





# Why Buzzards Bay?





Michael R. Deland

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The primary goal of the Buzzards Bay Project is to protect water quality and the health of living resources in the Bay. Through a team effort of local, state and federal agencies, the academic community, and local interest groups, we are beginning to develop a master plan that will ensure an acceptable and sustainable level of environmental quality for Buzzards Bay.

Buzzards Bay is a valuable Massachusetts 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 heavily indented coastline is uniquely beautiful and provides superb opportunities for fishing, bathing, and boating. In addition, it offers educational and research possibilities to academic institutions located on its shores.

In 1984, Congress recognized the unique value of Buzzards Bay by selecting the Bay as one of four estuaries in the country to be studied under a special \$4 million appropriation. The Project, sponsored by the Environmental Protection Agency (EPA) and jointly managed by EPA and the Massachusetts Executive Office of Environmental Affairs (EOEA), received \$400,000 in 1985, \$400,000 in 1986, and expects to receive similar funding in 1987. The Buzzards Bay Project will enhance the knowledge of local and state agencies of the sources and effects of contamination in Buzzards Bay.

The various uses of Buzzards Bay often conflict, and one result is highly contaminated sediment on the western shores of Buzzards Bay. For example, the harbors where we swim and harvest shellfish double as discharge sites for residential and industrial wastewater.

Along the eastern shore, burgeoning development has made Barnstable County the fastest growing county in New England at the expense of water quality. Industrial pollution and accelerated residential development combine to threaten the environmental and economic health of Buzzards Bay. The Buzzards Bay Project is working to alleviate such concerns by managing studies that achieve the following:

- Identify resource management problems in the region;
- · Investigate the causes of these problems; and
- Recommend actions that will protect our valuable resources from further environmental degradation.

The project has focused on two major issues during its first year: shellfish closures and toxic contamination.

The number of shellfish beds closed to harvesting as a result of contamination by coliform bacteria has increased during the last few years. The Buzzards Bay Project has funded a case study of the shellfish problem at Buttermilk Bay, located in the towns of Bourne and Wareham. The study will identify the sources of bacterial contamination and the transport of coliforms from their source to the shellfish. Based on the results of this work, the Project will help all Buzzards Bay towns develop and implement a clean-up program.

The project is also investigating the export of toxic contaminants from the Acushnet River Estuary to Buzzards Bay. Researchers are surveying fish, lobster, and quahogs throughout the Bay to ensure that levels of toxic contamination do not exceed standards for safe consumption by humans. A study of disease incidence in flounder and lobster is assessing the health of fish in the Bay.

A Bay-wide database of technical information now being assembled will include all information from previous studies as well as new information resulting from current research. State and local decision makers can use this database as they plan for the Bay's future. Environmental decisions are made at both the state and local levels of government. The complexities of environmental issues mandate the use of more sophisticated technical information. This information will become available to the appropriate agencies in the form of model regulations and by-laws.

We are optimistic that the health of Buzzards Bay and its resources can be insured for future generations through the Buzzards Bay Project. Because considerable control over environmental quality lies with individual citizens, we seek your support and welcome your suggestions. The future of our Bay depends on it.

Michael R. Deland Regional Administrator U.S. Environmental Protection Agency Region 1

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



# What are the Water Quality Problems Facing Buzzards Bay?

Water quality in Buzzards Bay is affected by discharges from a number of point and non-point sources. The Buzzards Bay Project is concentrating on (1) closures of shellfish beds due to pathogens, (2) contamination of fish and shellfish by toxic metals and organic compounds, and (3) high nutrient inputs and their potential pollutant effects.

Other problems may loom in Buzzards Bay's future including coastal erosion and sea-level rise. However, managers, citizens, and scientists concerned about the Bay, who are represented on Project committees, agreed that the first three problems are the highest priority for the Buzzards Bay Project.

#### Shellfish Closures

The number of shellfish beds closed to harvesting as a result of contamination by coliform bacteria has increased dramatically during the last few years. In 1986, 11,500 acres of productive shellfish beds along Buzzards Bay were closed to harvesting. Several types of sources may be responsible for the increased bacterial and nutrient loading to the Bay, including wastewater effluents, storm drainage, groundwater flow, recreational boating, agricultural runoff, and waterfowl. Two critical problems facing the Buzzards Bay Project are identifying (1) the relative importance of various sources of bacteria and (2) how the bacteria are transported in coastal waters. Fishery Closure Areas in Buzzards Bay



Locations of areas closed to shellfishing due to high coliform bacteria levels and areas closed to fishing for lobster and finfish because of PCB contamination.

#### **Toxic Contamination**

Toxic contamination of fish and shellfish stocks is a major environmental concern to both fishermen and consumers. The New Bedford area is contaminated by a number of chemicals, and more than 18,000 acres of its coastal water are closed to fishing because of contamination by polychlorinated biphenyls (PCBs). These highly toxic chemical compounds, although no longer in use by the electronics industry, remain in the contaminated sediments of the harbor. Lobsters living in the New Bedford Harbor and neighboring sections of Buzzards Bay have a high incidence of gill and shell disease, which may be associated with the high levels of contamination. The Buzzards Bay Project is funding a variety of studies that concentrate on this problem.

### **Coastal Eutrophication**

The third major growing concern in Buzzards Bay is the extent to which increasing additions of nutrients are affecting the Bay's health. Nutrients enter the Bay from a variety of sources, including discharge from sewage treatment plants, runoff from residential and agricultural land, and groundwater flow that may carry material from septic tanks into the Bay. High nutrient discharges to the Bay cause a decline in water quality as reflected by algal blooms.

# How the Buzzards Bay Project is Addressing the Priority Problems



#### History

From the beginning, the members of the Buzzards Bay Project realized that there was no central source of information about the Bay as a whole. Information was scattered in several locations. We decided that it was important to begin to organize this information, starting with those categories we believed would be most important:

- Fish and Shellfish Resources
- Water Quality
- Local Regulations
- Baseline Maps

In the fall of 1985, the EPA and the EOEA initiated several projects to evaluate environmental problems that threaten uses of the Bay.

## **Fish and Shellfish Resources**

The status of fish and shellfish resources concerns those of us who live along the shores of Buzzards Bay. Although Buzzards Bay has been closed to commercial finfishing since the late 1800s, it is still used as a recreational resource. Recreational use is evidenced by its 4,300 slips and moorings. Its 122,000 acres of bottom also provide ample habitat for the soft-shelled clams, quahogs, scallops, and oysters that are harvested by recreational and commercial fishermen. Two projects, **Finfish Resources of Buzzards Bay**, and **Shellfish in Buzzards Bay: A Resource Assessment**, will provide the first compilation of data on Buzzards Bay fishery resources. These data will help planners understand the magnitude of the Buzzards Bay resources and how they have been changing.

## Water Quality

With increasing development in coastal towns bordering the Bay, local managers are concerned that the Bay's water quality is decreasing. One warning signal is the fact that over 20,000 acres of the Bay are closed to fishing or shellfishing. The Buzzards Bay Project funded the project **Analyzing the Bay's History** to conduct a preliminary evaluation of the available literature and data sets concerning concentrations of toxic and organic compounds, and metals in water, organisms, and sediments. This project will assess the status and trends of water and biota quality by reviewing historical data. Concentrations of nutrients and coliform bacteria in waters around the Bay will also be studied. In addition, information on lobster landings is being collected to add to the fishery resource information.

### Local Regulations

Each town in the Buzzards Bay drainage basin confronts similar problems of regulating local development, landfills, subdivisions, sewer use, shellfishing, harbors, and wetlands. Members of the town boards, generally unsalaried and only working part-time, are often unaware of how neighboring towns regulate similar problems. The Water Quality Regulations in Buzzards Bay project compares how the towns around Buzzards Bay regulate each of those items that affect the water quality of the Bay and its tributaries. This project aims to make the public aware of management choices for the Bay.

#### **Baseline Maps**

There is no single map of Buzzards Bay and its drainage basin that allows local planners and resource managers to evaluate the impact of local decisions on the Bay as a whole. The project **Baseline Mapping of Buzzards Bay** will develop a standard baseline map of the entire Bay with all its drainage areas. These maps will be used in the Buzzards Bay Master Environmental Plan to display project information, such as land uses, abundance of major resources and problem areas.

## **Coliform Contamination and Shellfish Closures**

One of the indicators of the decline in water quality in Buzzards Bay is the increasing closure of shellfish beds due to bacterial contamination. Concentrations of coliform bacteria are monitored by the Massachusetts Department of Environmental Quality Engineering (DEQE) to determine whether the beds should be closed. Coliforms may not be directly harmful to humans, but are an easily measured indicator of pathogens. Two projects, **Bacteriological Monitoring of Buttermilk Bay** and **Coliforms and Pollutants in Buttermilk Bay**, are being funded jointly to evaluate the sources and transport of coliforms in Buttermilk Bay, an embayment at the northern end of Buzzards Bay in Bourne and Wareham, that has been closed to shellfishing due to coliform contamination.

By evaluating sources of coliforms in Buttermilk Bay, we will be able to develop recommendations to control coliform concentrations in other Buzzards Bay embayments. By determining the major sources of shellfish closures, we can advise local and state managers of the kinds of inputs that need to be regulated. In addition to these projects, Massachusetts DEQE is evaluating alternative microbial indicators that might provide a more reliable guide for closing waters to swimming and shellfishing.

#### **Toxic Contamination**

The location of an EPA Superfund site in the Acushnet River Estuary has raised concerns among citizens about toxic contamination from organic compounds and about metals in fish and shellfish caught in the Bay. The Massachusetts Division of Marine Fisheries' (DMF) Assessment of Toxic Contamination in Buzzards Bay and the DEQE's Cooperative Agreement for Buzzards Bay Assessment Studies projects will jointly analyze lobster, shellfish, and winter flounder for PCBs and heavy metals. The flounder and lobster will also be examined for external diseases and liver abnormalities and then compared to other areas in Massachusetts.

This project aims to determine the extent of environmental and public health consequences of toxic materials. Because pesticides and other toxic contaminants tend to become attached to particles and settle to the bottom, the DEQE will also sample sediments in Buzzards Bay to determine the concentrations of PCBs, metals, and petroleum-based compounds in these sediments.

Another project, Assessment of PCB Contamination in Winter Flounder and Lobster, will compare the ratio of PCBs in whole animals collected for the EPA Superfund Project with PCBs in the edible portions of flounder and lobster collected in the projects described above. We will then compare the data collected in the much larger Superfund project (in the New Bedford Harbor) with other data collected in Buzzards Bay.

The results of these three projects will allow the Buzzards Bay Management Committee to evaluate the extent of toxic contamination in the Bay and to determine whether or not further protective measures are required.





Figure adapted from Massachusetts Marine Fisheries Assessment at Mid-Decade (Nov. 1985).

#### **Public Participation Program**

The initial role of the Public Participation Program is to inform the public, interest groups, state agencies, and local 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 has been working on this program since the beginning of the Project.

This program educates us about management issues in the Bay through workshops, a quarterly newsletter, monthly calendars, brochures, public events, public and political briefings, and the development and support of the Citizens Advisory Committee (CAC). Workshops and programs have included a briefing for state and federal representatives and a workshop on Sanitary Surveys. The Buzzards Bay Project Newsletter contains updates, research, upcoming events, and environmental news from around the Bay.

The Lloyd Center is currently preparing a traveling slide show and display that will increase awareness of the Bay's problems. The CAC has become an active organization, and Buzzards Bay Day (September 1986) questionnaires showed that participants were over 99 percent in favor of forming a Buzzards Bay Advocacy Group. Through the combined efforts of the EPA Public Participation Program and the energy tapped from an interested public, there is increasing evidence that Buzzards Bay will be protected long after the Buzzards Bay Project has concluded.

4

# Who Runs the Buzzards Bay Project?

The Buzzards Bay Project has developed an organizational structure that includes the groups that are committed to the support and implementation of any resulting recommendations. These groups are key constituents to 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 components of a successful Buzzards Bay Project. To accommodate the variety of interests, the diversity of expertise, and the numerous organizations, perspectives, and agendas, the Project is organized into four 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 in the back of this report.

# A Wide Range of Organizations Are Part of the Management Structure



#### Key

Organizations listed include: U.S. Environmental 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), Southeastern Regional Planning and Economic Development District (SRPEDD), Cape Cod Planning and Economic Development Council (CCPEDC), Citizens Advisory Committee (CAC), Technical Advisory Committee (TAC), Food and Drug Administration (FDA), Mass. Division of Water Pollution Control (DWPC), Woods Hole Oceanographic Institution (WHOI), Southeastern Massachusetts University (SMU) and the Marine Biological Laboratory (MBL).

# **1986 Buzzards Bay Projects**

Shellfish in Buzzards Bay: A Resource Assessment Ms. Merryl Alber, Boston University Marine Program, Woods Hole

Understanding the extent and distribution of the shellfish resource in Buzzards Bay is extremely important to town managers. By assessing the shellfish resource, managers can predict future populations and decide where to focus enhancement efforts. The information collected in this study can be used to evaluate trends in shellfish catch and market value, and to set catch quotas. Having all this information centralized in the database would thus be very useful to shellfish managers interested in trends in catch data.

In an effort to aid shellfish managers, researchers compiled and evaluated catch data for all economically important shellfish. The list included soft-shelled clams, scallops, quahogs, and oysters. Catch records from each town, compiled by the State Division of Marine Fisheries (DMF), were formatted for the EPA Estuarine Studies Data Base. Records for the 19 years between 1967 and 1985 show that on the average 86,000 bushels of shellfish were reportedly harvested annually in Buzzards Bay. Forty percent of the catch for the four main species was recreational and sixty percent commercial.

In addition, this study found that more quahogs are caught in Buzzards Bay than any other shellfish, with an average annual catch of 50,406 bushels. Oysters, on the other hand, are a much less important resource in Buzzards Bay. Based on the National Marine Fisheries Service's average wholesale landing value in Massachusetts, the total value for the reported catch in 1985 was \$6,575,000.

To test the reliability of shellfish catch data reported to the DMF, shellfish officers were interviewed in each of the towns along Buzzards Bay. However, because the towns use different methods for estimating catch data, the data differ in quality. One of this study's recommendations is to standardize reporting procedures in each town and include the area fished, especially in towns that border more than one body of water.





The Finfish Resources of Buzzards Bay Dr. Sanford Moss and Dr. James G. Hoff, Southeastern Massachusetts University, North Dartmouth

This project established a finfish database for Buzzards Bay that contains a wealth of data now accessible for detailed analysis. The database will help ecologists, fisheries, biologists, and managers of the Buzzards Bay ecosystem document trends and understand how this resource is changing.

Sanford Moss and James G. Hoff have compiled and summarized the existing finfish database for Buzzards Bay from 37 sources. Information on more than 853,000 individual fish, representing 203 species, was obtained from published technical articles, student reports, theses and unpublished reports. Moss and Hoff assessed sources of information by their relative quality and arranged data in two subsets: one dating before 1920, the other after 1960. Very little information is available for the 1920-1960 time period.

The species data, along with their collection dates, data sources, station locations, and absolute and relative abundances, were then formatted into a computer database consistent with that being assembled by the National Oceanographic Data Center of NOAA. The completed database contains 4,145 records, 3,065 of which are in the post-1960 set.

4

An initial search of the post-1960 database showed that the population is dominated by scup, bay anchovy, Atlantic silverside, butterfish, and seven other species, each comprising more than 1 percent of the total catch. Historical records, accumulated prior to 1920, show that the commercial catch was dominated by Atlantic mackerel, butterfish, silver hake, alewife, blueback herring, scup, and three other species. Differences in species between the historical and recent finfish collections are thought to reflect the selectivities of different collecting gear and the sampling locations.



The present finfish fauna of Buzzards Bay includes a resident, year-round segment that features the commercially important winter flounder, and smaller forage species such as Atlantic silverside, mummichog, and fourspined stickleback. Transient species such as striped bass, bluefish, butterfish, black sea bass, and scup use the Bay in the summer and fall as a nursery ground. Moss and Hoff recommend that a continually updated database of Buzzards Bay finfish be maintained. Efforts should also be taken to apply uniform sampling throughout both the year and the Bay to examine the trends more closely.



# **Changes in Buzzards Bay Reported Fish Catches**

## Water Quality Regulations in Buzzards Bay

Susan Moor, Southeastern Regional Planning and Economic Development District (SRPEDD), Taunton

Cities and towns have only begun to use their powers to maintain and improve the water quality of Buzzards Bay. Actions taken by local officials and in town meetings have as much impact on water quality as anything done by federal or state agencies. This study describes what is regulated primarily by municipalities and primarily by the state. It also details how these regulations vary among communities. To help accomplish this, Susan Moor compiled and compared local zoning, health, sewer use, shellfish, harbor master, and wetlands regulations.

Although most federal and state actions are aimed at regulating point source discharges, the control of nonpoint sources rests primarily with local officials sitting on boards of selectmen or city councils, planning boards, and boards of health. But despite wide powers, local boards are not regulating non-point sources well. Why is this? Very simply, the by-laws and regulations local officials write and administer have a different objective than preventing water pollution.

B = BYLAW C = CONTRACT H = HEALTH Z = ZONING	ACUSHNET	BOURNE	DARTMOUTH	FAIRHAVEN	FALMOUTH	GOSNOLD	MARION	MATTAPOISETT	NEW BEDFORD	WAREHAM	WESTPORT
ZONING	*B	10/	10/	4	$\Delta$	0/	$\Delta$	•/	•/	4	•/
SUBDIVISION	•/	4	1		4	0/	•/	•	1	•	•
EARTH REMOVAL	0/	1/2	•	A/z	1/z	0/	•/B	•	0/	•/B	•/B
LANDFILLS	0/	$\Delta$	1×2	0/	A/c	0/	0/	4	0/	0/	0/
WETLANDS	0	0/	A/z	-	Z	0/	0/	۵/	0	AB	0/
AQUIFER	-	A/z	∆∕z	AZ	Z	0/	A/z		0/	AZ	0/
HARBOR	0/	•/	•/		$\Delta$	•/	•/		•/	4	0
SHELLFISH	-	•/	•/		•/	•	•/	•/	•/	•	•/
ANIMALS	-	∆⁄H	∆⁄H	0/	•/	0		0/	-/	-	0/
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## Inventory of Local Regulations Relevant to Water Quality

Municipality has no local regulation, but enforces state law wherever authorized.

Municipality regulates this function, but the regulations do not address water quality.

 $\bigtriangleup$  Municipality regulates this function and the regulations address water quality.

This study found that several problems surround the regulatory framework for these areas in Buzzards Bay. For example, inadequate communication between municipal officials means that boards are often unaware of each others' regulations and may issue contradictory requirements. The lack of available regulatory information makes planning by citizens and applicants difficult and reporting of violations unlikely. Furthermore, when local by-laws and regulations are obtained, they often mimic state regulations and do not authorize any additional local requirements. When they do expand on the powers granted by the state, many describe the purpose and extent of the regulations, but fail to outline standards.

As part of the Buzzards Bay study, SRPEDD will be working with local boards to control the non-point sources of pollution. Future recommendations will take into account the practicality of enforcement. Another step will be to evaluate the various strengths and weaknesses of the local regulations and suggest improvements in local water quality protection and water resource management. These model regulations will be discussed with local planners in various workshops aimed at improving how the Bay's water quality is managed.

### Analyzing the Bay's History

Dr. Betsy Brown, Battelle New England Marine Research Laboratory, Duxbury

This study was designed to identify and collect historical data sets for (1) lobster landings, (2) water quality and nutrients, and (3) toxic substances in organisms and sediments in Buzzards Bay. The project is the first step in characterizing these problems in Buzzards Bay. Future efforts will incorporate these priority data sets into the Bay's database and interpret the trends in water quality documented by these data.

Betsy Brown identified potential data sets by interviewing people from both the 1985 *Bibliography of Buzzards Bay* by Bruce Tripp and contacts at EPA and Battelle. These people had collected data on the Bay, and were asked such questions as their study topic and the area of Buzzards Bay covered.

When the existing data had been identified, the data sets were evaluated and their priority for entry into the EPA database management system was established. The designation of "high" or "low" priority does not necessarily reflect the value of the data set, and many data sets in the low priority group are valuable. The EPA and the Buzzards Bay Technical Advisory Committee ultimately will decide which data will be entered into the EPA database management system.

A total of 58 data sets were identified for the three topics studied, 15 of which were high priority sets. The Massachusetts Coastal Lobster Fishery Statistics provide the only available data on lobster landings for the counties bordering Buzzards Bay. While the currently available data may be useful in assessing the economics



of the lobster fishery based in Buzzards Bay, they do not provide information on the lobster resource within the Bay.

Water quality studies investigated many water quality parameters including coliform bacteria. Coliform data that have been collected for Buzzards Bay by the DEQE are currently being reviewed and formatted for entry into the EPA database. Polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), metals, and pesticides were the most investigated toxic substances in the Bay.

Although a great deal of information exists on the three topics, the data form a patchy network of information rather than an integrated body of knowledge. Phase II of the project is now under way to summarize the published literature and to identify major data gaps. Also, an assessment of coliform and nutrient data will identify historical and spatial trends as well as areas with similarly high concentrations of nutrient and coliforms.

# **Buttermilk Bay Studies**

Nearly 11,000 acres of shellfish beds in Buzzards Bay have been closed due to coliform contamination. As part of the goal to return the shellfish beds to a healthy condition, researchers have been using Buttermilk Bay as a model study to gain understanding of the sources, distribution, and significance of coliforms and other pollutants in the Bay. The information gained from Buttermilk Bay studies will be applied to other areas of Buzzards Bay where shellfish closures are a problem. The following two projects are being funded jointly to develop recommendations that will help Buzzards Bay managers control coliform concentrations in both Bays.

#### **Coliforms and Pollutants in Buttermilk Bay**

Dr. Ivan Valiela, Boston University Marine Program; Drs. Duncan FitzGerald Christopher Baldwin and D. Caldwell, Department of Geology, Boston University, Boston

Nutrient loading, an often ignored source of pollution, is being studied by scientists at Boston University. Eel grass has been disappearing from several areas of Buttermilk Bay, and data suggest that this may be a result of increased nutrients. It will be important to identify sources of nutrient pollution in the future so that methods of controlling the loading can be developed.

Preliminary data analysis has also suggested that groundwater is a major source of water-borne nutrients,

probably originating from septic tanks surrounding Buttermilk Bay. Water samples indicate that nitrogen compounds appear to be transformed away from the septic tanks. Nearshore nitrogen content is high and variable, 10 to 100 times that of Buzzards Bay. Offshore nitrogen content seems to vary seasonally, most likely caused by an increased flow in the septic tanks from summer tourists. Clues about sources, relative size of flows, etc., may be found if seasonal changes in various forms of nitrogen (nitrate and ammonium) can be determined. Research has also demonstrated the need for an independent tracer of wastewater to validate pollution indices and plume tracers. This study has shown the need for an alternative to the existing coliform method.

An additional study included in this project investigated the hydrography and circulation of Buttermilk Bay related to wind and tidal systems. By examining aerial photographs of Buttermilk Bay, researchers determined longshore circulation patterns. They also were able to study velocities and directions of water parcels at 145 stations throughout the Bay. This information will be valuable in understanding the freshwater and saltwater flushing in the Bay which provides natural cleansing.

# Septic Effluent Impact on Groundwater



# **Controlling Factors**

# **Septic System Factors**

- 1. Density
- 2. Type
- 3. Age
- 4. Seasonality of use
- 5. Rate of discharge

# **Geologic Factors**

- 6. Type of deposit(s)
- 7. Geometry of deposit(s)
- 8. Grain size properties
- 9. Clay mineralogy

# **Hydrologic Factors**

- 10. Precipitation
- 11. Unsaturated zone: moisture content
- 12. Unsaturated zone: thickness
- 13. Hydraulic gradient
- 14. Salt water wedge

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Each vector represents movement over a 20 minute period. The western trajectory begins at the mouth of Red Brook and the eastern trajectory at Queen Sewell Cove. The regions have been identified as areas of high coliform input. Both trajectories leave Buttermilk Bay during the 6 hour ebb tide.





Average concentration of fecal coliform in water from storm drains during discharging into Buttermilk Bay during 7 rain storms in 1986. The fecal coliform standard for shellfish closures is 14/100 milliliters.

## Bacteriological Monitoring of Buttermilk Bay George Heufelder, Barnstable County Health and Environmental Health Department, Barnstable

A major objective of the Buzzards Bay Project has been to identify the relative importance and amount of various inputs of coliforms to the Bay. In cooperation with Boston University, the Barnstable County Health and Environmental Department has been investigating coliform inputs to Buttermilk Bay. Researchers evaluated the contribution of various coliform sources — septic systems, stormwater runoff, drainage, animals and waterfowl, and recreational marine craft — and compiled significant public health information on these sources.

Baseline data has indicated that water quality degradation in Buttermilk Bay is strongly correlated with rainfall. Coliform counts of samples collected from six discharge pipes around the Bay ranged from 7,883 to 87,166 fecal coliform/100 ml in stormwater. George Heufelder is presently evaluating the importance of each stormwater discharge point to prioritize any possible future remedial actions.

Groundwater, waterfowl populations, and boating were all studied as possible coliform inputs. Heufelder

sampled groundwater to determine coliform inputs from septic plumes. Waterfowl population surveys, conducted throughout the year, have evaluated waterfowl as a source of fecal coliform pollution. The possible impacts of boats and marinas were evaluated by comparing water and sediment quality during different intensities of use. The sampling of fecal coliforms from marina and boat areas was complicated by the presence of greases, oils, and possibly metals; making analysis difficult. Preliminary results indicate that neither recreational boats nor waterfowl are primary sources of coliform bacteria in Buttermilk Bay.

An additional goal of the project was to develop and evaluate methods of locating coliform inputs in embayments. Currently, water is sampled in the area of shellfish beds to determine if a shellfish area should be closed. Data from this study suggest that there may not be a direct relationship between coliform levels in the water and those in shellfish. Instead a direct relationship between coliform levels in shellfish and those in the surrounding sediments seems probable. It is hoped that future research will determine if, in fact, we should be sampling sediments rather than water to assess fecal coliform pollution in the Bay.

#### **Baseline Mapping of Buzzards Bay**

Dr. Alan Hankin, Lloyd Center for Environmental Studies, Dartmouth

Segments of Buzzards Bay and resources related to the Bay appear on several different maps, but there was no single baseline map of the Bay upon which to overlay or mark the various resources of the region. Although federal, state, and local agencies have prepared maps relating to specific drainage basins, resources, and land uses, no catalogue of these maps existed at the beginning of the Buzzards Bay Project. The purpose of the Buzzards Bay Mapping Project was thus twofold:

- 1. To prepare a catalogue of existing maps, the information contained on each, and the availability of each map. This catalogue, aimed at resource managers, also includes maps of historic importance.
- 2. To prepare a baseline map of the Bay that can be used to map such elements as resources and contaminated areas, factors important to the Project and to resource managers.

The catalogue and large baseline maps will delineate drainage basins. In the future, these maps will be digitized and will allow for overlays of such factors as natural resources (barrier beaches, salt marshes, shellfish, etc.); recreational areas; sewage outfalls, closed shellfish beds, distribution of toxic contaminants; and harbors and areas of concentrated development. These maps will enable local and state planners to consider a wider variety of competing uses when evaluating future Buzzards Bay development.

### Assessment of PCB Contamination in Winter Flounder and Lobster

Richard McGrath, Battelle New England Marine Research Laboratory, Duxbury

This project will compare the levels of PCB contamination in whole animals with those of the edible portions of winter flounder and lobsters. The data will be incorporated with the data of other toxic contamination projects to evaluate the amount of toxic contamination in the Bay. Scientists are analyzing whole animals to estimate the food-chain transfer of PCBs and thereby predict the effectiveness of various clean-up alternatives at the New Bedford Superfund site. The analyses of edible tissues will allow us to begin to assess the risks to people eating fish caught in New Bedford Harbor.

Subsamples for determining PCB contamination in edible tissues of lobster and winter flounder were removed from specimens collected for whole body analysis in the New Bedford Harbor Superfund Project. Researchers collected the animals from the most contaminated, inner sections of New Bedford Harbor to the cleanest, central areas of Buzzards Bay. The data will illustrate the extent of contamination of fish and shellfish in Buzzards Bay and help researchers develop a strategy for dealing with the spread of New Bedford Harbor's contamination.

### Assessment of Toxic Contamination in Buzzards Bay Leigh Bridges, Massachusetts Division of Marine Fisheries, Boston

The DMF is conducting two fisheries-related studies to determine the extent of toxic contamination in fish and shellfish. The first study will determine PCB levels in winter flounder, lobster, and shellfish in areas of Buzzards Bay outside the New Bedford Harbor fishery closure area. The second study will determine the incidence of external diseases and abnormalities in finfish and lobster in the same area. Both studies relate to current fishery management issues that resulted from the contamination of New Bedford Harbor.

It is important to establish PCB body burden levels in fishery resources in Buzzards Bay because of the possible adoption of a 2 ppm (parts per million) tolerance by the State Department of Public Health. Similarly, the incidence of external diseases of finfish and lobster may be related to the New Bedford contamination problem. The information collected in these projects will be compared to similar information in other coastal areas.

Researchers have collected winter flounder and shellfish, and initiated PCB analyses. They have also collected and analyzed the lobsters. Results, to date, include a total of 40 lobsters with PCB levels ranging from 0.1 ppm to 2.8 ppm with a mean of 0.96 ppm. A total of 1,743 finfish and 94 lobsters have been examined for external diseases. Preliminary results show a 2.6 percent external disease prevalence in finfish and a 17 to 28 percent external disease incidence in lobster of black gill and shell disease.

## PCB Concentrations and Percent Incidence of Shell Disease in Lobsters in Buzzards Bay



Numbers represent average PCB concentrations of five lobsters (parts per million). Shading of lobsters represents percentage of animals with shell diseases.

## Cooperative Agreement for Buzzards Bay Assessment Studies

Kenneth Hagg, Massachusetts Department of Environmental Quality Engineering, Boston

The Technical Services Branch of DEQE is conducting five multidisciplinary studies to determine how water quality is being or has been affected by toxic contamination: (1) analyses of water column chemistry; (2) inputs from cranberry bog operations; (3) microbial indicators of non-point source pollution; (4) analyses of clams, lobsters, and winter flounder for heavy metals; and, (5) analyses of sediments for PCBs, heavy metals, and PAHs. These studies will be used in the formulation of a Buzzards Bay management plan that identifies pollutant sources, assesses the distribution and levels of pollutants in various parts of the ecosystem, and recommends methods of abating the Bay's pollution.

The water column and sediment chemistry program involved sampling almost 140 freshwater, inner and outer embayments, and outer bay locations in 1985 and 1986 along the major rivers entering Buzzard Bay. Total nitrogen content of water samples is classified in the same categories used in the Chesapeake Bay Study and DEQE is currently analyzing the data. This survey will be a valuable addition to the existing database on the water quality of Buzzards Bay, in part because no extensive Bay-wide water quality survey has been conducted since 1975.

Although inputs from cranberry bogs have previously received little study, they are potentially significant sources of agriculture-related compounds. The DEQE cranberry bog study measures levels of herbicides, insecticides, and nutrients that enter the sediments and water column of an embayment in Buttermilk Bay from a drainage basin containing cranberry bogs. This study will not only provide information on the inputs of specific bogs, but will also enable researchers to develop methods for projecting inputs into other embayments.

The microbial indicator study is an experimental approach to evaluate the impact of non-point sources of fecal contamination to estuary shellfishing areas closed because of elevated bacteria counts. This study will allow us to determine sources of pollution; evaluate the extent or severity of the pollution; and increase our understanding of the role non-point sources play in the pollution of estuaries. The study of metals in the tissues of clams, lobsters, and winter flounder is being conducted jointly with the DMF project to expand our existing database on the levels of priority pollutants in aquatic organisms in Buzzards Bay.

Researchers are analyzing sediment samples, collected near the sites DMF sampled for shellfish tissue analyses, for PCBs, PAHs, and metals. These data will provide information on the distribution of priority pollutants in the Bay's sediments and the relative concentrations of these pollutants within various estuaries in the Bay.

## Total Kjeldahl Nitrogen (mg/L)



Nitrogen concentrations of Buzzards Bay water as measured in August 1985. Samples on the Cape Cod side of the Bay may be elevated because of a rainstorm the day before sampling.

# **Committees Who Manage the Buzzards Bay Project**

#### **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 R. Deland Regional Administrator U.S. EPA Region I

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

#### 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 workplans for research, monitoring, and pollution control. Membership includes a representative from each of the state and federal agencies or regional planning commissions that have a responsibility for coastal environmental quality in and around the Bay. Members include:

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

Mr. Steve Bliven Mass. Office of Coastal Zone Management

Mr. Leigh Bridges Massachusetts Division of Marine Fisheries

Mr. Jack Clarke Cape Cod Planning and Economic Development Council (CCPEDC)

Ms. Meriel Hardin Mass. Department of Environmental Quality Engineering

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

Dr. Judith McDowell Chair, Technical Advisory Committee

Dr. Jack Pearce National Oceanic and Atmospheric Administration (NOAA)

Mr. Edwin H.B. Pratt Chair, Citizens Advisory Committee

Mr. Stephen Smith Southeastern Regional Planning and Economic Development District

Mr. Bruce Tripp Mass. 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 several academic institutions and agencies around the Bay that are active in research, monitoring, and resource assessment. The Committee reviews annual workplans, research proposals, and research results, and provides technical direction to various projects. Members include:

Dr. Judith McDowell, Chairman Woods Hole Oceanographic Institution (WHOI)

Mr. Alan Beck U.S. EPA Narragansett Laboratory

Mr. Steve Bliven Mass. Office of Coastal Zone Management (CZM)

Mr. Leigh Bridges Massachusetts Division of Marine Fisheries

Mr. Alan Cooperman Mass. Department of Environmental Quality Engineering

Ms. Tena Davies Mass. Department of Environmental Quality Engineering, Southeast Region

Dr. Karl Deubert University of Massachusetts Cranberry Experiment Station

Dr. John Farrington Woods Hole Oceanographic Institution

Mr. Larry Gil Mass. Department of Environmental Quality Engineering

Mr. Michael Hickey Massachusetts Division of Marine Fisheries

Dr. John Hobbie Marine Biological Laboratory (MBL)

Mr. Mark Mello Katharine Nordell Lloyd Center for Environmental Studies, Inc.

Dr. Francis O'Brien Southeastern Massachusetts University (SMU)

Dr. Henry Parker Southeastern Massachusetts University (SMU)

Dr. Jack Pearce National Marine Fisheries Service, NOAA

Mr. Ira Somerset Food and Drug Administration (FDA)

Mr. Bruce Tripp Massachusetts Executive Office of Environmental Affairs

Dr. Wendy Wiltse U.S. EPA Region I

#### **Citizens Advisory Steering Committee**

The Citizens Advisory Committee (CAC) is made up of representatives of local and regional government, elected officials, local resource managers (shellfish officers, harbor masters, etc.), educational institutions, industry, and concerned citizens. The Committee sponsored the Buzzards Bay Day Celebration in September 1985 to

Mr. Edwin H.B. Pratt, Chairman Marion, MA

Ms. Kim Allsup Kim Allsup Associates

Mr. Steve Bliven Mass. Coastal Zone Management

Mr. Leo Byrnes Centerville, MA

Mr. Jack Clarke Cape Cod Planning and Economic Development Council

Mr. Steve Collings Commonwealth Electric Company

Mr. Robert Cummings GHR Engineering

Mr. Thomas Fantozzi Bourne Board of Health

Mr. Bill Franz Ocean Spray

Mr. George Hampson Woods Hole Oceanographic Institution

Dr. Alan Hankin Lloyd Center for Environmental Studies

Mr. Peter Lavigne Westport River Defense Fund

Mr. Burke Limeburner Barnstable County Shellfish Officers Association announce the inauguration of the Project and also sponsored Buzzards Bay Day in October 1986. The Committee also serves as a conduit for public concerns to the management Committee regarding Bay resources. The CAC is guided by the Citizens Advisory Steering Committee whose members are listed below:

Ms. Susan Moor Mass. Coastal Zone Management and Southeastern Regional Planning and Economic Development District

Mr. Bill Nicholson Town of Mattapoisett

Mr. Jeff Osuch Fairhaven Board of Health

Mr. Chris Percy The Sounds Conservancy, Inc.

Mr. Walter Ramos New Bedford, MA

Mr. Dave Roach Shellfish Constable, Westport

Mr. Steve Smith Southeastern Regional Planning and Economic Development District

Mr. Curt Spalding U.S. EPA Region I

Ms. Katherine Kirk Stern Dartmouth Board of Health

Mr. Bruce Tripp Mass. Executive Office of Environmental Affairs

Mr. Carl Wakefield Wareham Health Agent

Dr. Wendy Wiltse U.S. EPA Region I

# Allocation of Funds by Project

Project	Amount	
Shellfish in Buzzards Bay: A Resource Assessment	\$ 5,000	
The Finfish Resources of Buzzards Bay	\$13,680	
Analyzing the Bay's History	\$46,324	
Baseline Mapping of Buzzards 8oy	\$10,000	
Water Quality Regulations in Buzzards Bay	\$10,000	
Sacteriological Monitoring of Buttermilk Boy	\$32,380	
Coliforms and Pollutants in Buttermilk Bay	\$73,585	
Assessment of Toxic Contamination in Buzzards Boy	\$37,400	
Assessment of PCB Contamination in Winter Flounder and Lobster	\$29,632	
Cooperative Agreement for Buzzards Bay Assessment Studies	\$70,563	
Lloyd Center Public Education	\$ 35,000	
Massachusetts Stote Coordinator	\$35,000	

# Allocation of Funds by Topic





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