The Buzzards Bay Project

Annual Report

1987

The Buzzards Bay Project 1987 Annual Report

Standing at the water's edge, we see few signs of Buzzards Bay's declining water quality. In many areas the Bay appears to be in pristine condition. Why then are shellfish beds being closed and beaches put off limits to swimmers? Why is the fish population decreasing? Why is the water in some poorly circulated bays becoming murky and slimy?

Unseen pollutants, such as excess nutrients, toxic chemicals, and bacteria, are threatening the Bay's health, and threatening our use and enjoyment of the Bay. Buzzards Bay is a resource at risk.

Buzzards Bay is one of the nation's irreplaceable natural environments, an invaluable economic, recreational, and aesthetic resource. However, we can no longer take the Bay for granted. Its clean waters, beautiful swimming beaches, and edible fish and shellfish must be protected because these resources will be valuable for generations to come.

The Buzzards Bay Project is dedicated to protecting both the water quality and the health of fish and shellfish in the Bay. This Project was initiated in 1984 when Congress acknowledged the unique value of Buzzards Bay by selecting it as one of four estuaries in the country to be studied under a special $4 million appropriation. Sponsored by the U.S. Environmental Protection Agency (EPA) and jointly managed by EPA and the Massachusetts Executive Office of Environmental Affairs (EOEA), the Buzzards Bay Project recently received $900,000 in state and federal funds when Buzzards Bay was designated as an estuary of national significance in the National Estuary Program (NEP). Congress and EPA initiated the National Estuary Program in 1985 in response to the need to focus attention on estuaries that are threatened by pollution, development, or overuse. This designation confirms the commitment of federal and state funds as well as local and state organizational support to the Buzzards Bay Project.

We have now passed the midway point for the Buzzards Bay Project, with 2 years of pollution studies of the Bay completed. These projects have given us a better understanding of the causes of water quality problems in the Bay and the processes that affect the input and fate of coastal contaminants. This improved understanding of the major problems of the Bay will help us decide how they can best be remedied.

Research continues on three priority problems in the Bay: (1) closures of shellfish beds due to bacterial contamination, (2) high nutrient inputs and their potential pollutant effects, and (3) contamination of fish and shellfish by toxic metals and organic compounds.

By early 1990, the Buzzards Bay Project will develop a Comprehensive Conservation and Management Plan (CCMP) that will incorporate the Project's three objectives:

- Develop recommendations, based on sound technical information, for managing regional water quality.
- Define the regulatory and management structure necessary to implement these recommendations.
- Educate and involve the public in formulating and implementing these plans.

This Plan will provide the regulations to systematically protect the water quality and marine resources of the Bay. The CCMP will include recommendations for control of point and nonpoint pollution sources, better management of resources, and long-term monitoring to assess the effectiveness of actions taken. Much work remains to be done to develop the Plan by March of 1990, but the Buzzards Bay Project is well on its way. The success of the Project and the health of the Bay depend on the commitment and involvement of everyone who lives, visits, and works along the Bay. We hope you find this mid-point review of the work done to date and the challenges that lie ahead useful, interesting, and inspiring. We remain optimistic that irreplaceable Buzzards Bay resources will continue to be used and valued by generations to come.

Michael R. Deland
Regional Administrator
U.S. Environmental Protection Agency
Region I

James S. Hoyte
Secretary
Massachusetts Executive Office of
Environmental Affairs

Designation of Buzzards Bay as an Estuary of National Importance

On January 29, 1988, Buzzards Bay (see Figure 1) was designated as an estuary of national significance in the National Estuary Program (NEP). This action represents a renewed commitment to improve and protect the environmental quality of the Bay. With the passage of the Water Quality Act in 1987, changes in the NEP prompted the Buzzards Bay Project to review its progress and plans. This review resulted in an agreement reflecting a formal partnership among the Commonwealth, the U.S. EPA, and the Buzzards Bay Project to meet the requirements of the Act, to provide funding, and to work toward cleaning up the Bay on a well-defined schedule.

The Water Quality Act of 1987 provides new authority for the NEP. The Act, which provides general guidelines to monitor the quality of estuaries, officially recognizes the NEP and authorizes the EPA Administrator to develop a Comprehensive Conservation and Management Plan in estuaries of national significance. EPA and the Buzzards Bay Project negotiated goals, schedules, and commitments to meet the requirements of the Act.

The Buzzards Bay designation emphasizes the fact that public health and environmental health are connected. The health of our bays and sounds will ultimately affect our personal health. The designation also recognizes the need for better long-range management of the Bay, and a long-term commitment to its environmental and economic health.

Buzzards Bay is not just a Massachusetts resource, but also a national resource. The NEP is designed to integrate the efforts of all levels of government – local, regional, state, and federal – into a national effort to protect our bays. Many of the problems and challenges facing the Buzzards Bay Project are similar to problems in other estuaries; with the support of these government agencies, as provided by the designation, the Buzzards Bay Project will be able to develop model regulations and plans that other estuary programs can use as a precedent to solve their own water quality problems. This Project thus represents a pioneer approach to deal with water pollution.

Press conference for the Buzzards Bay Project designation ceremony, 1987.

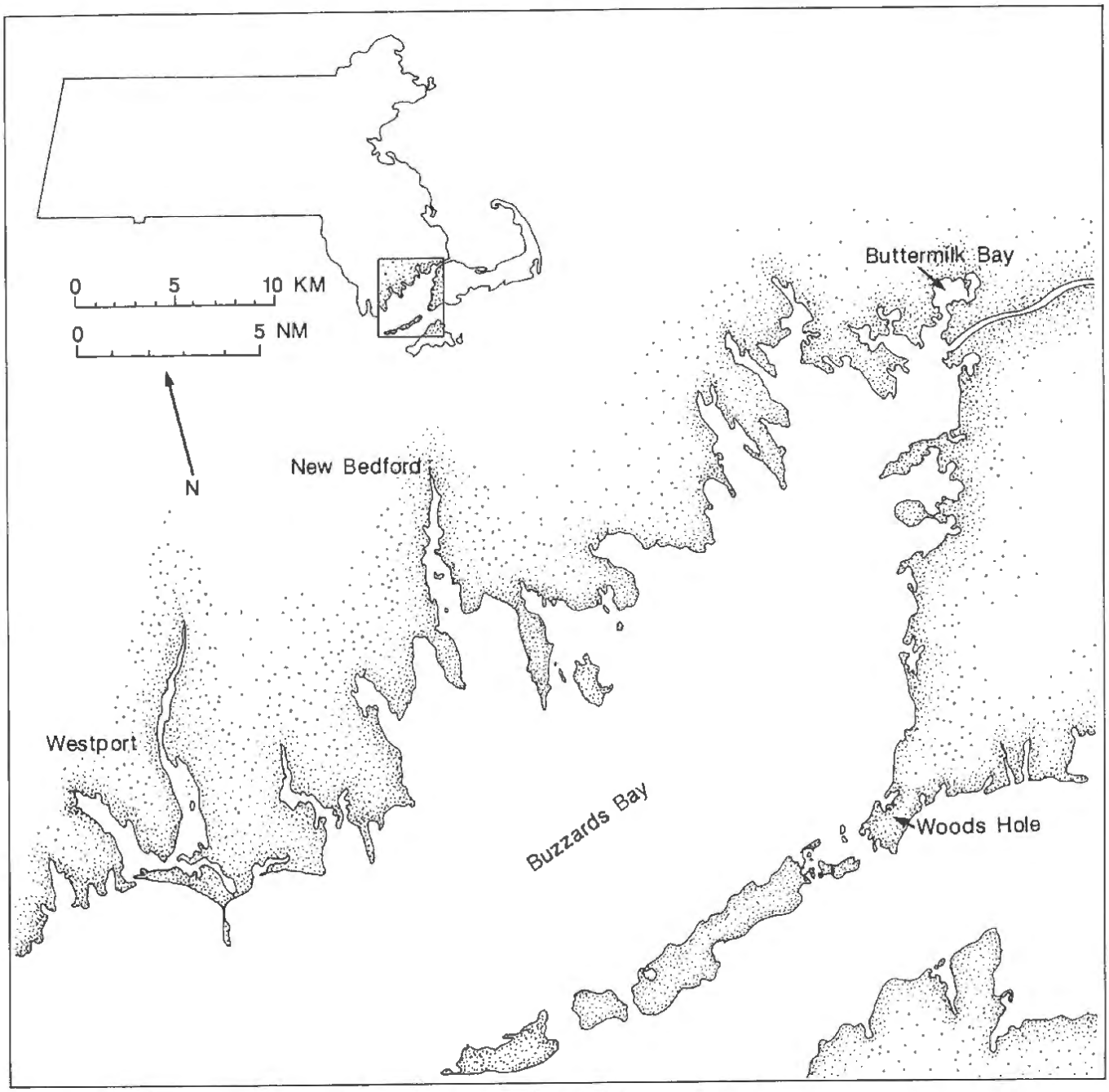


Figure 1. Buzzards Bay, Massachusetts, is located in Southeastern Massachusetts.

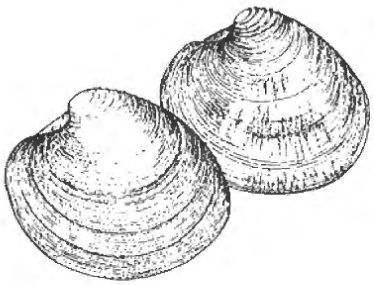
How Does the Buzzards Bay Project Study the Bay's Pollution Problems?

We depend on Buzzards Bay for a variety of uses: recreational and commercial fishing, pleasure boating, commercial shipping, shellfishing, and swimming. Unfortunately, these uses are threatened by development, overuse, and pollution, three factors that are causing a decline in the Bay's water quality. Scientists and managers who monitor Buzzards Bay's environmental status are studying the problems underlying these threats: coliform bacteria, nutrients, and toxic contamination.

The Buzzards Bay Project began addressing these priority problems in 1985 by collecting and evaluating historical information. This year the Project has continued to collect and evaluate new information through problem-specific studies around the Bay. We are also sponsoring a monitoring program to complement the information gained through these scientific studies. The Project is focusing on information that will help us understand how pollutants enter and move around the Bay, where they are most prevalent in the Bay, and how they affect the resources of the Bay.

The ultimate usefulness both of this information and the Project itself lies in the recommendations that they allow us to make about how to manage the Bay's resources. Each town along the Bay must create and enforce regulations to govern local development, landfills, sewer use, shellfishing, harbors, wetlands, and other uses of the Bay and the land that surrounds it. These regulations and action plans, some of which are already implemented in Buttermilk Bay, can help us protect Buzzards Bay by limiting the amount of pollutants entering it.

Scientists are concerned about development, pollution, and overuse of Buzzards Bay. (From the Lloyd Center for Environmental Studies)



Three Key Problems and Progress in Related Studies
Bacterial Contamination

Bacterial Contamination Studies

- **Bacteriological Data Report 1986: Microbial Indicator Surveys and Source Differentiation of the Fecal Streptococci Bacteria**
  Massachusetts Department of Environmental Quality Engineering (DEQE)
- **Bacteriological Monitoring in Buttermilk Bay**
- **Survival and Transport of Enteric Bacteria and Viruses in the Nearshore Marine Environment – An Annotated Bibliography**
  Barnstable County Health and Environmental Department
- **The Hydrogeology and Fresh water Influx of Buttermilk Bay, MA with Regard to the Circulation of Coliform and Pollutants: A Model Study and Development of Methods for General Application**
  Boston University

Bacterial Contamination of Shellfish Beds

Recent increases in the number of acres of shellfish beds closed to harvesting are an indication of the decline that high coliform counts (see Figure 2) have produced in the water quality of Buzzards Bay. In the last 2 years, some swimming beaches have also been closed because of potential health risks associated with coliforms. Coliforms are bacteria found in the intestines of humans and other warm-blooded animals. Their presence in water indicates contamination by sewage and a possible public health threat. Since 1984 the Buzzards Bay Project has monitored the amount of fecal coliforms in the Bay. When an area reaches a fecal coliform count of 14 parts per thousand (ppt), the Division of Marine Fisheries closes the area to shellfishing. An increase in coliform input is apparently related to increasing development of shoreline areas. Researchers are studying the sources of coliforms as part of the Project's goal to recommend remedial actions to protect the shellfishing waters.

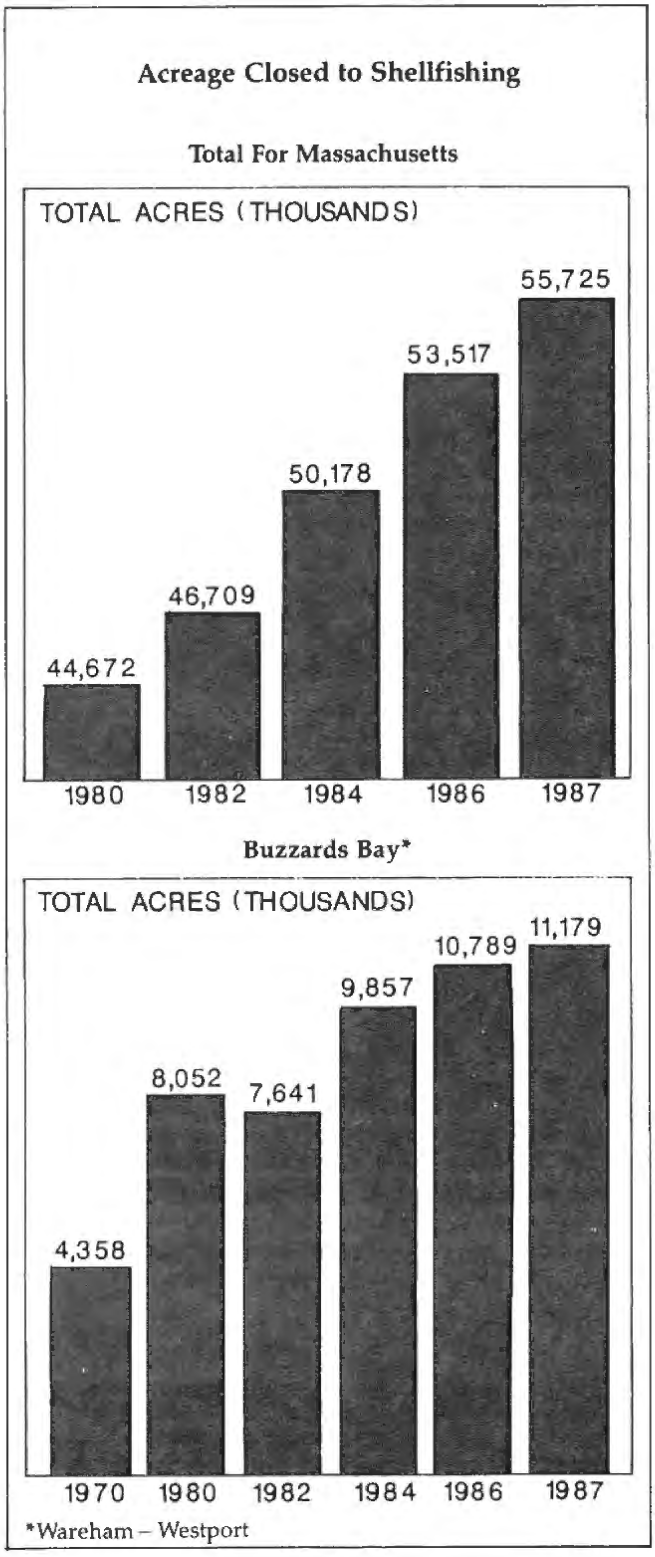


Figure 2. Acreage closed to shellfishing in Massachusetts and Buzzards Bay; Wareham to Westport. (From Massachusetts Division of Marine Fisheries)

Buttermilk Bay Study Serves as a Model

Many of the Buzzards Bay Project's efforts to study bacterial contamination have focused on Buttermilk Bay, an embayment located in the towns of Bourne and Wareham at the north end of Buzzards Bay. Researchers want to determine if remedies to clean up Buttermilk Bay are effective before using them in other parts of Buzzards Bay. For this reason, the studies of Buttermilk Bay that are the basis for remedial actions are referred to as demonstration projects.

Sources of Coliform Bacteria

As a follow-up to last year's study, researchers investigated six possible sources of coliform bacteria in Buttermilk Bay: stormwater, septic systems, wildlife, marinas, fresh water inputs, and point discharges (see Figure 3). Sample stations were established at 6 storm drains and 11 points on the Bay. Groundwater and sediments were sampled, and wildlife was monitored.

Baseline data in 1986 suggested that water quality degradation in Buttermilk Bay might be correlated with rainfall. This year's study, conducted by an investigator from the Barnstable County Health and Environmental Department, showed that stormwater runoff, carried through storm drains to the shores of the bay, is an important cause for the periodic closures of shellfish beds. This finding is typical for densely populated coastal areas and is related to the increased area of impervious surfaces (e.g., roof tops, driveways, roads) associated with residential development. The National Urban Runoff Study in Long Island Sound reached a similar conclusion.

Septic systems also contribute coliforms and nutrients to groundwater which then finds its way into Buttermilk Bay. The area surrounding the bay does not have sewers, and residents rely on individual disposal systems. On-site disposal systems, especially pre-Title-V systems, located near the coast are probably a significant source

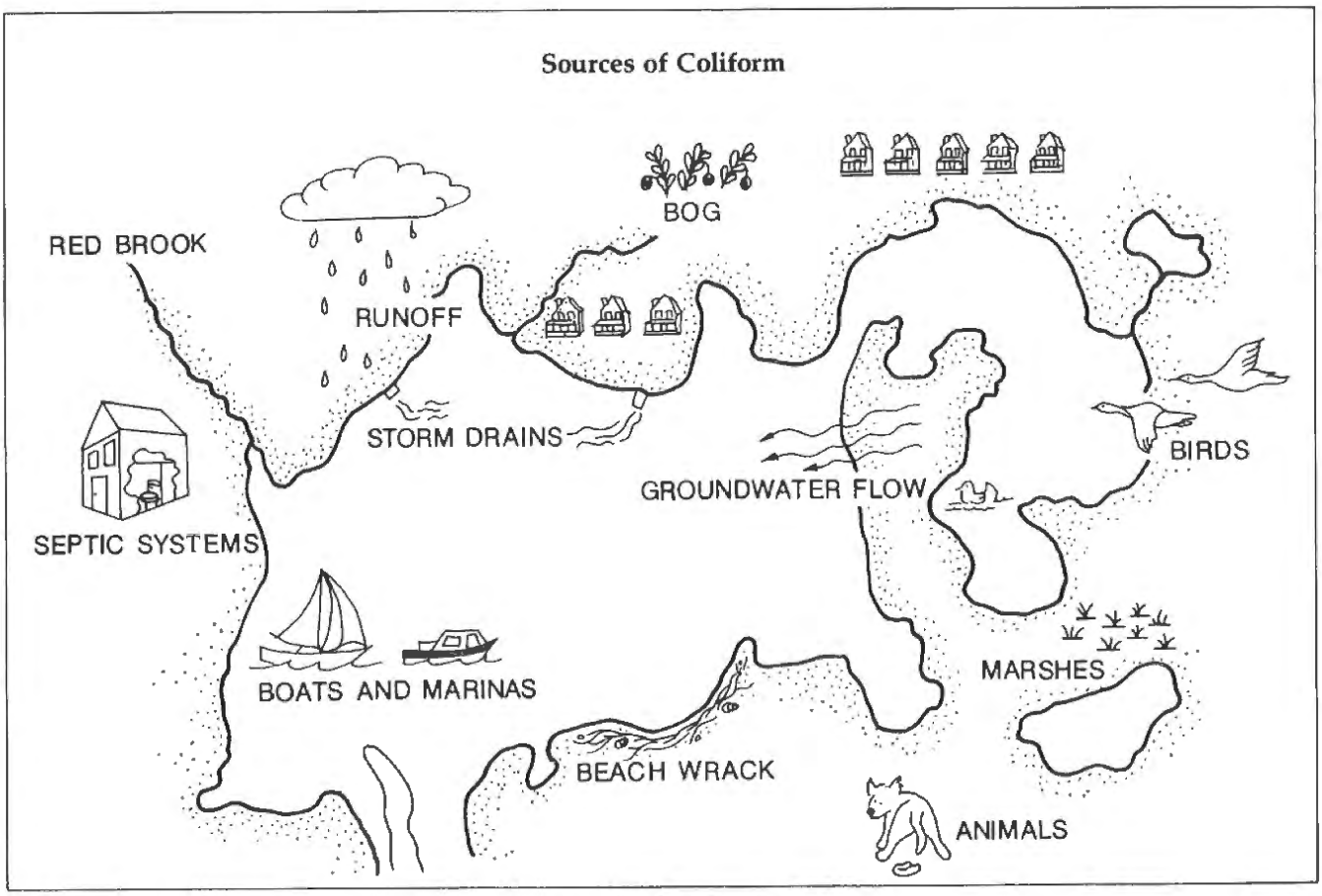


Figure 3. Sources of coliform bacteria. (From Wendy Arrington, U.S. EPA, Region I)

Stormwater runoff may be an important cause for the periodic closure of shellfish beds.

of bacterial contamination. The studies found that other potential sources, such as fresh water streams, wildlife, boats, and one point source, a fish market, contribute coliform bacteria to a lesser extent.

Researchers are also interested in factors that affect the survival and growth of coliforms after the bacteria enter Buttermilk Bay. Marshes and beach wrack debris also tend to retain coliform bacteria, allowing them to survive longer than usual. Do these factors have a bearing on how data on coliform levels are interpreted? Barnstable County investigators considered the effects of solar radiation, temperature, state of association with sediments, and availability of nutrients on the levels of bacteria in the bay. Their studies suggest that nutrient inputs, some of which can be traced to septic systems, may increase the ability of coliform bacteria to survive in the bay. This may happen in two ways: first, by reducing the amount of ultraviolet light, which is known to kill bacteria; and second, by actually promoting maintenance and even growth of coliforms.

Researchers at the Barnstable County Health and Environmental Department also compiled an annotated bibliography summarizing our current knowledge about the survival of sewage-related bacteria and viruses in groundwater and in the marine environment. This bibliography will make the Barnstable County report a valuable reference for other researchers and local officials.

Pollutant Load of Fresh Water

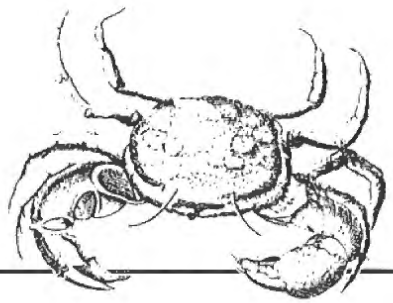
Scientists at Boston University estimated the quantity of fresh water coming into Buttermilk Bay to evaluate the impact of this water and trace its sources of contamination. This study involved Boston University Hydrogeology Group, Boston University Marine Program, and Barnstable County Health Department. The goal of the study was to determine the ground and surface water hydrogeology of Buttermilk Bay, Bay circulation patterns, the flux of nutrients into the Bay, and the source and magnitude of bacteria entering the Bay. Fresh water input was calculated by analyzing a variety of measurements of surface and groundwater discharges in Red Brook and other areas of Buttermilk Bay.

Fresh water en route to the Bay is carried through the upland soil and also runs across the surface. Project researchers conclude that more fresh water is flowing into coastal embayments directly from the surface of the land because development has increased the areas of surfaces, such as parking lots, roads, and rooftops that do not absorb water. This impervious surface prevents the natural retention of water in soils and reduces the amount of nutrients that are removed from the water by filtration through soils. Sewers, storm drains, and gutters also increase the rate of water movement to an estuary. This rapid flow of water flushes bacteria and nutrients directly into the Bay. The source of these contaminants may be local septic systems, cesspools, and farmland surrounding Buttermilk Bay.

The data from the Boston University report were used to estimate the concentration of nutrients and coliform bacteria entering the Bay. The concentration data will then be used to help identify pollution sources and to develop a strategy for monitoring other polluted coastal sites. From this work, recommendations for remedial actions are being developed.

The Technical Services Branch of the Massachusetts Department of Environmental Quality Engineering (DEQE) is studying the problem of shellfish contamination from pathogens. Pathogens, which are viruses or bacteria capable of causing disease, can be found in improperly treated sewage or in untreated waste from domestic animals and wildlife. Researchers studied sites that have been closed to shellfish harvesting because of fecal contamination. Possible sources of contamination include housing areas, a salt marsh, two marinas, and agricultural land. Together with the Boston University research, this study will help us regulate the input of coliform bacteria to Buttermilk Bay.

Nutrient Enrichment



Nutrient Enrichment Studies

- **Eutrophication of Buttermilk Bay, a Cape Cod Coastal Embayment: Concentrations of Nutrients and Watershed Nutrient Budgets**
  Boston University
- **Eelgrass in Buzzards Bay: Distribution, Production, and Historical Changes in Abundance**
  Boston University
- **Buzzards Bay REMOTS Survey New Bedford to Station "R" Transect**
  Science Applications International Corporation (SAIC)
- **Water Quality Data Asssessment for Buzzards Bay, Massachusetts**
  Battelle Ocean Sciences

Nutrient Enrichment of Embayments

One cause of declining water quality is nutrient enrichment. The Project is sponsoring studies that investigate the problems nutrients cause by changing the Bay's environment. High nutrient concentrations decrease water quality; the decline is reflected by turbid water, blooms of algae, lowered levels of dissolved oxygen, and perhaps loss of eelgrass beds. A high influx of nutrients increases the growth and production of marine life, which in turn depletes the supply of dissolved oxygen in the water. Low dissolved oxygen levels can result in physiological stress in organisms. Lowered levels of oxygen, especially at the interface between water and sediment, may serve as an indicator of possible nutrient enrichment.

Increased development along the coast has caused many changes in marine ecosystems, especially a shift in the contribution of nutrients (see Figure 4). Development increases the number of septic tanks, increases the amount of impervious surfaces, and decreases the open land needed to retain and recycle nutrients.

Nutrients enter Buzzards Bay from a variety of sources, including discharge from sewage treatment plants, runoff of fertilizer from residential and agricultural land, precipitation, and groundwater flow from septic tanks. Wildlife and waterfowl appear to contribute only slightly to nutrient input on a baywide scale.

How Nutrients Enter the Bay

Although nutrient levels are low in open waters, indicating that Buzzards Bay is still healthy, there are signs of stress near shore. The Bnzzards Bay Project is sponsoring studies that investigate the sources of nutrients in order to develop recommendations to control amounts entering the Bay. Much of this work is being conducted in Buttermilk Bay because its water quality has already declined somewhat and because variables can be measured more easily in this smaller embayment and then extrapolated to other areas.

Investigators from Boston University constructed a nutrient budget for Buttermilk Bay in a project designed to study the impact of wastewater on nutrient enrichment. Wastewater contains large amounts of nutrient compounds. Researchers seeking to determine the nutrient input from various sources measured nitrate, ammonium, and phosphate concentrations in the Bay, freshwater streams, and groundwater entering the Bay.

Results of the study suggest that more than two-thirds of the nitrogen entering Buttermilk Bay comes from groundwater flow. On-site septic systems and especially cesspools of homes near the shore contribute to high nitrogen concentrations of groundwater. Phosphate concentrations had a different cycle than nitrates and ammonium, indicating that they came from a different source. Ammonium and phosphate levels were higher in groundwater than in the Bay.

Assessing Nutrient Trends

The Massachusetts Division of Water Pollution Control (DWPC) completed a water quality survey in 1985-86 at 140 locations in freshwater streams and coastal embayments around Buzzards Bay. DWPC is interpreting the measurements, and Battelle Ocean Sciences is synthesizing these DWPC data with information from previous studies of water quality in the Bay. Battelle reviewed historical data, available in the EPA database management system, on coliform bacteria and nutrients in Buzzards Bay. The two reports will assess trends in nutrients and coliforms in the Bay, information which will be used to help draft future management recommendations for the Bay.

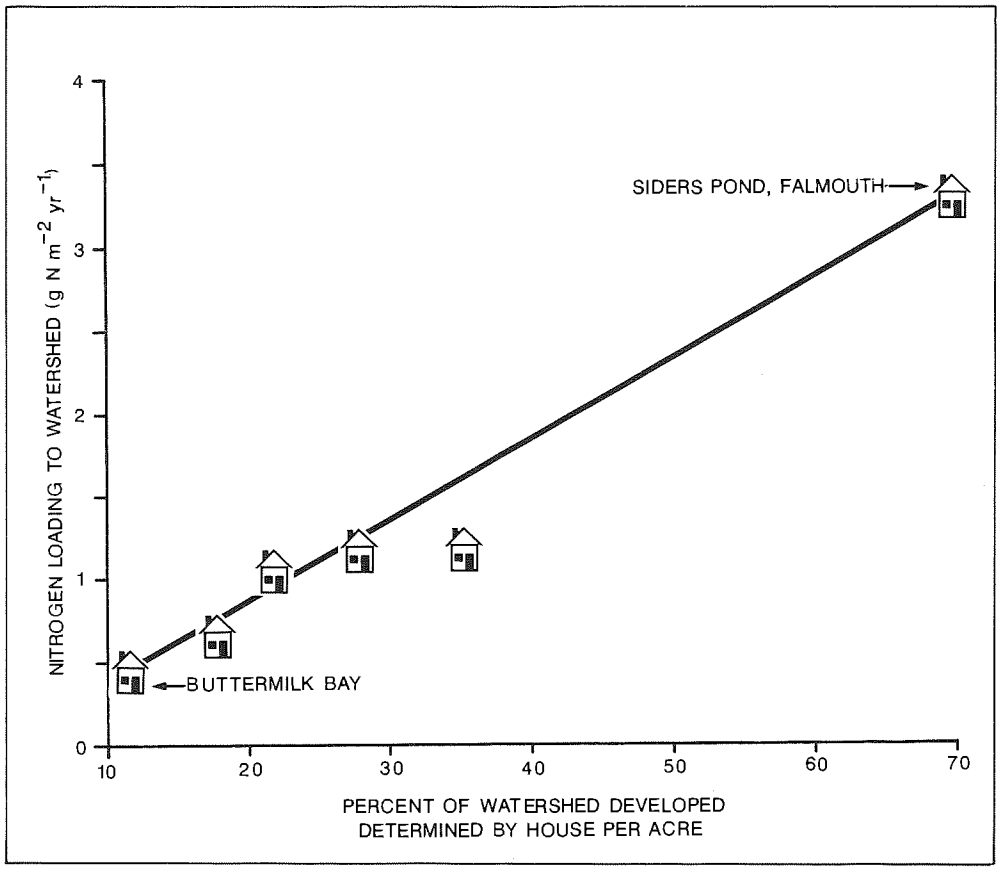


Figure 4. *Nitrogen loading rate in relation to the degree of development (calculated using >1 home per acre) in the watersheds of some coastal embayments and lagoons. (From Valiela and Costa, 1987)*

Recreational fishing and boating could be threatened if pollution sources are not identified and managed properly. (From the Lloyd Center for Environmental Studies)

Although water samples show that the highest nutrient levels occur near the shore, a study by Science Applications International Corporation (SAIC) examined the condition of bottom sediments, associated organisms, and dissolved oxygen along a transect from New Bedford Harbor to the center of Buzzards Bay. Some early signs of degradation due to nutrient enrichment were evident in communities of bottom-dwelling (benthic) organisms and in sediment profiles at shallow stations and in an offshore depression. Near the center of the Bay, the community of bottom organisms appears to be unchanged from conditions recorded 30 years ago.

The purpose of the SAIC study was (1) to test the utility of REMOTS, a remote sensing technique, as a survey tool to identify enrichment gradients on the bottom of Buzzards Bay, and (2) to compare the results with those from a traditional sampling method. REMOTS measurements are taken directly from film negatives by using a video digitizer and computer image analysis system. These images can be stored on a disk and used for continued analysis.

Buzzards Bay provides us with invaluable recreational and commercial resources, but as in so many parts of the Massachusetts Coastline, there has been a decline in water quality due to heavy demands on these resources. The Dukakis administration is committed to doing more to protect the Commonwealth's fragile coastline, and we are pleased to continue working with the U.S. Environmental Protection Agency in this area. We hope to develop an action plan to quickly assess the problem and produce a remedy.

James S. Hoyte, Secretary, Massachusetts Executive Office of Environmental Affairs

The REMOTS study demonstrated that dissolved oxygen levels were not low enough to produce physiological stress in organisms (<3mg/L). Data agreed with a previous study showing that net sediment transport occurs from New Bedford Harbor into Buzzards Bay. Stations located in New Bedford Harbor near the sewage outfall and in nearby Clarks Cove showed evidence of nutrient enrichment. Another series of stations, located in a channel-like depression that leads from the shallow waters of the harbor to the deeper waters of Buzzards Bay, also shows nutrient enrichment. The REMOTS study demonstrated that hand-held oxygen sensors cannot be placed with sufficient precision to detect early signs of lowered oxygen.

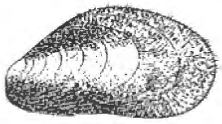
Disappearance of Eelgrass Beds

A Boston University investigator has used aerial photographs to document the decline of eelgrass beds in some poorly flushed embayments. Eelgrass beds are highly productive communities that are ecologically important in coastal waters because they serve as nurseries, refuge, and feeding grounds for fish, shellfish, waterfowl, and invertebrates. In addition, eelgrass can stabilize sediments and reduce erosion. Because of the ecological importance of eelgrass beds, the Buzzards Bay Project funded this project to study the distribution, production, and historical changes in the abundance of eelgrass. The disappearance of eelgrass through the years in a particular area may indicate that important changes have occurred in that coastal ecosystem.

Using vertical aerial photographs taken since 1978, researchers mapped the distribution of eelgrass in all of Buzzards Bay except the Elizabeth Islands. Information in the photographs was verified in the field by divers or surface observations. Researchers also used information from shellfish wardens, other reseachers, and local residents to interpret the photographs. Although grass beds declined in some areas and expanded in others, the maps indicate a net loss of eelgrass during the last 10 years.

The probable causes of eelgrass decline are toxic pollution and nutrient enrichment. Wasting disease (a natural disturbance affecting eelgrass abundance during 1931-1932) was apparently not a significant problem during this time period. The depth at which eelgrass grows is a good indicator of water quality and transparency. Light is less available to eelgrass in poorly flushed embayments than on more exposed shorelines. Water transparency is reduced in waters that are enriched with nutrients and develop high densities of phytoplankton. It appears that nutrient enrichment can have a serious effect on eelgrass growth.

Toxic Contamination



Toxic Contamination Studies

- **Ratios of Edible Tissue to Whole Body PCB Concentrations in Flounder and Lobster from New Bedford Harbor**
  Battelle Ocean Sciences
- **Buzzards Bay Sediment Data Report 1985-1986**
  Massachusetts Department of Environmental Quality Engineering (DEQE)
- **PCB Concentrations and Disease Incidence in Lobster and Finfish in Buzzards Bay**
  Massachusetts Division of Marine Fisheries (DMF)

Toxic Contamination of Fish and Shellfish

One reason the Project and those of us living around the Bay are concerned about toxic contamination in fish and shellfish caught in Buzzards Bay is the location of an EPA Superfund Site in the Acushnet River Estuary. High levels of polychlorinated biphenyls (PCBs) were discharged to coastal water from two electronics manufacturers who dumped waste directly into New Bedford's sewer system and harbor between 1940 and 1970. Since then these toxic compounds have persisted in the water and sediments of New Bedford Harbor. Consequently, the harbor has been officially closed to fishing for human consumption since September 1979. Eating fish and shellfish is the most direct way contaminants reach humans. The Buzzards Bay Project is funding studies by Battelle Ocean Sciences, Department of Environmental Quality Engineering (DEQE), and Division of Marine Fisheries (DMF) to determine the extent and effect of toxic contamination in fish, shellfish, and sediments of Buzzards Bay and humans who eat this seafood. By studying commercially valuable fish and shellfish as well as the sediments, the Project begins to provide information that can be used to determine the baywide and public health consequences of toxic contaminants.

PCB Levels in Seafood

Battelle Ocean Sciences is studying PCB concentrations in edible tissues and whole bodies of flounder and lobster taken from the New Bedford area where more than 18,000 acres are closed to fishing because of PCB contamination. To better assess the risk to human health, scientists need to understand the relationship between tissue content and actual dose of PCBs passed on to human consumers.

Investigators collected winter flounder and lobster in 1985 and analyzed them for PCB content. Edible tissue of flounder was less contaminated than nonedible tissue, probably due to greater accumulation of PCBs in fatty tissues, which are found in the nonedible portions of fish. PCB concentrations in edible muscles of flounder ranged from 0.5 to 1.7 parts per million (ppm) inside closed fishery areas and averaged only 0.3 ppm from parts of Buzzards Bay outside the closed area.

When evaluating PCB concentrations in seafood, an important way to quantify the level is to compare it to the U.S. Food and Drug Administration's (FDA) Action Level. Seafood with levels of PCB above the Action Level of 2.0 ppm is banned from interstate transportation, and states use the Action Level to issue consumption advisories for all fisheries.

When Battelle scientists analyzed PCBs by an EPA-recommended technique, they found that all samples of edible lobster muscle had PCB concentrations less than the Action Level of 2 ppm (total PCBs). However, PCB concentrations in the hepatopancreas of all lobsters collected in the closure areas, and in the hepatopancreas of five of six lobsters taken outside the closure areas, were well above 2 ppm. The hepatopancreas, or tomalley, is the green-colored substance that many people consider a delicacy. Although the Battelle results are not used for a closure decision, they indicate that a serious problem exists.

The Massachusetts Division of Marine Fisheries, using the standard FDA method, surveyed PCB levels in lobster, founder, and hard clams collected from areas of Buzzards Bay outside of New Bedford to see how widespread PCB contamination is. For lobsters, PCB levels ranged from 0.1 to 2.8 ppm with a mean of 0.96 ppm. Hard clams averaged 0.03 ppm with a maximum of 0.08 ppm PCBs, and flounder averaged 0.45 ppm with a maximum of 1.18 ppm PCB (see Figure 5). These studies show that clams have the lowest mean levels of PCBs, flounder have intermediate levels, and lobster

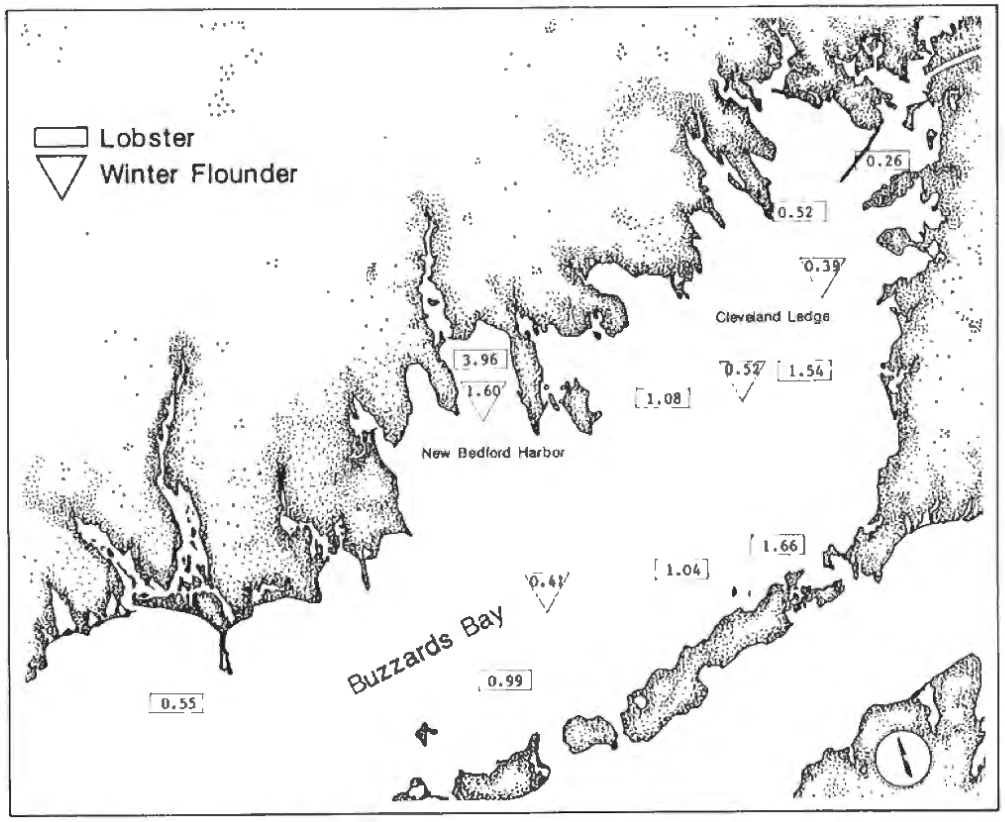


Figure 5. Average PCB concentrations for winter flounder and lobster collected at selected stations in Buzzards Bay. (From J. Schwartz, Division of Marine Fisheries)

have the highest levels. Although edible tissues of all three species taken from Buzzards Bay generally have PCB levels below 2.0 ppm, some samples are dangerously close to the FDA limit. In particular, the high concentrations of PCBs in lobster hepatopancreas indicate a need to further evaluate the potential health risk of eating this part of the lobster.

Toxic Contaminants in Sediment

Scientists have long recognized that toxic materials may build up in sediments, which then serve as a reservoir of contaminants that can be reintroduced to the biosphere. The DEQE's Division of Water Pollution Control is studying concentrations of toxic contaminants in sediments and what these concentrations reveal about the overall health of an estuary.

DEQE researchers had three objectives: (1) to provide background data on PCB levels in the sediments throughout the Bay; (2) to compare these data to those found by other studies; and (3) to evaluate the influence of the New Bedford Harbor/Acushnet River PCB problem on sediments in the upper reaches of Buzzards Bay.

Investigators selected stations that had been previously sampled, were near potential sources of contamination, and had fine-grained sediments. Samples were collected during the summers of 1985 and 1986 from 22 stations covering the inner embayments, the major estuaries, and the outer waters of Buzzards Bay. Samples were analyzed for heavy metals, PCBs, polycyclic aromatic hydrocarbons (PAHs), and grain size. Further study will provide a larger database to help us evaluate the extent of organic and metal contamination throughout Buzzards Bay.

Monitoring and Research

The Buzzards Bay Project must not only gather and interpret information from these individual studies on toxic contamination, nutrient enrichment, and bacterial contamination, but must place this information within the overall picture of the Bay's environmental quality. To make effective management decisions we need additional information from a scientifically sound monitoring program. A monitoring program should be supported by close interaction with the ongoing research because neither routine monitoring nor research results alone provide sufficient information to allow us to interpret trends. A goal of monitoring programs is to assess the status of a particular area, such as an embayment, by repeatedly measuring environmental characteristics that reveal the condition of the area over time. To evaluate whether an area is becoming more polluted or cleaner, these area-by-area measurements must be interpreted alongside similar measurements by other researchers.

The Buzzards Bay Project is using an up-to-date monitoring program to characterize the quality of water, sediments, and biological resources in individual embayments. Because problems deriving from contamination appear first in the embayments, rather than in the large, open bay, researchers will classify embayments according to their degree of pollution from various sources. This characterization will provide information necessary to detect and measure trends that will focus public interest and local action on effective remedial actions. The same monitoring program can then show the effectiveness of remedial actions such as habitat and wetlands protection programs. Local action plans will be developed from Project information to identify the pollution sources and to recommend and implement cleanup procedures.

Monitoring the Health of the Bay

This year, the Buzzards Bay Project initiated a monitoring program that incorporates an innovative method recently developed in the research community. Using transplanted mussels as sentinel organisms, scientists will monitor the water column at Clarks Cove to detect heavy metals and bacteria that are available for uptake by these filter-feeding shellfish. From these data, researchers will also be able to determine fluctuations in concentrations through the year.

This small monitoring program includes an exercise that compares the same water column measurements made by different laboratories. With assistance from the EPA Research Laboratory in Narragansett, Rhode Island, the Project will also characterize the contaminant input from street drains around Clarks Cove in an attempt to relate this potential contamination source with observations of water quality as recorded in the sentinel organisms. Together, these efforts make up the backbone of a monitoring program that will be able to detect geographic and yearly trends in coastal contamination.

Because scientists do not completely understand natural environmental processes (physical, chemical, and biological), any monitoring program leaves some unanswered questions about an area's water quality. This year, the Buzzards Bay Project funded three small research projects that will help us evaluate the overall environmental status of the Bay by complementing the monitoring information.

1. *The Role of Cranberry Bogs as Sources or Sinks of Nutrients to Buzzards Bay* (Woods Hole Oceanographic Institution). From this work, the flux of nutrients through cranberry bogs will be more precisely known and the relative importance of working bogs to the overall nutrient loading of the Bay more clearly understood.
2. *Effects of PCBs on Fish* (Woods Hole Oceanographic Institution). Chemical contaminants may cause a variety of sublethal effects on biota, and the Buzzards Bay Project is helping develop and test new methods to detect these subtle effects.
3. *Transport of Fluids and Particles in Outer New Bedford Harbor* (Woods Hole Oceanographic Institution and U.S. Geological Survey). The transport of contaminants must be understood before effective action can be taken to remedy existing problems. This study will provide better understanding of New Bedford Harbor's role as a source of contaminants to the rest of the Bay.

The Buzzards Bay Project's research may not resolve any of the major questions about the Bay's condition, but it creates an essential link with the academic research community. This link will permit us to move away from random environmental studies and incorporate information from various studies in order to detect trends in coastal contamination.

Where Are We Going From Here?

Buttermilk Bay Demonstration Project

As part of the Buzzards Bay Project, Buttermilk Bay is being used as a model to gain understanding of the sources, distribution, and impact of coliform bacteria and nutrients. Buttermilk Bay was closed to shellfishing in 1984 because of high coliform levels. Since then some areas have been reopened seasonally to shellfishing.

EPA has provided $300,000 to support a demonstration project that will evaluate recommendations for remedial actions to clean up Buttermilk Bay by reducing coliform inputs. Research findings from the Buttermilk Bay Demonstration Project will be described and evaluated in summary reports; the Buzzards Bay Project can use this information to assess the success of various projects in order to develop cleanup plans for other areas of the Bay.

For example, studies show that during dry weather, coliform counts are well below the standard that determines when it is safe for humans to eat shellfish, but when it rains, coliform counts greatly exceed this standard. Thus, two new stormwater treatment projects are being implemented to direct the stormwater to infiltrating basins instead of discharging directly into the Bay (see Figure 6). Allowing stormwater to be naturally treated by soil will reduce coliform input to coastal

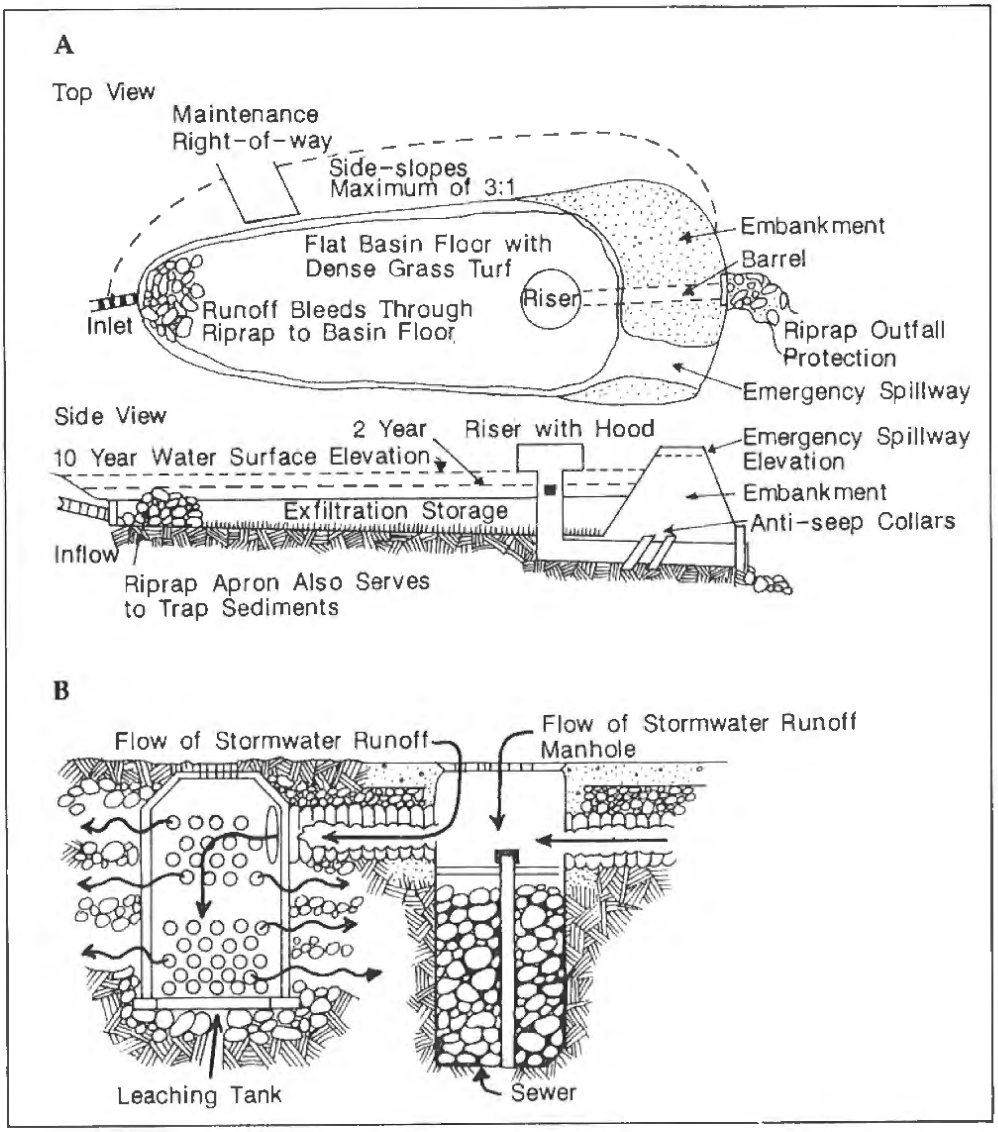
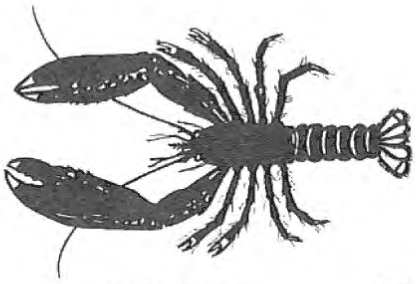


Figure 6. Two stormwater demonstration projects in Wareham and Bourne. Construction and monitoring activities are scheduled to begin in 1988.

A. Detention/Infiltration System. (From Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMP's, July 1987)

B. Stormwater enters the leaching tank from the sewers. It is funneled into the tank and from there it passes through a filter and then into the ground.



waters. Other action plans include public education programs, beach wrack cleanup, technical assistance to local boards of health in Bourne and Wareham, and development and implementation of local regulations to control sources of coliforms.

These remedial actions will be monitored closely over a 2-year period to assess their effectiveness. In this way, the Buttermilk Bay Demonstration Project will provide a model for protecting and restoring water quality in shellfishing areas. This model relies on citizen, local, state, and federal cooperation and is directly applicable to other areas in Buzzards Bay, Cape Cod, Narragansett Bay, Long Island, and coastal areas in general.

The Impact of Local Bylaws and Regulations on Water Quality

- **Inventory of Local Regulations Pertaining to Water Quality in Buzzards Bay**
  Southeastern Regional Planning and Economic Development District (SRPEDD)
- **Technical Resource Manual: A Reference for Buzzards Bay Communities**
  Southeastern Regional Planning and Economic Development District (SRPEDD)
- **Assessment of Past Implementation of Local Water Quality Recommendations in the Buzzards Bay Drainage Basin**
  Southeastern Regional Planning and Economic Development District (SRPEDD)
- **Model Bylaws and Regulations**
  Southeastern Regional Planning and Economic Development District (SRPEDD)

In addition to the cleanup activities being assessed in the demonstration project, there are other ways we can control pollution in Buzzards Bay. For instance, the Project is turning scientific information into specific actions by developing local bylaws and regulations to protect the resources of the Bay.

Most people associate water pollution with industrial discharges, antiquated sewage treatment plants, and combined sewer overflows; these people think of the solution as discharge permits, stricter enforcement of standards, and construction of new facilities. However,

Test of Validity for a Regulation

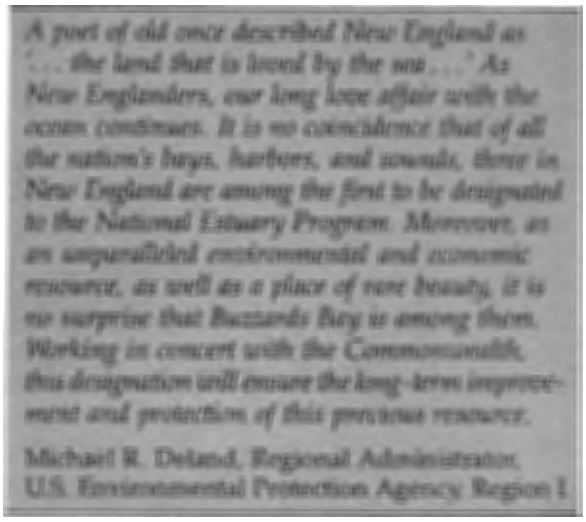
1. Legitimate Public Purpose
2. Relationship Between the Purpose and the Means to Achieve that End
3. Reasonableness of Application

the Buzzards Bay Project is not focusing primarily on such point sources of pollution because in most areas of Buzzards Bay, nonpoint sources of pollution also pose a significant threat. New Bedford Harbor, for example, is the only place in the Bay where point source discharge is a major water pollution problem.

Pollution from such nonpoint sources as faulty septic systems and road runoff is more difficult to identify, measure, and control. Moreover, the responsibility to control and mitigate these sources of pollution rests largely at the local level, governed by the rules and regulations adopted by different town boards, and bylaws adopted by town meetings. Southeast Regional Planning and Economic Development District's (SRPEDD) report *Model Bylaws and Regulations* and bylaw workshops in January 1988 addressed ways the Buzzards Bay Project can help communities control contamination at the local level where it begins.

Given the difficult and lengthy process of identifying sources of nonpoint pollution and their impact on water quality in Buzzards Bay, what can towns do to address pollution from nonpoint sources? SRPEDD's studies show that cities and towns in the Buzzards Bay watershed can help to improve water quality by enacting innovative bylaws and regulations. The model bylaw and regulation report offers seven examples of such measures, many of them already enacted by some nearby towns, that communities can adopt now, while the Buzzards Bay Project and other scientific investigators continue to expand our understanding of the sources and impacts of nonpoint source pollution.

For instance, SRPEDD's Model Subdivision Regulation for Runoff Control offers communities a useful regulatory tool for addressing the problem of shellfish bed closures



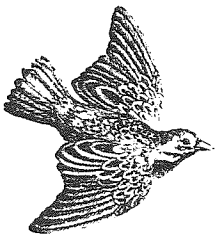
by controlling stormwater discharge in developed areas. This regulation should be enacted to maintain the integrity of natural drainage patterns. Under the provision of Chapter 41, Section 81Q, of the General Laws, planning boards already have the authority to adopt or amend subdivision regulation by vote of the board subject to public hearing and notice requirements. With this regulation, planning boards can control stormwater runoff through the provision of adequate drainage and the control of soil erosion.

Under SRPEDD's Model Subdivision Regulation for Runoff Control, approval of subdivision plans may be denied until planning boards are assured that adequate provisions will be made for maintaining the volume and rate of runoff at its natural or existing level. The developer may elect any method that can be demonstrated to control the required amount of runoff from the development site.

The system may use gutters, inlets, culverts, catch basins, manholes, subsurface piping, surface channels, natural waterways, and either open or stone-filled detention basins. Streets must be graded to provide for expeditious runoff of water, except that settling basins or other means of removing pollutants must be used in draining large parking areas or streets subject to heavy traffic or other sources of pollutants. No untreated wastewater can be discharged directly to a water body. Roof drains may be connected to the drainage system, but no industrial or domestic waste can be allowed to enter storm drains.

Although the adoption of such model rules and regulations represents a significant step in the effort to control one known source of nonpoint pollution, it is not a final solution. It is hoped, for example, that the 1988-1989 Buttermilk Bay Demonstration Project will produce additional information on the nature and control of nonpoint pollution: information that would allow communities to develop more effective nonpoint source regulatory controls than the Model Regulation recommended by SRPEDD.

For now, the process of regulating nonpoint source pollution through local bylaws is still evolving and will improve as the scientific relationship between the various nonpoint sources being regulated and their impact on the quality of water becomes better established. Much of the work of the Buzzards Bay Project is directed at establishing this connection. Although our capacity to predict, for example, the impact of subdivision runoff on shellfish beds, is improving, it is far from exact. Nevertheless, as local officials and citizens, we must take action now and exercise our authority to protect the waters of Buzzards Bay from further degradation.



Public Education and Workshops

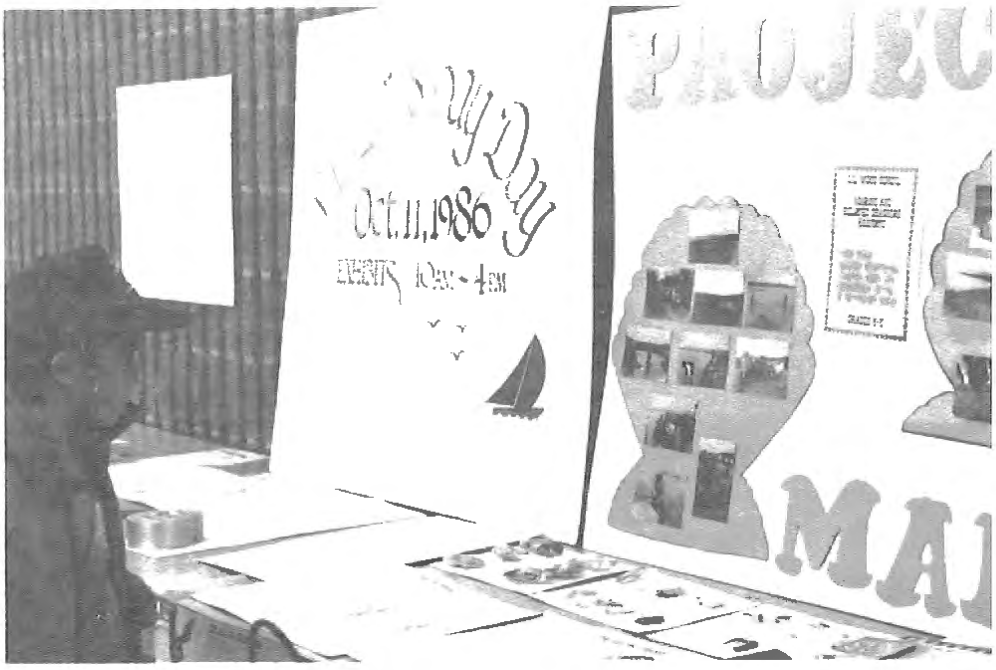
During fiscal year 1986, the Public Education Program of the Buzzards Bay Project was active with workshops, publications, meetings, and administrative support for the creation of the Coalition for Buzzards Bay, the second Buzzards Bay Day, and the Citizens Advisory Committee. Two major objectives of this year's program were to elicit public support for Project activities and to begin translating the results of the research studies into information accessible to the public. The Citizens Advisory Committee and its all-volunteer Buzzards Bay Day Committee involved citizens and citizen organizations in the Project.

The Lloyd Center for Environmental Studies produced the quarterly Buzzards Bay Project Newsletter which is distributed baywide and throughout the region to interested people. This year, the mailing list for this and for other Project publications grew to nearly 1,500 names. A monthly calendar of events, mainly listing programs at the many educational institutions and organizations around the Bay, was also distributed.

The Traveling Display, which includes a free-standing exhibit and a slide show with audio tape, was prepared by the Lloyd Center. The display was set up at numerous organizations, libraries, public buildings, conferences, and meetings. Staff at the Lloyd Center also used the slide show to give presentations to garden clubs, environmental groups, and other organizations around Buzzards Bay.

Through support of the Citizens Advisory Committee, the Project received comments on various issues. One major outcome was Buzzards Bay Day, October 11, 1986, which was designed to involve as many people as possible in the Project. During this day, shore walks, land and boat tours, and exhibits were organized in every town along the Bay and in the City of New Bedford. A boat tour aboard the Massachusetts Maritime Academy's *Ranger* from Bourne to New Bedford was followed by a press conference where State Representatives Roger Goyette and Thomas Cahir, David Fierra of EPA Region I, Bruce Tripp of Massachusetts Executive Office of Environmental Affairs, and Thomas Fantozzi, Chairman of the Citizens Advisory Committee spoke and recognized winners of the first annual Buzzards Bay Day Essay Contest.

Two workshops were held with the Southeastern Regional Planning and Economic Development District (SRPEDD) as a result of the bylaws study that SRPEDD performed for the Project. These well-attended workshops dealt with bylaws on health and planning issues. Representatives from all the towns along the Bay and from the City of New Bedford attended these informative sessions. The public education portion of the Buzzards Bay Project will contine to play an important role in the success of the Project because those of us who enjoy the Bay must support the Project's efforts to preserve the Bay.



Display at the first annual Buzzards Bay Day. (From the Lloyd Center for Environmental Studies)

In The Future

Michael Deland, Regional Administrator for EPA Region I, stated that growth and development of the shore surrounding Buzzards Bay are the biggest challenges to the future of the Bay. By the year 2000, 80 percent of the human population will live within 50 miles of coastal regions. We must plan for this growth now by continuing to implement effective plans to protect the Bay's resources for future generations.

In the near future, the Buzzards Bay Project will develop a Comprehensive Conservation and Management Plan that will recommend actions for controlling point and nonpoint sources of pollution, regulating land use, and managing marine resources. The plan will build upon the basin management plan, which is being prepared by Department of Environmental Quality Engineering, and the various summary and synthesis reports prepared throughout the Project's duration. In late 1988 and early 1989, an annotated outline of the CCMP will be developed, and the final draft should be ready by March of 1990.

Development of the CCMP will require that we prepare other reports on such subjects as options for the future of Buzzards Bay and on possible corrective actions and generic costs for these actions. In addition, we must continue to work on

1. Priority actions and recommendations to protect the defined uses of the Bay;
2. Plans and a compliance schedule for implementation of the CCMP; and
3. A monitoring plan.

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.

Lawrence J. Jensen
Assistant Administrator for Water
U.S. Environmental Protection Agency

Michael R. Deland
Regional Administrator
U.S. Environmental Protection Agency
Region I

James S. Hoyte, Secretary
Massachusetts Executive
Office of Environmental Affairs

Dated this 25th day of January, 1988

All of this work will be directed by the CCMP Coordinator and overseen by EPA and Massachusetts Executive Office of Environmental Affairs project managers. The public, the newly organized Buzzards Bay Advisory Committee, and the Coalition for Buzzards Bay will also play an active role in developing the CCMP by proposing their own recommendations and reviewing those proposed by the CCMP Coordinator. These groups will also be involved in implementing the CCMP, which is the means to the Project's ultimate goal of protecting Buzzards Bay.

In the meantime, some local implementation activities are already underway. For example, in 1988 the Buttermilk Bay Demonstration Project will begin to control stormwater discharges in Buttermilk Bay by installing and operating two different infiltration systems. The demonstration project will also sponsor other experimental projects to control the input of coliform bacteria to Buttermilk Bay. Other action plans that may be developed to preserve the Bay include efforts to protect fisheries, spawning areas, eelgrass beds, and wetlands. To help implement such action plans, Tom Fantozzi, the Buzzards Bay Project's new staff member, will continue to provide technical assistance to local boards of municipalities surrounding Buzzards Bay.

In addition, we will build on the model bylaw workshops to explain and publicize the regulatory authority of the boards and the important role of local bylaws in the protection of environmental quality. Model local bylaws that increase protection to coastal waters by regulating stormwater discharges, septic-system placement, and nutrient loading are being developed.

However, local action plans are only useful if local boards know they exist and how to implement them. To facilitate regional communication and to assist local boards in dealing with water quality issues, the Project organized a new Buzzards Bay Advisory Group. This group, which is the successor to the Buzzards Bay Project's original Citizens Advisory Group, will hold its first meeting in April 1988. The Buzzards Bay Advisory Group comprises approximately 20 town officials, namely selectmen and members of the conservation commission and the board of health, from communities in the Bay's watershed. This group will be actively involved in the development of the Comprehensive Conservation and Management Plan.

Appointment of a Technical Assistant Specialist

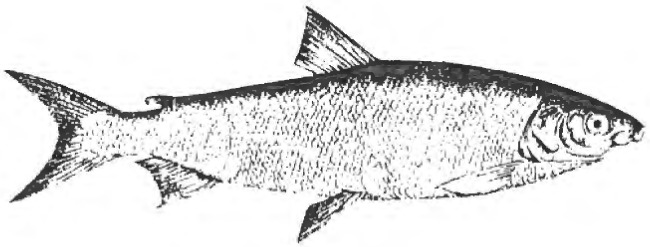
From the beginning of the Buzzards Bay Project, we recognized that a major challenge would be to translate the science and monitoring results into effective actions. Linking science and regulation has always been a difficult process that can cause a problem in a program, such as this one, that has only 5 years to complete the process. To facilitate this process, the Buzzards Bay Project recently hired a Technical Assistance Specialist who could bring the science to the local decision makers, either through case studies or by developing model bylaws.

Thomas E. Fantozzi, former Health Officer for the Town of Bourne, began work in November as part of the Massachusetts Coastal Zone Management (CZM) office. Using CZM's regional office, which recently moved from Dartmouth to Marion, as a base of operations, Fantozzi has contacted all of the health boards and departments around the Bay. In addition, he has helped run workshops on the capabilities of local Boards of Health and on bylaws for presentation to local town meetings. Mr. Fantozzi has urged the training of staff at various health departments in order to increase their expertise, and worked to form a more coordinated method of dealing with water quality issues among the communities on the Bay.

His efforts are based on the solid technical foundation provided by Project investigators, area researchers, and EPA staff. Mr. Fantozzi's experience with local board operations has made much of his knowledge easily transferable into immediate action.

The Remaining Years

Having now passed the midway point of the Buzzards Bay Project, we are making progress toward developing a CCMP. To date, all of the studies, demonstration projects, and regulations reflect the Project's commitment to maintaining the water quality of the Bay. Although we still must resolve the threats of toxic and bacterial contamination as well as nutrient enrichment, our progress so far demonstrates the intensity of our pledge to ensure that the Bay is a safe place for future generations to swim and fish. In the remaining years of the Project, we will continue not just to study trends in the status of the Bay's water, fish, and shellfish, but more importantly to develop and implement specific methods of controlling the problems these threats cause. With your support, we can create a cleaner Bay for ourselves and our children.



Committees Who Manage The Buzzards Bay Project

Who Runs the Buzzards Bay Project?
The organization of the Buzzards Bay Project includes the groups that are committed to the support and implementation of any resulting recommendations. These groups are key constituents for the Project's success. They include members from the research community, public interest groups, local officials, and state and federal resource managers.

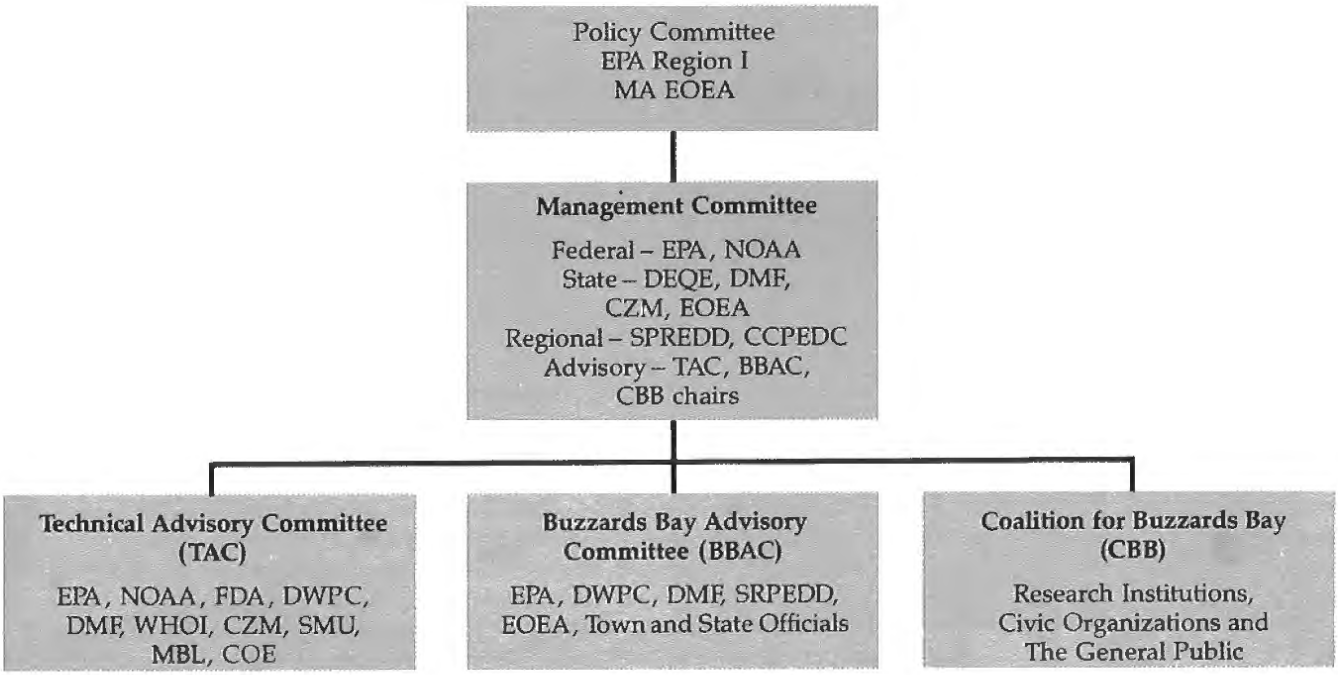
Policy decisions, project management, citizen involvement, and technical advice are all necessary for components of a successful Buzzards Bay Project. To accommodate the variety of interests, expertise, and organizations, perspectives, and agendas, the Project is organized into five committees that bring together people concerned with the differing aspects of a comprehensive estuarine management program. Each committee has a role that interrelates with other committees so that Project plans can be systematically reviewed and evaluated. The members of each committee are listed on the following pages.

Policy Committee
The Policy Committee sets the overall policy of the Buzzards Bay Project and ensures that a coordinated federal-state effort is made to address resource management decisions in Buzzards Bay. The two members are listed below:

Mr. Michael Deland
Regional Administrator
U.S. EPA Region I

Mr. James Hoyte
Secretary
Executive Office of Environmental Affairs
Commonwealth of Massachusetts

Buzzards Bay Management Structure



Key:
Organizations listed include U.S. Environment Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), Mass. Department of Environmental Quality Engineering (DEQE), Mass. Division of Marine Fisheries (DMF), Mass. Coastal Zone Management (CZM), Mass. Executive Office of Environmental Affairs (EOEA), Southeast Regional Planning and Economic Development District (SRPEDD), Cape Cod Planning and Economic Development Commission (CCPEDC), Food and Drug Administration (FDA), Mass. Division of Water Pollution Control (DWPC), Woods Hole Oceanographic Institution (WHOI), Southeastern Massachusetts University (SMU), the Marine Biological Laboratory (MBL), and the U.S. Army Corps of Engineers (COE).

Management Committee
The Management Committee directs program activities for the Buzzards Bay Project. It formulates a long-range strategy for the management of Bay resources and develops annual work plans for research, monitoring, and pollution control. Membership includes a representative from each of the state and federal agencies or regional planning commissions that have responsibility for coastal environmental quality in and around the Bay. Members include

Mr. David Fierra, Chairman
U.S. EPA Region I

Mr. Thomas Bigford, Co-Chair
Technical Advisory Committee

Mr. Steve Bliven
Massachusetts Office of Coastal Zone Management

Mr. Leigh Bridges
Massachusetts Division of Marine Fisheries

Mr. Jack Clarke
Cape Cod Planning and Economic Development Council

Ms. Meriel Hardin
Massachusetts Department of Environmental Quality Engineering

Dr. Russell Isaac
Massachusetts Department of Environmental Quality Engineering DWPC/TSB

Dr. Susan Peterson
President, Coalition for Buzzards Bay

Dr. Don Phelps, Co-Chair
Technical Advisory Committee

Mr. Edwin (Ted) Pratt
Chair, Buzzards Bay Advisory Committee

Mr. Stephen Smith
Southeastern Regional Planning and Economic Development District

Mr. Bruce Tripp
Massachusetts Executive Office of Environmental Affairs

Technical Advisory Committee
The Technical Advisory Committee (TAC) serves as a forum for technical expertise on Buzzards Bay. Membership is drawn from the academic institutions and agencies around the Bay that are active in research, monitoring, and resource assessment.

The Committee reviews annual work plans, research proposals, and research results, and provides technical direction to various projects. Members include

Mr. Thomas Bigford, Co-Chair
National Oceanic and Atmospheric Administration

Dr. Don Phelps, Co-Chair
U.S. EPA Narragansett Laboratory

Mr. Alan Beck
U.S. EPA Narragansett Laboratory

Mr. Steve Bliven
Massachusetts Office of Coastal Zone Management

Mr. Leigh Bridges
Massachusetts Division of Marine Fisheries

Dr. Judith McDowell Capuzzo
Woods Hole Oceanographic Institution

Mr. Frank Ciavattieri
U.S. EPA Region I

Mr. Alan Cooperman
Masssachusetts Department of Environmental Quality Engineering

Ms. June Cubillos
Masssachusetts Department of Environmental Quality Engineering, Lakeville

Dr. Karl Deubert
University of Massachusetts Cranberry Experiment Station

Ms. Kim Devonald
U.S. EPA Headquarters

Mr. Thomas Fantozzi
Massachusetts Office of Coastal Zone Management

Mr. Thomas Fredette
U.S. Army Corps of Engineers

Dr. Graham Giese
Woods Hole Oceanographic Institution

Mr. Larry Gil
Masssachusetts Department of Environmental Quality Engineering

Mr. Steven Halterman
Masssachusetts Department of Environmental Quality Engineering

Mr. Michael Hickey
Massachusetts Division of Marine Fisheries

Dr. John Hobbie
Marine Biological Laboratory

Ms. Carol Kilbride
U.S. EPA Region I

Mr. Mark Mello
Lloyd Center for Environmental Studies

Dr. Robert Merchalano
National Marine Fisheries Service Northeast Fisheries Center

Dr. Francis O'Brien
Southeastern Massachusetts University

Mr. Ira Somerset
Food and Drug Administration

Mr. Bruce Tripp
Massachusetts Executive Office of Environmental Affairs

Dr. Mantay Zerezghi
Southeastern Massachusetts University

The Buzzards Bay Advisory Committee
The Buzzards Bay Advisory Committee will help develop and implement the Comprehensive Conservation and Management Plan for the Bay. The group is comprised primarily of town and state officials. Members include

Mr. W. Thomas Barlow, Selectman
Bourne

Ms. Virginia Valiela, Selectman
Falmouth

Mr. Joseph Grassia Jr., Selectman
Wareham

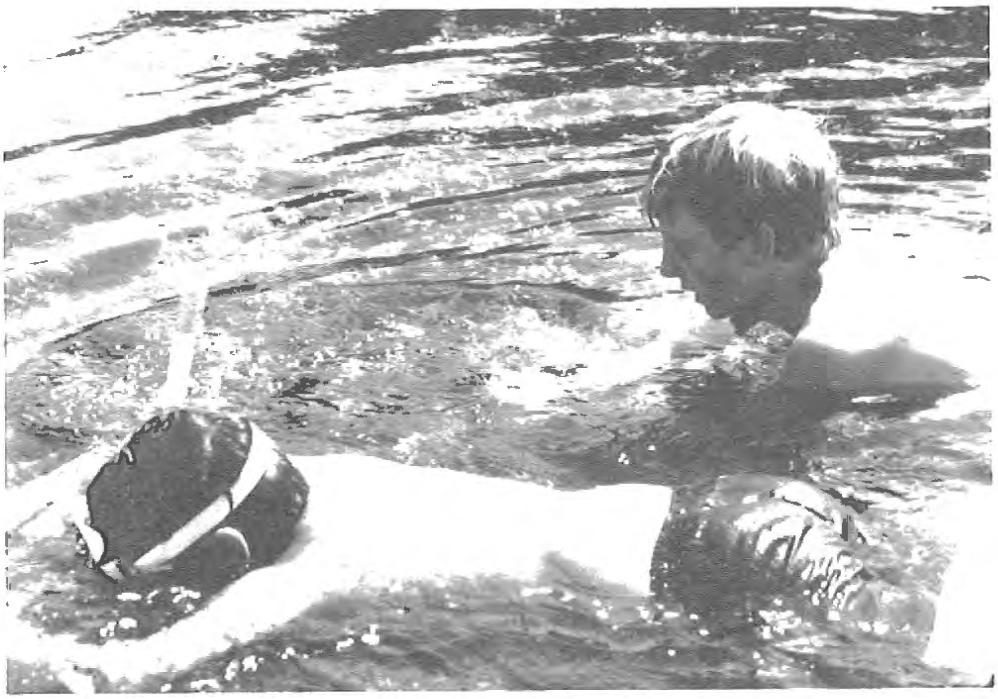
Mr. H. B. Pratt, Selectman, Chair BBAC
Marion

Mr. Nick Nicholson, Director Water Department
Mattapoisett

Mr. Jeffrey O'Such, Executive Secretary
Fairhaven

Ms. Marcy Wetherbee, Environmental Planner
New Bedford

Mr. David Roach Jr., Shellfish Officer
Westport



We will need to work together to create a healthier Bay for future generations to enjoy (From the Lloyd Center for Environmental Studies)

Buzzards Bay Coalition
The Coalition for Buzzards Bay serves to increase the awareness of citizens and communities surrounding the Bay regarding water quality and land use in the area. The Coalition advises, informs, and collaborates with local, state, and federal agencies responsible for environmental quality in Buzzards Bay. The organization includes members from research institutions, businesses, civic organizations, and the general public. Members include

Ms. Theresa Almeida
New Bedford

Mrs. John Bullard
South Dartmouth

Ms. Anne Dewees
North Falmouth

Ms. Liz DiCarlo
New Bedford

Ms. Harriet Didriksen
Mattapoisett

Mr. Seth Garfield
Westport

Mr. Robert Gray
Pocasset

Mr. George Hampson
North Falmouth

Dr. Alan Hankin
South Dartmouth

Mr. George Haydock
South Dartmouth

Mr. Thomas Kingman
Pocasset

Mr. Peter Lavigne
Westport

Mr. Robert MacGregor
South Dartmouth

Mr. Irwin Marks
Acushnet

Dr. Susan Peterson
Woods Hole

Ms. Viola Pina
New Bedford

Mr. Edwin Pratt Jr.
Marion

Mr. David Roach
Westport

Mr. Steve Smith
Taunton

Ms. Kathleen Smith-Brown
Falmouth

Dr. John Todd
Falmouth

Ms. Marcy Wetherbee
New Bedford

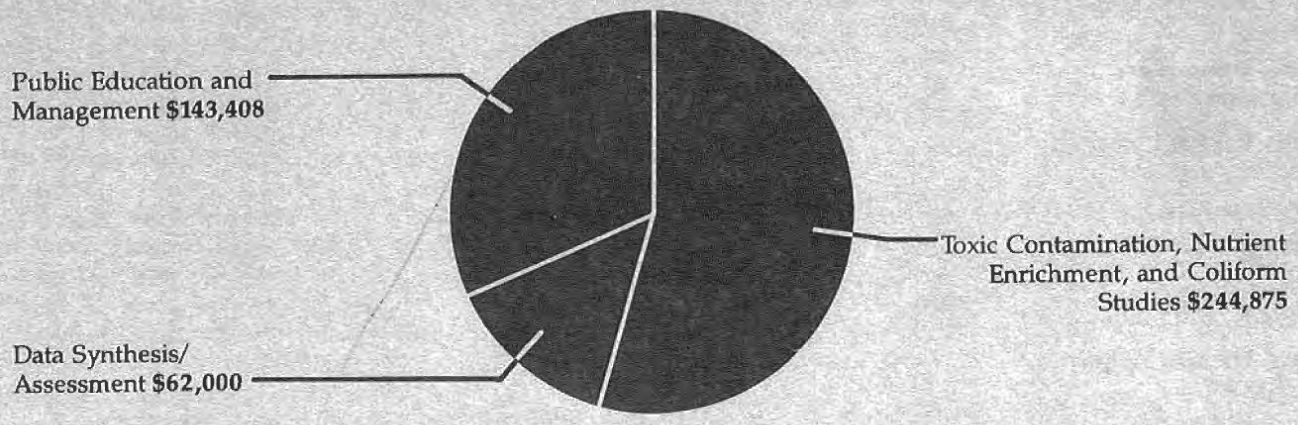
Mr. Mark Truran
East Wareham

Budget

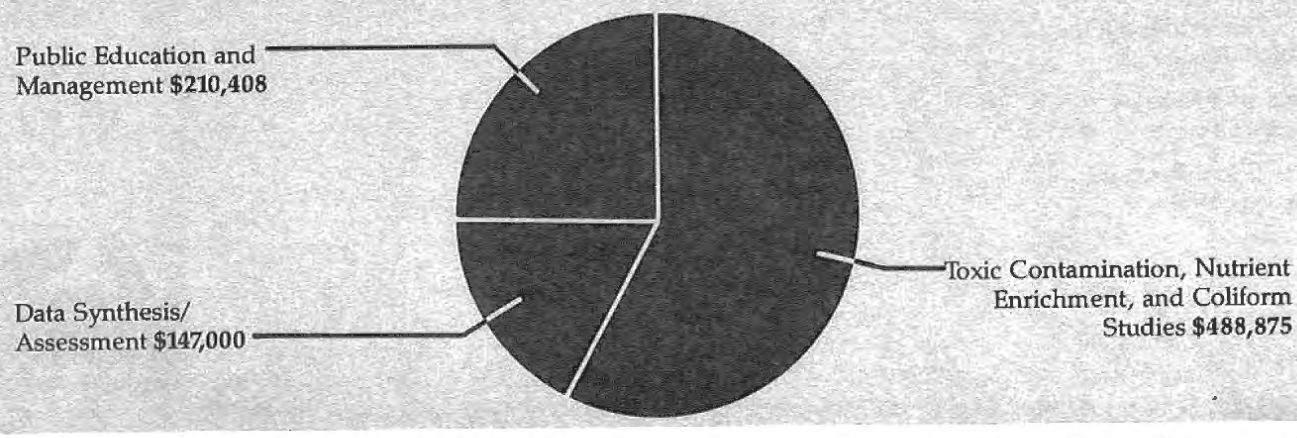
Allocation of Funds by Project in Fiscal Year 1986

Water and Sediment Quality Monitoring	$120,000
Finfish of Buzzards Bay: Status and Trends	12,000
Coliforms and Pollutants in Buttermilk Bay	44,883
Bacteriological Monitoring in Buttermilk Bay	15,620
Nutrient Input from Cranberry Bogs	24,799
Local Improvements to Water Quality Management	40,000
Contaminant Transport in Outer New Bedford Harbor	28,153
Land Use/Water Quality Mapping	50,000
PCB Effects in Buzzards Bay Fish	11,420
Massachusetts State Coordination	63,408
Public Education	40,000
Water Quality Data Assessment	35,000

Allocation of Funds by Topic
For Fiscal Year 1986



For Fiscal Year 1985 and Fiscal Year 1986 Combined



This project has been funded wholly or in part by the U.S. Environmental Protection Agency (EPA) under contract 68-03-3319 with Battelle Ocean Sciences. The contents of this document do not necessarily reflect views and policies of the EPA nor does mention of trade names or commercial products constitute endorsements or recommendations of use.