

# **REVISED WORKPLAN FOR THE DEVELOPMENT OF SEDIMENT QUALITY OBJECTIVES FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA**



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**Adopted May 21, 2003**

**STATE WATER**

**RESOURCES CONTROL BOARD**

**CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY**

**1001 I STREET**

**SACRAMENTO, CALIFORNIA 95814**



STATE WATER RESOURCES CONTROL BOARD  
RESOLUTION NO. 2003 - 0034

ADOPTING A REVISED WORKPLAN FOR THE DEVELOPMENT  
OF SEDIMENT QUALITY OBJECTIVES (SQOs) FOR  
ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA

WHEREAS:

1. California Water Code Section 13393 requires the State Water Resources Control Board (SWRCB) to develop SQOs for California's enclosed bays and estuaries.
2. In 1991, SWRCB adopted a workplan for the development of sediment quality objectives for California's enclosed bays and estuaries (1991 Workplan) as required under Section 13392.6 of the California Water Code.
3. Due to funding constraints, SWRCB did not implement the 1991 Workplan; consequently, environmental interests filed a lawsuit against SWRCB for failing to develop SQOs in accordance with the 1991 Workplan and the California Water Code.
4. In August 2001, the Court agreed with the petitioners and ordered SWRCB to prepare a schedule for revising the 1991 Workplan, developing draft objectives, and adopting the final objectives into a water quality control plan or policy.
5. The compliance schedule requires that SWRCB revise and adopt a revised workplan by June 30, 2003.
6. On May 6, 2003, SWRCB conducted a public hearing and workshop to consider the attached revised workplan.
7. This revised workplan replaces the 1991 Workplan.

THEREFORE BE IT RESOLVED THAT THE SWRCB:

1. Adopts the attached revised workplan for the development of SQOs for California's enclosed bays and estuaries.
2. Directs the Executive Director or designee to submit the revised workplan to the Legislature.

CERTIFICATION

The undersigned, Clerk to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on May 21, 2003.



Debbie Irvin  
Clerk to the Board



**TABLE OF CONTENTS**

ABBREVIATIONS ..... ii

1.0 INTRODUCTION ..... 1

    1.1 Importance of Sediment Quality ..... 1

    1.2 Regulatory Background ..... 1

    1.3 Resources and Schedule ..... 3

2.0 PROGRAM APPROACH ..... 4

    2.1 Priorities ..... 4

    2.2 Relationship to 1991 SQO Workplan ..... 5

3.0 SCOPE OF WORK ..... 7

    3.1 Program Guidance and Scientific Technical Review ..... 7

    3.2 Sediment Quality Database Development ..... 8

    3.3 Benthic Community Assessment Index Development ..... 8

        3.3.1 Refine Southern California Benthic Response Index ..... 9

        3.3.2 Evaluate the Feasibility of Statewide Benthic Response Index ..... 9

        3.3.3 Comparison of Field Methods for Benthic Community Assessment ..... 9

        3.3.4 Expand Geographic Applicability of Benthic Response Index ..... 9

    3.4 Effects Assessment and Guideline Performance Analysis ..... 9

        3.4.1 Data Quality Assessment ..... 9

        3.4.2 Evaluation of Natural Factors Affecting Sediment Contamination-  
Biological Response Relationships ..... 10

        3.4.3 Assessment of Existing Sediment Quality Guidelines for Predicting  
Biological ..... 10

        3.4.4 Evaluation of Fish Bioaccumulation Models ..... 10

    3.5 Sediment Quality Objectives Development ..... 10

        3.5.1 Develop Proposed Numeric Sediment Quality Objectives ..... 10

        3.5.2 Develop Proposed Narrative Sediment Quality Objectives ..... 11

        3.5.3 Bioaccumulation-based Objectives Case Study ..... 11

        3.5.4 Evaluate and Revise Draft Numeric SQO Performance ..... 11

    3.6 Program of Implementation ..... 11

        3.6.1 Methodology ..... 12

        3.6.2 Applications and Enforcement ..... 12

    3.7 Summary of Sediment Quality in California’s Bays and Estuaries ..... 13

    3.8 Adoption of SQOs and Implementation Program ..... 13

**ABBREVIATIONS**

1991 Workplan	Workplan for the Development of Sediment Quality Objectives for Enclosed Bays and Estuaries of California
AET	Apparent Effects Threshold
BPTCP	Bay Protection and Toxic Cleanup Program
BRI	Benthic Response Index
CAA	Cleanup and Abatement Account
CWC	California Water Code
EMAP	Environmental Monitoring and Assessment Program
ERM	Effects Range Median
FED	Functional Equivalent Document
LA CSTF	Los Angeles Contaminated Sediments Task Force
NOAA	National Oceanic and Atmospheric Administration
NSI	National Sediment Inventory
RWQCBs	Regional Water Quality Control Boards
RMP	Regional Monitoring Program
SCCWRP	Southern California Coastal Water Research Project
SQO	Sediment Quality Objective
SSC	Scientific Steering Committee
SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Load
USACE	U.S Army Corps of Engineers
U.S. EPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey

# 1.0 INTRODUCTION

## 1.1 Importance of Sediment Quality

Sediments in bays and estuaries are often contaminated with a variety of pollutants as a result of industrial and agricultural discharges, municipal wastewater treatment plants, and other point and nonpoint source discharges. Exposure to contaminated sediments can have a significant effect on the health, diversity, and abundance of benthic invertebrates such as clams and worms that live within and on the sediment. Fish and birds foraging on benthic invertebrates may also be exposed through ingestion of benthic invertebrates and sediment. Animals in higher trophic levels can also be exposed to bioaccumulative pollutants by eating contaminated fish. These effects underscore the necessity of developing sediment quality objectives for the protection of both marine and terrestrial ecosystems and human health and welfare.

State Water Resources Control Board (SWRCB) is initiating the process to develop and adopt sediment quality objectives (SQOs) for enclosed bays<sup>1</sup> and estuaries<sup>2</sup>. This process through adoption will require approximately four years to complete. SQOs will be adopted either into the existing Water Quality Control Policy for the Enclosed Bays and Estuaries of California or a new plan or policy will be created specifically for defining SQOs within enclosed bays and estuaries in California.<sup>3</sup> This workplan describes the approach and key tasks that will be implemented in order to develop SQOs for California. This document establishes a framework to guide SQO development. The tasks described in this document may be modified based upon more recent research and findings on contaminated sediment or upon the results of studies performed as part of this effort.

## 1.2 Regulatory Background

In 1989, the California Water Code (CWC) was amended to require the SWRCB to develop SQOs as part of a comprehensive program to protect existing and future beneficial water uses within California's enclosed bays and estuaries. In 1991, SWRCB prepared a conceptual approach to develop SQOs in a Workplan for the Development of Sediment Quality Objectives

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<sup>1</sup> ENCLOSED BAYS means 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 the headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. Enclosed bays include, but are not limited to, Humboldt Bay, Bodega Harbor, Tomales Bay, Drake's Estero, San Francisco Bay, Morro Bay, Los Angeles-Long Beach Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay. Enclosed bays do not include inland surface waters or ocean waters.

<sup>2</sup> ESTUARIES means waters, including coastal lagoons, located at the mouths of streams that serve as areas of mixing for fresh and ocean waters. Coastal lagoons and mouths of streams that are temporarily separated from the ocean by sandbars shall be considered estuaries. Estuarine waters shall be considered to extend from a bay or the open ocean to a point upstream where there is no significant mixing of fresh water and sea water. Estuarine waters include, but are not limited to, the Sacramento-San Joaquin Delta, as defined in Water Code Section 12220, Suisun Bay, Carquinez Strait downstream to the Carquinez Bridge, and appropriate areas of the Smith, Mad, Eel, Noyo, Russian, Klamath, San Diego, and Otay rivers. Estuaries do not include inland surface waters or ocean waters.

<sup>3</sup> The Water Quality Control Plan for Enclosed Bays and Estuaries was rescinded in the early 1990s.

for Enclosed Bays and Estuaries of California (91-14 WQ) (1991 Workplan). Insufficient funding resulted in significant delay of the program. SWRCB staff anticipated that the program described in the 1991 Workplan would require seven years to complete. In 2001, a lawsuit was filed against SWRCB for failing among other things, to adopt SQOs in accordance with the CWC. The Court agreed with the petitioners, and SWRCB was mandated to develop SQOs. Section 13391.5(d) of CWC defines SQOs:

*“Sediment Quality Objective’ means 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.”*

The beneficial uses commonly designated for enclosed bays and estuaries in California include:

- Industrial Service Supply
- Water Contact and Non-contact Recreation
- Commercial and Sport Fishing
- Aquaculture
- Estuarine, Marine and Wildlife Habitat
- Rare, Threatened or Endangered Species
- Migration of Aquatic Organisms
- Spawning, Reproduction and/or Early Development
- Shellfish Harvesting

Section 13392.6 of CWC states that SQOs shall target those constituents that have been identified in known or suspected hot spots or that have been identified as a pollutant of concern by SWRCB or the Regional Water Quality Control Boards (RWQCB). Section 13393 (b) further states *“that the SWRCB shall adopt the sediment quality objectives pursuant to the procedures established by this division for adopting or amending water quality control plans. The sediment quality objectives shall be based on scientific information, including, but not limited to, chemical monitoring, bioassays, or established modeling procedures, and shall provide adequate protection for the most sensitive aquatic organisms. The state board shall base the sediment quality objectives on a health risk assessment if there is a potential for exposure of humans to pollutants through the food chain to edible fish, shellfish, or wildlife.”*

This section also requires SWRCB to assess sediment quality criteria adopted by the U.S. Environmental Protection Agency (U.S. EPA) to determine if they meet the requirements described above. If they do, then those objectives can be adopted for use in California’s enclosed bays and estuaries. To date, U.S. EPA has not formerly adopted any sediment criteria.

The CWC also requires that the workplan discuss specific program aspects. Section 13392.6(a) states that the workplan shall include a list of priorities, a schedule, describe staffing and funding, and identify additional resource needs. The resources and funding dedicated to this program are discussed below in Section 1.3. Priorities are described in Section 2.1. The remainder of this workplan is organized as follows: Section 2.2 describes the relationship of this scope of work to that approved in the 1991 Workplan and Sections 3.1 through 3.7 describes in detail the anticipated tasks required to develop SQOs for California’s enclosed bays and estuaries. Section 3.8 summarizes the process for adopting SQOs and associated implementation policy.

### **1.3 Resources and Schedule**

On January 23, 2002, SWRCB approved Resolution No. 2002-0006, which allocated \$2,500,000 from the State Water Pollution Cleanup and Abatement Account (CAA) to specifically support the development of SQOs. SWRCB staff person responsible for awarding and managing contracts utilizing CAA funds is Chris Beegan, Environmental Scientist, Division of Water Quality - Ocean Standards Unit. Staff within the Standards Development Section of the Division of Water Quality and staff of the Southern California Coastal Water Research Project will provide support as needed on this project. Additional resources may be contracted for specific activities such as preparation of the Functional Equivalent Document (FED) and economic analysis.

As required by Court Order, SWRCB negotiated with the petitioners to develop SQOs under the following schedule:

- By June 30, 2003, SWRCB must adopt a scoping document and/or any necessary revisions to the 1991 Workplan.
- By August 5, 2005, SWRCB must circulate draft proposed objectives to the public.
- By February 28, 2007, SWRCB must adopt proposed objectives and implementation policy and submit to the Office of Administrative Law.

SWRCB also agreed to hold annual workshops that will present to the public the status of the efforts and activities either proposed or underway to develop the objectives.

## 2.0 PROGRAM APPROACH

### 2.1 Priorities and Additional Research

This workplan was developed following consideration of the tasks identified in the 1991 Workplan for SQO development. Differences between the 1991 Workplan and this workplan reflect the advances in the science of sediment quality assessment since 1991, funding constraints, and the time schedule mandated by the 2001 legal settlement. Only those efforts that could reasonably be completed within two or three years and that would be crucial to the development of objectives or implementation policy were given high priority and allotted resources.

The numeric SQOs developed in this program will be based on protecting sensitive aquatic life represented by sediment dwelling organisms (e.g., benthic macroinvertebrate community). The pollutants proposed for development of numeric sediment quality objectives will be prioritized based upon their occurrence as a source of impairment on the Clean Water Act 303(d) List and the existence of a predictive relationship between sediment chemical concentrations and biological effects. These SQOs will not directly address the exposure of fish, wildlife, or humans to sediment contaminants. The protection of beneficial uses related to wildlife health and seafood consumption is extremely important, but the funds and time schedule for this project are not sufficient to complete this endeavor. The relationship between contaminated sediments and the bioaccumulation of toxics is influenced by many species-specific and site-specific factors, such as sediment organic content, complexity of the food web, species-specific feeding habits, and fish movement. In addition, the estimation of risk to humans or wildlife requires accurate estimates of prey consumption rates, which are also regionally-specific and species-specific. Insufficient data are available for most regions of the State to enable the modeling of contaminant bioaccumulation and seafood consumption. A framework for the development of SQOs based on bioaccumulation, however, will be developed and illustrated with a case study. This framework will identify the process and data needs for deriving bioaccumulation-based SQOs on a regional basis.

Narrative objectives developed in this project will address the protection of beneficial uses influenced by contaminant bioaccumulation. The focus on protection of aquatic life is consistent with the emphasis of the 1991 Workplan and is expected to provide protection to wildlife and human health through an emphasis on protecting benthic organisms from long-term exposure impacts.

The workplan consists of seven high priority tasks:

1. Program Guidance and Scientific Technical Review
2. Sediment Quality Database Development
3. Benthic Community Assessment Index Development
4. Effects Assessment and Guideline Performance Analysis
5. SQOs Development
6. Application Guidance and Enforcement Policy Development
7. Summary of Sediment Quality in California's Enclosed Bays and Estuaries

These tasks are described in detail in Section 3 of this document.

## 2.2 Relationship to 1991 Workplan

This current workplan replaces the 1991 Workplan in its entirety. The 1991 Workplan described activities in nine developmental areas. The relationship of these areas to the current workplan is described below.

1. Identification of key species. The 1991 Workplan proposed conducting a feasibility study and workplan for a human health risk assessment with follow-up assessment work. This element is not included in the current workplan due to funding and time limitations. A case study demonstrating the application of a framework for deriving SQOs for the protection of human health or wildlife will be produced instead.
2. Development of ranking criteria. Ranking criteria were developed and applied as part of the Bay Protection and Toxic Cleanup Program (BPTCP) and will not be developed under the current program. However, some elements previously included under this task in the 1991 Workplan such as compilation of sediment quality data, calculation of chemical effects ranges, and development of narrative SQOs are included as elements within Sections 3.2, 3.4, and 3.5 of this workplan.
3. Development and verification of Apparent Effects Threshold (AET) values. This element included tasks for the development or selection of methods for toxicity testing, chemical analysis, field effects assessment, sampling, and reference site selection. Additional tasks included the compilation and analysis of data for development of AETs. The development of guidance for toxicity, chemistry, and benthic effects analyses is included in Task 6 of the current workplan. The analysis of California data for the development and evaluation of AETs and other types of numerical guidelines will be conducted as described in Section 3.4.
4. Proposed adoption of a toxicity objective. The development of a SQO based on sediment toxicity was proposed in the 1991 Workplan. This task is included in this current workplan in Section 3.5.
5. Field validation of equilibrium partitioning. Field and laboratory studies to measure pore water chemistry, contaminant desorption, and the effects of sediment resuspension on equilibrium partitioning were included in this element. These studies are not included in the current workplan due to time and budget constraints. Section 3.4 of this workplan will include an evaluation of the predicative ability of sediment quality guidelines based on equilibrium partitioning theory.
6. Spiked bioassays. Laboratory tests to measure the toxicity of chemicals spiked into clean sediment were included in this element of the 1991 Workplan. These studies are not included in the current workplan. Data obtained from spiked bioassays suggests that the method does not reflect conditions typically encountered in natural sediment. As an example, spiked bioassays cannot mimic natural conditions approaching equilibrium. This can have a very profound effect on bioavailability.
7. Adoption of SQOs. In the 1991 Workplan, SWRCB staff proposed adopting SQOs from existing sediment quality guidelines such as AETs and equilibrium partitioning guidelines. Activities to provide guidance and supporting information needed for the adoption of SQOs by the State are included in Sections 3.5, 3.6, and 3.7 of this document.

8. Investigation of additional evaluation tools. This element included studies to correlate lab and field results, measure the toxicity of sediment dilutions, evaluate biomarker methods, and investigate pulse loading events. Data analyses and field studies to examine the correlation of toxicity, chemistry, and benthos responses are included in Sections 3.4 and 3.5. The current workplan intends to develop or evaluate evaluation tools for the assessment of benthic community impacts (Section 3.3) and chronic sediment toxicity (Section 3.6).
9. Information needed to implement SQOs. This element included activities to identify options for the prevention, minimization, and remediation of impaired sediments, such as source identification, loading estimates, control methods, and treatment approaches. These activities are included in the development of Total Maximum Daily Loads (TMDLs) and hot spots cleanup plans within the State and are not included in the current workplan.

## 3.0 SCOPE OF WORK

### 3.1 Program Guidance and Scientific Technical Review

Members of state agencies that will use SQOs and other interested parties will be informed of the status of this project throughout its duration. Participating state agencies are expected to include coastal RWQCBs, Department of Fish and Game, California Coastal Commission, State Lands Commission, San Francisco Bay Conservation and Development Commission, Office of Environmental Health Hazard Assessment, and the Department of Toxic Substances Control. Annual public meetings and workshops will be held to describe progress on the workplan elements and to solicit feedback regarding technical and policy-related issues. Additional meetings with regulatory agencies will be held during the first two years of the project for the purpose of refining plans for developing implementation and enforcement guidance.

A Scientific Steering Committee (SSC) will be established to assist in the design of studies, data analysis and interpretation, and development of a strategy for SQO implementation. SSC will have approximately eight members, composed of scientists from state and federal agencies, academic institutions, and other research organizations. SSC will function throughout the life of the project. Key responsibilities of SSC will be: refinement of the draft workplan for SQO development, review of analyses and data interpretation, review of technical reports, and guidance to SWRCB regarding preparation of the FED for the plan or policy document containing SQOs and implementation program. The three primary criteria used to select members of the SCC are:

- A high level of technical experience either developing guidelines, assessing effects or developing or implementing sediment quality policy.
- A member of a key agency involved in sediment quality assessment such as U.S. EPA, USACE, NOAA or USGS.
- No direct involvement in water quality or sediment quality projects or issues in California.

In addition, the SWRCB will establish an advisory committee to assist in the development of SQOs. As required by CWC §13394.6, the committee will consist of stakeholders representing the following interests:

- Trade associations whose members are businesses that use bay, estuarine and coastal state waters as a resource in their business activities.
- Dischargers.
- Environmental, public interest, public health, and wildlife conservation organizations.

To form the committee, the SWRCB will likely solicit in writing the names of individuals willing to serve on the committee. The SWRCB will use the CWA §303(d) mailing list or other appropriately comprehensive mailing list for the solicitation. Once a list of potential participants is developed, the SWRCB will appoint committee members from this group that represent all of the interest groups listed above.

### 3.2 Sediment Quality Database Development

Much information describing the extent of sediment contamination and biological effects in California's enclosed bays and estuaries has been produced since development of the 1991 Workplan. The information produced by these studies will play a critical role in the development of SQOs; these data will be used to determine the relationships between contamination and biological effects and to document the accuracy and reliability of SQOs.

Relevant and reliable sediment quality data from the entire State will be compiled and integrated into a relational database to support SQO development and verification activities. This database will include all of the recent (i.e., last ten years) available data on sediment contamination, toxicity, bioaccumulation, and benthic community impacts for marine and estuarine areas of California. The specific studies that will be included in the database will be identified at the start of the project. The following sources may be included:

- Los Angeles Contaminated Sediments Task Force sediment quality database
- Bay Protection and Toxic Cleanup Program (BPTCP)
- Environmental Monitoring and Assessment Program (EMAP)
- San Francisco Estuary Institute regional monitoring program
- Navy dredging and cleanup studies in San Francisco Bay and San Diego Bay
- U.S. EPA National Sediment Inventory (NSI)
- Dredge material characterization studies in San Francisco, Newport, and San Diego Bays
- Newport Bay TMDL studies
- San Diego Bay TMDL studies
- San Diego Bay hotspot cleanup studies

The structure of this database will be based on the southern California sediment quality database recently developed by the Los Angeles Contaminated Sediments Task Force (LA CSTF). Preparation of the database began in January 2003. This database will be used to support statistical analyses specified in section 3.5.1. In addition, the database will be made available to State agencies and other interested parties for use in other projects, such as regional assessments of sediment quality, temporal analysis of environmental quality, and TMDL activities. A database users' manual will also be produced that describes the structure of the database and provides instructions for exporting information and adding new records.

### 3.3 Benthic Community Assessment Index Development

The emphasis of SQO development project is to develop objectives that will protect the most sensitive aquatic species, which are represented by the benthic macrofauna community. A factor limiting the use of benthic community data in previous SQO development activities was the difficulty in identifying impacts from the complex data obtained from biological field studies. Statistical indices for assessing benthic impacts that have recently been developed for the Southern California Bight will be refined and analyses conducted to determine their applicability to other regions of the State. Studies will be conducted to improve procedures for the measurement and assessment of benthic community impacts in response to sediment contamination. This information will provide the basis for developing numerical and narrative objectives for protection of benthic community health as described in Section 3.5. Four subtasks are planned for this portion of the project:

### **3.3.1 Refine Southern California Benthic Response Index (BRI)**

Development of BRI for use in the Bight '98 regional monitoring survey identified the need to obtain additional benthic community response data in order to improve the performance and reliability of the index. In this subtask, samples will be collected at selected contaminated and clean locations in southern California enclosed bays, estuaries, and harbors and analyzed for benthic community composition, contamination, and toxicity. These data will be used to improve or verify the ability of BRI to identify stress due to anthropogenic factors in the presence of varying habitat characteristics (e.g., depth, salinity, or grain size).

### **3.3.2 Evaluate the Feasibility of Statewide BRI**

Existing benthic community data from areas north of Point Conception will be analyzed to determine the extent to which the southern California BRI can be applied to northern portions of California. Work conducted in this subtask will include multivariate analysis of the data to determine the similarity in community composition among regions and an assessment of the adequacy of the data for index development or validation.

### **3.3.3 Compare Field Methods for Benthic Community Assessment**

Different sampling methods (i.e., different sized samplers and variable sieve meshes) have been used within the State for benthic community assessment, resulting in data of uncertain comparability. This subtask will compare data from previous studies that utilized different sampling methods in order to document the comparability of different methods. Additional samples will be collected from a range of enclosed bay/estuary habitat types in order to compare the cost and performance of selected sampling methods. The results of this subtask will produce recommendations on the sampling methods to be used for monitoring compliance with narrative SQOs.

### **3.3.4 Expand Geographic Applicability of BRI**

Sediment samples will be collected from selected reference and impacted stations in enclosed bays and estuaries north of Point Conception. The samples will be analyzed for sediment chemistry, toxicity, and benthic community composition. The data will be used to modify the southern California BRI so that it can be used in other regions of the State.

## **3.4 Effects Assessment and Guideline Performance Analysis**

Analyses of the statewide sediment quality database will be conducted to identify important aspects of the relationship between sediment contamination and effects in California. These analyses will comprise a scientific foundation that will be used to refine the planned statistical approaches for SQO development. Analyses will also be conducted to evaluate the performance of candidate numerical SQOs. Four types of analyses will be conducted as described in the subtasks listed below.

### **3.4.1 Assess Data Quality**

A specific approach for SQO development cannot be adopted without knowing how much information is available to support the statistical analyses needed. The contents of the California sediment quality database will be summarized and evaluated for applicability for SQO development. This work will include determining the number of records of matched sediment

chemistry and biological effects data available, assessing the completeness of chemistry information, assessing the spatial distribution of the data, and identifying potential outlier data that need verification.

### **3.4.2 Evaluate Natural Factors Affecting Sediment Contamination-Biological Response Relationships**

Statistical analyses will be conducted to identify important differences in contamination patterns, benthic communities, or habitat characteristics among the data. These differences will be incorporated into the statistical methods used to derive SQOs.

### **3.4.3 Assess Existing Sediment Quality Guidelines for Predicting Biological Impacts**

The use of existing sediment quality guidelines in regulatory and assessment programs by other states (i.e., Washington and Florida) will be summarized and used to select a subset of three to five guidelines for evaluation. The performance of each type of guideline in California will be assessed using the California sediment quality database. The efficiency, sensitivity, and specificity of each set of guidelines will be summarized and compared. These results will be used as benchmarks to guide the selection of numerical SQOs.

### **3.4.4 Evaluate Fish Bioaccumulation Models**

Several approaches have been developed to model the bioaccumulation of contaminants from sediments. These approaches range in complexity from the calculation of accumulation factors based on empirical data to the use of kinetic models that require detailed estimates of feeding rate, assimilation efficiency, respiration, and excretion. This subtask will evaluate the ability of several different modeling approaches to predict fish tissue concentrations based on sediment chemistry data. Sediment and tissue chemistry data from the statewide sediment quality database will be used to develop the model parameters for selected regions of the State. The accuracy of the model predictions will then be evaluated by comparing predicted tissue concentrations to data from an independent data set.

## **3.5 SQOs Development**

It is anticipated that multiple types of SQOs will be developed in this project. Statistical analysis of the statewide sediment quality database will be used to develop proposed numeric SQOs in the form of chemical concentrations, toxicity test responses, or benthic community condition. Several sets of SQOs may be developed for use in different applications (e.g., site assessment and cleanup). Narrative SQOs will also be produced in this project. Four subtasks are planned for this portion of the project as described below.

### **3.5.1 Develop Proposed Numeric SQOs**

Numeric values representing chemical-specific threshold concentrations will be developed and evaluated. These values will be based upon the statistical analysis of effects data contained in the sediment quality database. Statistical analyses of the performance of candidate SQOs will be conducted in order to evaluate the efficiency, specificity, and sensitivity of the values and aid in the selection of objectives for various applications. Results of the data analyses and special studies described in Sections 3.3 and 3.4 will be used to guide the statistical analyses. A variety

of approaches for deriving numerical objectives will be used and evaluated. These will include empirical approaches (e.g., Effects Range Median (ERM), AET, and logistic regression methods), and causal approaches (e.g., equilibrium partitioning). Input from SSC will be used to guide the selection and use of these statistical approaches.

### **3.5.2 Develop Proposed Narrative SQOs**

Narrative SQOs for the protection of beneficial uses will be developed. These objectives will complement the numeric objectives by encompassing a wider range of beneficial uses, addressing contaminants for which numeric objectives are not available, and providing a site-specific alternative for use when the numeric objectives are determined to be inappropriate for a particular application. Narrative objectives proposed in the past include:

- The concentration of chemical substances in enclosed bays and estuarine sediment shall not adversely impact beneficial uses,
- The concentration of chemical substances in enclosed bays and estuarine sediment shall not increase to levels that would degrade aquatic life, and
- The concentration of chemical substances in fish or other enclosed bays and estuarine resources used for human consumption shall not bioaccumulate from sediment into living resource to levels that are potentially harmful to human health.

### **3.5.3 Perform Bioaccumulation-based Objectives Case Study**

A framework for the calculation of sediment objectives based on fish bioaccumulation and consumption by humans or wildlife will be developed and illustrated through its application in a case study. Data from a region where sediment chemistry, fish contamination, and seafood consumption are reasonably well documented will be used to show how the framework can be applied to derive sediment objectives for specific contaminants. This framework and case study will serve to illustrate the methods and data needed to develop bioaccumulation-based sediment objectives by regulatory agencies.

### **3.5.4 Evaluate and Revise Draft Numeric SQO Performance**

The ability of the draft SQOs to predict biological effects and protect benthic resources will be evaluated. Data from independent studies, such as the Bight'03 regional survey in southern California and the 2003 Regional Monitoring Program (RMP) study in San Francisco Bay, will be used to document the sensitivity and reliability of the draft SQOs for predicting sediment toxicity and benthic community impacts. The draft SQOs will be presented to SSC and SWRCB for their review. Revisions and additional statistical analyses will be conducted in response to the comments received.

## **3.6 Program of Implementation**

A draft program of implementation will be developed for the proposed narrative and numeric SQOs developed in Task 3.5. The draft program of implementation will address the use of consistent and appropriate methods to measure sediment contamination, toxicity, bioaccumulation, and benthic community response, which is essential for the implementation of numeric and narrative SQOs. It will also describe how SQOs are to be applied under different situations and how the objectives could be used for enforcement purposes

### 3.6.1 Methodology

Use of appropriate methodology will be addressed in the program of implementation through the development of protocols for monitoring and assessment programs. Use of these protocols will help ensure that high quality data are obtained for comparison to SQOs. Six protocols are planned, which cover activities encompassing field methods, laboratory analyses, and information management. The subject areas are:

**Field sampling methods.** This protocol will describe the types of equipment to be used for sampling sediment in different types of habitats. Instructions will be provided for quality assurance, field observation data recording, and sample storage.

**Chemical contamination assessment.** This protocol will describe recommended methods for the extraction, digestion, and analysis of sediments for grain size, organic carbon, trace metals, and organics. Information on quality assurance and quality control procedures will be included.

**Toxicity assessment.** This protocol will specify the types of tests and test species for use in measuring the acute and chronic toxicity of bulk sediment, pore water, and water from the sediment-water interface. Methods for statistical analysis of the data will be included.

**Bioaccumulation potential of sediment contaminants.** This protocol will describe procedures for the exposure of invertebrates to sediments and subsequent measurement of tissue contaminant concentrations.

**Benthic community impact assessment.** This protocol will describe methods for the sampling and analysis of benthic communities. It will indicate recommended sampling methods, screen sizes, and provide a list of species reported for regions of the State. Guidance will also be provided on the statistical analysis of the data for the purpose of determining adverse impacts.

**Information management plan.** Standardized electronic data formats for the field and laboratory data will be described. These formats will be compatible with other data management plans under development by California.

### 3.6.2 Applications and Enforcement

The program of implementation will also address SQO application in contaminated sediment management activities. These recommendations may be based upon procedures that have been used by other states and will reflect the objectives identified during the planning process. Staff of RWQCBs for coastal areas of California will be consulted to determine their needs for contaminated sediment management and special circumstances that need to be addressed in the implementation program. Staff from federal agencies that manage contaminated sediments (e.g., U.S. EPA, Army Corps of Engineers, National Oceanic and Atmospheric Administration) and from other states (e.g., Washington and Florida) will also be consulted to obtain recommendations on formulating an effective implementation program.

The implementation program may address the use of SQOs for the following activities:

- sediment assessment and federal Clean Water Act Section 303(d) listing of impaired waters
- disposal of dredged material
- sediment cleanup actions
- control of point and nonpoint sources

The implementation program may also address enforcement. SWRCB staff anticipates using other regional sediment quality management programs, such as the program administered by the Washington State Department of Ecology, as guidance.

### **3.7 Summary of Sediment Quality in California's Bays and Estuaries**

The sediment quality in California's enclosed bays and estuaries will be evaluated using the SQOs developed under this program. A summary report will be prepared that describes the quality of the sediments within California's enclosed bays and estuaries and provides technical support, data and background information necessary for SWRCB to develop an FED for the proposed SQOs and implementation program to fulfill the requirements of the California Environmental Quality Act (CEQA), Water Code Section 13241, and the Administrative Procedures Act. Development of the FED is described below.

### **3.8 Adoption of SQOs and Implementation Program**

The SWRCB will adopt the proposed SQOs and implementation program in a new or revised water quality control plan or policy. Prior to adoption, SWRCB staff will prepare a written report, referred to as the functional equivalent document or FED, that will describe the proposed action, identify any potential significant adverse environmental impacts associated with the action and proposed alternatives and mitigation measures. These activities will fulfill CEQA requirements. (Cal.Pub.Resources Code §21000 et seq.; see Cal.Code Regs., tit. 23, §§3775-3782).

In addition, the FED will address the factors, including economic considerations, that the SWRCB must consider in adopting water quality objectives. These factors also include:

- The past, present, and probable future beneficial uses of water.
- Environmental characteristics of the hydrographic unit under consideration, including the quality of water available to the unit.
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area.
- The need for developing housing within the region.
- The need to develop and use recycled water. (CWC § 13241).

In adopting the proposed SQOs and implementation program, the SWRCB will comply with the peer review requirements specified in Health and Safety Code §57004. The SWRCB, additionally, is subject to notice and other public participation requirements contained in the Water Code and state and federal regulations. (CWC §§13140-13147, 13240-13247; Cal.Code Regs., tit. 23, §§3775-3782; 40 C.F.R. Part 25.).

Prior to adopting the proposal, the SWRCB will provide an opportunity for public comment, conduct a public hearing, at which oral and written comments may be submitted, and formally respond to comments. Final SWRCB action on the proposal will take place at a publicly-noticed board meeting. After adoption, the action will be submitted to the Office of Administrative Law (OAL) for approval. (See Gov. Code 11353). After OAL approval, the plan or policy must also be submitted to U.S. EPA for approval. (See 33 U.S.C. §1313(c)).