed by an end-user could be described in the proposed Provisions to address each potential scenario that could be encountered. As a result, Tier 3 is only limited by the criteria provided and the use of the Tier 2 assessment categories and thresholds. As designed, the Tier 2 assessment and associated results can be used to support the need for Tier 3 and the unique measurements the end user believes are necessary to support their Tier 3 study.	No
6.16	*3. **Table 21 appears to contain an error*** *Table 21. Site Sediment Linkage Categories for Tier 2 Evaluation (Provisions, p.29) appears to contain an*	Table 21 in the proposed Provisions has been revised to address these and other comments. See response to comment 11.23 and accompanying figure.	No

	error in the last row. The conditions defining outcome 4 ("High" Site sediment linkage) would be met by all of the conditions for outcomes, 1, 2, or 3. The table, and the scaling scheme it describes would make logical sense if the value in the first cell of the last row was 75%, not 25%. *Recommendation: Review and correct Table 21as described above, or provide additional explanation of the existing table.*		
6.17	**Comments on SQO Implementation** 1. **SQO Provisions regarding TMDLs and discharge limits are not retroactive.** The proposed amendments state that the SQO "implementation provisions … do not apply to dischargers that discharge to receiving waters for which a total maximum daily load (TMDL) has been established to address for [sic] the bioaccumulation of organochlorine pesticides or polychlorinated biphenyls from sediment into sportfish tissue within enclosed bays and estuaries unless the applicable Regional Board approves the application of such provisions." (Provisions, Section II.A.1.b, p.3). This provision is unnecessarily restrictive. Many existing TMDLs are based on outdated and faulty science, and are inconsistent with the proposed amendments. Some TMDLs rely upon comparison of site conditions to scientifically flawed sediment quality guidelines, such as ERLs and TELs that are not reliable indicators of benthic community impairment, and are fundamentally inappropriate for use in developing protective targets for human health or bioaccumulation. Re-evaluation of existing TMDLs under the final SQO guidance should be an option available for all California water bodies and dischargers, regardless of whether or not TMDLs have already been promulgated, when it results in a more scientifically defensible and reliable management goal.	See response to comment 2.1. In those enclosed bays and estuaries where TMDLs have not been promulgated by the effective date of these proposed Provisions, the SQOs must be applied. Where TMDLs have been developed, the Regional Water Boards have the discretion to reopen the TMDL and apply the SQOs. Members of the regulated community within those regions can encourage their Regional Water Board to reconsider or reopen TMDLs.	No
6.18	The proposed Provisions similarly include language regarding the implementation of SQOs in the development of receiving water and effluent	See responses to comments 2.1 and 6.17.	No

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	limitations, stating that "Effluent limits to be established to protect or restore sediment quality only after: i. A clear relationship has been established linking the discharge to the degradation ii. The pollutants causing or contributing to the degradation have been identified, and iii. Appropriate loading studies have been completed to estimate the reductions in pollutant loading that will restore sediment quality." (Provisions, Section IV.A.4.c, p.32) Again, many established receiving water and effluent limitations are inconsistent with the proposed SQO Provisions. As with TMDLs, updating current discharge limits driven by bioaccumulation of organochlorine chemicals in a manner consistent with the final SQO implementation guidance should be an option available to all dischargers. *Recommendation: The Board should modify relevant sections of the proposed Provisions to indicate that updating existing TMDLs and discharge/receiving water limits is an option for all waterbodies and existing limits that are based on less rigorous science.*		
6.19	**2. Aquatic life SQO scores should not be used as automatic triggers for impairment listings or determinations of receiving water limitation exceedances.** All tested stations in a Part 1 SQO assessment receive one of 6 categorical scores: "Clearly Unimpacted", "Likely Unimpacted, "Possibly Impacted", "Likely Impacted", "Clearly Impacted", or "Inconclusive". The proposed Provisions stipulate that an exceedance of a receiving water limit to protect aquatic life is demonstrated when "Any station within the site is assessed as Clearly Impacted as defined in Chapter IV.A.1.i and IV.A.1.j or the total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a permit cycle. Calculation of percent area shall be based on data from spatially	This comment is outside of the scope of the proposed Provisions. The use of the aquatic life categories for impairment listings was part of the provisions adopted in 2008 adoption of the Enclosed Bays and Estuaries Plan. That matter is not being addressed in these proposed Provisions. See responses to comments 1.22, 1.24, 1.26, 1.28, 2.13, 2.15, 2.16, 2.18, 3.3, 7.3, 7.4, 11.11, and 11.12. Additionally, in accordance with the Federal Clean Water Act Section 303(c) and Water Code section 13240, all Water Quality Control Plans must undergo a triennial review. The commenter raises similar comments during the triennial review of the Water Quality Control Plan containing the Sediment Quality Provisions.	No

	representative samples selected using a randomized study design or equivalent spatial analysis." (Provisions, Section IV.A.4.c, p.32-33). Similarly, the draft Provisions stipulate that 303(d) listings will be triggered by aquatic life SQO scores if either "i. Any station within the site is assessed as Clearly Impacted…" or "ii. The total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a listing cycle. Calculation of percent area shall be based on data from multiple spatially representative samples selected using a randomized study design or equivalent spatial analysis." (Provisions, Section IV.A.4.e, p.36-37).		
6.20	This automatic trigger for listing or flagging discharge exceedances is inappropriate for several reasons: • SQO station scores are not numeric standards based on measurable adverse effects and are not reliable stand-alone indicators of chemically-induced impairment (see comments on SQOs for protection of benthic communities above). • The trigger level of 15 percent of the site area exceeding any specified station score is arbitrary and unjustified. This threshold has no demonstrated relevance to the question of beneficial use impairment. The justification for this frequency provided in the draft Staff Report (Section 6.7, p104-106) is not technically valid. The review of "critical exceedance rates proposed by USEPA" (Staff Report, Table 6-9) is an evaluation of the predictiveness of concentration-based effect criteria (i.e., chemical concentration thresholds that have been determined by a statistically valid approach to be associated with the onset of adverse effects). SQO category scores are not adverse effect thresholds, and have no demonstrated level of predictiveness. They do not exhibit the same cumulative probability characteristics that concentration-based threshold exceedances do. Furthermore, if the minimum recommended number of	The scores are based on the evaluation of multiple lines of evidence, as provided in the previously adopted Enclosed Bays and Estuaries Plan in 2008. Those aspects of the SQOs are not addressed by these proposed Provisions. Applying 15% of site area as Possibly and/or Likely Impacted is consistent with the previous approach, assuming spatially representative samples. The existing approach required only 2 station exceedances out of a total number of stations of 2-24. Given a data set of 5-20 stations, the outcome should be similar to the approach being proposed. This would result in a similar probability of listings using the existing framework. The key difference is the requirement for spatially representative samples and additional consideration given to stations classified as Clearly Impacted.	No

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	stations (currently 5 for a small site) was assessed, a single “Possibly Impacted” or worse station would potentially trigger listing. This finding would be insufficient to classify any waterbody as impaired, regardless of the conditions at that single tested station. • “Possibly Impacted” scores are not indicative of impairment (see comment 3 below)		
6.21	Benthic SQOs are a valuable line of evidence that can and should be considered by the Board when making listing decisions. Notwithstanding the technical flaws in the benthic SQO method noted above, a rational assessment of benthic triad data is inherently more relevant than simple comparison of sediment chemistry data to published benchmarks (e.g., ER-Ls). However, stipulation of automatic listing due to the linear outcome of a SQO assessment of a small number of stations is inappropriate, particularly in the absence of a full causal analysis (i.e., a stressor identification with a clear outcome). Listing decisions should remain a professional judgment-driven process that can draw on all available site-specific information, including but not limited to SQO results.	The use of the Multiple Lines of Evidence (MLOE) and the resulting station categories supporting the benthic SQO were adopted by the State Water Board in the 2008 Enclosed Bays and Estuaries Plan. These comments are outside of the scope of the proposed Provisions.	No
6.22	Recommendation: Remove all language in the Provisions that specifies mandatory exceedance determinations or 303(d) listing for any SQO outcome. Specify that Board listing and exceedance decisions remain a professional judgement process, but that SQO findings should be considered synoptically with other relevant lines of evidence and information. Include requirements that causal analysis (stressor identification) must be conducted and conclusive before a waterbody can be listed for any specific cause.	See response to comment 6.21.	No
6.23	3. Listing decisions and receiving water limitation exceedances should not be triggered by the “Possibly Impacted” benthic community station category. As noted above, the range of benthic SQO station scores that can trigger 303(d) listing and limit	The use of Possibly Impacted categories for listings was adopted by the State Water Board in the 2008 Enclosed Bays and Estuaries Plan. The use of this category for listings in the new proposed assessment framework is consistent with the 2008 SQO provisions which allow for confirmation monitoring. In addition, the existing	No

	exceedances includes “Possibly Impacted” in the proposed Provisions. The description of the “Possibly Impacted” categorical score in Part 1 SQO guidance makes it clear that this outcome is not a finding of impairment, but of either small magnitude effects (possibly from non-Site related stressors) or uncertainty in the lines of evidence evaluated and/or the underlying data. The Provisions define “Possibly Impacted” as follows: “Sediment contamination at the site may be causing adverse impacts to aquatic life, but these impacts are either small or uncertain because of disagreement among LOE.” (Provisions, Section IV.A.1.i, p.14). The Provisions go on to provide the following guidance on interpretation of the “Possibly Impacted” category, describing it as “meeting the protective conditions if the studies identified in Chapter IV.A.4.f demonstrate that the combination of effects and exposure measures are not responding to toxic pollutants in sediments and that other factors are causing these responses within a specific reach segment or waterbody. In this situation, the Water Board will consider only the Categories Likely Impacted and Clearly Impacted as degraded when making a determination on receiving water limits and impaired water bodies as described in Chapter IV.A.4.” (Provisions, Section IV.A.1.i., p.15).	provisions allow for a Regional Water Board to make a decision in those cases where stressor identification indicates that other factors not related to toxic pollutants are driving the observed and measured biological impacts. Those provisions already exist and do not require additional clarification. Additionally, see responses to comments 1.22, 1.23, 1.26, 1.28, 2.13, 2.15, 2.16, 2.18, 6.19, 6.20, 6.23, 6.24, 6.25, 7.3, and 7.4.	
6.24	The “Possibly Impacted” outcome for an SQO station is not indicative of clear chemical associated BMI community impairment. Rather it is an indication of uncertainty in the analysis, often associated with the presence of non-chemical stressors at a site or variability in the community data. The logical interpretation of such an outcome is to supplement the default SQO analysis with additional information (such as a reference envelope comparison), or to perform stressor identification when uncertainty is widespread at a Site. To the extent that aquatic life SQO station scores are considered in impairment listing or discharge exceedance determination decisions, only	The Possibly impacted category indicates evidence of impact among the MLOE. Additionally, see response to comments 1.22, 1.23, 1.26, 1.28, 2.13, 2.15, 2.16, 2.18, 6.19, 6.20, 6.23, 6.25, 7.3, and 7.4.	No

	"Likely Impacted" and "Clearly Impacted" scores should be considered as evidence of possible impairment. Treatment of the "Possibly Impacted" finding as indicative of impairment is scientifically inappropriate and internally inconsistent with the SQO guidance itself. *Recommendation: Remove the inclusion of "Possibly Impacted" station scores from the description of aquatic life SQO outcomes that shall support any decision for impairment listing or exceedances of discharge or receiving water limits. "Possibly Impacted" findings should only be used as a justification for additional investigation or supplemental lines of evidence to characterize benthic conditions at a Site or waterbody.*		
6.25	4. Listing decisions and receiving water limitation exceedances should not be triggered by the "Possibly Impacted" human health site category. As with the aquatic life SQOs, the proposed Provisions require that waters be placed on the 303(d) list for exceedance of the narrative SQO for human health if Site sediments are categorized as "Possibly Impacted", "Likely Impacted", or "Clearly Impacted" over the duration of the listing cycle (6 years) (Provisions, Section IV.A.4.e, p. 38). As with the benthic station SQOs, the "Possibly Impacted" category for human health assessment is clearly not a finding of impairment. Rather, it is only indicative of high chemical exposure with low site sediment linkage (see Provisions, Table 22, p.29), a condition most likely associated with non-Site related factors. Such a finding should, at most, trigger additional investigation to assess the reasons for the uncertainty, not automatic listing or exceedance designations. To the extent that human health SQO Site scores are considered in impairment listing or discharge exceedances decisions, only "Likely Impacted" and "Clearly Impacted" scores should be considered as evidence of possible impairment.	The difference between low and very low site linkage is important in that low category ranges, from 26-50% of the cumulative linkage distribution, exceeds the linkage threshold of 0.5. This response coupled with the high exposure category would indicate that sediment is contributing albeit at low levels to the contaminants in the fish tissue.	No

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	Recommendation: Remove the inclusion of "Possibly Impacted" station scores from the description of human health SQO outcomes that shall support any decision for impairment listing. "Possibly Impacted" findings should only be used as a justification for additional investigation or supplemental lines of evidence to characterize human exposure conditions at a Site or waterbody.		

6.26	**5. The use of "regional background" in management decisions should be extended to benthic community SQO assessments.** The Provisions on human health SQO assessment include explicit consideration of regional background contamination levels during development of management guidelines, requiring such guidelines for a site to be established in consideration of regional background conditions: "Regional background contamination should be taken into account when establishing management guidelines or actions. Regional background is defined as the concentration of contaminant that is primarily attributable to diffuse sources, not attributable to a specific source or release. It is not feasible to establish management guidelines for a site that are below regional background, as they cannot be expected to be attained within a defined timeframe. Instead, such values should be regarded as management goals to inform watershed-based management plans." (Provisions, Section IV.A.4.h, p.43). This consideration is apparently restricted by the Provisions to human health management guidelines, and is not mentioned in the preceding section on benthic community protection guidelines. The scientific and regulatory rationale for inclusion of background consideration in management decision-making for human health protection apply equally to benthic and other ecological beneficial use protection. Regional background considerations should be integrated into the benthic Site-specific management guideline process. Derivation of background concentrations can be a challenging and contentious process. Further guidance should be developed by the Board on the appropriate statistical methods for estimation of regional background and comparison to Site data that are consistent with Board practice and risk assessment guidance. For example, use of background upper prediction limits or similar upper distribution points from	Impacts delineated through the benthic SQO assessment framework are typically localized, while impacts associated with the human health SQO can encompass significantly larger areas. Bioaccumulation into the food web can occur at very low levels. Unfortunately, for this class of contaminants (organochlorine pesticides and PCBs), they are broadly distributed in the environment. As a result, consideration for background in the development of management guidelines is important because establishing guidelines lower than background would result in entire waterbodies designated for cleanup, which is unrealistic. This situation is unlikely to be encountered in the implementation of the benthic SQO assessment framework.	No

	background/reference data distributions should be compared to Site data, not means or confidence limits on means (see USEPA 2002). *Recommendation: Add an explicit consideration of appropriate background data to the benthic community chemistry line of evidence. Sediments that do not exceed regional background should not be assigned "high" chemistry scores in a benthic triad assessment. Furthermore, management guidelines to protect benthic communities should explicitly incorporate consideration of regional background. Develop additional implementation guidance on estimation of regional background and appropriate statistical methods for comparison to Site data.*		

6.27	**6. Stressor Identification Evaluation guidance should be clarified.** Conceptual guidance is provided in flowchart form for the Stressor Identification Evaluation (SIE) process in Appendix A-2 of the Provisions (Provisions, p.49). The process requires a discharger to “review and revise SIE workplan” when the SIE is inconclusive and fails to identify the “chemicals or classes of chemicals” responsible for an SIE exceedance, an outcome that experience has shown is common. The result can be an infinite do-loop with no resolution in cases where positive stressor identification proves elusive. This flowchart should be amended to provide a decision point on when to end the evaluation process, as well as guidance on possible next steps (such as a Tier 3 human health assessment or reference envelope benthic assessment). *Recommendation: Revise the flow chart in Appendix A-2 to indicate a decision point on next steps in the event of an inconclusive SIE outcome.*	The content of the direct effects or benthic community assessment process is outside the scope of the proposed Provisions. This comment would be more appropriate for a triennial review where the State Water Board addresses significant problems that are not specifically related to any specific proposed amendment. Stressor identification has resulted in findings regarding classes of chemicals or in some cases identification of the specific contaminants. This information is much more beneficial and informative to managers than reliance on sediment quality guidelines, which has been used for many years.	No
7.1	The Ports are supportive of the adoption of the proposed amendments because Sediment Quality Objectives are comprehensive, science-based assessment tools. We have three comments on the proposed Plan, which we respectfully offer below:	Comment noted.	No
7.2	Fish Sampling Methods: The Draft Amendment provides guidance on field collection procedures as page 18 and 19, Section IV.A.2.b.3.b states, “Fish shall meet sportfish angling size requirements.” Meeting angling size requirements is often a challenge and could significantly hamper the success of field collection efforts. Recommendation: Modify the language to state, “Fish shall meet sportfish angling size requirements where possible.”	Chapter IV.A.2.b.3)4.b of the proposed Provisions (renumbered as Chapter IV.A.2.b.3) f) was revised to allow using fish that do not meet sportfish angling size requirements.	Yes
7.3	Consistency with SQO Direct Effects in the interpretation of “Possibly Impacted” category for the protection of aquatic life: On page 33, Section IV.A.4.c.2.a, the guidance suggests “Possibly Impacted” is a final result and is	The Possibly Impacted category is considered an impacted category regardless of whether the category is applied to the benthic or human health assessment framework. In both instances, confirmation monitoring may be performed. Unlike the benthic assessment	No

	treated the same as "Likely Impacted." This seems inconsistent with flexibility provided on page 38 under Stressor Identification for direct effects which allows further evaluation of the "Possibly Impacted" result. Recommendation: Add clarification that further evaluation of "Possibly Impacted" results to determine actual impairment may be conducted, as recommended in Section IV.A.4.f.	framework, there is no need to perform stressor identification as the human health assessment framework specifically identifies the contaminant that is causing the impairment.	
7.4	Consistency with SQO Direct Effects in the interpretation of "Possibly Impacted" category for the protection for Human Health: On page 33, Section IV.A.4.c.2.c, the guidance states an indirect effects category of "Possibly Impacted" results in a categorization of "Impaired." This seems inconsistent with flexibility provided on page 38 under Stressor Identification for direct effects which allows further evaluation of a "Possibly Impacted" result. Recommendation: Provide guidance for interpretation "Possibly Impacted" category consistent with direct effects.	As described in responses to comments 1.22, 1.26, 7.3, and 11.12, the flexibility provided with the Possibly Impacted category is associated with two issues. The first issue is uncertainty, so the existing provisions allow confirmation monitoring. The second issue is the resulting stressor identification, which is unnecessary with the human health assessment framework. As written, the proposed Provisions allow confirmation monitoring for both the existing assessment framework and the human health framework where only possibly impacted categories result. See Chapter IV.A.4.c.2).b.i	No
8.1	As the public trustee of San Diego Bay (Bay), the District shares common interest with the State Water Resources Control Board (State Board) in ensuring the protection of the Bays beneficial uses. The District supports the State Board's continued efforts to address sediment quality issues. Moreover, the District uses the current State Boards SQO framework as an assessment tool as part of the Regional Harbors Monitoring Program and recognizes the value in having consistent statewide methodology to evaluate sediment quality. The District recognizes the difficult task in developing a program to address multiple issues in bays and estuaries throughout California, and agrees that a narrative approach is more appropriate than numeric criteria. To this end, the District respectfully submits the following comments regarding the SQO provisions.	Comment noted.	No
8.2	1. The application of the SQO framework should be consistent across the State. The SQO process is intended to supplement current point and non-point	The proposed Provisions require a spatially representative assessment of the area of interest to evaluate impacts using the benthic MLOE approach. The area of interest	No.

	source discharge monitoring programs as a screening tool to identify area(s) having potential sediment impacts. The approach, as identified in the SQO provisions, monitors the health or marine sediments with a Multiple Line of Evidence (MLOE) approach. The District agrees with this useful tool for the purpose of assessing general conditions (i.e. screening) of embayments. The District also understands the SQOs are not intended to be used to analyze areas pre/post for routine maintenance or dredging. The guidance provided in the SQO Provisions, however, remains unclear in the regards to the use of SQOs for the identification, delineation, or impact analysis of legacy contaminated sites. The district believes that SQOs can be can be valuable to ensure ecosystem and human health protection at certain sites with legacy contamination, but must be used on a discretionary site by site basis to avoid misuse.	could consist of a highly contaminated area or hotspots for characterization or remedial investigation, a waterbody or site, or segment of a waterbody to assess whether a listing or delisting is appropriate. In addition, a site may consist of an area in and around an outfall to assess a discharges impact to receiving water and associated bottom sediments. Where resources allow, a random or stratified random design is preferred but not required. Because the design of a study will be site-specific, only general guidance is provided. See the existing Provisions, Chapter IV.A.4.d, which describes how to design a monitoring program. Examples of spatially representative monitoring programs include Southern California Bight Regional Monitoring Surveys, San Francisco Bay Regional Monitoring Program, and the San Diego Regional Harbors Monitoring Program.	
8.3	2. The State Board should provide guidance on the correct sampling frequency and collection methodologies needed to appropriately delineate the site "area" for SQQ analyses. The current language in the SQQ Provisions dictate that if 15% of the site "area" fails the SQO protocol, the site is considered impacted or potentially impacted. However, it is not specified how the size of the site will be determined. Including guidance on how to correctly sample and define a site "area" will avoid the potential misuse of site delineation which could in turn result in skewed results.	See response to comment 8.2. The correct sampling frequency depends on the specific permit and the application; for NPDES permits the minimum frequency is once per permit cycle (Chapter IV.A.4.c) and Regional Monitoring Programs are required to monitor once every five years (Chapter IV.A.4.d.8)). Where impacts are identified, the Regional Water Board can require more frequent monitoring. Size of the area is dependent on the type of assessment. For evaluating waterbodies, the area considered in the design represents the entire waterbody. If assessing only a segment or reach, consider the entire area of the segment or reach. For hotspots or areas around outfalls, the site assessed should extend beyond the area impacted or area influenced by the discharge in order to ensure that the full area of impact is delineated. In applying the human Health Assessment Framework, the minimum site size is 1 km^2. Applying best professional judgement and conferring with the applicable Regional Water Board should eliminate the potential for skewed results, especially given that significant information and data already exist for many major harbors in California.	No.

8.4	3. The District cautions the State Board to approach site linkage determinations in a regulatory context on a provisional basis. The amendment to the SQOProvisions includes the determination of site linkage between estimated fish tissue concentrations at the site being investigated and observed fish tissue concentrations in the general area of the site. As presented, the site linkage calculation process relies upon the Arnot and Gobas food web model, specified inputs, and the use of Monte Carlo simulations to develop a distribution of site linkages that takes into account uncertainty and variability of the input parameters. While this attempt at developing site linkages may be promising, the District is concerned that this novel approach may not useful in a regulatory context. For example, even with large datasets, site-specific models including the Arnot and Gobas model, are considered to be well calibrated if the estimated fish tissue concentration is within 2 times the measured concentration. With this level of variability between estimated and measured fish tissue concentrations, the ability to differentiate site linkages will be highly uncertain, particularly given that the framework does not appear to include a step to calibrate the model to a site, or even verify that it is reasonably able to predict site concentrations. Given this concern, the District is offering to work with the Regional and State Boards to validate this approach for San Diego Bay sites, when and where applicable.	The site linkage determination is only one piece of the framework. First and foremost, there must be some level of tissue contamination that exceeds Office of Environmental Health Hazard Assessment (OEHHA) tissue goals and advisories levels. If that occurs, the second piece of information needed to complete the assessment is the site linkage. Site linkage addresses the question: given a sportfish species with known and specified diet and home range, could contaminants from the site accumulate in the tissue of that fish? If so, how much? Site linkage addresses the question: is there the potential for bioaccumulation from site into sportfish? Site linkage is not intended to be predictive of tissue concentrations. Site linkage is simply evaluating the potential for contaminants from the site to be contributing to the contaminants in the sportfish tissue. For more detailed analyses Tier 3 would be appropriate where a fully calibrated site-specific food web model may be applied. The Tier 2 framework does assess waterbodies consistent with expectations for thirteen bays or portions there of as described in Appendix 6 of SCCWRPs technical document titled "Development of a Sediment Quality Assessment Framework for Human Health Effects" posted at the following link: https://www.waterboards.ca.gov/water_issues/programs/bptcp/docs/sqo_human_health_framework.pdf	No
8.5	4. The District recommends the analysis of all 209 polychlorinated biphenyl (PCB) congeners at sites where source identification is an objective. The SQQ Provisions require that a subset of 50 polychlorinated biphenyl (PCB) congeners consistent with those analyzed for the Surface Water Ambient Monitoring Program (SWAMP) be determined. Determining a subset of 50 congeners may be appropriate for monitoring sites where consistency over time is the objective. However, for sites where source	The use of the Surface Water Ambient Monitoring Program (SWAMP) list represents the minimum number of congeners. For comparison purposes it is important that both tissue and sediment analyte list be consistent.	No

	identification is of concern, the District recommends the requirement to quantify all 209 PCB congeners. The District understands that the cost to analyze all 209 PCB congeners is approximately double the cost to analyze the SWAMP congener subset recommended in the amendment. However, we surmise that the long-term benefits likely outweigh the cost, particularly at sites where the ultimate goal is reducing or eliminating the source of PCB contamination. Analyzing for all 209 congeners not only allows for a more accurate determination of total PCBs, it also allows for the evaluation of the distribution of congener patterns to help with the identification of PCB sources. This is particularly important for sites that have multiple and/or on-going sources. The requirement to analyze for only 50 of the 209 PCB congeners may not allow for adequate source identification. As such, the guidance should, at minimum, provide the Regional Boards the flexibility to consider the full suite of 209 PCB congeners as optional analysis in areas where PCBs are a higher priority.		
9.1	Baykeeper has been engaged on the development of Sediment Quality Objectives (SQOs) for nearly twenty years and cannot understate our disappointment with the slow pace of SQO development and implementation, which has inhibited the pace of toxic sediment cleanup throughout the state. Members of the environmental and public health community have repeatedly noted that the slow pace of development, overly burdensome stakeholder process, and perplexing technical aspects of SQO implementation procedures have ensured a lack of commitment to implement the SQOs in a timely and comprehensive manner by the Regional Boards and individual dischargers. We do not wish to restate these comments but incorporate by reference prior comments dating from 2006, 2010 and 2011.	The State Water Board approved the SQO work plan in 2003. That was followed by the adoption of the Enclosed Bays and Estuaries Plan in 2008. The Plan was amended again in 2011 and proposed for amendment in 2018. For a program without comparable efforts in other states or at the federal level, the technical team and partners have made significant and steady progress overcoming many challenges associated with assessing contaminant bioavailability and bioaccumulation. The stakeholder process has provided valuable input over the years. The staff and technical team have conducted multiple training classes in northern and southern California and provided spreadsheets and other tools to make implementation easier. In addition, the technical teams have used existing data to assess all major bays, beginning with the earliest assessment in 2007, followed by later assessments in 2013). See Bay et al 2013 Evaluation of Sediment Condition Using California's Sediment Quality Objectives	No

		Assessment Framework. Technical Report 0764. Southern California Coastal Water Research Project. Costa Mesa, CA. (http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/764_CASedEvalSQOFramework.pdf) Prior to that, the State Water Board developed the Consolidated Hotspots Cleanup Plan that encompassed many of the same waterbodies, segments and reaches as hotspots. Under Porter-Cologne,(§ 13225, § 13394). the Regional Water Boards are responsible for determining how and when each waterbody segment or reach is addressed and what program and tools are applied in the assessment.http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/764_CASedEvalSQOFramework.pdf) Prior to that, the State Water Board developed the Consolidated Hotspots Cleanup Plan that encompassed many of the same waterbodies, segments and reaches as hotspots. Under Porter-Cologne,(§ 13225, § 13394). the Regional Water Boards are responsible for determining how and when each waterbody segment or reach is addressed and what program and tools are applied in the assessment.http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/764_CASedEvalSQOFramework.pdf) Prior to that, the State Water Board developed the Consolidated Hotspots Cleanup Plan that encompassed many of the same waterbodies, segments and reaches as hotspots. Under Porter-Cologne,(§ 13225, § 13394). the Regional Water Boards are responsible for determining how and when each waterbody segment or reach is addressed and what program and tools are applied in the assessment.http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/764_CASedEvalSQOFramework.pdf) Prior to that, the State Water Board developed the Consolidated Hotspots Cleanup Plan that encompassed many of the same waterbodies, segments and reaches as hotspots. Under Porter-Cologne,(§ 13225, § 13394). the Regional Water Boards are responsible for determining how and when each waterbody segment or reach is addressed and what program and tools are applied in the assessment.	

		Regarding the commenter's request to incorporate by reference those prior comments dating from 2006, 2010 and 2011, it would be speculative to determine which of the many previously-submitted comments may have received inadequate responses in prior proceedings and for what reasons. Thus, comments not specifically presented at this time are not addressed.	
9.2	These comments focus on one particular change reflected in the Proposed Amendments at Chapter III.A.1.b.4: *Implementation provisions described in Chapter IV.A.2 and applicable provisions in Chapter IV.A.4 implementing the objective set forth in Chapter III.A.2.b. below do not apply to dischargers that discharge to receiving waters for which a total maximum daily load (TMDL) has been established to address for the bioaccumulation of organochlorine pesticide or polychlorinated biphenyls from sediment into sportfish tissue within enclosed bays and estuaries unless the applicable Regional Water Board approves the application of such provisions.* This element of the Proposed Amendments creates a non-expiring grandfathering clause for all waterbodies with TMDLs for organochlorine pesticide or polychlorinated biphenyls (PCBs). For context, a 2001 court decision (San Francisco Baykeeper, Inc. v. State Water Resources Control Board, August 2001) ordered the State Water Board to adopt SQOs pursuant to the California Water Code §13393. The law 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. Given that PCB impairments drive much of the sediment testing and assessments for San Francisco Bay and studies from recent years have upended the assumptions associated with the existing PCB TMDL, to excuse the San Francisco Bay	The language in Chapter III.A.1.b.4 of the proposed Provisions has been revised for clarity. The language providing that implementation provisions for the human health objective are inapplicable to receiving waters with a previously-adopted TMDL would only affect those TMDLs promulgated prior to the effective date of the proposed Provisions. As written, the language provides each Regional Water Board with the discretion to apply the SQOs. Staff Report for the San Francisco Bay PCB TMDL acknowledged the margins as potential hotspots and identified management strategies that could be addressed within the TMDL program areas and outside the TMDL program areas. Many of these strategies have been implemented. Due to the sheer size of the bay and expanse of nearshore margins, detailed characterization of sediment quality in the margins poses a significant challenge, especially where older industrial sites have been vacated or replaced by newer tenants. However, new findings would not alter ongoing activities to reduce pollutant loadings into the bay or remediate major source areas currently underway. See responses to comments 2.1, 6.17, and 6.18. The commenter does not specify what SF Bay PCBs TMDL assumptions have been upended by recent studies. The fundamental conceptual foundation of the PCBs TMDL in SF Bay remains sound. There have been advances in scientific understanding about the nature of PCBs impairment and characterization of in-bay source areas since the TMDL was adopted. Nonetheless, the PCBs TMDL	Yes

	Regional Water Quality Control Board from utilizing this tool for PCBs would likely mean that SQO testing and assessment will not be undertaken for San Francisco Bay. This should present serious concern for anyone involved in the SQO process or those with concerns over the slow pace of toxic sediment assessment and cleanup in California.	was founded on a robust conceptual framework using the same concepts and assumptions used to develop the bioaccumulation SQOs, and it explicitly included an adaptive approach to encourage the refinement of the conceptual model and to support the inclusion of updated technical information into the implementation of the TMDL. Also, ongoing studies are being pursued because the conceptual foundation of the San Francisco Bay PCBs TMDL called attention to their importance. These include: • exploring the role of priority margin (shoreline) areas in overall Bay impairment; • understanding how local watershed sources impact these margin areas; and • identifying and controlling source areas in local watersheds. These and other ongoing technical studies will not be hampered by the SQO "grandfather" clause. The TMDL calls for identifying source control implementation strategies, understanding the role of source areas as well as fate and transport of PCBs in contaminated shoreline areas. These and other ongoing TMDL technical efforts would not be aided by including SQOs as TMDL targets.	
9.3	Results from the last several years of study in San Francisco Bay have caused the scientists involved in the original PCB conceptual model and associated TMDL to 'go back to the conceptual drawing board', putting into question the assumptions used to develop the TMDL. Approval of these Proposed Amendments would remove any requirement to support future iterations of the PCB TMDL with the tools developed through the SQO process. Given that much of the scientific work undertaken to develop the SQOs were based on work related to assessment of PCB impairment in San Francisco Bay, there is no reasonable cause for removing the SQOs from the	See responses to comments 2.1, 6.17, and 6.18. Additionally, the Regional Water Board has the discretion to utilize the assessment framework and associated tools being proposed. The Regional Water Boards must reassess progress on TMDLs to ensure that management actions are effective and that the waste load allocations, load allocations, and targets are appropriate to protect beneficial uses. The Regional Water Boards are in the best position to determine when and under what conditions these TMDL reopeners will be completed. See responses to comments 2.1, 6.17, and 6.18.	No

	assessment toolbox as scientists and regulators undertake future revisions to the PCB TMDL in San Francisco Bay.	The commenter has provided no basis for the statement that the scientists involved in the original PCB conceptual model have gone “back to the drawing board”. This is a mischaracterization of the evolution of PCBs studies as envisioned in the TMDL and ongoing. See the response to comment 9.2.	
9.4	Baykeeper understands these Proposed Amendments retain the ability of Regional Boards to optionally utilize the SQO framework for revisions to TMDLs for PCBs and organochlorine pesticides. Given the significant investment already undertaken to develop the PCB TMDL in San Francisco Bay, which by admission of those involved in its development is fundamentally flawed, we feel it is highly unlikely the costly assessments needed to undertake the SQO process will ever be conducted. This translates into the highly likely scenario that needed SQO assessments will not be undertaken in San Francisco Bay, since PCB impairments have proven to be the motivating factor for sediment monitoring and assessments for much of the last 25 years.	See responses to comments 2.1, 6.17, 6.18, 9.2, and 9.3. There is no basis for the statement that the San Francisco Bay PCBs TMDL is fundamentally flawed or that any scientist involved in its conceptual development would have made such a statement.	No
9.5	The lack of SQO assessments in San Francisco has proven to be an impediment to identifying the magnitude and extent of sediment toxicity throughout the estuary, where sediment toxicity has been a chronic issue throughout the system for decades (Figure 3). In the last year, San Francisco Bay Regional Board staff attempted to pursue a 303(d) sediment toxicity listing for San Francisco Bay. This request was rejected by the Regional 2 Board on the grounds that an insufficient number of SQO assessments had been conducted to warrant this listing, despite decades of data indicating widespread, moderate levels of sediment toxicity throughout the estuary since monitoring began.	See responses to comments 2.1, 6.17, 6.18, 9.2, and 9.3. The commenter appears to be conflating different types of SQO assessments and their intended use. The SQO assessments at issue are for “indirect effects” such as bioaccumulation. These have nothing to do with the types of SQOs that could be relevant for assessing causes of direct toxicity, which was the issue in the listing determination mentioned by the commenter. Stakeholders in the San Francisco Bay area have been trying to determine the causes of persistent, moderate toxicity (to bivalve and amphipod test organisms) for about two decades. The indirect effects SQOs are not a tool relevant to this endeavor.	No
9.6	The lengthy process associated with developing these SQOs has contributed to the lack of action on this serious indicator of beneficial use impairments in San	The State Water Board and Regional Water Board have been working to understand the causes of sediment impairments and restoring those sediment dependent	No

	Francisco Bay and other enclosed bays and estuaries. The approval of these Proposed Amendments will virtually ensure decades of further inaction where this proposed grandfathering clause applies.	beneficial uses since the Bay Protection Cleanup Program was initiated in the early 1990's utilizing cleanup actions, TMDLs, and additional permit requirements.	
9.7	Requested Revisions to the Proposed Amendments Since Regional Boards and dischargers have long supported the development and application of SQOs when developing TMDLs for PCBs and organochlorine pesticides, Baykeeper recommends removal of the grandfathering clause provided at Chapter III.A.1.b.4. If this element of the Proposed Amendments reflects concerns that approval would immediately trigger the re-opening of existing TMDLs we ask the Board to consider a finite duration for the grandfathering clause and consider changing Chapter III.A.1.b.4 as follows: *Implementation provisions described in Chapter IV.A.2 and applicable provisions in Chapter IV.A.4 implementing the objective set forth in Chapter III.A.2.b. below do not currently apply to dischargers that discharge to receiving waters for which a total maximum daily load (TMDL) has been established to address for the bioaccumulation of organochlorine pesticide or polychlorinated biphenyls from sediment into sportfish tissue within enclosed bays and estuaries unless the applicable Regional Water Board approves the application of such provisions. Any future revisions and updates to applicable TMDLs are not subject to this exemption. Any TMDL revisions or permits where applicable TMDLs are implemented after 2020 shall require the application of these provisions.*	See response to comment 9.3. The language in Chapter III.A.1.b.4 has been revised to clarify that inapplicability of the implementation provisions is limited to only those existing TMDLs that are adopted prior to the effective date of the Provisions.	No
9.8	Despite long-standing critique of the SQO development process, Baykeeper recognizes the utility of the framework as a means of determining the magnitude and potential sources of sediment toxicity in California's enclosed bays and estuaries. As the largest estuary on the West Coast, with a number of unassessed and un-remediated sediment hot spots, we discourage any exemption targeting San Francisco Bay, which would effectively remove the SQO	See response to comment 9.7.	Yes

	framework from the toolbox available to regulators and dischargers. In sum, Baykeeper requests that the State Board either omits Chapter III.A.1.b.4 from the Proposed Amendments or limits the duration of their applicability to a clearly defined date.		
10.1	The SMWG appreciates the opportunity to provide comments on the proposed amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries of California to include application and implementation of sediment quality objective (SQO) protecting benthic communities from direct exposure to pollutant in sediments and application and implementation of the SQO protecting human health from exposure through fish consumption. This is a very important, but also highly technically complex topic. We at SMWG recently learned about this proposal at have not had a chance to fully evaluate and respond to the proposal. Therefore, we respectfully request an extension of time to provide comments on this topic of great interest to our members.	The proposed Provisions, Staff Report, and Substitute Environmental Document were released to the public on October 24, 2017. Notices were published in twenty-three papers within potentially affected regions that encompass bays and estuaries of California. In addition, the State Water Board also notified interested parties through multiple electronic subscriptions (for sediment quality subscribers alone over 2,000 valid email addresses were notified). Finally, no other commenters requested additional time to review the material. For those reasons State Water Board did not extend the comment period.	No
10.2	In the meantime, we urge the Board to give careful consideration to comments provided by the Western States Petroleum Association and other stakeholders to ensure that the final SQO reflect sound science and the input of all interested stakeholders. The SMWG would be pleased to provide further input to the Board in its deliberations. For further information and to confirm an extension of time to provide comments on the SQO, please contact the SMWG's Coordinating Director, Steven C. Nadeau, c/o Honigman Miller.	Comment noted. The State Water Board considers all relevant and timely comments. See responses to Western State Petroleum Association letter (number 11) for the responses to their comments.	No
11.1	As briefly highlighted here and discussed in detail in the attached memo prepared for WSPA by Susan Paulsen and Susan Kane Driscoll of Exponent, WSPA has concerns regarding the proposed SQOs. In addition to discussing the concerns, we are pleased to offer suggested revisions to address each of the issues.	Comment noted.	No

11.2	Applicability WSPA is concerned that the SQOs are not applicable to all waters, particularly in areas where a total maximum daily load (TMDL) has previously been developed. As currently constructed, the SQOs would not apply to entities who discharge to receiving waters that have an established TMDL for organochlorine pesticides or polychlorinated biphenyls from sediment in sportfish unless a regional board approves such an application. Our concern, however, is that many TMDLs are based on outdated and faulty science that is inconsistent with the proposed SQO provisions. WSPA recommends the Board revise the draft to apply SQOs to all waters, including those for which a TMDL has previously been developed. Additionally, WSPA recommends the state and regional water boards be required to develop TMDL allocations using the methodology of the proposed SQOs.	The SQOs are applicable to all enclosed bays and estuaries. However, in those waterbodies where a Regional Water Board has already developed a TMDL and associated target, the discretion to implement the provisions for use in developing TMDL targets lies with the applicable Regional Water Board. See, response to comment 9.7	No
11.3	**Consistency** The Board should revise the State Listing Policy to be consistent with the sediment quality provisions. The original Policy adoption occurred in 2004 prior to the adoption of the SQOs Part 1 and the Policy has not been modified in line with the SQO provisions that provide that sediment quality provisions that added an additional listing criterion should apply only to listing for exceedances of the narrative SQO for aquatic life protection. Instead, the Policy continues to allow sediment quality guidelines to be used in listing decisions and the use of them in this way as a basis for management actions is inappropriate as no single one can account for all of the factors that influence contaminant effects.	This comment is outside of the scope of the proposed Provisions. When the Listing Policy is reviewed in the future this change may be proposed by public and interested parties.	No
11.4	WSPA recommends the Board modify the Provisions such that listing decisions and receiving water limitation exceedances do not use the “Possibly Impacted” category. This particular category connotes significant uncertainty about the sediment condition and the cause of any impacts. Given such uncertainty, it should not be used as a basis for listing.	The Possibly Impacted category in the SQO Provisions was adopted by the State Water Board in the 2008 adoption of the Enclosed Bays and Estuaries Plan. The Possibly Impacted category represents impacted or degraded sediment. Additionally, see responses to comments 11.13, 11.14, and 11.15.	No

	Additionally, in situations where Stressor Identification Evaluations (SIE) are inconclusive, it is unclear whether or not an “off-ramp” exists. The flow chart and overall framework is in need of such clarification and off-ramp options when SIEs are inconclusive or at a minimum more explicit parameters being established to limit the scope of additional study required pending future, routine SQO monitoring.		
11.5	**Tier 2 and Tier 3 Assessments** WSPA recommends the bioavailability of sediment contaminants should be included as an option in Tier 2 and Tier 3 human health risk assessments. This is important as site-specific bioavailability of chemicals is core to understanding exposure and risks. Differences among sites in this regard are widely accepted.	The consideration of bioavailability and associated measures of porewater would certainly be appropriate for Tier 3; however, Tier 2 was not intended to utilize such measures. See responses to comments 11.18, 11.19, 11.20, and 11.21.	No
11.6	This memorandum focuses on both the new Part 2 SQOs and the implementation provisions for both Part 1 and Part 2 SQOs Prior comments submitted by WSPA on the SQOs are incorporated by reference. 1. **The Sediment Quality Provisions (SQO Provisions) should be applied to all waters, including those for which a TMDL has previously been developed.** Section III.A.1.b.4 (at p. 3) currently states that the SQO “*implementation provisions … do not apply to dischargers that discharge to receiving waters for which a total maximum daily load (TMDL) has been established to address for [sic] the bioaccumulation of organochlorine pesticides or polychlorinated biphenyls from sediment into sportfish tissue within enclosed bays and estuaries unless the applicable Regional Board approves the application of such provisions*.” However, many of the state’s previously adopted TMDLs are based on outdated and faulty science and are inconsistent with the proposed SQO Provisions. For example, many TMDLs are based upon sediment quality guidelines such as ERLs and TELs, which are inappropriate for use as indicators of bioaccumulation or targets for protection of human health, and which should not be used in development of TMDLs. The	See responses to comments 2.1, 6.17, 6.18, 9.2, 9.3, 9.4, and 9.7. The requested changes have not been made and the authority to utilize the proposed assessment framework remains with the applicable Regional Water Board.	No

	State has invested significant time and effort in the process of developing the proposed SQOs, and the proposed SQOs represent a significant advance in terms of applying appropriate scientific methods to evaluate both the human health risk posed by toxic pollutants in sediments and impacts to benthic organisms. The SWRCB should modify the proposed SQOs to require their use in evaluating existing TMDLs and in developing future TMDLs. Suggested language changes are provided below.		
11.7	The SQO Provisions similarly include language regarding the implementation of SQOs as receiving water and effluent limitations (see Section IV.A.4.c.1. at p. 32). Section IV.A.4.c.1.d requires effluent limits to be established to protect or restore sediment quality “only after: i. A clear relationship has been established linking the discharge to the degradation, ii. The pollutants causing or contributing to the degradation have been identified, and iii. Appropriate loading studies have been completed to estimate the reductions in pollutant loading that will restore sediment quality.”	See response to comment 11.8.	No
11.8	However, receiving water and effluent limitations have been developed across the state to implement TMDLs that are not consistent with the SQO Provisions. In many cases, the adopting agencies have not made these key findings. Permit limits have been applied in cases where no clear linkage between the discharge and the degradation has been established, and for pollutants that are unlikely to cause or contribute to degradation, because of TMDL targets and wasteload allocations that have been established without consideration of the requirements of the SQO Provisions. Only by revisiting TMDLs to ensure that they are consistent with the SQO Provisions will it be possible to develop receiving water and effluent limits that are consistent with the SQO Provisions and that are scientifically and technically appropriate.	See responses to comments 2.1, 6.17, 6.18, 9.2, 9.3, 9.4, 9.7, and 11.6.	No

	Recommendation: The SWRCB should modify Section III.A.1.b.4 (at p. 3) to read as follows: "Implementation provisions … ~~do not apply to~~ shall be used to develop requirements for dischargers that discharge to receiving waters for which a total maximum daily load (TMDL) has been established to address for the bioaccumulation of organochlorine pesticides or polychlorinated biphenyls from sediment into sportfish tissue within enclosed bays and estuaries ~~unless the applicable Regional Board approves the application of such provisions~~. Implementation provisions shall also be used to develop future TMDLs for the bioaccumulation of organochlorine pesticides or polychlorinated biphenyls from sediment into sportfish tissue within enclosed bays and estuaries." In the SQO Provisions Staff Report at pp. 106-107, Alternative 1 ("Do not include a clause that would grandfather those waterbodies with adopted TMDL") should be selected.		
11.9	**2. The Water Boards should be required to develop TMDL allocations using the methodology of the proposed SQOs.** Consistent with Comment 1, the Water Boards should be required to follow the proposed SQOs, once adopted, in all TMDLs adopted after the effective date of the Sediment Quality Provisions. *Recommendation: The SWRCB should modify language in Section IV.A.4. at p. 32 as follows: "These actions are further described in Chapters IV.A.4.f and IV.A.4.g. Nothing in this chapter shall limit a Water Board's authority to develop and implement waste load allocations for Total Maximum Daily Loads. ~~However, I~~ It is ~~recommended~~ required that the Water Boards develop TMDL allocations using the methodology described herein, ~~wherever possible~~."*	See responses to comments 2.1, 6.17, 6.18, 9.2, 9.3, 9.4, 9.7 and 11.6.	No
11.10	**3. The SWRCB should revise the State Listing Policy to be consistent with the Sediment Quality Provisions.** The State Listing Policy was initially adopted in 2004, prior to the adoption of the Sediment Quality	See response to comment 11.3.	No

	Objectives Part 1. The SQO Provisions specify that "the Sediment Quality Provisions adds [*sic*] an additional listing criterion that applies only to listing for exceedances of the narrative sediment quality objective for aquatic life protection in Chapter III.A.2.a" (Section IV.A.4.e.1 , p. 37). However, the State Listing Policy has not been modified accordingly, and continues to allow Sediment Quality Guidelines, including SQGs, such as ERLs and PELs, to be used in listing decisions (see Listing Policy Section 6.3.1 at pp. 19-20). However, the use of SQGs or chemical-specific concentration-based thresholds as a basis for management actions is inappropriate as "no single SQG approach is able to account for all of the factors that influence contaminant effects" (SQO Part 1 Staff Report at p. 92-93).[1] SQGs are an inappropriate basis for listing, and listing decisions should be made for toxic pollutants in sediment using only the SQO Provisions. The SQO Provisions continue to allow a water segment to be placed on the 303(d) list if that segment exhibits sediment toxicity but is not listed for an exceedance of the narrative objective for aquatic life protection (see Section IV.A.4.e.1 on p. 37, which allows such a listing in accordance with Section 3.6 of the Listing Policy). The SQO provisions also require that, if the water quality standard exceedance "consists of the sediment quality objective," the Regional Water Board is to re-evaluate the listing and delist if the water segment does not meet the criteria in the SQO Provisions. In practice, these provisions of the SQO Provisions and Listing Policy appear to conflict with each 1405218.000 – 6920 other, such that listing decisions have been made and TMDLs have been developed for toxic pollutants that do not appear to be responsible for the observed effects. *Recommendation: The SWRCB should review and revise the State Listing Policy to be consistent with the SQO Provisions. While that would require a separate regulatory action, the SWRCB should insert a finding*		

	into its resolution for the adoption of the SQO Provisions that requires appropriate revisions to be made to the Listing Policy.		
11.11	**4. The SWRCB should modify the Provisions so that listing decisions and receiving water limitation exceedances do not use the "Possibly Impacted" category.** a.) Part 1 direct effects SQOs. Section IV.A.4.c.2.a (p. 32-33) includes new language stating that an exceedance of a receiving water limit is demonstrated when "Any station within the site is assessed as Clearly Impacted as defined in Chapter IV.A.1.i and IV.A.1.j or the total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a permit cycle. Calculation of percent area shall be based on data from spatially representative samples selected using a randomized study design or equivalent spatial analysis." Similarly, Section IV.A.4.e (p. 36-37) is entitled "Evaluating Waters for Placement of [*sic*] the Section 303(d) List." This section includes new requirements for listing decisions based on both Part 1 (direct effects) and the Part 2 (human health) SQOs. Section IV.A.4.e.1 provides new requirements for listings based on the Part 1 SQOs (Aquatic Life – Benthic Community Protection). The new requirements provide that water segments shall be listed if either "i. Any station within the site is assessed as Clearly Impacted…" or "ii. The total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a listing cycle. Calculation of percent area shall be based on data from multiple spatially representative samples selected using a randomized study design or equivalent spatial analysis." [Section IV.A.4.e (p. 37)] However, the SQO Provisions from Part 1 define "Possibly Impacted" as "Sediment contamination at the site may be causing adverse impacts to aquatic life,	See responses to comments 11.13, 11.14, and 11.15.	No

	but these impacts are either small or uncertain because of disagreement among LOE." [Section IV.A.1.i.3 at p. 14]. Accordingly, the SQO Provisions require that the "Possibly Impacted" category shall be designated as "meeting the protective conditions if the studies identified in Chapter IV.A.4.f demonstrate that the combination of effects and exposure measures are not responding to toxic pollutants in sediments and that other factors are causing these responses within a specific reach segment or waterbody. In this situation, the Water Board will consider only the Categories **Likely Impacted** and **Clearly Impacted** as degraded when making a determination on receiving water limits and impaired water bodies as described in Chapter IV.A.4." [Section IV.A.1.i.4) at p. 15]. Because the Possibly Impacted category indicates significant uncertainty about the sediment condition and the cause of any impacts, sites in the Possibly Impacted category should not be used as the basis for listing.		
11.12	We also note that Appendix A-2 requires a Stressor Identification Evaluation (SIE) to be conducted only when a station is classified as Likely Impacted or Clearly Impacted, and not when the station is classified as Possibly Impacted. A classification of Possibly Impacted results when impacts are small or when the LOE are inconsistent. In our experience, it is difficult if not impossible to identify the stressor responsible for impacts that are small or when LOE are inconsistent (see SQO Part 1 Staff Report at p. 119). Thus, the requirement to conduct an SIE only when a station is classified as Likely Impacted or Clearly Impacted is appropriate. Consistent with this observation, it would be inappropriate to base a decision to place a waterbody on the Section 303(d) list or to determine that receiving water limitations have been exceeded, for the same reason it is inappropriate to perform an SIE for a station classified as Possibly Impacted.	Appendix A-2 is intended to indicate that in the case where stations are only categorized as Possibly Impacted and no stations are categorized as Likely or Clearly Impacted, there is an option to perform confirmation sampling. If the results of confirmation sampling are the same or worse (Likely or Clearly Impacted) the next step would be to perform stressor identification. See Chapter IV.A.4.f. of the sediment quality provisions for more details.	No
11.13	Based on these considerations, recommendations are as follows:	Stations categorized as Possibly Impacted should still be included in listing criteria, as those stations demonstrate	No

	1. The SWRCB should modify the language of Section IV.A.4.c.2.a.ii (p. 32-33) to read as follows: "ii. The total percent area categorized as ~~Possibly Impacted and/or~~ Likely Impacted equals or exceeds 15 percent of the site area over the duration of a listing cycle. Calculation of percent area shall be based on data from multiple spatially representative samples selected using a randomized study design or equivalent spatial analysis." *2. The SWRCB should also modify the language of Section IV.A.4.e.1.a.ii (p. 37) to read as follows: "ii. The total percent area categorized as ~~Possibly Impacted and/or~~ Likely Impacted equals or exceeds 15 percent of the site area over the duration of a listing cycle. Calculation of percent area shall be based on data from multiple spatially representative samples selected using a randomized study design or equivalent spatial analysis."*	some evidence of impact in at least two of the three lines of evidence. See response to 1.22.	
11.14	b.) As with the Part 1 SQOs, the SQO Provisions for Part 2 are drafted to require that waters be placed on the Section 303(d) list for exceedance of the narrative sediment quality objective for human health if sediments are categorized as Possibly Impacted, Likely Impacted, or Clearly Impacted over the duration of the listing cycle (6 years) [Section IV.A.e.2 on p. 38]. However, the "Possibly Impacted" category is indicative of high chemical exposure but a low site sediment linkage (see Table 22 on p. 29). The Possibly Impacted category indicates significant uncertainty that the site is contributing to the exposure, and thus the "Possibly Impacted" category should not be used for listing decisions. *Recommendation: The SWRCB should modify the language in Section* IV.A.e.2 *on p. 38 as follows: "Human Health – Water segments shall be placed on the section 303(d) list for exceedance of the narrative sediment quality objective for human health protection in Chapter II.A.2.b of the Sediment Quality Provisions if sediments from a site are categorized as ~~Possibly~~*	In this case for stations categorized as Possibly Impacted, data collected from the site demonstrate chemical exposure and some evidence of site linkage and as a result should be included in the listing criteria.	No

	~~Impacted,~~ *Likely Impacted or Clearly Impacted over the duration of the listing cycle (6 years)."*		
11.15	c.) Given the large uncertainty and conservative basis (i.e., likely to over-predict effect) of the various lines of evidence, the selection of "15% of the total area categorized as Possibly Impacted and/or Likely Impacted" as the cutoff for designating an area as in exceedance of a Receiving Water Limit, or for deciding to place a waterbody on the 303(d) list, is also overly conservative. *Recommendation: The criteria of total percent area categorized as Possibly Impacted and/or Likely Impacted should be substantially increased (e.g., 30-40%).*	As stated previously in response to comment 11.13, a 15% total area categorization as Possibly Impacted and/or Likely Impacted indicates that there is evidence of biological effects through either toxicity or community degradation as well as evidence of potential for chemically mediated effects. Furthermore, the use of 15% is consistent with the previous approach assuming spatially representative samples. The existing approach required only 2 station exceedances out of a total number of stations of 2-24. Given a data set of 5-20 stations, the outcome should be similar to the approach being proposed. The key difference is the requirement for spatially representative samples and additional consideration given to stations classified as Clearly Impacted.	No
11.16	5. **The use of "regional background" in establishing management guidelines for sites is appropriate and protective.** Because of widespread diffuse sources of organochlorines and PCBs, including atmospheric deposition from global sources and legacy pollutants from continental or regional sources, it is not feasible to eliminate these pollutants completely from the state's waters. These pollutants were banned decades ago, and their concentrations in the environment are declining slowly over time as they degrade and as diffuse sources show lower concentrations over time. WSPA supports the portions of the Sediment Quality Provisions that reference regional background contamination and require management guidelines for a site to be established in consideration of regional background conditions. We note that the three lines of evidence used in Part 1 SQOs (i.e., chemistry, sediment toxicity, and benthic infauna) are also subject to variability and regional differences. For this reason, results for individual site sample locations should be compared to indices at a	The chemical indicators were developed based on mixtures correlated with community effects or sediment toxicity. They are, as stated in the existing provisions, not intended for management guidelines or as TMDL targets. The role is to indicate whether there is potential at a station for chemically mediated effects, which also relies on sediment toxicity as well. Management guidelines, on the other hand, should account for regional background as it is unlikely that any cleanup action could encompass all sediment that exceed regional background.	No

	comparable reference location or to regional background conditions rather than to generic values. *Recommendation: Sample results for the three lines of evidence that comprise the Part 1 SQOs should be compared statistically to results at a reference site (or multiple reference sites) in order to characterize whether a particular site location is significantly impacted.*		
11.17	**6. The State Water Board should clarify that an "off ramp" exists when Stressor Identification Evaluations (SIE) are inconclusive.** The flow chart shown as Appendix A-2 on p. 49 of the Sediment Quality Provisions describes a point source assessment process. Appendix A-2 describes the actions to be taken when stations are classified as Likely or Clearly Impacted, including preparation and execution of a "Stressor Identification Evaluation" workplan. The flow chart requires a discharger to "review and revise SIE workplan" when the SIE is inconclusive and fails to identify the "chemicals or classes of chemicals" responsible for an SIE exceedance. *Recommendation: Consistent with the SQO Provisions at Section IV.A.4.f (p. 40-41), the SWRCB should clarify the flow chart in Appendix A-2 to note that the Water Board may require a one-time augmentation to that study or, alternatively, may suspend further stressor identification studies pending the results of future routine SQO monitoring.*	The content of the assessment process is not included in the proposed Provisions. That comment would be more appropriate for a triennial review where the State Water Board addresses significant problems that are not specifically related to any specific proposed amendment.	No
11.18	**7. Assessment of the bioavailability of sediment contaminants is fundamental to assessment of sediment quality and should be included as an option in Tier 2 and Tier 3 assessments of human health risk.** Site-specific bioavailability of chemicals is fundamental to understanding potential for exposure and risks. Differences among sites in bioavailability of sediment-associated contaminants have been well documented[2]. Soot and other forms of "black carbon," which are ubiquitous in coastal sediments, have been	Use of measured porewater concentrations to better inform site linkage indicator is acceptable for Tier 3; however, Tier 2 was developed in part to minimize the types and number of analyses required to assess site linkage. Benthic invertebrates, such as worms, consume sediment and as a result, their exposure and uptake through the gut represents a significant exposure route that porewater measurements do not represent. The food web model associated with Tier 2 incorporates those exposure routes and as a result these measurements are unnecessary.	No

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	shown to sorb hydrophobic contaminants and reduce bioavailability of sediment-associated hydrophobic organic contaminants (HOCs).[34] ,Abundant data have demonstrated that measured concentrations of HOCs in porewater are better predictors of bioavailability than bulk sediment concentrations.[5] This is not because porewater is the primary route of exposure, but rather because porewater concentrations reflect the fraction of the total sediment concentration that is available to partition among phases, including porewater and tissue. If porewater concentrations are lower than predicted based on generic partitioning coefficients, then bioavailability of sediment-associated HOCs are also expected to be lower. Because of the importance of taking into account site-specific bioavailability, EPA's Equilibrium Partitioning Sediment Benchmarks (ESBs) should be included as a sediment chemistry line of evidence.		
11.19	In addition, the option should be provided in Tier 2 to use passive samplers to measure the freely available concentration of HOCs in sediment, an approach that has been strongly endorsed by the EPA[9] and the scientific community.[10]	Tier 2, as written, requires measurement of freely dissolved water column pollutant concentrations. However, the use of freely dissolved porewater and prey tissue concentrations would only be acceptable in Tier 3. Tier 2 was purposely developed to provide the means to assess linkage while at the same time minimizing the need for measuring porewater or contaminant concentrations at various steps in the food web.	No
11.20	The Gobas and Arnot Model (2010) is used to calculate biota-sediment accumulation factors (BSAFs) for Part 2 SQOs to protect human health. Because Gobas and Arnot (2010) states that concentrations of freely dissolved contaminants in surface water and porewater should be used in calculating BSAFs[11], the guidance should clearly state that passive samplers can be used to measure concentrations of freely dissolved contaminants in surface water and porewater. In addition, since higher level consumers are expected to receive most of their dose via ingestion of food, the guidance should clearly	See response to comment 11.19.	No

	state that measured concentrations of contaminants in prey can be used in site-specific food chain models.		
11.21	*Recommendations: (1) EPA's Equilibrium Partitioning Sediment Benchmarks (ESBs) should be allowed to be considered in the sediment chemistry line of evidence. (2) Guidance should clearly state that 1) passive samplers can be used to measure site-specific concentrations of freely dissolved contaminants in porewater and surface water, and 2) measured concentrations of contaminants in prey can be used in site-specific food chain models.*	Tier 2, as written, requires measurement of freely dissolved water column pollutant concentrations. U.S. EPA's Equilibrium Partitioning Sediment Benchmarks (ESBs) were developed to protect aquatic life from direct exposure and are not intended to protect higher trophic levels from bioaccumulation and trophic transfer. The existing Enclosed Bays and Estuaries Plan (Appendix A, Section f) provides guidance on the use of mechanistic benchmarks to support stressor identification studies. As stated in response to comment 11.20, porewater measurements could only be utilized in Tier 3.	No
11.22	**8. Significant uncertainty is introduced by the use of a relatively small number of sediment samples and a generic BSAF to estimate site-specific tissue concentrations and corresponding site linkage factors.** The BSAF values derived by Gobas and Arnot (2010) were based on a dataset of ~1,284 sediment samples from San Francisco Bay. Even with this relatively large data set, the SCCWRP companion document[12] reported that the spatial variability of the measured PCB concentration in sediment was by far the largest contributor (81%) to the uncertainty in predicted tissue concentrations and corresponding BSAF values. Nonetheless, the authors asserted that their model-predicted tissue concentrations were in reasonable agreement with observed tissue concentrations. However, application of BSAFs derived on the basis of >1,000 sediment samples in one water body (San Francisco Bay) to a site-specific data set with far fewer sediment samples in another water body is unlikely to have similar predictive ability. This is because an estimate of the central tendency (and distribution) of tissue concentrations based on > 1,000 sediment samples is likely to be much more accurate than a prediction based on a minimum of 5 site sediment samples (as specified in Table 18 of the Amendments	The commenter states that the limited number of sediment samples (5) required to evaluate a site's contaminant contribution to the predicted contaminant concentrations in fish tissue is reason enough to delay the adoption to allow the technical team more time to perform additional analyses on the assessment framework. Selection of five sediment samples was based on the need for an accurate assessment of site sediment concentrations balanced with a desire to maintain an affordable approach for smaller permittees. The number of samples represents a minimum. Flexibility in the guidance allows for more samples in those cases where significant contaminant gradients or heterogeneity exists in the contaminant distribution at a site. See Appendix A-5 Design Considerations for Human Health SQO Assessment in the proposed Provisions.	No

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<td>to the Sediment Quality Provisions document). Since predicted fish tissue concentrations will be strongly influenced by how accurately the available site data characterize the actual distribution of sediment concentrations, it seems unlikely that fish tissue concentrations can be accurately predicted from a minimum of 5 sediment samples. Also, because the Site Sediment Linkage categories are based on estimated tissue concentrations, the accuracy of the linkages is also highly uncertain.
Recommendation: The amendments should be adopted only after a more detailed analysis of the accuracy and variability of various input parameters, including but not limited to sediment concentrations, and the resulting accuracy and distribution of estimated tissue concentrations and corresponding Site Sediment Linkage factors. The SQO Provisions should clearly discuss the implications of over- or underestimating sediment concentrations.</td>
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<td>11.23</td>
<td>**9. The Site Sediment Linkage Categories for Tier 2 Evaluations should be clarified.**
The degree to which measured concentrations of contaminants in fish tissue are “linked” to a site of interest is calculated via a site linkage factor. The site linkage factor was defined as the ratio of model-estimated tissue concentrations to measured tissue concentrations.
Site Linkage Factor = C_{Est}/C_{Tis} (see SQO Provisions at Section IV.2.d.4., p.27)
Where
C_{Est} = estimated tissue concentration (based on model)
C_{Tis} = observed tissue concentration (based on site-specific data)
The SQO Provisions specify that a Monte Carlo simulation is used to generate a cumulative distribution of site linkage factors for the site. The Monte Carlo simulation uses the variability and uncertainty in the site-specific fish and sediment concentrations, the model BSAF, and the fish home</td>
<td>Table 21 in the proposed Provisions has been revised for clarity. The same thresholds and values are used; however, ranges of the cumulative linkage distribution now defined as exceeding the threshold. Previously the very low, low, and moderate categories were defined as “less than” the linkage threshold
<table>
<tr><th>Cumulative % of sediment linkage distribution above threshold</th><th>Linkage threshold</th><th>Category</th></tr>
<tr><td>0-25%</td><td>0.5</td><td>Very Low</td></tr>
<tr><td>26-50%</td><td>0.5</td><td>Low</td></tr>
<tr><td>51-75%</td><td>0.5</td><td>Moderate</td></tr>
<tr><td>76-100%</td><td>0.5</td><td>High</td></tr>
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<td>Yes</td>
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<td>range. The results of the Monte Carlo simulation are compiled into a cumulative distribution. Table 21 (Section IV.2.d.7, p. 29) defines how the cumulative distribution of site linkage factors is used to define overall site linkage.
Table 21. Site Sediment Linkage Categories for Tier 2 Evaluations
<table>
<tr><th>Cumulative % of sediment linkage distribution</th><th>Linkage threshold</th><th>Outc</th></tr>
<tr><td>75%</td><td><0.5</td><td>1. V</td></tr>
<tr><td>50%</td><td><0.5</td><td>2. Lo</td></tr>
<tr><td>25%</td><td><0.5</td><td>3. M</td></tr>
<tr><td>25%</td><td>>0.5</td><td>4. H</td></tr>
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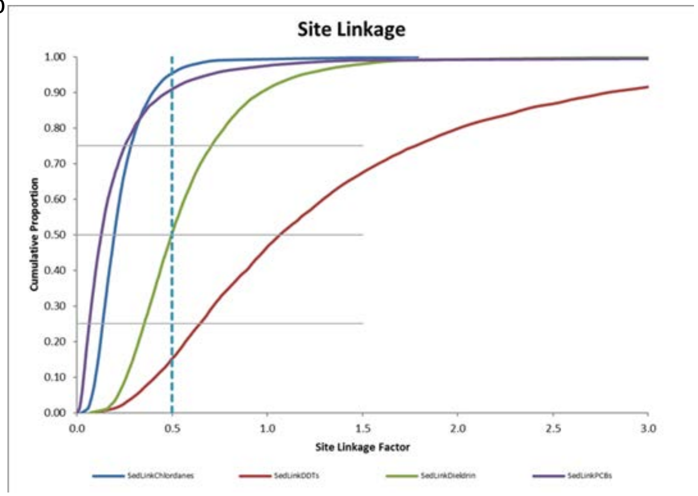
The categories above appear to be inconsistent. For example, if 75% of the distribution is <0.5, which is defined as Very Low, then the remaining 25% of the distribution would be >0.5, which would be defined as High. In fact, all of the distributions that fall into the Very Low, Low or Moderate categories, would also appear to fall into the “High” category since at least 25% of the distributions would be <u>> 0.5. These apparent inconsistencies should be resolved or clarified before adoption of the SQO Provisions.</u>
Recommendation. The Site Sediment Linkage Categories should be revised and/or clarified.</td>
<td>The figure below represents cumulative site linkage distribution for a site. The red line representing the cumulative proportion for DDT crosses the linkage threshold (dotted blue line) at roughly 13-14% or 0.13-0.14 on the vertical axis. From the table above, this outcome equates to very low. The green line representing cumulative proportion for Dieldrin crosses the threshold at 50% or 0.50, which would be classified as low. The blue and purple lines plot the cumulative proportions for Chlordanes and PCBs, both of which cross the linkage threshold at greater than 90% (0.90) which means for both contaminants the site linkage is high.

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Table 1. Comparison of original station classifications with those resulting from application of revised CSI chemical thresholds listed in 2011 Staff Report (original CSI category thresholds applied).

	Revised Station Category					
Original Category	Unimpacted	Likely Unimpacted	Possibly Impacted	Likely Impacted	Clearly Impacted	All
Unimpacted	114	0	0	0	0	114
Likely Unimpacted	0	35	1	0	0	36
Possibly Impacted	0	1	70	1	0	72
Likely Impacted	0	0	0	35	0	35
Clearly Impacted	0	0	0	0	20	20
All	114	36	71	36	20	277

Overall change in classification: 1.1% of stations
Change to less impacted classification: 0.4% of stations
Change to more impacted classification: 0.7% of stations

Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries of California:

Sediment Quality Provisions

Responses to Peer Review Comments

Peer Review Letter No.	Peer Reviewer	Conclusions Addressed[1]
1	Gary A. Buchanan, Ph.D.	Conclusions A5, A6, A7 and B1
2	Valery E. Forbes, Ph.D.	Conclusions A6 and A7
3	Robert J. Letcher	Conclusions A-3, A-4, A-5, A-6, A-7, B-1 and C
4	Elaine M. Faustman	Conclusions A1 and A2

Peer Review Request Package and responses are posted at https://www.waterboards.ca.gov/water_issues/programs/peer_review/date.shtml

[1] Conclusions addressed are described in Attachment 1 at the end of this document. Peer Reviewers were asked to address specific conclusions based on the reviewer's education and experience.

No.	Comment	Response	Revision[2]
1.1	In general, the primary documents were well-written, science based, supported by local, regional or state data, as well as substantiated by the supporting documents and appropriate peer-reviewed literature. Overall, the scientific portion of the proposed rule is based upon sound scientific knowledge, methods and practices. The only concern is with small sample size for Tier 1 evaluations as detailed in the specific comments.	Support for the overall scientific portion of the proposed Provisions is acknowledged. Comments related to sample size are addressed in responses to peer review comments 1.3, 1.7 and 1.9.	No.
1.2	Conclusion A5 – Site-specific and species-specific data are required to assess sediment linkage. This conclusion is fully supported by the science as detailed in the documents reviewed. Site specific and species-specific data are critical in the assessment of sediment linkage. Appendix 4, Sensitivity Analysis for Indirect Effects Assessment (Bay et al., 2017) provides evidence of the importance of obtaining site-specific data for sediment contaminant concentration and sediment total organic carbon. Having species-specific data are important to confirm that appropriate species are selected for the assessment and that they are based on a sediment related diet and appropriate home range. There is a sound scientific basis as detailed in Bay et al. (2017), e.g., Appendix 2 and 3.	Support for the site-specific and species-specific data to assess site linkage is acknowledged.	No
1.3	Conclusion A6 – The approach, methods and assumptions set forth in the optional Tier 1. Screening Evaluation are appropriate for screening low-risk sites or waterbodies. The Tier 1 approach, methods and assumptions are appropriate as a screening step in distinguishing low-risk sites. The conservative assumptions are generally appropriate for this initial assessment that would typically use available and potentially limited data. The use of C_{Tis95} data from the site to compare to the OEHHA ATL3 range maximum tissue threshold concentrations is appropriate and conservative. The sediment screening threshold that is based on the tissue screening threshold and BSAF for a range of sediment TOC is also appropriate.	This comment is more comprehensively addressed in peer review comment 1.7. Support for the proposed approach methods and assumptions that support Tier 1 is acknowledged.	No

[2] Revision pertains to a change made to the Proposed Final Staff Report and/or the Proposed Final Sediment Quality Provisions. A revision will be marked “Yes” only in the first instance the revision is described in the responses to comments.

	and conservative. However, please see comment below for page 82 of the Draft Staff Report concerning the use of ‘maximum concentration’. The use of less than 3 samples may not be appropriate or conservative depending on the size of the site, type of sample (composite or individual) and number of species tested. Clarification is recommended.		
1.4	Conclusion A7 – The approach, methods and assumptions set forth in Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted. The more robust Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted. The State of California has conducted significant research and a large volume of supporting information and data. The approach, methods and assumptions are clearly explained in the primary and supporting documents. I would consider this approach as setting a more concise, contemporary and scientifically supported benchmark for the assessment of sediments contaminated with organochlorine pesticides and PCBs.	Support for the proposed approaches, methods and assumptions that support Tiers 2 and 3 for organochlorine pesticides and PCBs. is acknowledged.	No
1.5	Conclusion B1 – The proposed approach to designate impaired sediment quality in relation to the SQO protecting benthic communities from direct exposure to contaminants in sediment is appropriate and scientifically sound. Use of severity of effects and spatial extent is appropriate when evaluating whether sediment dependent beneficial uses are supported in waterbodies. The existing use of multiple lines of evidence (MLOE) is appropriate and scientifically sound. This is further supported by the already developed indices for the benthic community, i.e., Benthic Response Index, Index of Biotic Integrity, Relative Benthic Index and River Invertebrate Prediction and Classification System. The use of the severity of effects, i.e., clearly impacted, to demonstrate exceedance of a receiving water limit at any station within a site is appropriate, as this reflects the highest severity of impacts based on the scientifically sound assessment approach. The use of ‘possible impacted’ and/or ‘likely impacted’ for total percent area greater than 15 percent for exceedance determinations is appropriate. While the chosen specific percent value for area is a policy decision, this level would generally be	Support for the proposed approach to incorporate spatial extent and magnitude for use in assessing impairments and in the implementation of receiving water limitations is acknowledged.	No

	protective. The requirement that the "calculation of percent area shall be based on data from spatially representative samples selected using a randomized study design or equivalent spatial analysis" provides a scientifically sound basis for this approach.		
1.6	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) Page 15, next to last sentence: Suggest removing the reference to methyl mercury, since it is distributed throughout the body and is not lipophilic. Page 74, 6.2.4, Alternative 3: Staff recommendation is alternative 3 and references Appendix A, C-6 (mislabeled (?) and assumed to be Draft Amendments Appendix A-6). However Alternative 3 recommends skin-on fillets, and Appendix A-6 lists skin-off fillets, which appears to support Alternative 4. This needs to be corrected and consistent in both primary review documents. Page 80: Reference to Fig 5.1 is a map and does not match the text description. Typo? Page 80 and 82, Tiered Assessment Framework: Page 80 states that "Tier 1 consists of a preliminary evaluation of either tissue data or sediment data…". Page 82 (6.4) states "or" and "or both" for Tier 1. Suggest making the sentences consistent or explaining the rationale more clearly.	These errors have been corrected in the Draft Staff Report.	Yes
1.7	Draft Staff Report Page 82, 6.4.1, use of maximum concentration: Less than three individual samples is not appropriate for a screening evaluation. One or two samples, even if using the maximum concentration, are not representative of conditions at a site and is not scientifically supported. This may be appropriate if the one or two samples were composites, i.e., multiple sites/fish combined in one sample and only for relatively small sites. If only one or two individual samples are available, recommend requiring a Tier 2 assessment. The other alternative is to allow this assessment with minimum data only if the data indicates	Draft Staff Report, Section 6.4.1 now identifies Alternative 2 as the preferred alternative. Accordingly, the use of a sample size of less than 3 and the related requirement to use the maximum concentration for sample sizes less than three has been removed from Chapter IV.A.2.c of the proposed provisions. These provisions now clarify that the minimum number of samples for either tissue or sediment is 3. Tier 1 does not require composite samples. A goal of Tier 1 is to support the use of readily available data in those waterbodies were the data has been collected.	Yes

	that a Tier 2 assessment is required, i.e., data that indicates no impact is not sufficient to characterize the site as unimpacted. While use of composite samples is mentioned elsewhere, it is not clear if that is the intent in this section of the document. In the Bay et al. (2017) supporting document (p. 44) state that OEHHA recommendations for screening surveys should be followed "…a minimum of three composite samples should be collected and analyzed for each target species…". Additional explanation/clarification should be added to both primary review documents.		
1.8	Draft Staff Report Page 83, 6.4.3: • References for BSAF are not listed on the References page or listed incorrectly in the text – Bay and Greenfield, 2015 and Greenfield et al, 2015. • The description of BSAF is adequate for the layman, but it does not follow the scientific definition for organic chemicals. BSAF is the ratio of the chemical concentration in the organism (normalized to the lipid fraction) to the chemical concentration in the sediment (normalized to the sediment organic carbon content) (Burkhard, 2009). It appears that the lipid and organic carbon content are accounted for in the Decision Support Tool and/or the bioaccumulation model in the calculation of the BSAF. If accurate, this should be noted in the document (e.g., footnote).	The references identified have been corrected and Greenfield et. al. 2015 has been added to the list of references. How the BSAF can be expressed and how it is expressed in the Draft Staff Report is now described in Section 6.4.3. The Gobas model (embedded in the Decision Support Tool) does take into account lipid and organic carbon.	Yes
1.9	Draft Staff Report Page 85, 6.4.4: Alternative 2 may not be adequately conservative in some instances, i.e., when tissue data shows no impact, but sediment sample size is small. See comment for section 6.4.1.	See response to peer review comment 1.7. Sample sizes less than 3 are no longer allowed in the Tier 1 assessment.	No
1.10	Draft Staff Report Page 91, Table 6.4: No footnote for "m" for lipid row. Does this indicate "modeled"?	"m' indicates measured value, and a footnote to explain this has been added to the table.	Yes
1.11	Draft Staff Report Page 133, last paragraph: The first two sentences are repeated in the next two sentences.	Repeated text referenced was deleted	Yes
1.12	Draft Staff Report Page 137, Mitigation: The fifth bullet in repeated further down on this page.	Repeated text referenced was deleted	Yes
1.13	Proposed Amendments Table of Contents: Appendix A-1 is not listed. Table 17 is listed twice.	These two errors were corrected in the Proposed Provisions Table of Contents	Yes
1.14	Page 4, III.A.1.d. Applicable Sediments: This states that	The intertidal zone limitation was necessary for the 2008 provisions	No

	the Sediment Quality Provisions apply to subtidal surficial sediments…seaward of the intertidal zone. Is the intertidal zone covered under another control plan? The sediments in intertidal zones can be a source of contamination to benthos and fish, e.g., during foraging at high tide.	because the benthic community metrics were derived from data sets that encompassed only subtidal communities. In order to maintain consistency and for simplicity of implementation, that limitation was retained for the human health SQO. If, however intertidal sediments represent a significant contaminant source into the waterbody and is entering the food web, it is unlikely that the adjacent subtidal sediments will be unaffected.	
1.15	Page 18, IV.A.2.b. In the last sentence under Tier 3, Chapter IV.A.2.b.7 is referenced. This section was not found in the document.	This error was identified in public comment letters and was corrected.	No
1.16	Page 20, IV.A.2.c.3. and Page 21, IV.A.2.c.4: same comment as Page 82, 6.4.1, use of maximum concentration, for the Draft Staff Report (see above).	See response to peer review comment 1.7 and the associated changes described.	No
1.17	Page 23, Table 17: It appears that the contaminant names in the second row on the table have shifted since “Chlor” is repeated twice under Benthic with piscivory, i.e., names are incorrect for that portion of the table.	The errors in Table 17 were identified in public comment letters and were corrected.	No
1.18	Page 54, Appendix A-5, consumption rates: Recommend that when identifying available information on local consumption rates that the effect of any fish consumption advisories in effect for the site on the consumption rate be considered. Fish advisories can reduce the consumption rate for some anglers, i.e., as compared to their consumption rate if there were no fish advisories for that waterbody, thus artificially reducing consumption rates for the assessment.	The text has been amended to include consideration for the influence of existing advisories on the consumption rate of those affected.	Yes
2.1	Comments on Conclusion A6: The approach, methods and assumptions set forth in the optional Tier 1 Screening Evaluation are appropriate for screening low risk sites or waterbodies. Overall, the approach, methods and assumptions proposed for Tier 1 seem appropriate in being standardized, require minimal data, are simple to apply, and are based on accepted human health thresholds for contaminant consumption.	Support for the approach, method and assumptions associated with Tier 1 is acknowledged.	No
2.2	It has been proposed that the 95th upper confidence limit of the mean sediment contaminant concentration be used when there are three or more sediment samples, and the maximum sediment concentration when there are fewer	The use of fewer than 3 samples in the Tier 1 assessment has been removed. See response to peer review comment 1.7 and associated changes.	No

	than three samples. To potentially base a Tier 1 assessment on only one or two sediment samples seems inadequate, particularly if the samples are below threshold, meaning that no further assessment would be required and potentially no further monitoring would be done for 5 years. If a Tier 1 assessment based on 1-2 sediment samples exceeds threshold and triggers a Tier 2 assessment, this is less problematic (though could still potentially result in a less efficient use of resources than a Tier 1 assessment based on a larger sample size). In my view there should be some minimum amount of information required at Tier 1 in order for a "no further assessment needed" decision to be made. For example, it should not be possible to conclude that a site is not degraded based on a Tier 1 assessment of one or two sediment samples alone (i.e., without corresponding fish tissue samples). If there are fish samples as well, and these support the conclusion based on the one or two sediment samples, this is probably sufficiently conservative for a Tier 1 assessment. Since a study design and workplan, based on a Conceptual Site Model (CSM), must be developed before sampling commences, the minimum number and spatial distribution of sediment samples would presumably be defined in this step. It would seem unlikely that a reasonable CSM would result in a study design that included only one or two sediment samples, so possibly this concern is unwarranted.		
2.3	However, whereas Tier 2 requires a minimum of 5 sediment samples per site in addition to a minimum of 3 tissue samples from at least two sportfish species, it would seem reasonable to set some minimum number of samples for Tier 1 as well. Potentially sites that are known to be unimpacted on the basis of previous monitoring studies and/or are located far from sources of contamination would warrant less sampling than other sites. The addition of guidance to this effect could potentially increase the efficiency of Tier 1 assessments further.	The use of fewer than 3 samples in the Tier 1 assessment has been removed. See response to peer review comment 1.7 and associated changes.	No
2.4	For fish tissue, the mean of the 95% upper confidence limit of the mean tissue concentration for each species is used.	See responses to peer review comments 2.3 and 1.7.	No

	If there are fewer than three samples for a given species the maximum concentration for that species should be used. Whether this is sufficiently protective will depend on whether/how many fish species are used in the Tier 1 assessment. This is not entirely clear from the document.		
2.5	The Tier 1 screening thresholds are based on Office of Environmental Health Hazard Assessment Advisory Tissue Levels based on three or five (for subsistence fishers) servings of 3 fish per week. The 95% UCL of the mean tissue concentration for sportfish is compared to the screening thresholds directly. For sediments, the 95% UCL of the mean site sediment concentration is compared to a sediment threshold calculated as the tissue threshold divided by the highest biota-sediment accumulation factor (BSAF) for the dietary guilds identified in the Conceptual Site Model. This seems a reasonable and conservative approach.	Support for the Tier 1 screening thresholds and the use of the 95% UCL of the mean is acknowledged.	No
2.6	The Tier 1 data requirements state that sediment and tissue data shall be no more than 6 years old at the time of the assessment and collected within site boundaries. This seems an arbitrary age that is given without any justification or reference to the published literature as far as I could tell. Also, this requirement says nothing about how the sediment or tissue samples should be stored prior to analysis although the document is rather explicit as to other aspects of sediment sampling such as method of collection, depth of sampling, etc.	The basis for the six years was a desire to accommodate data collected from regional monitoring programs, which vary in frequency. The largest effort, the Southern California Bight Regional Monitoring survey which encompasses the bays and estuaries as well as coastal waters from Point Conception to the Mexico Border, is conducted every five years. This requirement assumes that the data are available, and that the samples were collected and analyzed previously within conventional holding time limits (e.g., 6 months to 1 year).	No
2.7	Comments on Conclusion A7: The approach, methods and assumptions set forth in Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted. The required Tier 2 site-specific information, including the minimum number and type of sediment and fish tissue samples, is clearly spelled out in Table 18 of the amendment. Assuming that there are multiple sediment samples taken at each site (as indicated in Table 18; a minimum of 5), it is not clear how these data enter into the subsequent calculations to estimate ΣC_{sed}, BSAF, and the sediment linkage factor. It sounds as if the first two might be based on a single estimate of sediment concentration, whereas the latter attempts to incorporate the variability in	Chapters IV.A.2.d.4) and 6) of the proposed Provisions have been amended to clarify calculations of ΣC_{sed} ,the BSAF, as well as the site linkage distribution.	Yes

	sediment concentration measurements at a site. This needs further clarification.		
2.8	Interpretation of Table 21 is somewhat difficult to follow, and an example in the text would help to add clarity. For example (and assuming I understand this correctly), if the estimated fish tissue concentration is less than half of the observed fish tissue concentration (i.e., linkage threshold < 0.5) for 75% or more of the samples, then the site sediment linkage (outcome in Table 21) is categorized as "very low". Possibly, addition of Figure 7 from Greenfield et al. (2015) would add clarity. A combination of the chemical exposure evaluation (Table 20) and the site sediment linkage evaluation (Table 21) is used to determine the overall site assessment over a range from "unimpacted" to "clearly impacted" (Table 22). Use of these multiple categories is much better than a simple binary impacted vs. unimpacted categorization.	Table 21 was modified in response to public comments and now presents ranges corresponding to each category. See table and figure provided in response to public comment 11.23.	No
2.9	A Tier 3 assessment may be triggered when there are unique conditions associated with a site, to incorporate spatiotemporal factors into the assessment, to test Tier 2 assumptions, or to increase the accuracy or precision of a Tier 2 assessment. The intent is to allow for greater flexibility by allowing some of the parameters held constant at Tier 2 to be modified while keeping the overall decision framework indicators and decision criteria the same (important for ensuring consistency and transparency). Approval from the Regional Board is required in order for a Tier 3 assessment to be conducted and any changes in parameters compared to Tier 2 must also be approved. The strategy to only require added Tier 3 refinements when the specific site situation requires them, and that any such refinements need prior approval, is clearly in line with goals 3, 4, and 5 above.	Support for the proposed approach is acknowledged. Note that collecting data necessary to complete Tier 3 no longer requires prior approval by the applicable Regional Water Board.	No
2.10	General Comments on Proposed Amendments. The proposed amendments associated with the SQO for human health are based on well-developed and published methods and employ a tiered approach. The models and methods have been thoroughly evaluated in the peer-reviewed literature and demonstrated to be scientifically sound. The tiered approach is cost effective and designed	Support for the proposed approaches is acknowledged.	No

	to minimize unnecessary testing, monitoring, and assessment. Likewise, the weight of evidence approach to determine impacts on benthic communities that combines toxicity, benthic community condition, and sediment chemistry is a reasonable and pragmatic approach that has a long history of use. Thus, the proposed amendments fulfill the five goals outlined above.		
2.11	In general, the proposed amendments do an excellent job of minimizing reliance on best professional judgement compared to current practice (Attachment 6 – Draft Staff Report). This is an important improvement that will enhance consistency and transparency of the assessment process.	Support for the proposed approach in comparison to the existing approach is acknowledged.	No
2.12	The most important limitation of the approach is that it is restricted to a few legacy chemicals, and other groups of chemicals will continue to be assessed using current methods. As the revised approach begins to be implemented, it could be worthwhile to estimate the actual benefits (time, effort, money saved) of the revised approach as well as any improvements to beneficial uses of California's enclosed bays and estuaries compared to historical practices.	On the recommendation of the Scientific Steering Committee (Section 2.8 of the Draft Staff Report) the assessment framework was limited to legacy organochlorine compounds because the fate, transport, and trophic transfer were better understood for this group of contaminants than other contaminants that bioaccumulate into tissue. In addition, PCBs and DDTs are frequent causes of sediment and tissue related impairments within bays and estuaries throughout the state. Further, these contaminants are routinely measured in fish tissue and sediment in regional monitoring programs and permits such that significant data is available for those intending to apply the framework. The overall framework and indicators used is believed to be transferable to additional contaminants (including contaminants of emerging concern) that bioaccumulate from sediment into tissue in the future, provided required chemical exposure thresholds and model parameters are available.	No.
2.13	Clearly the Conceptual Site Model development (Appendix A-5) is a key part of the overall process. Based on the description, it would seem that this could possibly be the most time consuming step in a site assessment. Presumably, the largest effort would be required the first time that a site was being considered for assessment, and future assessments would only require minor revisions to existing CSMs. Since my understanding is that a goal of the amendments is to promote the efficient use of resources, it might be worth adding some text to this effect	In response to public comments, the CSM requirements have been simplified for Tier 1 (Appendix A-5). An appendix specific to CSM development for aquatic life SQO assessment was not included because such assessments are already widely conducted and the study design considerations are familiar to many permittees through existing permit requirements and through participation in ongoing regional monitoring programs.	No

	to Appendix A-5. Why is there no corresponding Appendix to address the aquatic life SQO? Overall, the proposed amendments document (Attachment 6) is rather difficult to follow with multiple cross-listings to various appendices. This is not facilitated by the rather complicated structure of the document, e.g., Chap IV.A.4.d.5. A more logical and hierarchical structure could be: Chap 1; section 1.1; subsection 1.1.1, etc.		
2.14	Additional Specific Comments: The proposed amendment document contains a mix of Roman and Arabic numerals to describe the Tiers (e.g., 2 or II). This should be cleaned up for consistency.	Format of numerals has been standardized for consistency. Replaced Roman with Arabic numerals in the proposed Provisions as well as the Draft Staff Report.	Yes
2.15	It is unclear how the weighting factors were derived for the CSI in Table 6. This should be explained.	Development of the CSI is described in the record for the 2008 proceedings. For description of how the CSI was developed see the 2008 SCCWRP Annual Report available here: http://ftp.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/2008AnnualReport/AR08_091_105.pdf	No
2.16	For ease of reference, a table should be provided with the OEHHA Advisory Tissue Levels based on 5 day consumption rates for subsistence fishers along with Table 16.	Because the applicable Regional Water Board must first designate such beneficial uses, the table may not be applicable across all enclosed bays and estuaries and, to avoid confusion, is not included.	No
3.1	A-3. The relative influence of site sediment contamination on fish contamination is an appropriate indicator of the contribution of site sediment contamination. In order to address the second question, the assessment framework requires an evaluation of site linkage; the proportion of measured tissue contaminant concentration estimated to result from site sediment contamination, calculated as a ratio of the estimated tissue concentration and the measured tissue concentration. R. Letcher review: The assessment framework for this SQO relies on the chemical exposure indicator for measures of sport fish contamination from the site and in comparison to consumption advisory thresholds. The SQO also relies on the site linkage indicator, which compares sport fish contamination measurements to estimated sport fish	Support for the chemical exposure and site linkage indicators is acknowledged.	No

	concentrations that would result from site exposure. The relative influence of site sediment contamination on fish contamination is an appropriate indicator of the contribution of site sediment contamination. The site linkage is sound based on the proportion of measured tissue contaminant concentration as a good estimate from site sediment contamination, which is calculated as a ratio of the estimated tissue concentration and the measured tissue concentration. The reasons for this agreement by the reviewer are described, and in the context of the tiered assessment framework in the subsequent conclusions. However, some additional factors to consider and recommendations are also detailed.		
3.2	With respect to the chemical exposure indicators, and in the context of the actual chemical contaminants to which the assessment framework applies, the target chemicals represent but of fraction of the known and unknown substances (Appendix A-7). Since the framework is specific to non-polar (or more lipophilic) chlorinated hydrocarbons (e.g. DDTs, PCBs, chlordanes and Dieldrin), these chemicals do not necessarily reflect the complexity of sediment contamination, which may be contributing to the contaminant burden in exposed fish. Numerous emerging and new chemicals have been reported in marine and freshwater sediment and in biota (including fish) in respective sites and ecosystems. Many of these new contaminants are more polar in nature and in many cases are short abiotic and biotic half-lives due to their instability to e.g. photolytic, microbial and metabolic degradation processes. Furthermore, many new chemicals are less lipophilic and thus bioaccumulation factors from sediment will be much lower than e.g. PCBs and also are likely to be cleared and depurated more rapidly. Such new chemical contaminants include emerging flame retardants (Chen et al. 2015), and pharmaceutical and personal care products (PPCPs). PPCPs currently number in the thousands of different compounds (e.g., antibiotics, blood lipid regulators, analgesics/anti-inflammatory agents, antidepressants, antiepiletics, and antineoplastics), and they comprise a wide range of different chemical	Comment acknowledged. See response to peer review comment 2.12.	No

	structures (Hua et al. 2006). PPCPs are viewed as emerging or newly established environmental contaminants and have experienced decades of unrestricted discharge to the environment. Point sources, such as wastewater and sewage treatment plants as well as surface runoff, are the main sources of PPCPs to the aquatic environment have been reported in WSTP effluent, surface waters and groundwaters. Organophosphate esters (OPEs) are current-use and high production volume chemicals, and are a good example of contaminants that have been shown recently to be unstable in aquatic media (e.g. Su et al. 2016) and via rapid metabolism in wildlife and fish (Greaves and Letcher 2017; Greaves et al. 2016a, 2016b).		
3.3	It is true that organisms can be exposed to and affected by sediment contaminants by multiple pathways that are both direct and indirect. Contamination in organisms can occur via direct contact with the sediment and sediment ingestion. Organisms living in the sediment are also exposed through the uptake of contaminants from pore water and via ingestion of sediments and subsequent accumulation by desorption during digestive processes in the gut, and via the consumption of contaminated prey. It is correct that the direct affect of the benthic community present at a site may be altered by a variety of environmental factors in addition to adverse effects from contaminants. Therefore, 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) should be calibrated to specific habitat types in order to provide an accurate assessment of biological condition of a site-specific community.	Comment acknowledged.	No
3.4	Described in the Draft Amendments Section, Chapter IV (A. 2. b3) are the field procedures for the assessment framework for the SQO components of chemical exposure indicators and site linkage indicators. The field procedures for sediment and fish collections are comprehensive and well designed. Grab sampling of surface sediment from the upper 5 cm for chemistry analyses is logical as the upper	Support for the field and sampling procedures is acknowledged.	No

	5-10 cm best reflects the benthic community exposure and the real-time variations in the sediment contamination as this top layer is subject to continuous changes to the physical and ecological aspects and the aquatic system and site. Such surface sediment sampling is routine for ongoing contaminant monitoring in Great Lakes jurisdictions by e.g. the US EPA and Environment and Climate Change Canada. A good example of Canada-U.S. cooperation in this regard is the study of flame retardant and other chemicals in sediment from several important sites in the Great Lakes (Letcher et al. 2015; Lu et al. 2015; Trouborst et al. 2015).		
3.5	The eight dietary guilds and the nine primary guild fish species identified in Appendix A-6 for sampling, is a comprehensive design to provide a good coverage of the sport fish species and the dietary exposure pathways from sediment, which are inherent to the bays and estuaries of California. It is also wise to have an alternate list of relevant and harvestable secondary species in the event that a primary species cannot be collected from the given site. Unless there are compelling reasons to do so, such alternate species inclusions should be keep to a minimum so that there is maximum similarities on the suite of species tested for optimal comparisons between affected sites.	Support for the dietary guilds, primary and secondary (alternative) species is acknowledged.	No
3.6	As for the sediment and tissue chemical analysis to be included as per Appendix A-7, see this reviewer`s earlier concern regarding the breadth of chemicals of aquatic concern, which should include priority substances that are not necessarily nonpolar and lipophilic with respect to bioaccumulation. The attention to sampling design details is supported by this reviewer. That is, before commencing with sample collection, a study design and work plan must be developed and approved by the Regional Board, but with a conceptual site model serving as the basis for the study design, define the site boundaries, guide selection of sport fish species to evaluate, and identify appropriate sediment contamination data.	Support for the need to develop a study design and work plan is acknowledged. Concerns regarding other pollutants is addressed in response to peer review comment 3.2	No
3.7	Finally, it is stated that all (fish and sediment) samples are tested in accordance with USEPA or American Society for	As stated in response to peer review comment 2.12, this framework was intentionally limited to organochlorine pesticides	No

	Testing and Materials (ASTM) methodologies where such methods exist. As listed in Table 15 in the Draft Amendments Section, Chapter IV (A. 2. b4), such testing is specific only for selected organochlorine pesticides (DDTs, chlordanes and Dieldrin) and a suite of PCB congeners (Appendix A-7). As mentioned previously, there are no details for the testing inclusion for newer and current-use chemicals (e.g. flame retardants and PPCPs) that are produced in high volume and found to be globally ubiquitous in aquatic environments, and particularly ones that receive heavy inputs from densely populated centers such as for bays and estuaries of California. It appears that some allowance for other priority contaminants is insinuated in the statement that where no EPA or ASTM methods exist, the Water Boards shall approve the use of other methods. It is strongly encouraged by this reviewer that this statement be expanded to include details that allow for the sediment and fish testing of newer chemicals that have been established as (aquatic) environmental pollutants. Further, to indicate some testing flexibility in this regard where new contaminant issues specific to certain bays and estuaries of California are warranted and represent a proven or potential exposure issue for benthic sediment communities and the primary and secondary gild fish species that exist in these affected sites. For sediment exposed aquatic organisms, the approach is sound that laboratory toxicity tests be used to assess the direct effects of, as well as the bioavailability of, sediment contaminants are based on lethal or sublethal responses of test species exposed to the sediment under controlled conditions.	and PCBs for the reasons described in that response. The overall framework that integrates chemical exposure with site linkage could be applied to any pollutant that bioaccumulates from sediment into tissue. The site linkage calculation would need to account for each contaminant's fate and transport, bioavailability and other characteristics. If resources are made available, such studies necessary to expand the list of contaminants can be initiated. The SQO framework is not intended as an early warning system for CECs in tissue. Existing regional monitoring programs as well as individual permittees evaluate a variety of tissue types for CECs in coordination with the Water Board's Surface Water Ambient Monitoring Program Bioaccumulation Oversight Group and also through supplemental environmental projects.	
3.8	A-4. Bioaccumulation modeling is an appropriate method to evaluate site sediment linkage. Estimated tissue concentrations are obtained using the steady state Gobas Food Web Model, calibrated for eight different feeding guilds. These feeding guilds encompass a variety of fish and their associated dietary preferences within California enclosed bays and estuaries. R. Letcher review:	Comment acknowledged. The proposed provisions utilize site sediment chemistry to assess only the contribution from the site and not the contribution from offsite sources.	No

	The eight dietary or feeding guilds and the nine primary guild fish species are identified in Appendix A-6. There is also an alternate list of relevant and harvestable secondary species in the event that a primary species cannot be collected from the given site. The assessment framework estimates fish tissue concentrations of the prioritized contaminants (Appendix A-7) using the steady state Gobas Food Web Model. It is true that chemical indicator-site linkage is typically evaluated by calculation of an empirical biota-sediment accumulation factor (BSAF; Gobas and Arnot 2010), using available field data as well as calculation methods. Although useful for risk assessment screening and planning purposes, BSAFs are indeed 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. As a consequence it is true that BSAFs have been shown to vary by an order of magnitude or more between sites for similar chemicals and species. It is agreed that the 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).		
3.9	As described in the Draft Amendments Section, Chapter IV (A. 2. d4) for determination of the site linkage, using an alternate approach rather than using BSAF values alone (Gobas and Arnot, 2010), is sound as it considers the possible influence of various unknown site-specific and biological factors for a given contaminant. That is, comparing tissue concentrations estimated from site sediments to the observed sport fish tissue contaminant concentration for a given fish species used in the chemical exposure evaluation. The use of the Monte Carlo simulation is appropriate and sound to generate a cumulative distribution of the site linkage factor. This	Support for the site linkage factor and how that relationship is established is acknowledged.	No

	reviewer is in agreement with seafood bioaccumulation from site sediment contamination should be model-based and relative to bioaccumulation derived from all field data sources that are available and applicable.		
3.10	As for quantification of site-related accumulation of contaminants, it is true that the food web bioaccumulation model for PCBs (or Gobas food web model) has been validated for several fish species relevant to assessing human health impacts (Gobas and Arnot 2010). Furthermore, this model has been shown to be effective in estimating PCB bioaccumulation from sediment in fish and wildlife. While it is true that the structure of this model is adaptable for other fish species, this reviewer notes a few caveats that should be considered in this assumption that the model can be applied to other chemical contaminants. This model is proven for contaminants such as PCBs that are among the more recalcitrant and bioaccumulative environmental contaminants in biota including in fish. However, for many emerging chemicals of concern there remains a dearth of available information on physico-chemical properties, environmental persistence, bioaccumulation, fate and other behaviors, as well as compound-specific information on uptake, deposition and depuration processes in exposed biota and including for fish. Many of these \`new\` contaminants are biotically and abiotically unstable including enzyme-mediated metabolism and other species-specific depuration pathway in exposed organisms. A prime example are organophosphate ester (OPE) flame retardants and plasticizers, which have been shown to be rapidly metabolized in a limited number of studies that are field and lab (in vivo and in vitro) based for exposed mammal, bird and fish species from both marine and freshwater aquatic environments (Fernie et al. 2015; Greaves et al. 2016a, 2016b; Greaves and Letcher, 2017). This is also true of many of the new flame retardant chemicals that have been mostly regulated (e.g. polybrominated diphenyl ethers and exabromocyclododecane) but more so for the (brominated) chemicals that are replacement and in current-use and	See response to peer review comment 3.7. Caution employing the Gobas food web model for less recalcitrant compounds in potential future application is acknowledged.	No

	that have been identified as contaminants in aquatic environments and ecosystems (e.g, Chen et al. 2015; Giraudo et al. 2017; Su et al.2017). An important point to mention is that if food web bioaccumulation models that do not adequately account for (e.g. fish) metabolism for a given chemical contaminant, than the (Gobas) food web model may be underestimating the sediment-based exposure and accumulation in fish, and thus an accurate categorization of the chemical exposure-site linkage.		
3.11	A-5. Site specific and species-specific data are required to assess sediment linkage. Measured site sediment concentrations, dissolved water concentrations, sediment total organic carbon, fish forage area, and site area represent key bioaccumulation model inputs. R. Letcher review: I fully concur that measured site sediment concentrations, dissolved water concentrations, sediment total organic carbon, fish forage area, and site area represent key bioaccumulation model inputs. 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. Other important factors are home range (in conjunction with the size of the area selected for assessment), and fish movements, foraging area and habitat quality. Also, variability in sediment chemical concentration is influenced by heterogeneity, gradients, hotspots and the physio-chemical properties of the contaminant in question such as the variability of bioaccumulation factors for nonpolar organics in aquatic organisms. It is good practice that using an expansion of the site area of the assessment provides greater confidence that the home range of a given fish species is included to reduce the sensitivity of the assessment to detect a significant site linkage.	Support for the site-specific and species-specific measurements proposed, and minimum site area is acknowledged.	No
3.12	As described in the Draft Amendments Section, Appendix A and Chapter IV (A. 2. d4) for site specific and species-specific data to assess sediment linkage, the recommendation of using alternate 2 is an appropriate choice. That is, adjust the site linkage calculation for offsite	Support for the site-specific and species-specific data to assess site linkage is acknowledged.	No

	foraging through use of a site use factor and consider fish movement and sediment contamination heterogeneity in selection of site boundaries (as per Table 6.5).		
3.13	A-6. The approach, methods and assumptions set forth in the optional Tier 1 Screening Evaluation are appropriate for screening low risk sites or waterbodies. The assessment framework consists of three tiers to address varying site conditions and situations from the simple (Tier 1) to complex (Tier 3). The optional Tier 1 is a conservative screening evaluation intended to distinguish low risk sites that clearly meet the SQO from those sites that require the full analysis of Tier 2 to make a confident assessment. Tier 1 uses either sediment or tissue data to directly compare tissue concentrations to OEHHA tissue thresholds. A table of model generated biota-sediment accumulation factors is used to convert sediment concentrations to expected tissue concentrations for comparison with tissue thresholds. The two possible outcomes from Tier 1 are Pass (sediment is unimpacted and meets the SQO) or conduct Tier 2 assessment. R. Letcher review: As described in the Draft Amendments Section, Chapter IV (A. 2. b and c), Tier I screening assessment allows for the rapid site assessment and uses conservative assumptions with low data requirements for assessments of low risk sites and waterbodies. The Tier 1 Screening Evaluation uses standardized conservative methods to evaluate the potential chemical exposure to human consumers of sport fish. The purpose of this tier is to determine whether site sediments pose a sufficient risk to warrant a complete (i.e., Tier 2) site assessment.	Comment acknowledged.	No
3.14	An upper confidence limit (UCL) of 95% of the arithmetic mean is generally used as a conservative assumption in risk assessment. It was initially suggested that for a Tier 1 assessment that the 95% URL be used for contaminant concentrations from sediment or tissue data. A drawback is that such an assessment uses available data and for cases where a small sample size is used to calculate the contaminant concentration. As recommended in the Staff	The use of the maximum concentration has been removed. See response to peer review comments 1.7, 2.3, and 2.4.	No

	Draft Report (pg. 83), the alternative 3 approach is recommended where the 95% UCL of the mean is used to estimate a contaminant concentration, but in cases where the sample size is less than three use the maximum concentration. This reviewer agrees that because of the increasing uncertainty associated with smaller sample sizes, it would be more logical to use the more conservative maximum concentration in place of the 95% UCL for a given chemical. However, this reviewer recommends caution in the use of maximum concentration for assessment at the Tier 1 level for data from very small sample sizes. For sample sized below 10, it becomes increasingly likely that a maximum concentration for a given sample may not be representative of the sample set and could possibly be an outlier. There would be greater confidence in the maximum concentration approach is for e.g. 3 samples there was a clear consensus in the values where perhaps a 20% variation exists among the three measurements.		
3.15	Tier 1 sediment evaluation is based on chemical exposure and is performed by comparing the measured contaminant concentration in sediment to the sediment thresholds (listed in Table 16 of the Draft Amendments Section, Chapter IV). The sediment threshold is calculated by dividing the tissue threshold by the BSAF. In general, this reviewer agrees the recommendation of alternate 2 (Draft Staff Report, pg. 83) to 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. It was previously commented in conclusion A-4 that it is true that the structure of the Gobas food web model is based on PCBs and may be adaptable for multiple fish species and to DDTs and chlordanes. A note that the sediment contaminant complexity goes well beyond PCB a few legacy pesticides (Appendix A-7). There are many new and emerging aquatic contaminants and ones of priority to a given site should (eventually) be considered. For a given emerging contaminant, caution and the testing and further validation of the Gobas food web model is recommended,	See response to peer review comments 3.7 and 3.10. The use of the Gobas food web model is limited to those compounds for which it has been validated and there is currently no effort underway to expand the use of the model to other contaminants.	No

	and the model is not likely to be well suited for chemicals of concern that are more polar, lipophilic and environmentally unstable.		
3.16	Any Tier 1 interpretation in considering fish tissue or sediment concentrations in samples are made relative to threshold levels (Draft Amendments, Table 16). As per Table 6.2 (pg. 84) in the Draft Staff Report, for all eight sediment and tissue evaluation scenarios it is only when above scenario six (sediment impacted, tissue potentially impacted) that Outcome Approaches 1 and 2 differ. This reviewer agrees with alternative 2 for scenario seven (sediment potentially impacted, tissue not impacted) that an assessment should not advance to Tier 2. This makes sense because the contaminant exposure from the sediment may exceed the threshold but the concentration in the fish tissue is not high enough to warrant Tier 2 concern. This may be due to some pathway specific inefficiency in the uptake of the contaminant in the fish, or possibly a relatively efficient rate of clearance results in lower tissue concentrations in the fish.	Support for the interpretation of Tier 1 results is acknowledged.	No
3.17	A-7. The approach, methods and assumptions set forth in Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted. Tiers 2 and 3 require analysis of both sediment and tissue chemistry data to assess whether site sediments meet or exceed the narrative objective; these tiers differ in the level of standardization and incorporation of site-specific parameters or conditions. A logic matrix is used for Tiers 2 and 3 in order to integrate the outcomes of the two indicators into site categories of Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted and Clearly Impacted. Sediments designated as Unimpacted and Likely Unimpacted meet the SQO, while sediment categorized Possibly Impacted, Likely Impacted and Clearly Impacted do not meet the SQO. R. Letcher review: As described in the Draft Amendments Section, Chapter IV (A. 2. d and e), Tier 2 screening assessment is the main approach proposed for evaluating sediment quality in	Support is acknowledged for using the proportion of seafood bioaccumulation determined from modeled site sediment contamination relative to field-measured bioaccumulation derived from all sources.	No

	relation to the human health narrative SQO. 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. For SQO assessment, a method is needed to 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. As noted in the Draft Staff Report, this reviewer agrees with alternative 4 where the proportion of seafood bioaccumulation determined from site sediment contamination (model-based) is relative to bioaccumulation derived from all filed data sources.		
3.18	The Tier 2 evaluation utilizes a combination of site specific variables presented in Table 18 (Draft Amendments Report) and fixed model input parameters. In addition to tissue and sediment contaminant concentrations, the Tier 2 evaluation depends on four other variable plus three optional variables, which define the specific site. Tissue samples are from the nine primary fish species for each dietary guild shall (Appendix A-6), which are California halibut, Spotted sand bass, White catfish, Queenfish, White croaker, Shiner perch, Common carp, Topsmelt and Striped mullet. The fish tissue threshold concentrations in Table 19 are the basis of the Chemical Exposure Evaluation, and based on human consumption serving of one, two and three 8-ounce servings over the course of a week. Tissue categories and outcomes are presented in Table 20. Tier 2 also employs the Gobas food web model to calculate the BSAF for each of the fish guild species. These approaches and methods are reasonable and sound but as previously mentioned, the Gobas food web model as applied to PCBs does not account for metabolic processes and assumes that PCBs in the model are driven by uptake only. This means that there is some limitations	See response to peer review comment 3.10.	

	to the BSAF for PCBs as well as for DDTs, chlordanes and Dieldrin, and some BSAF over-estimation is possible. Also, many of `new` contaminants are biotically and abiotically unstable including enzyme-mediated metabolism and other species-specific depuration pathway in exposed organisms.		
3.19	A Monte Carlo simulation is conducted using many random subsamples of the contaminant concentration and BSAF distributions on a log normal basis. Since there are various unknown site-specific and biological factors for a given contaminant, the use of the Monte Carlo simulation is appropriate and sound to calculated cumulative distribution of the site linkage factor. This reviewer is in agreement with seafood bioaccumulation from site sediment contamination should be model-based and relative to bioaccumulation derived from all field data sources that are available and applicable. The sediment linkage thresholds (Table 19) for PCBs, Dieldrin and chlordanes is used to determine the site linkage category (Table 21 in the Draft Amendments Report). The overall site assessment category is determined using the decision matrix presented in Table 22 (or Table 6.7 in the Draft Staff Report). As noted in the Draft Staff Report, this reviewer agrees with alternative 3 where a logic matrix is used to provide a standardized interpretation of each indicator combination relating to multiple categories of impact.	Support for the use of Monte Carlo simulation, the bioaccumulation model to evaluate linkage as well as the use corresponding logic matrix to standardize interpretation is acknowledged.	No
3.20	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. This reviewer agrees with the stated criteria to proceed	Support for the intent and basis for conducting Tier 3 and criteria is acknowledged.	No

	with Tier 3 assessment (pg. 30, Draft Amendments Report) where a site must meet one of several conditions that are based on the variation in factors or processes are present that affect contaminant bioaccumulation from sediment, and resulting in a difference in Sediment Linkage category. An important factor is when there are differences in physiological processes affecting bioaccumulation model performance, such as growth rate or assimilation efficiency. Another important factor is when the measured sediment concentrations are not representative of actual fish forage area due to spatial or temporal variations in sediment contaminant distribution, fate, or transport.		
3.21	B-1. Use of severity of effects and spatial extent is appropriate when evaluating whether sediment dependent beneficial uses are supported in waterbodies. The State Water Board is proposing a new approach that considers severity (any station classified as clearly impacted) and percent area of impact (stations classified as likely or possibly impacted, not to exceed 15 percent). The State Water Board currently relies on a frequency of exceedance approach based on the binomial statistic that was originally intended for water column applications. R. Letcher review: The implementation of the SQOs is to be conducted in accordance with several provisions. Each addresses a different receptor and/or exposure pathway, and sediments that meet one objective may not meet the other objective. It is logical that compliance with aquatic life objective is determined based on the individual assessment of two or more stations within a site. It also makes sense that compliance with the sport fish objective is based on an overall assessment of a site that encompasses multiple sediment and tissue samples from the site. Therefore, assessment of sediment quality relative to each objective may require a unique study design	Support for unique approach based on receptor and exposure pathway is acknowledged. Each objective requires a unique study design and assessment as described in the proposed and existing provisions included in Chapter IV.	No
3.22	Detailed on pages 32 and 33 of the Draft Amendment Report are the exceedances of a receiving water limit to	Support for the use of spatially representative samples and randomized design is acknowledged.	No

	protect aquatic life. The total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a permit cycle. It is reasonable that the calculation of percent area be based on data from spatially representative samples selected using a randomized study design or equivalent spatial analysis.		
3.23	As detailed in the Draft Staff Report on pages 104-106, 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. It is agreed that there is one important difference between the two applications. That is, implementation of the receiving water limitation requires that the degradation must be linked with the discharge. It is agreed that in 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. This reviewer agrees that 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. As recommended in the Staff Draft Report (pg. 106), this reviewer agrees with the alternative 2 approach recommendation to develop an approach based on size of area impacted and severity of impact.	Support for the use of area and severity of impact as a replacement for the frequency based approach is acknowledged.	No
3.24	C. Additional Issues related to the big picture Questions: 1) In reading the Draft Staff Report and proposed rule, are there any additional scientific findings, assumptions, or conclusions that are part of the scientific basis of the proposed rule not described above? R. Letcher response: In the context of the SQOs, and as detailed earlier, sediment and fish associated contaminants are complex and not simply restricted to lipophilic and nonpolar compounds such as PCBs, chlordanes, DDTs and Dieldrin. These all constitute historical or legacy	If resources are made available, the assessment framework could be expanded to address other contaminants. See response to peer review comment 2.12	No

	contaminants, and do not reflect the complexity of pollutants in aquatic environment where there are many emerging contaminants and where many are currently is use. Many of these new chemicals are less lipophilic and although could accumulated in fish, metabolic and other depuration processes can result in more rapid clearance and different toxicities due to such degradation products. New chemical contaminants include emerging flame retardants, and PPCPs. PPCPs currently number in the thousands of different compounds (e.g., antibiotics, blood lipid regulators, analgesics/anti-inflammatory agents, antidepressants, antiepiletics, and antineoplastics), and they comprise a wide range of different chemical structures (Hua et al. 2006). Another important classes of aquatic contaminants from WSTP discharges and run-off are antimicrobials such as triclosan (Hua et a. 2005). PPCPs are viewed as emerging or newly established environmental contaminants and have experienced decades of unrestricted discharge to the environment. Point sources, such as wastewater and sewage treatment plants as well as surface runoff, are the main sources of PPCPs to the aquatic environment have been reported in WSTP effluent, surface waters and groundwaters. Therefore, the scientific basis of the proposed rule in the present proposed amendments to the SQOs should not assume that this rather small suite of contaminants (OCBs, chlordanes, DDTs and Dieldrin) is entirely reflective of accumulated burden of contaminants in biota and fish from the bays and estuaries of California, and what constitutes contaminant exposure to the people that consume these sport fish.		
3.25	2) Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices? R. Letcher response: On the whole, this reviewer agrees that the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices. The approaches, methods and assumptions that form the basis of the Tier 1,	Support for the scientific portions of the proposed rule is acknowledged.	No

	2 and 3 assessments of sediment and fish tissue contaminant concentrations and biota-sediment bioaccumulation and the resulting evaluation outcomes are well designed. This include a comprehensive array of scientifically proven justifications to meet the SQOs for designating and categorizing assessed sites as Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted and Clearly Impacted.		
4.1	Reviewer Responses: The documents given to the reviewer provided excellent, detailed but very clear justification for assumptions made, equations proposed and tiered approaches for assessment that are both scientifically justifiable, human health protective but also cognizant of need for prioritization in a cost and labor efficient manner. The assessment framework presented and the alternatives chosen in all cases provide an improved approach to evaluate whether contaminants in resident fish tissue pose an unacceptable health risk to humans who eat sport fish. This reviewer agreed with almost all of the alternatives chosen and these provided guideline users a better, more site specific set of options to evaluate California contaminated enclosed bays and Estuaries. Examples were given that supported the translation of these guidelines. When this reviewer has some issues that needed clarification, the issues are detailed below.	Comment acknowledged. See responses to peer review comments 4.3 through 4.23 below.	No
4.2	One set of questions that this reviewer had was addressed for several of the initial key assumptions. These questions should be clarified in the document to ensure that all users are aware of potential challenges to the assumptions made. In no cases are these requested clarifications “show-stoppers” but rather require some responses to ensure all initial assumptions are put into the site specific context, the focus of the written amendments.	Comment acknowledged. See responses to peer review comments 4.3 through 4.23 below.	No
4.3	For example, this reviewer read with great interest Section 3.2 that establishes the Receptors and Exposure Pathways and Direct Effects to Benthic Communities and Indirect Effects on the Human Consumers of Fish. In general, this section established the rationale for site directed considerations. These are important and this	See response to peer review comment 1.18.	No

	reviewer does not dispute these approaches. Where this reviewer requests some additional acknowledgement is when these site based assessment fail. For example, fishing rates in areas where there are already restricting fish consumption advisories cannot reflect true fish consumption as this has already been suppressed by the advisory and pollution in place. Thus the use of the site specific consumption values is very limited and would bias towards not cleaning up a site when it is needed.		
4.4	Another example that needs to be clarified for the site specific basis of the sediment standards is the lack of discussion on tribal "usual and accustomed uses" of these sites. In section 4.1.4 on Native American Consultation there is a discussion of outreach to Tribal governments for their input in this document. However, I did not see any discussion of legally mandated access. A brief review of the Tribal governance literature for the Pacific Coast would suggest that such considerations should be addressed and discussed within the initial context for these revised amendments. There is a literature that suggests that if sediment assessments and clean-up efforts are not sufficient to ensure "usual and accustom use of sites" then this would be considered as an "environmental taking "as the fish would be contaminated and not of use. In addition, the emphasis on sport fish is rather irrelevant for these tribal assessments as again the literature suggests a much broader portfolio of fish consumption and use. Regardless, these considerations need to be discussed and stated upfront as the assumptions for use that need to be considered.	The proposed Provisions attempt to establish a uniform assessment framework that can be applied across all enclosed bays and estuaries of California. Where tribal related beneficial uses have been adopted by a regional water board, the proposed provisions provide exposure thresholds for higher consumption rates (e.g. Chapter IV.A.2.c.3.). Where additional site-specific factors require consideration, the proposed provisions include Tier 3, which is only limited by how the indicators are assessed. The potential site or waterbody specific data considered (including consumer information) are not restricted in Tier 3, so the assessment could be adapted to the factors or concerns that justify the Tier 3 assessment. In regard to cleanup, when a regional water board initiates cleanup actions, the regional water board must consider many factors including fishers, consumers, associated consumption rates, tissue types consumed, preparation methods as wells as sensitivity of consumer groups in consultation with toxicologist in the Office of Environmental Health Hazard Assessment. To provide a detailed analysis, summary and guidance for all factors to consider during the planning of cleanup actions would significantly expand the scope of these proposed Provisions.	No
4.5	By using site specific "use" data the assumption is made that this is a relatively "stable" condition. Although some limitations are discussed, (For example, section 6.5.4 addresses both lack of knowledge and variability in fish movement) this reviewer would suggest adding several additional statements.	See responses to peer review comments 4.6 and 4.7.	No
4.6	In this era of anticipated climate changes, it would also be good to state that site specific changes would be anticipated to change as well. In the document climate changes could be considered as part of needs assessment	Appendix A-5 of the proposed Provisions has been amended to describe the need to periodically refine the conceptual site model in order to address biological factors that could be altered due to climate change.	Yes

	for remediation actions. Again the report could make a statement on the time context for considering the "site specific" conditions.		
4.7	Other considerations for fish consumption should be the types of fish that subsistence fisherpersons consume. Again these can be quite different than sport fish lists and can be more determined on cultural differences, availability of fish and ease of catching fish. Some individuals desire to optimize their omega 3 fatty acid intake and although there was some discussion of these factors in the document, minimal information was presented on how such information would be integrated or affect site prioritization.	See response to peer review comment 4.4. The proposed Provisions are written to address all bays and estuaries using a framework that is consistent with the methodology employed by OEHHA to develop tissue advisories. The proposed Provisions cannot describe all possible scenarios or iterations that could be employed or addressed by the Tier 3 assessment.	No
4.8	In Section 3.2 there is a good background to the concepts regarding habitats and life histories of resident fish as well as anadromous fish and the approaches proposed in the document are sophisticated and accurate for how to address these differences in relationship to quantitation of contaminant loading. Other factors that could be mentioned include hatchery raised fish. Are these present in these waters covered by this document? If so some recognition regarding changes and shifts in husbandry should be mentioned. Changes in these practices can shift the loyalty of the fish to specific regions and can increase fishes return and time spent in local sites and thus increase their load of local contaminants. This should at least be mentioned and would support many of the revisions to accept site by site considerations.	Hatchery raised fish are generally freshwater (trout) or anadromous (salmon and steelhead) and are not considered in this framework as they are transient, with limited exposure to contaminants in bay sediment in comparison to resident fish. White seabass is raised in some enclosed bays but it also spends the majority of time upon release foraging in ocean waters.	No
4.9	Section 4.2.4 discusses regional monitoring and assessment programs. This section is very impressive and the importance of these programs in providing site specific information is great. It would be good to see a set of summary tables that summarize in tabular form the information on dates each program has been in place, frequency of sampling, what is sampled and results and availability to public. For example, monitoring data presented in Appendix 6 of Attachment 7 "Development of Sediment Quality Assessment Framework for Human Health Effects" presents some of this data. Please provide	Due to the size and complexity of the regional monitoring and assessment programs, this section was only intended to identify these efforts. Each of these programs includes some common elements. However, the details change from event to event based on the issues and concerns identified during each monitoring cycle. Where data and program information are available online, links to specific programs were added to the Section 4.2.4 of the Draft Staff Report.	Yes

	a link and possibly add to this information details about sampling frequency and timing.		
4.10	Section 4.2.4 also provides some specific highlighted examples from the monitoring program. For example, the Central Coast Long-term Environmental Assessment Network (CCLEAN) discussion describes sea otter issues and impacts. It is surprising given this example and the other numerous published reports on sea otters, that these species are not identified in Figure 3.3 as they are resident vertebrates with high local food consumption fish consumption (primary diet is macro invertebrates and epidentic fish and shellfish) and they have been noted as being affected by pollutants including PCBs in the relevant areas of this report. (See comments below about ecological impacts for Goals 3 and 4)	The focus of the proposed Provisions is on human consumers of sportfish and the food web diagram was not intended to represent all potential receptors. While there are some aspects that also address the aquatic life SQO there is no effort at this time to amend the existing provisions that address contaminant impacts to fish and wildlife. Protection of resident fish and wildlife were the focus of the 2011 amendments. See https://www.waterboards.ca.gov/water_issues/programs/bptcp/docs/sediment/012811staff_rpt.pdf.	No
4.11	Appendix 2 of the “Development of Sediment Quality Assessment Framework for Human Health Effects” presents the Dietary guild and Target Species Development. This was a very informative section and presented rationale for target species considered in the sediment assessments.	Comment acknowledged.	No
4.12	Equations presented in Section 4.2.4 for both Carcinogens and Non-carcinogens are accurate and scientifically defensible.	Comment acknowledged.	No
4.13	Reviewer responses: This reviewer had some conceptual questions on this statement. The report provides an excellent strategy to address the fundamental question of “Are sediment-associated contaminants at the site or area of interest contributing to the contaminate burden in fish tissue?” A detailed and scientifically justifiable set of approaches is presented. However this reviewer also read as two of the goals of these amendments was to (Goal 3) “Provide regulators, stakeholders and interested parties with transparent and scientifically sound process to better assess the effects caused by pollutants in sediments within California’s enclosed bays and estuaries and (Goal 4) Provide regulators, stakeholders and interested parties with an effective process that will promote the protection of sediment quality as well as management of sediments that do not meet the SQOs.” To meet these goals, the	See response to peer review comment 4.10.	No

	assessment and proposed amendments should expand and consider impacts on other consumers than humans of organisms associated with contaminated sediments. Please see my example of sea otters as one excellent example where it is unclear that protecting just human health will achieve the same protections for these sea mammals (vertebrate resident consumers) as called for in Goals 3 and 4. In the state of Wa for example water quality standards are driven by pesticide levels and toxicity for salmon not for toxicity in human eating salmon. Please expand or highlight the sections that meet these goals. Just evaluating the most frequently consumed sport fish species for humans will not ensure that these two goals are met. Note also that in the case of sea otters they are endangered species in California regions (See Table 7.8).		
4.14	Section 6 of the report addresses point my point alternatives and presents the recommended alternatives for the revisions. This reviewer felt that the alternative identified were rationale and agreed with choice of all except for a few discussion points listed below.	Comment acknowledged.	No
4.15	For section 6.2.2 on fish species used in evaluation of chemical exposure this reviewer had several questions. Please see my note above about expanding beyond “sport fish”.	See response to peer review comment 4.7.	No
4.16	For section 6.2.3 on species to be monitored and assessed please see my comments above regarding suppression of fish consumed by current fish advisories thus for this change I would suggest broadening the input to choose fish species beyond just site specific info. Use of different dietary guilds is good.	See response to peer review comment 1.18. In the development of the conceptual site model, it would be helpful for the end user to consider these factors where fish advisories are in place. However, the list of species for Tier 1 and Tier 2 assessment is unchanged.	No
4.17	For section 6.2.4 on tissue types to be used, several factors need to be considered. First there are cultural difference in how the fish is consumed. For example, many south east Asian communities leave the head on the fish. Note that other consumers of the local fish (i.e. non-human consumers) do not know that they are supposed to remove the internal organs before consuming so to address goals 3 and 4 and not just human associated impact from sediment contamination these whole fish estimates should be retained.	There are many different ways to prepare fish. However, a goal of Tier 2 is to provide a consistent framework that utilizes data that is comparable from different sites. As a result, the tissue preparation methods specified for Tier 2 assessment represent common approaches that are also employed in monitoring programs. If the objective is to evaluate the site in relation to unique preparation methods a Tier 3 analysis is necessary.	No

4.18	For section 6.2.7 on application of OEHHA Tissue Advisories and Goals and Section 6.2.8, I would concur with the choice of Alternative 3 for 6.2.7 however the fish consumption values used in setting the OEHHA guidelines need to updated to reflect more reasonable estimates of fish consumption. Only the three 8 oz. consumption levels approach levels that both WA and Oregon will use. Note that using site specific consumption rates for previously contaminated sites represent repressed levels. Also need to consider both Tribal as well as subsistence fisher people. Hence I would support alternative 2 for section 6.2.8 Is this where some considerations of health benefits of fish should be considered? How? I think more clarity is needed in these two sections.	The one through three meals per week consumption rate encompasses the general range of sportfish consumers in California bays and estuaries. See appendix G Final Staff Report: 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 (https://www.waterboards.ca.gov/water_issues/programs/mercury/docs/hg_SR_final.pdf) The Draft Staff Report erroneously identified Alternative 3. The correct alternative is Alternative 2. This change was made to the Draft Staff Report.	Yes
4.19	For section 6.2 Tiered Decision Frameworks—I am supportive of these prioritization schema except for the assumptions and alternative chosen in 6.4.2 where I would support alternative 2 and not 3 as proposed for the reasons listed above. For Section 6.4.4 evaluation of impact, this reviewer would have preferred to see more information in this document about acceptable sampling plans to consider the site has been sufficiently evaluated for site specific information to be included in the assessments. This reviewer supports the use of tissue level contaminate values to drive the decision for action when there are differences between tissue levels and site contamination.	Alternative 3 does support higher consumption rates as recommended by the reviewer in the previous comment. The minimum monitoring requirements have been amended to require an increased sample size to better reflect site conditions. The purpose of the CSM is to guide the design of the monitoring and assessment to ensure that the assessment is representative of the site. As stated previously, there are far too many unique factors to list all issues that could be considered in designing and developing a work plan for an individual site. See Appendix 5 of the proposed Provisions on CSM and study design.	No
4.20	For section 6.5.3 on food web variation I am supportive of the third alternative however this guidance of using “multiple” bioaccumulation models maybe too unrestricted. Perhaps some specific model use could be included as a part of this assessment.	Section 6.5.3 of the Draft Staff Report has been clarified to state that the Tier 2 model type is restricted to a single modeling approach that is parameterized specific to the primary species food web and foraging range that it is applied to.	Yes
4.21	For section 6.5.8 on protective condition, I was supportive of alternative 2 as I have had experience with the risk matrix approach and have found the 3 options as better able to clarify differences in scenarios and level of protection. Please note however I was surprised to see in the matrix only one cell with “possibly impacted” as it appears to be a lopsided example.	The category Possibly Impacted is relatively rare occurrence based on the technical team’s application of the framework in several waterbodies. Where it does occur, the category reflects high exposure and low site linkage that results in substantial uncertainty regarding whether it meets the definition of the protective condition. This designation of Possibly Impacted is also consistent with the use of this category adopted for the aquatic life SQO in 2008.	No

4.22	For section 6.6.1 this reviewer would suggest a recommendation to use Value of Information approaches to estimate the overall value in missing or confounded site information. Sensitivity analysis could identify key drivers in these comparisons and further support the tiered approaches.	Value of Information approaches may be considered by the end user to make a decision on whether or not Tier 3 should be performed. However, the identification of tools used to inform the decision are outside the scope of these proposed amendment and should be left to the end user to determine what analyses or tools should be conducted to determine if Tier 3 assessment should be proposed.	No
4.23	In summary, the overall document is exceptionally well done, clear, comprehensive and scientifically robust. Please feel free to use my suggestions to slightly adjust the alternative and discussion. Please see also my suggestion on expanding the context for assessment in order to address both the goals and the two questions posed to the reviewers.	Comment acknowledged, see responses to peer review comments 4.1 through 4.22.	

Attachment 1
Description of Scientific Conclusions to be Addressed by Peer Reviewers

The State mandate for external scientific peer review (Health and Safety Code Section 57004) states that the reviewer's responsibility is to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods and practices. We request that you make this determination for each of the following issues that constitute the scientific basis of the proposed regulatory action. An explanatory statement is provided for each issue to focus the review.

A. The proposed assessment framework to assess sediment quality in relation to narrative sediment quality objective (SQO) protecting human consumers from contaminants that bioaccumulate from sediment into fish tissue is appropriate and based on a sound approach and developed using sound scientific information and methods. The specific scientific findings, assumptions and conclusions to be evaluated for their basis in sound scientific knowledge, methods and practices are detailed below

This narrative SQO 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. Since adopted by the State in 2008, this SQO has been assessed and evaluated on a case-by-case basis, with little guidance other than a requirement to be based upon a human health risk assessment. Since 2009, the State Water Board's technical team has been developing an assessment framework based on a conceptual approach that addresses two fundamental questions:

- Do contaminants in resident fish tissue pose an unacceptable health risk to humans consuming those fish?
- Are sediment-associated contaminants at the site or area of interest contributing to the contaminant burden in fish tissue?

1. **Evaluation of health risk to humans is based on comparison to tissue contamination thresholds established by the State of California to protect consumers of local fish.** In order to address the first question, the assessment framework requires a comparison of average fish tissue contaminant concentrations to contamination goals and advisory tissue levels used to develop fish tissue consumption advisories for California sportfish derived by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA). **Suggested Expertise:** Public Health Toxicologist and Environmental Chemist. **Suggested References:** Draft Amendments Tables 16 and 20, Draft Staff Report (Sections 3.2, 4.2.4 and 6.2), OEHHA's Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish, and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.4)

2. **Health risk evaluation is based solely on fish likely to live within the site of interest and be consumed by the local population.** To ensure the tissue data fulfill the requirements of the assessment framework, only those bay and estuarine fish species that exhibit some level of site fidelity, consume benthic macrofauna as part of their diet and are commonly consumed by humans are considered in this framework.

Suggested Expertise: Public Health Toxicologist and Fish Ecologist. **Suggested References:** Draft Amendments Section IV. A.2.b, Appendix A-5 and A-6, Draft Staff Report (Sections 3.2, 4.2.4 and 6.2) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.6, 6.1, Appendix 2 and 3)

3. **The relative influence of site sediment contamination on fish contamination is an appropriate indicator of the contribution of site sediment contamination.** In order to address the second question, the assessment framework requires an evaluation of site linkage; the proportion of measured tissue contaminant concentration estimated to result from site sediment contamination, calculated as a ratio of the estimated tissue concentration and the measured tissue concentration. **Suggested Expertise:** Bioaccumulation Modeler, Environmental Chemist. **Suggested References:** Draft Amendments Section IV. A.2.d.1), 2), 4), 5), 6), 7), Tables 18 and 21, Appendix A-5, A-6, A-7 and A-8, Draft Staff Report (Sections 3.2, 6.5.1 thru 6.5.5) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.6, 4.2, 6.2, 6.3, 6.4 and Appendix 1) Gobas, Frank and Jon A. Arnot, 2010, Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry, Vol. 29, No. 6, pp. 1385–1395, 2010

4. **Bioaccumulation modeling is an appropriate method to evaluate site sediment linkage**. Estimated tissue concentrations are obtained using the steady state Gobas Food Web Model, calibrated for eight different feeding guilds. These feeding guilds encompass a variety of fish and their associated dietary preferences within California enclosed bays and estuaries. **Suggested Expertise:** Bioaccumulation Modeler, Fish Ecologist. **Suggested References:** Draft Amendments Section IV. A.2.d.1), 2), 4), 5), 6), 7), Tables 18 and 21, Appendix A-5, A-6, A-7 and A-8, Draft Staff Report (Sections 3.2, 6.5.1 thru 6.5.5) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.6, 4.2, 6.2, 6.3, 6.4 and Appendix 1), Gobas, Frank and Jon A. Arnot, 2010, Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry, Vol. 29, No. 6, pp. 1385–1395, 2010

5. **Site specific and species-specific data are required to assess sediment linkage.** Measured site sediment concentrations, dissolved water concentrations, sediment total organic carbon, fish forage area, and site area represent key bioaccumulation model inputs. **Suggested Expertise:** Bioaccumulation Modeler, Environmental Chemist. **Suggested References:** Draft Amendments Section IV. A.2.d.2) Table 18, Appendix A-5, A-8, Draft Staff Report (Section 6.5.1 thru 6.5.5) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Sections 4.2, 4.3, 4.4 and 4.5, Appendix 1), Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management.

6. **The approach, methods and assumptions set forth in the optional Tier 1 Screening Evaluation are appropriate for screening low risk sites or waterbodies.** The assessment framework consists of three tiers to address varying site conditions and situations from the simple (Tier 1) to complex (Tier 3). The optional Tier 1 is a conservative screening evaluation intended to distinguish low risk sites that clearly meet the SQO from those sites that require the full analysis of Tier 2 to make a confident

assessment. Tier 1 uses either sediment or tissue data to directly compare tissue concentrations to OEHHA tissue thresholds. A table of model generated biota-sediment accumulation factors is used to convert sediment concentrations to expected tissue concentrations for comparison with tissue thresholds. The two possible outcomes from Tier 1 are Pass (sediment is unimpacted and meets the SQO) or conduct Tier 2 assessment. **Suggested Expertise:** Environmental Risk Assessor, Public Health Toxicologist, and Bioaccumulation Modeler. **Suggested References:** Draft Amendments Section IV. A.2.b, c, e, f, Draft Staff Report (Section 6.3, 6.4, 6.5, 6.6) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Sections 2, 3, 4, 5), Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management.

7. **The approach, methods and assumptions set forth in Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted.** Tiers 2 and 3 require analysis of both sediment and tissue chemistry data to assess whether site sediments meet or exceed the narrative objective; these tiers differ in the level of standardization and incorporation of site-specific parameters or conditions. A logic matrix is used for Tiers 2 and 3 in order to integrate the outcomes of the two indicators into site categories of Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted and Clearly Impacted. Sediments designated as Unimpacted and Likely Unimpacted meet the SQO, while sediment categorized Possibly Impacted, Likely Impacted and Clearly Impacted do not meet the SQO. **Suggested Expertise:** Environmental Risk Assessor, Public Health Toxicologist. **Suggested References:** Draft Amendments Section IV. A.2.d, e, Draft Staff Report (Section 6.5, 6.6) and Bay et al, 20107, Development of Sediment Quality Assessment Framework for Human Health Effects (Sections 4, 5), Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management.

B. The proposed approach to designate impaired sediment quality in relation to the SQO protecting benthic communities from direct exposure to contaminants in sediment is appropriate and scientifically sound.

This narrative SQO 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 is assessed by evaluating sediment toxicity, sediment chemistry and biological condition at each station and integrating the responses into station categories consisting of; Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted and Clearly Impacted.

1. **Use of severity of effects and spatial extent is appropriate when evaluating whether sediment dependent beneficial uses are supported in waterbodies.** The State Water Board is proposing a new approach that considers severity (any station classified as clearly impacted) and percent area of impact (stations classified as likely or possibly impacted, not to exceed 15 percent). The State Water Board currently relies on a frequency of exceedance approach based on the binomial statistic that was originally intended for water column applications. **Suggested Expertise:** Environmental Risk Assessor, Environmental Chemist. **Suggested References:** Draft Amendments Section IV. A.4. c. 2) and e.1), Draft Staff Report (Section 6.7.1).

C. Additional Issues related to the big picture

Reviewers are not limited to addressing only the specific conclusions presented above, and are asked to contemplate the following questions:

1. In reading the Draft Staff Report and proposed rule, are there any additional scientific findings, assumptions, or conclusions that are part of the scientific basis of the proposed rule not described above?
2. Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

Reviewers should also note that some proposed actions may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statute requirement. In these situations, the proposed course of action is favored over no action. The preceding guidance will ensure that reviewers have an opportunity to comment on all aspects of the scientific basis of the proposed rule.

At the same time, reviewers should recognize that the State Water Board has a legal obligation to consider and respond to all feedback on the scientific portions of the proposed rule. Because of this obligation, reviewers are encouraged to focus feedback on scientific conclusions that are relevant to the central regulatory elements being proposed.