APPENDICES

APPENDIX 1

Environmental Inventory and Analysis

GEOLOGY, SOILS, AND TOPOGRAPHY

The geology of Boston can be described by its bedrock, structural, and surficial features including glacial, fluvial, and wind deposited sediments.

Boston is situated in a topographic lowland, referred to as the Boston Basin. This lowland is surrounded by a ring of hills that circle it from the Middlesex Fells in the north, inland to the Belmont Hills and Newton Highlands to the west, and around to the Blue Hills to the south. As with most areas in the Northeast, Boston's geology is attributed to several different geologic processes. The geology of Boston can be described by its bedrock, structural, and surficial features including glacial, fluvial, and wind deposited sediments. The soils of Boston reflect these geological factors, as well as influences due to vegetation and humans.

Bedrock Geology

The principal bedrock units that belong to the Boston Basin include the Cambridge Argillite, Roxbury Conglomerate, Mattapan Volcanic Complex, and the Dedham Granite.

The Cambridge Argillite is classified as a shale or mudstone. This fine-grained sedimentary unit was most likely deposited in deep oceanic waters millions of years ago when the Boston area was below sea level. This unit currently lies well below Allston, Back Bay, Central Boston, Charlestown, East Boston, South Boston, and the South End.

The Roxbury Conglomerate is known as a Puddingstone. This unit consists of pebbles and cobbles within a matrix of varying rock types. The range of size of the cobbles suggests that a river

Roxbury Puddingstone

or stream deposited this unit. The Roxbury Conglomerate underlies much of Boston including Brighton, Kenmore/Fenway, Jamaica Plain, Mission Hill, Dorchester, Roxbury, and the northern portions of Mattapan, Roslindale, and West Roxbury.

The Mattapan Volcanic Complex is one of the oldest rock units found in Boston. These volcanic rocks are primarily granite. Pebbles and cobbles from this unit have been found in the Roxbury Conglomerate. This suggests that the Mattapan Volcanic Complex is older than the Roxbury Conglomerate, having experienced erosion, producing pebbles and cobbles that later formed the Roxbury Conglomerate. The Mattapan Volcanic Complex lies under the southern portion of Mattapan and large portions of Hyde Park.

Dedham Granite is most likely the oldest rock unit found in Boston ... a Precambrian age rock that indicates an age well in excess of 600 million years.

The Dedham Granite is most likely the oldest rock unit found in Boston. This unit, which is found below the southern portions of Hyde Park and West Roxbury, is a Precambrian age rock that indicates an age well in excess of 600 million years.

Structural Geology

Structurally, several features distinguish the Boston Basin. These include plunges, folds, anticlines, synclines, and faults. These structural features are found throughout the many rock units in the Boston Basin. Geologists use these features to date rock units relative to each other.

Plunges are physically represented by a significant dip in the bedrock. In the Boston Basin, the bedrock generally plunges east/ northeast. This means that if a plunging rock unit were exposed at the surface in a southwest area of Boston, that same rock unit would be hundreds of feet deep in a northeast area of Boston.

Structural features such as folds in the bedrock are evident in the Boston Basin. These folds occurred over 600 million years ago as the rocks were subjected to tectonic stress, causing the once flat-lying rocks to bend and fold. This stress also resulted in the formation of anticlines and synclines. These features are simply bedrock that has been folded up or down, respectively. Anticlines underlie Central Boston, Mattapan, and the Lower Mills. Synclines are found under the Charles River basin, Roslindale, and Hyde Park.

Inactive faults can also be located within the Boston Basin. These faults mark boundaries where different rock units once met and moved relative to one another. Thrust faults, where one rock unit is lifted above the other, are found at Mt. Hope, the Neponset Valley, and Blue Hills. Transverse faults, where units move in opposite directions, include the Stony Brook fault.

Surficial Geology

The surficial geology of the Boston Basin is the dominant factor regarding Boston's landscape. The surficial geology of Boston includes glacial drift, glacial outwash, riverine deposits, and marine clays, as well as loess, which is fine silt deposited by wind.

Glacial landforms dominate the current topography of Boston. These landforms resulted from periods of extensive glaciation approximately 10,000 to 50,000 years ago. Repeated advances of thick glacial ice resulted in deformation of the earth's crust. Valleys that existed 50,000 years ago were scoured, deepened, and widened by glacial ice. Glacial till – unconsolidated, non-stratified glacial drift – was deposited in depths of up to 150 feet This till was commonly deposited as smooth, oval shaped hills known as drumlins. The Boston Basin has more than 100 of these drumlin features including the Harbor Islands, Breeds Hill, and Bunker Hill.

Glacial landforms dominate the current topography of Boston.

Deglaciation of the Basin had a profound effect on the current landscape. As glacial ice began to melt, the run-off deposited sands, gravel, and silts that had been trapped in the glacial ice. Changing sea levels, freshwater streams, wind, and erosion then modified these glacial deposits, thereby forming varied, sorted layers throughout the basin.

The prominent deposits on Boston's current topography include sand, gravel, till, bedrock, and silt and clay deposited by both fresh and estuarine water. Sand and gravel deposits run north/south through Boston. These deposits represent glacial outwash that was deposited as glacial ice melted. These deposits are found in abundance in Allston, Hyde Park, Jamaica Plain, North Dorchester, Roslindale, the South End, and West Roxbury. These deposits are well suited for development, as they are relatively stable and flat. Sand and gravel deposits typically, however, have a high water table, which may cause basements to be more susceptible to flooding. A high water table and the speed at which fluids move through sand and gravel can increase a surface release's capability to pollute groundwater.

Till and bedrock are found throughout the city and are characteristic of areas which contain drumlin hills. Neighborhoods that are dominated by till and bedrock deposits include Brighton, Central Boston, Dorchester, Mattapan, Roslindale, Roxbury, and West Roxbury. Till and bedrock are considered to be extremely stable materials for development, although they also present constraints. Bedrock presents difficulties in excavation while till is commonly found as a drumlin hill, possibly causing topographic restraints for development.

Floodplain alluvium consists of fine-grained material such as fine sands and silts that are found adjacent to, and deposited by, rivers and tidal marshes. These deposits underlie the Back Bay,

Fenway/Kenmore, and South Boston. These deposits are now covered by artificial fill that was laid down in the late 18th and 19th centuries to allow development of these lands. The obvious development constraints associated with this material include instability and a high water table. The material does, however, possess a low permeability, thus trapping pollutants and resulting in a slow migration which can be contained should a release of pollutants occur.

Soils

The soils of the Boston Basin are derived from natural glacial processes, and artificial processes attributed to the extensive filling of lands by humans. The three largest generalized soil units in Boston are Udorthents-Urban Land, Canton-Charlton-Hollis, and Newport-Urban Land units. These units are typically deep deposits found on land with a topographic range from nearly level to moderately steep.

Udorthents-Urban Land soils occupy most of Boston. These soils are found in areas that were previously tidal marshes, flood plains, bays, harbors, and swamps. Udorthents are classified as areas where native soil has been removed and filled with artificial soil material. The fill consists of soil material, rubble, refuse, and channel dredgings. Depth of this unit ranges from 2 to 20 feet. Land that is 85% or more covered by an impermeable surface such as concrete and asphalt including roads, sidewalks, and buildings is defined as Urban Land. Urban Land overlays actual soil units that cannot be determined due to the urban coverage.

The Canton-Charlton-Hollis unit is characterized by well drained, loamy soils formed from glacial deposits. This unit is typically found on low hills and uplands in Hyde Park, Mattapan, and Roslindale.

Canton soils are found on small undulating hills adjacent to valleys. Charlton soils are located in depressions between ridges at higher elevations. Hollis soils are found at the top of ridges and near rock outcrops. These soils are conducive to woodland growth, and are suitable for development.

Newport-Urban Land is commonly found on steep hillsides in the Boston Basin. This unit is found on top slopes and side slopes in Jamaica Plain and West Roxbury. Course fragments of flat dark gray shale and slate in the substratum characterize it. A layer of compacted glacial till causes low permeability and a perched water table, potentially contributing to wet basements in residential areas.

Topography

Ten to twelve thousand years ago, glaciers shaped the landscape that subsequently Native Americans inhabited and Europeans colonized. These massive sheets of ice moved across the land, totally displacing all flora and fauna in the area. The ice sheets' great weight caused the coastal lands to sink below the surface of the ocean. After the glaciers retreated, the most prominent landscape features were the drumlins, hills made up of glacial till. They tend to have an oval shape, with the "points" of the oval aligned in the direction of the glacial retreat. (Many of the harbor islands are such drumlins.) The glaciers also left sand and gravel deposits through many parts of Boston, such as along the Charles in West Roxbury and Allston-Brighton, in the Stony Brook Valley in Jamaica Plain, Roxbury, Roslindale, and Hyde Park, and near Dorchester Bay in Dorchester and South Boston. Overall, the terrain of Boston is gently rolling, with heights ranging from near sea level along the coast to 370 feet above sea level at the highest point, Bellevue Hill in West Roxbury, within the MDC's Bellevue Hill Reservation.

LANDSCAPE CHARACTER

Boston's landscape is rich in history. It has been changing since the city's founding in 1630. These changes have left traces on the landscape of the city. The growth of the city's landmass has been the most significant evidence of the change of this landscape.

Originally an area of 1,000 acres, the city has grown to its current area of approximately 30,000 acres through land reclamation and annexation.

History of the Landscape

Boston's original landscape is considerably different from its present day appearance. This landscape has changed more than any other city in the country. Boston was originally settled on the Shawmut Peninsula, which is now Central Boston. This peninsula was comprised of three hills: Beacon Hill, Copp's Hill, and Fort Hill. Washington Street, a thin neck of land that often flooded at high tide, connected the peninsula and its hills to the mainland. Originally an area of 1,000 acres, the city has grown to its current area of approximately 30,000 acres through land reclamation and annexation.

Development of the city involved the filling of its coastal and bay areas. The first salt marshes destroyed by European settlers were the land around the perimeter of Shawmut Peninsula and the Boston Neck. Between 1810 and 1850, Mill Cove was filled and development of South Boston had begun. By 1870 the Commonwealth was filling the Back Bay. During that same period, the City of Boston had planned and was developing the South End (the area surrounding Washington Street). Charlestown and South Boston continued to be filled during this period. Between 1870 and 1880 the Back Bay was completely filled while South Boston and East Boston continued to grow.

Water is a prominent part of the landscape character of Boston. With miles of coastline and riverfront, Boston is blessed with aquatic resources, coastal and estuarine wetlands, and scenic vistas.

Filling of salt marshes continued into the 20th century as East Boston and Breeds Island were connected and South Bay and Columbia Point were filled.

While the filling of salt marshes added new area to the city, annexation incorporated towns into the city's jurisdiction. Annexation began with Roxbury in 1868 and by 1874, Dorchester, Charlestown, Brighton, and West Roxbury had been added. Hyde Park was the last town annexed when it joined the City of Boston in 1912. These annexed towns now represent Boston's neighborhoods. Fenway/Kenmore and Mission Hill were formerly parts of the Town of Roxbury. Roslindale and Jamaica Plain were parts of West Roxbury. Dorchester included Mattapan, and Allston and Brighton were part of the Town of Brighton.

Current Assessment

Boston has become a highly urbanized area from the perspective of openness of the landscape. High-rise towers and dense apartment buildings dominate the landscape in the downtown areas. Nearby neighborhoods such as Charlestown, East Boston, South Boston, and Allston have considerable low-rise industrial development. Low-rise residential developments dominate the neighborhoods further out from downtown, such as Roxbury, the South End, Jamaica Plain, Mattapan, and Dorchester. A mix of high- and low-density residential developments dominates the landscape in neighborhoods such as Roslindale, West Roxbury, and Hyde Park.

Despite this historical spread of development across Boston's landscape, it has retained much natural beauty and many open lands thanks to the cumulative wisdom of its citizenry over time. It was felt that a portion of the city's land must be preserved for the recreation, relaxation, and scenic enjoyment of its citizens. Both the municipal and the metropolitan park systems preserve much of this landscape character. For example, hills, ponds, and wetlands are preserved in Allandale Woods under the city's jurisdiction, and in the Stony Brook reservation under the MDC.

Water is a prominent part of the landscape character of Boston. With miles of coastline and riverfront, Boston is blessed with aquatic resources, coastal and estuarine wetlands, and scenic vistas. Within city limits are many of the Boston Harbor Islands that now make up the Boston Harbor Islands National Recreation Area. Much of this area is considered a distinctive landscape, the highest categorization in the Department of Environmental Management's statewide Landscape Inventory. Boston's open lands are a mixture of uplands and wetlands. Most of the upland areas consist of forest, with the remainder in fields and meadows. These upland areas are generally either publicly owned parklands and cemeteries or privately owned cemeteries. The larger, expansive wetland areas are primarily under public ownership. Boston is a highly mature, developed

community. Developable land that is as yet undeveloped is extremely limited. The protection of the natural resources and open areas of Boston's landscape is as vital a function now as it was in the 19th and 20th centuries.

WATER RESOURCES

The settlement of Boston upon the Shawmut Peninsula took place due to the area's outstanding water resources. Mainland Boston is bordered by water to the north, south, and east. These water resources include an ocean harbor, rivers, streams, ponds, and wetlands.

Boston Harbor

To the east, the Boston Harbor occupies ten miles of shore line. The Harbor consists of several unique areas which border Boston, more specifically, its Charlestown, Central Boston, East Boston, South Boston, and Dorchester neighborhoods. Sections of the Harbor include the Inner Harbor, the Outer Harbor, and Dorchester Bay.

Harbor Island beaches are found on Spectacle Island, Long Island, Thompson Island, and Gallops Island.

Charlestown, East Boston, Central Boston, and South Boston bound the Inner Harbor. The Inner Harbor stretches from the confluence of the Mystic and Chelsea Rivers to the Fort Independence and Fort Winthrop sections of South and East Boston, respectively. This brackish water is classified as SB (swimmable and fishable) by the DEP. Though shellfish beds occur throughout the inner harbor, shellfishing is prohibited. The Inner Harbor is used for recreational fishing and maritime/industrial uses. Freighters and ferries are common in its shipping channels and designated deep port areas. The Inner Harbor includes three channels: the Little Mystic, Fort Point, and the Reserved Channel. These channels are large capacity docking points that can provide protection during rough seas.

The Outer Harbor is home to dozens of islands. The City owns four islands: Long, Moon, Rainsford, and a large portion of Spectacle Island. The islands are drumlin hills that are partly submerged in the water of the harbor. Rounded hills, open fields, forests, and historical sites characterize these islands. The Harbor Islands, which once had uses such as military forts and industrial plants, have generally reverted to a more natural state. Harbor Island beaches are found on Spectacle Island, Long Island, Thompson Island, and Gallops Island. The water of the Outer Harbor is typically used for boating, fishing, and navigation by commercial ships. Improvements at Spectacle and Long Island Beaches may encourage swimming as a use.

The Constitution Beach Bay area (aka Orient Heights Bay) of Boston Harbor is located on the eastern coast of East Boston between Logan Airport and Orient Heights. These waters are designated class SB waters by the DEP, which is suitable for

Carson Beach, South Boston

swimming and fishing, common activities in the bay. The bay includes 275 acres in Belle Isle Marsh, which is part of the designated Rumney Marsh Area of Critical Environmental Concern (ACEC). These marshes are among the most important biological resources in the city. They are host to numerous species of waterfowl, wading shore birds, migrant songbirds, invertebrates, and fish. Constitution Beach is a small beach area on tidal flats located in the northern section of the bay. Marshes to the west and the Belle Isle Marsh to the east border the beach.

Dorchester Bay stretches from Castle Island at Pleasure Bay in South Boston to the mouth of the Neponset River at Commercial Point in southern Dorchester. Primary uses of the bay include boating, fishing, and swimming. Dorchester Bay waters are classified as SB. However, shellfishing is prohibited, as is the case throughout Boston Harbor. Swimmers gain access to the water at several locations along the bay in both South Boston and Dorchester. Access points include the beaches of Pleasure Bay, L & M Street Beaches, and Carson Beach in South Boston, and Savin Hill and Malibu Beaches in Dorchester.

Rivers

The City of Boston contains, or is adjacent to, five rivers: the Charles River, the Muddy River, the Neponset River, the Chelsea River, and the Mystic River.

The Charles River originates southwest of Boston at Echo Lake in Hopkinton, MA. The upper section of the Charles River drains a watershed of approximately 310 square miles. The river meanders 80 miles from its source to the Charles River Dam where it empties into Boston Harbor. Before reaching the Harbor, the Charles flows along West Roxbury, Allston, Fenway/Kenmore, the Back Bay, and the West End of Boston. This constitutes eight miles of municipal shoreline that is bordered by the Charles River Reservation and the parkways of Soldier Field Road and Storrow Drive. The portion of the Charles between the Charles River Dam and Boston University Bridge is referred to as the Charles River Basin. This section of the river, which once inundated the Back Bay, is a wide and deep impoundment of freshwater used extensively for rowing and sailing. The water of the Charles River is classified as Class B by the Massachusetts Department of Environmental Protection (DEP). This type of water is considered swimmable and fishable, though these uses of the Charles River are currently impaired (see Water Quality section).

The Neponset River flows for a total of 28 miles from the Neponset Reservoir in Foxborough to Boston Harbor at Dorchester Bay. This drains a watershed of 323 square miles

south and west of Boston. The small gradient of the river results in slow currents and several wetlands along the Neponset. The Neponset flows east along seven miles of natural, meandering banks to the south of Boston through Hyde Park, and along Mattapan and South Dorchester. This section of the River is bordered by the Neponset River Reservation, which includes a large tidal wetland in South Dorchester. The lower four miles of the river from Dorchester Bay to the Lower Mills Dam in South Dorchester is tidal and frequently used for bird watching, picnicking, canoeing, and fishing. The Massachusetts DEP has classified these waters as SB, allowing fishing and swimming, but restricting shellfishing.

The City of Boston contains, or is adjacent to, five rivers: the Charles River, the Muddy River, the Neponset River, the Chelsea River, and the Mystic River.

The Muddy River originates at Jamaica Pond and flows north 3.5 miles before joining the Charles River. It flows through four distinct parklands designed by Frederic Law Olmsted: Olmsted Park from Wards Pond to Leverett Pond, the Riverway from Leverett Pond to Park Drive and Brookline Avenue, the Back Bay Fens from Park Drive and Brookline Avenue to the Boylston Street Bridge, and Charlesgate from the Boylston Street Bridge to the Charles River. Within these parks, the Muddy's Class B (DEP) waters are primarily used for passive recreation.

The river's watershed drains 8.6 square miles of land, only 25% of which are in Boston. From Jamaica Pond to Leverett Pond, the 2% gradient is steep, an average of a two-foot drop in elevation every 100 feet downstream. This section of the river flows through Olmsted Park, including Wards Pond, Willow Pond, and several small waterfalls.

The lower section of the river flows from Leverett Pond to the Charles River with a gradient of less than 0.01%, causing the river to be essentially flat with little current. From Leverett Pond, the Muddy meanders through the Riverway before reaching the Brookline Avenue gates at Park Drive. When these gates are opened during times of flood, a portion of the Muddy's flow is directed through the Muddy River Conduit under Brookline Avenue and is emptied directly into the Charles River. During periods of normal flow, river water travels one and one-half miles through the Back Bay Fens to the Charles River.

The Chelsea River is a short tidal estuary, and is Boston's only remaining undammed river. From its origin as Mill Creek in Chelsea and Revere, it flows approximately three miles past the heavily industrialized north shore of East Boston and into the Inner Harbor.

The Mystic River originates at the Mystic Lakes section of the Middlesex Fells Reservation, approximately five miles northwest of Charlestown. There are approximately two miles of Mystic River frontage on Charlestown's north shore, but most of this is dominated by industrial marine transportation enterprises. The Mystic meets the Chelsea River under the Tobin Bridge to form the northern part of the Inner Harbor.

Saw Mill Brook, Millennium Park, West Roxbury

Brooks & Streams

At one time, the Stony Brook traversed Boston for approximately seven miles. The majority of the stream has been culverted to accommodate development and stormwater conveyance. Currently, the only portion remaining above ground is at its origin in the Stony Brook Reservation in West Roxbury. The Stony Brook Conduit (SBC) discharges into the Muddy River in the Back Bay Fens. The SBC carries mostly brook flow in dry weather and combined sewer overflows (CSOs) along with stormwater flows in wet weather. The conduit discharges to the Charles River, and occasionally overflows to the Back Bay Fens Pond at Boston Gatehouse No. 1.

Mother Brook originates at a diversion dam on the Charles River in Dedham. It is the first canal constructed in the New World. It flows east through Hyde Park where it joins the Neponset River. The first three-quarter mile section of Mother Brook, located in Dedham, is an artificial canal excavated to connect the Charles River to a branch of the Neponset River formerly known as East Brook. Therefore, Mother Brook diverts one-third of the flow of the Charles River. This represents the equivalent of 60 square miles of drainage area added to a natural drainage basin of five square miles.

Bussey Brook flows through portions of West Roxbury, Roslindale, and Jamaica Plain, before discharging underground into the Stony Brook Conduit near the Forest Hills MBTA station. Like other streams in Boston, it has been almost completely buried, though remnant above-ground sections still occur in Allandale Woods and the Arnold Arboretum. Though seriously degraded by culverting and urban run-off, these remaining sections of Bussey Brook represent some of the most important aquatic resources in Boston.

Sawmill Brook traverses the perimeter of both Millennium Park (the former Gardner Street landfill) and the MDC Brook Farm Reservation in West Roxbury. Though channelized in sections and diverted by construction of the landfill, it is an important tributary to the Charles River. Small, wooded sections of Sawmill Brook occurring within the Brook Farm Reservation are critical habitat to a number of wildlife species, including a state-listed rare amphibian (see Wildlife section).

Dana Brook was formerly the main drainage channel in West Brighton. It now lays completely underground from Chandler Pond to the Charles River, a distance of approximately one and one-half miles. Segments of Dana Brook still exist upstream of Chandler Pond, on the Newton Commonwealth Golf Course within Newton. This is the main inlet for Chandler Pond.

Ponds

Boston contains several ponds and a reservoir. These bodies of water vary in nature and origin from glacial ponds to river ponds to artificial ponds and reservoirs. Glacial ponds were formed by glacial processes involving melting water and large blocks of ice deposited upon Boston's landscape, forming ponds. These glacial ponds are referred to as kettle ponds. Kettle ponds are common in the Boston Basin. One example is Jamaica Pond, at approximately 80 acres the largest natural pond in Boston.

Turtle Pond is located within the Stony Brook Reservation in Hyde Park and is another natural pond of great significance. It is a popular fishing spot and, despite the presence of the adjacent Turtle Pond Parkway, is relatively undisturbed and has generally good water quality. In addition, several small, unnamed ponds within the Stony Brook Reservation provide critical habitat to a number of important wildlife species. Other small woodland ponds occur in Allandale Woods.

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Boston also contains many artificial ponds, and ponds that are part of river systems. One of the most notable artificial ponds is the Public Garden Lagoon. This pond was created in 1838 during the construction of the Public Garden. Mill Pond in Hyde Park is an artificial pond that was created through an impoundment of Mother Brook. Chandler Pond, located in Brighton, was originally excavated for the purpose of producing ice. It is the last of more than 20 ponds once found in Brighton. Scarborough Pond in Franklin Park was dug out in the 1890s during the park's construction.

Among Boston's ponds that are part of river systems are Ward, Willow, Leverett, and Cow Island Ponds. Ward, Willow and Leverett Ponds are part of the Muddy River system located in Olmsted Park in Jamaica Plain. Cow Island Pond is a still water section of the Charles River in West Roxbury. The MDC Havey Beach borders this pond.

The MDC Chestnut Hill Reservoir, located in Brighton, is an artificial impoundment of water that once served as Boston's only water supply. The Reservoir was discontinued as a source of drinking water following completion of the Quabbin Reservoir in Western Massachusetts. The largest body of water located within Boston, the Reservoir is now used for scenic recreation purposes.

Wetlands

Wetlands serve a vital function for Boston. They assist in flood control, stormwater run-off, and provide food and shelter to fish, birds, amphibians, and other important animals. However, in the last one hundred years 6,000 acres of coastal wetlands and approximately 50% of Boston's inland wetlands have been destroyed. Boston has several wetland areas located

in the southern and western portions of the city, yet the largest single wetland, at 275 acres, is the Belle Isle Marsh in East Boston. Other substantial wetlands are found in the Neponset River Reservation in South Dorchester, the Stony Brook Reservation in Hyde Park, and the Brook Farm Reservation in West Roxbury. Smaller yet still significant forested wetlands are found near the Leatherbee/Hancock Woods in West Roxbury, and at Allandale Woods in Roslindale. Wetlands associated with rivers and streams include those along the banks of the Muddy River, Mother Brook, the Charles River, and Saw Mill Brook. (See Vegetation section for further description of wetland resources.)

VEGETATION

The natural vegetation of Boston is chiefly influenced by the city's topographic position along the Atlantic coast, the development of landforms resulting from recent glaciation, and a long history of human land use and manipulation of native habitats.

Upland Vegetation

Forested Uplands

The Boston area ... lies in ... the Appalachian oak-hickory forest zone. ...Red, white, and black oaks, [as well as] hickories dominate [this zone].

The Boston area, like most of eastern Massachusetts, lies in an area generally described as the Appalachian oak-hickory forest zone. This forest type occurs from southern Maine, throughout southern New England, south to Georgia at higher elevations and west to western New York. Red, white, and black oaks, with lesser densities of pignut, shagbark, bitternut, and mockernut hickories dominate the Appalachian oak-hickory forest zone. Other trees commonly found are white ash, black cherry, black birch, hophornbeam, and red maple. Numerous species of shrubs also occur. Among the most common are lowbush blueberry, maple-leafed viburnum, witchhazel, flowering dogwood, and beaked hazelnut.

In the Boston area, the oak-hickory forest is mixed with patches of other forest types found in adjacent northern and southern regions. Elements of the northern hardwood forest, such as sugar maple, eastern hemlock, yellow birch, and American beech can be found in Boston's forested areas, especially on north and west facing ridges. These species are generally prevalent throughout northern New England and southeast Canada. Conversely, areas in the city with well-drained, sandy soils and southeast exposures support woodland species more typical of Cape Cod and other coastal areas, such as pitch pine, scrub oak, and sweet fern.

White pine is a ubiquitous tree species throughout the region, frequently occurring in abandoned pastures and other open, sunny locations.

Given the long history of industrial and residential development within Boston, it is not surprising that natural forests and other native plant communities occur today in remnants and small patches. The largest forested area remaining in the city is the 466-acre Stony Brook Reservation in Hyde Park, Roslindale and West Roxbury. Other significant forested areas are Allandale Woods (100 acres, West Roxbury), Hancock Woods (55 acres, West Roxbury), Sherrin Street Woods (25 acres, Hyde Park), the Wilderness (100 acres, Franklin Park), Olmsted Park (50 acres, Jamaica Plain), Brook Farm (120 acres, West Roxbury), parts of the Arnold Arboretum (Jamaica Plain), and sections of several Boston Harbor Islands.

Boston's forests provide a range of recreational, scenic, and ecological benefits. They are the city's lungs, cleansing the air of carbon dioxide and producing oxygen. Summer temperatures are up to ten degrees cooler in city forests, helping to mitigate the warming effects of urban development and activity. They also help control stormwater and filter pollutants from urban run-off. Healthy forest communities are essential for preventing excess sedimentation of waterways, wetlands, storm sewers, and catch basins by stabilizing erodible soils and steep slopes.

Boston's forests provide a range of recreational, scenic, and ecological benefits.

Most of Boston's forested areas are open to the public and, thereby, provide both formal and informal environmental education opportunities to schoolchildren, families, and adults. Recreational activities, such as hiking, trail running, cross country skiing, wildlife viewing and tracking, and nature photography, provide city residents and visitors with the unique opportunity to experience and observe nature up close within the confines of an urban environment.

Though many of these areas are publicly owned and protected from outright development, they still suffer from a host of problems. Some, such as the Stony Brook Reservation, have been fragmented by the construction of parkways, creating more edge habitat, less interior habitat, and interrupting established wildlife corridors.

The habitat value of all forested areas is seriously degraded by the prevalence of non-native, invasive plant species. These plants were either purposely or accidentally introduced to the area and, because of their tolerant and hardy nature, have become major threats to the sustainability of native forest ecosystems. Among the most destructive non-native invasive plants in Boston forests are Norway maple, a widely planted street tree, European buckthorn, multiflora rose, oriental bittersweet, and Japanese barberry.

In addition, people subject forested areas in Boston to direct abuse. Severe littering, illegal dumping, vandalism, and trampling by foot and vehicles are chronic problems in all urban forests. Frequent fires, set deliberately or by accident, such as those that

occur regularly in Stony Brook and Allandale Woods, suppress regeneration of native trees and lead to the further proliferation of invasive trees, shrubs, and vines.

Serious blights and diseases currently threaten several tree species. Most notable is the decline of the eastern hemlock caused by an insect parasite, the wooly adelgid. The effects of this recent arrival to Boston have been minimal so far. However, based on the experience of other communities in Connecticut and New York, where the adelgid has been present longer, the outlook is bleak. Foresters predict that the long-term impact of the wooly adelgid on the eastern hemlock will be as devastating as the blight that virtually wiped out the American chestnut 70 years ago. Because of these issues, public ownership by itself is insufficient to protect Boston's forests from degradation and ensure their long-term sustainability. Active, hands-on management is required. Non-native, invasive plants need to be controlled, eroding soil stabilized and revitalized, and native species of trees and shrubs must be planted in order to restore a healthy forest ecosystem. In addition, activities that damage the forests – illegal dumping, fires, uncontrolled mountain biking, and off-road vehicles – must be curtailed, while beneficial and productive recreational and educational activities are promoted. With so little of Boston's original forest remaining, it is of paramount importance to maintain what is left to maximize the benefits it provides and ensure that it continues to function as an ecosystem for future generations.

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Non-forested Uplands

Non-forested uplands, primarily meadows, are a dwindling resource in Boston. Often a remnant of past agricultural use, virtually all meadows and pastures throughout the city have been subject to intense residential and commercial development. Most of those not developed have been left to grow into shrubby thickets and early successional forests dominated by non-native, invasive plant species.

Meadows and pastures provide critical habitat to many species of plants and wildlife that are rarely found in Boston and are increasingly uncommon throughout the northeast. They offer great scenic value, breaking up the monotony of dense residential areas and providing expansive views of the city, Boston Harbor, and the surrounding landscape. Boston's meadows are frequently found atop hills and other steep slopes subject to erosion problems. Viable, healthy meadow plant communities are thus important to stabilize vulnerable soil.

Significant upland meadows today can be found in the Arnold Arboretum, Franklin Park, the Boston Nature Center, Calf Pasture, the Walter Street Tract, Allandale Farm, McLaughlin Playground, and on several Boston Harbor Islands. Most of these sites are

current or former agricultural or horticultural sites. Turf grasses and opportunistic wildflower species of Eurasian origin are dominant. Farmers during the 17th and 18th centuries deliberately or accidentally introduced these species and turf grasses.

Because of the suppression of natural wildfires and the disappearance of farming practices such as haying and grazing, meadows now require regular intentional maintenance to sustain their open, pastoral character. Mowing is the most common method of maintenance; however in many cases mowing is done too frequently to allow for the development of a diverse meadow plant community. Such areas are generally devoid of any habitat value. To maximize floristic diversity and ecological value, most meadow habitats should be mowed only once per year, at the most, in the late summer.

The acreage of meadow found in Boston increased substantially in 2000 with the opening of Millennium Park, a new park atop the former Gardner Street landfill in West Roxbury. This 100-acre park will include over 70 acres of grassland comprised of both native and Eurasian grass species. Interpretive nature trail signs are planned to highlight the uniqueness and diversity of this beautiful ecosystem.

In addition, the Parks Department through its Urban Wilds Initiative is working with its Maintenance Division and the Boston Youth Fund to implement selective, low-impact mowing regimes at several meadows throughout the city's urban wilds and other natural areas. Community groups and other volunteers have also been involved in introducing native meadow plants, such as goldenrods and asters, and controlling non-native, invasive plant species at several sites.

Wetland Vegetation

Freshwater Wetland Vegetation

As throughout all of Massachusetts, Boston has lost a substantial percentage of its original freshwater wetlands to modern development. Intense filling and subsequent construction has occurred in the extensive marshes once found along the Stony Brook, Bussey Brook, and the upper Charles River. Isolated wetlands, bogs, vernal pools, and small ponds have been filled for residential development. Remaining wetlands have been affected by changes to hydrology as streams have been buried and diverted to storm sewers.

Wetlands serve a vital function for the city. They help to store, control, and cleanse stormwater run-off, a function that becomes increasingly important as additional impervious surfaces are created. They also provide essential habitat for a wide array of wildlife (see *Wildlife* section, below).

Several distinct plant communities are present in freshwater wetlands in Boston. Forest wetlands – such as red maple swamps and floodplain forests – are typified by large trees, such as red

maple, willows, basswood, green ash, silver maple, and a diverse shrub layer of dogwoods, alder, winterberry holly, viburnums, and swamp azalea. An outstanding remnant of the southern New England floodplain forest, a rare community type recognized by the Massachusetts Natural Heritage Program, occurs along the Charles River shoreline of Millennium Park in West Roxbury. A project is being planned to rehabilitate this floodplain forest. Other significant forested wetlands are found in the Stony Brook Reservation, Brook Farm, Sherrin Street Woods, and Leatherbee/ Hancock Woods.

Non-forested wetlands – marshes, shrub swamps, and wet meadows – are dominated by shrubs, such as buttonbush, highbush blueberry, dogwoods, and elderberry, along with an extremely diverse collection of grasses, grass-like plants, and herbs typified by cat-tails, water willow, pickerel weed, arrow arum, bulrushes, and sedges. Typical marshes are found at Allandale Woods, West Roxbury High School, Brook Farm, along the West Roxbury stretch of the Charles River, the Boston Nature Center, and adjacent to Chandler Pond in Brighton.

Coastal Wetland Vegetation

Coastal wetlands, primarily salt marshes in Boston, were once the most dominant plant community within the city. Thousands of acres occurred along the harbor shoreline and up into the estuaries of the Charles, Chelsea, Mystic, and Neponset Rivers. Over the past 350 years, these salt marshes have been lost to filling, alterations to hydrology, pollution, and other drastic changes to the shoreline. Today only about 400 acres of salt marsh remain. These are primarily found at the MDC's Belle Isle and Neponset River Reservations in East Boston and Dorchester, respectively, and at Massport's Wood Island Marsh in East Boston.

Salt marshes comprise one of the richest and most biologically productive ecosystems on the Earth. The precisely balanced cycles of tide, sedimentation, and decomposition all contribute to the production of up to 10 tons per acre per year of vital nutrients, minerals, and organic material to nearby aquatic and terrestrial habitats. Healthy salt marshes support dozens of animal species. Some species (ribbed mussel, salt marsh dragonfly, fiddler crab, for example) are restricted to this habitat for the duration of their lives, while other animals (sharp-tailed sparrow, mummichogs, meadow vole) use salt marshes for breeding or feeding but can also be found in other habitats.

Overwhelmingly dominated by salt marsh cordgrass and salt meadow grass, salt marshes also protect sensitive, low-lying coastal areas from flooding and other damage resulting from strong storms. They are vital to the maintenance of clean water in Boston Harbor. Other plants adapted to withstand the unique physical conditions in and around salt marshes include marsh elder, black rush, spike grass, glasswort, and sea lavender.

Because of their association with surface and groundwater and their position within a given watershed, both coastal and freshwater wetlands are particularly susceptible to the deleterious effects of urban development. Public ownership alone is insufficient to protect them and preserve the vital functions they provide. All of the wetlands occurring in Boston are degraded to a certain extent. They have been at least partially filled or drained, have received either too much or too little water of poor quality, and have been invaded by non-native, invasive plants that have outcompeted the native species. The most destructive non-native plants in Boston wetlands are giant reed *(Phragmites australis)* and purple loosestrife.

The City of Boston is pursuing a number of programs to restore some natural functions to the city's degraded wetlands. The prime example of this is the restoration of the Muddy River and Back Bay Fens. This project, estimated at $43 million, aims to remove years of accumulated sediment from the Muddy River and restore a diverse native wetland plant community along its banks, now dominated by a dense infestation of giant reed. A project is being planned to restore a salt marsh along the Belle Isle Inlet in East Boston, while a salt marsh restoration project will be completed along the Chelsea River (Condor Street Marsh) in early 2003.

Rare Species

The Massachusetts Natural Heritage and Endangered Species Program (MNHESP) lists several dozen rare plant species that are known to have occurred in Boston. However, only two of these have been seen in the past 20 years. Most records in the MNHESP database are dated prior to 1920.

Given the long academic history of the Boston area, it is not surprising that the city's natural areas were well-traveled by knowledgeable botanists and naturalists during the 19th century and the city's flora well documented. Conversely, given today's inattention to urban areas by like-minded 20th century botanists and naturalists, it is conceivable that a handful of these species may still be hanging on in the city. Without a doubt the vast majority of rare plant species habitat is long gone in Boston, but isolated occurrences may still exist in a few locations.

Cultural Communities

As one of the oldest cities in the U.S., Boston has a very long tradition of agriculture and horticulture. At one time, the majority of what is now the city was comprised of farmland. Jamaica Plain, Mission Hill, Dorchester, Roxbury, and Hyde Park were all intensely farmed into the early 20th century, providing food and supplies to the burgeoning industrial and commercial center in central Boston.

Pieces of this still remain. Allandale Farm in West Roxbury and Brookline, is the lone remaining working farm in Boston.

The Arnold Arboretum, managed by Harvard University on land owned by the Parks Department, is a world-famous facility, with a collection of trees and shrubs from all over the world

It is planted with vegetables, fruit, hay, and cover crops that are sold at the farm's retail stand.

The Arnold Arboretum, managed by Harvard University on land owned by the Parks Department, is a world-famous facility, with a collection of trees and shrubs from all over the world. Its lilac collection is particularly renowned. The site also contains several expansive, naturalistic meadows and unmanicured woodlands that provide excellent wildlife habitat and give visitors a sense of the area's pastoral history.

FISH AND WILDLIFE

Approximately half of Boston's 7,100 acres of open space, about 3,500 acres, is comprised of land that provides important habitat for wildlife in one form or another. These areas are made up of reservations, beaches, urban wilds, portions of parklands, sections of the Boston Harbor Islands, campus areas, and privately owned land. The diversity of these areas and the correspondingly diverse plant communities found at each support an abundant collection of both native and non-native animals.

Fish

The city's most diverse habitat for fish is Boston Harbor. This is probably one of the few habitats in Boston that supports a generally native wildlife population. This is also a major recreational resource for sport fishing. The commercial aspect of fishing, though integrally tied to the historic economic development of Boston, is almost completely limited to charter boats and other activity supporting sport fishermen. The most significant fisheries in Boston Harbor are striped bass, winter flounder, cod, mackerel, bluefish, and monkfish. Other important species are pout, hake, dogfish, menhaden, and killifish. The recent clean up of Boston Harbor has greatly improved the habitat for all marine wildlife, though populations of several fish species are still imperiled by over-fishing and degraded habitats. Good access for onshore fishing is found at Castle Island, Long Island, Harbor Point and along the Dorchester and East Boston shorelines.

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Shellfishing was at one time a mainstay of Boston's economy for both European settlers and native peoples and remains an important cultural artifact of the city's maritime past. Unfortunately, Boston's shellfish beds have been officially closed for many years. Though abundant populations of clams, mussels, scallops, and to a lesser extent, oysters, are still found within Boston Harbor, water quality has still not improved to the level required for state officials to allow their consumption. With the proper license, however, shellfish can be harvested from Boston

Harbor at Carson Beach and the mudflats in Orient Heights Bay off Bayswater Street and taken to a shellfish purification facility.

Sport fishing also occurs on several of Boston's rivers and ponds such as Scarborough Pond, Chandler Pond, Turtle Pond, the Charles River, and most notably Jamaica Pond. The Commonwealth stocks Jamaica Pond with hatchery-raised trout and smallmouth bass. Native species found in Boston's ponds include golden shiner, bluegills, pumpkinseed, chain pickerel, and American eel. These populations have suffered from generally poor water quality throughout the city and the introduction of non-native species, such as carp, bass, trout, and goldfish.

The Charles River still supports seasonal migrations of some anadramous fish (species that generally live in salt water and return to freshwater for breeding), most notably Atlantic herring and American shad. Herring runs also occur in the spring up the Muddy River to Leverett Pond.

One state-listed rare species of fish occurs in Boston, the three-spined stickleback. This small, inconspicuous fish lives in a small pool in Olmsted Park. The species occurs commonly in marine habitats, but freshwater populations are rare in New England. The Boston population is the southern-most freshwater occurrence and the only one in Massachusetts. The population is monitored regularly by researchers from Harvard University and appears stable. Efforts must be made by Boston Parks, the MDC, and the Town of Brookline to ensure the viability of this species at this location.

Birds

During the course of one calendar year, more than 200 species of birds can be seen within Boston. This great avian diversity stems from Boston's location on the Atlantic Flyway migration corridor and the diverse collection of habitats found within the city limits. Boston Harbor and its associated estuaries, salt marshes, beaches, and mud flats support numerous species of waterfowl, shorebirds, and seabirds. Forested areas and wetlands are home to a wealth of resident songbirds and dozens of species of neotropical migrants in the spring and fall. Meadows and other open areas attract raptors and owls.

During the course of one calendar year, more than 200 species of birds can be seen within Boston.

Birdwatching is an increasingly popular recreational activity in urban areas, as more people discover the great array of birds found even in the midst of extensive development. In the Back Bay Fens area of the Emerald Necklace alone, over 170 species of birds have been documented by local birders, all within the shadows of Fenway Park and the Hancock Tower.

Other important (and well-documented) habitat areas for birds are the Arnold Arboretum, the Belle Isle Reservation, Franklin Park, and the Stony Brook Reservation.

The Massachusetts Natural Heritage Program lists six species of rare birds that have nested in Boston: Vesper Sparrow, Common Tern, Least Tern, Barn Owl, Peregrine Falcon, and Upland Sandpiper. Several of these records, however, have not been updated in many years and it is currently unclear exactly which species still occur in the city. In addition, several state-listed rare species, such as pied-billed grebe and piping plover, have occurred in towns adjacent to Boston and could just as easily nest within the city boundaries. Though not listed by the state as a rare species, wild turkeys have returned to the city after an absence of many years. In addition, several Boston Harbor Islands host nesting colonies of egrets and herons. Given the colonial and sensitive nesting habits of these birds, these rookeries are of great regional significance.

The city also contains significant wintering habitat for several important bird species. The most famous examples of this are the snowy owls and other birds of prey that spend most winters along the runways at Logan Airport. This phenomenon has been well documented by researchers at the Massachusetts Audubon Society with the cooperation of Massport.

Release of swans, Jamaica Pond Park

Several species of birds, both native and non-native, have recently grown in population size to be considered public nuisances. The common pigeon, for example, was developed from the European rock dove and introduced into this country as a domesticated bird, but many of these birds escaped and formed feral populations. Today the pigeon is always found in association with human habitations and almost universally regarded as a serious pest.

Other non-native bird species, such as the house sparrow, European starling, and house finch, are also abundant in Boston and wreak havoc among populations of native birds. People introduced all of these species to North America. These non-native species have grown to a population size where they outcompete native species for food, nesting sites, and other resources. Canada geese and American crow, both native species, have also experienced recent population explosions, causing a variety of problems among other native bird populations.

Mammals

Like the rest of eastern Massachusetts, Boston is experiencing rapid and dramatic changes to its resident wild mammal population. A combination of factors – explosive residential development in the suburbs, intentional and inadvertent creation of forested wildlife corridors, and the continued habituation of animals to human activity, among others – has caused the sighting of species traditionally associated with remote wilderness areas to be an increasingly common occurrence within the city.

White-tailed deer, rarely seen within the Route 128 beltway only 15 years ago, are now year-round residents in Boston. They and signs of their presence – tracks, scat, antler rubbings, and browse – are frequently seen in Franklin Park, the Arnold Arboretum, Allandale Woods, and near Millennium Park, among other locations. As this becomes more common, concern will develop over the possible impacts deer may have on public and private lands and public safety. Shrubbery browsed by deer, the perceived increase in Lyme Disease, and the potential for deer-car collisions all contribute to the public's eventual intolerance for large populations of deer in dense residential areas. Coyotes have also made a dramatic comeback to eastern Massachusetts, after being almost completely extirpated by a government-sponsored eradication program during the 19th century. Coyote sightings are now commonplace throughout the state. In 1999, a family of coyotes, numbering up to ten individuals, summered in Mission Hill. This occurrence will likely be repeated in other neighborhoods in the future.

Small mammals adaptable to humans and human settlements, such as raccoons, possum, striped skunk, and cottontail rabbits, abound throughout the city

Small mammals adaptable to humans and human settlements, such as raccoons, possum, striped skunk, and cottontail rabbits, abound throughout the city, in both developed and undeveloped areas. Less conspicuous mammals, such as mice, voles, shrews, and moles, though rarely seen, are also common in natural habitats.

Reptiles and amphibians, commonly grouped as herpetiles, are Boston's most imperiled group of animals, and their presence and species composition are frequently used as ecological indicators to gauge the overall health of an ecosystem. Common Massachusetts species found in Boston include green frog, bullfrog, painted turtle, red-eared slider (non-native), snapping turtle, garter snake, red-backed salamander, and two-lined salamander. Though these species are common elsewhere, their occurrence in Boston is sporadic at best, with only scattered records existing in a few neighborhoods. In addition, two state-listed rare herpetiles occur in West Roxbury. Common Massachusetts species that should occur in Boston but have not been recently documented include milk snake, black racer, Northern-water snake, ribbon snake, American toad, wood frog, and spring peeper. Significant herpetile habitats are found in the Stony Brook Reservation, the Brook Farm Reservation/Millennium Park area, and Allandale Woods.

Insects and other invertebrates are also commonly used indicators of ecosystem viability, particularly for aquatic ecosystems. Preliminary studies of benthic macroinvertebrates conducted by the Parks Department at Chandler Pond, Scarborough Pond, Wards Pond, Willow Pond, and the Muddy River have shown very low species diversity, thereby confirming the poor water quality of these water bodies.

SCENIC RESOURCES & UNIQUE AREAS

Scenic Landscapes

Boston has many scenic and significant landscapes that define the city's character. The most extensive landscape type is the waterfront. Whether along Dorchester Bay, the Inner Harbor, Belle Isle Inlet, the Mystic, or the Chelsea, saltwater-oriented landscapes form much of the basis for Boston's attractiveness. Freshwater-oriented landscapes, such as the Neponset, the Mother Brook, Bussey Brook, Scarborough Pond, and Chandler Pond also have great scenic charm. The two most notable scenic landscapes based on fresh water are the Charles River Reservation and the Emerald Necklace. In the midst of a densely developed urban area, these green corridors provide a visual and recreational respite. As envisioned by Frederick Law Olmsted and Charles Eliot, the views they afford, and the opportunity to stroll away from streets and through naturalized and recreational landscapes, provide relief from the hectic pace of urban life.

Some new parklands developed on former landfills provide scenic landscapes themselves as well as provide the opportunity for viewing scenic vistas from them. Pope John Paul II Park along the Neponset in southern Dorchester provides views of the Neponset Estuary, including extensive estuarine wetlands. Millennium Park in West Roxbury forms a prominent hill along the banks of the Charles, a unique landform in the valley of a mature, meandering river. It provides vistas, especially to the west, that some have said are more typical of views from hilltops in rural Central Massachusetts. Of course, the exception is the view to the northeast, which shows the top of the glass Hancock Tower peeking over a wooded skyline.

Geologic Features

Geologic features are often described elsewhere in this appendix. The one geologic feature most appropriate for discussion in this particular section is Roxbury Conglomerate, also known as Roxbury Puddingstone. This particular bedrock unit is unique to the Boston Basin, yet quite prevalent within the Basin. Its presence as a rock outcrop is seen occasionally in parts of the city, oftentimes because of the expense of blasting it to provide

room for development. It forms a prominent feature in some parks and natural areas/urban wilds, such as Franklin Park, Allandale Woods, Hancock Woods, and Stony Brook Reservation. Such outcrops are natural play areas for children, who love to climb them.

Cultural and Historic Areas

Boston has numerous properties designated as historically significant as well as entire districts so designated. Much of the Emerald Necklace is so designated as well as several other parks. The protection of such cultural and historical resources has become city policy and a facet of our character and our strategy for redevelopment of neighborhoods, commercial areas, and parklands. A map has been included in this plan that shows the extensive designation of districts and sites throughout the city. These designations offer some degree of protection with a review process if federal or state monies, approvals, or licenses are required. Preservation of these areas not only protects the cultural heritage of Boston, but also maintains the visual character of the city.

Areas of Critical Environmental Concern (ACECs)

The Massachusetts Department of Environmental Management (DEM) administers the Area of Environmental Concern (ACEC) program in order to identify, inventory, and ensure careful stewardship of the Commonwealth's outstanding natural resource areas. The City of Boston contains portions of three ACECs – Rumney Marshes, Neponset Estuary, and Fowl Meadow/Ponkapoag Bog.

The Rumney Marshes

According to DEM's Office of Natural Resources, the U.S. Fish and Wildlife Service has characterized the Rumney Marsh ACEC as one of the most biologically significant estuaries in the state. The area includes approximately 1,000 acres of highly productive salt marsh, tidal flats, and shallow channels. The Belle Isle Marsh in East Boston is wholly included in the Rumney Marsh ACEC and is comprised of 275 acres of salt marsh, salt meadow, and tidal flats, providing critical wildlife habitat, flood storage, and water quality improvement functions. All of the Belle Isle Marsh is publicly owned by the Metropolitan District Commission, except for small parcels owned by the Town of Winthrop and the City of Boston-owned Belle Isle Fish Company Urban Wild.

The Neponset Estuary

The Neponset Estuary ACEC extends from the mouth of the Neponset River to the Lower Mills Dam, which separates the tidal and freshwater sections of the river. About 435 acres of the 1,260-acre ACEC are located in Boston with the remainder

located in Milton and Quincy. The Neponset Estuary provides valuable habitat for anadramous fish species, including smelt and blueback herring. Most of the open space along the Boston side of the estuary is owned by the MDC, providing a variety of public open space and recreational opportunities. The MDC's Lower Neponset River Reservation Master Plan provides a vision for the long-term development of these properties.

The Fowl Meadow/Ponkapoag Bog

The Fowl Meadow/Ponkapoag Bog ACEC is also located along the Neponset River, from the Readville section of Hyde Park and through the towns of Canton, Dedham, Milton, Norwood, Randolph, Sharon, and Westwood. Large areas of the 8,350-acre ACEC are part of the MDC's Blue Hills Reservation. This ACEC protects habitat for at least 13 rare species, several aquifers and public water supplies, floodplains, and wetlands associated with the Neponset and its tributaries. In Boston, Sprague Pond and the City-owned Sprague Pond Access Urban Wild are located within the ACEC.

ENVIRONMENTAL CONSTRAINTS

Boston's intense land use can pose threats to several different components of the environment. Most reflective of an environment's health is its water quality. Threats to water quality include hazardous waste sites, landfills, and sewer discharges. While these factors threaten water quality, water itself poses a threat to the landscape. Flooding, erosion, and sedimentation threaten both the constructed and natural landscapes of Boston. Recognizing and planning for these different threats is essential for the protection of both Boston's and the region's environment.

Hazardous Waste Sites

As of June 1997 there were 129 Tier I hazardous waste sites in the City of Boston. This figure represents a snapshot of conditions at a particular time. This is due to the nature of identifying hazardous waste sites. It is important to understand what a hazardous waste site is and the threats it may impose to the environment.

A hazardous waste site is an area in which a hazardous substance has been released into the ground. The most common hazardous waste released is petroleum-based. Therefore, the most common hazardous waste site is one that has a land use associated with motor vehicles. This may be a gas station, service garage, or junkyard. Leaking underground tanks are responsible for a substantial amount of contaminated sites. These tanks commonly hold fuel oil for homes and businesses, or gasoline for service stations. Other typical locations of hazardous waste include dry cleaners, which use harsh chemicals, and industrial land uses which use various chemicals in manufacturing or processing.

A hazardous waste site is an area in which a hazardous substance has been released into the ground.

Once released into the ground, pollutants may migrate towards ground and surface water resources. If the contaminated soil is exposed to the air (not covered by concrete or asphalt) the pollutant may vaporize causing unusual odors and harmful vapors. Physical contact with contaminated soil may cause skin irritation. Because of these threats to human health and the environment, remediation or cleansing of contaminated soils is necessary.

The Commonwealth's Department of Environmental Protection (DEP) is responsible for enforcing laws that require remediation of contaminated sites (primarily MGL Chapter 21E, aka the Massachusetts Contingency Plan or MCP). Sites that are considered to be of highest priority for clean up are designated as Tier I. Default Tier IB sites are sites where contamination has occurred, yet the property owner has failed to meet a significant DEP imposed deadline. Many of the hazardous waste sites in the city (124) are default Tier IB sites. This indicates that the level of contamination has not yet been determined for many of these sites. Therefore, many of these sites may not be seriously contaminated, making remediation a financially feasible possibility for the restoring and reusing of many sites across the city.

Landfills

Boston has several areas that have operated as landfills, dumps, or waste transfer stations. Boston does not currently have an active landfill. Former landfills include Spectacle Island and Gardner Street landfills. Both landfills have undergone a capping and reuse process that has resulted in both the safe containment of waste and the production of open space.

Millennium Park, West Roxbury

The Gardner Street landfill was Boston's most recently active landfill. The landfill's 75-acre site was located on the banks of the Charles River in West Roxbury. The landfill's operation began in the 1930's, at which point it received residential and commercial wastes, as well as incinerator ash. The landfill operated as an open dump with continuously burning fires until 1954 when it began operation as a sanitary landfill. The landfill was closed in 1980 but not capped. In an uncapped state, the landfill had contaminated surface runoff and groundwater flow, posing a threat to the water quality of the nearby Charles River and its associated wetlands and groundwater resources. In 1997, capping began with excess material from the Central Artery Project. The capping process involved relocating waste from perimeter locations in an attempt to contain the waste. Capping was accomplished by covering waste with a geotextile (plastic) layer and a layer of clay. With the completion of the capping project, the construction of a major 105-acre park – Millennium Park – began. Dedicated in 2000, this new park

Spectacle Island

under Parks Department jurisdiction, features several athletic fields, passive recreation areas, a canoe/kayak launch on the Charles River, six miles of paths, and nature study areas.

The Spectacle Island landfill, active until the 1950s, was located on Spectacle Island in the Boston Harbor. In an uncapped state, the dump presented a threat to water quality in the Boston Harbor due to its close proximity to the water. Capping of this landfill was completed with material from the Central Artery Project. This capping prevents contaminated runoff and infiltration from rainfall. Upon completion of the landfill, 105 acres of primarily passive parkland, a major attraction within the Boston Harbor Islands National Recreation Area, was then created. Upon completion of the visitor's center, the park will open to the public, which is currently projected to be late spring of 2003. The state Department of Environmental Management and the Boston Parks Department will jointly manage this new park.

Another capped landfill that now contributes to Boston's usable open space is the Hallet Street Landfill. Owned by the MDC, the landfill, totaling 57 acres together with the abutting Neponset Drive-In site, had been a largely vacant site located east of the Southeast Expressway along the Neponset River. It is included in the Lower Neponset River Reservation, which was the subject of a Master Plan prepared in the mid-1990s. With the support of state legislative action, the Metropolitan District Commission has closed and capped the landfill, and developed a new park over it, called Pope John Paul II Park. This park opened in 2000 with active and passive features as well as improvements for better access to the water for Bostonians and other visitors.

Erosion/Sedimentation

Pavement or structures cover a large percentage of Boston's surface area. This, in combination with an extensive stormwater drain system, minimizes most land erosion, yet also contributes to localized erosion problems both by increasing surface run-off volume and speed, and by concentrating flows at specific discharge points. Channelized streams and ocean walls, with varying results, have historically controlled erosion along the city's waterways. Erosion also occurs in areas that are undeveloped and not served by storm drains. In association with chronic erosion and uncontrolled run-off in Boston's open spaces, deposition of sediments has posed a threat to areas such as the Back Bay Fens and Muddy River system. The Muddy River is an area of intensive sedimentation within Boston (and Brookline). Large deposits of sediments are concentrated along the Riverway and Back Bay Fens sections of the Muddy River. The Muddy receives a large volume of inorganic sediment from storm runoff. This runoff is caused by the intense urbanization within the river's drainage basin. Urbanization is associated

with impervious surfaces that speed the delivery of water to the river channel and result in larger and quicker peak flows. These increased peak flows transport large sediment loads that are dumped upon reaching low energy environments (i.e., slower moving waters contained in broader, shallower channels) such as the Muddy River.

Construction of the Charles River Dam in 1910 prevented tidal flow into the Muddy therefore decreasing salinity and preventing flushing of river sediment. This river sediment has remained along the Muddy's banks, creating point bars that contribute to the proliferation of the non-native, invasive *Phragmites australis,* giant reed. Phragmites is a very tall freshwater grass species, with robust, hollow stems and dense, tasselling flower heads. These plants can be seen flourishing – up to 20 feet tall – along the banks of the Muddy. Phragmites contributes to sedimentation of the river by trapping sediment, which then further encourages Phragmites growth. While the Phragmites trap sediment, pollutants chemically bound to the sediment seriously degrade water quality in the river. Pollutants found in sediment include trace metals, inorganic nutrients, and organic compounds.

Phragmites can be seen flourishing – up to 20 feet tall – along the banks of the Muddy River.

Flooding

Boston is served by an extensive stormwater drainage system of dams, berms, and seawalls that are designed to prevent flooding. Recent major storms in 1996 and 1998, however, caused substantial flooding in the Fenway/Kenmore and Roslindale neighborhoods.

Flooding in Fenway/Kenmore is a result of flooding in the Muddy River system. High water levels of the Muddy River occur as a result of intense surface runoff, high water levels in the Charles River, and the nearly level gradient of the Muddy River in the Fenway area. These high water levels impede discharge from the Stony Brook Conduit, thus causing the Stony Brook Conduit to surcharge. The conduit carries stormwater, brookflows, and combined sewage from West Roxbury, Hyde Park, Roslindale, Jamaica Plain, and Roxbury. It has overflowed at two manholes on Park Street, the lowest area of elevation along the conduit. Recent flooding was concentrated in the Northeastern University and Kilmarnock Street areas of the Fenway neighborhood.

Recent flooding has also occurred in the Archdale Road area of Roslindale. In this area of Boston, storm drains and sanitary sewers are separated. Therefore, sewer lines are directed to treatment facilities while storm drains discharge directly to waterways. During this period of heavy rainfall however, surface runoff and groundwater infiltrated the sanitary sewer system. The amount of water flowing into the sanitary sewers exceeded capacity and resulted in surcharging of the sanitary

sewer system. This overflow of combined stormwater and sewage then discharged into basements and though manholes and onto streets. Flooding in the Archdale Road area was encouraged by low depth of cover over the sewers in low-lying areas and high groundwater levels.

To prevent recurrence of this flooding, the Massachusetts Water Resources Authority (MWRA), and the Boston Water and Sewer Commission (BWSC) have developed a plan of corrective action. This plan includes the removal of stormwater from sanitary sewer systems, the construction of a relief point that would drain high stormwater levels directly into rivers and streams that have capacity, and the optimization of drainage system capacity, which includes improving cleaning and maintenance of drainage systems.

Sewage Discharge

Approximately 380 million gallons of effluent (treated sewage) are released into Massachusetts Bay each day. Sewage from Boston and outlying communities is treated by the MWRA at the Deer Island Sewage Treatment Plant. The volume discharged is roughly equivalent to the combined flow of the Charles, Mystic, and Neponset Rivers. The Deer Island treatment facility now also treats sewage that is pumped under the Harbor from the former Nut Island treatment plant in Quincy. The Deer Island treatment plant is the second largest in the nation. It uses two phases of treatment, primary and secondary. Primary treatment separates the sewage by allowing sludge (primarily human waste) to settle from the water. Secondary treatment uses microorganisms to consume the remaining human waste and toxic chemicals. The effluent is then disinfected with chlorine and is 90% free of human waste and 70% free of toxic chemicals. It is released from the facility via a 9.5-mile 24-foot diameter deep rock tunnel. At its end, the tunnel diffuses the effluent into Massachusetts Bay where ocean currents mix and further dilute the effluent. This largely minimizes the impact of treated wastewater on Boston Harbor.

The most prominent point source pollution in Boston is discharge from combined sewer overflow systems (CSOs). Combined sewer overflow systems collect both sewage and surface water runoff from rainfall and snowmelt. During wet weather conditions, surface runoff causes sewer lines to overload. To prevent this overload from backing up into streets or basements, designated overflow discharge points are located along Boston Harbor, and the Charles and Muddy Rivers. Due to the various sources of CSO discharges, many pollutants may be present. These pollutants include fecal coliform bacteria, suspended solids, nutrients, metals, and floatable material. Discharges containing such pollutants create potential health impacts near areas such as swimming beaches and shellfish beds.

Substantial efforts have been made by the Massachusetts Water Resources Authority (MWRA) to reduce CSO discharge. This includes expansion of the Deer Island Treatment Plant that treats 89% of total overflow during an average rainfall year. An additional 6% of that overflow is treated by CSO treatment facilities that provide screening and disinfection of overflows. This accounts for treatment of 95% of discharges. Upon completion of further CSO improvements, the MWRA expects to treat 99.6% of overflows from combined sewer systems.

Although classified as SB waters, which are safe for swimming and fishing, inner harbor water is not recommended for these uses.

Water Quality

Water quality data is available for Boston's larger water systems. These water systems include Boston Harbor, the Charles River, the Neponset River, and the Muddy River. Water quality data primarily used for this plan was obtained from a 1994 "Baseline Water Quality Assessment" report produced for the Massachusetts Water Resource Authority. Where noted, more recent information was provided.

Inner Harbor

The Inner Boston Harbor consists of the Chelsea Creek and Mystic River Confluence, the Upper Inner Harbor, Fort Point Channel, the Lower Inner Harbor, and the Reserved Channel. Water of the Inner Harbor is high in pollutants including bacteria, solids and floatables, oil and grease, bottom pollutants, nutrients, and toxic materials. Although classified as SB waters, which are safe for swimming and fishing, inner harbor water is not recommended for these uses, as it is in non-attainment due to pollutants. These pollutants are attributed to sources such as CSOs, stormwater, shipping, industrial waste, and industrial cooling waters. The water of the Harbor has consistently violated water quality standards for bacteria levels. Dissolved oxygen (DO) levels below the Amelia Earhart Dam have been among the lowest in the Harbor and may be attributed to high bacteria and nutrient levels. Oil, debris, and sewage are discharged from CSOs during both dry and wet weather conditions. Large debris has been observed during wet weather conditions, and can cause substantial odors and adverse impacts on the color and turbidity of Harbor waters. This suggests a source of bacteria and nutrients. Petroleum-derived pollutants such as oil and grease may originate from the Chelsea Creek Oil Terminal area. Industrial land uses along the Upper Inner Harbor are most likely a source of bottom pollutants. Pollutants found in the bottom sediments of the Chelsea Creek and Mystic River Confluence include arsenic, chromium, copper, lead, mercury, nickel, and zinc that are carried by stormwater.

During 1998, beach closings based on testing for bacterial density (especially for fecal coliform) have shown an improvement for most of the beaches on Dorchester Bay.

Pleasure Bay

Dorchester Bay

Water quality in Dorchester Bay, which includes North and South Dorchester Bay, is affected primarily by CSO and stormwater discharges into the bay. Water quality differs significantly from north to south with North Dorchester Bay having better water quality than South Dorchester Bay. Combined sewer overflow (CSO) discharges have caused non-attainment of waters classified as SB, which are listed as swimmable and fishable. Bacteria counts, although slightly elevated during wet weather conditions, meet class SB water quality standards in North Dorchester Bay. Both Carson Beach and Pleasure Bay have lower counts than Savin Hill Cove, Tenean Beach, and South Dorchester Bay. This may be attributable to pollutants from the Neponset River, which discharges to South Dorchester Bay. Discharges from CSOs in South Dorchester Bay have resulted in pollutants such as sewage, debris, oil, and grease. Dorchester Bay sediments have tested high in bacterial bottom pollutants. This may be attributed to past sludge discharges. Nutrient levels of Dorchester Bay were tested and classified between healthy and poor. Bacterial and nutrient levels posed a fair to moderate risk to aquatic life and a moderate to high risk for swimmers in South Dorchester Bay.

During 1998, beach closings based on testing for bacterial density (especially for fecal coliform) have shown an improvement for most of the beaches on Dorchester Bay. This is likely due to the 1997 start-up of secondary treatment at Deer Island and the 1998 closing of the Nut Island primary treatment plant. However, the same general gradient of poorer water quality for swimming occurring as one proceeds from north to south along Dorchester Bay is borne out again by the 1998 data: Pleasure Bay Beach, 2 exceedances of bacterial standards during 1998; Carson Beach, 8 exceedances; Malibu Beach, 10 exceedances; Savin Hill Beach, 14 exceedances, and Tenean Beach, 38 exceedances.

The Boston Water and Sewer Commission has been undertaking a large sewer separation project throughout Dorchester to eliminate sewage discharges via CSOs to Dorchester Bay. The Bay's water quality will thus improve significantly over time, enabling further public confidence in swimming and fishing there.

The MWRA is also working to reduce untreated CSO discharges to the South Boston beaches areas. However, community concerns in South Boston have delayed further work. The MWRA is currently undertaking a reevaluation process to determine the best method and location for addressing CSO discharges in this area.

Outer Harbor

Water quality for Outer Boston Harbor and the Harbor Islands within the city limits of Boston typically meets water quality standards for bacterial contamination. Both bacteriological and sediment quality have been characterized as good quality. This is most likely attributed to few stormwater and CSO outfalls in the vicinity.

Charles River

Charles River water quality data includes data for both the Watertown Dam to the Boston University Bridge stretch of the Charles and the stretch from the Boston University Bridge to the Charles River Dam (the latter stretch aka Charles River Basin). Several different pollutants compromise the water quality of the Charles River. These pollutants include bacteria/ pathogens, nutrients, oil & grease, and metals.

It is believed that stormwater and combined sewer overflows (CSOs) as well as upstream sources from above the Watertown Dam are responsible for most of the pollution in the Charles River. High bacteria counts are present in both wet and dry conditions suggesting a dry weather source such as illegal connections to stormdrains or leaking sewers. Combined sewer overflows (CSOs) would be a likely wet weather source. High bacteria levels are considered to be of high risk to sailboarders and boaters who have contact with the water. Powerboats and marinas are a possible source of oil and grease, although these pollutants are commonly observed in wet conditions and therefore may be attributed to CSO discharge. Dissolved oxygen (DO) levels, which should be relatively high in a healthy water body, are low in the bottom waters of the Charles. This may be attributed to salt enrichment of the river bottom sediments, as surface waters do possess healthy DO levels. High BOD (Biological Oxygen Demand) levels because of discharge from the Cottage Farm CSO have also been shown to decrease dissolved oxygen levels of the Charles. As high levels of nutrients, especially phosphorus, are associated with algal blooms and eutrophic conditions, these pollutants affect passive recreation as they produce offensive odors and reduce DO needed for more desirable wildlife and recreational fisheries. Toxic pollutants in the Charles are typically metals such as copper and lead that affect aquatic life and fishing. Solids and floatables are present in the river following rain; this is attributed to debris from storm drains and CSOs.

Charles River

The water quality picture for the Charles has in recent years become less grim than in 1994. This is thanks to a concerted set of measures by various parties, such as the U.S. Environmental Protection Agency (EPA), the MWRA, the BWSC, the Charles River Watershed Association, and other municipal agencies in the watershed. In fact, according to the EPA, the Charles has

gone from a water quality grade of "D" to one of "B." This "B" grade means that while the Charles generally meets water quality standards for boating and swimming in dry weather, it generally fails to do so in wet weather and shortly afterwards. Fecal coliform contamination appears to result from several sources: 70% of wet weather fecal coliform is contributed by Stony Brook and the Muddy River; Laundry Brook in Newton and Faneuil Brook in Brighton are the source for 10%; water flowing over the Watertown Dam contributes another 10%; and many smaller streams and storm drains along the entire river account for the remaining 10%.

The BWSC Stony Brook sewer separation project will add about 75,000 feet of new storm drains to enable parts of Roxbury and Jamaica Plain to send all sanitary flows to Deer Island in a typical year. The BWSC expects to complete the project by 2006.

Treated CSO discharges have gone down from 1.5 billion gallons per year in 1988 to 75 million gallons per year in 2001, while 2006 conditions are projected at 27 million gallons per year. Untreated CSO discharges are at 58 million gallons per year in 2000, but the forecast for 2006 is 0 untreated CSO discharges in a typical year.

Public education to keep ... pet and wildlife waste from entering the Charles has started to become an important strategy toward improving the Charles' water and recreation quality [according to a 2001 US EPA report].

Figures from an April 2001 EPA report shows that while bacterial standards for boating were met 92% of the time overall, they were met only 59% of the time overall for swimming. This low percentage was primarily due to wet weather discharges, as bacterial standards for swimming were met 82% of the time during dry weather, but only 46% of the time during wet weather. The report further noted progress had occurred in eliminating impacts of illicit connections and CSOs and further progress was anticipated. The report suggested that the more significant future frontiers in water quality improvement for the Charles would be in municipal stormwater management and changing the public's behavior as each individual action impacts the watershed and the main stem, the Charles itself. Public education to keep fertilizers, automotive care products, household hazardous wastes, excessive runoff, and – particularly for bacterial contamination reduction – pet and wildlife waste from entering the Charles has started to become an important strategy toward improving the Charles' water and recreation quality.

One major accomplishment for Charles River water and recreation quality was the capping of the Gardner Street landfill in West Roxbury and the construction of a multi-purpose park above the cap (Millennium Park). The capping prevents rainwater from percolating into the hazardous materials in the landfill and then draining into the groundwater and toward the Charles River and Sawmill Brook, a tributary. Instead, the impermeable barrier forces runoff into retention basins, preventing excessive runoff and erosion during storm events (and

possible downstream flooding), and allowing for sediment settling and a cleaner flow to the Charles. The parkland includes a handicapped accessible canoe/kayak launch, encouraging recreational use of the Charles.

Such recreational use of surface waters promotes watershed awareness, a necessary component to help change the public's behavior toward best management practices at the individual level. Such individual practices include cleaning up pet waste, discouraging feeding of waterfowl, and proper disposal of waste motor oil and household hazardous wastes.

Orient Heights Bay

Constitution Beach receives pollution from combined sewage overflows and stormwater discharges. A considerable amount of this discharge is accounted for by stormwater discharge from Logan Airport. This pollution accounts for slightly elevated bacteria levels and high bottom pollutant levels. High bottom count levels have caused non-attainment for this class SB designated water body, which should be safe for swimming and fishing. High bacteria levels during wet weather prohibit swimming during those conditions. In 1998, there were 17 exceedances of bacterial standards for swimming at Constitution Beach. Other pollutants common to the Boston Harbor are not found in Orient Heights Bay.

Muddy River

The Muddy River is polluted from such sources as CSOs and storm drains that release high volumes of sediment, oil, and sewage from illegal connections. Oil spills and leaky underground tanks have contributed to pollution of the Muddy River. Although the Muddy River watershed is served by a separated sewer system, numerous cross-connections have resulted in the discharge of waste into the river. The Stony Brook Conduit (SBC), which serves the Stony Brook watershed, discharges to the Charles River, but occasionally contributes combined sewer overflows to the Back Bay Fens (part of the Muddy River) at Boston Gatehouse No. 1. This CSO includes stormwater and sewage, the latter contributing a high bacterial content. Bacterial levels exceed Class B levels (fishable and swimmable), for which the Muddy is designated, and result in non-attainment. Dissolved oxygen in the Muddy is very low, accompanied by high nutrient levels and excessive algae growth. Invasive vegetation (Phragmites) has contributed to sedimentation and the reduction of native vegetation. This has literally choked the river, which already experiences minimal flow due to an extremely low gradient in downstream sections. Concentrations of cadmium, copper, mercury, lead, and zinc have been found at excessive, highly contaminated levels.

Boston Gatehouse No. 1 contains four sluice gates designed to regulate discharges to the Fens from the SBC. During dry weather and smaller storm events, the closed gates in Boston Gatehouse No. 1 divert the flows from the SBC away from the Muddy River to the Charles River via the MWRA's Charlesgate East Gatehouse. During very large storm events it is possible for flows from the SBC to overtop the gates in Gatehouse No. 1 and discharge into the Back Bay Fens. However, for the last few years BWSC staff have been opening one of the gates in Gatehouse No. 1 whenever heavy rainfall is forecast (about 4 or 5 times a year) to allow discharges through the gate to the Fens to provide hydraulic relief for the Stony Brook system.

Boston Gatehouse No. 2, which is located approximately thirty feet northeast of Gatehouse No. 1, contains three inoperable sluice gates that are kept in the closed position. Flows from the Old Stony Brook Conduit (OSBC) pass by the Gatehouse and on to the Boston Marginal Conduit and the MWRA's Prison Point CSO Facility. The MWRA's Prison Point CSO Facility pumps dry weather flows to the Deer Island Wastewater Treatment Facility and wet weather flows to the Charles River. The wet weather flows are screened and disinfected before being discharged.

The BWSC will replace three of the gates and gate actuators in Gatehouse No. 1, and the fourth gate will be sealed in place. All three gates in Gatehouse No. 2 will be sealed in place, since their operation is not necessary. Restoration of the surrounding landscape and the Gatehouse buildings, in keeping with their historical and architectural significance, will be part of the project.

The BWSC is currently in the process of cleaning the SBC. This cleaning will reduce the frequency of flooding from significant rainfall events by restoring the hydraulic capacity and providing additional in-system capacity. The cleaning project began in 2001 and is expected to be complete in December 2002.

Separation of all the combined sewers in the areas tributary to the SBC will reduce the volume and frequency of CSO discharges to the SBC. Unless the gates at Gatehouse No. 1 are open, the wet weather flows from the SBC are conveyed to the Charles River. The Water and Sewer Commission began sewer separation in the SBC system in 2000, and expects to complete this program in 2006.

The upper reaches of the SBC, an area of about 6,000 acres, is served by separated sanitary sewers and storm drains. In January 1999, BWSC began a program to identify illegal sanitary sewer connections to storm drains in the separated areas of the SBC. Elimination of the illegal connections to the separated portions of the SBC will improve the quality of the dry weather discharges to the Charles River. (The SBC does not discharge to

Neponset River with Greenway Trail

the Fens Pond during dry weather.) The Water and Sewer Commission expects to complete this program in 2002.

The Parks Department with the Town of Brookline has proposed a comprehensive program of improvements that will address the Muddy River's water quality. This project is fully discussed in Part 3, in both the Fenway/Kenmore and Jamaica Plain chapters, and in Part 4, in the Emerald Necklace chapter.

Neponset River

The Neponset River has been polluted by upstream sources such as storm drains and CSOs. River water near CSOs and stormdrains below the Lower Mills Dam possesses lower bacterial counts than upstream water, thereby affirming the upstream source of contamination. Upstream counts of bacteria exceed Class SB standards (fishable and swimmable), for which the Neponset is designated. Sewage, debris, oil, and grease have been observed in minimal amounts in the Neponset. Nutrient levels in the Neponset are fair to poor. These high nutrient levels and the presence of oil and grease have a negative impact on aquatic life in the Neponset. Bacteria levels are high for boating in wet weather conditions, and high for swimming during both wet and dry weather conditions. Combined sewer overflows (CSOs) are now no longer a contributing factor to pollution of the Neponset, as the BWSC eliminated all CSOs to the Neponset River in Boston by 2000 through sewer separation.