

THE CLEAN ESTUARY PARTNERSHIP: LOCAL AND STATE COLLABORATION TO IMPLEMENT WATER QUALITY STANDARDS FOR SAN FRANCISCO BAY

Andrew J. Gunther
Applied Marine Sciences, Inc., 4235 Piedmont Ave, Oakland, CA 94611

David W. Tucker
Environmental Services Department, City of San Jose, CA

Thomas E. Mumley
San Francisco Bay Regional Water Quality Control Board

Geoffrey Brosseau
Bay Area Stormwater Management Agencies Association

ABSTRACT

Monitoring of the San Francisco Bay ecosystem indicates continuing impacts of pollution, and the Bay has been listed as impaired pursuant to §303(d) of the Clean Water Act for polychlorinated biphenyls (PCBs), mercury, selenium, dioxins/furans, and various pesticides. Many recent legal and regulatory conflicts have convinced stakeholders to investigate a more collaborative approach for developing long-term strategies to address these impairments. This led to the formation of the Clean Estuary Partnership (CEP) in 2001. The CEP is based on a Memorandum of Understanding signed by the San Francisco Bay Regional Water Quality Control Board, the Bay Area Stormwater Management Agencies Association, and the Bay Area Clean Water Agencies (publicly-owned treatment works).

By using the CEP in the process of developing TMDLs, the State of California obtains opportunities early on to work with stakeholders to develop implementation concepts, refine key uncertainties, and obtain peer review. This will result in greater consensus regarding the technical foundation for regulatory action, and reduces the likelihood of public controversy (including litigation) when load allocations are adopted in the San Francisco Bay Basin Plan and implemented through NPDES permits.

The CEP mission statement calls for strategies to attain water quality standards based on sound science, adaptive management, and public collaboration, as such strategies will have considerable credibility and legitimacy. To develop strategies with these characteristics, the CEP relies upon the development and use of conceptual models for each pollutant of concern. Conceptual models are an organized presentation (often in diagrammatic form) of existing knowledge of pollutant sources, pathways through the environment, and the physical and biological processes in the

ecosystem that produce impairments and mediate the response to management actions. Conceptual models also form the basis for the development of numerical models that can be used to predict the response of impairments to various management strategies. The CEP will sponsor collaborative review of conceptual models, identifying important uncertainties to address with technical studies as part of adaptive implementation of TMDLs.

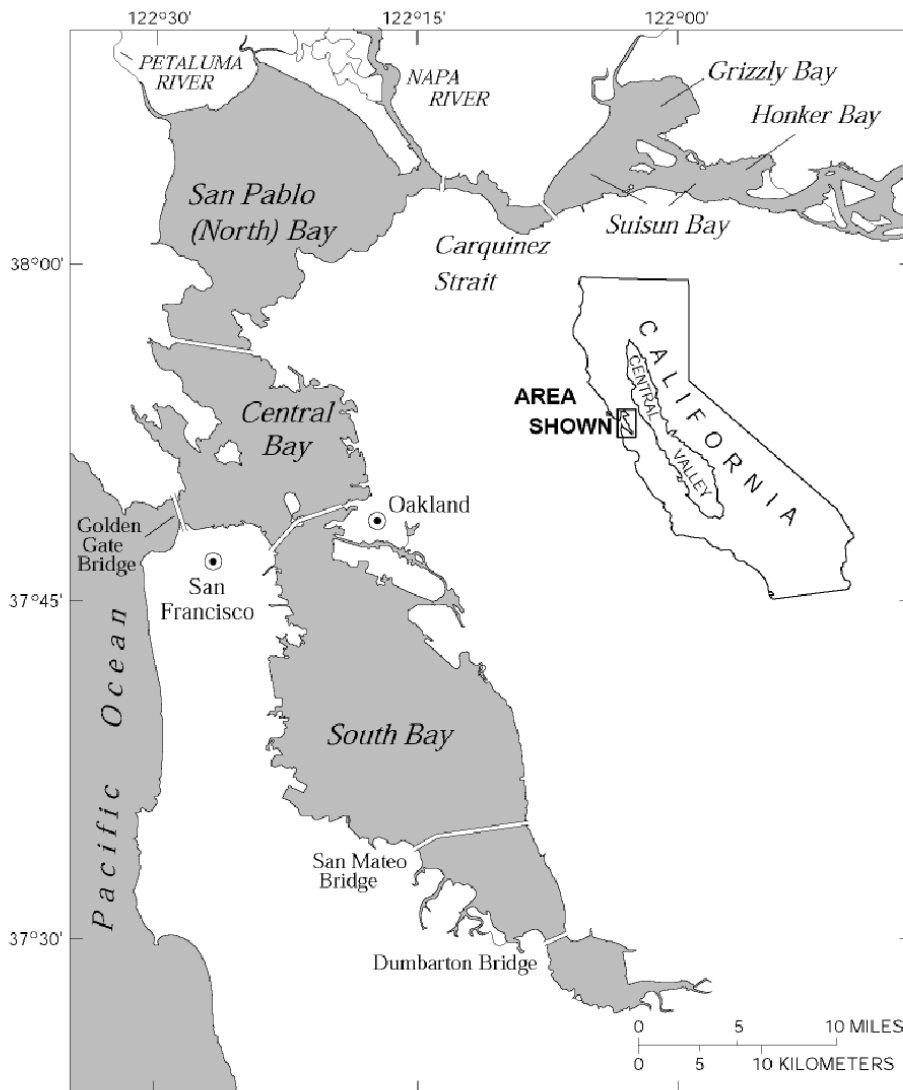
The successful adoption and implementation of strategies to attain water quality standards requires the support of a broad audience represented by elected and appointed officials, members of the media, and interested members of the public. The CEP is therefore implementing a directed program of outreach to these audiences that describes the impairments and strategies in concise, nontechnical language. Outreach materials (fact sheets, web pages, briefings) will be based upon the conceptual models.

By transparent development of conceptual models, and their revision based upon collaboratively-designed technical studies, the CEP seeks to merge the scientific method with adaptive management as part of the process for developing TMDLs in San Francisco Bay. The maintenance and refinement of conceptual models also provides a mechanism for the efficient transfer of scientific information to future generations of natural resource managers who will share the responsibility of addressing the pollution problems we have detected.

INTRODUCTION

San Francisco Bay is part of one of the largest estuarine ecosystems in the US. With a drainage area of 155,000 km² (40% of the land area of California and a small part of Oregon), this watershed provides drinking water to 20 million Californians and irrigates 4.5 million acres of farmland and ranches. Management of water quality in this large area is split between the Central Valley (Sacramento and San Joaquin river drainages and their joint delta), and San Francisco Bay itself (Figure 1). This paper will focus upon the latter, which includes the waters of South and Central San Francisco Bay, San Pablo Bay, and Suisun Bay.

Figure 1 - San Francisco Bay, California. San Francisco Bay is comprised of four sub-embayments: South Bay, Central Bay, San Pablo Bay (sometimes referred to as North Bay), and Suisun Bay. Map courtesy of the San Francisco Estuary Institute (www.sfei.org).



While much smaller than the Central Valley, the San Francisco Bay area includes the nation's fourth-largest metropolitan area (population of 5 million) living in eight counties and over 100 municipalities. Besides being a center for human enterprise, the Estuary is an immensely productive ecosystem supporting a diverse community of plant, animal and aquatic life. Half the birds migrating along the Pacific Flyway use the Estuary's wetlands for wintering, with more than one million shorebirds present in certain seasons. Hundreds of thousands of native and hatchery-bred salmon, including four separate runs of Chinook, migrate through Bay-Delta waters on their way to spawning grounds upriver. The Estuary supports a commercial fishery for herring, serves as a nursery area for other marine species, and supports a variety of sport and subsistence fisheries (USEPA 1993).

There is consequently great interest in protecting and enhancing the water quality of the Estuary. Since adoption of the clean water laws in the 1960s-70s and the subsequent clean-up of effluent discharges, the water quality of San Francisco Bay has improved significantly. Despite these gains, however, monitoring of the Bay ecosystem indicates continuing impacts of pollution. The State has issued human health advisories (OEHHA 1994) to limit consumption of fish and waterfowl due to high concentration of mercury, selenium, and polychlorinated biphenyls (PCBs) (Fairey, Taberski et al. 1997; Davis, May et al. 2002), and there is evidence of bioaccumulation of these pollutants to concentrations potentially toxic to wildlife (Ohlendorf and Marois 1990; Davis, Fry et al. 1997; Schwarzbach and Adelsbach 2003). Urban and agricultural runoff causes toxicity in rivers and streams, and sometimes in the Bay itself (SFEI 1998; Thompson, Hoenicke et al. 2000). The Clean Estuary Partnership was established to develop and implement strategies to address these environmental problems.

Developing and implementing long-term strategies for these problems is both scientifically and politically complex, because (1) we are still learning about both the causes of the problems we have detected and the nature of potential solutions, (2) pollutants discharged to the Bay prior to environmental regulations ("legacy" pollutants) are contributing to the problems, but these deposits are not readily removed except by natural processes that occur slowly, and (3) likely solutions will require long-term commitments of resources for which there are many competing uses in the near-term. Strategies will have to be carefully crafted utilizing high-quality science applied in a process that provides the opportunity for reconciling diverse interests.

In the past, pollution control strategies have relied mostly on the State's legal authority through a formal process centered on the issuance and enforcement of permits. While successful early on in developing and implementing strategies to deal with obvious issues, like best available technology standards to prevent anoxia, the permits and enforcement approach alone is not the most efficient mechanism for regional planning to solve legacy watershed problems. A more collaborative approach is needed among the regulatory authorities, the regulated community, and other stakeholders for developing long-term strategies. The potential for such an approach has been demonstrated by collaborative development and implementation of the Regional Monitoring Program in San Francisco Bay (Thompson, Hoenicke et al. 2000; Hoenicke, Davis et al. 2003)

during the last 10 years (www.sfei.org/rmp), and in developing long-term strategies to address copper and nickel pollution in South San Francisco Bay (Tetra Tech 2000).

To foster such an approach, a Memorandum of Understanding (MOU) was signed in September 2001 establishing the Clean Estuary Partnership (CEP). There are three signatories to the MOU; (1) the Bay Area Clean Water Agencies (www.bacwa.org), representing over 30 publicly-owned treatment works that discharge to San Francisco Bay or its local tributaries, the Bay Area Stormwater Management Agencies Association (www.basmaa.org), representing more than 90 local agencies working on stormwater discharges, and the San Francisco Bay Regional Water Quality Control Board (www.swrcb.ca.gov/rwqcb2).

The CEP finished its first full year of operation in June 2003. This paper presents the CEP's (1) mission and goals, (2) its role in the process of developing TMDLs (or other water quality attainment strategies) for San Francisco Bay, (3) program components, (4) recent progress, and (5) early challenges.

MISSION AND GOALS

The CEP mission statement calls for developing strategies to attain water quality standards in San Francisco Bay that are based on sound science, adaptive management, and public collaboration, as such strategies will have considerable credibility and legitimacy. To achieve its mission the CEP will pursue the five goals. These are listed below, with brief description of the methods to be used to achieve each goal.

1. Establish a transparent (easily understood and accessible) public process to promote construction collaboration. This public process will be established and maintained through the creation and staffing of committees to facilitate stakeholder communication, the operation of a web site with a user-maintained distribution service and project information archive, and support of a technical representative from the environmental protection and environmental justice communities.

2. Assist the State of California identify and adopt long-term, science-based strategies (including TMDLs) that provide a reasonable assurance of attaining water quality standards. Establishing a strategy for eliminating impairments is a legal mandate and must be accomplished in an expeditious fashion while recognizing scientific uncertainty, and California law requires that such a regulatory strategy include an implementation plan. The CEP will facilitate strategy development by providing a technical forum and process to (1) summarize the existing scientific evidence for impairments, (2) identify or assemble conceptual models that explain the source of the impairment and are consistent with available scientific data and theory, and (3) coordinate peer review of key scientific/technical documents.

Development of conceptual models will be a key product for achieving this goal. Conceptual models are an organized presentation (often in diagrammatic form) of our existing knowledge of pollutant sources, pathways of pollution through the environment, and the physical and biological processes in the ecosystem that produce impairments and mediate the response to management actions. Conceptual models are an essential tool for developing strategies based upon “sound science,” as preparing models forces scientists from varying disciplines to work together to prepare an overall ecosystem description, thereby clarifying key scientific uncertainties to be addressed by technical studies (NRC 2001; NRC 2002).

Preparing meaningful conceptual models also requires that scientists present their knowledge in a format that is understandable to nonscientists. Making scientific information available in this manner, and providing a public process for review and revision of the models, is a key method by which the CEP will foster the collaboration needed to generate a general understanding and agreement about the scientific basis for regulatory action. This agreement and understanding is a prerequisite for successful implementation of TMDLs or other strategies to attain water quality standards.

3. Reduce uncertainties and verify assumptions as part of adaptive implementation of the strategies. Science-based strategies maintain and strengthen their credibility and effectiveness through continued reassessment and refinement of the conceptual models upon which they are based. Using local and national peer reviewers, the CEP will identify key assumptions and important uncertainties that should be studied as part of adaptive implementation (NRC 2001) of TMDLs for San Francisco Bay. The CEP will provide a forum for the collaborative design of studies to test assumptions and reduce uncertainties. The results of these studies can be used to revise the science-based conceptual models, and subsequently the strategies for attaining water quality standards based upon these models.

4. Identify funding partners for strategy implementation. It is possible that full-scale implementation of some actions, particularly for nonpoint sources such as urban runoff or drainage from inactive mines, could require continued expenditure of resources for a long-term period. The resource limitations of local governments, due to factors such as the limitations on fee increases due to Proposition 218, increasing State-mandated fees, and decreasing State support for other local government programs, must be considered when designing long-term strategies to attain water quality standards. (Proposition 218, passed by the voters of California, limits the ability of municipalities or districts to raise fees without receiving at two-thirds majority vote for the proposal in an election). Achieving water quality standards for a waterbody as large as San Francisco Bay is a goal of statewide and national significance, and funding partnerships among local, State, and Federal governments, in addition to NPDES permittees, should be explored in an effort to make full-scale implementation more feasible.

5. Prepare publicly-accessible explanations of impairments and strategies. The successful adoption and implementation of strategies to attain water quality standards requires the support not only of technical professionals representing key stakeholders, but also a broader audience

represented by elected and appointed officials, members of the media, and interested members of the public. The CEP must therefore maintain a directed program of outreach to these audiences that describes the impairments and strategies in concise, nontechnical language. Outreach materials (fact sheets, web pages, briefings) will be based upon the conceptual models.

CEP ROLE IN TMDL DEVELOPMENT

Regulatory agencies have been working for many years to develop long-term strategies to address the remaining water quality problems in San Francisco Bay. The CEP program therefore cannot be developed and implemented on its own, but rather must be integrated into the existing public process for developing and adopting strategies for attaining water quality standards.

Existing law and policy guide selection of alternate strategies depending upon the nature of the problem (Table 1). These strategies include developing TMDLs, developing “site-specific objectives” (SSOs) based upon local research, considering new data to conclude that pollutants are no longer causing problems (“de-listing”), or preparing a “use attainability analysis” to demonstrate that it is not feasible to attain the beneficial use of a water body. Each strategy involves consideration of available data and conditions to justify strategy selection, development of associated technical documentation, and identification of the appropriate action to amend public policy. Often, this involves development and adoption of an amendment to the San Francisco Bay Water Quality Control Plan or *Basin Plan* (RWQCB, 1995 #56}, the master policy document for water quality regulation for San Francisco Bay.

The State has adopted SSOs for copper and nickel for the southern most portion of the Bay, and the remainder of the Bay (except for one small portion) was recently de-listed for copper and nickel. The State is currently planning to develop TMDLs for San Francisco Bay for the following pollutants that are a priority for the CEP: mercury, PCBs, “legacy” pesticides (DDT, deildrin, chlordane), selenium, and a TMDL for diazinon/toxicity in urban creeks. There are currently no plans for conducting use attainability analyses for San Francisco Bay. A TMDL may also be developed for dioxin/furans.

Table 1 - Available strategies for attaining water quality standards, and the conditions under which they might be utilized. Attainment of beneficial uses is often determined by comparison of pollutant concentrations to numeric water quality objectives, although certain narrative standards are also utilized.

Available Water Quality Attainment Strategy	Conditions of Water Body for Application of Strategy	Requirements
Develop and Implement TMDL	Beneficial use not fully protected, implementing a strategy to fully protect beneficial use feasible	Preliminary & final TMDL project reports, basin plan amendment
Adopt site specific objectives (SSOs)	Beneficial use protected, water quality objectives exceeded	Impairment assessment report, SSO report, action (non-degradation) plan, Basin Plan amendment
Remove pollutant from 303d list ("de-list")	Beneficial use protected, Water quality objectives attained	Supporting data submitted through 303(d) listing process, 303(d) listing report, approval of Regional Board recommendation by State Board and US EPA.
Remove beneficial use	Beneficial use not protected, Implementing a strategy to fully protect beneficial use infeasible	Use attainability assessment report (scope and content not well defined at present), Basin Plan amendment

The State of California has recently published draft guidance to assist with development and implementation of TMDLs. This document (which is a draft subject to revision) identifies eight phases for the development and implementation of TMDLs in California (column 1 of Table 2). Particular products are envisioned from each step of the TMDL process (column 2 of Table 2). These include:

- a Project Plan
- a Preliminary TMDL Project Report
- a Final TMDL Project Report (including load/wasteload allocations and implementation plan)
- the Basin Plan amendment (with its associated staff report)

The first two products present a description of the problem, its causes, and a strategy for solving the problem. The latter step is the formal process of adopting the strategy as public policy, and must satisfy the requirements of the California Environmental Quality Act and the California Office of Administrative Law, and be approved by the U.S. Environmental Protection Agency. Basin Plan amendments are prepared according to a process (considered functionally equivalent to the preparation of an Environmental Impact Report) that includes (1) evaluation of alternatives, (2) consideration of economics and attainability, (3) assessment of consistency with antidegradation policies, and (4) peer review.

Table 2 - Proposed State TMDL Process and Corresponding CEP Project Tasks. State TMDL Project Phase from draft State TMDL guidance document.

State TMDL Project Phase	TMDL Product	CEP Project Phase and Activities
Project Definition	Project Definition	Projection Definition/Planning Develop/refine conceptual models Conduct impairment assessments Manage peer review Facilitate stakeholder participation
Project Planning	Project Plan	
Data Collection	Data/technical reports	Data Collection/Analysis Scientific projects to address uncertainties and identify implementation options Manage peer review Facilitate stakeholder participation
Project Analyses	Preliminary Project Report	
Regulatory Action Selection	Final Project Report	Regulatory Action and Process Technical support for preparation of Basin Plan Amendment Facilitate stakeholder participation and outreach
Regulatory Process	Basin Plan Amendment	
Approval	TMDL approved by Regional Board, State Board, Office of Administrative Law, US EPA	Adaptive Implementation Undertake studies to reduce uncertainties and verify assumptions Coordinate pilot implementation projects Evaluate pilot project performance Conduct outreach and education Seek funding partners for implementation
Implementation	Adaptive implementation process	

The CEP multi-year plan has been designed to work in conjunction with the State's TMDL process. The CEP will organize its activities in four phases (column 3, Table 2):

- Project Definition/Planning
- Analysis and Reporting
- Regulatory Action and Process
- Adaptive Implementation

Through the CEP the State obtains opportunities early on to work with stakeholders to develop implementation concepts, refine key uncertainties, and obtain peer review. This process will result in greater consensus regarding the technical foundation for regulatory action, and reduces the likelihood of public controversy (including litigation) when the Basin Plan Amendment is proposed for adoption.

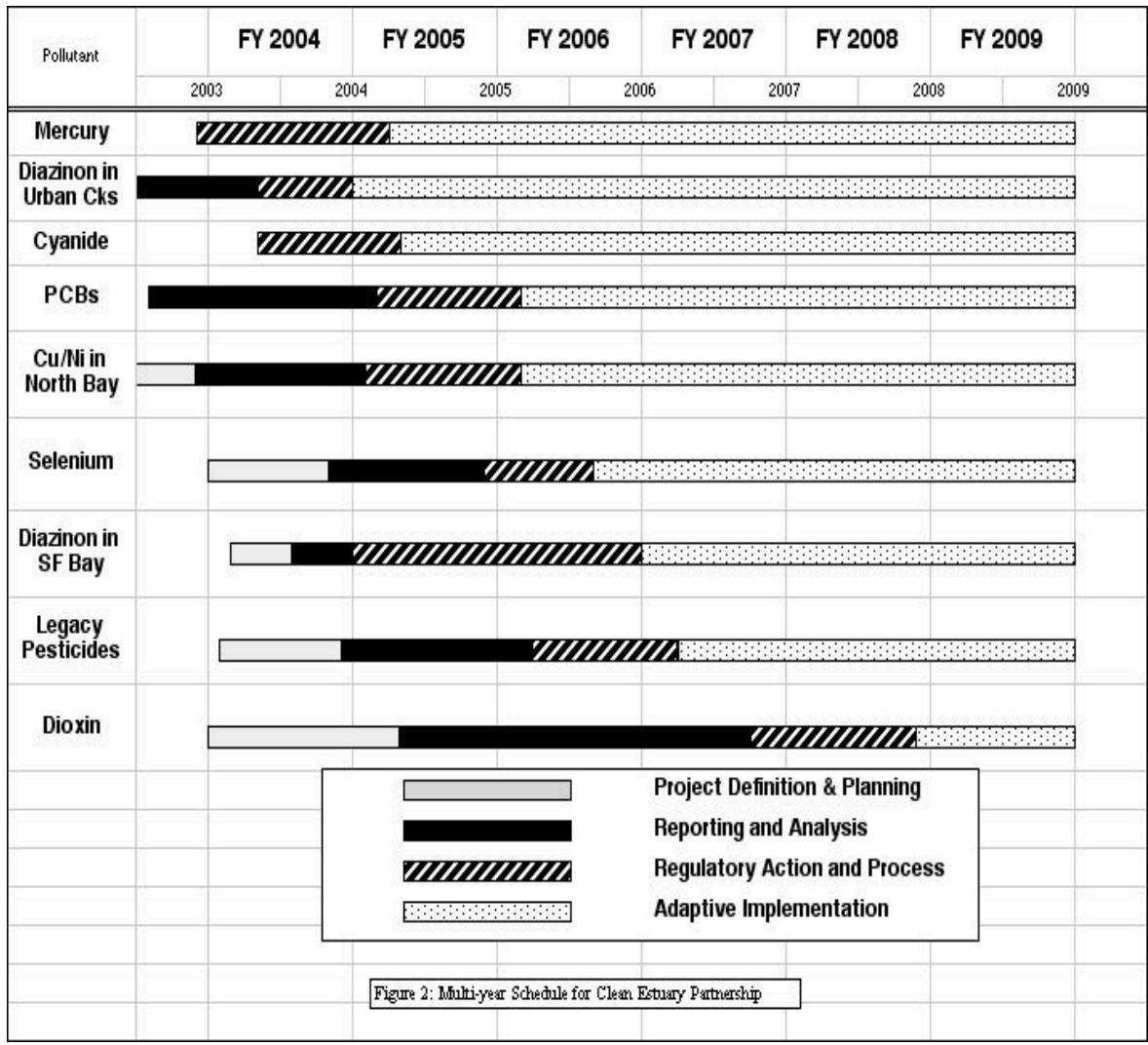
For planning purposes, the CEP has established a multi-year program schedule for each pollutant (Figure 2). This schedule presents the best estimate at present for the process of developing and adopting water quality attainment strategies for key pollutants in San Francisco Bay. Many technical, financial, and political factors could alter this schedule, and so the CEP plans to update this on a regular basis.

PROGRAM COMPONENTS

This section briefly describes the five major components of the CEP Program: Coordination, Participation and Outreach, Information Management, Technical Projects, and Administration.

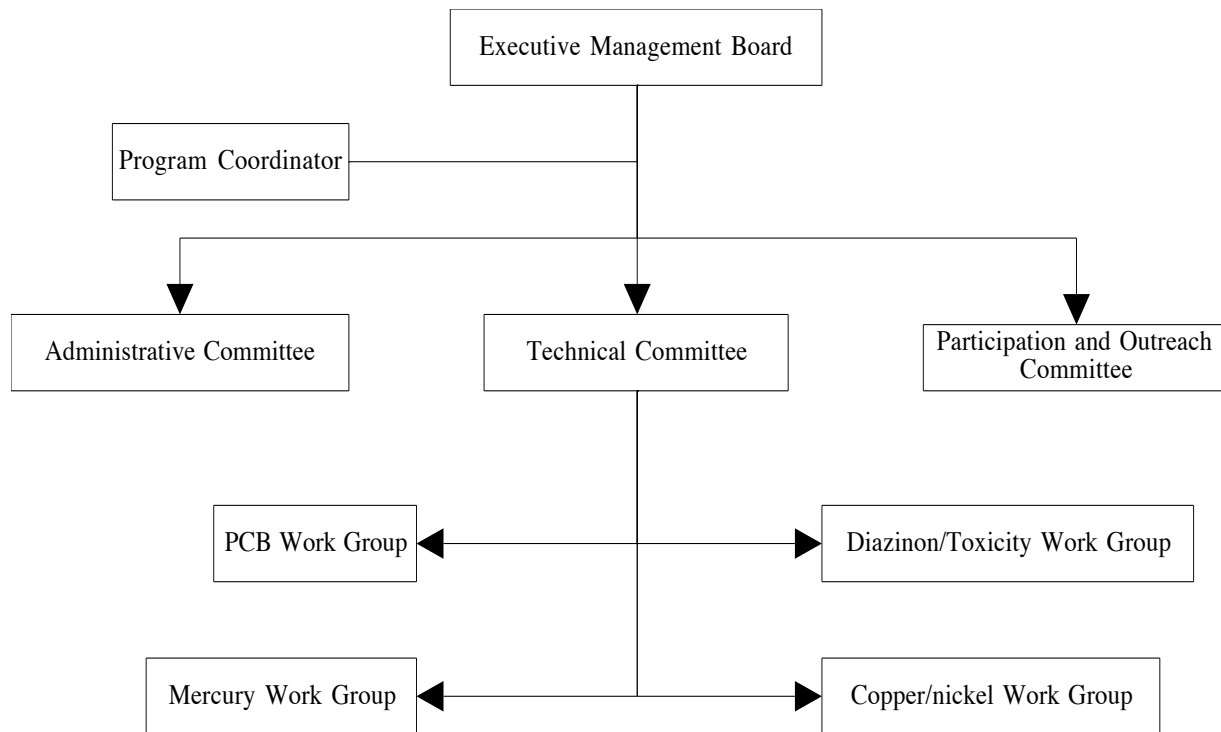
Coordination

For the CEP to effectively implement its mission, a well-defined and maintained process is required to support open communication among partners, identify the collective agenda, reach consensus on priorities, clarify disagreements, and make well-documented decisions. These activities are undertaken as part of the coordination component of the CEP. Tasks include preparation of meeting agendas and minutes, monthly reporting, annual and multi-year work plan development, and solicitation of outside funding.



The CEP is governed by an Executive Management Board (EMB) comprised of representatives of the MOU signatories, and is managed by a Program Coordinator (a competitive solicitation was conducted after execution of the MOU to hire a Program Coordinator, and a consulting team headed by Applied Marine Sciences (www.amarine.com) was contracted to provide these services). Three standing committees (Technical, Administrative, and Participation and Outreach) and several technical work groups report to the EMB (Figure 3), and all CEP meetings are open to the public. Additional technical work groups will be established in the future as the CEP technical program expands to address additional pollutants.

Figure 3 - Organization of the Clean Estuary Partnership



Participation and Outreach

The Participation and Outreach component contributes to achieving the goals of establishing a transparent public process to promote constructive collaboration and preparing publicly accessible descriptions of impairments and strategies. Activities being undertaken include (1) facilitating the involvement of key stakeholders in the process of strategy development, (2) preparing targeted outreach products for key stakeholders, particularly elected officials, regarding the process of TMDL development and implementation, and (3) developing and distributing educational materials for the general public.

As part of this program element the CEP will provide funding to support an independent technical representative to act as a liaison to the environmental and environmental justice (EJ) community. The presence of this representative will benefit the environmental/EJ community by establishing a key resource person with whom to vet their ideas, questions and concerns. It will also greatly benefit the CEP by (1) facilitating timely and structured input from the environmental community, (2) providing a vehicle for issues to be addressed periodically throughout the Project Definition/Planning and Reporting & Analyses Phases (Column 3, Table 2), rather than postponing discussion of these issues until regulatory action is proposed, and (3) enhance and reinforce the existing stakeholder education and outreach efforts.

Through the Participation and Outreach program the CEP will conduct proactive outreach to key stakeholders to encourage their participation and review of the conceptual models being developed for each pollutant. The CEP will also assist the State, as needed, to conduct public workshops associated with the release and distribution of the Preliminary Project Report, Final Project Report, and Basin Plan Amendments for each TMDL. Finally, the CEP will work collaboratively to develop “fact sheets” and other public education materials.

Information Management

The information management program component of the CEP utilizes the Internet to make accessible the information necessary to support and maintain a collaborative process among the large number of CEP participants distributed across the San Francisco Bay Area. Central to the design of the CEP web site is the need to provide efficient flow of information among participants and CEP staff regarding multiple projects, tasks, schedules and budgets. The site must also provide information for the general public and first-time visitors about the program’s mission, goals, and project components, with concise summaries of CEP activities and useful links to related programs.

These design goals are accomplished by using web-based applications to create a site with three key features. First, the site should utilize a user-maintained distribution service, allowing site users to subscribe/unsubscribe to various e-mail lists based upon their interests (certain CEP committees, particular pollutants, certain regions of the Bay, or by stakeholder type [e.g., member of the press]). CEP staff and participants can then use the site to communicate to stakeholders without the need to maintain and update mailing lists, but instead just direct communications to particular lists.

The second key feature is an information archive containing key documents for each project in the CEP. This portion of the web site acts as the CEP’s “joint filing cabinet,” allowing participants to access materials developed by the CEP (or related documents) as needed. Given that each project related to a listed pollutant will be active for many years (Figure 3), this archive will allow different people to become acquainted with current activities and consult historical documentation as needed.

Finally, the site must avoid the pitfall of being out-of-date due to information not being posted promptly. This often occurs because the people generating the information are not the same as the people who post the information. The CEP site will avoid this pitfall by creating web-based applications that allow authorized users to post documents or calendar events directly from their browser software without any specialized knowledge for updating or maintaining web sites.

Technical Program

The largest part of the CEP is the technical program, which includes all of the scientific and technical projects designed to support development and implementation of TMDLs for San

Francisco Bay. Project concepts are developed by the technical work groups, and these concepts are reviewed by the Technical Committee and integrated into an annual work plan. Prior to implementation, detailed scopes of work are prepared and reviewed for each project. As the CEP is only in its second year of operation, the technical program is just beginning to move forward. The section below on (Recent Progress) describes some of the projects underway.

Peer review is an essential component of the CEP technical program, and includes both “internal” and “external” peer review. The former involves review of first or “internal” draft documents by various local experts participating on CEP committees or work groups. After products have received internal review and are revised, external review by independent scientific experts will be conducted if participants believe it necessary.

While all documents will receive internal peer review through the activities of CEP Work Groups and Committees, it is likely that not all documents will require external peer review. External review will be initiated when it appears necessary to verify the validity of the findings and interpretations of a report or study and will contribute to building consensus among CEP participants. In these instances the CEP Technical Committee will be preparing focusing questions for the external peer reviewers to make sure that comments address issues of concern. The CEP has appropriated funds to be used to pay external reviewers for their time, as experience suggests this is the most effective method for receiving thoughtful and timely reviews.

Administration

The Program Administration component of the CEP includes those tasks that ensure smooth and cost-effective management and functioning of the CEP. This component ensures a satisfactory audit trail is in place to document the expenditure of public funds, and provides updated cost-tracking information to the Program Coordinator, managers of technical projects, and the Administrative Committee. This program component includes the preparation and execution of subcontracts and task orders, the administrative tracking of subcontractor invoices and deliverables, and preparation of monthly financial reports for the Administrative Committee and EMB. This task also supports the preparation of multi-year and annual budgets for the CEP, and support for third-party auditors.

RECENT PROGRESS

The first full year of CEP operations was completed on June 30, 2003. The following discussion describes briefly the progress in each of the five project areas. The CEP has established a functioning decision-making structure (Figure 3), providing the forum for collaborative activities to be undertaken, with an adopted multi-year plan and annual work plans. Committees are meeting regularly and reporting to the Executive Management Board, and funds are being collected and dispersed according to an approved budget and work plan.

The CEP sponsored a survey of stakeholders as one of the first Participation and Outreach tasks, in which a consulting firm conducted interviews with 28 individuals representing 27 organizations from a broad range of interests, including environmental groups, public agencies, homeowner groups, and industrial and civic associations. The key findings of this survey included the importance to stakeholders of (1) having science drive the TMDL process, (2) being explicit about how stakeholder input will be used, (3) keeping stakeholders informed about program objectives, priorities, deliverables, and timeframes, (4) working effectively with elected officials, and (5) establishing and maintaining clear lines of communication early on between the CEP and the various stakeholder groups.

The CEP web site is on-line at www.cleanestuary.org, providing participants access to documents, links, and other general information about the CEP. The site is updated regularly by CEP staff members from their personal computers using a web browser, and staff distribute program information using email lists that are user-maintained by individuals subscribing and unsubscribing to the lists. There is also a document database where CEP staff post documents (again using a web browser) for review by visitors to the site.

In June 2003 the State of California published the draft mercury TMDL for San Francisco Bay. The CEP completed reports regarding the mercury source assessment and implementation strategies for various source categories, which were used by the State in preparing the TMDL. During the preparation of the TMDL the CEP process provided a valuable forum for the exchange of ideas and concerns among regulators, NPDES permittees, and other stakeholders. A key uncertainty in the TMDL was the magnitude of loads from small, urbanized tributaries surrounding the Bay, and the CEP initiated a multi-year assessment of the loading of mercury, PCBs, and organochlorine pesticides from a representative tributary using state-of-the-art techniques. The results of this project will contribute to adaptive implementation of the TMDLs for these substances by (1) providing key data for refining the source assessment (including comparison of measured and modeled loads), and (2) providing baseline loading information that can be used in the future to assess the success of control measures.

The CEP has also started projects for selenium, legacy pesticides, and dioxin/furans. The first products for these projects will be Conceptual Model/Impairment Assessment reports, that will be prepared according to an outline developed by the CEP Technical Committee. These documents will summarize the existing data and rationale that led to the official finding of impairment, and present any new data or information available since the time of the listing. They will also present a first draft of a conceptual model for each pollutant in the Bay, including the mass balance, relevant physical, chemical, and biological processes, and simplifying assumptions used to make predictions about how the system will respond to management actions. After peer review, these documents will be used to develop a project plan to address the listing of the Bay for each pollutant.

EARLY CHALLENGES

For water quality management in the Bay Area the CEP represents a unique effort to form a productive collaboration between a regulatory agency, the regulated community, and other stakeholders. While the early progress described above provide evidence that this approach has great promise, there have been some important challenges that participants have been working to overcome.

The first challenge is the formation of a productive collaboration when one partner has authority over the other two. All partners recognize that as the State regulatory agency the Regional Board has the legal authority and responsibility to make judgments based upon available information in order to take regulatory action to protect beneficial uses. In order to maintain a sense of partnership when exercising its authority, the Regional Board must devote extra effort and time to communication with CEP partners prior to proposed regulatory actions. This problem is exacerbated when tight regulatory deadlines limit the time available for communication, and State fiscal problems constrain existing resources.

The second challenge is making the investment of resources to create a public process that allows partnership among many stakeholders. Such a process involves many people, many meetings, and careful follow-up, all of which require the time of skilled individuals and is therefore expensive. Moreover, this expensive investment is required in order to produce valued collaborative products, but the investment in process by itself produces little tangible product visible to elected officials or other stakeholders outside the process. The present expectation is that as the process helps create trust, our ability to produce collaborative products will accelerate, and the concern for the expense of the process will diminish.

Implementation of the CEP is also challenging in that it requires many individuals and organizations to commit to a new way of doing business. Replacing adversarial or confrontational relationships with more collaborative ones cannot happen with the signing of a Memorandum of Understanding, — only over time do positive outcomes and experiences develop a new partnership. The growth of new relationships is required not only for individuals, but also between institutions, as the collaboration among institutions and organizations will be essential for successful implementation of long-term strategies to address water quality impairments.

The final challenge is the problem of reaching agreement on what constitutes "sound" science when there is so much technical uncertainty. Regulatory authorities do not have the time or resources to address all these uncertainties, but must make assumptions and use best professional judgment in order to produce TMDLs that provide reasonable assurance of meeting water quality standards. CEP participants plan to use the partnership as a mechanism to apply the concept of adaptive implementation (cite NRC report) to test assumptions, reduce uncertainties, and revise implementation plans as necessary to achieve long-term water quality goals in San Francisco Bay.

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