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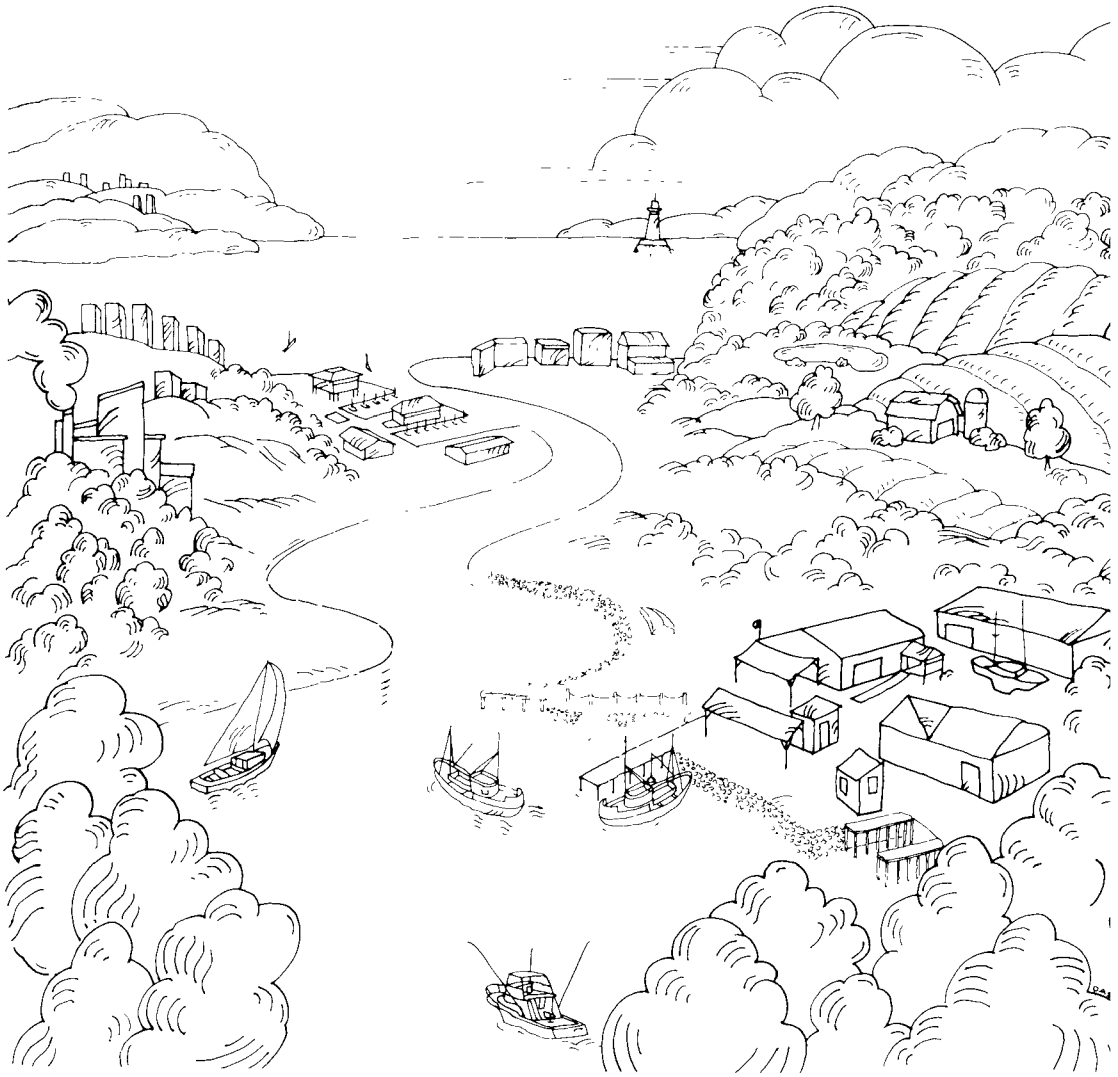
Saving Bays And Estuaries

A Primer For Establishing And Managing Estuary Projects



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Saving Bays and Estuaries: A Primer for Establishing and Managing Estuary Projects

Office of Marine and Estuarine Protection
U.S. Environmental Protection Agency

August 1989

ACKNOWLEDGEMENTS

A Primer for Establishing and Managing Estuary Projects is the result of a collaborative effort among EPA, its contractors, and representatives of other federal and state agencies.

The EPA Office of Water thanks its Office of Marine and Estuarine Protection (OMEP) for its leadership in developing the Primer. Special thanks are due to Michelle Hiller, Project Manager; Tom DeMoss; Tom Armitage; Norma Hughes; Steve Glomb; Mary Lou Soscia; Paul Kraman; Mark Alderson; and Tudor Davies, Office Director.

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Too numerous to mention are the participants in a September 1988 workshop where the question of what is a CCMP was addressed. Some of the answers are incorporated in this publication.

FOREWORD

A Primer for Establishing and Managing Estuary Projects is designed to help guide estuary and other coastal area programs as they grapple with the management of estuarine and coastal resources. As more and more of our nation's people move toward our coastlines, these areas experience increasing stress. Burdened with the demands of various interests—agriculture, recreation, conservation, fishing, manufacturing, mining—state and local decision makers have sought new ways to better manage coastal area resources. The National Estuary Program is attempting, through this document and other management tools, to support these state and local efforts.

This Primer is based on water management achievements in the Great Lakes, Chesapeake Bay, and Puget Sound, as well as on the cumulative experiences of water quality management efforts over two decades. Estuary program managers are encouraged to examine these earlier endeavors and review the water management plans developed by them. While this Primer can be used as a blueprint for estuary program management, it is not the only acceptable approach to estuarine management. The bottom line is that we restore our estuaries as we comply with the requirements of the laws governing them.

The Primer is a guidance tool which has evolved over several years. It represents the thoughts and ideas of many federal and state water quality program managers and others engaged in environmental management. But it is not the last word. It is our good fortune that we continue to learn.

The process described in this book is still evolving. Moreover, the steps in this process do not always follow one after another. Steps are often retraced, inverted, or overlapped.

There are two certainties, however. One is that the affected governments, institutions, and people need to be integral to each step in the estuary management process and lend support. The other is that funding must be secured for each management action. Funding options for both short- and long-term activities will need to be considered; firm commitments will have to be made if our estuaries are to be restored.

Tudor T. Davies, Director
Office of Marine and Estuarine Protection
United States Environmental Protection Agency

July 30, 1989

GLOSSARY

Anadromous fish: Fish that spend their adult lives in the sea but swim upriver to freshwater spawning grounds to reproduce.

Benthic organism: A form of aquatic plant or animal life that is found on or near the bottom of a stream, lake, or ocean.

Best management practices (BMPs): Methods or techniques to control nonpoint source pollutants from being washed into water bodies.

Carcinogenic: Cancer producing.

Combined Sewer Overflow (CSO): In a wastewater collection and treatment system where domestic and industrial wastewater is combined with storm runoff, a pipe discharges overflow when the system cannot handle the increased capacity caused by stormwater runoff.

Designated uses: Under the Clean Water Act, projected uses of a water body (e.g. industrial, contact recreation, coldwater fishery).

Dissolved oxygen (DO): The oxygen freely available in water. Dissolved oxygen is vital to fish and other aquatic life and for the prevention of odors. Traditionally, the level of dissolved oxygen has been accepted as the single most important indicator of a water body's ability to support desirable aquatic life. Secondary and advanced waste treatment are generally designed to protect DO in waste-receiving waters.

Head of tide: Landward limit of tidal influence within an estuary.

Eutrophication: The slow aging process during which a lake, estuary, or bay evolves into a bog or marsh and eventually disappears. During the later stages of eutrophication, the water body is choked by abundant plant life as the result of increased amounts of nutritive compounds such as nitrogen and phosphorus. Human activities can accelerate the process.

Marine biota: All of the living material in a marine area; often refers to vegetation.

National Pollutant Discharge Elimination System (NPDES): A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the United States unless a special permit is issued by EPA or (where delegated) a state or a tribal government on an Indian reservation.

Nonpoint source: Pollution source which is diffuse and does not have a single point or origin or is not introduced into a receiving stream from a specific outlet. The pollutants are generally carried off the land by stormwater runoff. The commonly used categories for nonpoint sources are agriculture, forestry, urban, mining, construction, dams and channels, land disposal, and saltwater intrusion.

Nutrients: Any substances assimilated by living things that promote growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

Organic: 1. Referring to or derived from living organisms. 2. In chemistry, any compound containing carbon.

Pathogens: Microorganisms that can cause disease in other organisms or in humans, animals, and plants. They may be bacteria, viruses, or parasites and are found in sewage, in runoff from animal farms or rural areas populated with domestic and/or wild animals, and in water used for swimming. Fish and shellfish contaminated by pathogens, or the contaminated water itself, can cause serious illnesses.

pH: A measure of the acidity or alkalinity of a liquid or solid material.

Phytoplankton: That portion of the plankton community comprised of tiny plants.

Plankton: Tiny plants and animals that live in water.

Point source: A stationary location or fixed facility from which pollutants are discharged or emitted. Also, any single identifiable source of pollution, e.g., a pipe, ditch, ship, ore pit, factory smokestack.

Pollutant loading: The amount of any given pollutant entering a body of water.

Tidal flushing: The movement of water and associated suspended or dissolved material from one location to another as a result of tidal influence.

Turbidity: 1. Haziness in air caused by the presence of particles and pollutants. 2. A similar cloudy condition in water due to suspended silt or organic matter.

Wasteload allocation: The maximum load of pollutants each discharger of waste is allowed to release into a particular waterbody.

Water quality management plan: A watershed management plan under the Clean Water Act, Section 208.

Watershed: The land area that drains into a waterbody.

Watershed geomorphology: Physical geological characteristics of a watershed.

Zooplankton: That portion of the plankton community composed of tiny aquatic animals.

CONTENTS

Chapter I

The National Estuary Program: An Overview

Unique Resources

Estuaries are unique waterways where fresh water drained from the land mixes with salt water from the ocean. This blend of salt and fresh water makes estuaries biologically productive, sustaining certain finfish, shellfish, marshes, underwater grasses, and microscopic marine life. Because of their economic, aesthetic, and recreational value, estuaries are increasingly attracting both people and commerce to their shores. Aquatic life is affected by these growing populations, which need and use water for services as well as for commercial and industrial activity.

In establishing the National Estuary Program under the Water Quality Act of 1987, Congress recognized the special need to protect an important but endangered resource: our nation's estuaries.

> According to the 1972 Federal Water Pollution Control Act, "the term 'estuary' means all or part of the mouth of a river or stream or other body of water having unimpaired natural connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage." The 1987 amendments, known as the Water Quality Act of 1987, expand the definition to include "associated aquatic ecosystems and those portions of tributaries draining into the estuary up to the historic height of migration of anadromous fish or the historic head of tidal influence, whichever is higher."

What Is the National Estuary Program?

The National Estuary Program is managed by the Environmental Protection Agency (EPA) to identify nationally significant estuaries threatened by pollution, development, or overuse, and to promote the preparation of comprehensive management plans to ensure their ecological integrity. The program's goals are protection and improvement of water quality and enhancement of living resources.

To achieve these goals, the National Estuary Program conducts activities to help

- Establish working partnerships among federal, state, and local governments;
- Transfer scientific and management information, experience, and expertise to program participants;
- Increase public awareness of pollution problems and ensure public participation in consensus building;
- Promote basinwide planning to control pollution and manage living resources; and
- Oversee development and implementation of pollution abatement and control programs.

Historical Perspective

The National Estuary Program has roots in earlier efforts and legislation. The experiences of the Great Lakes and the Chesapeake Bay provide useful models and lessons for the new program.

- The first is the phased program approach used to identify and define priority problems, establish their probable causes, and devise alternative strategies to address them.
- The second is the collaborative problem-solving process that involves all concerned parties in each phase of the program and secures commitments to carry out recommended actions.

Great Lakes Program

Launched in 1970, the Great Lakes Program is the oldest estuary-like program in this country. A cooperative effort between the United States and Canada, the program fulfills the Great Lakes Water Quality Agreements of 1972 and 1978 between the United States and Canadian governments. Waters of the Great Lakes were burdened with too many nutrients. The resulting eutrophication problems were depleting the supply of oxygen dissolved in the water, thus killing fish. Excessive phosphorus discharges were cited as the probable cause.

The program initially tackled control of pollution from individual, identifiable sources. Major municipal treatment plants were required to reduce phosphorus in effluents, and phosphate detergent was banned in many of the Great Lakes states. These efforts to reduce point-source pollution, which successfully reduced nutrients, resulted in elevated oxygen levels and restoration of some fish in Lake Erie and elsewhere.

The Great Lakes Program then turned to nonpoint sources of pollution. The principal nonpoint source of excess nutrients was the runoff of surface water from agricultural land. This water carries topsoil laden with nutrients (including fertilizers) to the estuary. To demonstrate the value of nonpoint source controls, the Great Lakes Program Office, working with the Department of Agriculture's Soil Conservation Service, funded projects with individual farmers. These projects were aimed at controlling nonpoint source pollution in several states. The program illustrated how voluntary best management practices could reduce phosphorus loadings from

agricultural sources, especially into Lake Erie and Lake Ontario. Today the states have their own phosphorus control programs as part of the implementation agreement with Canada.

After adopting measures to control point and nonpoint sources of nutrients, the Great Lakes Program focused on methods to abate pollution caused by nonpoint sources of toxics. Toxic pollution is the result of activities that have occurred in the watershed for many years. The Great Lakes Program is also studying the effects of airborne toxics.

One lesson from the Great Lakes Program is that pollution controls evolve from a phased process. After nearly two decades, the Great Lakes Program now focuses on toxics control. Its management process consists of identifying pollution problems based on "impaired uses"; linking critical pollutants to use impairments; identifying sources, primarily chemicals; developing remedial actions; and implementing actions.

A second lesson is recognition of the need for continuous monitoring of water quality and living resources. Without monitoring, there is no way to know whether the actions taken have worked. The Great Lakes Program is carrying out a monitoring plan that surveys the lakes to determine the levels of and trends in concentrations of nutrients, metals, and toxics. The results will enable the United States and Canada to assess compliance with the objectives of the agreement, evaluate the effects of the control program, and identify emerging problems.

Chesapeake Bay Program

The Chesapeake Bay Program, which was mandated by Congress, began in 1977 as a federal-state partnership. From 1978 to 1982, scientists examined the bay. They found that phosphorus and nitrogen loads from both point and nonpoint sources were the chief causes of the bay's declining water quality and resources. As a result, specific recommendations were made in 1983 to reduce sources of the nutrients and to clean up the bay.

The findings and recommendations of the study spurred the states to action. In 1983, the governors of Maryland, Virginia, and Pennsylvania, and the mayor of the District of Columbia, signed the Chesapeake Bay Agreement with EPA's Administrator. The agreement commits the states and the District to prepare plans that will improve and protect the bay's water quality and living resources. The following actions are being implemented successfully:

- Institution of land-use controls at or near the bay shoreline;
- Development of nonpoint source control programs for agricultural and urban sources;
- Acceleration of tighter controls of point sources, particularly municipal treatment plants; and
- Strengthening of wetlands protection laws and programs.

While continuing to implement those actions, a 1987 agreement pledged new regional leaders to more specific goals, objectives, and commitments. The 1987 Chesapeake Bay Agreement is supported by a series of plans, reports, and strategies describing how these goals, objectives, and commitments will be met.

In an ongoing effort to carry out these agreements, the state legislatures and the District of Columbia have appropriated money to effect the program's recommendations. The federal government continues to provide resources to assist in bay cleanup. The Chesapeake Bay and Great Lakes programs are both continued under the 1987 Water Quality Act.

Roots of the National Estuary Program

The lessons learned and the precedents set by the Chesapeake and Great Lakes programs, along with federal legislation and historic programs such as basin planning, helped lay the foundation for the National Estuary Program. This program employs collaborative problem-solving approaches to balance conflicting uses while restoring or maintaining the estuary's environmental quality. Further, the program follows the basic problem identification, characterization, and phased management process learned from earlier efforts.

An estuary program is woven together by two themes: progressive phases for identifying and solving problems and collaborative decision making.

Through the experiences of the Great Lakes, Chesapeake Bay, and other programs, EPA and program participants also learned how to get results with less money. The National Estuary Program encourages this by focusing on the most significant problems, using existing data, emphasizing applied research, funding specifically targeted basic research, and employing demonstrated management strategies. These techniques save both time and money, but more importantly, lead to earlier corrective actions.

In 1985, the Congress directed EPA to conduct programs in four estuaries: Narragansett Bay in Rhode Island, Buzzards Bay in Massachusetts, Long Island Sound in New York and Connecticut, and Puget Sound in Washington. In 1986, EPA added San Francisco Bay in California and Albemarle/Pamlico Sounds in North Carolina to the program.

The two estuaries were added in 1986 because EPA believed it was appropriate to extend the program to new coastal areas. The Agency also wanted to expand the types of pollution problems being addressed, while making certain they were issues of national concern. EPA was further persuaded by the obvious commitment state and local governments and the public in these estuaries had already made to pollution abatement. However, it was clear they could still benefit from the expertise available through EPA's national program.

The types of environmental problems the national program addressed were, and remain, complex. They include loss of habitat and living resources, contamination of sediments by toxics, elevation of nutrient levels, contamination by bacteria, and depletion of oxygen. These problems can affect human health through contact with the water and by ingestion of contaminated shellfish and

finfish. More frequently, pollution problems limit desirable uses of the estuary like recreational and commercial finfishing and shellfishing, and may even close beaches to swimming. Other important uses, such as shipping, municipal and industrial water use and disposal, may not be affected by environmental problems. Nevertheless, the program assumes that these potentially conflicting use demands can be met through collaborative planning.

Through 1986, program activities were supported by broad legislative authorities and funding appropriations. Despite the complexity and pressing nature of the problems, the Congress had yet to enact legislation aimed specifically at these fragile bodies of water. This situation was about to change.

Water Quality Act of 1987

Passage of the Water Quality Act of 1987 signaled recognition by Congress that the health of the nation's estuaries had to be protected. The new law amends and extends the Federal Water Pollution Control Act of 1972 and its 1977 amendments, known as the Clean Water Act. The Water Quality Act formally establishes the National Estuary Program. Section 317 declares that the increase in coastal population, demands for development, and other direct and indirect uses of the estuaries threaten these unique bodies of water. The law further states that it is in the national interest to maintain the ecological integrity of the nation's estuaries through long-term planning and management.

Section 320(b) of the Water Quality Act of 1987 states the purposes of Management Conferences.

(b) PURPOSES OF CONFERENCE.—The purposes of any management conference convened with respect to an estuary under this subsection shall be to—

(1) assess trends in water quality, natural resources, and uses of the estuary;

(2) collect, characterize, and assess data on toxics, nutrients, and natural resources within the estuarine zone to identify the causes of environmental problems;

(3) develop the relationship between the inplace loads and point and nonpoint loadings of pollutants to the estuarine zone and the potential uses of the zone, water quality, and natural resources;

(4) develop a comprehensive conservation and management plan that recommends priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution to restore and maintain the chemical, physical, and biological integrity of the estuary, including restoration and maintenance of water quality, a balanced indigenous population of shellfish, fish and wildlife, and recreational activities in the estuary, and assure that the designated uses of the estuary are protected;

(5) develop plans for the coordinated implementation of the plan by the States as well as Federal and local agencies participating in the conference;

(6) monitor the effectiveness of actions taken pursuant to the plan; and

(7) review all Federal development projects in accordance with the requirements of Executive Order 12372, as in effect on September 17, 1983, to determine whether such assistance programs or projects would be consistent with and further the purposes and objectives of the plan prepared under this section."

Section 320 authorizes the EPA Administrator to convene Management Conferences to develop comprehensive plans for estuaries of national significance. The conferees are charged with balancing the conflicting uses in the estuary while restoring or maintaining its natural character.

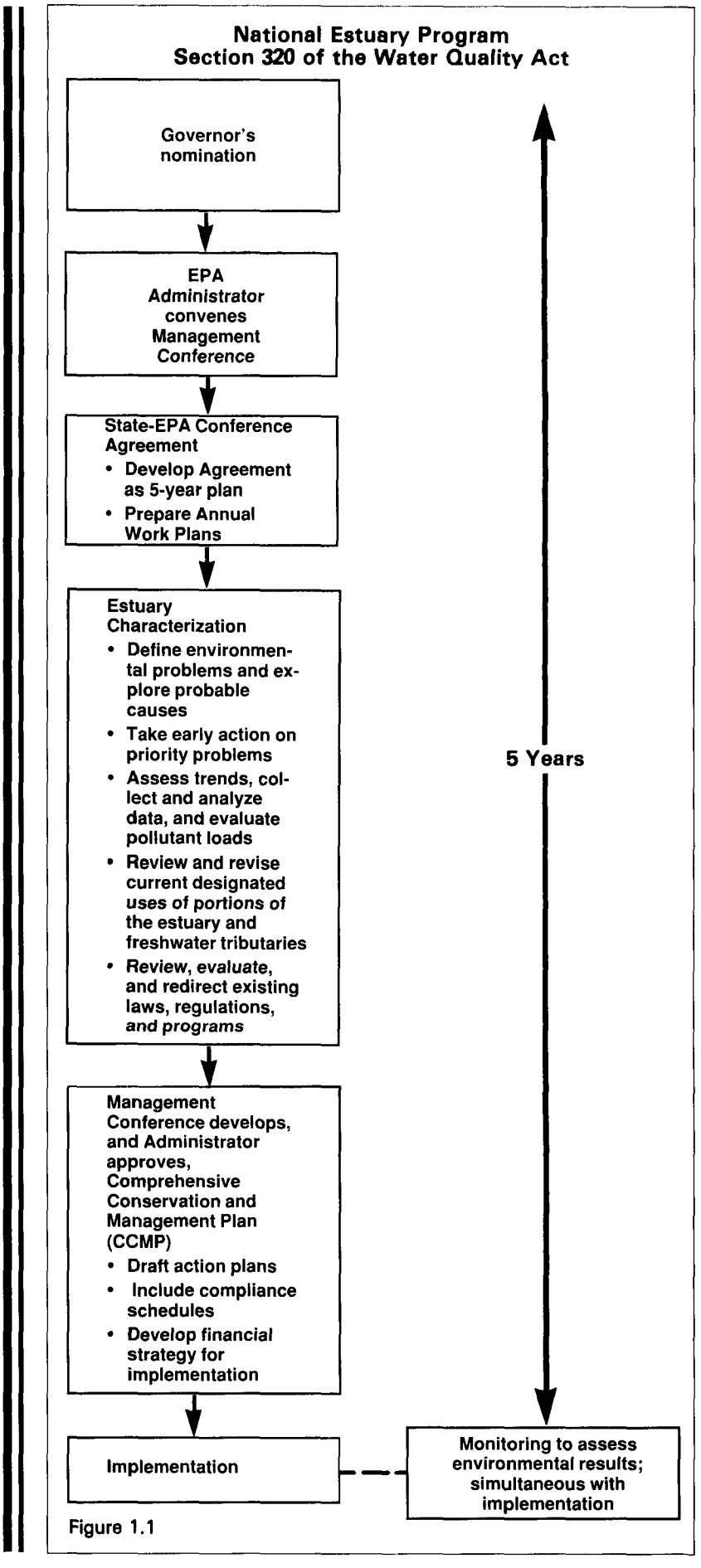
National Estuary Program
Section 320 of the Water Quality Act
Governor's nomination
EPA Administrator convenes Management Conference
State-EPA Conference Agreement
• Develop Agreement as 5-year plan
• Prepare Annual Work Plans
Estuary Characterization
• Define environmental problems and explore probable causes
• Take early action on priority problems
• Assess trends, collect and analyze data, and evaluate pollutant loads
• Review and revise current designated uses of portions of the estuary and freshwater tributaries
• Review, evaluate, and redirect existing laws, regulations, and programs
Management Conference develops, and Administrator approves, Comprehensive Conservation and Management Plan (CCMP)
• Draft action plans
• Include compliance schedules
• Develop financial strategy for implementation
Implementation
Monitoring to assess environmental results; simultaneous with implementation
5 Years

Figure 1.1

The law acknowledges the importance of collaboration by requiring Management Conferences; it also requires implementation by the conferees. Furthermore, it reflects the phased process used in the Great Lakes and Chesapeake Bay programs. Through this process, each estuary program examines changes in water quality and natural resources, evaluates point and nonpoint pollutant loadings, and determines the relationship between these loadings and pollution problems. The Conference then devises a management plan to address these problems. The law supports the notion that, through collaborative planning, disputes about uses of water can be resolved. It also endorses the value of education and research as essential components of longer term efforts to restore and maintain estuaries.

In 1988 Management Conferences were convened in six additional estuaries: New York-New Jersey Harbor, Delaware Bay, Delaware Inland Bays, Galveston Bay, Sarasota Bay, and Santa Monica Bay. As new estuaries are added to the National Estuary Program, new approaches to estuarine problem solving evolve. For example, it is now clear that when priority needs are identified, action plans addressing them should be put into place before completing comprehensive plans. Furthermore, financial strategies should be developed to support actions. In time it is hoped that additional management mechanisms will evolve, further advancing estuarine management.

The National Estuary Program's Approach

The National Estuary Program's approach is to convene a Management Conference, characterize the estuary, define the estuary's problems, and develop the Comprehensive Conservation and Management Plan (CCMP). Figure 1.1 outlines this approach, reflecting the mandate of Section 320 of the Water Quality Act.

Management Conference

A state governor may nominate an estuary by showing how this body of water is nationally significant and by meeting EPA program criteria. After the EPA Administrator reviews the nomination and selects the estuary for the National Estuary Program, the Administrator convenes a Management Conference to oversee activities. The Conference consists of representatives of EPA, state and foreign governments, appropriate interstate or regional agencies and other appropriate federal agencies, local governments, affected industries, public and private educational institutions, and the general public.

One of the first activities undertaken in the estuary program is drafting the State-EPA Conference Agreement. This agreement identifies program activities, products, and milestones and schedules that lead to the completion of the CCMP within five years and link it to the purposes of the Management Conference. A detailed annual work plan is also prepared.

The Conference lists the problems of the estuary and, from a broad array of concerns, selects specific areas to investigate. Narrowing the field, establishing priorities, and selecting which problems to tackle is a challenge. To meet that challenge, the Management Conference asks such questions as:

- Is the environmental problem systemwide and pervasive, or is it local, affecting small areas only?
- If the problem is local, is it nevertheless significant enough to adversely affect the entire estuary or its resources?
- Does the problem reduce the estuary's ability to support beneficial uses?
- What information is needed to identify the causes of the problem?
- What actions can be taken to abate the problem or its causes?
- Is enough known to take immediate action?

Characterization and Problem Definition

When a significant problem is identified by the Conference, early action to address the problem should begin. However, since most problems require further investigation, the Conference performs an objective, technical assessment of the state of the estuary. This assessment attempts to link pollution sources to environmental problems. It also evaluates the management programs in place to protect the estuary. This phase, called characterization, is the basis for defining and selecting the problems to be addressed in the CCMP. A blueprint for achieving environmental protection in the estuary, the CCMP requires a commitment to action by the conferees.

Comprehensive Conservation and Management Plan

A CCMP summarizes the estuary's problems and indicates which ones will be addressed. Through a collaborative process, the Management Conference establishes program goals and objectives, determining desirable and allowable uses for the estuary and its various segments. Specific pollution control and resource management plans, designed to meet each objective, are the core of the CCMP. After evaluating the range of approaches carefully, the conferees select those producing the greatest environmental benefit — at the least cost and in the most timely manner — for action. Actions are supported by a financial strategy; some actions may be eligible for special funding as demonstration projects. Strong public support and subsequent political commitments are required to carry out the actions agreed to in the CCMP.

Estuary Program Primer

Each estuary program must establish its own objectives and operating methods, which will depend on the character and problems indigenous to its body of water. The interests and values of its public are also a paramount concern. With flexibility to respond to the uniqueness of each estuary, all programs will entail the same four phases. These phases, highlighted here, are discussed thoroughly in the following chapters.

Phase 1, the Planning Initiative, consists of building a management organization for identifying and solving problems. This includes setting up the Management Conference and committee structure

(Chapter II). During **Phase 2**, Characterization and Problem Definition, the state of the estuary and its problems are defined (Chapter III). The chief task of **Phase 3** is to create a Comprehensive Conservation and Management Plan. The CCMP is designed, developed, and adopted by the Management Conference (Chapter IV). Implementation of the CCMP and reassessment of needs occur during **Phase 4** (Chapter V). Implementation will be the responsibility of the Management Conference using the resources provided under the Water Quality Act of 1987 and other federal, state, and local auspices. The four-phase process, basic to the program, is an iterative and complex one.

Management Process

Phase 1	Planning Initiative: Building a Management Framework
Phase 2	Characterization and Problem Definition
Phase 3	Creation of a Comprehensive Conservation and Management Plan
Phase 4	Implementation of the Comprehensive Conservation and Management Plan

Chapter II

The Planning Initiative: Building a Management Framework

Collaboration and Flexibility: Essential Ingredients

The management framework is essentially a vehicle for decision making. Conflicting needs and uses must be balanced without compromising the environmental goal of restoration and maintenance of the estuary. Not surprisingly, these decisions are often fraught with tensions. Therefore, each Management Conference must serve as a forum for open discussion, cooperation, and compromise among disparate interests, resulting in consensus. Such a forum is the instrument for collaborative decision making that leads to acceptance and support for implementation actions.

Building a Constituency

When creating its committee structure, the Conference targets four constituencies: elected and appointed policy-making officials from all governmental levels; environmental managers from federal, state, and local agencies; local scientific and academic communities; and private citizens and representatives from public and user interest groups — businesses, industries, and community and environmental organizations. These constituents are all key members of the Conference.

A Management Conference is a forum for open discussion, cooperation, and compromise that results in consensus.

Because each estuary is a unique body of water, its problems, citizens' concerns and preferences, state and local governments, and institutions are also unique. So flexibility is the key to organizing and managing an effective estuary program. Local needs and values are among the important forces driving the creation of a specific management organization — a framework that will determine program goals and objectives and how to achieve them.

A Local-State-Federal Partnership

As a local-state-federal partnership, the framework must also take into account differences in how state and local governments are organized. The division of responsibilities among resource, water, and commerce agencies, and the degree of centralization in environmental planning, are equally important considerations. Therefore, program planning and management for each estuary will probably involve a somewhat different mix of public agencies and different levels of representation. Flexibility ensures a dynamic program that allows both structure and strategy to be modified in response to successes, failures, political realities, and unforeseen problems.

Many of the strategies considered in the estuary program will require new laws, regulations, and policies. It may be necessary to create institutions or to modify the mission of existing ones. Funding to implement selected actions will certainly need to be identified. In addition, each state and local government has its own rulemaking process. It is, therefore, essential to understand how the systems work in the jurisdictions participating in an estuary program.

The recommendations in this chapter stem from EPA's experience with current estuary programs and the suggestions of their participants. They are offered only as guidelines, since the character of each program is different.

Management Conference: The Umbrella for Action

As Chapter I described, the Water Quality Act established the National Estuary Program to promote comprehensive planning for estuaries of "national significance" that are threatened by pollution, development, or overuse. The EPA Administrator, who decides which estuaries will be part of the program in response to nominations submitted by state governors, assumes significant responsibility. The Administrator may convene Management Conferences for estuaries with boundaries in more than one state. The Act relies on state implementation of its programs. Accordingly, the states are responsible for most estuary program activities.

Management Conference Process

The Management Conference, authorized by Section 320 of the Act, is the organizational umbrella under which each estuary program is conducted. Initially convened for up to five years, the Conference may be extended or reconvened to oversee implementation and to redirect or adopt new strategies.

The Conference's first major task is to build the management framework for identifying and solving problems in the estuary. Remembering the two themes driving an estuary program — progressive phases for identifying and solving problems and collaborative decision making — the Conference initiators begin to identify or build a constituency for the estuary.

Starting in the Right Direction

A kickoff meeting is a good way to start because it serves a number of purposes. As a media event, it can make the public aware that

all is not well in the estuary. And as an educational platform, it is a forum for identifying estuary problems and public concerns. The kickoff meeting is also an opportunity to involve all interested people and groups concerned about and affected by the estuary program. Furthermore, it is a chance to include influential officials in the earliest deliberations.

As an outgrowth of the kickoff meeting, a committee structure is set up and assigned responsibilities by the Management Conference. Each estuary program designs a committee structure to meet its particular needs. The Conference must strive to understand the community of the estuary: how decisions are reached, what perceptions are prevalent, and who or what institutions are influential. The size of the community also makes a difference. For instance, a comparatively small area like Buzzards Bay, located within a single state, requires a simpler committee structure than the much larger interstate estuary, Long Island Sound. Generally, the structure consists of a policy-making committee, a management committee, work groups or subcommittees, and other standing committees including a scientific and technical advisory committee (STAC), a citizens advisory committee (CAC), and often a local government committee (LGC) and a financial planning committee (FPC).

The organizational structures of several generic programs are depicted in Figures 2.1 through 2.4.

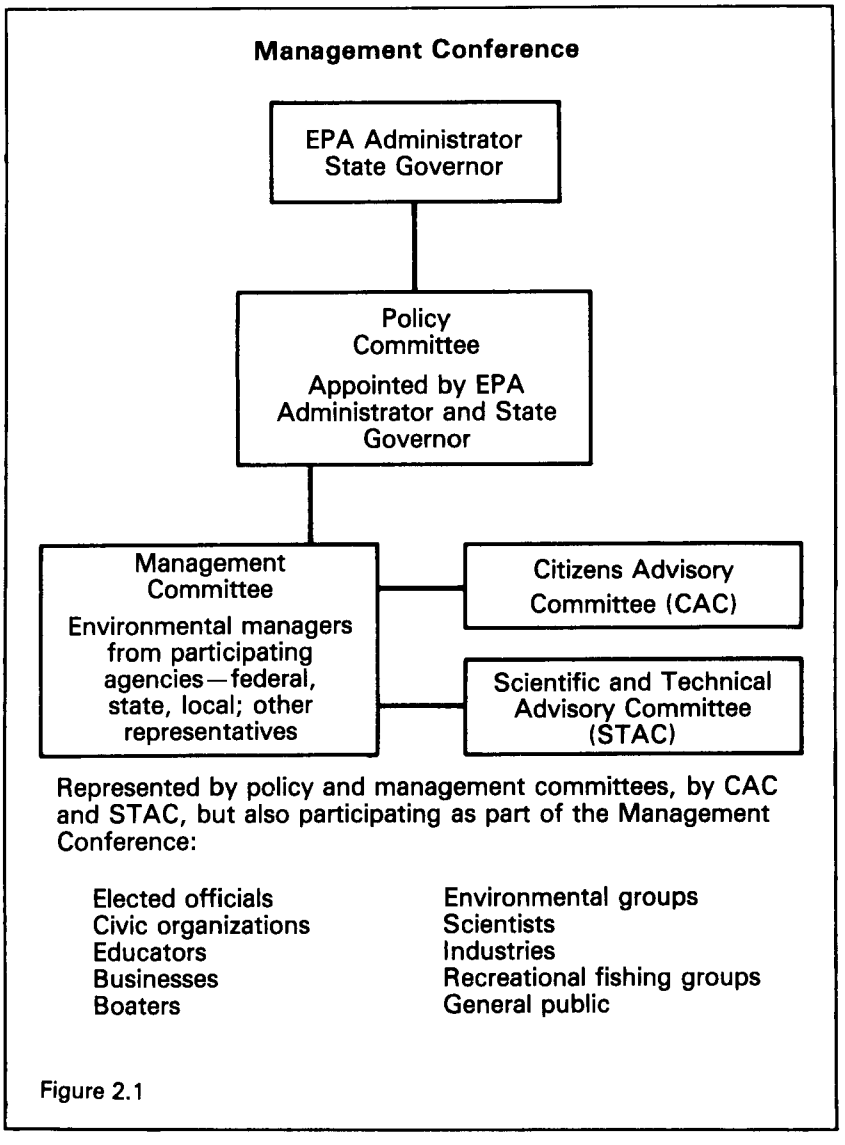

Figure 2.1

Who Are the Members of the Management Conference?

The Conference members include the EPA Administrator (or his or her designee); representatives of state, local, and foreign governments; and other appropriate interstate or regional agencies and entities. Affected industries, public and private educational institutions, and the general public are also represented. Collectively, all participants constitute the Management Conference.

EPA may act as the lead agency or serve as a cooperating or sponsoring agency for each program. EPA's role is primarily to facilitate and provide scientific and management expertise. The Conference may involve other federal agencies, such as the National Oceanic and Atmospheric Administration (NOAA), the Corps of Engineers, the Soil Conservation Service, and the Fish and Wildlife Service.

Policy Committee

Generally, estuary programs have identified a need for a high-level committee composed of federal, state, and local governmental decision makers. This committee (usually called a policy, lead, or sponsoring agencies committee) directs all Management Conference activities. Committee members are key officials, or their designees, who are in a position to ensure the resources and funding needed to support the program. They usually are appointed by the EPA Administrator or a state governor. Highly sensitive to both the special interests and needs of constituent groups, they are also well aware of the realities of time and resource constraints that confront environmental management agencies. Therefore, they routinely make decisions after weighing costs, benefits, and public

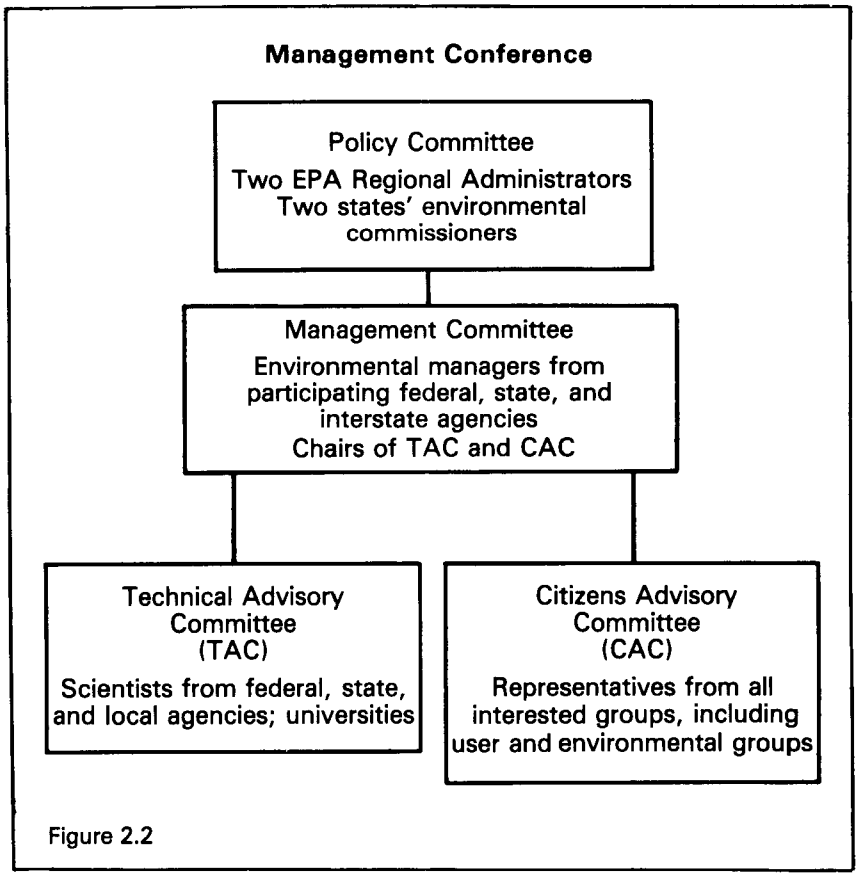

Figure 2.2

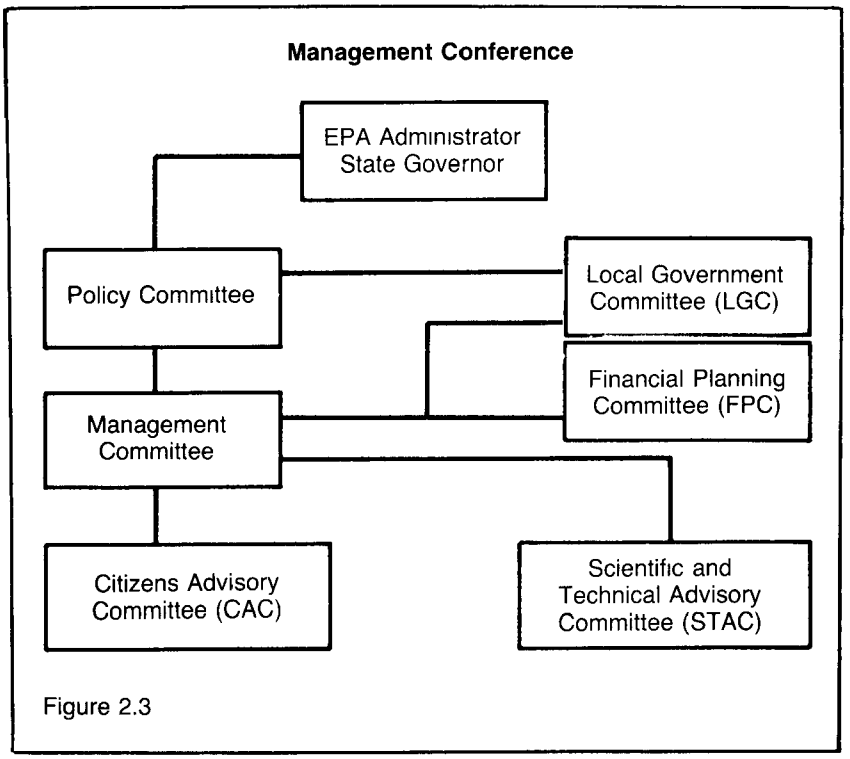

Figure 2.3

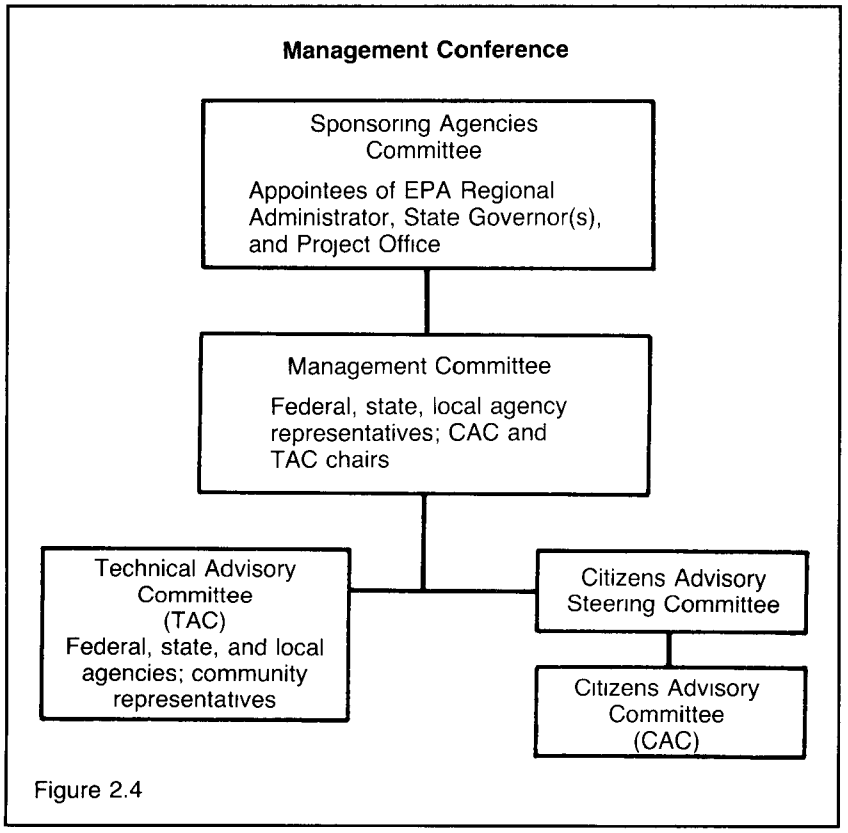

Figure 2.4

opinion. Within the Management Conference, their positions require them to make such decisions on behalf of their respective governments or agencies.

What Does the Policy Committee Do?

The policy committee sets program goals and objectives and establishes priorities and direction for the estuary program. Its members decide on recommendations from all committees. Al-

though the policy committee guides, reviews, and evaluates the program, it leaves the operational duties to other working committees.

Who Are the Members of the Policy Committee?

The EPA Regional Administrator and the governors of involved states or their designees are members of the key policy committee. Other political appointees, such as state secretaries of natural resources or environmental protection, may sit on the committee. A local mayor or other elected officials may serve; so may senior regional EPA managers (the Deputy Regional Administrator or the Water Management Division Director). One or more senior regional agency officials may be appointed by the governor of each participating state. Additional state and local representatives may also be members. These include appointees from the water department or water quality board, the public health department, or the department of natural resources. In some programs, committee chairpersons also sit on the policy committee.

Management Committee

An effective management committee communicates and collaborates among its members to build consensus for recommended actions. Members represent water quality, resource management, and other important environmental perspectives. They understand the estuary, what needs fixing, and what mechanisms are available or needed to fix it. The management committee members serve as the focal point for consensus building among Conference participants and all other committees. Their recommendations reflect this process.

Weighing differences and negotiating compromises can be difficult. Assume, for example, an estuary program has a $100,000 budget. The STAC believes this budget must support research to find out what is causing a decline in oyster reproduction. The user groups within the CAC want to establish oyster farming to offset the decline. The state environmental agency wants to manage septic systems in certain shore communities, because bacterial contamination is closing oyster beds. Opening such beds can offset the decline in production.

In these negotiations, members recognize that scientific studies to determine the cause of the decline may take several years. Nevertheless, the management committee may negotiate an agreement that allows for all three approaches in a phased program. The committee also understands that oyster farming may not succeed if the same problem affects new oysters. The committee may seek professional negotiators to facilitate consensus. In fact, failure to settle disputes amicably and early can lead to serious polarization, thus impeding later progress.

When setting up this committee, several pitfalls should be avoided. These include spending too much on a scientific study that will not yield results for years; committing resources to address a symptom, but neglecting its cause; and failing to keep lawmakers and other influential citizen leaders informed and involved.

What Does the Management Committee Do?

It is under the direction of the management committee that the tough day-to-day work gets done. Advised by staff, work groups, and other committees, the management committee defines and ranks the problems of the estuary, produces characterization reports, develops management strategies, and designs the CCMP. All management committee activities, including implementation, occur under the general guidance and direction of the policy committee.

In conjunction with the standing committees and work groups or subcommittees, the management committee develops the five-year State-EPA Conference Agreement, negotiated among EPA and the Conference states and their designees, to set major program milestones. It also oversees the annual work plans and budgets required by EPA, and approves all resource and funding allocations. (Appendix A describes the federal financial assistance process.) Planning to meet congressional deadlines, develop budgets and schedules, and meet work plan commitments is essential. The consensus-building process must account for this need.

The committee also oversees and supports the activities of the STAC, CAC, LGC, FPC, and the work groups or subcommittees. It is responsible for informing the public and providing for public involvement during each program phase. To ensure this, the management committee, working with the CAC, develops and funds a public participation program. It recommends key members for the committees, and establishes clear roles and responsibilities for them. When the management committee fails to give each committee a job to do, these key elements of the program founder.

Who Are the Members of the Management Committee?

The management committee may include the EPA regional Water Management Division Director and representatives of state and local agencies from each participating state. Representatives of key federal agencies, such as NOAA, may also be on the management committee. Mid-level agency managers and technical staff usually serve on this committee. Naturally, the number of representatives depends on the number of agencies involved. Nevertheless, the areas that should be represented include natural resources, pollution control, and planning. Representatives of the standing committees are also management committee members. Other members may include representatives of local academic and scientific communities, environmental groups, industry, and user organizations like receational and commercial fishery associations.

Scientific and Technical Advisory Committee

Each estuary program should determine the specific role and responsibilities of the scientific and technical advisory committee. It is especially important for the management committee to determine how the STAC is to function. It is equally important for the

STAC to understand that the estuary program is fundamentally a management program, rather than a research program.

At the same time, program managers must recognize the importance of basing the management strategies on sound scientific information. The STAC provides the science in estuary programs, identifying and defining the estuary's environmental problems. The STAC also recommends scientific studies, investigations, sampling, and monitoring programs that are necessary to determine the causes of environmental problems.

What Does the Scientific and Technical Advisory Committee Do?

The STAC reports to the management committee, and its chairperson may sit on that committee or on the policy committee. The STAC provides advice and guidance related to research, data management, modeling, and sampling and monitoring efforts, which affect the scientific adequacy of the estuary program activities. Depending on the problem, STAC members suggest the specific scientific activities necessary to meet program objectives established by the Management Conference. The STAC also conducts peer review of studies, reports on the status and trends in the estuary, and alerts the management committee to emerging environmental problems. In addition, it oversees the assembly and analysis of historical data bases for characterizing the estuary. To ensure scientific rigor and quality, the STAC also reviews the development of any requests for proposals and the actual proposals submitted.

In carrying out its responsibilities, the STAC may create work groups and subcommittees. It may also advise the management committee on the selection of work group members. The STAC may help provide initial direction for each work group or subcommittee. In addition, it may determine objectives and likely sources of scientific, technical, and logistical support required to perform assigned tasks.

Who Are the Members of the Scientific and Technical Advisory Committee?

Members are nominated by the management committee and appointed by the policy committee. They are selected with advice from local, state, and federal agencies; regional scientists; and public or private institutions conducting scientific studies in the water basin.

STAC members, who should represent a balance of scientific disciplines, may be noted local experts or outside scientists. An EPA regional representative from the Office of Research and Development should be included as well. Typically, members should have expertise in the following areas:

- Sources of nutrients/toxics;
- Transport and fate, including modeling;

- Ecological and human health effects; and
- Living resources.

Citizens Advisory Committee

Because public funds are used, the success of any estuary program will ultimately depend on citizen support. To generate that support the citizenry, persuaded that it has a vested interest in the outcome, must be involved in the entire program. The citizens advisory committee is germane to the estuary program because it ensures representation of the public voice during all program phases. An educated, informed, and involved citizenry is the estuary program's most valuable ally. In the long run, many people and corporations will be affected by measures taken to maintain and restore the estuary. These include, for example, levying additional taxes to pay for sewage treatment and sediment controls, imposing changes in lawn care and agricultural practices, restricting some waterfront land uses, and placing stricter regulations on dischargers.

Although the CAC is the formal mechanism for public involvement, it does not preclude the necessity for a general public participation program. The CAC's role must be clearly defined by the management committee. (For specific guidance on setting up a public participation program, see Appendix B.)

What Does the Citizens Advisory Committee Do?

The CAC reports to the management committee. CAC representatives may sit on that committee and on the policy committee. The CAC helps to ensure that the management committee and estuary program staff include the public in the decision-making process, and integrate public opinion and expertise into each program phase. The CAC recommends the most effective ways to inform the public and solicit its participation. It also identifies key people and organizations that can help bring estuary-related issues to the public's attention and build support for program activities.

The CAC ensures representation of public concerns while options are fluid, rather than after data collection and analyses have been completed and final decisions made. Public support for implementation is more likely if the public has been involved throughout program evolution. The CAC engages in the following activities to fulfill its role:

- Helps to establish program goals and objectives;
- Participates in determining funding levels for program activities;
- Comments on research priorities;
- Reviews technical findings and analyses;
- Helps develop implementation plans;
- Assists with public participation activities; and
- Educates user groups concerning the purpose and benefit of proposed programs.

The CAC may conduct some activities to obtain input from a cross-section of interest groups about goals, objectives, and preferences related to environmental quality. Public meetings are one vehicle. Other activities may be designed to disseminate information and secure comments from various representative individuals and groups about the scope, goal, and progress of the program. The numerous methods for this purpose include press releases, newsletters, and questionnaires. To accomplish specific objectives, the CAC may also establish special work groups, subcommittees, or task forces.

Who Are the Members of the Citizens Advisory Committee?

Citizens are nominated by the management committee and appointed by the policy committee. The CAC should represent a broad spectrum of major resource groups, for example, fishing interests, farmers, and recreational users. It should also include representatives from various environmental organizations and citizens councils. Equally important are representatives from business and industry, such as lumberers, shippers, and steel and petrochemical manufacturers. Of course, representation will vary with the type of users prevalent in the estuary basin.

Although each program needs to establish the specific criteria for appointees, nominees generally should meet the following criteria:

- Serve as a spokesperson for a major user or interest group;
- Have experience in the development of water quality and resource management policy;
- Understand the technical and economic feasibility of the pollution control options under consideration; and
- Represent a group that is affected by the recommendations and proposed programs.

Local Government Committee

Many of the actions selected for implementation are likely to affect local jurisdictions. To ensure that local governments and agencies are part of the decision-making process, an LGC may be established.

What Does the Local Government Committee Do?

Critical to implementing actions of the Management Conference, the LGC provides practical advice on sewage treatment, development issues, zoning ordinances, health concerns, and other local planning needs, issues, and existing projects. An LGC can also provide the political analyses that are needed for effective decision making.

Who Are the Members of the Local Government Committee?

As with all standing committees, local government representatives

are also nominated by the management committee and appointed by the policy committee. Representatives may come from important municipalities, counties, or townships; they may represent sewer districts, conservation districts, or agencies such as health or planning departments. Each Management Conference that chooses to set up an LGC should determine the most effective system for local government representation.

Financial Planning Committee

For every action the Management Conference selects for implementation, a method to pay for it must be determined. Some actions may be supported financially with Clean Water Act funds, some with state and local funds, and others using private sector funds. Whether financing is readily available or creative funding is explored, it is often useful to establish an FPC to develop a financial strategy to support CCMP actions. Action plans may call for the construction or improvement of sewage treatment plants, implementation of nonpoint source control programs, or restoration of fish and shellfish habitat. To move these plans into action, funding must be secured.

What Does the Financial Planning Committee Do?

The FPC develops a funding strategy that includes accessing revenues, such as taxes, fees, and assessments; managing the flow of funds; and recommending institutions to oversee financial planning and management. The FPC might also identify new sources of funding, like creating debt or soliciting from private foundations.

The Puget Sound FPC identified a number of possible state funding sources to support Management Conference activities. The sources included taxes on watercraft, litter, food fish and shellfish, pesticides, gasoline, and toilet paper. In addition, they identified potential projects that could be funded with local revenue or as EPA demonstration programs in watersheds, such as repairing failing septic systems, fencing streams, monitoring septic systems, and preventing erosion of river banks.

Who Are the Members of the Financial Planning Committee?

The FPC members should be knowledgeable about financing public projects and represent key interest areas or jurisdictions. The Puget Sound Financial Committee, for example, consists of 16 members. Its chair is a public finance and municipal lawyer and member of the Puget Sound Water Quality Authority. He helped set up the Washington State Public Works Trust Fund, a revolving loan fund to finance repair and replacement of existing public works projects. Also serving on the FPC are four local elected officials, two of whom are wastewater utilities managers; four state legislators on the Ways and Means Committee; one member from the Department of Revenue; three members from the business community, including a banker; and three members representing the public interest.

Staff Support for the Management Conference

Funds to support the Management Conference and to develop the CCMP are provided through Water Quality Act appropriations. Portions of these funds should be earmarked for staff support to the Conference. It is up to the Management Conference, however, to determine the composition of the staff, how it will be hired, and who will direct its activities. Various options are available.

A state project office may provide this support. The Conference may contract with a nonprofit organization, educational institution, or state/local entity to assume staff responsibilities on its behalf. By using the Intergovernmental Personnel Act (IPA), support can also be secured from EPA and other federal agencies, such as NOAA.

The Conference ultimately should try to have staff or other support with the following expertise:

- A program manager or staff director experienced in planning, operating, and budgeting, and sensitive to public concerns;
- Experienced public participation specialists to serve as staff to the citizens advisory committee and as liaison with the public (Appendix B);
- A staff member experienced in the development and evaluation of management strategies and with an in-depth understanding of major federal and state statutes and implementing regulations affecting water quality, coastal land use, and protection of living resources;
- Biologists knowledgeable about marine or estuarine systems to help characterize the estuary and recommend corrective actions;
- A chemist, toxicologist, or general environmentalist to support in the characterization phase; and
- A statistician familiar with environmental modeling to help in the characterization phase.

The Management Conference — its committees, elected officials, and the general public — form the management structure under which problems and concerns related to the estuary are addressed and, over time, resolved.

Chapter III

Characterization and Problem Definition

Setting the Course

Once the Management Conference has built a framework for identifying, negotiating, and solving problems, it is ready to embark on other tasks. The Conference begins to "take the pulse" of the estuary, determining the state of its health and the reasons for its decline, and taking early corrective action if possible. The process entails examining symptoms for probable causes, testing hypotheses for actual causes, and defining the most pressing problems. Known as "characterization and problem definition," this phase provides the objective basis used to develop action strategies for the estuary's Comprehensive Conservation and Management Plan.

Characterization is the description of the quality of the estuary, defining its problems and linking problems to causes.

Generally, a Management Conference is convened because there are obvious problems in the estuary. These may include, for instance, decline in a popular recreational or commercial fish species, contamination of beaches, kills of fish, or extensive bloom of algae. Although these occurrences are often referred to as "perceived problems," they actually are symptoms of water pollution. The challenge to the Conference, working with the STAC, is to separate these symptoms from their causes or sources. Frequently, some symptoms may be addressed by regulatory agency actions while scientists examine data to determine the exact cause. All participants, expressing their different economic, aesthetic, health, and recreational concerns, will help determine which problems will be addressed during characterization.

The scientific investigations and reports resulting from characterization must be translated into plain English, telling a story about the estuary that the public can understand. The importance of this step cannot be stressed strongly enough. The success of an estuary program depends on public understanding of the estuary's problems and public support for enacting prescribed remedies.

Scientific Characterization

Scientific data are used during the characterization phase as the basis for an integrated, systemwide assessment of each estuary. The assessment addresses historical trends, present conditions, and probable future trends if current practices are not modified. It is analogous to telling a story about the past, present, and potential future of each estuary. The results are used to substantiate environmental problems, evaluate their causes, recommend future remedial and management strategies, and develop long-term monitoring plans.

Estuary characterization relies primarily on existing scientific information, particularly historical data.

Estuary characterization relies primarily on existing scientific information, particularly historical data. Such information, which can be collected and analyzed relatively efficiently and cost-effectively, provides the most direct way to evaluate trends in estuarine conditions. Table 3.1 lists information used for characterization.

Table 3.1—Common Kinds of Historical Information Used for Estuary Characterization

Pollutant Sources to the Estuary
- Watershed geomorphology
- Land use patterns
- Freshwater input
- Pollutant loadings: direct discharges, riverine discharges, nonpoint source runoff

Circulation of Material in the Estuary
- Weather patterns
- Tides/currents
- Salinity
- Temperature
- Sediment grain size

Distribution of Chemicals in Estuarine Waters and Sediments
- Organic carbon
- Nutrients
- Dissolved oxygen
- Chemical contaminants

Distribution of Biological Organisms in the Estuary
- Plankton
- Benthic invertebrates
- Fish
- Aquatic vegetation
- Endangered species

Rates of Biological Processes
- Primary production
- Secondary production
- Respiration
- Commercial fishery catches
- Recreational fishery catches

Factors Important to Human and Environmental Health
- Distribution of bacteria and pathogenic organisms
- Prevalence of disease in fish and shellfish
- Tissue contaminants

Geographic Areas of Special Importance
- Critical spawning or nursery habitats
- Recreational areas
- Beach closures
- Shellfish harvesting areas

However, readily available historical data, which consists of information already computerized or collected by local, state, and federal agencies, may not address the specific problems being investigated in each estuary. Historical data are also incomplete and limited to specific regulatory programs. To overcome these limitations, new sources of data are identified and information is collected from virtually all possible sources—scientists, academic and research institutions, and public health and living resource agencies. Characterization should benefit from previous, published work as much as feasible; however, many of the analyses that will be done will require access to original data for manipulation.

Because collecting new scientific information is generally quite costly, historical data are used to set priorities for the kinds of new information needed for the characterization effort. These data are also used to shape new sampling and monitoring programs needed to define specific problems.

Characterization Steps

Characterization proceeds through the following major steps:

- Identifying the most significant problems for investigation;
- Collecting priority data sets;
- Identifying data management support;
- Screening priority data sets;
- Determining estuary segments;
- Analyzing data;
- Considering significant gaps in available data;
- Reporting results in both peer-reviewed technical publications and public documents; and
- Preparing a characterization report or a series of characterization reports.

The relationship among these steps is presented in Figure 3.1.

Identification and Ranking of Priority Problems for Study

The first step in the characterization process is identifying the most important environmental problems in the estuary. This activity is conducted by the Management Conference and therefore cannot begin until a management framework is set up. Because all the problems cannot be addressed, it is critical to rank them so that effort and funding levels can be allocated effectively. The Management Conference must establish criteria by which it will define and rank environmental problems for characterization.

Overestimating the severity or significance of certain problems can divert attention from those that actually deserve greater concern. The presence of toxic contaminants in the tissue of fish, for example, may capture widespread publicity and interest because of its potential effect on human health. However, the incidence of such contamination may be limited to specific sites. On the other hand,

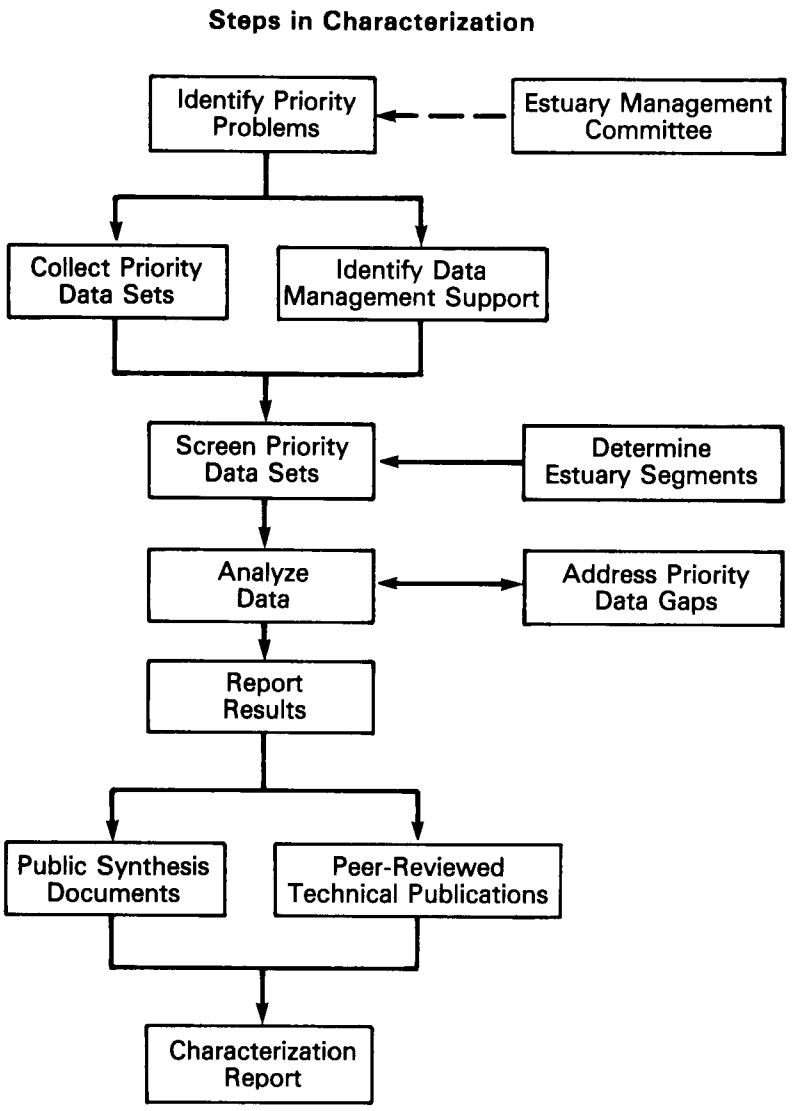

Figure 3.1 Relationships among characterization steps.

nutrient enrichment, eutrophication, and resulting dissolved oxygen depletion may have far greater systemwide impacts, affecting not only finfish species but shellfish and crab populations.

Problems with a systemwide impact generally are ranked higher than those with localized effects. Furthermore, problems that significantly curtail the designated uses of an estuary may be ranked high. Some problems may receive a high ranking because corrective mechanisms, such as regulatory programs and authorities, are already in place.

From a management perspective, simply knowing that a problem exists is not sufficient reason to study it. It is also necessary to be able to identify the likely cause and to ascertain whether corrective actions are feasible within reasonable cost and other limits. Tractable, or manageable, problems generally should be ranked higher than those with no apparent solution or those requiring an inor-

dinate amount of effort to correct. Furthermore, if the cause of a priority problem is understood, the conference should develop an "action-now agenda" for early action, redirecting resources from existing programs.

After specific criteria for the known environmental problems in an estuary have been developed, the problems are ranked to identify which warrant highest priority. These are considered in the remaining characterization steps.

Collection of Priority Data Sets

The second step in the characterization process is the collection of "priority data sets" that are

- Relevant to defining the nature and extent of a priority problem;
- Pertinent to specific parameters needed to define the problem;
- Broad in temporal and spatial coverage;
- Good quality, as indicated by a preliminary assessment; and
- In a usable format.

Although extensive information may be available for a particular estuary, the initial selection criterion (relevance) ensures that collection efforts focus only on data sets directly related to the priority problems. The second criterion (pertinence) further confines collection efforts to data sets containing information important for characterization, such as specific variables and sampling periods. The third criterion (breadth of temporal and spatial coverage) emphasizes data sets with broad temporal or spatial scales as opposed to data sets that represent a narrow time frame or those that are highly site-specific. The fourth criterion focuses on quality assurance to prevent questionable data from influencing the analyses. Finally, the data must be formatted for computer use.

The goal of the data collection and selection process is to identify what combination of data sets best provides the information needed for estuary characterization.

Rarely will any single data set rank highly with respect to all selection criteria. Instead, the goal of the data collection and selection process is to identify what combination of data sets best provides the information needed for estuary characterization.

To help identify the most important data sets, questionnaires frequently are sent to investigators and organizations. A sample data request form used to obtain information related to a priority problem in Long Island Sound appears in Figure 3.2.

Long Island Sound Data Characterization: Oxygen Depletion in Western Long Island Sound

1 LIS Document Reference Number _____
2. Organization Contacted _____
3. Principal Investigator _____
4 Contact. _____
5 Telephone Number _____
6. Address of Contact _____
7 Citation _____
a) Author(s) _____
b) Year _____
c) Title _____
d) Journal/Rept _____
e) Volume· Number _____
f) Pages _____

8. Sample, Survey Type·

	Y/N	Frequency/Resolution
a) Station(s)		
b) Synoptic Survey		
c) Vertical Resolution		

9 Measurement

	Y/N	Units
a) Dissolved Oxygen		
b) % Oxygen Saturation		
c) Temperature		
d) Salinity		
e) Phytoplankton Pigments		
f) Phytoplankton Counts		
g) Inorganic Nutrients (Ammonium, Nitrate, Phosphate, Silicate)		
h) Organic Nutrients (DOC, TOC, DON, TON, DOP, TOP)		
i) BOD, COD		
j) Biological Rates (Primary Productivity, Water Respiration, Sediment Respiration, etc.)		

10 Data, Study Area. _____
11 Time Span of Data. From _____ To _____
12 Status of Data

	Y/N	Availability	Cost
a) Ran			
b) Reprint			
c) Computerized			
d) Database Name			
e) Data Products			

13 Comments· _____

Figure 3.2 Example of a form used to identify priority data sets for use in estuary characterization.

Identification of Data Management Support

While key data sets are being identified, collected, and reviewed, each estuary program should find a data management system that can store large amounts of historical and future information related to the estuary's conditions. EPA's Ocean Data Evaluation System (ODES), for example, may be used for storing and analyzing marine environmental monitoring data. A data management system must support two primary functions. First, it enhances the characterization process by providing extensive data storage and analytical capabilities. It is thus a free-standing data base accessible to the scientific community conducting characterization studies. Second, it serves as a long-term archive that can be continuously updated. The data base will be expanded with information from sampling and monitoring efforts to determine whether the abatement and control programs improve water quality and living resources.

In developing data management support for each estuary program, existing systems are evaluated. The state agency responsible for implementing the estuary program's findings should use an existing data management system if possible. Evaluation criteria include the following:

- Ease of access and use;
- Use of relatively standard hardware and software;
- Capability of storing diverse kinds of information, such as physical, chemical and biological data; land use statistics; and point and nonpoint source records;
- Data analysis features, including analyzing statistics and generating presentations like tables, graphs, charts, and maps;
- Flexibility to adapt to changing needs; and
- Cost of usage and maintenance.

Screening Priority Data Sets

After priority data sets have been collected and entered into the data management system, they can be accessed as needed. Before data sets are analyzed, however, they must be screened (Figure 3.1).

The screening procedure is designed to review the quality of the data and to identify unusual values or missing information. For example, nonexistent observations from important time periods or sampling stations should be identified. In addition, unusually high or low data values can be isolated for closer inspection.

Screening can be conducted by combining computerized checks with experts' technical reviews. The results of the screening procedure are included in each data set. They help determine which data sets are appropriate for the various evaluations conducted during data analysis. Screening also helps identify insufficient or missing information that may need to be addressed later in the characterization process.

Estuary Segmentation

Estuary segmentation — partitioning an estuary into a series of spatial units or segments — is a useful analytical tool. It permits consolidating an extensive amount of environmental information into representative data elements when certain conditions, such as water temperature and salinity, are relatively homogeneous within a segment. During data analysis, historical information collected for each segment is combined to represent the average set of conditions encountered in the segment. In this manner, a data base consisting of hundreds of stations can be reduced to a description of conditions based on a relatively smaller number of segments (Figure 3.3). Besides facilitating data integration, segmentation also allows researchers to examine data based on station locations of uncertain origin. This is particularly useful because the lack of information on exact station locations is a limitation frequently encountered with historical data sets.

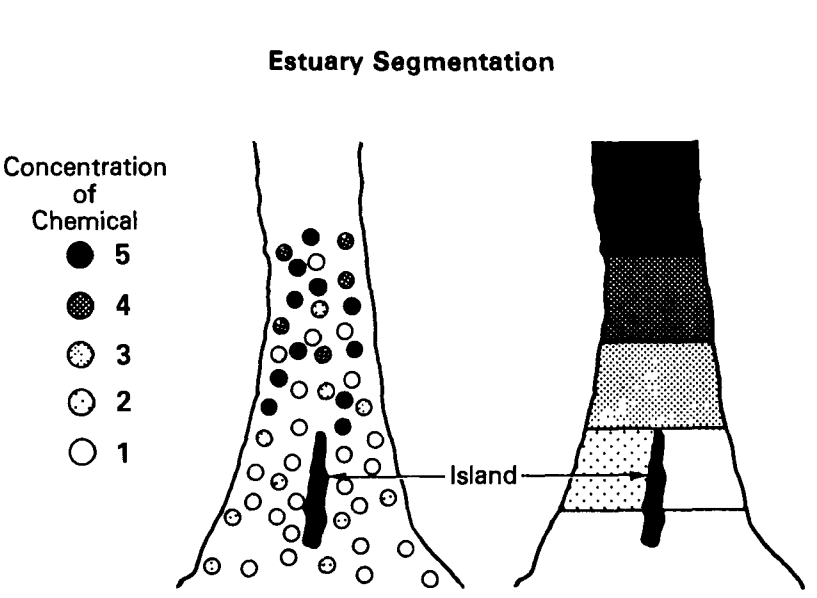

Figure 3.3 Estuary segmentation permits reducing the variability from hundreds of data points to a simplified picture of estuary trends.

In addition to providing a means for summarizing data for geographic stretches of the estuary, segmentation is important for the development of water quality models and the subsequent allocation of waste discharges into the estuary. Future management actions will most likely set pollution load reduction goals segment by segment. The impact of this scheme on the affected dischargers may be significant. Therefore, a segmentation scheme will need to consider political boundaries and the locations of the dischargers, as well as physical features and hydrography of the estuary.

Data Analysis

Once the data are screened, they can be analyzed by scientists to answer specific questions about the relationships among pollutants, pollutant loadings, and their effects on water, sediment, and living resources. The general objectives of these analyses are to:

- Determine the temporal trends and spatial patterns related to the most pressing problems of each estuary;
- Determine possible causes of these problems;
- Provide an integrated description of the conditions encountered in each estuary; and
- Identify significant, missing data that warrant additional monitoring or sampling.

The identification of temporal trends—or changes over time—is important for recognizing problems and suggesting potential causes. The landings of a particular species of fish in an estuary, for example, may continuously decline over a 40-year period (Figure 3.4). This trend suggests that the species may be adversely affected within the estuary, but it does not suggest the potential cause. Nevertheless, the temporal trend of interrelated, suspected causes, such as overfishing, pollution, or habitat loss, can be compared with the overall trend in fish landings. If there are

similarities between a suspected cause and the decline in landings, the cause may be further evaluated to determine whether it was the actual reason for the observed problem. Generally, characterization efforts do not establish cause-effect relationships. Absolutes or certainties are replaced with a philosophy that accepts a preponderance of evidence.

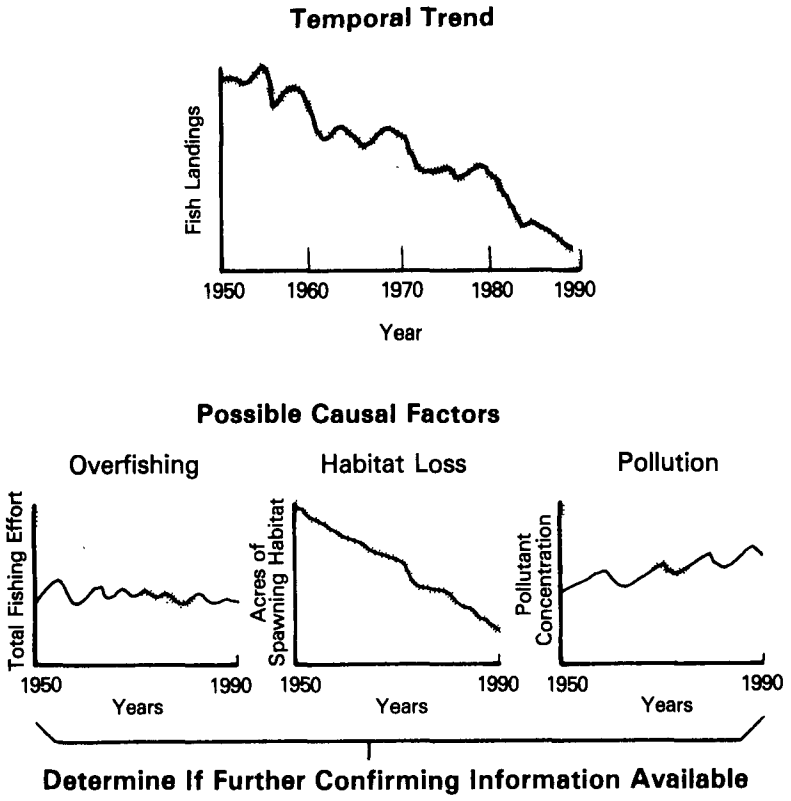

Figure 3.4 To suggest problem areas, temporal trends in important resources may be correlated with possible causal factors. Shaded zone indicates comparison of possible causal factors to temporal trend in fish landings.

Spatial patterns — relative locations — can also be used to identify problems and suggest possible causes. A gradient (that is, a continuous increase or decrease) in the distribution of copper concentrations in bottom sediments found near the head of an estuary is illustrative (Figure 3.5). Close inspection of the gradient might show that concentrations are highest immediately downstream from a city, but that they decline both up- and downstream as one moves farther away. Such a pattern suggests that the copper contamination originates in the city, and that subsequent analyses should attempt to identify the exact source.

Another analytical technique to determine the potential causes of environmental problems is an evaluation of relationships among environmental variables. The reduction of aquatic vegetation may, for instance, be cited as a priority problem in an estuary. The association between declining vegetation and a second estuarine variable, such as the presence of nitrogen in the water column, could be examined (Figure 3.6). If there is a positive correlation, nitrogen could be the culprit.

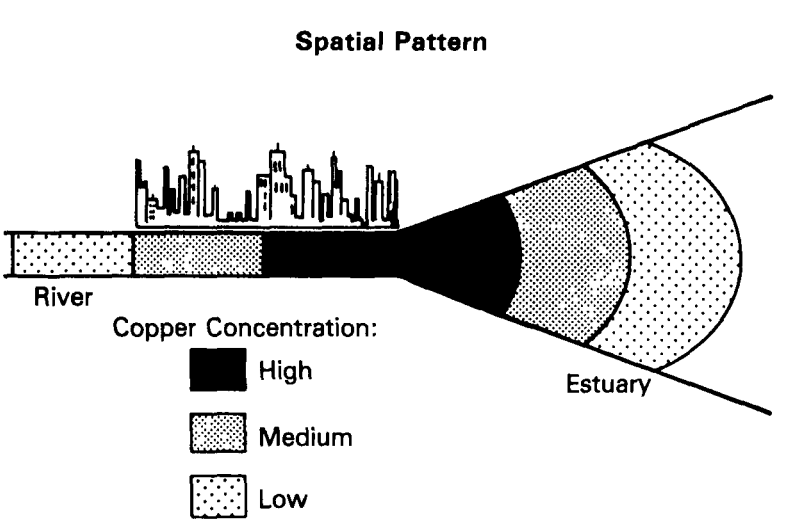

Figure 3.5 Example of a spatial pattern for copper concentrations in sediments found near the head of an estuary.

In all these examples, the potential cause of a problem is identified through association. Although this kind of circumstantial evidence is valuable, it does not conclusively prove a cause-effect relationship. The problem and potential cause could be associated purely by chance; both could be the result of yet another variable. Confirmation of cause-effect relationships usually requires conducting field or laboratory experiments under carefully controlled conditions.

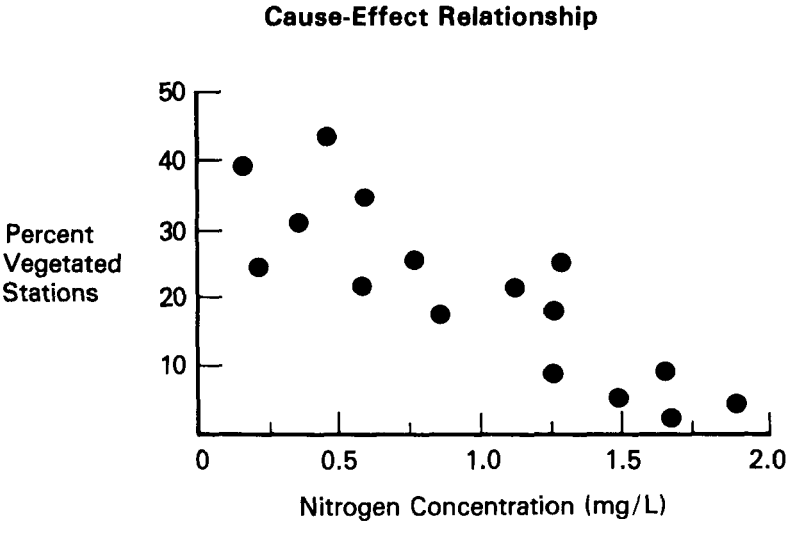

Figure 3.6 Example of a potential cause-effect relationship: The association between declining vegetation and the presence of nitrogen in the water.

Historical data sets for most estuaries differ in terms of factors like temporal and spatial coverage, kinds of measurements, and level of detail. Therefore, the analytical methods used for characterization generally include various quantitative and qualitative techniques. Nevertheless, the goal is to integrate a wealth of diverse information into a unified description of the past, present, and probable future conditions in each estuary (without, of course, exceeding inherent data limitations).

Consideration of Incomplete Data

As historical data are being analyzed during estuary characterization, various gaps in the historical data base are uncovered. Some of these data gaps substantially influence data analysis and therefore must be addressed. It is not feasible to address every missing link in the historical data base. Scientists must therefore rank this missing information to determine its importance to accurate analysis and interpretation. Once they have determined which information is required, they can overcome the deficiency by re-evaluating existing data or by collecting new information.

There may be significant gaps in data on temporal trends. Although a decline in landings of a species of fish may have been documented between 1950 and 1980, for instance, similar information may not have been summarized since 1980 (Figure 3.7). Without these data, it would be difficult to estimate whether landings continued to decline after 1980. This would be especially true if the number of landings remained relatively constant between 1970 and 1980. To determine whether the problem still exists, scientists would have to identify and collect additional existing information on landings from 1980 to the present. If a source of information cannot be identified, the estuary program may have to undertake its own sampling program to determine current conditions and any trends.

Historical Data Gaps

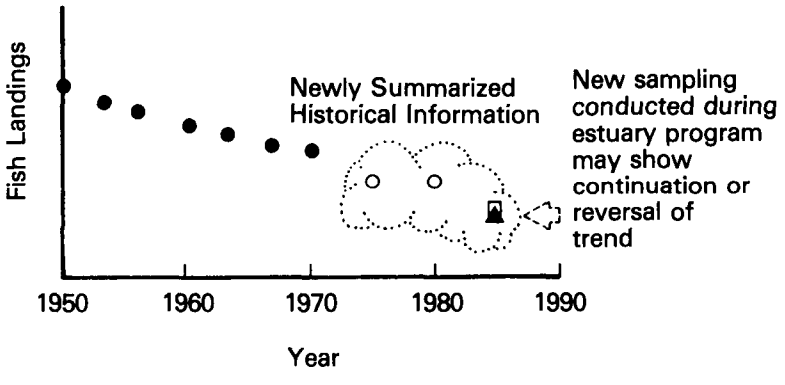

Figure 3.7 Missing information on the trend of parameters through time can be supplied by newly funded synthesis of previously collected data or new sampling.

Data for spatial patterns may also be incomplete. The presence of high concentrations of copper in bottom sediments downstream from a city again provides an illustration (Figure 3.8). Assume that information on concentrations upstream from the city and downstream from the area of high concentrations is not available. Without it, scientists cannot characterize the spatial extent of contamination or

determine whether the source of contamination is in the city. Such information is essential to determine the magnitude and likely cause of the problem. Accordingly, the acquisition of these data probably would be given a high priority. New data could be collected at a series of sampling stations located at increasing distances from the city and the area of high concentrations.

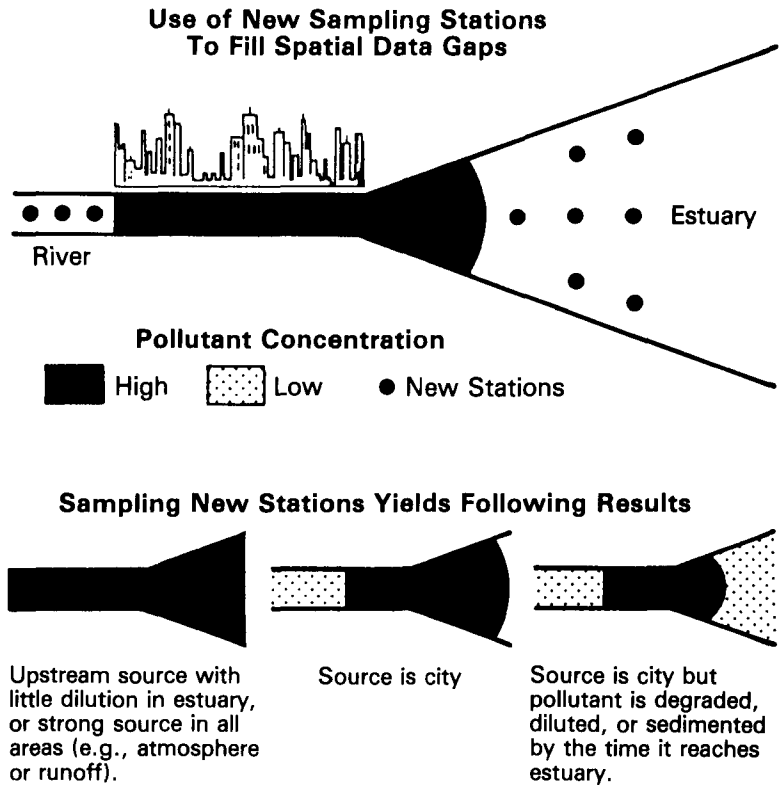

Figure 3.8 New sampling to fill in missing spatial data can yield important information about the source and extent of a problem.

Insufficient evidence about a suspected cause-effect relationship can lead to a pressing need to obtain missing data. Again, the relationship between declining aquatic vegetation and increased nitrogen concentration provides an illustration. This relationship could be due to the stimulative effect of the nutrient nitrogen on phytoplankton populations and the resulting decrease in light penetration through the water column. The relationship could be confirmed experimentally by exposing the aquatic vegetation to varying light intensities. Such an experiment would show the relationship between light reduction and mortality of the vegetation (Figure 3.9).

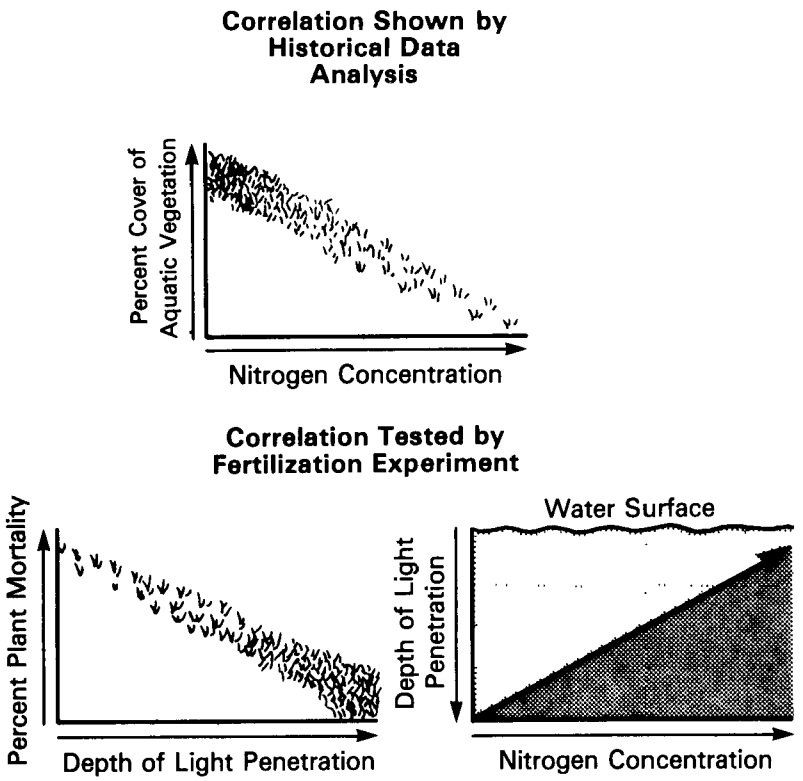

Figure 3.9 The collection of appropriate experimental data can be valuable for corroborating relationships suggested by historical data analysis.

Results are synthesized into scientific reports.

After data analyses are complete for each estuary problem, results are synthesized into scientific reports. These reports may be a series of findings on several identified problem areas and may be issued separately as they become available. To increase the pool of information and to encourage further research on the estuary, all scientific findings should undergo peer review. Publication in professional and academic journals should also be encouraged.

Reporting of Results

The reports provide evidence useful for the following:

- Summarizing major environmental problems within each estuary;
- Identifying suspected causes of as many of the problems as possible;
- Recommending early actions and future remedial and managerial strategies to correct the problems; and
- Developing a long-term monitoring program to evaluate the effectiveness of these strategies and to identify emerging environmental problems at an early stage.

Evaluation of Institutional and Management Programs

The scientific evaluation of the physical, chemical, and biological state of the estuary does not proceed in isolation. While it is under way, a simultaneous evaluation of the institutional structures, including laws, regulations, and management programs, is conducted. This evaluation addresses federal, state, and local laws, regulations, policies, and other institutional efforts. It looks at how regulations are being enforced, whether programs are being coordinated, and if resources are allocated and used effectively. As part of this evaluation, programs may be redirected and resources reallocated. For each priority problem that is considered, financial planning and analysis should be undertaken.

A simultaneous evaluation of the institutional structures, including laws, regulations, and management programs, is conducted.

For each priority problem, consider an evaluation of the following:

- Federal, state, and local laws and regulations that are in effect;
- Existing criteria, standards, and regulatory control programs, along with their compliance and enforcement records;
- Presence of needed regulatory authorities;
- Support from management institutions, such as planning and natural resource agencies and their policies;
- Integration among federal, state, and local agencies, institutions, and their programs; and
- Level and allocation of existing resources and potential new resources.

For each key problem, it would be helpful to develop an extensive list of laws, regulations, policies, control programs, and resources at federal, state, and local levels. Identify gaps and inconsistencies. Most of the existing regulatory programs are directed toward point source management. Therefore, if a priority problem is linked to a point source, determine how well these programs are working. Specifically, assess whether issued permits are of good quality, inspections are being conducted, and enforcement actions are taken when violations occur.

If, however, a priority problem is caused by surface runoff, for example, evaluate nonpoint sources of pollution. Find out whether an adequate nonpoint source program is in effect. Are other authorities to control nonpoint source pollution needed?

To improve management of living resources, inventory available and operational statutory, regulatory, and zoning ordinances. Sediment control or other point and nonpoint source requirements may need strengthening to ensure that water and sediment quality can sustain living resources. Initiatives to protect these resources and their habitats may be advisable. Such protections may include providing for minimum freshwater flows during drought conditions or establishing antidegradation policies for habitats critical to spawning, nursery, and forage areas.

Finally, examine how the various control programs are integrated; be sure that existing programs are not working at cross-purposes. Resources from each governmental level and program should be brought to bear on the most serious problems. Find out if programs are cooperating in this effort. Determine whether citizens are involved so they can help to ensure intergovernmental and interagency coordination. Some state and local governments may consider reorganizing their agencies to foster program integration and appropriate targeting of efforts.

During this phase, it is vital to understand what actions are already being taken within the current institutional framework. Further, environmental degradation can occur when existing authorities are not being exercised, or activities and resources are not focused on the right problem. It is also important to determine whether existing environmental regulatory programs are keeping pace with a growing population and its needs.

Often, early in the evaluation, a priority problem will be identified for early action. This action can proceed while the rest of the evaluation continues. Once this evaluation has been completed, the Management Conference summarizes the findings. These findings will help form the base of information needed to develop additional control strategies and to recommend initiatives.

Characterization Report

The characterization report or series of problem-specific characterization reports is a public education tool. Because it describes the estuary's problems objectively and lays out a range of potential solutions, the report must be widely read and understood. Scientific and technical findings and reports must be summarized in lay terms and presented clearly, using fact sheets and visual aids. The citizens advisory committee and public participation staff should be enlisted to help make the characterization report meaningful to the citizenry. The report's findings should also be presented at meetings and workshops for the public and for the mass media.

The characterization report tells the story of the state of the estuary. It describes both spatial and temporal changes that have been caused by human activity; natural climatic, biological, and physical changes; and occasional major natural events. The report highlights the way the estuary used to be, the way it is today, and the way it might become if current trends continue.

Population trends are an important part of the report. Significant population growth usually leads to increased withdrawal of fresh water. Population growth also results in additional needs for sewage treatment; greater runoff from paved surfaces, construction, and agricultural activity; and more pollution from commerce and industry.

> The characterization report is a public education tool . . . that sets the stage for the formulation of the CCMP and its action plans.

The characterization report describes changes in land-use patterns, such as reductions in cropland, pastures, and forested areas. Water quantity and flow levels needed to sustain important resour-

ces may also be addressed in the report. Hydrological information will be included. There may no longer be a free exchange of fresh and ocean waters. Pollutants may be trapped in the estuary, accumulating and changing the balance and function of the ecosystem. The report describes the estuary's major problems and suggests possible solutions based on objective evidence.

Besides depicting the physical, chemical, and biological state of the estuary, the characterization report assesses whether existing institutional mechanisms are appropriate in light of the estuarine system. The report addresses current laws, regulatory programs, and governmental and nongovernmental institutions, pointing to gaps and needs for new authorities and efforts. It may suggest a more strenuous set of standards and criteria, stepped up enforcement actions, or even a new regulatory agency.

The characterization report sets the stage for formulating the CCMP and its action strategies. Therefore, all participants in the Management Conference must be fully informed. They must understand the story the report tells and its implications for the future.

Chapter IV

The Comprehensive Conservation and Management Plan

A Blueprint for Action

The Comprehensive Conservation and Management Plan, developed by the Management Conference, is a blueprint for restoring and maintaining an estuary. It identifies the most pressing problems in an estuary and establishes goals and objectives for resolving them. The CCMP prescribes specific actions to protect and enhance the estuary and its water and sediment quality, living resources, and surrounding land and water resources.

> Section 320(b) of the Water Quality Act of 1987 directs Management Conferences to develop "a comprehensive conservation and management plan that recommends priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution to restore and maintain the chemical, physical, and biological integrity of the estuary, including restoration and maintenance of water quality, a balanced indigenous population of shellfish, fish and wildlife, and recreational activities in the estuary, and assure that the designated uses of the estuary are protected . . . ."

Developing a Comprehensive Conservation and Management Plan

The first task of the Management Conference is to summarize the characterization findings in "plain English." Characterization describes the estuary's problems and, where possible, links problems to causes and sources. It includes an analysis of institutions and geographical impacts for each problem that will be addressed. The conferees may then debate the merits of each problem and determine which ones will be the focus of the CCMP. These are called priority problems.

Characterization findings form the basis for developing the environmental quality goals and objectives that each Conference establishes for the estuary. Once these goals and objectives have been set, the Conference develops specific action plans to achieve them.

The action plans, which are the core of the CCMP, may address water and sediment quality, living resources, land and water resources, population growth, public access, or governance. They may focus on toxicants, pathogens, eutrophication, habitat loss or modification, another specific problem, or even a cause. Implementation activities are built into the action plans. Some action plans may be developed early, before the rest of the CCMP is developed, in response to a known priority problem. In fact, a CCMP could be, in effect, a series of action plans.

Implementing action plans is the key to estuary cleanup. To help ensure implementation, therefore, the following steps are recommended for developing the CCMP:

- Disseminate and discuss the characterization findings with affected parties in the watershed.
- Continue public information and involvement efforts to ensure support for the CCMP.
- Integrate and coordinate all activities for CCMP development and implementation; work with affected jurisdictions, agencies, and programs.
- Select, by Conference consensus, priority problems to be addressed in the CCMP.
- Establish, by Conference consensus, environmental quality goals and objectives for the estuary.
- Evaluate and select management activities.
- Prepare action plans for controlling pollution and managing resources.
- Secure commitments to implement action plans.
- Periodically review, evaluate, and redirect efforts as necessary while action plans are being carried out.

Components of a Comprehensive Conservation and Management Plan

The centerpiece of the CCMP consists of action plans for attaining the goals and objectives set by the Management Conference. Figure 4.1 depicts the relationship among the CCMP components and the process the Management Conference should use to conduct an estuary program. Table 4.1 presents the essential components in a CCMP.

Table 4.1.—CCMP Components

- **"Plain English" summary of the characterization findings**
- **Statement of priority problems to be addressed in the CCMP**
- **Environmental quality goals and objectives for the estuary**
- **Actions plans for achieving goals and objectives**

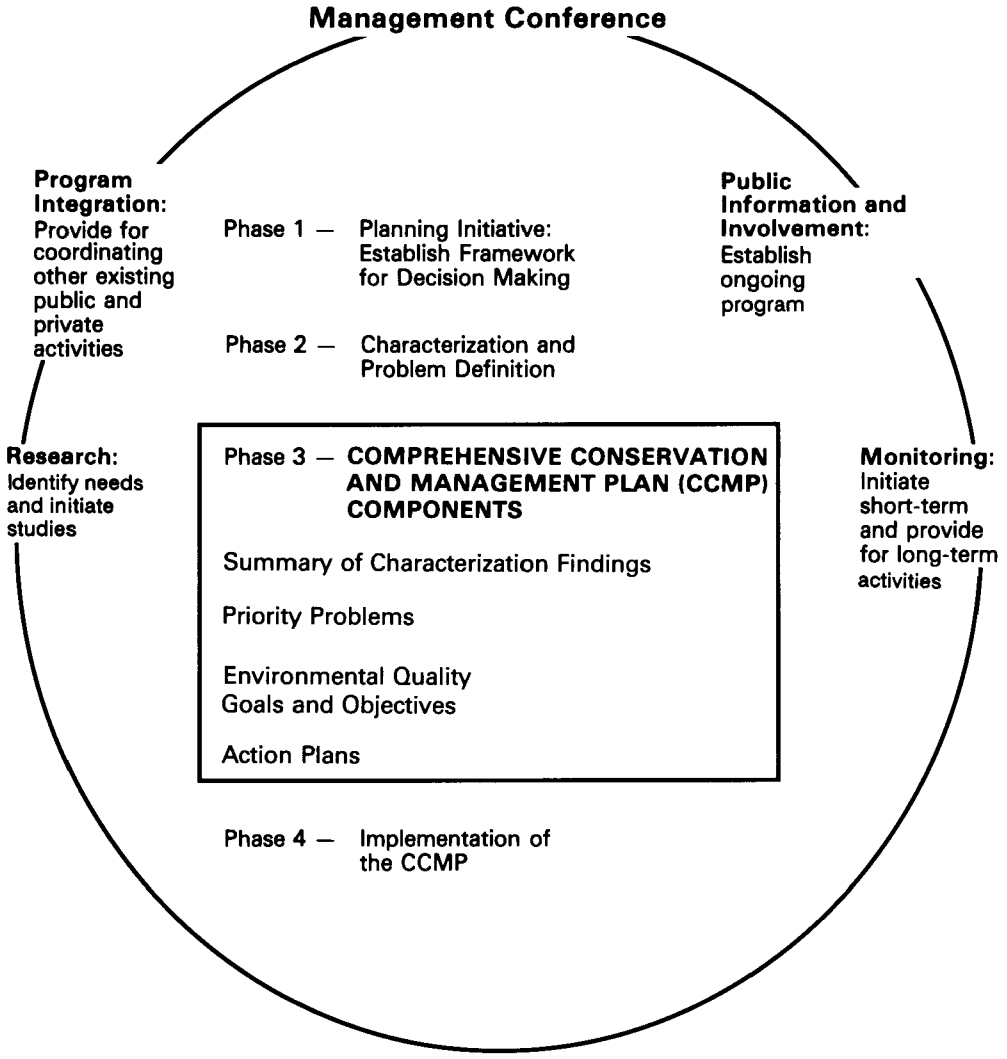

Figure 4.1 Relationship Among the CCMP Components and the Management Conference Process.

A Summary of the Characterization Findings

The characterization report developed during Phase 2 describes the estuary's current condition, historical trends, and projected future conditions (Chapter III). A summary of the report's findings is an important part of the CCMP. The summary highlights the most significant problems in the estuary. Subsequently, action plans will be directed toward abating one or several of these problems. The summary is also an important tool for public education and participation. It is a springboard for building consensus for the CCMP and its implementation. Characterization summaries may take the form of issue papers or fact sheets on one or several key problems. Whatever the form, however, it is critical that the public understand and accept the problem as real and needing to be addressed.

Priority Problems Addressed in the CCMP

Although the characterization report may include all the problems that were identified in the estuary, the Conference must select those that the CCMP will actually address. This selection process entails considering costs and benefits. It also requires assessing the length of time for problem resolution and the likely success of efforts. Using the criteria in Table 4.2, the conferees then rank priority problems. After conferees have developed and recommended a remedial course of action for the highest ranked problems, other problems can be addressed.

Table 4.2.—Selection Criteria for Priority Problems

- **Does the problem affect a number of resources and/or uses of the estuary?**
- **Does the problem adversely affect public health?**
- **Does the problem have a systemwide impact?**
- **Does the problem have a number of major local impacts of high priority to the general public?**
- **Is the problem of great concern to the public, major users, and political leaders?**
- **Can the problem be corrected through timely institutional or regulatory mechanisms?**
- **Can the problem be controlled at reasonable cost with existing technology?**
- **Does the problem require further research, thereby precluding immediate action?**

An obvious problem may be addressed early in the program, even before characterization. If the problem and a proposed action for adressing it meet the criteria set for an Action Plan Demonstration Project, funding can be sought from EPA. Such a project would have to demonstrate the effectiveness of a small-scale remedial strategy, while providing information that could be applied basin-wide. Another problem may be addressed because of early backing from a state legislature. But certain problems may be so complex that abatement or cleanup could consume all of an estuary program's resources. In these cases, the Conference should explore other funding sources. Some estuary programs may rely on creative financing, while others may redirect existing resources to a priority problem or tap funds held by Conference members. (Information on funding alternatives is included in Appendix E.)

Setting priorities requires great effort. After the characterization report has been released, the Conference holds workshops, meetings, and media briefings to educate all affected publics. The CAC, LGC, and STAC explain the characterization findings, and the management committee hears the concerns of citizens groups, local officials, users, and the regulatory community.

Figure 4.2 depicts a problems/causes matrix used to help present the characterization findings. It identifies problems and causes typically found in an estuary. The matrix may be a useful tool for explaining problems and determining priority problems.

	POINT SOURCES						NONPOINT SOURCES										OTHER					
Causes / Problems	Industrial Sources-Direct	Industrial Sources-Indirect	POTW's	CSO's	Storm Water	Animal Feedlots	Agri-culture	Urban	Mining	Silvi-culture	Construc-tion	Septic	Landfills	In-Place Sediments	Atmo-sphere	Ground Water	Shipping & Marinas	Dredging Operations	Shoreline Develop	Freshwater Flow	Sea-Level Rise	Other
Toxicants																						
Pathogens																						
Eutrophication																						
Habitat Loss/ Modification																						
Changes in Living Resources																						
Other																						

Figure 4.2 National Estuary Program Problems/Causes Matrix

Based on public feedback and other selection criteria, the management committee then recommends which priority problems should be the focus of the CCMP. The policy committee is responsible for adopting management committee recommendations and for securing commitments of local, state, and federal resources to solve the problems. A well-presented and understandable characterization report and summary documents can help to enlist these critical commitments.

Environmental Quality Goals and Objectives for the Estuary

When Congress established the National Estuary Program under the Water Quality Act, it mandated the restoration and maintenance of the nation's estuaries. The law provides that estuarine productivity is to be assured, and the needs of an array of users are to be accommodated. The Management Conference is charged with achieving this intricate balance by setting broad environmental quality goals that comply with the mandate of the Act and should reflect the will of the people.

Goals, Objectives, and Action Plans

GOALS are broad, long-term aims the Management Conference sets for the estuary.

OBJECTIVES are more specific, shorter-term targets for attaining goals.

ACTION PLANS are detailed programs for meeting goals and objectives, indicating who, what, where, when, and how the plans will be carried out.

Setting Goals

Goals are usually long term and broad in scope. The Conference establishes overall goals related to the desired condition for the estuary and its segments. To determine what goals the public wants to attain and will support, the Management Conference presents options for public discussion. These may range from maintaining current conditions to restoring the estuary to a past condition, or to restoring or maintaining pristine quality.

In one tributary where whitewater sports are popular, for example, the goal might be to maintain a pristine condition. In an industrialized segment, it might be to maintain the current condition by preventing further degradation. In yet another segment, the goal might be to restore wetlands to a previous, healthier condition.

Setting goals requires the public to understand the effects of population growth. Everyone must be aware that the needs of a growing population increase pollutant loads, foster industrial and commercial development, and create additional demands on water use. The consequences of population growth may be habitat modification and further environmental degradation.

Environmental quality objectives, unlike goals, are specific and shorter term. They are aimed at achieving broader, longer term goals. Achievable through the implementation of specific action plans, objectives generally reflect the environmental criteria, the preferred uses, or the elimination of use impairments that the Conference considers appropriate and desirable for various estuarine segments. Objectives undoubtedly will vary from one segment to another. Typically, they are established on the basis of preferred uses, standards, and permit activities to improve water quality. But objectives may also be based on changes in environmental indicators, such as diseased fish.

One of the goals in the Chesapeake Bay Program, for example, is to reduce point and nonpoint sources of pollution to improve water quality, thus sustaining the bay's living resources. Some 16 objectives have been set to reach that goal. Included is a commitment from Maryland, Virginia, Pennsylvania, and the District of Columbia to develop, adopt, and implement a basinwide plan that would reduce, by 40 percent, the nutrients entering the bay. Actions to meet this objective by the year 2000 began in 1988.

The Puget Sound Water Quality Authority provides another illustration of setting goals and objectives. One of the Authority's long-term goals is to protect consumers of shellfish from contaminants, maintain and enhance the abundance of shellfish, and control pollution so that closed shellfish beds can be reopened and additional closures prevented.

To safeguard consumers and shellfish, the Authority has set specific objectives and taken action to achieve them. Attaining one objective, the Puget Sound Authority is developing stormwater control programs that will reduce pollutant loadings from stormwater and combined sewer overflows. Besides instituting pollution control programs to protect and restore shellfish, it is testing for toxicants in certain shellfish beds. The Authority is also extending monitoring and certification efforts. In addition, it is attempting to further public education and involvement in the protection of shellfish, and to identify funding sources for shellfish protection programs. The Authority aims at prevention, not just remediation.

Action Plans for Controlling Pollution and Managing Resources

To help achieve environmental goals and objectives, the Management Conference develops action plans directed toward specific priority problems. Action plans may address the management areas, as shown in Table 4.3, or problems or causes such as those on the matrix in Figure 4.2. An action plan for a known problem may be implemented before the full CCMP is developed and adopted, but it is still considered a part of the CCMP. A CCMP usually contains more than one action plan.

Table 4.3.—Focus of Action Plans by Management Area such as:

- **Water and sediment quality: pollution abatement and control. Action plans focus on point and nonpoint sources.**
- **Living resources management, including specially protected areas. Action plans focus on protection and restoration.**
- **Land use and water resources management. Action plans focus on set asides as well as special protective legislation and initiatives.**
- **Population growth. Action plans may address local zoning restrictions or sewage treatment hookups.**
- **Public access. Action plans may focus on zoning, pier and beach use, and shoreline development requirements.**
- **Governance. Action plans focus on new and existing institutions or creative management.**

As the Management Conference designs the CCMP, it will consider the universe of management activities to meet its goals and objectives. Because water management problems are widespread, programs around the country have tried various measures to tackle problems. Many of these measures have worked successfully. The National Estuary Program handbook, *Saving Bays and Estuaries: A Handbook of Tactics,* describes various methods estuary programs have used to manage specific environmental problems. This handbook, available from the EPA Office of Marine and Estuarine Protection, is designed to provide assistance to Conferences as they assess and select management activities.

The steps to follow in preparing an action plan appear in Table 4.4. At least one specific action plan should be developed for each problem the Conference elects to address. Examples of action plans addressing typical problems are presented in this chapter.

Table 4.4.—Action Plan Steps

1. **State the problem, identifying the probable causes and sources.**
2. **State the program goals related to the problem, source, or cause.**
3. **Set specific objectives to attain the goals.**
4. **Determine the universe of possible management activities, both new and existing, for consideration.**
5. **Select the activity that will work, that the public will support, and that can be implemented within reasonable time and resources.**
6. **Establish specific action plans needed to abate and control the problem or protect the resource. Each action plan addresses:**
   - **WHO: Identify who will act, pay, and enforce; spell out roles and resource commitments for each participating agency, institution, and enterprise.**
   - **WHAT: Describe what will be done. For example, specify numerically based load reductions and use designations in this location; describe what specific activities are necessary to reach them.**
   - **WHERE: Describe the location this action will affect.**
   - **WHEN: Include schedules.**
   - **HOW: Outline the procedure used to perform this activity.**
   - **HOW MUCH: Cost-out the action and from where the funding will come.**
7. **Implement and monitor results.**
8. **Report on progress, costs, and results.**
9. **Review, re-evaluate, and redirect as needed.**

Table 4.5.—Steps in Approaching Action Plans

- **Identify problem of concern ---> Set objectives aimed at causes or sources.**
- **Assess source control programs ---> Improve programs through additional actions.**
- **Review laws and regulations affecting problem ---> Enforce, modify, propose new ones.**
- **Examine institutions ---> Improve management.**
- **Review designated uses ---> Revise to protect human health, water and sediment quality, living resources, and other concerns.**
- **Consider universe of management activities ---> Select highest ranking activities.**
- **Develop action plans ---> Set schedules; get commitments.**
- **Prepare a funding strategy ---> Determine costs and funding sources.**
- **Implement ---> Monitor, review, revise, refine, and redirect as necessary.**

Approaches to Action

As stated above, some action plans may focus on management areas such as water and sediment quality, living resources, land use, water resources, population growth, public access, or governance. Others may address specific pollution problems and their causes or sources. Each estuary may take a different approach, yet still develop an action agenda that solves a similar problem. It is best to consider, through "brainstorming," a myriad of approaches and actions. Also, consider any negative impacts one approach might have on another resource. The bottom line, however, is mitigating the problem and restoring the estuary's health. Table 4.5 outlines a general approach that may be used.

Controlling Point and Nonpoint Sources

To suggest an approach to improved water and sediment quality, consider the full range of point and nonpoint source controls. Point sources of pollution, which expel nutrients, toxics, suspended solids, and microorganisms, usually are abated by limiting the discharge under the National Pollutant Discharge Elimination System (NPDES) permit program. This program requires pretreating effluents, upgrading treatment technology, reducing concentrations of pollutants in the effluent, and properly maintaining and operating all equipment at both municipal and industrial plants. Improved management and enforcement of permit programs will most likely be important for controlling point source loadings in an estuary.

Like point sources, nonpoint sources consist of nutrients, toxics, sediments, and bacteria. Instead of being discharged from an outflow pipe of an industrial or sewage treatment plant, however, these pollutants run off the land. Nutrients and toxics usually come from agricultural land and from urban streets. Sediment is eroded from agricultural and urban sources and from construction sites. Animal and human wastes contribute to high bacterial levels. In addition, groundwater discharges may contain contaminants.

Many management practices can be used to control nonpoint sources of pollution. Referred to as best management practices, they range from planting cover vegetation and forests to reducing

the use of lawn fertilizer in urban and suburban neighborhoods and cleaning city streets. They may also include requiring NPDES permits for sources not traditionally considered point sources. Construction activities, animal feedlots, storm drains, car washes, and laundry facilities, for instance, may be issued permits. In addition, EPA is issuing stormwater permitting regulations and a national combined sewer overflow (CSO) permitting strategy.

Protecting Living Resources

A Management Conference should look at as many management options as possible if living resources management is a goal. An estuary's living resources range from fish and their spawning habitat to microscopic phyto- and zooplankton at the bottom of the food chain. Waterfowl and marshlands adjacent to the estuary are also estuarine resources.

Through the public participation program and the scientific characterization effort, the Management Conference determines which natural resources are of greatest public concern and which ones are critical to maintaining and restoring the stability and diversity of the ecosystem. The public often measures an estuary's health by the state of its living resources. Citizens may voice concern, for example, if a particular living resource like striped bass, oysters, or waterfowl is declining. An action plan can be directed to this popular resource, while contributing to the enhancement of the estuarine system.

Declines in living resources usually indicate a greater problem; therefore, the cause must be determined. Poor water quality is often the reason. Destruction of habitat or modification of spawning, nursery, and forage areas also stresses fish and wildlife. Overfishing and overharvesting, along with natural climatic changes and disease, may further affect living resources.

Generally, the causes of a declining species or altered habitat are complex. Although some causes may have been identified during characterization, others may require additional study. In any case, because the recovery period for living resources is long, interim steps aimed at suspected causes may be in order. Additional actions can follow once the actual causes have been discovered.

The preservation of living resources may require using an array of protective strategies. It may be necessary, for example, to control commercial and recreational catches. Wildlife and wetlands or other habitats may also need immediate protection.

Enhancement strategies may be considered to supplement protective strategies. These include stocking hatcheries, planting wetlands or underwater grasses, and initiating aquacultural programs. Obviously, such enhancements will require water and sediment of acceptable quality.

In its planning to protect and restore living resources, the Conference should also consider special protection areas, such as those set aside under federal, state, regional, and local programs. Some waters that have exceptionally significant recreational or ecological features may warrant special protection. Antidegradation policies may be developed for these waters. Other measures to protect exceptional areas include setting higher standards, severely restricting waste inputs, designating no-discharge areas,

or limiting shoreline development. Such areas may be slated as high priorities for study and monitoring.

Protection and enhancement of living resources require public understanding, not only of what is happening to the resource and why, but of the time necessary for recovery. The ecosystem's response to improvements will not occur overnight. Organisms will need time to re-establish themselves through natural propagation or through human intervention like developing aquaculture or hatcheries. The quality of the estuary will, however, have to be able to sustain living resources.

After the Conference has reviewed and selected management activities, it designs, writes, and enacts action plans. To protect and enhance a living resource such as submerged aquatic vegetation, an action plan will likely address improvements in water and sediment quality first. Replenishing grasses can then be considered. Table 4.6 outlines a preliminary plan of action to correct the loss of submerged grasses.

Table 4.6.—CCMP Action Plan Outline for Loss of Submerged Aquatic Vegetation

PROBLEM	**Loss of submerged aquatic vegetation in two major tributaries due to increased turbidity and sedimentation from nonpoint sources.**
PROGRAM GOAL	**Restore submerged aquatic vegetation beds to 1950 levels in identified tributaries.**
OBJECTIVES	**Reduce nonpoint source nutrient and sediment loadings to each tributary.**
	Re-establish submerged aquatic vegetation where water quality and clarity are sufficient to support it.
CCMP ACTIONS Within One Year:	**Survey tributaries and identify areas where water and sediment quality is sufficient to support submerged aquatic vegetation.**
	Identify groundwater discharges impacting the estuary.
	Identify tributary segments with highest nonpoint source loadings of nutrients and sediments.
	Develop a nonpoint source control program for each segment, setting targets for load reductions.
Within Two Years:	**Develop and implement revegetation programs for selected segments.**
	Develop and implement systemwide survey methodology for submerged aquatic vegetation.
	Conduct annual surveys.
Within Three Years:	**Full implementation of nonpoint source control program for selected segments.**
	Monitor segments for improvements in water quality.
LEAD RESPONSIBILITY	**State department of natural resources and water pollution control agency.**
COOPERATING AGENCIES	**Environmental Protection Agency, Soil Conservation Service, and Fish and Wildlife Service.**
RESOURCES	**Public and private organizations to conduct annual surveys of submerged aquatic vegetation to supplement aerial surveys.**
	$500,000 annually for revegetation program committed by state legislature.
	Redirection of existing resources and new funding of nonpoint source abatement and control programs in selected tributaries, agreed to by state/EPA. SCS to target special control projects in key tributaries.

Table 4.7 CCMP Action Plan Outline to Protect Wetlands*

PROBLEM	More than half of the wetlands along the coasts and riverbanks of Puget Sound have been destroyed by human activity: primarily agriculture and industrial activity and commercial and residential development.
PROGRAM GOAL	To ensure that the most important wetlands of the Puget Sound Basin are preserved in perpetuity and that degradation of other valuable wetlands is minimized.
OBJECTIVES	1. Identify those critical wetlands that should be preserved and either purchase or, through another mechanism, safeguard them. 2. Require local governments to develop local wetland protection programs that meet state standards. 3. Develop and implement a program to protect wetlands on state-owned uplands and aquatic lands. 4. Develop and implement a long-range wetlands education strategy.
ACTION #1:	Criteria Development and Program Planning
Who:	Department of Ecology (lead); Departments of Natural Resources, Fisheries, and Wildlife. A work group representing government and a balance of key citizen interests is evaluating funding sources.
What:	(a) Prepare detailed criteria for selection of wetlands to be preserved. (b) Evaluate techniques and mechanisms for their preservation such as acquisition, conservation easements, transfer of development rights.
When:	Criteria and techniques for preservation by 9/88; marine and estuarine components by 12/89.
ACTION #2:	Identification of Wetlands to Be Preserved
Who:	State agencies.
What:	(a) Develop preliminary list of already identified wetlands. (b) Identify additional areas meeting criteria set in #1. (c) Hold public workshops to educate and encourage citizens to participate in selection process.
When:	Final list by 4/90.
ACTION #3:	Wetlands Preservation
What:	(a) Develop management standards. (b) Prepare a preservation strategy for each site.
When:	Initial acquisitions by 8/88; site strategies by 12/90.
ACTION #4:	State Rules for Wetlands Protection
What:	Develop rules prescribing minimum standards for local wetlands, including schedules.
When:	5/89.
ACTION #5:	Local Program Development
ACTION #6:	State Wetlands Protection
ACTION #7:	Wetlands Education
PROGRAM COSTS	$4.7 million in FY 1990; $3.9 million in FY 1991; approximately $3.5 million a year thereafter. It is estimated that wetlands acquisition, the greatest portion of these monies, will cost about $2.5 million each year and could be financed from bond sales, state capital construction budget, and other sources identified by the working group.

*For complete plan, see 1987 Puget Sound Water Quality Management Plan.

To manage the use of land and water in the watershed, the Conference must determine why these resources are being adversely affected and how to prevent further major loss. Natural causes may be responsible for some of the loss. Other forces beyond the Conference's control, such as overwhelming demands from dramatic growth in population, may be the cause. A serious drought in a watershed with an already overextended supply of surface water may take many years to overcome. Planning ahead may help to reduce additional losses of land and water resources. In Puget Sound, for example, the loss of wetlands from human activity is a major concern. To preserve the remaining wetlands, the Puget Sound program is taking actions as briefly outlined in Table 4.7.

The Management Conference can use existing regulatory programs and other mechanisms to control land and water uses. Among those worth considering are federal, state, and local special protective laws and set aside programs that employ provisions of the following legislation and programs:

- Clean Water Act Section 208 planning, Section 303 designated use authority, and Section 404 permitting authority;
- Wild and Scenic Rivers Act;
- Endangered Species Act;
- Marine Protection, Research, and Sanctuaries Act;
- Historic Preservation Act;
- 1985 Farm Bill "swampbuster" provisions;
- Private and public land banks, including agricultural easements, conservation easements, wildlife refuges, and parks;
- Groundwater strategy;
- Critical, exceptional, or sensitive areas protective legislation;
- Wellhead protection program;
- Local zoning ordinances; and
- EPA and state antidegradation policies for water quality.

If, for example, freshwater inflow has been identified as a problem in the estuary, initiating conservation measures, developing reservoirs, or eliminating freshwater diversion to maintain minimum flows may be useful. Estuaries must often compete for fresh water. Needs for municipal water, hydroelectric power, and agricultural irrigation projects must be balanced against the needs of an estuary.

Because the nation's population is growing rapidly in coastal areas, it has become increasingly necessary to plan to protect land and water resources. Unless protective measures are adopted, population pressure and changing land use patterns undoubtedly will lead to further degradation of these resources.

In addressing problems of population growth, public access, or governance, all conceivable management and regulatory ap-

Table 4.8. CCMP Action Plan Outline for Controlling Metals: Copper, Nickel, Lead

1. State the problem, identifying the probable causes and sources. (The matrix was used to help select the problem.)
   - Elevated levels of copper (Cu), nickel (Ni), and lead (Pb).
   - Environmental indicator--quahog tissue.
   - Cu levels are believed to be from background, plumbing, and point sources; Ni from electroplating, POTW, and two tributaries; Pb from CSOs, URO, POTWs, and perhaps atmospheric deposition.
2. State the program goals related to the problem, source, or cause.
   - To reduce levels enough to meet public health-based standards.
3. Set specific objectives to obtain the goals.
   - To eliminate CSOs.
   - To tighten the pretreatment program.
   - To set load reductions (such as by 70% by 1995).
4. Determine the universe of management strategies, both new and existing, to consider.
   (The following list might represent the result of brainstorming exercises with committees. It includes existing programs and new initiatives.)
   - 304(l) program (toxics control strategy)
   - hazardous waste disposal program
   - national CSO strategy
   - regional/local CSO strategy
   - stormwater management regulations
   - legislated load strategy
   - tax on dischargers
   - pretreatment program enforcement
   - tax on leaded gas
   - low-cost loans for upgrading factories
5. Select the activity that will work, that the public will support, and that can be implemented within reasonable time and resources.
   (The following are selected as part of a major public participation effort.)
   - Enforce existing pretreatment permits.
   - Create a CSO permit program.
   - Legislate a surtax on leaded gas.
6. Establish specific action plans needed to abate and control the problem or protect the resource. Each action plan addresses:
   WHO: Identify who will act, pay, and enforce; spell out roles and resource commitments for each participating agency, institution, and enterprise.
   - Environmental regulatory agency with oversight authority for POTWs CSOs.
   - State legislature (Agency would draft model law, working with oil industry and station operators; or, petition to referendum): Tax on gas.

   WHAT: Describe what will be done. For example, specify numerically-based load reductions and use-designations in this location; describe what specific activities are necessary to reach them, including random monitoring and spot checking on effluents.
   - Develop a schedule and monitor compliance with pretreatment: CSOs.
   - Pass law: Tax on gas.

   WHERE: Describe the location this action will affect.
   WHEN: Include schedules.
   HOW: Outline the procedure used to perform this activity.
   HOW MUCH: Cost-out the action and from where the funding could realistically come.
   - Develop estimates, such as $5 million over five years, using costs above and beyond normal compliance and oversight costs.
7. Implement and monitor results.
   - Implementation would be ensured by signed agreements between the RA and the Governor.
   - Monitoring would include streams as well as larger receiving waters.
8. Report on progress, costs and results.
9. Review, re-evaluate, and redirect as needed.

proaches should be considered. Then, as part of a public forum, determine what will work, what the public and political climate will bear, and what can be implemented within reasonable time and resources.

The Management Conference may use an instrument, such as the problems/causes matrix in Figure 4.2, to help determine the focus of an action plan. This kind of tool may be useful in presenting to the public a range of problems and causes or sources for the selection of issues to address. For instance, the matrix may help focus attention on the adverse impacts caused by toxics, organics, or metals.

At a September 1988 workshop, for example, a group of estuary program managers assisted Narragansett Bay project leaders in developing a preliminary action plan. Using the matrix as a starting point, the group selected an attack on high levels of copper, lead, and nickel for a plan of action. The group prepared the sample, preliminary action plan that appears as Table 4.8. This action plan is being considered to help set the stage for the development of an actual plan by Rhode Island citizens and agencies. Although the action plan outline focuses on metals, it can be adapted for any pollutants.

Whatever approach is taken to develop actions, it is essential that the public and local governments participate actively. A brainstorming process is one suggested method for involving small groups of people in identifying and setting priorities for management or regulatory actions. Other community involvement processes and techniques, such as workshops, charettes, and conferences, can be used as well. However, those who will ultimately pay to implement actions will need to be part of the process and accept the actions.

After the CCMP is approved by the Management Conference, it must be submitted for the approval of the EPA Administrator and the state governor.

Chapter V

Implementing the Comprehensive Conservation and Management Plan

Every estuary program strives for the ultimate goal of restoring the estuary to a better condition. The process described in this Primer is designed to meet this end. But, even if everything is done right, CCMPs themselves will not protect and restore the estuary. The CCMP actions must be implemented.

Throughout this document, public involvement and support have been stressed. Political commitments have been emphasized. It has been stated that each action plan must identify who pays. These are the keys to implementation.

Funding

Implementation must be built into each action plan. However, implementation need not wait until a formal CCMP is submitted and approved by the EPA Administrator. If an action receives community support and funding can be secured, then implementation should begin. Implementation of an action should proceed at any point in the process that is possible, legally supportable, and makes sense. Implementing an action can be a local, state, or federal decision. Funds can come from a court settlement, a state or federal appropriation, or even private sources. Creating funding sources can be a challenge in itself. To ensure funding, however, a funding strategy should be part of the CCMP or each action plan. (Appendix E addresses funding alternatives.)

A Plan for Public Information and Involvement

This primer has stressed the importance of informing and involving the public throughout the life of the estuary program. To ensure public participation, a well-designed public participation strategy needs to be developed as an outgrowth of early Management Conference activities. The strategy should present ways to inform the public. It should describe methods for soliciting the concerns and opinions of affected persons and organized groups essential to the collaborative problem-solving and decision-making processes. It should be designed to mobilize support for the CCMP and its implementation.

The Water Quality Act, in fact, specifically mandates that public participation must be provided for, encouraged, and assisted by EPA and the states. In an estuary program, opportunities to inform and involve the citizenry occur through the CAC, but are broadened by a public participation program that develops educational materials, conferences, workshops, and public meetings.

Public acceptance, or informed consent, is necessary for CCMP implementation. The public, after all, pays for cleanup. Public pressure helps to ensure that federal, state, and local commitments for program implementation are met. Moreover, restoration and maintenance of an estuary is a long and arduous task. It requires public appreciation of the estuary's value for the citizens of today and tomorrow. (For guidance on how to develop a public participation program, see Appendix B.)

Program Integration and Coordination

The key to successful implementation of the CCMP may well be the influence of the EPA Administrator, affected state governors, and local elected officials. Through their efforts, the expertise and resources of other governmental programs — at federal, state, and local levels — can be applied to this effort. But these officials cannot carry the burden alone.

During all four phases of an estuary program, coordination among jurisdictions, agencies, and existing programs is vital. This is particularly important when responsibility for devising action plans is assigned. The Water Quality Act specifically requires that plans be drawn for coordinated CCMP implementation by the states as well as by federal and local agencies participating in the Conference. Each action plan, therefore, not only delineates roles and responsibilities for Conference participants, but also provides for the resource commitments to carry out the plan.

A specific role has been assigned under the Act to the National Oceanic and Atmospheric Administration (NOAA). At the EPA Administrator's request, NOAA is authorized to conduct monitoring and research activities. Although the Act does not specify roles for other federal agencies, they may also be involved in estuarine protection.

In addition, many federal statutes address this concern. Among them are the Marine Protection, Research, and Sanctuaries Act; Coastal Zone Management Act; Fisheries Conservation and Management Act; Resource Conservation and Recovery Act; 1985 Farm Bill; Safe Drinking Water Act; Clean Air Act; and Comprehensive Environmental Response, Compensation, and Liability Act (known as Superfund).

State laws and regulatory programs also affect the restoration and maintenance of estuaries. Many counties and other local subdivisions are engaged in similar efforts as well. Each estuary program identifies and includes local, state, federal, and nongovernmental programs that are or could be involved in this effort. The CCMP must consider, however, already established regulatory time frames, such as NPDES permit review cycles.

Each Management Conference evaluates all the existing environmental control programs affecting the estuary to be sure they are consistent with the goals and objectives set for the estuary. This evaluation, which begins during the characterization phase, leads to the identification of mechanisms that may enhance each program's effectiveness. On the other hand, an assessment of existing programs may indicate that environmental quality cannot be achieved without major new activities or programs, laws, or institutions. An evaluation assumes the cooperation of all agencies; its results may depend upon it.

Periodic Review, Evaluation, and Redirection

As implementation of an action plan proceeds, each activity is reviewed, evaluated, and redirected as necessary. Therefore, a schedule for Management Conference review, evaluation, and redirection of action plans is built into the CCMP. As each activity is reviewed, crucial data resulting from scientific research and monitoring are considered.

Generally, data gathering, research, and monitoring are initiated during the characterization phase since new and existing information is required to identify estuarine problems and their causes. For some problems, scientific activities may continue for years. The CCMP action plans, therefore, should specify what additional research is needed. CCMPs should also provide for ongoing monitoring. The Water Quality Act requires monitoring of all implemented actions to determine their effectiveness. Monitoring, therefore, goes hand-in-hand with implementation.

Establishing a Monitoring Program

Monitoring needs are identified as part of each action plan. As actions are implemented, monitoring begins. Monitoring, which is an essential part of the review and evaluation process, continues throughout the implementation phase to measure effects of actions and indicate any new trends. Results of monitoring may demonstrate a need to redirect efforts.

Although the states are primarily responsible for monitoring results of actions, the Management Conference may ask for EPA's assistance. EPA may, in turn, enlist NOAA's support as provided under the Act. In addition, to assist in monitoring, citizens have been recruited by some programs. Appendix F describes citizen monitoring efforts.

Providing for Research

As noted earlier, research efforts in an estuary generally consist of applied science. Research may be short or long term. Some problems identified through characterization may require long-term research, while others can be alleviated through more immediate abatement activities. As research results clarify a problem, the Conference may initiate a new program or modify an existing effort. EPA, NOAA, other federal agencies, state and local governments, educational institutions, and various private- and public-sector groups may sponsor research.

Modifying the CCMP

Because the CCMP is a flexible management tool, it permits an estuary program to adapt to changing circumstances and to apply the lessons learned by experience. Some CCMP actions may be unsuccessful. New data may reveal unforeseen problems. Earlier assumptions may have been incorrect, and technological advance may enhance cleanup capabilities. The resolution of some problems will free resources to tackle others.

Furthermore, even though the CCMP is a document reflecting consensus, conflicts among jurisdictions, agencies at various governmental levels, and the public are inevitable. These will need to be resolved, possibly by modifying the plan.

Implementation

Scientific evidence and public backing are vital for estuary restoration and protection. Developing a comprehensive series of actions aimed at cleanup is also essential. But it takes money and political will to make cleanup and preservation a reality. As part of the CCMP, the Management Conference ensures that funding sources are identified and that participating parties commit their moral support, political muscle, and financial resources to implementation. Agreements to this effect are required. The Administrator's approval and the governor's concurrence lend additional importance to the CCMP. Funds authorized under the Act, along with state and local resources, further support CCMP implementation.

Implementation has been a recurrent theme throughout the primer. Action plans are essentially implementation activities, and may be initiated before the CCMP receives formal approval. In such cases, funding may come from the National Estuary Program, from Management Conference participants, or other sources.

Implementation of some CCMP activities will certainly take longer than the five years the Water Quality Act allocates for a Management Conference. Therefore, the Act provides that the Management Conference may be extended or reconvened to oversee implementation, redress problems, and address additional concerns. In reality, it may take decades to restore and maintain those unique and fragile resources: the nation's estuaries.

Appendix A

Federal Financial Assistance Under the National Estuary Program

This appendix of *A Primer for Establishing and Managing Estuary Projects* provides guidance on how to apply for and process federal assistance agreements. The Primer, which describes the National Estuary Program's origins, statutory provisions, and approach, is designed for EPA's programs and regional offices, coastal states, and other interested parties. For more information, contact an EPA regional office.

Applying for Assistance

Section 320(g) of the Water Quality Act of 1987 authorizes EPA to award federal financial assistance to develop Comprehensive Conservation and Management Plans (CCMPs) under the National Estuary Program. Projects geared to formulating CCMPs are described in five-year State-EPA Conference Agreements and in more specific Annual Work Plans developed by Management Conferences, which the EPA Administrator convenes. This appendix outlines guidance for eligible applicants and estuary program managers. It provides information on the following application and review procedures:

- Estuary work plans;
- Types of projects;
- Who is eligible;
- Types of assistance;
- Selection criteria;
- How to apply;
- Review process;
- Timeframes; and
- How to get more information.

Estuary Work Plans

Establishing long-term and annual estuary work plans ensures the efficiency and coordination essential to the collaborative problem-solving process of the National Estuary Program. This work planning mechanism encourages annual evaluations of current and projected activities so that long-term plans can be modified or redirected as necessary.

Five-Year and Annual Work Plans

EPA has established a three-level process to assist individual estuary programs with planning and oversight of their activities and to manage the funds available to the National Estuary Program. The first, highest level planning is presented in a Five-Year State-EPA Conference Agreement that is developed by each Management Conference shortly after it is convened. This Agreement sets out milestones to be achieved over the term of each program.

Based on this Agreement, the Office of Marine and Estuarine Protection (OMEP) sets budgetary targets for each Management Conference when the fiscal year budget for the National Estuary Program is announced. These targets are broad budgetary goals for total expenditure by each estuary program (including the National Estuary Program contribution). They are directly related to the activities that are to be carried out by each Management Conference in that year as specified in the Agreement. Given the possibility that required activities may change during the course of the characterization and CCMP development phases of the estuary programs, Management Conferences may request that OMEP reconsider targets agreed upon prior to the budget cycle.

Annual Work Plans—a middle level of planning—are developed by the Management Conference for each year using the budgetary targets. These Annual Work Plans present progress to date, indicate major program directions necessary to meet previously accepted milestones, document projects to be undertaken in the upcoming year, and specify funds to be used to support the projects. They also document the way in which 25 percent cost-share requirement will be met. Annual Work Plans are similar to, but not the same as, Assistance Agreements as outlined in EPA's "Policy on Performance-Based Assistance" (May 31, 1985).

At the most specific planning level, a series of individual assistance applications are prepared by potential recipients. On a project-by-project basis, these applications describe in detail the work to be done, who will do it, what will be accomplished and how, and the costs and schedule for the work. Assistance applications are essentially the same as other grant applications for EPA funds, but the National Estuary Program has certain additional requirements, mentioned below.

Development and Submittal of Annual Work Plans and Assistance Applications

The Annual Work Plan for each estuary program must be approved by the Management Conference before individual assistance awards can be made. They should be prepared within 60 days of the receipt of targets for that year. The Management Conference must submit a draft Annual Work Plan to EPA headquarters, through EPA regions, for review and comment before final ratification by the Management Conference.

Individual assistance applications may be developed at the same time as the Annual Work Plan, but should not be submitted until after the Annual Work Plan is approved by the Management Conference. Since assistance application award decisions will be made by EPA regions, applications should be sent to the appropriate EPA regional grants administration office.

It is necessary that each assistance application be endorsed by the Management Conference before approval is granted. This requirement ensures that the Management Conference has control over how funds are spent on an estuary. It also allows the Management Conference to direct the effort, ensuring that each project is consistent with the Conference's annual goals and objectives.

Evaluation of Annual Work Plans

Compilation of an Annual Work Plan allows each Management Conference to review its current activities in the light of its goals and past activities, and encourages direct focus on necessary activities for the year to follow. The Annual Work Plan should be the result of extensive planning and review by each of the Conference committees and should represent a consensus on directions to be taken.

The Management Conference's development of the Annual Work Plan should address these questions:

- Have successes and failures in the program been taken into account in planning the new year's activities?
- Is planned work consistent with the seven purposes of the Management Conference specified in Section 320(b) of the Clean Water Act?
- Is planned work directed towards meeting negotiated milestones contained in the Five-Year State-EPA Conference Agreement?
- Will individual projects obtain information necessary to further define problems or develop solutions?
- Are the problems addressed significant to the entire estuary?
- Is there a demonstration of the 25 percent program cost share?

Types of Projects

Among the projects eligible for federal financial assistance under Section 320(g) are research efforts, surveys, studies, modeling, and other technical work needed to develop the CCMP.

A variety of tasks will be required as part of developing the management framework, characterization report, and CCMP. It will be necessary, for example, to gather and analyze existing historical data from information previously collected in the estuary. Identifying the need for and conducting research to acquire new or additional data to address priority problems may also be relevant. Perhaps the task will be to increase regional public understanding about the problems and complexities of the estuary and to solicit public involvement during the decision-making and management processes. A review and evaluation of new initiatives in water and sediment quality programs and in living resource programs may be called for. All these types of projects are eligible for federal financial assistance.

Who Is Eligible

Eligible applicants include state, interstate, and regional water pollution control agencies and entities; state coastal zone management agencies; interstate agencies; other public or nonprofit private agencies; and institutions, organizations, and individuals. For-profit organizations are not eligible for direct grants or cooperative agreements under Section 320 (g).

Where Management Conferences have been convened for a particular estuary, the responsible EPA regional office can provide preapplication assistance. All proposals or work statements respond to the priority tasks identified in the estuary program approved Annual Work Plan, which the Management Conference develops. Each estuary program handles its own request for proposals. Proposals are submitted to the EPA regional estuary coordinator. Appropriate advisory committees within the estuary management organization and the EPA regional program will review and approve each proposal.

Types of Assistance

Federal financial assistance is awarded under two categories: cooperative agreements and grants. They differ only in the degree of federal involvement during the project. Cooperative agreements require substantial federal involvement. Grants do not. The application form must clearly indicate which type of assistance is being requested.

Because EPA's award of assistance under the National Estuary Program depends on annual congressional appropriations and Annual Work Plans developed by the estuary program Management Conferences, National Estuary Program grants usually are funded on a 12-month basis. However, an applicant may choose its project period and budget period in consultation with and subject to the approval of the EPA Regional Administrator. Applications for assistance must be submitted annually during EPA's designated application period.

Matching Funds

Federal funds provided under the Water Quality Act, Sections 320(g) and 205(l), to each estuary program must be matched, in proportion, by non-federal funds. OMEP requires that 25 percent of the total estuary program cost be provided from non-federal sources. Each assistance application must be accompanied by a copy of the approved Management Conference Annual Work Plan. The required format and content of an Annual Work Plan are specified in the National Estuary Program grant regulations. The work plan must show that non-federal sources provide at least 25 percent of the aggregate costs of research, surveys, studies and modeling, and other technical work necessary for the development of a Comprehensive Conservation and Management Plan.

In many cases, the recipient of an individual assistance award may not be required to provide matching funds for a project because these funds are being provided by a state or third party. Nevertheless, the recipient remains responsible for matching funds. If funds are not provided as specified in the Annual Work Plan, the recipient may either provide matching funds or return the federal funds received. In order to ensure that grant recipients have met cost-share requirements, each award will contain a special condition that requires submittal of a financial status report at the end of each fiscal year, September 30.

Review Under Executive Order 12372

The EPA Grants Administration Division has determined that the National Estuary Program projects are eligible for review under Executive Order 12372, "Intergovernmental Review of Federal Programs." For more information on the review process, applicants should consult their state's office or the official designated as the single point of contact. Because this is a 60-day review period, all applicants should seek such review well before EPA's required dates for final applications.

Cooperative Agreements

To ensure substantial EPA participation and oversight, assistance under the National Estuary Program generally will be awarded in cooperative agreements. Therefore, the scopes of work in cooperative agreements must describe what EPA's involvement will be, when and how it will be performed, and the person responsible for carrying out EPA's part of the work. These provisions should be negotiated between EPA and the applicant during preapplication assistance, before the formal application is submitted.

During the final application review process, EPA may also determine that further involvement is necessary. If so, these provisions will be added as "special conditions" before EPA offers the award.

Grants

Usually, awards under $10,000 may be made in the form of grants. Such grants still require products or deliverables or both. Schedules must be clearly established in the statement of work.

Selection Criteria

Each Management Conference will approve preapplication proposals in accordance with the proposal's technical merit and relevance to the objectives, projects, and tasks identified in the estuary program's annual work plan.

How to Apply

Applicants should obtain an application kit from their EPA regional grants administration office. The kit contains the application form and other relevant documents, including pertinent regulations. EPA's regional estuary program coordinator will provide preapplication assistance. The completed application should be submitted to the appropriate EPA regional program office for approval and award.

Statements of work in the final application must contain schedules for progress reports and products (including workshops and educational materials) that will contribute findings and recommendations for management decisions. They must provide for the presentation of project data and information in EPA prescribed formats. Data collected for the National Estuary Program must be submitted in the Ocean Data Evaluation System (ODES) format developed by OMEP. (For information, contact Marine Operations Division of that office.) Statements of work must also specify methods to ensure ongoing project coordination and problem resolution.

Because an informed public is so critical to the estuary programs' success, the National Estuary Program has established policy that requires presenting all products and information in a form and format the public can readily understand. To support this policy, all products must be submitted to the National Technical Information Service for additional distribution to the public. In addition, applicants must demonstrate that they have adequate resources to complete the tasks described to meet work plan objectives.

Review Process

The EPA regional program office will review final applications, with approved scopes of work, for funding. Basically, there are two levels of review. First, the estuary management and advisory committees, along with the EPA regional office, review proposals submitted in response to the Annual Work Plan. If a proposal is approved, the applicant submits a formal, more complete application to the EPA regional office. The regional office has the authority to approve the application for EPA funding.

Evaluation of Assistance Applications

After the appropriate estuary management and advisory committees have approved the proposal, the EPA project officer reviews the final application, making sure it is complete and meets program requirements.

Based on the information presented in each assistance application, EPA approves or disapproves each application on the following criteria:

- Are the work, schedule, and budget consistent with the Annual Work Plan?
- Has the proposed work been adequately reviewed by the Management Conference, Conference committees, EPA, and if appropriate, other peer reviewers?
- Is the effort proposed consistent with the products to be obtained?
- In the case of cooperative agreements, is there substantial federal involvement in the project?
- Is the organization performing the work qualified?
- Is the 25 percent non-federal cost share requirement of Section 320(g)(3) being demonstrated?
- Are schedules, progress reports, products and deliverables, and requirements for submitting project data adequate, in Ocean Data Evaluation System (ODES) format, and in machine-readable form?
- Will products contribute to the development of a CCMP?

Headquarters Program Grants

In addition to grants issued to support the development of CCMPs for individual estuaries, EPA issues grants to support the broader attainment of National Estuary Program goals and objectives. These grants are national in scope. They are reviewed and approved by OMEP at EPA headquarters.

Office of Research and Development Concurrence

Concurrence by the EPA Office of Research and Development (ORD) will be required at the regional level for all projects involving laboratory and field studies. Concurrence should be secured by the ORD representative, or designee, on the scientific and technical advisory committee. An ORD concurrence form is available from the EPA regional office. The ORD representative will:

- Make certain the project does not duplicate current EPA/ORD research projects or activities;
- Evaluate whether the quality of science in the proposal is adequate; and
- Determine whether the research protocols in the proposal are consistent with those ORD and EPA have established.

Quality Assurance/Quality Control Requirements

The "General Regulations for Assistance Agreements" (30 CFR Sec. 30.302 [d]) stipulate that quality assurance/quality control plans are required for any projects containing environmental measurements. Therefore, where appropriate, each application must include a quality assurance plan certification. Valid quality assurance/quality control plans must be in place and certified by the regional quality assurance officer before EPA will fund the project. (For further guidance, see the EPA report, "Guide for Preparation of Quality Assurance Project Plans for the National Estuarine Program.")

The EPA regional estuary coordinator should identify which projects require quality assurance/quality control plans and refer them to the regional quality assurance officer before the region approves the application for funding. Some projects, like historical data collection or public participation, may not require a plan. In these cases, the regional quality assurance officer will prepare a negative statement to be submitted with the application.

Checklist

A checklist identifying the critical elements of a complete application appears in Figure A.1. The final application form should contain an original signature. In addition, it should include a detailed breakdown of budget categories and the applicant's procurement system certification (EPA 5700-48). The application kit provides further information.

Timeframe

Although there is some flexibility in the annual cycle, OMEP encourages each Management Conference to adopt a cycle that allows for completing Annual Work Plans and assistance application review within the first quarter (by January 1) of each federal fiscal year (October 1 to September 30). A typical cycle calls for establishing program targets for total expenditure on each estuary program by October 15, submittal of draft Management Conference Annual Work Plans by December 1, and submittal of assistance applications by January 1.

However, the annual schedule depends upon the date on which OMEP is informed of its annual budget. For instance, sometimes Congressional appropriations are not made by October 1st. In such cases, OMEP will inform Conferences two weeks after the OMEP budget is appropriated. The schedule for that year would be delayed.

To be considered for fiscal year funding, completed applications must usually reach the EPA regional program office by June 1. Check with the regional program office for information about deadlines for submittal of applications.

Figure A.1—National Estuary Program Application Checklist for Assistance Agreements

	YES	NO	NA
Preapplication assistance provided by regional office			
Proposal approved for funding by the management committee (date)_____			
Proposal reviewed and approved by the scientific and technical advisory committee or designated work group (date)_____			
EPA application form (Standard Form 5700-33) (state and local agencies) or			
EPA application form 5700-12 (educational institutions and others)			
• Agency/organization name, address, and contact person, including phone number			
• Correct budget and project periods			
• Proposed funding dollars correct: appropriate federal cost share (75 pecent) and non-federal cost share (25 percent), calculated as aggregate for all estuary program participants each fiscal year			
• Executive Order 12372 (replaces OMB Cir. A-95) requirements acknowledged			
• Official signature - original enclosed			
Budget			
• All budget categories properly identified and correctly totaled			
• Indirect cost rate and base shown; if previously negotiated, a statement of when and with what federal agency			
• Completed Procurement System Certification (EPA 5700-48) attached			
Statement of Work			
• Annual Work Plan			
• Clearly written statement of work attached; contains schedule for products and deliverables,including periodic progress reports to the region, state project officer, and management committee			
• Statement of work discussion describes relationship between proposal and approved fiscal year work plan elements			
• Statement of work contains requirements that newly generated data is in ODES format and machine-readable form			
• Separate pages of detailed project budget; project dollars justified with statement of work and reflected in total budget categories			
• Statement of work contains "substantial federal involvement" required for cooperative agreement(s)			
Quality Assurance/Quality Control			
• Quality assurance certification attached			
• Project officer's negative quality assurance statement attached			
Special Conditions			
• Separate list of conditions of substantial federal involvement identified in statement of work and/or other negotiated special conditions			
• A special condition applicable to all grants is that all final products must be submitted to the National Technical Information Service (11 copies plus applications)			
• Financial Status Report due annually (Sept. 30)			
Distribution of Form Application			
• Original plus three copies to EPA regional estuary program coordinator			

Project Officer/Reviewer_____Date_____

For More Information

Any questions? If so, please consult the EPA regional contact. Additional guidance is also available in the Catalog of Federal Domestic Assistance, 66.456, "Comprehensive Estuarine Management." The catalog is available from the Government Printing Office, SSOM, Washington, DC 20402.

EPA Contacts by Estuary Program

Program	FTS/Commercial
Albemarle/Pamlico Sounds	**257-2126**
Albemarle/Pamlico Sounds Study	(404) 347-2126
EPA Region 4	
4345 Courtland Street, N.E.	
Atlanta, GA 30365	
Buzzards Bay	**835-3514**
Buzzards Bay Project	(617) 565-3514
EPA Region 1	
John F. Kennedy Federal Building	
Room 2203	
Boston, MA 02203	
Delaware Bay	**597-9800**
Delaware Bay Estuary Program	(215) 597-9800
EPA Region 3	
841 Chestnut Street	
Philadelphia, PA 19107	
Delaware Inland Bays	**597-9800**
Delaware Inland Bays Estuary Program	(215) 597-9800
EPA Region 3	
841 Chestnut Street	
Philadelphia, PA 19107	
Galveston Bay	**255-6444**
Galveston Bay Estuary Program	(214) 255-6444
EPA Region 6	
1445 Ross Avenue	
12th Floor, Suite 1200	
Dallas, TX 75270	
Long Island Sound	**835-3550**
Long Island Sound Study	(617) 565-3550
EPA Region 1	
John F. Kennedy Federal Building	
Room 2203	
Boston, MA 02203	
Long Island Sound Study	264-2514
EPA Region 2	(212) 264-2514
26 Federal Plaza	
New York, NY 10278	

Narragansett Bay 835-3523
Narragansett Bay Project . . . . . (617) 565-3523
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John F. Kennedy Federal Building
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New York-New Jersey Harbor 264-2514
New York-New Jersey
Harbor Estuary Program . . . . . (212) 264-2514
EPA Region 2 . . . . . (212) 264-2514
26 Federal Plaza
New York, NY 10278

Puget Sound 399-0966
Puget Sound Estuary Program . . . . . (206) 442-0966
EPA Region 10
Office of Puget Sound
1200 Sixth Avenue
Seattle, WA 98101

San Francisco Bay/Delta 454-0960
San Francisco Bay/Delta Project . . . . . (415) 974-0960
EPA Region 9
215 Fremont Street
San Francisco, CA 94105

Santa Monica Bay 454-0960
Santa Monica Bay Estuary Program . . . . (415) 978-0969
EPA Region 9
215 Fremont Street
San Francisco, CA 94105

Sarasota Bay 257-4727
Sarasota Bay Estuary Program . . . . . (404) 347-4727
EPA Region 4
345 Courtland Street, N.E.
Atlanta, GA 30305

New Programs Contact

National Estuary Program 475-7102
Office of Marine and Estuarine Protection
(WH 556F) . . . . . (202) 475-7102
U.S. Environmental Protection Agency
Washington, DC 20460

Appendix B

Building An Effective Public Participation Program

This appendix of *A Primer for Establishing and Managing Estuary Projects* provides guidance on how to establish and manage a public participation program. The Primer, which describes the National Estuary Program's origins, statutory provisions, and approach, is designed for EPA's programs and regional offices, coastal states, and other interested parties. For more information, contact an EPA regional office.

A Cornerstone of Success

Informing and involving the public and getting its support can be the most difficult aspect of an estuary program, yet it is the cornerstone of a successful program. An effective public participation effort will help ensure implementation of the Comprehensive Conservation and Management Plan (CCMP). This plan is the product of a collaborative problem-solving process in which key members of the public have been fully engaged. The desired long-term improvements in the estuary will affect daily life through better septic systems, water conservation, additional taxes, or limits on some property uses. Everyone in the water basin needs to understand his or her role as a user of the estuary. Because so much is at stake, it is important to put the best talent, adequate resources, and full program commitment into designing and executing an effective process for full public participation.

This appendix provides guidance on what constitutes effective public participation, how to design and structure a program, how to carry it out, and what kinds of resources should be devoted to it. It will help programs meet the statutory requirement that public participation "be provided for, encouraged and assisted . . . ." as well as the regulatory requirements of 40 CFR Part 25, "Public Participation Under the . . . Clean Water Act."

Section 101(e) Federal Water Pollution Control Act
Public participation in the development, revision, and enforcement of any regulation, standard, effluent limitation, plan, or program established by the Administrator or any State under this Act shall be provided for, encouraged, and assisted by the Administrator and the States.

What Is Public Participation?

Public participation in the context of the National Estuary Program means involving citizens in the decision-making process that the Management Conference oversees.

Recognizing estuaries as commonly held treasures — productive, fragile, and enormously appealing places to live, recreate, and do business — the National Estuary Program has stressed the political and social ramifications of estuary management. This emphasis is expressed through requirements for an effective public participation program. EPA believes that estuary programs will reach the implementation phase only with public support. The Agency's conviction is validated by experiences in other programs.

The goal of public participation is to establish the public consensus that will ensure long-term support and implementation of the CCMP. As the Management Conference proceeds and the collaborative process evolves, public consensus must be achieved at least during two phases: first, when priority problems are identified and, second, when solutions and action strategies for implementation are selected and adopted.

Consensus signifies substantial agreement among the four key constituent groups: elected officials, environmental managers, scientists, and the public. These groups must concur that a particular course of action is technically well-founded, feasible, fair, and most likely to succeed. Consensus also implies the willingness of program participants to work together and to compromise. Sometimes participants will be unable to reach consensus. At other times — when enforcing regulations, for instance — agencies will have to carry out their legal responsibilities regardless of consensus. Nevertheless, agreement among these four groups is essential for general program direction and the development of long-range courses of action.

Designing the Public Participation Program

To achieve consensus, the public must have accurate, timely, and relevant information. It must be well-informed to participate intelligently in the decision-making process.

The Management Conference should develop a public participation work plan to ensure orderly, informed, and balanced participation. Planning for public participation activities should occur simul-

taneously with planning other aspects of the program — at the very beginning. Two steps should be taken to design the work plan:

- Assess issues and politics.
- Determine information and participation techniques.

After this, a public participation work plan should be designed to meet identified needs. The Conference may ask its citizens advisory committee (CAC) to develop the work plan, or it may engage a trained professional to complete this effort.

Assessing Issues and Politics

An assessment of policy issues and politics undoubtedly occurred before the estuary was placed in or nominated for the national program. Staff should review the materials gathered during the nomination process to develop a profile of the social, technical, and political issues related to the estuary.

There are various ways to do this. By answering the following questions, the Conference can begin to identify the organizations that are interested in the estuary.

- Are there major conservation groups, fishing associations, boating clubs, or businesses that regularly interact with EPA and state agencies on water quality issues?
- Do local newspapers consider the problems in the estuary an issue?
- Do citizen organizations or universities conduct public meetings or conferences on subjects related to the estuary?
- Have elected officials used the health of the estuary as a campaign issue?
- What do local environmental groups think about how the EPA and state agencies are implementating environmental protection laws?

The best and quickest way to assess whether the public understands the issues is through informal discussion. First, talk to interested people. Ask how they would rate the estuary's condition. Solicit their views on its major problems and their perceptions about how government (at all levels) is addressing them. Keep notes on conversations.

Determine which groups are influential, and assess public attitudes about issues.

- Do groups seem polarized on one or more issues?
- Is there substantial agreement on a particular issue?
- Is any environmentai advocacy group recognized as especially effective?
- Is there a coalition group that appears capable of getting other groups together?

The answers to these questions will help in planning a public participation program after issues and political ramifications have been assessed. The interviewees will form the nucleus of a mailing list. The kickoff meeting, described in Chapter II of the primer, is a particularly effective vehicle to answer these questions. Another option is to assign, through a grant or cooperative agreement, an organization to answer them.

Determining Information and Participation Techniques

Evaluation of information tools and participation mechanisms is the second step in designing the public participation work plan. For example, it makes no sense to produce another newsletter if several good ones are circulating. Research the existing public documents of agencies such as Sea Grant, Coastal Zone Management, Corps of Engineers, state water quality and resource agencies, Soil Conservation Service, Cooperative Extension Service and, of course, EPA. Find out about their distribution channels and mailing lists. In addition, examine the publications private groups are distributing.

When planning the public information part of the estuary program, take advantage of these and other existing communications channels; design the program to complement, supplement, and expand current efforts. New programs frequently are criticized because they are duplicative; with a little research, an estuary program will not make this mistake. Financial considerations are even more compelling reasons to determine what is already being done. There simply will not be enough money to do everything on the agenda. Smart choices require understanding the total picture.

To determine the most effective ways to involve the estuary's citizenry, its trust and confidence in EPA and other agencies must be assessed. Trust must be built.

Find out how the active citizens and interest groups in the area make themselves heard in the policy arena. Some groups attend public hearings; others prefer informal meetings. Some citizens prefer direct access to the EPA Regional Administrator, the governor, and other decision makers. So far, most estuary programs have developed informal participation programs. Find out whether constituents are comfortable with this approach or would prefer more structured, formal arrangements. Consider the size of the area and the number of governments, citizens, and interest groups that should be involved.

Preparing a Public Participation Work Plan

To prepare a simple and flexible work plan, take these steps:

- Define objectives;
- Foster both the information and participation activities necessary to meet them;
- Identify staff and budget resources; and
- Develop a schedule of activities.

Because the public participation program must respond to and support the overall estuary program, including each of its phases, this process will be relatively fluid. As the program changes in response to scientific findings, political issues, or funding restrictions, the public participation plan must be modified. The work plan should be simple and flexible — a means to an end, not an end in itself.

Making Public Participation Work

When designing the work plan, bear in mind that the public not only must have adequate, timely information, but also must be involved in the decision-making process. Every activity should be clearly linked to the goal of achieving the consensus needed for long-term support of the estuary program. Many expensive activities have been conducted in the name of public participation. These activities include educational films, exhibits, fancy publications, and programs for school children, which sap limited resources and do not immediately or directly contribute to the program goals. For instance, if a budget for public participation is $100,000 or less annually, it will pay only for a basic program.

The following components are essential for a basic program:

- An excellent experienced staff person;
- A comprehensive mailing list;
- A general program slide show;
- One written information piece: newsletter, newsbulletin, or fact sheet series;
- Public meetings; and
- A defined role for the citizens advisory committee.

A credible public participation program with these six components can be conducted for a reasonable sum.

Depending on the size of the geographic area, more staff may be necessary. If additional resources are available, the basic program can be expanded. Nevertheless, these six elements are neither expendable nor interchangeable; they form the foundation for a public participation program.

An Expert Staff Person

While in no way usurping the need for management, policy, other committee members, or the staff director as spokespersons, the person responsible for the public participation program serves as the linchpin. Because this staff member will interact with all kinds of citizens and their organizations, public speaking and writing skills are vital. He or she must understand technical material and be able to translate it into lay language for a variety of interest groups. A good listener as well, this expert must be able to convey citizens' concerns to the Conference. Sensitivity to the biases of various interest groups and an ability to put those biases in perspective, while maintaining a neutral stance, are essential qualities. Understanding the workings of government as well as the problems of the estuary will help. Further, the public participation expert supports other estuary managers, helping them deal effectively with public groups and the media.

There are several ways to organize and staff a public participation program. EPA or a state agency could provide for the public participation function, including an expert coordinator. The work could also be performed under contract. A grant or cooperative agreement can be arranged with an agency like Sea Grant or with a nonprofit organization. All these arrangements have been tested, with varying success, in the National Estuary Program.

A Comprehensive Mailing List

Knowing who constitutes the public for an estuary is essential to conducting an effective public participation program. Identifying target audiences and creating a representative, accurate mailing list of organizations and people will lay the groundwork for the information and participation activities. The mailing list will start to form as plans develop for the kickoff meeting. Although the groups undoubtedly will vary in each estuary, the following should be included:

- Conservation and environmental organizations;
- Service, civic, and good-government groups;
- Recreational boating clubs;
- Commercial and recreational fishing associations;
- Real estate firms and developers;
- Agricultural businesses and farm groups;
- Seafood packers and marketers;
- Chambers of commerce, business, and industry;
- Shippers and port-related groups;
- Local government elected officials;
- Federal and state legislators;
- Federal, state, and local agency officials;
- Scientists and educators; and
- Media — print, radio, and television.

The mailing list may contain as many as 10,000 names. To maintain a list this large and to exploit its potential, the list should be computerized. Coding and software that permit sorting by both geographic area and interest group will multiply the uses of the list.

It is not enough, however, to have assembled a list of names. The importance of maintaining personal contact with interest group leaders, media representatives, and key legislators and officials cannot be overstated. Sometimes the job of the public participation staff will be to initiate contacts and create opportunities for communication between these people and other program personnel. Public participation staff will also need to keep participants informed about work progress during the entire program. A slide show, basic program information paper, and public meetings are essential tools for initiating and maintaining contact with the target audiences.

General Program Slide Show

Capitalizing on the old adage that a picture is worth a thousand words, you may find that a good, straightforward slide show is an effective educational tool. It can translate technical, scientific, and regulatory information into an intelligent and convincing explanation of the need for an estuary program, its components, and how the program may change the future course of the estuary. Photographs depicting the state of the estuary, how it is used, and the sources of pollution — along with a pithy script — can help introduce the estuary program to the public.

Remember that technical slides and slides cluttered with words are inappropriate for a basic public presentation. On the other hand, maps are an effective way to translate technical material for a lay audience. A basic estuary map, color-coded or used with overlays to show which areas need protection, or where pollution problems have been pinpointed, is particularly useful if readily identifiable reference points are included. Although tables and charts with technical data should be reserved for scientific symposia, scientific findings summarized in bar and pie charts can be very effective. The slide show should create a visual image of the estuary and convey a few significant concepts about the program.

A basic slide show has several advantages. It will help ensure consistency in the delivery of the message, regardless of the presenter or the audience. It precludes the need to prepare a speech for every meeting, and anyone affiliated with the estuary program can use it easily. If the presentation is informal, it can be tailored to the specific audience — boaters and farmers, for instance — by adding a few slides.

The presentation can also evolve during the course of the estuary program. Initially, it probably will deal with broad issues and the intent of the program. Later on, it can include basic summaries of scientific findings and suggested management actions. It should contain up to 80 slides, which can be presented in 10 to 15 minutes. A script can be read by the presenter, or a taped, automated presentation can be used. A question-and-answer period should be built into every presentation.

One Written Information Paper

Information fuels the public participation program; people who are uninformed or misinformed cannot participate effectively. The estuary program has an obligation to provide information about why the program is being conducted, what its goals are, what problems it is trying to address, the progress it is making and, ultimately, what sorts of solutions it is proposing.

Generally, the public will be less interested in organizational details than in what substantive issues are being examined, how much money is being spent, and who may be affected. Citizens will be interested, for example, in the causes of the problem and possible solutions. But details about which federal or state agencies and departments are involved will not engage them. Relevance to the audience should be the guide.

Capturing public attention is the goal. If the estuary's problems are interesting, pertinent, and controversial, the media will cover them. Most organizations have their own information pieces, such as newsletters, and they often sponsor conferences. Take advantage of all these. Contacting the media regularly, preparing short articles for organizational newsletters, and speaking at conferences and workshops are effective communications tools.

In addition, the estuary program needs a vehicle to deliver its message directly to its target audiences. Newsletters, bulletins, fact sheets, and issue papers are commonly used. The logo and format should be distinctive and identifiable with the estuary program. Newsletters should be nontechnical and fairly short. Six or eight pages of well-written material every two or three months can be extremely effective. Printing and mailing are costly, so careful planning is essential. Do not allow newsletters, bulletins, or fact sheets to substitute for personal contact.

Public Meetings

Opportunities to provide information and interact personally with interested citizens occur frequently at organizational meetings, special workshops, and conferences. Exploit these opportunities fully. The slide presentation can become the core of a traveling road show to publicize the estuary program.

Public meetings fall under two categories: regularly scheduled meetings of organized groups, to which Conference representatives are invited to speak, and meetings that the Conference organizes. The former are, by far, the wiser use of time. Dozens of organization meetings can be attended in the same time it takes to organize a Conference-sponsored meeting. Other organizations' meetings have another advantage. Conference representation conveys how important it is for the group to participate in the estuary program. The Conference substantially expands its outreach potential by meeting people on their turf.

A mailing list should indicate when the group meets and who chairs the organization. A public participation strategy should include meeting with at least two or three affected organizations within each of the categories of interest groups in the estuary.

A Citizens Advisory Committee

The Management Conference will create a citizens advisory committee to ensure direct citizen involvement in the policy-making process. At explicit junctures in the estuary program, direct interaction among the various affected interest groups and between those groups and program managers needs to occur. A formally constituted advisory committee is an important way to facilitate this interaction.

There are many ways to operate a CAC. The chairperson or other CAC representative serves on the management committee or, in some cases, on the policy committee. Some estuary programs are experimenting with management committees that represent both public and private interests, in contrast to those composed solely of government agencies.

CAC members should be appointed by the Management Conference. The CAC should consist of about 20 people who broadly represent the estuary's user and interest groups. It is advisable to develop criteria for appointees. Usually each member should

- Serve as a spokesperson for a major user or interest group;
- Have experience in the development of water quality and resource management policy;
- Be knowledgeable about the technical and economic feasibility of some of the pollution control options being considered;
- Be potentially affected by the management recommendations of the Management Conference; and
- Be able to provide constructive advice and work with varying points of view in a committee setting.

The Conference must establish a clear charge for the CAC — what its purpose is and how it functions. The CAC's primary role is to help see that the public participation goal is met and that, through public consensus, long-term support for CCMP implementation is assured. It is critical that the committee's charge reflects this. Other specific functions of the CAC include these:

- Helping establish program goals and objectives;
- Helping set funding levels;
- Assisting with public participation activities;
- Helping to communicate program activities to user groups;
- Commenting on research priorities;
- Reviewing technical findings and analyses; and
- Helping to develop implementation plans.

Making advisory committees work well takes both planning and skill. With committees composed of diverse interests, the potential for conflict is great. Committee members and staff may benefit from some training in meeting facilitation and agenda-planning. Further, having by-laws and adopting Robert's Rules of Order generally help the committee function in a businesslike way.

An essential step in creating an effective advisory committee is taking the time for members to become acquainted. Every business meeting should include some time to converse informally. Meetings must be organized so that all committee members are encouraged to participate, but no one dominates.

Staffing a citizens advisory committee is a time-consuming, full-time job. If the committee meets four to six times annually, for example, providing direct support will require one to two days a week. Staff work will include organizing meetings, developing agendas, communicating with committee members, preparing background materials, and doing follow-up work.

Although the committee chairperson can be expected to take some responsibility for these tasks, the staff will need to do much of the work. Volunteer committees can accomplish more useful work if they are supported by strong staff and believe their contribution is worthwhile. People who serve on advisory committees generally have many commitments. If they think their time is being wasted, they will quickly lose interest. A clear charge for the committee and good staffing are, therefore, extremely important.

Providing direct advice to the program is not the CAC's only role, however. As leaders of a wide variety of interest groups, advisory committee members are the hub of a network that may become an estuary coalition. If one of the public participation program's goals is to help ensure long-term support and implementation of recommendations, the advisory committee should be an integral part of the management framework. Selecting members carefully and meeting their needs will increase the likelihood that they and their organizations will remain involved.

To supplement the CAC's formal advice, the groups they represent will probably want to provide their own input. Moreover, program managers need to recognize that a small committee, regardless of its quality, can never represent every viewpoint. So program managers should be open to input from other citizens. Encouraging broad public involvement means going beyond the CAC. If this is done well, it will facilitate the development of permanent networks and coalitions that are essential to sustained implementation of resource management programs.

A commitment to effective public participation requires dollars as well as staff. A typical program budget may be broken down as follows:

Item(s)	Percent of Budget
Staff salary and fringe benefits	30
Secretarial support (half-time)	10
Writer (half-time)	14
Slide show graphics and production	4
Newsletter (quarterly)	15
CAC meeting support and travel	10
Staff travel	4
Mailings, copying, office support, postage, and other miscellaneous expenses	8
Percent Total	**95%**

This leaves 5 percent for additional activities, such as a program kickoff event or a boat ride, press conference, workshops, a program logo and brochure, or a professionally produced public service announcement. The budget assumes that one of the participating agencies can provide support services like computer time for the mailing list. More elaborate activities, such as films, publications, citizen monitoring programs, and educational programs for school children, clearly exceed this budget.

Additional activities may be funded and conducted by participating agencies, private organizations, and foundations. A key responsibility of the Management Conference is to identify and obtain new and innovative sources of funding for work plan elements. For public participation, members of the CAC should place this objective on their agenda. All agencies have some money budgeted for public information materials. Many private groups conduct excellent educational activities. Coordination with these programs can expand the outreach capability of the estuary program.

In summary, the goal of the estuary program is to develop viable management strategies that will ensure protection of the estuary's resources. Legislatures, executive agencies, and public interest groups must cooperate to define policy priorities, initiate legislation, appropriate funds, and implement actions. Given the complexity of the issues related to estuarine management, it will not be easy. The guidance provided here will, however, help program managers design an estuary program with a high probability of success.

Appendix C

Using Finfish as Indicators of Toxic Contamination

This appendix of *A Primer for Establishing and Managing Estuary Projects* provides guidance on using finfish to indicate health or stress in an estuary and to monitor changes or trends in the estuary. The Primer, which describes the National Estuary Program's origins, statutory provisions, and approach, is designed for EPA's programs and regional offices, coastal states, and other interested parties. For more information, contact an EPA regional office.

EPA's Workshop on Finfish as Indicators of Toxic Contamination

Since 1985, the public has voiced strong concern about the high incidence of diseased finfish in the nation's estuaries. When EPA tried to determine the environmental significance of this phenomenon, it found no consensus within the scientific community. Consequently, in July 1986, EPA's Office of Marine and Estuarine Protection convened a workshop to determine if a set of scientifically appropriate, cost-effective finfish indicators could be identified and used to assess whether toxic contamination in estuaries significantly affected human health and ecology. Workshop findings led EPA to develop guidance for using finfish as indicators of estuarine health or stress and for monitoring the estuary. The workshop's report, "Proceedings and Summary of the Workshop on Finfish As Indicators of Toxic Contamination," is available from the National Estuary Program.

Setting Criteria

The first task for workshop participants was to develop, evaluate, and rank criteria related to finfish indicators so that the criteria would be useful in estuary programs. The recommended criteria appear in Table C.1.

Table 1.—Criteria for Using Finfish as Indicators of Toxic Contamination

The following criteria are essential:

- **Causality. There must be an unequivocal cause and effect relationship between toxic pollution and the indicator.**
- **Cost-Effectiveness. The indicator must be affordable and provide enough data to warrant the amount of money spent.**
- **Useability. Laboratories throughout the country must be able to use the indicator.**

The following criteria would also be helpful:

- **Specificity**
  - **—The method should be pollutant-specific. That is, its use should indicate the effects of a specific pollutant or class of pollutants.**
  - **—The method should be species-specific. That is, it should be applicable only to one or a limited number of fish species.**
- **Applicability to small or large spatial scales**
  - **—The method should permit identification of small areas of contamination within the estuary.**

OR

  - **—The method should also permit locating the effect of contamination in large areas of the estuary.**
- **Usefulness as an early or late indicator**
  - **—The method should be usable as an early indicator of toxic contamination. That is, it should be sensitive enough to demonstrate an effect after brief exposure to low concentrations of pollutants.**

OR

  - **—The method should be useable as a late indicator. That is, it should have a low degree of sensitivity and be capable of demonstrating an effect after prolonged exposure to high concentrations of pollutants.**

Highlights of Conclusions About the Usefulness of Finfish as Indicators

The following discussion highlights workshop conclusions regarding the usefulness of finfish as indicators of toxic contamination.

Screening Across Estuaries

Historical data on the abundance and distribution of fish populations and on the concentration of contaminants in fish generally are readily available. Therefore, these parameters are the most useful early screening tools. The use of other indicators is more limited because historical data are usually unavailable. Furthermore, cost and time considerations preclude collecting large amounts of field data during the screening phase.

Human Health Indicators

Concentrations of contaminants in tissues, or tissue residues, are useful indicators of human health effects. Lesions, tumors, and other histopathological changes are not useful for this purpose.

Fish Health Versus Ecosystem Health Indicators

Scientists participating in the workshop were reluctant to conclude that any single measure of fish health could be used as a definitive indicator of an ecosystem's health. However, if several indicators demonstrate change in a fish population, it is generally safe to assume that the ecosystem has been affected. This assumption should be strengthened by considering effects on organisms at other trophic levels, and by directly measuring contaminant levels in the environment.

Trend Monitoring

In a trend monitoring program, the use of finfish as indicators of toxic contamination is limited for three reasons: (1) some methods still need to be verified in the field; (2) fish move around; and (3) fish are very active as they undergo detoxification. Other organisms, such as bivalve mollusks, are better indicators on a small spatial scale because they are less subject to these constraints. Finfish may, however, be more suitable for future studies in which the objective is to assess toxic stress over relatively large areas, such as an entire estuary.

Early and Late Indicators of Toxic Stress

Enzyme and immunological tests are especially useful as early warning signs of toxic stress. They can also be employed to indicate the recovery of fish from toxic stress. Unlike lesions, death, or population changes, the effects of toxic contamination measurable by these tests appear sooner, and at lower levels and shorter lengths of exposure to pollutants. These effects are reversible as the fish recover from stress. Recovery can be measured in the field in less time than the life cycle of the species being observed. The effects of stress must, however, be measured at appropriate times during the species' life cycle.

Gross pathological and population changes appear over the longer term. Such effects indicate a highly disturbed ecosystem and suggest that fish have been exposed to high levels of pollutants for relatively long periods.

Establishing Causal Relationships as a Basis for Regulatory Action

In order to use indicators in developing regulations or permit requirements, EPA must establish a causal relationship between finfish indicators and toxic contamination. This will require further research because finfish indicators are not yet refined enough to prove such relationships. Therefore, it is too early to conclude that a particular finfish disease or population effect was caused by a particular environmental pollutant. Standard laboratory testing for toxicity is still needed.

Using only field data, EPA cannot expect to establish causal relationships between a specific pollutant and a specific adverse effect for any type of organism. Finfish indicators are, nevertheless, a useful monitoring tool. If estuary managers use several indicators that lead to the same conclusion, they can gather enough evidence to warrant some type of action, although it may not be regulatory action.

Recommendations for the Use of Finfish Indicators in Estuary Programs

Using historical data, program managers whose estuaries are known or believed to be stressed by toxic contamination should attempt to establish baseline conditions. Baselines should be set for water and sediment concentrations of toxic pollutants, the abundance and distribution of finfish, and the levels of tissue residue.

> The use of a single finfish indicator is insufficient to evaluate the ecological significance of toxic contamination....several indicators should be used simultaneously.

Monitoring should be conducted to determine the current locations and spatial extent of severe effects,and to identify the specific pollutants. The use of a single finfish indicator is insufficient to evaluate the ecological significance of toxic contamination. The workshop's scientists recommend using several indicators simultaneously. They also recommend that, depending on the stage of the program and the resources available, managers should select indicators from high- or low-level suites, discussed below.

A suite is a group of indicators that should be used to evaluate the significance of toxic contamination. Low-level suites employ methods that rely on historical data. These suites are useful for problem identification and assessment. High-level suites require collecting new information in the laboratory or in the field. Useful monitoring tools, high-level suites not only indicate the nature of the problem but enable managers to select methods to resolve it.

Indicators in the Low-Level Suite

Finfish indicators in the low-level suite are useful primarily for making nationwide comparisons of estuaries, and for identifying regional problems. The objective is to assess, on a preliminary basis, the extent and severity of ecological effects caused by toxic contamination. Because these indicators can be applied to analyze existing information, they are particularly appropriate for the early stages of estuary programs. During Phase 1, the Planning Initiative, they can be used as evidence in defining and ranking problems to be addressed by the Management Conference. During Phase 2, Characterization and Problem Definition, they can be used to establish status and trends.

The following indicators are from the low-level suite.

Sources of information. Information about problems related to toxic contamination, such as fishery closures, is compiled from various sources. These include newspaper articles, anecdotes, published reports, and newsletters.

Gross pathology. Reports of obvious anatomical abnormalities like fin erosion, skeletal deformities, and tumors help to identify the presence of a problem.

Behavioral abnormalities. Changes in behavior, such as avoidance or attraction of fish to contaminants, can be measured by comparing the reactions of fish before and after they are exposed to the test material. Other behavioral changes, for example erratic swimming or lethargy, may indicate specific modes of toxicity like neurological or metabolic dysfunction.

Distribution and abundance. Profiles of the spatial distribution and abundance of a species may be directly related to mortality caused by exposure to toxics, or to behavioral changes like avoidance and attraction cited above.

Tissue residues, especially in commercial species. Fish tissue should be analyzed for the concentration of some or all of the 129 priority pollutants. Bioaccumulation of certain substances in fish indicates not only that the contaminant is in the environment, but that it may potentially threaten the environment and human health.

Indicators in the High-Level Suite

Finfish indicators in the high-level suite are useful primarily for longer term monitoring studies. Monitoring is conducted in targeted studies to answer specific scientific or managerial questions raised during the problem definition and characterization phase. These indicators are also useful biological monitors of health or stress in the estuary. Because of their sensitivity, they may be used to determine the effectiveness of management actions. Methods in the high-level suite require collecting specific laboratory or field data.

In addition to the high-level indicators discussed below, certain low-level indicators—tissue residues and fish distribution and abundance, for example—should also be considered for use in monitoring studies.

Macrophage triad. The macrophage triad is a useful early warning of general stress. Macrophage cells exhibit three behaviors, or responses, that have demonstrated a direct relationship to the presence of toxics.

Enzymes (mixed function oxidases, metallothionein). Certain enzymes or proteins may be produced by an animal as a result of exposure to various classes of pollutants. Immunological methods measure the presence and amounts of the enzymes or proteins produced.

Hematology. Routine clinical tests of blood components can provide information about the physiological condition of the animal. They can also detect general stress.

Cytogenetics. Cytogenetics examines the relationship between changes in the chromosomal structure and pathological conditions. These changes can be linked to exposure to specific pollutants.

Histopathology. Finfish disease can be exhibited through structural change in tissues or organs during the course of an animal's exposure to pollutants. Tissue and organ abnormalities are observed using standard light microscopy techniques. Although these studies are more expensive, they can detect specific lesions that develop shortly after pollutant exposure, and long before gross abnormalities develop.

Egg and larval development and viability. Eggs and larvae are sensitive stages in the life cycle of fish. Problems with egg or larval development, such as death or deformity, indicate an ecological effect that may be due to toxic contamination.

Establishing Baselines and Reference Areas

Estuary program managers should establish baseline and/or control data for the species and indicator methods under consideration. Where historical data are inadequate, a reference area should be established. NOAA's Status and Trends Program has already set up reference areas in or near most of the estuaries in the National Estuary Program. Reference areas, which should be representative of the entire estuary under study, should be relatively free from toxic effects. If such an area cannot be found, estuary program managers should look for nearby areas with comparable hydrographic and faunal conditions.

How to Use Finfish Indicators in an Estuary Program

Years One and Two

During the characterization phase, a preliminary list of priority problems should be proposed. If there is a decrease in the abundance of fish, a high incidence of diseased fish, or a potential threat to human health due to toxins in fish, the following steps are warranted.

- Use the low-level suite of indicators; and
- Synthesize historical data on the abundance of fish, the amount and type of tissue residues, and the incidence of disease.

At the same time, collect and analyze data on toxic contamination, sources, and pollutant loads. If the analysis shows a correlation between toxic contamination and changes in fish, the program may choose to do the following:

- Conduct field sampling to define further the nature and extent of the problem;
- Conduct laboratory toxicity studies to identify the pollutants of most concern; and
- Identify any probable current sources of those pollutants and reduce current loadings.

Furthermore, if toxic contamination is the cause, follow-up activities should be conducted. The program should identify pristine reference areas and summarize all available data on these areas.

Years Three and Four

After the contaminant problem has been characterized and necessary critical information identified, a focused monitoring program should be designed to assess correlations between specific toxicants, or groups of toxicants, and the effects on fish. Indicators from the high-level suites should be used during this phase. To design the monitoring program, first select the appropriate species. Follow the guidelines developed in the workshop.

- A relatively nonmotile, nonmigratory species should be used.
- Commercially or recreationally important species are preferable.
- Species for which baseline data are available are preferable.
- Provisions for making an archive of tissue samples for future use in assaying additional indicators should be included.

Then consider which pollutants are of concern. Determine whether species-specific methods, scientific expertise, laboratory facilities, and background data are available. Be sure costs are reasonable. Technical staff and STAC members should consult and become familiar with the entire workshop proceedings. A summary report contains detailed information on the utility of the various indicator methods.

After Year Two

After an activity has begun, implement the monitoring plan. Analyze and synthesize monitoring data, comparing new data with historical data from the characterization report. Review and evaluate the data periodically to determine whether there has been any improvement in estuarine conditions. Management strategies may have to be redirected or supplemented to achieve a system response.

Appendix D

Summary of the Guidance Manual for Health Risk Assessment for Consumption of Chemically Contaminated Fish and Shellfish

This appendix of *A Primer for Establishing and Managing Estuary Projects* provides guidance for understanding the health risk assessment process for seafood consumption. The Primer, which describes the National Estuary Program's origins, statutory provisions, and approach, is designed for EPA's programs and regional offices, coastal states, and other interested parties. For more information, contact an EPA regional office.

The Guidance Manual: An Overview

One of the National Estuary Program's goals is to protect human health by helping state and local agencies identify the potential risks of eating aquatic organisms from chemically contaminated areas. This goal will be met, in part, by developing information on the relative health risks associated with consumption of fish and shellfish from a number of contaminated estuarine locations throughout the United States. A systematic risk assessment procedure to estimate health risks, with clear statements of assumptions and uncertainties, will be used.

This appendix summarizes a guidance manual that the National Estuary Program has developed. The manual facilitates standardization of procedures used to assess the human health risks of ingesting chemically contaminated fish and shellfish. As of 1987, the manual constitutes technical guidance under the National Estuary Program. It will probably be issued in 1989 as final EPA guidance applicable to all freshwater, estuarine, and marine fish and shellfish.

The risk analysis process consists of two distinct phases: risk assessment and risk management. Risk assessment involves estimating the scientific probability that an adverse health effect will result from exposure to a toxic agent. Risk management entails interpreting risk assessment results—scientific results—to formulate public policy. The National Estuary Program manual provides technical guidance on risk assessment procedures; risk management approaches, which involve policy decisions, are only briefly discussed. Selecting policy alternatives is left to state and local regulatory authorities. Public policy decisions based on risk management could be any of the following:

- Identifying locations as high-priority areas for environmental cleanup;
- Issuing public fish consumption advisories for certain areas; and
- Banning fishing in certain areas.

Contents of the Guidance Manual

The National Estuary Program health risk assessment guidance manual provides the following information:

- A description of the risk assessment procedure for chemically contaminated fish and shellfish;
- Guidance on presenting and interpreting risk assessment results;
- A summary of assumptions and uncertainties of the recommended procedure for risk assessment; and
- An explanation of the dose-response values that are available for individual chemicals, and of information sources for updating these values.

The document does not provide guidance on the risk management issue of which level of risk is small enough to be acceptable, given counterbalancing economic factors like consumer preference or economic impacts on recreational and commercial fisheries. State or local regulatory authorities will make case-by-case judgments concerning restricting sportsfishing or issuing informational health advisories even when fishing is not legally prohibited or limited.

What Is Risk Assessment?

Risk assessments are limited by rudimentary scientific knowledge of the effects of toxic chemicals on humans. Most of the present information is developed by interpreting results of laboratory tests on experimental animals like rats, mice, and primates for application to humans. Although this extrapolation carries many uncertainties, estimates of health risk can be used to formulate decisions about actions to reduce risk.

Many investigators and state and local regulatory agencies evaluate the significance of toxic contamination in fish and shellfish relative to human health concerns simply by comparing tissue concentrations of selected chemicals to Action Levels or tolerances established by the Food and Drug Administration (FDA). (An Action Level is a restriction on chemical contamination. Foodstuffs with concentrations of a chemical exceeding the Action Level are required by federal law to be confiscated and destroyed.) Action Levels do not provide a sufficient basis for all local risk assessments because they are available only for chemicals likely to be at levels of concern to commercial fisheries on a national basis. They do not, therefore, include some chemicals highly suspected of causing cancer or other adverse effects that might be of concern in some local areas due to higher-than-average local fish consumption and high, localized contamination levels.

Action Levels are national protective levels set by FDA. Tolerance levels indicate the ability of an organism to fend off an adverse effect.

FDA is authorized to develop Action Levels or tolerances for specific localities if it is in the national interest. Tolerances have legal enforcement status, whereas Action Levels have less formal regulatory limits. To date, however, all Action Levels and tolerances have been developed to be protective on a national basis, rather than regionally or locally.

The procedure for determining these national protective levels involves assessing the health risks to the average national consumer of a foodstuff. It presumes the consumer eats foods from a typical "national market basket," and weighs the resulting average national health risks against the likely national economic impacts of setting particular levels as Action Levels or tolerances. Therefore, FDA has stated that Action Levels and tolerances are not intended to protect local consumers of fish and shellfish, like sports-fishermen, who may eat more of a given fish than the average national consumer.

Risk Assessment

Estimation, using best available scientific methods, of the probable health risks of a given activity.

Risk Management

The use of regulatory tools to protect against levels of risk deemed unacceptable based on risk assessment and socioeconomic considerations.

FDA has the lead responsibility for managing risks related to consumption of foods distributed in interstate commerce. For some chemicals in foods, EPA assists FDA in its risk management responsibilities by helping conduct the technical risk assessments that are the starting point of risk management. FDA then incorporates economic considerations and develops Action Levels and

tolerances. Foods not distributed through interstate commerce are primarily a state responsibility, not FDA's. Previously, procedures for assessing risks from the consumption of contaminated fish and shellfish have not been standardized among agencies — or sometimes, even among programs within a single agency. In addition, risk assessment procedures for other problems, such as contamination of drinking water, have been better developed than those for consumption of contaminated aquatic organisms. The 1987 National Estuary Program guidance manual explains how to apply general EPA risk assessment policies to the particular "exposure route" (mechanism of human exposure) of eating fish and shellfish.

The EPA risk assessment process is based on estimating the highest probability, given uncertain technical information, of risks to humans. The process uses a combination of empirical data (observational data) on the long-term, chronic effects of toxic chemicals, and models for extrapolating from high doses to low doses and from animals to humans. In most cases, empirical data are available only for animal test species. This is primarily because it is hard to obtain long-term (a generation or lifetime) observations of human health effects like cancer, and human data are only rarely available, in cases where accidental exposures have occurred.

What Is Risk Management?

Risk management is the application of the results of risk assessment by regulatory agencies to formulate public policy. For example, regulatory agencies may use the results of risk assessment studies to develop public health advisories to limit consumption of particular fish species where contaminant levels are relatively low, or to ban such consumption where levels are higher. In general, the process and outcomes of risk management are case-specific because technical, socioeconomic, and political issues must be considered, and these factors are case-specific. Risk management requires policy makers at federal, state, and local levels to balance these public concerns.

In the National Estuary Program and other EPA or state programs for fresh, estuarine or marine waters, the results of health risk assessment for fish or shellfish consumption generally may be used in risk management to do the following:

- Identify problem areas, problem pollutants, and problem fish or shellfish species (and problem weight or length classes within species, if relevant);
- Develop guidelines and criteria for contaminant concentrations that would be used to develop fish and shellfish consumption advisories in cooperation with FDA and state governments; and
- Provide public information in cooperation with FDA or state governments.

Risk management is important in areas other than public policy making. It also provides the public with information on which to base individual decisions regarding where to harvest aquatic food organisms, which species to harvest, and how much to consume. In other words, where to fish, what to fish, and whether to eat what one catches.

Components of the Risk Assessment Process

The guidance manual discusses the four major components of the risk assessment process: hazard identification, dose-response assessment, exposure assessment, and risk characterization.

Hazard Identification

Hazard identification involves defining the toxicological hazards (toxicity profiles) posed by each chemical contaminant. Toxicity profiles are based on each chemical's physical, chemical, and metabolic properties, and on toxicological effects (also called "dose-response effects"). Noncarcinogenic effects (that is, all harmful effects other than causation of cancer, including birth defects) are summarized in the toxicity profile for each chemical of concern. The guidance manual also describes the "weight-of-evidence" approach used by EPA to classify chemicals according to their carcinogenic (cancer-causing) potential.

Dose-Response Assessment

Dose-response assessment is one factor in hazard identification. Data on the relationship between the contaminant dose and the observed "response" (effect on the test organism) are used to determine the toxicological potency of a substance. For carcinogens, there is presumably a finite risk of cancer, even at low doses. For noncarcinogens, chemicals that induce effects other than cancer, such as nervous system damage, liver effects, skin disorders, and birth defects, there is usually a dose below which adverse biological effects are not observed. This is called the "no-observed-adverse-effects level" or NOAEL. The EPA risk assessment approach is based on the use of dose-response data from epidemiological (human disease) studies or from bioassays of the animal species that are most appropriate for estimating a response in humans. Lacking this information, a measure of toxicological potency is derived from the dose-response relationship for the most sensitive species tested (usually a laboratory strain of rats or mice). Results of laboratory experiments are then extrapolated to humans.

A standardized set of dose-response data then takes into account all the appropriate laboratory animal and epidemiological studies available for each of approximately 200 chemicals provided by EPA in a computerized data base. The data base is called the Integrated Risk Information System (IRIS, EPA 1987). Periodically updated versions of the IRIS data base are also available in document format from EPA or from the National Technical Information Service. Data on new chemicals are continually added as they become available.

Exposure Assessment

Exposure assessment is the process of determining what human populations are exposed to chemicals of concern; the pathways by which they are exposed; and the magnitude, frequency, and duration of the exposure. An exposure assessment for contaminated fish and shellfish involves

- Analysis of tissue concentrations of contaminants in aquatic organisms;
- Analysis of the exposed human population, including fisheries harvest activities, rates of consumption of fish and shellfish, diet composition, and other population-related factors; and
- Estimation of the ingested dose of each food species by subgroup within the exposed population (for example, age groups, ethnic groups, and fishermen versus nonfishermen) and by geographic location.

This analysis of a subgroup's overall exposure is called "integrated exposure analysis."

Tissue Concentration Analysis. Studies to determine concentrations of contaminants in tissues of aquatic biota must be designed carefully. Features to consider include study objectives, species of concern, sampling locations, and sampling times. Examples of the relationship between possible objectives and various sampling strategies are provided in the guidance manual. The manual also provides guidance on selecting species for the study and on performing statistical analyses of the resulting data.

Exposed Population Analysis. The analysis of exposed populations includes four steps:

- Identify the potentially exposed population by fishery harvest area;
- Describe the demographic and aquatic harvesting activities of the population;
- Characterize catch and consumption patterns; and
- Estimate average consumption rates

The first three steps typically involve conducting surveys of the potentially exposed population. The guidance manual discusses survey methods, data analyses, and data reporting formats. The summary exposure variable for use in subsequent steps of risk assessment is the average consumption rate. The manual provides guidance for calculating average consumption rates for each harvested species and, if data are available, for each segment within the human population.

The manual also shows how to use alternative consumption rates derived by other investigators. Decision makers in each state or locality may choose whether to collect site-specific data on human consumption patterns, or to use typical values derived from other studies. Individuals can also be given the opportunity to determine their own personal consumption patterns if risk assessment site results are presented on the basis of "risk per meal of fish per week" or a similar approach.

Integrated Exposure Analysis. The integrated exposure analysis results in an estimate of ingested dose by species. The ingested dose is calculated for specific segments of the human population (for example, a certain age group along a certain stretch of river).

For a given segment of the exposed population, the ingested dose is calculated as shown below:

Ingested dose =	concentration of a chemical in the edible portion of an organism x a number representing the relative amount of chemical absorbed by the digestive system ÷ by the average body weight of all individuals in the population segment.

Risk Characterization

In the risk characterization stage, the preceding steps are brought together to estimate the probability and extent of adverse effects associated with consumption of contaminated fish or shellfish from a given water body. Numerical estimates of risk can be presented on an individual basis. Risk to an individual is expressed as a probability (for example, a one in 10,000 increased lifetime chance of getting cancer or other effects). Risk to a population is expressed as the excess number of cancers or other adverse effects produced within the specific population over one generation.

The results of risk assessment may be presented in both tabular and graphic format. All risk estimates should be interpreted as plausible-upper-limit values for the stated assumptions and exposure conditions, in keeping with EPA's national guidelines for risk assessment (EPA 1986). Risk estimates for a given area and aquatic food species vary with consumption rates, and consumption rates vary greatly among individuals. Therefore, graphs showing plausible-upper-limit risks versus consumption rates are recommended as the primary means of presenting results. Using the tables to compare the pattern shown on the graphs with personal consumption rates of various fish and shellfish, consumers can determine any extra risk to which they might be exposed.

Risk assessment results should include a summary of assumptions and an uncertainty analysis. The summary should note general assumptions inherent in all health risk assessments, and specific assumptions adopted for the risk analysis in question.

By using EPA's 1986 policy for risk assessments and estimating the plausible-upper-limit to risk, it is highly unlikely that risk will be underestimated. The "upper bound estimate" of the risk is not likely to be exceeded. The actual risk is likely to be below this level, and may be close to zero in some instances. Therefore, the estimate provides a consistent basis for relative risk comparisons

and is a very conservative (that is, a "protective") approach to determining whether there are any significant public health risks posed by specific chemicals' contamination of fish or shellfish in a given area. In instances of contamination by multiple chemicals, EPA's 1986 guidance recommends that the risk estimates from the individual chemicals be added together to obtain the overall risk assessment. This additive approach is neither conservative nor non-conservative because in a few instances effects could cancel one another out, while in others, effects could enhance one another. But the overall risk assessment will remain conservative because each of the underlying individual risk estimates was conservative.

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Appendix E

Alternative Financing

This appendix of *A Primer for Establishing and Managing Estuary Projects* is a summary of the guidance manual, *Financing Marine and Estuarine Programs: A Guide to Resources.* The Primer, which describes the National Estuary Program's origins, statutory provisions, and approach is designed for EPA's programs and regional offices, coastal states, and other interested parties. For more information, contact an EPA regional office.

An Overview

As part of the National Estuary Program (NEP), state resource managers, town planners, and local administrators jointly develop Comprehensive Conservation and Management Plans (CCMP) to protect estuaries. These plans call for a broad range of actions including the construction or improvement of sewage treatment plants, implementation of nonpoint source control programs, and habitat restoration programs. Implementing these plans will require the outlay of significant financial resources. Under NEP, funds are provided to develop comprehensive management plans and associated demonstration projects for resource protection, but not to implement cleanup activities. In order to move from planning to action, resource managers must therefore understand the financial mechanisms available to support their cleanup programs.

This appendix describes a guidance manual that the National Estuary Program has developed to help estuary program managers understand the concepts and terminology of public finance, and secure funds needed to support restoration and protection programs. The guidance manual, *Financing Marine and Estuarine Programs: A Guide to Resources,* is divided into three parts. The first part of the document, the financial primer, introduces basic financing concepts and explains initiatives needed to begin financial planning for long-term resource management activities. The second part includes case studies that provide specific examples demonstrating how towns and cities have raised money to solve specific water quality problems. The last part, a glossary, defines terminology that managers unfamiliar with financial planning must understand. The following pages present highlights of the primer.

The Financial Primer

In order to compete successfully for limited funds, estuary program managers must understand the basic principles of public finance. To finance technical plans, managers must access revenues, manage the flow of funds, and build institutions to oversee financial planning and management. The financial primer discusses ways to link sources and uses of funds, and institutions that control these programs.

Accessing Revenues

Several kinds of financial mechanisms, or tools, help establish a flow of funds from sources to their uses. The financial primer reviews the basic characteristics of five tools used to access capital including these:

- Levying taxes
- Collecting fees
- Securing intergovernmental transfers
- Issuing municipal bonds
- Attracting (extracting) private capital

The usefulness of each depends on the investment, project costs and benefits, and explicit acknowledgement of any financial risk.

Taxes. Cities and states have successfully used taxes to fund projects to protect the coastal environments. Income taxes, property and sales taxes, and commodity taxes—gas, cigarettes, and liquor—can be used to raise revenues. In Washington State, for example, an eight-cent-per-pack cigarette tax helps finance the state's water quality protection plan.

Fees. Fees, such as charges to polluters for the costs their discharges impose upon society, can be used to help finance pollution control activities. Fees can be calculated as a function of use—user fees—or on the basis of proportional cost imposed on the system—impact fees. For example, in many coastal areas septic systems are a source of near-coastal water pollution. Septic sources can be controlled by inspecting tanks periodically, pumping out septage, and replacing poorly operating drain fields. A number of communities have financed such programs entirely with periodic fees collected from homeowners with septic systems. Impact fees can be charged to recover the cost of services from those responsible for creating the need for those costs. In California, for example, several wastewater treatment plants have been financed with fees paid by land developers on the basis of demands for treatment that their developments are expected to generate.

Intergovernmental Transfers. Fees or taxes may be collected by one level of government and passed on to another. These intergovernmental transfers, as they are known, redistribute income geographically, usually from federal to state to local governments. Even though intergovernmental transfers are used for a considerable proportion of state and local revenues, their utility for supporting broad governmental activities is often limited.

Debt financing. Resource managers can use debt financing to raise "up-front" capital for a facility and then distribute the burden of repayment among those benefitting from it. Governments borrow funds from investors by issuing debt in the form of a bond. However,

a bond must be repaid, so revenue must be raised through taxes or user fees. While bonds cannot finance routine expenses such as water quality monitoring, they are well suited to finance facilities such as wastewater treatment plants. Bonds may be short-term, long-term, general obligation, or revenue bonds, depending upon how the principal and interest are repaid. When considering bonds to finance projects, planners must evaluate credit ratings and interest.

Private Capital. Tapping the resources of private capital is another way of financing projects to protect estuaries. Public/private partnerships are another way to finance estuary protection initiatives. For example, the public partner might finance and build the facility while, for a fee, the private partner operates and maintains it. In 1986, about 100 municipal wastewater treatment plants were operated privately. Some of the most innovative ways in which estuarine managers can attract private capital is to form new types of public/private partnerships by taking advantage of rapidly escalating real estate values. For example, impact fees have been used to finance capital facilities like sewage treatment plants in rapidly growing areas. Similarly, selling "capacity credits" to developers is a new way to finance pollution control projects. However, through the use of capacity credits, users pay voluntarily. Capacity credits are best suited to finance facilities such as treatment plants or stormwater control facilities.

Once funds have been secured, it is important that they be disbursed and managed successfully. Some activities require an initial lump sum while others require an annual budget to support ongoing activities. Taxes, fees, and other forms of revenue must be directed to the appropriate programs. Hence, it is extremely important that program managers understand the legislative budgetary and appropriating process. The financial primer explains three techniques for coordinating the distribution of money: appropriations, capital budgeting, and independent mechanisms.

Appropriations. Based on previously authorized budgets, a legislature appropriates funds to government programs annually. For some programs, the Congress, states, and local governments appropriate funds on a project-by-project basis. The most obvious drawback to this type of funding is that year-to-year appropriations for multi-year projects are not assured.

Capital Budgeting. Most state and local governments have some form of a capital budget that accounts for construction and upkeep of the physical facilities owned by public entities. Almost all capital budgets have four basic components:

- Selecting the scope of services for which the state or local government is responsible;
- Identifying assets through a physical inventory, an assessment of condition, and an evaluation of performance;
- Integrating the data with estimates of costs to operate and maintain existing facilities and build new ones;
- Drafting a summary plan for distribution to (and concurrence by) all governmental public works agencies and interested nongovernmental groups.

Through capital budgeting, all available funds are assembled and allocated to the highest priority capital project needs. Each year, projects can be recommended to the appropriate decision-making body for funding on the basis of a systematic, substantiated plan. Resource managers use capital budgeting to help set priorities for capital facilities such as municipal treatment plants.

Independent Mechanisms. Among other mechanisms, enterprise and revolving loan funds should be considered. Enterprise funds help manage the finances of government activities that are largely supported through user fees. Common city enterprise funds include water and sewer services, electric and gas utilities, airports, and local transit. An advantage to running a program through an enterprise fund is that revenues can be predicted with reasonable certainty.

Revolving loan funds (RLF) provide long-term, low-interest loans for major capital investments. Individual RLFs are capitalized and operated in various ways with which managers must become familiar. The benefits from revolving loan funds include the ability to target investments to specific project types and the security of a long-term source of capital with few effects from political volatility. However, because the fund must have capital to begin lending, the state must first authorize or otherwise secure seed capital.

Building Institutions

The 82,000 individual governments in the United States provide the framework within which capital for investment is secured and managed. The characteristics of these governments and their components are often the critical variables in the creation and implementation of a financing plan. Governments include federal, state, and local authorities (regional authorities and special districts).

Conventional governments, including federal agencies, state government, and governing boards of local governments, operate a wide variety of services, and they have the ability to authorize an equally wide variety of mechanisms to recover those services. However, conventional governments rely on only a few sources to recover costs. The federal government is the primary public investor in natural resource protection programs. EPA's National Estuary Program, for example, funds programs to preserve the water and resources of estuaries threatened by overuse and development. A number of other federal programs assist in the restoration and protection of estuarine and marine waters such as U.S. Soil Conservation Service, Farmers Home Administration, and Coastal Zone Management Act. State and local governments also play an important role in the financing of environmental protection programs.

In certain situations, the natural resources that need to be protected are not covered by existing institutional boundaries. Interstate and/or inter-jurisdictional coordination is frequently necessary. Often, many of the revenue-raising mechanisms that link users to payments are readily administered by special-purpose units created to manage such flows. Hence, managers looking for ways to raise revenue for implementing estuary protection programs should consider creating a special-purpose government. These governments include, for example, stormwater management dis-

tricts, interstate water management commissions, and regional port authorities. Since the early 1970s, special-purpose governments have proliferated. The fiscal limitations imposed by state and local debt limits have been one of the chief reasons for this rapid growth.

The Case Studies

The case studies in the financing primer demonstrate the use of financial tools, financial management mechanisms, and management institutions capable of raising revenue for a wide range of projects. The ten case studies presented in the primer discuss how various local, state, and special-district governments successfully used some of the financial mechanisms mentioned above, in addition to other techniques to finance environmental protection programs. Each case study includes a section that evaluates the applicability of the particular financing technique to estuarine and marine resource restoration and protection programs. The case studies provide a number of examples that may assist managers as they choose the financing tools to address their specific needs.

Appendix F

Citizen Monitoring

This appendix of *A Primer for Establishing and Managing Estuary Projects* provides guidance on how successful volunteer estuarine monitoring programs can be developed, implemented, and maintained, augmenting existing government-sponsored monitoring efforts. The Primer, which describes the National Estuary Program's origins, statutory provisions, and approach, is designed for EPA's programs and regional offices, coastal states, and other interested parties. For more information, contact an EPA regional office.

A Useful Tool

Government agencies participating in the National Estuary Program have recognized that monitoring programs operated by citizens can effectively support the development and implementation of comprehensive estuarine management plans in a number of ways. First and most important, citizen data can be high quality information that is vital to estuarine management. Citizens often can collect data that might not be available through generally accepted methods. Citizen monitors also help to build public commitment to environmental quality goals and objectives. Through their participation in monitoring programs, citizens learn how they contribute to pollution problems and develop a sense of guardianship toward the waters they are monitoring. Finally, these programs also help citizens understand the difficulties faced by the scientific community as it attempts to link water quality changes to impacts on living resources.

Citizen volunteers can easily learn how to collect environmental data in estuarine and near coastal waters. In the Chesapeake Bay, for example, an established citizen monitoring program has demonstrated that trained volunteers can collect data that are technically defensible. Citizen volunteers working in the Chesapeake Bay have responded to irregular events such as storms, algal blooms, and fish kills faster than government agencies. They have also provided greater geographical coverage than government agency monitoring programs. Moreover, citizens can collect useful and low-cost environmental data, while at the same time involving the public in working to solve estuarine environmental problems.

Establishing a Program

Monitoring involves the collection of repetitive environmental measurements or observations over time to determine a condition or track changes in environmental parameters. The information collected by citizen volunteers can be analyzed to describe the condition of a watershed, indicating whether water quality is improving or worsening.

A review of existing citizen monitoring programs has shown that there are several key ingredients required to establish a successful program: identifying needed information, obtaining funding and controlling costs, providing credible information, and selecting and keeping good volunteers.

Identifying Information for Collection

The first step in developing a citizen monitoring program is to determine the type of data that will be collected. Data should be collected in response to a specific question, a demonstrated need, or special use for the data. Citizen volunteers must know that the data they collect are contributing to some action, or will provide them with some direct benefit or personal reward.

The data to be collected should permit the use of simple methods and equipment that volunteers can quickly and accurately master. The monitoring project should include quality control assurance adequate enough to instill confidence among decision makers in the data generated.

Obtaining Funding and Controlling Costs

Funding for citizen monitoring programs can be obtained primarily from federal and state agencies and private industry and organizations. Federal sources include funds available under Sections 106 and 205(j) of the Clean Water Act, the National Estuary Program, and the National Oceanic and Atmospheric Administration's (NOAA) Sea Grant Program. State funding is sometimes available through general state revenues or through more innovative mechanisms such as user taxes on motorboat fuel or funds obtained from industrial fines. Other sources of funding can include grants from private industry or nonprofit organizations. Private funding has been obtained by a number of volunteer estuary monitoring programs. The Rhode Island Salt Pond Watchers organization, for example, has partially funded a citizen volunteer monitoring program through a grant from IBM Corporation. In establishing a volunteer monitoring program, it is very important to secure commitments for program funding. It is helpful if monitoring program project periods coincide with the period of time during which the volunteers can be supported. Loss of program funds during the monitoring project period has caused some volunteer monitoring programs to fail.

Simple and inexpensive sampling methods can help keep program costs down. Monitoring programs should evaluate a variety of sampling equipment to determine which provides the most useful result for the least cost. However, the quality of the data should not

be sacrificed just to reduce project costs. Since data of poor quality cannot be used in management decisions, the use of inferior equipment or methods may cause the project to be unsuccessful in fulfilling its objectives.

Providing Credible Information

In order to collect credible data, citizen monitoring programs must follow established quality control/quality assurance procedures. When possible, some sites monitored by citizen volunteers should be located near sites sampled by state agencies. Data collected by the volunteers can then be compared with results obtained at the nearby state sampling locations. The Chesapeake Bay Citizens Monitoring Program validated some data sets in this way and found little difference between data collected by the citizens and by the state. This analysis demonstrated that trained volunteers can collect quality-controlled and assured data. (An evaluation of quality assurance and quality control measures for citizen monitoring programs undertaken by the Alliance for the Chesapeake Bay describes the important elements in a quality assurance and quality control program. Copies of *Quality Assurance Project Plan for the Citizens Monitoring Project* are available from the Alliance.)

Sampling equipment used in citizen monitoring programs should be validated annually and maintenance records kept in the project files. To ensure quality assurance/quality control, all volunteers should receive training followed by biannual quality control sessions to verify that sampling procedures are consistent among volunteers. If volunteers do not attend at least one quality control session a year, the program coordinator should perform a site visit to validate their sampling techniques.

Data should be examined upon collection to identify questionable values, and the responsible volunteer should be consulted to determine possible causes of variation. If questionable data continue to be collected, the program coordinator should perform a site visit. If a volunteer cannot meet the quality standards established for the collection of data, the data collected by that volunteer should be kept separate from the remaining project data. The use of simple sampling methods should decrease the occurrence of poor quality data. A quality assurance project plan should be developed that establishes the steps to be taken to protect the quality and integrity of the data. Information concerning the development of a quality assurance project plan for environmental monitoring in estuaries may be obtained from the Office of Marine and Estuarine Protection (OMEP).

Selecting and Keeping Volunteers

Careful consideration should be given to the recruitment of volunteers. Participation should not be limited to the scientific community. Willing and able volunteers can be found among the retired community, environmental clubs, teachers, and other interested citizen groups. The citizen monitoring program manager or coordinator should be prepared to make a substantial investment of time in providing assistance to the volunteers.

After recruiting volunteers, it is essential to maintain their motivation and provide positive feedback to them. A survey of successful

citizen monitoring programs has identified program elements needed to maintain motivation and positive feedback. Disseminating information about their efforts was found to be a key element in motivating volunteers to participate effectively in a study of this type. The volunteers collecting the data are interested in knowing the data they collect are useful to decision makers or regulatory agencies. A newsletter may be helpful in achieving this goal. Program publicity acknowledging volunteer efforts is also a source of motivation for the volunteers. It was also found that periodic meetings among volunteer monitoring organizations for comparing notes and ideas help to maintain interest in a project. In addition, responsibility for coordinating some parts of the citizen monitoring program should be delegated to volunteers in order to encourage interest. Both interesting and tedious tasks should be rotated so that each volunteer can participate in all aspects of the program. An awards banquet can also be held to show the volunteers that their efforts are appreciated.

Managing a Citizen Monitoring Program

Once the purpose of a citizen monitoring program is established, key personnel must be selected. These personnel may include a program coordinator, volunteer technical advisors, and someone to manage and analyze the data. The coordinator of the citizen monitoring program is responsible for recruiting volunteers, establishing quality-control procedures, maintaining program files, and running the citizen monitoring program. The role of the data manager/analyst includes the maintenance of computer files and the development of report results. The citizen monitoring program can use the same data management system used by the Management Conference. This will allow the data generated by the citizen volunteers to be available to anyone interested in the estuary or the citizen monitoring program.

Recruiting volunteers is an on-going process. Throughout the duration of the project, the list of volunteers will change. Motivated volunteers will remain with the project and perhaps bring in new recruits. The coordinator should develop a system for evaluating the project so that volunteers can provide input that will strengthen the project.

Role of Citizen Monitoring in CCMPs

To augment already existing estuary monitoring programs, there are five major areas in which citizen volunteers can help (1) collecting data to characterize water resources; (2) collecting data to assist in planning and policy development; (3) functioning as "watch dogs" for enforcement and assisting in the implementation of regulations; (4) educating the public and promoting public awareness of environmental issues; and (5) collecting data for special research projects designed to address specific problems. A survey of existing citizen monitoring programs reveals a variety of data collection methodologies and objectives. Figure F.1 presents some parameters and sampling methods used by several volunteer monitoring programs and shows how these data assist decision makers. (Information describing these programs and others is available in EPA's *Directory of National Citizen Volunteer Environmental Monitoring Programs* and may be obtained from OMEP.)

Program Parameters and Sampling Methods	Characterization of Water Resources	Planning & Policy Development	Enforcement & Implementation of Regulations	Education & Public Awareness	Special Research Projects
Anne Arundel County Volunteer Monitoring Program					
pH color comparator kit; dissolved oxygen: micro winkler titration kit, water temperature thermometer; rainfall· rain gage, clarity; secchi disc, depth: secchi disc with measured line, air temperature: thermometer, salinity hydrometer, weather conditions· visual observation	X	X	X	X	X
Chesapeake Bay Citizen Monitoring Program					
Water and air temperature thermometer; ph: color comparator kit; clarity· secchi disc; depth: secchi disc with measured line; salinity· hydrometer; dissolved oxygen micro winkler titration kit, weather conditions visual observation; site characteristics· visual observation	X			X	
Boston Harbor Monitoring Program					
Temperature and salinity salinity/temperature meter, dissolved oxygen dissolved oxygen meter; charity: secchi disc	X	X	X	X	
Clean Ocean Action - Trash Attack					
Plastics, glass, and aluminum hand gathered		X		X	
Currituck Sound/Back Bay Monitoring Program					
Dissolved oxygen. micro winkler titration kit; temperature, thermometer; salinity· hydrometer, clarity secchi disc; pH color comparator kit, tide level visual observation	X	X		X	X
Rhode Island Salt Pond Watchers					
Bacteria hand collected into sterile bottles and stored in coolers until collected, chlorophyll a, nutrients, and salinity hand collected and filtered into bottles, then frozen until collected, temperature thermometer; eelgrass disease· visual observation and index chart; clarity secchi disc, dissolved oxygen· micro winkler titration kit, shoreline surveys visual observation	X	X	X	X	X
Adopt-A-Beach					
Program serves as a support program for individual projects that are monitoring a variety of parameters using well established field methodologies including· wetland characterization. visual observation; coliform levels in shellfish hand gathered, coliform levels in water hand gathered, epibenthic fauna: suction pump; marine debris. visual observation, long-term trends in bird mortality visual observation	X	X	X	X	X

FIGURE F 1 PARAMETERS AND METHODS USED BY SEVERAL CITIZEN MONITORING PROGRAMS TO COLLECT DATA AND THE GOALS THESE DATA ARE USED TO OBTAIN

Providing Data for Characterization

Citizen monitoring programs can provide frequent and time-variable sampling of water quality associated with storm events and algal blooms. Volunteers have collected data accurately, describing a number of parameters including the number and size of fish kills, precipitation levels, and the number of fish caught by recreational fishermen. The New Jersey Sea Grant citizen monitoring program, composed of members of fishing clubs, angler associations, and charter boat associations, collects data on marine recreational fishes. Volunteers can also provide ground-truthing for remote sensing data. Because of the large geographic areas covered by many citizen monitoring programs, volunteers can help assess water bodies that are not being monitored by government agencies, and collect needed samples or observations from remote locations or private property. It is difficult for volunteers to collect samples from boats because they may encounter problems locating sampling sites, personal safety cannot be assured, and bad weather can interfere with sample collection. Citizens in the Chesapeake Bay collect their data near shore; few differences in water quality have been observed between samples taken near shore and those taken from the center of tributaries to the bay.

Supporting Planning and Policy Development

Volunteer monitoring programs can complement government action; however, a clear statement of management issues and specific management questions that define the information needed for management action must be available to them. Citizen monitoring data can enhance citizen involvement in planning and policy development. Highly informed citizens can offer quality input in these ways:

- Critiquing local proposals for development.
- Acting as "expert witnesses," using trend data and information on past practices and conditions in a given area.
- Focusing attention on emerging issues.
- Forming constituencies for legislative initiatives or political actions.
- Influencing local action or ordinances.

Supporting Enforcement and Compliance

Citizen volunteers can act as "watch dogs" to ensure full implementation and enforcement of environmental regulations. Volunteers who collect samples often have a vested interest in the health and well-being of the local environment and can help the regulatory community in these ways:

- Producing an inventory of, or "red flagging," illegal pipes or discharges, and dumping sites.
- Collecting observations of excessive erosion and failed sediment control structures.
- Compiling data collected for compliance with National Pollutant Discharge Elimination System (NPDES) permits.
- Alerting officials to spills and their impacts.

Educating the Public

Citizen volunteers provide a valuable link to the local community. The "Adopt-A-Stream" program, established in the Pacific Northwest to promote environmental education and stream enhancement, provides a good example of public education through volunteer monitoring. Volunteers participate in the restoration of adopted streams to their original condition. Projects like "Adopt-A-Stream" promote the concept of stewardship for the resource being monitored. Such programs also help to instill a conservation ethic in local communities.

Providing Data for Research

Citizen monitoring can provide data for special research projects, such as shoreline cleanups, ground-truthing of submerged aquatic vegetation, wetland inventories, and other surveys. Volunteers can collect samples in remote locations at frequent intervals.

Citizen Monitoring Manual

EPA's Office of Marine and Estuarine Protection and Office of Water Regulations and Standards are jointly developing a detailed manual for citizen monitoring program managers. The manual will address how to do the following:

- Plan a citizen monitoring program.
- Develop a quality control/quality assurance plan.
- Raise money to support the program.
- Train volunteers.
- Select sampling equipment.
- Select parameters to measure.
- Develop a data management system.

For additional assistance, some citizen monitoring programs produce newsletters that are available to interested individuals. A list of the existing programs is provided in the *Directory of National Citizen Volunteer Environmental Monitoring Programs*, which is updated annually. Contact OMEP for more information or to receive a copy of these publications.