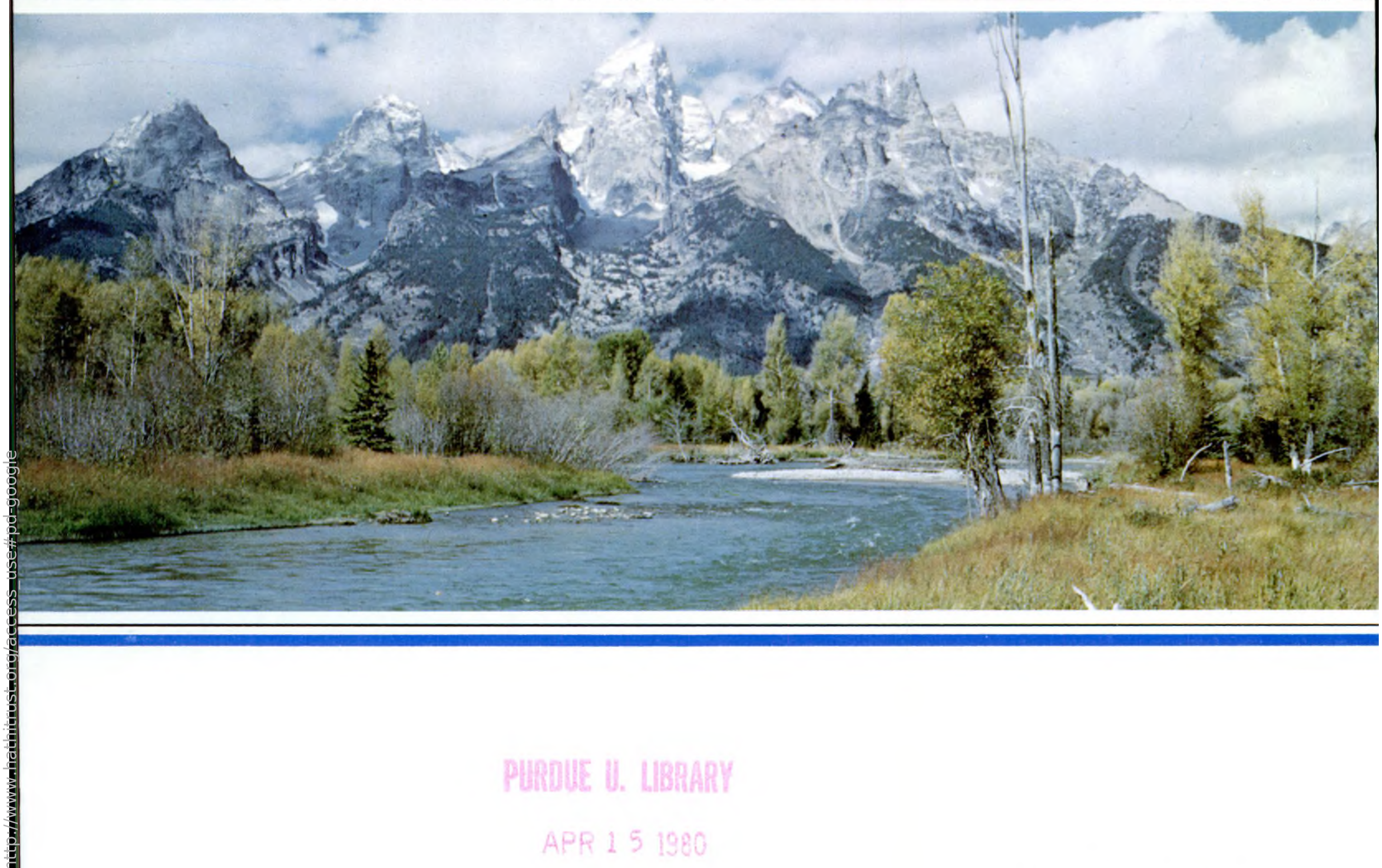
THE NATION'S WATER RESOURCES 1975-2000

Volume 4: New England Region



Second National Water Assessment by the U.S. Water Resources Council

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December 1978

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Foreword

The Water Resources Planning Act of 1965 (Public Law 89-80) directs the U.S. Water Resources Council to maintain a continuing study of the Nation's water and related land resources and to prepare periodic assessments to determine the adequacy of these resources to meet present and future water requirements. In 1968, the Water Resources Council reported the results of its initial assessment. The Second National Water Assessment, a decade later, provides a comprehensive nationally consistent data base for the water resources of the United States. The results of the Second National Water Assessment were obtained by extensive coordination and collaboration in three phases.

Phase I: Nationwide Analysis

The Council member agencies researched, analyzed, and prepared estimates of current and projected water requirements and problems and the implications of the estimates for the future.

Phase II: Specific Problem Analysis

Regional sponsors, one for each of the 21 water resources regions, surveyed and analyzed State and regional viewpoints about (1) current and future water problems, (2) conflicts that may arise in meeting State and regional objectives, and (3) problems and conflicts needing resolution.

Phase III: National Problem Analysis

The Council conducted this final phase in three steps: (1) An evaluation of phases I and II, (2) an analysis that identified and evaluated the Nation's most serious water resources problems, and (3) the preparation of a final report entitled "The Nation's Water Resources--1975-2000."

The final report of the Second National Water Assessment consists of four separate volumes as described below. These volumes can assist Federal, State, local, and other program managers, the Administration, and the Congress in establishing and implementing water resources policies and programs.

Volume 1, Summary, gives an overview of the Nation's water supply, water use, and critical water problems for "1975," 1985, and 2000 and summarizes significant concerns.

Volume 2, Water Quantity, Quality, and Related Land Considerations, consists of one publication with five parts:

Part I, "Introduction," outlines the origin of the Second National Water Assessment, states its purpose and scope, explains the numerous documents that are part of the assessment, and identifies the individuals and agencies that contributed to the assessment.

II, "Water-Management Problem Profiles," identifies ten general water problem issues and their implications and potential consequences.

Part III, "Water Uses," focuses on the national perspectives regarding existing ("1975") and projected (1985 and 2000) requirements for water to meet offstream, instream, and flow-management needs. State-regional and Federal perspectives are compared.

Part IV, "Water Supply and Water Quality Considerations," analyzes the adequacy of fresh-water supplies (ground and surface) to meet existing and future requirements. It contains a national water budget; quantifies surface- and ground-water supplies, reservoir storage, and transfers of water within and between subregions; describes regional requirements and compares them to supplies; evaluates water quality conditions; and discusses the legal and institutional aspects of water allocation.

Part V, "Synopses of the Water Resources Regions," covers existing conditions and future requirements for each of the 21 water resources regions. Within each regional synopsis is a discussion of functional and location-specific water-related problems; regional recommendations regarding planning, research, data, and institutional aspects of solving regional water-related problems; a problem-issue matrix; and a comparative-analysis table.

Volume 3, Analytical Data, describes the methods and procedures used to collect, analyze, and describe the data used in the assessment. National summary data are included with explanatory notes. Volume 3 is supplemented by five separately published appendixes that contain data for the regions and subregions:

Appendix I, Social, Economic, and Environmental Data, contains the socioeconomic baseline ("1975") and growth projections (1985 and 2000) on which the water-supply and water-use projections are based. This appendix presents two sets of data. One set, the National Future, represents the Federal viewpoint; the other set, the State-Regional Future, represents the regional sponsor and/or State viewpoint.

Appendix II, Annual Water Supply and Use Analysis, contains baseline water-supply data and baseline and projected water withdrawal and water-consumption data used for the assessment. Also included are a water adequacy analysis, a natural flow analysis, and a critical-month analysis.

Appendix III, Monthly Water Supply and Use Analysis, contains monthly details of the water-supply, water-withdawal, and water-consumption data contained in Appendix II and includes an analysis of monthly water adequacy.

Appendix IV, Dry-Year Conditions Water Supply and Use Analysis, contains both annual and monthly baseline and projected water-withdrawal and water-consumption data for dry conditions. Also, a dry conditions water-adequacy analysis is included.

Appendix V, Streamflow Conditions, contains detailed background information on the derivation of the baseline streamflow information. A description of streamflow gages used, correction factors applied, periods of record, and extreme flows of record, are given for each subregion. Also included is the State-Regional Future estimate of average streamflow conditions.

Volume 4, Water Resources Regional Reports, consists of separately published reports for each of the 21 regions. Synopses of these reports are given in Volume 2, Part V.

For compiling and analyzing water resources data, the Nation has been divided into 21 major water resources regions and further subdivided into 106 subregions. Eighteen of the regions are within the conterminous United States; the other three are Alaska, Hawaii, and the Caribbean area.

The 21 water resources regions are hydrologic areas that have either the drainage area of a major river, such as the Missouri Region, or the combined drainage areas of a series of rivers, such as the South Atlantic-Gulf Region, which includes a number of southeastern States that have rivers draining directly into the Atlantic Ocean and the Gulf of Mexico.

The 106 subregions, which are smaller drainage areas, were used exclusively in the Second National Water Assessment as basic data-collection units. Subregion data point up problems that are primarily basinwide in nature. Data aggregated from the subregions portray both regional and national conditions, and also show the wide contrasts in both regional and national water sources and uses.

The Second National Water Assessment and its data base constitute a major step in the identification and definition of water resources problems by the many State, regional, and Federal institutions involved. However, much of the information in this assessment is general and broad in scope; thus, its application should be viewed in that context, particularly in the area of water quality. Further, the information reflects areas of deficiencies in availability and reliability of data. For these reasons, State, regional, and Federal planners should view the information as indicative, and not the only source to be considered. When policy decisions are to be made, the effects at State, regional, and local levels should be carefully considered.

In a national study it is difficult to reflect completely the regional variations within the national aggregation. For example, several regional reviewers did not agree with the national projections made for their regions. These disagreements can be largely attributed either to different assumptions by the regional reviewers or to lack of representation of the national data at the regional level. Therefore, any regional or State resources-management planning effort should consider the State-regional reports developed during phase II and summarized in Volume 4 as well as the nationally consistent data base and the other information presented in this assessment.

Additional years of information and experience show that considerable change has occurred since the first assessment was prepared in 1968. The population has not grown at the rate anticipated, and the projections of future water requirements for this second assessment are considerably lower than those made for the first assessment. Also, greater awareness of environmental values, water quality, ground-water overdraft, limitations of available water supplies, and energy concerns are having a dramatic effect on water-resources management. Conservation, reuse, recycling, and weather modification are considerations toward making better use of, or expanding, available supplies.

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Illustrations

Physiography

Description

The New England Region encompasses 69,003 square miles[1] in the northeastern corner of the United States (Figure 1-1). The region includes Maine (47 percent of the region's land area), New Hampshire (14 percent), Vermont (14 percent), Massachusetts (12 percent), Connecticut (7 percent), Rhode Island (2 percent), and portions of New York (4 percent).

Parts of the region are highly urbanized, containing some of the most densely populated areas in the Nation. Sections to the north and west have remained rural, however, despite the increasing migration from urban centers towards rural nonfarm living and the trend toward second-home development that has occurred over the past decade. New England is particularly fortunate in having rural and even relatively wild sections of land within commuting distance of a number of major cities. (See Figure 1-2 for major land uses).

Over the past hundred years, there has been steady abandonment of farms due to competition from the more fertile and irrigated croplands of the West and longer growing season of the South. As a result, some of New England's land has reverted to forest. About 74 percent of the total surface area of the region is woodland and forests at the present time, with spruce-fir forests in the northern reaches and higher elevations, northern hardwoods (birch, beech, maple, and hemlock) through most of the area, and some oak-hickory forests in the south.

Geology

New England's three general physiographic regions--mountains, upland plateau, and lowland plains--range in elevation from sea level to the 6,288-foot-high Mt. Washington in New Hampshire. The mountains to the west (Green Mountains and Hoosac Range) are underlain primarily by metamorphic gneissic rocks, while the 75-mile corridor between the Connecticut River Valley and the coast is composed of granitic and

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[1] This is the sum of the areas of counties used to approximate the hydrologic area of the region. Land use and other socioeconomic data are related to this area. The drainage area within the hydrologic boundary is 71,990 square miles.

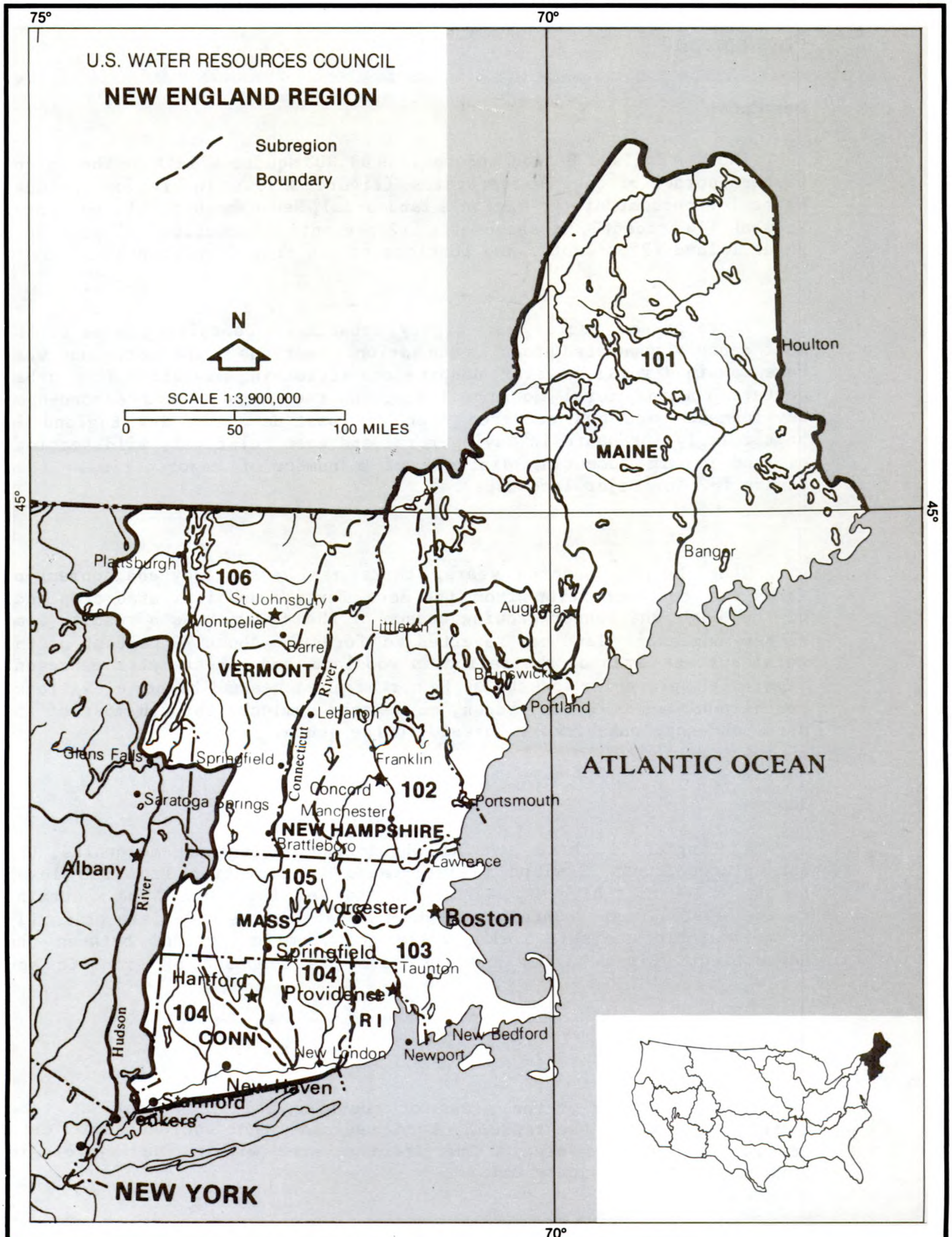


Figure 1-1. Region Map

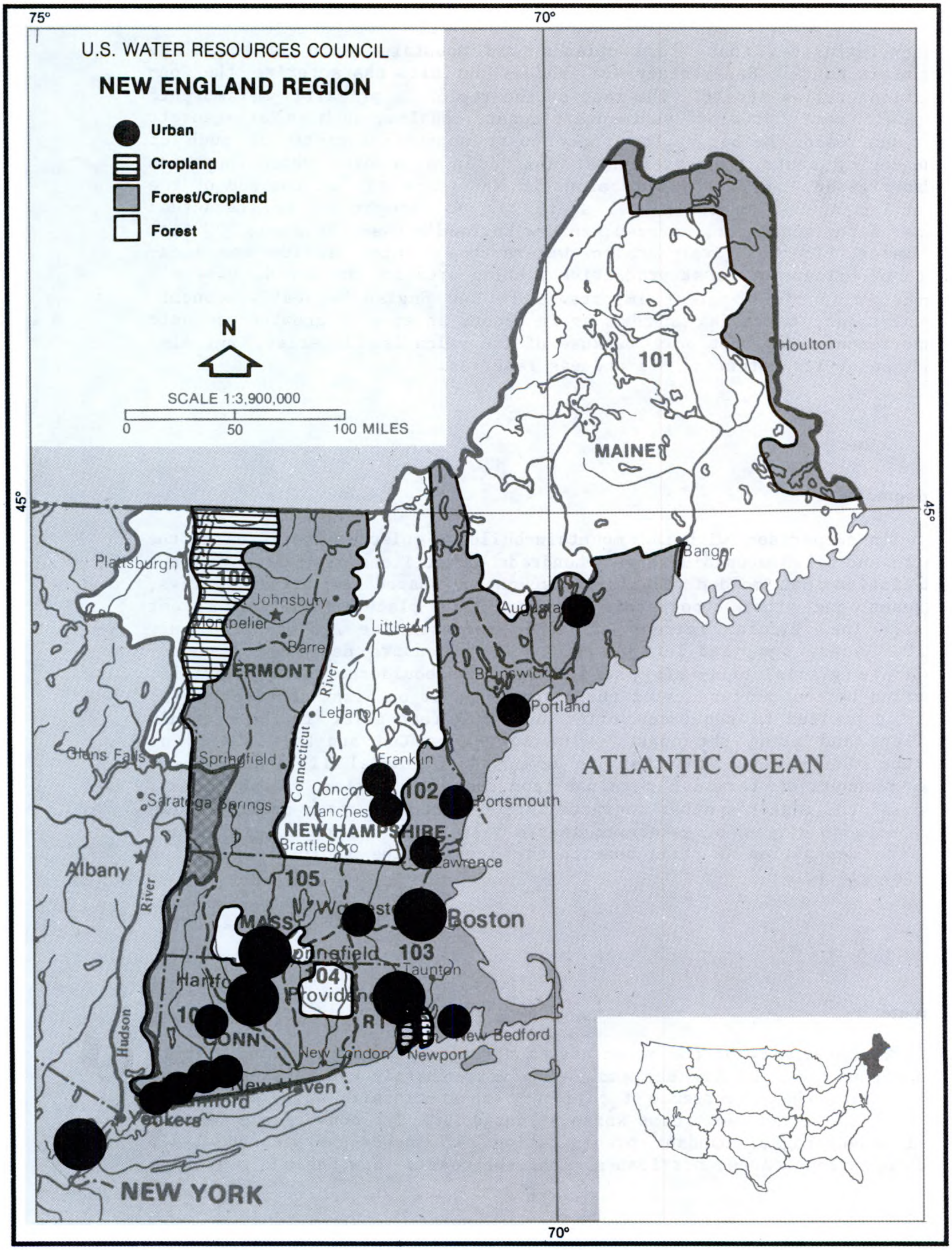


Figure 1-2. Present Land Use

other intrusives that form uplands and mountains such as the White Mountain Range. Sedimentary and igneous deposits characterize the Connecticut Valley itself. The rest of the region is primarily metamorphic rock with some "drowned" sedimentary coastal basins, such as Narragansett Bay and Boston Harbor. The rocky coast so characteristic of much of the region abuts the continental shelf, an area over which the ocean transgressed, or encroached, about 12,000 years ago at the end of the last Ice Age. The continental shelf can be thought of as the actual edge of the continent, covered, in New England's case, by about 500 feet of water. The relatively shallow waters thus created provide the location of perhaps the most productive fishing area in the world, George's Bank. A factor of great importance in New England's early economic development, George's Bank has again become an area of growing economic importance today, not only because of its valuable fisheries, but also because of its potential oil and gas reserves.

Topography

In comparison with the mountain-building episodes that created the White and Green mountain ranges hundreds of millions of years ago, the glaciation that molded today's landscape and shaped its hills, valleys, streams, and other topographic features took place in the very recent past. The glacial retreat of the Wisconsin Ice Age occurred only 12,000 years ago, and left in its place extensive deposits of unconsolidated glacial till--clay, sand, gravel, and boulders. These materials, carried by the meltwaters of the glaciers as if on giant conveyor belts, were deposited in sequences often over 100 feet thick in the region's valleys and along the coast. In fact, Cape Cod and the islands of Martha's Vineyard and Nantucket are composed of glacial till and represent the remnants of terminal moraines from the last period of glaciation. Many of the region's other characteristic landforms, from drumlin hills and sinuous ridges of eskers to kettle hole lakes and ponds, were formed by the deposition of till beneath the ice and the sculpturing action of the glaciers.

Climate

The proximity of the ocean has a moderating influence on the climate along the coast of New England. However, sharply contrasting seasons result from the convergence of cold, dry sub-Arctic air, warm, moist Gulf of Mexico air, and cool, damp North Atlantic air. The convergence results in frequent fogs, abundant precipitation (42 inches average annually), and in extreme cases, hurricanes along the coast. New England's average annual temperature is about 40° to 45°F and normally ranges from a high of about 90°F to a low of 10°F. The region's frost-free period averages from 100 to 150 days. Seasonal and geographical variations in precipitation and temperature also contribute to the great variety of vegetation found in the region.

People and the Resources

In order to provide a framework for the identification and analysis of New England's severe resource problems, this section presents a summary of present demographic, economic, and environmental parameters and estimates of future change in the region. Estimates and projections of the population, economy, land and water resources, as well as other parameters, were made for the Water Resources Council by various Federal agencies, as explained elsewhere in the national assessment reports. These data were provided for three reference years, 1975, 1985, and 2000, according to national, regional, and subregional boundaries (see Figure 1-1 for subregional boundaries). These federally-developed data constitute the Council's National Future (NF), one perspective on the most probable developments in population and economic growth and the resultant resource use over the next 25 years. State and regional representatives were encouraged to prepare alternative estimates for future growth and resource use in a corresponding perspective known as the State-Regional Future (SRF).

The development of such data was difficult in New England due to the lack of correspondence between the subregion and conventional State or Regional Future alternatives. The SRF information was used by the sponsor to develop a series of reports submitted to the Council, outlining a regional perspective on many of New England's water and related land problems. While much of the information generated in the regional reports is too extensive for summary in this section, a comparative table summarizing SRF and NF water supply and water use estimates is presented in the section on water resources. Most of the data used in this report were developed from the National Future figures unless they are specifically identified as SRF data.

Population

Population distribution in New England clearly illustrates the region's early dependence upon its harbors and navigable waterways for commerce and transportation, and upon its fertile river valleys for food. Of the 12.5 million inhabitants in 1975, approximately one-half live in subregion 103 (Rhode Island and coastal Massachusetts) within about 50 miles of the ports of Boston and Providence. Another third live in the Connecticut, Housatonic and Thames River valleys in subregions 104 and 105. Population density for the region as a whole was 192 persons per square mile in 1975, more than twice the national average, but ranged from a low of 23 persons per square mile in subregion 101 (northern Maine) to 1,012 per square mile in subregion 103. Although a greater percentage of the population (80 percent) lived in a standard metropolitan statistical area (SMSA) in 1975 than the national average, urban densities were considerably lower. This may reflect the "urban sprawl" type of development that characterizes much of this region.

The population of the region is expected to reach 13.6 million by 1985, and 15.3 million by 2000. This represents a growth rate slightly lower than the national average. During the 1960's, most of the region experienced a net in-migration, but recently this trend has reversed as migration towards the South and West, towards milder climates and more lucrative employment opportunities, becomes more common. In 1975, the region contained about 5.8 percent of the Nation's population; by 2000, it is projected to encompass 5.7 percent.

Despite the national trend of population distribution towards non-metropolitan areas, parts of the New England Region reflect significant diversification in place of residence. For example, although a progressively lower percentage of subregion 103's population (Rhode Island and coastal Massachusetts) will live in a metropolitan area by 2000, a significantly higher percentage in subregion 106 (Richelieu) is projected to live near urban centers.

Economy

Southern New England continues to be a major manufacturing, service, and financial center, with port facilities and transportation routes that tie in with a large consumer market. Forestry and associated pulp and paper manufacturing will remain a major source of earnings in northern New England, but greater earnings are projected for service industries.

About 5.5 million people were employed in the region in 1975. The 1975 total personal income, measured in 1975 dollars, was $83.3 billion, or about $6,669 per person in the region. Total earnings in 1975, also in 1975 dollars, are estimated to have been $63.6 billion. Major earnings, about 29 percent of the total, were from manufacturing which overshadowed the other individual categories. The "other" in Table 1-1 includes the following categories: services with 19 percent of the total regional earnings; wholesale and retail trade with 16 percent; government with 15 percent; contract construction with 7 percent; transportation, commodities, and public utilities with 6 percent; and finance, insurance, and real estate with 6 percent.

Table 1-1.--New England Region earnings--1975, 1985, 2000
(million 1975 dollars)

Earnings sector	1975	1985	2000
Manufacturing	18,558	24,538	35,403
Agriculture	726	722	835
Mining	59	76	100
Other	44,217	66,663	117,109
Total	63,560	91,999	153,447

Electrical machinery and supplies industries accounted for 13 percent of the manufacturing earnings. These were closely followed by machinery, excluding electrical, with 12 percent. Next came fabricated metals and ordnance, and transportation equipment, excluding motor vehicles, each with about 10 percent of manufacturing earnings. About one-fifth of the earnings are from other manufacturing. The remaining

35 percent of manufacturing industries' earnings were spread over many categories, led by printing and publishing, paper and allied products, and food and kindred products.

Total earnings and per capita earnings are expected to more than double over the next 25 years. By the year 2000 employment is projected to reach 7.2 million.

All categories will have increased earnings by 2000. A dramatic increase is expected in services, which will jump from 19 percent to 27 percent of the total, and replace manufacturing as the major source of earnings in the region. Manufacturing will drop to about 23 percent, the second largest category. The percentage of earnings in other categories will change only slightly.

Natural Resources

Approximately 74 percent of the total area in the New England Region is forest and woodland. In some northern sections of the region, this percentage is even higher, reaching 80 percent in Maine and 78 percent throughout most of New Hampshire. Urban uses take up over 6 percent of the total area, and cropland a little more.

By the year 2000, the amount of cropland is expected to decrease from 6.3 to 5.8 percent of the total surface area.

Table 1-2.--New England Region surface area and 1975 land use

Surface area or land use type	1,000 acres	Percentage of total surface area
Surface area		
Total	44,162	100
Water	2,458	5.6
Land	41,704	94.4
Land use		
Cropland	2,769	6.3
Pasture & range	957	2.2
Forest & woodland	32,582	73.8
Other agriculture	617	1.4
Urban	2,705	6.1
Other	2,074	4.6

Oil and natural gas reserves on George's Bank in New England's Outer Continental Shelf (OCS) are scheduled for exploration and possible development in the near future. Until this process is underway, however, reserve quantities are unknown. Other than OCS resources and potential coal deposits in the Narragansett Basin, the region has no known reserves of fossil fuels. Most of the area is underlain by basement rock types which virtually preclude the existence of such deposits.

Agriculture

The total amount of land in crops is decreasing in all of New England. This trend, projected over the next 25 years, will be slower in the northern portion of the region. The amount of harvested cropland is also declining, although cropland acreage in Maine, primarily potato production, is expected to remain fairly constant. Cropland for food production in the other States in the region is projected to decline by about 10 percent by the turn of the century. Between 1975 and 2000, harvested cropland in New England will increase from 1.7 million acres to 2 million in 1985 and drop back to 1.9 million in the year 2000. Unharvested cropland is expected to drop by 424,000 acres. About 60 percent of the region's cropland is now harvested. This is expected to increase to 74 percent by 2000. Irrigated land is projected to increase from 43,000 to 57,000 acres.

Table 1-3.--Projected changes in cropland and irrigated farmland in the New England Region--1975, 1985, 2000
(1,000 acres)

Land category	1975	1985	2000
Total cropland ------------	2,769	2,691	2,579
Cropland harvested --------	1,663	2,020	1,897
Irrigated farmland --------	43	48	57

Energy

The region's 41 steam electric powerplants larger than 25 megawatts (MW) in size generated almost 67,000 gigawatt-hours (gWh) in 1975. About 90 percent of these plants use a once-through water cooling system. Thirty-five of the plants used fossil fuels, and the other six used nuclear fuel. By 2000 annual electric power generation is expected to be about 295,000 gWh. More than two-thirds of this is projected to come from nuclear-fueled plants.

Table 1-4.--New England Region electric power generation-1975, 1985, 2000
(gigawatt-hours)

Fuel	1975	1985	2000
Fossil ----------------	44,196	51,630	89,900
Nuclear ---------------	20,241	72,250	201,710
Conventional hydropower	2,182	2,003	3,010
Total generation ----	66,619	125,883	294,620

About 87 trillion Btu (British thermal units) of heat per year are discharged from steam electric generating plants to fresh waters, and 273 trillion Btu to saline or brackish waters. By the year 2000, the use of cooling towers may result in the reduction of heat discharged to fresh waters to 9 trillion Btu per year, but the discharges to saline water may increase to 425 trillion Btu per year.

It is estimated that 128 trillion Btu of heat were discharged from manufacturing to fresh surface waters in 1975. Because of increased use of recycling systems, the total heat discharge from manufacturing in 2000 may be reduced to less than 7 trillion Btu per year.

Because of the uncertain practicality of developing coal resources in New England, no conversion facilities are projected. At present, no petroleum refineries exist in the region. Recent studies have questioned the economic advantages of installing petroleum refineries in New England; however, plans for such facilities are currently being considered. If exploration on George's Bank leads to large-scale development of major offshore oil and gas reserves, the building of a refinery in New England could be a strong possibility.

Navigation

Waterborne commerce is increasing in the New England Region as a whole (See Figure 1-3). For the 13 major ports (1 million tons or more) handling most of the cargo shipped into and out of New England, traffic increased by about 30 percent from approximately 70.8 million tons in 1965 to about 92.4 million tons in 1975. Petroleum and petroleum products accounted for most of the increase. In 1975 the ports of Portland (27.6 million tons), Boston (24.7 million tons), New Haven (11.4 million tons), and Providence (8.6 million tons) handled nearly 80 percent of the waterborne commerce through New England's major ports. Harbor congestion caused by the increased traffic and the trend toward larger deep-daft tankers suggest the need for a new system to handle petroleum deliveries in New England.

The largest amount of waterborne commerce in the region occurs in southwestern New England, which includes most of Rhode Island and eastern Massachusetts. This area's ports handle about 45 percent of the tonnage through the region's major ports. Boston's traffic increased almost 25 percent between 1965 and 1975. Commerce at Providence declined, but at Fall River, Salem, and on the Cape Cod Canal, it increased. Along the northeastern coast, tonnage rose at Portland (up almost 50 percent), Portsmouth, Searsport, and on the Penobscot River. In southern New England, traffic increased at New Haven, New London, and Bridgeport; held steady at Stamford; but decreased at Norwalk and on the Connecticut River. Activity grew at most ports and on three of the four waterways in the Lake Champlain Basin.

New England's heavy dependence on imported fuels and the extensive commercial fishing industry off its coast are reflected in the principal commodities handled in the region's ports. These include petroleum pro-

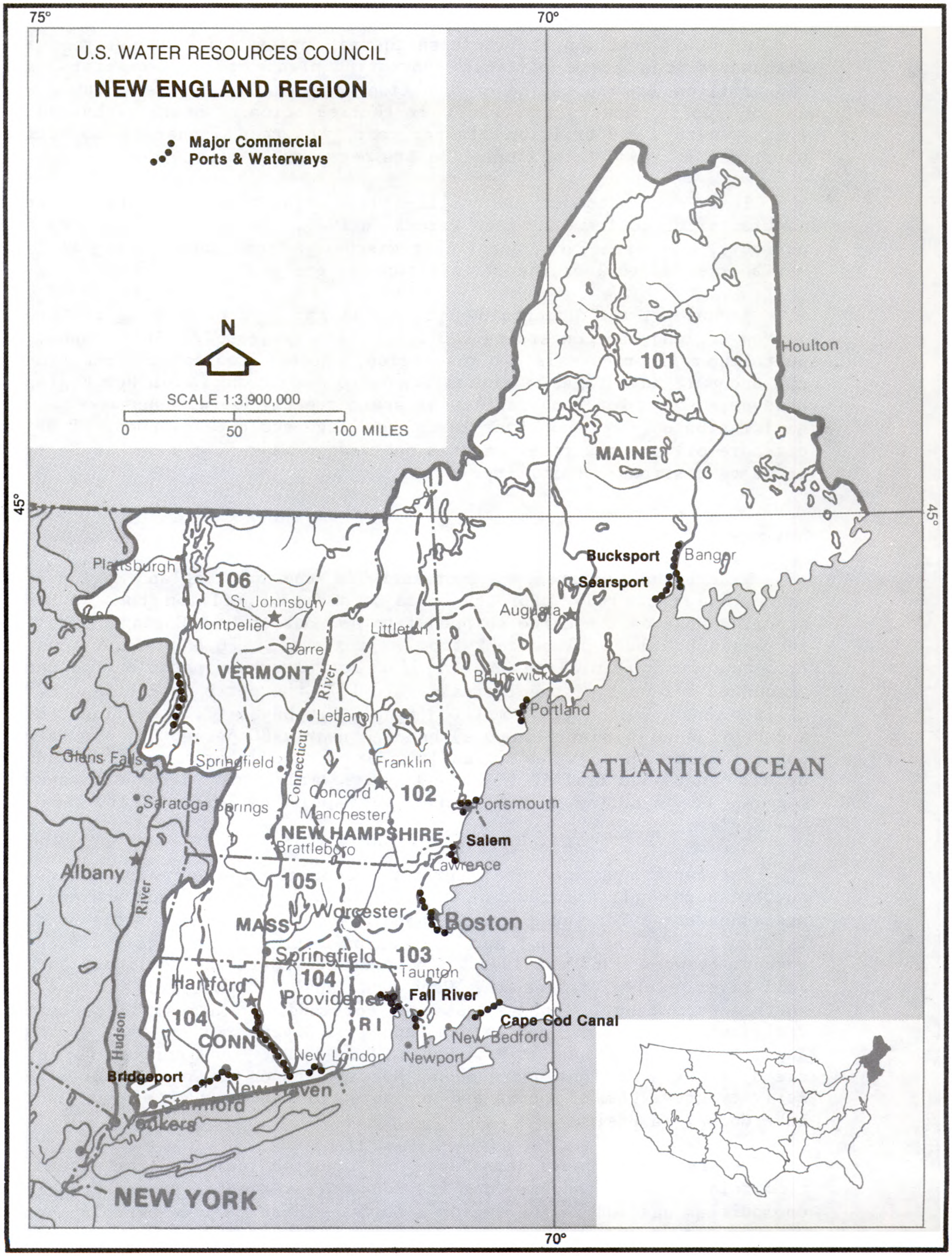


Figure 1-3. Navigation System

ducts, fish, fish products, and shellfish. In addition to the waterborne commerce in southeastern New England, there is significant commercial navigation along the coast of Maine; in Portland and Portsmouth Harbors; on Long Island Sound; and on Lake Champlain. Commercial navigation on the Connecticut River is impeded by the flood control and hydroelectric dams above Hartford. Between Hartford and Long Island Sound, however, the Connecticut is maintained and used for transportation of goods by barges and small coastal tankers.

The availability of domestic energy supplies and the recent extension of U.S. jurisdiction over fishery resources to 200 miles offshore will have a major effect on the future volume of commercial receipts in New England ports. The 200-mile fishing limit is expected to revitalize New England's fishing industry, and this will lead to increased landings in the region's ports. Upcoming lease sales for the exploration and development of offshore oil and gas reserves and a variety of energy research efforts throughout the country could have a significant influence on future petroleum imports in New England. Since the impact of these events on the fishing and energy industries is just beginning to be felt, it is difficult to predict the long-term commercial traffic volume in this region.

Environment

Abundant water resources, diversified land features, and seasonal variations provide much of the New England Region with opportunities for a high quality recreational and living environment. Within the region there are about 30,000 miles of streams, more than 5,000 lakes, and 6,000 miles of coastline. Floral and faunal zones range from sea level estuaries to alpine tundra, and there are nine distinct forest cover types. Recreational facilities catering to skiing, hiking, swimming, and fishing have extended the use of many areas through all seasons.

Thirty-seven sites in the region have been judged as nationally significant natural areas, and are included in the National Registry of Natural Landmarks. Most famous of these, perhaps, are the clay cliffs at Gay Head, Martha's Vineyard (subregion 103), and Mt. Katahdin in Maine, which dominates a 150-mile area. One river in the region is part of the National Wild and Scenic River System--the Allagash Wilderness Waterway, which is 92 miles long and contains 200,000 acres, 30,000 of which are water. Three other rivers, the Penobscot in Maine, and the Shepaug and Housatonic in Connecticut, are under consideration for inclusion in the national system (see Figure 1-4).

The U.S. Fish and Wildlife Service has designated 20 national wildlife refuges in the New England Region, totaling about 42,6000 acres. These areas provide nesting, feeding, and resting areas for all forms of wildlife, especially waterfowl and endangered species, such as the eastern cougar, shortnosed sturgeon, and Indiana bat. Many other species once indigenous to the region have not been seen locally for many years because of loss of habitat.

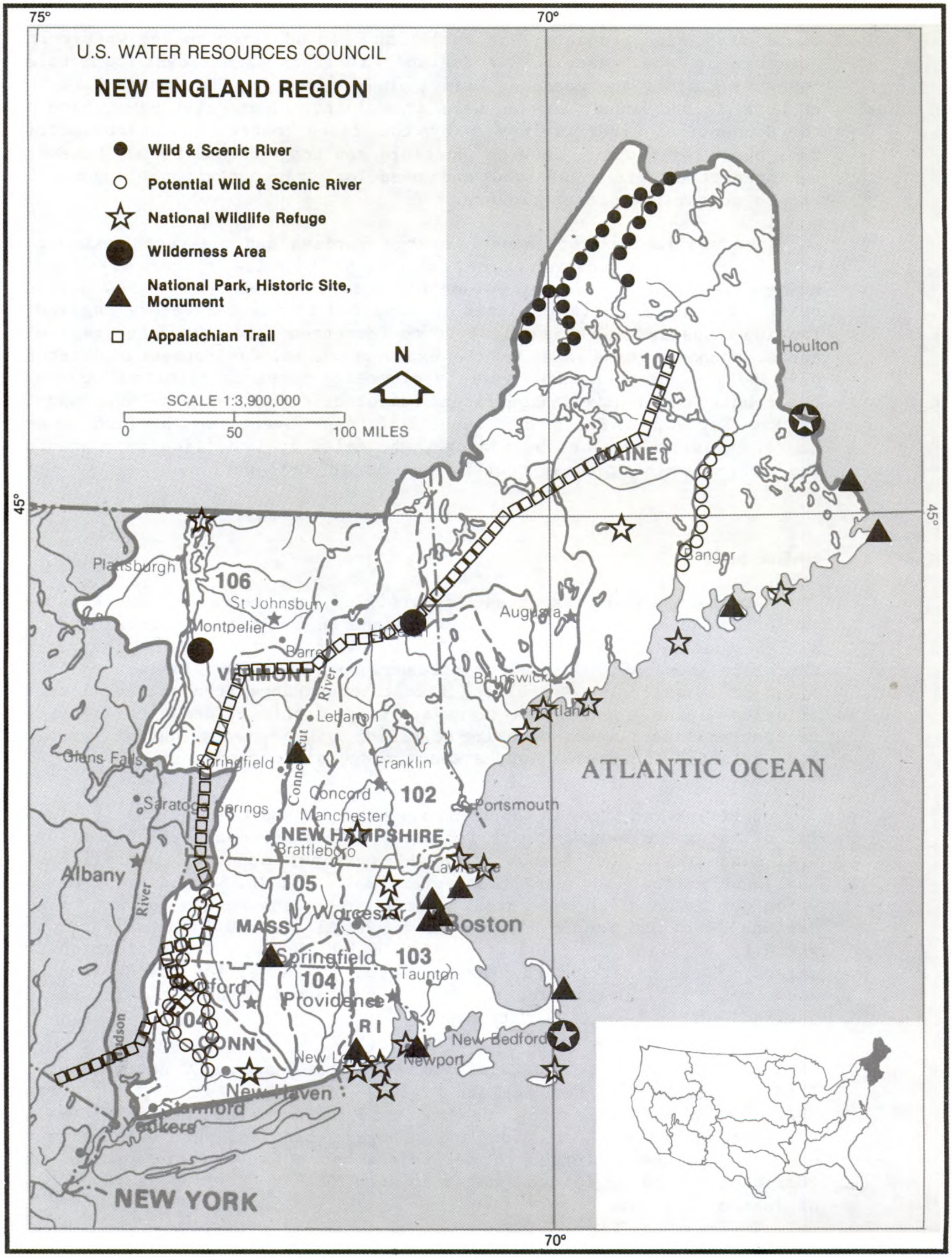


Figure 1-4. Environmental Resources

There are few significantly wild areas left in the region, but five wilderness areas totaling about 39,000 acres (about 0.1 percent of the total land area) have been identified by the U.S. Forest Service and the Fish and Wildlife Service. An additional 5,000 acres have been designated as potential wilderness areas. The National Park Service administers 16 parks, sites, and monuments, including Acadia National Park on Mt. Desert Island, Maine, and the Cape Cod National Seashore, which consists of 44,600 acres of coastal cliffs, dunes, and beaches. The Appalachian Trail is a National Scenic Trail which begins in Georgia, enters New England in western Connecticut and runs through Massachusetts, Vermont, and New Hampshire to its northern terminus in Maine.

In addition to its natural amenities, New England contains a most significant part of the Nation's historical heritage. Along with hundreds of State-designated sites, there are about 600 sites listed in the National Register of Historic Places. Of these, 182 are designated as National Historic Landmarks and are therefore of national significance. As would be expected, the bulk (121) of the National Historic Landmarks are located in subregion 103, surrounding the Boston area. Perhaps the most famous landmark is the 750-acre Minuteman National Historic Park, which includes the "Battle Road" between Lexington and Concord and the Old North Bridge, site of the beginning of the Revolution.

Although rich in natural and historical resources, New England's population density and the modification of the region's natural features have severely limited the recreational opportunities in those areas where the demand is the greatest--near urban centers. Rivers, lakes, and coastal waters located near urban areas are often too polluted to offer high quality recreational experiences. Thirteen percent of the rivers in the region (30 percent in highly populated subregions 103 and 104) do not meet "best practicable technology" water quality standards. In addition, overuse of existing facilities has reduced the quality of the recreational experience and, in some cases, has begun to destroy the resource itself. Despite the importance of tourism to the local economy of some regions, competition for land, especially for residential development and associated services, is intense.

An estimated 70 million instances of water-dependent recreation (boating, swimming, water skiing, and fishing) occurred in the New England Region in 1975, along with an additional 35.7 million instances of water-enhanced (picnicking and hiking) recreation. Almost half of these instances, both water dependent and water-enhanced were in subregion 103, eastern Massachusetts and Rhode Island. Despite the fact that facilities in this section are already severely overtaxed, the need for recreational opportunities will continue to grow. A 32-percent increase in the water-related recreational demand by 2000 will include the need for 929,000 additional acres of water surface and 28,400 acres of developed land in the year 2000. This will place severe pressures on the region's recreational resources and will provide a significant challenge to planners who are attempting to create greater recreational opportunities for New England's residents.

Water

This section attempts to summarize the region's available water resources, their current and projected use, and some potential problems associated with instream and offstream uses. The water withdrawal and consumption data are for base conditions unless otherwise stated.

Surface Flows

The total mean annual streamflow (assuming 1975 water use and streamflow regulations) for base year conditions in the New England Region is about 78.2 billion gallons per day (bgd). Almost half of this, 37.9 bgd, is found in subregion 101, which includes many of the major rivers in Maine, among them the Saint John, the Penobscot, the Kennebec, and the Androscoggin. The Connecticut River and its tributaries account for another 15 percent. The total streamflow is expected to decrease by about 0.2 percent by 1985 and by another 0.5 percent between 1985 and 2000, primarily due to increased consumption rates. In a dry year, these flows decrease by approximately 20 percent (Figure 1-5).

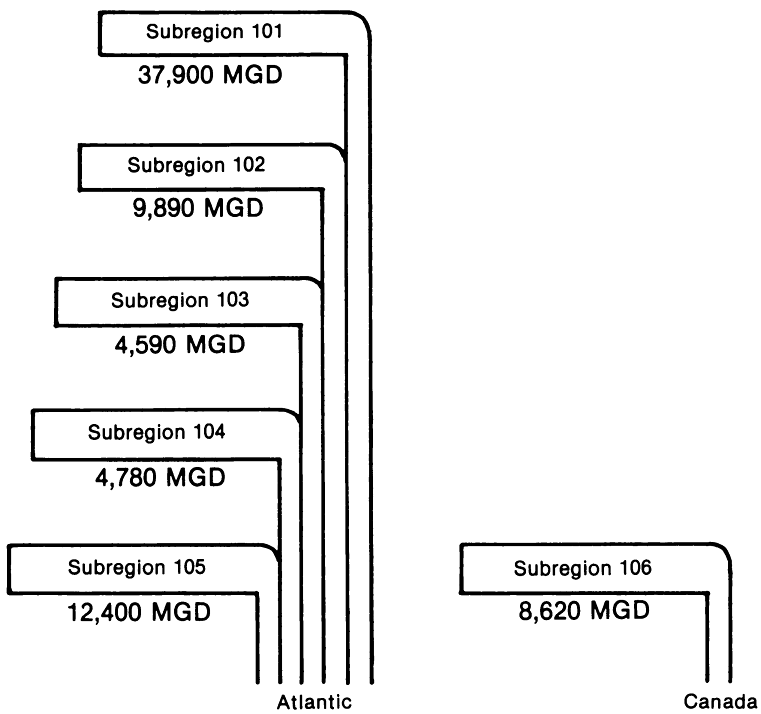


Figure 1-5. Streamflow

Surface flows vary considerably throughout the year and geographically, especially where there are fewer lakes and ponds to moderate the flows. Flooding occurs fairly often in smaller streams and tributaries, usually in conjunction with melting snow and spring rains. Extremely low flows, due either to low precipitation and high evapotranspiration, or to freezing temperatures in the northern regions, occur in midwinter (February) or during the late summer and early fall (August, September). Streamflows during the "critical month" (one in which the difference between the mean streamflow and instream requirements is greatest) of an average year vary from 34 percent of average annual flows in subregion 102 to 68 percent in subregion 106.

It is difficult to draw conclusions concerning specific streamflows in each subregion on the basis of these figures, because the streamflow figures refer only to streamflow at an outflow point for the subregion and are not representative of any one river segment within the basin.

Ground Water

The most productive aquifers in New England are the glacial deposits of unconsolidated sand and gravel along the region's major water courses (Figure 1-6). Induced infiltration of surface waters into aquifers from nearby streams has allowed sustained yields of up to 1 million gallons per day (mgd) in some prime areas. However, the parameters affecting groundwater availability, such as thickness of deposits, overall terrain, and precipitation, vary widely, and most wells in New England do not benefit from induced recharge because they are too far away from surface waters. Therefore, although potentially the most productive (their specific yield, a measure of the amount of water available from storage by gravity drainage, is estimated to be 20 percent in New England sand and gravel deposits), the total yield from unconsolidated aquifers is lower than from some other types of aquifers, and totals about 1.2 billion cubic feet.

Consolidated (bedrock) aquifers in New England are of three types of rock--crystalline, carbonate, and sedimentary. Pre-Triassic crystalline sources generally have a small yield (less than 12 gallons per minute--0.5 percent specific yield), but are so widespread that they account for alomst half of the total volume of water available from storage: 2.7 billion cubic feet. Carbonate rock accounts for about 1.1 billion cubic feet of water, while water supplies from the region's sedimentary rock amount to only 0.35 billion cubic feet.

There are two major problems which limit the use of ground water in New England, both relating to contamination. The high levels of contaminants occur naturally in the region, among which are iron and manganese, found in localized supplies throughout New England; sulfates, occurring in central parts of Massachusetts, Connecticut, and parts of northern Vermont; fluorides, found in parts of New Hampshire; and naturally radioactive materials which leach into supplies in some parts of Maine. A more severe but more controllable problem is contamination through leaching or induced infiltration from polluted rivers, landfills, and septic sys-

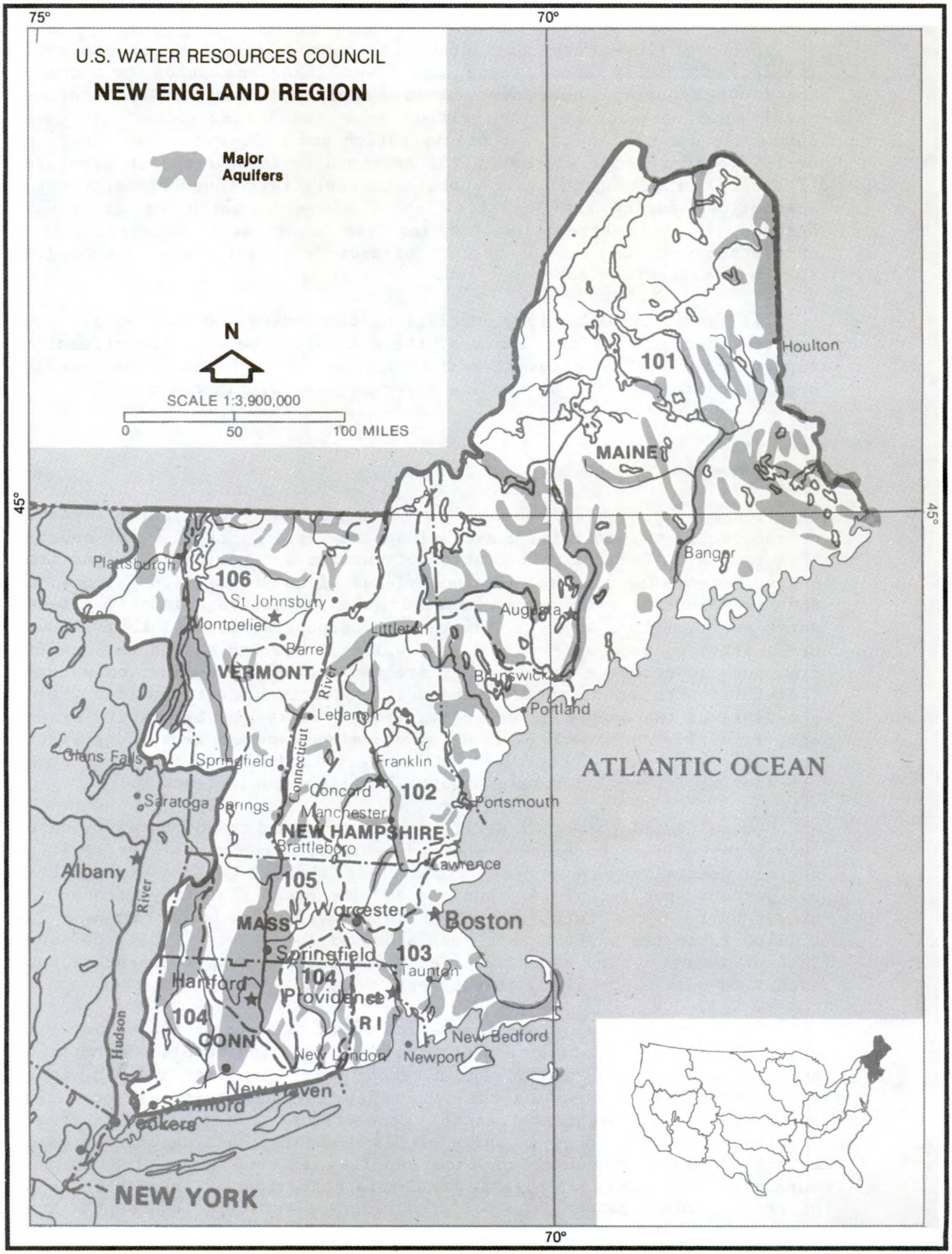


Figure 1-6. Major Aquifers

tems, and through salt-water intrusion due to over pumping along New England's coast.

Water Withdrawals

Annual fresh-water withdrawals from surface- and ground-water sources in the New England Region were 5.1 bgd in 1975 (Figure 1-7). Although 5.8 percent of the total U.S. population lives in this region, New England's withdrawals represent only 1.5 percent of the Nation's total fresh-water withdrawals. Manufacturing used 43 percent of the total, steam electric production used 25 percent, and domestic use accounted for a little more than one-fifth of the total.

Withdrawals for domestic water supplies were greatest in subregion 103 (Rhode Island and coastal Massachusetts) and smallest in subregion 106 (Richlieu). The Connecticut River Basin (subregion 105) is the largest total user, withdrawing 1.84 bgd. In addition, this subregion exports an average of about 179 mgd to the Boston metropolitan area in subregion 103. The largest user for manufacturing purposes is northern Maine (subregion 101), with the paper industry accounting for 79 percent of the total 784 mgd withdrawal.

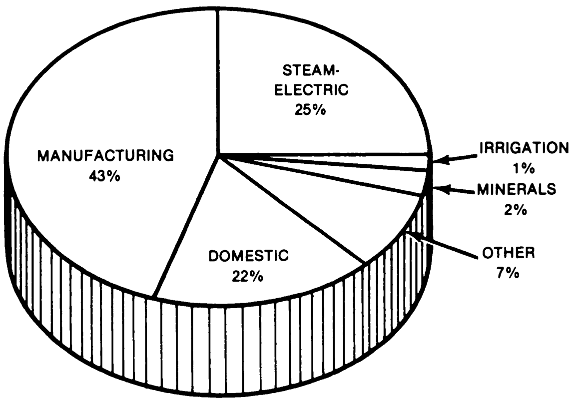
Ground-water withdrawals account for 12 percent of total withdrawals with a heavy dependence on such sources in subregions 102 (Merrimack), 103 (Massachusetts-Rhode Island coast), and 104 (Housatonic-Thames). In 1975, 5.2 bgd of saline water was withdrawn in the region; more than half of that amount was used in subregion 103.

In 1975, the region's total annual fresh-water withdrawal was about 5.1 bgd, and by 2000 it is expected to be only about 3.2 bgd (Figure 1-8). This projected decrease of 37 percent by 2000 is based on National Future (NF) assumptions of increased water recycling procedures by industries due to the "no discharge" requirements of the Federal Water Pollution Control Act (a 64-percent decrease in total manufacturing use is predicted for 2000) and the increased use of saline water for the cooling of steam electric plants (a 4.95-bgd increase in total saline withdrawals is expected by 2000).

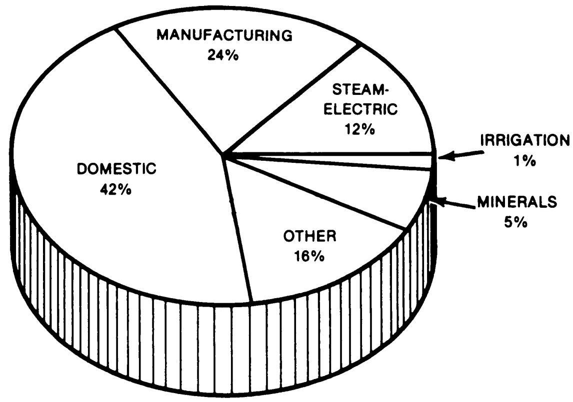
Water Consumption

Fresh-water consumption (loss by evaporation, transpiration, or incorporation into products) is expected to gradually increase from 0.48 bgd in 1975 (Figure 1-7) to 1.06 bgd in 2000 in the New England Region. The same National Future assumption of increased water recycling which results in the projections of decreased withdrawals noted above is also primarily responsible for this increase in projected water consumption, mainly through evaporative losses from cooling ponds or towers during the recycling process. Compared to nationwide figures, consumption rates in this region are relatively low. As would be expected from the comparable withdrawal rates, manufacturing currently accounts for almost half of this loss, about 40 percent. However, domestic use now accounts for

FRESHWATER WITHDRAWALS

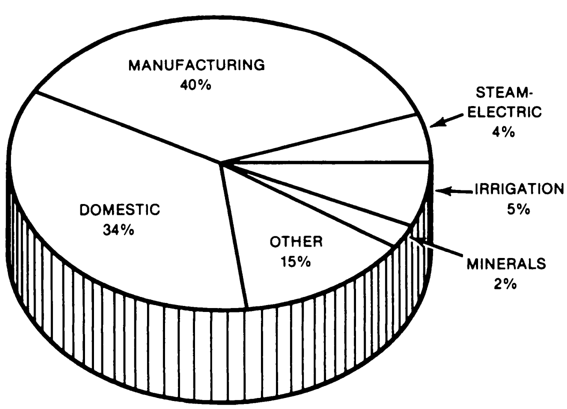


1975
Total Withdrawals — 5,098 MGD

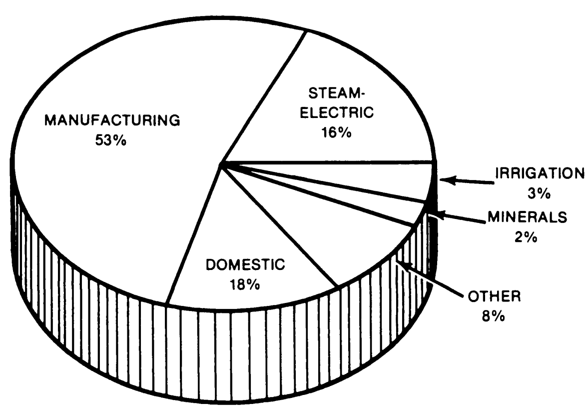


2000
Total Withdrawals — 3,230 MGD

FRESHWATER CONSUMPTION



1975
Total Consumption — 481 MGD



2000
Total Consumption — 1,063 MGD

Figure 1-7. Withdrawals and Consumption

34 percent of consumption, whereas domestic withdrawals in 1975 amounted to about 22 percent of withdrawals. Extensive lawn watering, an important component of domestic consumption, may have been responsible for this relatively high percentage. Subregion 103 (Massachusetts-Rhode Island coast) recorded the highest domestic consumption figures in the region while subregion 101 (northern Maine) had the highest manufacturing consumption figures.

By 2000, manufacturing use is expected to account for 53 percent of total fresh-water consumption (Figure 1-7). Again, this reflects the increased recycling expected in New England, partially in response to the Federal Water Pollution Control Act's "no discharge" requirements. The largest increase in consumption between 1975 and 2000 will be in the steam electric category, where rates will increase from over 4 percent of total consumptive uses to 16 percent as cooling waters are evaporated during the recycling process. These increases are comparable to national figures.

Instream Uses

Instream flow needs include recreation, waste disposal, navigation, fish habitat, and hydroelectric power production. However, NF figures are available only for fish and wildlife and navigation uses. It is estimated by the State-Regional Futures (SRF) that hydroelectric power production will require about 2.3 bgd in subregion 101 (northern Maine), about 1.2 bgd in subregion 104 (Housatonic-Thames), and about 5.0 bgd in subregion 105 (Connecticut River). Other subregions in the New England Region presently have hydroelectric facilities that have installed capacities of 25 mW or less. Flow needs for hydropower are not projected to change by 2000.

Annual average instream flow approximations for fish and wildlife were calculated by the U.S. Fish and Wildlife Service as follows: 33.4 bgd in subregion 101; 8.8 bgd in subregion 102; 4.0 bgd in subregion 103; 4.2 bgd in subregion 104; 11.0 bgd in subregion 105; and 7.6 bgd in subregion 106. Total instream flow needs for the entire region thus amount to 69.0 bgd. It is important to note, however, that the Fish and Wildlife Service added a qualification to its figures: ". . . expressing instream flow estimates for aquatic life within the fluvial waters of a basin as large as the subregions at the outflow point of a subregion is biologically unsound . . . we submit these products on the assumption that their inclusion will result in conclusions that are closer to (the) truth than if no quantification of instream flow estimates were made."

Water Supply and Demand

Not unexpectedly, the streamflows of "water rich" New England are far in excess of the water withdrawal and consumptive requirements of the region. However, it is equally clear that in a great number of cases, the region's water quality is not appropriate for municipal water supplies and, in some cases, not even for industrial use. There are many areas, particularly in the more populated southern New England States, where water supply shortages could become severe within the next 10 to 25 years if existing sources are not protected, new sources are not acquired and developed, and water supplies are not conserved and used as efficiently as possible. In addition, it should be remembered that the streamflow refers only to the flow at the exit point (or points) of each subregion or, for the region, to the total flow at these points. Such figures are thus extremely difficult to relate to water requirements within the subregions and within the region. Certainly these figures do not reflect local water supply shortages and abundances, which are determined by the volume of flows within the subregion, not at its exit point. The following general analysis of streamflows and water use in New England should be considered with these caveats in mind.

As of base year 1975, fresh-water withdrawals in the region as a whole used 6.5 percent of the NF's total streamflow. Consumptive uses accounted for almost 10 percent of withdrawals, or less than 1 percent of the region's total flows in an average year. By subregion, these percentages vary. For example, withdrawals in subregions 103, 104, and 105 account for 26.3 percent, 12.2 percent, and 14.7 percent of average year flows, respectively, while in the other three subregions, 101, 102, and 106, withdrawals claim 2.1 percent, 4.2 percent, and 2.6 percent, respectively. Consumptive requirements are largest in subregions 101, 103, and 105, but represent only about 7 to 11 percent of withdrawal rates. By 2000, withdrawals in all subregions are expected to decrease (because of reuse of water), averaging only 4 percent of total streamflow in an average year, regionwide. As explained above, recycling will increase consumption figures to approximately 33 percent of withdrawal, or about 1 percent of average year flow, by 2000.

New England's streamflows are also of importance when dealing with instream uses of water, but here again, the use of figures which relate only to outflow points of a subregion or the region require cautious analysis. The U.S. Fish and Wildlife Service's statement that "expressing instream flow estimates of aquatic life within . . . a basin as large as a subregion is biologically unsound " should be even more pertinent when an area as large as the New England Region is being considered. Moreover, the regional streamflow figures, which also reflect flows at the exit points of the subregions, do not reflect local instream conditions any more than they provide accurate indicators of local water shortages or abundances. For these reasons, a comprison of subregional or regional streamflows and instream needs should not be taken as indicative of specific conditions within each basin.

Because the instream flow approximations for maintaining aquatic habitats, which were developed by the Fish and Wildlife Service, are stringent, there are often many months during dry years when flows are lower than the service's estimated needs. For example, instream flow approximations exceed streamflows for all 12 months in a dry year in all subregions. In general, however, it is estimated that flows must be lower than 40 percent of a stream's natural flow (its flow if no consumption were to take place) in order to endanger aquatic life. In no case, either presently or in the future, are streamflows in New England projected to fall below 60 percent of their natural flows. Under base year conditions, the instream flow approximation never exceeds streamflow in any subregion. However, local variation in flow, due to regulation for hydropower or other uses, may significantly decrease flows within each basin.

Comparative Analysis

Table 1-5 compares the National Future (NF) and State-Regional Future (SRF) estimates of streamflows and water use in the New England Region. For withdrawal and consumption estimates it was necessary to adopt the National Future information as New England's State-Regional Future. This use should not imply full review and acceptance of the National Future data; instead, it reflects the lack of State information on a subregional basis. State data collection programs are addressing the information gap revealed in some of the resource categories. As it becomes available, more precise information will be incorporated into the continuing water assessment and basin planning programs. However, the subregions are not now appropriate geographic units for most State resource programs.

Values for streamflow at the outflow point in Table 1-5 represent the estimated streamflow of the region in an average year under present and future conditions of consumptive use, imports, exports, and reservoir evaporation. The slight difference between SRF and NF is attributed to differing population estimates.

Table I-5.--Socioeconomic and volumetric data summary: the New England Region

Category	1975 NF	1975 SRF[a]	1985 NF	1985 SRF[a]	2000 NF	2000 SRF[a]
SOCIOECONOMIC DATA (1000)						
Total population	12,492	12,380	13,613	13,442	15,313	14,965
Total employment	5,460	5,460	6,204	6,204	7,209	7,209
/OLUMETRIC DATA (mgd)						
-Base conditions-						
Total streamflow	78,661	NE	78,661	NE	78,661	NE
Streamflow at outflow point(s)	78,180	77,870	78,014	NE	77,598	NE
Fresh-water withdrawals	5,098	5,098	3,939	3,939	3,230	3,230
Agriculture	53	53	60	60	65	65
Steam electric	1,263	1,263	1,069	1,069	375	375
Manufacturing	2,170	2,170	1,022	1,022	781	781
Domestic	1,122	1,122	1,223	1,223	1,356	1,356
Commercial	361	361	393	393	442	442
Minerals	90	90	115	115	153	153
Public lands	2	2	2	2	3	5
Fish hatcheries	37	37	55	55	55	55
Other	0	0	0	0	0	0
Fresh-water consumption	481	481	647	647	1,063	1,063
Agriculture	43	43	48	48	52	52
Steam electric	21	21	18	18	167	167
Manufacturing	192	192	332	332	567	567
Domestic	164	164	179	179	196	196
Commercial	48	48	52	52	58	58
Minerals	11	11	16	16	20	20
Public lands	2	2	2	2	3	3
Fish hatcheries	0	0	0	0	0	0
Other	0	0	0	0	0	0
Ground-water withdrawals	635	664	NE	NE	NE	NE
Evaporation	0	0	0	0	0	0
Instream approximation						
Fish and wildlife	69,001	69,001	69,001	69,001	69,001	69,001

NE - Not estimated.

[a] The New England River Basins Commission adopted the National Future as New England's State-Regional Future for withdrawals and consumption because of the lack of State information on a subregion basis.

Problems

One of the primary purposes of the national assessment has been to identify the severe resource problems in each of the Nation's 21 regions. In New England, representatives from State, Federal and regional agencies, as well as private individuals concerned with the region's resource problems, participated in the identification of water and related land issues of vital interest in New England. The following problem descriptions discuss, by function, the resource issues which proved to be of major concern throughout the region. Recommendations addressing many of these issues will be presented in a later section of this chapter, and problem area summaries, in yet another section, will focus on specific problems in the region's river basins and coastal areas.

Water Quality

New England's population and development densities, its older urban centers with often antiquated waste collection and treatment facilities, and its concentrations of manufacturing and industrial activities, constitute some of the causes of water quality degradation in the region. Important sources of water pollution are discussed below.

Point Source Pollution

Since passage of the Federal Water Pollution Control Act (Public Law 92-500), the Environmental Protection Agency (EPA) and the States have made impressive efforts in the field of water quality, spending billions of dollars to restore New England's waters to at least Class B, or "fishable-swimmable" quality. Currently, most of New England's thousands of miles of upland tributaries have substantially retained their original high quality and meet at least Class B standards. Moreover, as of January 1977, approximately 3,309 of the 6,543 miles, or 51 percent of New England's major river main stems and tributaries had achieved or maintained at least Class B quality.

The treatment of industrial wastes in New England is showing particularly marked improvement. As of July 1, 1977, 338 out of 402 of the region's major industrial dischargers (84 percent) were utilizing best practicable technology (BPT), as mandated by Public Law 92-500, at their treatment facilities. However, although millions of dollars worth of municipal waste-water treatment facilities are currently under construction, only 58 percent of the 360 municipal sources provided secondary treatment by July 1. State water resource agencies currently estimate that pollution from some remaining point sources, particularly combined sewer overflows and substandard municipal discharges, in addition to continued degradation from nonpoint sources (see following section) will prevent at least 10 percent of the region's principal main stems and tributaries from meeting Class B standards by 1983.

There are several major problems associated with complete abatement of point source pollution. Insufficient funding for the construction, operation, and maintenance of waste-water facilities at the local level may delay treatment of municipal discharges. A related problem concerns the fact that even though costly treatment facilities are often not necessary or appropriate in rural communities, alternatives to treatment plant construction, such as well-monitored and regulated septic systems or small treatment systems, are not currently funded by EPA under Public Law 92-500. In the past, planning for sewering and treatment has not always included a thorough evaluation of the potential impacts of these systems on community growth nor, in the case of coastal communities, has it always taken into account the effects of ocean discharges on the depletion of fresh surface and groundwaters.

In urban areas, aging collection systems and combined sewer overflows may significantly retard the improvement of water quality. For example, Boston has identified 125 combined sewer overflow points in its major system connected to the treatment plant on Deer Island. In the southeastern New England Region it is estimated that of the 3.4 million people served by municipal sewers, 60 percent are connected, either directly or indirectly, to combined sewers. Costs of correction are extremely high. In its 1976 Water Quality Report to Congress, the Connecticut Department of Environmental Protection estimated that it would cost about $100 million to correct combined sewer overflows into New Haven harbor and 5.5 miles upstream.

The quality of urban waters is also impaired by the improper pretreatment of industrial discharges into municipal systems or by poorly trained operators of municipal or industrial treatment plants. Toxic sludges from past untreated discharges also present a problem in coastal and river waters. Moreover, sewage sludge and other toxic materials, significant byproducts of the treatment process itself, represent potential pollutants and present major treatment and disposal problems of their own.

Nonpoint Source Pollution

Surface and ground waters are currently polluted by nonpoint sources such as septic system effluents, landfill leachates, storm-water runoff from urban areas, runoff from improperly controlled agricultural and forestry practices, and poorly designed construction sites. It is difficult to quantify the amount of pollution resulting from such sources, but it has been estimated that anywhere from 40 to 80 percent of the total pollution load entering receiving waters of most cities is caused by storm-water runoff. Studies on eutrophic Vermont lakes have shown that nonpoint sources often account for more than 50 percent of the annual phosphorus load. The Environmental Protection Agency estimates that 41 percent of the New England population is served by solid waste disposal facilities that do not meet State requirements for prevention of water contamination. In Rhode Island and eastern Massachusetts, where about 30 percent of the population currently use on-site tanks and cesspools, the New England River Basins Commisssion's southeastern New England (SENE) study projects that over half of those users may eventually have to connect to sewer lines or find alternative forms of treatment because of undersized lots, poor soils, and inadequate depth to ground water.

It is clear that even if treatment of all point discharges were achieved by 1983, the goals for Class B "fishable-swimmable" waters throughout New England would not be completely met, due in part to continued pollution from nonpoint sources. While the Environmental Protection Agency has made efforts and has supported the efforts of others to control nonpoint pollution, the urgency of point source pollution and the relative ease with which point sources can be identified and addressed have prevented until recently full consideration of nonpoint pollution control. However, the development of areawide waste treatment management plans mandated by Section 208 of the 1972 Federal Water Pollution Control Act are scheduled to be completed shortly. Current planning and future management activities will concentrate on developing an overall strategy for the control of both point and nonpoint water pollution. One of the major problems faced by the Section 208 management program may be that of timing, as the planning and construction of treatment facilities for point sources, already well underway, may not always allow for the most efficient coordination of point and nonpoint pollution control. Another significant problem encountered by Section 208 agencies in the region is the lack of sufficient funding to adequately address the complex nonpoint pollution problems which are being discovered.

Accelerated Eutrophication

Eutrophication, which can be accelerated by human activities, causes algal blooms and weed beds which can impair recreational opportunities, lower property values, and diminish the quality of fish habitats in the region's lakes and ponds. Water pollution control agencies in the New England States have estimated that of the significant lakes in their States, those showing signs of eutrophication are: Connecticut, 24 percent; Maine, 1 percent; Massachusetts, 20 percent; New Hampshire, 5 percent; Rhode Island, 18 percent; and Vermont, 24 percent (Source: Regional Administrator's Annual Report, EPA Region I, August 1976). Marine eutrophication occurs in some harbors and enclosed areas such as the western end of Long Island Sound where tidal flushing is poor. The nutrients which cause eutrophication problems in marine and fresh waters can be contributed by either point or nonpoint sources. In some cases, upgrading of sewage treatment plants to secondary treatment causes or aggravates eutrophication of the receiving waters by making nutrients available and by reducing turbidity, thereby allowing more sunlight to penetrate and more photosynthesis and algal growth to occur. Other waste-water sources adding nutrients include drainage from septic systems, straight-piping of wastes, and in some cases, industrial discharges. In the National Future, it is estimated that over 700 million pounds of BOD (biochemical oxygen demand) are discharged in New England waters every year. Although waste water can be treated for nutrient removal, this is an expensive process which creates the problem of additional sludge disposal.

Nonpoint sources of nutrients contributing to eutrophication can include landfill leachates and drainage from shoreland development as well as runoff and erosion from construction sites and agricultural lands. In a study by the Environmental Protection Agency, for example, streams draining agricultural watersheds in the eastern United States were found to have higher nutrient concentrations than those draining forested watersheds, and nutrient concentrations were generally proportional to the percentage of land in agriculture. The difference in mean total concentrations of phosphorus was about ten-fold and nitrogen about five-fold between agricultural and forested lands. In Vermont, eutrophication of small lakes is caused primarily by nonpoint pollution. Even the Winooski River, with 17 treatment facilities, received more than 50 percent of its annual phosphorus loading from nonpoint sources. Other water bodies such as St. Albans Bay, however, receive greater nutrient loadings from point than nonpoint sources.

Because sources throughout a lake's entire watershed may contribute to its pollution, control of eutrophication often depends on a watershed-wide program.

Impacts of Dredging and Disposal of Dredged Materials

In order to accommodate desired levels of both commercial and recreational traffic in New England's ports and harbors, dredging of navigation channels is often necessary to maintain adequate channel depths. Between 1970 and 1975, the annual volume of dredging carried out in New England by the Army Corps of Engineers varied from 400,000 to 5,500,000 cubic yards. Although the volume of dredging in New England is small compared to most other portions of the country, pollution from dredging and materials disposal was identified as a problem in almost all of the region's coastal basins.

Because of the deleterious effects of the dredging and disposal process, dredging and disposal projects proposed by the Corps receive extensive review by the Environmental Protection Agency, Fish and Wildlife Service, National Marine Fisheries Service, State water quality and fish and wildlife agencies, as well as other interested persons or agencies.

In the case of projects proposed by State, local, or private interests, the permit required from the Corps for disposal in water, wetlands, or adjacent land areas must be based on a review of the potential impact of the dredging and disposal on a designated site. The dredging process can kill organisms and temporarily increase the turbidity of the water. What is usually of greater concern, however, is the disposal of dredged materials. If these consist of clean sands, they can be used for reconstruction of beaches and shorelines. In polluted areas, however, they may contain heavy metals, toxic hydrocarbons, free sulfides, and other toxic substances. Whether disposal occurs on land or in the water, protection is needed against contamination of ground and surfacewaters by these substances.

If the substrata to be dredged are highly toxic and no suitable disposal site can be found, the dredging may not be allowed to occur. A proposal by the Corps in 1973 for maintenance dredging in the upper part of Norwalk Harbor, Connecticut, for example, has not been carried out because a sufficient land disposal area is not presently available, and no satisfactory method is available for the offshore disposal of the toxic wastes. In 1973, the Corps began its Dredged Materials Research Program to look into the effects of dredging and disposal operations, to develop new techniques, and to find beneficial uses of dredged materials, such as creation of islands and marshes for recreation and wildlife habitat. Summary reports covering a wide variety of specific field studies have been published.

Discharged for Small Vessels

Surface-water quality is degraded by waste discharges from both commercial and recreational vessels. In the southeastern New England Region alone, 22 million gallons of waste water are discharged each boating season by the recreational boating fleet. Enforcement of existing Federal and State regulatory statutes is difficult, and consequently, pollution from this source continues, although the quantity of discharges is diminishing. The problem is still especially severe in crowed ports and harbors where concentrations of discharges occur, and near shellfish beds where even small amounts of pollution can adversely affect aquatic life and consequently limit fishery interests.

Water Supplies

Although New England is water rich in terms of precipitation and abundance of rivers, lakes, and streams, it may face increasingly severe water supply problems, especially in the more populous southern portion of the region, due to the poor distribution of water supplies with regard to population centers and the lack of water of sufficiently high quality to meet its growing municipal and industrial demands. The following paragraphs discuss the region's water supply problems in greater detail.

Insufficient Water Supplies

New England is generally known as a water-rich segment of the United States, with annual precipitation averaging 42 inches per year and an abundance of rivers, lakes, and streams. While this is indeed true, the poor quality of many of New England's waters often precludes their use as water supplies (see "Contamination of Water Supplies" in the following section). Moreover, the uneven distribution of the region's water supplies with regard to its major population and industrial centers, particularly in the southern New England States, has resulted in the past in the development of often controversial interbasin diversions. This practice is expected to continue as water requirements grow (see "Impacts of Interbasin Diversions" following next section).

Excessive water use and the generally high costs of water supply devlopment are two other factors that may lead to water supply shortages. Many urban areas are partially or wholly unmetered, and it is estimated that leakage through aging or faulty distribution systems may account for 10 to 15 percent of total withdrawals. Often, another 10 to 15 percent of withdrawals is unmetered for public uses such as street cleaning and fire fighting. At a general level, local costs to develop and treat (chlorinate) new ground-water sources and to operate local wells can amount to about $100 per million gallons, while the cost of developing comparable local surface supplies may be as high as $500 to $700 per million gallons. It is estimated that the latter costs could be reduced to approximately $400 per million gallons if development were regionalized, but intermunicipal cooperation is difficult to achieve. With limited opportunities for Federal assistance in financing the construction or upgrading of local water supply facilities, New England communities will find it increasingly difficult to fund the development of additional supplies, even if they are locally available.

Water conservation measures in New England as a whole have not been instituted except in cases of local shortages. As the more populated parts of the region are beginning to identify areas of decreasing water supplies and possible future shortages, communities and States will require financial assistance in setting up effective water conservation and public education programs.

Without increased efficiency in water use, conservation in both municipal and industrial sectors, preservation and protection of existing water resources, and research into advanced water saving and water augmentation technologies, New England may be faced with future shortages in its more populous areas despite its water-rich reputation.

Contamination of Water Supplies

Despite vigorous efforts on the part of some State health departments to protect the quality of existing surface- and ground-water supplies, many of these supplies continue to be threatened by contamination from both point and nonpoint sources and may be subject to contamination of their treatment and distribution systems as well.

The contamination of water supplies, which often stems from unwise land uses in water supply watersheds, from improperly located septic systems and landfills, and from pollutants such as road salt, fertilizers, or pesticides, will aggravate water shortages in the future unless existing and potential water supplies are protected. Contamination from road salting operations has been an acute problem in some areas. Whether the salt runs directly off roadways into surface waters or whether it is carried to rivers, streams, or lakes through the ground-water system, much of it may eventually reach both surface- and ground-water supplies, thereby posing an important health hazard. For example, in 1976, the water supplies in 117 towns in Massachusetts had sodium levels over 20 milligrams per liter, the limit recommended by the American Heart Association.

While ground-water mining does not pose the problem in New England that it does in the West, overpumping of ground-water supplies has resulted in salt-water intrusion and contamination of water supplies at several locations along the coast and is a particular threat on Cape Cod. Natural contamination of ground water by iron and manganese is an additional problem. Because the cost of treatment for sodium is extremely high, communities are usually forced to close water sources contaminated by salt. While the cost of treating water supplies for iron or manganese is not nearly as high, treatment still adds substantial amounts to water bills.

Contamination of water supplies may also occur in the treatment and distribution process. It now appears that potentially harmful substances may be formed by the interaction of chemicals used in some types of treatment, including chlorination, with contaminants in the water. Lead dissolved from the pipes commonly found in older distribution systems in New England is another hazardous contaminant.

Air and water quality problems overlap through a phenomenon of industrial society known as "acid rain." The combustion of fuels for electric power generation and in automobile engines releases sulfur dioxide and nitrogen dioxide into the atmosphere. These pollutants then fall to earth in raindrops as acid sulfate and nitrate ions. The ions have apparently raised substantially the acidity of surface waters in New England and in New York State, resulting in the decline of fish populations and of other aquatic organisms in some of the highly acidic ponds of the Adirondack Mountains. The long distance transport of these airborne pollutants adds another dimension to a complex water quality problem.

It is clear that without the identification of contaminants and the protection of water supplies, both at their sources and during their treatment and distribution, pollution may foreclose many opportunities to develop and deliver New England's future water supplies.

Impacts of Interbasin Diversion

While water supplies in New England are generally plentiful, clean potable water is not evenly distributed through the region, and populated areas must often rely on the resources of more rural parts of New England to meet their water needs. The interbasin transfer of water which results may cause interstate or intrastate controversy.

In Massachusetts, 115 communities "import" water across town boundaries, and there are 16 instances in the State where water supplies are diverted from one river basin to another. The largest interbasin diversion in New England involves the transfer of approximately 180 million gallons of water per day from the Connecticut River valley in western Massachusetts to the Boston metropolitan area. Increasing water needs in this predominantly urban and suburban part of the State have resulted in two proposals for additional interbasin transfers from the Connecticut Basin during times of high flow ("flood skimming"), averaging 72 and 76 million gallons per day. Both proposed diversions are extremely controversial as basin residents in western Massachusetts and Connecticut fear the effects of additional diversions on low streamflows, waste assimilation capabilities, estuarine salinity, fish and wildlife habitats, and groundwater recharge. In the case of most of New England's interbasin transfers, mechanisms for the equitable allocation of water resources, including representation of the donor basin's concerns, have yet to be established.

Demands on Public Water Supply Watershed

Increasing recreation demands conflict with the desire to protect surface water supplies from contamination by preventing recreation at reservoirs and on public water supply watershed lands in New England. Although the Safe Drinking Water Act's stringent water quality standards may impose further restrictions on the use of these areas, it is believed that the Act could also broaden recreational opportunities by necessitating the installation of treatment facilities, thereby allowing public and private water utilities to dispose of lands previously held for source protection. In Connecticut alone, 133,000 acres are held by water utilities, most within easy access of major urban areas where recreation needs are most critical. In the Fairfield-New Haven County area in southwestern Connecticut, the New England River Basins Commission's Long Island Sound Study (1975) estimated that the 12 local reservoirs could supply 3,500 picnic units and 2,700 camping units. It should be noted, however, that many parts of New England can support the required fresh-water recreational demands without relying on water supply resources. Moreover, there is currently very little information on the health effects of greater recreational use of watershed lands, with or without treatment beyond chlorination.

Historically, recreational use of water supply reservoirs and watershed lands has been restricted to protect public health. Such policies in the past were both workable and essential where water treatment was not available. Today, urban development patterns and toxic and new exotic substances found in water supplies make water treatment virtually mandatory. Improvements in water treatment technology, which are either widely used or likely to be required under the Safe Drinking Water Act, make possible the safe use of water supply reservoirs and watershed lands. Under these conditions, recreation becomes not only a compatible use, but also a very practical way to insure the public support necessary for the continued long-term protection of the watershed from the encroachment of other more intensive uses which may allow or accelerate introduction of new toxic or exotic substances.

The Federal Water Project Recreation Act, Public Law 89-72, which makes provisions for recreation as a full partner in water resource projects with other project purposes, is applicable to single-purpose water supply reservoirs provided that adequate water treatment is available. Water supply reservoirs and watershed lands can provide recreational opportunities in accordance with their capacity and suitability. The Council on Environmental Quality has examined opportunities at four northeastern U.S. reservoirs.

Inappropriate Land Use

Since virtually all land uses are integrally related to the quantity and quality of surface- and ground-water systems, no assessment of water resource problems would be complete without consideration of related land problems. This assessment therefore addresses a number of land-use issues, including solid waste disposal, coastal petroleum development, and destruction of prime agricultural lands, all of which can affect or be affected by water uses. Other problems relating to water quality, such as nonpoint source pollution or inland erosion and sedimentation, can be directly caused by inappropriate land uses. The purpose of this section on comprehensive land-use management is to acknowledge the multitude of interrelated land-use problems which affect water resources but are not covered by the other more specific sections of this report.

The major land use problem facing this country is the lack of an effective system for ensuring efficient and environmentally sound use of the land. As a result, development sprawls and valuable environmental resources are damaged or destroyed. While urban centers decline in population and face rising service costs, outlying areas are rapidly converted to large lot and highway strip development. In this cycle, vital conservation lands, wetlands, open space, and prime agricultural lands are being lost while city centers decay.

Specific problems such as loss of agricultural or wetlands areas are being addressed by a wide array of programs. There is also an assortment of tools which can be used by government agencies for land-use management, such as zoning codes, development standards, tax incentives, public works investments, or mortgage loans and insurance. What is missing is a set of broad, commonly accepted goals and objectives for development and a unifying structure within which programs for land-use control can be integrated to achieve these goals. Because comprehensive land-use management is still in its formative stages, only preliminary suggestions are made within this report.

Flooding and Wetlands Destruction

Severe flooding damages in New England involve not only imprudent development on flood plains and in coastal areas, but also the filling of wetlands which would have otherwise provided flood protection for downstream development. Wetlands not only provide efficient storm buffers and natural flood storage areas, but also serve as valuable wildlife habitats and conduits for ground-water supplies. New England's flooding problems, and the related issues of wetlands destruction, are outlined below.

Extensive Flood Damages

Flooding as a natural phenomenon performs some important hydrologic and biologic functions. Periodic overflows deposit fertile alluvial soils, facilitate the migration of some species of anadromous fish, recharge ground-water supplies, and provide for stream habitat renewal and the maintenance of productive wetlands. However, riverine and coastal flooding can also endanger personal safety, cause property damage, and diminish recreation opportunities where incompatible uses are located in flood-prone areas. Historically, New Englanders have developed in or near these areas because of the many amenities which these lands afford, such as prime agricultural soils and nearby water for energy, transportation, and domestic supply. The most vulnerable locations are frequently the most desirable as well, but the people of the region have attempted to protect themselves from the effects of floods by building structures such as dams and dikes. Unfortunately, development in the flood plain often increases downstream damage by preempting lands which were capable of storing or holding flood water.

Immediately after a major disaster, such as the hurricanes of 1938 and 1954, public concern for preventing flood damages is high, but this interest tends to fade with the memory of the losses. Thus, rebuilding in the flood plain has continued. Obviously, this pattern of development invites future damages. Lured by the advantages of locating near the water, industrial, housing, and commercial developers have taken the risk; similarly, many seasonal cottage dwellers have gambled that their homes will not be hit during their short term of ownership. Luckily, New England has not had a major flood or hurricane in 20 years. But sooner or later, the sea and the rivers will reclaim these lands.

The worst flooding episode in New England over the last 50 years occurred in September 1938 when 500 lives were lost, along with actual dollar losses of $300 million, in Connecticut, Rhode Island, and Massachusetts. There have been eight other major floods in the region since 1927; seven of the disasters involved fatalities and losses ranging from $45 million to $350 million. Since 1927, almost $500 million from Federal, State, and local sources has been invested in public projects to reduce the threat of flooding at high-hazard locations in New England. This total does not include investment in projects to lessen flood damages by other than structural means. For 1975, the average annual flood damages for the region have been estimated by the National Future to be about $92 million, in 1975 dollar values. The areas which suffered the most from flooding are in central and southern New England in the Connecticut River Basin, the lower Merrimack and the Housatonic basins, and along the coast in Connecticut, Rhode Island, and Massachusetts. By the year 2000, damages are expected to reach $153 million according to National Future projections, an increase of about 67 percent over 1975.

Where State or local flood-plain zoning ordinances to control additional development in flood-prone areas have not been enacted or enforced, increased flood damages have resulted. Existing flood-plain or shoreline managment programs may not be adequately enforced, due to insufficient local or regional funding and inadequate local knowledge concerning the full impacts of granting zoning variances in flood prone areas. Moreover, flooding can be further aggravated on some rivers through cumulative failure of many small, poorly maintained dams during periods of intense flooding. Without a balanced approach to both structural and nonstructural means of floodplain management based on the interrelationships between upstream activities and downstream flooding, flood damages and the threat to life and property will continue to rise in New England.

Destruction of Wetlands

Pressure from both rural and urban development threatens destruction of many of New England's coastal and inland wetlands. Since the early 1900's for example, Connecticut has lost 40 percent of its coastal marshlands, and less than 1,500 acres remain. About 20 percent of Massachusetts' tidal marshes have been filled in, leaving approximately 4,200 acres. On Long Island, nearly 30 percent of the coastal wetlands disappeared between 1955 and 1964 alone, and development pressures continually become more intense. Inland wetlands are similarly threatened. For example, it is estimated that 82,600 of Massachusetts' 309,413 acres of fresh-water wetlands of over 10 acres in size are in imminent danger of being altered.

It is important that both coastal and inland wetlands be protected because of their numerous valuable functions, including the retardation or storage of flood waters, the provision of food and habitat for many fish and wildlife species, and in the case of fresh-water wetlands, the protection of potable water supplies. Wetlands are also one of the most productive types of ecosystem. Evidence of this is the fact that two-thirds of the value of the commercial catch of fish and shellfish landed on the east coast of the United States come from species that live at least part of their life cycle in coastal marshes or estuaries. The estuaries and marshes are about ten times as productive as the coastal waters, which in turn are about ten times as productive as the open ocean. Moreover, some fresh-water wetlands provide the route through which precipitation seeps into underground water supplies.

Although all New England States have some laws designed to protect wetlands, enforcement has been difficult because of problems involving the specific definition and subsequent identification and mapping of individual wetlands. Acquisition is expensive, and local or State funds to purchase key wetlands are often unavailable or insufficient.

Erosion and Sedimentation Damages

Erosion, a natural process which is often aggravated by human activities, can cause property damage and lower water quality. Erosion from construction sites, road banks, and agricultural and forestry operations results in the loss of valuable topsoil, and the resultant sedimentation degrades stream quality and increases the need for dredging of harbors and navigation channels. Erosion of beaches and shorelines can be natural or caused by poorly planned coastal development, construction on barrier beaches, or overuse of recreational sites. Structural measures to control coastal erosion in exposed areas often are not effective, or if they are, interfere with natural shoreline areas. The promulgation of realistic nonstructural regulations for devlopment control in critical erosion areas is often impeded by the lack of implementation measures at local levels.

One example of serious inland erosion caused by human activities in New England is that of potato farming in northern Maine. Here, the average annual soil loss is 7.56 tons per acre of cropland, with some fields losing up to 85 tons per acre per day. Consequences of this erosion and sedimentation include a 2 percent per year decline in crop production due to the loss of fertile topsoil, the desruction of aquatic habitats in the Aroostook River and other streams, the need for additional treatment of drinking water supplies, and the clogging of highway drains. Conservation practices are not presently widely used because of their inconvenience and expense.

Critical coastal erosion over three feet per year is occurring in many places along New England's shoreline. For example, the seaward side of Cape Cod and the southern shores of the islands of Martha's Vineyard and Nantucket, all of which comprise a recreational area of national significance, are subject to critical coastal erosion along 407 miles of their sandy beaches and 5.6 miles of their sand and gravel bluffs.

Impoundments and Fluctuating Lake Levels

The impoundment of water and its periodic release is necessary for power generation, flood control, the augmentation of river flows, the provisions of water supplies, and the retention of spring snow melts. However, impoundments often flood valuable lands and can conflict with river-based recreation, wetlands protection, anadromous fish restoration, and in some specific instances, with proposals for river designation under the National Wild and Scenic River Act. Fluctuations in lake levels caused by operation of existing impoundments can adversely affect shoreline property, recreational activities, and wildlife habitats and, in some cases, can cause severe shoreline erosion.

An administrative problem concerning fluctuations exists in Maine where shoreline owners are unable to manage the levels of reservoirs where dams are no longer in use, even though legislation exists for a transfer of management.

Natural variations in precipitation may also cause significant lake level problems. The complexity of the problem of fluctuating lake levels is evident in the Lake Champlain Basin, where they have a significant impact on fish and wildlife survival, shoreline erosion, recreation facilities, water supply intakes, and waste-water discharges. The lake's normal annual variation is about six feet. A representative erosion rate for severely eroding areas in recent years has been estimated at nearly five feet per year. This is directly related to higher than normal water levels. Flooding from high water conditions often occurs in wetlands adjacent to the lake and in certain low-lying areas.

Low Streamflows

Low streamflows can occur naturally or as a result of man's actions. In dry summer weather, streamflows in some southern New England rivers may drop to as little as one tenth the average annual flow as a result of natural factors alone. Uneven flow releases below impoundments, out-of-basin diversions for water supply, and the discharge of effluents in other basins or coastal waters are among the most important man-induced causes of low flows. On the Connecticut and Deerfield rivers, pumped storage facilities have been developed that utilize the river bed as their lower reservoir, with resultant fluctuations of from two to five feet. These conditions can cause bank slumping, disrupt aquatic habitats, reduce opportunities for canoeing, swimming, and fishing, and inhibit the assimilative capacity of some of New England's rivers. Estuarine salinity and ground-water recharge may also be affected if flow reduction is large enough. On the other hand, some fish or aquatic plant species may require natural low flows as an essential component of their habitat during all or part of their life cycle.

A shortage of quantitative information regarding the effects of low flows on river ecosystems hampers the development of realistic strategies for streamflow management and the determination of minimum flow regulations. It is important to note that maintaining minimum flows, like installing fish passage facilities, involves costs as well as benefits. At hydroelectric power facilities for example, a portion of these costs would ultimately be borne by the public. New England has approximately 3,000 dams, most of which are single-purpose in nature. Nearly half of the dams are used for recreation, over 300 for flood control, and over 700 for water supply. Fewer than 300 now produce electric power. The use of many of New England's small dams for hydropower could benefit the region economically and would help to conserve precious fuel resources. However, because most hydroelectric facilities rely on ponding, or retention of flows, to generate enough power during hours of peak demands, low flow problems may result below the plants.

Currently, the Army Corps of Engineers, the Department of Energy, and the New England River Basins Commission are conducting studies related to the development of hydropower in New England, and the Department of Energy is investigating low-head turbines. If 10 percent of the untapped dams were used for hydroelectric production, with installations averaging 5,000 kilowatts each, 1,430,000 kilowatts of additional capacity would result. This could save New England up to seven million barrels of oil per year. At $15 per barrel, this would amount to an annual savings of $105 million in oil purchases. However, operation of the dams would have to be carefully managed to ensure the maintenance of minimum flows.

Inadequate Water-oriented Recreation

There continues to be a shortage of water-based recreational opportunities in New England in spite of several major Federal and State programs designed to provide expanded opportunities. Regionwide supply and demand figures are difficult to develop due to different units of measurement from State to State and because migration to and from the region for recreational purposes is difficult to quantify.

It appears, however, that the distribution of recreational facilities is one of New England's primary problems. Recent attempts to expand recreational opportunities near urban centers have been delayed by prohibitive acquisition and maintenance costs. Nearly 4,000 acres in Narragansett Bay and 1,000 acres in Boston harbor still await adequate funding for recreational development, although in 1975 eastern Massachusetts and Rhode Island had a deficit of more than 9,000 acres of picnicking facilities alone. Less than half of the full amount of money needed for implementation of the Boston Harbor Islands project is available, despite the projected 500 percent increase in use of the islands that would result from development. Unfortunately, increasingly high costs of recreational lands and, once they are purchsed, the high costs of maintenance of the lands and facilities, are major obstacles to recreational development in much of New England.

Another primary problem is one of access. Although in certain instances recreational resources are theoretically adequate to supply the region's needs, access to the resources, because of restricted use or lack of transportation, precludes their full utilization. Opportunities for swimming, one of the most popular recreational pursuits in the region, have been limited by private ownership of lake and seashore frontage. Along southeastern New England's 1,540-mile shoreline, only 225 miles of rocky shores and beaches are available to the public. And on Long Island Sound's 600 mile coastline, there are currently only six developed State parks.

In some parts of the region, access is not a problem, but overuse is. Environmentally fragile areas such as dunes require increased protection, and the region is in need of better managed and maintained areas for dispersed recreation such as hiking and wilderness camping. Trails and camping areas in the White and Green mountains are heavily used and, indeed, are threatened by overuse. Furthermore, there are only one designated and three proposed wild and scenic rivers in New England, in addition to five wilderness areas totaling 43,000 acres under the jurisdiction of the Forest Service and Fish and Wildlife Service.

Recreational demand in New England is expected to steadily increase. For example, slips and moorings for boats are one of the greatest needs projected for the southeastern portion of the New England Region for 1990, but only 20 percent of the requirement will be met. Long Island Sound has a predicted need for access to 35 miles of beach, 1,800 more acres of campground, 1,600 acres of picnic facilities, and 46,000 additional moorings by 1990. Demands for recreation, from both residents of, and visitors to, the region will continue to increase. Coordinated planning among the New England States is required to efficiently meet the recreational needs it will face in the next 10 to 25 years.

Energy Facility Siting

Because of their regional impacts and the large amounts of land and water that they require, the siting of energy facilities needs to be carefully planned. As energy demands grow and as available water and land resources diminish, the need for this planning and regulation becomes more urgent. According to National Future projections, in the year 2000 New England will need an annual electrical generation of about 295,000 gigawatt-hours, about five times as much as the region produced in 1975. Thus, New England must produce over 200,000 gigawatt-hours of additional generation capacity in the next 25 years. Even scaling down this estimate to reflect possible conservation measures, it is clear that a significant number of new power facilities will be necessary.

The number of options available to New England for providing generating capacity to meet these future loads are limited as compared to other parts of the Nation because of the scarcity of conventional fuels in the region. Currently, New England is almost completely dependent on foreign oil and nuclear energy for electricity production.

Although development of energy facilities can have significant effects on water supplies, public health, environmental quality, and patterns of land use, there is no comprehensive plan in New England for energy facility siting. Since the late 1960's, New England utility companies have been cooperating through an organization known as the New England Power Pool (NEPOOL) to pool power supplies and to plan for future development. However, to date, State and regional government agencies have not worked together to produce a comprehensive plan for the development and siting of energy facilities. Communication and coordination are needed between the States and NEPOOL to determine the regional need for, and effects of, power development. The ability of the electric utility industry to continue to meet regional energy needs is dependent on more efficient procedures for site selection, plan review, and power facility licensing.

The Federal Water Pollution Control Act generally prohibits the discharge into water bodies of cooling waters from all new powerplants. Although cooling towers will come into increased use, once-through cooling, resulting in thermal discharges, may be allowed if it is demonstrated that its adverse effects are not significant. Thus, information is needed not only on the availability of water and land to meet energy needs, but also on the capacity of receiving waters to assimilate byproducts of power generation, especially thermal discharges. Although thermal effluents can sometimes be used for beneficial purposes such as aquaculture, they can also accelerate eutrophication, kill aquatic organisms, and damage fish, shellfish, and wildlife habitats. Because the effects of heat on many aquatic organisms are not known, the impact of massive thermal discharges often cannot be quantitatively predicted. The location of the discharge point and the type of dispersal system employed by the powerplant have a major influence on the degree of impact of thermal effluents. More information is needed on how these discharges affect individual species and what other changes they produce so that siting and design of facilities can be planned for minimum impact on ecosystems.

Coastal Petroleum Development and Transporttion

Offshore petroleum exploration and development may have a substantial impact on New England's coasts. The extent of the impact will depend on the quantity of petroleum found and the techniques used for its discovery, extraction, processing, and transportation.

As a general example, the New England River Basins Commission's Resource and Land Investigations Study (RALI) has developed a "medium find" scenario consisting of 900 million barrels of oil and 4.2 trillion cubic feet of natural gas which would require the following onshore facilities:

- 4-5 temporary service bases
- 6-12 permanent service bases
- 1 platform installation service base
- 1 pipeline installation service base
- 1 pipecoating yard
- 2 pipelines and landfill sites (both for natural gas)
- 2 gas processing and treatment plants

Development of these facilities would require something in the order of magnitude of 600 acres of land and 600 million gallons of water per year. If a refinery were added, an additional 1,000 acres and 5 billion gallons per year would be required. Information is needed on suitable sites both along the coast and inland for facilities such as these.

Unlike the electric utility industry, the petroleum industry is intensely competitive, which hampers joint industry-government cooperation in facilities planning. Careful planning will be needed, however, to protect environmental quality and provide the land and water needed for facilities development. Coordination for this type of planning is possible through New England's Coastal Zone Task Force, created in 1974 through the New England River Basins Commission to provide a means for the States to work together on coastal problems of common interstate, regional, or Federal-State concern.

Even if no offshore oil and gas are discovered, exploration will be carried out. In addition, transport of imported petroleum through New England's coastal waters will have to increase to continue meeting the region's rising energy needs.

Stringent regulation is needed to minimize the probability of oil spillage and to protect New England's recreation and commercial fishing industries.

The Coastal Energy Impact Program, established by the 1976 amendments (Public Law 94-370) to the Coastal Zone Management Act and administered by the Federal Office of Coastal Zone Management, is designed to help States minimize the social, economic, and environmental impacts of coastal energy development. By helping States to plan for and provide needed public facilities and services while limiting unavoidable losses of environmental or recreational resources, the program should help to balance the need for new energy facilities with the need to protect other land and water uses in New England's coastal zone.

Depressed Commercial Fishing Industry

Commercial fishing has declined over the past several decades. Landings in 1975 were down 54.5 percent from 1950. Key factors in this decline appear to be obsolete equipment and increasing labor and financing costs. The cost of fuel alone may be as much as 10 percent of the total value of the catch. In addition, shellfish beds have been closed due to pollution and more stringent health standards, and estuarine habitats are continually threatened by the filling of salt marshes and the potential adverse effects of offshore oil exploration and development. Competition from foreign vessels has been a serious problem in the past. In 1974 the United States took only 13.3 percent of the catch from George's Bank. Such competition and overfishing along New England's coasts should be mitigated if the recent Fisheries Resources and Conservation Act of 1976 (200-mile limit) is properly enforced. A rise in recent New England catches on George's Bank, as much as 25 percent greater than catches before the 200-mile limit went into effect, appears to bear this out and could bring renewed propserity to the rest of the fishing industry.

Limited Anadromous Fish Restoration

Anadromous fish, such as Atlantic salmon, striped bass, sturgeon, searun brook trout, shad, alewife, and smelt, once constituted a major portion of the commercial fishing industry in New England. Dams and other obstacles to streamflow, in addition to poor water quality, have limited migration and virtually eliminated all anadromous species from a number of rivers. Fishways, the improvement of water quality, and some stocking may eventually restore this resource, but inadequate funding at all governmental levels hampers program coordination. Of the 15 major dams on the main stream of the Connecticut River, eight are hydroelectric power facilities. Fish passage facilities are expensive, and where they are installed at power facilities, costs are reflected by increased electrical rates. Northeast Utilities projects that the fish passage at Turner's Falls on the Connecticut will cost $14.4 million. Fishways at three hydroelectric power facilities upstream are projected to cost about $7 million apiece. Design capacities for the fishways on these dams range from 40,000 to 20,000 Atlantic salmon and from 1 million to 750,000 shad, according to distance upstream. A rough estimate of the increased cost to affected consumers is about 15 cents on the average (500 kilowatt-hours) monthly bill.

Loss of Prime Agricultural Land

Prime agricultural lands throughout New England are being lost to residential and commercial development or are being abandoned as farmland. For example, the number of farms in Massachusetts has declined since World

War II from 35,000 to fewer than 5,000, with the number of farmland acres plummeting from over 2 million to about 575,000 in the same period. In the interval between 1945 and 1969, New England States lost the following percentages of their farmland:

Connecticut	66%
Maine	62%
Massachusetts	66%
New Hampshire	70%
Rhode Island	74%
Vermont	51%

(Source: U.S. Census of Agriculture)

Similarly, in the years from 1959 to 1969, the number of farms in Maine dropped from 17,360 to 7,791, a decrease of over 50 percent. The conversion or abandonment of New England's agricultural lands is causing not only a reduction of what amounts to a nonrenewable resource, the region's food producing capacity, but results in a loss of key esthetic and cultural assets as well. Since prime agricultural lands often coincide with flood plains and aquifer recharge areas, development is not only a less suitable use, but also destroys the natural flood protection or ground-water replenishment characteristics of these lands.

Mineral Exploration and Development

Throughout most of New England there are valuable mineral resources, especially sand and gravel deposits and crushed stone. In addition, coal deposits in the Narragansett Basin are currently being evaluated for their development potential in light of the region's increasing energy needs. Total mineral production in 1970, principally from sand and gravel mining, amounted to approximately $173.5 million. Over 15 million tons of sand and gravel were mined in the southeastern New England region alone. Because deposits are localized and transportation costs are very high (10 to 12 cents per ton per mile), mineral sites lost through development for uses which preempt extraction can deal a heavy blow to the mining industry and to its primary consumer, the construction industry.

The lack of good data on the specific location, character, and extent of mineral deposits throughout New England allows continued unnecessary loss of these resources. In addition, extraction of sand and gravel has often occurred in the past without regard to social and environmental impacts. Municipalities have consequently severely limited extraction operations, leading to underutilization of resources. Because of the proximity to markets and the relatively low costs of barge transport, it is anticipated by some experts that sand and gravel extraction in the shallow waters of the near-shore area will increase substantially during the next decade. As yet, however, the effects of such mining or the potential conflicts with other uses in New England's coastal waters have not been fully evaluated.

Loss of Key Historical and Prehistorical Sites

New England, with its abundance of water resources, contains many water-related historic and archeological sites. Many are threatened by development because they are invisible above ground (Indian encampments, burial grounds) or because they have outlived their usefulness (water-powered mills, old wharf areas).

Existing preservation programs lack funds to purchase known sites and to adequately survey for archeological remains. In Massachusetts alone, 2,355 archeological sites have been identified. There is generally less education and concern for the preservation of our prehistoric heritage than for our historic heritage, and through lack of identification, significant portions of potentially productive sites are destroyed each year.

Individual Problem Areas

Figure 1-8a shows the location of the problem areas that have been identified by the regional sponsors. Figure 1-8b is a tabulation of of regional, State, and local resource issues in New England that have been identified by State and Federal agency representatives, resource planning agencies, water planners, and concerned citizens. The region was divided into 22 problem areas:

1. St. John River Basin
2. St. Croix and Maine Eastern Coastal
3. Penobscot River Basin
4. Maine Central Coastal
5. Kennebec River Basin
6. Androscoggin River Basin
7. Presumpscot River and Casco Bay
8. Saco and Maine Southern Coastal
9. New Hampshire Coastal
10. Merrimack River Basin
11. Massachusetts Coastal
12. Narragansett Bay
13. Blackstone River Basin
14. Pawtuxet River Basin
15. Pawcatuck River Basin
16. Connecticut River Basin and Connecticut Central Coastal
17. Connecticut Western Coastal
18. Housatonic River Basin
19. Thames River Basin and Connecticut Central Coastal
20. Lake Champlain Basin
21. Lake Memphremagog-St. Francis River Basin
22. Long Island Sound

The text that follows describes each problem area and highlights the most severe problems.

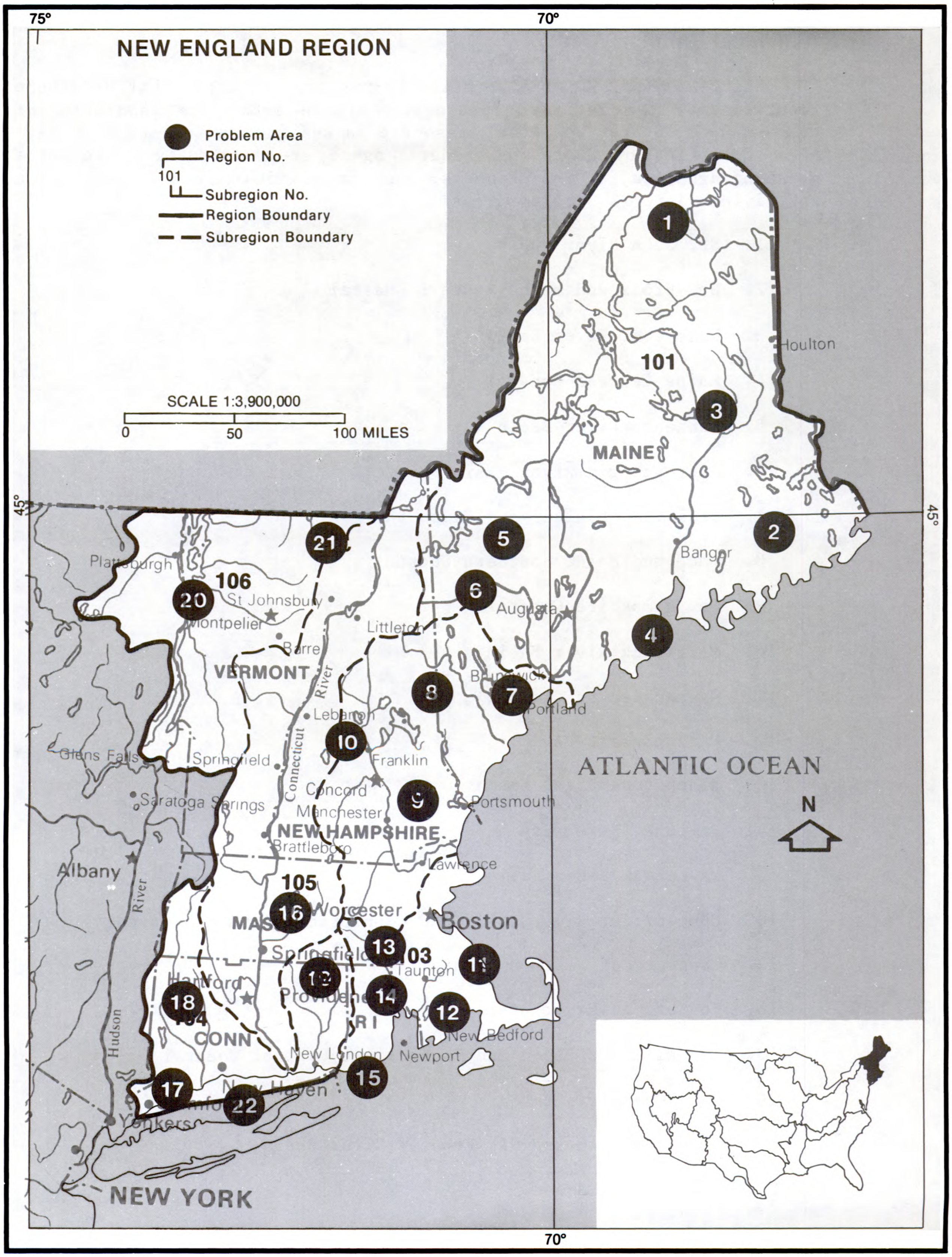


Figure 1-8a. Problem Map

NEW ENGLAND REGION (1)

PROBLEM MATRIX

O= Identified by Federal Agency Representatives X= Identified by State-Regional Representative

Problem area		Problem issues													
No. on map	Name	Water quantity				Water quality				Related lands					
		Fresh surface	Ground	Marine and estuarine	Surface/depth	Fresh surface	Ground	Marine and estuarine	Surface/depth	Flooding	Drainage	Erosion and sedimentation	Dredge and fill	Water related use conflicts	Other
Subregion 101	Northern Maine					O		O				O		O	
Area 1	St. John River Basin	X				X	X			X		X		X	
2	St. Croix and Maine Eastern Coastal					X	X	X		X			X	X	
3	Penobscot River Basin		X			X	X			X			X	X	
4	Maine Central Coastal					X	X	X		X		X	X	X	
5	Kennebec River Basin					X	X			X		X	X	X	
6	Androscoggin River Basin					X	X			X			X	X	
Subregion 102	Saco-Merrimack					O							O	O	
Area 7	Presumpscot River and Casco Bay					X	X	X		X		X	X	X	
8	Saco and Maine Southern Coastal	X	X			X	X	X		X		X	X	X	
9	New Hampshire Coastal	X	X			X	X	X		X		X		X	
10	Merrimack River Basin	X	X			X	X	X		X		X	X	X	
Subregion 103	Massachusetts-Rhode Island Coastal	O				O	O			O		O	O	O	
Area 11	Massachusetts Coastal	X	X			X	X	X		X		X	X	X	
12	Narragansett Bay	X	X			X	X	X		X		X	X	X	
13	Blackstone River Basin	X	X			X	X			X		X		X	
14	Pawtuxet River Basin	X	X			X	X			X		X	X	X	
15	Pawcatuck River Basin	X	X			X	X			X		X		X	
Subregion 105	Connecticut River	O		O		O				O			O	O	
Area 16	Connecticut River Basin and Conn. Central Coastal	X	X			X	X	X		X		X	X	X	
Subregion 104	Housatonic-Thames	O		O		O		O		O			O	O	
Area 17	Connecticut Western Coastal	X	X			X	X	X		X		X	X	X	
18	Housatonic River Basin	X	X			X	X	X		X		X	X	X	
19	Thames River Basin and Conn. Eastern Coastal	X	X			X	X	X		X		X	X	X	
22	Long Island Sound		X			X	X	X						X	
Subregion 106	Richelieu				O							O		O	
Area 20	Lake Champlain Basin		X			X	X			X		X		X	
21	Lake Memphremagog-St. Francis River Basin													X	

Figure 1-8b. Problem Matrix

Problem Area 1: St. John River Basin Area

Description

The St. John is an international river basin, located in Maine and in the Canadian provinces of Quebec and New Brunswick. Of the basin's 21,360 square miles, the 7,360 square miles in Aroostook County, Maine, compromise the St. John problem area. Major rivers in the U.S. portion of the basin include the upper St. John, Allagash, Fish, Aroostook, and Meduxnekeag, and the Prestile Stream. The Allagash is included in the National Wild and Scenic River system.

The western portion of the basin is totally forested and lightly settled; most of the population is concentrated along the Maine-New Brunswick border, and key labor market centers include Fort Kent, Madawaska/Van Buren, Caribou/Presque Isle, Houlton, and Patten/Island Falls. In 1970, the population of the problem area was 88,000, yielding an average population density of 12 persons per square mile.

Aroostook County is one of the major potato producing areas in the country, and the production of starch and processed foods such as potatoes and peas is an important industrial activity. The production of pulp, paper, lumber, and wood products is also a major element of the area's economy. The relative wilderness of the area provides recreational experiences and preserves ecosystems that are unique in the New England Region.

The Northern Maine Regional Planning Commission has been awarded a grant to develop an areawide waste-water management plan under Section 208 of the Federal Water Pollution Control Act. The 208 Water Quality Plan covering the nine towns in central Aroostook and Prestile subbasins was completed in July 1977. Work is currently in progress on the other nondesignated communities in the remainder of the region.

Problems

Water Issues

Pollution from the pulp and paper industry, the food processing industry, and especially from agricultural runoff has degraded water quality in the St. John and Aroostook rivers for many years. Although it appears that recent improvements in the treatment of industrial discharges will result in significant upgrading of water quality, 43 of the assessed stream miles in the basin are not expected to meet Maine's Class B standards by 1983. The most severely degraded segment in the St. John Basin lies on the main stem between Madawaska and Grand Falls and on the Aroostook River between Presque Isle and Caribou. There is little recreational use of the river below Presque Isle.

A recent study of water quality on the St. John, conducted by the International Joint Commission, recommends that negotiations leading to a water quality agreement between the United States and Canada should begin immediately and that the two countries should adopt specific water quality objectives for the river in order to preserve, maintain, and improve its present benefits.

Water supplies in the St. John River Basin are generally plentiful for domestic, industrial, and agricultural purposes. As part of its St. John Basin Study, the Corps of Engineers is currently investigating whether crop production can be increased if additional irrigation is used in the basin. If so, additional water supplies may have to be developed. The Corps' interim report on irrigation and agricultural erosion was scheduled for completion in mid-1978.

Related Land Issues

Flooding has been a serious problem in some communities of the St. John Basin. While Fort Kent's flood damages exceeded $3 million in 1974, a dike completed by the Army Corps of Engineers in October 1977 now substantially protects the town's central business and residential district. The authorized Corps of Engineers Dickey-Lincoln School Lakes hydroelectric project, which would provide 830,000 kilowatts of generating capacity for peaking power to the New England grid, would also provide flood control benefits to other downstream communities. However, the regional and local benefits of this project are currently being weighed against the impacts it will have on the basin's resources and recreational opportunites. The project would flood some 278 miles of streams, including 66 miles of the St. John River, covering 88,000 acres of timberland, fish and wildlife habitats, and other resources. Construction of the dams would create opportunities for lake recreation, but the existing river recreational uses would be substantially reduced. The Corps published a Draft Environmental Impact Statement in August 1977, which inventories existing environmental conditions and addresses some of the potential impacts of the proposed project. The Corps' St. John River Study is investigating flooding problems along several tributary streams.

Erosion from agricultural lands has not only resulted in the loss of valuable soils but has also caused significant siltation in the area's surface waters. Siltation has affected fish habitats and degraded water quality with pesticides and nutrients from fertilizers. Furthermore, a soil loss study by the Northern Maine Regional Planning Commission as part of its "208" investigations showed that the average annual soil loss in the nine-town 208 area was 7.56 tons per acre of cropland. The study conservatively estimated that over 117,000 tons of soil are deposited annually in the surface waters of central Aroostook County, which produces 85 percent of the vegetables (principally potatoes) grown in New England. Soil conservation is one remedy for the current decline in agricultural production.

Problem Area 2: St. Croix and Maine Eastern Coastal Area

Description

This problem area consists of most of Washington and Hancock counties on Maine's easternmost coast. The northern portion of this area drains into the St. Croix River, which, with its headwater tributary, Monument Brook, forms part of the international boundary between Maine and New Brunswick, Canada. Approximately 60 percent of the St. Croix Basin's total area lies in the United States and thus in the problem area. The southern part of the problem area is drained by a number of coastal rivers, including the Dennys, East Machias, Machias, Pleasant, Narraguagus, and Union rivers. Some of the coastal lands along the southwestern bountry of this area drain into Penobscot Bay.

The year-round population for this area in 1970 numbered about 65,000 people; population concentrations are found in Calais, Eastport, Machias, Jonesport, Ellsworth, and Bar Harbor.

Lumbering and the manufacturing of paper and wood products are the major industrial activities in the heavily-forested St. Croix Basin, while the coastal communities are centers of commercial fishing and tourism. Farming is a significant activity in some of the southern towns in the problem area, but becomes less important in the north. One of the region's major recreational facilities is Acadia National Park, located on Mt. Desert Island, and Schoodic Point. Opportunities for hunting, fishing, camping, and swimming are abundant throughout the problem area.

Problems

Water Issues

Recent improvements in the treatment of pulp and paper discharges and the discontinuance of log driving on the St. Croix River have significantly improved the river's quality, and fish have returned to some of the St. Croix's previously polluted reaches. Unfortunately, a persistant source of pollution, not readily corrected, is that of the sediment oxygen demand created by years of untreated paper and pulp mill discharges. In its 1977 report on Maine's water quality status, the Maine Department of Environmental Protection characterized the sediments as "the major water quality problem" expected in the lower ten miles of the river in future years.

Improper subsurface disposal of waste water, along with individual point source discharges or undertreated municipal discharges into coastal rivers in the problem area, have also degraded the area's water quality and resulted in the closing of many coastal clam flats, particularly in Hancock County. As in many other parts of the New England region, the lack of local funding for the construction, operation, and maintenance of treatment facilities may delay water quality improvements.

Related Land Issues

Flooding is a problem in this area due both to continuing development in its flood plains and the loss of flood storage wetlands to development and, potentially, to large-scale peat mining in Washington County. The potential cumulative failure of poorly maintained small private dams in the basin represents another possible flood hazard. Currently, some of the smaller communties in this problem area do not have zoning ordinances or management programs which, with the National Flood Insurance Program, are adequate to guide growth away from flood plains and wetlands.

Lake level regulation for hydropower generation has also been identified as a matter of concern in the problem area. For example, the rapid fluctuations of lake levels required for power generation on Graham Lake in Hancock County cause shorefront erosion and sediment loading in the lake, limit access to some of the summer camps on the shore, and harm fish habitats. The regulations concerning fluctuating lake levels on Graham Lake and other lakes used for hydropower are currently inadequate to control shoreline erosion.

Problem Area 3: Penobscot River Basin Area

Description

The Penobscot River Basin consists of 8,910 square miles in northern Maine, more than one quarter of the State. The major rivers within the basin are the Penobscot's east and west branches and its main stem, and the Mattawamkeag, the Piscataquis, and the Passadumkeag rivers. The east branch of the Penobscot and all but 15 miles of the west branch have been recommended for inclusion in the National Wild and Scenic Rivers system.

Most of the area's population is concentrated in the southern portion of the basin near Bangor. The basin's 1970 population was approximately 184,000. Presently, most industrial development within the basin is located within a 25-mile radius of Bangor. The area's predominant industry is pulp and paper. The Penobscot Valley Planning and Development District, which covers 73 organized townships, has been designated as a 208 areawide waste treatment management planning agency by the Governor.

Problems

Water Issues

Water quality remains a major resource issue in the basin, despite recent improvement in the quality of discharges from pulp manufacturing. A 14.6 mile segment on the main stem of the Penobscot between Millinocket Stream and Weldon Dam is not expected to meet Maine's Class B standards in 1983 due to continued pollution from sedimentary deposits in the streambed and some remaining pulp and paper discharges. Municipal discharges into the main stem from Old Town, Bangor, and Brewer also degrade water quality, and in some cases local funds are inadequate to provide for the construction or upgrading of municipal treatment plants. Recreation acttivities and fish habitats are adversely affected by poor water quality in these areas and by eutrophication on Pushaw Lake, west of Old Town.

While water supply is currently not a major resource problem in this basin, there is concern that future supplies may be insufficient. This concern stems from a lack of data concerning the availability of groundwater supplies for rural use and insufficient information regarding the dynamics of ground-water recharge and contamination. Inadequate identification and protection of potential ground-water resources in the basin could result in future shortages for both rural and urban areas.

Related Land Issues

Flooding is a problem of some concern in portions of the Penobscot River Basin. The Piscataquis River has caused extreme flash flood damages, and the presence of poorly maintained small private dams in the basin increases the chances of potentially severe flooding in both rural and urban aras. Development on wetlands may also rob the basin of some of its most valuable flood storage areas.

Currently, the basin lacks an adequate flood-plain inventory. Thus, implementation of a realistic flood management program is hampered. Flooding damages will continue if such a program is not instituted.

Problem Area 4: Maine Central Coastal Area

Description

The Maine central coastal area comprises most of Knox, Lincoln, and Sagadahoc counties, and all but the northeast and northwest corners of Waldo County. The basin is drained by numerous streams, among them the St. George, Medumcook, Medomak, Pemaquid, Johns, Damariscotta, Sheepscot, and Back rivers. In addition, the problem area includes the mouths of the Androscoggin and Kennebec rivers, which flow into Merrymeeting Bay, and small streams flowing into Penobscot Bay. The problem area consists of aproximately 1,200 square miles.

The area is predominantly rural, with a total 1970 population of about 80,000. Many of the inhabitants live in the four major municipalities in the southern portion of the area: Bath, Topsham, Rockland, and Belfast. This portion of the area experienced a growth rate of 10.7 percent between 1960 and 1970, due primarily to its proximity to the cities of Augusta and Portland and to the availability of undeveloped land for industrial, commercial, and recreational uses. On the other hand, the northern portion of the area experienced an overall decrease in population.

Commercial fishing, fish processing, and boat building and repair are significant economic activities in the coastal communities of this area, while textile manufacturing, farming, and lumbering predominate in the inland areas. Tourism is increasing steadily, and Belfast, Camden, Rockport, and Boothbay Harbor are well-known summer resorts.

The Southern Mid-Coast Regional Planning Commission, located primarily in this problem area, is currently working on a water quality management program for its twenty-seven coastal communities.

Problems

Water Issues

The improper disposal of solid wastes has been identified as one of the major threats to water quality in this problem area. Communities do not have the money or the land required to deal adequately with the solid waste disposal problem. Other nonpoint sources such as septic tank effluents and livestock wastes pollute the area's ponds and streams, while point discharges from municipal combined sewers and ocean products plants have been responsible for the closing of coastal clam flats. Some of the communities that need treatment facilities are low on the construction timetable, and it is expected that their waste waters will continue to pose a water quality problem in the area for at least the next ten years.

As part of its water quality management program for communities in this area, the Southern Mid-Coast Regional Planning Commission will examine residential sewage disposal, municipal solid waste disposal, agricultural operations, general erosion problems, and other types of nonpoint pollution.

Related Land Issues

Natural forces of erosion along central Maine's coastal beaches have been accelerated by poorly planned development. Erosion problems are particularly serious at Popham Beach in Phippsburg and in the area of Reid State Park. More complete knowledge of the effects of shoreline development and recreation on the erosion of the area's beaches would allow the State, through the Shoreland Zoning and Subdivision Control Act, to more effectively control coastal erosion.

Problem Area 5: Kennebec River Basin Area

Description

The Kennebec River Basin is located in west-central Maine and constitutes nearly one-fifth of the total area of the State. The basin extends abut 166 miles, (including 21 miles of tidal reach) from Moosehead Lake to Merrymeeting Bay at Abagadasset Point. Major tributaries include the Moose and Roach rivers in the headwater area, the Dead, Carrabasset, Sandy, and Sebasticook rivers, and Austin, Messalonskee and Cobbosseecontee streams.

The northern half of the basin is in the White Mountains physiographic region, an eastern extension of the White Mountains in New Hampshire, while most of the southern half falls within the New England upland area. Sugarloaf Mountain, at an elevation of 4,237 feet, is the highest point in the basin. Over 75 percent of the total land area is forested; much of the rest is used for cropland, pasture, and dairy and poultry production.

The northern half of the basin is sparsely populated. Community populations in this portion of the basin rarely exceed 1,000 people and many of the unorganized territories are unpopulated. Population in the southern half of the basin is greater and is concentrated primarily along the main stem. Major economic centers are Waterville (1970 population 18,192), the State capital, Augusta (1970 population 21,945), and their surrounding urban areas. Secondary population centers are Skowhegan (1970 population 7,601), Farmington (1970 population 5,657), and Pittsfield (1970 populaion 1,617). Many communities in the southern half of the basin have experienced population increases averaging approximately 22 percent between 1960 and 1970.

Timber harvesting has played an important role in the economy of the basin for over 150 years and continues to dominate land and water use in the north. In the lower portions of the basin, cut timber is used for pulp and paper manufacturing. Other important economic sectors in the south include tanning, textile production, and government services. Services and accommodations for the many vistors enjoying the recreational opportunities in the basin are an important source of income to local inhabitants. There are highly developed and popular recreational areas around the southwestern shore of Moosehead Lake, the five Belgrade Lakes west of Waterville, and the lake area near Augusta. Commercial navigation, transportation of distillate fuel oil and fresh fish, and testing and delivery of boats built at Bath, are conducted chiefly on the 21 mile tidal portion of the river.

The Southern Kennebec Valley Regional Planning Commission is conducting a 208 study in a "designated" area in the southern one-third of the basin. The study focuses on land and water uses in the Cobbossee Lakes drainage, and nonpoint source pollution. In addition, the State Department of Environmental Protection is coordinating planning in "nondesignated" areas of the basin with the two other regional planning commissions whose jurisdiction falls within the basin's boundaries (North Kennebec and Androscoggin Regional Planning Commissions) and the Land Use Regulation Commission.

Problems

Water Issues

Combined sewer overflows from the primary treatment plant in Augusta, raw sewage discharges from Farmingdale, Gardiner, Hallowell, and Randolph on the Kennebec River, and from Newport, Pittsfield, Clinton, and Winslow in the Sebasticook drainage area, seriously degrade the water quality of the lower Kennebec, the Sebasticook, and the east branch of the Sebasticook. There are 45 overflow points in the Augusta system alone. Combined sewer systems in this and other communities may have to be separated before treatment is begun or upgraded, despite the prohibitive costs involved. Costs of correcting the combined sewers in the Augusta system are presently estimated at $90 million. Storm-water runoff, runoff of sediments and fertilizers from the southern agricultural areas, and other nonpoint sources also contribute to poor water quality in the Augusta area. The Sebasticook main stem from Hartland to Winslow and the entire east branch are expected to be below Maine's Class B standards by 1983. The Augusta portion of the Kennebec River also may not meet these standards in 1983 due to overflows and runoff. The pollution limits swimming and recreational fishing and seriously harms the local commercial fishing industry.

The Maine Department of Environmental Protection has initiated enforcement action against an Augusta scrap yard which was identified as a source of polychlorinated biphenyl (PCB) contamination. Oil from one of the scrap yard's lagoons which eventually drains into the Kennebec River, showed extremely high PCB concentrations, on the order of one or two percent.

Lake eutrophication is prevalent in the southern half of the basin, primarily due to an increase in seasonal and year-round home development on shorelines, which may increase erosion and leachates from improperly placed septic systems. The eutrophication is also attributable to runoff from agricultural lands. Some of the eutrophic lakes are used for public water supplies; other higher quality supply lakes are threatened and may require an increase in treatment of the water before distribution.

Related Land Issues

Although control of Moosehead and Flagstaff lakes offers some flood water storage, there has been extensive flooding in the upper portion of the basin, due in part to its steep, mountainous topography. Potentially, the cumulative failure of some of the old, poorly maintained small dams in the basin increases the risk of flood damages in both rural and urban areas. Although flood damages are low when compared to other portions of New England, average annual damages range from $100,000 to $500,000 in Augusta, Gardiner, and Farmington. Insufficient implementation of the Department of Housing and Urban Development's Flood Insurance Program and the lack of flood-plain management at the State and local levels has hampered flood damage reduction.

Inadequate regulations for sand and gravel extraction may give rise to water-related use conflicts. Current State law regulates activity in pits over five acres, but these constitute only a small portion of the total resources. Because there is little information concerning the overlap of sand and gravel sites with prime aquifers and recharge areas, the severity and extent of this problem has not been determined. However, if no regulations are promulgated, unregulated mining may destroy aquifer recharge areas and possibly pollute the basin's ground-water resources. Moreover, with no reclamation requirement, other uses of the pit areas following extraction may not be possible.

Problem Area 6: Androscoggin River Basin Area

Description

The Androscoggin River Basin lies in northeastern New Hampshire and western Maine and encompasses approximately 3,400 square miles. Major tributaries include the Little Androscoggin, the Ellis, Swift, Webb, and Nezinscot rivers. The northern portion of the basin includes the rugged terrain of the White Mountains in New Hampshire and the Longfellow Mountains in Maine. Mount Washington, the highest peak in the northeastern United States, and the other summits of the Presidential Range separate the Androscoggin Basin from the Connecticut and Saco river basins.

The Androscoggin flows 161 miles from its source at Lake Umbagog in New Hampshire to tidewater at Brunswick, descending a total of 1,245 feet, 789 of which have been developed by private interests for hydroelectric power purposes.

Industrial and population centers in the problem area include Rumford, Mexico, Lewiston, Auburn, and Lisbon in Maine, and Berlin and Gorham in New Hampshire. Pulp and paper manufacturing are key industries in the basin (90 percent is forested), followed by machinery, shoe, and textile production. Service employment, farming, and, to a growing extent, tourism, are important economic activities. The headwaters of the Androscoggin main stem are popular for canoeing, camping, fishing and hunting, while skiing is becoming a major winter activity in the middle basin.

The Androscoggin Valley Regional Planning Commission, which consists of ten communities in the basin, has been designated as a 208 areawide waste treatment planning agency.

Problems

Water Issues

One of the most polluted stream segments in New Hampshire, the main stem of the Androscoggin from Berlin to the Maine-New Hampshire border, receives wastes from the paper industry and from combined sewers in Berlin and Gorham. Although the paper company discharges will comply with at least New Hampshire Class C effluent limitations, significant pollution will continue until the municipal overflows are corrected. It is also expected that municipal discharges from Norway and Paris, Maine, and municipal and industrial discharges from South Paris, Maine, will prevent 6.3 miles of the Little Androscoggin River, from Paris to Oxford, from attaining Maine's Class B standards by 1983. Local, and in some cases private industrial, funding to correct major sources of pollution in the basin is currently inadequate and will continue to delay pollution abatement efforts. Furthermore, nonpoint pollution resulting from the improper disposal of sludge, septic system leachates, and highway salt threatens the quality of the problem area's ground waters.

Related Land Issues

Flood hazards are considerable in portions of the Androscoggin problem area, particularly along the Dead River and on the main stem in Berlin, Gorham, and Shelburne, New Hampshire. Old, poorly maintained, small private dams increase the potential for flood damages, as does continuing incremental development on the area's flood plains.

Problem Area 7: Presumpscot River Basin and Casco Bay Area

Description

This problem area consists of the land in southwestern Maine that drains into the Presumpscot River and Casco Bay. While the headwaters of the Presumpscot originate at Songo Lake in the White Mountain National Forest, the river itself originates below Sebago Lake, the second largest lake in Maine, at the towns of Standish and Windham. The Presumpscot then flows southeast for 24 miles to its mouth at Casco Bay, between Falmouth and Portland. The Songo and Crooked Rivers and Long Lake feed into Sebago Lake while the Presumpscot's major tributaries are the Pleasant and Piscataquis rivers, and the Little River in Gorham. Principal coastal streams that also drain into Casco Bay are the New Meadows, Royal, Stroudwater, and Nonesuch rivers. Scarborough Marsh, the largest salt marsh in Maine, lies in this problem area. Casco Bay is located between Cape Small, Phippsburg, and Cape Elizabeth.

The problem area includes Portland, Maine's largest city (1970 population, 65,000). The Portland metropolitan area is the most populous section of Maine. The 1970 population of the entire problem area was approximately 175,000 is projected to be over 195,000 by 1990.

Portland is the principal distribution and industrial center for Maine, and high levels of manufacturing activity occur in the Portland, South Portland, and Westbrook area. Portland Harbor, the third busiest waterway in New England, handles the highest tonnage of commercial goods in the region and received over 27.5 million tons of waterborne commerce in 1975. Crude pertroleum and petroleum products account for over 90 percent of these goods; other commodities include fresh fish and shellfish. Tourism, recreation, dairying, and poultry and vegetable farming are other important activities in the problem area.

Problems

Water Issues

Poor water quality in the lower Presumpscot River is aggravated by storm-water runoff and by the decreased streamflows that occur when a major paper company shuts down, temporarily impounding the river's waters. The low flow problem, which is especially severe for one week in July, reduces capacity to assimilate municipal wastes, places stress on aquatic habitats, and impairs recreational uses of the Presumpscot. If the low flow problem remains, the river will routinely meet Class C standards or better with the exception of the period in July when its waters are temporarily impounded. If the problem is resolved, the river would meet at least B_2 standards except under severe runoff conditions.

Coastal water quality in the problem area is affected by storm-water runoff and straight-piping of waste water into Portland Harbor. Serious bacterial pollution results. Moreover, shellfish areas in Scarborough are contaminated by improper underground waste-water disposal and storm-water runoff. Even if pollution from septic systems is eliminated, increased bacterial pollutants in the runoff from developing shoreline areas will remain a problem.

Improper subsurface disposal, combined with a high water table, is also responsible for some contamination of individual private ground-water supplies in this problem area. The regulation of subsurface disposal has been a major focus of the Greater Portland Council of Government's 208 areawide waste management study. It appears that the most cost-effective solution to this disposal problem will be the strict enforcement of the State plumbing code and the enactment of community regulations requiring periodic inspection and maintenance of all septic systems.

Related Land Issues

Maintenance dredging for commercial and recreational navigation is especially necessary in this problem area, particularly because Portland Harbor is the nearest deep-water port to Europe and, thus provides a strategic commercial gateway to Canada and the northern United States.

However, the disposal of dredged material, if poorly planned, has the potential of harming marine fish and shellfish habitats. Additional knowledge concerning the environmental effects of dredged material disposal, as well as proper planning, will be necessary to protect the marine environment of Casco Bay.

Conflicting land uses are a growing problem in the more populous parts of this area. As second home development, suburban sprawl, and recreational uses of the basin and coastal resources increase, greater pressure is placed on the area's water supplies, water quality, and fish and wildlife habitats. Communities are now beginning to face and plan for the social, economic, and environmental effects of growth heretofore considered characteristic only of the southern New England States.

Problem Area 8: Saco and Maine Southern Coastal Area

Description

The Saco River Basin covers an area of 1,697 square miles. Originating below Saco Lake in Crawford Notch, New Hampshire, the Saco flows through the White Mountain National Forest, entering Maine at Fryeburg, and continues its 125-mile course to the Atlantic Ocean at Biddeford and Saco, Maine. Eleven industrial or utility dams have been developed on the river's main stem to harness its power. The Saco's major tributaries include the Ossipee, Little Ossippee, Ellis, and Swift Rivers.

This problem area includes portions of Carroll, Grafton, and Coos counties in New Hampshire, and York and southern Oxford counties in Maine. It is generally sparsely populated, except for centers such as Biddeford, Saco, and Sanford, Maine, and Conway, New Hampshire. However, the summer population in many of the coastal communities may be three or four times greater than the winter population. Manufacturing, tourism, and commercial fishing are important economic activities in the coastal towns and along the Maine portion of the Saco River; recreational activities and tourism are the mainstay of the New Hampshire portion, followed by wood-using industries (90 percent of the New Hampshire portion is forested). There is also some dairy and poultry farming in the area.

The Southern Maine Regional Planning Commission, which involves nine communities in the problem area, is an areawide waste treatment management agency under Section 208 of the Federal Water Pollution Control Act.

Problems

Water Issues

Water quality on the Saco is relatively good, but pollution of the river is occurring from a woolen mill in Parsonsfield, Maine, a fiberboard plant in Buxton, Maine, and a tannery and waste treatment plant in Saco. A 2 1/2-mile segment in the basin, Goosefare Brook in Saco, is not expected to meet Maine's Class B standards by 1983, nor is a 12-mile segment of one of the coastal streams, the Mousam River, expected to be "swimmable-fishable" by that date.

Over 90 percent of southern Maine's coastal clam flats are closed due to pollution, particularly during the summer months when seasonal visitors place severe stress on the area's treatment facilities. Many of the tidal flats close at the beginning of the tourist season and reopen at its end. The Southern Maine Regional Planning Commission, through its 208 waste management effort, has suggested that alternatives to large sewer systems and treatment facilities ought to be investigated, as the larger facilities would allow unwarranted development in many coastal communities.

Water supplies in the problem area are presently sufficient, but may become less abundant in the future, due to contamination from septic system leachates and increased seasonal home development. Localized water supply shortages for both domestic and industrial use may develop in the New Hampshire portion of the Saco Basin within the next 25 years, especially during summer months as the increased seasonal population places heavy demands on the area's resources. In the Maine portion of the problem area, the lack of sufficient funds for water supply development and the lack of proper protection and preservation of existing supplies may combine to create future water shortages.

Related Land Issues

Urban and rural flooding caused by hurricanes and spring runoff result in damages to the problem area's homes, croplands, and recreational areas, as well as to industrial buildings, especially in Biddeford, Maine, and the lower reaches of the basin. Extreme flash flooding risks exist throughout the Saco Basin and are most severe in Fryeburg, Maine. The lack of maintenance of small private dams on the basin's rivers increases the danger of severe flooding due to the threat of cumulative failure during times of high stream flow.

Increased development in the problem area has placed greater demands on its natural resources. Coastal and streambank erosion, often due to development on shorelands, has resulted in the narrowing of beaches and the lowering of water quality in the area's rivers and streams. Valuable agricultural soils have been lost to erosion and will continue to be lost unless more effective farming practices are instituted. Development has also resulted in recreational problems, limiting public access to some of the problem area's rivers and great ponds as well as threatening fish and wildlife habitats through lowered environmental quality or through the mere proximity of suburban or recreational development to previously unsettled forests or streams.

Problem Area 9: Hew Hampshire Coastal Area

Description

This problem area comprises the New Hampshire portion of the Piscataqua River drainage basin and the New Hampshire coastal basins, which extend from the Piscataqua watershed to the New Hampshire-Massachusetts border. The area covers approximately 830 square miles, and its coastline is approximately 16 miles long. The Piscataqua River, which is tidal for its entire 13-mile length, is formed by the confluence of the Salmon Falls and Cocheco Rivers between Rollinsford and Dover. Portsmouth Harbor, along the lower reaches of the Piscataqua River, is the most important waterway in the area. Nearly 3 million tons of petroleum products, limestone, salt, and other products were received in 1975. Other rivers in the Piscataqua Basin include the Isinglass, Lamprey, and Exeter.

The area's topography ranges from low mountains and steep hills in the northwestern section of the Piscataqua River Basin and low, rounded hills in the southern portion of the basin to a gently rolling plain, bordered by salt- and fresh-water marshes, along the coast. The 1974 year-round population of the area was approximately 147,000, although seasonal vacationers add significantly to this figure in coastal communities. Recent population growth has been concentrated mostly in the coastal and tidal sections of the area, as well as in the vicinity of Dover and Rochester. Towns north of Rochester are expected to remain rural, while the populations of the southern communities are most liely to increase. Portsmouth, Dover, and Rochester are the three largest cities in the area.

Primary economic activities in the problem area include industrial and residential development and commercial lobstering. The area's major industrial centers include Seabrook, Dover, Portsmouth, Rochester, and Somersworth. Dairy and poultry farming are the predominant agricultural activites in the inland communities, but agriculture as a whole is of minor importance along the coast.

Problems

Water Issues

Population growth in the coastal and tidal sections of this problem area has caused biological pollution of some of the coastal waters, particularly Great Bay. Recreational and commercial shellfishing have been severely limited by this pollution, and it is questionable whether New Hampshire's present pollution abatement mesures will sufficiently reduce pollution to reopen the Great Bay clam flats and oyster beds.

Inland water quality has also been adversely affected by development.

Significant eutrophication has occurred in eight lakes whose total of 820 acres comprise 17 percent of the problem area's lakes and ponds over 20 acres in size. Algal growth in these lakes has been accelerated by shoreline uses, among them domestic, agricultural, and industrial discharges. Continued eutrophication will decrease recreational opportunities, degrade fish habitats, and diminish the esthetic value of the area's lakes until the nutrient sources are controlled.

There are current uncertainties regarding the adequacy of in-basin ground- and surface-water supplies to satisfy the problem area's reasonable short-term growth needs. The Army Corps of Engineers' Southeast New Hampshire Water Supply Study (1976) has indicated that by 1980 water supplies in several area communities, among them Epping and Raymond, will not be sufficient to meet the demands placed upon them. Continued contamination and depletion of existing ground-water supplies may result in increased competition among domestic, manufacturing, refining, recreation, and preservation interests for the use of inadequate fresh surface-water supplies. Salt-water intrusion caused by overpumping ground-water aquifers along the coast has already occurred to a minor extent in Portsmouth and may further reduce the availability of the area's ground-water supplies.

Related Land Issues

The problem area's limited land resources, combined with increasing development pressures, have created land-use conflicts, especially in the more populous southeastern portion of the area. Conflicting desires for additional residential and key industrial development, increased recreational facilities, extended transportation corridors, and preservation of wetlands and flood plains for flood protection will continue to increase and could develop into major problems if effective State and local land-use regulations are not established and enforced. Current development threatens natural resources, increases the chance of severe flooding damages, and precludes public recreational access to many of the area's great ponds and lakes.

Problem Area 10: Merrimack River Basin Area

Description

The Merrimack River Basin covers an area of 5,010 square miles, extending from its source in New Hampshire's White Mountains to its mouth on the Massachusetts coast. The Merrimack enters the Atlantic at Newburyport, Massachusetts, and its estuary extends about 22 miles inland to Haverhill. Principal tributaries include the Pemigewasset, Winnepesaukee, and Contoocook rivers in New Hampshire; the Sudbury, Assabet, and Concord rivers in Massachusetts; and the Nashua River in Massachusetts and New Hampshire.

The total population of the basin in 1970 was approximately 1.4 million people. In the mountains and steep valleys in the northern portion of the problem area, population is sparse, and most of the northern area's residents live in the industrial and manufacturing cities of Concord, Manchester, and Nashua, New Hampshire. The largest portion of the work force in these towns is employed by service industries. The manufacturing of electrical and electronic equipment, while employing smaller percentages, also contributes significantly to the area's economy. Further south, in Massachusetts' industrial and urban centers of Lowell, Leominster, Fitchburg, Lawrence, and Haverhill, manufacturing includes textiles, leather goods, machinery, paper, plastics, and electronics. The rural and residential areas along the Assabet, Sudbury, and Concord rivers in Massachusetts include the sites of some of the earliest battles of the Revolution, the historic town of Concord, and Minuteman National Park, one of only two national parks in the Commonwealth. Further north, along the coast, Newburyport, Massachusetts, is an important recreational and charter boat harbor.

There are five 208 planning agencies in the Merrimack Basin. They are: the Lakes Region Planning Commission and the Strafford-Rockingham Regional Council in New Hampshire, and the Metropolitan Area Planning Council, Massachusetts Regional Planning Commission, and the Northern Middlesex Area Commission in Massachusetts. In addition, the Merrimack Valley Planning Commission in Massachusetts has been designated by the Governor, but has not yet received 208 funding.

Problems

Water Issues

An overriding problem facing the Merrimack River is the conflicting demand being placed upon it to provide municipal water supplies for the urbanized areas of both eastern Massachusetts and southeastern New Hampshire. Potential competition for supplies may occur between water users if the diversion of Merrimack waters, considered as a possible long-term water supply alternative for the Boston Metropolitan District Commission and/or coastal New Hampshire, is implemented. The river is also being considered as a potential water supply source for the in-basin Massachusetts communities of Littleton, Carlisle, Bedford, Acton, and Concord. Supply problems are aggravated by the high costs of treating poor quality water for domestic use and by the increasing demands for industrial supplies.

Exisitng ground-water supplies are also insufficient to meet 1990 maximum daily demands in many of the suburban towns. Increased development in the basin can pose the threat of contamination of ground-water supplies from septic system effluents. Naturally high levels of iron and manganese also limit the supply of ground water in parts of the Merrimack Basin. Without effective conservation measures and careful planning for the use of both surface- and ground-water supplies, serious shortages will develop in the problem area.

Degradation of water quality is a problem in the Merrimack and most of its tributaries. The Merrimack River and its estuary are being polluted by raw municipal sewage, combined sewer overflows, and industrial discharges, including paper product wastes, textile wastes, and silver plating chemicals. Because the entire main stem of the Merrimack is currently of Class C or lower water quality, use of the water for drinking requires expensive treatment and filtration, and opportunities for swimming, boating, and fishing are limited.

Pollution problems are also numerous on the Merrimack's tributaries. For example, discharges from a secondary treatment plant are currently polluting the Spickett River in Salem, New Hampshire, while the Nashua River in Massachusetts and New Hampshire is receiving untreated paper processing wastes, inadequately treated municipal wastes, combined sewer overflows, and urban runoff. Natural low flows contribute to poor quality in the Assabet River, where effluents from several municipal treatment facilities cannot be assimilated in spite of a low-flow augmentation project. The Sudbury and Concord rivers similarly cannot maintain high water quality because of sluggish streamflows. Portions of the Merrimack and all of these tributaries are not expected to meet Massachusetts' and New Hampshire's Class B standards by 1983.

Lake eutrophication, from both point and nonpoint sources, has also been identified as a significant problem thoughout the Merrimack Basin. In the New Hampshire portion of the basin, 51 of 297 lakes and ponds greater than 20 acres in size are reported to be eutrophic or to have other water quality problems. Many of the lakes and ponds in the Massachusetts portion of the basin also have problems with aquatic vegetation and algal growth.

Related Land Issues

The communities along the Merrimack River are subject to significant flood damages, which are estimated to reach $19 million basinwide by the year 2000. Incremental development in flood-plain areas has reduced the storage capacity of wetlands, adversely affected fish and wildlife habitats, and increased the potential for flooding damages. These problems will worsen unless future development is directed away from flood plain and wetlands areas and a comprehensive plan for flood-plain management throughout the basin is developed.

Water-related use conflicts exist in the more heavily populated portion of the Merrimack Basin, due principally to increasing development pressures. Present State and local land use regulations are often inadequate, allowing development to conflict with the preservation of natural areas and open space as well as with recreational activities in the basin. Laws ensuring public access to great ponds in the problem area are not enforced, and in many instances, shoreland development effectively precludes public recreational use. The lack of legislation, educational programs, or surveys in the Merrimack Basin leaves many of its archeological and historic sites unprotected. More comprehensive land use and water resource planning will be required to allow continued productive growth and development in the basin while simultaneously protecting its valuable natural resources.

Problem Area 11: Massachusetts Coastal Area

Description

The Massachusetts coastal problem area comprises the watersheds of all rivers in eastern Massachusetts south of the Merrimack which drain into the Atlantic Ocean. Major rivers include the Ipswich, Mystic, Charles, Neponset, and North rivers.

The basin has a total drainage area of approximately 2,300 square miles including its offshore islands. Its coastline, almost 2,000 miles long, varies from jagged headlands in the north to broad barrier beaches in the south. The mainland is gently sloping plain with elevations generally less than 200 feet, except where the scattered, glacially formed hills rise an additional 50 to 100 feet. Extensive swamps and numerous lakes and ponds are found in the lowland areas. The offshore islands, including Nantucket (about 50 square miles) and Martha's Vineyard (about 100 square miles), are characterized by low terrain with sparse vegetation. Their coastlines are composed of bluffs, dunes, sandy beaches, and tidal marshes.

The area's 1970 estimated population was 3,080,000, an increase of 9.5 percent over the 1960 population. Population density varies considerably throughout the area, from 52 persons per square mile on Martha's Vineyard to 17,000 people per square mile in Boston, and over 20,000 people per square mile in Somerville.

The problem area is heavily industrialized, with the greatest manufacturing concentrations occurring in and around the Boston area. Major industries include printing and publishing, food processing, and manufacturing of leather goods, chemicals, machinery, tools, apparel, and paper products. Commercial fishing and shipbuilding are also important industries. Boston, Gloucester, and New Bedford are among the largest fishing ports in the United States. There is dairy, poultry, fruit, and truck farming, and an area near Cape Cod produces nearly two-thirds of the Nation's cranberry crop. Along the less developed coastal areas and on Cape Cod and the offshore islands, tourism is the foundation of the economy, and is one of the major sources of pressure on the environment. Population in some of the more popular resort areas doubles or even triples during summer months.

Problems

Water Issues

Over half of the assessed mileage of rivers flowing into Boston Harbor is expected to be too polluted to meet Massachusetts' Class B water quality standards by 1983. Chemical and biological pollution from combined sewer overflows, domestic septic systems, municipal and industrial wastes, sludge disposal, landfill leachate, and runoff is degrading the quality of the

Mystic, Charles, and Neponset Rivers, threatening their value for recreational use and for fish habitat. Leachates from domestic septic systems are also contributing to accelerated eutrophication in the problem area, especially on Cape Cod and in the South Shore region.

Marine water quality is being degraded by chemical and biological pollution from combined sewer overflows (125 overflow points exist between Deer Island and the mainland in Boston Harbor), storm-water runoff, sludge disposal, and vessel wastes. As a result, some shellfish areas have been closed, and coastal recreational opportunities threatened, especially along Buzzards Bay in New Bedford Harbor and on the Acushnet River. Polychlorinated biphenyls (PCB) have also been identified as a hazardous pollutant in the Acushnet. Leachate from the New Bedford landfill, which contains 50,000 pounds of PCB is being monitored to assure that it is not causing further contamination, and industrial discharges from two principal users of PCB in the area have been significantly reduced, but the State Public Health Commission has advised against the consumption of bottom feeding fish, shellfish, and eels caught in the river. Major pollution problems exist in Boston Harbor as a result of oil spills during ship-to-shore transfers, as well as from storage tank farms. Onshore facilities associated with offshore oil development, or increased oil tanker traffic in Boston Harbor and along the Massachusetts coast, may increase the potential for oil leakage accidents.

Although adequate water supplies are currently available in most parts of the problem area, critical shortages will develop in the near future if existing supplies are not protected and either stringent conservation measures enforced or additional sources developed.

The Metropolitan District Commission (MDC), which supplies the Boston metropolitan area, is presently operating at a deficit in terms of safe yield from its water supply sources. Proposals for additional interbasin diversions from the Connecticut River to augment the MDC's supplies have generated considerable controversy in Connecticut and Massachusetts. An improved accounting system to measure municipal usage is badly needed to determine water requirements in the Boston area.

Many of the area's towns using their own ground- or surface-water sources are expected to have shortages by 1990. Ground-water shortages may develop in Wilmington, Reading, Hamilton, and Wenham (perhaps due in part to the Massachusetts policy prohibiting in-basin disposal of treated effluent to the Ipswich River). The quality of both rural and municipal ground-water supplies is being threatened by malfunctioning septic systems, runoff of deicing salt, and leachates from landfills. Naturally high concentrations of iron and manganese necessitate costly treatment in other areas. In Plymouth, Cape Cod, Martha's Vineyard, and Nantucket where ground water is the only available supply source, shortages may develop because of overpumping, salt-water intrusion, and paving over or contamination of aquifer recharge areas. Land disposal of waste water may provide a means for augmentation of ground-water supplies, but the feasibility of this technique has not been fully tested in New England.

Related Land Issues

Maintenance channel dredging is necessary for commercial and recreational navigation in Salem, Beverly, Gloucester, and Boston Harbors, and in bays on Nantucket and Martha's Vineyard (including Edgartown), but it can have detrimental effects on marine life. Clam beds in Gloucester, Newbury, Salem, Revere, and Saugus have been damaged by dredge and fill operations and various other activities. Although water quality and marine life will inevitably be affected by dredging and disposal of dredged materials, the extent of damage can be minimized by careful planning and regulation of these operations.

Coastal erosion is occurring at a critical rate (greater than three feet per year) along many sections of the shoreline in this problem area. Some of the erosion processes are natural and there is no feasible technique in highly exposed areas for halting erosion without more harmful repercussions. In other cases, coastal development and overuse of recreational areas accelerate the erosion process. Whatever the cause, however, the results of erosion include property damage and reduction of recreational opportunities. Moreover, the erosion of barrier beaches leaves coastal areas open to greater storm damages. An effective solution to these problems is to minimize damages by encouraging and relocating development away from critical erosion areas.

Coastal flooding is another problem made worse by development in naturally hazardous locations. Existing urban development on about 15,000 acres of coastal land on the South Shore is subject to damages from the 100 year tidal flood. In Scituate alone, $4.3 million in damages occurred in the 1972 storm. All of the houses on Peggotty and Humarock beaches, which were washed away in the flood, have been rebuilt on their original sites, so similar damages can be expected to occur again. In order to reduce coastal flooding damages, development should take place outside of tidal flood plains, and the buffering action of coastal wetlands and barrier beaches should be protected.

Due to high population densities and intense development pressures in some parts of the problem area, water related use conflicts occur. Development is conflicting with a number of other uses, including sand and gravel mining (North and South Shore and Cape Cod), agriculture (South Shore area), preservation of critical environmental and historic areas (Boston), and the expansion of recreation facilities (Cape Cod).

Problem Area 12: Narragansett Bay Area

Description

This problem area includes the Narragansett Bay area in southeastern Rhode Island as well as the Taunton River drainage basin which extends into

Massachusetts. The islands in the bay and Block Island, located off the Rhode Island coast, are also included. The Taunton River flows through low, flat, wetlands in Massachusetts from Bridgewater to Mount Hope Bay, the northeastern arm of Narragansett Bay, and has a drainage area of 543 square miles. The problem areas include numerous wetlands, both inland and coastal; among them is Massachusetts' largest inland wetland, Hockamock Swamp, which covers approximately 7,500 acres.

Narragansett Bay is divided into three navigation routes by Aquidnect, Conanicut, and Prudence islands. In 1975, approximatly 13.1 million tons of petroleum products and other waterborne commerce were carried in the bay. The shoreline of the bay and its major islands is approximately 290 miles in length and includes many sand and gravel bluffs, tidal coves, and estuaries. Eighteen miles of public beaches provide recreational opportunities, not only for residents of the Narragansett Bay area, but for those of other regions as well. The popularity of swimming and boating along the coast makes recreation an important source of employment in this area. Manufacturing, however, is the principal employer, with a range of products that includes textiles, apparel, fabricated metals, jewelry, machinery, and silverware. Government jobs closely follow manufacturing as an important source of income in the area. Agricultural land uses such as cranberry bogs and small dairy and truck farms are expanding in some of the rural areas.

Principal population centers include Providence, Warwick, and Newport, Rhode Island, and Brockton and Fall River, Massachusetts. Population growth in the area has been rapid, although Newport lost many residents when its naval base personnel were reduced in 1972.

Problems

Water Issues

Because the waters of Narragansett Bay receive intense commercial and recreational use, maintenance of its clean waters and improvement of its polluted waters are of great importance. Although the southern portion of the bay has generally clean water, other areas such as the Providence River and Mount Hope Bay have severe water quality problems.

Pollution of the upper Narragansett Bay is principally caused by combined sewer overlfows from the Providence, Rhode Island, metropolitan area. These overflows result in 56 direct discharges of untreated waste water and storm water into the Providence, Seekonk, Woonasquatucket, Moshassuck, and West rivers. The Rhode Island Divison of Water Supply and Pollution Control has named this problem as the number one priority in the State. Fourteen combined sewer overflows from Fall River, Massachusetts, into Mt. Hope Bay, as well as the primary effluent from the hydraulically overloaded Fall River waste-water treatment facility severely degrade water quality. Raw waste-water overflows occur even during dry weather from some of the sewers, indicating the severity of the problem. These pollution sources limit water recreation activites in Narragansett and Mt. Hope bays and close shellfishing areas in the bay during and after heavy rainfalls. Oil spills from petroleum transport tankers, as well as bilge discharges from commercial vessels, add to the pollution in Narragansett and Mt. Hope bays. Four percent (4,932 acres) of the waters of Narragansett Bay are not expected to meet Class SB standards by 1983.

Rivers that flow into Narragansett Bay are being polluted by inadequately treated municipal and industrial waste-water discharges, especially from Brockton, Taunton, and Fall River, Massachusetts, into the Taunton, Ten Mile, and Lee rivers. Streamflows in the Taunton and Three Mile rivers are insufficient to dilute wastes at their headwaters in Brockton and Mansfield, Massachusetts, respectively. Sixty-four of the stream miles in the Taunton River Basin (48 percent of the assessed miles) are not expected to meet Rhode Island's and Massachusetts' Class B standards by 1983. Urban runoff, especially from Brockton, Taunton, and Fall River, Massachusetts, also contributes to water quality problems in this area. Financing from Federal, State, and local sources is currently inadequate for the necessary construction of municipal treatment plants and the correction or treatment of combined sewer overflows in the basin.

Population growth in the Narragnasett Bay area has been rapid, and surface- and ground-water supplies are inadequate to meet projected 1990 needs in many parts of the problem area. In the Rhode Island section, imports will be required to meet the needs because in-basin sources are lacking. Ground-water sources are already scarce as a result of salt-water intrusion and thin aquifers. Ground-water supplies in many communities are polluted or threatened by pollution from landfill leachates and salt-water intrusions. Surface-water supplies are also threatened. Discharge from the Mansfield, Massachusetts, municipal treatment facility into Norton Reservoir is severely degrading this water supply source.

Related Land Issues

Upland erosion is a problem on approximately 4,000 acres of cropland and 6,000 acres of urban and developing lands in the problem area. The most severe agricultural land erosion problems are in Little Compton, Middletown, Portsmouth, and Tiverton, Rhode Island. Middletown, North Kingstown, and Warwick, Rhode Island, experience the worst urban erosion problems. Critical coastal erosion (3 feet or more per year) is occurring along 1,888 feet in Warwick, 2,400 feet in Narragansett, and 31,000 feet in Block Island, Rhode Island. Residential development on barrier beaches along the southern coast increases coastal erosion, thereby reducing storm buffers and causing flood damages to be more severe. Regulations are needed to keep development away from critical erosion areas and to prevent construction or agriculture from causing undue erosion at other sites.

Coastal areas of the basin are subject to severe flooding from hurricanes and other storms. The Army Corps of Engineers has identified Mt. Hope Bay, Newport Harbor, Warren River, Greenwich Bay, and Wickford Harbor as being within the coastal damage zone. If destruction of barrier beaches is allowed to continue, coastal flooding will become more severe. Development should be prohibited on barrier beaches and other areas that help to buffer coastal communities from storm damages.

Development pressures, both within and outside the problem area, have created water-related use conflicts with regard to recreation. The capacities of existing public beaches, marina facilities, and camping and boating areas are insufficient to meet current demands, especially on the southern coast. More than one-half of the recreation users of the area come from outside the region, and there is a problem with inadequate access, parking facilities, and rest rooms. Existing recreational facilities can meet only one-sixth of the expected 1990 demands for picnicking and camping and one-third of the demand for boat launching and marina facilities. Thus, severe shortages will develop unless new facilities are provided.

Problem Area 13: Blackstone River Basin Area

Description

The Blackstone River rises in Worcester, Massachusetts, and flows 46 miles southeastward to Narragansett Bay at Pawtucket, Rhode Island. The total drainage area of the basin is approximately 540 square miles, consisting of 382 square miles in Massachusetts and 158 square miles in Rhode Island. Parts of Worcester, Norfolk, and Bristol counties in Massachusetts and the northeastern portion of Providence County in Rhode Island are included in the basin. The Ten Mile River, located in the eastern part of the Blackstone River Basin, begins in Plainville, Massachusetts, and also flows into Narragansett Bay, draining an area of 54 square miles. Two of its largest tributaries are the Bungay and the Seven Mile rivers. The problem area also includes the Woonasquatucket and Moshassuck river basins in Rhode Island, which join to form the Providence River at Providence.

The basin is generally hilly or rolling and is one of the most heavily industrialized areas of New England. The second and third most populous cities in New England, Worcester and Providence, are located at the upper and lower ends of the basin, respectively, and there are numerous smaller communities that have grown around the manufacturing plants located along the main stem of the Blackstone and larger tributaries. The 1970 population of the Blackstone River Basin was 550,000, with an average population density of 951 persons per square mile. Population density in the Massachusetts portion of the basin is slightly lower than that of the Rhode Island portion, but displayed a growth rate of 4.2 percent between 1960 and 1970, compared to a corresponding rate of only 3.2 percent in the Rhode Island portion.

Manufacturing comprises the largest portion of the basin's economy, including 360 small textile enterprises, some of the few remaining from an industry that used to dominate New England's economy. Providence is a major seaport, ranking fourth in New England in total tonnage, most of which consists of petroleum products. Retail trade, service, and government are also significant economic activities in the problem area.

Problems

Water Issues

Municipal and industrial waste-water discharges have been identified as major threats to water quality. The discharges include combined sewer overflows from Worcester, Massachusetts, industrial discharges, and untreated waste-water from Uxbridge, Massachusetts, and discharges from the jewelry and metal finishing industries along the Ten Mile River. Untreated textile wastes are also being discharged into the Mumford River. Inadequately treated municipal wastes from Hopedale degrade the Mill River and Harris Pond, a backup source of water supply for Woonsocket, Rhode Island.

Discharges from several of the basin's industries cannot be connected to municipal sewer systems. This is due either to a lack of sufficient treatment capacity or, in the case of jewelry and metal-finishing wastes, to interference with municipal treatment processes. Most of these industries now provide individual treatment in accordance with EPA guidelines, but higher levels of treatment may be required to meet the "fishable-swimmable" goals of Public Law 92-500. Continued water pollution from deposits of metals that have accumulated in the sediments from past discharges may also delay the achievement of water quality goals in the basin. Thirteen of the assessed river miles in the Ten Mile River Basin are not expected to meet Rhode Island's Class B standards by 1983, while 77 of the assessed river miles in the main Blackstone Basin may not attain Massachusetts' and Rhode Island's Class B standards by that date.

Contamination from various sources also degrades the quality of water supplies in the Blackstone River Basin. Ground-water sources in the basin are threatened with pollution from sanitary landfill leachates, malfunctioning septic systems, and urban runoff. Increased concentrations of ammonia and metals, perhaps due to polluted surface waters, have been measured in water supply wells along Central Pond (Ten Mile Basin). Development north of Lake Quinsigamond has reduced ground-water recharge and resulted in decreased yields (in one case, total depletion) of several contaminating private wells in Sutton, Massachusetts, and municipal wells in Auburn, Massachusetts.

Related Land Issues

Development and recent highway construction have increased potential flood damages where serious flood hazards already exist. These activities encroach on flood plains and result in the loss of wetland storage areas and fish and wildlife habitat. Flood hazards threaten existing and future development in population centers such as Central Falls, Pawtucket, and Providence, Rhode Island, and Attleboro, Massachusetts. Without State or local management programs to guide development away from flood-prone areas and to protect key wetlands from overdevelopment, flood damges in the basin will continue to be a serious problem.

Development pressures also create water-related use conflicts with regard to the preservation of aquifer recharge areas, remaining agricultural lands, and unique natural and cultural sites in the basin. Communities in this heavily populated, highly industrialized area must carefully coordinate their economic development and management of their environmental resources in order to derive the highest benefits from both.

Problem Area 14: Pawtuxet River Basin Area

Description

This problem area, located in central Rhode Island, consists of all lands in the Pawtuxet River Basin, excluding those portions of Providence, Cranston, and Warwick which lie along Narragansett Bay. The north branch of the Pawtuxet begins at the Scituate Reservoir, a major Rhode Island water supply source. The south branch is an extension of the Big River, which flows from West Greenwich into the Flat River Reservoir in Coventry. Both branches flow west through hilly terrain to their confluence in West Warwick. From there, the Pawtuxet continues east 11 miles to Pawtuxet Cove on the west side of the Providence River. Two other principal tributaries to the Pawtuxet are the Meschanticut Brook and the Pocasset River.

There are many lakes and ponds throughout the basin, but relatively few wetlands, most of which occur in the upper portion of the watershed. Sand and gravel deposits are found throughout the area. Development is extensive in the lower part of the basin; in fact, the problem area had the highest population growth rate in Rhode Island between 1960 and 1970. Most of the region's growth occurred in Cranston (1970 population, 74,300), Coventry (1970 population, 22,900), West Warwick (1970 population, 24,300), and Johnston (1970 population, 22,000).

One-third of the area's work force is employed in manufacturing. Retail and government jobs comprise another third of the economy. Sand and gravel deposits totaling 14.2 million cubic yards, located primarily in coventry and West Greenwich, are also economically important. Output from this activity accounted for 50 percent of Rhode Island's total production in 1970 and was valued at $2.9 million.

Problems

Water Issues

Pollution of the main stem of the Pawtuxet has resulted in a severe water quality problem. Municipal and industrial discharges have resulted in a large portion of the river being classified by Rhode Island as C, with a small section below a chemical manufacturing firm classifed as D. With advanced treatment, the lower Pawtuxet may be upgraded to Class C, but the sheer volume of the discharges into the small, sluggish river may effectively limit a higher classification. Recreational use of the river and aquatic life are adversely affected. Fifty percent of the basin's assessed waters are not expected to meet Rhode Island's Class B standards by 1983.

Existing surface- and ground-water supplies will be insufficient to meet the basin's projected demands by 1995. This problem is aggravated by the pollution of potentially valuable supplies. For example, intense urbanization directly over a large aquifer in the Cranston-Providence area has increased surface runoff, decreased ground-water recharge, and has caused some pollution of this potentially significant source of industrial water supply.

Low streamflows on both branches and on the main stem of the Pawtuxet limit the river's ability to assimilate waste. The South Branch is regulated at the Flat River Reservoir to meet downstream water needs of some industries. On weekends, when the water needs of these industries are low, stream flow in the South Branch drops considerably. Flow is also impeded by about 19 mill dams along both branches and the main stem. The combined effects of the existing out-of-basin transfer of 73 million gallons of water per day (mgd) from the Scituate Reservoir (north branch) and a possible 26 mgd transfer from the proposed Big River Reservoir will decrease the average streamflow from the upland subbasins even further.

Related Land Issues

Riverine flooding in the Pawtuxet River Basin is severe, and is greatly intensified by lack of adequate wetlands to act as natural flood storage areas and also by significant urban and industrial development. Approximately 10 percent of the natural valley storage area on the main stem has been developed over the last decade. At the mouth of the river, serious storm flow flooding is intensified by high tides. Other flooding problems exist on the north and south branches, Meschanticut Brook, and the Pocasset River. Tidal flooding occurs in the lower Pawtuxet, especially when riverine flooding is synchronized with high tides. Continuous and extensive urbanization, such as that in Warwick and Cranston, may aggravate future potential flooding in the area.

Development in the Pawtuxet River Basin not only increases flood damages, but creates other water-related use conflicts as well. The Bureau of Outdoor Recreation predicts a severe shortage of recreational facilities in this basin by 1990, particularly for swimming, picnicking, and boating. Existing public access to hunting grounds and to ponds and streams for sport fishing is also inadequate to meet future demands. Increasing demands for recreational waters and lands and the need for access to these areas can conflict with the growth of urban areas. It can also conflict with the desire to protect surface-water supplies through recreation on the watershed lands of reservoirs such as the Scituate and the proposed Big River Reservoir.

Problem Area 15: Pawcatuck River Basin Area

Description

The Pawcatuck River Basin is located principally in the southwestern portion of Rhode Island. Portions of four towns in the southeastern corner of Connecticut are also included in the basin. The river flows a total of 33 miles, running southwest from Worden Pond in South Kingstown, turning sharply south to form the border between Westerly, Rhode Island, and Stonington, Connecticut, and finally entering Fisher Island Sound. Principal tributaries of the Pawcatuck include the Wood, Ashaway, and Usquepaug rivers.

The topography of the area is characterized by lowlands and gently rolling hills. Glacial features such as terraces and kettle holes are abundant, as are lakes and ponds. Elevations in the basin rarely exceed 100 feet and, due to poor drainage, much of the problem area consists of wide, flat wetlands and valleys. The largest water body, Worden Pond, covers over 1,000 acres in the middle of the Great Swamp, a large portion of which has been designated as a wildlife reservation. Ground water is plentiful, and Pawcatuck Basin aquifers are among the most potentially productive in the southeastern New England Region.

In 1970, over 88 percent of the area was still forested, open, or agricultural land. The basin is predominately rural, with population centers in South Kingstown (1970 population, 16,900) and Westerly (1970 population, 17,200). The rural characteristics of the basin may change, however, as its growth rate has been very high, ranging from 20 to 30 percent since 1960. Most growth has taken place in the area's existing urban centers, but its agricultural lands have been primary sites for development since 1960 as well.

Over one-third of the Pawcatuck Basin's work force is involved in manufacturing, including textiles and apparel, printing, electrical equipment, machinery, fabricated metals, and granite quarrying. A percentage of the area's labor force also commutes to the New London area for employment in the shipbuilding industry. Although there is still some dairying and truck farming, manufacturing, government, retail trade, and service represent 90 percent of the problem area's employment.

Problems

Water Issues

Due to the area's relatively few point sources, surface-water quality in the Pawcatuck River Basin is, basinwide, probably the best in Rhode Island. However, inadequately treated waste waters, landfill leachates, and septic system effluents do cause some pollution of the basin's surface and ground waters. Westerly's primary waste-water treatment facility, the area's only treatment plant, is one of the largest pollution sources on the river. Ten percent of the assessed river miles in the Pawcatuck Basin are not expected to reach Rhode Island's Class B standards by 1983.

Because of soil conditions and the low population density, on-site disposal systems are the most common method of treatment. Leachates from such private systems and from landfills in Richmond, Hopkinton, South Kingstown, and Westerly, Rhode Island, and Stonington, Connecticut, are additional sources of pollution. Unless adequate protection, in the form of land use regulations, is given to the abundant ground-water sources, a potentially valuable supply source for the less water-rich parts of the State will be lost.

Related Land Issues

Serious tidal flooding, causing increased erosion and property damage, occurs in Westerly and Charlestown, Rhode Island, and in Stonington, Connecticut. During major coastal storms, high tides of over 15 feet can occur and inundate large areas of low lying land, especially along barrier beach areas. Residential development on these barrier beaches is not only subject to severe damage, but also contributes to erosion of the beaches, thus destroying these natural storm buffers and increasing the probability of more severe storm damages. Critical coastal erosion (3 feet or more per year) occurs along a total of 8,800 feet of shoreline in Westerly and south Kingstown.

Development of the proposed Wood River Reservoir to meet the future water supply needs of the Providence metropolitan area could cause water-related use conflicts, adversely affecting the recharge from streams to some ground-water aquifers during dry years in the Wood River Basin. Moreover, this reservoir would cover approximately 3,000 acres (40 percent) of the Arcadia State Management Area, thus reducing opportunities for land-based recreation, while as a water supply reservoir, it would not be available for water contact recreation. The reservoir could also conflict with consideration of a segment of the Wood River as a State wild and scenic river. A careful evaluation of the reservoir's benefits and of the resource benefits it would replace should be required before it is developed.

Problem Area 16: Connecticut River Basin and Connecticut Central Coastal Area

Description

The Connecticut River Basin spans about 11,137 square miles of Vermont, New Hampshire, Massachusetts, and Connecticut, with a total basin length of about 300 miles. A small portion of the basin, approximately 114 square miles, also extends into Canada. The river itself is approximately 400 miles long. The Connecticut central coastal area, also included in this problem area, covers about 520 square miles, extending about 27 miles along Long Island Sound west of the mouth of the Connecticut River. This area includes the Quinnipiac River Basin. The total 1970 population of these two areas was about 2.5 million people, generally concentrated in the southern third of the Connecticut Basin and along the coast.

The northern section of the Connecticut River forms the border between Vermont and New Hampshire, and this portion of the basin contains about 62 percent of the total basin area. The White River is the principal tributary in this section, draining 930 square miles of Vermont. The topography in the northern portion of the basin is characterized by highlands and mountains between 2,000 and 6,000 feet in altitude. The basin is heavily wooded and predominantly rural, except for the more urbanized centers of Hanover, Lebanon, Claremont, and Keene in new Hampshire and St. Johnsbury, Springfield, White River Junction, Bellows Falls, and Brattleboro in Vermont. Principal economic activities include farming (especially dairy products), timber harvesting for lumber and paper products, printing and publishing, and machine tool manufacturing. Pressures for development of seasonal homes and recreation centers are increasing. A series of major hydroelectric power dams impound and control a large portion of the upper Connecticut River.

As the Connecticut continues southward into Massachusetts (the Millers, Deerfield, Westfield, and Chicopee rivers are major tributaries in this section), the valley becomes broader. Again, the area is predominantly rural, and population concentrations generally occur along the river. Farming is an important economic activity in this part of the basin, but over 50 percent of the work force is employed in manufacturing. Farther south, the communities of Greenfield, Gardner, Northampton, Holyoke, Chicopee, Springfield, and West Springfield, Massachusetts, are characterized by higher population concentrations and greater industrial activity. Pulp and paper manufacturing and farming (orchards, dairy, and poultry) are steadily decreasing in this area as other forms of manufacturing, as well as service and recreational activities, become more important.

In the State of Connecticut, the basin encompasses broad lowland areas and irregular uplands. The Farmington River is the principal tributary of the Connecticut in this part of the basin, draining 498 square miles of northwestern Connecticut. The Connecticut's estuary covers approximately 5,600 acres of salt marsh and numerous undeveloped inlets and coves. The basin contains some of Connecticut's major population centers: Hartford, Middletown, Meriden, and New Britain.

The Quinnipiac River has a total length of 45 miles and flows into New Haven Harbor. New Haven, also one of the problem area's large population centers, is the third largest port in New England, primarily handling petroleum products, as well as bulk cargos such as scrap metal, iron, and steel. The Quinnipiac Basin covers 360 square miles and, like the Connecticut Basin, has extensive coastal marshlands. The total coastline of the entire area is about 80 miles long.

Problems

Water Issues

The Connecticut River Basin faces ever increasing demands for water supply from basin communities as well as from diversions to the Boston Metropolitan District Commission (MDC) area. Currently, exports from the basin to MDC average 179 million gallons per day. A cumulative decrease in the basin's water resources, through diversions, cooling water withdrawals, and industrial processes, is not currently a major problem. It may grow more serious, however, if continued water consumption is not evaluated and planned. A lack of comprehensive water supply planning for the entire Connecticut River Basin may lead to future supply shortages.

The increasing water requirements of Massachusetts communities, both within and outside the Connecticut Basin, will place increasing pressures on its valuable surface- and ground-water resources. Vermont's laws are currently inadequate to protect dwindling ground-water supplies, and Connecticut law prohibits the withdrawal of potable supplies from waters that receive wastes, no matter how well treated. This will soon remove the Connecticut from consideration as a potential water supply option for the State.

Increasing demands for water supplies in eastern Massachusetts have resulted in proposals for two additional diversions from the Connecticut Basin in the western part of the State--the Northfield Mountain and the Millers River Basin projects. These transfers would be "flood skimming" projects that divert an average of 72 and 76 million gallons per day, respectively, from the basin during periods of high flow. Both diversions are controversial, as basin residents in western Massachusetts and Connecticut are concerned about the environmental impact of additional transfers and the ability of alternative in-basin resources to meet water needs if future diversions are developed. In Massachusetts, increasing demand for water supplies have led to Executive Office of Environmental Affairs policies emphasizing full use of inbasin resources, through environmental evaluation of proposed diversions, and the need for implementing a comprehensive water conservation effort throughout the Commonwealth.

There are problems with water quality throughout the Connecticut River Basin, but the major sources of pollution vary. Vermont cites municipal sewage systems, urban runoff, failure of on-site sewage disposal, and agricultural runoff; New Hampshire lists industrial discharges--especially from pulp and paper mills--and municipal systems; Massachusetts cites urban discharges and industrial discharges from paper mills, chemicals, and primary metals; and Connecticut lists combined sewer effluent as well as commercial and industrial wastes as major polluters. The river's assimilative capacity to dilute pollutants is reduced along some reaches because of intermittent, low streamflows caused by the operation of major power, industrial, and water supply impoundments. Some of the Connecticut's tributaries have naturally low streamflows which are insufficient to assimilate the wastes they receive. In the lower 20 miles of the river, recreational boating and marina discharges are significant sources of pollution, raising the coliform bacteria counts in some parts of the estuary to levels far above the State standards for SB--"fishable-swimmable"--waters.

Current programs to abate pollution in the Connecticut Basin are hampered by: (1) the lack of interstate coordination and coordination between Federal, State, and local agencies; (2) the lack of funding for the abatement of combined sewer overflows where such sources will substantially delay the attainment of water quality goals; (3) inadequate funding and inefficient programs at various governmental levels; (4) the current lack of control over nonpoint pollution sources; (5) deficiencies in enforcing programs for control of paper company wastes on some rivers; (6) the absence of programs for regulating sewage disposal systems other than treatment plants and the resultant lack of Federal funding for such systems; and (7) a general lack of attention to land-use controls (zoning, easements, etc.) necessary to achieve water quality goals.

Approximately 7 percent of the assessed river miles in the Connecticut Basin will not attain Class B standards by 1983. Pollution in these stretches of the Connecticut and its tributaries will continue to preclude their use as water supplies. It will continue to affect the quality of nearby ground-water supplies, limit recreational uses, and damage fish and wildlife habitats if higher water quality goals are not effectively achieved.

Related Land Issues

Tidal flooding affects both residential and recreational uses of the Connecticut central coast. All coastal communities in the basin are affected, with the most severe damages occurring in Old Lyme, Old Saybrook, Branford, and New Haven.

Riverine flooding is a problem throughout the Connecticut River Basin, especially in urban areas along upstream tributaries where there are no flood protection facilities. Small flash flooding is very difficult to control, and damages are widespread. In the northern portion of the basin, flooding problems are aggravated by ice jams during winter months.

Main stem damages have been reduced in part by flood control dams and dikes, but the potential for urban flood damage along the main stem still exists and will probably increase in the future. Urban flooding has occurred along the main stem in Springfield and Chicopee, Massachusetts, in East Hartford, Connecticut, and along the Westfield River in Westfield, Massachusetts. Six of the seven existing main stem local protection projects are not high enough to provide the desired level of flood protection.

Exisitng State and local programs have not been able to guide development away from flood plains or to protect wetlands with flood-water storage or attenuation capabilities. In general, the Department of Housing and Urban Development's flood insurance program has not yet been properly implemented at a local level. The opportunities for multi-State flood-plain management afforded by the Connecticut River Flood Control Commission, as defined by compact, have not been used to advantage. As a result of these and other problems, implementation of a comprehensive flood-plain management program in the basin has not taken place.

However, with the assistance of basin States and Federal agencies, the New England River Basins Commission has recently completed a comprehensive program for flood-plain management in the Connecticut River Basin. Implementation of this strategy, which emphasizes nonstructural methods of flood damage reduction and prevention, but also recognizes the need for local flood control structures, would achieve a unified, basinwide approach to flooding. Without such comprehensive management, continued development in flood-prone areas and the destruction of valuable natural valley storage areas will inevitably result in growing flood damages throughout the Connecticut Basin.

Problem Area 17: Connecticut Western Coastal Area

Description

The Connecticut western coastal problem area consists of approximately 440 square miles in the southwestern corner of Connecticut between the New York border and the Housatonic River Basin. It encompasses the western and central two-thirds of Fairfield County, Connecticut, including the cities of Stamford, Norwalk, Bridgeport, and Stratford. The nine largest streams draining the area are the Byram, Mianus, Rippowam, Noroton, Fivemile, Norwalk, Saugatuck, Mill, and Pequonnock rivers. The coastline is rocky and irregular with many coves and promontories and several islands.

About 50 percent of the land is developed in this highly urbanized problem area. Its 1970 population was about 650,000 with an average population density of 1,500 people per square mile. The region is an important manufacturing center for electrical equipment, instruments, machinery, and ordnance. It also serves as suburban residence for many of New York City's managerial and professional personnel. Commercial growth, resulting from residential growth and the recent trend toward siting the headquarters of major industrial firms in the region, has resulted in more than a 20 percent increase in population since 1960. The coast includes harbors such as Bridgeport, Stamford, and Norwalk, which accommodate commercial shipping (mostly petroleum products, sand, gravel, and crushed rock) and major recreational boating facilities. The coastline is a popular site for many summer tourists as well. Despite the area's overall population density and high development pressures, there are several important scenic areas and valuable wildlife refuges associated with its tidal marshes and islands.

Problems

Water Issues

Coastal water quality problems caused by combined sewer overflows, municipal and industrial discharges, and petroleum transport are severe in this problem area. Regionalization of municipal treatment facilities and pre-treatment of industrial wastes have begun to reduce pollution from these sources. However, because funds for correcting sewer and stormwater overflows are inadequate, Bridgeport and Norwalk harbors are not expected to meet Connecticut Class SB standards by 1983, even after new treatment facilities are fully operational.

Seepage from oil terminals and spills from petroleum transport barges pose threats of marine and estuarine pollution. Moreover, along parts of the coast there are still areas that contain high quality fish, shellfish, and recreational waters. These will become polluted unless they are designated as "non-degradation zones," where the discharge of additional point sources of pollution is prohibited and control of nonpoint sources is strictly enforced. The Norwalk Islands, Saugatuck River south to Westport, Southport Harbor, and the Sasco Brook area in Fairfield would be included in this category.

Related Land Issues

Coastal flood damages are high in shoreline towns, especially in Fairfield, Westport, Norwalk, Greenwich, and Stamford, and small stream flash flooding and drainage flooding have threatened inland communities. Unless flood-plain managment measures are introduced, future damages could increase substantially.

The maintenance dredging of the upper part of Norwalk Harbor has not been possible because of the toxic nature of the sediments to be dredged. Currently, there is no appropriate site for land disposal of the dredged materials and no satisfactory method for the offshore disposal of these wastes. These elements may harm bottom-dwelling marine life or interfere with swimming and fishing opportunities if they are not deposited at a suitable site.

The densely populated nature of this area has given rise to water-related use conflicts, both inland and along the coast. The demand for recreational facilities in this area excceds available supplies, and anticipated needs may conflict with urban growth and development in the shoreline areas, and with the desire to protect inland surface water supplies on reservoirs. Public marina facilities, including additional slips, moorings, and boat ramps, will be in particularly high demand in this area.

Problem Area 18: Housatonic River Basin Area

Description

The Housatonic River enters Long Island Sound after flowing 130 miles from the Berkshire Mountains through western Massachusetts and Connecticut. Over half of its 2,000 square-mile watershed lies in Connecticut. Much of the basin is characterized by narrow flat-topped hills which rise to elevations of 2,500 feet in the northern portion. The main valley is broad and steep-walled in the upper and middle portions of the basin, becoming narrower and shallower in the river's lower reaches. Major tributaries of the Housatonic are the Naugatuck, Shepaug, and Still rivers. There are four major hydropower dams on the Housatonic main stem. Candlewood Lake, one of Connecticut's largest inland water bodies, and the site of the region's first pumped storage facility, is located within the basin. Toward the mouth of the Housatonic lies the Great Marsh, a 316 acre area of open land and wetlands.

The 1970 population of the Housatonic Basin was approximately 560,000.

This population is concentrated in the southern portion of the basin, especially in the area along the Naugatuck River, which includes Waterbury, Connecticut, a manufacturing city which is the basin's major population center. Other significant population centers in the basin include Danbury, Connecticut, and Pittsfield, Massachusetts.

Over 40 percent of the labor force in the lower basin is employed in industries manufacturing such articles as non-ferrous metal and rubber products. Tourism is also an important factor in the economy of the sparsely populated woodlands in the northern portion of the basin. A heavy influx of summer residents cluster around numerous lakes, ponds, and scenic mountains in this area.

The upper Housatonic and Shepaug rivers are being considered as potential additions to the National Wild and Scenic Rivers system. A study on the upper Housatonic by the Bureau of Outdoor Recreation has been initiated, and a similar study on the Shepaug will soon begin.

Problems

Water Issues

Water quality in the lower Housatonic River and its tributary Naugatuck River is degraded by discharges from non-ferrous metal and rubber industries and combined sewer overflows from Derby, Shelton, and Waterbury. Many of the combined sewer and nonpoint problems will persist even after new treatment facilities are operational. As a result, over 20 miles of the Naugatuck River and 12 miles of the Housatonic River estuary are not expected to meet Connecticut's Class B standards by 1983.

Sampling of the Housatonic River in both Massachusetts and Connecticut has identified significant polychlorinated biphenyl (PCB) contamination below a factory in Pittsfield, Massachusetts, and near Cornwall, Connecticut. The Pittsfield plant has now ceased discharging PCB into the river, but analysis of brown trout from the Cornwall area early in 1977 showed PCB concentrations of 14 to 45 parts per million, well above the tolerance level of 5 parts per million established by the U.S. Food and Drug Administration.

Tourism is an important factor in the economy of the woodland portions of the basin, but the recreational value of several of the lakes has been reduced by accelerated eutrophication, nitrification, and algal growth caused by septic system effluents and industrial discharges. A significant segment of the problem area's economy, as well as the esthetic value of its lakes, will be lost if eutrophication is allowed to proceed unchecked.

A shortage of potable water supplies exists in the lower Housatonic Basin. Supplies could be augmented by diversion of one of the Housatonic's tributaries, the Shepaug River, but this would conflict with the Shepaug's potential designation as a wild and scenic river. In the Naugatuck, Housatonic, and Still River basins, residential and commercial development above stratified drift ground-water sources limits natural recharge. The ground-water supplies can also be contaminated through septic system leachates or infiltration of waste water from sewer lines. Without better protection of recharge areas, ground-water supplies, and potential reservoir sites, and without stronger conservation efforts to promote the most efficient use of existing supplies, water shortages in the basin will grow worse.

Related Land Issues

Erosion and subsequent sedimentation from untreated croplands, streambanks, and construction sites adversely affect the area's surface waters, wetlands, fish and wildlife habitats, and recreational uses. Coastal erosion is severe in Stratford. Continued erosion will impair property values, delay achievement of high water quality in some of the basin's lakes and streams, and reduce recreation opportunities.

Flooding quickly develops after storms in this problem area. This is especially true of the Naugatuck and Still rivers into which many short, steep tributaries empty at about the same time. Although National Weather Service flood warnings and storage at seven flood control dams in the Naugatuck sub-basin offer much protection, continued development in the flood plains along the Naugatuck, the Housatonic, and their tributaries could increase flood damages in the basin. Flood-plain management programs and regulations are needed to guide development away from flood-prone areas.

Problem Area 19: Thames River Basin and Connecticut Eastern Coastal Area

Description

The Thames River Basin includes approximately 1,500 square miles primarily in eastern Connecticut, with small sections in south central Massachusetts and northwestern Rhode Island. The Thames is formed by the confluence of the Quinebaug and Shetucket rivers at Norwich. It flows 15 miles from there to New London, Connecticut, where it enters Long Island Sound. The Thames estuary extends the entire 15 miles up to Norwich. Major tributaries in the basin are the Yantic, the French (tributary to the Quinebaug) and the Willimantic (tributary to the Shetucket). The headwaters of both the Shetucket and Quinebaug rivers lie in Massachusetts. The watershed is primarily hilly and wooded with many natural lakes and ponds. Its soils are generally stony and poor for agricultural purposes.

The Connecticut eastern coastal rivers drain approximately 150 square miles in southeastern Connecticut. Major rivers in the area are the Niantic and the Mystic. The irregular coastline of the area is over 80 miles long and is characterized by numerous bays, coves, and promontories.

In 1970, the population of the entire problem area was approximately 405,000. The Thames River Basin is rural and relatively sparsely populated. Population density is approximately 400 people per square mile in the lower basin. The problem area's growth rate, however, is slightly higher than Connecticut's average and is expected to remain high in the urban core along the Thames River and especially in outlying suburban areas. Major population centers of the problem area are Norwich and New London. New London Harbor presently serves shipments of sand, gravel, petroleum products, general cargo, and submarine traffic.

Manufacturing is the largest single employer in the problem area, with industries such as shipbuilding, textiles, lumber, furniture, rubber, fabricated metals, and machinery. Government is also a major employer, with the State University, U.S. Coast Guard Academy, and U.S. submarine base all located in the Connecticut portion of the basin.

Problems

Water Issues

Water quality problems are significant in this area. The Quinebaug River, one of the Thames tributaries, is polluted by inadequately treated municipal wastes from Southbridge, Massachusetts, and paper wastes from Dudley, Massachusetts. One of its tributaries, the French River, receives untreated textile wastes and inadequately treated municipal wastes from Dudley and Webster, Massachusetts. The water quality problems on the French River are compounded by streamflows that are naturally too low to assimilate these wastes. Thirty-three stream miles (35 percent of the assessed miles) in the French and Quinebaug river basins are not expected to meet Massachusetts' and Connecticut's Class B standards by 1983. Ten of these miles, located on the Quinebaug main stem from Griswold to Norwich, will not meet the national deadline because of combined sewer overflows.

The entire length of the Thames River is degraded by combined sewer overflows and industrial effluents. Although abatement procedures for some of these pollution sources are underway, 15 miles of this river are not expected to meet Connecticut's Class B standards by 1983 because of combined sewer overflows from Norwich.

Lake eutrophication is being accelerated by intense development adjacent to recreational lakes and by nutrient loadings in feeder streams. Resultant problems are diminished property values along lake shorelines and the loss of recreational swimming, boating, and fishing opportunities.

Population increases in the problem area are expected to result in a shortage of potable water supplies. The possibility of future shortages makes the protection of existing water resources, the identification of additional supply options, and public education efforts regarding water conservation issues of major importance in the problem area.

Related Land Issues

Flooding occurs along the Yantic River in Norwich and in New London at the mouth of the Thames River. However, a hurricane barrier local protection project is scheduled for construction on the Thames at New London. This should alleviate much of the flood damage potential there.

Erosion of untreated cropland, roadbanks, streambanks, and at construction sites results in loss of land and subsequent sedimentation in nearby streams and lakes. Beach erosion may limit recreational uses in this problem area. Continued erosion will delay achievement of high water quality in some stream reaches. It will degrade fish habitats and lower recreational opportunities. However, damage reduction beyond the present State program is currently not economically and environmentally feasible.

Existing recreational facilities and access points will not meet future demands, and the increasing demand for these facilities conflicts with the growth of urban areas and with the desire to protect surface-water supplies by preventing recreation on reservoirs and reservoir watershed lands.

Problem Area 20: Lake Champlain Basin Area

Description

The Lake Champlain drainage basin consists of 8,234 square miles in northeastern Vermont, northeastern New York, and Quebec. The lake itself covers 490 square miles. Principal rivers in the basin include the Saranac, Ausable, Chazy, Bouquet, LaMoille, LaPlatte, Winooski, Missisquoi, and Otter Creek. The basin's topography ranges from the rugged peaks of the Adirondacks and Green Mountains on its western and eastern borders to the level lowlands surrounding the lake. The largest population centers include Burlington, Rutland, Essex, Barre, and South Burlington, Vermont, and Plattsburgh and Granville, New York. The 1970 population in the U.S. portion of the basin was about 430,000.

The Champlain Basin is predominantly rural, and its largest single economic activity is agriculture, including dairy, poultry, and livestock farming. Increasing amounts of land are being devoted to recreational uses including skiiing, camping, and water-based recreation. The manufacturing industry, based primarily in Chittenden and Franklin counties, centers around the basin's raw materials such as food, lumber, stone, clay, and glass.

Problems

Water Issues

One of the major water quality problems on Lake Champlain is biological pollution and eutrophication, the result of nutrient contamination from both point and nonpoint sources. The algal blooms which occur in many of the bays decrease water quality and reduce the use of the lake for swimming and water supplies. Many rocky reefs, once considered good small-mouth bass areas, are being overgrown with aquatic vegetation and no longer provide good fish habitat. Other water quality problems in Lake Champlain result from waste-water discharges, continued pollution from the old sludge bed below the International Paper Mill in Ticonderoga, New York, and the transport of oil up the Champlain Barge Canal.

Resolution of the eutrophication and pollution problems in Lake Champlain will require that the entire basin be managed as a hydrologic entity. Since the political boundary between New York and Vermont runs down the middle of the lake, State water management programs have historically stopped at this border. Coordination and cooperation between the States will be needed to solve the complex water and related land problems in this basin.

Related Land Issues

The ongoing Level B study has not yet determined whether a single agency or institution should be given an effective mandate for providing a basinwide focus on resource issues and problems in the Champlain Basin. Such a determination will be made at a later date. The lack of such an entity is of particular concern in Champlain because of the international and interstate nature of some of the problems, including the water-use conflict of fluctuating lake levels in Lake Champlain.

Lake Champlain has a natural fluctuation of about six feet per year which causes flooding, erosion, disruption of recreational uses, and changes in assimilative capacity of the water. If the natural cycles of lake level fluctuation were changed, however, wetlands along the shorelines could lose their value as productive habitats for many fish and wildlife species. The Canadian government wishes to complete structures at Lake Champlain's outlet in Quebec to regulate water levels in the lake, in order to decrease flooding along the Richelieu River. The International Joint Commission is currently looking into the potential environmental impact of this water-level control on both the river and the lake.

The potential for costly flood damage is high in urban portions of the basin, such as Barre, Montpelier, Waterbury, and other communities along the Winooski River. A recurrence of a November, 1937, flood could severely damage many major buildings in the valley even with the flood control dams in operation. Flooding is also a problem for nonurban agricultural lands along the tributaries of Lake Champlain. Inadequate coordination between State and local governments in Vermont concerning flood-plain management may hamper restoration and protection programs. Local regulations for the control of shoreline development are not currently enforced. Flood damages will continue to increase without better management of flood-plain zoning and other protective measures.

Problem Area 21: Lake Memphremagog — St. Francis River Basin Area

Description

The Lake Memphremagog drainage basin covers 806 square miles, 71 percent of which are in Vermont and the remainder of which are in Canada. Less than one-third of the 36.5 square-mile surface area of the lake, however, lies within U.S. boundaries. The average depth of the lake is 55 feet, with an annual lake-level fluctuation averaging 3.8 feet caused by operation of the outlet dam in Magog, Quebec. Principal U.S. tributaries to the lake include the Black, Barton, and Clyde rivers, each with a drainage area greater than 100 square miles. The remaining portion of the problem area is made up of the Coaticook and Tomifolia rivers, which join in Quebec to form the St. Francis River.

The lake Memphremagog-St. Francis River Basin problem area lies entirely within the Vermont Piedmont physiographic region. It is hilly to mountainous, largely forested, and contains a large number of lakes and ponds. Recreational development, dairy farming, and timber growth are major uses of the land. The basin's population in 1974 was estimated to be 18,000. Population in 1974 was estimated to be 18,000. Population centers such as Newport City and Derby are few and scattered, and the population density is significantly lower in the problem area than in the State as a whole (31 versus 48 persons per square mile).

Problems

Water Issues

The U.S. portion of Lake Memphremagog is eutrophic. Nutrients contributing to this water quality problem enter the lake from agricultural runoff and other nonpoint sources as well as from waste-water discharges in the city of Newport. The waste-water pollution will be alleviated by late 1979, when a treatment facility with phosphorus removal is scheduled for completion.

The use of lakes and ponds for recreation conflicts with protection of their quality for water supply in the Lake Memphremagog region, where one-third of the domestic water supply comes from surface-water sources. Although ground-water resources are abundant and could be used to greater extent for water supply, manganese concentrations in several of the sources exceed the State's recommended limits.

Water-related use conflicts exist over regulation of water levels in Lake Memphremagog. Storage of water for power generation conflicts with maintenance of constant lake levels for recreational uses and fish and wildlife habitats. There is much unused potential for hydroelectric generation, but further development of this power could jeopardize the basin's valuable sports fisheries by changing water levels. Information is needed on the economic feasibility and environmental desirability of expanding hydropower production in this area.

Related Land Issues

There is a severe erosion problem on the shores of Lake Memphremagog, particularly at the Bluffs portion of Newport City. The problem is aggravated by manipulation of water levels in the lake. Lake-level regulation will continue to be a major problem in this basin until the conflicting needs can be studied and acceptable lake management strategies developed.

Problem Area 22: Long Island Sound Area

Description

Although this problem area consists only of Long Island Sound itself, the land which borders the sound must be considered because of its effects on the water body. Problems along the north shore of the sound in Connecticut have been discussed in previous problem area summaries. The south shore includes approximately 812 square miles of the island coast. This problem area includes portions of Westchester, Bronx, and Queens counties, about one-third of Nassau County, and part of Suffolk County, all in New York. Major bays and harbors in the area include: Little Neck, Manhasset, Hempstead, and Oyster bays, and Cold Spring, Huntington, Northport, Port Jefferson, and Mt. Sinai harbors.

Population concentrations vary significantly between the western and the eastern portions of the island. Westchester, Bronx, and Queens counties have a total population of about 4,350,000 people, while only about 14,000 people live in the far eastern portion of Suffolk County. It is expected, however, that the largest future population increase will occur in the latter area. Land uses vary from undeveloped wooded bluffs, large estates, and single family residences in the east, to high-rise residential and manufacturing areas in the western part of the problem area.

Industries in the western portion of Long Island manufacture articles such as clothing, textiles, food products, and machinery. Coal yards and lumber yards are also important economic activities. The ports in the eastern portion of the sound receive petroleum and sand and gravel products.

Problems

Water Issues

The concentration of development in the western portion of Long Island Sound creates many water quality problems, which are made more severe by the poor tidal flushing at the sound's enclosed western end. The primary pollutants are waste-water treatment plant discharges and combined sewer outfalls from New York City and surrounding towns. Urban runoff, leachates from abandoned dumps, oil spills, and other discharges from the dense vessel traffic also contribute to pollution of the sound.

The high nutrient concentrations from runoff and waste-water discharges have accelerated eutrophication of the western sound, and upgrading of treatment plants may worsen the problem since toxins and suspended solids will be removed, leaving nitrogen and phosphates which support algal growth. If a nutrient-removal process is instituted to limit eutrophication, a sludge disposal problem will arise.

Discharges of waste-water into Long Island result in the lowering of ground-water recharge and a consequent lessening of water supplies in the problem area. Moreover, the resultant overpumping of ground water has led to salt-water intrusion in some areas. Because ground water represents a major source of water supply in this problem area, continuing ground-water depletion will result in water supply shortages unless additional sources are developed or interbasin diversions are made. In any case, the efficient use of water should become one of this area's primary objectives in order to preserve existing sources and to protect them from contamination.

Related Land Issues

Although dredging is necessary for maintenance of commercial and recreational navigation in the sound, the dredging process and the disposal of dredged materials can destroy marine habitats and degrade water quality. The toxic industrial and municipal wastes which have accumulated in some of the sound's harbors make these sediments particularly difficult to dispose of without contaminating marine or fresh-water supplies. The Army Corps of Engineers is working on developing techniques for safe disposal of wastes such as these.

Three water-related use conflicts arise from the population density in the western portion of the Long Island Sound problem area: the demand for adequate recreational facilities, the lack of access to the coast, and a shortage of available land for recreational activities. Water pollution in the sound also limits recreational opportunities, even when access is available. The disparity between recreational needs and the number of facilities available to meet them will continue to increase unless concerted efforts are made to acquire additional recreation land and to assure access to the sound.

Summary

The land and water resources of New England have supported the needs of a continually expanding population for over 200 years. Overall, the region appears to have adequate water and related land resources to provide for future generations despite seasonal and geographical variations in precipitation and runoff. Continuing settlement in urbanized areas has placed quantitative and qualitative stress on local resources, and there are sometimes scarcities at the local level because essential water supply is not available when and where it is needed. The primary challenges facing the New England Region in the near future include distribution of high quality water resources in sufficient quantity to provide for domestic, industrial, and agricultural needs, and the allocation of land to uses that are appropriate both to economic growth and to intrinsic environmental potential.

Most of the rivers in the New England Region flow in a generally southerly, or southeasterly direction, toward Long Island Sound or the Atlantic Ocean. Exceptions are the Saint John River, which flows northward and eastward, forming the border between Maine and New Brunswick Canada, and the Lake Champlain and Lake Memphremagog drainages, which flow northward into Canada and the St. Lawrence River Basin. New England's largest single basin is that of the Connecticut River, which dominates much of the western half of the region. The Connecticut forms the boundary between Vermont and New Hampshire and flows through western Massachusetts and Connecticut before entering Long Island Sound.

The region contains about 69,003 square miles encompassing about 2 percent of the Nation's total surface area. Its physiographic features range from mountains of 4,000 to 6,000 feet in elevation, to rolling uplands and lowland plains meeting the rocky shoreline or sandy beaches along the coast.

The ocean's proximity has a moderating influence on coastal climates, but seasonal changes are distinct, ranging in temperature from a high of about 90°F to a low of approximately 10°F. Precipitation is abundant, averaging 42 inches annually, and rain or snowfall is evenly distributed throughout the year. The region's growing season averages about 100 to 150 days, which is quite short, considering the added burdens faced by persistant New England farmers: the abundant glacial "erratics," boulders and stones left by the retreating glaciers of the Wisconsin era, and sandy glacial soils. However, some of these same unconsolidated sand and gravel deposits also form the excellent ground-water aquifers that characterize certain parts of New England.

Twelve and one-half million people lived in New England in 1975, and the region's population density ranged from 23 persons per square mile in northern Maine to over 17,000 per square mile in the Boston area. By 2000, the population is projected to reach 15.3 million.

Historically, much of the development in New England has taken place on flood plains and along the coast because of favorable commercial sites, the

ease of river or ocean transportation, rich fishing areas, the need for hydropower, and other amenities. While urban areas thus tend to cluster on the coast or in river valleys, much of the land in the higher elevations of northern and western New England has remained relatively rural. However, a recent trend in population migration can be characterized by the increasing growth of these less developed sections of New England and movement away from the older urban centers.

Manufacturing, primarily of machinery and other durable goods, accounts for the largest percentage of earnings in the region, where total earnings in 1975 were about $64 billion. Services and wholesale and retail trade are also important employers. Both total earnings and per capita earnings in New England are expected to more than double over the next 25 years, with services replacing manufacturing as the chief employer.

Although there are currently no fossil fuel resources developed in the region, 35 of the 41 steam electric powerplants in New England are fossil fueled. Investigations into potentially productive coal deposits in the Narragansett Basin are currently underway, but it is not yet known whether the deposits can be developed economically or environmentally. Even with their development, the region's dependence on imported fuels will increase, as the 1975 energy generation of 67,000 gigawatt-hours increases to a projected 295,000 gigawatt-hours by the year 2000, even though a large proportion of this increase may come from nuclear powerplants. The region's dependence on imported fuels is also reflected in the principal commodities handled in New England's ports. The major ports of Boston and Portland in southeastern New England handle a steadily increasing amount of petroleum product deliveries. This increase in traffic, coupled with the possibility of offshore oil and gas reserves being found on George's Bank, and with the recently expanding needs of the resident fishing industry, has made harbor management an important concern in the region.

New England's "product-oriented" resources are somewhat limited. Glaciation left valuable sand and gravel deposits in some of the valleys, and the Outer Continental Shelf area of George's Bank is one of the most productive fishing areas in the world. Petroleum reserves may also be available on the shelf.

With increased demands for power, the aforementioned Narragansett Basin coal deposits could provide a future energy source. However, New England's primary resources are the natural amenities that are, or should be, used in a less consumptive manner.

The region's abundant water resources, including 30,000 miles of streams, more than 5,000 lakes, and 6,000 miles of coastline form the basis for high quality recreational and living experiences in New England. Although there are few truly wild areas left, there are a number of Federal- and State-administered parks and forests that preserve some of the region's natural amenities. New England was also the site of the first campaigns of the Revolution, and contains a significant part of the Nation's historical heritage. There is a problem with distribution of recreational opportunities, a problem that will only be alleviated by opening up more recreational areas near large population centers or by improving transportation to existing facilities.

Water supplies and withdrawals vary considerably throughout New England and again illustrate the discrepancy between the location of the region's needs and the location of its resources. Industry is the largest user of water in New England, followed by electric power production and domestic use. In 1975, annual fresh-water withdrawals from both surface and ground sources averaged 5 billion gallons per day. Recent trends in the development of effective water conservation programs have not yet been fully evaluated, but even if the rate of domestic water use is stabilized or reduced, it seems clear that population growth will increase the need for domestic water supplies over the next 20 years. While domestic water withdrawals are thus projected to increase by the year 2000, increased recycling by industry and the use of saline cooling water for electric powerplants are expected to result in an overall decrease in fresh-water withdrawals in the region. On the other hand, if cooling towers and other evaporative processes become widely used, as is expected, net water consumption (i.e., water not returned to the streams which supplied it initially) in New England may as much as double by 2000.

Overall, the rate of water consumption in the region is currently low, as industrial uses in New England are generally not consumptive in nature. However, low streamflows may be significant local problems in terms of aquatic habitat preservation; many of the region's larger rivers are impounded and their streamflow regulated.

Although New England is generally characterized as an area of relatively abundant water supplies, abundance alone cannot assure the availability of its water resources; water quality and distribution must also be taken into account. Water pollution is still one of the most serious resource problems in New England, despite ongoing Federal, State, and local efforts to improve the quality of the region's waters. The purity of local streams is determined by many factors, including water use, population density, natural flow, availability of cleanup funds at all levels, and citizen awareness. In New England as in the rest of the country, the cleanup of point sources will be achieved, given enough time, but the solution of some nonpoint source problems will require additional expenditures of time and money.

Many of the region's water supply problems stem from the fact that water resources in New England's heavily populated areas have often been fully developed, or their development has been foreclosed by urbanization itself. It is ironic that poor water quality or the inhibition of groundwater recharge in urban areas limits water supplies needed to support large concentrations of population and industry, and it has necessitated costly, and often controversial, interbasin diversions to the cities from the more rural areas of New England. Water supply and water quality problems are worsened by antiquated supply distribution and waste-water collection systems in many of the region's older cities and towns. Leaks and breaks in the distribution systems can result in significant water losses, and the impact of combined sewer overflows on New England's rivers and coastal waters can be extremely detrimental to the achievement of water quality goals.

Flooding is also a serious problem on a local basis. For 1975, the average annual flood damages are estimated to have been about $92 million (in 1975 dollar values). By 2000, damages are expected to increase by 67 percent. Flood-plain zoning is not always enacted or enforced, and implementation of the Department of Housing and Urban Development's Flood Insurance Program has been slow in many New England communities.

Lake water quality, the siting of energy facilities, and the impacts of dredging and dredged material disposal are other serious problems. Moreover, conflicts over the use of water and related lands are complicated in the region by many small private holdings, relatively few public lands, limited availability of land, and by a strong tradition of home rule.

As would be expected, New England's problems are most severe near the metropolitan areas. Urbanization has occurred primarily along the downstream reaches and around the mouths of navigable rivers: the relatively flat, fertile lands surrounding the Connecticut River, and the lowlands directly inland from the safe ports of Boston Harbor and Narragansett Bay. Surface water flows at these points are often insufficient to assimilate the accumulated domestic, industrial, and agricultural wastes of the entire river basin. Intense development along the flood plain in the urban areas has effectively reduced the flood-carrying capacity of the rivers, thereby increasing flood damage potential. Upstream, the filling of, and development on, wetlands has reduced their potential to store or retard runoff and decrease flooding.

Conclusions and Recommendations

A primary step in the development of recommendations for New England's water resources was establishing basic objectives which provide a consistent framework for problem resolution. Such objectives can also serve a larger purpose beyond their role in this assessment by providing the regional sponsor's basin planning program with a consistent set of criteria against which to evaluate resource management plans and programs throughout the region. While space does not allow a complete summary of all objectives and recommendations proposed for the New England Region, some of the highlights of this approach to problem resolution are considered in this section.

Objectives

A separate set of objectives was developed for each significant water and related land problem identified in the region. The recommendations that addressed these problems were then drafted to be as consistent with the desired strategy as possible. For example, in order to resolve the problem of insufficient water supplies in parts of New England, the proposed objectives were:

- To make maximum efficient use of the region's water supplies, maintaining and protecting the quality and yield of existing sources, and encouraging water conservation where possible;
- To assure equitable distribution of the region's water supplies by requiring the identification, protection, and development of in-basin resources before interbasin diversions are made;
- To encourage intermunicipal cooperation in the development, management, and use of supplies by providing appropriate legal and institutional mechanisms to address water rights issues (allocation, compensation, etc.); and
- To augment the region's water resources in the future by encouraging research into advanced water saving and water augmentation technologies.

Recommendations made to State and Federal agencies for the resolution of New England's water supply issues were developed within the context of these objectives, and emphasized the importance of preserving existing supplies, and using water efficiently and equitably to meet the region's municipal and industrial needs.

Rather than describing the objectives in detail, it will be more instructive to summarize the general statements from which each specific set of objectives was derived. For the New England region, the major resource-related objectives are:

- To protect the health and safety of the people of the region;
- To identify and preserve the remaining high quality resources in the region;
- To restore, in economically and socially acceptable ways, the resources which have been degraded;
- To efficiently manage all resources to minimize conflict and limit additional loss or degradation;
- To identify managers at the most efficient and responsive levels of government;
- To coordinate and provide a context for the individual decisions of key factors in the region at State, Federal, local, and regional levels; and
- To ensure that the people of the region participate directly and meaningfully in the decisions which affect their lives.

Recommendations

The following recommendations suggest solutions that incorporate the elements outlined in the statements above. According to Water Resources Council guidelines, recommendations were to be prepared for several categories of problem resolution: data collection and research; planning studies; and legal, institutional, and policy changes. A fourth category, the Federal role in problem resolution, was also suggested, but as the regional sponsor has chosen to consider the Federal role with regard to each of the other categories (for example, recommendations for data collection or planning programs are made to several Federal agencies), it will not be presented as a separate section.

Due to limited space and the summary nature of this chapter, not all of the regional sponsor's recommendations can be considered separately in the following sections. For a full discussion of all objectives and recommendations for this region, refer to Technical Memorandum 4, Summary Report: Severe Resource Problems and Recommendations for Their Resolution, prepared for the Water Resources Council by the New England River Basins Commission. The section below will attempt to outline some of the more significant recommendations from that report, presenting a representative selection of recommendations in the categories of data collection and research, planning, and legal, institutional, and policy changes.

Data Collection and Research

Water Quality

- In order to develop a widespread, ongoing water quality inventory, the Environmental Protection Agency (EPA) should encourage States to monitor water quality conditions and changes (emphasizing proper water quality parameters) at selected U.S. Geological Survey (USGS) stream gaging stations and to install their own water quality monitoring systems at frequent intervals on the region's rivers and streams. Such systems should enable the States to maintain an annually updated data base for water resource planning and management, to evaluate the efficiency of existing treatment facilities, to develop their construction-funding priority lists, and to determine if higher (advanced) levels of treatment are necessary. A water quality inventory of this kind is presently being developed by Connecticut, in cooperation with USGS.

- USGS should expand its system of ground-water observation wells and surface-water quality monitoring stations in New England to provide a regional data base for analyzing the effects of nonpoint sources such as runoff, landfill leachates, and septic system effluent on the quality of ground and surface waters. USGS and EPA should assist the States in water quality monitoring programs. Particular documentation of ground-water pollution from nonpoint sources is required.

- EPA or the Office of Water Research and Technology (OWRT) should fund continued research into sewering alernatives, including methane digestion and dry disposal systems such as composting toilets which would conform to stringent public health standards. Research should also be conducted into methods of reducing the amount of residential waste water, such as the reuse of "grey" water from bathtubs and washing machines.

- Along with ongoing research into alternative sludge disposal practices such as composting and incineration, EPA should fund additional research and demonstration projects to evaluate the most economical techniques for the reuse or disposal of sludge with minimum adverse environmental effects.

- The Army Corps of Engineers, in cooperation with the National Marine Fisheries Serivice and EPA, should continue to monitor all of the consolidated dredged material disposal sites, before, during and after disposal, to develop baseline information on the continuing impact of dredged material on water quality and fish habitats. The results of this monitoring should be used to develop procedures and standards to control the impacts of new dredge disposal activities.

- EPA should promote its program of Lake Restoration Demonstration Grants in the New England States in order to support research on the causes, effects, and extent of eutrophication and to promote the development of new techniques to prevent or reduce this problem. Research into innovative treatments, including composting toilets capable of meeting stringent public health standards, and other alternatives to septic systems for houses around lakes with eutrophication problems should receive particular attention.

Water Supplies

- The States, using the U.S. Geological Survey's cooperative program, should request that USGS continue, and accelerate where possible, its surveys of the location, extent, and character of the region's ground-water supplies in order to: (1) assist municipalities in designing their exploration programs for well sites; (2) assist State agencies in evaluating future needs to supplement ground-water supplies; and (3) assist municipalities in regulating, protecting, and preserving their existing and potential ground-water resources; (4) develop descriptions or models of and surface-water interrelationships, allowing States to evalute water supply alternatives in the context of integrated water management; and (5) inform regional and State agencies about available ground-water sources which should be considered in preparing their water supply plans.

- EPA (through Section 1442 (a) of the Safe Drinking Water Act) and/or USGS (through its Federal-State cooperative program) should fund research in New England which will yield more detailed information on the dynamics of ground-water recharge with regard to the impact of development on recharged areas and the effects of septic system and landfill leachates as well as urban and highway runoff on the quality of ground-water sources.

- EPA, through funding provided by Sections 1442 and 1444 of the Safe Drinking Water Act, should further investigate potentially harmful substances in drinking water, for example, the organics formed by the interaction of chemicals used in certain treatment processes with contaminants in the water. EPA should also consider methods of identifying and measuring these substances, their effects on health, new techniques for their treatment, and new procedures required for the operation and maintenance of the treatment facilities.

- OWRT is encouraged to continue its efforts to develop economical methods for desalination as a long-term source of water supply. The environmental effects of various desalination processes, such as the impact of brine disposal, should also be investigated.

- In order to reduce or stabilize per capita water demand, OWRT should appropriate funds for its program to support projects designed to improve water-use efficiency (no funds were appropriated in FY 1977). Research under this program could include the development of water-saving appliances such as more efficient dishwashers, washing machines, and commercial air conditioners, as well as investigations of waterless disposal systems such as composting toilets or mineral oil systems which would be required to conform to stringent public health standards. Water-saving devices for industrial use and safe, efficient methods of recycling domestic and industrial water should also be investigated.

Flood Management

- The National Weather Service should expand its flood and hurricane forecasting and warning systems through new technologies, monitoring systems, additional river gaging stations, and an improved communications network, and should assist municipalities in updating their local flood warning and evaluation systems. Investment in flood prediction and response systems has proved to be one of the most cost-effective means of reducing loss of life due to floods in the region.

- The Department of Housing and Urban Development should accelerate its flood insurance rate mapping program and promptly complete maps of all of New England so that all localities can join the regular insurance program. Standards should be redefined to ensure the accuracy of the maps and their suitability as a basis for insurance rate-setting.

- Every State not having done so should undertake a program to upgrade local and State wetlands maps using natural indicators such as plant communities and soil types. Critical wetlands should be identified based on their values for water supply, flood prevention, wildlife habitat, or recreational use.

- OWRT, the New England Water Resources Research Institutes, and other appropriate funding institutions should support research into the capacities of wetlands as natural flood-water retention areas to aid in their identification and preservation.

Erosion and Sedimentation Damages

- Research on coastal and inland erosion should be conducted or funded by the Agricultural Research Service, Army Corps of Engineers, or the OWRT. This research would study natural erosion processes and determine how these processes are affected by natural factors such as soil type, slope and drainage, or by various types of development or recreational use. Such information could be used in the formulation of erosion control regulations.

Low Streamflows and Fluctuating Lake Levels

- OWRT and the New England Water Resources Research Institutes should support investigation into the quantitative beneficial and adverse effects of natural and man-induced lowered streamflow and flow augmentation on fish and wildlife habitats, estuarine salinity, ground-water recharge, and riverine assimilative capacities.

- OWRT and the New England Water Resources Research Institutes should support research into the effects of lake level fluctuation on wetlands, fish and wildlife habitats, algal and weed control, shoreline erosion rates, and water quality conditions.

Inadequate Water-oriented Recreation

- A New England-New York recreational demand study group is currently designing a methodology to predict recreational demand. This study should be extended to present each State's recreation supply data according to standardized units. This will create a consistent data base for recreational information in New England, which can be used in the development of statewide comprehensive outdoor recreation plans.

Energy Facility Siting

- The New England States should assemble information on areas where adequate land and water would be available for energy development, and on critical environmental areas such as shellfish spawning sites, valuable wetlands, or key recreational facilities, which should not be considered as energy development sites.

Coastal Petroleum Development and Transportation

- The EPA, Coast Guard, and other agencies should expand their research on oil spills to improve capability to both prevent spills and minimize spill impacts. Emphasis should be placed on development of new equipment and techniques for containment and cleanup of spills, especially in the rough seas off New England's coasts. Nonequipment approaches to spills during cold-weather conditions should also be investigated. Cost effectiveness studies and case histories on past spills should be compiled and analyzed in order to improve oil spill contingency planning.

Planning Studies

Water Quality

- The EPA and the States cooperatively should inventory existing high-quality waters throughout New England in order to determine which ones could be designated as "no discharge" zones for protection under EPA's nondegradation standards. The EPA should conduct a study analyzing New England's various 208 planning programs, comparing and evaluating the different methods by which the region's designated agencies develop selected elements of their areawide programs. Elements should include strategies to control nonpoint sources and consideration of the relationship between water quality and land use. The study should include recommendations on preferred water quality management strategies based on its evaluation of alternatives.

- The EPA should fund a study to be conducted by New York and Connecticut to determine whether nutrient enrichment in the western portion of Long Island Sound could be controlled through nutrient removal at waste-water treatment plants. The study should investigate means of disposal of the extra sludge which would be generated, including the possibility of land application.

Water Supplies

- In light of increased water development and energy costs, environmental objections to new supply development, and new technologies, the New England River Basins Commission should conduct a study to reevaluate water conservation measures as an alternative to development programs in selected New England communities. The study should analyze the major factors responsible for increased per capita use of water (e.g., more appliances, higher standards of living) and should evaluate methods of demand reduction (e.g., better technology, public education).

- Where such a plan has not already been developed, States should conduct a water supply policy study similar to one recently completed in Massachusetts, inventorying the water supply in the State and developing statewide goals and policies for the management and allocation of water supply resources.

- The New England River Basins Commission, with EPA, should conduct a study analyzing the implications of the Safe Drinking Water Act's more stringent treatment requirements on the use of watershed lands presently used for water supply protection. The study, which will be part of a broader investigation of the impacts of the Safe Drinking Water Act, should include an evaluation of the benefits of watershed lands in controlling pollution and should also include recommendations concerning watershed management for both public and private water supply operators.

- Working with State water resource agencies in Connecticut, Massachusetts, New Hampshire, and Vermont, the New England River Basins Commission's special study on cumulative water use in the Connecticut River Basin should inventory existing and proposed uses of water in the basin with the objective of providing a basis for a multi-State water resource allocation model. The study should recommend additional technical investigations or resource models with which to evaluate the impact of cumulative upstream water uses on downstream activities and environments.

Flood Management

- A flood management planning procedure for coastal areas should be developed as a parallel effort to the flood-plain management case studies currently being carried out under Section 73 of the Water Resource Development Act of 1974. This study is being conducted on the Connecticut River by the New England River Basins Commission, the Army Corps of Engineers, the Soil Conservation Service, and the basin States. The coastal study, which should be coordinated with the work of State coastal zone management agencies, should determine the relative efficiency of structural and nonstructural approaches to flood protection in coastal areas, and should facilitate the implementation of Section 73 funding in the coastal zone.

- Based on data accumulated by the Army Corps of Engineers concerning small dam ownership, maintenance, and use, the Corps, the Federal Energy Regulatory Commsission, and appropriate State agencies should study unused and unsafe small dams in New England to determine which dams should be dismantled and which should be rehabilitated and perhaps used for flood control and hydropower generation. In addition, the study should identify appropriate custodians to be responsible for the maintenance of all rehabilitated dams and should design a monitoring program to ensure compliance with the safety program.

- The New England States should request that the Army Corps of Engineers study the cumulative effect that the loss of natural valley flood storage could have on flooding throughout New England, especially in the Connecticut River Basin. The applicability of other nonstructural solutions to flood reduction should be analyzed on a case-by-case basis as well.

Erosion and Sedimentation Damages

- State coastal zone programs, individually or collectively, should consider conducting a study that would include an update of the coastal erosion situation. The study could be undertaken as part of the expanded planning requirements for shoreline erosion in Coastal Zone Management Act Amendments of 1976. Such a review would consider the technology of erosion control, the effects of control measures, and the development of a strategy for erosion control.

Low Streamflows and Fluctuating Lake Levels

- The Army Corps of Engineers should conduct a study on lake level regulation in Lake Memphremagog on behalf of the International Joint Commission. The study should reevaluate the suitability of current miminum and maximum lake-level standards in light of the existing environmental problems that have resulted from lake-level regulation (erosion, loss of recreation opportunities, and loss of fish and wildlife habitats.) The study should also recommend means of resolving conflicting lake-level needs.

- Studies concerned with the feasibility of increasing hydropower development in New England are currently being conducted by the Army Corps of Engineers, the Department of Energy, and the New

England River Basins Commission. These studies should include the impact of possible impoundment fluctuations as one aspect of their investigations.

- The New England States should evaluate and define the conditions under which proposed hydropower facilities, flood control dams, water supply reservoirs, and related works would have significant adverse environmental and social impacts upon streams and scenic areas that might otherwise be reserved for purposes of the Wild and Scenic River Program.

Inadequate Water-oriented Recreation

- Through their coastal zone management programs, appropriate State agencies should study the feasibility of increasing the number of small recreational boat harbors in New England, taking into account the potential pollution problems created by vessel and marine discharges and identifying suitable sites for marina development. Where there is specific local interest in such harbors, the Army Corps of Engineers should conduct a study evaluating proposed channels, navigational aids, and boat storage facilities for harbors which can handle increased traffic.

- As part of their areawide and facilities planning programs, State, substate, regional, and local agencies should seriously study what impact attaining "fishable-swimmable" water quality would have on recreational opportunities. They should also investigate opportunities for combining open space and recreational concerns with waste treatment management.

Energy Facility Siting

- The New England River Basins Commission should work with the States, the New England Power Pool, and the New England Council of Water Center Directors to identify the best locations for new power facilities in New England. One element to be considered should be the assimilative capacity of the region's surface waters to receive thermal discharge from powerplants that are not using cooling towers. States should take the lead in inventorying critical environmental areas and in recommending suitable power site locations. The Federal Government should fund the State studies and should provide a regional overview and a means of integrating the State plans.

Coastal Petroleum Development and Transportation

- The New England River Basins Commission, in conjunction with the New England Regional Commission, should continue to pursue funding options and develop program details for a special study on New England's ports and harbors. Such a study could rely upon previous studies by the Army Corps of Engineers and could look into the possibility of consolidating petroleum ports to reduce the extent of oil spillage in New England's coastal waters.

Legal, Institutional, and Policy Changes

Water Quality

- Congress, in its oversight review of the Federal Water Pollution Control Act, must consider revising the Act to accommodate necessary extensions in the July 1, 1977, deadline for secondary or best practi cable technology (BPT) control at discharges where these requirements cannot be met. Congress should also consider revising the Act to include provisions for "nonattainment" zones, similar to those proposed for air quality, where Class B standards cannot reasonably be met and lower goals should be at least temporarily applied. Designation of such zones must consider the water quality goals of other programs, such as recreation and anadromous fish restoration plans.

- EPA should increase its funding for water quality management studies, and should step up water quality monitoring in both the designated and nondesignated areas of the New England States under Section 208 of the Federal Water Pollution Control Act. The States and designated agencies are urged to complete their areawide 208 waste treatment management plans as quickly as possible and to take positive steps to ensure that additional treatment facility construction will be consistent with a well-coordinated, overall water management strategy.

- EPA, in conjunction with the States, should set national nondegradation standards prohibiting discharges into high-quality waters.

- EPA and State water quality agencies should provide funding for the abatement of pollution from combined sewer overflows through treatment of the overflows, storage of high flows by means of in-system controls or off-system retention, and treatment of low combined flows. Combined sewers should only be separated where this proves to be the most cost-effective alternative.

- As part of their balanced mangement strategies for waste-water control, EPA should encourage the States to control nonpoint pollution at its source, rather than relying on the treatment of point sources (some of which may have begun as nonpoint pollutants) to attain water quality goals. Management controls of some nonpoint scources could be implemented through recently proposed regulations under which EPA would issue general area permits for sources such as storm sewers and agricultural feed lots, requiring that they be managed to abate or prevent nonpoint pollution.

- EPA should provide additional funding and incentive to assure that 208 planning for both designated and nondesignated 208 areas is fully implmented by the States and designated 208 agencies. Part (F)(1) of Section 208 specifically requires that the EPA administrator provide grants for the continuing areawide waste treatment management planning process.

- In areas where States have identified eutrophication problems in their inventories mandated by the Federal Water Pollution Control Act (Public Law 92-500) EPA should make its funding of any new waste-water treatment facilities contingent on approval of a eutrophication control plan that specifies a means of nutrient control for the area.

Water Supplies

- In areas where there is a reasonable basis for believing that distribution systems are losing a significant amount of water through major leaks and breaks, Federal assistance should be made available through a grant or loan program to assist in lead detection and system repair. In order to prevent economically avoidable losses, State and Federal funds for additional water supply development should be made available only on the condition that system rehabilitation efforts be undertaken.

- The States should develop financial and technical assistance programs to support municipalities and water utilities in the efficient use and maintenance of their existing water supply sources and in the protection and development of future water supply options. These programs could be directed toward:

  - assisting municipalities and industries in maintaining the quality and yield of their existing sources of supply;

  - assisting muncipalities in the early identification, acquisition, and management of key watersheds and potential reservoir sites, well sites, and significant recharge areas;

  - determining management techniques, through State forestry agencies, to enhance the yield and quality of water from forested watershed lands;

  - encouraging the judicious use, first, of in-basin ground water and second, of in-basin surface water resources; supporting water conservation measures to the greatest extent feasible before obtaining supplies from interbasin transfers;

  - supporting the development, where feasible, of intermunicipal water supply systems, which would provide the benefits of cost sharing, operational efficiency, and quality control for a relatively small group of neighboring communities;

- providing matching grants or a revolving fund of low-interest or interest-free loans to assist regional and local water supply studies and facilities construction in conformance with State approved plans;

- developing and implementing a strategy for water demand management, including pricing mechanisms for high volume users, where economically feasible, as well as water conservation education programs for residential consumers;

- supporting statewide conservation efforts, encouraging the development and use of water-saving devices (shower heads, toilet tanks) for both domestic and industrial uses, and requiring the installation of proven water saving applicances in all new buildings;

- encouraging the construction and maintenance of recharge basins to capture storm-water runoff in areas where development has covered major recharge lands;

- requiring the metering of all water utility deliveries and the rehabilitation of water distribution systems that have been shown to lose significant amounts of water through leaks and breaks.

o State or local authorities currently promulgate and enforce regulations concerning the protection of ground- and surface-water sources and drinking-water quality. However, EPA will enforce minimum national standards under the Safe Drinking Water Act if a State's program does not meet Federal criteria. In general, the New England States should consider some of the following opportunities for the protection of their water supplies:

  - Develop realistic siting criteria and land use controls for landfills and for development involving septic systems in order to protect aquifers and recharge areas. These criteria should be based on capabilities:

  - Where they do not already exist, establish statewide water management planning agencies supported by Title III grants of the Water Resources Planning Act to coordinate and integrate water supply and water quality planning;

  - Consider ground- and surface-water quality benefits when evaluating landfill recycling or incineration programs;

  - Improve water supply supervision programs, including adequate legislative authority, comprehensive regulations, and additional manpower and equipment for site visits, surveillance, enforcement, and technical assistance (possible with State program grant funds under Section 1443(a) of the Safe Drinking Water Act).

- The appropriate water resource agency in each State should be responsible for developing a statewide water allocation policy based on an inventory of State water supplies and a determination of equitable water distribution. Using this policy as a guide, the agency should have the authority to arbitrate in-State water rights issues regarding interbasin diversions.

Flood Management

- In line with the requirements of Section 73 of the Water Resources Development Act of 1974, Congress and the President should provide financial resources for the utilization of all alternative flood management techniques through such actions as the approval of budget requests.

- State-level programs and regulations can greatly facilitate the reduction of flood damages, especially if programs are consolidated under the auspices of a single State agency or office: Programs and regulations that should be considered for the New England States are:

  - State requirements that localities develop and enforce zoning regulations to restrict development in flood-prone areas to those uses which are in the best interests of public safety and welfare and which comply with established standards. Such regulations should be consistent with, and satisfy the requirement of, the Department of Housing and Urban Development's (HUD) flood insurance program. Through their coastal zone management programs, States could prepare model shoreline zoning regulations to assist local formulation of regulations. Govermental control over the location of essential public facilities and services can be used as an additional tool to guide development away from flood hazard areas.

  - State funding for either State or local acquisition of key undeveloped flood-plain lands and major natural flood storage areas for recreational or open space uses; State encouragement for continued maintenance of existing agricultural and open space flood-plain uses. A State policy could be established to make location in a flood-prone area one consideration in the choice of lands to be purchased with Federal and State acquisition funds such as those of the Land and Water Conservation Fund Act, the Wildlife Restoration Act, and State "self-help" programs.

  - State guidelines for making exisitng structures in flood-prone areas flood resistant, and a local permit program requiring that any new development in flood-prone areas meet flood resistance standards.

- State establishment of stream channel encroachment lines, similar to those currently authorized in Connecticut and Massachusetts. These would be based on accurate flood insurance rate maps. States should strictly regulate permitted activities within these lines, or prohibit all activities within them as is recommended in Massachusetts.

- State and/or local establishment of property tax rates which would encourage compatible uses in flood-prone areas, (i.e., preferential taxes for open space, agriculture, or recreation areas), and of additional tax incentives for making existing structures flood resistant.

o Maximum protection of critical wetlands areas should be provided wherever feasible through acquisition of easements or development rights through outright purchase of the land. These actions should be permitted and encouraged in the implementation of all Federal programs, including regulatory (Army Corps of Engineers and EPA) and planning (HUD) programs as well as acquisition programs such as the Land and Water Conservation Fund. States should also consider purchasing easements, development rights, or land in critical wetlands areas, and both Federal and State governments whould institute a policy against support of construction activities in such areas.

Erosion and Sedimentation Damages

o Based on strategies developed through their coastal zone management programs and consistent with requirements of the Coastal Zone Management Act, New England's coastal States should require local regulations such as zoning ordinances, building codes, and subdivision regulations to prohibit development in serious erosion areas along the shore and to protect other areas from erosion. Where municipalities fail to enact these controls, State regulations should be applied. The controls should prohibit construction in the zones which are expected to erode within the design lifetime of the structures.

o States should establish regulations or guidelines to reduce inland erosion and sedimentation. Such programs should make use of Soil Conservation Service soil erodibility data and should be consistent with recommendations of the 208 plans for reduction of nonpoint source pollution. The following measures should be included:

- Ordinances and minimum standards for municipal sediment and erosion control. The ordinances should identify streams and lakes that could be damaged by sedimentation and should strictly regulate development in the buffer strips along these shorelines;

- Regulation of construction practices to specify procedures clearing, grading, altering drainage, etc.;

- Control of forestry practices through the preparation of guidelines for erosion control or through a requirement that timber operators file an erosion control plan for environmentally sensitive areas with the appropriate State regulatory agency; and

- Regulation of agricultural practices, including specification of techniques to be used in lessening runoff and trapping sediments, provided that such controls do not substantially lower net farm income and force prime agricultural lands out of production.

Low Streamflows and Flucuating Lake Levels

o Quantitative environment information developed through research should be used as the basis for developing minimum streamflow standards on all New England rivers which are major sources of water supplies or which are regulated for power generation or other uses.

o The Federal Energy Regulatory Commission of the Department of Energy should have the authority to develop and enforce these standards for all dams under their jurisdiction. States should have the authority for all other dams.

o The Federal Energy Regulatory Commission should consider fish and wildlife requirements in establishing maximum and minimum standards for lake levels at all regulated lakes under their jurisdiction. Where appropriate, States should institute maximum and minimum lake level requirements at appropriate dams under their jurisdiction, paying similar attention to fish and wildlife needs.

Inadequate Water-oriented Recreation

o To optimize use of the Federal share of Land and Water Conservation Funds, the Federal proportion could be determined on a sliding scale concurred in by the States. This scale would be such criteria as land costs, regional impact, climate, population density, degree of national significance, and degree of nonresident use.

o A number of New England States have Great Ponds statutes, dating from colonial times, which require public access to ponds over a certain size. Enforcement of these and any other public access statutes, as well as the development of new ones, would greatly increase recreational opportunities.

- In some States, State funds to match Federal Land and Water Conservation Fund monies are limited to passive recreation uses only. These States may want to consider establishing a separate fund for urban "active" recreation facilities, as has been proposed in Massachusetts. Full funding of these matching or "self-help" programs (such as the Green Acres program in Rhode Island) should be a high priority.

- The use of private facilities could be encouraged through the development of tax incentives for recreational development, by assuring limited personal injury liability for landowners if public access is granted, and by municipal (and State) procurement of recreational easements where appropriate.

Energy Facility Siting

- If appropriate, potential energy facility sites that best meet environmental and public safety criteria could be purchased by the States with a combination of Federal and State funds, or rights of first refusal could be secured. The lands could then be made available to utility companies either through long-term leases or through acquisition at a price equal to the States' purchase costs plus maintenance expenses. Permission for construction of energy facilities on other sites could be granted on the condition that these sites are equally suited to energy development with minimal environmental disruption or hazard to public safety.

- Energy demands should be reduced through State programs for energy conservation. Reduction in consumption should be encouraged through measures such as tax credit incentives, revisions in rate structure, and inclusion of mandatory conservation standards in building codes.

Coastal Petroleum Development and Transportation

- The New England States should work together through the Coastal Zone Task Force to coordinate the State oil spill contingency plans and to develop a plan for regional cooperation, i.e., sharing of equipment and expertise. The U.S. Coast Guard and Environmental Protection Agency working together and with States, should continually revise their contingency plans for coastal and inland regions. All of the contingency plans should specify priorities for protection of critical resources and should outline provisions for transportation and disposal of waste oil and debris cleaned up after a spill. They should be made compatible with the State coastal zone management programs.

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The United States Water Resources Council was established by the Water Resources Planning Act of 1965 (Public Law 89-80).
The purpose of the Council is to encourage the conservation, development, and utilization of water and related land resources on a comprehensive and coordinated basis by the Federal government, States, localities, and private enterprises with the cooperation of all affected Federal agencies, States, local government, individual corporations, business enterprises, and others concerned.