Massachusetts
Wetland Resources

Wetlands cover about 11 percent of Massachusetts (Dahl, 1990) and are an important component of the State's water resources. Wetlands are valued and protected by the State for the environmental and economic benefits they provide, such as flood control, mitigation of storm damage, water-quality improvement, maintenance of ground-water supplies, wildlife habitat, and spawning and nursery habitat for many of the estuarine and marine fish and shellfish that support the State's sport-fishing and seafood industries (fig. 1). Most wetland functions are tied to the presence, movement, quality, and quantity of water in wetlands (Carter and others, 1979). For example, flood-plain wetlands along the Charles River provide natural storage and a reduction of floodwaters such that the least-cost solution to prevent future flooding was to acquire and protect the wetlands (U.S. Army Corps of Engineers, 1971). Massachusetts wetlands provide not only the functions and values for which they are protected by the State but other benefits such as scenic beauty and recreational opportunities. The benefits that Massachusetts' wetlands provide are a reflection of the diversity of the State's wetland resources.

TYPES AND DISTRIBUTION

Wetlands are lands transitional between terrestrial and deepwater habitats where the water table usually is at or near the land surface or the land is covered by shallow water (Cowardin and others, 1979). The distribution of wetlands and deepwater habitats in Massachusetts is shown in figure 2*A*; only wetlands are discussed herein.

Wetlands can be vegetated or nonvegetated and are classified on the basis of their hydrology, vegetation, and substrate. In this summary, wetlands are classified according to the system proposed by Cowardin and others (1979), which is used by the U.S. Fish and Wildlife Service (FWS) to map and inventory the Nation's wetlands. At the most general level of the classification system, wetlands are grouped into five ecological systems: Palustrine, Lacustrine, Riverine, Estuarine, and Marine. The Palustrine System includes only wetlands, whereas the other systems comprise wetlands and deepwater habitats. Wetlands of the systems that occur in Massachusetts are described below.

System	Wetland description
Palustrine	Nontidal and tidal-freshwater wetlands in which vegetation is predominantly trees (forested wetlands); shrubs (scrub-shrub wetlands); persistent or nonpersistent emergent, erect, rooted herbaceous plants (persistent- and nonpersistent-emergent wetlands); or submersed and (or) floating plants (aquatic beds). Also, intermittently to permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep.
Lacustrine	Nontidal and tidal-freshwater wetlands within an intermittently to permanently flooded lake or reservoir larger than 20 acres and (or) deeper than 6.6 feet. Vegetation, when present, is predominantly nonpersistent emergent plants (nonpersistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both.
Riverine	Nontidal and tidal-freshwater wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.
Estuarine	Tidal wetlands in low-wave-energy environments where the salinity of the water is greater than 0.5 part per thousand (ppt) and is variable owing to evaporation and the mixing of seawater and freshwater.
Marine	Tidal wetlands that are exposed to waves and currents of the open ocean and to water having a salinity greater than 30 ppt.

The most recent inventory of Massachusetts wetlands, performed during 1975–77 by the FWS National Wetlands Inventory Project, mapped about 590,000 acres of wetlands in the State (Tiner, 1992). According to Metzler and Tiner (1992), the maps are at least 95 percent accurate. Palustrine wetlands are the most common wetland type in the State, followed by estuarine and marine wetlands (fig. 2*B*); all together, they constitute about 99 percent, by area, of the State's wetlands. The combined area of lacustrine and riverine wetlands makes up the remaining less than 1 percent of wetland acreage. A description of Massachusetts' most common wetland types follows.

Palustrine wetlands.—Vegetated palustrine wetlands in Massachusetts include ponds and shallow lakes in which the dominant vegetation is floating or submersed (aquatic-bed wetlands); freshwater marshes, fens, and bogs dominated by herbaceous plants (emergent wetlands); and bogs and swamps dominated by shrubs or trees (scrub-shrub or forested wetlands). Vernal pools are small, seasonally flooded wetlands that occur throughout Massachusetts. Because most vernal pools dry up, they are devoid of fish and thus provide a safe breeding habitat for many amphibian and invertebrate species.

Palustrine forested wetlands constitute 56 percent of the State's wetlands (Tiner, 1992) and consist primarily of red maple swamps with some evergreen forested wetlands. Red maple grows in most inland wetlands because it tolerates a wide range of flooding and soil-saturation conditions (Metzler and Tiner, 1992). The vegetation found with red maple, in the understory and intermixed or codominating in the canopy, differs according to nutrient conditions and water regime. Atlantic white cedar wetlands, the most common

Figure 1. Namskaket Marsh on Cape Cod. This wetland is the site of U.S. Geological Survey studies that monitor the development and fate of a wastewater plume moving toward this tidal wetland. *(Photograph courtesy of Kelsey-Kennard Photographers, Chatham, Mass.)*

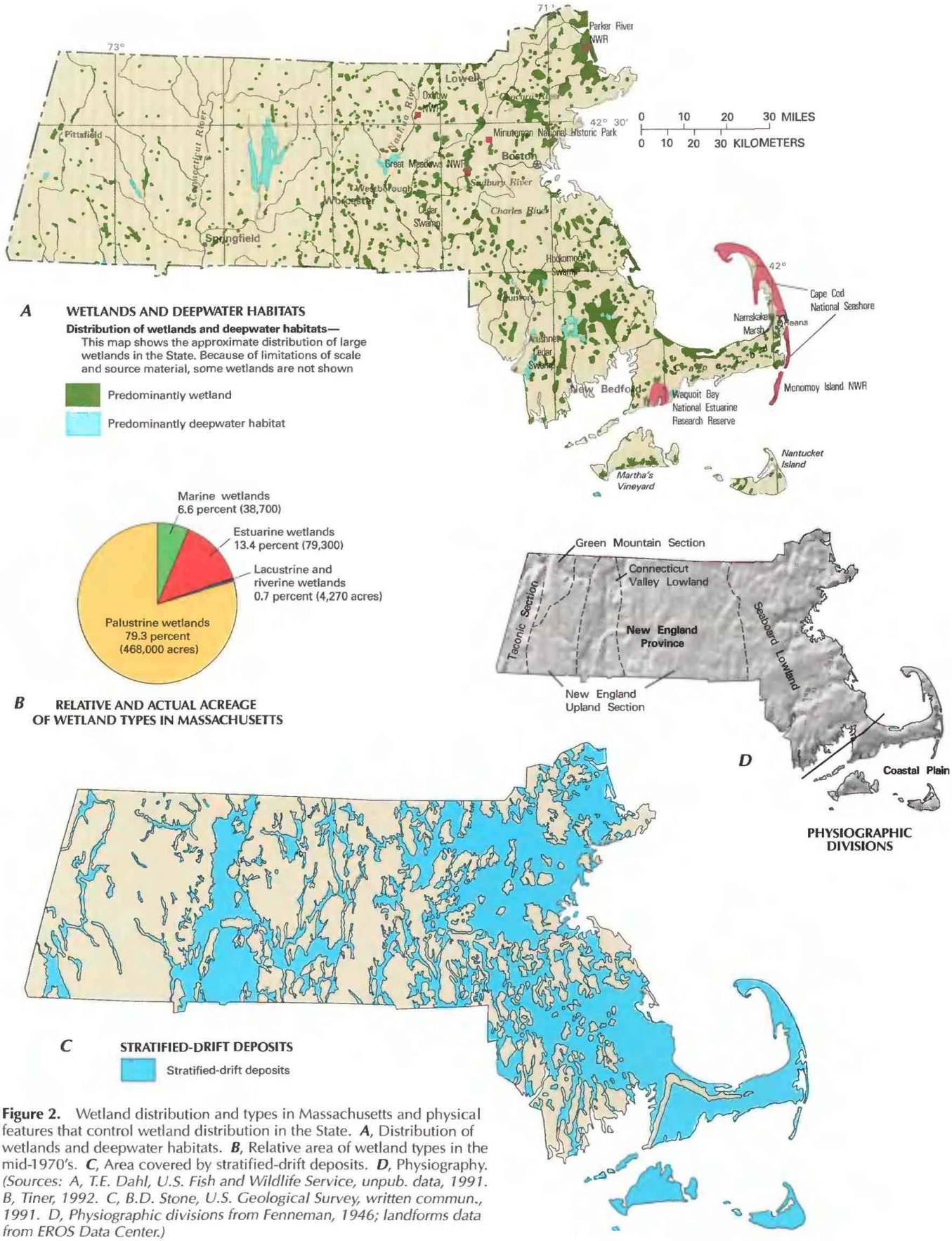

Figure 2. Wetland distribution and types in Massachusetts and physical features that control wetland distribution in the State. ***A***, Distribution of wetlands and deepwater habitats. ***B***, Relative area of wetland types in the mid-1970's. ***C***, Area covered by stratified-drift deposits. ***D***, Physiography. *(Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. B, Tiner, 1992. C, B.D. Stone, U.S. Geological Survey, written commun., 1991. D, Physiographic divisions from Fenneman, 1946; landforms data from EROS Data Center.)*

evergreen forested wetlands, are concentrated south of Boston and form isolated wetlands in western and north-central Massachusetts and in the Connecticut River Valley (Sorrie and Woolsey, 1987).

Lacustrine and riverine wetlands.—Although present throughout the State, lacustrine and riverine wetlands comprise only a small percentage of Massachusetts' wetland area. These freshwater wetlands generally are restricted to the littoral zone between the shore and deepwater habitat and, if vegetated, have only aquatic-bed or nonpersistent emergent vegetation. The majority of riverine wetlands occur adjacent to the Connecticut River (Tiner, 1992). Wetlands in the shallows of rivers or lakes are classified as palustrine wetlands if there is persistent emergent vegetation present.

Estuarine and marine wetlands.—Estuarine and marine wetlands account for 20 percent of the State's total wetland acreage. In Massachusetts, marine wetlands consist of exposed intertidal flats and beaches and minor acreages of rocky shores and aquatic beds. Estuarine wetlands consist of salt and brackish marshes (emergent and scrub-shrub wetlands) that have developed behind coastal dunes and in protected coves and embayments along the coast and estuaries. These wetlands are commonly vegetated by grasses and aquatic plants. Sparsely vegetated estuarine flats and beaches, alternately flooded by tide or exposed to air, also are present.

HYDROLOGIC SETTING

Wetlands form in geologic, topographic, and hydrologic settings that enhance the accumulation and retention of ground water, surface water, or both for a period of time. Hydrologic processes are the primary factor determining the existence of wetlands; even if the geologic and topographic settings are favorable for wetland formation, unfavorable hydrologic conditions can inhibit wetland formation (Winter, 1988). On an annual basis, precipitation exceeds evapotranspiration losses in Massachusetts, resulting in an annual moisture surplus. Hydrology, therefore, favors the formation and maintenance of wetlands throughout the State, and wetland location is determined primarily by geologic and topographic controls.

Massachusetts was almost completely covered by ice during the last glaciation; the ice margin reached its maximum extent at Martha's Vineyard and Nantucket Island. Large quantities of glacial drift were deposited over bedrock throughout the State. This sediment was left in place as deposited from the ice as till or was eroded and reworked by glacial meltwater and deposited as stratified drift. Till is exposed at the land surface, primarily on upland hilltops and slopes. Stratified drift was deposited in topographically low areas where glacial meltwater collected—major lowlands such as the Coastal Plain Province, the Seaboard Lowland and Connecticut Valley Lowland Sections, and in stream and river valleys throughout the New England Upland, Green Mountain, and Taconic Sections (fig. 2*C* and 2*D*). Although stratified drift covers only 44 percent of Massachusetts, 68 percent of wetlands are underlain by this deposit (Motts and O'Brien, 1981). In general, the percentage of land containing wetlands decreases from east to west in the State; this decrease can be directly attributed to the distribution of stratified drift.

Inland wetlands.—Surficial materials of the Coastal Plain, which encompasses Cape Cod, Martha's Vineyard, and Nantucket Island, consist primarily of permeable stratified drift characterized by low relief. Despite the low relief, surface water does not collect in these areas because of the rapid infiltration of precipitation. Wetlands occur in the numerous kettle holes that intersect the ground-water table and receive water from ground-water discharge and precipitation. Kettle holes, closed topographic depressions, were created by the melting of stagnant ice blocks that were embedded in glacial sediments. Kettle holes pit the surface of stratified drift throughout the State. Because ground water moves relatively rapidly through the surficial materials of this area, plants in these wetlands are adapted to low-nutrient conditions. Kettle ponds in the Coastal Plain provide a habitat for plants that grow only on the exposed, sandy shores of nutrient-poor, acidic ponds and require seasonal water-table fluctuations (Henry Woolsey, Natural Heritage and Endangered Species Program, written commun., 1993).

Glacial lakes occupied the Connecticut Valley Lowland and Seaboard Lowland of Massachusetts, depositing extensive areas of flat, nearly impermeable stratified drift (Schafer and Hartshorn, 1965). Impermeable stratified drift that was deposited in a marine environment underlies areas of the Seaboard Lowland to the north of and surrounding Boston (Stone and Peper, 1982). These coastal areas were depressed by the weight of glacial ice to beneath even the lowered sea level but rose rapidly after deglaciation to expose marine sediments. The low relief and impermeable materials of these areas slow the drainage of surface-water, promoting the formation and maintenance of wetlands. Sources of water for these wetlands include precipitation, ground-water discharge, and river overflow. Slow drainage leads to acidic, low-nutrient conditions through the accumulation of plant metabolic wastes and through the gradual depletion of nutrients as water flows through the wetland. Because of the low slope, small drainage obstructions can form large wetlands—such as the 6,000-acre Hockomock Swamp near Taunton, the 1,500-acre Cedar Swamp near Westborough, and the 1,000-acre Acushnet Cedar Swamp near New Bedford.

Within the bedrock and till-covered hills of the New England Upland and Taconic Sections, wetlands occur primarily in depressions where surface runoff and ground-water discharge collect. The depressions have no outflow or have drainage controlled by bedrock sills, stratified drift, beaver dams, or manmade structures. Seepage wetlands can form where the ground-water table intersects or is close to the land surface—on concave slopes and at breaks in slope. However, these wetlands are permanently saturated only if ground-water discharge is perennial; otherwise, the wetlands are seasonally saturated for varying periods of time (Winter, 1988). Wetlands also form in river valleys, where they occupy kettle holes in stratified drift or areas modified by the erosion and deposition of rivers—in abandoned river channels, behind levees and overbank sediments adjacent to rivers, and in backswamp areas. As water moves through soil and surficial materials, it is enriched in nutrients for plant growth. The longer the flowpath beneath the surface, the more the water is enriched. Wetlands in upland till and bedrock depressions are primarily areas of discharge from nutrient-poor, local to intermediate ground-water flow systems, whereas wetlands in lowland valleys receive discharge from nutrient-enriched, intermediate and regional ground-water flow systems.

As vegetation became established after ice retreat and developed in response to the warming of climate, open-water areas filled with sediment and organic matter to become wetlands or remained lakes with wetland habitats fringing open water. Studies of upland wetlands in Connecticut have shown that wetlands developed over many divergent paths in the time since glaciation; however, all wetlands have been strongly affected by postsettlement agricultural and industrial practices (Thorson, 1990; Thorson and Harris, 1991). Many wetlands resulted from colonial agricultural practices and the creation of ice ponds and mill ponds for water-powered industries.

Beavers have created many wetlands in Massachusetts by flooding uplands and narrow river valleys. Beaver populations in Massachusetts have been successfully reestablished and now occupy all suitable habitats in the State (Thomas Decker, Massachusetts Division of Fisheries and Wildlife, oral commun., 1993). Beaver-created wetlands have many of the positive aspects associated with wetlands—including habitat for waterfowl and other wildlife, flood control, sediment control, fish production, and recreational and esthetic values—but the property damage beaver ponds may cause can result in conflict between beavers and humans (Decker and Cooper, 1991).

Tidal wetlands.—Tidal wetlands are present along coastal areas of the State in the Coastal Plain and the Seaboard Lowland. Tidal wetlands form a broad continuum from marine to estuarine, riverine, and palustrine wetlands. The effects of wave energy and salinity on the wetlands diminish along this continuum. Tidal wetlands receive freshwater from upland areas through ground-water discharge, stream overflow, and hillslope runoff. Regional ground-water discharge is greatest near the break in slope between upland and coastal areas, and intermediate and local ground-water flow systems increase in importance in areas that have less topographic relief (Winter, 1988). Floodwater resulting from high tides or stormflows may be temporarily stored in the wetland. The drainage of floodwater and hillslope runoff from the wetland surface is slowed by the low slope of coastal areas.

The major factors affecting the development and persistence of tidal wetlands are the rate of sea-level rise, the tidal regime, the supply of sediments to the wetland, and the ability of plants to survive submergence by saltwater (Redfield, 1972). Unless the submergence of tidal wetlands by rising sea level is counteracted by the vertical accretion of the wetland by sediment deposition and plant accumulation, the wetland will drown and become a deepwater habitat. As the last glacial ice melted and water was returned to the sea, sea level rose, encroaching upon land and submerging many stream and river valleys to form estuaries. Tidal wetlands either have migrated inland along estuaries, river valleys, and coastal slopes, or the wetlands have been completely submerged. Most existing saltwater wetlands in New England are younger than 4,000 years and might have thick freshwater deposits below saltwater peat (Redfield, 1972). Presently, tidal wetlands exist in a narrow setting between rising sea level and expanding coastal development. The migration of these wetlands inland, as sea level continues to rise, is hindered by the previous destruction of coastal-margin wetlands and by present development in low-lying uplands.

TRENDS

The FWS estimates that Massachusetts has lost 28 percent of its original wetlands over the 200-year period between the 1780's and the 1980's (Dahl, 1990). Agricultural and urban expansion in the Boston, Cape Cod, and Connecticut River Valley areas have caused many wetland losses (Motts and O'Brien, 1981). There are no statewide estimates of recent wetland losses or alteration; however, wetland losses and alterations continue in Massachusetts despite Federal and State regulation. In southeastern Massachusetts, about 1,300 acres of vegetated wetlands were either lost or altered from 1977 to 1986 through agriculture, development, and conversion of vegetated wetlands to open water (Tiner and Zinni, 1988).

Since 1978 there have been more than 51,000 permit applications submitted to the Department of Environmental Protection for work proposed in or near wetlands in the State. More than 9,000 applications were submitted in 1991; about one-third of these applications were from Cape Cod and the southeastern part of the State, one-third were for projects proposed in and around metropolitan Boston, and the remaining one-third were for projects in central and western Massachusetts (Massachusetts Division of Wetlands and Waterways, 1991).

CONSERVATION

Many government agencies and private organizations participate in wetland conservation in Massachusetts. The most active agencies and organizations and some of their activities are listed in table 1.

Federal wetland activities.—Development activities in Massachusetts wetlands are regulated by several Federal statutory prohibitions and incentives that are intended to slow wetland losses.

Table 1. Selected wetland-related activities of government agencies and private organizations in Massachusetts, 1993

[Source: Classification of activities is generalized from information provided by agencies and organizations. •, agency or organization participates in wetland-related activity; ..., agency or organization does not participate in wetland-related activity. MAN, management; REG, regulation; R&C, restoration and creation; LAN, land acquisition; R&D, research and data collection; D&I, delineation and inventory]

Agency or organization	MAN	REG	R&C	LAN	R&D	D&I
FEDERAL						
Department of Agriculture						
Consolidated Farm Service Agency	...	•	...	...	...	...
Forest Service	...	..	...	...	...	•
Natural Resources Conservation Service	...	•	...	...	...	•
Department of Commerce						
National Oceanic and Atmospheric Administration	•	•	...	•	•	...
Department of Defense						
Army Corps of Engineers	•	•	•	•	•	•
Military reservations	•	...	...	...	..	..
Department of the Interior						
Fish and Wildlife Service	•	...	•	•	•	•
Geological Survey	...	...	..	...	•	...
National Biological Service	..	..	...	...	•	...
National Park Service	•	..	•	•	•	•
Environmental Protection Agency	...	•	..	...	...	•
STATE						
Department of Environmental Management	•	...	•	•	•	...
Department of Environmental Protection						
Division of Water Pollution Control	•	•	..	...	•	...
Division of Water Supply	•	•	...	..	...	..
Division of Wetlands and Waterways	...	•	•	...	•	•
Department of Fisheries, Wildlife and Environmental Law Enforcement	•	•	...	•	•	•
Massachusetts Environmental Policy Act Unit	...	•	...	..	...	...
Metropolitan District Commission	•	...	...	•	...	•
University of Massachusetts	..	...	...	..	•	•
TOWN AND CITY CONSERVATION COMMISSIONS	•	•	...	•	..	...
PRIVATE ORGANIZATIONS						
Ducks Unlimited	...	...	..	..	•	•
Massachusetts Audubon Society	•	...	•	•	•	•
The Nature Conservancy	•	...	...	•	•	•
The Trustees of Reservations	•	...	•	•	•	•

Some of the more important of these are contained in the 1899 Rivers and Harbors Act; the 1972 Clean Water Act and amendments; the 1985 Food Security Act; the 1990 Food, Agriculture, Conservation, and Trade Act; and the 1986 Emergency Wetlands Resources Act.

Section 10 of the Rivers and Harbors Act gives the U.S. Army Corps of Engineers (Corps) authority to regulate certain activities in navigable waters. Regulated activities include diking, deepening, filling, excavating, and placing of structures. The related section 404 of the Clean Water Act is the most often-used Federal legislation protecting wetlands. Under section 404 provisions, the Corps issues permits regulating the discharge of dredged or fill material into wetlands. Permits are subject to review and possible veto by the U.S. Environmental Protection Agency, and the FWS has review and advisory roles. Section 401 of the Clean Water Act grants to States and eligible Indian Tribes the authority to approve, apply conditions to, or deny section 404 permit applications on the basis of a proposed activity's probable effects on the water quality of a wetland.

Most farming, ranching, and silviculture activities are not subject to section 404 regulation. However, the "Swampbuster" provision of the 1985 Food Security Act and amendments in the 1990 Food, Agriculture, Conservation, and Trade Act discourage (through financial disincentives) the draining, filling, or other alteration of wetlands for agricultural use. The law allows exemptions from pen-

alties in some cases, especially if the farmer agrees to restore the altered wetland or other wetlands that have been converted to agricultural use. The Wetlands Reserve Program of the 1990 Food, Agriculture, Conservation, and Trade Act authorizes the Federal Government to purchase conservation easements from landowners who agree to protect or restore wetlands. The Consolidated Farm Service Agency (formerly the Agricultural Stabilization and Conservation Service) administers the Swampbuster provisions and Wetlands Reserve Program. The Natural Resources Conservation Service (formerly the Soil Conservation Service) determines compliance with Swampbuster provisions and assists farmers in the identification of wetlands and in the development of wetland protection, restoration, or creation plans.

The 1986 Emergency Wetlands Resources Act and the 1972 Coastal Zone Management Act and amendments encourage wetland protection through funding incentives. The Emergency Wetland Resources Act requires States to address wetland protection in their Statewide Comprehensive Outdoor Recreation Plans to qualify for Federal funding for State recreational land; the National Park Service (NPS) provides guidance to States in developing the wetland component of their plans. Coastal States that adopt coastal-zone management programs and plans approved by the National Oceanic and Atmospheric Administration (NOAA) are eligible for Federal funding and technical assistance through the Coastal Zone Management Act.

Federal agencies are responsible for the proper management of wetlands on public lands under their jurisdiction. The FWS protects and manages wetlands in four National Wildlife Refuges in Massachusetts: approximately 3,300 acres of salt marsh and freshwater wetlands in the Parker River National Wildlife Refuge, 1,000 acres of flood-plain wetlands along the Nashua River within the Oxbow National Wildlife Refuge, flood-plain wetlands along 12 miles of the Concord and Sudbury Rivers of the Great Meadows National Wildlife Refuge, and 2,750 acres of marine, estuarine, and palustrine wetlands in the Monomoy Island National Wildlife Refuge. The NPS protects, manages, and studies many diverse wetlands in the Minuteman National Historic Park and the Cape Cod National Seashore. The Corps manages about 1,000 acres of wetlands at dams and reservoirs located throughout the State and 8,000 acres of wetlands in the Charles River Natural Valley Storage Project.

State wetland activities.—All State agencies that have responsibilities for wetland protection, management, and planning are managed by the Executive Office of Environmental Affairs chaired by the Secretary of Environmental Affairs. The principal authority of this office is to implement and oversee State policies that preserve, protect, and regulate natural resources and the environmental integrity of the Commonwealth of Massachusetts. The Water Resources Commission establishes statewide water-resources policies for agencies within the Executive Office of Environmental Affairs. In 1990, the Water Resources Commission adopted a policy of no net short-term loss of wetlands and a net long-term gain of wetlands; the policy incorporates the principles of avoidance or minimization of adverse impacts on wetlands and full compensatory mitigation for unavoidable wetland losses (Massachusetts Division of Wetlands and Waterways, 1991). Primary responsibility to implement this policy was delegated to the Department of Environmental Protection.

The Department of Environmental Protection's Division of Wetlands and Waterways implements two complementary programs for wetland protection—the Wetlands Protection Program and the Wetlands Conservancy Program. The Wetlands Protection Program functions primarily through permitting and enforcement by local conservation commissions. The program handles appeals and provides training, technical assistance, and enforcement support to conservation commissions. The Wetlands Conservancy Program is mapping the State's wetlands through aerial photography at a scale of 1:5,000. The wetland maps will provide a detailed inventory of the extent and condition of the State's wetlands to be used to identify illegal wetland alterations and quantify wetland losses. In addition, important wetlands are selected for permanent deed restrictions prohibiting activities that impair wetland functions. At present (1993), 46,000 acres of coastal wetlands and 8,000 acres of inland wetlands are protected by deed restrictions.

The Department of Environmental Protection is integrating the 401 water-quality certification program with wetland permitting under the State's Wetland Protection Act. Under section 401 of the Federal Clean Water Act, any activity that results in a discharge, including that of fill into wetlands or State waters, that also requires a Federal permit must obtain a 401 water-quality certification stating that the activity will not result in violation of State surface-water-quality standards. Many activities exempted under the Wetland Protection Act will be in the Department of Environmental Protection's jurisdiction under the 401 certification program. Use of the antidegradation provisions of State surface-water-quality standards on wetlands defined as "waters of the Commonwealth" provides enhanced wetland protection. Antidegradation provisions provide for the protection of existing uses in wetlands and the level of water quality necessary to maintain those uses. No degradation is allowed in areas designated as Outstanding National Resource Waters, such as National Wildlife Refuges, National Parks, State parks, wildlife areas, and other areas of ecological significance. Vernal pools that have been certified by the State are designated as Outstanding Resource Waters and therefore have added protection through section 401 and its antidegradation provisions.

The Department of Environmental Management is the primary land-management and natural-resource planning agency in the State. The Department is the largest landholder in Massachusetts, having 270,000 acres of State forests, parks, beaches, and wildlife areas that include wetlands. As a part of its land-stewardship plans, the Department oversees many activities and programs including research and data collection, land-resource inventory, coastal-dune restoration, and natural area programs. The Wildlands Program sets aside areas of State forests and parks that contain examples of unique plant communities or geologic formations in the State. The Office of Water Resources, within the Department of Environmental Management, is involved in two significant programs related to wetlands—the river-basin planning program and the watershed-protection and flood-prevention facilities program (Michael Gildesgame, Office of Water Resources, written commun., 1993). The river-basin planning program analyzes the water resources of each basin and develops recommendations for regional and community water-resources management that balance the consumptive needs of municipal, industrial, and commercial water withdrawals with the instream flow needed to maintain natural resources such as wetlands, wildlife, and fisheries. The 35-year-old cooperative Federal and State watershed-protection and flood-prevention facilities program maintains and preserves about 5,000 acres of open space associated with 32 flood-prevention facilities across the State. Installation of these structures has promoted the development of new wetlands and has enhanced wildlife habitat, public recreation, and water supply. The Waquoit Bay National Estuarine Research Reserve, located on the southern coast of Cape Cod, is cooperatively managed by the Department of Environmental Management and NOAA's Sanctuaries and Reserves Division. The 2,250-acre reserve was created under section 315 of the Federal Coastal Zone Management Act and has barrier beach, salt pond, salt marsh, and open-water habitats. The reserve serves as a natural laboratory and is the site of several interagency research projects.

The Department of Fisheries, Wildlife and Environmental Law Enforcement protects and manages the State's wild and living natural resources, including rare and endangered plant and animal species. Wetland protection is part of the overall mission of the De-

partment—the protection of natural ecosystems. Critical wildlife habitats are protected by an aggressive land-acquisition program that emphasizes the natural corridors formed by rivers, streams, and their associated wetlands. The Natural Heritage and Endangered Species Program, which is funded primarily through voluntary income tax contributions, inventories rare- and endangered-species habitats in the State.

Local wetland activities.—The local conservation commissions of the 351 cities and towns in Massachusetts implement the State's Wetland Protection Act with jurisdiction over any work in, over, or adjacent to water bodies, wetlands, rivers, and streams within each municipality. No person may dredge, fill, or alter wetlands without notifying the local conservation commission in writing to explain the proposed work. In addition, cities and towns may enact local wetland bylaws, which can provide more stringent wetland and resource protection than that specified in the State's Wetland Protection Act. Commissions consist of three to seven volunteer members appointed directly by local elected authorities.

Private wetland activities.—Private organizations in Massachusetts are active in land acquisition and management, research, education, and policy review and planning. The Massachusetts Audubon Society owns 22,000 acres of land containing wetlands. The Trustees of Reservations owns and manages 18,000 acres of land in the State with historic, scenic, or ecological value. Ducks Unlimited provides technical and financial assistance to Federal and State agencies in order to protect waterfowl habitat in Massachusetts.

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