UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 14 1992

THE ADMINISTRATOR

Honorable William F. Weld
Governor
Commonwealth of Massachusetts
Boston, Massachusetts 02133

Dear Bill:

It is my pleasure to officially approve the Comprehensive Conservation and Management Plan (CCMP) submitted for Buzzards Bay. The Buzzards Bay CCMP is only the second CCMP to be completed and approved under the National Estuary Program, Section 320 of the Clean Water Act. With this approval, funds become available for monitoring and oversight of CCMP implementation.

I want to congratulate the Commonwealth of Massachusetts and the communities of Buzzards Bay for their exceptional cooperation and leadership during the development of the CCMP. This is a time of economic worry and mounting concern about the ability of government at all levels to take constructive action. With the Buzzards Bay CCMP, we now have an outstanding demonstration of commitment to the protection of estuaries by state and local governments, as well as a model for innovative, targeted management. The priorities you have chosen to address in Fiscal Year 1992 provide important milestones to evaluate the effectiveness of the actions you have recommended, as well as build the critical momentum to carry you towards full implementation of the CCMP.

We at the Environmental Protection Agency look forward to working further with the Commonwealth of Massachusetts and the communities of Buzzards Bay in ensuring the restoration and protection of this vital aquatic ecosystem for future generations.

Sincerely yours,

Bill

William K. Reilly

A fine accomplishment that should put protection efforts on a firm foundation!

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street, Boston, 02202

WILLIAM F. WELD
GOVERNOR

ARGEO PAUL CELLUCCI
LIEUTENANT GOVERNOR

SUSAN F. TIERNEY
SECRETARY

(617) 727-9800

September 11, 1991

The Honorable William Reilly
Administrator of EPA
Washington, D.C. 20460

Dear Administrator Reilly:

I am pleased to submit for your review and approval the Buzzards Bay Comprehensive Conservation and Management Plan.

I have examined this Management Plan, and as Governor, approve it. The public and officials from all levels of government have had an opportunity to review and comment on the document. The Plan has also been reviewed and approved by the Massachusetts Coastal Zone Management Office and has been determined to be consistent with Massachusetts Coastal Zone Management Policy.

Upon your approval, I look forward to formally incorporating this document into our Coastal Zone Management Program to establish its goals and objectives as official state policy and help ensure that the Buzzards Bay area is protected as a special resource for both the Commonwealth and the Nation.

Sincerely,

W. Wm F. Weld

William Weld
Governor

Acknowledgements

Volume I of the Buzzards Bay Comprehensive Conservation and Management Plan (CCMP) is the work of many dedicated people. The Buzzards Bay Project staff was instrumental in preparing this document. At the Massachusetts Coastal Zone Management Office (MCZM) those who participated were Joseph Costa (Project Manager), Mara Altman, David Janik, Neil MacGaffey, Claudia Shambaugh, Tracy Warncke, and Judith Pederson. The U.S. Environmental Protection Agency (EPA) participants were Carol Kilbride, Bruce Rosinoff, and Gwen Ruta. Bruce Rosinoff deserves special recognition for preparing initial drafts of most of the action plans and chapters and for incorporating new or revised material into subsequent drafts. The CCMP Editorial Board also wrote parts of the CCMP and revised the document to incorporate comments by reviewers. Members were Joseph Costa, Gwen Ruta, Carol Kilbride, Bruce Rosinoff, and Judith Pederson. Joseph Costa was managing editor and oversaw the revision and production of the CCMP. The technical editor was Victoria Gibson. Special thanks to Tracy Warncke, who typed most of this and other drafts and exhibited grace and professionalism under pressure.

Most of the CCMP was reviewed by members of the Buzzards Bay Management Committee and its various subcommittees. All past and present Buzzards Bay committee members are listed on the following pages. The chairpersons of these committees played important roles.

Many others provided invaluable assistance in developing and writing the CCMP. These include Jeff Benoit, Steve Bliven, Sue Moor, Jan Smith, MCZM; Eric Hall, Ray Hall, Ron Manfredonia, Bob Morehouse, EPA; Bill Hubbard, Army Corps of Engineers; George Heufelder, Barnstable County Health and Environmental Department; Tom Barlow, Town of Bourne; Mark Robinson, the Compact of Cape Cod Conservation Trusts, Inc.; Larry Gil, Steve Halterman, Department of Environmental Protection; Charlie Swain, Town of Falmouth; Stan Humphries, IEP; Tom Bigford, National Marine Fisheries Service; Bill Napolitano, Steve Smith, Southeast Regional Planning and Economic Development District; and Graham Giese, and Bruce Tripp, Woods Hole Oceanographic Institution. Horsley Witten Hegemann, Inc. merits a special acknowledgement for its major contribution to Chapter 7, Land-Use Management, and for helping implement the Project's nitrogen management strategy in Buttermilk Bay.

The Buzzards Bay Project has a long history involving many people. The original coordinators, Wendy Wiltse, formerly of EPA Region I, and Bruce Tripp, formerly of the Massachusetts Executive Office of Environmental Affairs, together with Rich Delaney and Steve Bliven of MCZM, Dave Fierra of EPA, Judith McDowell-Capuzzo of Woods Hole Oceanographic Institution, and Ted Pratt of the Town of Marion, were instrumental in establishing the direction of the Project. Ted Pratt was also the inspiration behind many local strategies contained in the CCMP and he made the Buzzards Bay Action Committee into an effective political force. Special thanks are due to Alan Hankin and Barbara Sego of the Katharine Nordell Lloyd Center for Environmental Studies for producing the Buzzards Bay Project Newsletter and organizing and administering many Project workshops, meetings, and press events. Thanks also to Sue Beede, EPA, and Tom Fantozzi, formerly of MCZM, who reached out to the public and municipalities in the Project's early days, and especially to Mimi McConnell who turned the Coalition for Buzzards Bay into a strong citizens advocacy group in support of the CCMP. The Town of Marion graciously provides office space to the Project. Finally, thanks to all scientists, planners, town, state and federal officials, and interested citizens who have made the Project a success.

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Former: Alan Hankin, Ph.D., Stephen Silva, Wendy Wiltse,Ph.D.

Table Of Contents

List of Tables

List of Figures

Chapter 1

Introduction to the Comprehensive Conservation and Management Plan

What Is the Comprehensive Conservation and Management Plan?

In 1985, the Buzzards Bay Project was established with the goal of developing and implementing management recommendations that would preserve and protect water quality and living resources in Buzzards Bay. The development of the Buzzards Bay CCMP is an example of an emerging nationwide effort to develop management strategies that take into account the uniqueness of certain coastal areas. This "special area management" approach is being successfully carried out in several other regions, including Chesapeake Bay, the Great Lakes, Puget Sound, and San Francisco Bay. This Comprehensive Conservation and Management Plan (CCMP) is one of the first of several such plans currently under development in other estuarine areas designated as part of the National Estuary Program of the U.S. Environmental Protection Agency (EPA).

This Comprehensive Conservation and Management Plan for Buzzards Bay lays out an approach for achieving the goal of a clean and healthy Bay. The CCMP is based on the scientific and technical information gathered by the Buzzards Bay Project over the past five years and an analysis of the present regulatory programs designed to protect the Bay.

The Buzzards Bay CCMP is a three-volume document. The main document is the Management Recommendations and Action Plans. It contains a synopsis of the problems facing the region and detailed recommendations on how to protect and preserve water quality and living resources in Buzzards Bay. The Management Recommendations and Action Plans identifies what actions need to be taken and who should take them. Two volumes complement the Management Recommendations and Action Plans — the CCMP Financial Plan and the CCMP Monitoring Plan.

Environmental protection often costs money and uses human resources. The Financial Plan will identify the costs associated with certain management actions recommended in the CCMP and financial strategies for meeting them. The Buzzards Bay Project has investigated a variety of funding sources to underwrite the costs of implementing recommendations in the CCMP and this information is also included in the Financial Plan.

Environmental management also requires a coherent and effective monitoring strategy to determine if actions taken are effective and warrant further expenditures. In order to judge the success of this Project over time, data that show a reduction in pollution discharged into the Bay must be collected. These needs are addressed in the Monitoring Plan, which contains the overall monitoring goals for Buzzards Bay, the specific

environmental quality questions being asked, and the methods and approaches to answer those questions.

Those seeking detailed information on various aspects of the Project will have access to other documents including a Pollution Characterization Report; a Report on Living Resources of Buzzards Bay; and the Buzzards Bay Project Technical Report Series, which contains technical and scientific papers on issues and problems facing Buzzards Bay.

During the summer and fall of 1990, the CCMP was presented to the public for review and comment. At the same time, it was sent to all government organizations that have the responsibility to implement its recommendations. A series of meetings and hearings were held throughout Buzzards Bay to discuss the recommendations and receive comments. This document reflects the comments that were received both verbally and in writing during the review period. It also reflects additional comments received on an interim draft completed in May 1991.

Completion of the CCMP is not the end of the Buzzards Bay Project, but a beginning. Implementation of the plan will be a top priority for the Project in the coming years. Because new insights and technological advances are expected, periodic revisions will serve to update the plan.

What Does the Management Plan Address?

The Buzzards Bay Project identified three pollution problems that require management attention: health risks from pathogens associated with the improper treatment or disposal of human wastes, and the subsequent closure of shellfish beds; excessive nutrient inputs to the Bay, and their potential for causing water quality degradation and loss of habitat; and contamination of fish, shellfish, and lobsters by toxic substances such as trace metals, hydrocarbons, pesticides, and polychlorinated biphenyls (PCBs). The loss of marine habitat and resources because of pollution and physical disturbances is also a major concern of the Project. These problems are the focus of the management recommendations in the CCMP.

This CCMP has evolved from discussions with the Buzzards Bay Project's committees, concerned citizens, local officials, and the public. Scientific and technical studies sponsored by the Project, in part, served as the basis for the plan. This information, combined with the knowledge gained from other estuarine programs and studies, has been transformed into a set of management recommendations and strategies. These recommendations cover a wide range of activities including changing individual habits, strengthening regulations and bylaws, and planning for actions that minimize the impact of pollution sources such as stormwater runoff and wastewater. Recommendations are found in Chapter 5, which includes 11 action plans; in Chapter 6, where special problems faced by the City of New Bedford are discussed; and in Chapter 7, where specific options for management of land use are presented. These action plans form the "core" of the CCMP. Other chapters in this document provide additional information that supports the major action recommendations. In summary, the CCMP identifies what needs to be done, why it is necessary, and who should do it.

The CCMP is written for the benefit of the public — the people who live around Buzzards Bay, those who visit the region, and anyone who uses or benefits from the Bay. The CCMP is directed at various target audiences and includes specific recommendations for the public and for federal, state, and local agencies.

The municipalities around Buzzards Bay are a major target audience for actions in the CCMP. This is because nonpoint sources of pollution and cumulative impacts caused by growth and development (including pathogen contamination and nitrogen loading) are leading cause of habitat loss and water quality degradation in much of the Bay; these impacts must be managed and controlled locally. The state and federal governments have limited authority and capacity to deal with problems of this kind. The future of Buzzards Bay rests with the communities and their ability to control the quality of their environment.

Among the municipalities in the Buzzards Bay region, New Bedford is beset with a special set of problems. One feature of Buzzards Bay demography is that 60% of the population within the drainage basin resides within the greater New Bedford area. The dense development and intense industrial activity in and around New Bedford has resulted in a highly contaminated estuary. Solutions to New Bedford's problems will require close coordination and cooperation between the city and state and federal agencies. Some of the pollution from New Bedford affects mainly that city and adjacent towns. For these reasons an entire chapter focuses on the special needs and problems faced by New Bedford. For the most part, however, the CCMP focuses primarily on non-point and cumulative pollution impact issues outside the greater New Bedford area allowing state and federal efforts to address the Superfund site cleanup and the Sewage Treatment Wastewater Facility ongoing siting and upgrade.

Management Plan Organization

This Management Plan is organized into chapters on significant issues. Chapter 2 describes the history of the Project and Management Plan; Chapter 3 covers salient features of the Bay and its surrounding drainage basin; and Chapter 4 describes the scientific findings of the Project, particularly the characterization of pollution sources in the Bay. Chapter 5 contains the action plans; Chapter 6 highlights the special needs of New Bedford; Chapter 7 assesses various strategies for land-use management; and Chapter 8 outlines the Buttermilk Bay case study. Chapter 9 presents a strategy for how the action plans should be implemented; and the index, glossary, and appendixes facilitate the use of this document.

In August 1991, representatives of EPA and the Commonwealth of Massachusetts signed a pledge of commitment to support the goals of the Buzzards Bay Management Conference, to restore and protect environmental quality, and to implement the Comprehensive Conservation and Management Plan. The pledge underscores the long-term commitment to the vision of a clean Bay for future generations.

Pledge for
BUZZARDS BAY

WE, the undersigned, find and declare that —

Buzzards Bay is an important natural resource that provides incomparable beauty and significant recreational and commercial benefits;

The Bay's living resources, water quality, and aesthetic character have suffered from rapid development and other human uses; and

Restoration and protection of the Bay's environmental quality require focused management by a partnership of Federal, State and local governments, affected industries, academia, and the public.

WE therefore pledge to support the goals of the Buzzards Bay Management Conference and we commit to restore and protect the environmental quality of Buzzards Bay through the implementation of the Comprehensive Conservation and Management Plan.

Julie Belaga

Julie Belaga
Regional Administrator
U.S. Environmental Protection Agency
Region I

Susan F. Tierney

Susan Tierney
Secretary
Massachusetts Executive Office of Environmental Affairs

Dated this 16th day of August, 1991

Chapter 2

History and Accomplishments of the Project

What Is the Buzzards Bay Project?

The Buzzards Bay Project is one of the first estuary protection programs in the country. It was initiated in 1985 under the joint management of the U.S. Environmental Protection Agency (EPA) and the Massachusetts Executive Office of Environmental Affairs (EOEA). From the beginning, the Project had a threefold objective: (1) to set up a management structure to coordinate Project activities and help achieve long-term goals; (2) to identify and research the priority water quality problems in Buzzards Bay; and (3) based upon these findings, to develop a management plan for the protection of the Bay's water quality and valuable resources.

On January 29, 1988, Buzzards Bay was officially designated "an estuary of national significance" within the National Estuary Program, in accordance with the provisions of the Water Quality Act. This event represented a renewed commitment on the part of the Project's participants to improve and protect the environmental quality of Buzzards Bay.

The culmination of the information-gathering phase of the Buzzards Bay Project is a long-term management plan, and Buzzards Bay is one of the first estuary programs in the country to draft its blueprint for the future. This document, called the Comprehensive Conservation and Management Plan (CCMP), is the result of five years of research and demonstration activities designed to help understand the most pressing problems in the Bay and to identify the solutions.

Buzzards Bay Project Milestones

1985	Buzzards Bay Project established.
	Management, Technical Advisory, and Citizens Advisory Committees established.
	Characterization, research, and assessment activities begin. Public outreach/education begins.
1987	Citizens Advisory Committee splits into the Coalition for Buzzards Bay (citizens advocacy group) and the Buzzards Bay Advisory Committee (town officials).
1988	Buzzards Bay designated in the National Estuary Program.
1989	Project holds management goals workshops to identify goals for the Management Plan.
1990	Management Plan Advisory Committee established.CCMP drafted, reviewed by state and federal agencies, and open for public comment.
1991	12 municipalities surrounding the Bay sign the BuzzardsBay Compact for the protection of Buzzards Bay and implementation of the CCMP
1991	CCMP finalized and approved by the Commonwealth and EPA.
1991-93	Buzzards Bay Project will guide and oversee implementation of CCMP.

Why Buzzards Bay?

Buzzards Bay is a valuable resource, important for its economic, recreational, and aesthetic values. The economic resources of the Bay range from the harvest of its rich fisheries to its use as a transit route for the New Bedford fishing fleet and for shipping

through the Cape Cod Canal. Its ragged coastline is beautiful and provides many opportunities for fishing, boating, and bathing, as well as critical habitat for a variety of plant and animal species. Buzzards Bay also offers educational and research opportunities to the research laboratories and academic institutions located throughout the region.

The various uses of Buzzards Bay often conflict. Harbors used for swimming and harvest of shellfish double as discharge sites for residential and industrial wastewater. Approximately 18,000 acres surrounding New Bedford Harbor have high levels of polychlorinated biphenyls (PCBs) and are closed to the taking of lobsters, finfish, and shellfish. Burgeoning development has made Barnstable County the fastest growing county in New England and has contributed to declining water quality. Proliferation of boats and piers is causing habitat loss in many of the smaller bays and harbors. Industrial pollution and accelerated residential development combine to threaten the environmental and economic health of Buzzards Bay.

Despite these changes, Buzzards Bay is still considered a relatively pristine estuary. The Buzzards Bay Project developed this plan as a way to prevent further degradation and restore impacted areas.

What Is the National Estuary Program?

Recognizing the threats to our nation's estuaries, the United States Congress appropriated $4 million to EPA in 1985 for study and assessment of four major estuaries around the country. Along with Buzzards Bay, the other estuaries selected for study were Narragansett Bay in Rhode Island and Massachusetts; Long Island Sound in New York and Connecticut; and Puget Sound in Washington. These efforts were the precursor of EPA's National Estuary Program — a framework for addressing pollution problems and the effects of overuse and development and for preparing comprehensive management plans to ensure an estuary's ecological integrity.

The goals of the National Estuary Program (NEP) are protection and improvement water quality and enhancement of living resources. To achieve these goals, the NEP works to

- 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
- Oversee development and implementation of pollution abatement and control programs.

Two major themes of the NEP are (1) a phased program approach to identify and define priority problems, establish their probable causes, and devise strategies to address them; and (2) a collaborative problem-solving process that involves all concerned parties in each phase of the program and secures commitments to carry out recommended actions.

Through 1986, program activities in the four selected estuaries were supported by broad legislative authorities and funding appropriations. 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 formally established the NEP. Section 317 of the Act 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 of the Clean Water Act 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.

What Is the Buzzards Bay Project?

The management structure of the Buzzards Bay Project includes groups that are committed to the development and implementation of the management plan. These groups are the key to the Project's success and together make up the Management Conference (Figure 2.1). They include members from the research community, public interest groups, local government, and state and federal resource-management agencies.

Policy decisions, project management, citizen and local involvement, and scientific advice are all necessary components of a successful Buzzards Bay Project. To accommodate the variety of interests and expertise, organizations and perspectives, the Project is organized into five committees that bring together people concerned with different aspects of a comprehensive estuarine management program. Members of each committee are listed in the acknowledgements section at the front of this document.

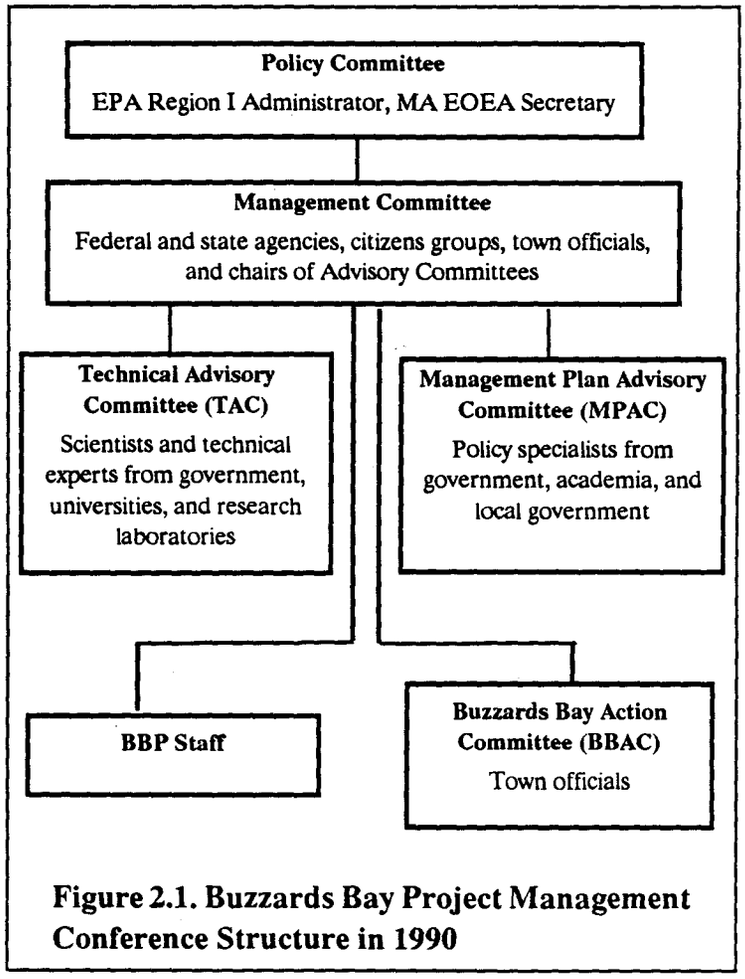


Figure 2.1. Buzzards Bay Project Management Conference Structure in 1990

Policy Committee

The Policy Committee sets the overall policy of the Buzzards Bay Project and ensures that a coordinated federal and state effort is made to address resource management decisions in the Bay. The Policy Committee is composed of the Regional Administrator of EPA Region

I and the Secretary of the EOEA of the Commonwealth of Massachusetts.

Management Committee

The Management Committee directs program activities for the Project. It formulates a long-term strategy for the management of Bay resources and develops annual work plans for research, monitoring, and pollution control. Membership includes representatives from various state and federal agencies, regional planning commissions that have responsibility for coastal environmental quality in and around the Bay, local communities, and the public.

Technical Advisory Committee

The Technical Advisory Committee serves as a forum for scientific input and advice on issues relating to Buzzards Bay. Membership is drawn from the academic institutions and state and federal agencies that are active in research, monitoring, and resource assessment. This committee reviews annual work plans, research proposals, and technical reports, and provides overall scientific direction to the various funded studies.

Buzzards Bay Advisory Committee

The Buzzards Bay Advisory Committee (BBAC), now known as the Buzzards Bay Action Committee facilitates regional communication and cooperation among municipal agencies concerned with the management of Buzzards Bay and its watersheds. This committee has been instrumental in developing the CCMP and will have a continuing role in its implementation. The group is composed primarily of local officials from the communities surrounding Buzzards Bay. The Action Committee is no longer a subcommittee of the Buzzards Bay Management Conference and became an independent, non-profit organization in 1991. The BBAC does remain a voting member of the Management Committee. The BBAC originated in 1987 when the Buzzards Bay Project's Citizen Advisory Committee divided into two groups, the Buzzards Bay Advisory Committee, and the Coalition for Buzzards Bay, a non-profit citizen's group, which like the BBAC is a voting member of the Management Committee.

Management Plan Advisory Committee

The Management Plan Advisory Committee consisted of administrators and marine policy specialists from local, state, and federal agencies and from academia. Its primary function was to assist with the development of the management plan, particularly with respect to state and local policies. This Committee was dissolved in 1990 shortly after the first public draft of the CCMP was released.

How is the Project Funded?

Prior to 1988, the Buzzards Bay Project received 95% of its funding from the federal government through a grant from EPA. Since 1988, the Commonwealth of Massachusetts has contributed at least 25% of the Project's annual budget.

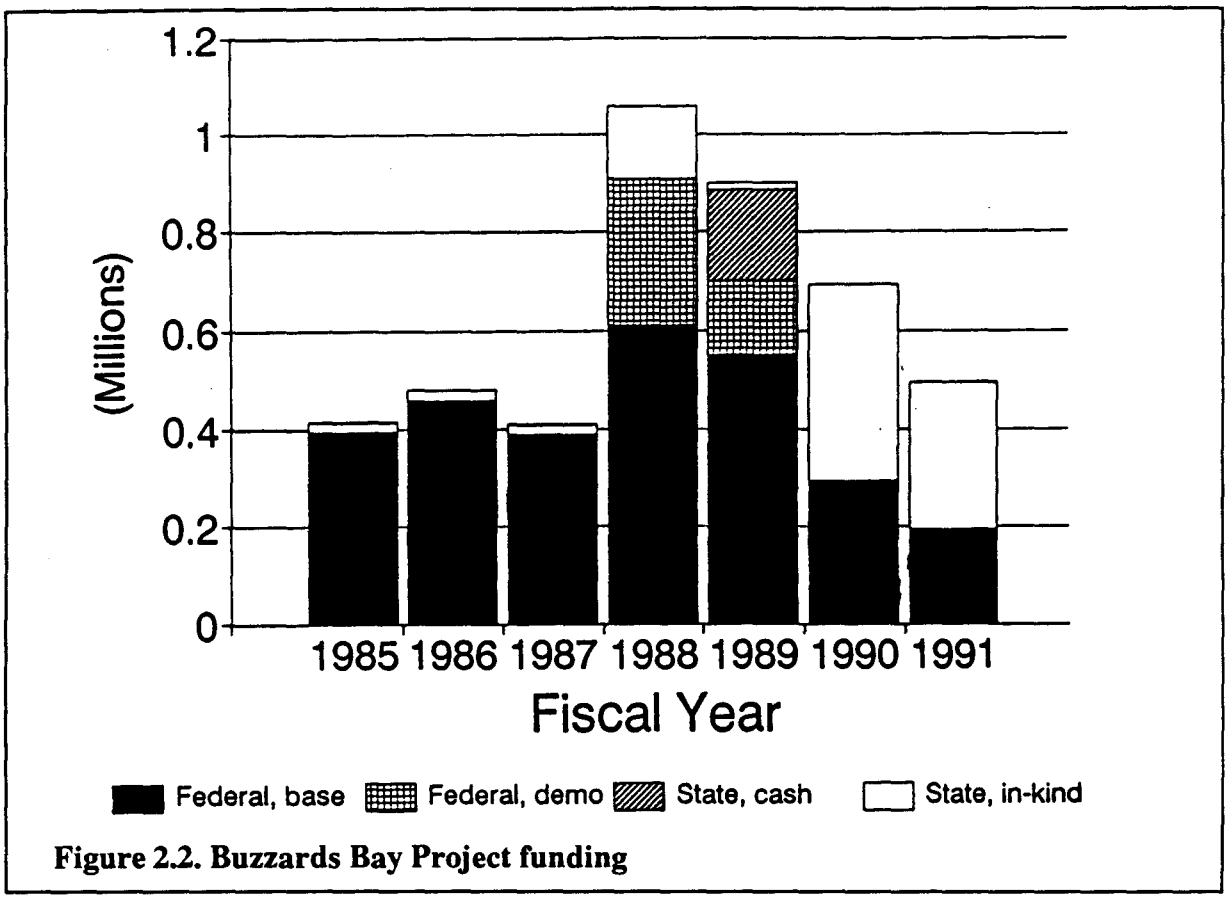


Figure 2.2. Buzzards Bay Project funding

How has the Project Addressed Priority Problems?

Between 1985 and 1989, the Buzzards Bay Project funded a number of studies to assess and characterize existing conditions in the Bay, including the status of water quality, sediments, and living resources. Based on these studies and results from prior research and scientific investigations, the Management Conference, through the process of consensus-building, identified the three priority problems in Buzzards Bay — closure of shellfish beds due to contamination by disease-causing bacteria and viruses known as pathogens; high nutrient inputs and their impact on coastal ecosystems and habitat; and contamination of fish, lobsters, and shellfish by toxic metals and organic compounds, such as PCBs.

The Buzzards Bay Project began addressing these priority problems in 1985 by collecting and evaluating historical information; conducting baywide surveys of water, sediment, and biota quality; and investigating the relationship between land-use practices, nutrient enrichment, and the closure of shellfish beds. Over the past five years, the Buzzards Bay Project has funded a number of studies designed to better understand the relationship between pollutants in the environment and their impacts on the resources of Buzzards Bay, including its water quality.

1989 Community Minigrant Awards

The Community Minigrant Program was established by the Buzzards Bay Advisory Committee to support local efforts at addressing priority issues in water quality, resource management, and land use. In July, 1989, seven grants totaling nearly $100,000 were awarded; eight communities received funds in amounts from $5,000 to $25,000. These projects are intended to serve as models for other communities facing similar problems.

- New Bedford and Fairhaven: Design a plan for pump-out facilities to handle sanitary wastes and used oil from commercial fishing vessels.
- Dartmouth: Delineate the Buttonwood Brook Watershed, document land-use patterns, and develop a water quality management plan.
- Acushnet, Rochester, Marion: Establish a Regional Health District and hire a regional sanitarian to assist the towns in carrying out state and local requirements for the sanitary code (Title 5).
- Wareham: Establish a grid system for moorings in the harbor.
- Fairhaven: Educate town boards on legal responsibilities and facilitate coordination between boards within and between towns.
- Westport: Establish a mobile marine pump-out program in the Westport River.
- Marion: Implement a citizen's monitoring program to collect water quality samples.

Funds from the Buzzards Bay Project have been used not only to study the problems of the Bay, but also to demonstrate the effectiveness of a variety of actions to help clean up the Bay and to educate and involve the public in the Project. For example, the Buzzards Bay Project has funded two large-scale demonstration projects to address stormwater and sanitary wastes. In addition, the Project (through the Buzzards Bay Action Committee) awarded area communities nearly $100,000 in 1989 to encourage and support local efforts at improving and protecting the resources of Buzzards Bay. In 1990 the Project will award nearly $140,000 for a variety of activities including coastal resource mapping, oil spill containment, stormwater treatment and boat pumpout facilities.

The Buzzards Bay Project has sponsored continuing efforts to inform the public, interest groups, and local and state agencies about the water quality problems and resources of Buzzards Bay and to stimulate interest and communication regarding the Buzzards Bay Project. The Lloyd Center for Environmental Studies in South Dartmouth, Massachusetts, has worked in this field since the beginning of the Project and has undertaken a variety of activities to carry out a well-balanced program of public education.

Prior to 1991 the Lloyd Center produced quarterly newsletters that contained lists of upcoming events, research updates, and environmental news from around the Bay. The newsletter was distributed baywide to over 1,500 people. Fact sheets on important issues affecting the Bay have also been produced and distributed throughout the region. The Lloyd Center has also arranged and conducted many public events and workshops on behalf of the

Project on such important topics as environmental testing, model bylaws, and the state of Buzzards Bay. A traveling display, which includes a free- standing exhibit and a slide show with audio tape, was prepared by the Lloyd Center. The display is set up at libraries, public buildings, conferences, and meetings. The staff of the Lloyd Center also uses the slide show to give presentations to garden clubs, environmental groups, and other organizations around the Bay.

The Buzzards Bay Project now produces an "in-house" newsletter containing pertinent information about the Project and news stories that affect the protection of the Bay. The project will also continue to distribute fact sheets on relevant subject matter.

The Buzzards Bay Project believes that it is important to educate young citizens about the Bay. As part of the public education program, the Lloyd Center has developed a curriculum for use in local schools. The curriculum stresses the Bay as a resource, the problems facing the Bay, and the role of the individual in protecting the Bay.

A second, and equally important role, of the Project's outreach efforts has been to ensure and facilitate adequate public involvement. In 1985, environmental organizations and municipalities around the Bay joined together to form a Citizen's Advisory Committee to work with the Buzzards Bay Project. One goal of this group was to create an organization that would continue to bring organizations, municipalities, and individuals together on behalf of the Bay for generations to come and would serve as an advocate for environmental issues of concern to the region. On Buzzards Bay Day, October 11, 1986, the Committee overwhelmingly confirmed the establishment of the Coalition for Buzzards Bay, a baywide citizen's advocacy organization.

The Coalition for Buzzards Bay is an independent nonprofit, tax-exempt organization dedicated to inform and involve the public in the cleanup, restoration, and protection of Buzzards Bay. During the past four years, the Coalition for Buzzards Bay has grown to more than 600 members and is a strong and viable force committed to protecting the future of Buzzards Bay.

Since 1985, the Project has sponsored a number of meetings and workshops on problems facing Buzzards Bay. In 1989, the Project held a series of workshops specifically for citizens and local officials of Buzzards Bay communities. At these workshops, scientific findings were presented and the Project entertained suggestions on how problems in the Bay should be managed within the existing regulatory framework at the state and local levels. Many of the initial recommendations in the CCMP were developed from the dialogue that occurred during the workshops.

Chapter 3

The Buzzards Bay Setting: The Bay, Its Drainage Basin and Living Resources

Buzzards Bay is a moderately large estuary located between the western most part of Cape Cod, Southeastern Massachusetts, and the Elizabeth Islands. The bay is 28 miles long (45 kilometers), averages about 8 miles (12 kilometers) in width, and has a mean depth of 36 feet (11 meters). It is approximately 228 square miles (590 square kilometers) in size. The coastline stretches over 280 miles (470 kilometers) and includes 11 miles (18 kilometers) of public beaches that lure thousands of tourists from Massachusetts and neighboring states.

The Buzzards Bay drainage basin (Figure 3.1) covers 432 square miles (1120 square kilometers) and includes all or sections of 17 municipalities[1]. The ratio of land to water surface is 1.9:1; this is low compared to estuaries such as Chesapeake Bay and Delaware Bay, which have land-to-water ratios of 14.5:1 and 17.3:1 respectively. Approximately 236,000 people reside in the drainage basin at an average concentration of 540 per square mile, or 0.84 people per acre. The Bay itself is part of an interconnected hydrologic system that includes several rivers. Groundwater seepage is also part of the inflow to Buzzards Bay.

Along its western shore (west of the Cape Cod Canal) the drainage basin is formed by seven major river basins and a number of smaller ones. The largest river basins include the Agawam, Wankinco, Weweantic, Mattapoisett, Acushnet, Paskamanset, and Westport.

The eastern shore of Buzzards Bay (Cape Cod Canal to Woods Hole) is drained mostly by groundwater. Several river systems smaller than those on the western shore also drain this portion of the basin. The prominent freshwater streams along the eastern shore are the Back , Pocasset, and Wild Harbor Rivers and Herring Brook.

In general, rivers within the drainage basin are slow-moving, meandering streams near their headwaters and for most of their freshwater length. Nearing the coast, the action of the tides rapidly widens the channels as the transition occurs from freshwater stream to tidal estuary. On average, Buzzards Bay rivers are considerably shorter (usually much less than 20 miles (34 kilometers)) and have smaller drainage areas than other rivers within the state.

Physical Features of the Bay

The Bay was formed during the last ice age approximately 15,000 years ago. Before that, Buzzards Bay was periodically submerged as glaciers advanced and retreated through the region, causing sea levels to rise and fall. The southeastern side of the Bay (Bourne,

1 The Buzzards Bay basin includes small portions of two additional communities in Massachusetts and portions of three communities in Rhode Island. Refer to Appendix B for more details.

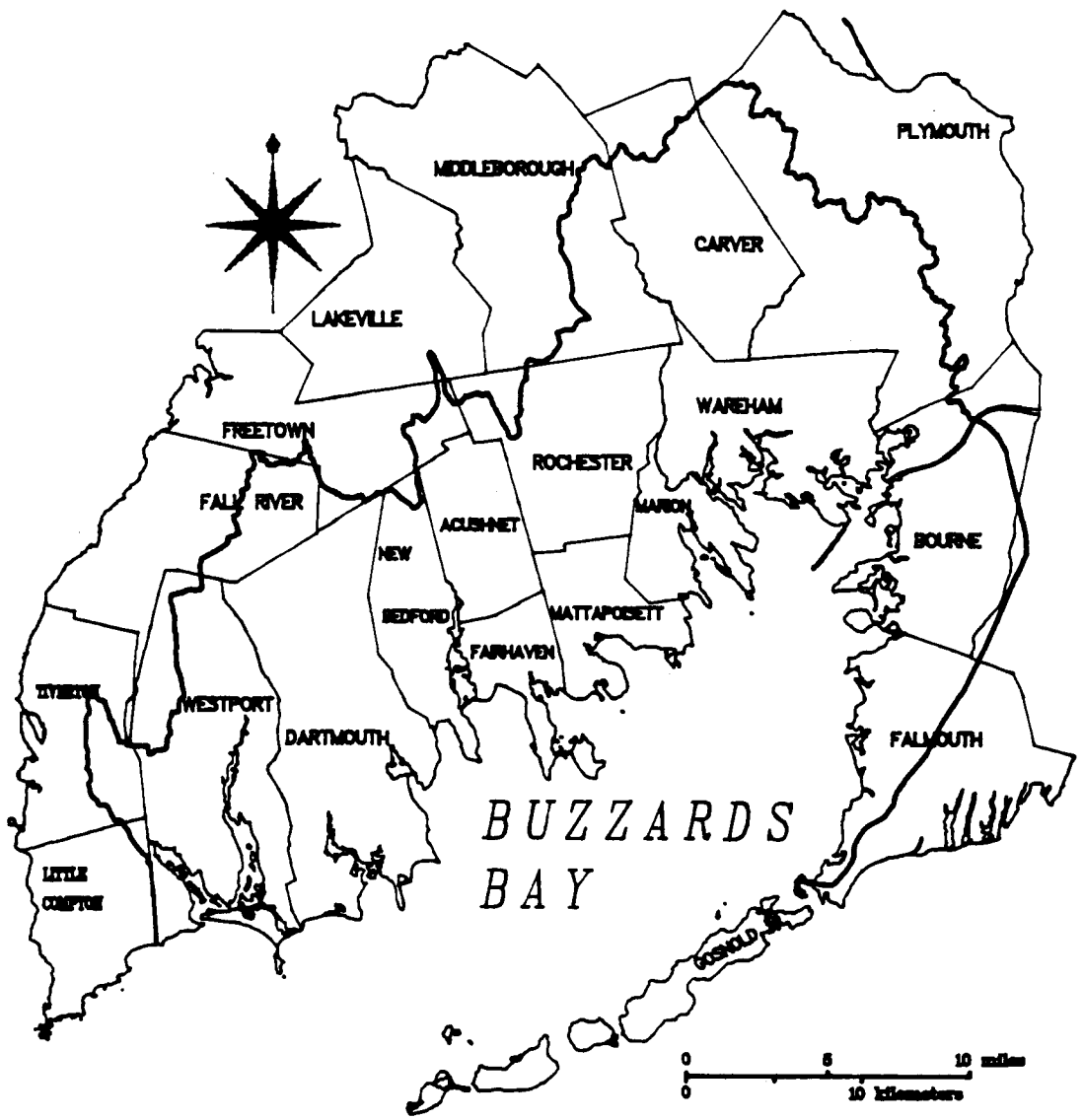
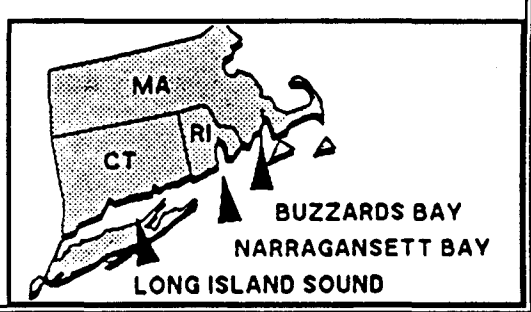


Figure 3.1. Buzzards Bay and its drainage basin

Town boundaries provided by MassGIS and digitized from 1:25000 scale USGS quadrangle maps. Basin boundary compiled by USGS-WRD and digitized by MassGIS. Cape Cod side basin boundary based on interpretation of water table elevation contours published in Hydrologic Atlas No. HA-692.



Falmouth, and the Elizabeth Islands) consists of glacial debris deposited by the glacier's leading edge. Consequently, it has a relatively smooth shoreline composed mostly of sand and gravel particles. The northwestern side (Wareham to Westport), with its numerous elongated bays and inlets, was formed by the glacier's retreat to the north. Many of these bays and inlets have since become sheltered from the ocean through the formation of barrier spits.

The distribution and stability of a bay environment depends on three primary physical characteristics of the water: circulation, salinity, and temperature. Tidal currents and wind are the dominant circulation forces in Buzzards Bay because the Elizabeth Islands protect the bay from large, long-period, open-ocean waves. Complete tidal mixing of Bay water with ocean water is estimated to occur every 10 days (Signell, 1987).

Water temperatures in the Bay range from a summer maximum of 71.6°F (22°C) to 28°F (-3°C) in winter. During colder winters, the upper reaches of the Bay often freeze, whereas during the spring and summer, solar warming keeps surface waters warmer than the deeper waters. The water temperature gradually decreases in relation to depth until a point is reached at which the temperature drops abruptly. Below that point, known as the thermocline, the temperature resumes a gradual drop until the coldest depths are reached at the bottom. The thermocline can act as a barrier to vertical mixing within estuaries and bays. Water turbulence helps to break up the thermocline and diminish layering. The shallowness of the Bay, combined with surface wave mixing and turbulent tidal flow, prevents strong thermal stratification, so that the Bay is well mixed through most of the year.

Salinity has a small annual range and gradually increases offshore. There are few large streams bringing fresh water into the Bay, with the result that salinity offshore is essentially the same as that of other embayments, such as Block Island and Vineyard Sounds, that receive relatively little fresh water. In the semienclosed embayments along shore, salinity is more variable. Overall, the Bay is a tidally dominated, well-mixed estuarine system.

Land Use Within the Bay

Much of Buzzards Bay remains undeveloped, with slightly over 60% of the land classified as forest[2] and 14% of the land classified in the residential/ commercial/ industrial categories (Table 3.1). Much of the forested land is away from the coast. When land use within a half mile of the coast is examined, only 40% is forested, and more than 30% is in the residential/industrial/commercial categories. Within specific embayment drainage basins, there is considerable variation as well. In the Buttermilk Bay drainage basin, 70% of the land is forested and 16% is developed, whereas in the Apponagansett Bay drainage basin, 37% is forested and over 31% is developed (Table 3.1). The large amount of undeveloped land highlights the importance of wise land-use planning to protect Buzzards Bay.

2 Figure as of 1984 from MassGIS database. Aerial surveys were conducted during a "leaf on" period, hence the low density development areas with dense tree cover may be underestimated somewhat and the forest overestimated. Land that has been already subdivided but has not been cleared or had structures built on it will generally fall in the "forest" category. The forest category also includes forested wetlands.

Table 3.1 Comparisons of land use in the Buzzards Bay drainage basin[1]

Land-Use Type	whole basin acreage	%	1/2 mile buffer of whole basin acreage	%	Buttermilk Bay acreage	%	Apponagansett Bay acreage	%
Cropland	9256	3.5	2478	4.6	72	1.0	159	4.6
Pasture	6161	3.4	1092	2.0	27	0.4	320	9.3
Forest	161153	61.5	21927	40.6	4408	70.0	1286	37.2
Non-Forest Wetland	4766	1.8	585	1.1	81	1.3	45	1.3
Mining	1585	0.6	348	0.6	0	0.0	8	0.2
Open Land	12675	4.8	2775	5.1	68	1.1	164	4.7
Particip. Recreation	778	0.3	197	0.4	0	0.0	4	0.1
Spectator Recreation	520	0.2	190	0.4	2	0.0	6	0.2
Water-Based Recreation	2045	0.8	1372	2.5	4	0.0	59	1.7
Resid.,Multi-Family	834	0.3	166	0.3	16	0.2	13	0.4
Resid., 1/4 Ac. Lots	6850	2.6	3858	7.1	272	4.3	82	2.4
Resid., 1/4-1/2 Ac. Lots	14045	5.4	5629	10.4	539	8.6	777	22.5
Resid., 1/2 Ac. lots	12572	4.8	5113	9.5	159	2.5	176	5.1
Salt Marsh	4907	1.9	4505	8.3	8	0.1	286	8.3
Commercial	2415	0.9	1156	2.1	23	0.4	21	0.6
Industrial	1380	0.5	688	1.3	0	0.0	10	0.3
Urban Open	4568	1.7	920	1.7	62.1	1.0	41	1.2
Transportation	3515	1.8	490	0.9	44	0.7	0	0.0
Waste Disposal	822	0.3	70	0.1	4	0.1	0	0.0
Woody Perennial	10993	4.2	501	0.9	500	7.9	2	0.0
TOTALS	261840	100.0	54060	100.0	6293	99.6	3457	100.0

[1] Note that these figures for acreage do not include land-use data for Rhode Island. Inland water area is ommitted from totals.

Habitats Of the Bay

Buzzards Bay is a special coastal region in the Commonwealth. The jagged border of Buzzards Bay bound by the glacial deposits that form the Elizabeth Islands creates many diverse environments around the Bay. The coastal zone of Buzzards Bay is characterized by a variety of important habitats including salt marshes, tidal streams, eelgrass beds, tidal flats, barrier beaches, rocky shores, and a number of subtidal habitats. Buzzards Bay is within the Virginian Biological Province, which means that the species in Buzzards Bay are typical of those found along the east coast between Chesapeake Bay and Cape Cod. The Cape Cod Canal, however, forms a direct tie to the cold-water species found north of Cape Cod. For these reasons, a unique mix of semitropical and arcadian species can be found in Buzzards Bay during different times of year.

Salt Marshes and Tidal Streams

Salt marshes are among the most productive ecosystems in the world—even exceeding most types of agricultural land. Historically viewed as waste land, salt marshes and tidal streams are now valued as an important resource that provides wildlife habitat, produces and exports large quantities of plant material and food to nearby coastal food webs, protects the coastal zone from floods, and absorbs some water-borne contaminants. Salt marshes add greatly to the aesthetic diversity of the coastal landscape, providing a source of recreational enjoyment through fishing, shellfishing, waterfowling, and nature appreciation in all seasons.

Salt marshes typically are located in intertidal areas behind barrier beaches, bordering pools or quiet water, or along the banks of tidal rivers. In 1984, there were an estimated 5,000 acres of valuable salt marshes along Buzzards Bay. Significant salt marsh areas are located in Dartmouth, Wareham, Westport, and Fairhaven (see Table 3.1).

"High marshes" are the areas of salt marshes inundated only during spring tides and characterized by the presence of the grass *Spartina patens*. "Low marshes" are the areas submerged by tides daily and characterized by the grass *Spartina alterniflora*. High marsh is dominated by salt-tolerant plants and terrestrial species of animals. Many shorebirds nest in the high marsh. Estuarine and marine invertebrates and fish are often abundant in low marshes and associated tidal creeks.

Water draining marshes enters coastal waters via streams or groundwater. Because dense layers of peat under marshes impede groundwater flow, groundwater transported from uplands may break out at the surface in springs or travel under the marsh's peat. The specific pathway of transport of waterborne contaminants such as coliforms and nitrogen through and around marshes has management implications because of potential human health risks and rates of attenuation differ depending on whether land drainage passes over or under a marsh.

Ditching of salt marshes has been a common practice since the 1930s as a method of mosquito control. The objective of ditching is to drain pools of water ("pans") in salt marshes as well as to provide fish access to these pools to feed on mosquito larvae. Today, new ditches are not commonly dug but old ditches continue to be maintained.

The practice has come under increased scrutiny and some scientists feel that valuable feeding habitat for shore birds and waterfowl may be lost by ditching efforts. Some open-marsh management programs are developing better ditching patterns to allow enhanced access by fish. The only alternative to ditching for mosquito control is limited pesticide use.

Eelgrass

Beds of subtidal eelgrass (*Zostera marina*), like salt marshes, are important food-production and nursery areas. This perennial plant is found in waters of varying salinity, growing in sand or mud, in depths ranging from just under low-tide level to 20 feet below sea level in places where sunlight penetrates to the ocean floor and current or wave action is not too severe. Eelgrass flourishes in salt ponds, bays, and at the mouths of estuaries and tidal creeks.

Eelgrass beds are important because they serve as a substrate for other plant and animal life, are consumed directly as food by grazing animals, offer protection and security to other marine animals, cycle nutrients in subtidal coastal waters, and provide a habitat for marine animals such as winter flounder. Eelgrass provides a critical nursery area for bay scallops, which often survive their first month of life by attaching themselves to eelgrass stems.

During the 1930s, most eelgrass disappeared in Buzzards Bay (and elsewhere in the Atlantic) because of a "wasting disease." The causes and timing of this event are still not fully understood, but eelgrass subsequently recovered throughout most of the Bay. Some areas showed no recovery, and in others, eelgrass recovered but new declines occurred, particularly during the 1970s and 1980s. The lack of recovery and the losses in these areas appeared to be the result of human disturbance and pollution, particularly from the addition of nitrogen to coastal waters (Costa, 1988). These new losses are a serious concern because, unlike areas affected by natural disasters, these areas will never recover until nitrogen inputs and other disturbances are reduced. Areas in Buzzards Bay where eelgrass has been impacted include New Bedford, Apponagansett Bay, the Wareham River estuary, and portions of West Falmouth Harbor, Buttermilk Bay, and Onset Bay. These areas have histories of human disturbance and pollution such as heavy boat traffic, sizeable nitrogen inputs from septic systems or wastewater treatment plants, and documented impacts such as shellfish bed closures and fish kills.

Because eelgrass beds are ecologically important and are increasingly threatened by human activity and development, there is interest in resource management initiatives to protect the beds. In addition, the now widespread distribution of eelgrass and its sensitivity to pollution qualifies its use as an indicator species to identify water quality degradation and declining health of coastal ecosystems.

Tidal Flats

Tidal flats are found in estuaries and quiet bays, behind barrier beaches, in salt ponds, and, depending on slope, below the depth of wave disturbance along the open shores of Buzzards Bay. These shallow, sloping flats exist in a range of salinities from the coastal areas to the upper reaches of the estuary. The substrate is composed of materials

ranging from very fine silt and clay to coarse sands. It is the combination of salinity, substrate quality, and character of water movement over the flat that determines the species composition of plants and animals.

Because of the lack of suitable substrate and the nature of the sand-mud environment, large plants do not take hold on these tidal flats. Instead, microscopic algae are prevalent. Most tidal-flat animals, such as clams, quahogs, and marine worms, have adapted to daily environmental stress either by burrowing beneath the exposed surface during low tide, or by living there at all times.

There are over 5,000 acres of tidal flats within the Buzzards Bay drainage basin. The largest amounts are found in Westport, Falmouth, Fairhaven, Mattapoisett, and Wareham.

Barrier Beaches

Barrier beaches are formed from sand and gravel transported by waves from a sediment source. Typically, they begin as sand spits that grow out from and parallel to the shore. Barrier beaches are usually long and narrow; they may be barely elevated above the level of high tide, or they may contain high dunes.

Barrier beaches can become islands when their connection to the shore has been breached by storm waves. Buzzards Bay has 209 designated barrier beaches covering 1,689 acres. Building on barrier beaches should be discouraged because these beaches protect the lands behind them from storm damage and because they tend to move over geological time.

Fisheries of the Bay

Lobster

Buzzards Bay lies in the central portion of the North American coastal range of the American lobster, *Homarus americanus*. In the United States, coastal Maine waters produce the greatest annual landings, with Massachusetts ranking second. The Buzzards Bay area records annual landings of approximately 253,000 pounds, or less than 3% of the statewide total. This represents an annual retail value close to $1,000,000. The total value of the lobster fishery for 1988 in Buzzards Bay, including vessels, gear, and lobster, was approximately $2.3 million. Although the lobster fishery is important to the local economy, Buzzards Bay is one of the less productive areas in terms of statewide commercial landings. Overall, lobster catches around the state and in Buzzards Bay have remained relatively constant over the past 10 years.

Lobsters are taken by pots or traps tended several days a week by licensed lobstermen. Massachusetts law prohibits the taking of lobsters by spearing, dipping, or dragging. In 1988, it is estimated that approximately 200 to 250 commercial lobstermen fished Buzzards Bay. In addition to the commercial fishery in Buzzards Bay, lobsters are taken by noncommercial lobstermen who fish up to the 10-trap limit or dive, taking lobsters by hand. There is no estimate of how many of the more than 10,000 noncommercial lobstermen in the state fish Buzzards Bay.

The lobster resource of Buzzards Bay, although not as economically productive as that of other coastal areas in Massachusetts, is extremely important for its production of lobster larvae. Female lobsters in Buzzards Bay mature earlier and at a smaller size than in more northerly coastal areas. This means that the existing legal size limit tends to protect some small mature females, allowing a higher percentage of them to bear eggs. This smaller size at sexual maturity may help account for an abnormally high incidence of egg-bearing lobsters in Buzzards Bay. In 1988, 28% of the female lobsters sampled by state biologists in the commercial fishery of Buzzards Bay were egg-bearing, compared to only 5% in other samples from coastal areas in the Gulf of Maine. Some researchers have attributed this earlier maturity to physical characteristics of the habitat, for example, relatively high water temperatures in the summer and restricted water circulation and exchange, in combination with a high population density of lobsters.

In June and July of each year, very large numbers of lobster larvae hatch in the waters of Buzzards Bay. Researchers have estimated larval concentrations to be 8 times higher in Buzzards Bay than in Block Island Sound during these months. A significant number of these larvae end up in the Cape Cod Canal and further east in Cape Cod Bay, contributing to its lobster population.

The lobster is a bottom-dwelling animal that is affected by and succumbs to disease caused by environmental pollution. In their investigations of 12 coastal sites in the state, the Massachusetts Division of Marine Fisheries found that two conditions, black gill disease and shell disease, were more common in lobsters from Buzzards Bay than in animals from other coastal sites. Lobsters sampled from the New Bedford Inner Harbor had the greatest incidence of the two diseases.

In 1979, PCB contamination prompted the Massachusetts Department of Public Health to close approximately 18,000 acres of fishing grounds surrounding New Bedford to lobstering. Recent investigations by the Division of Marine Fisheries found PCB levels in lobster averaged 0.96 parts per million (ppm). Concentrations in hepatopancreas (tomalley) probably exceed the 2-ppm action level established by the U.S. Food and Drug Administration.

Shellfish

The commercial and recreational shellfisheries of Buzzards Bay include quahog (*Mercenaria mercenaria*), bay scallop (*Argopecten irradians*), soft-shell clam (*Mya arenaria*), and oyster (*Crassostrea virginica*). In 1988, the commercial shellfish harvest in Buzzards Bay was worth $4.5 million, as compared to a statewide value of $18.8 million.

The quahog and bay scallop make up most of the annual commercial shellfish landings. The soft-shell clam and oyster are harvested primarily in the recreational fishery and together constitute a small portion of the total reported landings.

The shellfisheries in Buzzards Bay are managed in accordance with Massachusetts General Laws, Chapter 130, which authorize local control. Methods used by local officials to collect catch data from both the commercial and recreational fisheries vary by community. This makes the catch estimates of recreationally harvested shellfish problematic, particularly for use in implementing new management practices.

Like the rest of Massachusetts, Buzzards Bay is experiencing a dramatic increase in the number of acres of shellfish beds closed as a result of fecal coliform contamination. As of April 1991, there are 13,150 acres of shellfish areas closed. This represents a significant percentage of the Bay's productive areas.

The Division of Marine Fisheries authorizes the relay, or transplant, of quahogs from closed areas to clean areas. After relocation, the quahogs are allowed to depurate for at least three months, and through a spawning period, before the area is opened for shellfishing. Most relayed shellfish are taken out of areas closed because of coliform levels. Relaying of shellfish from toxically contaminated areas is less common but does occur, even out of severely impacted areas like New Bedford Inner Harbor. There is a lack of information on depuration rates of some toxic contaminants such as PAHs. Contaminated shellfish have been relayed to all Buzzards Bay towns in order to increase the utilization of the resource.

Finfish

Buzzards Bay is recognized as a highly valuable resource area for the many species of finfish that inhabit the Bay and also for those species that migrate north during the spring and summer. Its numerous inlets, coves, and freshwater streams are rich with small fish (minnows, sand eels, silversides, alewives) to attract the larger fish. Salt marshes and eelgrass beds offer protection to many species of young fish.

Buzzards Bay as spawning and nursery grounds for many important commercial and recreational species. Because of its recreational fishing values, Buzzards Bay was closed to commercial fishing by nets, seines, and fish traps nearly 100 years ago by an act of Congress. Species such as scup, sea bass, tautog, butterfish, winter flounder, shad, and alewife are the primary species that depend on the Bay for spawning and nursery grounds. During the spring and summer, bluefish, striped bass, and weakfish migrate north.

Other Living Resources

Marine Mammals

The harbor seal is the most abundant marine mammal throughout New England and the only marine mammal species commonly found in Buzzards Bay. Harbor seals are present in the Bay between mid-October and early May. Although a few seals are observed throughout the year, most move north to coastal Maine and eastern Canada prior to the pupping season, which occurs from mid-May through early July. Harbor seals occur throughout the Elizabeth Island chain. The largest single concentration of seals generally occurs at Gull Island; in 1988, about 280 seals were recorded at this location. Approximately 300-400 seals are found throughout the Elizabeth Islands and the remainder of Buzzards Bay throughout the winter.

In addition to the harbor seal, gray seals are occasionally seen on rock ledges in the Bay, but in very small numbers. Buzzards Bay is not considered a high-use habitat for whales, dolphins, or porpoises. However, these species have occasionally been observed or stranded in the Bay, because of its proximity to the southwest Gulf of Maine and Cape Cod Bay.

Marine Turtles

The leatherback turtle is the species most frequently encountered in Buzzards Bay, generally from July through November. Unfortunately, these turtles often are found dead due to entanglement (and subsequent drowning) in lobster gear, collisions with boats, or occasionally due to intestinal blockage after eating floating plastics.

The Kemp's ridley turtle is known to frequent areas adjacent to Buzzards Bay. In fact, it is the most common marine turtle reported (caught in fishing nets or stranded) within Cape Cod Bay. However, sightings within Buzzards Bay are rare, possibly because commercial fishing by nets and seines is prohibited from Buzzards Bay. Given the distribution of the species and the favorable conditions found in Buzzards Bay, the Bay may be a potentially important foraging area for juvenile and subadult turtles of this species during late summer and early fall.

Waterbirds

Although greatly reduced in numbers from previous levels, and somewhat reduced in diversity, birds remain an important component of the Buzzards Bay ecosystem. Because birds accumulate and are often sensitive to certain toxic chemicals, their health and breeding success can reflect the fates and persistence of environmental contaminants within Buzzards Bay.

Three species of terns breed along Buzzards Bay shores in significant numbers: the common tern, roseate tern, and least tern. The roseate tern, a worldwide species, breeds exclusively in only two areas: the northeast coast of the United States (New York to the Canadian Maritimes) and the Caribbean Islands. Buzzards Bay terns have experienced declines largely due to competition with gulls, although human disturbance is also a major factor influencing breeding numbers and distribution. Buzzards Bay roseate terns are currently listed as a federally endangered species. Recently (1988-89), several dead roseate terns and common terns with high levels of PCBs in their body tissue were picked up on Bird Island; these species sometimes feed in the vicinity of New Bedford Harbor. Bird Island in Buzzards Bay serves as the nesting areas for 98% of the North American breeding population of roseate terns (Blodgett, personal communication).

The arrival of herring gulls in the mid-1930s displaced nearly all the terns from several nesting colonies in just a few years. Because herring and (especially) black-back gulls eat tern eggs and chicks, the terns tend to move their colonies in response to influxes of gulls.

The piping plover is listed as a "threatened species" in Massachusetts. Fencing around piping plover habitat to exclude predators has been highly successful, boosting reproductive success significantly. Islands and other isolated areas make ideal nesting habitat for plovers and terns.

Only one species of cormorant breeds in Buzzards Bay: the double-crested cormorant. After being nearly eliminated in the 19th century, this species recolonized the Weepecket Islands in 1946. Since about 1970, this colony has been growing rapidly,

increasing from 150 breeding pairs in 1971 to 1135 in 1984. In 1986, another colony began on Ram Island, perhaps due to spillover from the Weepeckets.

During the 18th and 19th centuries, ospreys undoubtedly were abundant along the shores of Buzzards Bay. It is assumed that the early explorers in Buzzards Bay named this body of water after the osprey ("buzzards"). During the 1950s and 1960s, ospreys decreased by more than 50% due to DDT-related reproduction failure. Local use of DDT ceased after the mid-1960s and osprey reproduction revived about a decade later. By 1979, the Westport population had grown to 20 active nests (all but one on artificial platforms). A decade later, Westport had 69 active nests and ospreys were reappearing throughout the Bay, mostly because local residents put tremendous effort into building nesting platforms. Availability of safe, sturdy nest sites is a key limiting factor for this species.

Two species of wading birds are known to nest along Buzzards Bay shores: black-crowned night herons and snowy egrets. Several other waders roost and feed here, but none have been confirmed as breeders. At least 20 species of waterfowl (swans, ducks, and geese) are found on Buzzards Bay waters. Two broad categories of these waterfowl are sea ducks, such as common eiders, old squaw, and white-winged scooter, and estuarine species such as Canada goose, canvasback, and black duck.

Chapter 4

Characterization of Pollution Sources

Buzzards Bay is an important segment of the Massachusetts coastline for both its economic and aesthetic resources. The economic resources of the Bay range from the harvest of its fisheries to its use as a transit route for shipping traffic through the Cape Cod Canal. Its aesthetic resources include recreational opportunities such as bathing beaches, boating, hunting, and fishing.

Buzzards Bay is an estuary in transition. Along its shores, communities are faced with widespread coastal development. The legacy of industrial pollution from greater New Bedford combined with widespread accelerated development threaten the Bay's environmental and economic health and typify the stresses placed on many estuaries of the Northeastern United States by conflicting uses. The wise management of Buzzards Bay requires an increasingly sophisticated knowledge of estuarine processes and an understanding of the effect of land use on water quality.

Contamination or pollution sources entering a body of water are divided into point and nonpoint sources. Point sources occur at discrete and identifiable points, usually through pipeline discharges or direct dumping. Obvious point-source discharges into estuarine and coastal waters include sewage treatment plants, industrial discharges, and combined sewer overflows (CSOs). Nonpoint sources are diffuse, often intermittent, and sometimes ill-defined inputs to an estuary. These sources include surface runoff, rainfall, atmospheric deposition, underground transport, and leaching of materials to the estuary.

The Buzzards Bay Project has focused its efforts on three priority pollution problems — pathogen contamination, toxic contamination, and increasing nitrogen inputs — and how they affect water quality and living resources in Buzzards Bay. These pollution problems were selected because it was determined that they had the greatest impact on the economic , ecological, and aesthetic values of Buzzards Bay. This chapter is an overview of the findings on which the management actions in this document are based. These findings are the result of the many studies conducted by the Buzzards Bay Project during the past five years.

Pathogen Contamination

Degradation of water quality due to contamination by pathogens represents a serious health risk and economic loss to many parts of Buzzards Bay. The pathogens associated with sanitary waste disposal that are of primary concern to humans are disease- causing bacteria and viruses. Some bacteria are free-living organisms able to survive on their own and grow in an aquatic habitat; viruses, on the other hand, can grow only inside of a suitable host. Of the many different viruses associated with human wastes, most are responsible for causing gastrointestinal illness, but some cause significant illnesses such as hepatitis and polio. Pathogenic bacteria found in waste material are responsible for a variety of diseases.

The presence of human pathogens in waters overlying shellfish harvesting areas has historically been the primary index of the "health" of Buzzards Bay. Because public health agencies are not able to measure the entire host of human pathogens directly, they have relied on "indicator" organisms to assess the probability of the presence of pathogens. The indicator organisms presently used to evaluate the status of overlying waters are a group of bacteria called fecal coliform. This fecal coliform indicator test has been in use since the early 1980s. Formerly 'total coliforms' a superset of fecal coliform, had been used as the basis of regulatory action back to the 1920s.

Large numbers of fecal coliform bacteria are present in the fecal material of warm-blooded animals. For the most part, fecal coliforms are not themselves pathogenic, but are often found associated with other organisms that do cause disease in humans. When predetermined concentrations of fecal coliforms are reached, the area is considered unsafe for certain uses. Shellfishing is prohibited when concentrations reach 14 fecal coliforms per 100 milliliters (ml); bathing may be forbidden at levels of 200 fecal coliform per 100 ml by the public health agency overseeing the beach.

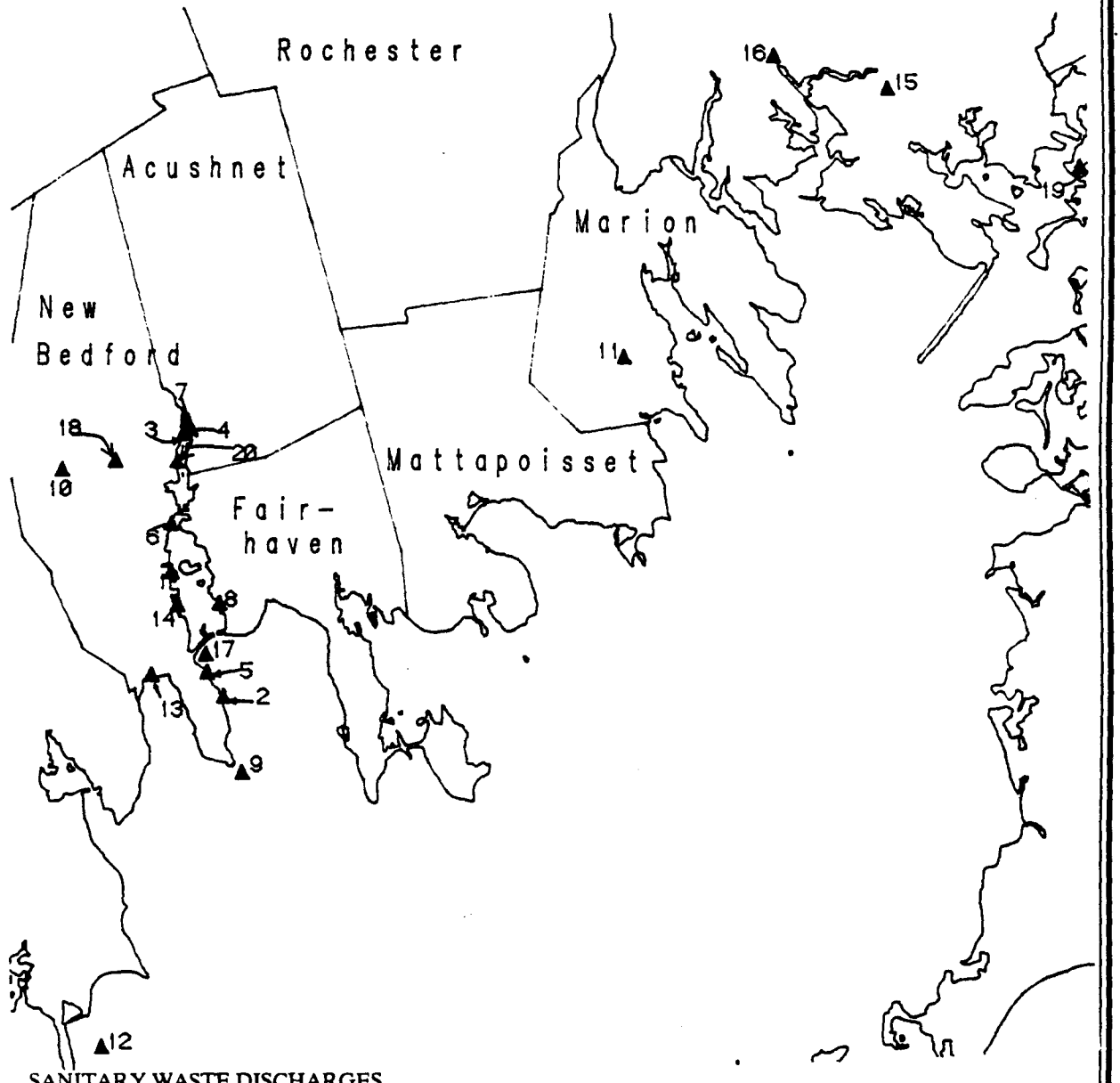
A number of problems are associated with the use of fecal coliform as an indicator of public-health risk. Although this method may protect human health from bacterial pathogens, the same may not be true for viral pathogens. Under certain circumstances, fecal coliforms bear little, if any, quantifiable association with pathogens of concern, including viruses such as hepatitis A. In addition, the fecal indicator does not differentiate between human and animal wastes. The health risk and implications of the presence of fecal coliform originating from nonhuman sources have not been determined.

Sewage Treatment Plants

The most significant potential point sources of human pathogens into Buzzards Bay is discharge of sanitary wastes from sewage treatment plants (Figure 4.1). The combined capacity of all such discharges to the Bay exceeds 37 million gallons per day (MGD). Although these plants should be discharging only disinfected wastewater, occasional plant malfunctions and failures do occur. In general, closed "safety zones" around the immediate discharge areas are designed to protect the public from exposure to pathogens and are sized to allow adequate time to close adjacent shellfishing areas in the event of plant failure. However, a growing body of scientific evidence strongly suggests that, in some cases, traditional fecal indicator organisms are not adequately portraying real pathogen risks. For example, following chlorination, many pathogens, as well as fecal coliforms, may enter a state where they are viable but non-recoverable or detectable using standard assay methods. Fecal coliforms may also die off more rapidly than some viruses. Because of the high volume of untreated sewage that they release, CSOs in New Bedford are a major source of fecal coliforms to Buzzard Bay. The impacts of bacteria and pathogens from both sewage treatment facilities and CSOs are largely localized in the vicinity of these discharges.

Vessel Sanitary Wastes

Discharge of sanitary wastes from marine craft is a locally significant direct source of pathogens to Buzzards Bay. The more than 4,300 slips and moorings in the Bay and



SANITARY WASTE DISCHARGES

1. Glen Petroleum Corp.
2. Teledyne-Rodney Metals
3. Aerovox Corporation
4. Acushnet Co. - Rubber Division
5. Cornell-Dublier Electric
6. Revere Copper Products
7. Acushnet Co. - Golf Division
8. Fairhaven Wastewater Treatment Plant
9. New Bedford Wastewater Treatment Plant
10. Shawmut Avenue Landfill
11. Marion Wastewater Treatement Plant
12. Dartmouth Wastewater Treatment Plant
13. Goodyear Tire and Rubber
14. Commonwealth Electric
15. Wareham Wastewater Treatment Plant
16. Tremont Nail Company
17. Berkshire Hathaway Company
18. Chamberlain Manufacturing Corp.
19. Massachusetts Maritime Academy
20. Acushnet Capacitor

Figure 4.1. Selected surface wastewater discharge locations (NPDES permitted[1]) to Buzzards Bay

[1] Data source: NPDES permit files, Massachusetts Division of Marine Fisheries sanitary survey, and staff of pemitted entities.

the nearly 20,000 vessels passing through the Cape Cod Canal yearly create a considerable potential for waters to be contaminated by untreated sanitary waste from boats. Because of the intermittent and often covert nature of disposal from vessels, the overall impact of sanitary wastes on Buzzards Bay is difficult to assess. Few marinas in Buzzards Bay provide pump-out facilities. Marinas that do have these facilities report that they are seldom used.

The impact of sanitary waste pollution from boats tends to be site specific. In poorly flushed areas that have low dilution, the effect may be substantial and unpredictable. Health implications are difficult to evaluate from such unpredictable, and usually undetectable, changes. Nonetheless, direct illegal discharge of human wastes is a potential threat that must be addressed because of the large number of boats using Buzzards Bay.

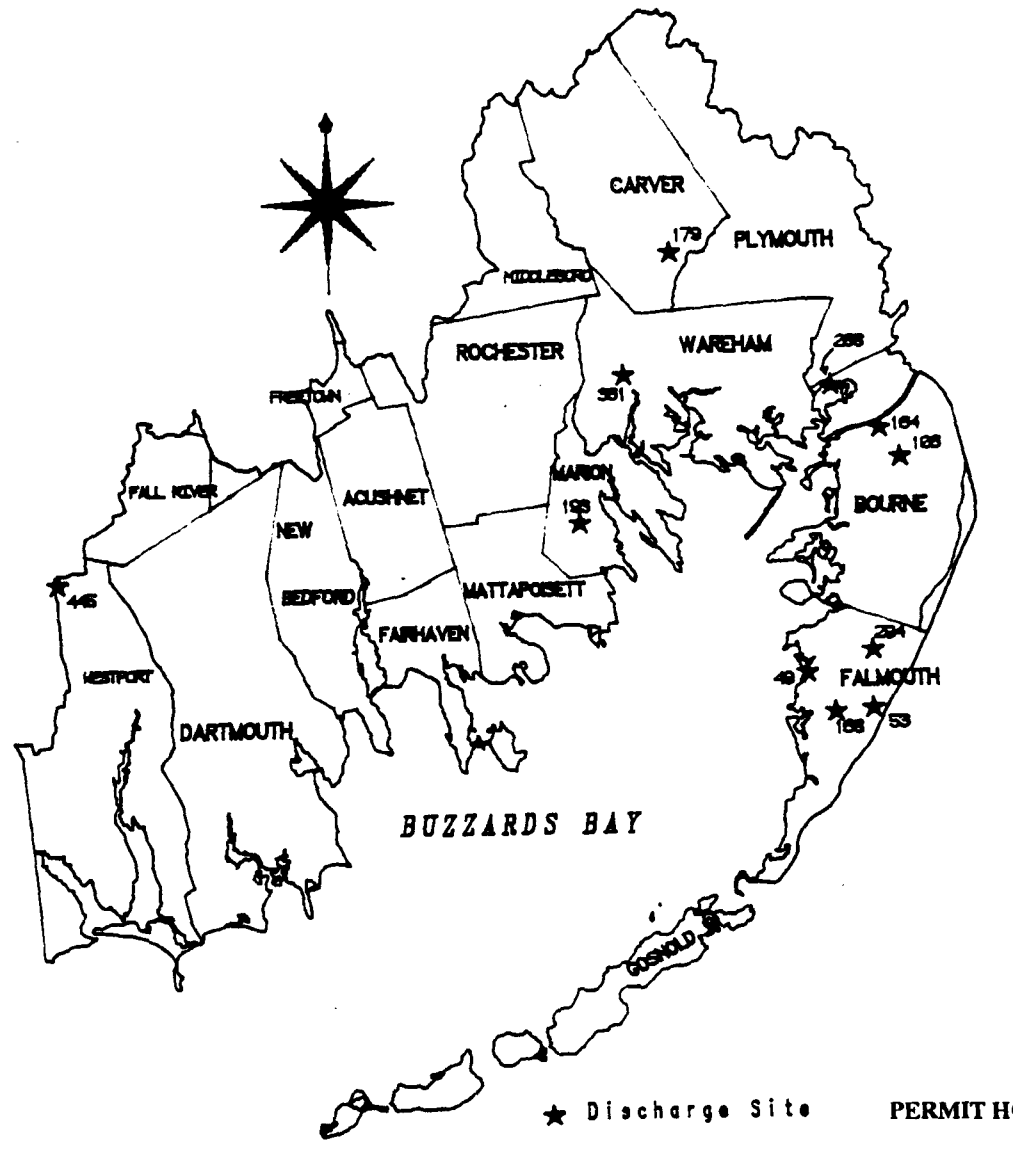
On-Site, Sub-Surface Sewage Disposal

Approximately half of the residents of the Buzzards Bay watershed use on-site, subsurface sewage disposal systems (cesspools or septic systems) to dispose of sanitary wastes. Construction of these systems is regulated by the state's sanitary code, known as Title 5, which sets minimum standards for design and placement. Pathogens are removed from septic-system wastes by two mechanisms — physical retention (or straining) by the receiving soil, and adsorption (or adherence) of pathogens onto soil particles. Groundwater discharges of over 15,000 gallons per day must have state permits issued by the Massachusetts Department of Environmental Protection (Figure 4.2). Many other large groundwater discharges exist, but were planned for less than 15,000 GPD to avoid permit requirements.

Pathogen contamination of Buzzards Bay from septic systems can occur in at least three ways. The most obvious threat to public health is an overt system failure. Such a failure results when soils can no longer receive septic effluent, and sewage collects on top of the septic system, often breaking out onto the surface of the ground. Sewage may then be transported into the receiving waters by stormwater drainage systems or overland flows. Overt system failure during dry weather probably plays a minor role in the overall pathogen contamination of Buzzards Bay. During heavy rains, many inadequately designed or maintained systems overflow, and this may be a significant source of coliforms in some areas. Many of these failures can be prevented by routine maintenance such as pumping out the solids that collect in the tank.

Closely related to overt failure is the existence of overflow pipes. Such pipes were once connected to the leaching component of septic systems to prevent failure and subsequent surface break-out. Overflow pipes were often designed to empty directly into a major water body or connecting ditch or stream. This practice of connecting overflow pipes is thought to have been quite common in past years, but is now illegal. A recent survey by state and local authorities has documented the locations of many of these overflow pipes around Buzzards Bay.

Pathogens from septic systems can also enter Buzzards Bay through groundwater. Studies conducted by the Buzzards Bay Project examined the potential for pathogen transport by this route. Results support the contention that, in most instances, soils filter pathogenic bacteria out of wastewater over a distance of only a few yards.



PERMIT HOLDERS

49 - Seacrest Hotel
53 - Falmouth Septage#
106 - Bourne Septage Disposal
164 - Bourne Laundromat
168 - Falmouth DPW
179 - Ocean Spray
193 - Town of Marion
288 - Hideaway Village
294 - Whitney - Cape Cod
361 - Spring Born Bionomics
445 - Old Colony Petroleum #
- Ceased Discharge

Sites discharging more than 15,000 gpd to groundwater must have a state permit. These permits are issued by the Mass. Dept. of Env. Protection's Div. of Water Pollution Control, Groundwater Section (DWPC-GW). The computer map of site locations was provided by DWPC-GW. The town and basin boundaries were provided by MassGIS. The Cape Cod side basin boundary was delineated by USGS based on water table elevation contours published in hydrologic atlas HA-692. This map was produced by the Buzzards Bay Project in March 1990, using ARC/INFO software.

Figure 4.2. Groundwater discharges (with state permits) in the Buzzards Bay drainage basin

Although properly functioning (no observed overflow) septic systems were generally not found to contribute to the indicator levels in the Bay, there is still concern that the much smaller pathogenic viruses may pass through the soil and reach the Bay, even when state requirements are being met (see review in Heufelder, 1988).

Stormwater Runoff

Stormwater refers to that portion of precipitation that is returned to a water body via surface routes from an adjacent land mass. Although precipitation when it falls is generally devoid of fecal indicator organisms, as it flows over the ground, it washes debris and sediments into surface waters. This debris may be composed of, or contaminated with, human or animal wastes.

Stormwater is managed to reduce or eliminate local flooding or to drain road surfaces for safety. Roadways and other developments are often designed so that excess water collects in drainage basins, ditches, and pipes and is then directed to the nearest river, stream, estuary, or other surface water body. An additional component of stormwater runoff that is of particular significance in agricultural areas is the sheet flow from land masses. In this case, instead of being collected and discharged through pipes, the flow is unconsolidated and enters the receiving water in broader, less defined areas. Generally, development further contributes to the amount of runoff by increasing the amount of paved or impervious surfaces and reducing the surface area available for precipitation to naturally percolate into the ground.

Investigations by the Buzzards Bay Project confirm the findings of the National Urban Runoff Program indicating that stormwater runoff is a major contributor of fecal indicators to surface waters. Agricultural runoff, which dominates the western portion of the Bay near Westport, and urban runoff, which dominates New Bedford and other residential areas near cities and town, enter the Bay both at discrete points such as pipes and open ditches and in broader, less defined areas of sheet flow.

Two distinct classes of urban runoff enter Buzzards Bay. Many older cities such as New Bedford built their storm and sewer systems using a single pipe, or combined sewer, approach that combines sewage wastes from households with stormwater. During heavy rainstorms, the waste treatment facility in New Bedford is unable to handle both the sewage and stormwater, and the untreated excess flow is discharged directly into Buzzards Bay through overflow pipes. These pipes are called combined sewer overflows (CSOs). There are 38 such discharges into the Acushnet River Estuary and Clarks Cove (see Figure 4.3). Data show that the highest densities of fecal coliform from all storm pipes investigated generally come from CSOs.

In addition to the CSOs of the New Bedford area, stormwater from other urban or suburban areas around the Bay often shows high fecal coliform counts, even where storm and sewer systems are not tied together. The source of coliforms in non-CSO discharges is the subject of considerable speculation. Pathogens may originate from

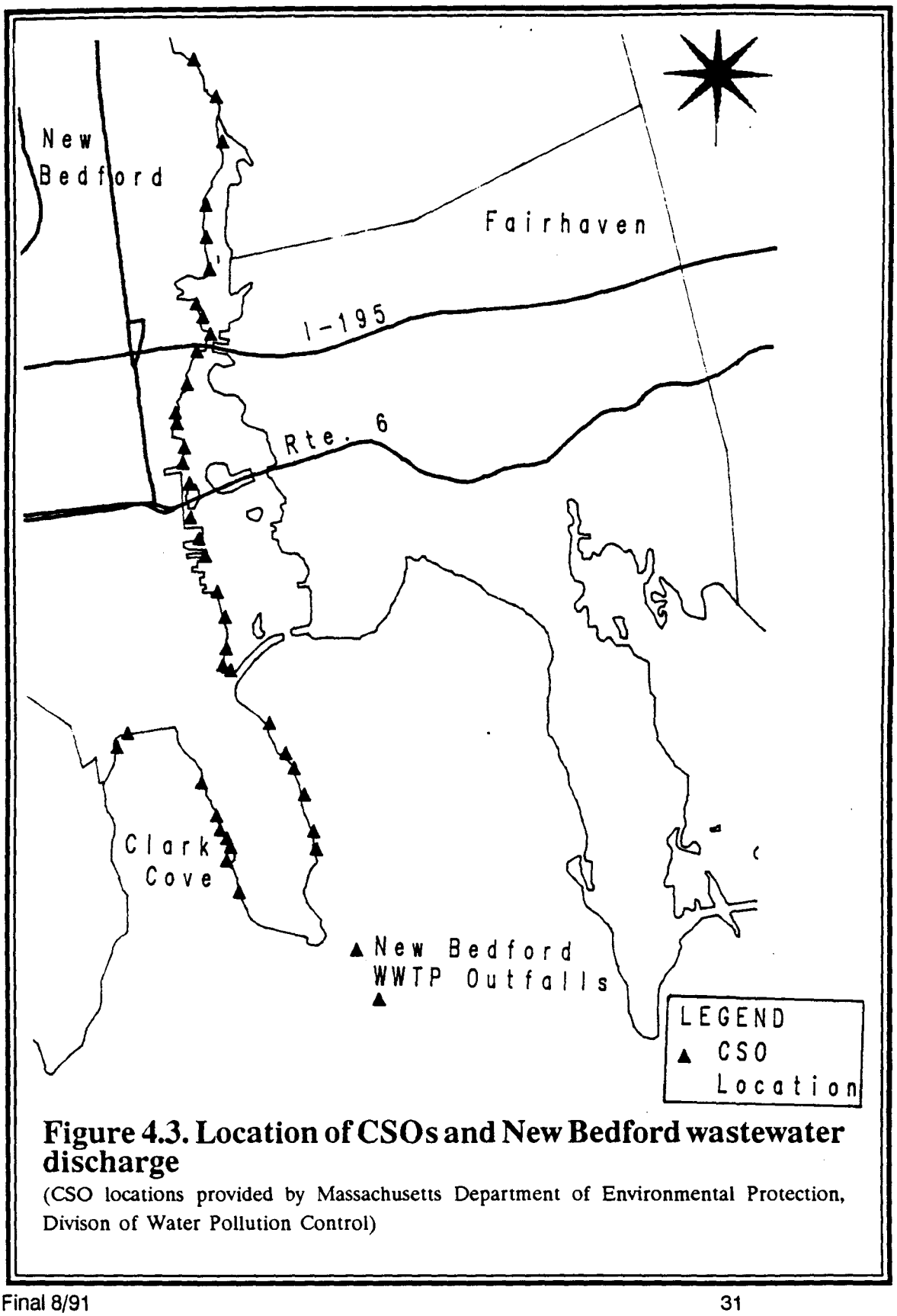


Figure 4.3. Location of CSOs and New Bedford wastewater discharge

(CSO locations provided by Massachusetts Department of Environmental Protection, Divison of Water Pollution Control)

illegal home hook-ups or domestic and wild animals, or from failing septic systems whose sanitary wastes may pool on the top of the ground and find a surface pathway to the receiving water during a rain event. The Massachusetts Division of Marine Fisheries has recently completed sanitary surveys in Buzzards Bay under the Shellfish Sanitation Program[2] , and has identified more than 500 discharge pipes in open shellfish resources in Buzzards Bay and ranked their potential for contamination. This information is being used by the Buzzards Bay Project and Buzzards Bay municipalities to prioritize stormwater pipes and other sources for remediation.

The extensive use of the western shore of Buzzards Bay, particularly near Westport, for agricultural purposes makes this area highly susceptible to agricultural runoff. Fecal coliforms from this type of runoff originate primarily in animal feces, resulting from animal raising and crop-management practices (i.e., manure spreading).

Wildlife, Waterfowl, and Domestic Animals

Animal wastes enter Buzzards Bay in at least two ways. Stormwater, previously discussed, periodically washes animal wastes from both wildlife and domestic animals into the Bay. A more continuous input is from aquatic birds such as Canada geese and other shore birds. The effects from these inputs vary. Generally, the impact is less in well-flushed areas and greater in poorly flushed areas with organic sediment where the longevity of bacterial species is enhanced. A Buzzards Bay Project study in Buttermilk Bay has indicated that waterfowl waste can accumulate in other protected environments such as beach wrack (the free-floating plant material that washes up with the tide), which appears to prolong bacterial survival (Heufelder, 1988). Thus it is believed that wildlife, waterfowl, and domestic animals may be locally important sources of coliform contributing to the closure of resource areas.

Other Sources of Coliforms and Pathogens

Although not an original source, certain sediments in Buzzards Bay may act as a protective sink for fecal coliform and pathogens, releasing them back into the water column when the sediment is disrupted during storms or tidal fluxes. It is likely that in areas close to point-source discharges, such as CSOs and stormwater pipes, the sediments provide a protected habitat for settled microorganisms and prolong their survival. Soft organic sediments (e.g., muds) are more able to support bacterial survival and viral stability than are inorganic sediments such as sand and gravel. The introduction of nutrients from septic systems or sewage treatment plants may also play a role in the proliferation of pathogens harbored in sediments (Heufelder, 1988).

In addition to coliforms and pathogens stored in protective sediments, a number of human pathogens have been found to be normal inhabitants of estuaries elsewhere. No attempt has been made to document the presence of these pathogens in Buzzards Bay, but it is presumed they exist.

2 DMF is responsible for conducting shellfish area sanitary surveys in Massachusetts waters to identify existing and potential sources of coliform and pathogens in shellfish resource areas. A detailed explanation of the program is given on page 49.

Toxic Contamination to Buzzards Bay

Buzzards Bay receives a wide range of chemical contaminants from industrial and municipal wastes, dredged material, atmospheric fallout, river inputs, and other nonpoint pollution sources. Chemical contaminants enter Buzzards Bay through accidental oil spills, effluent discharges, river discharges, atmospheric transport and deposition to the Bay, or deposition to land and direct runoff to the Bay. Chemical pollutants associated with urban and industrial activities enter Buzzards Bay primarily in the western portion near the New Bedford, Fairhaven, and Dartmouth urban areas. Chemicals associated with agricultural activities are more likely to enter the Bay from runoff, creeks, and small rivers in the Westport, Dartmouth, Fairhaven, Mattapoisett, Marion, Wareham, Bourne and Falmouth areas.

The greater New Bedford area is clearly the major contributor of chemical contaminants to Buzzards Bay. The Harbor itself is extremely polluted with polycyclic aromatic hydrocarbons (PAHs), trace metals, and polychlorinated biphenyls (PCBs) as a result of industrial discharges between the 1940s and 1970s and stormwater runoff. On a regional scale, however, stormwater runoff, particularly from paved surfaces, is a major source of hydrocarbons to Buzzards Bay.

Evaluation of the fate and effects of chemical contaminants in the marine environment requires an understanding of the temporal and spatial distribution of contaminants; the partitioning of contaminants in the ecosystem among the sediment, the water column, and the living resources; and the level of damage imposed by accumulation of contaminants in the living resources.

Concern about contaminant input to coastal waters is focused on the accumulation and transfer of metals and organic contaminants in marine food webs, including accumulation in seafood species and potential impacts on human health. Additional concerns include toxic effects of contaminants on the survival and reproduction of marine organisms and the resulting impact on marine ecosystems. Chemicals of concern are those that have known or potentially deleterious effects on populations of living marine resources and on humans. Chlorine residuals from disinfected sewage discharged from treatment plants may also represent a threat to marine organisms.

Petroleum and Fossil Fuel Hydrocarbons

Hydrocarbon inputs to Buzzards Bay are the result of accidental oil spills, industrial and municipal wastes, stormwater runoff, small boats and other marine craft, and creosote-treated wood pilings. Buzzards Bay and the Cape Cod Canal serve as a major transportation route for small tankers and barges carrying petroleum products to the Boston market. It has been estimated that over 260,000 gallons of fossil fuel hydrocarbons have been accidentally spilled into the Bay between 1973 and 1989. However, the everyday, more insidious inputs of hydrocarbons to the Bay — from stormwater and wastewater from industry and sewage treatment facilities — have been calculated to be equal to or greater than the inputs from accidental spills.

Pesticides

There is little doubt that chlorinated pesticides were used extensively in the Buzzards Bay area during the 1950s and 1960s. In coastal regions with large areas of wetland and marshes, these pesticides were used to combat insects such as mosquitos that were potential carriers of human diseases. Pesticides were also used to combat crop pests. Since that time, use of many of the persistent chlorinated pesticides has been reduced or banned, and these chemicals have been replaced by less damaging and less persistent forms.

It is estimated that approximately 33,000 pounds per year of pesticides are used in agriculture in the Buzzards Bay drainage basin, primarily on crops such as cranberries (almost 20,000 pounds of pesticides per year), feed corn, sweet corn, potatoes, and squash (Farrington and McDowell-Capuzzo, BBP in press). Pesticides from household use may enter municipal waste sewers and storm sewers, and eventually reach the Bay. Although this may be a cumulatively large input, the relatively nonpersistent nature of pesticides currently in use suggests that the effects may be nominal.

Polychlorinated Biphenyls (PCBs)

PCBs are a family of organic compounds used since 1926 in electrical transformers as insulation, and in liquid coolants, flame retardants, lubricants, carbonless copy paper, adhesives, caulking compounds, and marine paints. PCBs are extremely persistent in the environment because they do not readily break down into less harmful chemicals.

Extensive PCB contamination in the New Bedford Harbor area resulted from manufacturing operations that discharged PCBs directly into the Acushnet River Estuary and indirectly through the municipal sewage treatment plant between the 1940s and 1970s. Over 18,000 acres of productive fishing grounds around New Bedford remain closed due to PCB contamination.

Sediments in the Harbor continue to act as a major source of PCB contamination to Buzzards Bay. Other past sources include atmospheric transport from New Bedford and other industrial areas in the northeast, and the disposal of New Bedford Harbor dredged materials into the Bay.

The extent of PCB contamination in marine resources taken from areas outside of New Bedford has been studied. Results show that although edible tissues of the three species tested (lobster, flounder, and quahog) generally have PCB levels below the FDA Action Level of 2.0 ppm (parts per million), some samples are dangerously close to the FDA limit, especially lobster hepatopancreas, or tomalley (Schwartz, 1987).

Other Organic Pollutants

Analysis of the effluent from the New Bedford sewage treatment plant has shown that several of the synthetic organic compounds listed by EPA as priority pollutants are present in measurable quantities. These compounds are typical of what is found in sewage from urban industrialized areas.

Historically, a variety of industrial wastes containing chemicals of concern were discharged into New Bedford Harbor. More recently, research has shown that tributyltin (TBT), which is sometimes added to marine paint as an antifoulant, is toxic and harmful to marine organisms in coastal ecosystems, even at the extremely low concentrations observed when TBT leaches from boats. Recent federal legislation phases out the use of TBT as an additive to marine paint. As of April 1988, Massachusetts banned the use of TBT-containing paints on all non-aluminum vessels under 25 meters in length. Paints with low TBT release rates (micrograms per day) can be used on larger vessels.

Trace Metals

Trace metals are chemical elements; as such they cannot be destroyed or broken down through treatment or environmental degradation. Certain metals occur naturally at low concentrations in seawater and in marine and estuarine sediments. Additional metals can be added to the marine environment through municipal and industrial wastewater discharges, atmospheric deposition, stormwater runoff, and leaching from boat paints and moorings. Once in the marine environment, metals are generally incorporated into the sediment. Marine invertebrates that live in sediments with high metal contamination may accumulate the metals above natural levels. These toxic metals may then be passed along the marine food web that includes humans.

Evidence shows that the New Bedford Harbor area, especially the Inner Harbor, has received substantial inputs of trace metals such as copper, nickel, zinc, and chromium in the past. High metal concentrations are often found in sediments around docks and mooring areas. Dredging, disposal of dredged materials in the main part of Buzzards Bay, and normal physical processes such as storms are contributing trace metals to the Bay.

Nutrients and Eutrophication in Buzzards Bay

Nitrogen, the primary nutrient of concern in marine waters such as Buzzards Bay, is essential for the proper growth and reproduction of individual organisms and, consequently, for the general productivity of the Bay (Figure 4.4). In nature, nitrogen occurs in many forms (e.g., ammonia, nitrates). The addition of excessive amounts of nitrogen (also called "nutrient enrichment" or "nitrogen loading"), to coastal waters results in eutrophication effects and a general decline in the health of coastal ecosystems.

In general, excessive nutrient inputs can result in increased growth of microalgae (such as phytoplankton) and macroalgae (seaweeds), which in turn changes the distribution and abundance of species present and in food-web relationships. For example, increased turbidity from phytoplankton growth prevents sunlight from reaching submerged vegetation like eelgrass, and beds of eelgrass begin to disappear. Because eelgrass beds are a valuable habitat and nursery for many organisms, the loss of this community can cause shifts in many populations of animals. Excessive algal growth may result in the depletion of oxygen levels when algae die and decompose. Severe oxygen depletion leads to fish kills and death of sensitive benthic organisms.

There is also increasing evidence that the effects of high nutrient loading, such as increased turbidity and the release of dissolved organic matter from algae, contribute to the prolonged survival and possible growth of coliform bacteria in coastal waters. Because coliform levels are used to classify swimming and shellfish areas, nutrient loading may contribute indirectly to the closing of these areas.

Coastal embayments receive nitrogen from a variety of sources including septic systems, sewage facilities, atmospheric inputs, and fertilizers used on lawns, golf courses, and agricultural areas. The nitrogen from these sources is conveyed to the Bay by effluent outfalls, streams and rivers, overland runoff, and groundwater that drains from the land. The relative importance of these sources depends on the specific land use within each drainage sub-basin.

In Buzzards Bay as a whole, sewage treatment facilities, together with CSOs, are the principal source of nitrogen entering the Bay, accounting for 62% of all inputs (Table 4.1). Although these inputs are very significant, the effects of nitrogen from these discharges are largely confined to the vicinity of the outfalls. Even a large nitrogen source like the New Bedford sewage treatment facility are localized and the nitrogen impacts to benthic communities occur mostly within several miles of the outfall, and may contribute to hypoxic conditions. For these reasons, nitrogen inputs from this outfall must be managed. However, studies conducted by the Buzzards Bay Project, have shown that the central portion of most of the Bay is not nutrient enriched,

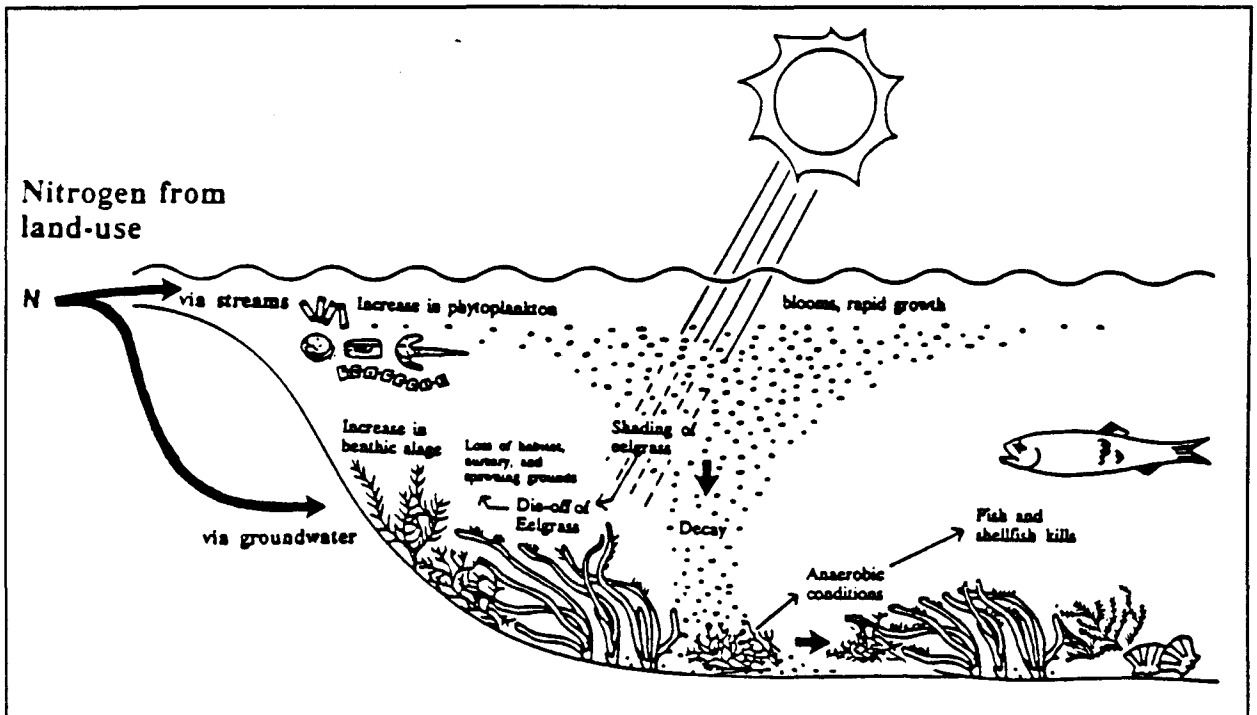


Figure 4.4. Generalized response of shallow coastal embayments to nitrogen loading

Source : Modified from U.S. Fish and Wildlife circular , Restore Chesapeake Bay (2/90).

(Rhoads, BBP in press; Hampson, BBP in press; CDM, 1989). Except in surrounding waters, the New Bedford outfall is not the cause of eutrophication effects observed in embayments in the Bay.

In general, most of the more serious effects of nitrogen loading that are observed in Buzzards Bay are localized in the network of shallow embayments that border the Bay, and are the result of inputs from land in the surrounding drainage basin. In many of these embayments, septic systems are the primary source of nitrogen. For example, in Buttermilk Bay, septic systems now account for more than 74% of the nitrogen entering this system. Septic systems release large amounts of nitrogen as ammonia, which is rapidly transformed to nitrate in the presence of oxygen in the groundwater. In general, nitrate in groundwater flows great distances without attenuation (or dilution) and with little chance of uptake by plants. In rural agricultural areas like Westport, more nitrogen may be contributed to embayments by fertilizers and animal wastes than by septic systems.

Table 4.1. Relative contribution[1] of anthropogenic nitrogen inputs to Buzzards Bay and Buttermilk Bay drainage basins from various sources

	Percent Contributions	
Source	Buzzards Bay[2]	Buttermilk Bay
Precipitation		
- runoff from developed land	2	2
- directly on Bay	12	1
Sewage Treatment Facilities (including CSOs)	62	0
Septic Systems	15	74
Fertilizer		
- on lawns	4	18
- agricultural use	5	5

[1]Sources: Based on Valiela and Costa (1989), SAIC 1991, Horsley Witten Hegeman, Inc., 1991.
[2]Total annual loading is 2246 metric tons.

Chapter 5

Action Plan Introduction

The action plans contained in this chapter form the centerpiece of the Comprehensive Conservation and Management Plan along with the chapters on New Bedford and Land-Use Management. Successful implementation of these plans should lead to protection of the water quality and natural resources of Buzzards Bay.

Action plans are divided into seven sections: Problem, Background, Major Issues, Goals, Objectives, CCMP Commitments and Other Recommended CCMP Actions. The first three categories provide the reader with the necessary background for a full understanding of the subject matter and set the stage for the action items. Goals are broad, long-term aims that indicate the desired condition for Buzzards Bay. Objectives are more specific, shorter-term targets for attaining goals. CCMP commitments are actions that have been agreed to by federal, state, and regional agencies as well as municipalities based upon recommendations contained in the May 1990 Draft CCMP. Other Recommended CCMP Actions are suggested items that have not yet been agreed upon.

The costs required for implementing several of the Action Plans, together with the possible funding sources and most realistic financing options are included in Volume II of the CCMP, Financial Plan. Implementation costs are also included in this chapter. Recommendations for monitoring to document the need for, or success of, management actions are included in Volume III of the CCMP.

Action Plan

Managing Nitrogen-Sensitive Embayments

Problem

In Buzzards Bay, as in most coastal waters, nitrogen, which is an essential nutrient, typically limits the growth of algae. Algae, which includes macroalgae or "seaweeds" and microalgae such as phytoplankton, form the base of many marine food webs. Excessive inputs of nitrogen from human activities threaten many embayments within Buzzards Bay by stimulating excessive growth of both types of algae. This increased production and accumulation of micro- and macroalgae can result in many adverse changes to coastal ecosystems, and is often referred to as "coastal eutrophication" or "nutrient enrichment". For example, increased abundance of algae can limit the transmission of light reaching eelgrass leaves, resulting in loss of eelgrass beds that provide habitat for shellfish and other animals. Dense layers of macroalgae accumulate on the bottom of some shallow bays and exclude shellfish and other invertebrates, destroying valuable habitat. In addition, decay of macroalgae depletes oxygen in the water and causes unpleasant odors. Severe oxygen depletion can kill fish and shellfish. There is also evidence that excess nitrogen loading promotes, directly and indirectly, the survival of coliform bacteria, which contributes to closures of shellfish areas. Algae blooms and accumulation of macroalgae may also cause aesthetic problems and inhibit typical recreational uses of the water such as swimming and boating. Overall, the excess addition of nitrogen is one of the most serious long-term problems threatening many embayments around Buzzards Bay.

Sources of anthropogenic nitrogen reaching coastal waters (also defined here as "nitrogen loading") include sewage treatment facilities, septic systems, acid rain, and fertilizer used on lawns, golf courses, and agricultural land. The nitrogen from these sources enters the Bay via streams, groundwater, direct deposition, and direct effluent discharge. Most of the nitrogen entering Buzzards Bay comes from sewage treatment discharges; the next highest amount is from home septic systems (refer to Table 4.1). In general, the effects of nitrogen inputs are localized near the sites of input. This is true even of large sewage treatment facility discharges such as New Bedford's, whose nitrogen inputs mostly affect waters within several miles of the outfall. Although such discharges are important and must be managed for nitrogen loading, Buzzards Bay has a large volume of water relative to nitrogen inputs and is flushed well enough that nitrogen from human activity does not affect the central portion of the Bay to the same degree that small embayments are affected. In Buzzards Bay, shallow, poorly flushed embayments are most sensitive to new nitrogen additions and are most likely to exhibit the symptoms and impacts described above; these are called "Nitrogen-Sensitive Embayments."

The relative importance of the various nitrogen sources in any embayment depends largely on the land use in the drainage basin that surrounds that embayment. Septic systems are the major source of nitrogen in most moderately developed embayments around Buzzard Bay. All septic systems, both properly operating and failing, release

large amounts of nitrogen as ammonia that is rapidly converted to nitrate. Nitrate in groundwater flows great distances without attenuation and with little chance of uptake by plants. For example, in Buttermilk Bay, septic systems account for more than 74% of the nitrogen entering this coastal embayment (Table 4.1). In some rural agricultural areas like Westport, fertilizers and wastes from livestock may be significant contributors of anthropogenic nitrogen. In an urban area like New Bedford, the sewage treatment facility and combined sewer overflows are the principal sources of nitrogen to surrounding coastal waters.

As noted above, it is important to realize that nitrogen inputs from a sizable discharge like the New Bedford sewage outfall do not contribute appreciable amounts of nitrogen to embayments more than a few miles from the discharge and thus does not affect most embayments in Buzzards Bay. Instead, each embayment is affected most by waterborne nitrogen conveyed through groundwater and stream discharges within that embayment. Consequently, any strategy to manage nitrogen inputs to an embayment or estuary must be directed toward those identified sources and land uses.

This action plan principally targets management of point and nonpoint sources of nitrogen at an embayment level, rather than baywide. Nitrogen loading from sewer outfalls is addressed in more detail in the action plan on Sewage Treatment Facilities.

Background

Impacts from excessive nitrogen-loading are mostly a localized phenomenon in the network of shallow embayments that line the shores of Buzzards Bay. Consequently, the Buzzards Bay Project has targeted these embayments for management action.

Shallow, poorly flushed embayments that have large land areas (and hence a potential for sizeable nitrogen inputs from development) with respect to the size of the receiving waters are most susceptible to adverse effects from nitrogen loading. The Project has developed embayment nitrogen loading limits based on embayment volume, flushing time, bathymetry, and water quality classification. Embayments will likely be critically impacted by nitrogen inputs as their drainage basins are fully developed.

DEFINITIONS

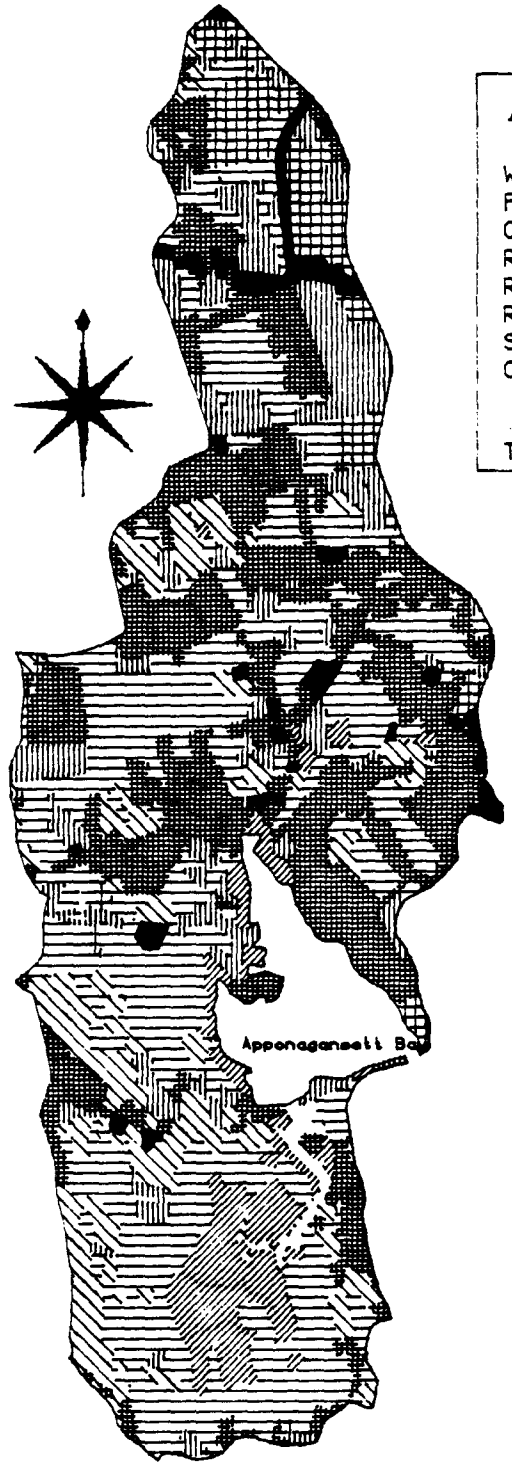
Nitrogen loading: inputs of nitrogen to receiving waters from anthropogenic sources. Excessive nitrogen loading leads to environmental degradation.

Nitrogen-sensitive embayment: any embayment that has the potential of being critically impacted by nitrogen loading from existing land use or future development. In general, shallow, poorly flushed embayments tend to be most sensitive to nitrogen loading.

Nitrogen impacted embayment: Any embayment whose resources and ecosystem have been adversely impacted by nitrogen loading.

Some embayments are already significantly impacted by excess nitrogen loading, either from existing land use, or from sources external to the drainage basin, such as sewage treatment facilities that collect waste streams from outside the embayment's drainage basin. These bays are defined here as "nitrogen-impacted embayments."

Nitrogen-sensitive embayments can be protected through a combined strategy of managing growth, reducing fertilizer use, and promoting treatment technologies capable of reducing nitrogen through a denitrification process. This



ACREAGE BY LAND USE GROUPINGS

Water	3.9
Forest	1753.2
Cropland/Pasture/Other Agric.	530.0
Recreational Uses/Open Land	557.2
Residential Lots < 1/4 Acre	258.4
Residential Lots > 1/4 Acre	1357.3
Salt Marsh/Non-Forested Wetland	316.6
Commerc'l/Industr'l/Transport'n Mining/Waste Disposal	137.9
TOTAL	4914.5

LEGEND

- Water
- Forest
- Cropland/Pasture/Other Agric.
- Recreational Uses/Open Land
- Resid'l - lots up to 1/4 acre
- Resid'l - lots more than 1/4 acre
- Salt Marsh/Non-Forested Wetland
- Commerc'l/Industr'l/Transportat'n/ Mining/Waste Disposal

Land use data compiled by U. Mass. - Amherst Resources Mapping Group from 1:25000 scale aerial photography; data supplied to Buzzards Bay Project (BBP) by MassGIS. Drainage basin boundary delineated by BBP with assistance and review from USGS staff. Map prepared by Buzzards Bay Project using ARC/INFO software.

Scale is approximately 1 inch = 1 mile.

Figure 5.1. Apponagansett Bay, Dartmouth, drainage basin and land use

strategy can similarly be applied to nitrogen-impacted embayments, but more dramatic solutions such as sewering portions of the drainage basin may be required to adequately lower inputs of nitrogen. Some communities have gone so far as to dredge harbor entrances to increase flushing rates, but this strategy is controversial because enlarging channels may increase tidal ranges, change salinities, limit light penetration, or result in significant changes in sediments deposition; these changes could have significant impacts on the distribution and abundance of many species.

To address problems caused by nitrogen-loading, some municipalities have already adopted bylaws and health regulations. One strategy has been to establish total nitrogen "critical concentrations" that should not be exceeded in embayments. These critical concentrations are often set to reflect existing development and existing total nitrogen concentrations so that embayments not yet impacted can be protected with more stringent standards, and polluted embayments do not worsen. The basis of this strategy is to determine whether nitrogen from a proposed development will raise the existing total nitrogen concentration above critical limits. One problem with this approach, however, is that total nitrogen is not always an adequate measure of existing nitrogen contributions to the watershed and receiving waters. For example, nitrogen entering groundwater from septic systems may not reach coastal receiving waters for many years or even decades because groundwater typically travels 1-3 feet per day in the region, and inland portions of some watersheds may be miles from shore. Hence total nitrogen concentrations in seawater may not be representative of existing land loadings. Furthermore, there is debate about the adequacy of certain methods currently used for measuring total nitrogen in seawater, as well as about the location and number of sampling stations required, and the frequency at which they must be sampled. Finally, not all nitrogen that enters the Bay remains in the water column. Shallow bays may accumulate dense layers of drift algae, which would maintain low nitrogen concentrations in the water, thereby failing to reflect the increased loading.

For these reasons, the Buzzards Bay Project is recommending an alternate approach similar to that used to protect large well-recharge areas. That is, decisions on development should not be based on projected elevations of existing concentrations of nitrogen in coastal waters. Instead, the nitrogen contributions allowed from the watershed in the future would be determined by comparing the mass loading rates from existing development with the critical mass loading limits set for each embayment. The critical mass loading limit chosen would be set to prevent critical impacts to the health of that embayment and based upon the volume and flushing time of water specific to each embayment. These limits can then be reflected in zoning bylaws and health regulations. In other words, these nitrogen mass loading limits would be the basis for a nitrogen "carrying capacity" specific to each bay and used for setting lot size, loading rates per acre, or other management strategies.

Technical basis of the proposed strategy

The response of coastal ecosystems to excessive anthropogenic contributions of nitrogen is complex and varied but is most pronounced in embayments with restricted water exchange or where the amount of nitrogen added is large compared to the volume of the receiving water. Perhaps the most overriding feature that defines the response of coastal ecosystems to nitrogen loading is the bathymetry of the receiving waters, particularly the area of bottom within the photic zone.

In the Project's approach, anthropogenic nitrogen mass loading limits are established for embayments to minimize the risk of critical environmental degradation. These limits were chosen based on the best available scientific information from experimental mesocosm manipulations, as well as ecosystem scale case histories where adverse impacts have been documented and nitrogen loadings estimated. Because nitrogen loading rates can be meaningfully characterized as either annual loadings per unit area or loadings per unit volume during the water turnover time, both methods are used to establish nitrogen loading limits. The proposed loading rate limits are tiered to reflect existing water quality classifications as well as bathymetric and hydrographic features of the embayment.

Application of this nitrogen loading management strategy requires that several features of the embayment and its drainage basin be accurately determined including, embayment volume, bathymetry, turnover times, delineation of the surrounding drainage basin, and quantification of existing and potential future nitrogen load from point and non-point sources. The methods for determining each of these parameters are described in Costa et al. (1991). To calculate anthropogenic nitrogen loads, a parcel level land-use analysis is required using a well defined set of nitrogen loading assumptions. These are given in Appendix D.

Tiered loading rate limit

The Buzzards Bay Project is recommending that environmental regulators adopt the following nitrogen loading rate limits as the basis of their strategy to manage nitrogen inputs to coastal waters. These rate limits are embayment specific because they account for the volume and flushing rate of the receiving waters, and they are also tiered to reflect state water quality standards, bathymetry and other special designations. Special designations include ACECs and Outstanding Resource Areas under the Anti-degradation Provision of the Clean Water Act. Shallow embayments are defined as those with 40% or more of their area less than 1 m MLW or having a mean depth at half-tide no greater than 2 m.

Table 5.1. Recommended nitrogen loading limits for coastal embayments

Embayment	Waters classified SB	Waters classified SA	SA waters desig. Outstanding Resource Waters
Shallow			
-flushing: 4.5 days or less	350 $mg/m^3/Vr$	200 $mg/m^3/Vr$	100 $mg/m^3/Vr$
-flushing: greater than 4.5 days	30 $g/m^2/y$	15 $g/m^2/y$	5 $g/m^2/y$
Deep			
-select rate resulting in lesser annual loading	500 $mg/m^3/Vr$ or 45 $g/m^2/y$	260 $mg/m^3/Vr$ or 20 $g/m^2/y$	130 $mg/m^3/Vr$ or 10 $g/m^2/y$

Note: Vr= Vollenweider flushing term, defined by the equation $Vr=r/(1+sqrt(r))$. When used above, should be read as loading during the "Vollenweider-term adjusted flushing period." Shallow is defined as 40% or more of area less than 1 m or having a mean depth of 2m or less.

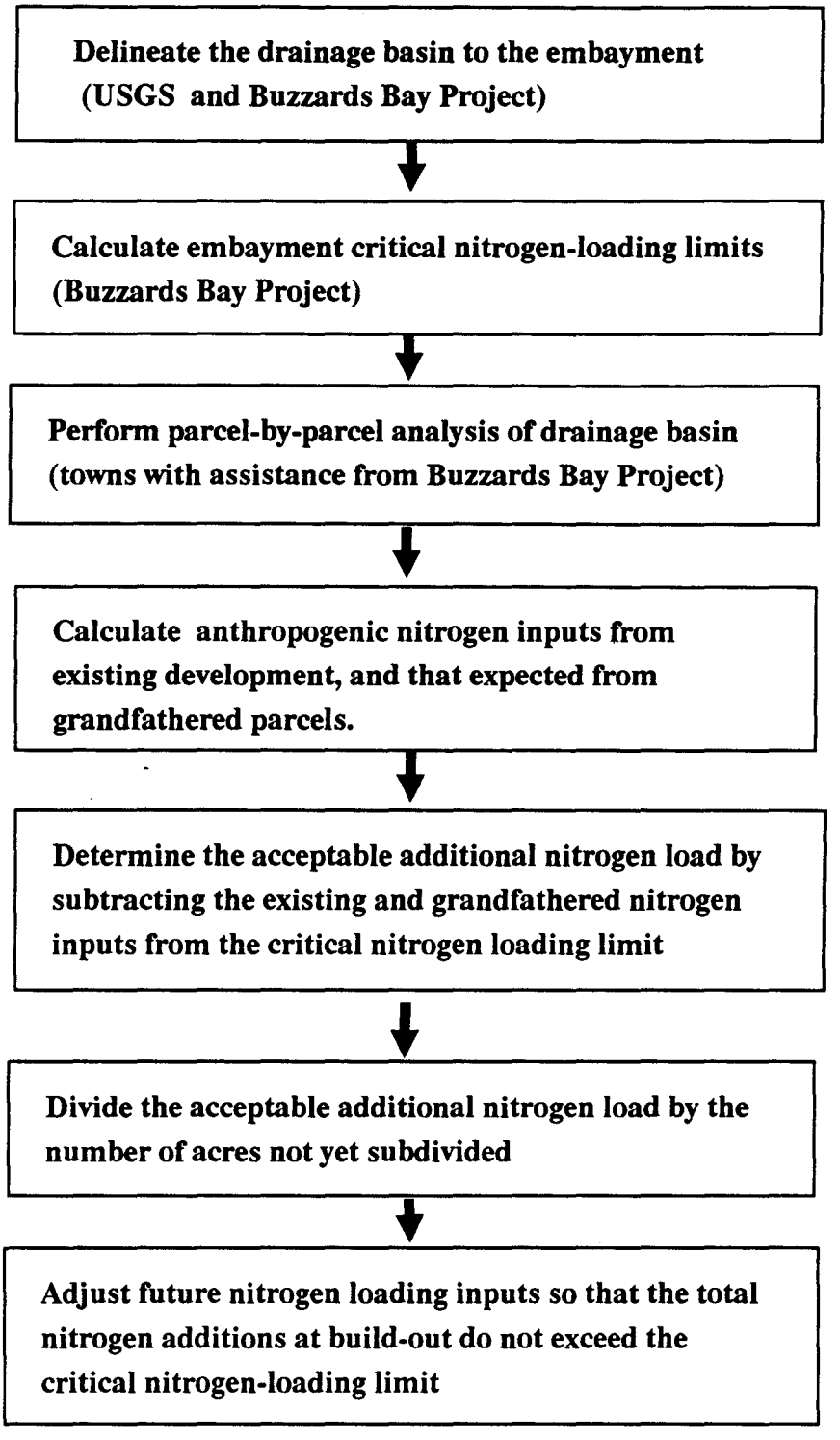


Figure 5.2. Nitrogen loading program for sensitive embayments not yet critically impacted

The Buzzards Bay Project has conducted a preliminary assessment of Buzzards Bay embayments to determine whether management action is likely to be required to meet proposed nitrogen loading limits (Table 5.2). Based on this information, a town can decide whether it wishes to select an embayment and its drainage basin for more detailed assessment and possibly management action. Once an embayment is selected for a more detailed assessment, the community or communities must assess existing nitrogen contributions from the existing land use and identify the ecological, economic, and aesthetic values of embayment resources. Figure 5.1 shows the delineated drainage basin and land use around Apponagansett Bay, an embayment being evaluated by the Buzzards Bay Project and the town of Dartmouth.

The Project is recommending that towns select appropriate bays for this management strategy to prevent anthropogenic nitrogen inputs from reaching the recommended loading limits (see flow diagram in Figure 5.2 and worksheet in Appendix D, Part 1). In practical terms, the drainage basin around each embayment would have a specific limit (# pounds of nitrogen per year) that could not be exceeded (Table 5.2).

This strategy has several advantages. Growth would be managed through more effective planning and zoning; less reliance would be placed on individual residential permit review. The permit-review process could instead be used to focus on subdivisions and large commercial projects and determine whether the proposed development would exceed the designated nitrogen contributions permissible per unit land area (refer to Appendix D, Part 4). If exceeded, developers would then need to devise innovative solutions to limit nitrogen — such as reducing lawn sizes and fertilizer use, purchasing or setting aside open spaces, or installing private treatment plants that remove nitrogen.

The first step in this management strategy is to estimate existing nitrogen loading to the embayment from development within the surrounding drainage basin. A nitrogen loading worksheet is used for this purpose (see Appendix D). The estimate is adjusted for flushing and volume of the embayment and is compared to the embayment's designated nitrogen-loading limit. The next step is to conduct a developable lot, or "buildout," analysis. This will determine the number of additional residential and commercial units that are expected to be constructed under current zoning in undeveloped parts of the basin. This analysis can be conducted for an entire municipality as well as for any geographic subset. The Buzzards Bay Project completed such a buildout and nitrogen-loading analysis of the drainage basin to Buttermilk Bay. The Project then worked with the towns of Plymouth, Wareham, and Bourne to change zoning in a way that would limit excess nitrogen additions and prevent over-enrichment of the embayment. This effort resulted in a prototype nitrogen management district for other nitrogen-sensitive embayments in Buzzards Bay.

Major Issues

The methods for calculating present and future nitrogen loadings have been developed. Although initial outlays of manpower and funding are required to obtain these data, as well as to characterize hydrologic features, this nitrogen loading management approach establishes an objective process for state and local managers to manage nitrogen inputs from both point and non-point sources in coastal embayments.

Table 5.2. Preliminary assessment of nitrogen loading to some Buzzards Bay embayments[1]

BUZZARDS BAY EMBAYMENT	Existing N Load (kg/y)	Future N Load (kg/y)	Classif. Goal	Recommended Load limit (kg/y)	Preliminary Recommended action
Acushnet River New Bedford inner	333,000	360,000	SB	256,000	Manage Growth & Remediation
Apponagansett Bay, inner	52,000	63,000	SA	35,700	Manage Growth & Remediation
Buttermilk Bay	41,300	57,600	SA	55,200	Manage future growth
Hen Cove	9,100	10,500	SA	5,600	Manage Growth & Remediation
Marks Cove	6,100	7,500	ORA	21,800	no action
Mattapoisett upper+lower	49,000	106,000	SA	86,000	Manage future growth
Inner Nasketucket Bay	44,300	51,100	ORA	107,000	no action
Onset Bay	29,400	40,000	ORA	37,000	Manage future growth
Phinneys Harbor	17,700	25,900	ORA	127,000	no action
Pocasset River	12,700	32,700	ORA	21,500	Manage future growth
Quisset Harbor	1,500	1,900	ORA	40,000	no action
Red Brook Harbor	3,000	6,000	ORA	18,600	no action
Sippican Harbor upper harbor	12,600	15,600	SA	25,500	no action
Slocums River	97,000	178,000	SA	29,600	Manage Growth & Remediation
Squeteague Harbor	8,500	16,200	SA	31,000	no action
Wareham River	94,200	222,000	SA	37,400	Manage Growth & Remediation
West Falmouth Harbor	24,000	31,000	SA	37,200	no action
Westport River, East Branch	123,000	219,000	SA	120,300	Manage Growth & Remediation
Westport River, West Branch	27,900	56,000	ORA	26,600	Manage Growth & Remediation
Weweantic River	144,000	291,000	SA	47,600	Manage Growth & Remediation
Widows Cove	200	800	ORA	28,000	no action
Wild Harbor	8,000	9,400	ORA	30,400	no action
Wings Cove	2,001	3,700	ORA	28,000	no action

[1]This table is a preliminary assessment of nitrogen loading based on the limits recommended in Table 5.1 and embayment hydrologic features and estimated loadings calculated from landuse reported in Costa et al., 1991 and based on MassGIS landuse statistics and other sources. Because these are preliminary estimates, it is recommended that environmental managers consider more detailed assessments before implementing any specific actions or determining that no action is required, particularly where predicted loads are near recommended limits. Water quality classifications are recommended goals, not actual existing classifications. SA = high water quality areas that have excellent habitat and ecological and aesthetic values, SB =areas that have good habitat and ecological and aesthetic values, shellfish areas are restricted and require depuration, ORA = Outstanding resource areas with exceptional habitat, aesthetic, and ecological values.

Future nitrogen management strategies may be based on embayment-specific nitrogen limits determined from computer models based on a large number of variables. This approach has not yet been developed and the proposed tiered approach is the most practical strategy based upon existing scientific understanding of coastal ecosystem response to nitrogen loading. Nonetheless, the proposed loading rates in table 5.1 should not be used if it can be well documented that a more appropriate limit be selected. For example, if it has been documented that an embayment showed catastrophic decline of eelgrass habitat or shellfish abundance at a certain time in its recent history – and that it has been demonstrated that this loss was due to nitrogen loading, then an appropriate loading limit goal for remediation activities should be set for nitrogen impact rates before the catastrophic degradation.

The major responsibility for implementation will be at the town level, where a shortage of expertise may present a problem. This situation can be alleviated if the Project and state, federal, and regional agencies provide the municipalities with the information and tools necessary to carry out nitrogen-management programs. The towns are still responsible for conducting buildout analyses, but this cost in most cases is nominal ($5,000-$8,000). The cost of administering a nitrogen-management program, a bylaw, or both is also nominal.

DEP can adopt these loading limits by including them in the Massachusetts Surface Water Quality Standards. In this way, permitted discharges can be required to comply with these limits. The standards proposed here are meant as minimum standards of protection, and municipalities or state agencies may choose more stringent standards. In determining which embayments should be designated for special protection, the regulatory authorities must assess both existing nitrogen inputs and identify the ecological, economic, and aesthetic values it wishes to protect.

If nitrogen inputs to an embayment already exceed critical limits and that embayment has ecological or economic resources and values a community wishes to protect, the problems faced by a community trying to reduce nitrogen impacts are more difficult, but there are still solutions. Both short term and long term goals must be established with the eventual result that nitrogen inputs from future growth must be limited, and existing inputs must be reduced. Thus, impacted embayments must be protected and restored through a combined strategy of managing growth, reducing fertilizer use, promoting advanced onsite sewage treatment technologies capable of reducing nitrogen, and more dramatic long-term solutions such as sewering portions of the drainage basin, and where appropriate upgrading some public wastewater treatment facilities to include nitrogen removal.

For example, stringent growth-management strategies and new nitrogen controls must be put in place to ensure that nitrogen export from any future growth is consistent with long term goals for remediation. To reduce existing nitrogen inputs, sewering of homes in the embayments drainage basin is the approach most likely to result in reduced future loadings, but this strategy must include safeguards to prevent the sewering of areas in which growth should be discouraged such as near wetlands, critical areas, and beach areas that receive wave action during storms (the velocity zone). The sewering solution is most suitable when the existing facility provides denitrification (convert dissolved inorganic nitrogen to its harmless atmospheric form) or some other capacity to remove nitrogen (e.g., spray irrigation

and assimilation of N in biomass as in Falmouth), and is not being merely disposed in another sensitive estuary or waterway. Another option to reduce inputs is to require that septic systems be upgraded with denitrifying systems when these are approved for permits, or to connect homes in sensitive areas to small, advanced sewage treatment facilities. The costs of sewering or replacing septic systems within a drainage basin is very high and costs will vary among embayments. Strategies such as implementing best management practices in agricultural areas and reducing fertilizer use on lawns and golf courses, particularly in coastal areas, will help as well.

It is true that the costs associated with the traditional methods of wastewater denitrification and other nitrogen removal techniques are still exorbitant. As state and federal funding for large public treatment facilities continues to decrease, towns must not rely solely on typical large-scale structural remedies for controlling excess nitrogen loading to sensitive embayments. Alternative technologies such as denitrifying septic systems, biological uptake, and small-scale tertiary treatment facilities must be fully researched through state and federal programs and accepted as viable approaches for reducing nitrogen. Of course, some experimental denitrifying systems constructed in the state cost more than $15,000 per unit, more than double the cost of a standard Title 5 system but these costs are expected to drop considerably if these systems were granted permits for general use and more were manufactured and installed.

Goals

1. Ensure that no beneficial water uses[1] will be lost, nor will ecosystems be adversely affected by excessive contributions of nitrogen to any embayment within Buzzards Bay.

2. Restore any beneficial water uses and ecosystems lost or impacted by the excessive contribution of nitrogen to any embayment within Buzzards Bay.

Objectives

1. To control the amount of nitrogen entering Buzzards Bay as a whole.

2. To limit new additions of nitrogen entering nitrogen-sensitive embayments.

3. To reduce the amount of nitrogen entering nitrogen-impacted embayments.

4. To develop and support the use of alternative technologies that achieve denitrification of wastewater.

[1] Beneficial uses are those listed in Massachusetts Water Quality Standards, see entry in Glossary.

5. To develop a monitoring program that can assess the effectiveness of management actions taken and determine changes in water quality and health of coastal ecosystems (A description of this monitoring strategy is included in Volume III).

CCMP Commitments

Department of Environmental Protection (DEP)

1. DEP will adopt regulatory standards for nitrogen inputs to coastal embayments in its 1993 revision to State Water Quality Standards.

Target date: 6/93.

Interim Actions: By 12/92 DEP will adopt a regulatory policy on nitrogen loading to coastal waters and field test it. DEP will work with the town of Marion and the Buzzards Bay Project to evaluate nitrogen inputs from point and non-point sources to Aucoot Cove. Based on these results, the findings and recommendations of the Buzzards Bay Project, and related research activities at the Waquoit Bay National Estuary Research Reserve, DEP will adopt appropriate nitrogen discharge limits for Marion's sewage treatment facility. DEP's Antidegradation Task Force will use this information to adopt an interim policy on nitrogen control and will develop a nutrient water quality standard. EPA and the Buzzards Bay Project will develop a list of nitrogen-sensitive embayments in Buzzards Bay (using embayment flushing rates and other criteria developed by the Project) to help DEP determine where to apply the state standard.

2. DEP will actively promote the development and acceptance of cost-effective alternative technologies for wastewater denitrification by assigning additional personnel to overview pilot projects.

Target date: 12/91

Environmental Protection Agency (EPA)

1. EPA, through its Near Coastal Waters Program, will construct and evaluate approximately four experimental denitrifying onsite wastewater disposal systems in Buzzards Bay municipalities.

2. EPA will contribute a water quality specialist's skills in working on nitrogen issues within the context of DEP's Anti-Degradation Task Force.

Target date: Beginning 1991

Buzzards Bay Municipalities

Per Project recommendations, Bourne, Plymouth and Wareham have adopted an intermunicipal overlay district around Buttermilk Bay to manage future nitrogen inputs in the surrounding drainage basin. These towns have amended their zoning bylaws so that future development will not exceed proposed nitrogen loading limits. They will also adopt, where appropriate, other bylaws and regulations to meet nitrogen loading goals. Dartmouth will pursue development of a nitrogen loading strategy for the Apponagansett Bay Watershed. Westport will pursue a nitrogen loading strategy for the Westport Rivers.

Target date: 9/91-9/92.

Other Recommended CCMP Actions

1. Municipalities should adopt nitrogen-loading bylaws, subdivision regulations, or health regulations to implement nitrogen-management programs around appropriate embayments.

Target dates: technical basis, 9/92; community action, as appropriate.

The Buzzards Bay Project (BBP) will coordinate with the scientific community and with state, federal, and regional agencies to provide municipalities with all the tools and building blocks to implement local nitrogen-management strategies. The BBP, with the assistance of the U.S. Geological Survey, has delineated preliminary drainage areas for nitrogen-sensitive embayments and incorporated these boundaries into the MassGIS system. The BBP has also worked with the scientific community to define flushing rates for all major embayments in Buzzards Bay. The BBP will develop criteria for identifying nitrogen-sensitive embayments and present this information to the communities. The BBP will work with planners and scientists to develop generally accepted methods for determining nitrogen loading through a "build-out" analysis. The BBP will work with the scientific community to establish theoretical critical loading rates for each nitrogen-sensitive embayment.

Using this information, the communities in Buzzards Bay must then decide which embayments they wish to restore or protect from future degradation. These communities would then adopt nitrogen-loading bylaws, subdivision regulations, or health regulations to implement nitrogen-management programs. Technical assistance on bylaw development and implementation will be provided by the BBP and the Southeastern Regional Planning and Economic Development District (SRPEDD). The U.S. Soil Conservation Service (SCS) will advise the communities on best management practices to reduce nitrogen from agricultural sources and on helping growers to implement these best management practices.

2. The Cape Cod Cranberry Growers' Association (CCCGA) in cooperation with the Plymouth County Conservation District should be encouraged to continue implementation of its Water Quality Protection Initiative.

Although not considered a significant wide-spread problem, continuing efforts to reduce fertilizer and pesticide discharges from cranberry bogs should be encouraged and supported. The primary initiative related to this goal is the implementation of the CCCGA Surface Water Protection Strategy. This initiative involves conducting on-site evaluations of water management systems and providing growers with specific recommendations, in accordance with Soil Conservation Service standards for decreasing the potential for nutrient and pesticide discharges. Other components of the strategy include comprehensive grower education and research related to new technology and Integrated Pest Management.

3. State and federal agricultural programs should coordinate efforts to assist farmers in implementing best management practices to control nitrogen release from agricultural land.

To the extent possible, the USDA Hydrologic Unit Plan for Buzzards Bay should coordinate its activities to implement Best Management Practices with similar efforts

of the CCCGA, the Plymouth County Conservation District and the Buzzards Bay Project to avoid duplication of efforts and assure that maximum benefit is derived from these efforts.

Action Plan

Protecting and Enhancing Shellfish Resources

Problem

Since the 1970s, Buzzards Bay has been experiencing a tremendous increase in the number of shellfish-harvesting areas closed as a result of potential pathogen contamination (see Figure 5.3). In 1970, slightly more than 4,000 acres of shellfish beds were closed in Buzzards Bay; in 1991, approximately 13,200 acres are closed. Degradation of water quality due to pathogen contamination represents a serious human health risk and economic loss.

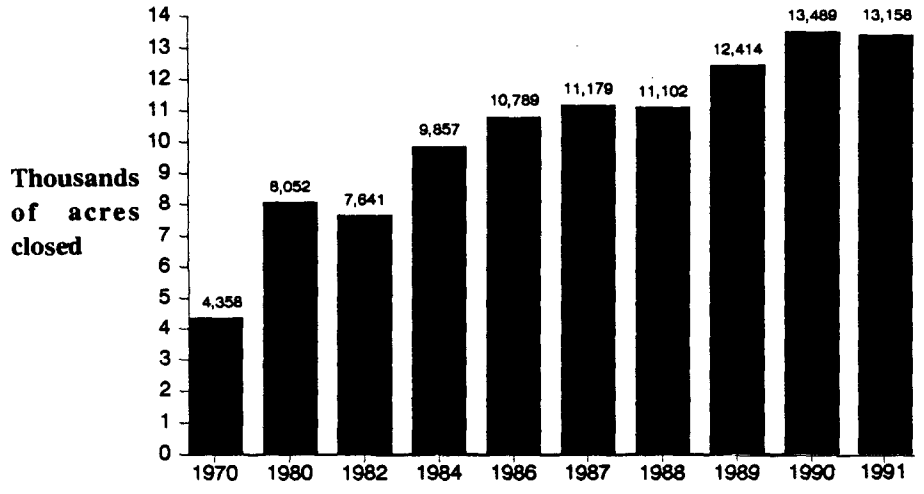


Figure 5.3. Shellfish resource areas closed in Buzzards Bay

These shellfisheries are a valuable resource and need to be protected. Quahogs, bay scallops, soft-shell clams, and oysters are the predominant species harvested. In 1988, the landed value of the commercial shellfisheries of the Bay was $4.5 million out of a statewide total of $18.8 million (Figure 5.4). Landings of quahog and bay scallop constitute the majority of the commercial shellfishery in Buzzards Bay.

For these reasons, the closing of shellfish beds is one of the priority problems that has been addressed by the Buzzards Bay Project over the past five years. More beds are being closed because more pathogens are finding their way to the Bay and, to a lesser extent, because improved monitoring has identified previously undocumented problems.

NATIONAL SHELLFISH SANITATION PROGRAM

In order to protect public health from shellfish contaminated by sewage, the National Shellfish Sanitation Program (NSSP) was established in the 1920s. Composed of federal, state, and industry representatives, today this program is carried out through a forum known as the Interstate Shellfish Sanitation Conference. In Massachusetts, the Division of Marine Fisheries and the Massachusetts Division of Food and Drugs are the responsible state agencies in the NSSP.

One goal of the NSSP is the proper classification of shellfish resource areas to safeguard public health from pathogen-contaminated shellfish. A major portion of the classification process involves the growing-area survey, or sanitary survey. A sanitary survey must be conducted in each shellfish harvesting area prior to its approval by the state for any harvesting purpose. The sanitary survey has four major components: (1) evaluation of potential pollution sources affecting the area; (2) evaluation of the meteorological factors affecting the entrance and dispersal of contaminants; (3) evaluation of hydrographic factors affecting the distribution of pollutants in the area; and (4) assessment of the water quality. The synthesis and analysis of this information to determine the proper classification of the area is referred to as a sanitary survey report.

The classification process requires periodic evaluation and review. Each year, water quality data are collected and analyzed on at least five separate occasions for each approved growing area. Every three years, the classification of each growing area is reevaluated based on the latest survey report and most recent data. Every 12 years, a complete shoreline survey is conducted to pinpoint obvious pollution sources.

A second goal of the NSSP is to determine appropriate classification standards that will protect public health. As indicated in Chapter 4, fecal coliform bacteria are currently used to classify shellfish harvesting areas. Because public health agencies are not able to measure the entire host of human pathogens directly, they rely on fecal coliform bacteria as an indicator of public health risk. Although the fecal coliform standard appears to be a very conservative measure, legitimate questions have been raised about the accuracy of the method.

As important recreational and commercial shellfish areas are closed, fishing pressure on open areas increases. Therefore, in addition to pathogen contamination, this action plan addresses several resource-management issues as a means to enhance the productivity of open shellfish areas. Other action plans, especially Controlling Stormwater Runoff, Managing Sewage from Boats and Managing On-Site Systems, deal with controlling sources of pathogen contamination.

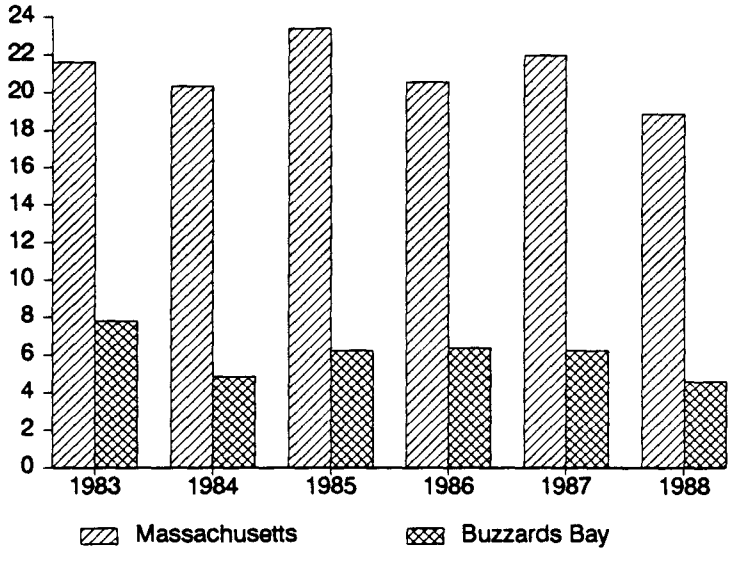


Figure 5.4. Annual value of shellfish landings in Buzzzards Bay and all of Massachusetts

Background

Major sources of pathogens and coliforms entering Buzzards Bay include sewage treatment plants, combined sewer overflows (CSOs), stormwater runoff, boat sewage, and septic systems. As of April 1991, 13,150 acres of shellfish areas were closed due to pathogen contamination; 19,550 acres were under administrative closure because they had not been surveyed by DMF; and 554 acres were conditionally approved (DMF, personal communication).[1] Chapter 4, Characterization of Pollution Sources, presents a full discussion of the sources of pathogens entering Buzzards Bay.

In the New Bedford area (Clarks Cove and Outer New Bedford Harbor) closures because of sewage contamination have resulted in the loss of nearly 500,000 bushels of

1 All of Buzzards Bay is subdivided into approximately 60 shellfish "resource areas" for classification purposes. Shellfish resource areas include both productive beds and commercially and recreationally unproductive areas. For this reason, both closed and open shellfish areas are not always indicative of the viable shellfish resource in that area. As of April 1991, there were a total of 114,383 acres of resource areas approved for shellfishing.

quahogs valued at nearly $5 million (Conservation Law Foundation, 1988). This contamination is primarily the result of CSOs located in the area, as well as inadequate performance of the New Bedford sewage treatment plant. This is perhaps the most striking example of the magnitude of the problem of pathogen contamination.

In the less urbanized areas, Project findings indicate that stormwater runoff is a major factor contributing to the increased closings of shellfish beds around the Bay and that discharge of sewage from boats represents a significant potential source of pathogens impacting shellfish-harvesting areas.

In 1989, the Division of Marine Fisheries (DMF) completed an extensive effort to survey shellfish-growing areas along the coast. Information from sanitary survey reports are being entered into the Buzzards Bay Project database to prepare maps, such as that shown in Figure 5.5 for Dartmouth, and other useful products for state and municipal environmental managers.

The problem facing the shellfisheries of Buzzards Bay is not limited to the closure of harvesting beds; the headline news of the productivity of open areas is also an issue. In general, shellfish management is vested in local communities (size limits are set by the state). Over the past 20 years, local shellfish management has improved as the result of the technical and financial assistance programs administered by the DMF. These programs are being severely undermined as a result of fiscal constraints at the state level. The expansion of local shellfish programs has increased the need for technical assistance from the state, but state funding for such assistance has not kept pace with the demand. In addition, classification of shellfish areas has taken precedence over technical assistance in assignment of staff time. In the state budget for fiscal year 1991, the financial assistance program (reimbursements to local communities for shellfish-related expenditures) was not funded.

Impediments to sound shellfish management at the local level include lack of consistent and reliable catch data and lack of state oversight for management planning. Currently, data on commercial and recreational harvest are collected at the local level, using methods that vary from town to town. Information is often based on personal observations or estimations, reducing its reliability. Catch data are important and can be used to evaluate trends, set quotas, establish economic value, and assist in predicting future populations.

Although the state formerly provided financial assistance to local shellfish programs, there has never been a mechanism to ensure effective management planning. The financial assistance program was simply a reimbursement program open to all coastal communities. Reimbursements were based on available funds at the state level ($300,000 to $400,000 annually) and the expenditures at the local level. At one time, local communities were reimbursed for as much as 50% of their expenditures. More recently, this figure had dropped as low as 15%. In 1989, Buzzards Bay communities received an average of $7,800 (DMF).

Legislation is needed to establish a grant program that provides aid to local communities in management of the resource, and at the same time provides state oversight to ensure effective management planning. A shellfish grant program to foster improved protection of the shellfish resources of the Commonwealth has been introduced in the Massachusetts Legislature.

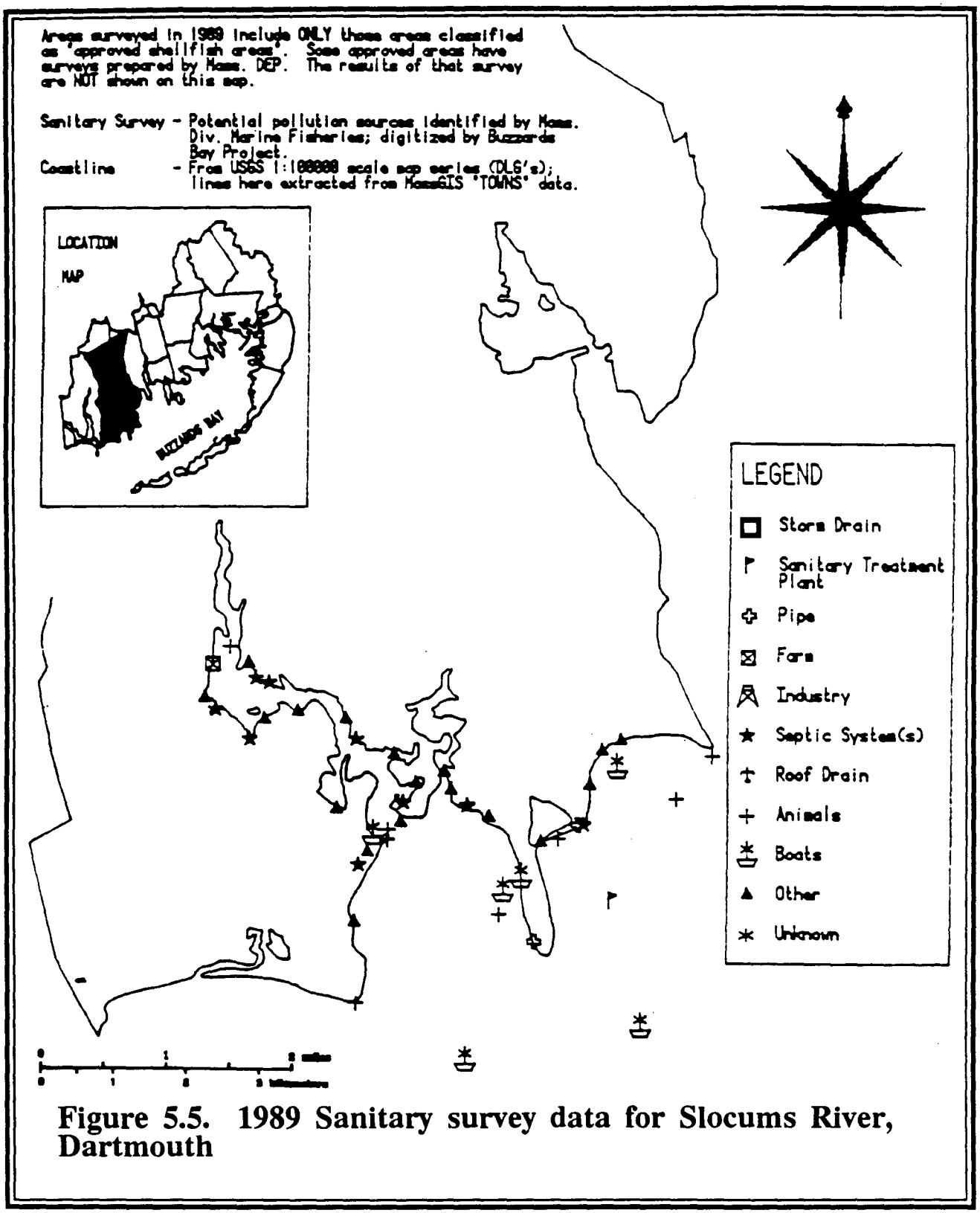


Figure 5.5. 1989 Sanitary survey data for Slocums River, Dartmouth

Shellfish harvesting areas that are subject to intermittent, somewhat predictable, pollution events, such as rainfall, may be classified as conditionally approved. In 1990, only one area in Buzzards Bay, 894 acres in the Westport river, had this classification. Significantly more documentation of water quality conditions surrounding the pollution event is required for conditional approval. A management plan that includes enforcement contingencies and safeguards must be developed and approved by DMF. The process is a very rigorous one. For example, Westport conducted a study to assess coliform levels and sources in the Westport River estuary. This study cost $50,000 and allowed Westport to identify protocols, stations, and sampling frequency for a monitoring program. This effort enabled DMF to allow conditional closures in the Westport River after rain events, allowing greater utilization of the shellfish resources in that estuary. If a town is willing to provide the resources, conditional approval is a way in which productive shellfish areas can be kept open much of the time.

Sanitary survey shellfish bed classification

Approved – any growing area that does not contain pathogens, fecal material, or poisonous substances in dangerous concentrations. Shellfish can be harvested recreationally and commercially.

Conditionally Approved – any growing area that is subject to intermittent pathogen pollution. Shellfish can be harvested only under certain specific conditions.

Restricted – any growing area that indicates a limited degree of pathogen pollution. Shellfish are moderately contaminated and can be harvested by specially-licensed diggers for purification at the state-operated depuration plant.

Conditionally Restricted – any growing area that is subject to intermittent pathogen pollution. Shellfish may be harvested at times when contamination is predictably low.

Prohibited – any growing area that is closed to the harvest of shellfish at all times. Shellfish cannot be harvested under any circumstances.

Major Issues

In order to improve the shellfisheries of Buzzards Bay, state and local governments need to work cooperatively to identify and correct known sources of pathogens impacting all productive shellfish areas. There is also a need for better management to reduce fishing pressure on open areas. The use of the conditional-approval classification standard can increase availability of open areas and better reflect conditions responsible for increased coliform concentrations. Methods for collecting shellfish catch data need to be improved and standardized for both the commercial and recreational shellfisheries. Increased state funding is necessary to carry out the Shellfish Sanitation Program and to continue providing the appropriate level of technical and financial assistance to local communities to enhance resource productivity and improve shellfish management.

As noted in Chapter 4, use of fecal coliform bacteria as indicators of public health risk has raised serious questions. While this indicator has provided reasonable protection from bacterial pathogens, it has not been shown to correlate well with the occurrence of viral pathogens. Despite this, research has not yet provided a better indicator.

Goal

Increase availability of shellfish resources for recreational and commercial uses.

Objectives

1. To keep open all shellfish areas that have not closed and open priority areas that are closed.

2. To enhance efforts to manage shellfish resources at both the state and local levels.

3. To increase the capacity and commitment of municipalities to remediate identified pollution sources and to assist in conducting the sanitary survey program.

4. To increase the ability of DMF to carry out the sanitary survey program and provide technical and financial assistance.

5. To expand the use of the conditionally approved classification for shellfish areas.

CCMP Commitments

Division of Marine Fisheries (DMF)

1. DMF will work to train individuals in each Buzzards Bay town in shoreline surveys and strive to develop long-term cooperative arrangements that ensure consistency of town participation and supplements limited state personnel with local manpower.

Target date: 1991-1993.

2. DMF will encourage Buzzards Bay towns to work cooperatively with them to expand the number of conditionally approved shellfish areas.

Target date: 1991-1993.

Department of Environmental Protection (DEP)

DEP will take enforcement action against significant illegal discharges identified by DMF's sanitary surveys.

Target date: 12/93

Buzzards Bay Municipalities

1. Falmouth, Bourne, Mattapoisett, and Dartmouth have initiated coordinated efforts within their towns to identify and set priorities for illegal discharges that may be affecting shellfish beds.

2. Falmouth, Bourne, Wareham, and Fairhaven have designated individuals with public health jurisdiction to assist DMF in classifying shellfish areas within their jurisdiction.

3. With DMF assistance, Fairhaven and Dartmouth will pursue conditionally approved shellfish areas within their towns.

Target date: 1991

Other Recommended CCMP Actions

1. All other coastal municipalities should correct identified sources of coliforms and pathogens entering the Bay.

Target date: immediately.

This CCMP contains action plans with recommendations to reduce pathogen inputs from major sources including sewage treatment plants, CSOs, stormwater runoff, boat sewage, and septic systems. Based on the sanitary survey reports prepared by the DMF, local communities should begin to prioritize major sources and then take the necessary corrective actions. The major responsibility for this action rests with the board of health and the local shellfish department. Implementation costs will vary widely and are site specific. The Buzzards Bay Project, DMF, and SCS will provide technical assistance on remediation strategies.

The Buzzards Bay Project has identified strategies to finance remediation. See the accompanying document, Financial Management Plan for funding options and cost figures for stormwater treatment, boat sewage solutions, and septic system management.

2. EOEA should increase funding to carry out the Shellfish Sanitation Program.

Target date: July, 1992. Cost: an additional $400,000 annually.

In fiscal year 1988, DMF was given full responsibility for shellfish classification (formerly it was shared with DEP) and the program has become a top priority for DMF. DMF, however, received only half the necessary funding to conduct these activities. Consequently, approximately 420,000 acres have yet to be classified statewide, and as a result, these areas remain closed. In addition, DMF is unable to provide adequate technical assistance to meet the needs of the communities. Full funding of the sanitation program should resolve these problems.

3. All other coastal communities should designate an individual with public health responsibility to assist DMF in classifying shellfish areas within their jurisdictions.

Target date: 1992.

Local communities need to take a greater role in providing assistance to DMF in classifying shellfish areas in an effort to maximize availability of existing shellfish resources. In addition, increased local participation should result in increased enforcement action and remediation of known pollution sources.

4. EPA and FDA should develop a new indicator or suite of indicators to replace fecal coliform as an indicator of human health risk.

Target date: begin immediately.

A new indicator or suite of indicators are needed that will differentiate human sources of pathogenic contamination from animal sources; give protection from viruses as well as bacteria; reflect actual health risk; and be easy and inexpensive to measure.

5. The Massachusetts Legislature should pass legislation to improve financial assistance at the local level.

Target date: 1992. Suggested funding level: $400,000 annually.

Implementation of a shellfish grant program administered by DMF will provide appropriate management oversight at the state level and incentive at the local level to enhance shellfish productivity. For 1988, the landed value of the shellfisheries of the Commonwealth was $18.8 million; this represents an important economic asset. Currently, the Massachusetts Legislature is considering such a bill.

6. DMF should develop standard methods for towns to report commercial and recreational shellfish catch data as a first step in monitoring resource utilization or losses.

Target date: 1993.

DMF and local shellfish authorities should work cooperatively to improve the collection and reporting of shellfish catch data from both the commercial and recreational shellfisheries.

Action Plan
Controlling Stormwater Runoff

Problem

Rainwater running off streets, parking lots, roofs, lawns, golf courses, agricultural land and other pervious and impervious areas carries a number of important contaminants into Buzzards Bay via stormwater drains. Paved roads and parking lots that are connected to Buzzards Bay by drainpipes offer major contaminant pathways for wastes that were once isolated from the Bay. Bacterial loading from stormwater runoff is forcing the closure of shellfish beds and sometimes the temporary closure of swimming beaches in Buzzards Bay embayments. Stormwater runoff is also contributing to other water quality problems, including pollution from hydrocarbons, metals, and floatable debris, and accelerated sedimentation. Although concerns remain about the long-term impact of metals and other pollutants discharged during storm events, this action plan is most concerned with the closure of shellfish beds due to fecal coliform bacteria in stormwater runoff.

At least three years of site-specific data from Buttermilk Bay, as well as data produced nationwide, have pointed to stormwater as a major source of bacterial contamination. Over 22 discharge points into Buttermilk Bay have been investigated. Although no illegal sanitary hookups to stormwater pipes were found, during rain events the stormwater pipes were found to discharge significant amounts of bacteria that led directly to shellfish bed closures.

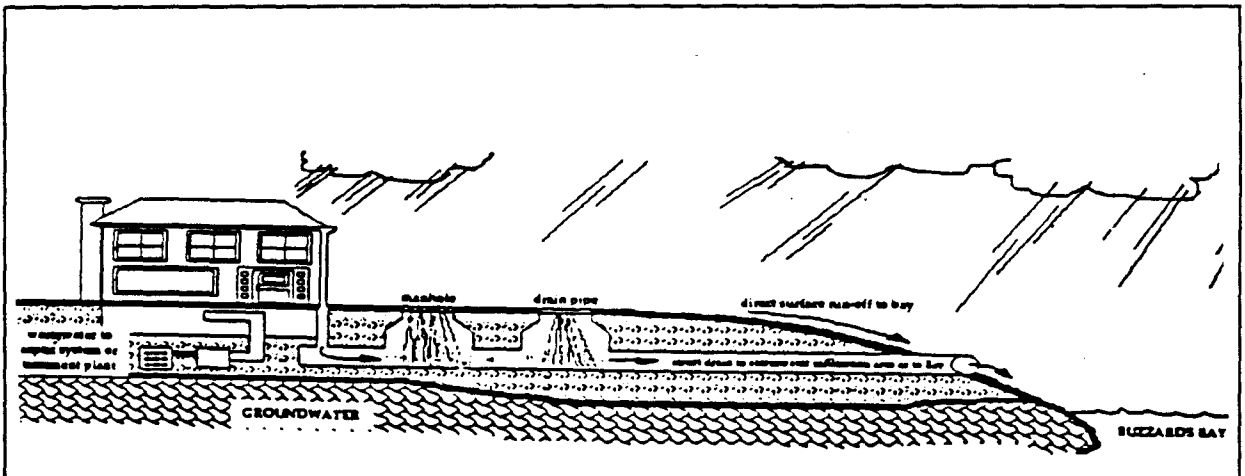


Figure 5.6. A multiple pipe system consists of pipes carrying residential wastewater and separate pipes carrying stormwater.

Background

EPA recently issued national regulations governing permitting of certain categories of stormwater discharges. These include stormwater discharges associated with industrial activity; discharges from large municipal separate storm sewer systems (systems serving a population of 250,000 or more); and discharges from medium municipal separate storm sewer systems (systems serving 100,000 or more, but less than 250,000). Unfortunately, these categories do not apply in Buzzards Bay – even New Bedford is under 100,000 population. However, the regional EPA office has indicated its willingness to issue permits, on a limited basis, for problem drains that adversely impact the Bay, its uses, or critical areas surrounding the Bay such as wetlands. These permits would require that stormwater discharges meet existing state water quality standards, including standards for fecal coliform.

At present, new storm drains are being regulated entirely at the local level through subdivision bylaws and road-drainage regulations. This type of local regulation is sometimes inconsistent from one community to the next. More of a problem, though, is that neither the federal permits nor local regulations address the majority of existing storm drains, which is the major problem.

The Massachusetts Division of Marine Fisheries recently completed sanitary surveys for open shellfish areas in Buzzards Bay. These surveys contain a wealth of information on existing stormwater drains that are sources of fecal coliform bacteria and are causing or threatening to cause the closure of shellfish beds. This information is available to all Buzzards Bay communities and provides an excellent database of existing drains, their location, size, and probable impact to receiving waters.

In 1988, the Buzzards Bay Project initiated a demonstration of ways to remediate existing stormwater discharges. Under a grant from EPA, water from major storm drains (Electric Avenue in Bourne and Red Brook in Wareham) is being diverted so that it no longer flows directly into Buttermilk Bay. In the case of the Electric Avenue discharge pipe, a structure that resembles a large septic system with several leaching chambers was constructed to receive the stormwater flow and discharge it to the ground adjacent to the bay. Monitoring wells have been installed near the discharge points to determine the effectiveness of this method. Using a similar principle, the Red Brook drain will be diverted into a ponding area where the water can percolate naturally through the soil before it reaches the bay. These methods were chosen based upon results of National Urban Runoff Program and other appropriate projects. Evidence from these studies indicates that when facilities are properly located, sized and installed, they achieve high levels of stormwater treatment and result in insignificant groundwater degradation.

An archaeological investigation and easement arrangements have delayed the Red Brook project. However, monitoring at the Electric Avenue structure indicates that over 98% of the fecal coliform is being removed. These facilities will not only remove bacteria, but will also significantly reduce the concentrations of heavy metal, pesticides, and hydrocarbons in stormwater reaching the Bay. Some contaminants will settle to the bottom or float to the top of the settling tank and be pumped out regularly while ohter pollutants may be tied up in the unsaturated soil beneath the leaching field.

No single stormwater remediation technique solves all runoff problems. Accepted best management practices (BMPs) for stormwater include:

- Infiltration devices to increase the percolation of stormwater into soil and thus decrease overland runoff volume, including porous pavement, soak-away pits or dry wells, seepage or infiltration trenches, recharge or percolation basins and grass swales
- Wet detention basins to detain runoff and allow for settling of pollutants associated with sediments and reduction of nutrients through biological processes
- Public works cleaning practices to remove potential pollutants from streets and storm sewers, including street cleaning and cleaning catchbasins and stormsewer pipes.

A proper mix of stormwater control techniques can satisfy four major concerns: flooding, erosion, water quality, and groundwater recharge. Individual site conditions, type and use of receiving waters, and cost will determine the most appropriate design. Costs are usually determined by the system's capacity, which is primarily designed to handle the "first flush" from a storm, when contaminant levels are highest. Maintenance costs, however, may exceed construction costs with certain systems. Of the techniques listed, infiltration devices are most efficient at controlling coliform pollution from stormwater runoff.

The greatest potential for utilizing the full range of BMPs for stormwater control is in undeveloped areas where the reduction of future pollutant loadings can be realized for the least cost. There is a great opportunity in such areas to employ land-use planning, especially in subdivision designs, to reduce future runoff volumes and corresponding pollutant loads. Developing communities can incorporate structural measures to reduce runoff and can also implement construction-site erosion BMPs into their development plans.

In developed areas, structural controls may be expensive to implement and land for retention basins may be either prohibitively expensive or not available at all. The Electric Avenue structure cost over $100,000 to complete. The Red Brook project is feasible only because the land owner is a conservationist who allowed an easement to the town. The costs of stormwater BMPs are usually borne by the municipality and its residents, but benefits accrue to all users of the municipality's coastal resource. These benefits can include restored recreational opportunities, maintenance of land values due to the aesthetic appearance of receiving waters, and of greatest relevance here, restored or continued shellfishing opportunities.

Major Issues

The State Department of Public Works (DPW) has as its primary mission the construction of safe roads. This includes the removal of stormwater from those roads as quickly as possible. Accordingly, resource protection and water quality considerations are secondary concerns for DPW. Also, bridge projects and widening of less than one lane on state roads are exempt from the Wetlands Protection Act. This exemption compromises the ability of local conservation commissions to protect wetlands. It is important to work with the DPW to ensure that water quality impacts

are considered during road and bridge construction. The activities of town DPWs should receive the same attention.

As discussed above, the construction of stormwater treatment facilities can be costly. Any town that is contemplating such an effort must consider all facets of the issue, including land acquisition, installation techniques, cost, treatment effectiveness, and maintenance requirements. Sampling data may be needed to determine the relative impact of each drain on water quality degradation. Before targeting a particular storm drain for action, the town should ensure that the problem is not emanating from septic systems that are "cross-connecting" with the drain.

Stormwater runoff from more than one town may be contributing to water quality degradation or shellfish-bed closures in a specific embayment. Each contributing town must effect similar and equitable stormwater controls in order for the affected resource to be fully protected.

Most stormwater drains in Buzzards Bay are primarily wet weather discharges only. Those that have continuous, dry weather flows may be an indication of illegal cross connections with sewer lines or septic systems (see discussion in Chapter 8). Alternatively, dry weather flows could merely indicate groundwater infiltration.

On pages 26 and 164, inadequacies of the fecal indicator are discussed. While it is true that many stormwater discharges are high in fecal coliforms and not necessarily high in pathogens, treatment is desirable for the removal of other pollutants.

Goals

1. Prevent new or increased untreated stormwater flows to Buzzards Bay that would adversely affect shellfish harvesting areas, swimming beaches, water quality, and wetlands.

2. Correct existing stormwater runoff problems that are causing or contributing to water quality degradation or shellfish-bed closures in Buzzard Bay.

Objectives

1. To institutionalize at the local level (through education and regulation) the use of best management practices for stormwater control in newly developed areas.

2. To develop a regional and local program to execute appropriate mitigation measures for existing stormwater discharges. The program would include construction, operation, and maintenance of stormwater control structures.

CCMP Commitments

Department of Environmental Protection (DEP)

DEP will work cooperatively with EPA to develop a policy including criteria to determine when permits for stormwater discharges are required. DEP will include these criteria in its State Water Quality Standards. DEP will also consolidate its regulatory authority for controlling stormwater runoff.

Target date: 6/93

Interim Action: DEP in association with EPA will conduct a pilot stormwater permitting project in one or two Buzzards Bay towns. During the fall of 1991, discharges in these towns will be monitored before and after rain events by DEP and EPA. In late 1991 and early 1992, using the information gathered during this sampling project, DEP and EPA will issue joint permits for those discharges which are causing a significant water quality impact. In addition, DEP will work with EPA and the Town(s) to develop a policy on how many new discharges can be allowed or what types of best management practices must be put into place without causing state water quality criteria to be exceeded.

The DEP Antidegradation Task Force will consider the results of the above project in developing its stormwater policy for adoption in the 1993 revisions of the state water quality criteria.

Buzzards Bay Municipalities

Bourne, Wareham, and Marion will pursue adoption of subdivision rules and regulations that require best management practices for stormwater runoff.

Target date: 1992

Other Recommended CCMP Actions

1. All other Buzzards Bay communities should adopt subdivision bylaws that require that best management practices for stormwater runoff be incorporated into any new development plans.

Target date: 1994.

BMPs such as porous pavement for driveways or parking lots, infiltration basins, and grass swales can be quite effective in reducing stormwater runoff from residential or commercial areas. By incorporating such practices as mandatory requirements for new areas of development, future stormwater impacts to Buzzards Bay and its resources can be avoided. In general, efforts should be made to retain and treat stormwater on site.The USDA Soil Conservation Service (SCS) should provide technical assistance to communities in developing BMPs for their subdivision bylaws. SRPEDD will help ensure consistency of regulations between communities that share watershed areas.

2. Each Buzzards Bay community should implement best management practices for storm drains that are contributing to shellfish-bed closures.

Target date: beginning immediately and as funds allow.

Communities should prioritize storm drains based on their effect on critical waters and the feasibility and cost of remediation (as described in the attached worksheet). Towns sharing an embayment or particular affected shellfish resources should coordinate their efforts to ensure that the remediation projects will result in the reopening of shellfish beds. SCS will provide technical assistance in helping communities determine BMPs for site-specific situations. The Buzzards Bay Project will provide communities with maps indicating major stormwater problems.

Implementation Costs

There are a number of Best Management Practices that can be used to control stormwater runoff. The Financial Plan provides a brief description of each BMP and the estimated costs for new construction, routine and non-routine maintenance, and retrofitting. See Financial Plan Volume II, Chapter 2 for potential sources of funding and revenue options.

3. The Commonwealth, through the Executive Office of Environmental Affairs, should provide funding for local stormwater remediation projects.

Target date: 1993.

The state should expand its current stormwater-remediation bond program to encompass all Buzzards Bay communities and should use funds generated through issuance of these bonds to finance stormwater remediation projects undertaken in the Buzzards Bay watershed. These funds should be preferentially directed to communities willing to match state funds with local funds.

4. The State Legislature should not continue to exempt bridge work and road widening by the state DPW from review by local conservation commissions.

Target date: 1992.

Eliminating this exemption will allow Buzzards Bay communities to protect sensitive wetlands from stormwater runoff from roads.

5. SCS should institute a program for implementing best management practices on agricultural lands in the Buzzards Bay area.

Target date: 1991.

SCS has targeted Buzzards Bay under its new "hydrographic unit initiative" and has begun a three-year program for providing education and technical assistance to reduce nonpoint-source pollution from agricultural operations and stormwater. In addition, cost sharing has been expanded for construction or installation of agricultural BMPs.

WORKSHEET FOR PRIORITIZING STORMWATER DRAINAGE MITIGATION PROJECTS[1]

PART I — DESCRIPTION OF AREA

The first part of the prioritizing process is to physically describe the area of the proposed mitigation. Make a copy of a map of the area from any convenient source (town assessor's map, commercially produced, or enlarged section of U.S. Geological Survey map) and attach it to this worksheet. On the map, note the locations of all potential sources of additional contamination within 500 yards of the proposed mitigation project. Then describe these potential sources below in as much detail as possible. This information is extremely important because it helps determine the probability that mitigating this drainage problem will be successful (i.e., result in a noticeable improvement in water quality after its completion).

NAME OF DRAINAGE AREA PROPOSED FOR MITIGATION (reference drain by street, receiving water, and adjacent landmarks)

DESCRIPTION OF POTENTIAL SOURCES OF CONTAMINATION IN THE AREA NEAR THE PROPOSED MITIGATION SITE.

OTHER DISCHARGE PIPES:

DISTANCE IN FEET FROM RESOURCE:

BOAT RAMPS:

BERMED SECTIONS OF ROADS:

MARINAS:

SEPTIC SYSTEMS:

OTHER:

PART II — CALCULATION OF NUMERICAL INDEX

The second part of the prioritizing process is to calculate a numerical index for ranking proposed projects. The index incorporates information about the relative importance and present state of the resource impacted (i.e., how is the shellfish/swimming resource now classified?).

Question 1. Does the discharge impact an area containing shellfish?

Score 5 if YES

Score 0 if NO

Question 1 score_____

Question 2. Does the discharge enter a swimming area?

Score 5 if YES

Score 0 if NO

Question 2 score_____

Question 3. Usage of the swimming area.

Score 20 if public beach, heavily used with all facilities

Score 15 if public beach, no facilities

Score 5 if other (small beaches with limited access)

Question 3 score_____

Question 4. As a result of the discharge, do the waters at the adjacent beach experience elevated fecal coliform counts following rain events?

Score 20 if fecal coliform >199 FC/100 ml

Score 10 if fecal coliform >49 FC/100 ml but < 200 FC/100 ml

Score 5 if fecal coliform >0 FC/100 ml but <50 FC/100 ml

Question 4 score_____

Question 5. Is there sufficient data to demonstrate that remediation of this source will significantly improve water quality in the area?

Score 15 if professional judgement of DMF that this is a significant source and its clean up may cause reclassification of the area.

Score 10 if some substantiating data by DMF and other sources

Score 5 if professional judgement not substantiated by significant data

Question 5 score_____

Question 6. Is the area productive for shellfish?

Score 20 if very productive

Score 15 if moderately productive

Score 10 if has some production

Score 5 if no history of significant production

Question 6 score_____

Question 7. Is the shellfish harvesting area now open?

Score 20 if YES

Score 10 if SEASONALLY

Score 5 if CLOSED

Question 7 score_____

INDEX CALCULATION

TOTAL SCORE QUESTIONS 1 THROUGH 7_____

1 This worksheet was developed by the Cape Cod Marine Water Quality Task Force and has been slightly modified.

Action Plan

Managing Sewage From Boats

Problem

Information developed through the Buzzards Bay Project and monitoring conducted by the Department of Environmental Protection (DEP) indicates that sewage from boats is probably being discharged regularly in the nearshore waters of Buzzards Bay, particularly in and around marinas. The boat sewage itself, as well as chemicals used to deodorize and disinfect the sewage, are believed to be degrading water quality and potentially affecting resource areas — such as shellfish beds. The major products used as chemical additives are alcohol, formaldehyde, zinc salts, ammonium salts and chlorine. A survey of harbor masters indicates that alcohol and formaldehyde are the most common chemicals used in Buzzards Bay waters in Type III MSDs. High concentrations of formaldehyde in discharges represent a potential health threat to bathers and a threat to the environment.

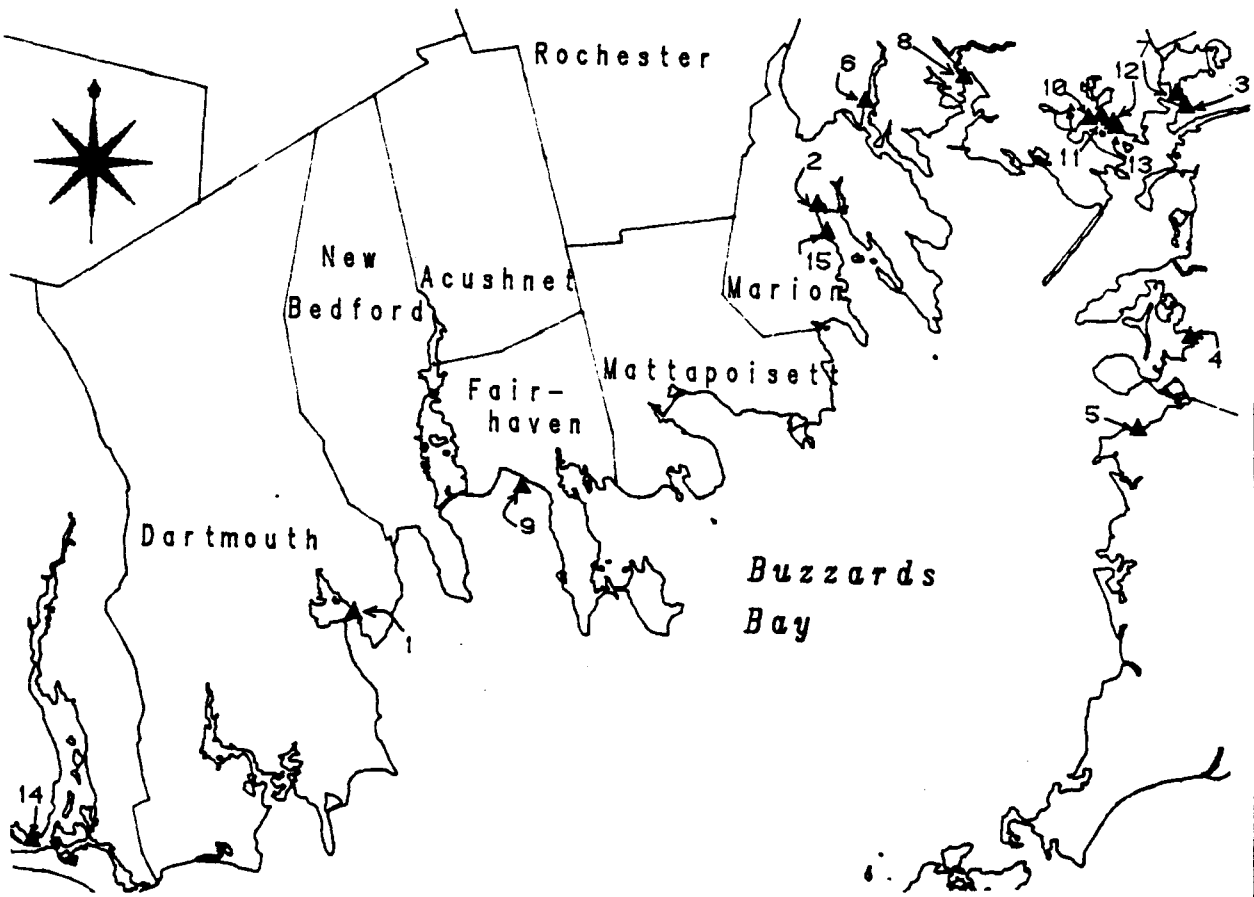
Approximately 11,000 boats are docked or moored in embayments around Buzzards Bay. However, only about 11 publically available boat pumpout facilities exist for the entire Bay (Figure 5.7). Moreover, in most cases these facilities are so significantly underutilized that their presence is immaterial.

Data on the extent of the boat sewage problem are sketchy due to the difficulty in conducting monitoring programs to document this transient pollution source. A Maryland study documented the water quality conditions in a shallow embayment before and after a major boating weekend in July 1978. Fecal coliform per 100 milliliters in and around the marina increased from a range of 3-28 before the boats arrived to a range of 7-68 after they left.

The Marine Policy Center at Woods Hole Oceanographic Institution conducted similar work in Edgartown Harbor at Martha's Vineyard over the 4th of July weekend in 1989. This study shows highest levels of fecal coliform during peak boating activity (Gaines, 1990).

Background

Many of the boats in Buzzards Bay have installed marine heads (toilets); many others have uninstalled removable portable heads. The Federal Water Pollution Control Act Amendments of 1972 (FWPCAA) authorize the Coast Guard to regulate marine head discharges from vessels with installed heads. Unfortunately, the Coast Guard does not have the necessary personnel to enforce the law. The Commonwealth has the authority to regulate discharges from vessels that use uninstalled heads such as port-a-potties. Through Title 5 of the State Sanitary Code, the DEP prohibits the discharge of wastes from these temporary marine heads into marine and freshwater. However, due to inadequate staffing, the DEP Division of Water Pollution Control is unable to enforce the law.



FACILITY NAME	PUBLIC	MOBILE
1. Apponagansett Bay Pumpout	Y	Y
2. Burr Brothers	Y	N
3. Bourne Town Marina	Y	N
4. Parkers Marina	Y	N
5. Fiddlers Cove	N	N
6. Wareham Boatyard	Y	N
7. Bevans Marine	Y	N
8. Warrs Marine	Y	N
9. Fairhaven Union Wharf	Y	Y
10. Onset Town Pier	Y	N
11. Stonebridge Marine	N	N
12. Pt. Independence Yacht Club	Y	N
13. Onset Bay Marina	Y	N
14. Westport Harbor	Y	Y
15. Marion Island Wharf	Y	N

Figure 5.7. Boat pumpout facilities in Buzzards Bay

(Pumpout locations provided by the Coalition for Buzzards Bay. Other map data courtesy of MassGIS)

Marine heads installed on boats of 65 feet or less must be serviced by one of three types of marine sanitation devices (MSDs). Type I and Type II MSDs macerate and disinfect waste with chlorine, formaldehyde or other disinfectants. The Type I MSD treats the waste to a level not to exceed 1000 fecal coliform/100 ml and the Type II MSD treats to a level not to exceed 200 fecal coliform/100 ml and 150 mg/l suspended solids. Type III MSDs are holding tanks to prevent discharge of sewage near shore. These systems typically use formaldehyde, alcohol, or both, primarily to deodorize waste while it is stored in the holding tank. Boats larger than 65 feet, must use Type II or Type III MSDs. Types I and II MSDs are permitted under the FWPCAA to discharge into all coastal waters. Type III MSDs are fitted with piping to enable sewage discharge, but this discharge is prohibited in marine waters within 3 miles of shore or within the territorial sea which includes all of Buzzards Bay. Nonetheless, it is widely believed that discharge nearshore and in harbors does occur. Several harbormasters and boat dealers believe that Type I and Type II systems are not widely sold today and that most new boats are installed with Type III MSDs.

Marine heads that are not installed in the vessel are typically portable, self-contained units that have holding capacities of 2 to 5 gallons. These units can be carried on or off boats for proper disposal into toilets but can also be easily (and illegally) emptied overboard. These systems use little water for flushing and therefore only collect human wastes and whatever deodorizing/disinfecting chemicals are added by the boat operator. Some Buzzards Bay harbor masters have estimated that these systems are most often used on boats between 18 and 26 feet.

The state has the authority to require all marinas to install and maintain pumpout facilities through the annual permit process in Chapter 91 regulations. The DEP's Division of Wetlands and Waterways (DWW) is responsible for enforcing Chapter 91 provisions. The state also has authority to develop design standards for pumpout facilities. The DWW often requires a pumpout facility when a marina seeks a construction permit, however because of a lack of design standards and personnel shortages, DWW does not currently enforce the annual permit requirements.

The use of existing pumpouts at either private or public marinas is usually very low. The reasons revolve around convenience, cost, education, and enforcement. Many boaters find it more convenient to dump their wastes into marine waters than to invest time and effort into getting their boats to the pumpout facility. Others think that the cost of a pumpout is excessive, even though it is typically less than $10. Moreover, some boaters do not feel that boat waste seriously degrades water quality, or they believe that their incremental addition does not make a difference.

In 1989, the Executive Office of Environmental Affairs formed a Task Force to develop a policy on issues surrounding boat sewage collection and disposal. The Task Force met several times to consider issues such as increasing the number and availability of pumpout facilities; proper disposal of sewage from boat pumpout facilities, how shellfish and swimming areas should coexist with marinas; and the creation of no-discharge zones. The Task Force has identified the regulatory and management issues that need to be addressed and are working with DEP to develop solutions.

The Buzzards Bay Project through demonstration projects and other funding has assisted the communities of Westport, Dartmouth, Fairhaven, Mattapoisett, and Marion in purchasing and installing mobile and land based boat pumpout facilities.

The Coalition for Buzzards Bay has provided a valuable boater education component to this effort through its "Handbook for Mariners of Buzzards Bay". These efforts along with the municipal agreements to maintain and enforce pumpouts and their use has allowed great progress to be made in managing boat sewage in Buzzards Bay.

Major Issues

Disposal of boat sewage once it is removed from vessels is often an obstacle in siting boat pumpout facilities. Few marinas in Buzzards Bay are tied into public sewer systems. In addition, recent DEP policy specifies that boat waste cannot be disposed of in a septic system. This regulation is based on the possibility of failure in the performance of the septic tank, as well as the potential of groundwater contamination. As a result, most sewage pumped from boats will be stored in tight tanks and then transferred to treatment works for ultimate disposal. Three major problems emerge: (1) formaldehyde that now must be disposed of at the treatment plant may not be diluted (as it would be if carried through a sewer system) and some contend that it will interfere with the treatment process (2) during peak flows, particularly in the summer, local treatment plants may lack the capacity to accept any additional sewage and; (3) pumpout facilities are often far from the nearest treatment plant, which makes hauling of the boat sewage expensive.

A successful boat pumpout program is a major undertaking that demands the full commitment of the harbormaster, the board of health, and the shellfish warden. It requires a comprehensive program with equal parts public education and enforcement. This type of total townwide dedication and cooperation is necessary to generate the ingredients for a successful program. Grass roots support for action was also an important ingredient in the initiation of some programs.

The Division of Marine Fisheries prohibits shellfishing in the areas beneath marinas and in buffer zones around marinas. The buffer area size depends upon the number of boats and a specific dilution ratio. It is critical that Buzzards Bay towns work with DMF in developing data on water quality and pumpout utilization to minimize the size of the buffer zones around marinas. The towns, through more effective planning and management, should address and minimize the inherent conflicts between these two uses of coastal waters.

Goal

Eliminate the discharge of wastewater from all boats in Buzzards Bay embayments.

Objectives

1. To build more pumpout facilities and to promote their use by educating boaters, making facilities more accessible, and enforcing the regulations.

2. To develop financially self-sustaining pumpout programs at the town level.

3. To designate embayments in Buzzards Bay as no-discharge area.

CCMP Commitments

Department of Environmental Protection (DEP)

1. DEP, using its Chapter 91 permitting authority, will require new marinas or expansions of existing marinas (greater than 10 additional slips) to have adequate pumpout facilities.

Target date: Beginning 12/92.

2. DEP will implement a policy ensuring adequate management and treatment for sewage pumped from boats.

Target date: Beginning 1992.

3. DEP will implement a policy to eliminate toxic additives in marine sanitation devices.

Target date: 1991.

4. DEP will review problems of treating and disposing of boat sewage.

Interim Action: DEP, with assistance from EPA, will continue to provide technical assistance and oversight to the town of Marion in developing advanced boat sewage treatment technology now being tested at a pilot project at the town's wastewater treatment facility.

Coastal Zone Management Office (CZM)

1. CZM and DEP will develop a program that ensures adequate pumpout facilities for all harbor areas.

Target Date: 12/92.

2. CZM and the U.S. Environmental Protection Agency (EPA) will assist Buzzards Bay municipalities to develop a strategy for designating EPA "no discharge areas" within coastal embayments. The Buzzards Bay Project and the Buzzards Bay Action Committee will work with municipalities to encourage construction of boat pumpout facilities as well as the delineation of no discharge areas in Buzzards Bay.

Target date: 1992

3. CZM, under its Coastal Facilities Improvement Program, will give serious consideration to eligible projects that propose to construct municipal marine pump-out facilities where needed and appropriate.

Target date: 1991

Environmental Protection Agency (EPA)

EPA, under the Clean Water Act, will designate an embayment in Wareham as a no-discharge area.

Target date: 12/91

Buzzards Bay Municipalities

Dartmouth, Westport, Marion, Mattapoisett, and Fairhaven, with grants from the Buzzards Bay Project, will provide mobile or land based boat pumpout facilities and develop management plans for ensuring their use.

Target date: 7/91

Other Recommended CCMP Actions

Boards of Health and Harbormasters should enforce the use of pumpout facilities by all boaters using Type III MSD's or portable toilets in Buzzards Bay embayments.

Target date: 1993.

The Buzzards Bay Project, as part of its municipal grants for boat pumpout construction, will encourage muncipalities to have an enforcement component to their boat pumpout programs.

Implementation Costs

For communities that wish to implement a pumpout program immediately, the most appropriate revenue source is through the yearly mooring permit fee or marina fee. To facilitate usage, each boat owner could be required to pay a deposit at the time of mooring registration. The amount of the deposit would be based on the estimated number of pumpouts needed for the season, and money would be refunded to the facility as pumpouts occur. See Financial Plan, Chapter 2 (Boat Pump-out Facilities) for implementation costs, and for additional revenue options.

Another option would be for the funds to be used by the municipalities to operate a pro-active pumpout program where pumpouts are free upon demand.

Action Plan

Managing On-Site Wastewater Disposal Systems

Problem

In the Buzzards Bay drainage basin, 43% of the population, or more than 100,000 people, use on-site wastewater disposal systems. Moreover, most of the localized embayments are more affected by on-site wastewater disposal systems rather than by wastes from treatment plants. Thus, on-site systems represent a significant source of contaminants to the Bay itself, as well as to other resource areas within the drainage basin. Title 5 of the State Environmental Code (Minimum Requirements for the Subsurface Disposal of Sanitary Sewage) includes basic rules directed principally toward local boards of health for regulating on-site wastewater disposal. In the 13 years since Title 5 was promulgated in 1978, understanding of the way contaminants act within the subsurface has grown significantly.

Title 5 regulations were designed principally for the control of human pathogens, and for bacteria, at least, they are still adequate. However, scientific research has shown that viruses may not be adequately addressed by Title 5. In addition, the control of nitrogen from septic systems is not considered in the regulations. Other thorny issues, particularly those concerning the siting of systems, have also arisen over the years. Through minimum standards developed at the state level, or through supplements to Title 5 enacted locally, the program must be upgraded and expanded to better protect public health and the environment.

Background

Three primary components govern the placement of a septic system: (1) the elevation of the site above groundwater, (2) the lateral distance between the leaching component of the facility and a point of water use (well, watercourse, surface waters, etc.), and (3) the suitability of the soils or sediments to receive and treat the liquid effluent from the wastewater disposal system.

Pathogens in septic tank effluent are removed primarily through two mechanisms in the soil — physical retention or straining, and adsorption onto soil particles. The efficiency of these processes decreases as the moisture in the soil increases and drops drastically if the soil is saturated. For this reason, a minimum separation distance between the bottom of a leaching facility and groundwater has been adopted in most states. In Massachusetts, the minimum allowable distance is 4 ft.

Although distance to groundwater and treatment of wastes in the unsaturated zone is an important aspect of soil treatment, the lateral distance wastewater travels between entering the groundwater and intercepting a point of human contact is also important. For this reason, Massachusetts has adopted minimum lateral distances between the septic tank and leaching facility and points of water use or potential human exposure.

The third major consideration in the placement of septic systems is the ability of the soils to allow infiltration of septic wastes. In Massachusetts, suitability is determined by examining a "deep observation hole" and performance of soil percolation tests that are witnessed by a representative of the local board of health. The purpose of the deep observation hole is to determine and record the kinds of soil in the proposed leaching area. In addition, deep observation holes are used to evaluate groundwater elevation. They are generally dug when groundwater is at or near its maximum elevation.

Percolation tests are performed at the proposed disposal site to determine the ability of the soil to accept water. Under present Massachusetts regulation, any soils with receiving rates slower than 30 minutes per inch (or 20 minutes per inch for larger systems) are deemed unsuitable for on-site wastewater disposal. In general, the "faster" the soil, the smaller the surface area required for the leaching facility.

The contamination of Buzzards Bay from on-site wastewater disposal systems can occur in at least three ways. Perhaps the most obvious public health threat occurs when a system experiences overt failure. Failure occurs when soils can no longer receive septic tank effluent, and sewage levels rise or back-up in the system, often breaking out onto the surface of the ground. This process is often more noticable during periods when soils are saturated or very wet from heavy rains. When a system is near shore, this sewage, which may contain both bacterial and viral pathogens, can be transported to surface waters via stormwater drainage systems or overland flow. In general, systems experiencing overt failures are usually pumped out quickly because they are often offensive to the property owner and adjacent residents, but they may or may not be repaired. Pumping a failing system is not a viable long-term solution to the problem, and consideration should be given to system rehabilitation. The local board of health has full authority under Title 5 to require the repair of failing on-site wastewater disposal systems, but because of under reporting or lack of resources by boards of health, only a percentage of failing systems are addressed. It is unclear what role overt failures play in the overall pathogen contamination of Buzzards Bay, but they may be locally significant.

It is suspected that covert failures may play a more significant role in the pathogen contamination of specific embayments surrounding Buzzards Bay. Many on-site systems installed before 1978 had little or no separation from groundwater. Sewage from these systems is discharged directly to the groundwater, without the benefit of filtration through unsaturated soil. These systems are often assumed to be functioning effectively because no visible wastewater appears on the ground surface, but in reality they are adding pathogens directly to groundwater. Depending on the horizontal distance this contaminated groundwater flows before reaching surface waters, the potential for pathogens to reach coastal waters can be significant.

Another type of covert failure is the problem of overflow pipes. Before the enactment of Title 5, these pipes were often used as backups to prevent overt failure of systems. They were designed to empty directly into a major body of water, or in some cases, into a connecting ditch, stream, or wetland. The practice of connecting overflow pipes is thought to have been quite common in past years. Today the installation of these connections is illegal. Many old overflow pipes undoubtedly still exist in Buzzards Bay and should be corrected. The amount of contamination entering the Bay from this source is uncertain. A series of sanitary surveys were conducted on the eastern shore

of Buzzards Bay and the overflow pipes that were discovered are now being eliminated. Sanitary surveys have also been completed for much of the western shore and have resulted in the discovery of a number of pipes that are being investigated for illegal connections with on-site wastewater disposal systems.

The possibility of viral pathogens entering Buzzards Bay from properly designed and installed on-site systems is also of concern. Research conducted through the Buzzards Bay Project and elsewhere has suggested that, although fecal indicator organisms are adequately filtered out in the leaching component of on-site wastewater disposal systems, the virus component of sewage may pass through the unsaturated soil layer, reach groundwater, and travel great distances. As viruses travel with groundwater they become public health threats to any resource area (aquifer, shellfish area, swimming beach) intersected by the groundwater flow. Existing Title 5 setback requirements from on-site wastewater disposal systems to private wells, surface water bodies, and other areas are inadequate to provide protection against virus transport.

Title 5 regulations were originally written as minimum standards of protection. In recognition of this fact, some boards of health have adopted supplements to the regulations that offer extra protection to public health and enhance environmental protection. Some coastal communities have been quite aggressive in formulating supplements, but others have made few changes. Most of the Title 5 setback supplements have been developed on a town-by-town basis with little understanding as to why a specific setback was selected (Table 5.3).

In addition to considering virus transport, the siting of septic systems should recognize impacts from nitrogen. The cumulative impact from all septic systems contained in the drainage area to an embayment can be significant because nitrogen is not typically attenuated within the subsurface.

Table 5.3. Examples of leaching facility setbacks in Buzzards Bay

	WELL	SURFACE WATER SUPPLY	WATER COURSE	SUBSURFACE DRAIN
Title 5	100'	100'	50'	25'
Westport	100'	100'	100'	25'
Fairhaven	150'	100'	100'	25'
Marion	100'	100'	75-100'	25'
Carver	150'	100'	200'	25'
Plymouth	100-200'	200'	75'	25'

Title 5 does not address cumulative nitrogen impacts. Several communities have, however, initiated performance standards in an attempt to protect valuable coastal waters and other resource areas. These standards are based on the total loading, from septic systems and other minor sources of nitrogen within drainage areas, to coastal water bodies.

Local boards of health possess enormous authority to protect public health and the environment. Chapter 111 of Massachusetts General Laws directs boards of health to examine, and make regulations to protect the public health and safety from, all nuisances and causes of sickness, and to destroy, remove, or prevent these nuisances as the case may require. Boards of health may also make other reasonable regulations that they believe are necessary to protect public health and safety. In addition, they have authority to prohibit activities that may result in a nuisance or are harmful to the inhabitants of the town. Some boards of health have used this authority extensively to protect public health and prohibit environmental degradation through far-reaching supplements to Title 5. These have invariably been upheld when challenged in court as long as the regulation was administered fairly. Finally, Title 5 is currently undergoing a thorough assessment at the state level and amendments are expected.

Major Issues

Existing setback requirements from on-site wastewater disposal systems to private wells, surface water bodies, and other areas are inadequate to provide protection against virus transport. During the Buzzards Bay Project's workshop on sewage treatment options, greater setback distances were suggested to protect resource areas from virus pollution. The Buzzards Bay Project followed this recommendation with development of a scientifically-based regulation for communities to adopt. This regulation suggests a 250 ft. setback from surface water and wetlands. Where this setback can not be met, changes in system design and application rate are required to ensure virus removal.

Title 5 does not address the issue of how nitrogen contamination can be reduced to preserve water quality in sensitive coastal embayments and protect drinking water supplies. Nitrogen is present in septic system effluent at significant concentrations. It is known that soil infiltration primarily converts ammonia nitrogen to nitrate nitrogen with very little removal. If the nitrate nitrogen reaches drinking water supplies, it may cause them to exceed drinking water standards. Excessive nitrates reaching near-coastal waters will accelerate eutrophication and contribute to a decline in overall water quality.

Velocity zones, as defined by the Federal Emergency Management Agency's Flood Insurance Rate Maps, are not suitable locations for mounded septic systems. In the event of a severe storm, an unstabilized, mounded system may be uncovered and torn loose by wave action, becoming a safety hazard. Sludge collected in a dislodged system may leach out during and after a storm, causing a danger to public health. When mounded systems are stabilized (armored), they cause another set of problems by deflecting wave energy around the system and increasing erosion of these areas.

Consideration should be given to the rise in sea level, and the accompanying rise in groundwater, expected to occur over the next 25 to 50 years. A rise will reduce the distance from the bottom of leaching facilities to the groundwater. Therefore, systems currently designed and installed with the minimum 4-ft separation will not be adequate as groundwater levels rise.

Many boards of health do not administer Title 5 effectively. In some towns, variances become commonplace rather than special exceptions, due in large part to a lack of knowledge.

Goal

Prevent public health threats and environmental degradation from on-site wastewater disposal systems.

Objectives

1. To enforce the provisions contained in Title 5 regulations.

2. To upgrade pre-Title 5 systems suspected of contaminating groundwater or surface waters.

3. To address the inadequacies of Title 5 through board-of-health regulations.

4. To improve the Title 5 code through recognition of nitrogen impacts, virus transport, and sensitive areas.

5. To promote innovative technology that will reduce nitrogen.

CCMP Commitments

Buzzards Bay Municipalities

Falmouth, Bourne, Wareham, Marion and Westport will pursue amending their Board of Health regulations to allow for better treatment and removal of viruses from on-site wastewater (See Appendix E).

Target date: 1991-1992

Other Recommended CCMP Actions

1. DEP should amend the Title 5 Code so that it becomes a more comprehensive environmental regulation.

Target date: 1992.

The present initiative to bring Title 5 up to date with current knowledge should be pursued aggressively. The code should be amended to(1)require a DEP review of all resource setback and groundwater separation variances in sensitive coastal resource areas such as within the coastal velocity zone; (2) require increased setbacks from resource areas or special designs and loading rates to minimize potential virus transport; (3) address, at least in general policy terms, problems with the cumulative impact of nitrogen from septic systems; (4) address considerations of sea-level rise; (5)

allow installation of denitrifying septic systems and require them in nitrogen-sensitive embayments that are designated outstanding resource waters.

2. DEP should elevate the priority of the Title 5 Program.

Target date: 1992.

Staff positions should be added and the threshold for state review (currently 15,000 gallons per day) should be reduced so that state personnel review more systems. In addition, more regularly scheduled training sessions should be provided by DEP to assist boards of health in administering Title 5 regulations. DEP should develop a group of qualified staffers who not only hold training sessions, but also offer direct assistance on difficult cases.

3. All boards of health should employ a full-time qualified health agent.

Target date: 1992-1994.

All Buzzards Bay towns now employ at least a part-time health agent. Each town should strive for a full-time agent so that boards of health can expand their programs to require certified septic system inspections in cases such as the sale of a house or the conversion of a seasonal dwelling to year-round use.

4. All boards of health should adopt a series of regulations that address the placement of septic systems in special resource areas.

Target date: 1991-1993.

The boards should consider a prohibition on variances to their regulations in environmentally sensitive areas. In addition, they should not allow mounded septic systems in velocity zones. Also, the 4-ft. separation distances to groundwater in coastal areas should be increased to account for sea-level rise.

5. All boards of health should amend their regulations by increasing the setback distance required between on-site wastewater disposal systems and resource areas or requiring adjustments to the system design and application rate to account for virus transport.

Target date: 1991-1993.

The Buzzards Bay Project will provide technical assistance to boards of health on how to determine setback distances and when variances may be allowed without causing environmental or health threats. A model bylaw covering these subjects will be produced and direct technical assistance will also be provided.

Implementation Costs

Preliminary cost estimates for activities related to on-site septic systems can be found in the Financial Plan, Chapter 2. Topics include costs for health agents, inspections, system upgrades, maintenance, tight tank installation and pumpout, denitrification technology and limited sewering alternatives.

Action Plan

Preventing Oil Pollution

Problem

A report by the National Academy of Sciences (NAS, 1985) estimated that 3.9 millions tons of oil enter the world's marine environment each year (Table 5.4). This oil enters the marine environment both through large newsworthy tanker accidents and through chronic small spills from fueling, tank cleaning, bilge pumping, improper waste oil disposal, and stormwater runoff. Between 1969-1989, it is estimated that over 1600 tons of petroleum hydrocarbons entered Buzzards Bay from accidental oil spills. During the same 20-year period more than 2,000 tons of hydrocarbons from other sources — including sewage effluent, stormwater runoff, and industrial effluent — are estimated to have entered the Bay.

Oil spills impact stationary plants and animals, sensitive species, and vulnerable life stages, e.g., eggs, larvae, and juveniles. Immediately after a spill, high mortality is observed (as was the case in the West Falmouth oil spill), and for organisms that survive, short-term stress and impaired metabolism are also observed. Long-term impacts are associated with the persistence of hydrocarbons and residual toxic effects on individuals and, if the toxicity is pervasive, on populations. Twenty years after the West Falmouth oil spill, effects can still be observed and oil residues identified.

If a spill occurs in a small, confined embayment so that oil is unable to escape, damage is heavier than in offshore spills. Prevailing winds are likely to push oil into harbors

Table 5.4. Oil input to the marine environment[1]

Source	Million Metric tons per annum	% of total
ACCIDENT		
Offshore Petroleum	0.04	1.0
Tankers	0.39	9.8
Non-Tankers	0.02	0.5
NON-ACCIDENTS		
Offshore Production	0.01	.03
Tanker Operation	0.71	17.9
Marine Transportation	0.82	20.7
Coastal Refineries	0.10	2.5
Industrial Discharge	0.20	5.1
Municipal Discharge	0.75	18.9
Urban Runoff	0.12	3.0
River Discharge	0.04	1.0
Ocean Dumping	0.01	0.3
Atmospheric Fallout	<0.5	12.6
Natural Seeps	0.20	5.1
Erosional Processes	0.05	1.3
TOTAL	**3.96 mta**	**100%**

[1]Source: Adapted from: NAS, Oil in the Sea, 1985.

and embayments, particularly on the eastern side of Buzzards Bay, where it may be trapped and concentrated. Nearshore communities, including shellfish areas, eelgrass beds, and bathing beaches, are among the most vulnerable areas.

This Action Plan primarily addresses oil spills and oil from stormwater discharges. Industrial and municipal discharges of oil and other toxics are addressed in the Toxics Reduction and Managing Sewage Treatment Facilities Action Plans.

Background

Buzzards Bay is a major transit route for small tanker and barge traffic transporting heating and industrial oil and gasoline into the greater Boston and northern New England markets. In addition, several tankers dock in New Bedford and at the Cape Cod Canal Electric Power Plant in Sandwich. The Army Corps of Engineers reported that during 1988, 1929 tankers and tank barges passed through the Cape Cod Canal with a total net cargo of approximately 2.8 billion gallons of oil.

Oil spills have been a frequent occurrence in Buzzards Bay. Some spills of note were:

- No. 2 fuel oil on Horseneck Beach on the west side of the bay in Westport during the late 1940s
- No. 2 fuel oil off Cleveland Ledge which came ashore at Nyes Neck, Falmouth, during the winter of 1963
- The barge *Florida* went aground in 1969 off West Falmouth and spilled 185,000 gallons of No. 2 fuel oil into Buzzards Bay and along the shoreline of West Falmouth
- In October 1974 the barge *Bouchard 65* struck a submerged object at the west end of the Bay and was towed to an anchorage off Scraggy Neck at the east end of the Bay, with oil coming ashore at North Falmouth and Bourne
- The same barge ran aground again in January 1978 and spilled 81,000 gallons into the east end of the Bay
- The cruise ship went aground June 10, 1990 on Cleveland Ledge and leaked more than 7,500 gallons of No. 6 oil of which approximately 3,000 gallons washed ashore on Naushon Island.
- The fuel barge *Bouchard 145* went aground June 18, 1990 on Cleveland Ledge and leaked 100 gallons of No. 2 oil.
- Smaller spills of gasoline and fuel oil have occurred every few years in the Bay or in the Cape Cod Canal.

Response to the problem of oil spills generally falls into three categories: prevention, early response, and mitigation. As long as oil is used as an energy source, spills will not be eliminated. Therefore, we should pursue a dual policy of reducing the occurrence of spills and preparing to limit their damage. The number of spills may be reduced by mandating safety procedures and safety features on equipment used for storage, transport, and handling of oil.

Once a spill has occurred, the principal factor in minimizing environmental damage is speed of response. Oil spreads rapidly; begins to disperse through the water column, making clean-up efforts more difficult; and eventually contaminates sediments. Cleanup effectiveness diminishes over time as weathering disperses the oil. Most often, not more than 10-20% of the oil is recovered. The cleanup of the *World Prodigy* spill

in Narragansett Bay, which was generally considered a very successful operation, collected only about 10% of the spilled product. In this spill, most of the lighter hydrocarbons evaporated, but substantial amounts entered coastal sediments, beaches, flats and marshes. Without adequate technology to recover greater percentages of the spill, emphasis should be on prevention and speedy response. It is vital that the logistics be in place so that when an incident occurs, it is clear who to call, where equipment is located, and which cleanup methods are appropriate.

The recent *Exxon Valdez* oil spill in Prince William Sound, Alaska, in March 1989 and the weekend of spills that occurred in Narragansett Bay, the Delaware River and the Houston Ship Channel in June 1989 and especially for Buzzards Bay, the two spills at Cleveland Ledge 8 days apart in June, 1990, have renewed public concern about the effects of major oil spills.

These events resulted in Congressional passage of the Oil Pollution Act of 1990. The Act addresses a number of issues including liability and compensation, vessel manning and training requirements, alcohol and drug screening, manning standards for foreign tankers, vessel traffic and communications systems requirements, and the requirement of double hulls for tankers. The Act also requires the Coast Guard to maintain a computer file of available spill containment and cleanup equipment, and for the federal government to develop Area Contingency Plans and modify the National Contingency Plan. Finally, the Act includes monies for oil pollution research.

Under the U.S. Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), in effect since 1986, those who spill hazardous substances, including oil, must pay cleanup costs. The federal government and the states, in their roles as trustees, can claim damages for injuries to natural resources.

In Massachusetts, the response to oil spills is the responsibility of the Department of Environmental Protection (DEP). The Coast Guard generally takes control for spills in marine waters, whereas DEP is responsible for spills on land and small spills such as those from moored boats. The Coast Guard has containment equipment for limited spills, but the primary response is by private contractors. The responsible party will be held responsible for cleanup expenses.

Both the Coast Guard and DEP have standing contracts with private firms to contain and cleanup spills. Offshore spills are generally handled by the Coast Guard. If the spill cannot be contained with equipment locally available, a federal strike team is contacted. As a result of the Oil Pollution Act, the strike team for the east coast will be located in Elizabeth City, North Carolina.

A regional oil-spill contingency plan for Buzzards Bay, developed in 1981, is being updated. This is a compilation of local information on shoreline access points, oil transfer, processing and storage facilities, environmental sensitivity maps, and available equipment and services. Information contained in a current contingency plan is invaluable to the individual communities, DEP and the Coast Guard in implementing a timely response to a spill. Actions taken by town personnel during a spill event, in support of the Coast Guard or DEP, can make the difference between success and failure.

Major Issues

Pilotage, or the requirement that a certified pilot familiar with the local harbors, channels or embayments board a ship and take it into port, is not mandatory in Buzzards Bay. This is a glaring deficiency in protecting the Bay from accidental spills. Rhode Island requires pilotage, as does the Army Corp of Engineers in regulating activities in the Cape Cod Canal. Pilotage is also required in Boston Harbor.

Commercial fishing vessels, which operate mostly out of New Bedford but also Westport, usually have their engine oil changed (10-120 gallons per boat) after practically every trip. It is believed that the inconvenience and the expense (about 30 cents per gallon) of safely disposing of waste oil has resulted in a number of boat operators blatantly dumping oil into the Bay or offshore waters. Although this is illegal, it is difficult to document violations and hence take enforcement actions against the appropriate fishing boats. Convenience and expense in disposing of waste oil may also be a problem for the general boating public but oil changes in small launched boats is less common.

Buzzards Bay communities are ill-prepared to provide assistance during an oil spill or to protect sensitive areas. There is uncertainty about what equipment is available, where it is stored, and how it is to be used. There is also no formal inter-town coordination mechanism to maximize the equipment that is available within regional areas of the Bay. Because few drills or rehearsals have been held at a town level, personnel have not received proper training, and potential liability claims from cleanup participants who are injured during clean-up efforts. Experience gained during the *World Prodigy* spill points up the importance of educating the general public to understand the health risks involved with any direct contact with the spilled product.

Wave action helps in breaking up oil, and dispersants are used to keep oil from moving intact toward valuable resource areas. Dispersants also dilute the concentration that ultimately reaches bottom sediments, thus reducing localized catastrophic effects. Some experts believe that dispersants are a very valuable response tool if used under the appropriate conditions. However, experts opinions differ, and Massachusetts and Rhode Island have not agreed to the use of dispersants. The Coast Guard, with the approval of the Regional Response Team (EPA, Department of Interior, and the Commonwealth), can authorize the use of dispersants during a spill.

Goals

1. Reduce the amount of petroleum hydrocarbons entering Buzzards Bay.

2. Minimize the occurence of oil spills in Buzzards Bay, both large and small.

3. Minimize the environmental effects from oil inputs to Buzzards Bay.

Objectives

1. To promote a regional strategy for preventing and managing oil spills.

2. To implement a source-reduction plan for chronic inputs of PAHs to Buzzards Bay.

3. To provide adequate facilities for the collection of waste oil from cars and boats.

4. To take enforcement actions against the illegal discharge of oil.

CCMP Commitments

The Coastal Zone Management Office (CZM)

1. CZM will provide technical assistance to Buzzards Bay communities developing contingency plans in each municipality.

Target date: Beginning 1991

2. CZM will encourage the satisfactory completion of oil spill contingency plans by each municipality.

Target date: Beginning 1991

The Buzzards Bay Action Committee (BBAC)

1. BBAC will ensure that each municipality appoints an oil spill coordinator responsible for overseeing maintenance and deployment of equipment and for directing response activities.

Target date: 1991

2. BBAC will develop a mutual aid protocol that will govern the purchase and use of oil spill equipment by the towns.

Target date: 4/92

3. BBAC will develop model regulations that will: a) require all boatyards and marinas to maintain oil containment and cleanup equipment on site; and b) manage the appropriate fueling of vessels.

Target date: 2/92

The U.S. Coast Guard

1. Coast Guard will conduct training sessions on the use of oil spill equipment and other contingency plan activities for all Buzzards Bay towns once a year.

Target date: Beginning 1991

2. Coast Guard will review and approve each municipality's contingency plan and utilize those plans in the event of a spill.

Target date: Beginning 1992

3. Coast Guard will advise municipalities on the appropriate spill equipment that should be maintained.

Target date: Beginning 1991

Buzzards Bay Municipalities

1. Falmouth, Bourne, Wareham, Marion, Mattapoisett, Fairhaven, New Bedford, Dartmouth, and Westport have appointed oil spill coordinators, some of whom are developing local contingency plans.

2. Marion (through its Marine Resources Commission) is working with the boatyards and marinas to ensure they maintain adequate oil response equipment.

3. The Coalition for Buzzards Bay will continue to work with state legislators to refile a bill in December 1991 that addresses oil spill prevention including: pilot accountablity language, better pilot testing and training including recertification on a regular basis, and pilotage requirements in the upper portions of Buzzards Bay and the Cape Cod Canal. An early version of the bill was filed in December 1990 but was not voted upon.

Other Recommended CCMP Actions

1. To reduce the impact of future spills, DEP should coordinate annual regional oil spill response drills for Buzzards Bay communities on land, to ensure preparedness and proper interface between themselves and local personnel.

Target date: Beginning 1992.

2. All other communities should require all boatyards and marinas to have specified response equipment on site.

Target date: 1993.

3. All levels of government should adopt a policy to minimize or reduce oil entering the Bay.

- Municipalities should require performance standards for catch basins that remove oil and grease and implement a maintenance program.

  Target date: 1992-1994

- Enforcement Task Force of the Executive Office of Environmental Affairs should enforce proper storage and disposal of oil.

  Target date: Immediately

- Buzzards Bay communities should adopt regulations managing fueling of vessels; regulations should include a provision requiring booms and absorbant material available at all fuel loading facilities.

  Target date: 1993

4. The state should develop a policy and criteria for the use of dispersants in Buzzards Bay during oil spills.

Target date: 1992

5. DEP should adopt a policy for treating stormwater by requiring oil and gas traps, absorbent pads, and regular catch-basin maintenance.

Target date: 1992

6. The Coast Guard should install a more effective navigational system at the western entrance of the Cape Cod Canal.

Target date: 1992

Implementation Costs

Preliminary cost estimates for oil spill containment equipment and training can be found in the Financial Plan. This includes costs for trailers to house equipment, pumps and hoses, booms, sorbent pads, etc. An explanation of training options is also provided. The Buzzards Bay Project has awarded grants totaling $6,000 to the municipalities of Westport, Marion, New Bedford, and Fairhaven for the purchase of oil spill containment equipment. These funds leveraged an additional $1,500 in local funds. Equipment purchases were coordinated by the Buzzards Bay Action Committee which helped ensure that all equipment was compatible and therefore has the ability to be loaned among communities. Coordination efforts also resulted in the communities receiving a large quantity order price per unit and therefore more containment equipment.

Action Plan

Protecting Wetlands and Coastal Habitat

Problem

Marine and freshwater wetlands are some of the world's most naturally productive areas, and they perform many functions that are useful to man. In its Wetlands Protection Act, the state officially recognizes that wetlands are crucial to the following interests:

- Protection of public and private water supply
- Protection of groundwater supply
- Flood control
- Prevention of storm damage
- Prevention of pollution
- Protection of land containing shellfish
- Protection of fisheries
- Protection of wildlife habitat.

Marine wetlands, especially salt marshes, eelgrass beds, shellfish beds, and other marine habitats, are fundamental for healthy coastal ecosystems. With respect to protecting marine water quality and coastal resources, freshwater wetlands are most important in removing nutrients and other pollution associated with development. The need, as recognized by the legislature, to preserve freshwater wetlands, can be an important factor in limiting growth in certain coastal areas. For these reasons, coastal wetlands and certain inland wetlands are a major focus of the Buzzards Bay Project.

In Massachusetts, 40-50% of the wetlands base has been lost, and wetlands continue to be destroyed and degraded at an unacceptable rate. A recent study conducted in the southeastern part of the state indicated that, between 1977 and 1986 alone, over 1300 acres of freshwater wetlands were lost. Although the passage of the inland wetland protection regulations in 1983 improved this situation considerably, these wetlands are still being lost, and the current regulations for freshwater wetlands fall short of full protection. In contrast, Massachusetts has put its coastal salt marshes off limits through the Wetlands Protection Act and the Wetlands Restriction Program. The situation for subtidal wetlands and habitat is more bleak, although they are protected by the Wetlands Protection Act, they nonetheless are being destroyed or altered, particularly by the cumulative impacts of the construction of docks and piers, dredging of private and public channels, increases in boat activity, and declines in water quality associated with inputs from development.

In general, cumulative impacts from many small projects are a major threat to all types of wetlands and are often the most significant cause of wetland loss and habitat decline.

This is because the existing management framework for wetland protection is inadequate for assessing and protecting against cumulative impacts.

An important part of the problem in protecting wetlands is that some Conservation Commissions may not be using existing state regulations as effectively as possible to protect wetlands and marine habitat. Many environmentalists believe that the present regulatory process is totally inadequate to deal with the growth that is fueling the continuous loss of wetlands.

Because many view the states Wetlands Protection Act as offering only minimal protection, some communities have also recognized the role wetlands play in erosion and sedimentation control, recreation, agricultural and historical values, aesthetics, aquaculture, and public trust rights by adopting local non-zoning wetlands bylaws that include these interests, and hence offer more protection than the state regulations.

The DEP has worked with other agencies in the Executive Office of Environmental Affairs (EOEA) to develop a strategy to fully implement the policy of no net loss of wetlands adopted in June of 1990. A three-tiered approach of avoidance, minimization, and mitigation is used to achieve this goal.

Background

Wetlands Protection Act

In 1963, with the adoption of the Jones Act, Massachusetts became first in the nation, including the federal government, to protect coastal wetlands. This Act, in conjunction with the "Hatch Act," passed in 1968 to protect inland wetlands, has evolved into the current Wetlands Protection Act. Significant revisions of the WPA regulations were promulgated in 1978 for coastal wetlands and in 1983 for inland wetlands. These revisions established the current system of resource areas, presumption of significance, and performance standards. The Massachusetts program is still viewed as one of the most protective in the country, but given the state's historic loss of wetlands and the fact that this loss continues today, it has been referred to as "the best of a bad lot" by a high-ranking state official. However, the program has been strengthened considerably with new upgraded policy directives, especially in the area of no net loss of wetlands. These will need to be incorporated into the regulatory structure for full effectiveness.

The WPA is designed to protect the natural resource values of both inland and coastal wetlands. The regulations specifically define 4 inland wetland resource areas and 11 coastal resource areas for protection.

Inland resource areas

- Banks and beaches
- Bordering vegetated wetlands
- Land under water bodies and waterways
- Land subject to flooding

Coastal wetland resource areas

- Land under the ocean
- Designated port areas
- Coastal beaches
- Coastal dunes
- Barrier beaches
- Coastal banks
- Rocky intertidal shores
- Salt marshes
- Land under salt ponds
- Land containing shellfish
- Anadromous/Catadromous fish runs

These resource areas are believed to contribute to one or more of the eight interests listed in the preceding section.

The primary responsibility for implementing the WPA regulations rests with local conservation commissions, which consist of three to seven appointed members. The regional office of the DEP is responsible for oversight and review of local decisions that are appealed. DEP also provides technical assistance and training to conservation commissions.

In Massachusetts wetlands delineation is primarily based on the occurrence of specific vegetation or geologic features. The WPA specifies that boundaries of vegetated wetlands be delineated based on the occurrence of vegetation that is indicative of saturated conditions for a significant portion of the year. Non-vegetated wetlands are typically delineated based on geological features. Regulations require that a permit be obtained from the commission before proposed activities that would alter wetlands can occur in or within 100 feet of wetlands. This permit, called an Order of Conditions, should include conditions necessary to protect the interests of the Act. At a minimum, performance standards provided in the regulations must be met.

Wetlands Conservancy Program

The Coastal and Inland Wetlands Restriction Acts, which together are referred to as the Wetlands Conservancy Program (WCP) formerly known as the Wetlands Restriction Program, were passed in 1965 and 1968 respectively. This program is intended to protect the state's most significant wetlands. It clearly delineates protected areas and requires that activities in these areas meet the requirements of the Wetlands Protection Act. All wetlands 1/4 acre or larger will be identified on aerial photographs and landowners with wetlands 1/2 acre or larger on their property are notified and a restriction order is recorded at the Registry of Deeds. The WCP is a proactive approach to ensure that the larger, more significant wetlands are protected under the WPA. The Wetlands Conservancy Program was first applied to coastal wetlands in the

1970s, particularly salt marshes, tidal flats, barrier beaches, sea cliffs, dunes, and salt ponds. No lands under the ocean have been restricted. The WCP is being reactivated, particularly for restricting freshwater wetlands. Several communities in the Buzzards Bay drainage basin will participate in the next phase of the WCP.

At present, in 39 of the Commonwealth's 78 coastal communities, at least some significant coastal wetlands have been included in this program. Only a few communities, on the other hand, have had inland wetlands included in the program. Statewide, approximately 50,000 acres have been restricted, but this is almost exclusively coastal salt marshes, beaches, tidal flats, and dunes. In Buzzards Bay, some or all of the coastal wetlands in 6 out of 10 coastal towns have been restricted, but significant inland wetlands have been restricted in only one community in the drainage basin. This program, which was originally intended to be the cornerstone of wetlands protection in Massachusetts, has fallen short of its goal because of the high implementation cost.

After a decade of inactivity, a second phase of WCP implementation has begun, and Buzzards Bay is a priority area. The towns of Mattapoisett and Westport were added to the program in 1990, and as many as 4 additional towns will be added in 1991. Of great significance is that freshwater wetlands will be included in this new phase of the program.

Although the WCP protects resource areas and interests similar to those covered by the WPA, it provides a potent management tool that will be invaluable in Buzzards Bay. It would be especially helpful to communities having difficulties ensuring that all projects in or near significant wetlands are brought into the permitting process.

Local Implementation

Buzzards Bay communities processed approximately 1500 permits filed under the WPA last year. The communities also issued between 120 and 150 enforcement orders. Three towns (Westport, Dartmouth, and Falmouth) have full-time conservation agents and four communities have part-time secretaries for their conservation commissions. Five Buzzards Bay communities (Falmouth, Bourne, Wareham, Dartmouth, and Fairhaven) have adopted non-zoning wetlands bylaws to supplement the Wetlands Protection Act. Falmouth and Dartmouth have also adopted regulations to further define their bylaws.

Local bylaws and regulations are valuable for addressing the inadequacies of the WPA regulations, increasing the fee-generating ability of a town to pay for professional staff and expert advice, and expanding the number of wetland resource areas and interests that can be protected. However, they require effort beyond the WPA to be truly effective, and may require additional legal counsel. In an attempt to better protect wetlands, conservation commissions in Buzzards Bay have adopted a wide array of enforcement and implementation tools. The following is a partial list:

- Noncriminal disposition to levy fines for small violations (Falmouth).
- Confiscation of heavy equipment used in illegal operations (Falmouth).
- Bringing of criminal charges against chronic violators (Falmouth).

- Use of local Department of Natural Resource police to gain access to private property to investigate suspected wetland violations (Falmouth).
- Detailed filing requirements (Bourne).
- Restrictive policy on new dock and pier construction (Bourne).
- Designation for sensitive wetlands as Areas of Critical Environmental Concern (Bourne).
- A setback from wetlands of 50 ft for all structures (Bourne).
- Recording of enforcement orders on deeds until mitigation activities are satisfactorily accomplished (Rochester).
- Townwide aerial mapping of wetlands and floodplain (Dartmouth)

Clean Water Act

The federal Clean Water Act mandates that the state (DEP's Division of Water Pollution Control) must certify that any activities requiring federal permits e.g. NPDES, §404 are consistent with state water quality standards. NPDES permits are issued jointly by EPA and the Commonwealth and regulate the discharge of effluent to surface waters. The Clean Water Act §404 program is jointly implemented by EPA and the Army Corps of Engineers, and regulates discharges of dredged and fill material into wetlands and other waters of the United States. Under §10 of the Rivers and Harbors Act, the Corps regulates any excavation or construction in traditionally navigable waters. §10 permits usually involve the construction of piers. Water quality certification enables the state to protect wetlands from a broad range of activities potentially impacting physical and biological integrity of the wetlands in addition to the chemical integrity of the water column. The DEP's Water Quality Certification program was established to ensure that water quality standards are not violated by these activities. The additional requirement of developing water quality standards for wetlands, allows DEP an opportunity to strengthen this program even further. The program adds another layer of protection to the WPA.

Planning and Preemption

Too much reliance has been placed on the wetlands regulatory process, which allows for ad hoc decision making. Planning and preemption are more effective ways to protect wetlands. Planning involves the identification of sensitive resources and the justification of their significance. It establishes a framework upon which to justify preemption techniques and base permitting decisions. Relevant local plans include comprehensive master plans, and plans for open space, watershed management, water quality, harbor management, and management for Areas of Critical Environmental Concern (ACEC).

Preemption is the foreclosing of opportunities for use of wetlands by not allowing certain activities to be proposed for permitting. Preemption tools include the Wetlands Restriction Program described earlier, as well as zoning, conservation restrictions, land acquisition, temporary moratoriums, and, if effectively managed, ACECs.

Many conservationists believe the best way to protect land is to own it. Vigorous municipal land-acquisition programs and the blossoming of the nonprofit land-trust

movement in the 1980s have led to the acquisition of many wetlands through purchase and donation. Ownership by public conservation agencies or private conservation organizations may offer the best preemption situation because these groups have neither the philosophy nor the financial incentive to propose development in or near wetlands.

Chapter 7 (Land-Use Management) includes a full discussion of nonregulatory techniques for protecting critical areas. In particular, tax incentives that accrue from various options are listed.

Major Issues

Septic System Setbacks

Administration of the Wetlands Protection Act has been undermined in the past through action taken under Title 5 of the State Environmental Code, which regulates the subsurface discharge of sanitary waste. WPA regulations require that a leaching facility, regulated under Title 5, be set back at least 50 ft horizontally from the boundary of coastal banks, coastal beaches, coastal dunes, salt marshes, and bordering vegetated wetlands (BVW) to receive the presumption of protecting the eight interests of the Act. However, the cross-referenced section in Title 5 stipulates a 50-ft setback from a watercourse, which is defined differently from the resource areas listed above. Title 5 is incompatible with the WPA because it ties all measurements to annual flood elevations or mean high water, and does not recognize that some wetland areas may almost never have standing water.

Recent DEP correspondence clarifies that the setback distance for septic systems should be measured from the edge of the bordering vegetated wetland (BVW), both inland and coastal, as defined by the WPA, rather than from mean high water. In this correspondence BVWs specifically include inland freshwater BVWs and salt marsh. They do not include coastal dunes, coastal banks, beaches, or barrier beaches. DEP is seeking additional information on the benefits of prohibiting septic systems in these areas.

Permitted Filling of Bordering Vegetated Wetlands (BVWs)

In 1983, regulations describing general performance standards for BVWs were adopted to allow the discretionary destruction of up to 5000 sq ft, if the area is replaced in accordance with seven general conditions. This provision was viewed by some as a political concession to avoid the issue of taking without compensation. Given that BVWs are probably the Commonwealth's most important inland habitat for wildlife and that their role in protecting other interests of the Act is recognized, it may be appropriate to improve the existing performance standards. This is particularly relevant in view of the questionable success of wetlands replication.

Wetlands Filling Under the Limited Project Provisions

Regulations allow conservation commissions to issue permits for unlimited wetland alteration without replication for a host of activities including agriculture, silviculture, construction and maintenance of roadways and driveways, and inland docks and piers. Currently, many conservation commissions feel they must grant permits for such proposed projects. Commission members need to be educated about the circumstances where it is appropriate for them to deny permits and stop projects. They must also be educated about necessary and desirable conditions that should be incorporated in orders of condition to protect the interests of the Act.

Of particular concern is a provision that allows construction of a new roadway or driveway in inland wetland areas. Concern centers upon the complete destruction of that part of the wetland to be covered by the road or driveway. Moreover, there is no limit to the area that can be destroyed for a limited project. The 5000 sq ft provision for discretionary filling of BVWs does not apply to limited projects. Replication may or may not be a condition of a limited project, at the discretion of the conservation commission.

Wetland Replication

Many scientists and managers are concerned with the use of wetlands replication as a routine management tool for two reasons. First, wetlands replication projects have a high failure rate. In New England it has been estimated that 50% of all replication efforts fail because of inadequate design or maintenance (Ed Reiner, EPA, personal communication). Second, many functions performed by natural wetlands may not be performed by artificial or replicated wetlands. Although it may be possible to replicate the flood control, sediment trapping, and waterfowl values of some wetlands, scientists have identified at least 75 complex ecological relationships among soils, hydrology, water quality, vegetation, and wildlife, many of which take centuries to develop. Many of these relationships play significant or as yet undetermined roles in the protection of the eight wetland interests listed in the WPA or of other interests included in local wetland bylaws. Many wetland replication projects have difficulty recreating even the typical vegetative community of a wetland, much less these other complex relationships that make a natural wetland.

For these reasons, wetland destruction should be avoided except in very extreme cases or on projects with an overriding public purpose. When wetland destruction is the last resort, a genuine effort must be made to recapture the lost values of the destroyed wetlands. Given the high failure rate of replicated wetlands, a ratio of replicated wetlands to destroyed wetlands of much greater than 1:1 must be required to achieve a true no net loss.

For the most part, wetland replication efforts have been limited to the freshwater wetlands. Replication of a salt marsh is rare because existing regulations seldom permit destruction of salt marshes. Replication of land under sea occurs in only two cases. First, the replication of eelgrass beds has been permitted on a trial basis with mixed success. Second, orders of conditions for projects involving the dredging of boat

channels usually require the transplantation of shellfish. In a sense, such efforts are replicating "land containing shellfish" if the shellfish are transplanted to areas that do not contain shellfish. However if there areas do not have the appropriate characteristics conducive for shellfish propagation and survival, such as sediments, water quality, and salinity, the replication efforts are wasted. It has been pointed out that the dredging of channels represents a permanent loss of shellfish habitat.

Conservation Commission Training

Local conservation commissions represent the first line of defense for implementing the WPA. The Act and its associated regulations are very complex and have a number of areas in which educated judgments and interpretations are required. Currently, training of commission members is not compulsory. Courses are taught by the DEP on a regularly scheduled basis and many commissions are never formally trained in the provisions of the Act and its regulations. Although "hands on" experience is valuable, it should be supplemented with a comprehensive understanding of the program. Without this understanding the learning curve is extended and, when combined with the relatively high turnover-rate of commission members, often results in a poorly informed commission that inadequately administers regulations it does not fully understand. Detailed training on how to write effective orders of condition is especially important.

Dock and Pier Construction

Through the WPA, conservation commissions have the authority to review projects on land under the ocean, land under salt ponds, fish runs, and land containing shellfish. This authority can be used to protect valuable marine habitats such as DMF-designated productive shellfish areas, town-designated resource areas, habitat in ACECs, fish runs, and eelgrass beds, by prohibiting or limiting the number of new docks, piers, and their associated dredging activities, as well as reducing or mitigating the impact of approved projects.

In order to reduce the likelihood of a decision by a conservation commission being overturned, commissions should develop, and towns adopt, an explicit management plan regarding the location and construction of projects in the critical habitat areas discussed above. The plans or bylaws should clearly define and delineate the sensitive habitats that are being protected, the reason for protecting these areas, the type of projects that harm the habitats, and how the adverse effect is created. Regulations should also be adopted that specify the necessary mitigating measures to be taken if a project is approved.

A comprehensive approach to this problem would be for communities to develop local waterfront, harbor, or embayment plans that are accepted and approved by the town and the state. These plans must specify jurisdiction and enforcement capabilities of conservation commissions to review the consistency of projects with approved plans. This approach is new, and would be an extra tool for conservation commissions to protect coastal and marine wetlands. This plan could also be used as the basis for zoning restrictions that specify acceptable and unacceptable locations for docks and piers.

A generic environmental impact report (GEIR) was proposed by the Office of Coastal Zone Management. Unfortunately, attempts to secure funding for this project have been unsuccessful. However, this is an important task and should be considered seriously for future funding.

Buffer Zone Protection

The 100-ft buffer zone around all coastal and inland wetlands, especially around coastal ponds and bays, is a jurisdictional area that receives discretionary protection that may not be adequate in all situations. There are no performance standards for these areas and therefore the protection they receive is highly variable depending on the conditions set forth by each individual commission. Performance standards would help significantly because a large part of the time spent by commissions involves cases in the buffer zone (Falmouth estimates 85%). Detailed guidance and assistance from DEP in writing orders of conditions to protect buffer zones would also help local commissions. Buffer zones are important because they protect the wetland from a wide variety of pollutants and provide valuable wildlife habitat. Towns are permitted to adopt construction setbacks from wetlands, just as they adopt setbacks under local zoning.

Land Acquisition

Land acquisition and other nonregulatory protection techniques are important mechanisms for protecting coastal and inland wetland resources that are tremendously underutilized. Land acquisition does cost money. Fortunately, the environmental value of wetlands far exceeds the market value, and significant habitats can be purchased inexpensively. Many landowners are even willing to donate wetlands for conservation purposes in exchange for tax advantages. Critics contend that it is wasteful to spend tax dollars purchasing wetlands because their development potential is low. They feel that reliance should be placed on the permitting system to protect these areas. Management costs are also cited as a reason not to acquire conservation lands. However, only the most passive forms of recreation are suitable in wetlands, so management costs should be low or nonexistent. Ideally most land acquisition should be directed toward upland areas particularly those that would compliment wetland easements and donations.

The loss of municipal revenue if too much land is removed from the tax rolls is another criticism of open-space acquisition. This may be unfounded because fiscal impact analyses have shown that development seldom makes up in taxes the costs incurred for additional municipal services. (The balance of cost depends on the type of project being considered; e.g., office parks generate enough revenue to recoup the cost of local service.) Moreover, the assessed value of wetlands is low, so their elimination from taxes through acquisition or restriction is insignificant. In one small coastal community, it was shown that the 1,040 acres of salt marsh within the town contributed less than 0.07% to the total real-estate valuation.

Isolated Vegetated Wetlands (IVWs)

So-called "Isolated Vegetated Wetlands" (e.g., wetland vegetation surrounding permanent small ponds and pools, and isolated land subject to flooding such as vernal pools) are not now recognized as a resource area in the regulations.[1] IVWs contribute to many of the eight interests listed in the WPA, as well as to other interests, and hence should be protected.

Intermittent Streams

At present, intermittent streams up-gradient of a resource area are not defined as streams and thus are not afforded protection under the Act. Only those intermittent streams flowing through a resource area or out of a resource area are defined as streams. In situations where up-gradient intermittent streams play a significant role in maintaining the function of a down-gradient resource area, they should be recognized as a resource area and protected. This would also help protect some isolated vegetated wetlands by defining them as bordering vegetated wetlands.

Protection of endangered species, anadromous fish habitat

Anadromous species like alewives (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) have declined dramatically during the past century in Buzzards Bay. Not only were these fish historically important as a fishery in Buzzards Bay, but they are also important food species for many fish, whales, and coastal birds. Buzzards Bay also contains important populations of some endangered and threatened species. For example, Buzzards Bay has the largest colony in North America of the roseate tern (*Sterna dougallii*), a U.S. endangered species. Protection and enhancement of these important species may require special efforts to enhance the reproductive success of their populations or to restore their habitat. For example, restoration of herring populations will require repair or installation of fish ladders or enlarging river culverts passing under roads. Tern restoration programs may require control of gull populations. Generally these kinds of wildlife improvement projects are conducted by the U.S. Fish and Wildlife Service, the Massachusetts Department of Fish and Wildlife, and the Massachusetts Department of Environmental Management. The Buzzards Bay Project may need to work with these agencies and Buzzards Bay municipalities to expand these efforts in Buzzards Bay and insure their success.

1 To be recognized under the WPA, wetlands must border a freshwater body, the smallest of which is a 10,000-sq-ft pond, or fit the definition of *isolated land subject to flooding,* in which case only limited interests may be protected.

Goal

Long-term increase of high-quality wetlands and coastal habitat in Buzzards Bay.

Objectives

1. To protect existing wetlands.

2. To encourage restoration of wetlands (and allow replication as a last resort).

3. To improve enforcement of wetlands laws.

4. To upgrade the capability of local conservation commissions.

5. To encourage non-permitting options as a supplement to the issuance of permits whenever possible.

6. To protect and restore habitat used by threatened, rare and endangered coastal species and anadromous and catadromous fish.

CCMP Commitments

Department of Environmental Protection (DEP)

1. DEP has identified Buzzards Bay as a priority area for implementing the Wetlands Conservancy Program. Mattapoisett and Westport were included in the program during 1990 and 4 additional towns are scheduled for 1991. DEP's goal is to ultimately include all Buzzards Bay towns in the Conservancy Program.

Target dates: Implementation in Mattapoisett and Westport - 1993

Implementation in 4 additional towns - 1993-1995

Interim Actions: As part of this initiative DEP has taken aerial photographs of Buzzards Bay towns and will digitize these images to delineate wetlands. DEP will conduct a public education campaign on these efforts and meet with concerned landowners. Restrictions will require projects in identified resource areas to go through the WPA permitting process and will be placed on properties containing protected wetlands.

2. DEP will use its water quality certification authority under Section 401 of the Clean Water Act and in conjunction with the Wetlands Protection Act to:

- Require analysis of alternative strategies and options before wetlands are allowed to be destroyed or altered and only allow destruction under extreme circumstances or in projects with an overriding public purpose.

- Require restoration or replication, at a ratio of at least 1:1, of any wetlands that are allowed to be altered or destroyed.
- Require the same level of analysis and protection for isolated vegetated wetlands and intermittent streams as for other wetland areas.

Target date: 1991

3. DEP will establish criteria for designating wetlands as waters of the Commonwealth using water quality standards, and subjecting these areas to stringent controls under the Antidegradation provision of the Clean Water Act.

Target date: 1992.

Buzzards Bay Project

The Buzzards Bay Project staff will develop criteria for determining the appropriate size of a buffer area.

Target date: 1991

Buzzards Bay Municipalities

Dartmouth will pursue watersheet zoning on a limited basis as part of its Harbor Management Plan.

Target date: 1992

Other Recommended CCMP Actions

1. DEP should amend the regulations to the Wetland Protection Act to better protect wetlands in order to achieve and exceed the Commonwealth's no net loss policy.

Target date: 1993

The following recommendations address current weaknesses in the Act:

- When wetlands are allowed to be altered or destroyed, require restoration and/or replication at a ratio of at least 2:1.
- Stipulate specific limits on the total area of wetlands that can be destroyed by limited projects.
- If discretionary destruction of BVWs is allowed, it should be in accordance with the above recommendations.
- Define performance standards for the 100-ft buffer zone around wetlands.
- Require mandatory attendance by conservation commission members at Wetland Protection Act training courses.
- Enhance protection of marine habitat and resources contained in lands under the ocean.

2. Conservation commissions should upgrade their ability to protect wetlands.

Target date: 1991-1994.

The complexity and magnitude of wetlands protection requires that towns have professional conservation administrators or agents to guide and facilitate the conservation commission's actions. Commissions should strive for the greatest level of wetlands protection possible under the WPA, including protection of critical habitat areas such as shellfish areas and eelgrass beds. Wetlands protection can also be greatly enhanced through the adoption of zoning and non-zoning wetland protection bylaws and regulations that supplement the state program deficiencies discussed in recommendation #1. Local wetlands bylaws should also include filing and review fees to help defray the costs of hiring staff and paying for outside consultants on difficult projects.

3. Town boards and local environmental organizations should assist in protecting wetlands.

Target date: 1991-1994.

The board of selectmen is crucial to this effort and should appoint conservation commission members who are dedicated to aggressive implementation of the WPA and protection of wetlands.

Planning boards can also help by adopting subdivision filing rules that require wetland delineation prior to subdivision approval. Over the long term, planning boards should work toward changing the way minimum lot size is calculated. Only the upland portion of a property should be applied toward the minimum lot size requirements. (Although this may require an amendment to the local zoning bylaw, it would minimize the necessity for some discretionary filling of BVWs and be a very effective tool for wetlands protection.)

Boards of health can also participate by adopting regulations that prohibit the use of filled wetlands to meet setback requirements from septic systems. Also, all setbacks should be measured from the edge of the delineated wetland, as defined by WPA regulations.

Local environmental advocacy groups can participate in wetland protection by pressuring boards of selectmen to appoint wetland advocates to the conservation commission and filing Request for Determination of Applicability forms with the commission to ascertain the legality of suspected wetlands violations, as well as by appealing deficient orders, and setting up education programs.

Also, communities should fully utilize resource planning techniques to protect wetlands. These include ACEC nominations, the Natural Heritage Program for vernal pool identification, harbor planning, and open space planning.

4. Communities (selectmen, conservation commissions, land trusts, etc.) should fully utilize nonregulatory wetlands protection techniques wherever possible.

Target date: 1991-1994.

Some specific techniques for communities are:

- Conservation restriction program together with major property tax reductions

- Use-assessment tax programs for forest, farmland, and recreational/open space lands through Massachusetts General Laws Chapters 61, 61A, and 61B
- Differential taxation policies as provided in Chapter 54 of Special Act 797 passed in 1979, which allows open space to be taxed at a rate significantly lower than for residential or commercial property.

5. DEP should prohibit the issuance of permits to chronic violators of the Wetlands Protection Act.

Target date: 1992.

DEP recognizes that much of the recent wetland destruction or damage is caused by a group of chronic offenders. Often the same individuals who are in violation of regulations at one site are requesting permits for work on another site. Legislative action allowing DEP to withhold the processing of a wetlands application if the project proponent is violating provisions of the WPA elsewhere would be necessary to restrict these illegal activities.

6. All municipalities should adopt embayment or harbor management plans that identify watersheet uses for their entire coastline.

Target date: 1994.

An embayment plan that effectively plans watersheet uses should identify resource protection areas and also designate dock-free zones, mooring areas, boat exclusion zones, boat speed limit zones, exclusion zones for hydraulic dredging (so-called "jet clamming"), and areas where dredging is permitted. They should also specify times of year when construction or dredging are permitted so as to minimize ecosystem impacts. To effectively support such a plan, a municipality should document the distribution and abundance of shellfish beds, eelgrass beds, fringing marshes, spawning or migratory areas, nurseries, and any other valuable habitats. Only with this documentation and the plans in place will conservation commissions and harbormasters successfully deny activities that would adversely impact critical resource areas. Embayment and harbor plans should include representative public participation in all aspects of their development. Before plans developed by conservation commissions or harbormasters are used as the basis for decisions, these plans should be reviewed by residents of the municipality. These plans may also need to be adopted as town bylaws.

Action Plan

Planning For A Shifting Shoreline

Problem

Buzzards Bay shores are subject to rise in sea level, erosion, natural shifts of barrier materials, storms, and other natural phenomena that change the shape and size of the shoreline. Rising waters and associated physical forces can shift barrier beaches and alter wetland areas, resulting in loss of habitat for certain species and financial losses to coastal landowners and communities.

Two principal ways of measuring these changes are through tidal data and shoreline migration. Tidal data collected over the past century indicates that global sea level has been rising at an average rate of approximately 0.3 ft per century. In Buzzards Bay, sea level has been rising at a slightly higher rate, approximately 0.8 ft per century, due to the slow subsidence of the earth's crust along the northeast coast (Braatz, 1987). Recent studies have indicated that the present rate of sea-level rise may accelerate dramatically within the next 10-100 years as a result of global warming (Charney, 1979; Smagorinsky, 1982).

Background

Shorelines have shifted significantly over geologic time. As recently as the last ice age, the southeastern Massachusetts land mass extended seaward 100 miles to the area now bounded by Block Island, Martha's Vineyard, Nantucket, and Georges Bank. In the 15,000 years since the ice began retreating, the shoreline has withdrawn slowly inland. At the same time, sandy shores such as those along southern New England have shifted, due to erosion largely in response to major hurricanes and winter storms.

These natural processes now appear to have been altered by a variety of environmental changes, including some prompted by human activities. In particular, atmospheric concentrations of carbon dioxide, methane, and other gases released during the combustion of fossil fuels such as coal and gasoline are increasing. The concentration of chlorofluorocarbons released because of wide-spread use in modern industrial society is also increasing. Because these atmospheric gases absorb and trap heat like the glass panels of a greenhouse, this phenomenon is known as the "greenhouse effect."

In recent decades, the concentrations of "greenhouse gases" have been increasing, and as the human population spirals upward and industrial growth continues, the rate of global warming is predicted to increase. Many scientists predict that a warmer planet could raise sea level by expanding ocean water and melting glaciers and polar ice sheets. This would result in increased coastal inundation, more severe storms, and significant changes along our coastline. Along the shores of Buzzards Bay, some low-lying shores may be particularly susceptible.

A recent study funded by the Buzzards Bay Project (Giese, 1989) evaluated the potential loss of upland area due to sea-level rise in the 11 communities directly abutting the Bay. Results showed that even under a conservative scenario, several

municipalities bordering Buzzards Bay would experience significant submergence of their coastal uplands by rising waters. Effects from these losses would include increased occurrences of floods at higher elevations, loss and erosion of wetland resource areas, and elevated groundwater levels and saltwater intrusion; these effects would be accentuated during major coastal storms. Table 5.5 shows the projected upland losses for the communities surrounding Buzzards Bay through the year 2100. The estimates shown in the table were calculated using a conservative rate of sea-level rise (1.3 to 2.1 ft per century), considering only increases in ocean volume that would result from higher ocean temperatures. If melting of ice and snow were also factored into the projected rate of rise (2.2 to 10.6 ft per century), upland losses could be 4 to 5 times as great after 2050.

Table 5.5. Projected upland loss in acres (Geise, 1989)

	YEAR			
	Town	**2025**	**2050**	**2075**
Westport	66	118	190	283
Dartmouth	121	215	348	519
New Bedford	35	63	102	152
Acushnet	13	23	37	56
Fairhaven	80	142	229	342
Mattapoisett	41	72	117	175
Marion	126	224	362	539
Wareham	227	493	799	1189
Bourne	90	161	260	387
Falmouth	225	401	649	966
Gosnold	34	61	99	147
TOTAL	**1108**	**1973**	**3192**	**4755**

Major Issues

These issues can be described as problems in search of a policy. At the international and national levels, sea-level rise and climatic shifts are already receiving significant scientific attention. However, at a policy and management level, little has been done. This may be because the scientific basis for predicting the details of a natural phenomenon like global warming is uncertain. How can these uncertainties be translated into an equitable planning or zoning process?

Even though the magnitude and timing of future shoreline changes is not well known, the fact that shorelines migrate is incontrovertible. Unfortunately, regulations at all levels of government currently assume a static sea level and shoreline. Recently, the Coastal Zone Management Office (CZM) has begun to address the issue. CZM has developed a draft policy that calls for consideration of sea-level rise for projects within the 100-year floodplain. Towns should also consider shifting shorelines in all development and redevelopment requests.

The major issues surrounding shoreline dynamics involve changes that will occur within three hydrologic regions: flood-prone areas, surface-water areas, and groundwater areas. Issues to be considered include loss of uplands, increased flooding impacts, loss of wetlands, accelerated shoreline changes, saltwater intrusion, and elevated groundwater levels. For currently developed areas, two basic management strategies are available: retreat from the rising water or attempt to protect threatened areas, with varying combinations of both. For undeveloped areas, avoidance is another possibility. However, political, legal, and economic considerations will probably override the scientific issue. Although we know that changes are occurring now and cannot be reversed, the issues of property rights and equity will probably dominate how the problem is managed. The challenge is to incorporate existing scientific information, even with its uncertainties, into a rational and equitable management scheme.

Goals

1. Protect public health and safety from problems associated with higher waters and shifting shorelines.

2. Reduce the public financial burden caused by the destruction of or damage to coastal property.

3. Plan for the loss of buffering wetlands and shifting sand formations.

Objectives

1. To incorporate sea-level rise and shoreline change phenomena into all relevant planning and management programs.

2. To develop a comprehensive strategy for handling existing structures in areas predicted to be affected by future shoreline changes.

3. To adopt regulatory and nonregulatory measures for guiding growth and development in areas that will be influenced by new shorelines.

4. To restructure the flood and hazard insurance programs in threatened areas so that the financial burden on the general public is decreased.

CCMP Commitments

Department of Environmental Protection (DEP)

DEP will amend its wetlands regulations and adopt performance standards for the resource area "Land Subject to Coastal Storm Flowage" (100 year floodplain).

Target date: 1991

Coastal Zone Management Office (CZM)

1. CZM will provide technical assistance to Buzzards Bay area planning boards, conservation commissions and other relevant local committees, commissions and boards in mapping coastal areas that are, or will be, affected by erosion and/or sea level rise.

Target date: Beginning 1991

2. CZM will provide technical assistance to Buzzards Bay communities in developing by-laws, regulations, guidelines, and policies for building in flood zones mapped by the Federal Emergency Management Agency.

Target date: Beginning 1991

Other Recommended CCMP Actions

1. Buzzards Bay communities should pass bylaws increasing the required setback for septic systems from groundwater, waterbodies, and vegetated wetlands for areas subject to sea-level rise, erosion, or flooding.

Target date: 1992-1994.

The new setbacks should take into account site-specific information on tidal fluctuations of groundwater, predicted movement of the coastline, and anticipated inland migration of wetlands.

2. Buzzards Bay communities should establish coastal construction setbacks and regulate construction activities more stringently for areas predicted to be subject to sea-level rise, erosion, or flooding.

Target date: 1992-1994.

The new setbacks and regulations should address those portions of the 100-ft buffer zone from a vegetated resource area that would be affected by a likely shift in shorelines, and should incorporate erosion, sea-level rise, and shoreline data. In particular, these regulations should prohibit the construction of seawalls, revetments, and groins to allow wetland and natural sediment migration processes.

3. Buzzards Bay communities should establish higher flood elevations that exceed the minimum elevations mapped by the Federal Emergency Management Agency.

Target date: 1992.

New flood elevations should be based on reasonable scenarios for sea-level rise and shoreline erosion. These new elevations would make it harder for coastal developers to obtain flood insurance from the Federal Emergency Management Agency for construction in threatened areas.

Action Plan

Managing Sewage Treatment Facilities

Problem

All sewage facilities cause, or have the potential to cause, local decline in water quality. In many instances, sewage treatment facilities have caused regional declines in the health of coastal ecosystems. The type of treatment provided, the location of the discharge, and the types of wastes collected by sewers are critically important to the impacts caused by these systems. As population in the Buzzards Bay drainage basin grows, there will be a need to expand the capacity of existing facilities or to create new ones. Most of these systems are publicly owned sewage treatment facilities (also called publicly owned treatment works, or POTWs), hence the operation of these facilities and the siting of future sewage treatment facilities is critically important to the local and regional water quality in Buzzards Bay.

Background

There are six publicly owned treatment works (sewage treatment facilities) in the Buzzards Bay drainage basin (Table 5.6). One of these facilities discharges to groundwater (Falmouth); the others discharge to surface water.

The federal Water Pollution Control Act of 1972 required that, by 1983 (later adjusted to 1988), sewage treatment facilities that discharge to surface waters must provide a minimum of secondary treatment (biological processes that remove a minimum of 85% of the organic matter). The Act does not apply to Falmouth, because it has a groundwater discharge. All facilities, except New Bedford, have now complied with the

Table 5.6. Buzzards Bay POTWs

City POTW	Design Capacity	Average Discharge	Population Served	Treatment Level	Improvements Underway	Site Of Discharge
Dartmouth	2.0 MGD	2.8 MGD	10,000	Secondary	2.8 MGD	Marine
Fairhaven	5.0 MGD	4.9 MGD	15,000	Secondary		Marine
Falmouth	0.8 MGD	0.6 MGD	1,500	Second/Tertiary	-	Groundwater
Marion	0.6 MGD	0.4 MGD	2,100	Secondary	--	Freshwater
New Bedford	30 MGD	23 MGD	102,000	Primary	Secondary	Marine
Wareham	1.8 MGD	1.0 MGD	10,000	Secondary	--	Freshwater

Act. Because there are special problems faced by New Bedford and the upgrade of its treatment facility, these issues are discussed separately in Chapter 6.

For the most part, detrimental effects from the discharges of sewage treatment facilities are localized near the sites of discharge. These effects are most acute when the discharge occurs in poorly flushed areas. Both the New Bedford and the Dartmouth

plants discharge to well-mixed portions of Buzzards Bay, although the New Bedford discharge is of such a magnitude that it has appreciable effects over a broad area. The Fairhaven treatment facility discharges to New Bedford's Inner Harbor and would be a significant source of pollution except that resources in this area are significantly impacted by other pollution. The Wareham and Marion facilities discharge to streams or rivers that flow into small embayments (Wareham River estuary and Aucoot Cove, respectively), and nitrogen from these facilities is probably impacting the receiving waters, especially in the poorly flushed Wareham River estuary. The Falmouth facility discharges some effluent from the secondary treatment lagoons by spray irrigation. This removes large amounts of nitrogen from this part of the total facility volume. Both the spray irrigation and the infiltration beds servicing the lagoons leach into groundwater and will eventually impact West Falmouth Harbor with nitrogen inputs. There has not been enough study to determine to what degree these embayments have been, or will be, impacted.

State and federal governments regulate the discharges of sewage treatment facilities through permits granted under the National Pollutant Discharge Elimination System (NPDES). These permits set allowable concentrations of pollutants in the effluent from treatment plants. Discharge permits generally have requirements limiting the concentrations of suspended solids, biochemical oxygen demand (BOD), fecal coliform bacteria, and chlorine that can be in the effluent. Nutrient levels (nitrogen and phosphorus), in the discharge also cause problems in the receiving waters, but are typically not addressed in the permit.

If an industry tied into the system is known to produce toxic materials, or if there has been an identified contaminant problem in the past, the permit may also contain chemical-specific limits, so that special attention can be focused on the contaminants of concern. All permits require self-monitoring by the discharger in order to demonstrate compliance with the specified permit limits. According to federal and state law, municipal plants that treat industrial and commercial contaminants must institute a pretreatment program. This program is designed to identify the sources of toxic compounds and require the contributor to reduce or remove these materials prior to discharge into the sewer system. Each individual contributor must therefore remove specified pollutants from the flow before it is discharged into the municipal system. In some cases, industries are issued their own permits to discharge directly to the receiving water. The requirements for these permits are always at least as strict as those for a municipal discharge.

Three of the existing municipal facilities in Buzzards Bay (Table 5.4) are in either the planning or construction phase of capacity expansion or treatment-level upgrade. New Bedford is under a court order to upgrade its treatment level to secondary by 1994.

All of the discharges are sources of bacterial contamination and require closure areas around the outfalls for the protection of public health. These discharges have a significant impact on shellfish resources and sometimes close swimming beaches. This is particularly true for New Bedford and Dartmouth and, to a much lesser extent, for the other communities. All of these treatment plants use chlorine to disinfect the treated wastewater. Although chlorine is an efficient and cost-effective means of disinfection, there is concern that chlorine residuals in wastewater discharged to the

Bay may have detrimental effects on marine life and the long-term viability of the ecosystem.

The Ocean Sanctuaries Act prohibits any new discharges from wastewater treatment plants directly into Buzzards Bay. This includes any increase over the design capacity of the discharge, even if it is of significantly higher quality. Thus, a community cannot increase its volume of discharge in response to increased development or sewer use. An amendment to the Act was passed in January 1990 to allows for a variance procedure administered by the Department of Environmental Management. However, in keeping with the spirit of the Ocean Sanctuaries Act, any variance that is considered must meet very stringent criteria. In general, municipal wastewater discharges will only be allowed when an existing discharge had degraded or threatens to degrade Buzzards Bay and when a land application is not feasible.

The antidegradation provision of the Commonwealth's water quality standards is a potent regulatory tool that protects the beneficial uses of the state's waters from contamination by municipal treatment plants and other sources. The antidegradation policy (1) safeguards present water quality conditions necessary to protect existing uses; (2) maintains water quality that exceeds the level necessary to support propagation of fish, shellfish, wildlife, and recreation unless lower water quality is necessary to accommodate economic or social development; and (3) maintains and protects outstanding resource areas designated by the state in an absolute fashion with no qualifications.

Major Issues

Population in the basin will grow, and there will be future need to increase the capacity of existing facilities or introduce new facilities. To protect marine water quality, the preferred option for disposing sewage appears to be land-based disposal, particularly if it includes tertiary treatment (as is the case in Falmouth). But in many areas, land-based application is not a feasible option, either because of hydrologic conditions or shortage of suitable land. In these cases, other alternatives must be considered that would best protect human health and the environment. In most cases, disposal of primary or secondary effluent to surface waters is not desirable, particularly if they are nitrogen-sensitive, or have significant living resources or uses.

All treatment plants produce sludge as a by-product. Given the capacity problem at local landfills to receive sludge, the long-term disposal is an issue. Sludge with low concentrations of toxic materials can be composted and used as a soil additive. However, sludge with high concentrations of toxic materials is harder and more costly to dispose of. Toxicants in sludge result largely from materials entering the sewer systems from homes and industry. For this reason, the reduction of toxic contaminants entering the waste must be accomplished through aggressive programs of industrial pollution prevention and if necessary, pretreatment and homeowner toxic use reduction.

Many of the treatment plants in the area have antiquated sewer collection systems. These are either combined sanitary/stormwater systems, or they were intentionally designed to allow for the draining of groundwater from low areas. The introduction of stormwater and groundwater into the collection system reduces the effectiveness of the

plant. Although the cost is prohibitive to correct all the sources of groundwater and stormwater to these systems, correction of the major problem areas can improve plant operation and capacity. Water-conservation measures are also very effective at reducing volume of flow at treatment facilities.

Goal

Achieve water quality standards and protect natural resources at all POTW discharge points.

Objectives

To improve POTW efficiencies by setting limits on chlorine residual discharges and monitoring for effective effluent disinfection, encouraging industrial pollution prevention and pretreatment efforts, and reducing nitrogen inputs.

CCMP Commitments

Department of Environmental Protection (DEP)

DEP will designate all existing aquatic Areas of Critical Environmental Concern (ACECs) as outstanding resource waters subject to the highest level of protection under the Antidegradation provisions of the Clean Water Act. DEP will work with the Buzzards Bay Project, Coastal Zone Management, and the Cape Cod Commission to determine if additional areas within the Buzzards Bay watershed should be designated as ACECs.

Target date: 1992

Environmental Protection Agency (EPA)

EPA will conduct evaluations of Dartmouth, Wareham and Fairhaven municipal discharges. Using the ten criteria established under Section 403(c) of the Clean Water Act, EPA will ensure that these discharges are not having an adverse impact on coastal water quality and ecosystems.

Target date: 9/91

Other Recommended CCMP Actions

1. The state management framework for protecting the quality of surface water should be made more comprehensive to address nitrogen from existing and future sewage treatment facilities. In particular, DEM should enforce the Ocean Sanctuary Act.

2. Communities should develop and implement plans to reduce effluent volume.

These plans should include strategies to reduce groundwater infiltration and stormwater inputs, as well as to promote water conservation by individuals and businesses.

3. Communities should develop and implement programs of industrial pretreatment and industrial and household hazardous waste reduction where appropriate.

4. Future sewage treatment facilities and outfalls should be sited so that they minimize pathogen contamination, nitrogen impacts, and threats to human health and marine ecosystems.

Action Plan
Reducing Toxic Pollution

Problem

Although most of Buzzards Bay is considered pristine compared to other more developed estuaries, located within the Bay is one of the few marine Superfund sites in the country. Buzzards Bay is further distinguished by having the only fishing area in Massachusetts closed because of chemical contamination (others are closed because of pathogens). Most of the toxic problems in Buzzards Bay are associated with the Acushnet River watershed, which includes the municipalities of New Bedford, Acushnet, and Fairhaven. Toxic materials enter the system from point-source discharges, e.g., sewage treatment facilities, industrial discharges, combined sewer overflows, and storm sewers. Less recognized as a problem are the numerous small, unregulated toxic inputs that are discharged directly into receiving waters from the atmosphere, groundwater, overland runoff, and other sources. Of greatest concern is the risk that toxic chemicals pose to human health through direct contact or consumption of contaminated seafood.

Although there is a general perception that toxic contamination is widespread, the geographic extent, ecological significance, and human health impacts of the problem are not well understood because of a lack of basic data.

This plan focuses on the baywide management of toxic contaminants. Several other action plans make recommendations that are directly related to this issue, including those on reducing oil pollution and managing dredging and dredged material disposal. Other related action plans include recommendations that decrease toxic inputs from point and nonpoint sources (e.g., wastewater treatment facilities, combined sewer overflows, industrial discharges and stormwater run-off).

Background

Over 70,000 man-made chemicals have been introduced into the environment since the 1940s. Although there are many beneficial uses for these chemicals, some cause cancer, change genetic material, and cause birth defects in human and marine organisms. Toxic contaminants are divided into two major classes — metals and organic compounds. A third, diverse group is classified as household hazardous wastes and includes some additional inorganic chemicals. These chemicals have multiple routes of entry to the marine environment, which complicates identification of the relative contribution of toxicants from specific sources. Once toxic chemicals reach the marine environment, they behave differently and have different effects on organisms and humans. In an effort to simplify the complexity of the effects, this section describes important contaminants and major sources and briefly discusses the fate and effect of contaminants once they reach the marine environment.

Metals

Metals of concern are copper, arsenic, lead, cadmium, mercury, silver, chromium, nickel, and zinc. Sources of metals are associated with metal-plating industries, jewelry-making, textile mills, and leather manufacturing. Almost all industrial discharges are regulated by NPDES permits or their wastestreams are discharged into public sewers. Copper and lead from pipes and silver from home darkrooms and small photographic businesses are examples of metals that continue to enter the Bay at elevated levels. Chromium and cadmium are associated with automobiles and other vehicles and enter via road runoff. Decreases in metal inputs are typically related to implementation and enforcement of pollution prevention and pre-treatment controls on industrial users, and elimination of lead in gasoline. To achieve future reductions in metal loadings to coastal waters, it will be increasingly important to manage the acidity (Ph) of public water supplies to minimize the rate of copper and lead leaching from plumbing.

Organic Compounds

Organic compounds include fossil fuel hydrocarbons and a subset of chemicals known as polynuclear (or polycyclic) aromatic hydrocarbons (PAH); polychlorinated biphenyls (PCB); pesticides (including herbicides and fungicides); and several other organic compounds, e.g., dibenzofurans and phthalates. PAHs are pervasive compounds that represent a significant threat to humans and the ecosystem. Both combusted and noncombusted fossil fuels contribute to the pollution of the environment via the atmosphere, road runoff, oil spills, and point-sources of discharge. Some PAHs cause cancers and birth defects and others are accumulated in tissues, causing physiological damage.

Most chlorinated pesticides have been banned and replaced by shorter-lived, target-specific chemicals. Pesticides enter Buzzards Bay largely from nonpoint sources, e.g., agricultural runoff, golf courses, lawn care, and gardens. Cranberry growers have lowered pesticide input by reducing applications and adopting integrated pest-management practices.

PCBs are a group of chemicals primarily used in the manufacture of electrical equipment. These chemicals are long-lived and accumulate in sediments and organisms. The major sources are several industries in the New Bedford area that manufactured capacitors and generators and discharged PCB-containing waters through the sewage treatment plant. Because PCBs are present in fluorescent light transformers, nonpoint sources of contamination from legal and illegal dumping are additional sources.

PCB levels in the New Bedford area resulted in designation of the Upper Acushnet River as a Superfund site. Feasibility studies to remove, destroy, and remediate the affected areas are being developed. Although PCBs are no longer manufactured and have not been since 1978, they still persist in sediments to levels that violate water quality standards, posing a risk to humans and the ecosystem. As a result, fisheries, both finfish and shellfish, throughout New Bedford Harbor and into Buzzard Bay have been closed.

Sources

Urban centers such as New Bedford and Fairhaven contribute substantially to mass loadings of toxicants largely via point sources of discharge through sewage treatment facilities, industrial discharges, combined sewer overflows, stormwater outfalls, and surface runoff. Because of the intensive sampling for the Superfund site, wastewater treatment facilities and compliance monitoring requirements for NPDES permits, more data are available on types and levels of contaminants in the New Bedford area than elsewhere. Both organic compounds (PAHs and PCBs) and metals make this area one of the most contaminated in the nation.

Less well-known are the cumulative impacts of chronic pollution from nonpoint sources that enter small embayments, harbors, and marinas. Nonpoint sources of contaminants include boat antifouling paints, oil spills, creosoted and chemically treated pilings, and overland runoff carrying metals, organic compounds, and pesticides into receiving waters. These contaminants are often associated with particles and accumulate in sediments; but without an adequate monitoring program, the extent of contamination remains undocumented.

Homes are responsible for 25% of the hazardous waste disposal in the Commonwealth and discharge a variety of toxic materials into the wastewater stream and landfills. Contaminants from this source include everyday household products such as chlorine, ammonia, shampoos (which may contain high levels of selenium), batteries, oven cleaners, spot removers, paints and paint solvents. Empty and partially empty containers are disposed of in landfills or the contents are poured directly through drains to enter sewers and septic systems. An unknown, but dangerous, household hazardous waste are degreasing agents used in some septic systems. One of these cleaners contains trichloroethylene (TCE), which is a common contaminant of drinking water and is difficult or impossible to eliminate once it reaches water supplies. Groundwater carrying household contaminants is an important nonpoint source of toxic input into embayments throughout Buzzards Bay.

Fate and Effect

The fate and effect of contaminants in Buzzards Bay depends on several factors. Most contaminants are associated with particles and accumulate in sediments, usually near the source of the input or in depositional areas. The greatest concentrations are found closest inshore where there is the greatest human activity and productive shellfishing. Metals do not degrade, but are usually accumulated. Some organic compounds, e.g., low molecular weight PAHs, may be degraded or broken down by organisms into compounds that are more or less toxic. Other organic compounds, e.g., PCBs and high molecular weight PAHs, are bioaccumulated and transferred along the food web to higher organisms. PAHs are known carcinogens; PCBs have deleterious effects on nervous systems; and both PAHs and PCBs negatively impact reproduction, survival, and growth.

Even if all sources of toxic chemicals were eliminated tomorrow, it would be a very long time before the ecosystem was restored to its original state. The numerous pathways

by which contaminants enter, accumulate, and move in marine ecosystems make them difficult to regulate. In general, it is easier to regulate point sources of discharge than nonpoint sources. Regulations are designed to protect the ecosystem and human health, and criteria have been established for chemicals in the water, in sediments, and in tissues (of seafood). Nonetheless, there are many unknowns, and much basic data must be gathered if we are to set realistic and cost-effective goals.

Major Issues

Some specific toxic contamination issues in Buzzards Bay are being addressed or reviewed by regulatory agencies. These include remediation of the Superfund site in the Upper Acushnet River and attention to sewage treatment problems in New Bedford. The latter includes upgrade of the treatment facility from primary to secondary, development of a plan for controlling combined sewer overflows, and aggressive pursuit of a pretreatment program. Ongoing review of NPDES permits allows for incorporation of best available technology or best management practices to reduce wastes in discharges.

This technology-based approach must be balanced with water quality-based controls. Sometimes effluent limitations by themselves will not be stringent enough to meet water quality standards. In these cases, pollutant-specific standards will be necessary to achieve or maintain the beneficial uses of the Bay.

Once toxic chemicals get into the marine environment, they are difficult to remove. One estimated cost for remediation of PCBs from the New Bedford area range from $30 million for removal, treatment, and incineration of the hot spot sediments to more than $300 million for a similar effort to remove, treat, and /or cap sediments contaminated down to 1 ppm. Most speculate total cleanup costs will be closer to $100 million. Preventing contaminants from reaching the marine environment is cheaper and more protective. Massachusetts has recently passed a Toxics Use Reduction Act that requires a 50% reduction in hazardous wastes in discharges by the year 1997 and provides for a funding mechanism to do so. A pilot project in the Taunton and Fall River areas was successful in reducing metal discharges from jewelry manufacturers. Other areas of the country have implemented toxic audit program to assist small businesses and industries in reducing both the use and generation of toxic materials.

Toxic contaminants associate with particles and accumulate in the sediments, where they remain for long periods. Through complex interactions they may be buried, resuspended, eaten, or directly absorbed into organisms. Although federal agencies have been attempting to set sediment criteria that protect the environment and human health, this has not occurred. Recently, the state of Washington proposed criteria based on organic content in sediments. Massachusetts is preparing a draft PAH policy. These criteria are needed and should be established.

There are a number of critical unknowns in defining risk to humans from eating contaminated seafood. Based on the conclusions from the Symposium on Chemically Contaminated Aquatic Food Resources and Human Cancer Risk held by the National Institute of Environmental Health Sciences, some basic approaches are available that are more appropriate than our past approaches. The recommendations include, but are not limited to, locating sources of carcinogens in water, suspended and sedimented particles; identifying biochemical markers in seafood as indicators of organisms of

concern; and pursuing specific research studies that link environmental neoplasms (cancerous tissues) to specific causes. Many of these recommendations require resources at a national level. Nonetheless, some of the actions will be of direct benefit to Buzzards Bay communities and are included in this section.

Goal

Protect the public health and the Bay ecosystem from the effects of toxic contaminants entering Buzzards Bay.

Objectives

1. To reduce the amount of toxic contaminants entering Buzzards Bay.
2. To reduce hazardous leachate from landfills and to minimize other nonpoint sources of toxic contaminants to the Bay.
3. To meet all state, federal, and local action levels for water and seafood.

Recommended CCMP Actions

1. Municipalities should establish and implement a program of toxic-waste reduction for industries that discharge directly into receiving waters or sewage treatment facilities.

Target date: 1993

The Commonwealth has just passed a Toxic Use Reduction Act that will require a 50% reduction of hazardous wastes by the year 1997. Funds will be available to assist industries in implementing this goal. Part of the waste-minimization program should include an environmental audit team to assist industries and businesses to reduce their toxic usage. The metal-reduction program in Fall River by DEM was discontinued due to lack of funding; this should be reinstated.

Implementation Costs

Preliminary cost estimates for conducting a toxic audit can be found in the Financial Plan, Chapter 2 (Toxic Audit Teams). This includes time requirements, on-site activities, follow-up activities and overall total costs.

2. DEP should reduce oil entering the environment through enforcement of adequate collection regulations.

Target dates: Oil strategy policy enforcement, immediately; legislative action on refundable tax, 1992; boat waste collection regulations, 1993.

DEP should enforce legal provisions requiring large retail facilities to provide collection containers (See Oil Strategy Policy, 1989). In addition, the Massachusetts legislature should pass a refundable tax on each can of oil sold. A third target area is to establish a boat-waste collection program with regulatory teeth.

3. Buzzards Bay municipalities should collect and properly dispose of household hazardous waste on a continuous basis.

Target dates: DEP household hazardous waste permitting by 1992; bans on organic degreasers by 1993; funding by 1993.

DEP should facilitate the permitting process for municipalities to create collection facilities for hazardous waste. Buzzards Bay municipalities should develop an aggressive program to educate the public about the use of alternatives to common household products. Municipalities, possibly through boards of health, should collectively agree to ban the sale of septic-system cleaners, especially those using organic degreasers. The legislature should identify and provide a funding source that ensures public safety.

4. SCS and the Cooperative Extension Service should develop and implement strategies to minimize the use and potential off-site impact of agrichemicals

Target dates: 75% implemented by 1995.

Currently, farmers are encouraged to adopt integrated pest management programs and best management practices to reduce the off-site impact and the use of pesticides. A similar program for lawn-care services should be developed to reduce or eliminate herbicides and pesticides. An education program to decrease lawn-care applications may be effective, or local or state legislation may be necessary.

5. EOEA should establish sediment criteria that are protective of the ecosystem and of human health for selected contaminants.

Target date: Draft PAH policy by September 1991; final by 1992; sediment criteria by 1994.

CZM is preparing a PAH policy that defines acceptable levels of PAH in sediments, including methods for analyses. This policy should be adopted by regulatory agencies. EOEA agencies, particularly DEP, should establish criteria for acceptable levels of contaminants in sediments.

6. EOEA should coordinate with the Massachusetts Department of Public Health to review the current seafood-testing program and develop recommendations for future actions.

Target date: 1992.

Action Plan

Managing Dredging and Dredged Material Disposal

Problem

The harbors, channels, and embayments of the Buzzards Bay system require periodic maintenance and improvement dredging to compensate for natural sedimentation and to allow for appropriate shoreline development. In some instances, dredged material can have beneficial uses; for example, capping potentially contaminated deposits or nourishing beaches. However, most dredging is of fine-grained sediments containing one or more contaminants of concern. In New Bedford Harbor, sediments have such elevated levels of PCBs that they are unsuitable for ocean disposal and may be unsuitable for most landfill sites. Disposal of sediments with elevated chemical concentrations has resulted in sediment background levels that are potentially carcinogenic to bottom-dwelling fish (MBDS, 1989; and R. A. Murchelano, National Marine Fisheries Service, unpublished data). Currently, a comprehensive analysis of dredging needs and dredged material disposal does not exist for Buzzards Bay.

Background

The only active site in Buzzards Bay that receives dredged material is Cleveland's Ledge. The site primarily receives dredged material from activities in the Cape Cod Canal and most recently material from Falmouth Harbor. Local, state, and federal permitting of dredging and dredged material disposal has been evaluated on a project-by-project basis. However, this system has not addressed potential negative, cumulative impacts of such projects. Effective review of dredging permits and management of all dredged material disposal in Buzzards Bay requires a cooperative state and federal effort. The Army Corp of Engineers (COE) is preparing an evaluation of dredged material disposal sites. The Department of Environmental Management is preparing a list of anticipated dredging projects. In the New Bedford area, metals, PAHs and PCBs are at elevated levels in sediments, generally making them unsuitable for ocean disposal. In other harbors and marinas, petroleum hydrocarbons, including PAHs and metals from antifouling paints, are likely to accumulate in sediments and possibly contaminate nearby shellfish.

Although the Region I EPA and the COE-New England Division have recently adopted more stringent testing protocols to assess sediment quality, further modifications to the testing procedure are expected. A tiered approach to testing sediments for ocean disposal is required; this approach assesses the quality of the sediments and, if necessary, requires bioassay and bioaccumulation tests. Bioassay tests quantify mortality rates of organisms exposed to sediments and bioaccumulation tests are designed to evaluate the potential for organisms to accumulate selected chemicals when exposed to the sediments. These tests are expensive and may not always be conclusive; nonetheless, they are frequently the basis on which decisions about dredged material disposal are made. An important data set is the historical records of spills,

accidents, previous polluting activities, and sediment quality. This information is often overlooked partly because the data are not readily available to decision makers.

Because sediments vary in grain size (which determines whether they can be used for beach nourishment) and contamination levels of specific chemicals, several options should be available for disposal of dredged materials. Federal and state agencies with different mandates, perspectives, and authority need to cooperate to develop a management plan for dredging and dredged material disposal.

Major Issues

The PCB levels in areas to be dredged from New Bedford are a problem. Even sand materials have elevated levels of PCBs normally associated with finer particles, e.g., Palmer Cove. Improper disposal of PCB-laden sediments at a dredged spoils site off West Island has contributed to the spread of PCBs in Buzzards Bay. Existing sediment criteria for contaminants may not be protective of the ecosystem, a fact that is evidenced by the presence of cancerous tumors in bottom-feeding fish.

The use of uncontaminated sandy dredged material for beach nourishment is considered beneficial and recommended on a project-specific basis. The disposal of silty material may require expensive contaminant testing, and is reviewed on a project-specific basis. The tests are often inadequate to protect the environment, and data on potential "hot spots" should be integrated more fully in the decision-making process. An accessible database for all agencies involved in permitting dredging and dredged material disposal will facilitate making decisions protective of the environment.

Goal

Establish a comprehensive framework to manage dredging and the disposal of dredged material for Buzzards Bay.

Objectives

1. To minimize the negative impacts of dredging and disposal of contaminated and uncontaminated dredged material throughout Buzzards Bay.

2. To develop a database of potential hot spots, sediment and biota contaminant levels, and general information obtained from dredging and disposal testing.

3. To maximize the beneficial uses of dredged material by creating opportunities for disposal of dredged material, for example, nourish beaches or cover contaminated areas.

4. To review permits for dredging and dredged material disposal more uniformly and efficiently.

CCMP Commitments

U.S. Army Corps of Engineers (COE)
Executive Office of Environmental Affairs (EOEA)

COE, with assistance from EOEA, will initiate and co-chair an interagency committee of local, state, and federal authorities to develop a dredged material disposal plan for Buzzards Bay.

Target dates: Task force assembled by 12/91

Management plan by 12/93

Chapter 6

Pollution Remediation Projects in New Bedford

Existing Conditions in the New Bedford Area

The most populous community in the Buzzards Bay drainage basin is the City of New Bedford. With a population of nearly 100,000, it represents approximately 40% of the total population in the Bay's drainage basin. New Bedford is a highly urbanized, industrialized area that contributes significantly to pollution in Buzzards Bay through sewage, industrial effluent, combined sewer overflows, and storm-sewer discharges. The Acushnet River, which flows through Acushnet and New Bedford, drains approximately 15 square miles and discharges into New Bedford Harbor. The Harbor serves as the home port to approximately 350 commercial vessels that fish on Georges Bank and in other areas of the Northwest Atlantic, and New Bedford Harbor is the leading commercial fishing port in America in terms of annual value of catch landed.

New Bedford Harbor has been designated as a Superfund site: it is severely polluted with high levels of polychlorinated biphenyls (PCBs) and other toxic wastes from industrial activities in the area. Significant levels of these pollutants have accumulated in sediments, water, fish, lobsters, and shellfish in the Harbor and adjacent areas. Lobsters in the Harbor typically have PCB concentrations of 1.0 to 4.9 parts per million (ppm) in their bodies, with some lobsters containing up to 23.8 ppm (Hillman et al., 1990; Schwartz, 1987). The U.S. Food and Drug Administration action level for PCBs in seafood is 2.0 ppm. Because of the presence of PCBs in seafood species, the entire Inner Harbor and portions of the Outer Harbor and surrounding waters have been closed to shellfishing, fishing, and lobstering since 1979[1] (Figures 6.1 and 6.2). Through sediment transport processes, the Harbor now acts as a source of these pollutants to other areas of Buzzards Bay near the mouth of the Harbor.

In addition, the New Bedford municipal sewage treatment plant discharges approximately 30 MGD of inadequately treated sewage, industrial waste, and stormwater into the Outer Harbor. The large industrial waste component makes this discharge the largest source of toxic contamination reaching the Bay. Organic material, metals, and other toxic chemicals in the sediments near the outfall site and contribute to fishing restrictions in the Outer Harbor and Clark's Cove.

1 The closure of shellfish areas around New Bedford is principally due to coliform contamination. Shellfish that are relayed out of the closure areas are tested for both PCBs and other toxics before they are transplanted.

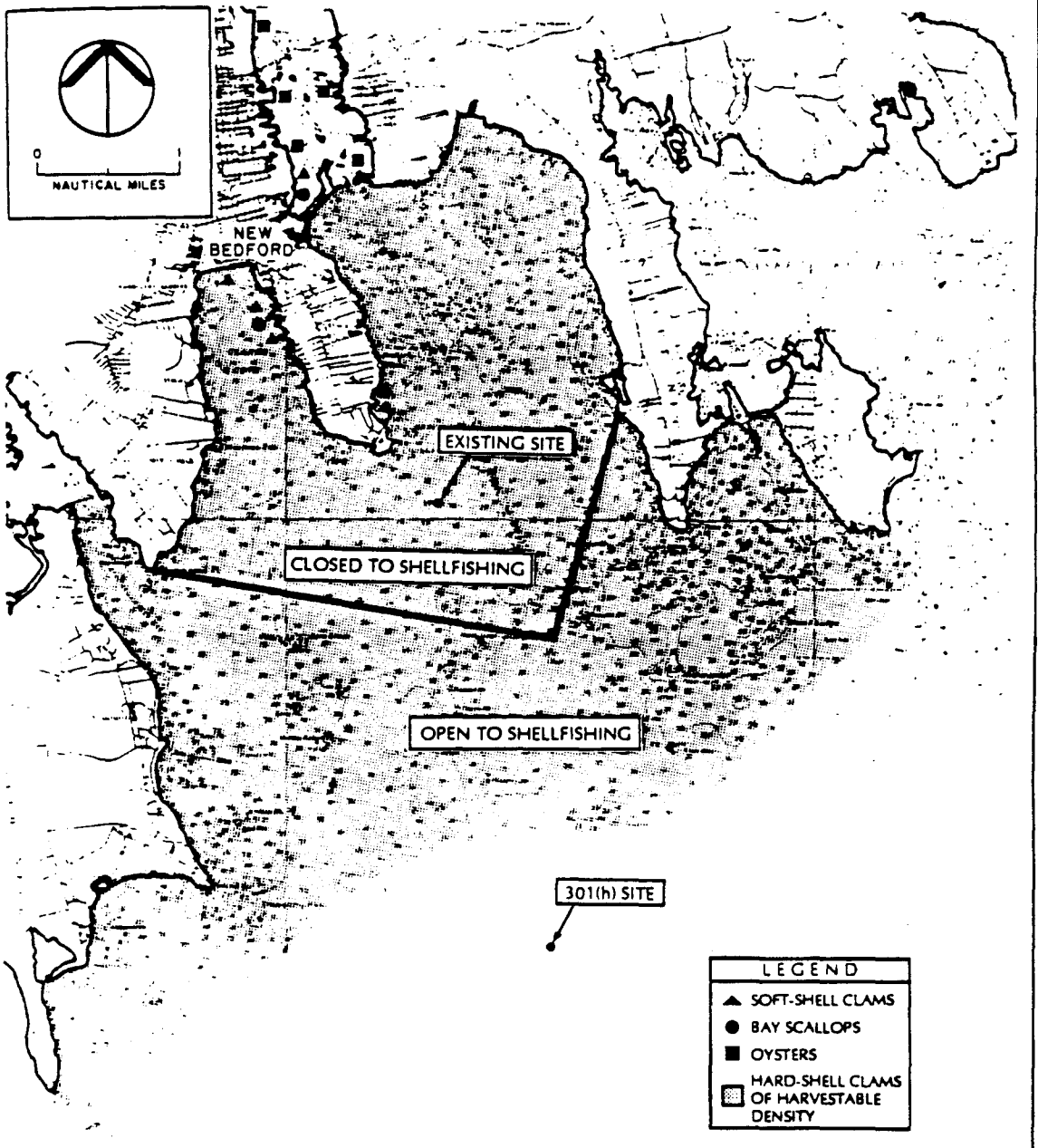


Figure 6.1. Shellfish closures around New Bedford due to pathogen contamination

Source: City of New Bedford Wastewater Facilities Plan, CDM (1989).

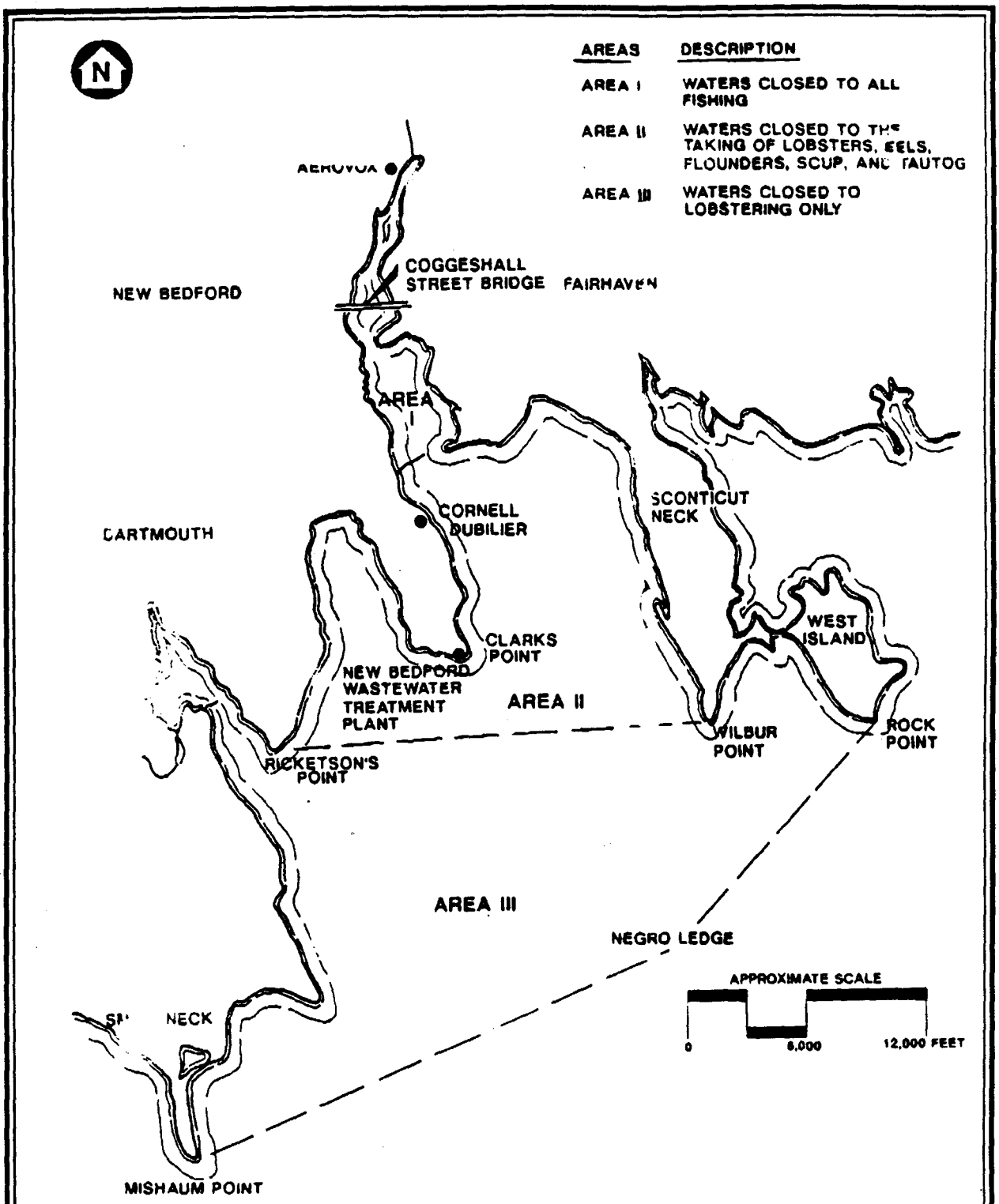


Figure 6.2. Finfish and lobster closures around New Bedford due to PCB contamination

source: City of New Bedford Wastewater Facilities Plan, CDM (1989)

New Bedford is also the only major municipality in the Buzzards Bay area to discharge significant amounts of untreated combined sewage, industrial waste, and stormwater from combined sewer overflows (CSOs). CSOs are overflow pipes connected to combined stormwater and sewer systems. During periods of heavy rain, when the treatment plant or sewer lines have reached their capacity, the CSOs discharge a portion of the combined sewage and stormwater flow directly into surface water. In addition, many CSOs discharge continuously, even during dry weather, because of poor sewer system design or inadequate CSO maintenance. The inadequate capacity of the New Bedford treatment plant also contributes to the high volume of CSO discharges during wet weather. In all, New Bedford has 38 CSOs (Figure 6.3), 20 of which discharge a combined volume of 4 MGD continuously during dry weather. The remaining 18 CSOs are wet-weather discharges with variable volumes, depending on the amount of rainfall. The CSOs discharge into all coastal sections of New Bedford, including the Inner and Outer Harbor and Clark's Cove, and are the primary cause of the permanent shellfish closure in Clark's Cove. Some areas within the Inner Harbor have been closed to shellfishing since the 1920s due to bacterial contamination.

Together, the New Bedford Superfund site, the treatment plant, and the CSOs contribute the greatest amount of pollution into central Buzzards Bay, and are among the most costly and difficult problems to remediate. In addition to affecting the ecosystem and public health, they also have a large impact on the economy of the region. The hard-shell clam (quahog) is the most important mollusc in the Harbor because of its high economic value, with an estimated worth of 520,000 bushels (nearly $5 million) in the closed area alone. Closure of the lobster fishery has resulted in an estimated loss of $250,000 per year (CDM, 1989). The finfish industry and recreational fishing have been negatively affected as well. The pollution in New Bedford has also inhibited Harbor development, which often requires sediment removal, because of the high cost of disposing of sediments contaminated with PCBs and other toxics, and because of potential risks to human health due to exposure to toxic sediments.

Together with Boston Harbor, Buzzards Bay has the highest incidence in Massachusetts of two lobster diseases that are associated with pollution: black gill disease and shell disease (Estrella, 1987). Black gill disease occurs when pollutants or suspended particles are accumulated on gill filaments, causing a blackening of the gills, a reduction in the lobster's ability to exchange oxygen with the water, and lower resistance to secondary infection. Shell disease includes shell erosion, pitting and tunneling, and ulceration. In New Bedford Harbor, half of lobsters sampled showed evidence of both black gill disease and shell disease. The impact of these diseases on the Buzzards Bay lobster population is difficult to assess.

Ongoing Federal and State Actions

The problems described above have been recognized by federal and state agencies, particularly the U.S. Environmental Protection Agency (EPA) and the Department of Environmental Protection (DEP), for some time. In particular, the existing treatment plant and CSO discharges are in violation of the Federal Water Pollution Control Act of 1972 (also known as the Clean Water Act), and the City of New Bedford is currently under court order to correct these violations. The court order specifies that the city must plan, design and construct new treatment facilities according to a certain

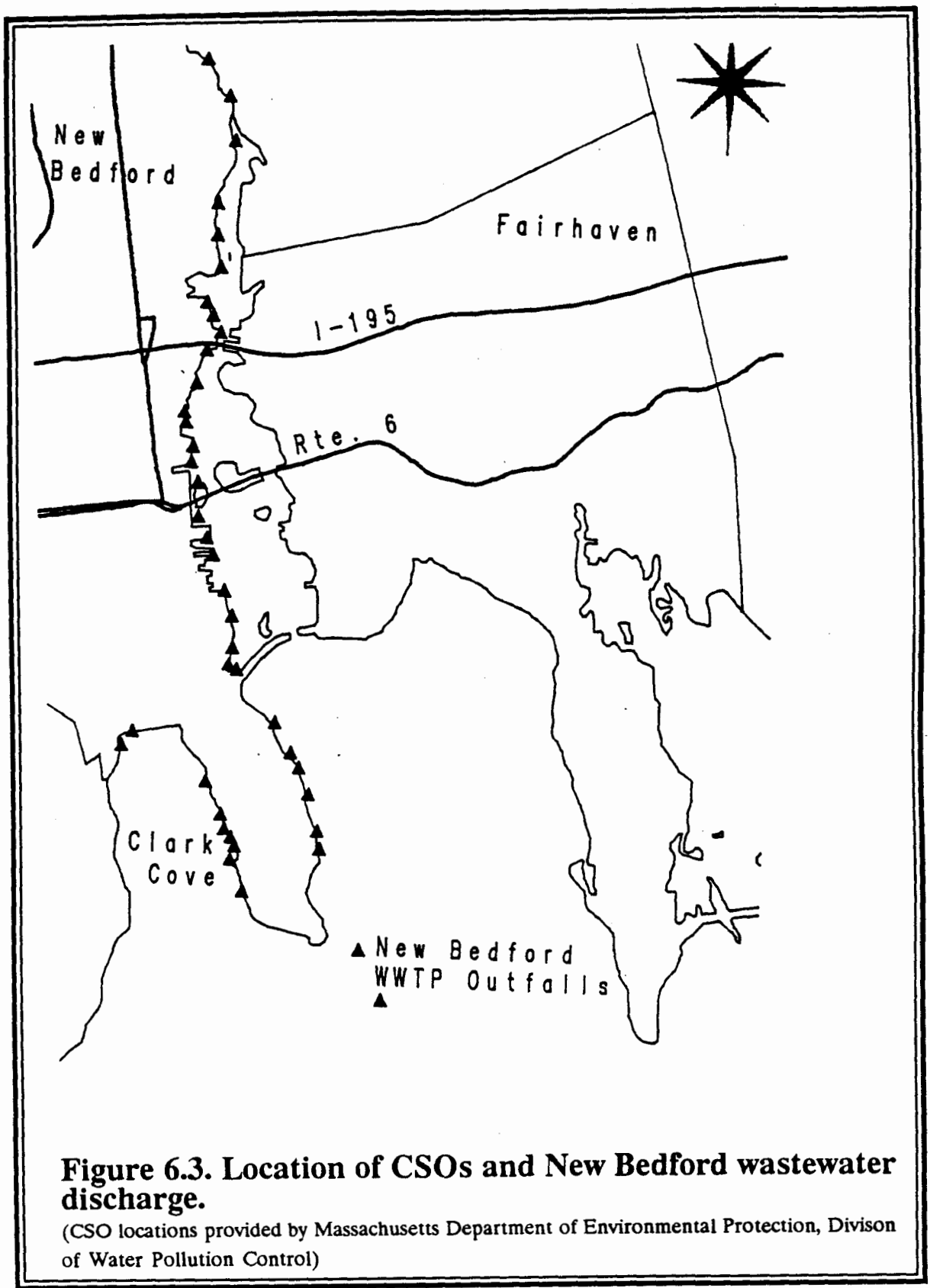


Figure 6.3. Location of CSOs and New Bedford wastewater discharge.

(CSO locations provided by Massachusetts Department of Environmental Protection, Divison of Water Pollution Control)

schedule. In addition, New Bedford, along with other potentially responsible parties, is the subject of an EPA Superfund enforcement action related to the PCB contamination of New Bedford Harbor. The enforcement action will require responsible parties to offset EPA's and the Commonwealth's expense in cleaning up the Harbor.

These problems are already being addressed through ongoing enforcement actions. The Buzzards Bay Project supports the goals of the enforcement actions, which are consistent with the goals of the Project. The remediation of the Superfund site, the upgrade of the treatment plant, and the mitigation of CSO problems are high priorities for water quality and habitat restoration around New Bedford, as well as for the protection of the Buzzards Bay ecosystem. What follows is a description of the issues surrounding each project and a discussion of how each project relates to other actions discussed in this Comprehensive Conservation and Management Program (CCMP). Goals, objectives, and recommended actions for these three issues are combined within this section.

The Superfund Project

PCBs, a family of synthetic chemicals used generally in electronic equipment, were employed in manufacturing processes in New Bedford from the 1930s until 1977, when EPA banned production of PCBs. The presence of PCBs in New Bedford Harbor and Buzzards Bay was first documented in 1974. Over the next several years, additional studies confirmed the extent of the contamination — sediment concentrations as high as 100,000 ppm were found. Concentrations of PCBs in excess of 50 ppm are considered hazardous wastes; hence, in July 1982, the upper Acushnet River was placed on EPA's Interim National Priorities List as a high priority for remediation under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), better known as Superfund, and the amendments of 1986 known as the Superfund Amendment and Reauthorization Act (SARA).

PCB contamination is not limited to the sediments of the Acushnet River and Inner Harbor; high levels of PCBs also are found in the Outer Harbor and Buzzards Bay (Figure 6.4). These sediments also contain elevated levels of other contaminants, e.g., petroleum hydrocarbons, PAHs, and trace metals, especially copper. Sediments along the New Bedford shoreline south of the Hurricane Barrier are also contaminated, with concentrations occasionally exceeding 50 ppm (Fig. 6.4). The water column in New Bedford Harbor contains PCBs in the parts-per-billion range, well in excess of EPA's guideline of 30 parts per trillion for protection of saltwater aquatic life from chronic toxic effects.

A significant issue surrounding the PCB contamination in New Bedford Harbor is its potential effects on human health. A probable route of PCBs into humans is by consumption of contaminated fish, lobsters, and shellfish, although contacts with water, sediments, and air are also possible pathways in selected areas and with particular age groups. Widespread contamination of the Acushnet River estuary and Inner Harbor has resulted in the accumulation of PCBs in many marine species. Although thousands of acres have been closed to the harvesting of shellfish, finfish, and lobsters, residents are known to harvest and eat all three groups, thus exposing themselves to potential health effects resulting from ingestion of PCBs. In addition,

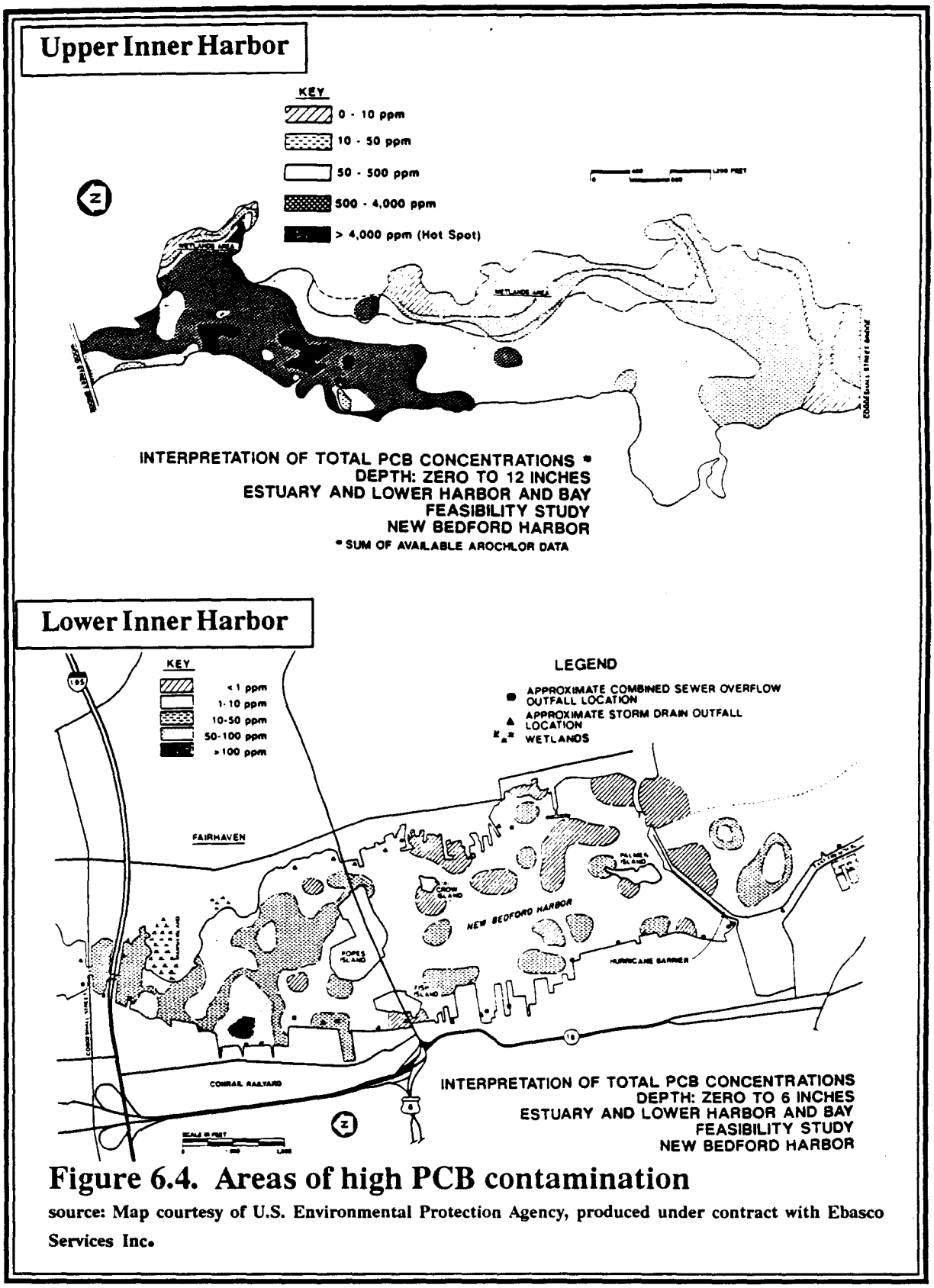


Figure 6.4. Areas of high PCB contamination

source: Map courtesy of U.S. Environmental Protection Agency, produced under contract with Ebasco Services Inc.

many individuals regularly consumed contaminated fish before the extent of contamination by PCBs was known. The long-term health effects on these individuals are not well understood. The Massachusetts Department of Public Health (1987) tested PCBs levels in blood serum of New Bedford residents and found that concentrations were within an acceptable range compared to the national population. Unfortunately, the experimental design did not include many seafood consumers and results were less than conclusive.

Another potential source of PCBs to consumers is consumption of shellfish that have been relayed out of PCB (and coliform) contaminated areas and then sold at market. Currently, there is an active shellfish relay program that takes quahogs from Clarks Cove and the Inner Harbor and relays them to "clean" areas on Cape Cod and Martha's Vineyard for at least the period of a spawning. These shellfish are tested for coliform bacteria and toxic chemicals including PCBs. Some scientists have contended that even after several months in clean areas, quahogs may still have elevated levels of contaminants like PAHs, which may represent a threat to consumers.

PCB contamination is also affecting the health of marine organisms themselves. Winter flounder from PCB-impacted areas near Clark's Cove showed higher larval mortality, smaller size at birth, and slower juvenile growth rates compared to winter flounder from cleaner areas (Black, 1987). Some have suggested that tumors in winter flounder from the New Bedford area are correlated with PCB levels (Stegeman, 1988). Even organisms at higher trophic levels are susceptible. Dead terns from Bird Island appear to have high PCB levels in nervous tissue (Blodgett, Massachusetts Division of Fish, Wildlife and Environmental Law Enforcement, personal communication).

Beyond carcinogenic risks assumed to be associated with PCBs, PCBs negatively impact nervous systems, reproduction, survival, and growth in vertebrates. These chronic effects are not easily assigned risk in our current governmental evaluation process (see PTI, 1987).

The cleanup operation has been divided into two phases. The first phase is the remediation of the hot spots where approximately 45% of the total amount of PCBs are present at sediment concentrations from 4000 ppm up to 100,000 ppm. It is currently proposed that these sediments be removed , treated, and incinerated on site. The second phase is the cleanup of the remainder of the Superfund site to some, as yet unagreed upon, level. Currently EPA proposes to dredge sediments above 50 ppm and to contain and cap these sediments within a portion of the harbor. Other affected areas may also be restored.

Unresolved issues still to be addressed include control of resuspension during any dredging or other sediment disturbance activities, determination of appropriate cleanup levels, and selection of optimal solutions for different areas being affected. A Citizens Advisory Committee and working committees composed of representatives from state and federal agencies meet regularly to review proposed solutions.

Determining responsibility for damages has resulted in litigation against potentially responsible parties. Recently, a settlement has been reached with three defendants. Some of the money from the settlements is earmarked for restoration. The Commonwealth of Massachusetts, as represented by the Secretary of Environmental

Affairs, the National Oceanic and Atmospheric Administration (NOAA), and the Department of Interior (DOI) has appointed trustees to oversee restoration activities.

The cost of cleanup ranges from $30 million for removal and incineration of PCBs in the hotspot and dredging and capping of sediments contaminated with more than 50 ppm to more than $300 million for a similar treatment strategy down to 1 ppm.

Upgrading the New Bedford Wastewater Treatment Plant

The Clean Water Act requires that all publicly owned sewage treatment facilities provide at least secondary treatment (that is, treatment to remove 85% of the suspended solids and organic matter). The New Bedford municipal treatment plant is the only facility discharging to Buzzards Bay that does not currently meet the secondary standard. The present level of primary treatment at the New Bedford facility consists of settling the solids out of the wastewater and adding chlorine to reduce the number of harmful bacteria and other pathogens in the effluent. Primary treatment removes only approximately 30-40% of suspended solids and organic matter. Furthermore, because of poor design and maintenance, this treatment plant sometimes fails to reach this level of treatment for the 30 million gallons of effluent discharged daily.[2] This level of treatment is a problem, not only because of the large amounts of nitrogen and pathogens discharged to Buzzards Bay, but because the wastewater handled by this system includes approximately 6 MGD of industrial wastewater bearing toxic contaminants.

In 1987, EPA, DEP and the Conservation Law Foundation (a nonprofit environmental advocacy group) sued the City of New Bedford for failure to meet the secondary treatment requirement of the federal and state Clean Water Acts. Under the suit, a consent decree was rendered requiring the city to plan, design, and build a new secondary treatment plant and to strengthen its program for minimizing industrial discharges into the sewer system. New Bedford has nearly completed the planning phase of the project, and has selected sites and technologies for the new secondary plant, the effluent outfall, and the sludge processing and disposal facilities.

Several issues are currently being debated in New Bedford. For example, residents of the neighborhoods surrounding the proposed plant site have criticized the city's decision, citing concerns over construction noise, odors, aesthetic impacts, and potential decreases in property value. The siting process is still the subject of ongoing state and federal reviews. The Buzzards Bay Project supports the selection of a workable and acceptable treatment plant site as expeditiously as possible, so that the city's can begin to construct a secondary treatment facility as soon as possible.

The site for the outfall is another issue being debated as part of the facilities planning process. There are convincing arguments both for moving the outfall further out into

[2] Mean dry weather flow is 24 MGD; 30 MGD is based on annual discharge including stormwater.

Buzzards Bay (the 301h site) and for keeping it at its current location. The cost of moving the outfall to the 301h site may add approximately $74 million to the cost of the new sewage treatment facility,[3] whereas keeping it at its current site may run from $10 to $50 million depending upon technologies used. A driving force in the decision is whether water quality standards for both dissolved oxygen and selected metals can be met at the current site. The Executive Office of Environmental Affairs Technical Advisory Group (TAG) and scientists from the Buzzards Bay region reviewed the relevant data (including studies supported by the Buzzards Bay Project and conducted by A. Giblin of the Marine Biological Laboratory [unpublished data] and R. Geyer of the Woods Hole Oceanographic Institution [Geyer, 1989]), particularly the dissolved oxygen predictions based on nutrient loading. The TAG recommended that additional dissolved oxygen data be collected to make an informed decision. New Bedford will soon begin a study to gather the water quality data necessary to select the outfall site.

Perhaps the largest issue surrounding the new treatment facilities is funding. The current estimated construction costs for the new plant, sludge facilities, and outfall range from $187 million to as high as $300 million, depending on design criteria and outfall location. Should the city be unable to secure state or federal funds for this project, financing the facility could become a huge financial burden for New Bedford and its residents. The Buzzards Bay Project supports the Mayor of New Bedford's current efforts to secure outside funding. Possible funding mechanisms under consideration by New Bedford include no-interest or low-interest loans through the State Revolving Fund, increased user fees, and taxes. Moreover, the Project encourages the city in its efforts to implement water conservation measures and to reduce toxic inputs to the wastewater system through pretreatment and source reduction. Aggressive programs in these areas would both reduce pollution loadings to Buzzards Bay and help cut costs.

The Action Plan Managing Sewage Treatment Facilities, contains recommendations applicable to the New Bedford Facility.

Controlling New Bedford Combined Sewer Overflows

As part of the consent decree discussed above, the City of New Bedford is required to construct and implement measures to control CSO discharges, which are one of the largest sources of pathogens to Buzzards Bay and the primary cause of shellfish and swimming beach closures around New Bedford. Although detailed plans have yet to be worked out, the city has focused on offering the most immediate and highest degree of protection to locations with sensitive uses such as swimming and shellfish harvesting. Priorities for upgrading CSOs are to eliminate all dry-weather overflows and to phase efforts to obtain maximum tangible benefits first. Once the dry-weather overflows, which still discharge raw untreated sewage into the Harbor and vicinity, are remediated,

3 The total cost of the New Bedford Sewage Treatment facility is projected to be $185,000,000 to $300,000,000. The cost to eliminate or repair the CSOs tied into the system will be an additional $50,000,000 to $75,000,000.

then Clark's Cove and other highly ranked areas could be restored by eliminating all CSO discharges.

In particular, the city has identified Clark's Cove as a high priority, because controlling the CSOs here should allow the reopening of very productive shellfish beds and afford protection for beaches. Conversely, the Inner Harbor has been identified as a lower priority because, even if CSOs were controlled, the existing contaminants in the sediments would continue to impact future uses in this location. The Outer Harbor has been judged to be a middle priority because the potential benefits of CSO controls would be offset by impacts from stormwater discharges from Fairhaven, which are estimated to have a significant impact on resource areas in the Outer Harbor. Regardless of timing, however, under the consent decree, all CSO discharges must eventually be controlled to the point at which they do not have a negative effect on water quality and marine resources.

The major issues surrounding CSO control concern schedule and cost. In particular, the relative priority of constructing CSO controls versus constructing the new treatment plant, sludge facilities, or outfall has yet to be negotiated between the city and the parties to the lawsuit. The timing of these projects is also inextricably connected to the cost to the city for these construction projects. Again, the Buzzards Bay Project supports New Bedford's efforts to gain federal or state funding so that these projects may be completed as soon as possible.

Large projects like the New Bedford Superfund Project and the CSO and sewage treatment facilities upgrades require close cooperation and coordination among many agencies and groups. Even though the same agencies at the state and federal level are responsible for oversight of both the cleanup of the Superfund site and the upgrade of the treatment facility, conflicts have occurred, and coordination between the agencies' divisions and branches could be improved. Because of the integrated approach of this CCMP, the Buzzards Bay Project will support ongoing efforts and facilitate communication between and among agencies.

Goal

Support the ongoing projects designed to remediate pollution in New Bedford Harbor and to restore habitats and use to the greatest extent possible.

Recommended Actions

Superfund Cleanup and Restoration

1. EPA and DEP should continue to move forward on adoption and implementation of a remediation plan.

Because EPA and DEP are lead agencies, they assume overall responsibility for the cleanup. In addition to human health risks, ecosystem risk should be taken into account in determining the level of PCB cleanup in sediments.

2. Trustees (EOEA, DOI, and NOAA) should oversee development and implementation of a restoration plan that benefits those who have been most affected by lost use of the resource.

The Trustees are responsible for developing and implementing a restoration plan that provides the greatest benefit to the ecosystem and those who have suffered lost use as a result of contamination.

Treatment Facility and CSO Recommendations

1. The City of New Bedford should continue to meet deadlines for the planning efforts (as outlined in its draft Facilities Plan) to upgrade its treatment facility to secondary treatment.

The City of New Bedford is preparing a Final Facilities Plan which will incorporate comments from state and federal agencies and the general public. The Facilities Plan includes all the technical and design details, requirements and schedules related to constructing and operating the plant. Siting the treatment facility and outfall and securing finances to proceed with construction are major issues to be resolved.

2. The City of New Bedford, with DEP and EPA, should carefully coordinate CSO and sewage treatment facility upgrades so that benefits from CSO remediation can be realized as soon as possible.

3. The City of New Bedford should implement approved plans for CSO upgrades.

The city has prepared a draft Environmental Impact Report recommending that dry-weather discharges be eliminated first. Clark's Cove and other areas that have beach and shellfish closures due to CSOs are also high on the priority list.

Target dates: Ongoing, with project-specific times according to the various plans.

Chapter 7

Land-Use Management

Land Use in Buzzards Bay

The Buzzards Bay ecosystem is basically healthy. With the exception of waters around New Bedford, the water quality and living marine resources in the Bay have not yet experienced the degree of stress associated with other coastal areas such as Chesapeake Bay, Narragansett Bay, and Long Island Sound. However, the ability of the Buzzards Bay environment to sustain its many beneficial uses is being threatened as growth in the area continues to accelerate.

Population in the Buzzards Bay drainage area increased nearly 49% between 1950 and 1986 and is still growing rapidly. Between the years 1970 and 1995, population in the Buzzards Bay watershed is expected to increase 31%, based upon population projections from the Massachusetts Institute for Social and Economic Research (1988). This population increase reflects the development of land programmed for subdivision by the Buzzards Bay communities through their zoning bylaws. Expansion of the second-home market and the increasing willingness of home buyers to pay inflated prices to live near the coast are creating economic pressure to convert rural or agricultural land to residential development. In addition, seasonal seaside homes are now commonly converted to year-round residences. These trends are demonstrated in the Buzzards Bay drainage basin by the 100% increase in residential land use between 1951 and 1985. Most of this development has occurred in low and medium density areas, indicating a move towards suburban sprawl and away from more established urban centers.

These recently developed areas are contributing new pollutant loads to the Buzzards Bay ecosystem. These loads are the result of increased runoff from roads and lawns and increased volumes of sewage from residences and commercial establishments. Imprudent development will ultimately impact coastal ecosystems by providing pollutants such as bacteria, viruses, heavy metals, hydrocarbons, and nutrients with pathways to the Bay. The Alliance for the Chesapeake Bay (1989), in its white paper on growth management, reinforces the need for greater control and states that growth management may become the watchword of the '90s. The Alliance further indicates that managing growth is essential to protecting natural resources and that regulations, financial resources, and pollution-control devices are of limited value.

The action plans presented in the previous chapters addressed specific types of pollution sources or sensitive habitats and made specific recommendations for reducing pollutant loads and protecting areas of special concern. The individual action plan recommendations alone are not sufficiently protective; inherent in each set of recommendations is an understanding that a holistic approach to water quality protection is needed. The cornerstone of such an approach is land-use planning for growth management.

Developing a Local Land-Use Plan

The underlying assumption of growth management is that there are limits to the amount of unmanaged growth that an area can withstand without serious harm to public health, safety, or the environment. Environmental systems, and specifically coastal embayments, reach limits at which they can no longer absorb the impacts from additional development without degradation or impairment of uses. Of specific concern in Buzzards Bay are the localized embayments where the greatest amount of human activity (swimming, fishing, boating) takes place. Aggressive land-use management and planning can ensure that the water quality of an embayment is protected, particularly when drainage basins contain appreciable amounts of developable land.

A key component of local land-use planning is the identification of critical areas for protection. Escalating growth patterns place stress on these critical resource areas,and the stress is often proportional to growth. Identification of these areas will provide communities with a planning tool to begin answering questions of where to allow development, how much of it can occur, and how best to regulate potentially detrimental future land uses.

Land use can contribute all major classes of pollutants to coastal waters, i.e., pathogens, nutrients, and toxic materials. These pollutants may enter coastal waters either via groundwater or surface flows. The relative contribution of pollutants from land use depends upon the pollutant and may depend upon the distance from shore. For example, coliforms and pathogens enter the coastal environment mostly through direct surface flow from streams, stormwater discharge, and overland flow, as well as from groundwater draining from septic systems within 300 feet (91 m) of shore or streams. The area of contribution of coliforms and pathogens is relatively small and generally close to shore or close to streams, and generally has a short travel time to the receiving waters. These inputs contribute to the closure of shellfish beds and swimming areas and represent a human health risk. In contrast to pathogen inputs, nitrogen — the nutrient of most concern in coastal waters — is contributed from the entire drainage basin surrounding a coastal body of water. This is particularly true for nitrogen inputs from septic systems, because nitrates travel great distances in groundwater without attenuation. Because some drainage basins are large, nitrogen sources many miles away from shore will eventually reach the coast. Inputs of toxic compounds, like pathogens inputs, are often associated with stormwater runoff, particularly from paved surfaces, but may also originate from landfills, pesticide applications, and septic disposal of household hazardous wastes. Zones of pollution contribution can be delineated from maps of storm drainage systems, topographic, and groundwater height.

In addition, as discussed in the action plan on protecting wetlands and marine habitat (which play an important role in flood control and provide special habitat for many species of plants and wildlife), shoreline areas potentially susceptible to erosion or sea-level rise, shellfish beds, bathing beaches, freshwater ponds, drinking water supplies, and flood plains also warrant special attention.

In addition to critical areas, potential buffer zones may also be identified. Buffer zones can be used either to protect certain land uses or to protect certain resources. For

example, a municipality may want to identify a buffer zone around a coastal residential area to provide adequate protection in the event of storms or coastal erosion. A buffer zone limiting development and potential coliform pollution could be established near important coastal shellfish beds.

One tool for identifying potential development scenarios for a town is a parcel-by-parcel analysis. On the basis of zoning within the study area, these analyses quantify nitrogen inputs from existing development as residences, industries, open space, as well as from potential development after full built-out. The number of existing units can easily be determined from assessors' maps and tax data. Potential development is assessed based on existing zoning and subdivision rules and regulations. The results of a typical developable-lot analysis are illustrated in Figure 7.1. This type of analysis can be used to predict future problems and may be used to estimate nitrogen inputs from the watershed.

Cranberry farmers have been an important part of the landscape in Southeastern Massachusetts and Cape Cod for well over one hundred years. While visitors and neighbors enjoy the view of the bogs, they rarely have an opportunity to see the adjoining ponds, wetlands and woodlands that comprise the cranberry bog system. This unique environment plays an increasingly important role in the preservation of open space, water storage and conservation, groundwater recharge and in providing wildlife habitat.

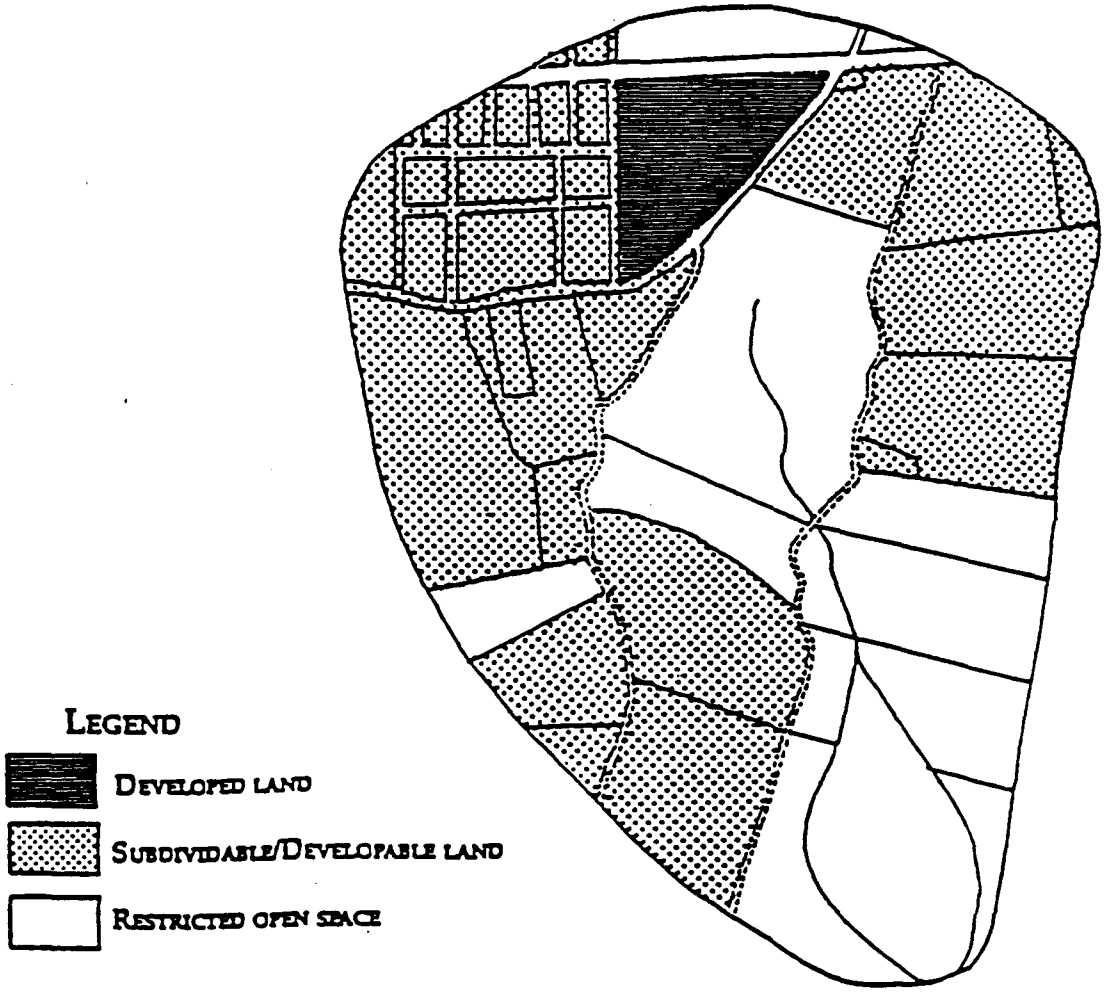
Although, 12,700 acres are in actual production, cranberry growers own and manage nearly 62,000 acres of ponds, bogs, wetlands and upland forest. As the region becomes more developed, this land takes on more and more importance.

Implementing a Local Land-Use Plan

The validity of local government regulation is predicated on the broad concept of police power: the power of government to regulate for the advancement and protection of the health, safety, and welfare of the inhabitants of the community. In the Buzzards Bay area, this broad authority has been typically exercised through zoning techniques such as dimensional requirements including lot size, setbacks, and lot coverage. A handful of communities have expanded their zoning regulations to focus on the protection of water quality, and a smaller number have given the protection of Buzzards Bay water quality a high priority in their zoning codes and subdivision and health rules. The following regulatory and nonregulatory techniques represent a sampling of those methods that Bay communities could adopt to provide added protection from the pressures of growth and development.

Zoning Bylaws and Ordinances

Zoning in Massachusetts is governed by the Massachusetts General Laws, Chapter 40A (Zoning Act), which sets out the authorities and limits each municipality has in determining zoning districts. Zoning can be a powerful tool for water quality protection when used in conjunction with a carrying-capacity/buildout analysis.



CATEGORY	ACRES	UNITS
Developed land	31	95
Subdividable/Developable Land	337	219
Restricted Open Space	243	
Total	611	314

Figure 7.1. Developable-lot analysis of an estuary recharge area

Buildout Analysis in Falmouth

Description

Falmouth was the first town in Buzzards Bay to complete a buildout analysis. The assessment was conducted in 1984, at a time when the town was experiencing steady growth and the year-round population was approximately 20,000. Town residents knew that the town was growing rapidly and might develop problems in the future, but the results of the buildout analysis were sobering. They indicated that, based on allowable growth under existing zoning regulations, the population of Falmouth could more than triple, to an ultimate population of 68,000 people. With this information, town leaders can make better informed decisions to limit or control growth and its impacts on the environment.

Use

One result of the buildout study in Falmouth was the establishment of a nutrient-loading program (the portion of that program that covers nitrogen loading to coastal ponds inspired the nitrogen-sensitive-embayment concept developed by the Buzzards Bay Project). Because the program uses a mass loading formula that is principally based upon population increase, it is one of the best land-use management tools available in coastal areas. Falmouth's program goes beyond federal and state laws and increases the opportunity to protect sensitive coastal areas from the cumulative impacts of growth.

Operation of Coastal Pond Nutrient-Loading Bylaws

Developers proposing projects within the drainage basins of Falmouth's coastal ponds must determine the probable impact of the proposed development (in addition to already developed properties) on the receiving waters. To ensure that all developments are treated equally, the town has set standards for calculating the level of nitrogen loading. The developer must implement mitigating measures to reduce the nitrogen output generated by the development if analysis indicates it will cause the receiving waters to exceed their critical concentrations.

Outcome

The greatest advantage of this program is that it allows the town's regulatory boards to identify areas in which the density allowed under zoning is inappropriate. The program has also established a means by which the town can determine the developments that will contribute more than their "fair share" of nitrogen. This enables the town to objectively and equitably scale down the density. The program is designed so that the private sector shoulders the major implementation costs. The town is not forced to conduct exhaustive townwide land-use studies to allocate and regulate growth. Instead, the program is triggered on a project-by-project basis, and the developers are responsible for determining the impact of additional development. The Project is recommending a slightly different approach to address the nitrogen-pollution problem as outlined in the Managing Nitrogen-Sensitive Embayments Action Plan.

Overlay Ground/Surface Water Protection Districts

An overlay ground or surface water protection district protects resources through regulatory restrictions on activities in a drainage basin or other important land areas. These ordinances and bylaws, while varying in their approach toward resource protection (i.e., prohibition of various uses versus special permitting and/or performance criteria), are similar in their goals of defining a resource by mapping boundaries and enacting specific legislation for land uses and development within these boundaries. Whenever possible, stormwater should be contained and treated on site.

Performance Standards

Performance standards are based on the assumption that any given resource has a critical limit (carrying capacity) beyond which the resource deteriorates to unacceptable levels. Performance controls assume that most uses are allowable within a designated area, provided that the use or uses will not overload natural or man-made resources. To apply this concept to Buzzards Bay, the critical limits of nitrogen-sensitive embayments must be determined. Once determined, each development project within the drainage basin would be allowed to contribute a defined percentage of nitrogen, relative to the capacity of the embayment.

This approach may provide the only comprehensive mechanism for equitably protecting Buzzards Bay from increasing additions of nitrogen. The Bay's ability to assimilate nitrogen is limited, but establishing a program that is based upon performance regulations is an exciting and imaginative mechanism for ensuring the Bay's long-term viability.

Surface Water Buffer

Stormwater runoff is a major component of nonpoint-source pollution in surface water and contains pathogens, nutrients, and contaminants associated with road runoff. Studies have shown that undisturbed lands are generally more permeable and, as a result, allow higher levels of stormwater percolation and natural treatment of associated contaminants. Municipalities can require that undisturbed vegetative upland buffers be left adjacent to and within a defined buffer area (e.g., 100 ft) of surface waters in order to promote natural stormwater treatment.

Cluster Design

Cluster zoning is an alternative to the standard grid-style subdivision. In a cluster development, smaller building lots are allowed, with resulting land savings set aside in contiguous areas of open space. Clustering can be done at the same density that could be obtained in a grid system or with greater density "bonuses." Typically, cluster development allows shorter streets, reducing construction and maintenance costs. It provides tremendous flexibility for both the developer and municipality, and often allows for greater creativity in the division of large land parcels. Among other benefits, large open spaces may serve as buffers.

Subdivision Control

Subdivision regulations, as described in Massachusetts General Laws Chapter 41 (the "Subdivision Control Law"), differ from zoning bylaws in that they focus less on land

use and more on engineering concerns such as street construction (grade, width, intersection angles), utility placement, and traffic patterns of individual subdivisions. Protecting water resources via subdivision control is, therefore, far less effective than through zoning, particularly because the expressed intent of the Subdivision Control Law is to have planning boards approve plans that meet a community's subdivision rules and regulations. This strategy should not be overlooked, however, as a tool for environmental protection.

Drainage Requirements

Runoff from roads and lawns within subdivisions contributes significant amounts of contaminants to the coastal ecosystem. As part of the subdivision review process, planning boards have the opportunity to protect coastal water quality through the use of strong drainage-control requirements. Criteria for type of catch basins to be used, requirement for maintenance of catch basins, and limitations on lawn-fertilizer applications are examples of drainage standards that planning boards can employ when reviewing subdivision plans. Many communities have developed strong drainage requirements through their subdivision rules and regulations, but the better ones develop standards that are geared directly toward water resource protection. Whenever possible, stormwater should be contained and treated onsite.

Performance Standards

Like drainage requirements, performance standards should be enacted at the subdivision review stage. It is possible, for example, to determine the water quality impact of a 20-lot subdivision, calculating the nitrogen contribution from road and lawn runoff and septic systems. Planning boards can use this information to regulate subdivisions by limiting development so that water quality will not be compromised.

Board of Health Review

Section 81-U of the Subdivision Control Law requires that boards of health review all subdivision plans to ensure that they do not pose any public health concerns. When used appropriately, board of health review under Section 81-U can ensure that threats to water quality are minimized. Planning boards are constrained from approving subdivision plans that the board of health stipulates are not suitable for construction due to public health issues. This review authority vests considerable power in the board of health, but also has the effect of encouraging planning boards to work cooperatively with local health boards to ensure adequate protection of public health.

Board of Health Regulations

The development of health regulations, as provided for in Massachusetts General Laws, Chapter 111, can be an extremely effective method of land-use management. Although zoning bylaws and subdivision rules and regulations have limited ability to protect water resources, regulations adopted by boards of health can be powerful protective mechanisms. This is due in part to the fact that health regulations can be adopted very quickly, only requiring a majority vote of the board of health.

Because of the extensive protection afforded to land owners through zoning, many communities have opted for regulatory programs administered by boards of health. The urgency of adopting growth controls and the impressive powers that boards of

health possess make these boards probably the most effective local institution upon which to base a strategy for land-use management. The courts have consistently upheld these powers when they have been challenged, as long as the process is well conceived, is logical in its approach, and does not totally deny the use of property. Several examples of effective board of health regulations are discussed below.

Dennis

State law currently governs the siting and operation of septic systems, requiring setbacks from environmentally sensitive areas. Concerned about the rising number of variances being granted from these regulations, the Dennis Board of Health has defined environmentally sensitive areas to include

- Land area (whether developed or not) that borders on and is within 100 ft of marshlands, tidal flats, coastal dunes, barrier beaches, coastal banks, coastal beaches and surface water
- Land area containing subsurface water that is 6 ft or less below natural ground surface elevation
- Existing or known future water supplies
- Terrestrial and/or threatened or endangered species.

Variances from septic system regulations are granted by the Dennis Board of Health in environmentally sensitive areas only under exceptional circumstances.

Brewster

Brewster requires a water quality report to be submitted to the board of health for all developments that will discharge greater than 2000 GPD of wastewater. This regulation attempts to address large projects with heavy wastewater discharge flows that will not meet the state review threshold of greater than 15,000 GPD. Proposed projects with a density of less than one unit per 2 acres are exempt.

Information submitted to the Brewster Board of Health must demonstrate that no significant impact to water resources will occur as a result of the project. Also, it must be demonstrated that the nutrient contribution of the proposed project, when added to the existing and potential nutrient level of other developments and acreage within the specific recharge or drainage area, will not result in nutrient levels that exceed the receiving water's critical eutrophic level.

Variances may be granted by the board of health, but the applicant must prove that sewage disposal will not adversely affect, among other uses, any shellfish or recreational waters. The information required is extensive and amounts to a local environmental impact report.

Bourne

The Bourne Board of Health prohibits the construction of septic systems in areas of shifting sands (coastal beaches, coastal dunes, barrier beaches, coastal banks). This is to prevent systems from being torn loose during storms and becoming health and safety hazards. In addition, in an attempt to discourage septic systems highly "mounded" above natural ground level in coastal areas, the board of health requires greater than 6 ft of separation between the original ground elevation and groundwater.

A duplicate regulation administered by the Sandwich Board of Health was recently challenged in court. The Superior Court of Barnstable found that the restrictions are a valid exercise of the town's police power to prevent the use of property in a manner that is detrimental to the public's interest. The court also found that the regulations were promulgated in response to identifiable local concerns regarding (1) the installation of septic systems as affecting the public health, and (2) maintenance and preservation of coastal areas.

Nonregulatory Techniques

Most municipalities have relied upon the aforementioned "traditional" regulatory tools to protect water quality: zoning, subdivision, and health regulations. Although these regulatory tools serve a legitimate purpose, over-reliance upon them merely programs a municipality for development and allows little flexibility for change if the original program was inaccurate, or if better information has been made available since the program was devised.

Many communities in Massachusetts, including several in Buzzards Bay, have taken advantage of nonregulatory options for resource protection. Nonregulatory water resource programs include donations of land, sale of lands, tax deferments, and conservation easements.

(The Buzzards Bay Project contracted with The Compact of Cape Cod Conservation Trusts to produce two guidance documents on non-regulatory techniques: "Non-Regulatory Methods of Wetlands Protection" and "Strategy for a Town Conservation Restriction Program". These valuable documents are available through the Buzzards Bay Project.)

Donations of Land

Landowners can donate a piece of land (as part of a development project or an entire developable parcel) either to the community or a nonprofit land-holding organization. Donating the land for preservation is advantageous to land owners because of a variety of tax savings. Donations eliminate estate or capital gains taxes and avoid real-estate taxes, insurance, and maintenance costs. The entire value of the donation can be deducted, over time, from federal income tax obligations.

Purchase of Land

Many communities are committed to the acquisition of selected parcels of land deemed so significant to the town's future that it may be willing to purchase them outright at market prices. These acquisition priorities include large tracts of undeveloped land, land within defined water resource areas, land containing unique or rare and endangered wildlife, and land with unique ecological character. There are four variations:

- Sale at fair market value: Sale at the price a buyer is willing to pay a seller to purchase a piece of property.
- Bargain sale: The sale of property below fair market value to a conservation organization or municipality. The difference between fair market value and the reduced price may qualify as a charitable deduction from income taxes.

- Installment sale: Sale that allows the seller to spread the income from the sale of property over several years, thus deferring and, in some cases, reducing income taxes. This allows the buyer greater flexibility in raising funds for acquisition.
- Sale with a reserved life estate: The transfer of property upon the death of the individual land owner. This option allows landowners to sell or donate now, but continue to use the property during their lifetimes or the lifetimes of other members of their immediate families. This allows use of tax benefits now and avoids inheritance tax requirements that can lead to the sale of property later.

Tax Deferments

One factor that often pressures individuals into selling their land is the property tax, because it taxes land based on the market price for development, regardless of the land's present use. All New England states currently provide for some degree of reduction in real-estate tax for lands used for conservation. In Massachusetts, open space for forest, agricultural, or recreational uses can receive from 75% to 90% reduction in real-estate taxes. Inheritance tax generally is 50% of value. In land-rich, cash-poor situations, this can lead to the need to sell property at the highest value to settle an estate.

Conservation Easements

An easement is a limited right to use or restrict land owned by someone else. Easements are either positive (rights-of-way) or negative (conservation, scenic) and may take a variety of forms. Negative easements can effectively assist a community in protecting land from development by restricting all or a portion of the property to open-space or limited development uses. The granting of a conservation easement does not involve the transfer of ownership of the land; instead it means giving up certain development rights of the property. For example, a conservation restriction may limit the number of houses to be built upon a parcel, restrict development to specified types, or specify that portions of the parcel within sensitive areas will remain undeveloped in perpetuity.

Conservation Commission Policies

Local conservation commissions, in their role of implementing the Wetlands Protection Act, have significant land-use responsibility. For example, they have the authority to protect critical wetland areas through local initiatives that assert their jurisdiction within the 100-ft buffer zone around wetlands. Conservation commissions can protect sensitive coastal wetlands by requiring strict standards within buffer areas. A buffer zone is extremely important for the protection of both wetland functions and wildlife habitat.

Neither state nor federal government has a setback requirement in its wetland regulations, but towns are permitted to adopt construction setbacks from wetlands. Some towns have adopted wetland setbacks of 25-50 ft and, in the case of Areas of Critical Environmental Concern, 100 ft. Others, such as Falmouth, have adopted regulations requiring new construction to provide at least 25 ft of vegetated buffer to the wetland. Most towns on Buzzards Bay do not, however, have standard wetland setbacks and thus must negotiate buffer belts on a case-by-case basis. The drawback to this ad hoc approach is that negotiations begin from the wetlands edge rather than some distance away.

State and Regional Involvement

Although it is important for local boards to adopt regulatory programs individually, it is also important that they attain a consistent level of effectiveness collectively. Such a collective approach is the only way to ensure that a resource the size and complexity of Buzzards Bay is adequately protected. In addition, collective decision-making criteria or processes can help each individual town defend its decisions and can guarantee that fair and equitable decisions are made. This is especially important when several towns contribute to the same watershed or abut a particular sensitive area. For these reasons, state and regional involvement in the planning process is desirable.

Realizing that growth and land-use management were becoming central issues to many communities in Massachusetts, the state legislature recently established a Special Commission on Growth and Change. This Commission made two major recommendations:

- Adoption of a comprehensive planning process, including the creation of state policies and regional and local plans to guide development
- Creation of new tools to empower communities to work together to plan for growth and to protect shared resources.

However, many communities have found that even when they try to take a proactive approach to land-use management, they are thwarted by a state zoning statute that effectively ties their hands. Massachusetts General Laws, Chapter 40A (Zoning Act) and Chapter 41 (Subdivision Control Law) clearly illustrate that once a town establishes its blueprint for the future through zoning and subdivision, development will occur according to that blueprint. The town must adhere to its program by granting subdivision approval and ultimately issuing building permits for residential and commercial construction. Massachusetts statutes do not currently contain a requirement for planning prior to zoning, and as a result, many communities have found that their programs call for land development that exceeds the carrying capacity of their natural resources. Once this process gets to the permit stage, there is very little that can be done to avoid unwanted development. Unfortunately, it is often at this point that a town first realizes that it has "over-zoned" a specific area and fears the effects on sensitive coastal ecosystems.

The Massachusetts Zoning Act makes it very difficult for a community to protect sensitive areas once they have been programmed incorrectly. A change by a town to more restrictive or large-lot zoning will have no effect on any subdivision plans that have been submitted under previous zoning unless actual construction does not occur within eight years. This extensive "grandfathering" provision is the major roadblock in seeking to protect sensitive areas once they have been inappropriately zoned.

This problem has become especially severe on Cape Cod as the population density around drinking water supplies, inland ponds, and coastal embayments continues to rise. The situation has led to the passage of special legislation that establishes a regional land-use agency with the authority to supersede key provisions of Chapter 40A, most notably the grandfathering provision. This regional concept is also effective in protecting resources like Buzzards Bay that extend beyond the corporate limits of a single town, and in regulating large development projects that will impact a regional

or multi-town area. Martha's Vineyard is the only other location in Massachusetts that has a regional land-use authority.

The State Special Commission on Growth strongly supports the creation of regional entities such as those on Martha's Vineyard and Cape Cod. The Special Commission recommends changing the state zoning law in ways that may impact the grandfathering provision.

State Implementation

Aside from planning and zoning, the state has regulatory tools that can be used to address land-use management through water quality protection. Two such tools are the "antidegradation" provisions of the state water quality standards and the review process required by the Massachusetts Environmental Policy Act (MEPA). Antidegradation provides that water quality cannot be degraded in a way that would eliminate any existing uses of the water body. It also provides special levels of protection for waters classified as high quality or outstanding resource waters. MEPA requires the state Executive Office of Environmental Affairs to review the potential environmental impacts of all activities conducted, funded, or permitted by the state. In particular, MEPA requires an analysis of the potential cumulative (or collective) impacts of a proposed project and a special level of state review for Areas of Critical Environmental Concern (ACECs), which are designated by the Secretary of Environmental Affairs.

Together, these two provisions could be effectively used as tools for land-use management. For example, any development project needing a state permit (e.g., for a wastewater discharge) could be required under MEPA to conduct a cumulative analysis of the impact of nitrogen in its discharge, combined with existing nitrogen inputs, to a receiving embayment. Any increase in nitrogen over the carrying capacity of that embayment could be considered a degradation of an existing use (e.g., that use of the embayment by eelgrass habitat would be lost due to excessive nitrogen loading) and therefore not permittable under the state water quality standards.

Also, the ACEC designation could be used to provide an extra level of review and protection for nitrogen-sensitive embayments. ACECs may be nominated for selection at the municipal level and, in the past, designation has been most effective when an activity required a specific state regulatory review. The cumulative impacts from growth in ACECs have not been adequately addressed by local government, and management of resources within and adjacent to the boundary areas has not occurred. Moreover, because of the optional nature of the program, only two areas, both in Bourne, have been designated in Buzzards Bay. A more aggressive approach for protecting ACECs could be taken by the state.

Goal

To manage and direct growth so that critical resource areas are protected from cumulative impacts.

Recommended Actions

Local Actions

1. Each town in the Buzzards Bay area should conduct a buildout analysis to determine its maximum potential use under current zoning and subdivision bylaws.

The results of a buildout analysis will allow land-use plans to be developed as a first step in implementing a program. This may ensure the protection of critical resource areas.

2. Each town in Buzzards Bay should adopt a strategy of using existing rules and regulations and provide for project oversight or tracking.

Under the current management framework the most effective approach to land-use management combines adoption of compatible zoning bylaws, subdivision rules, health regulations and nonregulatory techniques. This strategy provides a comprehensive approach that takes effect at all levels of land permitting and development.

3. Towns should be aggressive in using the full authority of their local boards to carefully regulate land-use activities so that the most valuable and sensitive areas receive full protection.

Boards of health, in particular, have extensive powers and authority to expand their historic role of protecting public health to protecting public health and the environment. Under current legislation, boards of health are probably best suited to protect critical resource areas from the cumulative effects of growth and development, although planning boards and conservation commissions have authority to implement regulations protective of natural resources.

4. Towns should preserve and enhance the viability of existing cranberry bogs through appropriate land use management regulations.

Cranberry and surrounding uplands, when properly managed, have less impact on the environment than the same land used for residential or commercial development and for these reasons, should be preserved.

5. Towns should establish buffer zones around cranberry bogs through the use of cluster zoning or other appropriate land use techniques. Residential structures should not be constructed within 200 feet of a bog.

This would create a buffer zone to protect cranberry bogs from the adverse effects of development and also protect the public from exposure to pesticide applications on bogs.

Regional Actions

1. Regional planning agencies (RPAs) should provide technical assistance to communities in conducting buildout analyses and planning for land-use management.

RPAs should encourage the creation of management plans for areas that extend beyond community boundaries. They should also work with all communities around Buzzards Bay and provide effective management tools for regulating land-use activities. Performance standards, such as nitrogen-loading bylaws, are particularly valuable.

2. RPAs should be aggressive in protecting critical resources.

When they comment on development projects through the MEPA process, RPAs should focus attention on the protection of critical resource areas. Moreover, the regulations and management tools that will be developed by the newly formed Cape Cod Commission (CCC) should be used as models by other regional agencies. The CCC will be establishing guidelines for regulating developments of regional impact, i.e., extremely large projects and projects that will affect critical resource areas that cross town boundaries. Regional agencies are the appropriate bodies for coordinating these types of inter-municipal projects.

3. RPAs should work to establish uniform regulatory controls for the Cranberry Industry for use by towns to minimize confusion and allow for efficient compliance.

State Actions

1. Massachusetts should take a leadership role in land-use management by adopting the recommendations of the Special Commission on Growth and Change and incorporating that report into comprehensive legislation.

2. The Executive Office of Environmental Affairs should develop guidelines for ACEC management plans and require that towns and regions develop and adopt plans.

This concern can be addressed through broadening and strengthening the ACEC program. The Executive Office of Environmental Affairs should be aggressive in nominating and designating ACECs, and then mandating local and regional management plans as required. Management plans should contain specific provisions that will adequately protect the resource areas.

3. The Environmental Protection Agency and the Department of Environmental Protection should codevelop a policy on antidegradation as it relates to nutrient (especially nitrogen) inputs to embayments and other pollutants.

Projects that are reviewed through the MEPA process should be addressed in terms of the cumulative effects from excessive levels of nitrogen. Permits should not be issued for development projects that exceed the critical limits of any pollutant in a sensitive embayment.

4. Massachusetts should create agricultural incentive zones, similar to an ACEC, to protect intensive farm areas from encroachment by development projects.

Chapter 8

Embayment Management in Buttermilk Bay: A Case Study

Background

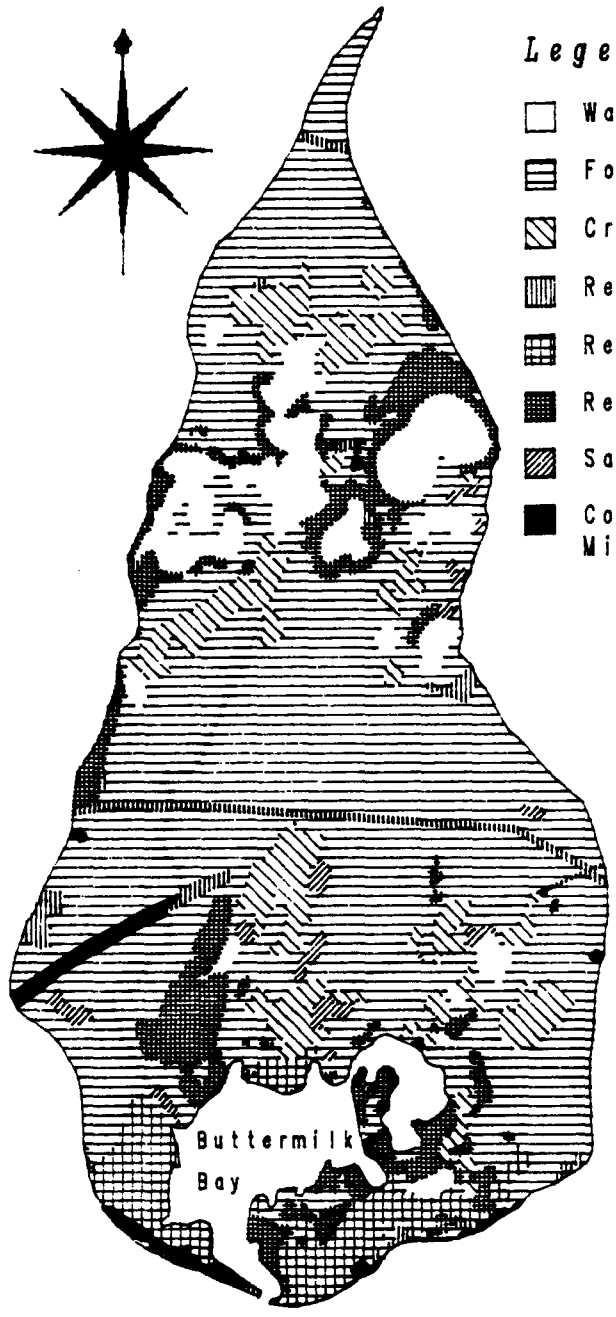
The Buzzards Bay watershed has a number of large pollution sources that are regulated by state and federal agencies. Most of these sources cause local, rather than baywide, water quality declines, and many of them are located in the greater New Bedford area. Throughout most of Buzzards Bay, coastal water quality is typically dominated by many small or diffuse pollution sources. These sources are inadequately regulated by federal or state agencies because they are either beyond an agency's purview, below a threshold level, or simply too low a priority. It has been left to local boards to fill this void and address these small (yet cumulatively significant) sources, such as failing or inadequately designed septic systems, storm drains, boats, and marinas. Consequently, residents and local government have considerable responsibility and authority for controlling contamination within Buzzards Bay.

To better understand the magnitude of the problem at the local level, to determine the sources and transport mechanisms for coliforms and nutrients in a single embayment, and to establish how nonpoint-source pollution could be quantified, ranked and managed within the local and regional framework, the Buzzards Bay Project has sponsored a number of studies within the Buttermilk Bay embayment. Buttermilk Bay contains high levels of fecal coliform (as documented by state and federal sampling); and shellfish beds in the Bay are closed and swimming beaches are threatened.

The case study of Buttermilk Bay case study described below presents a convenient framework that serves as a model for other embayments throughout the Buzzards Bay estuary, and demonstrates that effective implementation is best achieved at the local and regional levels. The following discussion of knowledge gained in Buttermilk Bay will help communities establish management strategies for other geographic areas within Buzzards Bay.

An Embayment Management Approach

A critical part of the study of Buttermilk Bay pollution was delineation of the drainage area contributing water to the embayment. Although the most obvious areas of concern are the embayment itself and the immediate coastline, it is also important to manage the upland portion of the drainage basin (Figure 8.1). Many pollutants that enter groundwater and streams ultimately enter the Bay. In the case of Buttermilk Bay, nitrogen is the pollutant of most concern. Buttermilk Bay has a large drainage area (19 square miles) whose farthest point is 8 miles from the coast. Much of this area is undeveloped, with most residential development along the coast and along the shoreline of the headwater lakes.



Legend

- Water
- Forest
- Cropland/Pasture/Other Agric.
- Recreational Uses/Open Land
- Resid'l - lots up to 1/4 acre
- Resid'l - lots more than 1/4 acre
- Salt Marsh/Non-Forested Wetland
- Commerc'l/Industr'l/Transportat'n Mining/Waste Disposal

Land Use Acreage

Cropland	71.5
Pasture	27.2
Forest	4412.6
Non-forested Wetland	80.7
Mining	2.9
Open Land	69.8
Participation Recreation	0.0
Spectator Recreation	2.5
Water Based Recreation	6.4
Residential: Multifamily	20.3
Residential: < 1/4 Ac. Lots	348
Residential: 1/4 - 1/2 Ac.	544.5
Residential: > 1/2 Ac. Lots	166.7
Salt Marsh	8.4
Commercial	41.1
Industrial	0.0
Urban Open	63.8
Transportation	44.6
Wast Disposal	3.8
Water	618.7
Cranberry Bogs	500.4
TOTAL	7033.7

1 mile

0.5

Figure 8.1. The Buttermilk Bay drainage basin, 1984 Land Use

Source: Land-use data compiled by U. Mass.-Amherst Resource Mapping Group from 1:25,000 scale aerial photography; data supplied to Buzzards Bay Project (BBP) by MassGIS. Drainage basin boundary delineated by BBP with assistance and review from USGS staff. Map prepared by Buzzards Bay Project using ARC/INFO Software (see also Appendix B).

Sources of nitrogen and coliform pollution differ in type, importance, and origin. These pollutants also differ in their impacts and their remedies. Most coliforms enter the coastal zone through direct surface flow (i.e., via streams, stormwater discharge points, and overland flow). Nitrogen contributions, on the other hand, come from the entire drainage basin through either surface or groundwater discharges to the bay.

First, potential sources of nitrogen and coliform pollution were identified. Once identified, water quality testing was used to evaluate these sources of nitrogen and coliform pollution for their relative contributions to Buttermilk Bay. Sanitary surveys conducted by the Division of Marine Fisheries Shellfish Sanitation Program were used for both the inventory and the source evaluation. Nitrogen concentrations were monitored in groundwater, streams, and runoff, and a mass loading budget for nitrogen was developed.

Finally, a strategy was developed to address nitrogen and coliform pollution in Buttermilk Bay. The strategy encompassed voluntary and technical regulatory approaches for controlling the sources of fecal coliform contamination, a comprehensive monitoring program to assess results, and a public participation effort.

Bacteriological Loading and Management

Sources of Coliform Contamination

An essential part of the study of Buttermilk Bay, and critical for any embayment project, was an inventory of possible sources of coliform contamination (Figure 8.2). This was accomplished through sanitary surveys that identified the sources of fecal coliform that were causing, or had the potential to cause, shellfish closures in Buttermilk Bay. The inventory included storm drains, septic systems, wildlife, marinas, freshwater inputs (streams, marsh areas) and point discharges, and it provided an excellent snapshot of potential sources of coliform. The Buzzards Bay Project funded the sanitary surveys that were later incorporated in the state program.

Sanitary Survey Has Four Major Components:

1. An evaluation of the pollution sources that may impact the area
2. An evaluation of the meteorological factors
3. A review of hydrogeographical factors that may affect the distribution of pollutants
4. An assessment of water quality (water testing for the presence of bacteria) under adverse pollution conditions.

Storm Drains

Stormwater discharges around Buttermilk Bay (Figure 8.3) appear to be the most important factor causing the periodic closure of shellfish harvesting areas (Heufelder,

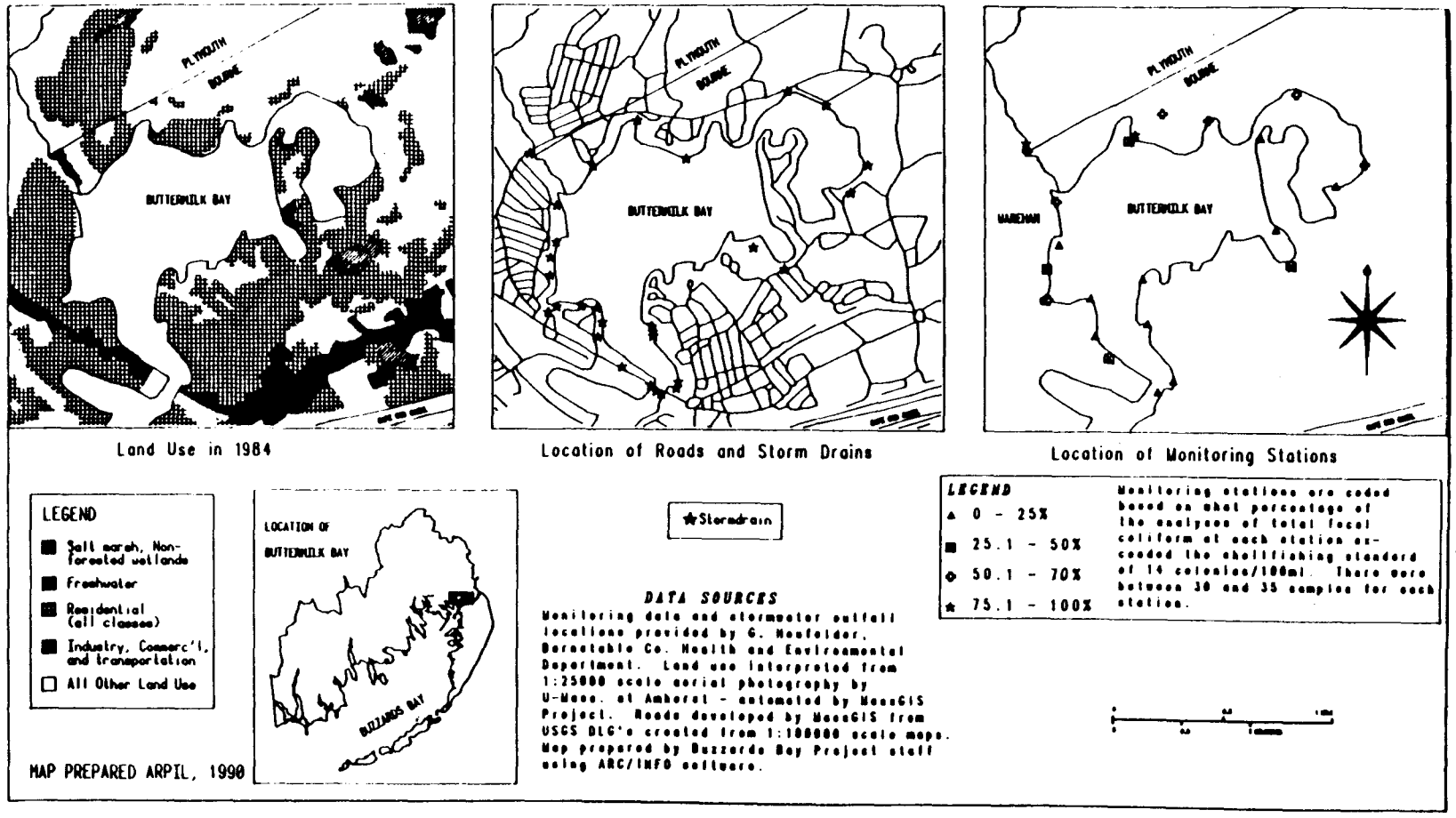


Figure 8.2. Fecal coliform monitoring in Buttermilk Bay, July 1988 to September 1989

Source: Heufelder (1988) and unpublished data.

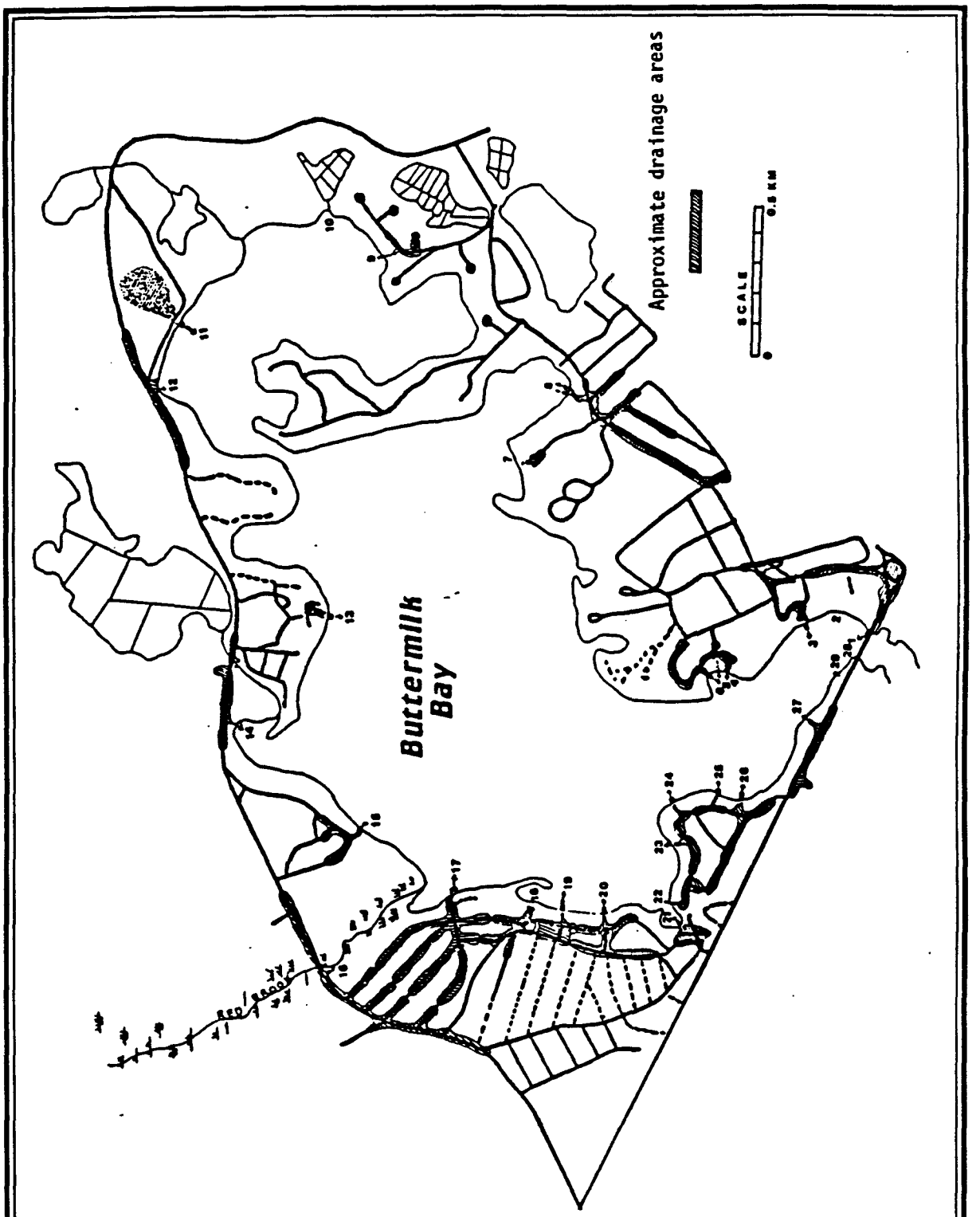


Figure 8.3. Stormwater drainage system in Buttermik Bay
Source: Heufelder (1989). Numbers indicate position of outfalls.

Indicator Test for Fecal Coliform Bacteria

Managers and health agents need to assess the risk of disease associated with pollution sources. Because it is too costly and time consuming to test for all known pathogenic (disease-causing) organisms, regulators have settled for the fecal coliform indicator test as an overall assessment of health risks. Fecal coliforms in themselves do not cause disease, but are indicators that human pathogens are present. This test was chosen because most pathogens are associated with human wastes, and human wastes have high concentrations of fecal coliforms.

As with any simplified method, this test poses a number of problems. First, fecal coliforms are not restricted to humans; that is, all warm-blooded animals (including waterfowl, dogs, etc.) excrete coliforms. It is agreed that bird wastes present less of a threat to human health than human wastes; therefore high fecal coliforms from nonhuman sources may misrepresent true health risks. Another problem is that organisms that may confound the test are found in the environment. The fecal coliform test is specific to two groups of organisms: *Escherichia coli*, which is found in the intestines of warm blooded animals, and *Klebsiella*, a bacteria found on decaying plant matter. The presence of *Klebsiella*, together with wildlife, may in part account for high fecal coliform levels found in relatively pristine marshes. A third problem is that coliforms are effectively filtered out during passage of groundwater through the sandy soils of the region. However human pathogens, such as viruses, may travel 300 ft or more without attenuation. For this reason the indicator test *underestimates the presence of human pathogens from septic systems.* Finally, there is evidence that the indicator may persist and possibly reproduce in sediments and beach wrack in nitrogen-enriched areas. These phenomena complicate the use of coliform as a management tool and indicator of public health risk.

1988)). The level of fecal coliform contamination from stormwater discharges is probably related to three factors:

1. The extent and density of residential development nearshore

2. The frequency of rain events and the collection and direct discharge of stormwater to the Bay (frequent rain lessens the ability of fecal matter to accumulate), and

3. Seasonality (with drastically increased bacterial counts in warmer months).

A survey of storm drains during dry periods failed to disclose any cross connections of sanitary pipes. This suggests that the source of fecal coliform during discharge events is not human sanitary waste, but wastes from dogs and birds and materials flushed from the drainage system. In addition to direct discharges, storm events cause a significant release of fecal indicators from sediments and beach wrack.

Septic Systems

Research on several septic systems in Buttermilk Bay has shown that under dry weather conditions they are typically an insignificant source of fecal coliform to the Bay. This is not to say that septic systems never create bacterial problems. Several systems were found to overflow during rainy weather. These overflow conditions probably present the greatest threats to water quality and health due to surface ponding and surface breakout. Factors that affect the performance of septic systems (such as depth to water

table and effluent loading rate) may play a critical role in controlling the extent of contamination from any particular septic system.

The transport distance of bacterial indicators through sandy soils is limited, but it has been documented that viruses may travel up to 220 ft in soils similar to those around Buttermilk Bay (see review in Heufelder, 1988). The transport of these potentially pathogenic organisms in groundwater has not been adequately addressed and is a management issue that must receive increased attention.

Waterfowl

A waterfowl survey (Figure 8.4) was conducted to determine bacteriological impact. Field measurements indicated that, except in certain areas, the waterfowl has minimal direct impact on water quality. A long-term cumulative impact on water quality from fecal deposits on the beach areas was, however, suggested, because fecal coliform counts were high in beach wrack (Heufelder, 1988). The bird wastes accumulate in

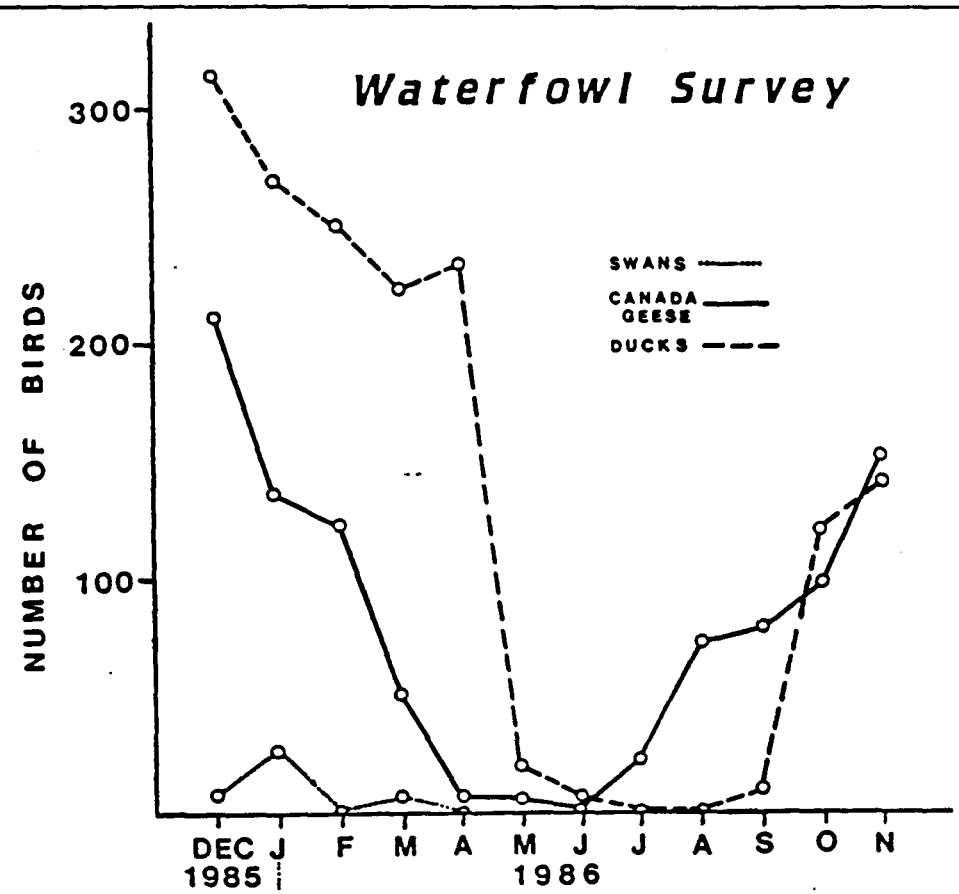


Figure 8.4 Waterfowl survey monthly averages in Buttermilk Bay

Source: Heufelder (1988).

winter, and fecal coliforms survive until summer and may even multiply in wrack during warm months. With each high tide that inundates the wrack, the coliforms may then be released in a slow, diffuse pattern. This release of fecal coliform bacteria would then raise coliform bacterial contamination in the embayment.

Marinas

A small marina operates in Buttermilk Bay, and a large marina operates just outside the Bay's entrance. No measurable contribution of fecal coliform bacteria was observed in Buttermilk Bay as a result of marina operations. These results must be interpreted with caution, however, because the mobility of boats makes it very difficult to determine actual impacts without continuous monitoring. In addition, the two marinas studied were atypical due to the lack of on-board heads on boats at the small marina (it could only handle small boats), and the presence of a pumpout facility at the other. In general, the extent of marina impact will be determined by many factors, including the level of convenience and cost associated with the proper handling of sanitary waste at each facility. The direct discharge of wastewater from boats could represent a significant health risk. Some studies have documented that marinas have the potential to significantly impact water quality. Sediment resuspension from boat prop wash may also resuspend coliforms deposited in sediments and contribute to coliform loads. The impact of boats on coliforms is further addressed in the action plan "Managing Boat Wastes."

Streams

There are five significant surface water sources to Buttermilk Bay. Red Brook supplies the greatest volume of water and has a drainage area that is relatively undeveloped and composed mainly of cranberry bogs. Most of Red Brook's water originates from groundwater infiltration. Historical data and recent field investigations confirm that Red Brook's drainage into Buttermilk Bay is a consistent source of fecal coliform. Although no sources of pollution were identified, several possibilities exist for the consistently high fecal coliform densities recorded. Septic plumes may be entering the brook at undiscovered locations (although extensive survey work did not reveal any), and wildlife, stormwater, or both may contribute appreciable amounts of coliforms. Confounding the situation, it has been suggested that organic material in the extensive marsh area near Red Brook enhances the ability of fecal coliform to survive and produce. Two other streams in the Buttermilk Bay drainage basin show high coliform concentrations as well. One clearly is impacted by septic systems; the other, like Red Brook, has little development and is surrounded by marsh. This important topic requires further investigation.

Point Sources

Buttermilk Bay is predominantly residential and only one point source discharge was identified (a pipe in a local fish market discharges water from lobster tanks directly into the lower portion of the Bay). Water samples from this discharge showed high coliform concentrations, but the impacts of the effluent were probably minimal because the discharge site is well flushed and effluent volume small.

Beach Wrack Impacts

Beach wrack, which in Buttermilk Bay consists largely of decaying eelgrass and algae, appears to act as a protected repository for fecal coliform. This wrack has been found to be an important source of fecal coliform. The relationship between wrack and the fecal indicator was studied in the field as well as under simulated conditions in the laboratory. Laboratory experiments showed that (1) fecal indicators are present and dissociate from wrack and (2) incubation in wrack piles along the shoreline prolongs survival, and possibly induces growth, of fecal coliform.

Field testing involved removing wrack from four beaches and monitoring bacteria before and after removal. At one of four sites, bacterial counts on outgoing tides were distinctly lower than counts prior to removal. Both laboratory experiments and field observations clearly show the potential for wrack to be a significant factor influencing fecal coliform levels in the bay. However, it is probably only in poorly flushed areas that removing the wrack will show major water quality improvement. Because the efficiency of this strategy is questionable and probably impractical on a large scale, it does not appear that this is a priority management option.

Bottom Sediments

There is mounting evidence that fecal coliform accumulates and possibly reproduces in Buttermilk Bay sediments. This phenomenon appears to be related to changes caused by nitrogen loading (e.g., decreased water transparency, more organic matter in the water). During storms, coliform in the sediments may be resuspended and contribute to high coliform concentrations that result in shellfish-bed closures. Although other sources of coliform (e.g., stormwater, overflowing septic systems) remain the root cause of coliform contamination, the survival and possible reproduction of coliform in sediments needs to be carefully assessed and addressed.

Synergistic Effects with Nitrogen Pollution

Research suggests a link between nutrient enrichment and bacteriological contamination. Experiments have shown that solar radiation is a prime determinant of fecal coliform survival in Buttermilk Bay waters. In areas with higher nutrient concentrations, ultraviolet light penetration may be blocked, which in turn increases survival of fecal coliform. Moreover, laboratory investigations suggest that algae may release sugars and nutrients that promote the growth of fecal indicator bacteria.

The survival and reproduction of fecal coliform in wrack deposits was noted above. Increased amounts of wrack from algal blooms may be contributing to the problem. In addition, the possibility exists that the indicator may be surviving, and possibly multiplying, outside a host in the marshes and bogs of the watershed.

Subsurface soils around septic systems adequately trap bacterial indicators within tens of feet, but viruses travel much greater distances. Thus, bacterial indicators may not adequately represent the health risk from viruses. This possibility has obvious health implications for shellfish beds and bathing beaches near unsewered residential areas.

Nitrogen-Loading Impacts and Management

Impacts from nitrogen loading are mostly a localized phenomenon in the network of shallow embayments that border Buzzards Bay. Consequently, the Buzzards Bay Project has targeted "nitrogen-sensitive embayments" for management action. The activities that were undertaken in Buttermilk Bay should serve as a model to protect these embayments.

Managing nitrogen loading in an embayment requires a different approach than managing the sources of bacterial contamination. All possible sources within the drainage basin must be weighed, not just nearshore sources. Controlling nitrogen requires more long-term efforts devoted to preventing the water body from reaching eutrophic conditions. It involves a proactive strategy that requires knowing how much nitrogen is entering an embayment and how much can be tolerated.

Eutrophication of coastal water occurs when nitrogen triggers excessive plant growth. This is not only aesthetically displeasing but represents a threat to environmental quality. Eutrophic conditions can also result in decreased dissolved oxygen levels that lead to fish and shellfish kills.

An assessment of nitrogen loading for Buttermilk Bay indicates that freshwater drainage into the basin contributes nearly all nitrogen entering the Bay. In Buttermilk Bay, groundwater contributes 60% of the fresh water entering the Bay and transports over 85% of the projected nitrogen load. According to Valiela and Costa (1988) most of the nitrogen that enters Buttermilk Bay originates from septic systems. The same authors identify the leaching of fertilizers as the second largest source.

At present Buttermilk Bay, because of its extremely high flushing rate, is not displaying baywide eutrophication problems. However, a study of all existing sources of nitrogen in the drainage basin, along with the loadings that each source represents, indicates that Buttermilk Bay is close to surpassing its carrying capacity for nitrogen. Some localized areas of dense development are already exhibiting symptoms of eutrophication. A growth management strategy for the entire drainage basin is the proper course for ensuring the long-term health of Buttermilk Bay.

Future Conditions

A study of all developable property in the drainage basin indicates that additional growth will eventually overburden the Bay's capacity to avoid adverse impacts and will result in eutrophication. Only 55% of the drainage basin has been developed, mostly for residential use. This translates to approximately 55% of the total potential nitrogen loading. In addition, because groundwater moves at such a slow rate (about 1 ft per day), only a portion of the existing nitrogen load has already reached the Bay.

The developable lot survey or "buildout" analysis was conducted to compute nitrogen loading under various buildout conditions. The analysis suggests an increase of 30-130% in the amount of nitrogen entering Buttermilk Bay under existing conditions.

The actions required to manage future nitrogen problems in Buttermilk Bay present a challenge, but one that can be met. The primary responsibility for managing what is essentially a problem of land use and development lies with the local communities.

This sensitive growth issue is complicated in Buttermilk Bay by the need for coordination and cooperation among Bourne, Wareham, and Plymouth, who share the drainage basin. Management strategies must be crafted with a regional perspective or risk ultimate failure.

Several options are available for controlling the long-term nitrogen loading within the drainage basin. Managing growth, reducing fertilizer use, and promoting treatment capable of reducing nitrogen in wastewater through a denitrification process are all effective approaches. The Buzzards Bay Project worked with Bourne, Wareham, and Plymouth to implement a program in Buttermilk Bay that focuses primarily on growth management.

Public Involvement

Public involvement is a vital part of an embayment-management program. The commitment of the citizens who live near the Bay is essential for success. Although the problems are often technical, much of the solution relies on local and personal involvement. The research in Buttermilk Bay was conducted by federal and state agencies, but was brought to life by citizens' groups who conducted public information campaigns to educate the Buttermilk Bay community.

The Coalition for Buzzards Bay served the essential role of catalyst and organized public education and involvement projects within the Buttermilk Bay area. By bringing together existing neighborhood associations and other groups that frequent particular beaches, the Coalition helped local residents identify Buttermilk Bay as a common resource.

Staff from the Buzzards Bay Project, together with key researchers, instructed Coalition personnel in the scientific background necessary to understand and communicate the issues facing Buttermilk Bay.

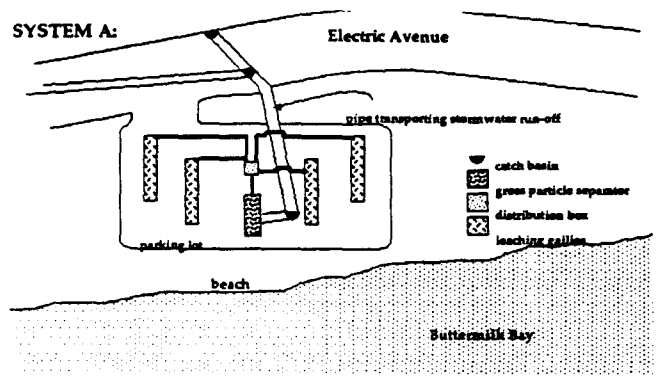
The Coalition managed an extensive canvassing program that reached nearly 1,000 households and 20 businesses. Over 400 residences and businesses were contacted in person, and the rest received printed information about the project and its preliminary results. The objective of the canvassing was to inform a wide audience and receive feedback. About 70 percent of the respondents were supportive of the project's efforts, and 30 percent ranged from apathetic to skeptical. Unfortunately, only 1 percent indicated they were ready for active participation.

The activities that garnered the most favorable response were those that involved concrete examples of water quality improvement. Both the planned construction of stormwater treatment facilities and the beach wrack cleanup project were favorably received. Problems associated with the safe collection and disposal of household and commercial hazardous waste were a major concern to many area residents. The Coalition has reacted to this message and is establishing hazardous waste management as a major part of its ongoing public education program.

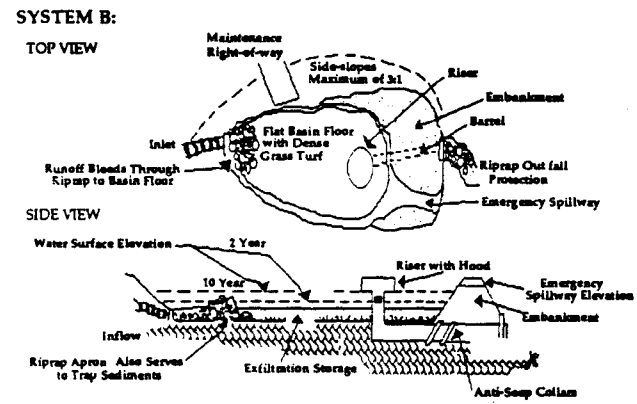
Another productive result of public involvement in the Buttermilk Bay Project has been the interaction between policy makers, researchers, and the general public. Neighborhood conferences, public meetings, and other interactions between representatives of government agencies, the consulting engineer, and homeowners

helped in the design and acceptance of best management practices for treating stormwater. Once the purpose and method of treatment was understood, the project received the full support of the neighborhood. This was critical because installation of part of the treatment system required the donation of land.

In addition, the direct involvement of the public in removing beach wrack from several beaches and participating in the monitoring program was extremely valuable. Citizens were informed of the hypothesis concerning wrack impacts upon bacterial counts, and then participated in testing the hypothesis. The public involvement program for Buttermilk Bay should serve as a model for other state and federal projects in the future.



Stormwater collects in catch basins, then is diverted into a gross particle separator where large particles are settledout and the remaining liquid is discharged through leaching gallies.



Stormwater is funneled to the inlet where it passes through to a dry pond. The stormwater then percolates through the soil to the groundwater.

Figure 8.5. Stormwater catch basin designs in Buttermilk: System A, Electric Ave. Beach; System B, Red Brook

Implementation

Controlling Stormwater

Research in Buttermilk Bay has identified stormwater runoff as the most significant source of fecal coliform bacteria. Approximately 30 storm drains discharge runoff into the Bay, forcing the closure of shellfish beds following rainfall. Thus, the central part of the project was to demonstrate practical and effective ways to treat stormwater and maintain water quality for shellfishing as well as bathing. Stormwater discharges at Electric Avenue Beach in Bourne and Red Brook in Wareham were selected for treatment (Figure 8.5). Both sites were confirmed as significant contributors of bacterial contamination, and officials from both towns agreed that they were high priorities. The outlet pipe at Electric Avenue Beach discharged directly into the water at a bathing beach and was a visible, hazardous object protruding through the sand at low tide. The perception of the local officials and area residents was that elimination of the stormwater discharge would benefit water quality and enhance recreational bathing.

A settling tank and leaching chambers were installed for the Electric Avenue Beach site, and a detention-recharge basin will be installed at Red Brook. These methods were chosen based upon information from the National Urban Runoff Program and the results of site investigation. Both systems rely on infiltration, which provides high removal levels of coliform bacteria and insignificant groundwater degradation when facilities are properly located, sized, and installed. These facilities not only remove bacteria, but also significantly reduce concentrations of heavy metals, pesticides, and hydrocarbons. This project demonstrates that these systems work well using the subsurface soils of the Buttermilk Bay area.

The tank and leaching chambers installed at Electric Avenue Beach have achieved the high degree of treatment that was expected. Over 98% of the fecal coliform entering the system is being removed prior to discharge. Once the detention-recharge basin is completed for the Red Brook area, fecal coliform levels after rainfall should remain below the shellfish standard and allow shellfish harvesting. The Red Brook system has been significantly delayed due to an archaeological investigation.

Acquiring the appropriate local and state permits required for construction took months and required the involvement and active participation of all relevant local boards and departments. This sort of delay should be anticipated for similar projects elsewhere in Buzzards Bay. In Bourne, wetlands and floodplain permits were required, as well as a state underground injection permit from the Department of Environmental Protection. The project was further reviewed through the Massachusetts Environmental Policy Act provisions, by the Massachusetts Historical Commission, and by the Bourne Board of Health.

Other major considerations were (1) acquiring a site for disposing sludge that accumulated in the basin and (2) ensuring that the installation of the basin did not interfere with underground utilities. Because the land area necessary for construction and treatment of stormwater is not always town property, additional complications may be encountered. Land purchases or easements must often be considered. The Bourne

facility required formal approval at Town Meeting for the use of publicly owned land. For the Wareham facility, survey work, deed restriction language, landowner acceptance, and recording of deeds were required for attaining easement rights. The Wareham facility also required an easement because the system will be installed on private land.

Obviously, stormwater management for a large developed area requires a well-conceived plan. The Bourne project represents a typical situation in which all the land was privately owned except for roads and the beach parking area. Existing drains in developed areas are difficult to locate and the many utilities running under the street limit construction. The Electric Avenue Beach site demonstrates that, with cooperation and creative planning and design, treatment facilities can be installed and can be effective.

Although every community is different, the following is a general strategy that may be useful in designing a stormwater management plan.

- Inventory and identify the location of all drains and their drainage areas. Drains that receive discharges from the most heavily travelled roads usually carry the most pollution.
- Check for dry-weather discharges or illegal connections, for example, from washing machines or drainage sumps.
- Sample the discharge 15 minutes after the first runoff flush and at least 3 days after the previous rainfall to identify major sources of coliform.
- Implement best management practices to control the first flush, which often carries sizeable amounts of coliform bacteria. (A variety of designs are available, and in general, larger designs are more costly. Decisions on the appropriate technology should involve the local departments, typically public works, who are responsible for operation and maintenance. Problems from clogging by coarse sediments, road sand, etc., must be considered if infiltration using a settling tank is the treatment technology chosen.)
- In developing areas, insistence upon proper land-use measures is the most effective approach. In these areas, extending or adding to existing storm drains is a common problem that must be addressed.

Model criteria have been developed to help communities set priorities to repair, replace, or eliminate storm drains. Factors to be evaluated include

- Rate and volume of stormwater discharge
- Impervious area drained
- Best management practices available
- Installation problems
- Relative cost to implement
- Expected treatment effectiveness
- Maintenance requirements.

The town of Bourne has already expanded the Buttermilk Bay approach to other areas and is rapidly developing a comprehensive understanding of townwide stormwater problems. The Buzzards Bay Project is working directly with Bourne, Wareham, and Plymouth (a town that does not border Buttermilk Bay, but contains most of the land

in this drainage basin) to review, and possibly improve, each town's regulations and bylaws for managing stormwater. This will be accomplished through strengthening zoning bylaws, subdivision rules and regulations, health regulations, and wetlands bylaws and regulations.

In addition to stormwater management, the Project will be assisting the towns in the development of regulatory tools for controlling other sources of bacterial contamination, especially on-site septic systems. Areas that will be addressed are Title 5 upgrades, system maintenance, setbacks from watercourses and marine waters, and distance to groundwater. This strategy, in conjunction with other actions, will reopen shellfish beds in Buttermilk Bay.

Controlling Nitrogen Loading

Controlling long-term nitrogen loading to Buttermilk Bay is critical to the future health of the embayment. The Project calculated future loadings to this Bay based upon growth that would occur under existing zoning rules. The nitrogen that would be added to the system from the increased residential use would seriously jeopardize the health of Buttermilk Bay.

This information served as background for Bourne, Wareham, and Plymouth in evaluating the need for nitrogen-loading standards. With the assistance of the Project, the three towns examined options for managing nitrogen impacts from future development that would eliminate the excessive nitrogen load which would cause Buttermilk Bay to exceed its nitrogen carrying capacity.

The Buzzards Bay Project recommended a tri-town nitrogen management overlay district for the drainage basin surrounding Buttermilk Bay. Within the overlay district, two of the towns, Bourne and Plymouth decreased their zoning densities. By doing this they eliminated over 400 potential house lots (with their accompanying nitrogen contributions). Wareham already had large sized lots which did not require a zoning change. However, Wareham did adopt the overlay district with strong language that discouraged the granting of variances that could increase the nitrogen load. It is believed that this is the first time an overlay district has been used to protect a coastal embayment. Details of managing nitrogen-sensitive embayments are included in an action plan in Chapter 5.

Summary and Conclusions

Most of the sources of contamination in the Buzzards Bay drainage basin are small, nonpoint sources that will probably never receive the full regulatory response of state and federal agencies. Local governments and concerned citizens will be primarily responsible for protecting the Bay from these small yet cumulatively significant sources. The Buzzards Bay Project, through its work in Buttermilk Bay, has tried to demonstrate that an embayment-management approach is the most effective means for mitigating pollution from nonpoint sources. The Project hopes that the process that was used in Buttermilk Bay will serve as a model to be transferred to other embayments.

Embayment management as conducted in Buttermilk Bay has the following major components:

- Delineation of the drainage basin
- Research and monitoring of water quality and living resources to identify sources, loadings, and impacts of pollutants
- Analysis of full-growth potential (buildout)
- Calculation of nitrogen loading and embayment carrying capacity to avoid adverse impacts
- Involvement of the public
- Implementation of remediation projects and best management practices
- Establishment of local bylaws and long term planning.

Although each embayment has its own characteristics and conditions, the process outlined above should provide a starting point for local and regional action.

Chapter 9

Implementing the CCMP

The Players and Their Roles

Buzzards Bay is an estuary in transition. Increased development along its shores, coupled with decades of dumping industrial and municipal wastes into its waters, has placed the Bay in jeopardy. Fortunately, it is not too late to reverse the current trend of declining water quality.

The action plans presented in Chapter 5 include a number of stated commitments and other recommended steps that must be taken now and in the future to preserve and protect Buzzards Bay. The action plans also identify the organizations that are responsible for taking those steps. These organizations include regulatory and planning agencies at the federal, state, regional, and local level, legislative bodies, and citizens groups. Table 9.1 shows which organization is primarily responsible for each of the recommendations in the action plans. This chapter describes the role of each of organization involved in implementing these recommendations and future work that is needed to ensure that complete implementation occurs within a reasonable time.

For many of the recommendations, these organizations share overlapping responsibilities, and close coordination is required to ensure that the proper actions are taken. For other recommendations, a single organization can achieve the desired result. For still others, the implementing responsibility may belong to one organization, but another may be able to provide technical or financial assistance.

Federal and state regulatory agencies such as U.S. Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (DEP) have authorities that will be used to address many of the recommendations contained in the action plans. However, the major focus of this CCMP and the Buzzards Bay Project as a whole has been on compelling local authorities to take action to preserve the Bay and its resources because, in the New England tradition of home rule, such management decisions belong to the community and its inhabitants. At the same time, the CCMP recognizes that a fully integrated intergovernmental approach is optimal, because federal and state agencies not only can provide local managers with scientific and technical information needed for wise municipal decisions, but also can complement those decisions with additional regulatory actions on the multitude of existing and potential pollution problems. This is a particularly appropriate role for state government, which owns all rights in tidal waterways beyond the low water mark and holds a public access easement for fishing, fowling, and navigation in the intertidal zone - all "in trust" for the beneift of the general public. The Commonwealth has a responsibility for effective stewardship of these and other public trust lands, and protecting the integrity of the Buzzard's Bay ecosystem is clearly an important part of that responsibility. (A full discussion of the Public Trust Doctrin is contained in Slade, 1990).

Table 9.1. Direct applicability of action plans to local, state, and federal authorities

Action Plan	LOCAL					STATE			FEDERAL	
	Reg[1]	BOH	Pln Brd	Con Com	Other	EOEA	DEP	Other	EPA	Other
Managing N-Sensitive Embayments	T,P	R	R			MEPA:P	P,R			
Protecting Shellfish Resources		R						DMF: F,T	T	FDA:T,P
Controlling Stormwater Runoff	P	R	R	R			R	DPW:P	R	SCS:T,F
Managing Boat Sewage		R			Harb;P,R,T	P;CZM:P	R			
Managing On-Site Systems	P	R					P,R			
Preventing Oil Pollution	T				Fire:P,R,T Harb:P,R,T	P,R;CZM:T	R			USCG:T,R
Protecting Wetlands and Marine Habitat	P			R	Selectm:P		R,T			COE:P,R
Planning for Shifting Shorelines		R	R	R		CZM:P,T	R			
Managing Sewage Treatment Facilities		R			Selectm:P	P	R	DEM:T		
Reducing Toxic Pollution		R			Selectm:P	CZM:P	R		T	SCS:T
Managing Dredging and Dredged Material							P,T			COE:T

Key

R=Regulation/Implementation
P=Policy
F=Finance
T=Technical

[1]The Southeastern Regional Planning and Economic Development Distric has planning functions and the T represents their activities. The Cape Cod Commission has both planning and regulatory authority, P represents their activities. The regulatory authority will be used to set policy in specific areas for towns.

NOTE: Reg Agn = regional agency, BOH = board of health, Pln Brd = planning board, Con Com = conservation commission, EOEA = Massachusetts Executive Office of Environmental Affairs, CZM = Massachusetts Office of Coastal Zone Management, DEP = Department of Environmental Protection, EPA = U.S. Environmental Protection Agency, Fire = fire department, Harb = harbor master, Selectm = selectmen, MEPA = Massachusetts Environmental Policy Unit, DMF = Division of Marine Fisheries, DPW = Massachusetts Department of Public Works, FDA = U.S. Food and Drug Administration, SCS = U.S.D.A. Soil Conservation Service, USCG = U.S. Coast Guard, COE = U. S. Army Corps of Engineers.

Underlying all the recommendations presented earlier is the need for citizen involvement. Such involvement will be the crucial ingredient for the success of this Plan and the protection of Buzzards Bay. The management recommendations presented here will not be accepted merely because they are good ideas. There is a political element too, one that involves individual hardships as well as implementation difficulties and cost. Citizens must be prepared to support local initiatives resulting from these recommendations and to demand action if none is taken.

Over the past six months, the Buzzards Bay Project staff have negotiated with the state and federal agencies identified as responsible for specific regulatory or institutional actions. These commitments have been included in the respective Action Plans with which they correspond (See Chapter 5). Also, a full set of commitment letters in support of the CCMP are included at the end of this chapter. Of the federal and state agencies discussed, state agencies under the Executive Office of Environmental Affairs (EOEA) will have the most wide-ranging regulatory authority to control point and nonpoint sources of pollution to Buzzards Bay, and these agencies have formally committed to many of the actions prescribed in this CCMP. In particular, DEP (an agency under EOEA) is prepared to dedicate manpower and resources toward implementing the recommendations contained here.

Equally as important, Buzzards Bay Project staff have received first year commitments from several Buzzards Bay municipalities. These local commitments have been included with the relevant action plans. In future years, the Project, working through the auspices of the Buzzards Bay Action Committee (BBAC), will continue to receive commitments from the towns on an annual basis.

Over the next two to three years, EPA and the Commonwealth, through the National Estuary Program (NEP), will hopefully continue to support the Buzzards Bay Project. During this time, the Management Committee will continue to direct allocation of available NEP funds, monitor the status of CCMP implementation activities (including identifying any major roadblocks that develop and devising strategies for overcoming them), and monitor the effectiveness of actions taken in protecting the Buzzards Bay environment. It is expected that most of the funds from EPA will be used to support several BBP staff positions, headquartered at the CZM office in Marion, to assist local communities in carrying out CCMP recommendations. The BBAC will have the major responsibility for long-term implementation of the CCMP at the local level. However, for this to occur the BBAC must find a funding mechanism to support an Executive Director. It is hoped that once federal and state funds are no longer available, the municipalities will combine to continue this critical position.

Implementation of this CCMP will take place over the next several years. It will require that local, regional, state, and federal entities continue to cooperate to protect and enhance the viability of the Bay and its resources. Implementation can be achieved in a variety of ways — improving regulatory programs, planning for the future, establishing a regional perspective, taking legislative action, and institutionalizing the CCMP. The following sections of this chapter present a general discussion on each of these strategies.

Improving Regulatory Programs

The discussion below outlines regulatory actions necessary for action plan implementation. These could include developing new regulations or simply interpreting or enforcing existing laws and regulations more stringently. Some of these

actions have been agreed to, with commitments established, while others remain as CCMP recommendations.

Federal

In Massachusetts, EPA has primary responsibility for issuing wastewater discharge permits under the National Pollutant Discharge Elimination System (NPDES), although most permits are issued jointly with DEP. EPA is expanding its authority toward the permitting of stormwater discharges. Preliminary steps have already been taken to develop a process for permitting those discharges that are causing the closure of significant shellfish resource areas.

The Food and Drug Administration (FDA) and EPA will need to develop a new indicator or set of indicators to assess public health risk from coastal waters contaminated by sewage. The current fecal coliform indicator used to classify shellfish areas has serious limitations, but research has not yet provided a better indicator.

State

The action plans contain several recommendations that call for new or amended state regulations and standards. In Massachusetts, DEP is the major regulatory authority for environmental protection, and as such will have responsibility for several of the recommendations contained here. As discussed above, DEP jointly administers the NPDES program and has agreed to work cooperatively with EPA in establishing a policy for stormwater permitting.

DEP should revise Title 5 to account for the effects of sea-level rise and shoreline erosion. The Title 5 regulations should also be expanded to allow for the installation of septic systems that control pollution through new technologies such as denitrification. Although DEP is moving more in this direction, a full commitment will be necessary. Without such an expansion, there will be no impetus for homeowners or communities to upgrade or install state-of-the-art septic systems.

State water quality standards do not contain numerical criteria for nutrients, but include a general statement that nutrients should not exceed site-specific limitations necessary to control "accelerated or cultural eutrophication." In order for communities to more readily and equitably implement the CCMP recommendations addressing nitrogen-sensitive embayments and land-use management, DEP will need to adopt regulatory loading standards for nitrogen. The Department has, in fact, committed to adopting such a standard for nitrogen inputs to sensitive embayments in its 1993 revision to state water quality standards. DEP will also need to more stringently interpret the current "antidegradation" provisions of its water quality standards to encompass nutrient loads and their potential impacts on water uses. Progress is also being made here as DEP's Antidegradation Task Force will look toward adoption of an interim policy in cooperation with EPA and the Buzzards Bay Project.

DEP should also improve the state's wetlands regulations to address a number of identified weaknesses that are contributing to small but cumulative losses of wetlands over time. While there have been some improvements at a policy level (in particular, no net loss of wetlands) these changes should also be made at a regulatory level. Improvements in wetlands protection also include a commitment for expanding the Wetlands Conservancy Program to protect existing wetlands in most Buzzards Bay towns.

The action plans call for EOEA to develop criteria for regulating contaminated sediments for purposes of dredged material disposal and to ensure that pollutants in sediments are not allowed to accumulate to levels that will endanger aquatic resources or be taken up by seafood species and pose a potential threat to public health. EOEA also has established an Enforcement Task Force. To help prevent oil spills and runoff of oil into the Bay, this task force should more aggressively pursue violations of the state's oil storage and disposal regulations.

Implementation of the Massachusetts Environmental Policy Act (MEPA) should also be enhanced by more carefully considering the potential cumulative impacts of proposed development projects in the Buzzards Bay area and by requiring developers to determine the total pollutant loads, including the effects of their development, in comparison to the carrying capacity of the embayment for specified pollutants.

Local

Much of Buzzards Bay is dominated by small yet cumulatively significant nonpoint sources of pollution. Except for the major discharges located in and around the greater New Bedford area and around certain other sewage treatment outfalls, most of the environmental degradation that has occurred elsewhere in the Bay is the result of the cumulative input of contaminants from small individual sources such as septic systems, stormwater runoff, lawn care and agricultural practices, and boats. In Massachusetts, because a considerable amount of authority has been delegated to local boards, these discharges will be managed only if these local authorities take action. This will not happen automatically; serious time and effort must be devoted to ensuring that implementation occurs.

The Buttermilk Bay Overlay District, designed to protect Buttermilk Bay from excessive nitrogen inputs and approved by Plymouth, Wareham and Bourne, is the first major implementation success. This is the only coastal overlay protection district in the country designed to prevent eutrophication of coastal waters. It will serve as the prototype for similar local initiatives.

Most of the municipalities surrounding Buzzards Bay have agreed to pursue initiatives recommended in CCMP action plans as part of the first year's implementation agenda. These actions include:

- Develop nitrogen loading strategies (Dartmouth, Westport, Bourne, and Falmouth)
- Identify and correct illegal discharges affecting shellfish areas (Dartmouth, Mattapoisett, Bourne, and Falmouth).
- Designate a public health official to assist the Division of Marine Fisheries (DMF) in classifying shellfish areas (Fairhaven, Wareham, Bourne, and Falmouth).
- Work with DMF on expansion of the "conditional approval" program for shellfish areas (Dartmouth and Fairhaven).
- Adopt subdivision bylaws that require best management practices for stormwater runoff (Marion, Wareham, and Bourne).
- Construct a boat pumpout facility and develop a management plan for ensuring its use (Westport and Dartmouth).

- Amend the local sanitary code to increase the setback of septic systems from resource areas and private wells (Westport, Wareham, Marion, Bourne, and Falmouth).
- Appoint an oil spill coordinator who is fully cognizant of the local contingency plan and prepared to handle necessary response activities (Westport, Fairhaven, Mattapoisett, Marion, Wareham, Bourne, and Falmouth).
- Implement a program that ensures boatyards and marinas have specified spill response equipment on site (Marion).
- Develop watersheet zoning bylaws (Dartmouth).

Communities that have not yet agreed to pursue many of the actions listed above will be encouraged to do so in future years. The action plans include other recommendations for new or tougher local bylaws to protect critical resources from degradation. The following list summarizes regulatory measures recommended for each of the municipalities that will also be pursued by the Buzzards Bay Project and the Buzzards Bay Action Committee.

- Amend zoning and subdivision bylaws where possible to incorporate the results of a buildout analysis and better land-use management.
- Adopt non-zoning wetlands bylaws and regulations to give better protection to isolated wetlands and wetland buffer zones.
- Develop performance standards for oil and grease removal from catch basins.
- Develop regulations governing management practices for fueling of vessels in harbors.
- Develop regulations requiring oil-spill-response equipment at marinas.
- Develop coastal construction setbacks from resource areas such as wetlands, and more stringently regulate construction in areas subject to sea-level rise and shoreline erosion.
- Develop regulations banning the use of septic-system cleaners that contain carcinogens.

Many Buzzards Bay communities are handicapped in their efforts to implement local regulatory programs because they lack personnel with the requisite technical expertise. Most communities do not employ planners and several do not maintain full-time health agents or conservation agents. Due to the wide range of disciplines required of any one local employee, even the communities that retain staff are hard-pressed to deal expertly with the many complex environmental issues that they must confront. Technical expertise and professional staff are needed not only for planning and protection of wetlands and public health, but also to manage a host of other land-use activities. To ensure complete, efficient, and consistent implementation by various local boards of the myriad recommendations that affect water quality, communities should establish the position of water quality coordinator. The responsibilities of the water quality coordinator would be to:

- Establish water quality goals and objectives so that all involved local departments and boards clearly understand the critical water quality issues that need to be considered in making any decisions or policies that affect living resources or water quality.

Table 9.2. Action plan relevance for protecting Buzzards Bay water quality and resources

Action Plan	Community in Buzzards Bay Drainage Basin																
	A[1] cushn	Bourne	C[1] arver	Dartmo	Fairha	F[1] allRi	Falmou	F[1] reeto	Gosnol	Marion	Mattap	M[1] iddle	NewBed	P[1] lymou	R[1] oches	Wareha	Westpo
Managing N-Sensitive Embayments		●[2]	§	●[2]	●	§	●[2]	§	§	●	●	§	§	§	§	●	●[2]
Protecting Shellfish Resources		●[2]		●[2]	●[2]		●[2]		§	●	●[2]		§			●[2]	●
Controlling Stormwater Runoff		●[2]		●	●		●		●	●[2]	●		§			●[2]	●
Managing Boat Waste		●		●[2]	●		●		●	●	●		§			●[2]	●[2]
Managing On-Site Systems		●[2]	§	●	●		●[2]		§	●[2]	●	§		§	§	●[2]	●[2]
Preventing Oil Pollution	§	●[2]		●	●		●[2]		●	●[2]	●[2]		●			●[2]	●[2]
Protecting Wetlands and Marine Habitat	●	●	§	●[2]	●	§	●	§	●	●	●	§	§	§	§	●	●
Planning for Shifting Shorelines	§	●		●	●		●		●	●	●		●			●	●
Managing Sewage Treatment Facilities	§			●	●		●			●			●			●	
Reducing Toxic Pollution		§		●	●		§		§	§	§		●			●	§
Managing Dredging and Dredged Material	●	§		§	●		§			§			●			§	§

Key

● = high
§ = moderate
= little or none

[1] These municipalities have little or no coastline on Buzzards Bay, therefore marine water-based action plans to protect Buzzards Bay water quality and coastal resources do not apply. Because Plymouth and Fall River have significant coastlines not on Buzzards Bay, many water-based action plans will be of interest to these communities. Some water quality action plans apply to inland communities traversed by major streams or rivers.

[2] These municipalities have agreed to pursue CCMP recommended actions or have already taken action.

- Review the community's present management and regulatory policies and recommend necessary modifications.
- Advise selectmen and other policy makers as to appropriate actions necessary to meet established CCMP goals and objectives.
- Review relevant environmental data collected by the Division of Marine Fisheries and other agencies, as well as data from research organizations, and integrate this information into the management program.

Planning for the Future

To protect the ecological integrity of Buzzards Bay, decisions must be made within an established framework that sets forth the goals, objectives, and policies for appropriate uses of the Bay. Planning is one way to anticipate the future or to allocate scarce resources. At the federal and state levels, several opportunities exist to improve water quality planning. However, at the local level, careful examination of future needs and opportunities is lost in the overwhelming workload of reviewing and permitting development proposals.

Federal

Federal agencies should undertake a variety of planning activities to implement the recommendations in this CCMP. The U.S. Army Corps of Engineers has already committed to help initiate the development of a dredged material management plan for the Bay. The U.S. Fish & Wildlife Service needs to ensure that any remediation plan developed for the New Bedford Harbor Superfund site will adequately protect natural resources. The Federal Emergency Management Agency should adopt new floodplain boundaries submitted by communities subject to sea-level rise or shoreline erosion. The U.S. Department of Agriculture should continue to work with agricultural users to minimize the offsite transport of agrichemicals.

State

In accordance with the provisions of Section 319 of the federal Clean Water Act, DEP has prepared the Massachusetts Nonpoint Source Management Plan (NPS Plan). The NPS Plan proposes an orderly and progressive approach to prevent continued degradation of Massachusetts surface waters and groundwaters due to nonpoint sources. Because the NPS Plan is used as a guide for awarding federal funds to the state for nonpoint-source pollution projects, DEP should adopt appropriate CCMP recommendations and incorporate them into the NPS plan immediately.

In addition to the NPS Plan, the federal Clean Water Act also requires each state to establish and maintain a planning process for managing water quality. One element of the state's water quality management program has been to prepare basin plans for various river basins within Massachusetts. A basin plan identifies water quality problems and proposes solutions. At present, DEP is revising its basin plan for Buzzards Bay. DEP should adopt the CCMP as part of this planning effort. EPA uses the basin plan in the same way as the NPS Plan — to focus its grant funds on activities that address priority problems.

Local

Most importantly, as discussed in Chapter 7, Buzzards Bay communities must engage in land-use planning to manage future growth. Previous efforts to manage growth in Massachusetts have failed because of the lack of a coordinated planning framework. In Massachusetts, planning is not a prerequisite to zoning.

Buzzards Bay communities need to plan for growth and development in a way that protects environmental quality. Existing tools include the buildout analysis (which considers the maximum carrying capacity of embayment areas to assimilate pollution) harbor-management plans, and oil-spill contingency plans.

Local communities also need to plan for predicted changes to the natural environment due to phenomena such as sea-level rise and coastal erosion, for protecting critical environmental areas such as wetlands and shellfish habitat, and for reducing effluent flows from municipal sewage treatment plants. As more shellfish areas are closed, fishing pressure upon open areas is increased. Shellfish managements plans and good catch statistics are important to enhance resource productivity.

Planning is also an important element in correcting known pollution sources, whether they be from stormwater, septic systems, or boats. Resources (both personnel and financial) are limited. Communities must identify and prioritize sources that have the greatest impact on water quality.

The Buzzards Bay CCMP has incorporated many examples of effective approaches that communities can adopt and utilize to protect the Bay. In addition, Table 9.2 contains a matrix showing the relative importance of each CCMP action plan for individual Buzzards Bay communities. The key determinant of action plan relevance is protection of the Bay's water quality and resources. Buzzards Bay communities should use this matrix in determining their priorities for implementing CCMP recommendations.

Establishing a Regional Perspective

As mentioned throughout the CCMP, there is an essential need to view Buzzards Bay as a regional resource that is shared by 17 communities. Collectively, little has been done to ensure that abutting communities sharing the Bay adopt similar regulations. Moreover, even within many towns, cooperation and coordination among boards is lacking. The protection of a resource the size and complexity of Buzzards Bay requires cooperation among the communities sharing the resource as well as between the local institutions responsible for proper control of land use. A regional body acting through influence or authority, operating with and through existing interests and jurisdictions, will promote the concepts of the CCMP and ensure that its recommendations are carried out equitably and completely at the local level. In addition, given the significant annual turnover of local board members, a regional body is also important to maintain consistency and a high technical level of understanding of Bay problems and available solutions.

Realizing the importance of a regional organization to the future of Buzzards Bay, the Buzzards Bay Action Committee (BBAC) was created in September, 1990. The BBAC is actually an outgrowth of the Buzzards Bay Advisory Committee which was formed

THE BUZZARDS BAY ACTION COMPACT

We, the undersigned municipalities, recognize the serious threat to Buzzards Bay as a significant resource through its deteriorating water quality and the associated threat to public and environmental health, to the viability of the economic base, and the quality of life.

We further recognize that the drainage basin of Buzzards Bay crosses municipal boundaries; that the future of the Bay depends on the ability of neighboring communities to control the quality of their environment through regional communication and cooperation among municipal, state, and federal agencies responsible for managing the Bay and its watershed.

We support the formation of a voluntary, regional organization of local governments to be known as the Buzzards Bay Action Compact. The Compact's members agree to exchange information and ideas that will expedite the region's ability to implement sound environmental regulations and by-laws to protect and enhance our mutual resource, Buzzards Bay.

We agree to review and update our individual town by-laws and regulation so as to voluntarily:

- manage nitrogen sensitive embayments
- protect and enhance shellfish resources
- control stormwater runoff
- manage wastes from boats
- manage individual septic systems
- prevent oil pollution
- protect wetlands and marine habitat
- plan for a shifting shoreline
- reduce/eliminate toxic pollution
- manage dredging and disposal of dredged materials

These actions are contained in the Buzzards Bay Comprehensive Conservation and Management Plan.

Acushnet Earle H. Blanchard

Bourne

Dartmouth

Fairhaven

Falmouth

Gosnold

Marion

Mattapoisett

New Bedford

Rochester

Wareham

Westport

signed this 11th day of January, 1991

through the auspices of the Buzzards Bay Project to allow municipal officials a role in the direction of the Project. However, the BBAC has now evolved into an independent voice speaking for Buzzards Bay towns.

The first major step in the evolution was hiring an executive director with the primary responsibility of promoting implementation of the CCMP by organizing local action and developing regional approaches to common local problems. The executive director has four major tasks:

- Work with the BBAC to assist in the development of an organizational purpose to facilitate CCMP action.
- Diagnose the capability of local boards to implement the CCMP recommendations and work with the BBAC to correct any identified problems.
- Facilitate the provision of technical assistance to local boards and officials to carry out their CCMP responsibilities.
- Work towards the development of mechanisms for ensuring the long term implementation of the plan. Develop inter-municipal cooperation procedures and explore financing alternatives.

The initial accomplishment of the BBAC was the unanimous agreement of all 12 member communities to sign the Buzzards Bay Action Compact. This includes all 10 coastal communities plus Rochester and Acushnet which do not have coastline but are within a few miles of the Bay. The Compact's major features are: 1) agreement to exchange information and ideas to expedite the region's ability to implement sound environmental regulations and enhance Buzzards Bay and; 2) agreement to review and update town regulations in support of the action plans contained in the CCMP. The Compact was signed by the Mayor of New Bedford and the leading Selectman from each of the other 11 towns on January 11, 1991. Since the signing of the Compact, Plymouth has also joined the BBAC. The 4 additional towns that lie in the outer reaches of the Buzzards Bay drainage basin are presently being approached to become member communities. The evolution of the BBAC into an action-oriented organization and the adoption of the Buzzard Bay Compact are major achievements for an area with no history of conducting regional programs.

Ultimately, the success of the BBAC will hinge upon the continued ability to fund an executive director. EPA Region I has provided funding for 2 years, and it is hoped that the member communities will combine to appropriate funds each year after that.

Taking Legislative Action

The Massachusetts Legislature is considering a bill that proposes to establish a shellfish grant program to provide financial assistance to local communities for enhancing shellfish productivity. This program would replace the shellfish reimbursement program that had been in effect for nearly 30 years. This bill should be enacted at a funding level of $400,000.

In 1988, the Massachusetts Legislature passed a transportation bond bill containing a number of provisions for control of nonpoint sources. One provision created a stormwater runoff grant program. This grant program should be expanded to fund stormwater runoff projects in the Buzzards Bay area.

Since 1987, proposed legislation has been before the Massachusetts Legislature to establish a state program for nonpoint-source control. The Legislature should take immediate action to formally establish such a program within EOEA in order to provide regulatory authority to control and abate nonpoint-source pollution.

At the federal level, there are several bills now pending before the Congress that would address estuarine protection issues such as elimination of marine combined sewer overflows, establishment of marine water quality standards, and improved point and nonpoint-source marine pollution control. Passage of these bills would provide stronger regulatory tools for EPA and the states to control coastal pollution.

Other federal legislation has been introduced by Congressman Studds and is referred to as "Operation Coastal Shield of 1991". In particular, this Act seeks to extend EPA's involvement in each estuary's management conference beyond the approval of the CCMP. Operation Coastal Shield also authorizes funds up to $20 million per year for National Estuary Programs with an approved CCMP.

Institutionalizing the CCMP

CZM has a well established and effective review process for evaluating actions, especially federal actions, that may impact the state's delineated coastal zone. This process has been institutionalized within the state's governmental framework for over 12 years. It is well suited for overseeing proposed actions or projects for their consistency with the CCMP. While the review of federal actions through the "federal consistency" review process carries the greatest authority, CZM presents the added dimension of reviewing other actions that will significantly affect the coastal zone. This is particularly relevant to Buzzards Bay where the CCMP has identified local land use activities as its area of greatest concern.

The Buzzards Bay Management Committee in consideration of this, as well as the NOAA-EPA Agreement ("... to avoid duplication of effort ... and the development of conflicting regulatory mechanisms...") has determined that it is in the best interest of the Buzzards Bay Project and its CCMP to delegate the function of federal consistency review and the review of other non-federal actions to CZM. This will be accomplished by incorporating the CCMP Action Plans into the Massachusetts Coastal Zone Management Plan (CZMP).

The most significant result from incorporation of the CCMP into the CZMP will be the expansion of the coastal zone boundary to encompass some or all of the Buzzards Bay drainage basin and thus expand CZM's oversight. The evaluation of projects, many of which involve critical land-use decisions in the upper reaches of the basin, would be most valuable to CZM and the Buzzards Bay Project. The recent reauthorization of the Coastal Zone Management Act has strengthened the state's authority to review land-side effects and it should provide the flexibility for allowing this change.

After the Administrator of EPA signs the final CCMP for Buzzards Bay, the process of incorporating the document within the state's coastal program will begin. New CZMP regulatory policies will be drafted that apply only to the Buzzards Bay drainage basin. In addition, non-regulatory policies that apply to non-enforceable CCMP actions will also be drafted. Because this will be the first attempt to merge a CCMP

and a CZMP, it will receive close scrutiny and probably require a lengthy review period. A complete discussion of this and other consistency issues, together with the list of federal programs to be reviewed, is available in the Buzzards Bay Federal Consistency Report.

The Buzzards Bay Project envisions that once the CCMP is merged with the CZMP, CZM will be responsible for periodically convening the Management Committee on an as needed basis. The primary purpose will be to ensure that state and federal agencies are complying with their CCMP commitments. All state and federal agencies that have made implementation commitments will be represented on the Management Committee. The BBAC will also be represented on the committee and will be responsible for municipal commitments. In order to keep the management framework intact and help ensure that implementation is successful, the Buzzards Bay Management Conference will ask the EPA Administrator to extend the Conference for an additional five years.

Addendum to Chapter 9

Supporting Documentation for CCMP Implementation

The following correspondence and endorsement demonstrate the wide-spread support garnered for the Buzzards Bay CCMP. Included are a resolution from the Buzzards Bay Action Committee, representing the municipalities of Buzzards Bay, as well as letters of commitment from key federal and state agencies. Also included is a federal consistency determination from the Massachusetts Coastal Zone Management Office. The Buzzards Bay Project is proud of the unanimous acceptance and endorsement that the CCMP has received from those who will be directly responsible for its implementation. The BBP is confident that this will be translated into the long-term protection of Buzzards Bay as a special national resource.

RESOLUTION OF SUPPORT FOR THE COMPREHENSIVE CONSERVATION AND MANAGEMENT PLAN FOR BUZZARDS BAY

Whereas: The member municipalities of the Buzzards Bay Action Committee recognize the importance of a clean Buzzards Bay to the regions health, the commercial and recreational values of Buzzards Bay and its economic vitality.

Whereas: The municipalities of the Buzzards Bay region recognize the serious threat to its cherished bay.

Whereas: After a five year in depth study by the Buzzards Bay Project, a plan of action containing numerous recommendations to protect and enhance the water quality and living resources of the bay has been written and thoroughly reviewed .

Whereas: The 13 member municipalities of the Buzzards Bay Action Committee have agreed unanimously to enact said plan as stated in the Buzzards Bay Action Compact, dated January 11, 1991.

Be it therefore resolved that: The membership of the Buzzards Bay Action Committee unanimously agree to request that the Honorable William F. Weld, Governor of the Commonwealth of Massachusetts and Mr. William K. Reilly Director of the United States Environmental Protection Agency to approve the final draft dated July 1991 of the Buzzards Bay Comprehensive Conservation and Management Plan as soon as possible.

By: Acushnet ____________ Mattapoisett ____________

Bourne ____________ New Bedford ____________

Dartmouth ____________ Plymouth ____________

Fairhaven ____________ Rochester ____________

Falmouth ____________ Wareham ____________

Gosnold ____________ Westport ____________

Marion ____________

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection
One Winter Street
Boston, Massachusetts 02108

Daniel S. Greenbaum
Commissioner

December 7, 1990

Dear Secretary DeVillars and Administrator Belaga:

The Department of Environmental Protection (DEP) has taken an active role in the development of the Buzzards Bay Comprehensive Conservation and Management Plan (CCMP). Over the last few months, DEP has evaluated the goals, objectives and commitments outlined in the draft CCMP. Much of the responsibility required by this important document falls to DEP for implementation. We take this responsibility seriously. The following attachment summarizes the major DEP commitments and target dates for completing them.

The regulatory framework to meet these commitments currently exists. Certain regulations such as Title 5 (the State Sanitary Code) and the Water Quality Standards are proposed for regular review and update and will further strengthen the Department's ability to improve water quality. Over the next three years, DEP will incorporate the implementation goals into our program plans and will strive to meet or exceed each of the commitments.

Based on our review of the draft document, we believe that the goals of the CCMP can be met by the cooperative relationship of DEP and local environmental officials, supported by EPA. I look forward to working together to make this country's first CCMP a success to protect the important resources of Buzzards Bay.

Very truly yours,

Daniel S. Greenbaum
Commissioner

DG/BD/la

Attachment
\ccmp

DEP COMMITMENTS FOR IMPLEMENTING THE CCMP

Managing Nitrogen Sensitive Embayments

DEP will adopt a regulatory standard for nitrogen inputs to sensitive embayments in its 1993 revision to State Water Quality Standards. Target Date: 6/93.

Interim Actions

By 12/92 DEP will adopt a regulatory policy on nitrogen loading to coastal waters and field test it. DEP will prepare a nitrogen budget and nitrogen-specific waste load allocation for Marion Harbor (specific monitoring and loading studies will be coordinated with EPA's Waquoit Bay Project which is determining nitrogen transport and uptake mechanisms for that Bay). Using this information, DEP's Antidegradation Task Force will adopt an interim policy on nitrogen control and will develop a nutrient water quality standard. EPA and the Buzzards Bay Project (BBP) will develop a list of nitrogen-sensitive embayments in Buzzards Bay (using embayment flushing rates currently being developed by the Project) which will be used to determine where to apply the state standard.

DEP will actively promote the development and acceptance of cost-effective alternative technologies for denitrification. Target Date: 12/91.

Interim Actions

DEP will continue to provide technical assistance and oversight to the town of Marion in developing its solar aquatics system for wastewater treatment.

Protecting and Enhancing Shellfish Resources

DEP will take enforcement for significant illegal discharges identified by DMF's sanitary surveys. Target Date: 12/93.

Controlling Stormwater Runoff

DEP will work cooperatively with EPA and develop a policy on stormwater permitting (addressing prioritization of discharges and permit requirements) and DEP will include provisions for stormwater permitting in its State Water Quality Standards. DEP will coordinate its regulatory authority (under MGL Ch. 131 s. 40, 310 CMR 4.00, Water quality Certifications, NPDES) for controlling stormwater runoff.

Target Date: 6/93.

Interim Actions

DEP in association with EPA will conduct a pilot stormwater permitting project in one or two Buzzards Bay towns. During the summer of 1991, discharges in these towns will be monitored before and after rain events by DEP and EPA. In late 1991 and early 1992, using the information gathered during this sampling project, DEP and EPA will issue joint permits for those discharges which are causing a significant water quality impact. In addition, DEP will work with EPA and the Town(s) to develop a policy on how many new discharges can be allowed or what types of best management practices must be put into place without causing state water quality criteria to be exceeded.

The DEP Antidegradation Task Force will consider the results of the above project in developing its stormwater policy for adoption in the 1993 revisions of the state water quality criteria.

Managing Sanitary Waste from Boats

Using its Chapter 91 permitting authority, DEP will require new marinas or expansions of existing marinas (greater than 10 additional slips) to have adequate pumpout facilities. Target Date: 12/92.

DEP will implement a policy ensuring adequate management treatment for sewage pumped from boats. Target Date: 1992.

DEP will implement a policy to eliminate toxic additives in marine sanitation devices. Target Date: 1991.

Interim Actions

DEP is currently developing its revisions to Title 5. An initial study is due 3/91, with final revisions scheduled by 12/91. In addition, DEP has completed a final Generic EIR on the use of Privately-owned Sewage Treatment Facilities (PSTFs). These studies will form the basis of DEP policies/regulations on the use of septic systems.

Protecting Wetland and Marine Habitat

DEP will use its water quality certification authority under Section 401 of the Clean Water Act and in conjunction with the Wetlands Protection Act to:

- Require an analysis of alternative strategies and options before wetlands are allowed to be destroyed or altered, and only allow destruction under extreme circumstances or in projects with an overriding public purpose.

- Require restoration or replication of any wetlands that are allowed to be altered or destroyed at a ratio of at least 1:1.

- Require the same level of analysis and protection for isolated vegetated wetlands and intermittent streams as for other wetland areas.

DEP will implement its Wetlands Conservancy Progam in Mattapoisett and Westport. Target Date: 1993.

Interim Actions

This initiative will include DEP conducting aerial flyovers and digitizing wetland areas using the ensuing photographs. Title restrictions governing alteration of wetlands will be placed on properties containing identified wetlands. This process has already successfully taken place in other Buzzard Bay towns.

DEP will establish criteria for designating wetlands as waters of the Commonwealth using water quality standards and subjecting them to stringent controls under the Antidegradation provision of the Clean Water Act. Target Date: 1992.

Planning for a Shifting Shoreline

DEP will amend its wetlands regulations and adopt performance standards for the resource area "Land Subject to Coastal Storm Flowage" (100 year floodplain). Target Date: 1991.

Managing Sewage Treatment Facilities

DEP will designate all exisitng aquatic Areas of Critical Environmental Concern (ACECs) as outstanding resource waters subject ot the highest level of protection under the Antidegradation provisions of the Clean Water Act. DEP will work with the BBP, CZM and the Cape Cod Commission to determine if additional areas within the Buzzards Bay watershed should be designated as ACECs. Target Date: 1992.

COASTAL ZONE
MANAGEMENT

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

October 4, 1990

Mr. David Fierra, Chairman
Buzzards Bay Project Management Committee
U.S. Environmental Protection Agency/R1
Water Management Division
JFK Federal Building
Boston, MA 02203-2211

Dear Mr. Fierra:

The Massachusetts Executive Office of Environmental Affairs' (EOEA) Coastal Zone Management (CZM) Program supports the overall goals and objectives of the Buzzards Bay Project as outlined in the Comprehensive Conservation and Management Plan (CCMP).

For Fiscal Year 1991 (FY91), The Massachusetts CZM Office commits to implementation of the following components of the Action Plan:

I. Managing Boat Waste.

A. CZM and EOEA's Department of Environmental Protection (DEP) will develop a program that ensures adequate pumpout facilities for all harbor areas.

1. DEP's Division of Wetlands and Waterways Regulation and Division of Water Pollution Control will advance this action item through recently enacted Tidelands Licensing Program Regulations (MGL CH. 91) and Water Quality standards, respectively, as a part of the CZM Program.

B. The CZM convened interagency Task Force on Marine Sanitation Devices will invite a member of the Buzzards Bay Advisory Committee (BBAC) to sit on the Task Force.

C. CZM and the U.S. Environmental Protection Agency (EPA) will work with Buzzards Bay municipalities to develop a strategy for nominating to EPA and designating "no discharge zones" within coastal embayments. CZM and EPA will work with the BBAC on which priority nominations will most affectively advance the goals and objectives of the Buzzards Bay Project CCMP.

D. Under CZM's Coastal Facilities Improvement Program, CZM will give consideration to eligible projects, including those of Buzzards Bay, that propose to construct municipal marine pump-out facilities where needed and appropriate.

II. Planning for a Shifting Shoreline.

A. CZM will assist Buzzards Bay area planning boards, conservation commissions and other relevant local committees, commissions and boards in mapping coastal areas that are, or will be, affected by erosion and/or sea level rise.

B. CZM will provide technical assistance to Buzzards Bay communities in developing by-laws, ordinances, regulations, guidelines and policies for building in flood zones mapped by the Federal Emergency Management Agency. Such building standards will be based upon the interests of public safety, environmental protection and public health. The standards will rely on scientifically accurate data.

III. Managing Dredging and Dredged Material Disposal.

A. CZM and the U.S. Army Corps of Engineers will form an interagency committee to develop a dredged material disposal plan for Buzzards Bay. Appropriate state and federal agencies, such as the National Marine Fisheries Service and EOEA's Division of Marine Fisheries will be invited to sit on the committee. A Buzzards Bay Dredged Material Regional Disposal Plan draft scope of work will be outlined. The draft will include alternative disposal sites beyond that of the traditional Cleveland Ledge site.

CZM will continue to develop and refine its FY91 commitments to the Buzzards Bay Project as the Management Conference completes its work on the final CCMP and begins first year implementation.

Sincerely,

Jeffrey R. Benoit
Director

JRB:JJC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

November 1, 1990

Mr. John DeVillars
Ms. Julie Belaga
Policy Committee
Buzzards Bay Project

Dear Secretary DeVillars and Administrator Belaga:

The Water Management Division of the Environmental Protection Agency (EPA) will provide staff expertise and available funding for three years toward ensuring successful implementation of the Buzzards Bay Comprehensive Conservation and Management Plan (CCMP).

EPA will contribute the specialized knowledge of its personnel on an as needed basis, especially the staff from the Marine and Estuarine Protection Section. In addition to the Project's base funding (presently $200,000) from the Office of Marine and Estuarine Protection in Washington, EPA Region I will provide $100,000 over two years to fund the Executive Director of the Buzzards Bay Advisory Committee (BBAC). We feel this is critical because the BBAC will hold the key to ultimate success in Buzzards Bay.

While primary implementation responsibility rests with state and local governments, EPA will assume a strong supporting role. The agency will contribute technical assistance where it is appropriate and provide leadership in developing new initiatives in Buzzards Bay. A full time staff position will be assigned to assist the Buzzards Bay Project in implementing the CCMP during the coming year. This assignment may be extended through 1993.

EPA specifically commits to the following activities:

Managing Nitrogen Sensitive Embayments:

EPA will assist the Department of Environmental Protection (DEP) in reviewing the solar aquatics technology to be tested in the town of Marion. Charles Conway, EPA wastewater treatment specialist, will be available to DEP in assessing this innovative treatment approach during 1991.

EPA will contribute the time of a water quality specialist to serve on DEP's Anti-Degradation Task Force. This group will be

addressing objectives contained in the CCMP's nitrogen strategy.

Stormwater Management:

EPA will assist DEP in developing a policy for stormwater permitting that will be incorporated in state water quality standards in 1993.

As interim measures, EPA will work with DEP and one or two towns willing to conduct a pilot stormwater permitting program. During the summer of 1991 priority discharges in these towns will be monitored before and after rain events. In late 1991 and early 1992, using the sampling information gathered, EPA will issue permits for those discharges causing a water quality impact, requiring that the state standard for coliform be met. In addition, EPA will work with DEP and the towns to develop a policy on how many new discharges can be allowed without exceeding state water quality criteria.

Managing Sanitary Wastes from Boats

EPA will designate at least one embayment as a no discharge zone during 1991.

As interim measures, EPA will prioritize embayments for no discharge zone status with assistance from the Buzzards Bay Project (BBP). If necessary and available, EPA may provide partial funding for pumpout facilities in priority embayments. EPA will assist the BBP in preparing no discharge zone applications for those embayments.

Managing Sewage Treatment Facilities

EPA will conduct evaluations of Dartmouth, Wareham and Fairhaven municipal discharges. Using the ten criteria established under Section 403(c) of the Clean Water Act, EPA will ensure that these discharges are not having an adverse impact on coastal water quality and ecosystems. This analysis will be completed by 9/91.

We look forward to fully participating as a partner agency in accomplishing the goals of the CCMP.

Sincerely,

David A. Fierra

David A. Fierra, Director
Water Management Division

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

March 14, 1991

Planning Directorate
Impact Analysis Division

Mr. David A. Fierra
Director of Water Management Division
U.S. Environmental Protection Agency
Region I
J.F.K. Building
Boston, Massachusetts 02203-2211

Dear Mr. Fierra:

The U.S. Army Corps of Engineers fully supports the goals and objectives contained in the Buzzards Bay Comprehensive Conservation and Management Plan (CCMP). We will be pleased to offer our expertise toward the protection and restoration of water quality, living resources and marine habitat in Buzzards Bay..

Implementation of the recommended actions in the CCMP will require a coordinated effort by local, state and federal agencies. We look forward to participating in this process as an active member of the Buzzards Bay Management Committee and by working cooperatively with Project staff.

Specifically, the Corps of Engineers commits its resources to the following activities:

1) Working cooperatively with the Executive Office of Environmental Affairs to initiate an interagency committee of local, state and federal authorities to develop a dredged material disposal plan for Buzzards Bay. A task force will be assembled by 12/91.

2) Co-chairing the above-mentioned task force. The task force will be responsible for summarizing the needs and character of dredged material disposal for Buzzards Bay and developing a management plan. As part of the plan, the task force will review the permitting process for the purpose of facilitating greater efficiency while ensuring protection of the environment. A draft management plan will be completed in 1993.

3) Exchanging and transferring data on sediment and water quality as well as climatological and hydrographic data with the Buzzards Bay Project. This will be compiled in an accessible database for users. It will be an ongoing project to begin in October, 1991.

4) Pending the availability of funds, NED will support the Buzzards Bay Project with economic analysis of resource values in the Bay. Shellfish values will be assessed from data provided by the Massachusetts Division of Marine Fisheries.

5) Continuing to work with the U.S. Coast Guard to promote safe navigation in Buzzards Bay and the Cape Cod Canal. This will include evaluating measures which could reduce the potential for shipping accidents in the western approach to the Canal. One specific measure involves proposed Cape Cod Canal regulation changes which would require earlier notification by commercial shipping interests requesting permission to enter the west end of the canal. This change, already implemented on an informal basis, will serve to forewarn mariners of potential difficulties in the area and enable them to respond accordingly.

In addition, the Corps will be extensively involved in future remedial actions at the New Bedford Harbor Superfund Site. These activities will include an extensive monitoring program. We will share information and coordinate our activities with the Buzzards Bay Project to the extent possible.

We look forward to being an active partner in the longterm protection of Buzzards Bay.

Sincerely,

LTC, E Actg Cdr

Philip R. Harris
Colonel, Corps of Engineers
Division Engineer

SOUTHEASTERN REGIONAL PLANNING
AND ECONOMIC DEVELOPMENT DISTRICT
88 BROADWAY • TAUNTON, MASS. • 02780 • (508) 824-1367

March 11, 1991

Mr. David Fierra, Chairman
Buzzards Bay Project Management Committee
U.S. Environmental Protection Agency
Water Management Division
JFK Federal Building
Boston, MA 02203

Dear Mr. Fierra:

The Southeastern Regional Planning and Economic Development District has played a major role in the development of the Comprehensive Conservation and Management Plan for Buzzards Bay, and wishes to participate in its implementation.

SRPEDD is one of 13 regional planning agencies created by the Massachusetts legislature. SRPEDD has jurisdiction over all cities and towns in the Buzzards Bay watershed except for Falmouth, Bourne and Plymouth. Our powers are advisory only. As a regional agency, SRPEDD will work closely with the Buzzards Bay Action Committee and the Coalition for Buzzards Bay to prevent duplication of effort.

We pledge to undertake the following actions to assist in the CCMP's implementation:

Overall

- SRPEDD will use its statutory review authority under Executive Order 12372 and the Massachusetts Environmental Policy Act to seek compliance with the CCMP. SRPEDD routinely makes comments and recommendations under these programs.

- As a comprehensive planning agency, SRPEDD has concerns which go beyond environmental issues to encompass economic development, transportation and housing, among others. SRPEDD policies and plans promote the idea that a strong economy and a healthy environment are compatible with each other if there is good comprehensive planning. We will work to insure that planning and development in the Buzzards Bay region is balanced, so that needs for jobs, housing and transportation can be met without adverse impact on the Bay.

- SRPEDD's planning and review will consider development outside the drainage area and the indirect impacts such development could have on Buzzards Bay.

Land Use Management

- SRPEDD supports the recommended regional actions on p.141 of the CCMP, specifically calling for RPA's to provide technical

assistance in conducting buildout analyses and planning for land use management and for RPA's to aggressively protect critical resources. We concur with these recommendations consistent with our budget, and will use our review authority to further these actions.

Managing Nitrogen Sensitive Embayments

- SRPEDD will employ buildout analyses (see Land Use Management above) to determine total projected nitrogen loading for various buildout scenarios.

Controlling Stormwater Runoff

- SRPEDD will continue to work with municipalities to revise their subdivision regulations to reduce stormwater runoff from new development.

Reducing Toxic Pollution

- SRPEDD's industrial source reduction program will be pursued in Buzzards Bay. Some effort is projected for 1991 with New Bedford industries.

It is our hope that the collective efforts of all federal, state, regional and local agencies can make the CCMP a model plan to preserve Buzzards Bay.

Sincerely,

Stephen C. Smith

Stephen C. Smith
Executive Director

SCS:njb
(L-91-56)

COASTAL ZONE
MANAGEMENT

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

Memorandum of Understanding

The Massachusetts Coastal Zone Management Office
And The Buzzards Bay Action Committee

In order to maximize scarce manpower and provide as much protection as possible to the sensitive coastal resources of Buzzards Bay from the accidental spillage of oil, Massachusetts Coastal Zone Management Office (MCZM) and the Buzzards Bay Action Committee (BBAC) agree to work in a cooperative program that will lead to a regional strategy for managing oil spills in Buzzards Bay.

MCZM Southeast Region Activities

-MCZM Southeast will provide each town with a generic outline for a local oil spill plan to be used in the preparation of a plan for local oil spill coordinators of each town in Buzzards Bay. The outline will be loosely based on the U. S. Coast Guard Oil Spill Contingency Plan to facilitate easy transfer of relevant information from the local plan to the federal plan.

-MCZM Southeast will provide technical assistance to Buzzards Bay communities to facilitate the identification and prioritization of sensitive environmental areas in danger of damage from oil spills. It will be up to each town to map this information for inclusion in the final plan. CZM will provide mapping guidelines to insure consistency between towns within the region.

-MCZM Southeast will work on a system to regionally prioritize the areas identified by each town, to provide a regional hierarchy for use in the event of a catastrophic oil spill.

-MCZM Southeast will encourage the satisfactory completion of oil spill contingency plans by each Buzzards Bay town.

BBAC Activities

-BBAC will ensure that each town appoints an oil spill coordinator responsible for maintaining and overseeing the deployment of equipment and directing response activities including coordinating with the Coast Guard during a spill event.

-BBAC will develop a mutual aid protocol that will govern the purchase and use of oil spill equipment by the towns.

-The BBAC will coordinate the sharing of equipment between towns, once a mutual aid

agreement is in place between the Buzzards Bay Communities, and spill equipment lists have been made for each town.

-BBAC will develop a model bylaw that will require all boatyards and marinas to maintain specified oil containment and cleanup equipment on site.

-BBAC will develop a model bylaw that will serve to manage the fueling of vessels.

-BBAC will coordinate the logistics of oil spill training exercises with the towns.

Jeffrey R. Benoit
Director, CZM

Edwin H.B. Pratt
Chairman, BBAC

The Commonwealth of Massachusetts
Division of Marine Fisheries
Leverett Saltonstall State Office Building
100 Cambridge Street
Boston, Massachusetts 02202
727-3193

PHILIP G. COATES
DIRECTOR

March 6, 1991

Mr. David A. Fierra
Director of Water Management Division
WAA-442
U.S. Environmental Protection Agency
John F. Kennedy Federal Building 2100
Boston, Massachusetts 02203-2211

Dear Mr. Fierra:

The Division of Marine Fisheries(DMF) has taken an active role in the development of the Buzzard Bay Comprehensive Conservation and Management Plan(CCMP). Over the last few months, DMF has evaluated the goals, objectives and commitments outlined in the draft CCMP particularly as they relate to living marine resources and especially shellfish growing areas. The responsibility for protecting and enhancing the shellfish resources and growing areas is shared by the municipalities and DMF. The towns have the primary responsibility and authority to protect shellfish growing areas from contamination that has forced public health closures. DMF is responsible for conducting shellfish sanitary surveys and classifying growing areas as approved for harvesting or prohibited(closed) to harvesting of shellfish for human consumption. Both DMF and the municipalities share responsibility for management of the shellfisheries.

The DMF takes it's responsibilities seriously and is committed to working with Buzzards Bay communities as outlined in recommendations number 2 and 3 of the CCMP recommended action regarding protection and enhancement of shellfish growing areas for 1991(see attached).

Throughout this current year, DMF will incorporate the goals of establishing guidelines for towns to conduct shoreline surveys and field train designated town personnel to insure continued cooperative shoreline survey programs and increase the number of conditionally approved shellfish areas.

Based on our review of the draft CCMP, we believe that DMF can meet these goals by working cooperatively with local officials.

Very Truly Yours,

Philip G. Coates
Director

PROTECTION AND ENHANCEMENT OF SHELLFISH GROWING AREAS

Goal

Increase availability of shellfish resources for recreational and commercial uses.

Strategy

The enhancement of shellfish growing areas demands a twofold approach. The primary method requires the towns to correct the sources of contamination that are forcing shellfish closures and not permitting any new sources in shellfish areas. Because of the extent of the problem and the cost of solutions, towns will need to set priorities. Secondarily, towns should work closely with the Division of Marine Fisheries (DMF) in an attempt to keep open as many shellfish areas as possible.

Major Recommended Actions

1) Towns should correct the sources of contamination that are closing shellfish beds and not allow new sources in these areas: Boards of Health, Departments of Public Works and Shellfish Wardens should take the initiative for accomplishing this.

Shellfish Sanitary Survey Reports from DMF should be the starting place for developing a strategy. The reports will indicate suspected and identified sources of contamination. The Board of Health should enforce the upgrade of all gross septic system failures and remedy illegal connections to storm drains prior to consideration of solutions to stormwater problems. The Boards of Health should not allow any additional pollution without requiring an NPDES permit from the Environmental Protection Agency. (See Stormwater Action Plan for stormwater related problems.)

2) Selectmen should designate individuals in each town (preferably with public health responsibility) in the continuing update of shoreline survey information in cooperation with DMF.

DMF should provide field training for these individuals. In addition, DMF and the towns should develop long-term cooperative arrangements that ensure consistency of town participation and maximizes limited state personnel with local manpower.

3) DMF and the towns should work together and increase the number of conditionally approved shellfish areas: Selectmen should be responsible for demonstrating to DMF the communities' commitment in undertaking this effort.

DMF should meet with the communities and explain the necessary procedures and commitment of municipal funds for establishing a program for conditionally approving shellfish areas. DMF and the individual communities should determine whether the necessary funding and manpower is available to accomplish the task.

COASTAL ZONE
MANAGEMENT

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

July 1, 1991

David A. Fierra, Chairman
Buzzards Bay Management Committee
c/o US EPA, Water Management Division
WQE-1900
JFK Federal Building
Boston, MA 02203-2211

Re: Federal Consistency Certification: Buzzards Bay Program Comprehensive Conservation and Management Plan (CCMP).

Dear Mr. Fierra:

The Massachusetts Coastal Zone Management (MCZM) Office has completed its review of the proposed CCMP for Buzzards Bay.

We concur with your certification and find that the activity as proposed is consistent with the MCZM Program Policies.

If the above-referenced proposal, which has received this concurrence from MCZM, is modified in any manner or is noted to be having effects on the coastal zone or its uses that are substantially different than originally proposed, please submit an explanation of the nature of the change to this Office pursuant to 301 CMR 21.17 and 15 CFR 930.66.

Thank you for your continued cooperation and good luck with the project.

Sincerely,

Jeffrey R. Benoit

Jeffrey R. Benoit,
Director

JRB/jbm

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Glossary

Aerobic. Living, active, or occurring only in the presence of oxygen.

Algal Bloom. A condition resulting from excessive nutrient levels or other physical and chemical conditions that enable algae to reproduce rapidly.

Anadromous Fish. A species, such as salmon, alewives, or river herring, that is born in fresh water, spends a large part of its life in the sea, and returns to freshwater rivers and streams to procreate.

Anaerobic. A process occurring in the absence of free oxygen.

Anoxic. A condition in which oxygen is absent.

Antidegradation provision. Standards in the Clean Water Act which regulate activities in order to maintain and protect existing water uses in designated areas.

Area of Critical Environmental Concern (ACEC). An area encompassing land and water resources of regional or statewide importance, designated by the Secretary of the Executive Office of Environmental Affairs (in accordance with 301 CMR[1] 12:6.40-6.55), to receive additional protection and management.

Aromatic Hydrocarbons. Compounds that contain at least one 6-carbon ring; often important components of oils.

Attenuation. The process by which a compound is reduced in concentration over time or distance through absorption, degradation, or transformation.

Barrier Beach. A narrow low-lying strip of land generally consisting of coastal beaches and coastal dunes extending roughly parallel to the trend of the coast. It is separated from the mainland by a narrow body of fresh, brackish, or saline water or by a marsh system.

Beneficial Uses. Uses designated in Massachusetts Surface Water Quality Standards — for public water supply, for protection and propagation of fish and other wildlife, and for primary and secondary contact recreation — and any other uses that do not impair these designated uses.

Best Management Practice (BMP). A method for preventing or reducing the pollution resulting from an activity. The term originated from rules and regulation in Section 208 of the Clean Water Act. Specific BMPs are defined for each pollution source.

Bioaccumulation. The process by which a contaminant accumulates in the tissues of an individual organism. For example, certain chemicals in food eaten by a fish tend to accumulate in its liver and other tissues.

1 CMR = Commonwealth of Massachusetts Regulation. Copies of all state regulations can be obtained in the State House Bookstore in Boston. See all entries under Massachusetts General Law.

Biochemical Oxygen Demand (BOD). A measure of the organic material that can be readily oxidized through microbial decomposition, consuming oxygen dissolved in water. BOD is often used to assess the effects of a discharge, especially sewage.

Board of Health. A municipal, elected or appointed authority responsible for administering bylaws addressing health, safety, and welfare issues covered in the State Environmental Code, including Title 5.

Bordering Vegetated Wetlands (BVW). As defined in 310 CMR 10.55, the Wetlands Protection Act Regulation, freshwater wetlands that border on creeks, rivers, streams, ponds, and lakes. The types of freshwater wetlands are wet meadows, marshes, swamps, and bogs. They are areas where the topography is low and flat, and where the soils are saturated at least part of the year.

Buildout Analysis. A parcel-by-parcel analysis to estimate the total number of existing and developable units, based on current zoning and other land-use regulations. Such an analysis is essential for managing and limiting impacts of growth.

Cape Cod Commission (CCC). A regional planning agency, formerly known as the Cape Cod Planning and Economic Development Commission (CCPEDC), which includes Buzzards Bay's eastern shore municipalities, Bourne, and Falmouth. As a result of legislative action and local approval, this agency has review authority over land-use decisions throughout Cape Cod. The CCC also provides technical assistance, coordinates inter-municipal activities, and serves as a depository for regional information.

Carcinogen. A substance that causes cancer.

Carrying Capacity. The limit of a natural or man-made system to absorb perturbations, inputs, or population growth.

Catadromous Fish. A freshwater species that spawns in salt water.

Cesspool. A covered pit with a perforated lining in the bottom into which raw sewage is discharged: the liquid portion of the sewage is disposed of by seeping or leaching into the surrounding porous soil; the solids, or sludge, are retained in the pit to undergo partial decomposition before occasional or intermittent removal. Cesspools are no longer permitted for waste disposal.

Chlorinated Hydrocarbons (CHCs). All aromatic and nonaromatic hydrocarbons containing chlorine atoms. Includes certain pesticides, polychlorinated biphenyls, and other solvents.

Coastal Bank. As defined in 310 CMR 10.30 (2), the Wetlands Protection Act Regulation, the seaward face or side of any elevated landform, other than a coastal dune, which lies at the landward edge of a coastal beach, land subject to tidal action, or other wetland. A typical working definition is "the first major break in slope above the 100-year flood elevation, but this definition may not apply in certain special circumstances.

Coastal Wetland. As defined in Massachusetts General Law Chapter 131, Section 40, the Wetlands Protection Act Regulation, any bank, marsh, swamp, meadow, flat, or other low land subject to tidal action or coastal storm flowage and such contiguous

land as the Commissioner of the Department of Environmental Protection deems necessary.

Coastal Zone. As officially defined in 301 CMR 20.00, the zone that extends landward to 100 feet beyond specified major roads, rail lines, or other visible rights-of-way; includes all of Cape Cod, Martha's Vineyard, Nantucket, and Gosnold; and extends seaward to the edge of the state territorial sea.

Coastal Zone Management (CZM) Program. A federally funded and approved state program under the Federal Coastal Zone Management Act of 1972. The program reviews federal permitting, licensing, funding, and development activities in the coastal zone for consistency with state policies.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). A federal law administered by the Environmental Protection Agency, dealing with the assessment and remediation of hazardous material disposal sites. Superfund activities are performed under this Act.

Combined Sewer Overflow (CSO). A pipe that, during storms, discharges untreated wastewater from a sewer system that carries both sanitary wastewater and stormwater. The overflow occurs because a system does not have the capacity to transport and treat the increased flow caused by stormwater runoff.

Combined Sewers. A system that carries both sewage and stormwater runoff. In dry weather, all flow from sewer lines and street drains goes to the wastewater treatment plant. During heavy rains, treatment plants usually can handle only part of this flow, and the sewer system is overloaded. The overflow mixture of sewage and stormwater is discharged untreated into the receiving water.

Conservation Commission. An appointed municipal agency responsible for administering the Wetlands Protection Act at the local level.

Contaminant. A substance that is not naturally present in the environment or is present in unnatural concentrations that can, in sufficient concentration, adversely alter an environment. Federal regulations (40 CFR 230) for the discharge of dredged or fill material into navigable waters regulated by Section 404 of the federal Clean Water Act define a contaminant as a chemical or biological substance in a form that can be incorporated into, onto, or be ingested by and that harms aquatic organisms, consumers of aquatic organisms, or users of the aquatic environment.

Cumulative Effects. The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be serious.

Department of Environmental Management (DEM). The state agency responsible for managing natural resources, including, but not limited to, water resources. DEM administers the Massachusetts Ocean Sanctuaries Act.

Department of Environmental Protection (DEP). The state agency, formerly known as the Department of Environmental Quality Engineering, responsible for administering laws and regulations protecting air quality, water supply, and water resources, such as Chapter 91 and Title 5, and for administering programs such as the Wetlands

Protection Program and Wetlands Restriction Program. It is also responsible for overseeing the cleanup of hazardous waste sites and responding to hazardous waste emergencies and accidents.

Designated Port Areas. As defined in Chapter 91 Regulations, that portion of certain urban harbors where maritime-dependent industrial uses are encouraged to locate. This concentration of uses maximizes public investments in dredging, bulkheads, piers, and other port facilities.

Division of Marine Fisheries (DMF). The agency within the Massachusetts Executive Office of Environmental Affairs responsible for managing the Shellfish Sanitation Program, overseeing shellfish relays, depuration plants, commercial fishing licenses, and management and stock assessment of Massachusetts fisheries.

Drainage Basin. The land that surrounds a body of water and contributes fresh water, either from streams, groundwater, or surface runoff, to that body of water.

Dredging. The removal of materials including, but not limited to, rocks, bottom sediments, debris, sand, refuse, and plant or animal matter in any excavating, cleaning, deepening, widening or lengthening, either permanently or temporarily, of any tidelands, rivers, streams, ponds or other waters of the Commonwealth, as defined in 310 CMR 9:04.

Ecosystem. A community of living organisms interacting with one another and with their physical environment, such as a salt marsh, an embayment, or an estuary. A system such as Buzzards Bay is considered a sum of these interconnected ecosystems.

Eelgrass (*Zostera marina*). A marine flowering plant that grows subtidally in sand and mud. In Buzzards Bay, eelgrass is widespread and grows to depths of 20 feet. Eelgrass beds are an important habitat and nursery for fish, shellfish, and waterfowl.

Effluent. The outflow of water, with or without pollutants, usually from a pipe.

Embayments. A small bay or any small semi-enclosed coastal water body whose opening to a larger body of water is restricted.

Environmental Protection Agency (EPA). The federal agency principally responsible for administering the Clean Water Act, National Estuary Program, CERCLA, Superfund, and other major federal environmental programs.

Estuary. A semi-enclosed coastal body of water having a free connection with the open sea and within which seawater is measurably diluted with fresh water.

Eutrophication. The process of nutrient enrichment in aquatic ecosystems. In marine systems, eutrophication results principally from nitrogen inputs from human activities such as sewage disposal and fertilizer use. The addition of nitrogen to coastal waters stimulates algal blooms and growth of bacteria, and can cause broad shifts in ecological communities present and contribute to anoxic events and fish kills. In freshwater systems and in parts of estuaries below 5 ppt salinity, phosphorus is likely to be the limiting nutrient and the cause of eutrophic effects.

Fecal Coliform. Bacteria that are present in the intestines of feces of warm-blooded animals and that are often used as indicators of the sanitary quality of water. Their degree of presence in water is expressed as the number of bacteria per 100 milliliters

of the sample. The greater the number of fecal coliforms, the higher the risk of exposure to human pathogens.

Floodplain. The area of shorelands extending inland from the normal yearly maximum stormwater level to the highest expected stormwater level in a given period of time (e.g., 5, 50, 100 years).

Flushing Time. The mean length of time for a pollutant entering a water body to be removed by natural forces such as tides and currents; also referred to as residence time or turnover time.

Food and Drug Administration (FDA). The federal agency that is responsible for, among other things, administering the National Shellfish Sanitation Program.

General Bylaws. Local laws that can be adopted with a simple majority vote at the town meetings. Cities adopt ordinances by a simple majority vote of the city council.

Grandfathering. A provision from Massachusetts General Law Chapter 40 that allows existing land uses or structures to remain without coming into compliance with upgraded zoning or building requirements.

Habitat. The specific area or environment in which a particular type of plant or animal lives. An organism's habitat must provide all the basic requirements for survival.

Heavy Metals. A group of elements that is present in the environment from natural and anthropogenic sources and can produce toxic effects. This group includes mercury, copper, cadmium, zinc, and arsenic.

Hypoxia. A condition in which oxygen is deficient.

Impervious Surface. A surface that cannot be easily penetrated. For instance, rain does not readily penetrate asphalt or concrete pavement.

Impervious Material. With respect to Title 5 Regulations, a material or soil having a percolation rate greater than 30 minutes per inch; including, but not limited to, bedrock, peat, loam, and organic matter.

Industrial Pretreatment. The removal or reduction of certain contaminants from industrial wastewater before it is discharged into a municipal sewer system. Reduced loading of contaminants from industries can reduce the expense of managing and designing municipal treatment facilities.

Infiltration. The penetration of water through the ground surface into subsurface soil. Some contaminants are removed by this process.

Kettle Holes. A small, glacially formed freshwater body.

Leaching Facility. An approved structure used for the dispersion of septic-tank effluent into the soil. These include leaching pits, galleries, chambers, trenches, and fields as described in 310 CMR 15.11 through 15.15.

Massachusetts Environmental Policy Act (MEPA). Massachusetts General Laws Chapter 30, the state law, administered by the MEPA unit within the Executive Office of Environmental Affairs, establishing a uniform system of environmental impact review.

Massachusetts General Law Chapter 40. The state zoning law for which the municipal planning boards and the zoning boards of appeal are responsible.

Massachusetts General Law Chapter 41. The state law governing subdivisions, administered by municipal planning boards and zoning boards of appeal.

Massachusetts General Law Chapter 91. The Waterways Licensing Program governing waterfront development in Massachusetts, administered by the Department of Environmental Protection and the Office of Coastal Zone Management.

Massachusetts General Law Chapter 111. State law (Section 40) that vests municipal boards of health with the broad authority for maintaining the health, safety, and welfare of the public. Regulations are promulgated under this act through 310 CMR 10.0.

Massachusetts General Law Chapter 131, Section 40. The Wetlands Protection Act (WPA) administered by conservation commissions on the municipal level and by the Department of Environmental Protection on the state level.

Massachusetts Ocean Sanctuaries Act. Administered by the Department of Environmental Management, the state law governing activities and structures in the ocean, seabed, or subsoil that would have an adverse affect on the "ecology or appearance" of the ocean sanctuary. Buzzards Bay is included in the Cape and Island Ocean Sanctuary.

Mean High Water. The average height of the high tides over a 19-year period.

Mean Low Water. The average height of the low tides over a 19-year period.

Mounded Septic System. Similar to a typical septic system except the leaching facility, in order to maintain an adequate separation to groundwater, is installed in mounded or filled material above the naturally occurring ground elevation. The mounds are typically planted with grass vegetation. In the velocity zone, some mounded systems are armored with rip rap, but this approach conflicts with CZM policies.

National Estuary Program (NEP). A state grant program within the U.S. Environmental Protection Agency established to designate estuaries of national significance and to incorporate scientific research into planning activities.

National Pollutant Discharge Elimination System (NPDES). A requirement in the federal Clean Water Act for dischargers to obtain permits. EPA is responsible for administering this program in Massachusetts.

Nonpoint-Source Pollution. Pollution that is generated over a relatively wide area and dispersed rather than discharged from a pipe. Common sources of nonpoint pollution include stormwater runoff, failed septic systems, and marinas.

Notice of Intent. A form submitted to the municipal conservation commission and DEP which serves as the application for an Order of Conditions under the Wetlands Protection Act. It includes information on the site's wetland resources and the proposed work.

Nutrients. Essential chemicals needed by plants and animals for growth. Excessive amounts of nutrients, nitrogen, and phosphorus, for example, can lead to degradation

of water quality and growth of excessive amounts of algae. Some nutrients can be toxic at high concentrations.

Order of Conditions. The document, issued by a conservation commission, containing conditions that regulate or prohibit an activity proposed in the resource area defined in MGL Chapter 131 §40.

Pathogen. Any organism, but particularly bacteria and viruses, that causes disease. For example, human pathogens in shellfish can cause hepatitis and intestinal disorders.

Performance Standards. Federal, state, or local codified specifications that condition development activities to limit the extent to which a structure or activity may affect the immediate environment.

Petroleum Hydrocarbons. The mixture of hydrocarbons normally found in petroleum; includes hundreds of chemical compounds.

Point-Source Pollution. Pollution originating at a particular place, such as a sewage treatment plant, outfall, or other discharge pipe.

Polychlorinated Biphenyls (PCBs). A class of chlorinated aromatic compounds composed of two fused benzene rings and two or more chlorine atoms; used in heat exchange, insulating fluids and other applications. There are 209 different PCBs.

Porous Pavement. A hard surface that can support some vehicular activities, such as parking and light traffic, and which can also allow significant amounts of water to pass through.

Primary Treatment. Physical processes used to substantially remove floating and settleable solids in wastewater. This process can include screening, grit removal, and sedimentation.

Publicly Owned Treatment Works (POTW). Any sewage treatment system operated by a public agency.

Pumpout. The process through which septage is removed from a septic tank or boat holding tank, usually by a mobile tank attached to a truck, and taken to a wastewater treatment plant for disposal.

Request for Determination of Applicability. A written request made by any person to a conservation commission or to the Department of Environmental Protection for a determination as to whether a site or work on that site is subject to the Wetlands Protection Act.

Runoff. The part of precipitation that travels overland and appears in surface streams or other receiving water bodies.

Salt Marsh. A coastal wetland that extends landward up to the highest high tide line, that is, the highest spring tide of the year, and is characterized by plants that are well adapted to living in saline soils.

Salt Pond. A shallow, enclosed or semiclosed saline water body that may be partially or totally restricted by barrier beach formation. Salt ponds may receive fresh water from small streams emptying into their upper reaches or groundwater springs in the salt pond itself.

Secondary Treatment. The process used to reduce the amount of dissolved organic matter and further reduce the amount of suspended solids and coliform in wastewater.

Septage. That material removed from any part of an individual sewage disposal system.

Septic System. A facility used for the partial treatment and disposal of sanitary wastewater, generated by individual homes or small business, into the ground. Includes both a septic tank and a leaching facility.

Septic Tank. A watertight receptacle that receives the discharge of sewage from a building sewer and is designed and constructed so as to permit the retention of scum and sludge, digestion of the organic matter, and discharge of the liquid portion to a leaching facility.

Sewerage/Sewage. Liquid or solid waste that is transported through drains or sewers to a wastewater treatment plant for processing.

Shellfish Bed. An area identified and designated by the Division of Marine Fisheries or conservation commissions as containing productive shellfish resource. Shellfish bed maps are based upon written documentation and field observations by the shellfish constable or other authoritative sources. In identifying such an area, the following factors shall be taken into account and documented: the density of all species of shellfish, the size of the area and the historical and current importance of the area to recreational or commercial shellfishing. Protecting designated shellfish beds may be an important consideration when local boards and state agencies review projects.

Shellfish Resource Area. An area, designated by the Division of Marine Fisheries, that contains productive shellfish beds, and used for establishing shellfish resource area closure boundaries.

Shellfish Resource Area Closures. Closure, due to potential health risks, of shellfish resource areas to shellfish harvesting. Closure decisions are made by the Division of Marine Fisheries, using a current standard that specifies that if the geometric mean of 15 samples equals or exceeds 14 fecal coliform per 100 milliliters of sample water or if 10% of the samples exceed 49 fecal coliform per 100 milliliters of sample water, the station can be closed. The five shellfish-bed classifications are approved, conditionally approved, restricted, conditionally restricted, and prohibited.

Sludge. Solid or semisolid material resulting from potable or industrial water supply treatment or sanitary or industrial wastewater treatment.

Soil Conservation Service (SCS). A branch of the U.S. Department of Agriculture that, among other things, provides technical assistance in resource management and planning and implementation of agricultural BMPs. SCS works closely with Agricultural Stabilization and Conservation Services (ASCS) and County Extension Services to achieve their goals.

Southeastern Regional Planning and Economic Development District (SRPEDD). A regional planning agency to which all of the Buzzards Bay municipalities belong, except Bourne, Falmouth, and Gosnold (see Cape Cod Commission). The agency provides technical assistance, reviews projects for MEPA, coordinates inter-municipal activities, and acts a clearinghouse for regional information.

Spring Tides. Higher than normal high tides observed every 2 weeks when the earth and moon align.

Storm Drain. A system of gutters, pipes, or ditches used to carry stormwater from surrounding lands to streams, ponds, or Buzzards Bay. In practice, storm drains carry a variety of substances such as oil and antifreeze which enter the system through runoff, deliberate dumping, or spills. This term also refers to the end of the pipe where the stormwater is discharged.

Stormwater. Precipitation that is often routed into drain systems in order to prevent flooding.

Subdivision. A means for dividing a large parcel of land into more than one buildable lot, administered under MGL Chapter 41.

Superseding Determination. A Determination of Applicability issued by the Department of Environmental Protection deciding whether or not the area and activity are subject to the regulations under the Wetlands Protection Act.

Superseding Order of Conditions. A document issued by the regional office of the Department of Environmental Protection containing the conditions necessary for a project to proceed and still protect the interests and resource areas specified in the Wetlands Protection Act. These conditions supersede Orders of Conditions set by the local conservation commission unless the local order is also issued under the authorization of a local bylaw. These superseding orders can be requested by a number of people who may not be satisfied with the local Order of Conditions.

Suspended Solids. Organic or inorganic particles that are suspended in and carried by the water. The term includes sand, mud, and clay particles as well as organic solids in wastewater.

Swales. Vegetated areas used in place of curbs or paved gutters to transport stormwater runoff. They also can temporarily hold small quantities of runoff and allow it to infiltrate into the soil.

Tertiary Treatment. The wastewater treatment process that exceeds secondary treatment; could include nutrient or toxic removal.

Tidal Flat. Any nearly level part of the coastal beach, usually extending from the low water mark landward to the more steeply sloping seaward face of the coastal beach or separated from the beach by land under the ocean, as defined in 310 CMR 9:04.

Tidelands. All lands and waters between the high water mark and the seaward limit of the Commonwealth's jurisdiction, as defined in 310 CMR 9:04. Tidewaters are synonymous with tidelands.

Title 5. The state regulations (CMR 15) that provide for minimum standards for the protection of public health and the environment when circumstances require the use of individual systems for the disposal of sanitary sewage. The local board of health is responsible for enforcement of these regulations and may upgrade them.

Total Nitrogen. A measure of all forms of nitrogen (for example, nitrate, nitrite, ammonia-N, and organic forms) that are found in a water sample.

Toxic. Poisonous, carcinogenic, or otherwise directly harmful to life.

Wastewater. Water that has come into contact with pollutants as a result of human activities and is not used in a product, but discharged as a waste stream.

Water Column. The water located vertically over a specific point or station.

Watercourse. Any natural or man-made stream, pond, lake, wetland, coastal wetland, swamp, or other body of water. This includes wet meadows, marshes, swamps, bogs, and areas where groundwater, flowing or standing surface water, or ice provide a significant part of the supporting substrate for a plant community for at least five months of the year, as defined in 310 CMR 15:01. Boards of Health can adopt the definition of wetlands in 310 CMR 10.0 or broader language in Title 5 as a "watercourse" in determining setbacks.

Wetlands. Habitats where the influence of surface water or groundwater has resulted in the development of plant or animal communities adapted to aquatic or intermittently wet conditions. Wetlands include tidal flats, shallow subtidal areas, swamps, marshes, wet meadows, bogs, and similar areas.

Wrack. Algae, plant and animal matter, and drift material (including solid wastes and other pollutants) that accumulate on beaches, usually at the high tide mark.

Zoning Bylaws. Local laws that designate areas of land for different uses at established densities. These bylaws require a two-thirds majority vote of town meeting or city council.

Appendix A

The Management Framework In Buzzards Bay

The wise management and utilization of the resources in Buzzards Bay come under the purview of a variety of legislative mandates and regulatory agencies at the federal, state, and local levels. In addition, there are a number of nonregulatory programs carried out by governmental entities, including regional planning agencies, that have a role to play in restoring and protecting Buzzards Bay. This appendix will provide an overview of the existing governmental framework and provide a context for many of the recommendations described in the text of the Comprehensive Conservation and Management Plan (CCMP).

Federal Agencies

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) operates under several important pieces of federal legislation of concern in Buzzards Bay. These include the Clean Water Act; the Comprehensive Environmental Response, Compensation, and Liability Act; and the National Environmental Policy Act.

The Clean Water Act of 1977 regulates "discharges" from all point sources into navigable waters of the United States. Its coverage generally extends to pipeline discharges and the disposal of dredged material in estuaries. Outfalls from land-based facilities such as sewage treatment plants and industrial plants also are subject to regulation under the Clean Water Act.

Under the Clean Water Act, as amended by the Water Quality Act of 1987, EPA is responsible for

- Coordinating the National Estuary Program, of which Buzzards Bay is one of the 12 "estuaries of national significance", EPA Region I has direct responsibility for the administration of the Buzzards Bay Project in partnership with the Commonwealth
- Regulating industrial discharges and publicly owned sewage treatment facilities under the National Pollution Discharge Elimination System, which governs point source pollution
- Setting water quality standards for all significant bodies of surface waters
- Controlling nonpoint-source pollution, such as agricultural and stormwater runoff
- Protecting wetlands and other waters by co-administrating, with the U.S. Army Corps of Engineers, a permitting program that regulates the discharge of dredged or fill material into waters of the United States

- Administering the Construction Grants Program and the State Revolving Loan Funds Program.

Under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and the amendment, SARA, better known as Superfund, EPA is to provide emergency response and cleanup capabilities for chemical spills and releases from hazardous waste treatment, storage, and disposal facilities. New Bedford Harbor has been designated a Superfund site due to extensive contamination of the sediments by polychlorinated biphenyls (PCBs)

The National Environmental Policy Act of 1970 requires that an environment impact statement (EIS) be prepared for all proposed legislation and all major Federal activities that could significantly affect the quality of the human environment. EPA Region I has recently prepared an EIS for the secondary wastewater treatment plant proposed for New Bedford.

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers provides engineering services and construction support for a wide variety of military and civilian projects. The Corps' primary civil role is to manage the country's waterways and wetlands. Its projects include reducing flood damage, improving harbors and navigation channels, protecting stream banks and shorelines, and other activities aimed at preserving and safeguarding the environment.

The Corps issues permits (under Section 404 of the Clean Water Act) for discharging of dredged materials into waters or placing dredged (or fill) material in waters or wetlands. Hence, constructing piers, docks, and ramps, or any dredging activities in navigable waters, requires Corps 404 permits.

Under its Comprehensive Flood Damage Protection Program, the Army Corps of Engineers manages the hurricane barriers in New Bedford Harbor. As part of its navigational responsibilities, the Corps develops, maintains, and improves harbors and waterways to meet commercial and recreational needs. Operating and maintaining the 17.5-mile-long Cape Cod Canal is under the jurisdiction of the Corps. The Corps of Engineers also helps to protect and restore shores and beaches from erosion damage.

The New England Division of the Army Corps of Engineers has been involved in Superfund activities such as the cleanup of a toxic waste dump near Dartmouth and in studies of contamination in New Bedford Harbor as part of the cleanup efforts.

National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) is part of the Department of Commerce. As the nation's lead marine science agency, NOAA's estuarine and coastal program responsibilities involve research, data collection and assessment, and management. In addition, NOAA has established the Estuarine Programs Office to coordinate its diverse estuarine activities both internally and with other organizations.

NOAA's research programs are directed at improving current knowledge of the physical processes of estuaries, the natural and human-induced factors affecting the productivity and health of fishery resources, and the effects of habitat loss and of chemicals and pathogens on edible fish and shellfish.

NOAA collects, archives and synthesizes a variety of oceanographic, climatic, fisheries, and pollution data. Its Status and Trends Monitoring Program assesses the effects of environmental degradation by measuring toxic chemicals in sediments, fish, and shellfish. Under this program, NOAA conducts sampling in Buzzards Bay.

The Coastal Zone Management Act of 1972 administered by NOAA, provides funds, policy guidance, and technical assistance to coastal states to help them establish and maintain coastal zone management programs. Such programs are designed to promote the wise use and protection of coastal land and water resources. The Massachusetts Coastal Zone Management Program was the first state effort on the east coast and the fourth in the nation to receive federal approval in 1978.

As required by the Coastal Zone Management Act, the state program reviews all federally conducted or supported activities that directly affect the coastal zone. The purpose of the review is to assure that these activities are in compliance with approved state environmental programs. This federal consistency review process is a powerful implementation tool to protect and manage the coastal zone in Buzzards Bay. The Buzzards Bay Project is administered by the Massachusetts Office of Coastal Zone Management in conjunction with EPA Region I.

USDA Soil Conservation Service

The Soil Conservation Service (SCS) is part of the U.S. Department of Agriculture (USDA). SCS supports local communities in the management of agricultural waste and stormwater runoff, which are two major nonpoint pollution sources in Buzzards Bay. In the past, SCS focused primarily on agricultural practices. As part of the USDA Rural Clean Water Program, an experimental project was conducted in the Westport River Watershed to control animal wastes that were contributing to the closure of shellfish beds.

Recently, SCS has directed some of its efforts to provide technical assistance to communities experiencing impacts from development. The SCS has now established a work group to address problems in the Buzzards Bay basin.

In addition, USDA is in the process of implementing a new program, the hydrologic unit initiative, to address the declining quality of the nation's groundwater and surface water. Buzzards Bay is one of the targeted areas. Under this initiative, USDA which includes SCS, the Agricultural Stabilization and Conservation Service and Cooperative Extension has begun a five-year program, in cooperation with the Buzzards Bay Project, to provide education and technical assistance to reduce nonpoint-source pollution from agricultural operations and stormwater.

U.S. Coast Guard

The U.S. Coast Guard enforces provisions of the Clean Water Act regarding discharges of oil, hazardous substances, and sanitary wastes from boats and ships. The Coast

Guard also establishes regulations regarding performance standards for marine sanitation devices, in cooperation with EPA. The Coast Guard regulates all public and private aids to navigation used in coastal waters.

U.S. Food and Drug Administration

The U.S. Food and Drug Administration is responsible for setting seafood quality standards to protect public health and regulating the quality of shellfish products entering interstate commerce. This agency oversees the National Shellfish Sanitation Program.

State Agencies

Executive Office of Environmental Affairs

The Executive Office of Environmental Affairs (EOEA) is a cabinet-level secretariat whose principal authority is to implement and oversee state policies that preserve, protect, and regulate natural resources and the environmental integrity of the Commonwealth of Massachusetts. Of the departments and units within EOEA, the following are most involved with the management issues for Buzzard Bay:

- The Massachusetts Coastal Zone Management Office (CZM)
- The Massachusetts Environmental Policy Act Unit (MEPA)
- The Department of Environmental Protection (DEP)
- The Department of Environmental Management (DEM)
- The Department of Fisheries, Wildlife, and Environmental Law Enforcement (DFWELE)

The responsibilities and activities of these agencies are described below.

EOEA may designate certain protection areas. One of these are Areas of Critical Environmental Concern (ACEC). An ACEC designation recognizes the importance of such systems, alerting regulatory agencies and the public alike that activities therein must meet high environmental quality standards.

Massachusetts Coastal Zone Management

The Massachusetts Coastal Zone Management Office (CZM) develops state policy to protect resources and manage development in the coastal zone. As officially defined, the Massachusetts coastal zone extends landward from the coast to 100 ft beyond specified major roads, rail lines or other visible rights-of-way and seaward to the edge of the territorial sea and includes all of Cape Cod, Martha's Vineyard, Nantucket, and Gosnold.

Developed under the authority of the federal Coastal Zone Management Act of 1972, the Massachusetts Coastal Zone Management Plan was approved in 1978 and established 27 policies to protect and manage the Commonwealth's coastal zone and its valuable resources.

CZM is a planning and policy agency. To carry out its responsibilities, the agency relies upon existing state regulatory authority and the federal consistency review process. CZM administrates a number of local financial assistance grant programs and provides technical assistance to local communities. The primary areas of CZM concern include coastal hazards, marine environmental protection, energy, waterfront development and harbor planning, and recreation. CZM also supports scientific studies, mapping

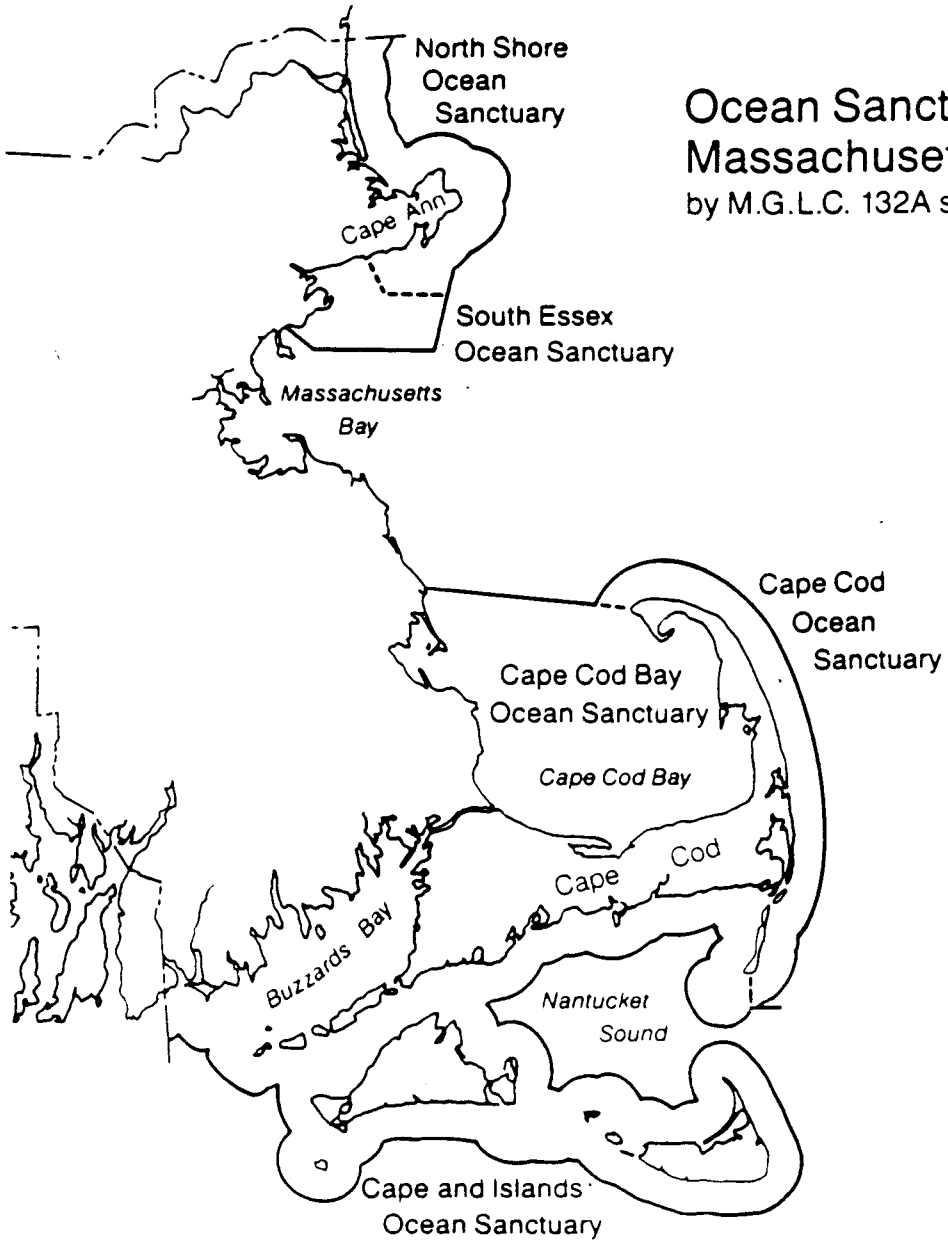


Figure A.1. Ocean Sanctuaries of Massachusetts, as defined by M.G.L.C. 132A subsections 13-16 and 18.

projects, and other activities that add to the knowledge of coastal resources and enhance planning and decision-making in Massachusetts. The Coastal Resources Advisory Board (CRAB) and various Citizens Advisory Committees add an essential citizen perspective to CZM's work.

Through the federal Coastal Zone Management Act, CZM is empowered to review all federal activities in Massachusetts to ensure they are consistent with state coastal policy. Any large coastal project requiring a federal license or permit, implemented by a federal agency, or carried out with federal funds must undergo this consistency review.

The Coastal Facilities Improvement Program is administered by CZM to assist eligible coastal communities in the construction, reconstruction, repair of maintenance of coastal facilities and the preparation of comprehensive harbor plans.

Massachusetts Environmental Policy Unit

The Massachusetts Environmental Policy Act (MEPA) directs state agencies, when permitting and licensing proposed development, to review, evaluate, and determine the impact on the natural environment of these works, projects, or activities and to use all practicable measures to mitigate their impacts and minimize damage to the environment. Regulations under Title 301 of the Code of Massachusetts Regulations (CMR) Chapter 11.00 define which projects are subject to MEPA review. Projects below thresholds are exempt, although projects or projects in sensitive areas are likely to trigger MEPA review.

Department of Environmental Protection

The Department of Environmental Protection (DEP) administers most of the Commonwealth's environmental regulatory programs. These programs address a variety of concerns including air and water quality, solid and hazardous waste disposal, and development of wetlands and waterways. The following discussion describes the divisions most closely related to the CCMP.

The Division of Wetlands and Waterways

The Division of Wetlands and Waterways administers three programs - the Coastal Wetlands Restriction Program (Massachusetts General Laws, Chapter 130, Section 105; the Wetlands Protection Program (Massachusetts General Laws, Chapter 131, Section 40) and the Waterways Act (Massachusetts General Laws, Chapter 91).

Wetlands Protection

Conservation commissions, which are locally appointed bodies, are the first line of defense in wetlands protection under the Massachusetts' Wetlands Protection Act. They have primary authority to review projects proposed in or near wetlands, and issue Orders of Condition (written statements that control the impact of activities in wetlands by stating the conditions under which the activities must take place). Regulations and policies to guide the conditioning process are developed by the Division of Wetlands and Waterways. The division reviews local conservation commission decisions which have been appealed. All decisions by DEP may be appealed to an adjudicatory hearing.

Wetlands Restriction

Activities within especially large or otherwise significant wetland areas throughout Massachusetts are controlled by the Inland and Coastal Wetlands Restriction Acts. Restrictions are placed on the deeds of properties within significant wetlands, which gives these resource areas an extra measure of protection. About two-thirds of the state's coastal wetlands have been mapped and restricted, and the division is now working to complete the process throughout the state.

Chapter 91 (Waterways) Licensing

Massachusetts General Laws Chapter 91 require that DEP review and license activity in state waterways. Activities that require Chapter 91 licenses include the placement of piers, wharves, and other structures or fill; changes in use of existing structures and fill; and dredging. Before a Chapter 91 license is issued, Wetlands and Waterways must determine that the proposed project will not interfere with navigation or the operation of public facilities; is structurally sound; promotes public access and will not diminish public rights or the rights of adjacent shoreline property owners; and finally, will not adversely impact environmental resources such as wetlands, fish runs, shellfish beds, and fish spawning and nursery areas.

The Division of Water Pollution Control

The Division of Water Pollution Control is the lead unit for improved water quality and water pollution prevention in accordance with the provisions of the Massachusetts Clean Water Act. The division issues Water Quality Certificates — permits that regulate pollution discharges and the effects of dredging projects on water quality. The Division also issues National Pollutant Discharge Elimination System (NPDES) permits for surface water discharges and separate permits for groundwater discharges. NPDES permits are jointly issued by DEP and EPA, who develop pollutant discharge limits to ensure compliance with water quality standards. Groundwater permits are required for discharges greater than 15,000 gallons of sewage and for any industrial waste.

The Bureau of Municipal Facility Grants and Loans

The Bureau of Municipal Facility Grants and Loans administers the state/federal construction grants program, which has evolved from a previous federal and state combined grant program that once provided state grants for planning, and federal and state grants for the construction of municipal sewage treatment plants. This program is now principally a loan program under a state revolving fund. A construction grants program is also available. This program is directed at wastewater projects that are not funded by the federal program or have lower priority in the federal system.

The Division of Hazardous Waste

The Division of Hazardous Waste regulates transportation, storage, and disposal of waste materials within the Commonwealth, and monitors the environmental impact of these materials with regard to public health and safety. The division licenses haulers of hazardous waste, uses computers to track waste disposal, and penalizes violators of state and federal hazardous waste regulations. The division also works to clean up

existing hazardous waste sites and assists communities in cleaning up oil and chemical spills.

The Division of Solid Waste Management

The Division of Solid Waste Management regulates solid waste generated by municipalities, industry, commercial sources, and consumers. The Division assesses waste sites and waste facilities, and enforces all provisions of the Massachusetts Solid Waste Act. The Division also develops and manages programs for recycling, composting, and other technologies for waste minimization and source reduction.

Department of Environmental Management

The Department of Environmental Management (DEM) is responsible for preserving and protecting the natural resources of the Commonwealth and for managing state lands and waters. The work of the following divisions is most closely related to the CCMP.

The Division of Water Resources

The Division of Water Resources has three priorities: to collect, refine and update basic water resources data for dissemination to state, federal, and local agencies and the general public; to prevent loss of life and damage to property through flood control; and to facilitate the development of a comprehensive water resources management plan for Massachusetts. The state's Ocean Sanctuaries Program is located in this division (Figure A.1). The Ocean Sanctuaries Act (Massachusetts General Laws, Chapter 132A, Section 13-16 and 18) established sanctuary areas that must receive a special level of protection from "any exploitation, development or activity that would seriously alter... endanger the ecology or the appearance of the ocean, the seabed, or subsoil ... ." Buzzards Bay is part of the Cape and Islands Ocean Sanctuary established in 1971. In addition, the Division of Water Resources acts as state coordinator for the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA).

The Division of Waterways

The Division of Waterways improves, develops, maintains, and protects the Commonwealth's inland and coastal waterways. Specific programs include the Rivers and Harbors Program, which identifies the need for renovations and improvement to the state's inland and coastal waterways; waterways projects, which include dredging to maintain navigable channels, beach nourishment, and the construction and rehabilitation of piers and other coastal facilities; the State Piers in Gloucester, New Bedford, and Fall River, which are administered by the division and leased to private operators and managers; recreational facilities projects, including capital improvements to existing state recreational facilities (beaches, etc.) and construction of new ones; and public access projects, including the design and construction of marinas, boat ramps, and Public Access Board projects funded by the Department of Fisheries, Wildlife and Environmental Law Enforcement, but administered by the Division of Waterways as the contracting agent.

Office of Safe Waste Management

The Office of Safe Waste Management is responsible for planning and facilitating the safe and efficient management of hazardous waste in Massachusetts.The Office of Safe Waste Management sponsors the Household Hazardous Waste Program, which funds community collections of household hazardous waste and works to increase public awareness of the larger problem of hazardous waste disposal statewide. They have also conducted pilot projects on source reduction in industrial discharges. This program employed audit teams — a free multi-media non-regulatory service provided to businesses with industrial discharges.

Department of Fisheries, Wildlife and Environmental Law Enforcement

The Department of Fisheries, Wildlife, and Environmental Law Enforcement (DFWELE) is responsible for the management and conservation of the Commonwealth's freshwater and saltwater fisheries and its wildlife, including rare and endangered species. The department enforces the state's wildlife laws and regulations and conducts research on wildlife and the environmental factors that influence them. The department also has jurisdiction over registration and operation of motorboats and off-road vehicles, and operates 140 public access sites statewide.

The Division of Marine Fisheries protects and enhances the state's living marine resources, especially commercially and recreationally caught shellfish, lobster, and finfish. As part of its management responsibilities, the division issues permits for the taking, harvesting, and landing of fish for commercial purposes as well as permits for the recreational harvest of lobsters. A unique feature of the Massachusetts fisheries laws provides local control of shellfish, eels, sea worms, and alewives.

The division administers the Shellfish Sanitation Program and determines the classification of shellfish areas within the state. It also works to promote and develop Massachusetts' commercial and recreational fisheries and to implement strategies that will maintain the integrity and future availability of the Commonwealth's valuable marine resources.

Management at the Local and Regional Level

The Commonwealth of Massachusetts has a long-standing tradition of local self-determination, or home rule. But it was not until 1966, with the adoption of the Home Rule Amendment to the state's constitution, that this philosophy changed the thinking and actions of legislation and court decisions in Massachusetts. Generally, municipalities are authorized to exercise through the "adoption, amendment, or repeal of local ordinances or by-laws ... any power or function ... not denied ..." by the state. This is one of the strongest declarations in this country of the right to local control. The legislature, although it has the authority, has rarely used its power to preempt local initiative.

Home rule authority is highly valued and strongly defended in Massachusetts communities. Land-use controls, in particular, are viewed as a local prerogative. In Buzzards Bay, attention to land-use issues is of vital importance to environmental quality and conservation of resources. However, towns and cities must follow ground rules for local governments as stipulated in state law. Legal decisions that strike down local controls are more likely to be based on procedural problems than on the substance of what the municipality is attempting to accomplish.

Another long-standing tradition in Massachusetts is town meeting. The town meeting is the legislative body of town government. Generally, it is a gathering of all the eligible voters in the town to conduct town business (some towns have adopted representative Town Meeting). Town meeting decides for what purposes the town will spend money and how much may be spent; adopts and amends bylaws to govern the conduct of the inhabitants of the town in local affairs; and elects citizens to fill certain town offices.

Boards of Selectmen

Boards of selectmen, as principal officers of the town, have general supervision over all matters that are not delegated by law or by vote at town meeting to some other officer or board. These boards have three to five members and may act as assessors, water commissioners, sewer commissioners, and boards of health. In Gosnold, an island community where there are few year-round residents, the board of selectmen assumes responsibility for all the major boards within the town. In some towns, selectmen have full-time professional staff to assist them or act on their behalf in the management of the municipality. New Bedford is the only city on Buzzards Bay and, as such, has a different form of governance. Its governing structure is composed of a mayor and an 11-member city council elected separately every two years.

Boards of Health

Towns elect a board of health (most have three members) or the selectmen can act in this capacity. In New Bedford, the board of health is appointed by the mayor. A board of health has far-reaching authority in exercising its responsibility to protect the health, safety, and welfare of the community. Their broad regulatory authority has thrust them into the forefront of environmental protection on the local level. Boards of health can adopt regulations for any activity that might endanger public health or contaminate surface water or groundwater. In many communities, the chief duties of boards of health have become the regulation of landfills and approval of septic system installations. Under Title 5 (State Sanitary Code) boards issue permits for any septic system receiving up to 15,000 gallons per day (e.g.,a large condominium project); larger systems must be approved by DEP. In granting or denying a permit, the Board relies primarily on two tests: a percolation test to see if water will pass through soil at a reasonable rate and a deep-hole test to determine the level of groundwater.

Boards of health have a major role in subdivision review. They have special authority over drainage and waste disposal in proposed subdivisions. Every definitive subdivision plan must be submitted to the board for its recommendations to the planning board. If the board of health rejects a plan, providing specific reasons why areas are not suited for building, the planning board cannot override the decision. However, there must be evidence that a serious pollution problem is likely to occur if the development goes

forward. Finally, boards of health inspect private wells, swimming pools, and certain other facilities.

Conservation Commissions

The Conservation Commission Act of 1957 enabled local towns to establish a special commission to protect natural resources, serve as an advisor in municipal decision-making, accept gifts of money and land, and regulate local wetland use. When DEP developed its regulations for the Wetlands Protection Act in 1978 and 1983, most municipalities that had not already done so, found it necessary to establish a conservation commission to administer the new and relatively stringent state wetland regulations. Commissions consist of three to seven members appointed by the selectmen or mayor. Conservation commissions determine if a project will alter wetland resources and what conditions are required to protect the statutory wetland interests of water supplies, prevention of storm damage, prevention of pollution, and protection of fisheries and wildlife habitat. The commission has authority to order modifications of a proposed project if they determine it will damage or destroy a wetland resource. Conservation commissions have authority to regulate activities within 100 feet of inland and coastal wetlands, within the 100-year floodplain, and within land under water bodies and waterways.

Home rule allows the municipalities to expand state regulations by adopting local wetland bylaws. These bylaws may give conservation commissions the authority to adopt regulations, tighten permit requirements, and add wetland values to be protected. Conservation commissions also have the authority to accept and hold permanent or temporary conservation restrictions. These restrictions authorize and enable the Commission to prevent landowners from using their land in a way that damages natural resources. Conservation commissions can also acquire conservation lands that are valuable for habitat protection, aquifer protection, open space, or any environmental value.

Harbor Masters

Harbor masters have broad powers to regulate uses and activities of waterways. The harbor master is typically appointed by the selectmen to oversee harbor activities and enforce Massachusetts General Laws Chapter 90B Section 15B. These regulations authorize towns, through their harbor masters, to regulate vessels in municipal waterways. The regulations address the safe operation of boats, boat speed limits, channel obstructions, boat seaworthiness, fishing, swimming, diving, and refueling. Some municipalities have harbor regulations that limit the number of moorings to avoid crowding and boat pollution in certain areas. Harbor regulations may also prohibit the discharge of trash, oil, and untreated sewage into town waters.

Planning Boards

Planning boards were created by Massachusetts General Laws, Chapter 41 (containing the municipal planning and subdivision control acts) to plan for the "resources, possibilities, and needs" of their communities, including the protection of natural resources. Planning boards contain from five to nine members. Towns have the option

of deciding by town meeting vote whether the board shall be appointed by the selectmen or elected by the voters. In New Bedford, the mayor appoints the planning board.

Planning boards are generally responsible for community development through the adoption and implementation of zoning and subdivision ordinances or bylaws. Zoning is one of the basic powers conferred on local government under home rule. Zoning in Massachusetts is employed to guide the physical development of a community by dividing the municipality into zones and specifying the permissible land use, for example, residential, commercial, industrial.

Subdivision regulations govern the process of dividing a parcel of land into two or more lots. Under these regulations, planning boards generally require each developer to submit a subdivision plan for approval prior to the start of any construction. Approval or nonapproval is based on compliance of the proposed development with standards as provided in the local subdivision regulations.

Zoning Boards of Appeals

Boards of appeals were established by Massachusetts General Laws, Chapter 40A, to authorize zoning variances to alleviate individual hardship from subdivision control and zoning bylaws or ordinances. In addition, decisions may also be appealed to the superior court. The mayor (subject to confirmation of the City Council) or board of selectmen appoint three to five members of the zoning board of appeals. Under the law, no variances can be granted unless three circumstances existing on a property create a hardship for the owner and entitle that owner to a variance: soil conditions, shape of lot, and topography. The other major duty assigned to boards of appeals is to hear and decide applications for special permits. Often this involves permits in special zoning areas, such as an overlay protection district. The boards of appeal also are empowered to issue comprehensive permits under the affordable housing provisions of Chapter 40B.

Regional Planning Agencies

Regional planning in Massachusetts is carried out by 13 active regional commissions formed under Chapter 40B of Massachusetts General Laws. The commissions represent the participating cities and towns in each region and employ professional staff that carry out planning responsibilities. The regional planning agencies (RPAs) compile data, conduct research, and prepare comprehensive plans for the area's physical, social, and economic development. One of the responsibilities of the RPAs is to participate with the Executive Office of Communities and Development in the review of federal funding applications and federal development proposals. This review is the so-called "A-95" review and gets its name from the U.S. Office of Management and Budget circular A-95, which was written in 1969 to provide for the review of almost 1,000 federal programs. In 1982 the process was modified, allowing states and RPAs to develop their own process and reducing the number of programs to be reviewed to approximately 200. In Buzzards Bay there are two RPAs that represent all but two of the 17 municipalities that make up the watershed area, the Southeastern Regional Planning and Economic Development District (SRPEDD) and the Cape Cod Commission (CCC). SRPEDD covers 12 Buzzards Bay towns and the City of New Bedford, while CCC represents the Cape towns of Bourne and Falmouth. In addition,

the Old Colony Planning Council represents Plymouth, and the Martha's Vineyard Commission covers Gosnold. Both SRPEDD and CCC have planning staffs that provide technical assistance to their respective towns and produce regional plans, primarily in the areas of environmental protection and transportation. As an example, SRPEDD developed the Mattapoisett River Watershed Protection Plan for the towns of Rochester, Acushnet, Marion, Mattapoisett, and Fairhaven. Its staff is now supporting the five town effort to regulate activities in the watershed.

A significant new focus on regional planning may be on the horizon for Massachusetts. Since 1986, CCC has taken the lead with an innovative approach to planning for the future of Cape Cod. Through a process of consensus-building, citizens of the Cape identified a need for more effective land-use planning and greater authority to regulate land use, control urbanization, and better manage shared resources. The result was a proposal to create a Cape Cod Commission with certain regulatory and regional powers. In November 1988, 76% of Cape Cod voters supported a nonbinding referendum to establish the Cape Cod Commission. In January 1990, state legislation was passed to create the Cape Cod Commission. This legislation was ratified in a special county-wide election on March 27, 1990, thereby creating the Cape Cod Commission.

Appendix B

Land-Use Statistics and Explanatory Notes

The Buzzards Bay Project (BBP) has drawn extensively on a database of geographic information developed by the MassGIS Project. The MassGIS Project was established to develop a geographic information system and uses ARC/INFO computer software. The project is administered through the Massachusetts Executive Office of Environmental Affairs.

Statewide coverage of a variety of geographic information is available through MassGIS. Most of this information is from maps at a scale of either 1:25000 or 1:100000. Land use has been mapped for most of the state, including southeastern Massachusetts, and the BBP has used this information extensively. The discussion below provides background information on the source of the land-use data, the methods used in compiling it, and some of its limitations.

Sources and Methods

Statewide land-use mapping based on interpreting aerial photographs has been performed since the early 1950s by the University of Massachusetts in Amherst. The Resource Mapping Project (RMP) in the university's Department of Forestry now interprets and maps information on land use. One of the land-use maps prepared at the university was based on aerial photography from 1971. The 1971 map has since been computerized by RMP staff using a microcomputer version of the ARC/INFO software.

The most recent land-use mapping by the RMP is based on interpreting 1:25000 scale 9- x 9-in color infrared aerial photographs taken in September of 1984 and 1985. The photography for southeastern Massachusetts dates from 1984.

Land use for 1984 was determined by comparing the 1984 photographs to those taken in 1971. Resource Mapping Project staff mapped the land-use changes since 1971. The RMP then used ARC/INFO software to create a computer map of only the changed areas. The MassGIS project combined the 1971 information and the 1984 changes to produce a map of land use in 1984.

Additional information concerning interpretation of land use from aerial photographs can be obtained by contacting the Resource Mapping Group. The 1984/1985 photographs are held by the Cartographic Information Research Service at the University of Massachusetts in Amherst.

Land-Use Categories

The original 1971 map included 104 land-use categories. The RMP aggregated these 104 categories into 21 categories (28 on the western shore of Buzzards Bay) before

interpreting the 1984 photographs. The 21 categories are listed in Table B.1. On the western shore, 28 categories better suited the needs of the Southeastern Regional Planning and Economic Development District (SRPEDD). The seven additional categories were marinas, cranberry bogs, power lines, saltwater sandy beaches, golf courses, tidal salt marshes, and irregularly flooded salt marshes. However, for consistency across all Buzzards Bay communities, the extra categories were aggregated into the 21 categories listed in Table B.1. The percentage of a specific land-use type is calculated relative to the total **land** area; area in water is not included in that total.

Cape Cod towns have four additional categories defined: cranberry bogs, golf courses, marinas, and new ocean. As with the western shore of Buzzards Bay, these extra categories have been aggregated into the more common 21 categories.

Limitations

Land-use classification does not fit neatly into specific categories, no matter how many categories are defined. Photograph interpreters make subjective classification decisions. The RMP staff performing the interpretations are well trained and their land-use interpretations have resulted in maps that a variety of users have found a satisfactory and valid source of information.

Specific limitations of the photo interpretations are as follows. The smallest area mapped as being in a specific land-use category was approximately 1 acre. In addition, the accuracy of the interpretations of changes in land use were not tested in the field. However, the RMP and its staff have extensive experience in interpreting land-use photographs and the photo-visible characteristics of specific land-use types are well known and have been field verified.

The 1984 photographs were taken in September, when leaves were on all trees and bushes. This condition may have resulted in overestimates of the "forest" category, and underestimates of low density development: that is high density of trees in low density residential development may result in incorrectly classifying some low density residential areas as forested areas if roads and homes are not visible from the air. The extent to which the leaf-on condition contributed to overestimates of the "forest" category is not known. Forested wetlands were not easy to discern with this particular areal coverage, hence, forested wetlands are included in the forest category.

Finally, it is important to note that the land-use maps presented in the CCMP (e.g., Apponagansett Bay, Chapter 5, and Buttermilk Bay, Chapter 8) are at a much larger scale than the source maps from which they were extracted. The CCMP land-use map scales are approximately 1:3500, whereas the source map scale was 1:25,000 (or "smaller" in cartographic terms). This difference in scales means that the boundaries between land-use types in the CCMP land-use maps are less exact than shown.

Table B.1. 1984 Land use in the Buzzards Bay drainage basin

(areas in acres unless noted otherwise)

LANDUSE	footnote	Acush	Bourn	Carve	Dartm	Fairh	FallR	Falmo	Free	Gosno	Mario	Matta	Middl	NewBe	Plymo	Roche	Sand	Wareh	Westp	BASIN TOTALS RI	BASIN TOTALS (acres)	BASIN TOTALS (sqMi)	BASIN (% of land)
cropland	1	462	67	104	2391	557	70	2	44	0	78	277	137	8	142	796	0	22	4216	490	9863	15.41	3.5
pasture	2	986	35	56	2304	645	0	53	150	0	75	139	43	131	14	940	0	116	520	0	6206	9.70	2.2
forest	3	7029	14953	11721	23528	2829	5694	7765	1967	3451	5837	7740	8307	3601	22268	14078	833	12282	16817	3675	174375	272.46	62.7
non-forest wetland	4	199	125	1361	311	17	216	28	93	41	176	70	442	228	158	638	0	781	315	1	5199	8.12	1.9
mining	5	282	140	63	450	0	3	225	26	0	21	76	47	8	23	59	0	82	133	0	1638	2.56	0.6
open land	6	535	965	504	1585	316	120	358	131	4633	166	295	190	357	570	398	85	785	914	2	12910	20.17	4.6
particip. recreat.	7	30	130	15	84	17	6	89	0	0	9	5	0	421	212	118	68	23	71	0	1297	2.03	0.5
spectator recreat.	8	3	114	8	96	49	0	6	0	0	29	21	0	118	3	13	12	34	14	0	521	0.81	0.2
waterbased recreat.	9	5	90	1	494	52	0	83	1	24	198	103	0	37	3	2	0	238	235	0	1566	2.45	0.6
resid, multi-fam	10	3	402	10	89	24	0	12	0	0	2	4	0	244	0	0	6	33	4	0	833	1.30	0.3
resid,<1/4 ac lots	11	203	684	243	296	635	0	88	0	0	37	304	0	2931	57	0	0	1262	59	0	6800	10.62	2.4
resid,1/4-1/2 acre	12	664	1112	940	2700	1188	0	1354	77	42	434	504	41	723	1125	45	0	1450	1240	162	13799	21.56	5.0
resid,>1/2 ac lots	13	819	1284	640	1804	218	29	1125	339	203	857	679	275	73	401	820	0	1108	2046	0	12718	19.87	4.6
saltmarsh	14	23	267	0	1168	693	0	298	0	140	433	409	0	0	0	0	0	783	1046	0	5260	8.22	1.9
commercial	15	78	239	40	411	170	0	68	25	0	90	94	0	596	5	29	0	379	190	50	2463	3.85	0.9
industrial	16	24	83	2	75	69	0	23	1	0	24	33	7	944	2	9	0	75	16	0	1387	2.17	0.5
urban open	17	108	561	195	797	183	110	108	55	3	140	63	122	805	360	285	186	431	201	0	4713	7.36	1.7
transportation	18	20	295	59	242	236	4	233	0	0	164	212	147	912	232	17	16	629	250	0	3669	5.73	1.3
waste disposal	19	63	8	26	247	59	0	6	0	0	61	31	0	174	1	22	0	57	59	0	814	1.27	0.3
water	20	284	184	1005	331	18	566	234	10	178	7	15	38	87	1906	1072	0	988	177	0	7099	11.09	
woody perrenial	21	291	210	4457	168	43	0	53	202	0	237	98	1081	32	1098	1789	0	2382	31	0	12173	19.02	4.4
LAND TOTAL (acres)	22	11830	21763	20445	39239	8000	6252	11976	3111	8538	9068	11155	10840	12342	26675	20057	1206	22952	28377	4380	278204		100
LAND TOTAL (sq.mi.)		18.48	34.00	31.95	61.31	12.50	9.77	18.71	4.86	13.34	14.17	17.43	16.94	19.28	41.68	31.34	1.88	35.86	44.34	6.84		434.69	
Saltmarsh,source #2	23	30	298	0	1143	608	4	297	0	90	306	350	0	0	0	0	0	917	1117	NA	5159	8.06	
(acre diff from GIS)	24	-7	-31	0	25	85	-4	1	0	50	127	59	0	0	0	0	0	-134	-70		101		
#desig Barr Beaches	25	0	28	0	13	23	0	19	0	44	14	26	0	0	0	0	0	36	6	NA	209		
Barrier Beach area	26	0	75	0	154	86	0	278	0	186	37	84	0	0	0	0	0	59	729	NA	1689	2.64	
Marine Flat area	27	0	36	0	15	442	0	880	0	25	47	440	0	0	0	0	0	256	0	NA	2141	3.34	
Estuar. Flat area	27	50	166	0	267	140	0	122	0	9	47	14	0	108	0	0	0	195	2033	NA	3150	4.92	
TOTAL Tidal Flat	27	50	202	0	282	582	0	1002	0	34	94	454	0	108	0	0	0	451	2033	NA	5291	8.27	
1988 population estimated within basin		8907	14145	7986	25607	15410	229	8332	983	50	4240	5980	1471	92719	8108	4057	112	21120	13281	NA	232737		

Town abbreviations for Acushnet, Bourne, Carver, Dartmouth, Fairhaven, Fall River, Freetown, Gosnold, Marion, Mattapoisett, Middleborough Plymouth, Sandwich, Wareham, Westport, and Rhode Island (principally Tiverton and a small part of Little Compton)

Footnotes for Table B.1.

FOOTNOTE EXPLANATION

[1] Cropland = Intensive agriculture

[2] Pasture = Extensive agriculture

[3] Forest = Forest

[4] Wetland = Nonforested freshwater wetland

[5] Mining = Sand, gravel & rock

[6] Open Land = Abandoned agriculture, power lines, areas of no vegetation

[7] Participation Recreation = Golf, tennis, playgrounds, skiing

[8] Spectator Recreation = Stadiums, racetracks, fairgrounds, drive-ins

[9] Water Based Recreation = Beaches, marinas, swimming pools

[10] Residential = Multi-family

[11] Residential = Smaller than 1/4 acre lots

[12] Residential = 1/4 - 1/2 acre lots

[13] Residential = Larger than 1/2 acre lots

[14] Salt Wetland = Salt marsh

[15] Commercial = General urban, shopping center

[16] Industrial = Light & heavy industry

[17] Urban Open = Parks, cemeteries, public & institutional greenspace, also vacant undeveloped land

[18] Transportation = Airports, docks, divided highway, freight storage, railroads

[19] Waste Disposal = Landfills, sewage lagoons

[20] Water = Fresh water, coastal embayments

[21] Woody Perennial = Orchard, nursery, cranberry bog

[22] Land totals for all categories except 20 (water)

[23] Salt marsh area from U.S. Fish and Wildlife Service maps as digitized and reportedin Hankin et al. (1985). Falmouth total adjusted by multiplying the ration of saltmarsh area inside the basin to salt marsh total for town based on MassGIS data (=5.6%)

[24] Differences in totals reflect the differing methodologies used, but basinwide, values differ by only 5%

[25] From CZM maps

[26] From Hankin et al. (1985); areas for Gosnold include total for all shoreline

[27] From Hankin et al. (1985)

OTHER NOTES

-% land use derived by dividing total for land-use category excluding category #2, water area. No drainage basin bounary was delineated for the Elizabeth Islands, hence GIS land use for Gosnold included all island land areas.

Appendix C: Units of measure and abbreviations commonly used

ac	=	acre
g	=	gram
ga	=	gallon
gpd	=	gallons per day
ha	=	hectare
kg	=	kilogram
km	=	kilometer
l	=	liter
lb	=	pound
m	=	meter
mgd	=	millions of gallons per day
mt	=	metric ton
mi	=	mile
yd	=	yard

Distance

1 yd	=	0.9144 m (m)	1 m	=	1.0936 yd
1 mi	=	1609 m(1.609 km)	1 km	=	0.622 mi

Area

1 mi^2	=	640 acres	1 km^2	=	100 ha
1 mi^2	=	2.589 km^2	1 km^2	=	0.386 mi^2
1 mi^2	=	259 ha	1 km^2	=	247.1 acres
1 acre	=	0.4047 ha	1 ha	=	2.471 acres
1 ft^2	=	.093m^2	1 ha	=	107,637 ft^2
1 acre	=	43,560 ft^2			

Volume

1 yd^3	=	0.7646 m^3	1 m^3	=	35.31 ft^3
1 ga	=	3.785 l	1 m^3	=	1000 l
1 ft^3	=	7.48 ga	1 m^3	=	258.1 ga

Weight

1 lb	=	0.455 kg	1 kg	=	2.205 lb
1 ton	=	907.2 kg	1 mt	=	2205 lb

Special units

OIL: 1 barrel of oil= 42 gallons; 1 ton of oil = 6.3 barrels or 264.6 gallons (Gerlach, 1981); WATER: 1 gallon = 8.33 pounds.

Appendix D

Nitrogen-Loading Worksheets for Coastal Embayments

On the following pages are worksheets that describe how to implement a nitrogen management strategy for sensitive embayments around Buttermilk Bay. Because physical characteristics are different for each embayment, the critical nitrogen-loading limit will also be different. To calculate this critical nitrogen-loading limit for each embayment, a community fills out the first worksheet (Part 1). The next step (Part 2) is to inventory the existing and grandfathered anthropogenic nitrogen inputs in the drainage basin. The third step (Part 3) is to calculate what the expected future nitrogen-loading inputs will be from development expected to occur in the drainage area based on current zoning. The Total Nitrogen at Buildout is equal to the Existing Nitrogen Loading from Part 2 and the Additional Nitrogen Loading Expected from Part 3.

If the Total Nitrogen Load at Buildout [Item 23 in Part 3] is less than or equal to the Critical Loading Limit to the Embayment [Item 9c in Part 1], no changes are needed to the existing land-use program for that embayment drainage basin.

If the Total Existing Nitrogen Load [Item 17 in Part 2] or the Total Nitrogen Load at Buildout [Item 23 in Part 3] is greater than the Critical Loading Limit to the Embayment [Item 9c in Part 1], a nitrogen management strategy is needed for that embayment. The strategy must include changes in the expected future land use of the embayment's drainage basin to conform with established goals. Part of that strategy could be to require that proposed subdivisions meet loading limits per unit of land area developed (Part 4). If existing loading exceeds limits, a long term strategy to reduce existing inputs must be developed if the embayment is to be restored. Specific recommendations and nitrogen-management strategies are described in the action plan entitled Managing Nitrogen-Sensitive Embayments in Chapter 5. The technical basis of the nitrogen management strategy is contained in Costa et. al. 1991.

Part 1: Establishing Nitrogen-Loading Limits

1. Embayment: _____
2. Area of Bay:_____ hectares
3. Mean depth of bay at MLW:_____ m
4. Tidal prism volume: _____ cubic m
5. Volume at mid-tide: _____ cubic m[1]
6. Flushing time or residence period _____ days[2]
7. Flushing time or residence period ([item 6a] /365) _____ years
8. Critical loading rate for this embayment— (select 8a or 8b)[3]

   8a (volume-flushing adjusted limit):_____ mg/cu. m flushing during Vollenweider period

   8b (area adjusted limit): _____ mg/sq. m per year
9. Critical loading limit to embayment (use 9a or 9b based on criteria in Table 5.1):

   (METHOD 1, volume-flushing adjusted limit as in 8a)[4]

$$\frac{[\text{Item 8a}] \times [\text{Item 5}] \times (1+\text{sqrt}[\text{item7}]) \times 2.2}{[\text{item7}] \times 1{,}000{,}000} =$$

   9a. _____ lb N/year to the drainage basin

   (METHOD 2, area adjusted limit as in 8b)

   [Item 8b] x [Item 2] x 10 x 2.2 =

   9b. _____ lb N/year to the drainage basin

[1] Volumes of most major embayments are available from the Buzzards Bay Project. Volume at mid-tide can also be calculated by adding 1/2 the tidal prism to the volume of the bay at mean low water (MLW), or [Item 2] x [Item 3] + [Item 4]/2.. If mean depth is unknown, it will be necessary to calculate the area of each bathymetric contour on nautical charts to determine volume at MLW.

[2] Flushing should be calculated by a qualified hydrographer. The Buzzards Bay Project is developing criteria for the application of different flushing calculation methodologies. Preliminary flushing calculations for Buzzards Bay embayments are included in Table 5.2.

[3] Refer to Table 5.1 for the appropriate limits and method to use.

[4] The term (1+sqrt(flushing time in years) is an adjustment to the flushing period as described by Vollenweider (1976) and Costa et al., 1991, and referred to here as the Vollenweider term.

Part 2: Existing Anthropogenic Nitrogen Inputs

10. a. Number of existing residences in drainage basin: _____

    b. [Item 10a] x 17.7 lb/yr/residence[5] = _____ lb/year

11. [Item 10a] x 5000 sq ft/unit x 0.6 lbs N/1000 sq ft/yr[6] = _____ lb/year

12. a. Cranberry bog area in drainage basin: _____ acres

    b. [Item 12a] x 15.8 lb/ac/yr = _____ lb/year

13. a. Other agricultural area in drainage basin:

    b. Pounds and type of animal raised per year x _____ lb N/100 lb of animal/yr[7] =

    c. Acreage of various crops raised x _____lb N/ac/yr = _____ lb/year[7]

14. a. Area of existing paved surfaces in drainage basin: _____sq ft

    b. [Item 14a] x 0.31 lb N/1000 sq ft/year = _____ lb/year

15. a. Acreage of golf courses and cemeteries in drainage basin: _____

    b. [Item 15a] x _____lb N leached/1000 sq ft/yr = _____ lb/year

16. a. Significant non-residential land uses in drainage basin[7]: lb/year

Source	Flow	Units	Volume	N-Concentration	N Load
					lbs/yr
					lbs/yr
					lbs/yr
					lbs/yr

17. TOTAL EXISTING NITROGEN LOAD (add items 10 -16): _____ lb/year

[5] Presumes 3 people per residence, 5.9 lbs/person/year

[6] This assumes an application rate of 3 lbs N/1000 sq ft and a 20% combined leaching and runoff rate

[7] To calculate these inputs, use the methodology and assumptions outlined in "A Mass-Balance Nitrate Model for Predicting the Effects of Land Use on Groundwater Quality," USGS Open-File Report 88-493.

Part 3: Expected Additional Anthropogenic Nitrogen Inputs from Undeveloped Lands

18. a. # of additional residences in drainage basin: _____

    b. [Item 18a] x 17.7 lb/yr/residence[5] = _____ lb/year

19. [Item 18a] x 5000 sq ft/unit x 0.6 lb N/1000 sq ft/yr = _____ lb/year

20. a. Area of additional paved surfaces in drainage basin: _____ sq ft

    b. [Item 20a] x 0.31 lb N/1000 sq ft/year = _____ lb/year

21. Significant additional non-residential land uses in the drainage basin:[8]

Source	Flow	Units	Volume	N-Concentration	N Load
					lb/yr
					lb/yr
					lb/yr
					lb/yr

TOTAL non-residential: _____ lb/year

22. TOTAL ADDITIONAL ANTHROPOGENIC NITROGEN LOADS EXPECTED FROM UNDEVELOPED LANDS (add items 18 -21) _____ lb/year

23 TOTAL NITROGEN LOAD AT FULL BUILDOUT:

(Add Items 17 and 22)

If item 23 exceeds item 9c, nitrogen reduction strategies must be considered for the embayment.

If item 23 is less than item 9c, nitrogen-limiting strategies do not have to be considered for the embayment.

[8] Contributions from other types of proposed development should follow the methodology and loading assumptions outlined in "A Mass-Balance Nitrate Model for Predicting the Effects of Land Use on Groundwater Quality," USGS Open-File Report 88-493.

Part 4: Contributions from a Proposed Subdivision[9]:

Overlay District's permitted nitrogen loading limit to drainage basin: ____ lb/acre/yr

24 a. Number of units with 3 bedrooms or less: ____

b. [Item 24a] x 17.7 lb/yr/unit = ____ lb/yr

25 a. Total number of bedrooms from units with 4 bedrooms or more: ____

b. [Item 25a] x 5.9 lb/yr/bedroom = ____ lb/yr

26 a. Total number of units: ____

b. [Item 26a] x 5000 sq ft lawn/unit x 0.6 lb N/1000 sq ft/yr [10] =

_____lb/yr

27 a. Calculate the sq ft of paved or potentially paved surfaces in the subdivision:____

b. [Item 27a] x 0.31 lb N/1000 sq ft/year = _____ lb/1000 sqft/yr

28. a. TOTAL NITROGEN FROM SUBDIVISION (add items 24 - 27) ____ lb/yr

28. b. [Item 28a]/area of the subdivision in acres= ____ lb/acre/yr

If the per-unit-area contribution of nitrogen loading from the subdivision (Item 28b) is less than or equal to the permitted nitrogen-loading limit, and if the total nitrogen contribution from the subdivision (Item 28a) when added to Item 17 does not exceed embayment loading limits (Item 9c), no changes are needed to reduce nitrogen from the development.

If these conditions are not met, the proposed development must be changed to reduce the expected nitrogen loading to be less than or equal to the permitted nitrogen-loading limits.

The inputs from land left in its naturally vegetated condition should not be considered in this calculation.

[9] Contributions from other types of proposed development should follow the methodology and loading assumptions outlined in "A Mass-Balance Nitrate Model for Predicting the Effects of Land Use on Groundwater Quality," USGS Open-File Report 88-493.

[10] The average lawn size may be reduced if necessary provisions are included to guarantee the reduced size. As before, the assumed application rate is 3 lbs N/1000 sq ft and a 20% combined leaching and runoff rate.

Appendix E

Septic System Construction Regulation For Effective Virus Removal

On the following pages is a model Board of Health Regulation designed to regulate the construction of septic systems permitted within 250 feet of watercourses, and inland or coastal bordering vegetated wetlands. The primary goal of this regulation is to reduce the risk of contaminating surface waters with viral pathogens from wastewaters. The regulation is recommended for adoption in all municipalities within the Buzzards Bay drainage basin and may also be applicable to other coastal communities throughout the Commonwealth. The BBP recommends that the setback distances be 250 ft. from watercourses and inland or coastal bordering vegetated wetlands. When this setback distance cannot be met, we recommend that the application area and distribution systems of the septic system be modified as recommended by this regulation in order to maximize attenuation of viruses.

Because of their extremely small size, viruses are the most difficult pathogen for on-site wastewater disposal systems to remove. Studies have documented that viruses entering groundwater can travel in excess of 200 feet. The maximum travel distance of a particular virus is variable and depends on: groundwater flow velocity, temperature, soil characteristics, and the natural decay rate of the particular type of virus.

Because of the long distances viruses can potentially travel in saturated soil conditions, as well as the difficulty in precisely determining the maximum travel distance for a specific set of conditions, the model regulation attempts to maximize the potential for removal of viruses in the unsaturated zone beneath wastewater disposal systems located within 250 feet of a watercourse or wetland.

The four primary factors that affect the efficiency of viral removal in the unsaturated zone are the soil characteristics, the thickness of the unsaturated zone, the design application rate, and the actual distribution of the wastewater in the leaching facility.

Soils with slower percolation rates are more effective at virus removal than soils with faster percolation rates. However, soils with slower percolation rates do not have the ability to accept wastewater over the long term as effectively as soils with faster rates. For these reasons percolation rates have been considered in this model regulation.

There is an inverse relationship between application rate and virus removal efficiency. The model regulation recognizes this relationship and reduces the acceptable maximum application rate compared to what is acceptable under current state regulations. This reduction is expected to increase virus removal in the unsaturated zone by spreading the effluent over a larger area.

The thickness of the unsaturated zone also affects viral transport and where the unsaturated zone thickness is less than 14 feet, this set back regulation will apply because application rates currently allowable under state regulations do not maximize virus removal.

Appendix E: Effective Virus Removal

Although septic system leaching facilities are designed to receive a specific application rate, this application rate is seldom what actually occurs in a leaching facility that has gravity distribution, as is the case with most septic systems. What typically does happen is that the lowest part of the system is loaded at a much greater rate. This excess loading causes a biological mat to form more quickly in this particular area of the leach field. Once this mat has formed it slows the percolation of wastewater into the soil and the next lowest section of the leaching facility receives excess loading. This situation is referred to as the creeping failure phenomenon. When any particular area of a leaching facility receives excess hydraulic loading its ability to remove viruses from the wastewater is reduced. The model regulation includes measures to help insure better distribution of the wastewater in the leaching facility to reduce the likelihood of excess loading in one area of the leaching facility.

A more detailed description of the rationale behind this model regulation, as well as other model regulations, are available through the Buzzards Bay Project.

Proposed Regulation

Supplement To Title 5

Septic System Construction

Section 1.1 General Requirements.

1.11)No septic system leaching facility shall be constructed within one-hundred (100) feet of a Watercourse, as defined in 310 CMR 15.00: THE STATE ENVIRONMENTAL CODE, TITLE 5: MINIMUM REQUIREMENTS FOR THE SUBSURFACE DISPOSAL OF SANITARY SEWAGE, Section 15.01 Definitions, or within one-hundred (100) feet of an inland or coastal Bordering Vegetated Wetland as described in 310 CMR 10.00: WETLANDS PROTECTION.

1.12)If a proposed leaching facility is to be located less than two-hundred and fifty (250) feet from a watercourse, or inland or coastal bordering vegetated wetland, and the bottom of the facility is less than fourteen (14) feet from the maximum adjusted groundwater elevation, the application rate shall be as follows:

Percolation Rate	Application Rate
Minutes/Inch	Gallons/SqFt/Day
6.0 or less	0.75 or less
6.0	0.50 or less

(The application area needed to achieved these rates shall be calculated using formula given in Section 1.2.)

Maximum adjusted groundwater elevation must be determined using one of the following methods, or a method approved by the Board of Health:

1) using ESTIMATING HIGH GROUND-WATER LEVELS FOR CONSTRUCTION AND LAND USE PLANNING-A CAPE COD, MASSACHUSETTS EXAMPLE, by Michael H. Frimpter and Martha N. Fisher, U.S. Geological Survey, Water Resources Investigations 83-4112, Sep 1983, or;

2) performing an observation test during the wet season as determined by the Board of Health. In marine coastal settings, observation tests must be performed over a complete tidal cycle, excluding "minus tides" as defined by a standard tide table.

A variance application from this section must include a hydrogeologic study showing that no portion of the contaminant plume from the proposed septic

system will intercept any watercourses, or coastal or inland bordering vegetated wetlands within a distance of 250 ft.

1.13)The bottom of any proposed leaching facility subject to Section 1.12 must be at least five (5) feet above the maximum adjusted groundwater elevation. If a variance from this section is approved by the Board of Health (allowing a separation distance of four (4) feet), the proposed leaching facility must be designed such that the application rate does not exceed 0.50 gallons per square foot per day (gal/sqft/day).

1.14)Each leaching pit, galley, flow diffuser, chamber or other leaching unit, and every ten (10) feet of leaching pipe length in leaching trenches, fields, beds or other pipe oriented systems subject to Section 1.12, must be fed by a separate line from the distribution box (see Figure 2).

1.15)The invert elevations of all exit pipes in a distribution box must be equal. It is recommended that all exit pipes be fitted with an invert leveler cap. All exit pipes must convey equal flows. Equal flow can be accomplished by one of the following methods or a method approved of by the Board of Health:

1) the distribution box must be installed on crushed stone which at least six (6) inches deep or on eight (8) inch thick concrete masonry units (or cinder blocks) having a surface area equal to or greater than the base of the distribution box, or;

2) the use of a balance-pan spill-type distribution box. A balance-pan spill-type distribution box fills a small (1-2 gallon) pan, inside the distribution box, with effluent before "spilling" out the exit pipes, or;

3) the use of a siphon or pump chamber.

1.16)The maximum allowable effective width of a leaching facility shall be twelve (12) feet.

SECTION 1.2 Calculation of Application Area.

1.21)The application area (AA) for a leaching structure subject to Section 1.12 shall be the effective bottom area plus six (6) inches around it for lateral dispersion (see Figure 1). The application area required to satisfy the application rates as stated in section 1.12 can be calculated using the following formula:

AA REQUIRED(sqft) = FLOW(gal/day)/0.75 or 0.50(gal/sqft/day)

where,

Flow = Gallons/Day as Determined By Title 5, Section 15.02

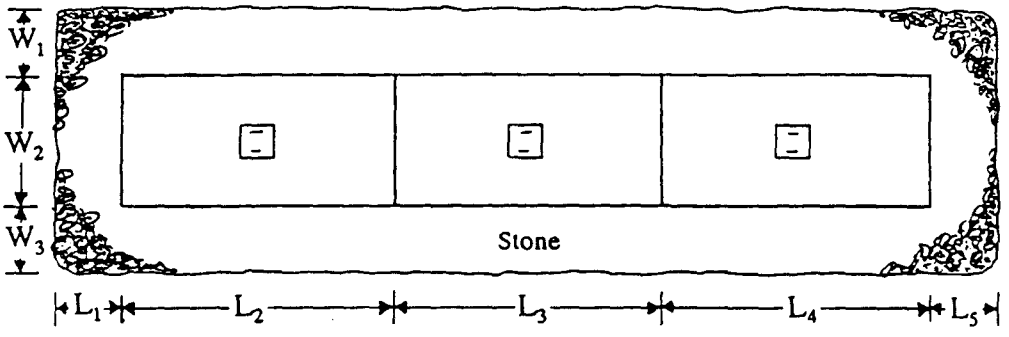
0.75 or 0.50 = Required Application Rate From Section 1.12 or 1.13 Above

Fig. 1 DETERMINING APPLICATION AREA (AA)

For Rectangular Structures

$$AA = (L_1 + L_2 + L_3 + L_4 + L_5 + 1 \text{ ft.}) \times (W_1 + W_2 + W_3 + 1 \text{ ft.})$$

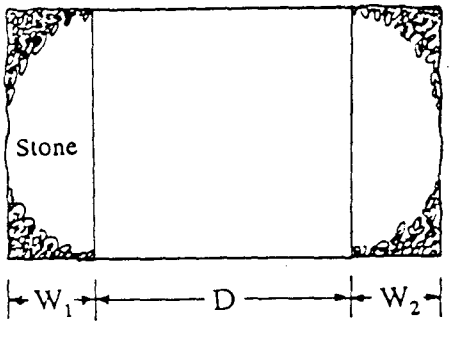
Top View



For Circular Structures

$$AA = [(W_1 + D + W_2 + 1 \text{ ft.})/2)]^2 \times (3.14)$$

Side View



Top View

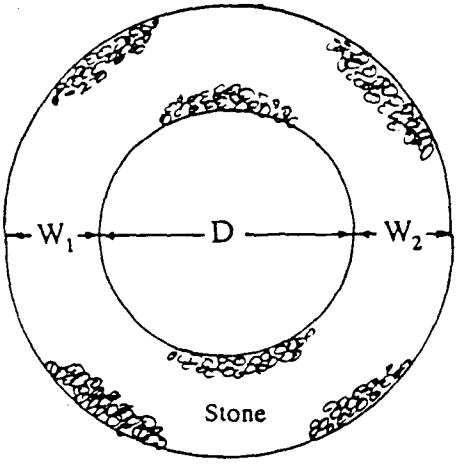


Fig. 2 RECOMMENDED DISTRIBUTION THROUGH FLOW DIFFUSERS

CURRENT METHOD

RECOMMENDED METHOD