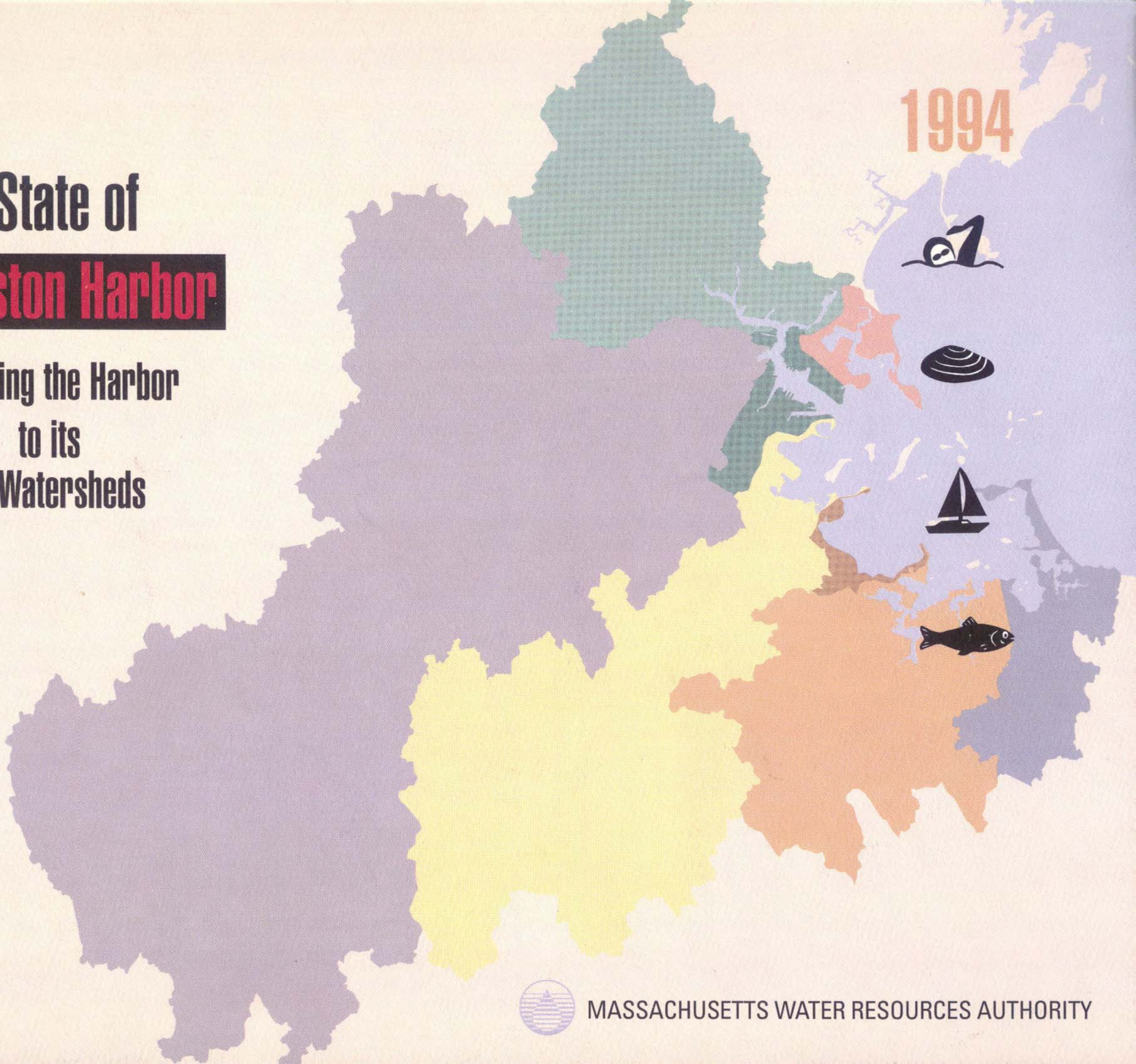
The State of Boston Harbor

Connecting the Harbor to its Watersheds



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MASSACHUSETTS WATER RESOURCES AUTHORITY

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Connecting the Harbor to its Watersheds

October 1995 - Prepared under the direction of:

Douglas B. MacDonald, Executive Director
John F. Fitzgerald, Director, Sewerage Division
Michael S. Connor, Director, Environmental Quality Department

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Acknowledgements

Prepared by:

Wendy Smith Leo
Andrea C. Rex
Sally Rege Carroll
Michael S. Connor

Graphics, maps, and layout by:

Rita Berkeley
Carolynn DeCillo
Susan Curran Ford
Mark Goodwin
Jennifer Siegel

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The Watersheds of MWRA Communities

The centerpiece of this report is a series of maps describing water quality in the watersheds that together form the larger Boston Harbor watershed. The following list links the municipalities in the MWRA service area with the watersheds of Boston Harbor and surrounding areas.

MWRA Communities in Boston Harbor Watersheds

Winthrop Bay Watershed

Boston:
  East Boston■
Revere■
Winthrop

Mystic River Watershed

Arlington■
Belmont■
Boston:
  Charlestown■
  East Boston■
Burlington
Cambridge■
Chelsea
Everett
Lexington■
Malden
Medford
Melrose
Reading
Revere■
Somerville■
Stoneham
Wakefield
Watertown■
Wilmington
Winchester
Woburn

Charles River Watershed

Arlington■
Ashland
Belmont■
Boston:
  downtown■
  Allston
  Back Bay
  Brighton
  Charlestown■
  Jamaica Plain
  Mattapan■
  Roslindale
  Roxbury■
  West Roxbury■
Brookline
Cambridge■
Dedham■
Lexington■
Natick
Needham
Newton
Somerville■
Walpole■
Waltham
Watertown■
Wellesley
Weston
Westwood■

Inner Harbor Watershed

Boston:
  downtown■
  Charlestown■
  Dorchester■
  East Boston■
  Mattapan■
  Roxbury■
  South Boston■
  South End

Neponset River Watershed

Boston:
  Dorchester■
  Hyde Park
  Mattapan■
  South Boston■
  West Roxbury■
Canton■
Dedham■
Milton■
Norwood
Quincy■
Randolph■
Stoughton■
Walpole■
Westwood■

Quincy Bay Watershed

Quincy■

Weymouth Fore and Back River Watershed

Braintree
Canton■
Hingham■
Holbrook
Milton■
Quincy■
Randolph■
Stoughton■
Weymouth■

Weir River Watershed

Hingham■
Weymouth■

MWRA Communities Not in Boston Harbor Watersheds

North Coastal Watershed

Lynn
Lynnfield
Marblehead
Nahant
Peabody
Saugus
Swampscott

Blackstone River Watershed

Worcester

Concord River Watershed

Framingham
Marlborough
Northborough
Southborough

■ A purple square indicates a community that lies in more than one Boston Harbor watershed.

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Executive Summary

As MWRA's new Deer Island treatment facility has progressed towards a completion date in 1999, the annual State of Boston Harbor report has documented that the harbor has entered the early stages of ecosystem recovery. With start-up of the new primary treatment plant in January 1995, this recovery is expected to continue. However, the limited nature of environmental improvements to date underscores the need to press ahead with work on the new secondary treatment plant and on the outfall tunnel that will discharge treated effluent 9.5 miles out in the deep waters of Massachusetts Bay. The full operation of these facilities remains a priority for the restoration of Boston Harbor. However, greater understanding of the harbor's water quality problems and a recognition of the many pollution sources that are not directly linked to the region's sewer systems point to the need for a water quality management approach with a much broader scope.

Watershed management and watershed-based planning are now the watchwords for citizens focused on improving the state of Boston Harbor and other harbors, bays and rivers. This State of Boston Harbor report focuses primarily on assessing each of the eight watersheds that contribute to Boston Harbor and introduces many of the pollution management issues affecting the entire watershed. A sample of the local watershed issues demonstrates the broad scope of water quality problems:

- The 308 square-mile Charles River Watershed is Boston's largest. The Charles River enjoys good water quality for much of its length. However, as the Charles reaches the urban communities along its route to the harbor, high bacteria counts impair its use. Raw sewage from combined sewer overflows (CSOs) and contaminated storm drains adversely affect the Charles River Basin, the Back Bay Fens and the Muddy River. The harbor in turn can be affected by Charles River pollution.
- The Neponset River Watershed is home to some of the area's richest wetlands resources. However, past industrial pollution in the upstream portion of the river has resulted in high levels of toxic contamination, while sewage discharge from downstream CSOs remains a problem for both the river and the beaches along Dorchester Bay.
- In the Mystic River Watershed, the Alewife Brook, which still supports a few of its namesake fish, is among the most polluted waterways in all of metropolitan Boston. Elsewhere in the watershed, pollution from oil port operations in the Chelsea and Island End rivers adversely affects the health of marine animals and the biodiversity of the bottom-dwelling community.

In applying a watershed approach to controlling pollution in Boston Harbor, MWRA has undertaken several projects–both planned and ongoing–within the watersheds. Among those discussed in this report are:

- The new **CSO Plan**, with projects in Boston, Cambridge, Chelsea, and Somerville, will dramatically reduce the frequency of untreated overflows to no more than four per year; provide for the treatment of the largest CSOs; and eliminate CSOs altogether in Dorchester Bay, the Neponset River, and Constitution Beach in East Boston.
- **Interceptor construction and replacement projects** will increase the capacity of old interceptors and prevent untreated sewage from entering the rivers and groundwater.
- **Pollution prevention programs** are helping industries, municipalities, businesses, and residential neighborhoods decrease the amounts of toxic metals and other contaminants that enter the region's sewers.

- **The Infiltration/Inflow Assistance Program** provides over $20 million to MWRA communities for projects to reduce stormwater and groundwater flow into the sewage collection and treatment system.

MWRA is not alone in confronting the challenge presented through watershed improvements. Other state and local authorities, along with private industry and citizens, are responding to the need for more careful management of our critical watershed resources. For example:

- **Stormwater management projects**, like those undertaken by the Boston Water and Sewer Commission and the Town of Brookline, identify and eliminate unlawful sewer connections to stormwater drainage systems.
- The Charles River Watershed Association recently launched an **Integrated Monitoring, Modeling, and Management (IM3) Project** which includes a full range of monitoring and community involvement programs to better understand all aspects of the watershed.
- **The Boston Harbor Beaches Fund**, established by the Joint Commission on the Future of Boston Harbor Beaches, includes beach restoration and increased public access to harbor beaches.
- By **reducing the use of fertilizers, pesticides, and other toxic materials** and disposing of such materials properly, industry and neighborhood residents can reduce sources of runoff contamination.

The improvements in environmental quality that have been achieved since MWRA's Boston Harbor Project began have not just resulted in a healthier harbor ecosystem. Public use of the harbor's recreational offerings has also been bolstered and it is likely that further improvements this decade will lead to even greater appreciation, not only of the harbor itself, but of all the watershed's resources.

In the coming years, a watershed-based approach towards protecting and maintaining Boston Harbor will prove essential in developing both the harbor and its adjoining watersheds for the benefit of all the surrounding communities. This report is intended to provide information on the harbor's watersheds that will stimulate regulatory agencies, environmental and citizen's groups, and elected officials to explore new ways of enjoying and maintaining a cleaner Boston Harbor.

Introduction

In the past, the annual State of Boston Harbor report has primarily examined the relationship between MWRA projects and the environmental health of Boston Harbor. This year, a different approach is taken: water quality is viewed from the broader perspective of watershed planning. Updated information on selected MWRA projects, such as sewer system improvements, industrial pretreatment, and treatment plant performance, is integrated into a discussion of how Boston Harbor's watersheds are polluted. MWRA and community projects are used as examples to illustrate new approaches to effectively managing water quality.

The centerpiece of this report is a series of full-color maps of the eight watersheds that drain into the harbor. These watershed maps illustrate the variety of land uses and resources unique to each area, and how these characteristics determine which pollution problems are most important. The state of the wetlands, rivers, streams, groundwaters, and estuaries of Boston Harbor's watersheds is linked to the health of the harbor–and these waters are priceless recreational, ecological, and health resources in their own right. As we continue to work on the Boston Harbor Project, a watershed perspective reminds agencies and citizens alike that the health of Boston Harbor depends on attention to all our water resources.

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Pollution in Watersheds: the Boston Harbor Example

Much of the pollution entering the harbor is carried by water originating from the harbor's watersheds. Watersheds come in all sizes–large watersheds are made up of many smaller ones. For example, among the Boston Harbor watersheds, the Alewife Brook watershed is part of the Mystic River watershed. Quincy Bay, a part of Boston Harbor, has a small watershed; the watershed of the Charles River, a major tributary to Boston Harbor, is many times larger. The Boston Harbor watersheds are shown in Figure 1.

MWRA's water and sewer systems serve more than two million Massachusetts residents as well as industries and businesses in 61 cities and towns. The water system imports hundreds of millions of gallons of water per day to the Boston Harbor watersheds from several sources in western and central Massachusetts that would otherwise naturally drain to Long Island Sound via the Connecticut River or to the Gulf of Maine via the Merrimack River. Much of the imported water eventually becomes household and industrial wastewater that is transported through a network of local sewers and MWRA interceptors (large regional sewers) to one of two MWRA treatment plants on the shores of Boston Harbor. The wastewater also includes runoff, rainwater and snowmelt that is carried from parts of Boston, Cambridge, Somerville, and Chelsea, and sewage from communities that have non-MWRA sources of water, such as Cambridge. Together these flows make up the 370 million gallons of sewage collected for treatment on an average day. After treatment, the treated wastewater, or effluent, is released into the harbor.

Virtually all human development of the land affects the flow of water and degrades water quality

Virtually all human development of the land affects the flow of water over and under the ground and degrades water quality by adding pollutants or compromising natural processes of water purification. Undeveloped land acts to clean water that flows through natural vegetation and layers of soil. In contrast, stormwater drainage systems and paved ground drastically alter the response of land to a rainstorm. Rainwater quickly runs off paved land, carrying pollutants either into a stormwater collection system or directly into a water body without benefit of natural filtering. Thus urban stormwater, even without sewage connections or industrial discharges, can have pollutant concentrations as high as those in treated municipal wastewater (Ellis, 1986; Bigornia-Vitale et al., 1995).

FIGURE 1: The watersheds of Boston Harbor and MWRA's sewer communities.

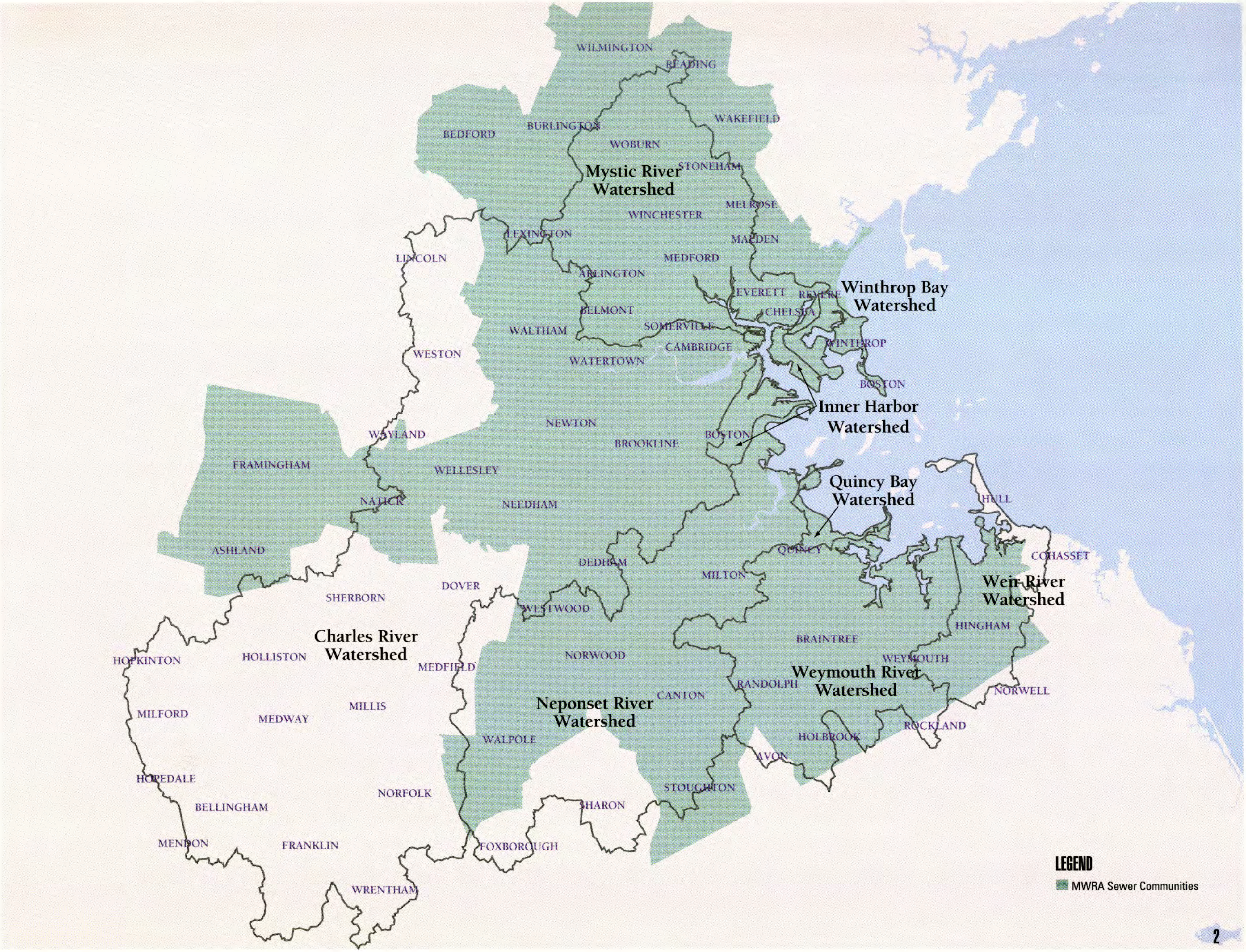

WILMINGTON
READING
WAKEFIELD
BEDFORD
BURLINGTON
WOBURN
STONEHAM
Mystic River Watershed
WINCHESTER
MELROSE
MALDEN
LEXINGTON
LINCOLN
MEDFORD
ARLINGTON
EVERETT
REVERE
Winthrop Bay Watershed
BELMONT
CHELSEA
WALTHAM
SOMERVILLE
WINTHROP
CAMBRIDGE
WESTON
WATERTOWN
BOSTON
Inner Harbor Watershed
NEWTON
WAYLAND
BOSTON
BROOKLINE
FRAMINGHAM
WELLESLEY
Quincy Bay Watershed
HULL
NATICK
NEEDHAM
ASHLAND
QUINCY
COHASSET
DEDHAM
MILTON
Weir River Watershed
DOVER
SHERBORN
WESTWOOD
HINGHAM
Charles River Watershed
BRAINTREE
HOPKINTON
HOLLISTON
NORWOOD
WEYMOUTH
MEDFIELD
Weymouth River Watershed
RANDOLPH
NORWELL
CANTON
MILLIS
Neponset River Watershed
MILFORD
MEDWAY
ROCKLAND
WALPOLE
HOLBROOK
AVON
HOPEDALE
NORFOLK
STOUGHTON
BELLINGHAM
SHARON
MENDON
FRANKLIN
FOXBOROUGH
WRENTHAM
LEGEND
MWRA Sewer Communities

TABLE 1:
Violations of interim discharge limits include biochemical oxygen demand (BOD), total suspended solids (TSS), and pH violations at Deer Island and Nut Island in 1993 and 1994.

# OF TREATMENT PLANT VIOLATIONS				
Deer Island				
Fiscal Year	**BOD**	**TSS**	**Coliform**	**pH**
1993	16	0	0	0
1994	16	1	0	1
Nut Island				
Fiscal Year	**BOD**	**TSS**	**Coliform**	**pH**
1993	6	0	0	10
1994	8	1	0	7

Wetlands are especially effective in reducing pollution by absorbing water that would otherwise run off, filtering out pollutants, and recharging groundwater aquifers. Creating undeveloped buffers around water bodies reduces water pollution, which is why MWRA and the Metropolitan District Commission (MDC) maintain watershed protection areas around our drinking water reservoirs. Boston Harbor and its watersheds receive municipal and industrial wastewater from dozens of dischargers ranging from the wastewater of a single home or factory or a small single-town sewage treatment facility to the huge discharges of 43 sewer communities through the two MWRA treatment plants. These wastewater discharges often contribute significant pollutant loads to their receiving bodies of water. The focus of the federal and state clean water laws on strict permitting, monitoring, and enforcement for such discharges has greatly reduced their overall impact.

Upstream sources of pollution, whether industrial discharges, contaminated runoff, or leaking septic systems that are poorly sited and maintained, can affect water quality downstream as well as locally.

MWRA provides technical assistance to industrial sewer users on methods of pollution reduction and prevention.

Sewage treatment plants are one source of pollution to the harbor watershed

There are six sewage treatment plants that discharge to Boston Harbor or its tributaries. The two largest treatment plants in the Boston Harbor watershed are operated by MWRA. These treatment plants, at Deer Island and Nut Island, must operate without interruption. At Deer Island this has meant keeping the old plant running while building the new one around it. Flow was introduced into the new, larger primary plant in January 1995. At Nut Island, the aging plant must be kept running until the new Nut Island-to-Deer Island tunnel is complete. Because these old primary treatment plants cannot meet federal and state standards, MWRA has been given interim standards which it must meet until the new, federally mandated secondary treatment plant is completed. Table 1 shows the number of violations of the plants' interim limits over the past two years.

At Deer Island, the number of violations has decreased over the past ten years (Lavery et al., 1994). At Nut Island, total suspended solids (TSS) and fecal coliform violations have generally remained constant. There were a higher number of biochemical oxygen demand (BOD) violations in Fiscal Years 1993 and 1994, possibly due to changes in sludge processing and other construction-related factors. pH at Nut Island can fall below the standard in the incoming wastewater, and pH cannot be adjusted at the plant. Low pH may occur during periods of greater precipitation and resulting high runoff.

Can the impact of treatment plants be reduced?

The most cost-effective way to control pollution, especially from toxic chemicals, is to reduce both the use and the discharge of toxic compounds at their sources–industries, businesses, and residences. MWRA regulates the discharge of toxic pollutants from industries by setting strict limits on the types and amounts of pollutants that may be discharged to the sewer system; inspecting and issuing discharge permits to over 1,100 industrial sewer users and sampling their wastewater; and taking enforcement actions against those sewer users who violate their permit requirements. For example, strict mercury limits have essentially eliminated industry as a source of toxic mercury to the MWRA system.

MWRA also provides technical assistance to industrial sewer users on other methods of pollution reduction and prevention, and works cooperatively with industry groups on solutions to difficult discharge problems. For example, the MWRA-sponsored Mercury Products Workgroup assists hospitals and other mercury users in identifying and eliminating their mercury discharges.

With the aid of an improved computerized tracking system, MWRA's follow-up and enforcement actions against industries that do not meet their discharge permit requirements have continued to be aggressive in Fiscal Year 1994.

MWRA HAS IMPROVED ENFORCEMENT SINCE FISCAL YEAR 1990

Enforcement action	1990	1991	1992	1993	1994
Enforcement notice* (written or verbal)	0	16	127	370	481
Noncompliance notice**	23	99	171	132	120
Penalty assessment notice	2	15	11	19	22
Penalties assessed	$1,105,000	$611,000	$1,045,00	$800,000	$922,050
Significant Industrial Users in significant noncompliance	116	107	114	113	98

*An informal notification to give the industry warning of potential problems and a chance to correct its violations.

**A formal notification if industry fails to correct its violations.

TABLE 2

Many industries address violations at the first stage of enforcement and avoid further action.

The New Deer Island Sewage Treatment Plant

MWRA's major accomplishment in the past year has been the Phase One start-up of the new primary treatment plant on Deer Island, which currently treats 260 million gallons of North System flows on an average day. Eventually the plant will have the capacity to treat up to a peak flow of 1,280 million gallons per day–although the expected peak flow is 998 million gallons–enough capacity to handle not only North System flows but also South System flows now treated at Nut Island in Quincy. It is too soon to evaluate the new plant's performance; next year's State of Boston Harbor report will discuss the start-up of this major facility and assess effluent and harbor quality as they relate to the new plant.

Sources other than treatment plants are also important

While we are increasingly able to control the quality of MWRA treatment plant effluent through improved technology and infrastructure, other sources of pollution seriously affect water quality in the watershed. These include sanitary sewer overflows, stormwater, deposition from the atmosphere, leaking septic systems, contaminated groundwater, spills, and combined sewer overflows. Some of these sources and their relationship to MWRA operations are addressed in this section.

Sanitary sewer overflows contribute to local watershed contamination

Wet weather and high groundwater levels in the springtime increase the overall amount of flow in the region's sewers and can lead to overflows where local system capacity is exceeded. In order to prevent infiltration of groundwater through cracks in pipes, or inflow of stormwater through unlawful sewer connections, MWRA and the service area communities have increased pipe repair and inspection. Pipes are inspected using closed-circuit TV cameras to spot cracks and stormwater connections. MWRA replaces or repairs deteriorated interceptors; local pipes are the responsibility of each community.

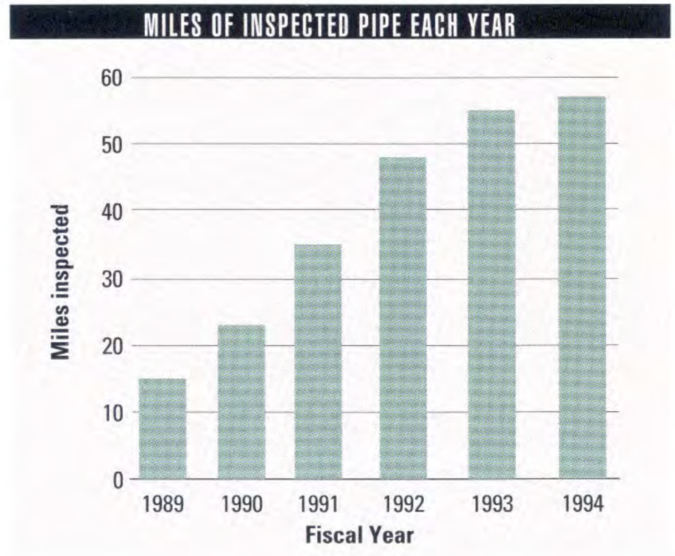
Illegal sewer connections can be a major contributor of bacteria and other pollutants to the harbor

Stormwater carries pollutants from the streets to water bodies

To prevent flooding in paved and built-up areas, stormwater systems rapidly drain rainwater from our streets and channel it through pipes into a nearby river or harbor. Oil, litter, animal and bird waste, and other pollutants from the street are carried along with the water. Unfortunately, motor oil, paint, and other toxic pollutants are sometimes illegally dumped into storm drains instead of being disposed of properly.

Stormwater systems can be the dominant source of many pollutants to a water body. This is especially true when storm drains are contaminated by untreated sewage from household, business, or local sewer cross-connections. Such illegal connections can be a major contributor of bacteria and other pollutants to the harbor. Although it may not stand out as a major source of pollution when averaged over the whole year, stormwater can cause serious pollution problems during periods of heavy rain or snowmelt.

FIGURE 2:
Pipes are inspected using closed-circuit TV cameras; in 1994 MWRA and its communities inspected 57 miles of pipe. Between 1989 and 1994, a total of 232 miles of pipe was inspected, much of it for the first time.

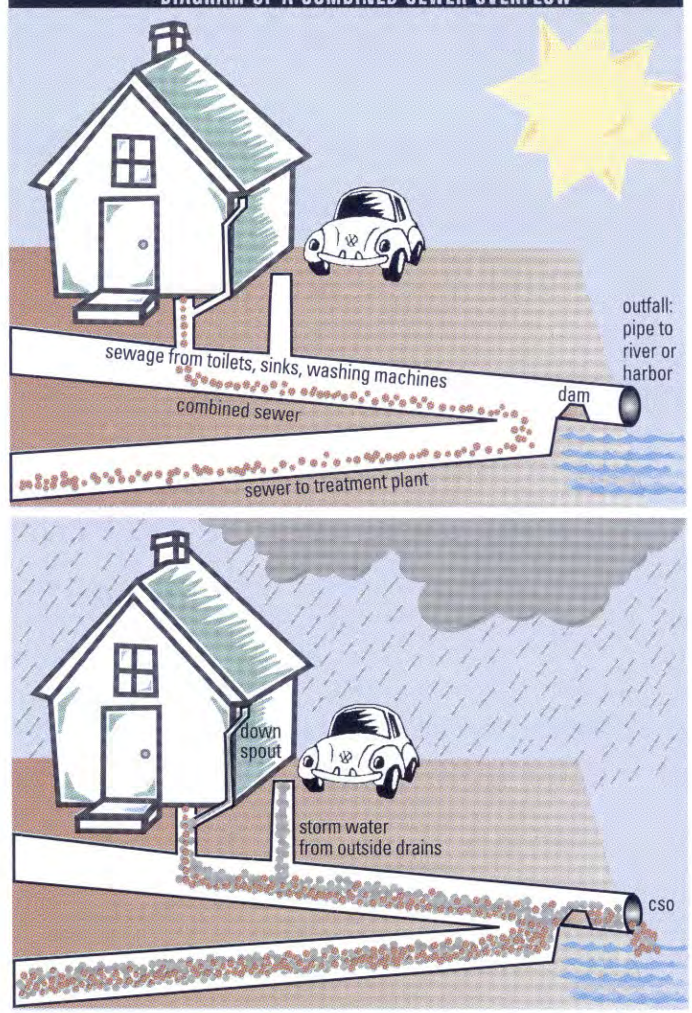


Many municipalities are actively working to reduce stormwater contamination through better street cleaning, inspecting and repairing leaking stormwater and sewer pipes, dye-testing new sewer connections from homes and businesses to make sure they are not connected to storm sewers, passing "pooper-scooper" laws to minimize contamination from pet feces, monitoring stormwater contamination, or treating the largest stormwater sources.

Combined sewer overflows (CSOs) can be a major source of pollution in urban watersheds

Some older cities, including Boston, Cambridge, Chelsea, and Somerville, have combined sewer systems, which carry sewage and stormwater runoff in the same pipe. These antiquated systems are designed so that if stormwater inflow is more than the system can handle, a mixture of stormwater and raw sewage overflows into the receiving body of water rather than backing up into the streets. There are 81 combined sewer outfalls in the Boston Harbor watershed. Some of the larger combined sewer outfalls have treatment facilities which screen out objects and disinfect the sewage with chlorine. Where there are many or large untreated CSOs, they can be the primary source of bacterial contamination. MWRA has developed a plan to control CSOs, part of the System Master Plan described in the following section.

DIAGRAM OF A COMBINED SEWER OVERFLOW



Many municipalities are actively working to reduce stormwater contamination

FIGURE 3:
The term Combined Sewer Overflow (or CSO) refers to either the combined sewer structure or to the overflow event. The wastewater that is released during that event, through a CSO outfall (pipe), is called CSO discharge.

Watershed Planning: MWRA's System Master Plan/ CSO Plan

Water pollution problems are complex, varying between watersheds but crossing political boundaries. Modern water quality management strategies are based on understanding each watershed's geology, patterns of development, and pollution problems. For example, CSOs may be the worst problem in one watershed while contaminated stormwater is the major pollutant in another.

Watershed-based planning is more flexible than traditional regulatory approaches

Watershed-based planning is more flexible than traditional regulatory approaches, transcends town and state boundaries, and permits targeting antipollution strategies to efficiently yield the greatest benefit in water quality.

Current watershed-based plans in the Boston Harbor watershed include the following:

- **The Commonwealth of Massachusetts Watershed Initiative** in the Executive Office of Environmental Affairs began in 1994 with a pilot study of the Neponset River Basin. The plan includes monitoring and protection of rivers and critical resources, wetlands restoration and land acquisition, and public education about watersheds. Citizens' groups and businesses are active participants.
- **The Charles River Watershed Association Integrated Monitoring, Modeling and Management Project** emphasizes monitoring with community involvement to measure the sources and effects of pollution and how pollution relates to water use.
- **MWRA's System Master Plan/Conceptual CSO Plan** (referred to as the CSO Plan) examines each sub-basin of Boston Harbor and proposes a variety of sewer system projects to improve water quality. The next section describes in more detail how a watershed approach focuses resources on the most serious CSO problems.

CSO Plan: History and Overview

The evolution of MWRA's CSO Plan (MWRA, 1994) provides a good example of the opportunities and challenges of watershed-based planning. In 1990, MWRA developed a CSO Facilities Plan to build miles of deep rock tunnels to store combined sewage which would otherwise overflow during rainstorms. The stored combined sewage would be pumped to the treatment plant in dry weather. However, as MWRA continued to gather environmental quality data and better combined sewage flow data, we learned that both the volume and the environmental effects of combined sewage had been overestimated and that the costly tunnel system might not be necessary.

To develop a better plan, MWRA collected data that greatly increased our understanding of how the combined sewer system functions in response to storms. Then the problem was reexamined from a watershed-based perspective.

The new CSO Plan evaluates the relative impacts of pollution sources. Different solutions are used in different locations depending on the amount of CSO, amount of pollution from other sources, existing water quality, water quality goals, and present uses of the watersheds. The primary CSO pollution problem is the risk to public health from sewage-borne pathogens (disease-causing bacteria and viruses), which make swimming and shellfishing unsafe. Therefore, the plan puts special emphasis on eliminating CSOs near beaches and clam flats. By separating sewers or by relocating the CSOs to other, less sensitive areas, beaches in East Boston and South Boston and shellfish beds in the Neponset River estuary will be better protected.

In areas where CSOs appear to be a much less significant source of pollution than other sources, a more modest level of CSO control will be applied. For example, even with CSO disinfection in the Charles River, swimming in the Charles River Basin will remain a health risk unless other sources of pathogens are controlled as well.

Responsibility for implementing the CSO Plan is shared between MWRA and the CSO communities. Larger, more complex projects will be implemented and ultimately owned and operated by MWRA. The communities will be responsible for projects involving improvements to their pipes and to their CSO outfalls. MWRA maintains several CSO treatment facilities that remove some solids and disinfect the sewage before discharge. Under the plan, dechlorination will be added to the treatment process to reduce any toxic effects on the environment. More flow will be treated by these facilities and several new ones will be built. Some overflows will be prevented by enlarging sewers or building small storage facilities. While some of this work can be completed quickly, larger sewer separation projects will extend over a number of years.

After the CSO Plan is fully implemented there will still be occasional overflows in some areas (less than four times per year on average) but the volume discharged will be greatly reduced. Wherever the potential for large CSO discharge remains, including the Charles River Basin, Fort Point Channel, and the Reserved Channel, the discharge will be disinfected. Slicks, floatables, and odors from CSOs will be greatly reduced or eliminated everywhere.

CSO Plan: Optimizing Sewer System Performance

Although the major construction projects of the CSO Plan are still in the future, important elements of the plan are already being implemented. The amount and impact of CSOs can be significantly lessened through small construction projects, attention to routine maintenance, and learning how to redirect flow within the sewer system to maximize storage and protect sensitive areas like beaches.

The amount of CSO is very dependent on the weather; large storms or extended periods of wet weather can result in frequent or large overflows. It is no surprise, then, that the record high amounts of rain and snow in calendar 1993 and 1994 caused increased runoff that overwhelmed combined sewer systems and increased overflow into Boston Harbor and its tributary rivers during those two years above the level of drier 1992.

Improvements to the sewer system appear to have reduced the amount of CSO produced by heavy rainfall. For example, there was slightly more precipitation in 1994 than in 1990, but the amount of CSO discharge was less. Although CSO discharge will

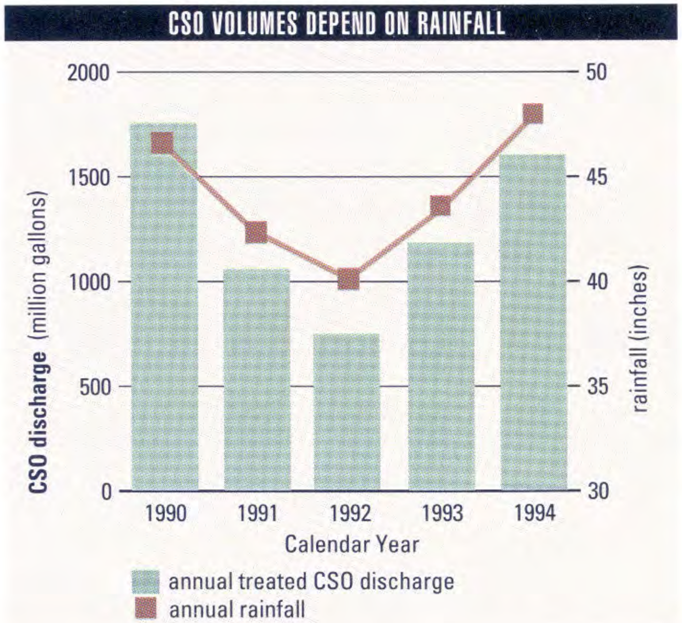
After the CSO Plan is fully implemented there will still be occasional overflows but the volume will be greatly reduced

always fluctuate with the weather, it has been reduced over the past 10 years. The following projects helped bring about that reduction:

- **Small-scale optimization projects**–several sewer system improvement projects have been completed by CSO communities recently, and others will continue over the next few years. Projects include increasing the size of interceptors and raising weirs to prevent overflow during smaller events. In part because of such improvements, Boston Water and Sewer Commission has been able to eliminate seven CSO outfalls in the last five years.
- **Improved system maintenance**–MWRA and CSO communities have stepped up their efforts to clean sewers and maintain regulators and tide gates. If combined sewer structures are not functioning properly, they can discharge sewage even in dry weather. Because of system improvements, there have been no dry weather overflows since 1992.
- **Changes to headworks operations**–MWRA's headworks facilities remove rags, grit, and large objects from sewage before it enters the treatment plants. When Deer Island plant capacity is reached, the headworks can also "choke" back flow to prevent plant flooding. Flow then backs up into the collection system, taking advantage of in-system storage but also risking greater CSO discharge. Recent operational improvements at the headworks, especially in the coordination between headworks and treatment plant operators, have optimized the system's ability to protect the plant while minimizing CSO effects.

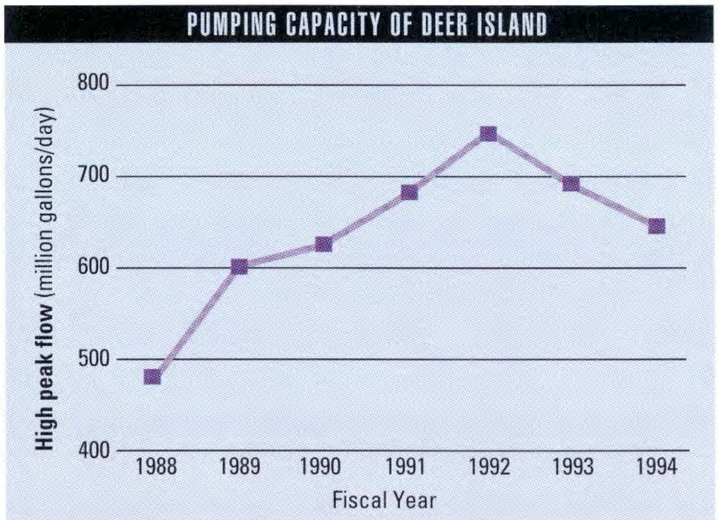
Boston Water and Sewer Commission has been able to eliminate seven CSO outfalls in the last five years

FIGURE 4:
Combined sewer overflow volumes vary considerably depending on the number and size of storms. (Source: MWRA CSO treatment facility records)



- **Increased outfall flow capacity**–repairs to existing outfalls on Deer Island in the last few years increased the amount of flow the plant can handle without flooding. When complete, the new outfall tunnel will have sufficient capacity to convey all plant flows.
- **Increased pumping capacity**–MWRA's nine sewage pumping stations help move sewage through interceptors to the treatment plants; two additional facilities on Deer Island also have pumps to lift sewage into the plant. Over the past decade, CSOs have been reduced due to improvements to the existing treatment plant at Deer Island and to the upgrade of pumping stations in Charlestown and East Boston. Although

FIGURE 5:
Treatment plant pumping capacity has increased since the late 1980's, as measured by the highest hourly flow recorded each year at the Deer Island Pump Station.



MWRA has continued its pump maintenance efforts in Fiscal Year 1994, pumping capacity was down slightly as pump replacement work integral to the startup of the new plant caused interruptions in service.

Local CSO and other projects related to water quality are discussed in more detail on the following watershed maps. By using this new approach together with new data, the CSO Plan is expected to attain comparable or better water quality benefits than the plan that preceded it for hundreds of millions of dollars less. Money for CSO remediation is now being directed where the benefit will be greatest.

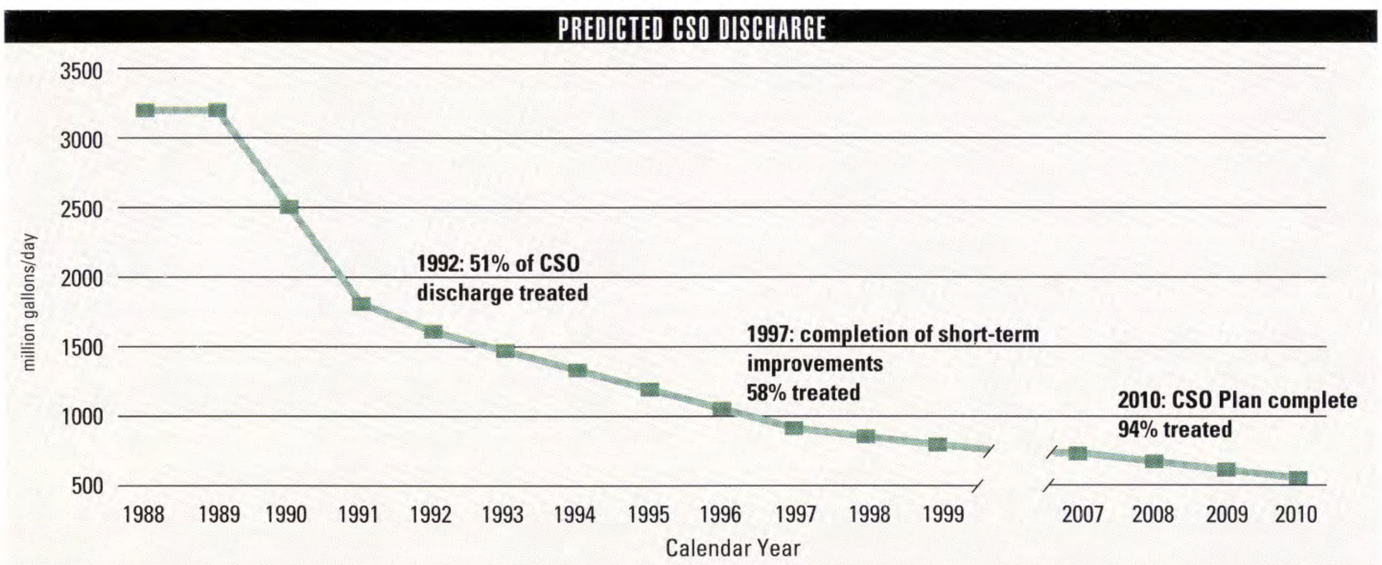


FIGURE 6:
A computer model shows how predicted CSO discharge for an average rainfall year has declined considerably since the late 1980s and will continue to decline as the CSO Plan is gradually implemented. Although a model may sometimes differ from actual flows, it is a useful planning tool.

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The Watershed Maps and How to Use Them

On the following pages, information is presented on the eight Boston Harbor watersheds. Because two of the watersheds are supplemented by close-up maps of specific areas, there are 10 maps in all. Before you read the section on the watershed of concern to you, you might want to familiarize yourself with the format in which the maps are presented.

Map descriptions: The text describes the general characteristics and unique features of each watershed, and some of the plans and projects that will improve water quality and public use in the future.

Scale bars: The scale bar provides a point of comparison between the very different sizes of the watersheds.

Land use pie charts: Land use, especially whether land is developed or undeveloped, can greatly affect water quality. These 1985 land use data are from MassGIS.

Open space: Major areas of open space (parks or conservation land) are shown on the map. An Area of Critical Environmental Concern (ACEC), designated by the state for special protection because of its ecological value, is a darker green.

Pollutant sources pie charts: These pie charts show the annual amounts of contaminants from various sources of pollutants in a watershed. The pies show our best estimates of the relative importance of each pollutant source. There is little information about pollutant loads in the upstream reaches of the larger watersheds, so for the Mystic, Charles, Neponset, Weymouth, and Weir watersheds only pollutant loads to the portions near the harbor are calculated. The pollutant load entering from the upstream part of these watersheds is given by the "upstream" source. A brown line separates the area of a watershed included in the upstream source from the downstream area included in the other sources.

Pollutant loads are calculated by multiplying flow volume times pollutant concentration. Because volume and concentration vary considerably over time, pollutant loads cannot be estimated very precisely. Also, because we have insufficient information on how pollutant concentrations in CSO, groundwater, and stormwater vary, we generally used the same average concentration multiplied by that estimated flow.

Pollutant source locations: Symbols indicate the locations of wastewater discharges and of combined sewer overflows (CSOs).

Water quality charts: These charts summarize available data from a wide variety of information sources. Where possible, we compared the data to state standards or federal guidelines for water quality. We considered several factors that make up water quality: fecal coliform bacteria, dissolved oxygen, enrichment by organic matter or nutrients, sediment contamination and enrichment, toxicity, and aesthetics.

CSO tables: In watersheds with CSOs, model estimates and predictions for 1985, 1992, 1997, and the implementation of the CSO Plan recommendation are presented. All estimates assume a "typical" rainfall year to allow comparison between years. The model was not run for 1994; 1994 values would fall between those predicted for 1992 and 1997.

WATER QUALITY SYMBOLS

- **Good:** meets state water quality standards and scientific criteria
- **Fair:** sometimes meets water quality standards, but occasionally fails
- **Poor:** frequently fails water quality standards
- **Dry/Wet:** water quality is worse after wet weather when there is CSO and stormwater discharge
- **Variable:** generally good or fair but with problems in some locations
- ? **Insufficient Information:** not enough information to assess water quality

Resource icons: Whether or not specific activities are impaired by pollution is indicated by colored icons for each activity:

Swimming: A fair or poor rating (purple or red swimmer symbol) means that the water often does not meet the state swimming standard.

Beaches can be contaminated by pathogens in sewage and stormwater, increasing a swimmer's risk of contracting disease. To decrease the risk to public health, the Metropolitan District Commission (MDC) or town Board of Health monitors the beaches during the swimming season and posts as unsafe those which show high counts of fecal coliform bacteria which indicate the presence of pathogens. Because bacteria levels depend greatly on rainfall and subsequent discharges of combined sewage and stormwater, the number of beach postings varies from year to year. In 1994, virtually all the beaches were posted at least once because of a heavy rainstorm (more than 2 inches) in August.

Shellfishing: This symbol indicates the location of clam beds. A purple clam means that under state shellfishing standards the water quality is fair for clamming. These standards are necessarily stringent to protect public health, which is why no blue (good water quality) clams appear in the maps. "Fair" areas are open to licensed diggers and may be closed if monitoring indicates bacteria counts have risen, as often happens after rainfall. All clams from Boston Harbor are purified in clean water after harvest.

Boating: Standards for boating are less stringent than for swimming. Places where swimming and boating quality differ, as in parts of Dorchester Bay, indicate that the water meets the boating standard but not the stricter swimming standard.

Aquatic Life: In evaluating the ability of the water to support aquatic life (marine plants and animals), we considered the amount of dissolved oxygen in the water and sediment and the presence of toxicity; the availability of habitat was also considered. A fair or poor rating (purple or red fish symbol) could mean the water has insufficient oxygen to support life or that the sediments are too degraded to support a naturally diverse community of organisms.

Evaluating Beach Quality MDC's weekly sampling program gives a general idea of the status of beach quality. Environmental data often have a great deal of variability that makes long-term trends difficult to measure.

The beach quality data shown on the maps indicate that the summer of 1994, when beach postings increased, serves notice that problems remain which continue to affect beach water quality. Bacterial contamination of the beaches is much more affected by local, shoreline sources than by the discharge of treated effluent from MWRA's Deer Island and Nut Island treatment plants. In general, except in the very largest storms, only sources of contamination within several hundred yards are important (Adams and Zhang, 1991). These can include untreated CSOs and contaminated stormwater, which are discussed in greater detail on the watershed maps. Beaches in southern Dorchester Bay are also affected by bacterial contamination of the Neponset River by upstream sources. Elimination of CSOs and stormwater contamination, and watershed planning and management in the Neponset River will be necessary if these beaches' remaining problems are to be solved.

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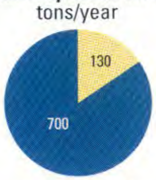
Except near the Deer Island outfalls, the water quality of Winthrop Bay is good. Based on a computer model of harbor currents, only about 3% of the Deer Island effluent enters Winthrop Bay; nevertheless, it is the dominant source of most pollutants to Winthrop Bay. The effluent contributes a high load of solids, with associated toxic contaminants and organic matter. Near the Deer Island outfalls the water has lower dissolved oxygen, animals suffer from the toxicity of the effluent, and sediments are contaminated and enriched. The Constitution Beach CSO facility discharge is also chlorinated and may cause toxicity. Shellfish beds in Winthrop Bay are closed after rain, due to bacteria in stormwater.

Pollutant Sources

Total suspended solids
tons/year



Stormwater[1]
Effluent[2]

[1]Includes airport runoff
[2]Assumes 3% of Deer Island effluent enters Winthrop Bay

Winthrop Bay

This small, heavily developed watershed includes runoff and 260 million gallons a day of effluent from the Deer Island treatment plant, the largest single pollution source in Boston Harbor as a whole. Nevertheless, except near the Deer Island outfalls where water quality is poor (see water quality table), this watershed's water quality is generally fair to good. This surprisingly good water quality exists because swift tidal currents disperse the effluent around the harbor and flush it into Massachusetts Bay, with only a portion of the effluent entering Winthrop Bay. Effluent dominates the loads of most pollutants; stormwater and groundwater are also major sources of pollution in this watershed.

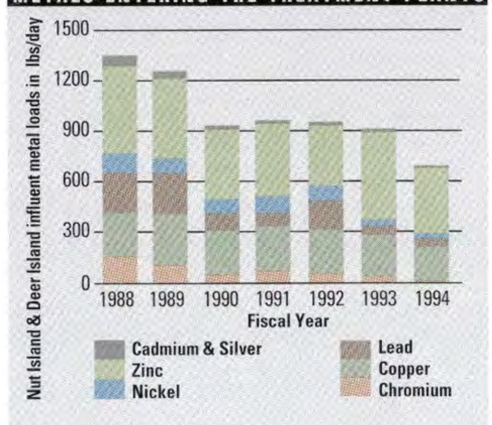
Shellfish beds in and around Winthrop Bay produce a commercially important harvest. Belle Isle Marsh is one of the few large salt marshes remaining in Boston Harbor, and is state-designated an Area of Critical Environmental Concern deserving special protection.

Constitution Beach in East Boston has generally good water quality, especially since MWRA opened its local CSO treatment facility in 1987, and contamination to a storm drain on the beach was corrected by the Boston Water and Sewer Commission.

Because of source reduction, the amount of toxic pollutants entering and leaving the treatment plants has fallen substantially over the past several years. The metals trends figure shows that amounts of metals entering the two MWRA treatment plants have declined. For some metals, the downward trend seems to be leveling off; for copper and lead, controlling the corrosion of residential pipes containing these metals will likely be key to further reducing their levels.

Reductions of toxic contaminants discharged in the effluent, and the end of sludge dumping in 1991, have resulted in lower levels of contaminants (such as PAH) accumulating in mussels set out in cages near the discharge to monitor bioaccumulation.

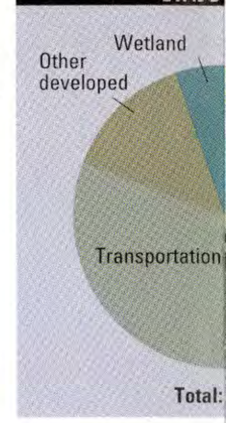
METALS ENTERING THE TREATMENT PLANTS



COMBINED SEWER OVERFLOW IMPROVEMENTS

	1985	1992	1997	CSO PLAN
number of outfalls	1	1	1	0
number of overflows/yr	36	24	16	0
volume (million gallons)	7	4	1	0
% treated	0%	100%	100%	N/A

LAND



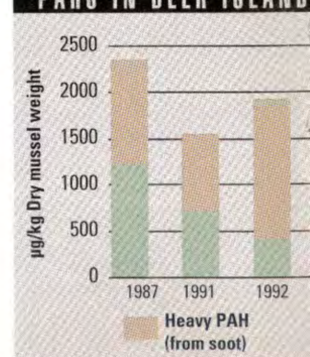
The Future of Winthrop Bay

The addition of secondary treatment facilities to the Deer Island treatment plant (in 1996) and the relocation of the treatment plant effluent outfalls from near Deer Island to 9.5 miles offshore will remove the largest source of most pollutants to this watershed. Later this year, MWRA will repair a breach in one of the effluent outfalls which has caused some effluent to discharge even closer to shore with less dilution than intended.

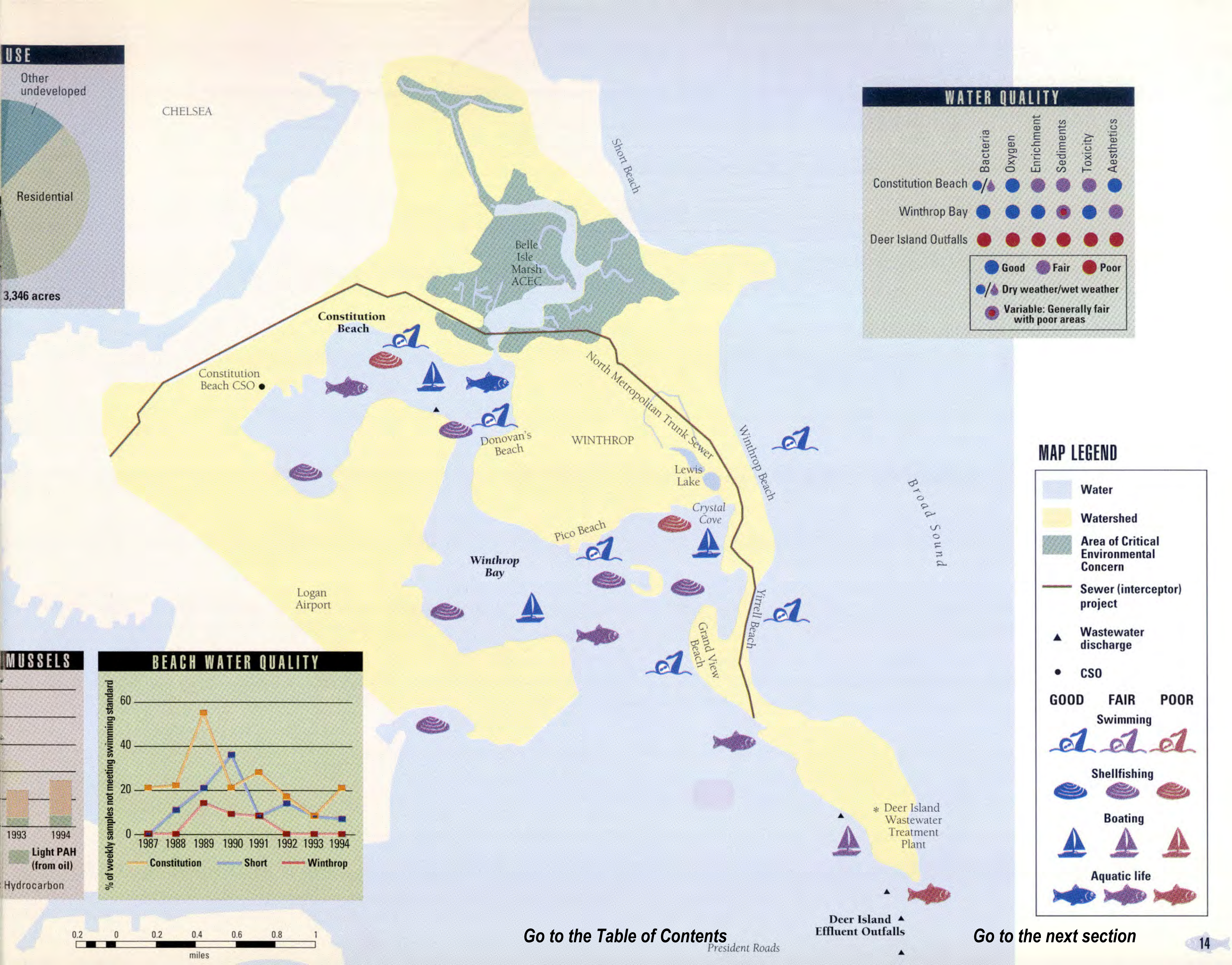
MWRA's CSO Plan will completely eliminate CSO discharges to the Constitution Beach area by constructing separate stormwater and sanitary sewers. The removal of these discharges, along with the Boston Water and Sewer Commission's ongoing aggressive work to remove illegal sewer connections to storm drains, may allow more shellfishing and improve conditions for swimming.

Other water quality benefits will result from MWRA's rehabilitation of the North Metropolitan Trunk Sewer, the Massachusetts Bays Program's salt marsh restoration project at Lewis Lake, and the Boston Harbor Beaches Commission's project to reduce stormwater runoff by improving landscaping and planting at Constitution Beach. MWRA's eventual construction of a park encircling the new Deer Island plant will create a much-needed public recreation area with access to the harbor.

PAHS IN DEER ISLAND



PAH: Polycyclic Aromatic



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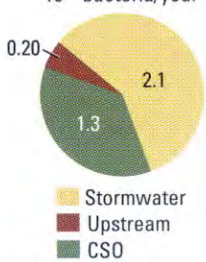
Although water quality in much of the watershed is fair to good, serious pollution problems exist in several locations. There are high bacteria counts and low dissolved oxygen in the Alewife Brook, one of the most polluted waterways in the Boston area. Pollution from oil port operations contributes to toxicity in the sediments of the Chelsea and Island End rivers. Below the Amelia Earhart Dam, river water quality and aesthetics are impaired by a large CSO.

Pollutant Sources

Fecal coliform

10^{15} bacteria/year



Mystic River

This large watershed extends from the head of the Aberjona River in suburban Reading to heavily industrialized areas near the mouths of the Mystic and Chelsea rivers. In the central watershed, the Middlesex Fells Reservation includes more than 2,000 acres set aside to protect drinking water supplies and provide recreation.

Water quality is generally fair in those areas that MWRA monitors, except for the Alewife Brook. Because of large pollutant inputs and poor flushing, the Alewife Brook is among the most polluted waterways in all of metropolitan Boston; nonetheless, it supports a few of its namesake fish. Every year, alewife spawn in one of the largest runs in Massachusetts Bay, coming through Boston Harbor and up the Mystic River into the Lower Mystic Lake. There are also runs of smelt and blueback herring.

COMBINED SEWER OVERFLOW IMPROVEMENTS

	1985	1992	1997	CSO PLAN
number of outfalls	27	22	19	17
number of overflows/yr	55	50	35	8
volume (million gallons)	439	220	142	103
% treated	58%	58%	75%	95%

Oil tankers make up over 87% of shipping in Boston Harbor (Harbor Visions, 1994). Most of their cargo is unloaded into the Chelsea tank farms. The inevitable minor spills and leaks pollute the sediments and water of the Chelsea and Island End rivers. Levels of polycyclic aromatic hydrocarbons in the sediment are very high in the Island End River, and fish (mummichogs) caught there showed much higher levels of liver disease than those from nearby areas (Moore et al., 1995). In addition to the oil port activity, much of the harbor's ocean freight is handled at MassPort's Moran Terminal at the mouth of the Mystic River.

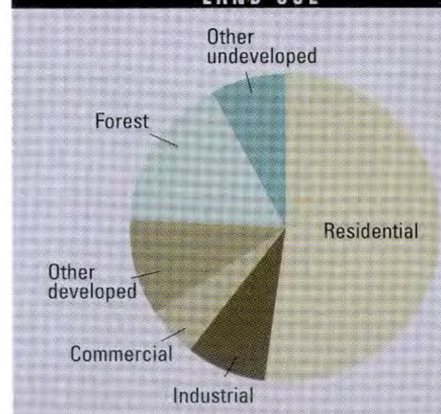
Other than the heavily impacted Alewife Brook and lower Mystic/Chelsea section, the main water quality problem is that nutrients from a variety of sources in the upstream portion of the watershed can cause excessive algal growth.

The Future of the Mystic River

The water quality in the Mystic River, Alewife Brook, and Chelsea River will be greatly improved by implementation of MWRA's CSO Plan. Extensive sewer separation in the Alewife Brook area and smaller areas along the Mystic River, along with construction of larger sewers in Chelsea and East Boston, will allow the elimination of five CSO outfalls and the reduction of the volume and frequency of discharges from those that remain. The large Somerville Marginal CSO facility will be upgraded, increasing the effectiveness of disinfection and reducing chlorine toxicity. CSO volume will be reduced by more than half compared to present conditions, and nearly all of the flow will be treated.

Complementing the CSO Plan are community-based actions to reduce other sources of pollution and improve habitat. Citizens are working with state agencies and local governments to identify unlawful sewer connections to storm drains in the Alewife Brook, to design improvements in spawning habitats based on monitoring of fish migration, to restore wetlands and stream banks, and to control erosion.

LAND USE



Total: 42,308 acres

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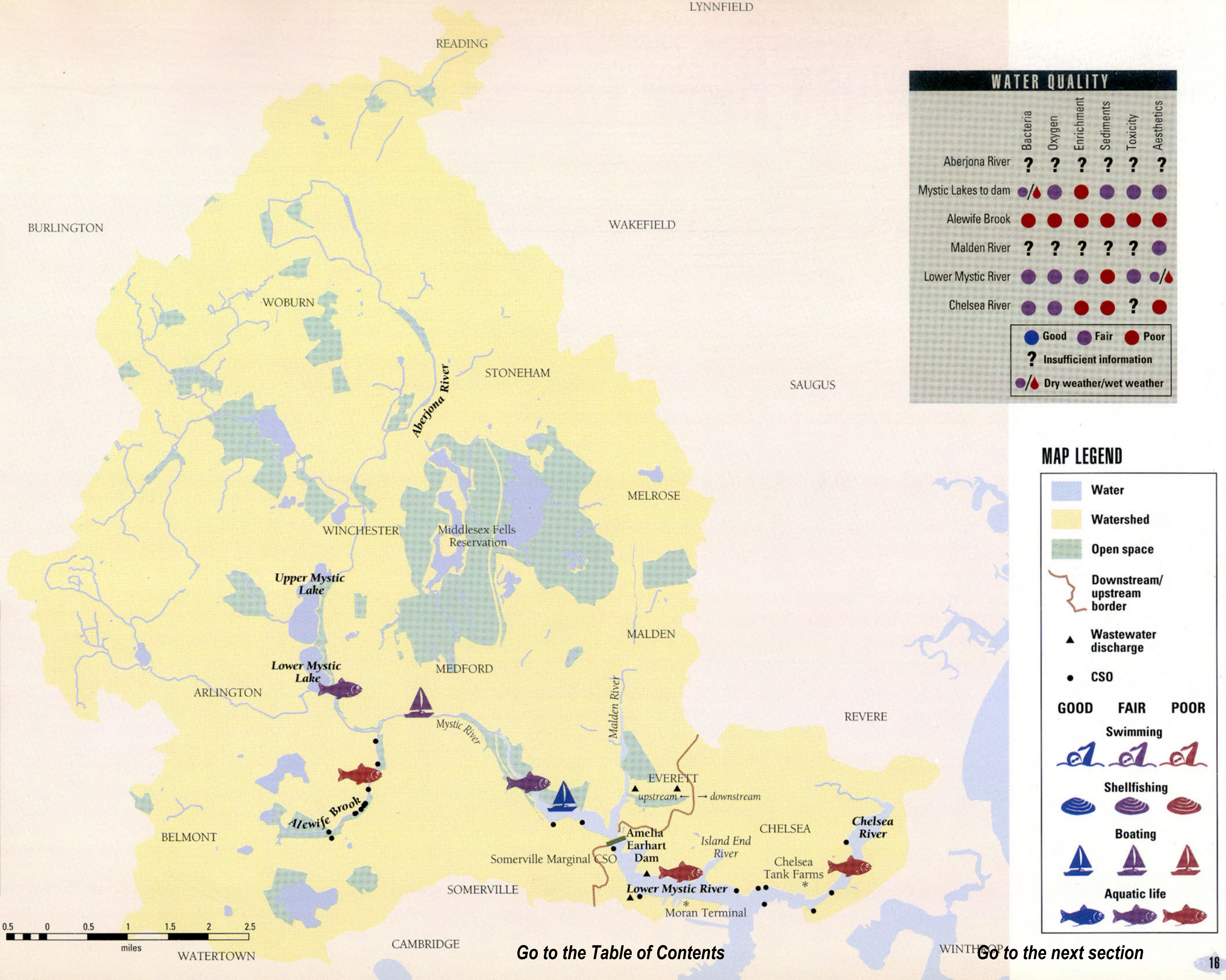

WATER QUALITY

	Bacteria	Oxygen	Enrichment	Sediments	Toxicity	Aesthetics
Aberjona River	?	?	?	?	?	?
Mystic Lakes to dam	Fair/Poor	Fair	Poor	Fair	Fair	Fair
Alewife Brook	Poor	Poor	Poor	Poor	Poor	Poor
Malden River	?	?	?	?	?	Fair
Lower Mystic River	Fair	Fair	Fair	Poor	Fair	Fair/Poor
Chelsea River	Fair	Fair	Poor	Poor	?	Poor

Good Fair Poor

? Insufficient information

/ Dry weather/wet weather

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The Charles River maintains overall good health, because of large areas of wetlands and other undeveloped land in its watershed. However, sewer overflows, sewage treatment plant discharges, and apparent unlawful sewer connections cause localized problems.

Charles River

At 308 square miles, the Charles River watershed is Boston Harbor's largest. The Charles flows approximately 80 miles from Hopkinton to Boston. On the next page is a close-up map of the lower Charles River (the section from Watertown to Boston Harbor). The map on this page describes the Charles River as a whole.

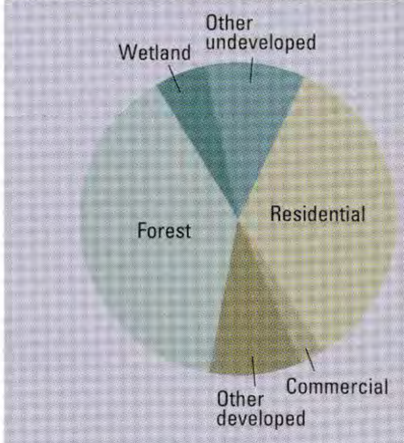
In spite of the watershed's long history of settlement and industrial and commercial use (there are 20 dams along its length as a result), a large amount of undeveloped land remains, especially in the upstream reaches. Extensive wetlands are scattered throughout the upper and central watershed, including 8,100 acres of Charles River Natural Valley Storage Areas managed by the Army Corps of Engineers. These wetlands improve water quality and provide flood protection by smoothing out fluctuations in river flow.

The downstream reach of the Charles River supports a large population of migrating blueback herring, as well as smelt and eels. Fishways allow passage of migrating herring up to Wellesley.

The Charles River watershed is an important source of drinking water. It contains the reservoir which supplies the City of Cambridge, three small MWRA reservoirs, Echo Lake, and many wells that provide groundwater. Withdrawal of water from aquifers for water supply, or other human uses of water resources in the watershed, must be carefully balanced with concerns about low river flow and ensuing water quality problems.

The water quality of the Charles River is good for much of its length. Individual pollution sources can lead to localized high counts of bacteria, but the effect does not usually persist very far downstream. For example, high bacteria counts have occasionally been seen near the Medfield sewage treatment plant and some other locations, but the counts fall to background levels a few miles downstream (J. Lancaster, personal communication 1995). In the Dover-Wellesley-Needham reach of the river, undersized MWRA sewer have spilled raw sewage into the river, leading to high bacteria counts in wet weather (Webber, 1991). Just above the Watertown Dam, high bacteria counts and elevated concentrations of other pollutants have been measured but the source of these problems is unclear (Webber, 1991).

LAND USE

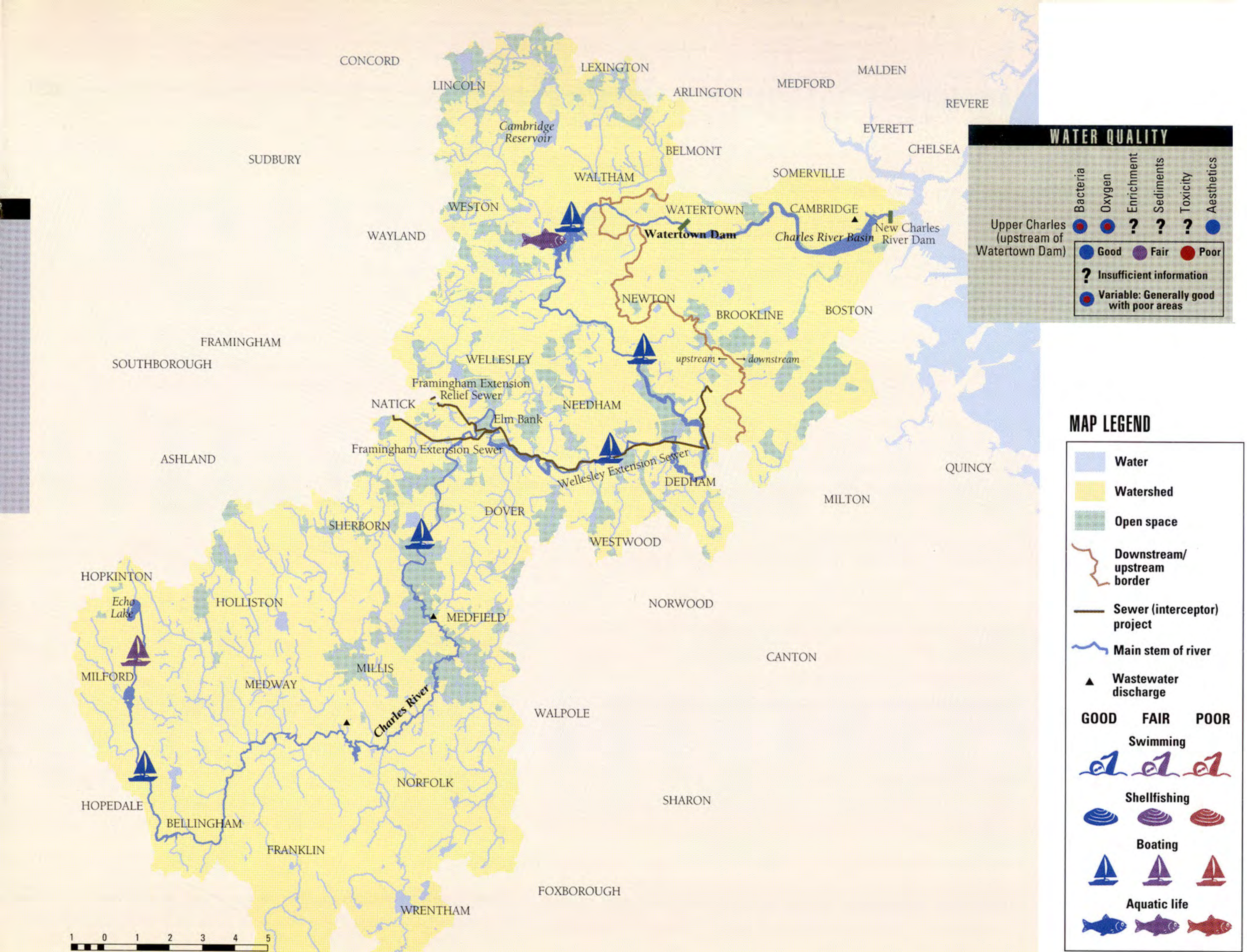


Total: 194,204 acres

The Future of the Charles River

A number of long-term projects will gradually improve Charles River water quality. MWRA's plans for CSO control are discussed on the Lower Charles River map. MWRA's Framingham Extension Relief Sewer project will eliminate sanitary sewer overflows near the Elm Bank Reservation in Dover, as the Wellesley Extension Sewer Replacement is doing in Wellesley, Needham, Dedham, and Dover. EPA has required eight communities abutting the Charles River to document their stormwater discharges and identify unlawful sewer connections. Projects by the Metropolitan Area Planning Council and Metropolitan District Commission will also improve water supply and river water quality in parts of the watershed.

The Charles River Watershed Association's recently launched Integrated Monitoring, Modeling, and Management (IM3) Project includes a full range of monitoring and community involvement programs to better understand all aspects of the watershed.



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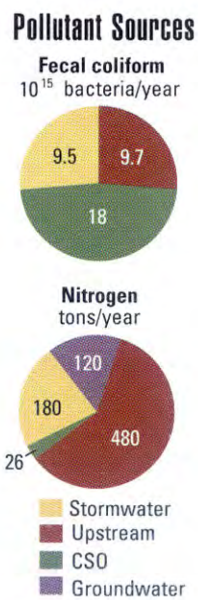
The Lower Charles River has severe water quality problems because the dam at the river's mouth blocks exchange of water with Boston Harbor. The Charles River Basin is further degraded by high-density development. Bacteria counts are high in dry weather and even higher after rainstorms. High loads of nutrients from sewage, stormwater, and upstream sources cause excessive growth of algae in the Basin. The Muddy River and Back Bay Fens have similar problems, made even worse by very low flow.



Lower Charles River

People come to the lower Charles River to visit the Esplanade, hear concerts at the Hatch Shell, and to boat, bike, rollerblade, walk, sunbathe, and relax. A previous generation of visionary planners, including Frederick Law Olmstead and Charles Eliot, reclaimed the land along the banks of the Charles and Muddy rivers and set it aside as part of Boston's "Emerald Necklace."

The lower Charles receives a heavy load of pollutants from upstream, as well as pollutants from CSOs and stormwater. Unfortunately, the antiquated drainage system in this heavily populated area makes pollution reduction complex and difficult. The water quality, especially in the "Basin," is poor, and stormwater and CSOs make it worse in wet weather. Monitoring data collected over the last five years also show that bacteria counts vary little along the lower Charles, except near the mouth where the river water is diluted by cleaner Boston Harbor water, indicating that there are a number of pollutant sources along the river in both dry and wet weather.

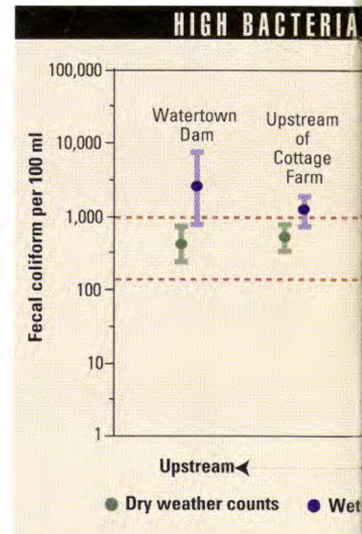
The old Charles River Dam at the Museum of Science was originally built to solve a pollution problem: sewage discharges onto the mudflats of the Charles River estuary were causing aesthetic and public health problems that were obvious at low tide. The dam was built to maintain the water at a constant level, but ironically has exacerbated pollution by eliminating tidal exchange between harbor and river, making the Basin a virtual lake. The small amount of salt water that leaks into the Charles River Basin by operation of the Gridley Locks in the new Charles River Dam stagnates at the river bottom because it is denser than fresh water. Oxygen from the surface does not penetrate below this layer, and the river bottom is oxygen deficient and virtually devoid of life. Bubblers were installed on the Basin bottom to mix the water, but they are now broken. The Muddy River flows into the Charles River Basin through the Back Bay Fens. The Fens have similar water quality problems to those in the Basin because the Muddy River receives pollutants from stormwater and CSOs, but the problems are made more extreme by the very low flow of the Muddy River.

COMBINED SEWER OVERFLOW IMPROVEMENTS

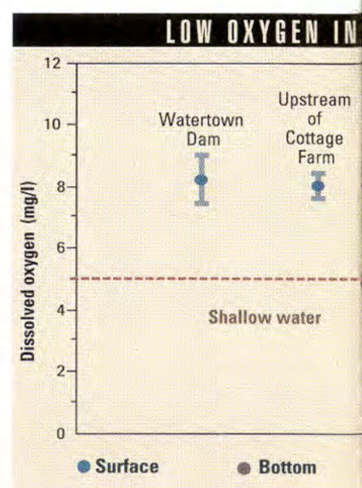
	1985	1992	1997	CSO PLAN
number of outfalls	27	20	20	18
number of overflows/yr	50	39	30	26
volume (million gallons)	787	394	225	121
% treated	54%	54%	57%	97%

The Future of the Lower Charles River

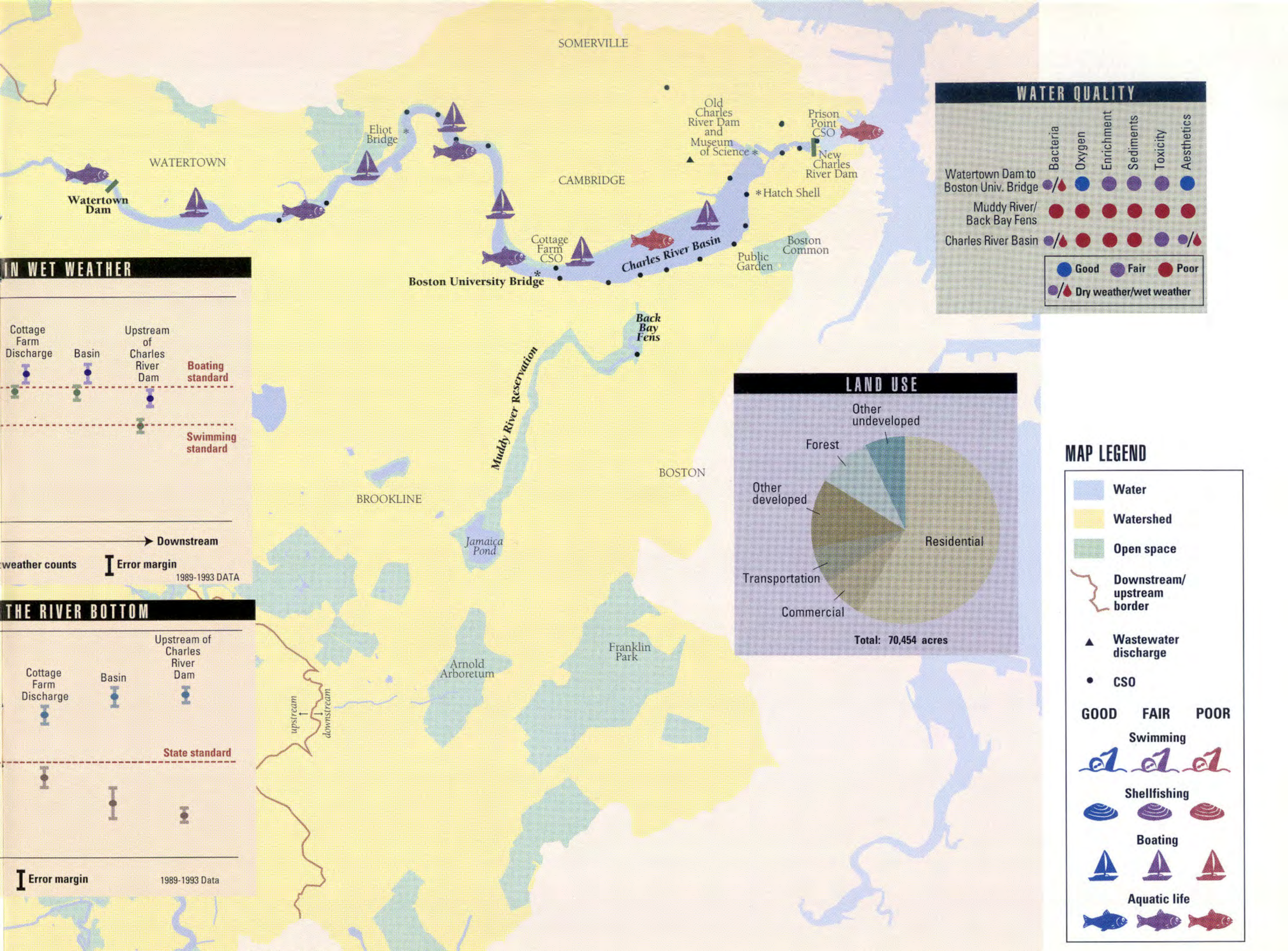
MWRA's CSO projects in the lower Charles River will eventually cut the frequency of overflows by half and reduce the volume to only 30% of current overflows. In addition, 97% of the remaining CSO volume will be treated, compared with about 50% of the CSO discharge now. Specifically, screening and chlorination/dechlorination at a new Stony Brook facility and at one near the Eliot Bridge will improve aesthetics and reduce the risk of exposure to pathogens. (Since chlorination to kill pathogens can be toxic to aquatic life, dechlorination will be performed at the Cottage Farm and Prison Point CSO facilities.) Increased sewer capacity leading to the Prison Point CSO treatment facility will reduce untreated CSOs near the river mouth. These CSO projects will alleviate some of the lower Charles River's very complex water quality problems.



The Muddy River's water quality will be helped not only by the CSO Plan but also by Brookline's and Boston's work to remove illegal sewer connections to storm drains into the Muddy River, and by an Army Corps of Engineers' project to increase Muddy River flow.



Even with new CSO control infrastructure, the water quality in the Charles River Basin is likely to remain poor to fair as long as other sources remain. Over time, the combined efforts of the CSO program and other projects, such as the Charles River Watershed Association's Integrated Monitoring, Modeling, and Management (IM3) study, could lead to local implementation of remediation projects which will result in substantial water quality improvement.



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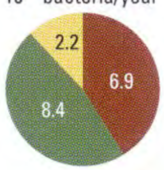
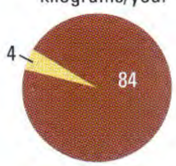
The heavily developed Inner Harbor watershed has severe water quality problems. Bacteria counts are high in wet weather due to CSOs and stormwater. The Inner Harbor has the highest levels of sediment contamination measured in Boston Harbor. Sources of toxic contaminants include the Charles and Mystic rivers, stormwater, and combined sewer overflows.

Pollutant Sources

Fecal coliform
10^{15} bacteria/year



Pyrene
kilograms/year



Stormwater[1]
Upstream
CSO

[1] Includes airport runoff

Inner Harbor

When most people think of Boston Harbor, it is the Inner Harbor that comes to mind. On Boston's historical waterfront and in adjacent downtown areas are several museums, the Freedom Trail, numerous restaurants, the Harborlights concert pavilion, and tour boats; all of these draw residents and tourists alike.

On the water, sailboats share the harbor with large ships heading for shipping terminals in Charlestown, Chelsea, Everett or South Boston. A number of water passenger shuttles also operate in the Inner Harbor.

In spite of large tides that flush the harbor, the Inner Harbor has many water quality problems. Very little of the watershed is undeveloped. Major pollutant sources include a large number of CSOs, stormwater discharges, and the Charles, Mystic, and Chelsea rivers.

COMBINED SEWER OVERFLOW IMPROVEMENTS

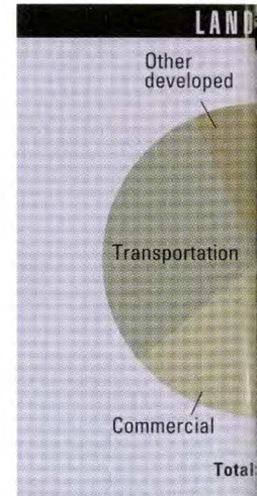
	1985	1992	1997	CSO PLAN
number of outfalls	26	26	24	21
number of overflows/yr	70	65	44	14
volume (million gallons)	1463	732	469	339
% treated	36%	36%	42%	96%

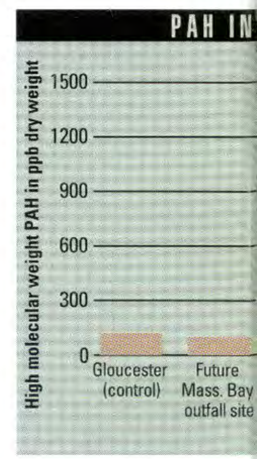
Water quality problems are most severe in Fort Point Channel, a small, poorly flushed inlet that now receives the largest untreated CSO discharge in the Boston Harbor watershed. The importance of local sources is demonstrated by the bioaccumulation of polycyclic aromatic hydrocarbons (PAH) in mussels set out in monitoring cages near the New England Aquarium (Downey et al., 1995). Caged blue mussels placed in the water near the Aquarium for two months accumulated higher levels of heavier PAH compounds (byproducts of burning fossil fuels) than did mussels set out in the plume of the existing Deer Island outfall. These Inner Harbor mussels accumulated more of many other contaminants too.

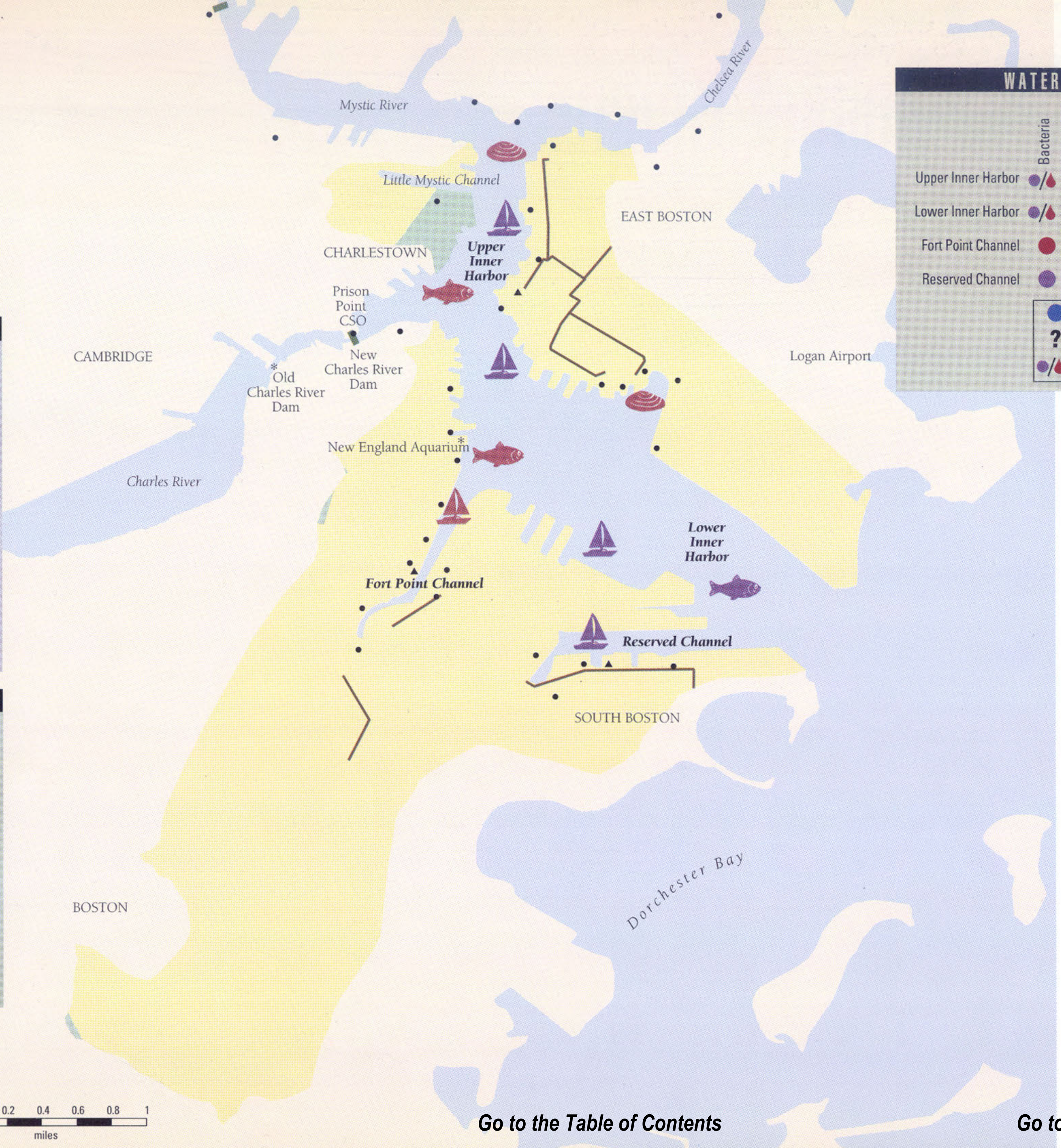
The Future of the Inner Harbor

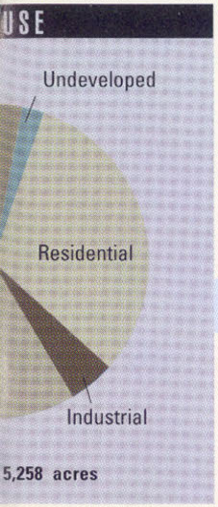
If current plans and projects are fully implemented, the Inner Harbor will become relatively clean for an urban harbor, especially if water quality in the tributary Charles and Mystic rivers can be improved.

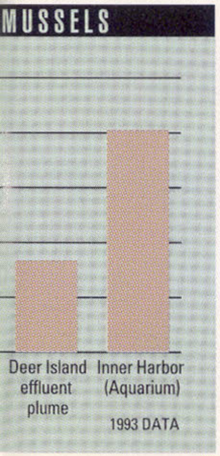
The Inner Harbor now receives the greatest share of the untreated CSO discharge from the sewer system (see CSO table). The MWRA CSO Plan will disinfect or reroute to Deer Island much of the CSO discharge that now enters Fort Point Channel, greatly reducing the pathogen load to this highly impacted area and improving dissolved oxygen levels. Through the CSO plan, a small disinfection facility will reduce bacteria loads to Little Mystic Channel in Charlestown; interceptor relief will reduce discharges from East Boston CSOs; and the relatively large CSOs in the Reserved Channel will be consolidated and disinfected. The Prison Point CSO facility will be upgraded, and two downtown waterfront overflows eliminated. Though the Inner Harbor will continue to suffer impacts typical of busy urban harbors, those who use and enjoy the water and the waterfront should find it safer and more attractive in years to come.











WATER QUALITY

	Bacteria	Oxygen	Enrichment	Sediments	Toxicity	Aesthetics
Upper Inner Harbor	Fair/Poor	Poor	Poor	Poor	Poor	Good/Fair
Lower Inner Harbor	Fair/Poor	Fair	Fair	Poor	Poor	Fair
Fort Point Channel	Poor	Poor	Poor	Poor	Poor	Poor
Reserved Channel	Fair	Good	Fair	Poor	?	Fair

Good Fair Poor
? Insufficient Information
/ Dry weather/wet weather

MAP LEGEND

The water quality in the Neponset River above the Baker Dam in Milton is fair to poor, even though much of the watershed is undeveloped. Sanitary sewer overflows, contaminated storm drains, and failing septic systems cause high bacteria counts. Sediments are contaminated by past industrial pollution. The growth of aquatic weeds that are choking some tributaries may be accelerated by excess nutrients from sewage.

Neponset River

This map focuses on the freshwater portion of the Neponset River, and the following map illustrates the Neponset River Estuary together with Dorchester Bay. Although the Neponset River watershed includes urban areas of Boston, the map and land use pie chart show that a surprisingly large portion of undeveloped land is preserved for an area so close to a major city. The more than 6,000 forested acres of the Blue Hills Reservation, the wetlands of the Fowl Meadow and Ponkapoag Bog Area of Critical Environmental Concern (8,350 acres), and town conservation areas comprise more than half the watershed. There is relatively little commercial and industrial development. Unfortunately, despite the abundant open space and limited industry, the Neponset River suffers severe degradation from toxic pollutants, which accumulate in sediments and from sewage, which causes high levels of bacteria.

In the Neponset, sediment concentrations of toxic contaminants vary dramatically along the river. For example, cadmium levels in sediments just downstream of the Neponset Reservoir were about 70 times higher than concentrations generally expected to harm aquatic life, while the metal was not detected in sites further downstream (Mass. DEP, 1995).

Bacteria in the water also show a pattern of areas of high contamination interspersed with relatively clean locations. Fecal coliform counts during dry weather average about 10 times higher than standards and can significantly increase during rainy weather.

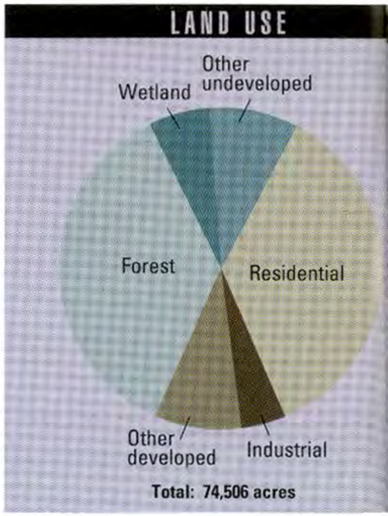
Low levels of dissolved oxygen occur sporadically along the river, caused in part by excess nutrients. Contributing to both bacterial and nutrient pollution are myriad sources of sewage along the length of the river: sanitary sewer overflows, failing septic systems, and storm drains contaminated with animal waste and sewage.

The Future of the Neponset River

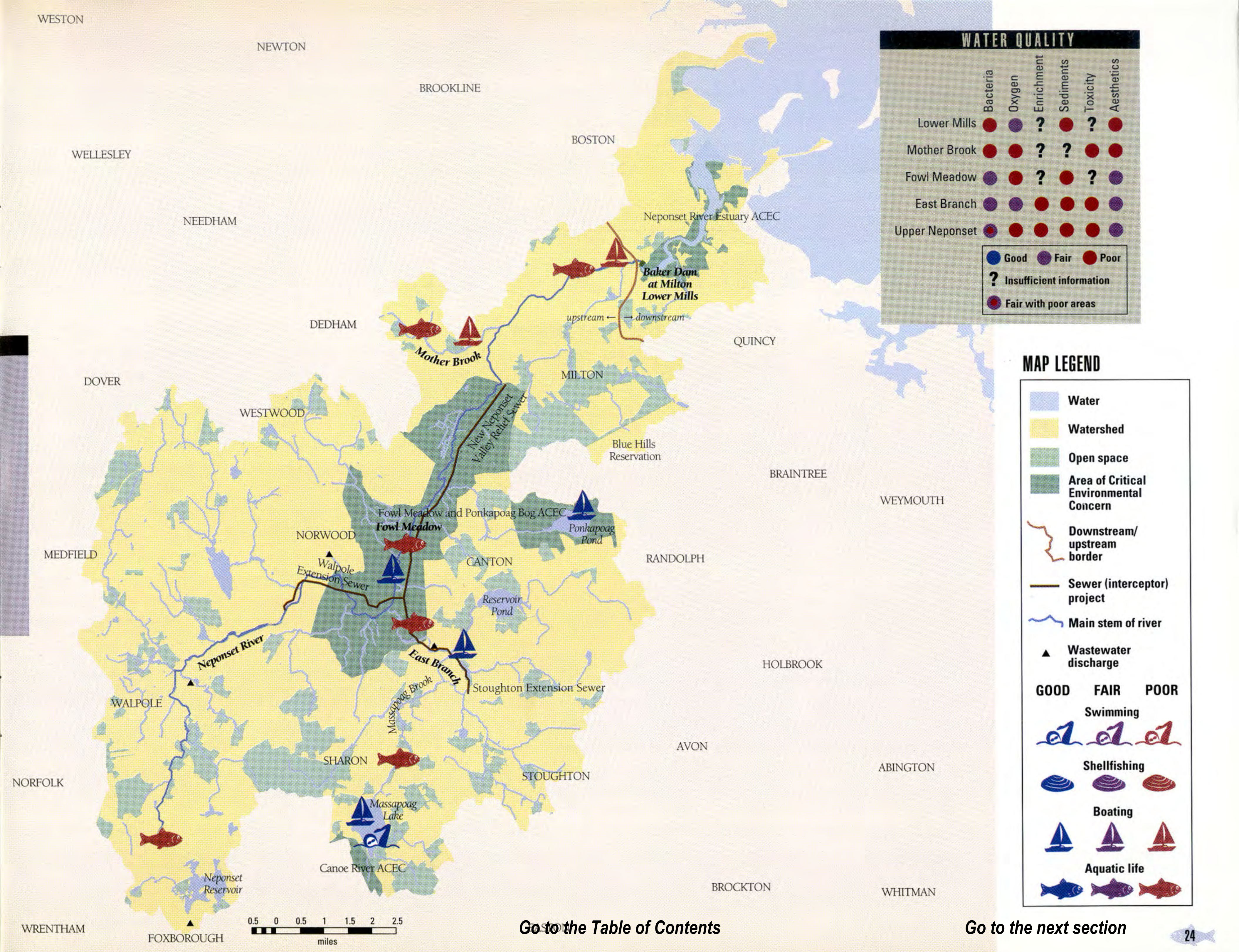
Although severely affected now, the Neponset is the focal point of planning and remediation efforts that promise to restore it to ecological health, and to enhance the potential for human use and enjoyment.

In 1993, MWRA began construction of the New Neponset Valley Relief Sewer, which will alleviate sanitary sewer overflows from the aging and overburdened Neponset Valley sewer and provide sewer capacity for future population growth.

The Executive Office of Environmental Affairs has selected the Neponset River watershed for a pilot study to develop a watershed management methodology. The Department of Environmental Protection's Neponset River Resource Assessment studies began in 1994. The state, cities and towns, and local citizens' groups have identified many sources of sewage, from failing septic systems to overflowing municipal sewers. Several sources have already been repaired. The Metropolitan Area Planning Council (MAPC), with funding from the Massachusetts Bays Program, is studying nonpoint sources and stormwater runoff. The MAPC has also evaluated water resources, land use and potential contamination sources in an effort to protect water supplies in the watershed. Citizen volunteers are working with the Division of Marine Fisheries to improve and expand smelt and herring habitat.



Because large parts of the watershed have been preserved in a natural state, the once-neglected Neponset has the potential to be reclaimed as a haven for wildlife and people.



WATER QUALITY

	Bacteria	Oxygen	Enrichment	Sediments	Toxicity	Aesthetics
Lower Mills	Poor	Fair	?	Poor	?	Poor
Mother Brook	Poor	Poor	?	?	Poor	Poor
Fowl Meadow	Fair	Poor	?	Poor	?	Fair
East Branch	Fair	Fair	Poor	Poor	Poor	Fair
Upper Neponset	Fair with poor areas	Poor	Poor	Poor	Poor	Fair

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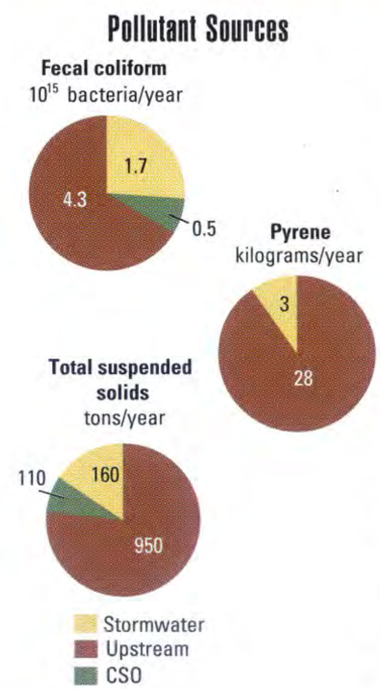
Dorchester Bay
and Neponset Estuary

Water quality in the Neponset River estuary generally improves downstream towards Dorchester Bay, although the estuary and bay suffer from sediment contamination and nutrient enrichment. Parts of the bay have few bottom-dwelling species because the sediments are oxygen-poor. Northern Dorchester Bay has generally good water quality. Beaches near the mouth of the Neponset River often have high bacteria counts because of sewage entering upstream and from contaminated storm drains.



This map focuses on the tidal portion of the Neponset River downstream of the Baker Dam, including Dorchester Bay. Here, some of the richest wetlands resources remaining in Boston Harbor are abutted by highways, a gas storage tank, railroads, commercial buildings, and dense residential areas. Dorchester Bay beaches are among the most popular in Boston Harbor.

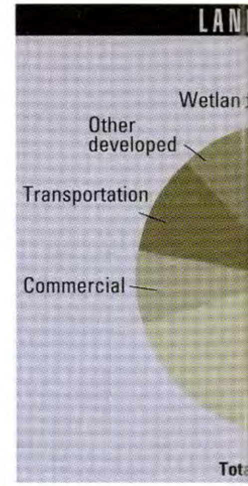
COMBINED SEWER OVERFLOW IMPROVEMENTS

	1985	1992	1997	CSO PLAN
number of outfalls	13	12	12	0
number of overflows/yr	82	80	78	0
volume (million gallons)	414	207	183	0
% treated	0%	90%	92%	N/A

The Neponset River estuary was recently designated an Area of Critical Environmental Concern; the ACEC's 1,260 acres include the 700-acre MDC Neponset River Reservation, one of the few salt marsh habitats in Boston Harbor. The estuary is home to more than 200 bird species including rare owls, egrets, and terns (Massachusetts Executive Office of Environmental Affairs, 1995). Striped bass, bluefish, and winter flounder feed here. Blueback herring and rainbow smelt spawn below the Baker Dam. There are abundant soft-shell clams in the mudflats, although they are too contaminated by bacteria to harvest.

Where the Neponset River meets Dorchester Bay, marshlands give way to development that includes seven beaches, yacht clubs, and walkways along the shore. Although the water quality in Old Harbor and Pleasure Bay is relatively good, sewage pollution prevents full use of the Bay area. Twelve CSOs, contaminated storm drains, and upstream pollution of the river contribute sewage-borne pathogens to this area. Water quality is worse after heavy rains, when high counts cause closed beaches in Old Harbor. Beaches that are unaffected by CSOs (Pleasure Bay) or which have only small CSOs (Carson Beach, L Street Beach) have good water quality, and did not see much change between 1993 and 1994. MWRA has constructed CSO treatment facilities at Fox Point and Commercial Point, and there has been improvement in beach water quality over the past several years. However, nearby Tenean and Malibu beaches continue to be affected by storm drain contamination and by the poor water quality of the Neponset River.

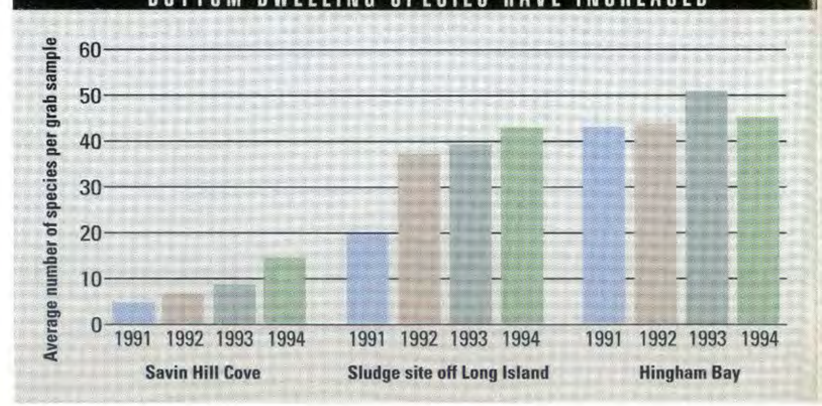
Other problems are found in the sediments: toxic chemicals and organic matter enter the estuary through storm drains and CSOs. Past discharges of sewage sludge and untreated sewage contaminated small embayments like Savin Hill Cove, depleting sediment oxygen and affecting the health of marine life. The bar graph shows the improvements, since sludge discharges ceased, in the numbers of bottom-dwelling species at the former Nut Island sludge discharge site off Long Island. No significant change in species numbers has been observed in Savin Hill Cove or at a less impacted site in Hingham Bay.

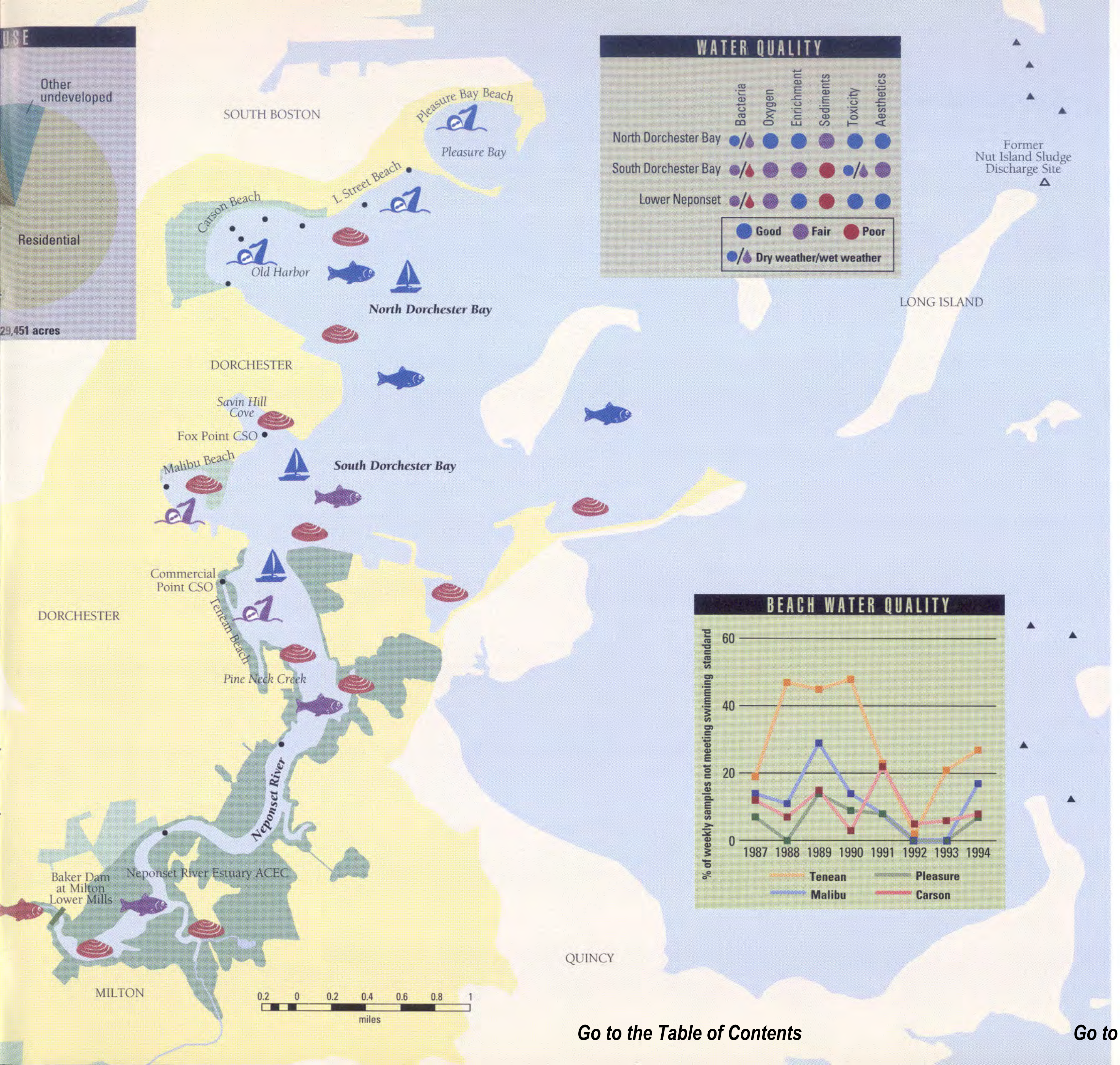


The Future of the Estuary and Dorchester Bay

MWRA's CSO Plan will eliminate all combined sewage in this area by building separate storm drains and sewers in the estuary and southern Dorchester Bay and by collecting the CSOs along South Boston beaches in a new interceptor. Wet-weather aesthetic and bacterial pollution will be reduced, the shellfish beds may reopen, and sediment quality should slowly improve. The Boston Water and Sewer Commission is working to eliminate illegal sewer connections to storm drains, for example in Pine Neck Creek near Tenean Beach, which will further improve swimming and shellfishing. A regional Plan for the Future of Boston Harbor Beaches includes re-sanding and other physical improvements to the beaches here. The MDC is cleaning up a former landfill near the Neponset Reservation and creating bicycle and pedestrian pathways there.

BOTTOM-DWELLING SPECIES HAVE INCREASED

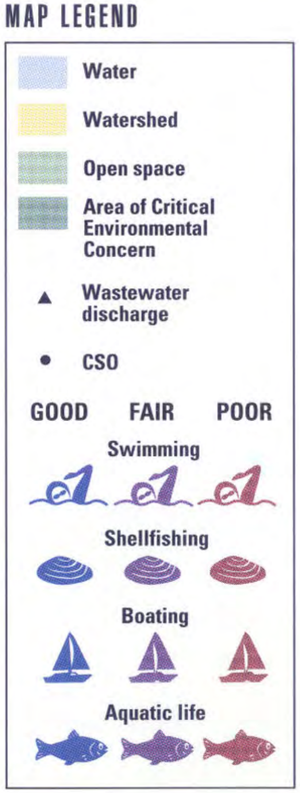




WATER QUALITY

	Bacteria	Oxygen	Enrichment	Sediments	Toxicity	Aesthetics
North Dorchester Bay	Good/Fair	Good	Good	Fair	Good	Good
South Dorchester Bay	Fair/Poor	Fair	Fair	Poor	Good/Fair	Fair
Lower Neponset	Fair/Poor	Fair	Good	Poor	Good	Good

Good Fair Poor
Dry weather/wet weather



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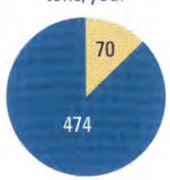
Water quality is generally good, with local problems near contaminated storm drains and the treatment plant outfalls. Computer modelling of harbor currents shows that about 4% of the Nut Island treatment plant effluent enters the bay; this fraction can increase during an onshore wind. The effluent contributes suspended solids and associated contaminants, and nutrients, which may adversely affect water clarity in the bay. Local bacteria problems are associated with contaminated storm drains.

Pollutant Sources

Fecal coliform
10^{15} bacteria/year

Total Suspended Solids
tons/year



Stormwater
Effluent *

* Assumes 4% of Nut Island effluent enters Quincy Bay

Quincy Bay

Water quality in Quincy Bay is generally good. The land use in Quincy Bay's small watershed is primarily residential. The major pollution source within the watershed appears to be stormwater discharge contaminated by sewer cross-connections. Quincy Bay can also be affected by effluent discharge from the MWRA Nut Island treatment plant under certain wind and tide conditions (see also Weymouth River watershed on following pages). There are no CSOs in Quincy Bay, although the area was affected by CSO discharges from Moon Island up until 1990 (Rex, 1993).

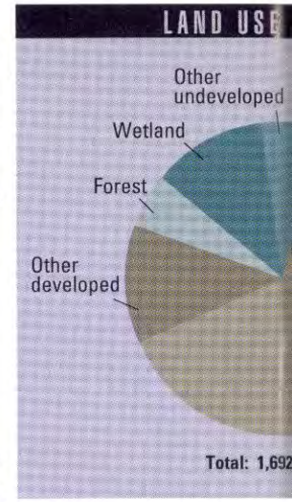
Wollaston Beach in Quincy Bay has variable water quality for swimming. The amount of time that bacteria counts exceed the standard in weekly beach monitoring has varied greatly over the past several years and was particularly high in 1994. The City of Quincy is working to repair problems with storm drain contamination in this area.

Quincy Bay has historically been one of the great recreational flounder fishing areas on the east coast. However, in the last decade the number of flounder has fallen dramatically, partially due to commercial overfishing of flounder stocks throughout New England waters. The health of flounder, however, has improved. The effects of eliminating sludge discharge and reducing toxic contaminants in the effluent is seen in the decreasing occurrence of liver disease in flounder. Boston Harbor flounder once had a very high incidence of liver tumors, but this disease has not been observed since 1991 in monitoring by researchers from Woods Hole and other institutions (Moore and Stegeman, 1993, Hillman and Peven, 1995). The incidence of early liver disease, a precursor to tumors, has also declined since the mid-1980s, apparently stabilizing since 1989 at levels well below those found in 1984 .

Quincy Bay also has productive shellfish beds; half of the soft-shell clams harvested in Massachusetts come from Boston Harbor, a substantial fraction from Quincy waters. However, many other beds have been closed because of pollution.

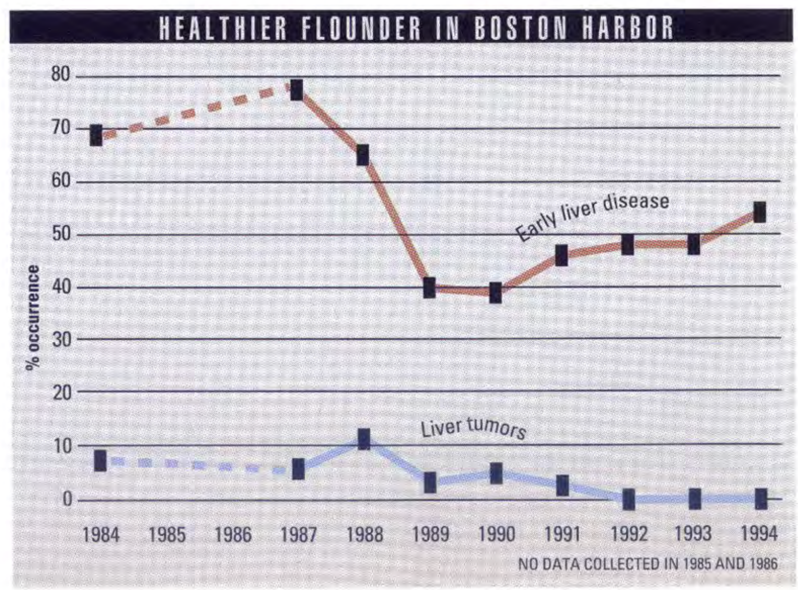
The Future of Quincy Bay

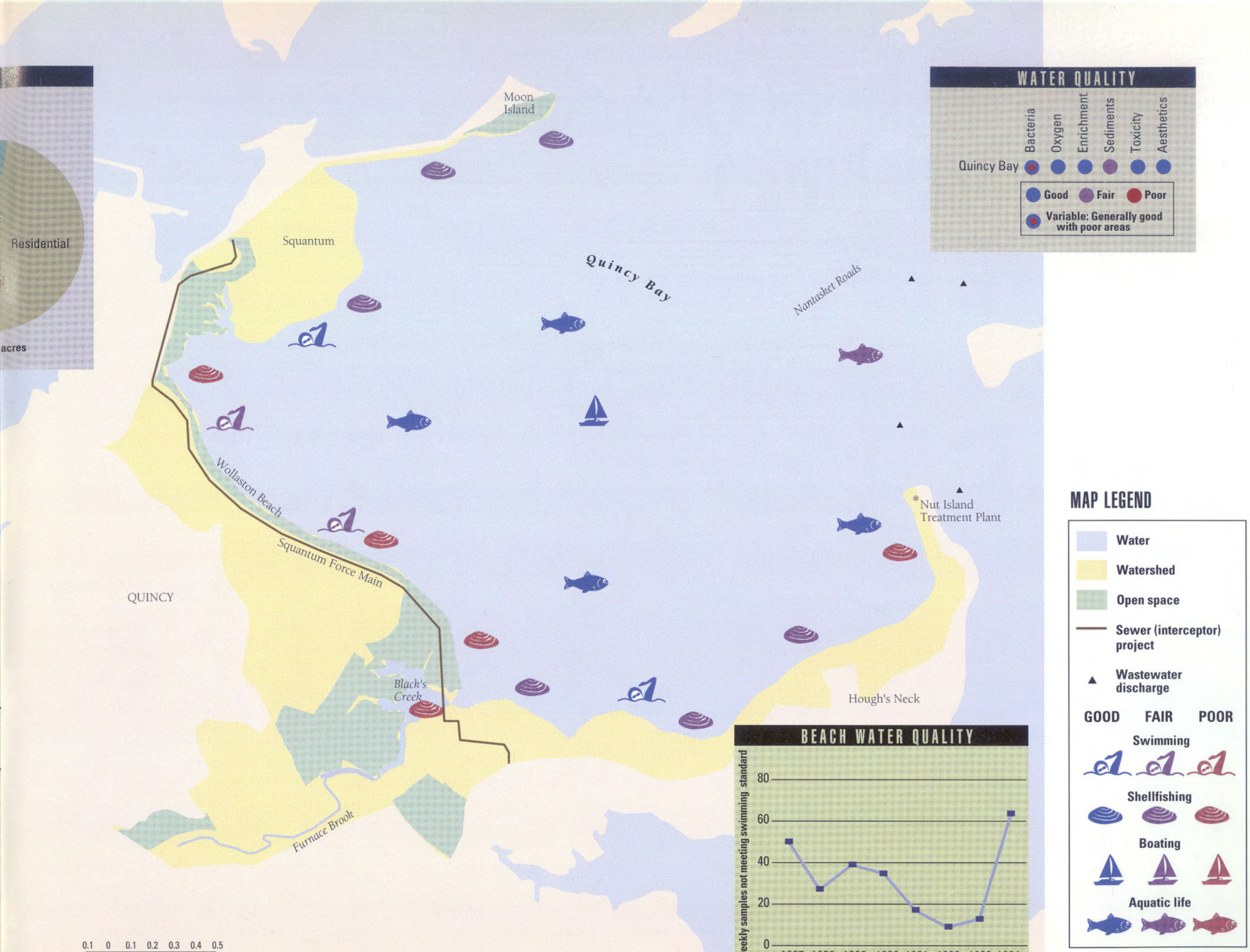
The City of Quincy's ongoing repairs to contaminated storm drains should lead to noticeable reduction in bacterial contamination at Wollaston Beach. Many sections of this area's crumbling infrastructure have already been rehabilitated (Weston & Sampson Engineers, 1995). For example, the city and the Massachusetts Bays Program replaced a broken tide gate that had let seawater into the storm sewer system on every high tide. The Massachusetts Bays Program is also investigating storm drain contamination affecting a shellfish bed at the northern end of the beach, and hopes to be able to restore the use of this bed.



As part of MWRA's Boston Harbor Project, the Nut Island treatment plant will stop discharging to Nantasket Roads once a five-mile tunnel is built to carry wastewater from Nut Island to the new Deer Island Treatment Plant. Once the Nut Island plant is no longer needed, it will be replaced by a headworks and a public park. In addition, MWRA has recently relined the Squantum Force Main to eliminate seepage out of this major sewer.

The Plan for the Future of Boston Harbor Beaches includes many improvements to Wollaston Beach: upgraded sanitary facilities, sand replenishment, drainage facilities, and sea wall renovation. Once these projects and the improvements to the sewer system are complete, we can expect to see expansion of swimming and shellfishing in Quincy Bay.





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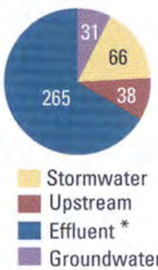
This watershed includes two rivers with differing water quality. The Fore River suffers from localized bacterial contamination, low dissolved oxygen, and high nutrient levels. The Back River, which has a relatively undeveloped watershed with parkland surrounding the estuary, has generally very good water quality.

Pollutant Sources



* Assumes 9% of Nut Island effluent enters the Fore River

Weymouth Fore and Back Rivers

The Weymouth River watershed actually contains two rivers, the Fore River and the Back River. Both of these rivers support important fishery resources, including two of the three largest smelt runs in Massachusetts Bay and river herring runs. Three fishways on Back River dams allow passage for the river herring. Shellfish flats are harvested for more than 12,000 bushels of clams annually. There are also commercial lobster and menhaden (pogie) fisheries, as there are in many other parts of Boston Harbor.

Except for the vicinity of the Fore River estuary, the Weymouth River watershed consists of undeveloped and low-density residential land. The watershed contains two Areas of Critical Environmental Concern (ACECs), the Cranberry Brook Watershed ACEC (1,041 acres) on the Fore River and the Weymouth Back River ACEC (957 acres) at the mouth of the Back River. A portion of the Fowl Meadow ACEC is also within the watershed.

The former Fore River Shipyard is evidence of the river's industrial past. The Back River was also once a center of boat building, particularly during World War II. The decline in economic fortune of the area's industry has, however, improved water quality in the rivers. There are several industries still in the area, including the Twin Rivers alternative diesel fuel manufacturing facility and an oil terminal. MWRA's sludge-to-fertilizer plant in the old shipyard, now the Fore River Staging Area for the Boston Harbor Project, contributes to water quality improvements throughout the harbor by its role in ending the sludge discharges from the two MWRA treatment plants.

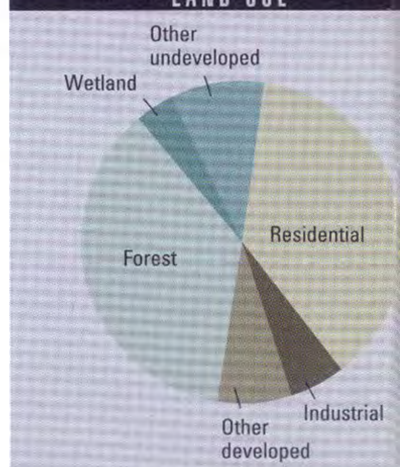
Water quality in the Fore River is affected by the discharge of MWRA's Nut Island treatment plant into Nantasket Roads. Although strong currents help disperse the effluent, field and computer model studies indicate that some effluent tends to wash into the mouth of the river (McDowell et al. 1991, Signell, 1992). There is also localized sewage contamination; for example, there are sewer overflows from MWRA's Braintree-Weymouth Interceptor in wet weather. The Massachusetts Bays Program has identified local creek and storm drain contamination as well. The Back River was also impacted by sewer overflows from the Hingham Pump Station before MWRA completed its rehabilitation in 1992.

The Future of the Weymouth Fore and Back Rivers

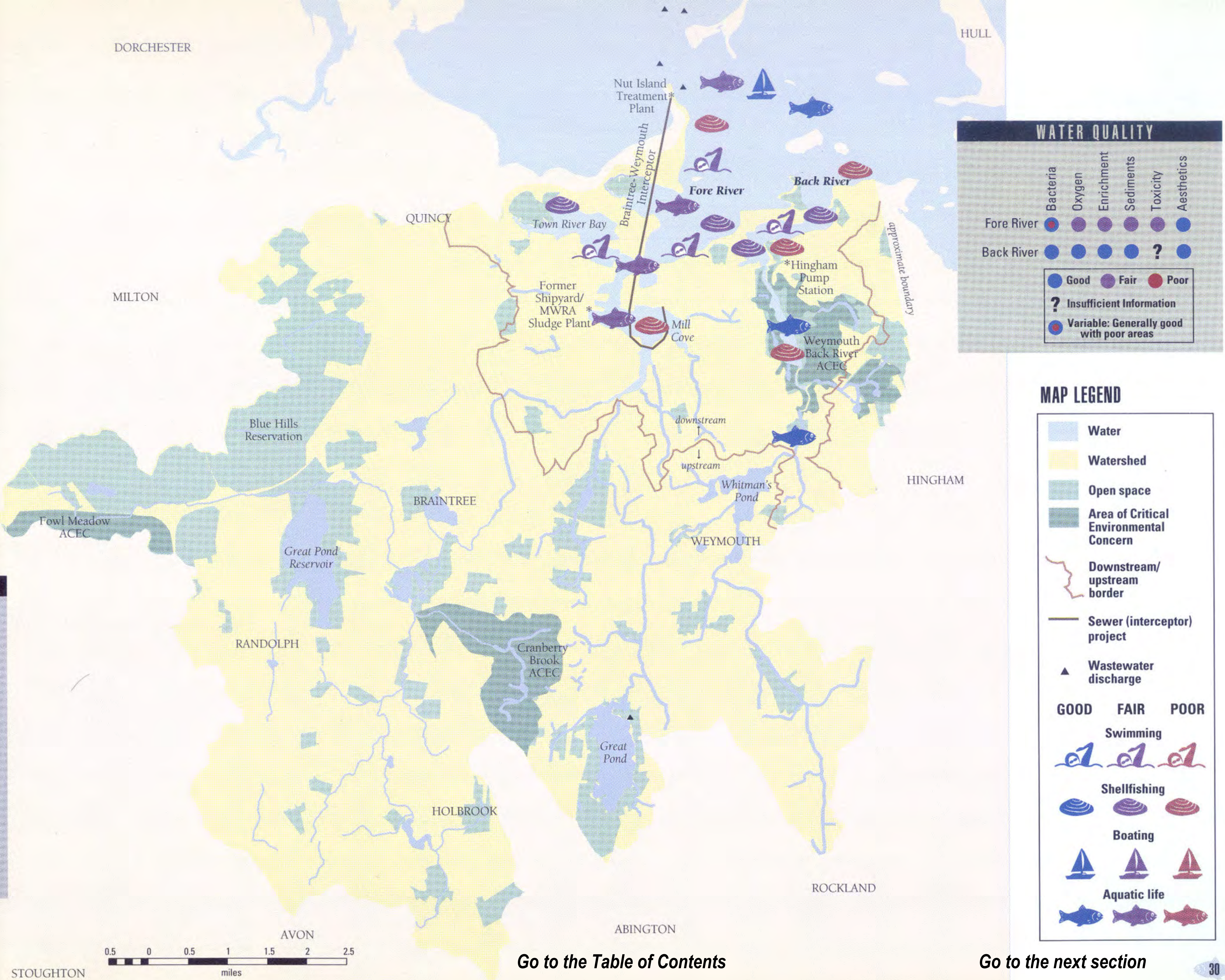
The replacement of MWRA's Braintree-Weymouth Interceptor will eliminate sewage spills that currently occur in wet weather. The decommissioning of the Nut Island treatment plant (see Quincy Bay) will also improve conditions, especially at the mouth of the Fore River estuary.

The Massachusetts Bays Program's Fore River Project is a joint effort of concerned citizens and federal, state, and local governments. The project's management plan focuses on cleaning up local pollution sources that are responsible for closing shellfish beds, including beds in Mill Cove and Town River Bay.

LAND USE



Total: 39,876 acres



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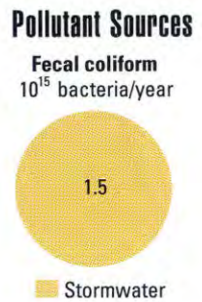
The water quality in the Weir River estuary and in Hingham and Hull bays is generally good. More than half the land in the watershed is undeveloped forest and wetland. However, bacteria (primarily from stormwater) may result in local shellfish bed closures and restrictions. Little information is available about the water quality in the Weir River upstream, but state monitoring has indicated problems with dissolved oxygen and bacteria.



Weir River

Hingham and Hull Bays

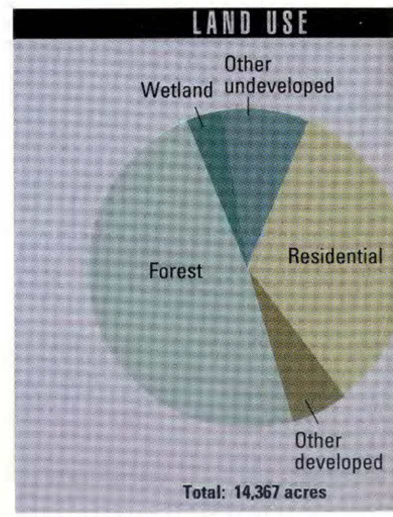
The Weir River, which drains into Hull Bay, gets its name from the fishing weirs that were once used to harvest the river's rich fishery. This watershed includes Hingham and Hull bays, the most pristine areas of Boston Harbor. The good water quality is due largely to the undeveloped nature of the watershed and the lack of large point sources of pollution.

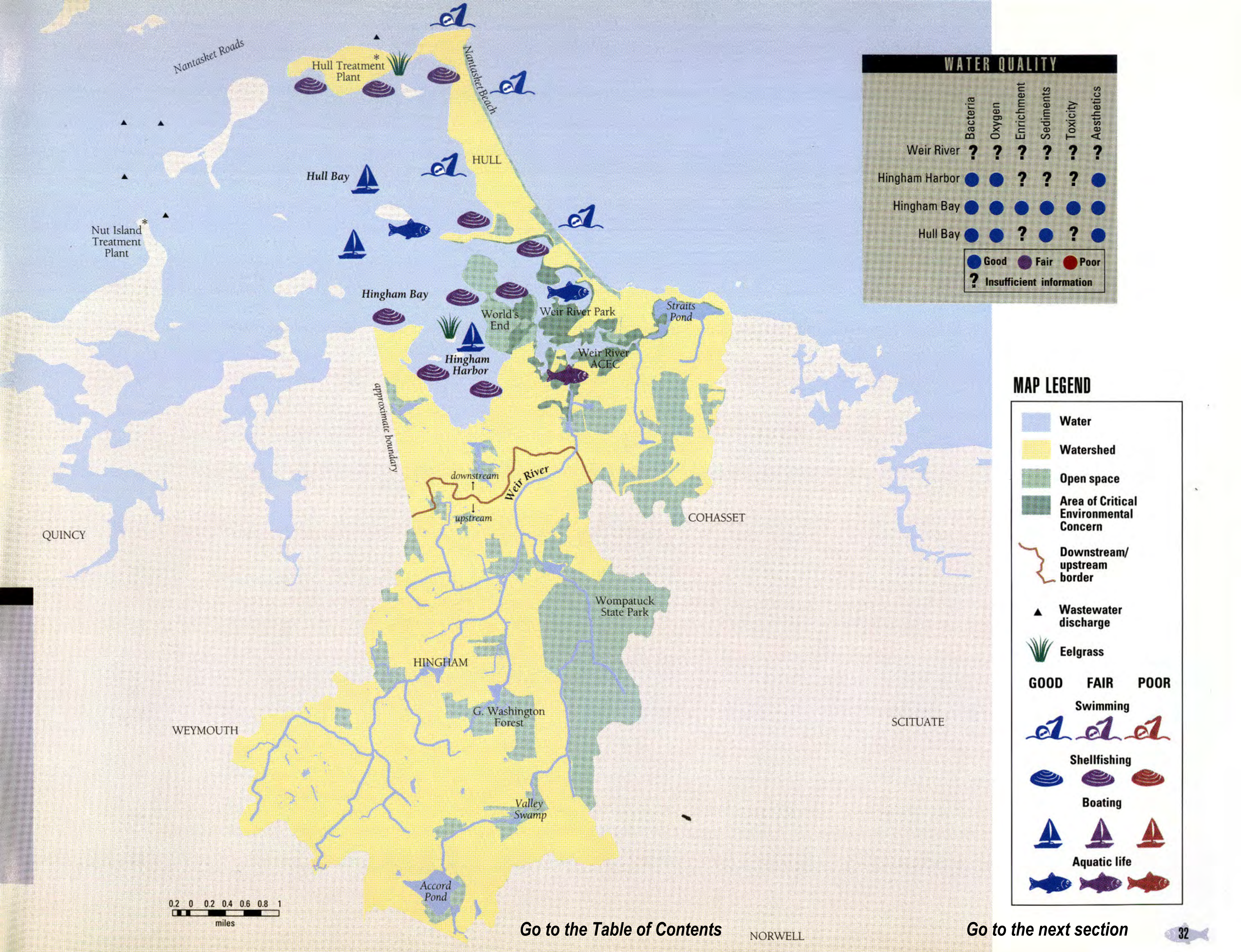
Clean water means that there is nearly full use of the area's resources. Swimmers enjoy Nantasket Beach on the ocean side and other beaches on the harbor side of the Hull peninsula. Boating and fishing are popular here, and shellfish are harvested by commercially licensed master diggers. The Weir River sustains a fairly good smelt run and a small alewife run.

Stormwater is the most important source of bacterial pollution in this watershed. Although water quality is generally good, there are local sources of pollution that cause some problems, especially in the Weir River. Straits Pond suffers from failing septic systems. To solve this problem, homeowners may need to be connected to the Hull or MWRA system. The Hull sewage treatment plant discharges three million gallons per day of treated wastewater into the swift current of Nantasket Roads.

The Weir River ACEC and the recently created Weir River Park protect the estuary and provide opportunities for environmental education.

Eelgrass (*Zostera marina*) is a plant that grows in shallow coastal areas below the low tide line. Eelgrass beds are an important habitat for marine animals; the beds provide food and shelter from predators, especially for young fish. Other animals, such as scallops and lobsters, also prefer eelgrass beds as habitat, and many animals and birds feed on eelgrass leaves (Buchsbaum, 1992). If the water is turbid, however, it is difficult for eelgrass to get enough light. Eelgrass along the Atlantic coast has also suffered several declines due to "wasting disease," which occurs when a parasite grows on the leaves. Eelgrass was once fairly widespread in Boston Harbor, but disappeared, probably due to a combination of wasting disease, water turbidity, and habitat destruction by filling. Hingham and Hull bays are now the only locations in Boston Harbor in which the presence of eelgrass has been confirmed (P. Colarusso, EPA, pers. comm. 1995). However, with improved water quality due to pollution control efforts of MWRA and others, EPA is interested in trying to increase the extent of eelgrass habitat by replanting other areas.





WATER QUALITY

	Bacteria	Oxygen	Enrichment	Sediments	Toxicity	Aesthetics
Weir River	?	?	?	?	?	?
Hingham Harbor	Good	Good	?	?	?	Good
Hingham Bay	Good	Good	Good	Good	Good	Good
Hull Bay	Good	Good	?	Good	?	Good

Good · Fair · Poor
? Insufficient information

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Glossary

Aesthetic pollution: Floating debris and litter, oily slicks, and odors.

Aquifer: A geologic formation that holds groundwater. Many non-MWRA communities rely on wells drilled into aquifers for their drinking water supply.

Area of Critical Environmental Concern (ACEC): An ecologically valuable area designated by the state for special protection.

Bioaccumulation: The process by which toxic chemicals can accumulate in animal tissues and become concentrated when they move up the food chain.

Biochemical oxygen demand (BOD): A measure of the amount of oxygen-consuming organic matter in water.

Chlorination: Disinfection by adding the chemical chlorine, the active ingredient in household bleach. Chlorine is very effective at killing pathogens but is also poisonous to other organisms at high enough concentrations.

Combined sewer system: An antiquated sewer system in which storm runoff and sewage from homes and businesses are carried by the same pipes.

Combined sewer overflow (CSO): (1) A structure designed to provide relief for a combined sewer system during wet weather. (2) An overflow event that occurs when the volume of stormwater entering a combined sewer system overwhelms the capacity of the system.

CSO discharge: The discharge of stormwater and sanitary sewage resulting from a CSO event that is discharged into the receiving water through a CSO outfall.

CSO facility: A treatment facility that operates in wet weather to treat combined sewage before discharge. Includes disinfection; may also include some removal of suspended solids or floatable pollutants.

Dechlorination: The addition of a chemical (usually sodium bisulfate or sodium thiosulfate) to neutralize the toxicity of chlorine after it has been used for disinfection.

Dissolved oxygen: Fish and other aquatic animals breathe oxygen dissolved in the water. Algae and other plants growing in the water produce oxygen, and atmospheric oxygen also dissolves in water at the surface. In polluted ecosystems dissolved oxygen can fall below levels necessary to sustain life. [See also Oxygen-consuming organic matter and Nutrients.]

Effluent: Disinfected wastewater, the final liquid by-product of the wastewater treatment process flowing out of a treatment plant.

Estuary: A water body where salt and fresh water mix. Examples are Boston Harbor, Plum Island Sound, and Narragansett Bay.

Fecal coliform: Because most pathogens are very difficult to measure directly, their presence is usually inferred from the presence of fecal coliform bacteria which are also found in human and animal waste but are easier to measure. If counts of fecal coliform above state standards are measured by a monitoring agency, beaches are posted as unsafe or shellfish beds are closed until levels fall back down.

Groundwater: Water that saturates the rocks and soil. It flows through the ground and, if it is contaminated, can carry pollutants into surface water bodies.

Headworks: Preliminary sewage treatment facilities that remove grit and large objects from the sewage flow before it enters MWRA treatment plants. First stage of primary treatment.

Interceptors: Large regional sewers that collect sewage from local sewerage systems.

Nonpoint sources: Pollution sources at many unspecified locations, such as unsewered rainfall runoff, leaking septic systems, and other intermittent sources of pollution.

Nutrients: Chemicals that are necessary for the growth of plants, but an excess of which can accelerate growth of algae or aquatic weeds. In marine waters the growth of algae is usually limited by nitrogen, so that adding nitrogen increases algae. In fresh water, the limiting nutrient is usually phosphorus. Many detergent manufacturers have eliminated phosphates from their products in order to avoid causing nutrient pollution of freshwater lakes and streams.

Outfall: Pipe releasing wastewater at a fixed location. Often outfalls are placed away from shorelines in areas where the wastewater will be rapidly diluted.

Oxygen-consuming organic matter: If a large amount of organic material–leaves, plants, wastewater or plant growth spurred by excess nutrients–decomposes in a body of water, it depletes the dissolved oxygen level necessary to support aquatic life.

Pathogens: Short for "pathogenic microorganisms." These disease-causing viruses and bacteria enter the harbor through inadequately treated or raw sewage and from animal and bird waste in storm runoff. They can cause stomach ailments, ear, eye, or skin infections, and even serious diseases such as hepatitis.

Point sources: Sources of pollution that enter the aquatic environment through pipes or confined channels such as ditches.

Polycyclic aromatic hydrocarbon (PAH): Complex organic chemical found in petroleum and in products of fossil fuel combustion. Many PAHs are known carcinogens. (Also called polynuclear aromatic hydrocarbon.)

Primary treatment: The first stage of the wastewater treatment process, which uses gravity to separate effluent from sludge (which sinks) and scum (which floats).

Regulator: A structure within a combined sewer system, such as the dam shown on Figure 3, that directs most of the flow to the treatment facility while diverting excess flow to a CSO outfall.

Runoff: Rain and other water that is not absorbed into the soil and instead drains off the surface land.

Sanitary sewers: A sewerage system which carries wastewater only from the drains and toilets of homes and businesses. (Compare to combined sewers.)

Sanitary sewer overflows: These overflows occur when the capacity of a sewer system is overwhelmed and the sewer "backs up," spilling untreated wastewater into nearby waterways.

Secondary treatment: The second stage of the wastewater treatment process, often using microorganisms to break down oxygen-consuming organic matter in wastewater.

Sediment contamination: Sediments tell us the history of pollutant inputs because, over time, sediments accumulate toxic con-taminants. Contaminants stick to particles, which settle to the bottom. Concentrations of toxic organic compounds and most heavy metals in the *water* in Boston Harbor meet state standards; there are very few measurements of toxic chemicals in the freshwater portions of the harbor's tributaries, however. Even if water quality standards are met, toxic chemicals can accumulate in animal tissues or in bottom sediments to levels that harm marine life.

Sediment enrichment: Even if the water's dissolved oxygen does not fall too low, a lot of organic matter falling on the bottom produces an organic-rich sediment. Bacteria in the sediment use up oxygen as they consume the organic matter. While healthy sediments have an oxygenated layer above a layer that is anaerobic (without oxygen), very organic-rich sediments have no oxygenated layer. In this environment anaerobic bacteria can thrive, as they use sulfur instead of oxygen, and produce toxic hydrogen sulfide. Few animals can live in this oxygen-poor, sulfide-rich environment; the resulting low diversity and small number of animals indicate an unhealthy ecosystem.

Spawn: Certain fish, such as alewives, blueback herring, and smelt, live in the ocean and travel up into rivers to lay their eggs, or spawn. Eels live in rivers and spawn at sea.

Stormwater: Rainwater and snow melt that runs off the land. In developed areas, stormwater is collected by a system of storm drains.

Surfactants: Chemical compounds, such as those found in detergents, that break down grease and other kinds of dirt. In high concentrations they are toxic to aquatic life.

Suspended solids: Tiny particles of material, like mud, sand, and organic debris, that are suspended in water but can settle out over time. Pollutants often attach to solids or are solids themselves (e.g. pathogens, toxic contaminants, and some nutrients). Excess suspended solids can clog the feeding organs of some animals and prevent light from reaching aquatic plants.

Tide gates: Structures that permit the discharge of wastewater but prevent river or harbor water from entering the sewer system.

Toxic chemicals: Also called toxic compounds, these chemicals are poisonous at high enough concentrations. They include toxic organic compounds such as hydrocarbons, PCBs, and pesticides. Heavy metals can also be toxic at high concentrations, and include arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, silver, and zinc.

Toxicity: The capability of a substance to poison living creatures. Some of the substances found in wastewater that can cause toxicity in water or sediments include chlorine, surfactants, heavy metals, and some organic compounds.

Tributary: A stream draining into another stream or river, pond, lake, or estuary.

Water quality: The overall health of a water body and its ability to support aquatic life and human uses (swimming, boating, fishing, aesthetics). Properties that are measured to evaluate water quality include fecal coliform bacteria, dissolved oxygen, pH, temperature, salinity, the amount of algae, water clarity or suspended solids, and concentrations of nutrients and toxic chemicals.

Watershed: A geographic area in which water, sediments, and dissolved materials drain to a common outlet–a point on a river or lake, an estuary (like Boston Harbor), or an ocean.

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What You Can Do

MWRA is just one of many public and private entities whose part in watershed management is critical to overall clean water objectives. Others include: •U.S. Environmental Protection Agency •U.S. Army Corps of Engineers •Mass. Department of Environmental Protection •Mass. Division of Marine Fisheries •Mass. Division of Fisheries, Wildlife, and Environmental Law Enforcement •Massport •Boston Water and Sewer Commission •city and town governments and their public works departments •watershed associations •public interest groups •citizens.

As concerned citizens, there are several ways each of us can contribute to improved water quality in our watersheds:

- Learn about your watershed–its water resources and its water quality problems. See the bibliography section at the end of this report for more information.
- Reduce excessive use of fertilizer and pesticides, both sources of runoff contamination. Use only the water you really need when you water your lawn, both to conserve water and to reduce the amount of soil and fertilizer washing off.
- Reduce the amount of toxic materials you use at home, and dispose of them properly. Store hazardous wastes until you can bring them to a community hazardous waste pick-up. Never pour oil or other hazardous wastes into a storm drain or sewer. Oil can be returned to the point of purchase or to a city waste oil disposal location. A reference guide to alternatives to toxic household products is available from Denise Breiteneicher at MWRA (617-242-6000 extension 2328).
- If you have a septic system, make sure it is in good working order and have it pumped out regularly.
- Get involved in your community's affairs. Be aware of possible pollution sources, such as erosion at construction sites or illegal sewer connections to storm drains, and speak out if you see problems (call the environmental strike force at 617-556-1000 or MWRA's TRAC Dept. at 617-242-6000). Show concern and help to inform local officials and political candidates about the importance of local impacts on watershed quality.
- If you live in a neighborhood with combined sewer overflows or use a water body affected by CSO, participate in a neighborhood working group to comment on implementation of the CSO Plan. Contact Vincent Ragucci, MWRA (617-242-6000 ext. 1191).
- Consider becoming a volunteer water quality monitor. Contacts include:
  - Betsy McEvoy, Massachusetts Bays Program, Coastal Zone Management Office, EOEA, 100 Cambridge Street, Boston, MA 02202 (1-800-447-BAYS).
  - Edmund Toomey, Mystic River Watershed Association, 117 Dover Street, Medford, MA 02155 (617-395-7155).
  - Bob Zimmerman, Charles River Watershed Association, 2391 Commonwealth Avenue, Auburndale, MA 02166 (617-965-5975).
  - Ian Cooke, Neponset River Watershed Association, 2468A Washington Street, Canton, MA 02021 (617-575-0354).
  - Katie Barrett, Fore River Watershed Association, P.O. Box 2356, Quincy, MA 02269 (617-472-3189).
  - Linda Beres (Weir River), 24 Douglas Ave. Ext., Hull, MA 02045 (617-925-5693).