US Army Corps
of Engineers
New England Division

Water Resources Development

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1991

Rhode Island 1991

On the Cover: *Block Island Harbor of Refuge*

The work of the U.S. Army Corps of Engineers in Rhode Island 1991

This booklet presents a brief description of water resources projects completed by the U.S. Army Corps of Engineers in Rhode Island. It describes the role of the Corps in planning and building water resource improvements and explains the procedure leading to the authorization of such projects.

For ease of reference, the material is arranged according to the type of project, i.e. flood damage reduction, navigation, or shore and bank protection. There is also a reference at the end of the booklet that lists Corps' projects by community. A map showing the location of all Corps projects in the state is provided on the underleaf of this page.

The Corps of Engineers water resources development program exerts a significant impact on Rhode Island's physical, economic, and social environment. This publication affords citizens the opportunity to learn about the various projects and to determine how they can participate in decisions regarding present and future activities.

For further information, call the Corps of Engineers at 617-647-8777, or write:

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New England Division

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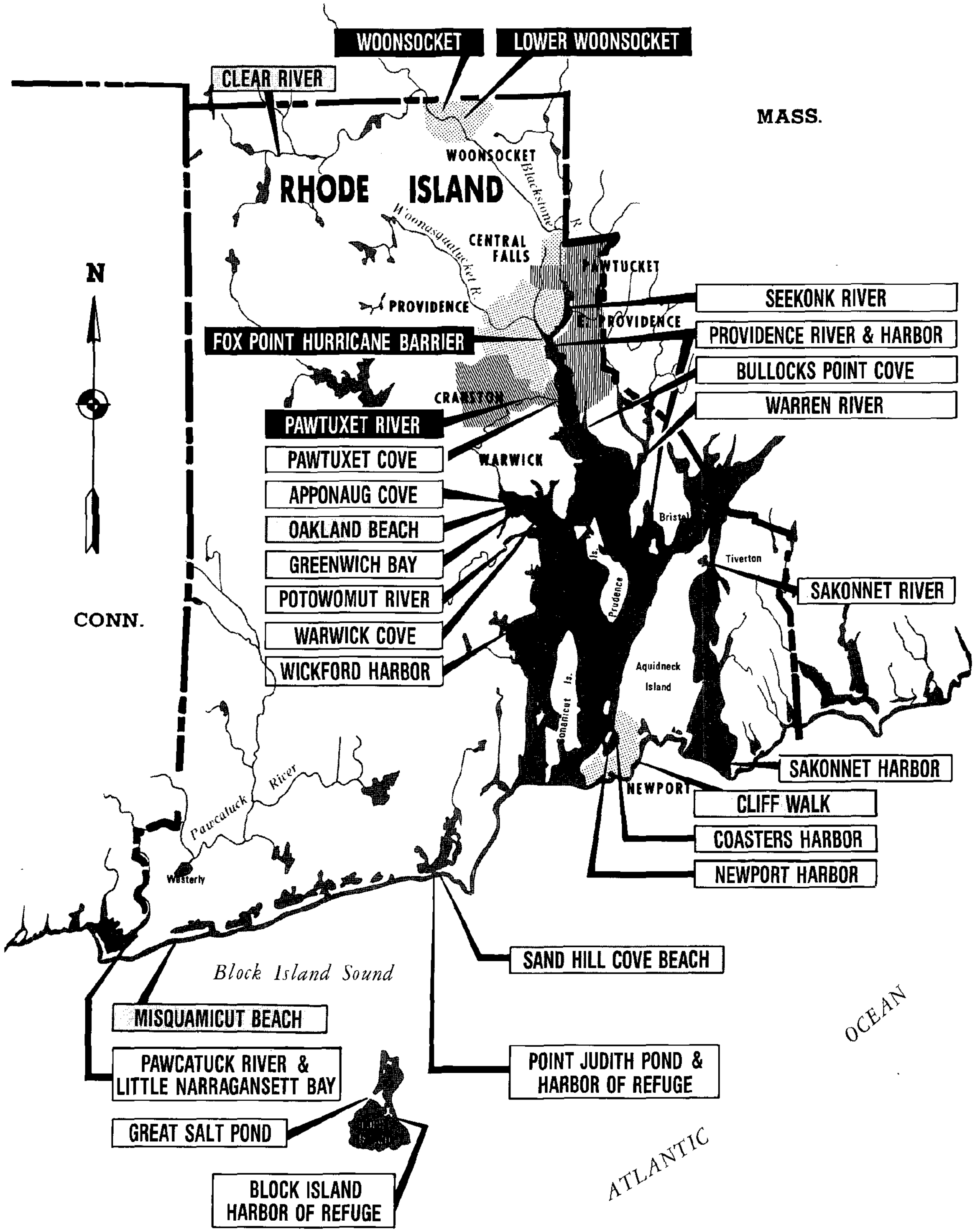

Corps' Projects in Rhode Island	
FLOOD DAMAGE REDUCTION	■ (black bar)
NAVIGATION	□ (open bar)
SHORE AND BANK PROTECTION	□ (open bar)

MILES

US Army Corps of Engineers
New England Division

For more than 216 years, the missions and accomplishments of the U.S. Army Corps of Engineers have closely reflected the needs and wants of a growing, changing nation. For much of this time, the Corps has played a major role in our nation's water resources development, including navigation, flood control, water quality and supply, recreation and related projects.

Although the driving force behind our water resources development mission has remained constant—providing quality service to the nation there have been several challenging adjustments in how we meet this requirement.

One such change was the introduction of non-federal cost sharing in the Water Resources Development Act. Though legislatively reaffirmed in the subsequent acts of 1988 and 1990, the true value of cost-shared development can be measured by the many successful projects of this partnership and the healthy water resources program it ensures for the future.

Another challenge we have faced recently is the increased public concern for their environment. We have always complied with environmental laws and regulations and managed our projects as a trust we hold for the future. Compliance, however, is no longer enough. We are taking an active position to not only protect but enhance our fragile environment.

The Secretary of the Army has been directed to include environmental protection as one of our primary missions, and the Water Resources Development Act of 1990 established a "no net loss" policy as an essential part of all water resources development. In addition to making environmental considerations as important as engineering and economic considerations for new start projects, we are taking a new look at existing projects to determine how they can be environmentally improved.

Looking ahead to the needs of our nation, we are taking a lead role in helping rebuild our nation's aging infrastructure. The U.S. Army Corps of Engineers has always been at the forefront of infrastructure development in the United States exploring new territory for settlement, surveying transportation routes and opening rivers to navigation. While we work to restore and strengthen the vital links in our infrastructure, we are also exploring new methods to meet increasing and varying national requirements. One such effort is a joint federal, non-federal demonstration project to determine the feasibility of a U.S. developed and built high-speed magnetic levitation transportation system.

We have also been working actively with the construction industry on a cost-shared Construction Productivity Advancement Research Program. This program has the double benefits of increasing the U.S. construction industry's competitive ability in the international market while providing more effective techniques, equipment and processes for federal and non-federal projects in the United States

With these initiatives, we are building on the Corps' traditions of professionalism and service to meet the needs of our nation for another 200 years. We are proud of the partnerships we have forged, and look forward to an exciting, rewarding future in water resources development.

This booklet is one in a series detailing water resources programs in the 50 states and U.S. possessions. I hope you find it interesting and feel some pride of ownership.

H.J. HATCH
Lieutenant General, USA
Commanding

US Army Corps of Engineers
New England Division

The U.S. Army Corps of Engineers has a long and proud history of applying its expertise in engineering and related disciplines to meet the Nation's needs. Over the years, those needs have evolved, from such 19th Century activities as exploration, pathfinding and lighthouse construction to such modern missions as hazardous and toxic waste removal and environmental improvement. The central focus of its Civil Works mission, however, has, from its earliest days, been development of the Nation's water resources.

The water resource projects developed by the Corps of Engineers, in cooperation with State and local project sponsors, have proven themselves time and again as wise investments of public funds, returning to the public in benefits—low cost transportation, flood damages prevented, etc.—far more than their cost to plan, build and operate. As a result, the Civil Works program enjoys a high degree of credibility within the Administration, and with Congress. With a program of more than $3.5 billion in Fiscal Year 1991, the Civil Works program was one of the very few "domestic discretionary" activities of the Federal government to receive an increase in funding that year.

Yet, proud as we are of the respect this program commands within the Federal government, we are even prouder of the trust that our partners the States, local governments, port authorities, water management districts and other local project sponsors place in us.

Each Corps of Engineers project is the product of an orderly study and design process. Under provisions of the Water Resources Development Act of 1986, sponsors demonstrate their commitment early in the project development process by agreeing to joint funding of the feasibility study upon which a project's construction authorization will be based, and to cost sharing of the project's construction once it is authorized. To date, more than 150 non-Federal sponsors have signed Local Cooperation Agreements for studies or congressionally authorized projects.

The engineering expertise and responsiveness of the Corps of Engineers, gained in the Civil Works and Support for Others programs as well as in its military construction role, has stood the Nation in good stead from Alaska, where it participated in the oil spill cleanup; to Puerto Rico, the Virgin Islands and the Southeastern States, where it spearheaded recovery efforts after Hurricane Hugo; to California in the aftermath of the Loma Prieta Earthquake; to the Midwest and California as they deal with continuing drought; to Panama and the Middle East in Operations JUST CAUSE and DESERT SHIELD/DESERT STORM; to dozens of other locations. Whatever challenges arise in the years and decades ahead, I have no doubt that the Army Corps of Engineers will be equal to the task.

G. Edward Dickey
Acting Principal Deputy
Assistant Secretary of the
Army (Civil Works)

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U.S. Army Corps of Engineers

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Civil Works Overview

Introduction

The Corps traces its history back to April 26, 1775, seven days after the first shots of the American Revolution were fired at Lexington, Massachusetts. Recognizing that the need for military engineering skill would be important in the war with England, the Massachusetts Provincial Congress appointed Boston native Richard Gridley to the rank of Colonel and chief engineer of the troops being raised in the colony.

In the early morning hours of June 17, 1775, Gridley, working under the cover of darkness, constructed a well-designed earthwork on Breed's Hill that proved practically invulnerable to British cannon. The British eventually took the hill (later called the Battle of Bunker Hill) when the patriots ran out of gunpowder, but at a cost in casualties greater than any other engagement of the war.

Gridley was to play other critical roles in the early days of the Revolution. On the evening of March 4, 1776, Gridley, along with 2000 men and 360 oxcarts loaded with entrenching materials, moved into Dorchester Heights. By daylight, two strong protective barriers looked down at the British. An astonished General Howe, commander of the British forces, reportedly remarked that the Americans had done more in one night than his entire army would have done in six months. Exposed to the American batteries on Dorchester Heights and not strong enough to fight Washington's troops in other parts of Boston, the British army and fleet departed Boston on March 17, never again to occupy Massachusetts.

In 1802, Congress established a separate Corps of Engineers within the Army, and at the same time established the U. S. Military Academy at West Point, the country's first—and for 20 years its only—engineering school. With the Army having the Nation's most readily available engineering talent, successive Congresses and Administrations established a role for the Corps as an organization to carry out both military construction and works "of a civil nature."

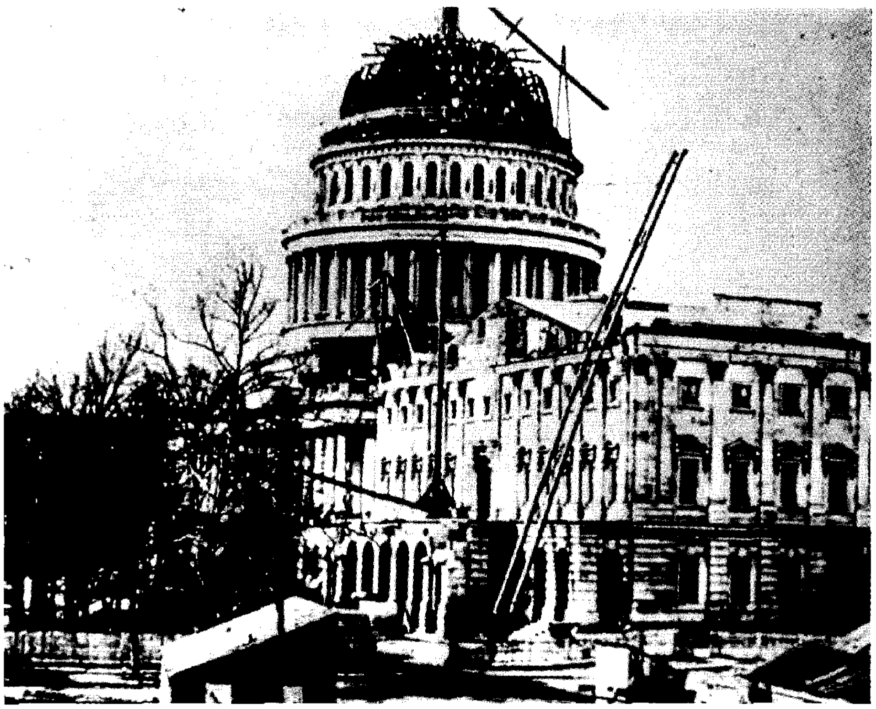
Throughout the nineteenth century, the Corps supervised the construction of coastal fortifications, lighthouses, several early railroads, and many of the public buildings in Washington, DC, and elsewhere. Meanwhile, the Corps of

Under the direction of Colonel Richard Gridley, American patriots worked diligently throughout the early morning hours of June 17, 1775, designing a stout earthwork fortification that helped protect American soldiers from British cannonade in the historic Battle of Bunker Hill.

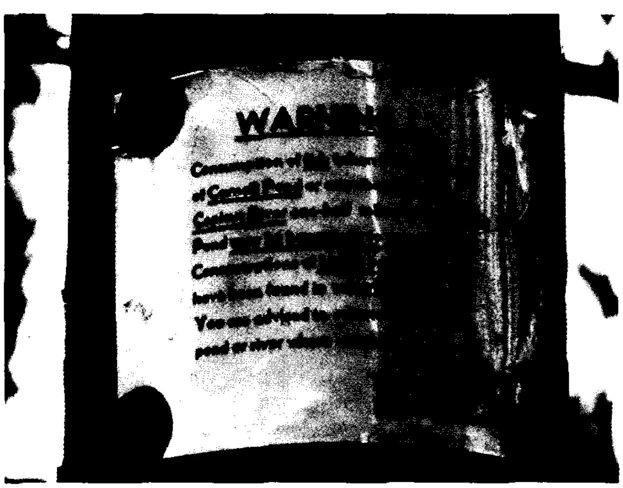
Topographical Engineers, which enjoyed a separate existence for 25 years (1838-1863), mapped much of the American West. Army Engineers served with distinction in war, with many Engineer officers rising to prominence during the Civil War.

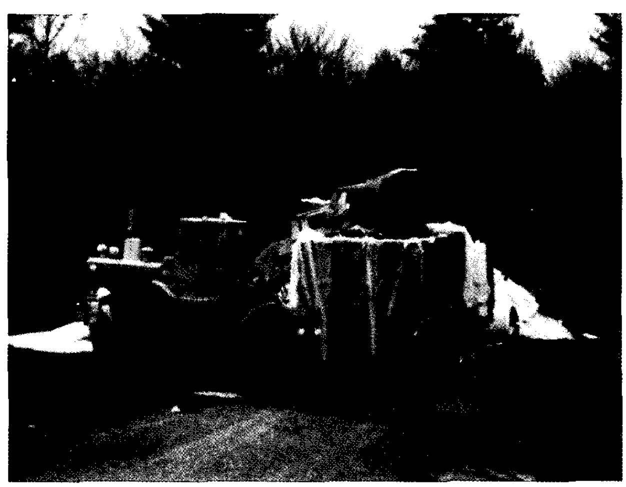
In its civil role, the Corps of Engineers became increasingly involved with river and harbor improvements, carrying out its first harbor and jetty work in the first quarter of the nineteenth century. The Corps' ongoing responsibility for federal river and harbor improvements dates from 1824, when Congress passed two acts authorizing the Corps to survey roads and canals and to remove obstacles on the Ohio and Mississippi Rivers. Over the years since, the expertise gained by the Corps in navigation projects made it a natural to assume new water-related missions in such areas as flood control, shore and hurricane protection, hydropower, recreation, water supply and quality, and wetland protection.

Today's Corps of Engineers carries out missions in three broad areas: military construction and engineering support to military installations; reimbursible support to other Federal agencies (such as the Environmental Protection Agency's "Superfund" program to clean up hazardous and toxic waste sites); and the Civil Works mission, centered around navigation, flood control and—under the Water Resources Development Acts of 1986 and 1990 a growing role in environmental protection.



Army engineers contributed to both planning and construction of our nation's capital. When the Capitol Building had to be reconstructed in 1857, the Corps built two new wings and redesigned the dome with cast and wrought iron. The completed dome, which weighed almost nine million pounds, was used by President Abraham Lincoln during the Civil War as a symbol of his intention to preserve the Union.





Cleaning chemical spills at hazardous waste sites is a team project between the Corps and the EPA. An area identified as a hazardous waste location was this site in Dartmouth, Massachusetts, near Cornell Pond and the Copicut River.

Authorization and Planning Process for Water Resources Projects

Water resources activities are initiated by local interests, authorized by Congress, funded by Federal and non-Federal sources, and constructed by the Corps under the Civil Works Program. New England Division has water resource responsibilities in all six New England states. The area assigned to New England Division contains 66,000 square miles, 13 million people, 6,100 miles of coastline, 13 major river basins and 11 deep draft commercial ports.

The Water Resources Development Act of 1986 made numerous changes in the way potential new water resources projects are studied, evaluated and funded. The major change is that the law now specifies non-Federal cost sharing for most Corps water resources projects.

When local interests feel that a need exists for improved navigation, flood protection, or other water resources development, they may petition their representatives in Congress. A Congressional committee resolution or an Act of Congress may then authorize the Corps of Engineers to investigate the problems and submit a report. Water resources studies, except studies of the inland waterway navigation system, are conducted in partnership with a local sponsor, with the Corps and the sponsor jointly funding and managing the study.

For inland navigation and waterway projects, which are by their nature not "local," Congress has established, in the Water Resources Development Act of 1986, an Inland Waterway Users Board, comprised of waterway transportation companies and shippers of major commodities. This Board advises the Secretary of the Army and makes recommendations on priorities for new navigation projects (e.g., locks and dams, channel improvements, etc.). Such projects are funded in part from the Inland Waterway Trust Fund, which in turn is fed by waterway fuel taxes.

Normally, the study process for a water resource problem will include public meetings to determine the views of local interests on the extent and type of improvements desired. The desires of local interests and the views of Federal, State, and other agencies receive full consideration during the planning process.

Considerations which enter into recommendations to Congress for project authorization include determinations that benefits will exceed costs, and that the engineering design of the project is sound, best serves the needs of the people concerned, makes the wisest possible use of the natural resources involved, and adequately protects the environment.

A report, along with final environmental documentation, is then submitted to higher authority for review and recommendations. After review and coordination with all interested Federal agencies and Governors of affected States, the Chief of Engineers forwards the report and environmental statement to the Secretary of the Army, who obtains the views of the Office of Management and Budget before transmitting these documents to Congress.

If Congress includes the project in an authorization bill, enactment of the bill constitutes authorization of the project. Before construction can get underway, however, both the Federal government and the local project sponsor must provide funds. Budget recommendations are based on evidence of support by the State and by the ability and willingness of non-Federal sponsors to provide their share of the project cost.

Appropriation of money to build a particular project is usually included in the annual Energy and Water Development Appropriation Bill, which must be approved by both Houses of the Congress and the President.

Navigation

Rivers and waterways were the primary paths of commerce in the new country. They provided routes from western farms to eastern markets. They promised a new life to the seaboard emigre and financial reward for the Mississippi Valley merchant. Without its great rivers, the vast, thickly-forested, region west of the Appalachians would have remained impenetrable to all but the most resourceful early pioneers.

Consequently, western politicians such as Henry Clay agitated for federal assistance to improve rivers. At the same time, the War of 1812 showed the importance of a reliable inland navigation system to national defense. Thus, both commercial development and military needs required attention to river and harbor development. There was, however, a question as to whether transportation was, under the Constitution, a legitimate Federal activity. This question was resolved when the Supreme Court ruled that the Commerce Clause of the Constitution granted the Federal Government the authority not only to regulate navigation and commerce, but also to make necessary navigation improvements.

The system of harbors and waterways maintained by the Corps of Engineers remains one of the most important parts of the Nation's transportation system. Without constant supervision, rivers and other waterways collect soil, debris and other obstacles, which lead to groundings and wrecks. New channels and cutoffs appear frequently, and the main traffic lanes require continual surveillance.

Where authorized to do so, the Corps maintains the Nation's waterways as a safe, reliable and economically efficient navigation system. Inland waterways carry one sixth of the Nation's inter-city cargo, and one job in five in the United States is dependent, to some extent, on the commerce handled by the Nation's ports.

River and Harbor work by the Corps of Engineers in New England was initiated by a congressional appropria-

Jetties help provide safe channels for commercial and recreational vessels. The jetties at Saquatucket Harbor in Harwich, Massachusetts, also help prevent the buildup of sediment in the channel by directing and confining the tidal flow.

tion of $20,000 on May 26, 1824 "to repair Plymouth Beach, in the State of Massachusetts, and thereby prevent the harbour at that place from being destroyed." From that initial project at America's first permanent settlement, New England Division has completed 173 navigation projects , including federal navigation projects in 11 deep draft ports and adjacent waterways. The most visible of The Corps navigation responsibilities is the Cape Cod Canal, which has been operated by the federal government since 1928. The canal is 17.5 miles long and is traversed by 19,000 vessels annually. In addition, its recreation features attract over 4 million annual visitors to the project.

Flood Control and Flood Plain Management

Federal interest in flood control began in the Alluvial Valley of the Mississippi River in the 19th Century. As the relationship of flood control and navigation became apparent, Congress called on the Corps of Engineers to use its expertise in navigational work to devise solutions to flooding problems along the river.

After a series of disastrous floods affecting wide areas, including transportation systems, in the 1920's and 30's, it was recognized that the Federal Government should participate in the solution of problems affecting the public interest when they are too large or complex to be handled by States or localities. As a result, Corps authority for flood control work was extended in 1936 to embrace the entire country.

The purpose of flood control work is to prevent flood damage through flood flow regulation and other means. In addition, the Flood Control Act of 1944 provided that "flood control" shall include major drainage of land. These objectives are accomplished with structural measures, such as reservoirs, levees, channels and floodwalls, or non-structural measures which alter the way people would otherwise occupy or use the flood plain. Levees, channel improvements and flood walls built for flood control by the Corps of Engineers are turned over to non-Federal authorities for operation and maintenance.

Reservoirs constructed for flood control storage often include additional storage capacity for multiple-purpose uses, such as the storage of water for municipal and industrial use, navigation, irrigation, development of hydroelectric power, conservation of fish and wildlife, and recreation.

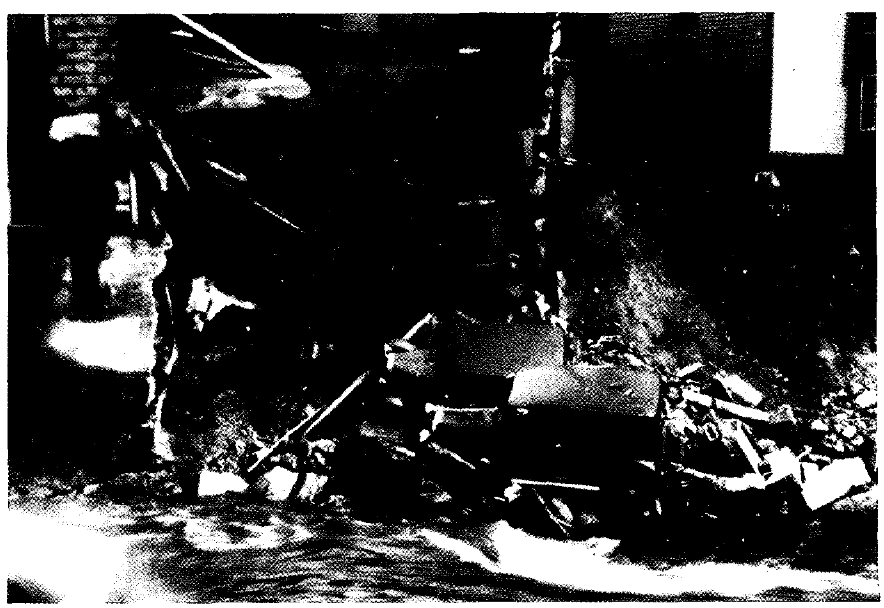
The Corps fights the Nation's flood problems by not only constructing and maintaining flood control structures, but also by providing detailed technical information on flood hazards. Under the Flood Plain Management Services Program, the Corps provides, on request, flood hazard information, technical assistance and planning guidance to other Federal agencies, States, local governments and private individuals. This information is designed to aid in planning for floods and regulation of flood plain areas, thus avoiding unwise development in flood-prone areas. Once community officials know the flood- prone areas in their communities and how often floods would be likely to occur, they can take necessary action to prevent or minimize damages to existing and new buildings and facilities by adopting and enforcing zoning ordinances, building codes and subdivision regulations. The Flood Plain Management Services Program also provides assistance to other Federal agencies and to State agencies in the same manner. In many cases, fees are collected to cover a portion of the costs of these services.

Flooding in New England

New England has a long history of flooding. Through the years it has been hit with various storms that have caused millions of dollars in damages. Some of the more destructive hurricanes and floods the area has experienced since 1900 occurred in November 1927; March 1936; September 1938; September 1954; and August 1955. However, some of the highest flood levels in New England history occurred in April 1987 and gave many Corps dams their most serious test since they were built. Despite having six dams channel excess water through their emergency spillways because their reservoir capacities had been reached, the 35 dams under the jurisdiction of the Corps' New England Division held back billions of gallons of water that otherwise would have caused severe flooding downstream. The amount of water held back by these dams from this heavy rainfall was equivalent to a reservoir that could put the entire state of Rhode Island under more than one foot of water. Damages prevented by Corps flood control projects during the April 1987 storm amounted to $462.6 million.

1927

Floodwaters swirl around homes and trees in this Vermont community during the November 1927 flood. The storm claimed 21 lives and caused $29.3 million in property damage.



1936

The rampaging waters of the North Nashua River ripped through the downtown area of Fitchburg, Massachusetts, during the March 1936 flood, taking with it homes, automobiles, and commercial and industrial property. Eleven lives were lost from this flood and damages were estimated at $66.4 million.

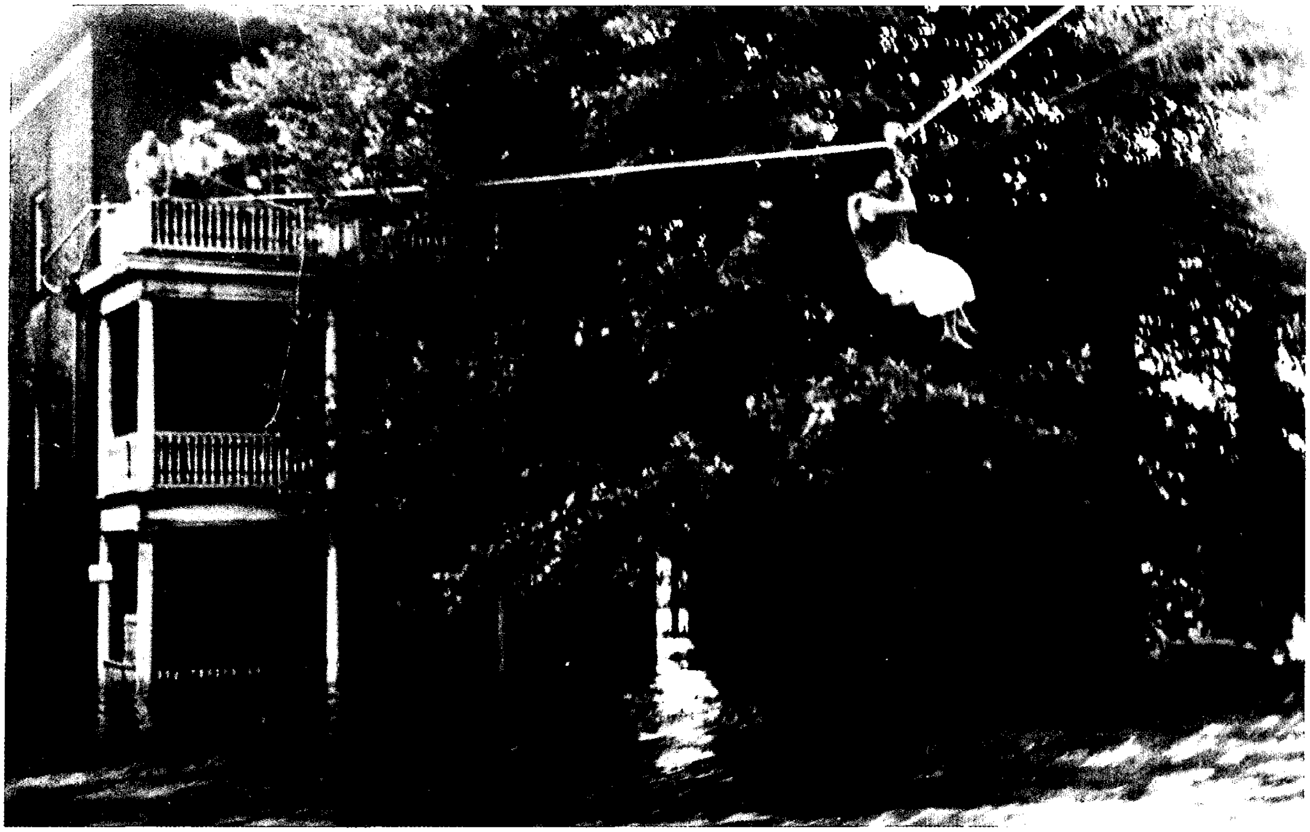
1936 *Waters from the Connecticut River surround the Hartford South Meadows Power Station (center) and cover much of Hartford, Connecticut, during the March 1936 flood The spring floods of 1936 brought widespread disaster from Maine to Maryland and helped mold political and public opinion that culminated in the Flood Control Act of 1936, which recognized the proper involvement of the federal government in flood control (Copyright 1936* The Hartford Courant*)*

1938

The heavy rains of the September 1938 hurricane caused the Contoocook River to flood a section of East Jaffrey, New Hampshire This storm with its 121 m p h gusts, took the lives of eight people in New England and caused damages of $48 6 million (about $740 million in today's dollars)

1954 *Hurricane Carol, which struck the New England coast in August 1954, caused damages estimated at $186 million ($685 million in today's dollars). The storm achieved its greatest fury in a band stretching from New London, Connecticut to the Cape Cod Canal. All that remains of the Rhode Island Yacht Club (above) in the Pawtuxet Neck section of Warwick, Rhode Island, is a cradle of piles after the structure was destroyed by Carol's high winds and waves. (Copyright 1954* The Providence Journal Company*).*

1955 *The Blackstone River overflows its banks and floods several businesses and homes in Pawtucket, Rhode Island as a result of the heavy rains of Hurricane Diane in August 1955.*



1955

No natural disaster in New England history compares with the devastation caused by the sudden and torrential rainfall which accompanied Hurricane Diane in August 1955. The disaster killed 90 people and caused almost $458 million (about $1.82 billion in today's dollars) in property damage throughout the six-state region. In Connecticut alone, Diane's floodwaters killed 47 people and caused damages totalling about $370 million (about $1.3 billion in today's dollars). The rains of Hurricane Diane fell on ground already saturated by the rains of Hurricane Connie one week earlier.

One of the communities that sustained heavy damage was Winsted, Connecticut. The waters of the Mad River overflowed its banks and roared through Main Street, uprooting foundations and flooding homes and businesses. When the floodwaters receded, the devastation became apparent (right). Main Street had become a pile of rubble, cluttered with debris ripped from its understructure.

The storm also forced hundreds of New Englanders to evacuate their homes, including a Connecticut woman (above) who was dramatically rescued from ravaging floodwaters. (Copyright 1955 The Hartford Courant*).*

Only two months later, as Connecticut was getting back on its feet, another severe flood disrupted rehabilitation measures and caused losses estimated at $6.5 million. In response to these major floods, the Corps built several dams and local protection projects that, in a recurrence of the August 1955 flood today, would prevent damages of $1.04 billion

1955 *As these photos from August 1955 demonstrate, floodwaters pose a powerful threat to property and lives. As the top photo shows, this Southbridge, Massachusetts home was toppled when the floodwaters of the Quinebaug River weakened its foundation. Note the overturned automobile on the left; its only identifiable remains are its tires.*

Floodwaters from the Blackstone River (above) roar through Webster Square in Worcester, Massachusetts.

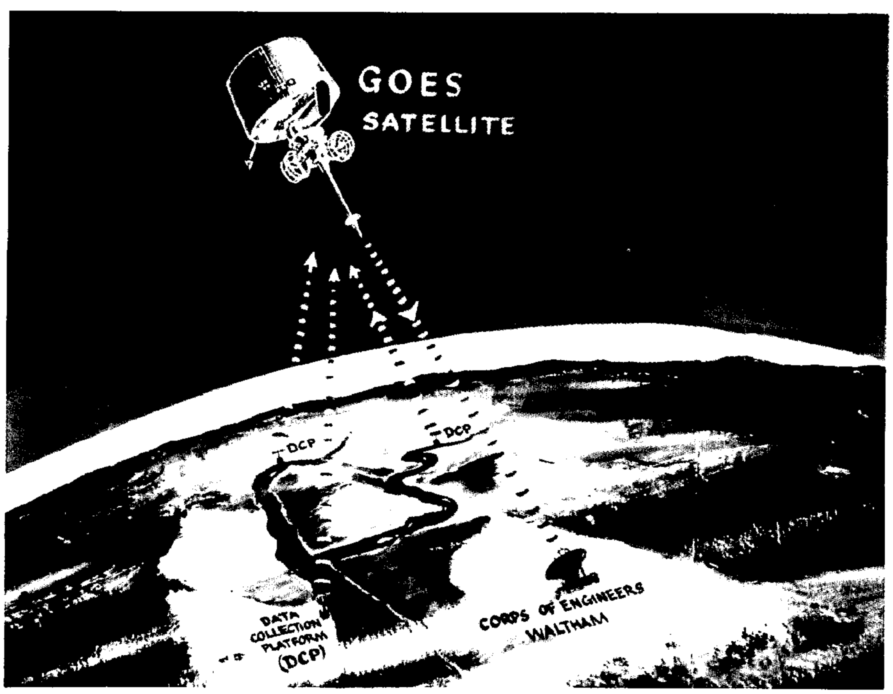
Reservoir Control Center

As a flood situation develops, considerable judgment and experience are required to efficiently manage Corps dams and reservoirs. Weather conditions, reservoir storage capacity, and the flood levels of rivers are important factors when operating dams that maximize the protection of downstream communities and minimize flood damage. The nature of New England weather requires the region's dams and reservoirs be professionally managed by trained engineers and hydrologists. These skilled technicians, using sophisticated communications equipment, form an integral part of the Corps' flood control efforts known as the Reservoir Control Center (RCC).

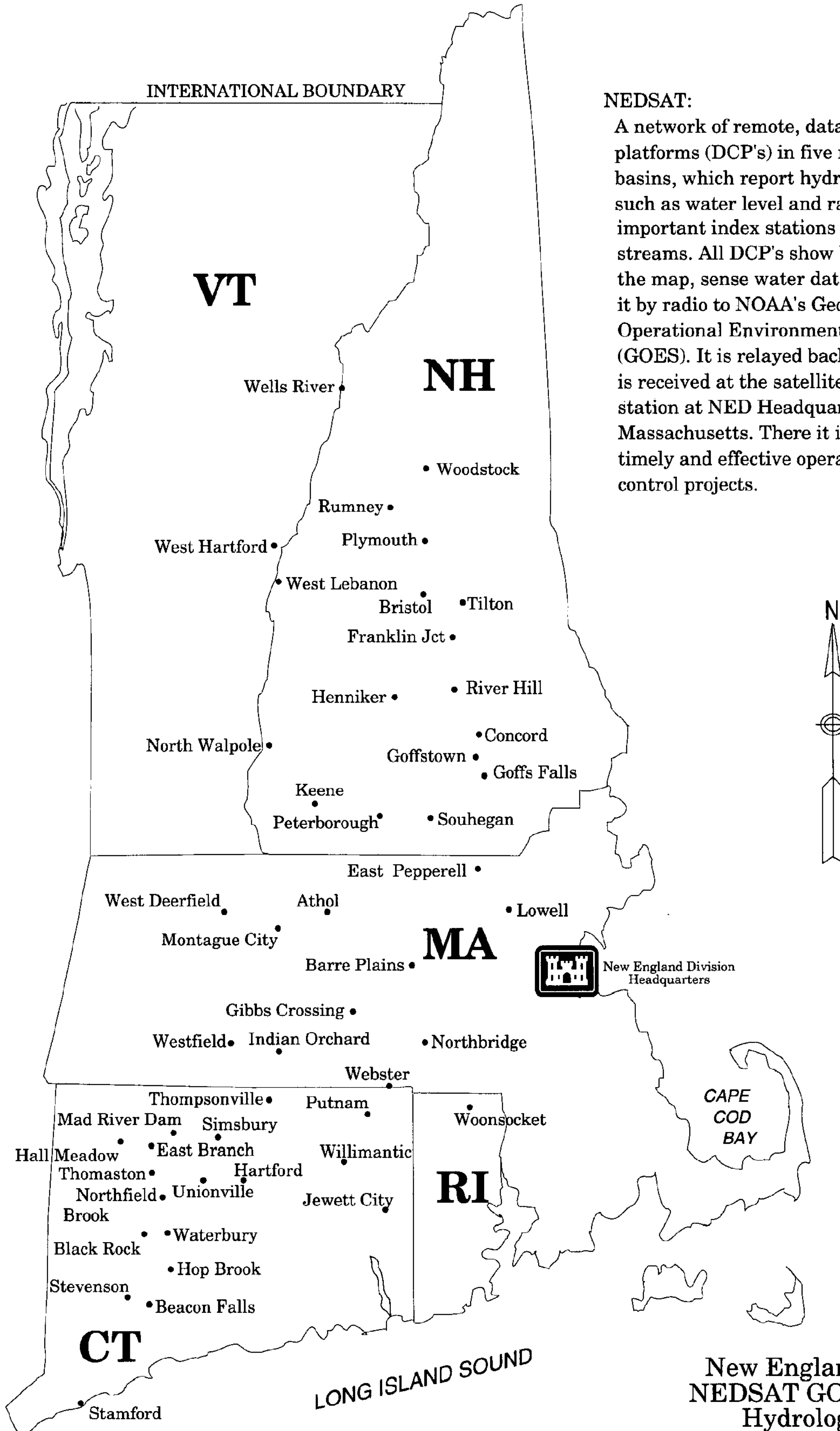
The RCC is located at the Corps' New England headquarters in Waltham, Massachusetts. From this site, Corps engineers closely monitor precipitation, river levels, and tidal levels in New England. The state-of-the-art communications equipment used by RCC personnel is complemented by the Geostationary Operational Environmental Satellite (GOES) System. The GOES system serves as a communication link for the relay of hydrologic and meteorological data. Information from about 50 data collection platforms at key locations along rivers, streams and other bodies of water is relayed to a stationary satellite, which transmits this data by radio signal to the RCC. Engineers then examine and analyze this hydrologic information for potential flood conditions. This data indicates when to operate the flood control gates and when to release stored floodwaters from reservoirs once downstream flood conditions have receded. During flood emergency periods, additional information is obtained by telephone, teletype, and radio from field personnel and other agencies, such as the National Weather Service and the U.S. Geological Survey.

The Reservoir Control Center has helped minimize or prevent severe and damaging floods in many New England communities. The Corps is proud of its commitment to provide the public with improved flood protection through the professional management of its dams and hurricane protection barriers.

New England Division has been an innovative leader in the use of non-structural solutions for flooding problems. The Charles River Natural Valley Storage Project provides a novel approach to flood protection in parts of Boston and Cambridge by retaining flood flows on 8,100 acres of wetland areas aquired by the government at a cost of $9 million. In Warwick, Rhode Island flood-prone properties were aquired, removed or modified to withstand high water events with the federal government underwriting 80% of the cost. In these times of environmental concern and building restrictions, non-structural flood protection projects have the potential to protect life and property with minimal adverse environmental impacts.



The GOES network, or the New England Division Satellite System (NEDSAT), plays a key role in helping the Corps reduce flood damage. About 50 data collection platforms (DCPs) are situated on various rivers and streams throughout the five New England states (opposite page) where the Corps has dams and hurricane protection barriers. Hydrologic and meteorological data from these DCPs are relayed to a satellite stationed above the earth (right). The satellite then transmits this information by radio signal to the Corps' Reservoir Control Center in Waltham, Massachusetts. The data tell Corps' engineers when to open or close the floodgates of Corps' dams and hurricane protection barriers, thus limiting damage to communities downstream. The GOES system also provides the national weather maps displayed by local TV weathermen during their forecasts.



NEDSAT:
A network of remote, data collection platforms (DCP's) in five major river basins, which report hydrologic data, such as water level and rainfall, from important index stations on rivers and streams. All DCP's show by dots on the map, sense water data and transmit it by radio to NOAA's Geostationary Operational Environmental Satellite (GOES). It is relayed back to Earth, and is received at the satellite ground station at NED Headquarters in Waltham, Massachusetts. There it is used for timely and effective operation of flood control projects.

New England Division
NEDSAT GOES Satellite
Hydrologic Data
Collection Network

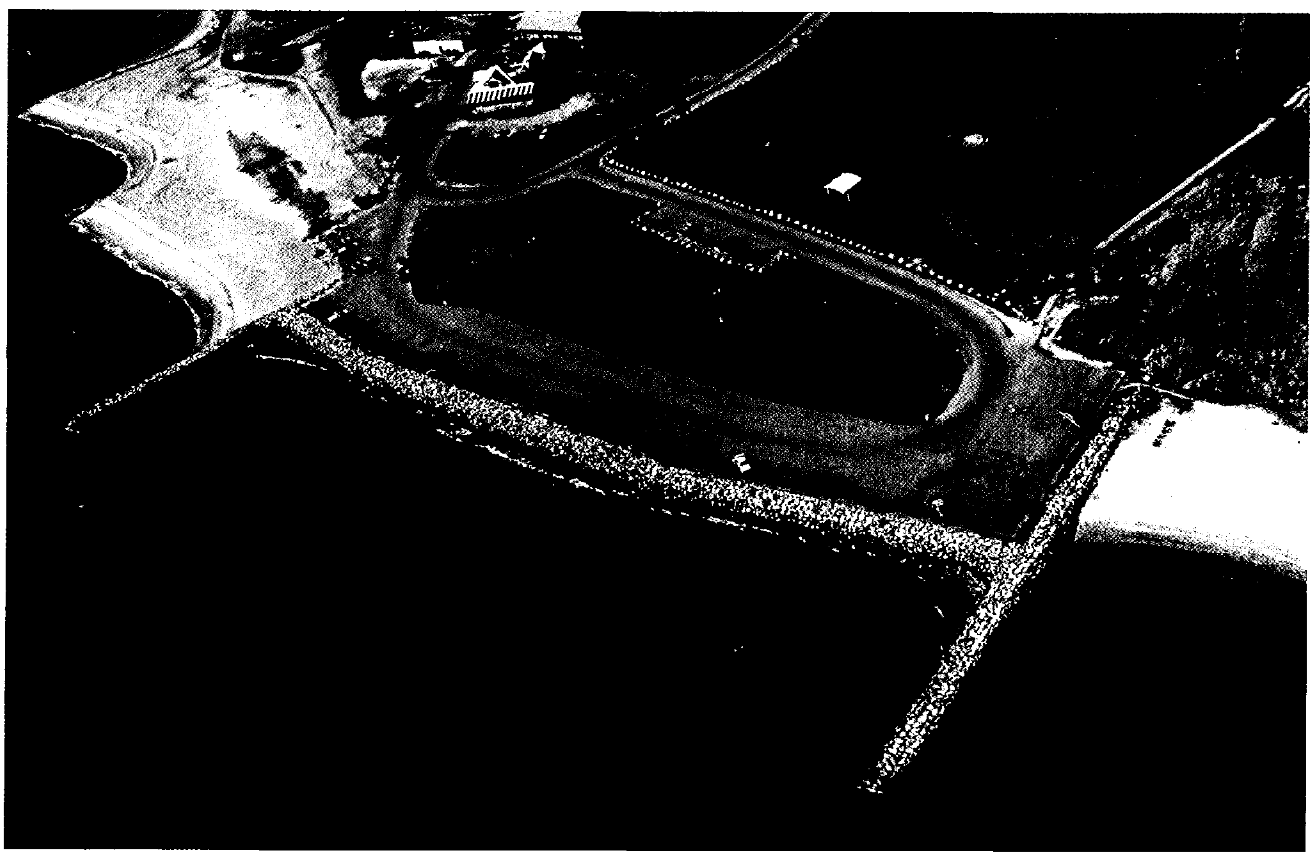
Shore and Hurricane Protection

The Corps work in shore protection began in 1930, when Congress directed it to study ways to reduce erosion along U.S. seacoasts and the Great Lakes. Corps of Engineers hurricane protection work began in 1955, when Congress directed it to conduct general investigations along the Atlantic and Gulf Coasts to identify problem areas and determine the feasibility of protection.

While each situation the Corps studies requires different considerations, engineers look at each one with structural and non-structural solutions in mind. Engineering feasibility and economic efficiency are considered along with the environmental and social impacts. A recommendation for Federal participation is normally based on shore ownership, use and type and frequency of benefits if there is no public use or benefit, Federal participation is not recommended. Once a shore protection project is completed, non-Federal interests assume responsibility for its operation and maintenance. The New England Division has completed 36 streambank/shoreline protection projects in the region.

New England Division has been a pioneer in the construction of hurricane protection barriers. NED has constructed and operates hurricane barriers in Stamford, CT and New Bedford, MA. Additionally NED has constructed barriers in Providence, R.I.; Pawcatuck, CT; and New London, CT. The local communities have assumed responsibility for their operation and maintenance.

Section 145 of the Water Resources Development Act of 1976 authorizes placement of beach quality sand from our dredging projects on adjacent beaches with local interests picking up the additional costs of the disposal. Section 933 of the Water Resources Development Act of 1986 reduces this local cost share from 100 to 50 percent of additional costs.



This shore protection project at Oakland Beach in Warwick, Rhode Island, is a good example of how Corps' works help protect shores and restore beaches. Sand replenishment, which widened and restored the two beach areas on the far left and far right, slows the ocean's inland advance. The four groins maintain shore alignment by trapping and retaining sand. The stone revetment, in the center of the photograph between two groins, retards erosion.

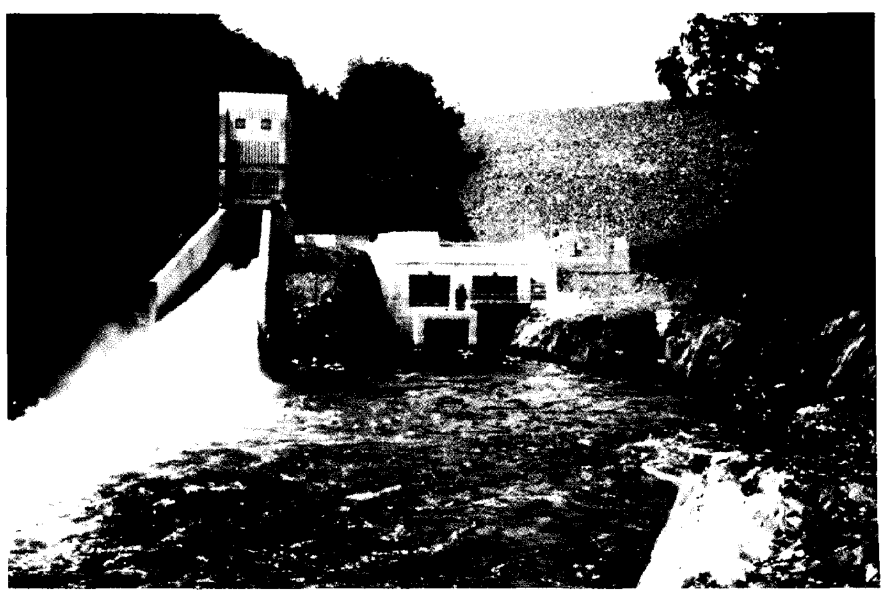
Hydropower

The Corps has played a significant role in meeting the Nation's electric power generation needs by building and operating hydropower plants in connection with its large multiple-purpose dams. The Corps' involvement in hydropower generation began with the Rivers and Harbors Acts of 1890 and 1899, which required the Secretary of War and the Corps of Engineers to approve the sites and plans for all dams and to issue permits for their construction. The Rivers and Harbors Act of 1909 directed the Corps to consider various water uses, including water power, when submitting preliminary reports on potential projects.

The Corps continues to consider the potential for hydroelectric power development during the planning process for all water resources projects involving dams and reservoirs. In most instances, hydropower facilities at Corps projects are now developed by non-Federal interests without Federal assistance, but the Corps becomes involved with the planning, construction and operation of hydropower projects when it is impractical for non-Federal interests to do so. Today, the more than 20,000 megawatts of capacity at corps-operated power plants provide approximately 30 percent of the Nation's hydroelectric power, or 3.5 percent of its total electric energy supply.

In New England, the Corps does not operate any hydroelectric power facilities, but there are eight hydroelectric power plants at Corps flood control dams which are owned and operated by nonfederal interests. These plants are located in:

- *North Hartland, Vermont,* about 500 feet downstream of the North Hartland Lake Dam. This facility produces 4 megawatts of power. All power generated at this plant is used by the Vermont Electric Cooperative or is sold to other utilities.
- *Quechee, Vermont,* 2.5 miles upstream of the North Hartland Lake Dam and within the reservoir area. Built on Corps land, this plant produces 1.8 megawatts. Power is sold to the Central Vermont Public Service Corporation.
- *Waterbury, Vermont,* at the base of the dam at Waterbury Reservoir. This facility generates approximately 5.5 megawatts of power, which is used by the Green Mountain Power Corporation.
- *Montpelier, Vermont,* approximately 200 feet downstream of the dam at Wrightsville Reservoir. The plant has the capacity to produce 1.2 kilowatts of power, which is used by the Washington Electric Cooperative.
- *Franklin, New Hampshire,* on Salmon Brook. Built on Corps land within the Franklin Falls reservoir, this facility produces 0.2 megawatts of power. Power is sold to the Public Service Company of New Hampshire.
- *Bristol, New Hampshire,* on the Newfound River. This plant produces 1.5 megawatts and lies on private property but within the Franklin Falls reservoir area. Power is sold to the Public Service Company of New Hampshire.
- *Peterborough, New Hampshire,* on Verney Mills Dam at Edward MacDowell Lake. This facility began producing power in 1990. The power is sold to the Public Service Company of New Hampshire.



Although the Corps does not presently operate any hydroelectric power plants in New England, there are five hydropower plants located at Corps flood control projects in the region that are owned and operated by nonfederal interests. The North Hartland hydropower facility in North Hartland, Vermont, located 500 feet downstream of the Corps-operated North Hartland Lake Dam, is one such facility.

- *Colebrook, Connecticut,* at the intake of the dam at Colebrook River Lake. This facility began producing power in 1989. The 3.3 megawatts of power is sold to the Connecticut Light and Power Company.

New England Division is evaluating a prototype design for installation of a vertical axis hydro turbine (VAHT) which would harness the energies of the continual tidal currents at the Cape Cod Canal. If installed, the energy generated would offset the current electrical bill. This prototype has widespread repercussions as it does not require the costly superstructure of conventional submerged hydro turbines.

Water Supply

The Water Supply Act of 1958 authorized the Corps to provide additional storage in its reservoirs for municipal and industrial water supply at the request of local interests, provided those interests agree to pay the cost. For irrigation, the Flood Control Act of 1944 provided that the Secretary of War, upon the recommendation of the Secretary of the Interior, may utilize Corps reservoirs, provided that water users agree to repay the Government for the water in accordance with the 1902 Reclamation Law, as amended. Both Littleville and Colebrook Lakes have been designed to provide backup water supplies to surrounding communities in times of severe droughts. Littleville Lake will serve communities in the Springfield, MA area, while Colebrook Lake will serve communities in Northwestern Connecticut.

Reservoir capacity can also be used for water quality and streamflow regulation, as authorized by the Federal Water Pollution Control Act Amendments of 1961.

Environmental Quality

In conducting its Civil Works Programs, the Corps must comply with many environmental laws and executive orders and numerous regulations relating to the environment. Consideration of the environmental impact of a Corps project begins in the early stages and continues through design, construction and operation of the project. The Corps must also comply with many of these environmental regulations in conducting its regulatory programs *(see next section).*

The National Environmental Policy Act (NEPA) of 1969 is the national charter for the protection of the environment, and its procedures ensure that public officials and private citizens may obtain and provide environmental information before Federal agencies make decisions concerning the environment. Corps of Engineers project planning procedures under NEPA often point out the need for more extensive environmental studies, namely the preparation of environmental impact statements. In selecting alternative project designs, the Corps strives to choose options with minimum environmental impact.

Under Section 1135 of the Water Resources Development Act of 1986, the Corps is authorized to modify its existing projects—many of them built before current environmental requirements were in effect for environmental improvement. Proposed modifications under this authority range from use of dredged material to create nesting sites for waterfowl to modification of water control structures to improve downstream water quality for fisheries. Several of these proposals were specifically designed to help meet the goals of the North American Waterfowl Management Plan. The Corps is working to select additional projects for modification.

A beaver pipe allows water to pass underneath a beaver dam, preventing the flooding of nearby roads and controlling the water level. This beaver pipe was constructed and installed at Surry Mountain Lake Dam in Surry, New Hampshire.

Regulatory Programs

The Corps of Engineers has regulatory authority over any construction or other work in navigable waterways under Section 10 of the Rivers and Harbors Act of 1899, and authority over the discharge of dredged or fill material into the "waters of the United States" a term which includes wetlands and all other aquatic areas under Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500, the "Clean Water Act").

The Corps regulatory program is the principal way by which the Federal government protects wetlands and other aquatic environments and ensures the continued navigability of the Nation's waterways. The regulatory program's goal is to ensure protection of the aquatic environment while allowing for environmentally sustainable development.

The standard permit evaluation process includes a public notice with a public comment period and an opportunity for a public hearing before the Corps makes a permit decision. In its evaluation of permit applications, the Corps considers all the relevant factors, including conservation, economics, aesthetics, general environmental concerns, historical values, wetland values, fish and wildlife values, flood damage prevention, land use classifications, navigation, recreation, water supply, water quality, energy needs, food production and the general welfare of the public.

The Corps of Engineers has issued a number of nationwide general permits for minor activities which require little or no individual review. Individual Corps districts have also issued regional permits for certain types of minor work in specific areas. Corps districts have also issued State Program General Permits in States with comprehensive wetland protection programs. These permits allow applicants to do work for which a State permit has been issued. These general permits reduce delays and paperwork for applicants and allow the Corps to devote its resources to the most significant cases while maintaining the environmental safeguards of the Clean Water Act.

Baker Cove in Groton, Connecticut, like many wetlands, supports numerous plant and animal species. Before building a proposed project in a given area, the Corps looks closely at the effects such a project may have on the environment and surrounding wetlands. The Corps considers all options, including those that preclude development, in finding a solution to a water resources problem.

Recreation

The Flood Control Act of 1944, as amended, provides authority to construct, maintain, and operate public park and recreational facilities at water resources development projects under the control of the Secretary of the Army and to permit the construction, maintenance, and operation of such facilities. It also provides that the water areas of projects shall be open to public use - generally for boating, fishing, and other recreational purposes. The Corps of Engineers today is one of the Federal government's largest providers of outdoor recreational opportunities, operating more than 2,000 sites at its lakes and other water resource projects, and receiving more than 600 million visits per year.

The recreation opportunities attract 7.9 million visitors to New England Division projects per year. Of these, 3.9 million visitors utilize the flood control projects, while 4.0 million take advantage of various facilities of the Cape Cod Canal.

There are many recreational opportunities available at the 35 dams and reservoirs built by the Corps' New England Division such as snowmobiling at Blackwater Dam in Webster, New Hampshire (right); and fly fishing at Townshend Lake Dam in Townshend, Vermont (below).

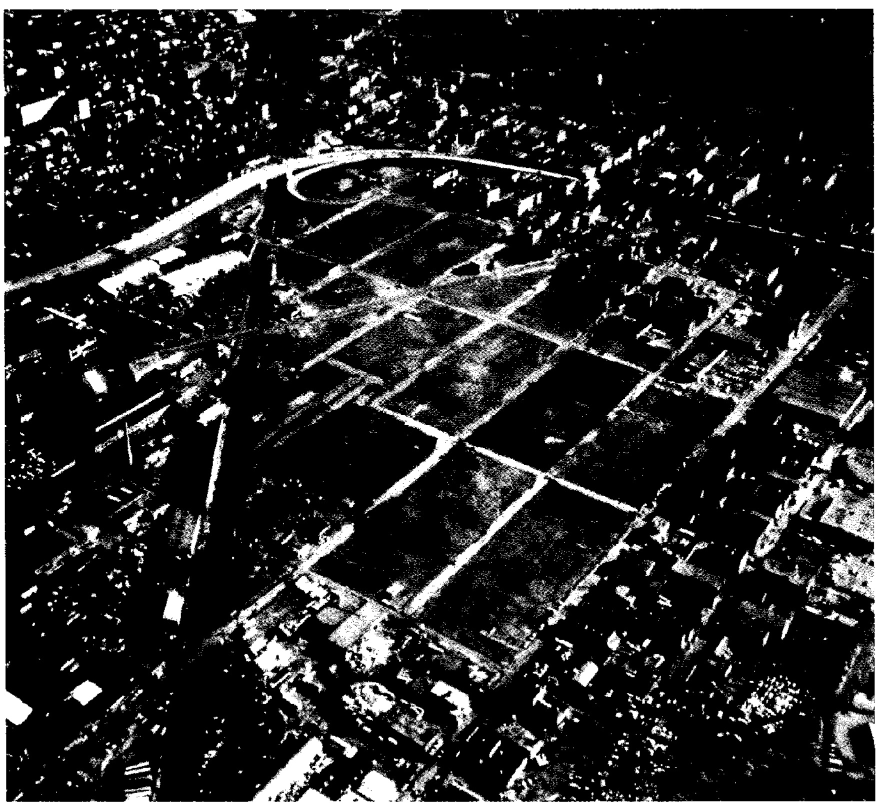
Emergency Response and Recovery

Corps assistance for emergency/disaster response and recovery is provided under Public Law 84-99, covering Flood Control and Coastal Emergencies, or in support of other agencies, particularly the Federal Emergency Management Agency (FEMA). under Public Law 93-288 (the Stafford Act), as amended.

Under PL 84-99 the Chief of Engineers, acting for the Secretary of the Army, is authorized to undertake activities including disaster preparedness, advance measures, emergency operations (e.g., flood fighting, rescue and emergency relief activities), rehabilitation of flood control works threatened or destroyed by flood, protection or repair of Federally authorized shore protection works threatened or damaged by coastal storms, and providing emergency supplies of clean water in cases of drought or contaminated water supply. In post-flood response activities, the Corps provides temporary construction and repairs to essential public utilities and facilities and emergency access for a 10-day period, at the request of the Governor.

Under the Stafford Act and the Federal Disaster Response Plan, the Corps of Engineers has a standing mission assignment to provide public works and engineering support in response to a major disaster or catastrophic earthquake. Under this Plan, the Corps will work directly with the State in providing temporary repair and construction of roads, bridges, and utilities, temporary shelter, debris removal and demolition, water supply, etc.

In addition to its mission under the federal Disaster Response Plan, the Corps is one of the Federal agencies tasked by FEMA to provide engineering, design, construction and contract management in support of recovery operations.



The Corps provided disaster relief assistance to residents of Chelsea, Massachusetts, when fire destroyed 18 city blocks in October 1973.

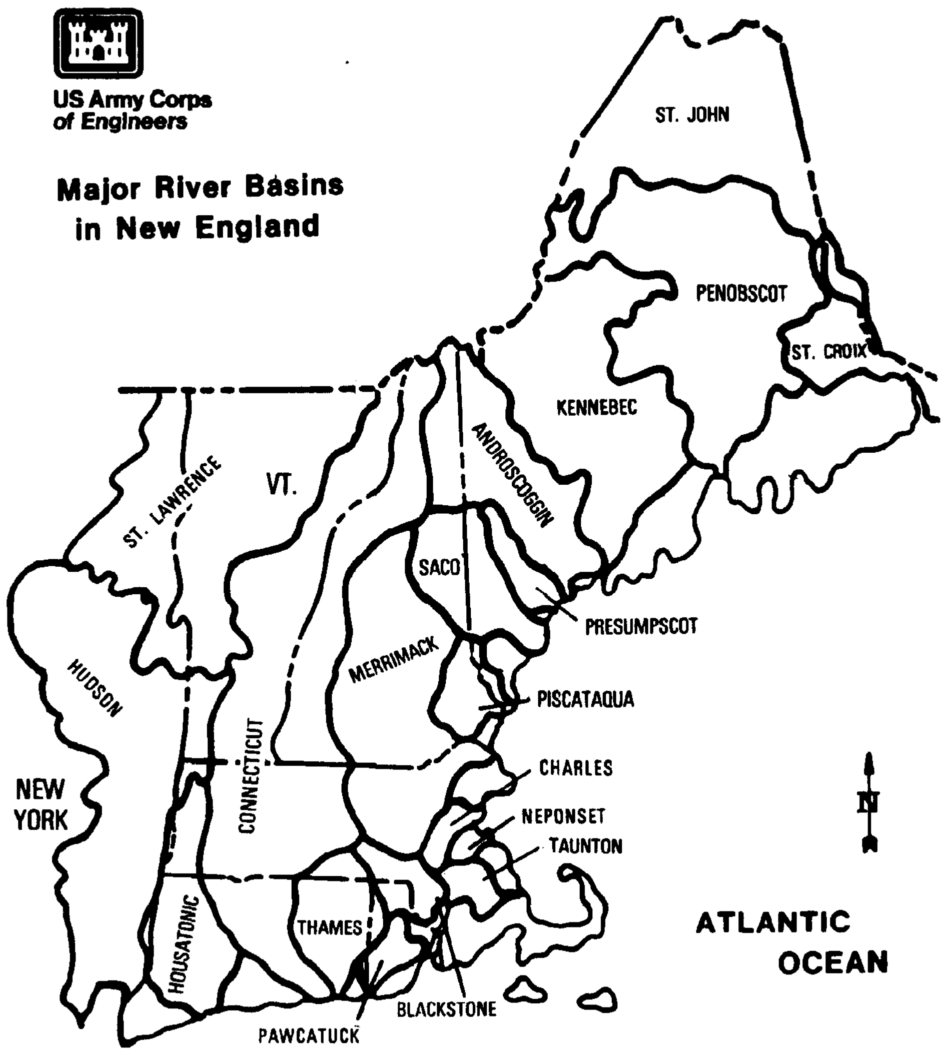
DESCRIPTION OF PROJECTS

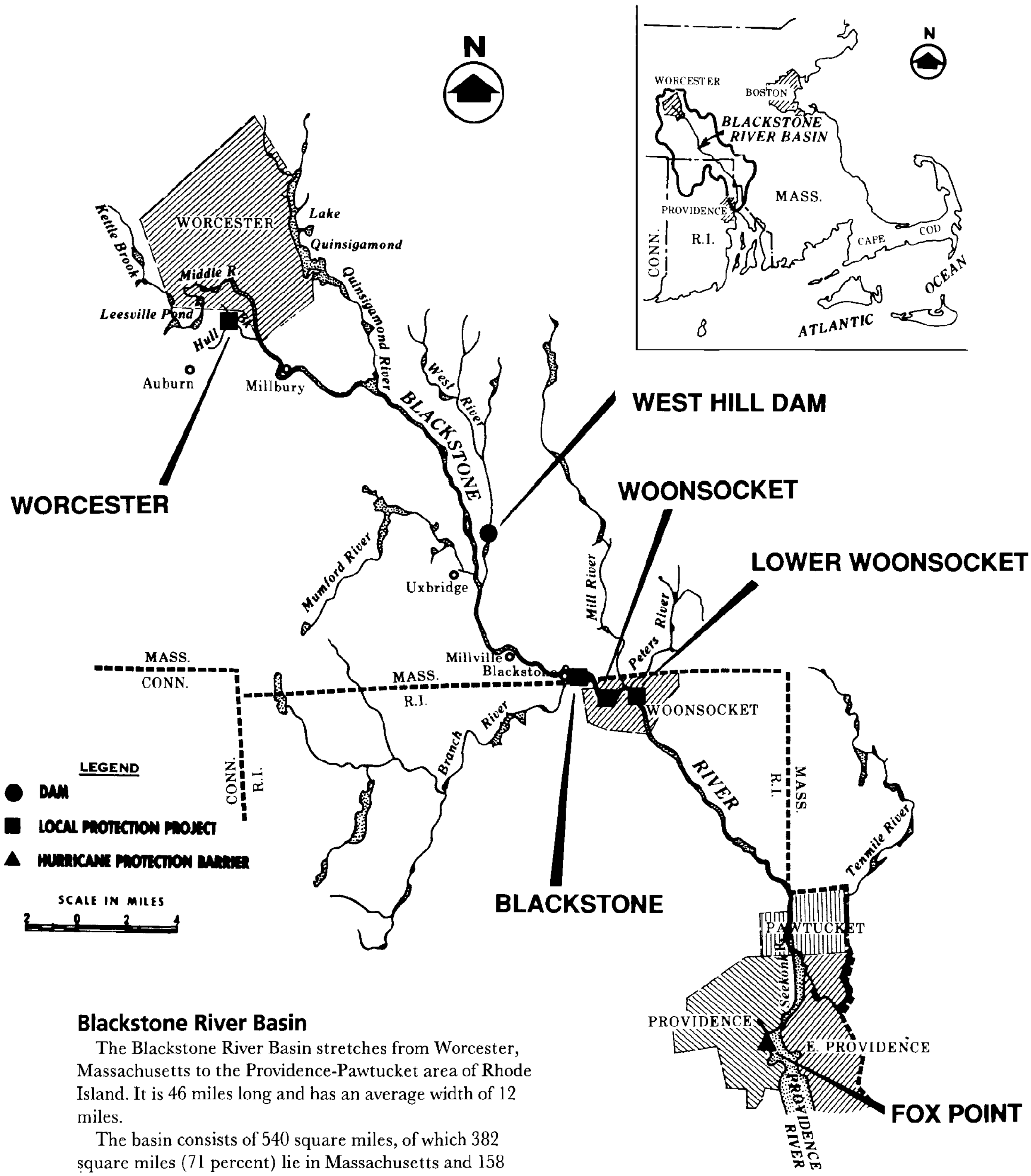
River Basins

Flooding may be caused by a combination of many factors related to the underlying river basin. Corps' Flood Damage Reduction projects, such as dams and Local Protection Projects, are designed and constructed as part of an overall plan to limit flooding in a particular river basin.

There are 19 principal river basins that lie entirely or partially in New England. Of this number, three lie in parts of Rhode Island — the Blackstone, Thames, and Pawcatuck. All three river basins have Corps' Flood Damage Reduction projects within their drainage areas. Rhode Island is the Nation's smallest state (in terms of area) with 1214 square miles.

The following pages show where these three river basins lie in the state and the location of Corps' Flood Damage Reduction projects within each basin.

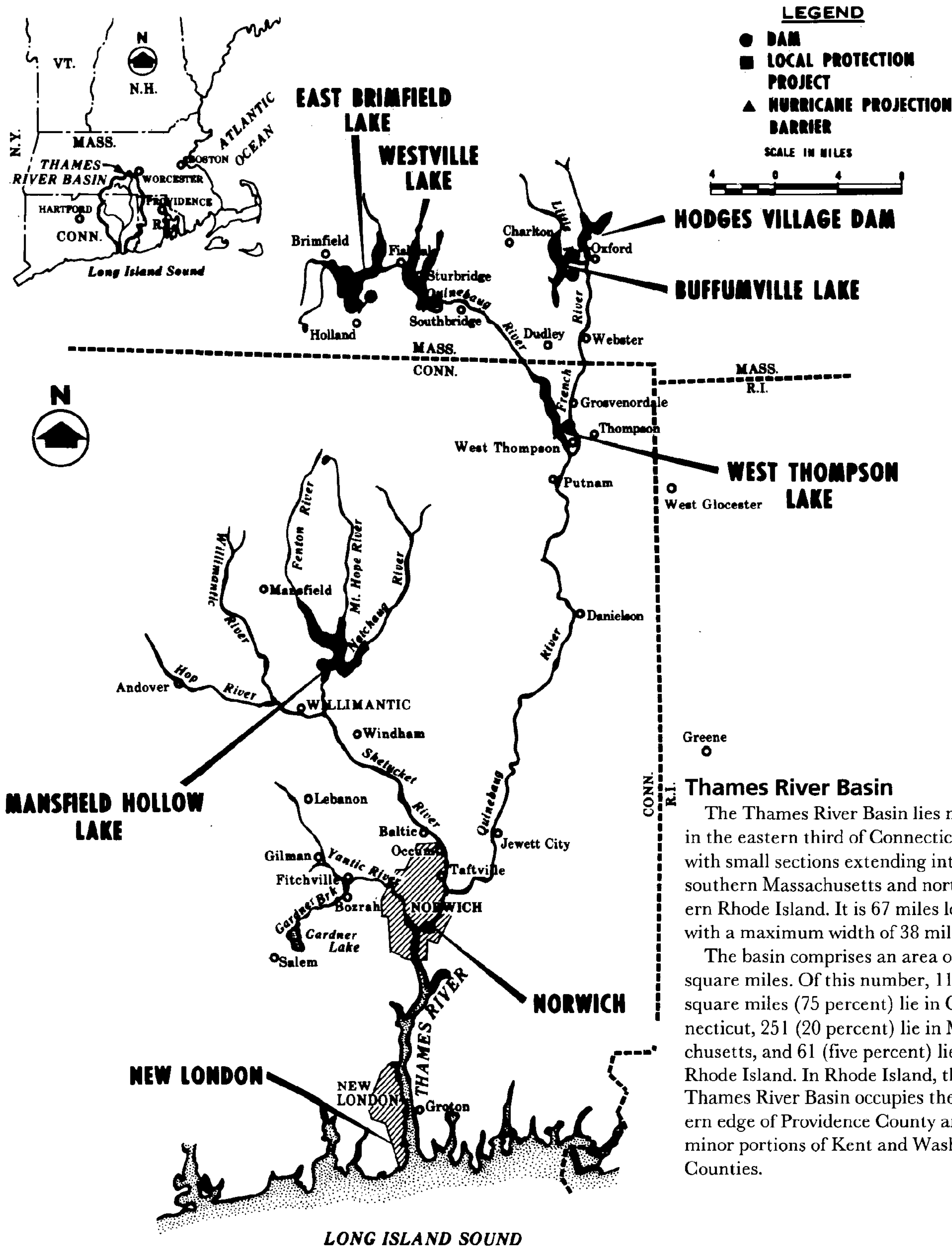




Blackstone River Basin

The Blackstone River Basin stretches from Worcester, Massachusetts to the Providence-Pawtucket area of Rhode Island. It is 46 miles long and has an average width of 12 miles.

The basin consists of 540 square miles, of which 382 square miles (71 percent) lie in Massachusetts and 158 square miles (29 percent) lie in Rhode Island. In Rhode Island, it occupies one-third of Providence County, mainly in the county's northern and northeastern sections.



Thames River Basin

The Thames River Basin lies mostly in the eastern third of Connecticut, with small sections extending into southern Massachusetts and northwestern Rhode Island. It is 67 miles long with a maximum width of 38 miles.

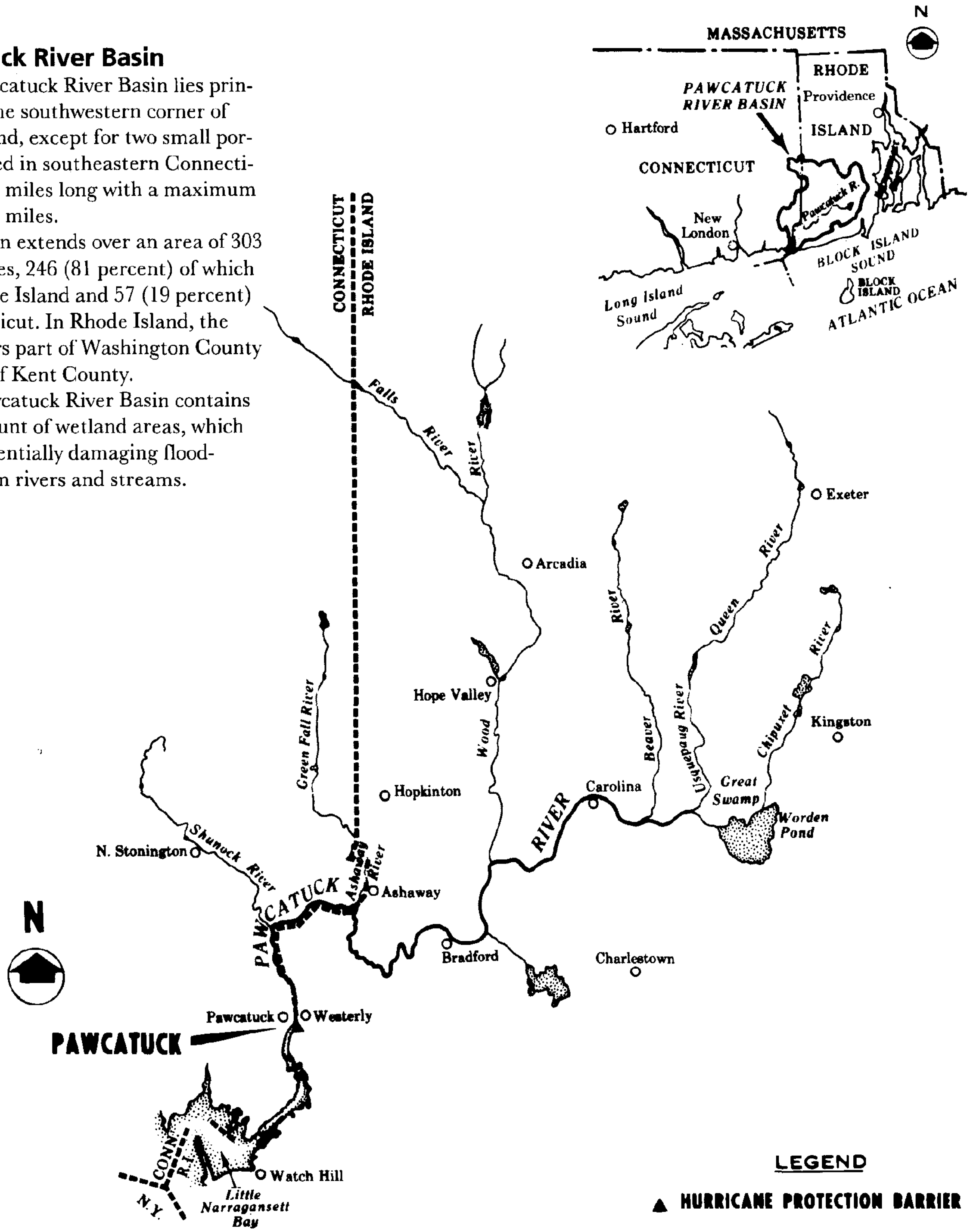
The basin comprises an area of 1474 square miles. Of this number, 1162 square miles (75 percent) lie in Connecticut, 251 (20 percent) lie in Massachusetts, and 61 (five percent) lie in Rhode Island. In Rhode Island, the Thames River Basin occupies the western edge of Providence County and minor portions of Kent and Washington Counties.

Pawcatuck River Basin

The Pawcatuck River Basin lies principally in the southwestern corner of Rhode Island, except for two small portions located in southeastern Connecticut. It is 22 miles long with a maximum width of 22 miles.

The basin extends over an area of 303 square miles, 246 (81 percent) of which lie in Rhode Island and 57 (19 percent) in Connecticut. In Rhode Island, the basin covers part of Washington County and most of Kent County.

The Pawcatuck River Basin contains a vast amount of wetland areas, which absorb potentially damaging floodwaters from rivers and streams.

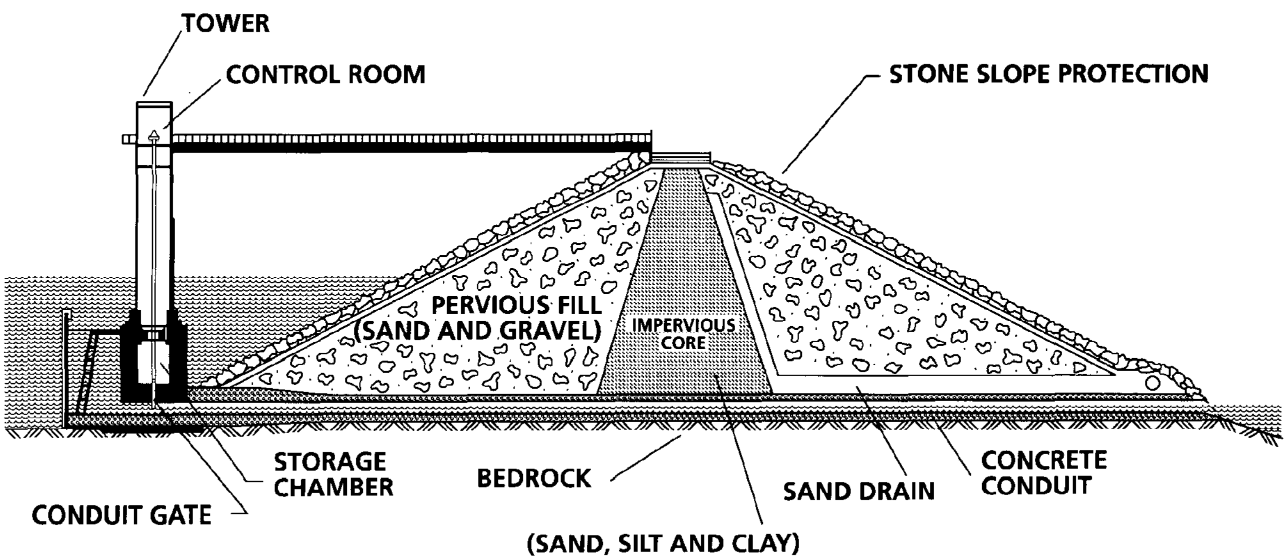


Flood Damage Reduction

The U.S. Army Corps of Engineers has constructed four flood damage reduction projects—a hurricane protection barrier and three local protection projects—in Rhode Island.

The Fox Point Hurricane Protection Barrier in Providence protects the center of the city from tidal flooding caused by hurricanes and other coastal storms. Costing $15 million to build, the city-operated barrier has prevented flood damages estimated at $745,000. The three local protection projects, which provide flood protection to northern and central Woonsocket and the Belmont Park section of Warwick, cost a combined $17.7 million to construct and have prevented an estimated $43.4 million in flood damages. Local protection projects in Rhode Island are operated and maintained by the respective municipalities. The following pages give a brief history and description of the flood damage reduction projects constructed by the Corps in Rhode Island.

Note: Figures given for damages prevented by each flood control project are estimated through September 1990.



TYPICAL CROSS SECTION OF AN EARTHFILL DAM

Flood Damage Reduction Projects in Rhode Island

Hurricane Protection Barrier

Fox Point in Providence

Local Protection Projects

Lower Woonsocket
Pawtuxet River, Warwick
Woonsocket

The Fox Point Hurricane Protection Barrier

Fox Point

The Fox Point Hurricane Protection Barrier in Providence is located immediately south of the Narragansett Electric Company plant, about 0.2 mile north of Fox Point and one mile south of downtown Providence.

The project provides virtually complete protection against tidal flooding from hurricanes and other coastal storms to about 280 acres of downtown Providence. The protected area includes the commercial and industrial center, transportation facilities, public utilities, and many homes. The city suffered extensive damage from the hurricane of 1938 and Hurricane Carol in 1954 when, in each instance, water depths of up to eight feet were experienced in the city's commercial area. Damage from the 1938 hurricane amounted to $16.3 million—approximately $212 million in today's dollars. Damage from Hurricane Carol amounted to $25.1 million—about $126 million in today's dollars. Construction began in July 1961 and was completed in January 1966 at a cost of $15 million. Since the barrier was completed, it has prevented flood damages estimated at $745,000. The city of Providence operates and maintains the project.

The barrier itself is a 700-foot-long concrete structure, 25 feet high, that extends westerly across the Providence River from Tockwotton Street, near Fox Point, to Globe Street, near the power plant. The structure contains three tainter gate openings that prevent the entry of floodwaters in the bay when closed and permit passage of small vessels when open. Each gate is 40 feet high and 40 feet wide.

Two 10 to 15-foot-high earthfill dikes, each with stone slope protection, flank each side of the barrier. The eastern dike is 780 feet long and the western dike is 1400 feet long.

A pumping station and cooling water canal are integral parts of the project. During a flood situation, the pumping station's five large pumps can discharge the floodwaters of the Providence River through the barrier into the bay. Two gated openings in the pumping station, each 10 feet high and 15 feet wide, admit water into the cooling water canal used by the Narragansett Electric Company, located immediately behind the barrier.

There are three vehicular gates, located at Allens Avenue, South Main Street, and the Narragansett Electric Company and five sewer gates that prevent high tides from backing up through the sewer lines.

Local Protection Projects

Lower Woonsocket

Pawtuxet River, Warwick

Woonsocket

The Lower Woonsocket Local Protection Project protects industrial and commercial establishments and densely populated residential areas from flood flows on the Blackstone, Mill, and Peters Rivers. The photo shows a section of the 1860-foot-long earthfill dike and a section of concrete floodwall along the river's left bank (top bank in the photo) in the city's Social District. Also, this part of the Blackstone River was deepened.

Lower Woonsocket

The Lower Woonsocket Local Protection Project in Woonsocket is located along the Blackstone River and two of its tributaries, the Mill and Peters Rivers, in an area downstream of the South Main Street Bridge.

The project, in conjunction with the Woonsocket Local Protection Project located upstream and West Hill Dam in Uxbridge, Massachusetts, protects industrial and commercial establishments and densely populated residential areas from flood flows on the Blackstone, Mill, and Peters Rivers. The Lower Woonsocket Local Protection Project and the Woonsocket Local Protection Project have together, since their completion, prevented flood damages totalling $43.4 million (Flood damage prevention figures for the two projects are calculated together and not individually).

The project was built between December 1963 and April 1967 at a cost of $8.3 million. Construction required the alteration of utilities at five points along the east bank of the river where the two pressure conduits cross existing streets. Woonsocket operates and maintains the project.

The project consists of work in three areas of Woonsocket: The Social District Unit, the Hamlet District Unit, and the Bernon Unit. Work in the Social District Unit involved improvements on the Blackstone, Mill, and Peters Rivers. On the Blackstone River, the Corps constructed a 1860-foot-long earthfill dike with stone slope protection and three concrete floodwalls totalling almost 1100 feet, both along the river's left bank. A pumping station removes interior drainage behind the dike and floodwalls during flood periods. Also, about 600 feet of the Blackstone River was deepened. Improvements on the Mill River include construction of 2410 feet of dike, four concrete floodwalls that total 600 feet in length, 1700 feet of channel excavation, and a 1150-foot-long concrete pressure conduit that passes beneath Social Street, John A. Cummings Way, and Clinton Street. The conduit is a twin-barrelled structure, with each barrel 12 feet high and 21 feet wide. As part of its improvements on the Mill River, the Corps replaced the East School Street Bridge so that the eastern bridge abutment could be tied into a floodwall, strengthening the project's flood damage reduction capabilities. Improvements on the Peters River include construction of 770 feet of earthfill dike, 250 feet of concrete floodwall, 400 feet of channel excavation, and an 1180-foot-long concrete pressure conduit, 10 feet high and 17 feet wide, that passes beneath Elm, Godfrey, and Cumberland Streets.

Work in the Hamlet District Unit entailed construction of three earthfill dikes with stone slope protection that total almost 3100 feet on the Blackstone River's right bank; 75 feet of concrete floodwall between the upper two dikes; a pumping station behind the lower dike that discharges interior drainage during flood periods; and about 2000 feet of channel excavation on the Blackstone River. In addition to this work, the Corps removed the Hamlet Dam.

In the Bernon Unit, the Corps removed the 194-foot-long Bernon Dam on the Blackstone River; constructed a pilot channel, 50 feet wide and 600 feet long, between the former dam and the Bernon Street Bridge; and modified the bridge by removing a steel truss beneath the bridge and raising utility conduits, allowing flood flows to pass underneath.

Pawtucket River, Warwick

The Pawtuxet River Local Protection Project in Warwick is located on the Pawtuxet River at the northern end of the city's Norwood section, referred to as Belmont Park.

The project prevents flood damage to approximately 38 acres of residential land in Warwick, much of it bounded by the Pawtuxet River.

The Pawtuxet River is formed by the junction of its north and south branches in West Warwick. It flows northeasterly for 11 miles through Warwick (including the Belmont Park section) and Cranston before it empties into Narragansett Bay at Pawtuxet Cove on the Cranston-Warwick line. Belmont Park, a low-lying floodplain, had been subject to more frequent and severe flooding in recent years from increased development along the river. To help stem this severe flooding, the Corps evaluated both structural and nonstructural flood damage reduction plans. A structural plan would have required construction of a nearly one-mile-long dike around the Belmont Park area. The nonstructural plan called for the demolition and/or removal of several homes situated close to the river and the installation of an automated flood forecasting and warning system. After careful study, the Corps determined that the nonstructural plan would be more cost effective.

The work involved moving or eliminating 61 homes; purchasing outright 19 privately-owned vacant lots; constructing 12 above ground utility room additions to residences in the area which historically experienced less severe flooding; and installing the automated flood forecasting and

The Pawtuxet River Local Protection Project, one of two nonstructural plans the Corps oversees in New England, prevents flood damage to approximately 38 acres of residential land in Warwick. The project called for the demolition and/or removal of several homes situated close to the river and the installation of an automated flood forecasting and warning system.

warning system so that the remaining homes could be evacuated and property vulnerable to basement flooding could be protected. Work began in September 1982 and was completed in July 1985 at a cost of $4 million. Some of the homes demolished were used for training by firefighters in Warwick and neighboring communities. Warwick is responsible for operating and maintaining the flood forecasting and warning system.

The Nonstructural Approach

The Pawtuxet River Local Protection Project is one of two nonstructural flood damage reduction projects the Corps' oversees in New England. The other, the Charles River Natural Valley Storage Project in Massachusetts, is one of the country's largest and most successful applications of the nonstructural approach to flood control.

By purchasing 38 acres of land along the Pawtuxet River, the Corps has effectively prevented any development on them. Instead of building a dike after the flood prone area had been affected by private development, the Corps bought the land and returned it to its natural state to limit the river's flood damage potential.

Recognizing the value floodplains have in our society, the U.S. Council on Environmental Quality said in its 1973 Annual Report:

"The movement is away from the 19th century idea that land's only function is to permit its owner to make maximum profit. Whereas the traditional answer to the question, 'Why regulate land use?' was 'To maximize land values,' the new answer is becoming 'To make the best use of our land resources.' (This is) a far cry from the simple value maximization concepts of early real estate interests....

"The goal of long-range enhancement of land values is replacing a system aimed solely at increasing the short-run value and salability of land. The interest of the general public and of future generations is no longer ignored..."

The Woonsocket Local Protection Project, located along the Blackstone River in the industrial area of Woonsocket, protects several homes, commercial establishments, and about one-half of the industrial properties in the city. The Woonsocket Falls Dam, shown with its four tainter gates open (center of photo), has helped to reduce flood damage along the river.

Woonsocket

The Woonsocket Local Protection Project is located in the industrial area of Woonsocket along the Blackstone River. The project area extends 8300 feet downstream from the Massachusetts state line to the center of the city near the South Main Street Bridge. A small portion of the project along the west bank of the river lies in North Smithfield.

Woonsocket suffered flood damage estimated at $22 million from the heavy rains of August 1955. The project protects about one-half of the industrial properties in the city, several homes, commercial establishments, transportation facilities, and public utilities. The Woonsocket Local Protection Project and the Lower Woonsocket Local Protection Project have together, since their completion, prevented flood damages totalling $43.4 million (Flood damage prevention figures for the two projects are calculated together and not individually).

The project was built between July 1956 and April 1960 at a cost of $5.4 million. Construction required the relocation of three water lines and four sewer siphons. The Woonsocket Local Protection Project is operated and maintained by Woonsocket.

The project involved constructing channel improvements, a concrete floodwall, four earthfill dikes, and a pumping station; replacing an industrial dam; and modifying two railroad bridges. This work is described below.

Channel improvements included widening, deepening, and straightening 6700 feet of the Blackstone River in Woonsocket and North Smithfield and constructing 1600 feet of new channel. The work extends from the Rhode Island-Massachusetts State Line to the vicinity of the South Main Street Bridge.

The concrete floodwall is located on the river's east bank and extends 316 feet downstream from the Singleton Street Bridge to Dike Two (discussed below). It has a height that varies between 13.5 and 21 feet.

The four earthfill dikes total 1310 feet. Dike One, 800 feet long with a maximum elevation of 10 feet, begins about 1200 feet south of the state line and extends along the east bank of the river to the Singleton Street Bridge. Dike Two, 240 feet long with a maximum elevation of 10 feet, extends from the south end of the floodwall and ties into high ground on the easterly bank. Both of these dikes have stone slope protection. Dike Three, 160 feet long with a maximum elevation of eight feet, lies adjacent to the southern end of Saranac Pond and extends from high ground adjacent to the railroad tracks to River Street. Dike Four, 110 feet long with a maximum elevation of five feet, is basically a continuation of Dike Three and extends from River Street to the western abutment of the Singleton Street Bridge. Dikes Three and Four protect the River Street area from Saranac Pond flooding.

The pumping station handles storm drainage behind the dikes and floodwall during high river stages. The dikes, floodwall, and pumping station protect about 20 acres of industrial property in the vicinity of Singleton Street that would otherwise be subject to flooding.

The Woonsocket Falls Dam is located about 100 feet upstream of the South Main Street Bridge. Replacing an older structure that impounded a pool used for industrial purposes, the new concrete dam is 266 feet long with a maximum height of 13 feet. It is equipped with four tainter gates, with each gate 10.1 feet high and 50 feet wide, which can be raised to allow passage of flood flows.

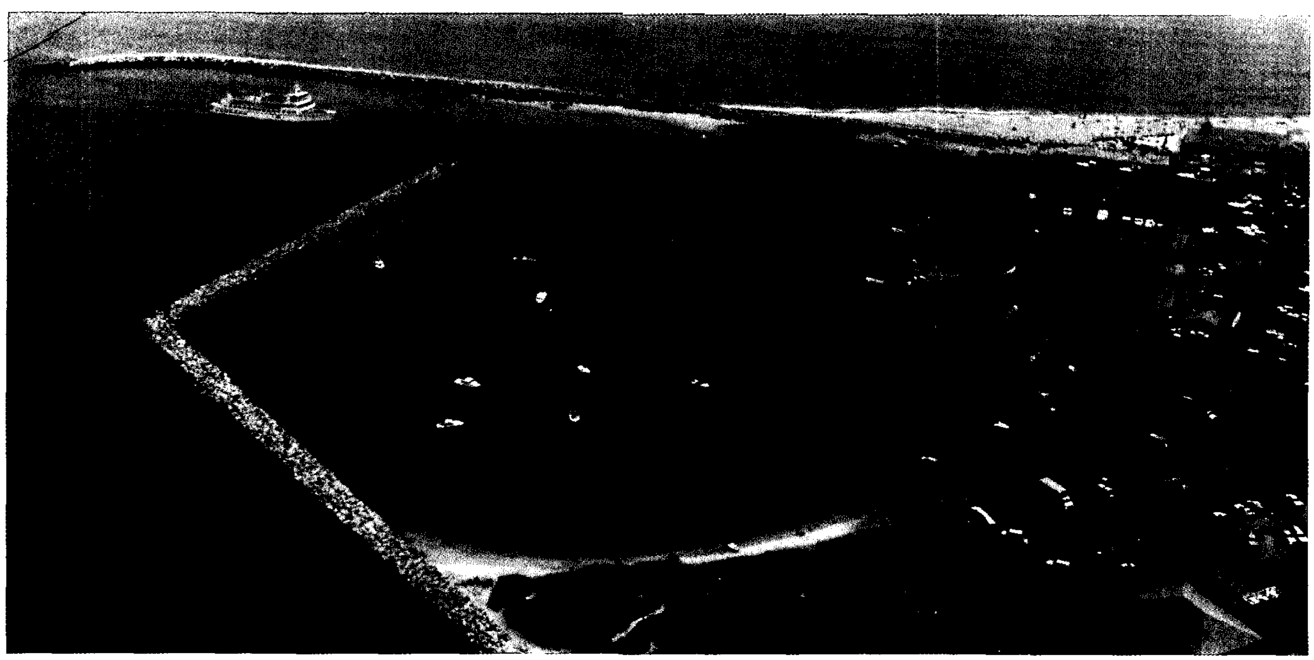
The modified railroad bridges are located near River Street and above Sayles Street. The Corps strengthened the underpinnings of both bridges, and also constructed a new span and abutment at the bridge above Sayles Street.

Navigation

The Corps has completed 18 navigation projects in Rhode Island. These projects have improved rivers, bays, coves, and harbors that are used by commercial interests, fishermen, and the many recreational boaters that benefit from Rhode Island's intricate and fascinating coastline and its inland waterways.

Initial work on many of the projects dates back to the 19th century. However, most of the navigational work in today's waterways has been constructed by the Corps within the past 50 years, costing an aggregate $33.3 million.

The following pages describe the Corps' navigation projects in Rhode Island. Depths given for channels and anchorages are those at Mean Low Water.



A ferry boat enters the Block Island Harbor of Refuge, used by freight and commercial passenger boats, a small fishing fleet, and recreational craft. The Corps built the two stone breakwaters that partially enclose the inner portion of the harbor.

Navigation Projects in Rhode Island

Apponaug Cove

Block Island Harbor of Refuge

Bullocks Point Cove

Coasters Harbor

Great Salt Pond

Greenwich Bay

Newport Harbor

Pawcatuck River and Little Narragansett Bay

Pawtuxet Cove

Point Judith Pond and Harbor of Refuge

Potowomut River

Providence River and Harbor

Sakonnet Harbor

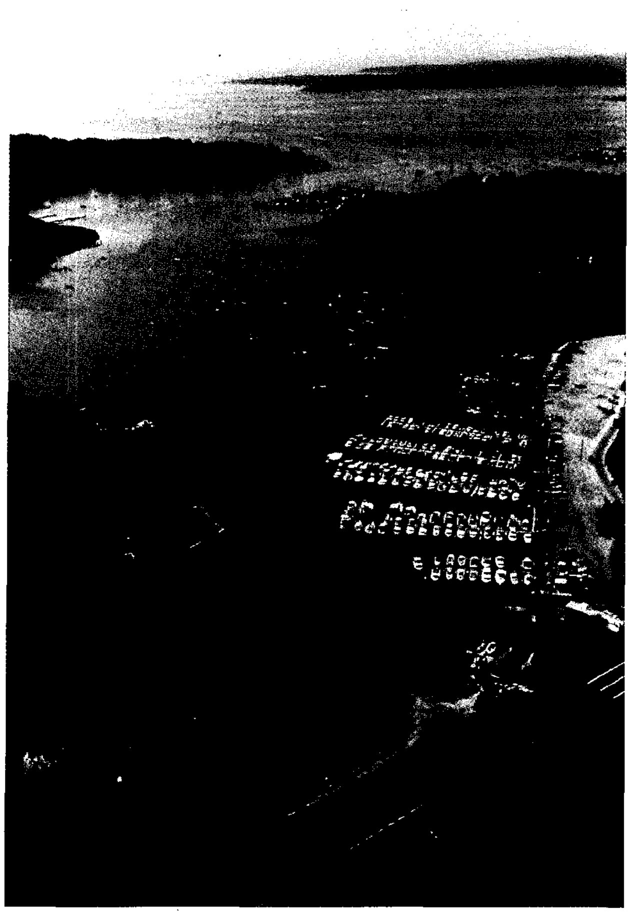
Sakonnet River

Seekonk River

Warren River

Warwick Cove

Wickford Harbor



Apponaug Cove is used by local and transient fishing and recreational craft. The above photo shows the cove's Outer Basin.

Apponaug Cove

Apponaug Cove in Warwick lies at the head of Greenwich Bay, about 10 miles south of Providence. Used by local and transient fishing and recreational craft, Apponaug Cove consists of three connecting basins—Outer Basin, Middle Basin, and Inner Basin.

The project, completed in 1963, included construction of a six-foot-deep channel, 100 feet wide, extending 0.8 mile from Greenwich Bay through Outer Basin and most of Middle Basin. The channel ends at a point about 200 feet east of the railroad bridge that separates Middle and Inner Basins. Also constructed was a six-foot-deep anchorage in Middle Basin, southwest of the channel. The anchorage is 10 acres in area and 400 feet wide at its widest point.

Block Island Harbor of Refuge

Block Island, coextensive with the town of New Shoreham, is an 11-square-mile island lying 12 miles off the southern coast of Rhode Island and 15 miles northeast of Montauk Point, the eastern tip of Long Island, New York. The Block Island Harbor of Refuge, which indents the island's east side, is used by a small fishing fleet, freight and passenger boats, and transient recreational craft.

The project, completed in 1916, consists of: Two stone breakwaters that partially enclose the 640,000-square-foot Inner Harbor. The 1950-foot-long easterly breakwater extends northerly, and the 1100-foot-long westerly breakwater extends northerly and then turns easterly in a right angle toward the east breakwater.

- A T-shaped stone jetty, about 140 feet long and 100 feet across, located about 600 feet south of the east breakwater.
- A 0.2-mile-long channel, 15 feet deep, extending from Outer Harbor to the southeastern head of Inner Harbor.
- A 15-foot-deep anchorage covering about 67 percent of Inner Harbor.

The dredged area includes the above-mentioned channel and the 75,000-square-foot area in Inner Harbor's southeasterly corner known as The Basin.

- Masonry walls that enclose The Basin.

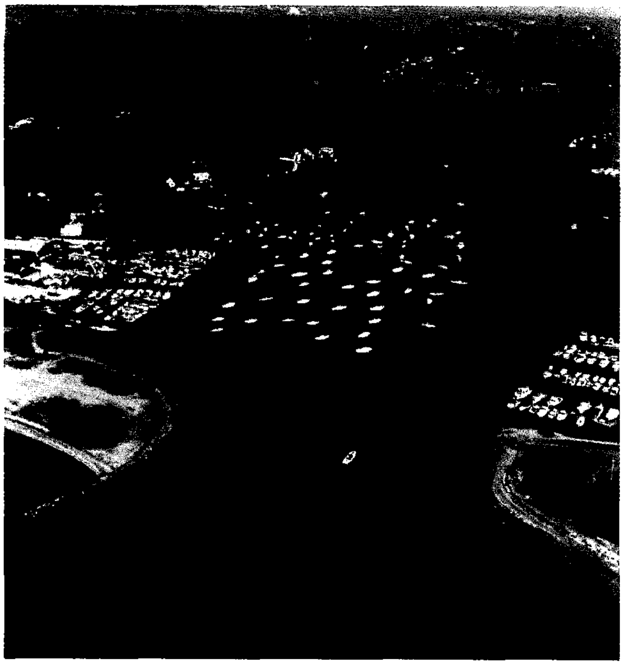
In 1942, the Corps constructed a 255-foot-long steel bulkhead on the east side of The Basin. In 1971, stone was placed against the bulkhead and a timber pier was constructed over it.

Bullocks Point Cove

Bullocks Point Cove lies between East Providence and Barrington on the east shore of the Providence River, about five miles southeast of Providence. The cove is used for pleasure boating and serves as a refuge for recreational craft.

The project, completed in 1959, consists of:

- A 1.1-mile-long channel, 75 feet wide, extending from deep water in the Providence River to an area opposite Haines Memorial Park. From deep water in the Providence River to a point just inside the cove (0.6 mile), the channel is eight feet deep. From this area to a point opposite Haines Memorial Park (0.5 mile), the channel is six feet deep.
- A six-foot-deep turning basin and anchorage, 8.3 acres in area, on the west side of the inner harbor, opposite the boat club.
- A six-foot-deep turning basin, 2.9 acres in area, at the end of the channel, opposite Bullocks Point. The turning basin is on the channel's westerly side.
- A reconstructed Bullocks Point. Dredged material was used to rebuild the area to a height of nine feet.
- A 600-foot-long stone dike and a 300-foot-long stone jetty that protects the reconstructed area.



Bullocks Point Cove in Barrington and East Providence.

Coasters Harbor

Coasters Harbor in Newport is a small, protected harbor situated between Coasters Harbor Island, at the northern end of Newport Harbor, and the mainland. Coasters Harbor Island is located about 0.5 mile south of Coddington Point, and is the base of operations for the U.S. Navy Newport Training Station and the U.S. Naval War College. A cove at the southeastern end of Coasters Harbor Island is used principally by vessels operating from the Naval Training Station.

The Corps' project, completed in 1892, involved deepening the channel leading from Newport Harbor into the cove to nine feet. It also provided for cutting additional openings in the causeway located immediately north of the cove. This causeway is the southernmost of three causeways that join Coasters Harbor Island with Newport.

Great Salt Pond

Great Salt Pond in New Shoreham is located along the western shore of Block Island, an 11-square-mile island lying 12 miles off the coast of Rhode Island and 15 miles northeast of New York's Long Island. Great Salt Pond stretches about 1.2 miles southeast to a smaller pond, known as Inner Harbor or Trim Pond. Together, both ponds nearly bisect Block Island. Inner Harbor is used by the local fishing fleet as well as outside fishermen who use Inner Harbor as a base during the spring and summer. Inner Harbor is also used by commercial passenger lines carrying summer visitors to the island, and a number of local and transient recreational craft.

The project, completed in 1905, consists of:

- A 0.6-mile-long entrance channel extending from the ocean to the pond. The channel is generally 18 feet deep and 300 feet wide, but has a central depth of 25 feet over a width of 150 feet.
- A 1691-foot-long stone jetty on the southern side of the entrance channel. About 837 feet were built by the state; the Corps built the remaining 854 feet.
- Stone revetments on both sides of the entrance channel.
- Sand fences situated south of the entrance channel.

Greenwich Bay

Greenwich Bay in Warwick is located southwest of Warwick Neck, about 10 miles south of Providence. Greenwich Cove is the small inlet at the southwestern end of Greenwich Bay that is bordered on the east by Goddard State Park in Warwick and on the west by the Warwick-East

Coasters Harbor is a small, protected harbor situated between Coasters Harbor Island on the left and the mainland on the right. Coasters Harbor Island serves as a base of operations for the U.S. Navy Newport Training Station and the U.S. Naval War College. The cove at the southeastern end of Coasters Harbor Island, shown in the forefront of the photograph on the left, is used principally by vessels operating from the Naval Training Station.

This 1691-foot-long stone jetty on Great Salt Pond helps to maintain the proper depth of the 0.6-mile-long entrance channel by preventing the buildup of sediment.

The Greenwich Bay project provides access to Greenwich Cove (left), a small inlet used by fishing and recreational craft.

Greenwich waterfront. Greenwich Cove is used by fishing and recreational craft.

The project, completed in 1891, consists of a 500-foot-long channel through the sand bar at the entrance to Greenwich Cove, west of Long Point. The channel, 10 feet deep and 210 feet wide, provides access to the Warwick-East Greenwich waterfront.

Newport Harbor

Newport Harbor in Newport is situated between Goat Island and the mainland, about 12 miles northeast of Point Judith Harbor. One of the Atlantic coast's principal yachting centers and resorts, Newport Harbor accommodates a wide variety of boating craft, including commercial fishing boats, cabin cruisers, schooners, sightseeing and cruise boats, sail boats, visiting foreign sailing ships, ferries, and oil barges. Several inns, restaurants, and shops dot the historical waterfront. Newport Harbor is the starting point for the Newport to Bermuda Yacht Race and the finish of the Annapolis-Newport Yacht Race. For many years it was the site of the America's Cup Race. Newport Harbor is also home to the U.S. Naval War College and Destroyer Base.

Initial work in the harbor, completed in 1906, provided for a 15-foot-deep channel extending southerly from the East Passage of Narragansett Bay, around the southern end of Goat Island, to the inner harbor; a 10-foot-deep anchorage off the south end of the main waterfront; a 13-foot-deep anchorage off the north end of the main waterfront; a stone jetty at the southwest end of Goat Island; partial removal of a sand spit at the south end of Goat Island; and construction of additional jetties along the western shore of Goat Island to reduce erosion.

The present project, completed in 1940, consists of:

- A 1.25-mile-long channel, 21 feet deep, along the east side of Goat Island. The channel is initially 300 feet wide at its northern end, and widens to 450 feet at the southern end of the island.
- A 1-mile-long channel, 18 feet deep, situated east of and parallel to the 21-foot-deep channel. The 18-foot-deep channel is initially 450 feet wide and gradually narrows to 350 feet near the southern end of the island.
- A 1-mile-long channel, 18 feet deep, situated west of and parallel to the 21-foot-deep channel. This channel is initially about 100 feet wide at its northern end and gradually merges with the 21-foot-deep channel at a point about halfway past Goat Island. The channel then widens as it continues around the southern end of the island.
- Two adjacent anchorage areas along the main waterfront. The southern anchorage, which begins at the City Stone Pier Marina on Newport Neck and extends northeasterly toward the Newport waterfront, is 13 feet deep. The northern anchorage is 18 feet deep and lies along the Newport waterfront.

Newport Harbor

- The removal of Nourmahal Rock in Brenton Cove, situated off the Fort Adams waterfront about 0.5 mile southwest of Goat Island. This provided the channel with a depth of 18 feet.

Pawcatuck River and Little Narragansett Bay

The Pawcatuck River rises in Worden Pond, situated in the Great Swamp in South Kingstown, and follows a 33-mile-long course, meandering mostly through open and sparsely settled country having a multitude of lakes and swamps. The river flows in a generally southwesterly direction into Little Narragansett Bay at the Rhode Island-Connecticut state line. The lower part of the river forms the boundary between Stonington and North Stonington, Connecticut and Westerly, Rhode Island.

Initial work on the project was completed in 1903, with the most recent work completed in 1949. The project consists of:

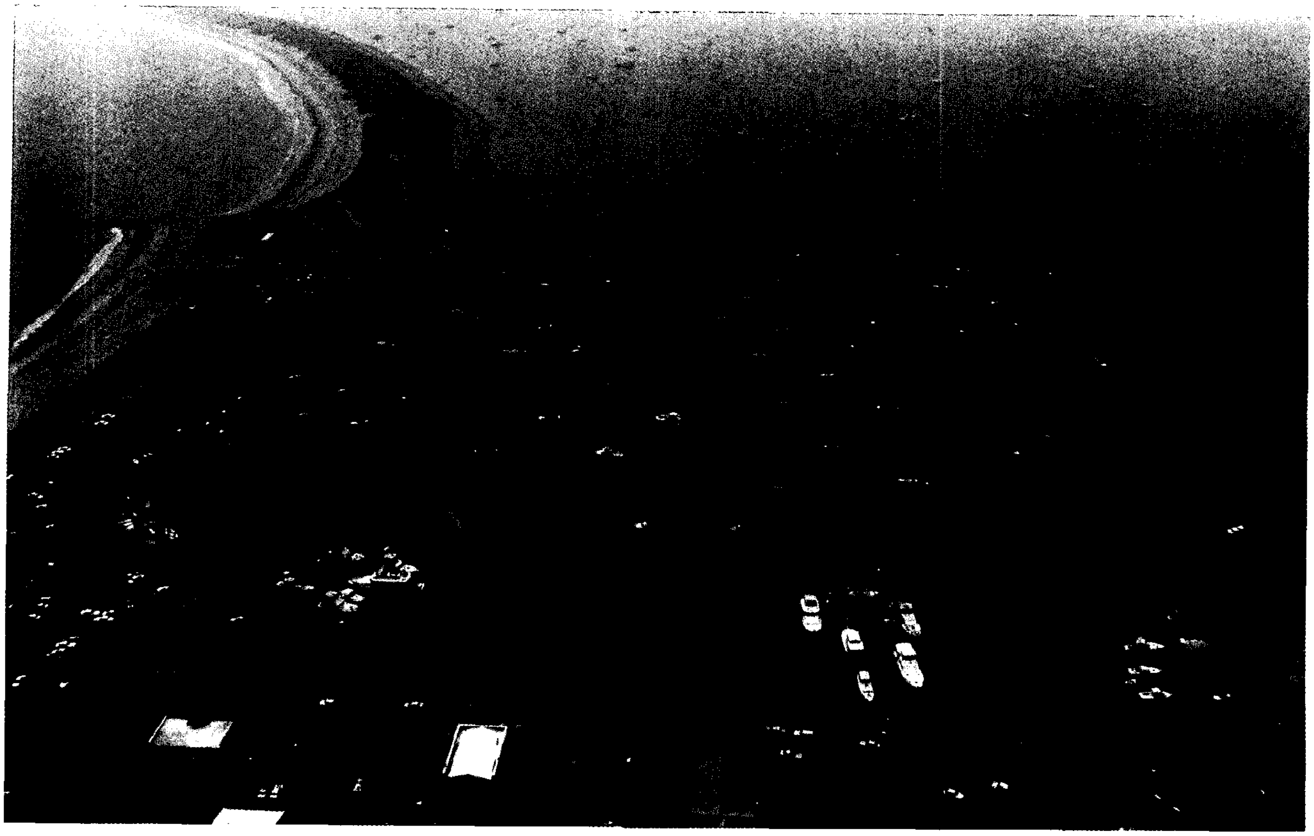
- A 7.5-mile-long, 10-foot-deep channel extending easterly from Stonington Point in Connecticut, located on Little Narragansett Bay's western end, through Little Narragansett Bay and then northerly up the Pawcatuck River to the upper wharves in Westerly. The channel is 100 feet wide from Stonington Point to the lower wharves at Westerly (about seven miles), then narrows to 40 feet for 0.5 mile to the upper wharves.
- A 0.28-mile-long channel, 10 feet deep and 100 feet wide, extending southerly from the mouth of the Pawcatuck River into Watch Hill Cove in Westerly.
- A 10-foot-deep anchorage basin, 16 acres in area, in Watch Hill Cove.
- A 200-foot-long stone jetty near the southwestern end of Watch Hill Cove.

Pawtuxet Cove

Pawtuxet Cove lies along the Cranston-Warwick city line at the mouth of the Pawtuxet River, which discharges into Providence Harbor. The cove serves primarily as a base for recreational boating.

The project, completed in 1966, consists of:

- A six-foot-deep channel, 100 feet wide, extending westerly from deep water in the Providence River to the cove entrance, then turning northerly up the cove behind Washout Point to the head of the cove at Cranston;
- A six-foot-deep turning basin at the head of the cove, across from the mouth of the Pawtuxet River;
- A six-foot-deep anchorage, 14 acres in area, situated south of the cove entrance and north of Warwick Downs State Park; and



Watch Hill Cove in Westerly, part of the Pawcatuck River and Little Narragansett Bay project.

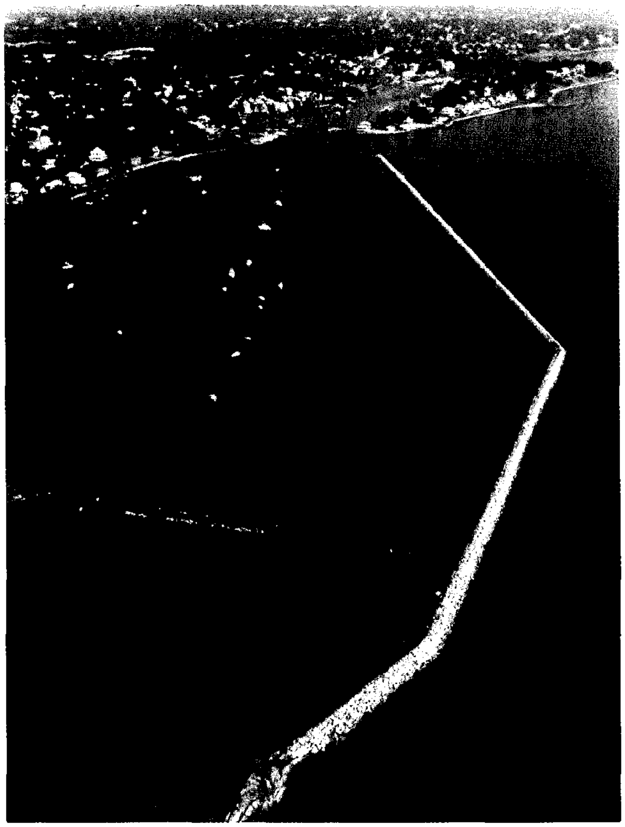
- A 2200-foot-long stone dike along the east side of the anchorage. The 12-foot-high dike extends northward from Rock Island to Marsh Island and affords shelter and protection to the cove.

Point Judith Pond and Harbor of Refuge

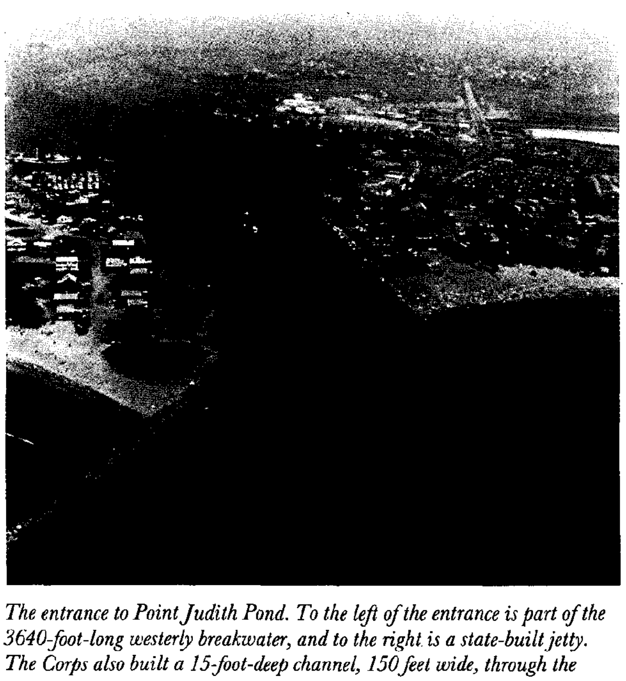
Point Judith Pond is a shallow, four-mile-long salt water body lying behind the barrier beaches and sand dunes that form Point Judith Harbor, which lies immediately west of Point Judith in Narragansett at the southwestern tip of Narragansett Bay. Located about 14 miles southwest of Newport Harbor, Point Judith Pond forms a partial border between the communities of Narragansett and South Kingstown, and is connected to Point Judith Harbor by a narrow waterway that cuts through the beaches and sandy shoreline. This waterway is used by a large fishing fleet and local and transient recreational craft, and the harbor handles a large amount of passenger traffic, primarily during the summer. Year-round ferry service is available between Point Judith and Block Island.

Original work in Point Judith Harbor dates back to 1905. Work in the present project, completed in 1950 (except where noted), consists of:

- A 6970-foot-long main stone breakwater in Point Judith Harbor, situated about 0.5 mile from shore. This breakwater, constructed roughly in a "V" shape, and the two others mentioned below were built in 1914.
- A 2240-foot-long stone breakwater extending southwesterly from Point Judith. This breakwater forms an easterly arm of the main breakwater. Between the breakwaters there is a gap of about 1200 feet, which allows boating craft to enter the harbor.
- A 3640-foot-long stone breakwater extending southerly from the entrance to Point Judith Pond. This breakwater forms a westerly arm of the main breakwater. Between this breakwater and the main breakwater there is a gap of about 1500 feet.
- A 15-foot-deep channel, 150 feet wide, that runs along the east side of the west breakwater and extends past the entrance to Point Judith Pond and the state-built jetties at the port of Gallilee. The channel ends on the west side of the pond at a point 100 feet north of the state pier in Jerusalem.



A 2200-foot-long stone dike affords shelter and protection to Pawtuxet Cove, which serves primarily as a base for recreational boating.



The entrance to Point Judith Pond. To the left of the entrance is part of the 3640-foot-long westerly breakwater, and to the right is a state-built jetty. The Corps also built a 15-foot-deep channel, 150 feet wide, through the entrance.

- A 15-foot-deep channel, 200 feet wide, that branches off from the aforementioned channel at a point past the state-built jetties and extends up the east side of Point Judith Pond. When originally constructed in 1950, the channel ended about 100 feet north of the state pier in Galilee. In 1977, the channel was lengthened by 1400 feet and widened to dimensions varying between 150-640 feet. This most recent work was completed as a small project under Section 107 of the Continuing Authorities Program.
- A 10-foot-deep anchorage, five acres in area, located on the pond's westerly side, immediately inside the pond's entrance.
- A 4.5-mile-long channel, six feet deep and 100 feet wide, starting at a point 100 feet north of the state pier in Jerusalem and running generally along the west side of the pond, ending in the Wakefield section of South Kingstown.
- A six-foot-deep anchorage, five acres in area, at the end of the 4.5-mile-long channel in Wakefield.
- The removal of two shoals to a depth of 18 feet. One shoal was removed from the 10-foot-deep anchorage area, and the second from the east side of the Point Judith Pond entrance. This work was completed in 1921.
- Various works to help trap and retain sand at the entrance to the pond.

Potowomut River

The Potowomut River is a small coastal stream that empties into Narragansett Bay at a point about one mile south of Greenwich Bay and 10 miles south of Providence. Used by small fishing boats and recreational craft, the Potowomut River forms the boundary between North Kingstown and the southeastern section of Warwick known as Potowomut.

The project, completed in 1881, involved constructing a 0.5-mile-long channel, five feet deep and 115 feet wide, through the bar at the entrance to the river; and removing Eustons Rock on the north side of the channel.

Providence River and Harbor

The Providence River is formed by the junction of two small streams, the Woonasquatucket and Moshassuck Rivers, which rise in northern Rhode Island. The river flows southerly for one mile to the head of Providence Harbor at Fox Point in Providence, where it is joined by the Seekonk River. The Corps project, a 16.8-mile-long channel, begins near the head of Providence Harbor and follows the river on a southerly course through the communities of East Providence, Cranston, Barrington, Warwick, Bristol, and Portsmouth. Providence River and Harbor together constitute the principal commercial waterway in Rhode Island.

Providence River and Harbor together constitute the principal commercial waterway in Rhode Island.

Initial work on the river and harbor began in the 19th century with the construction of a nine-foot-deep channel near the head of the harbor. Subsequent improvements involved the construction of a 5.5-mile-long channel, 25 feet deep and generally 600 feet wide, extending from Fox Point to Bullocks Point in East Providence; and extending this channel 5.1 miles southward to North Point (Popasquash Neck) in Bristol and deepening it to 35 feet through its entire length.

A modification to the project was completed in 1976. This involved extending the channel 6.2 miles southward to the southeasterly side of Prudence Island, and deepening the entire channel to 40 feet. The channel is generally 600 feet wide, except for the stretch between Field Point (near the Providence-Cranston city line) and Fox Point, where it has varying widths of up to 1700 feet.

Sakonnet Harbor

Sakonnet Harbor, originally known as Church Cove, is located in the Sakonnet section of Little Compton, near the entrance to the Sakonnet River. Used by fishing boats and recreational craft, Sakonnet Harbor is about 0.4 miles north of Sakonnet Point and five miles east of Newport.

Initial work in the harbor, completed in 1908, involved constructing a 400-foot-long breakwater extending northerly from the western side of the harbor, and removing a ledge near the wharf to a depth of eight feet.

The project was modified in 1957 when the Corps constructed a 400-foot-long extension to the breakwater and dredged the harbor to a depth of eight feet. The total area dredged was about 13 acres.

Sakonnet River

The Sakonnet River extends northward from Rhode Island Sound to Mount Hope Bay, passing along the east side of Aquidneck Island, the largest island in Narragansett Bay. The Corps' project is located at the northern end of the river, between the island town of Portsmouth and the mainland town of Tiverton.

The project, completed in 1905, involved deepening and widening the small section of channel that passed through the draw opening of Stone Bridge, which at that time connected Tiverton and Portsmouth. The channel was deepened to 25 feet and widened to 100 feet. Stone Bridge was removed by the state in 1956 following the construction of a new highway bridge about one mile northward.

Seekonk River

From the natural falls at Pawtucket, the Seekonk River flows about five miles southerly between the cities of Providence and East Providence before emptying into Providence Harbor at India Point.

Original work on the river around the turn of the century provided for a 12-foot-deep channel extending from the mouth of the river to the wharves at Pawtucket. The present project, completed in 1927, consists of a 3.4-mile-long channel, 16 feet deep, extending northerly from near the Henderson Bridge connecting Providence and East Providence, about 0.8 mile upstream of India Point, to the Division Street Bridge in Pawtucket. The channel is 150 feet wide from the Red Bridge to an area opposite Goose Point (a distance of about one mile), where it widens further to 230 feet for a distance of about 0.5 mile. The channel then narrows to 150 feet for a distance of about 1.7 miles to a point upstream of the state pier, where it narrows to 100 feet through the ledge at Pawtucket and narrows further to 60 feet as it approaches the Division Street Bridge.

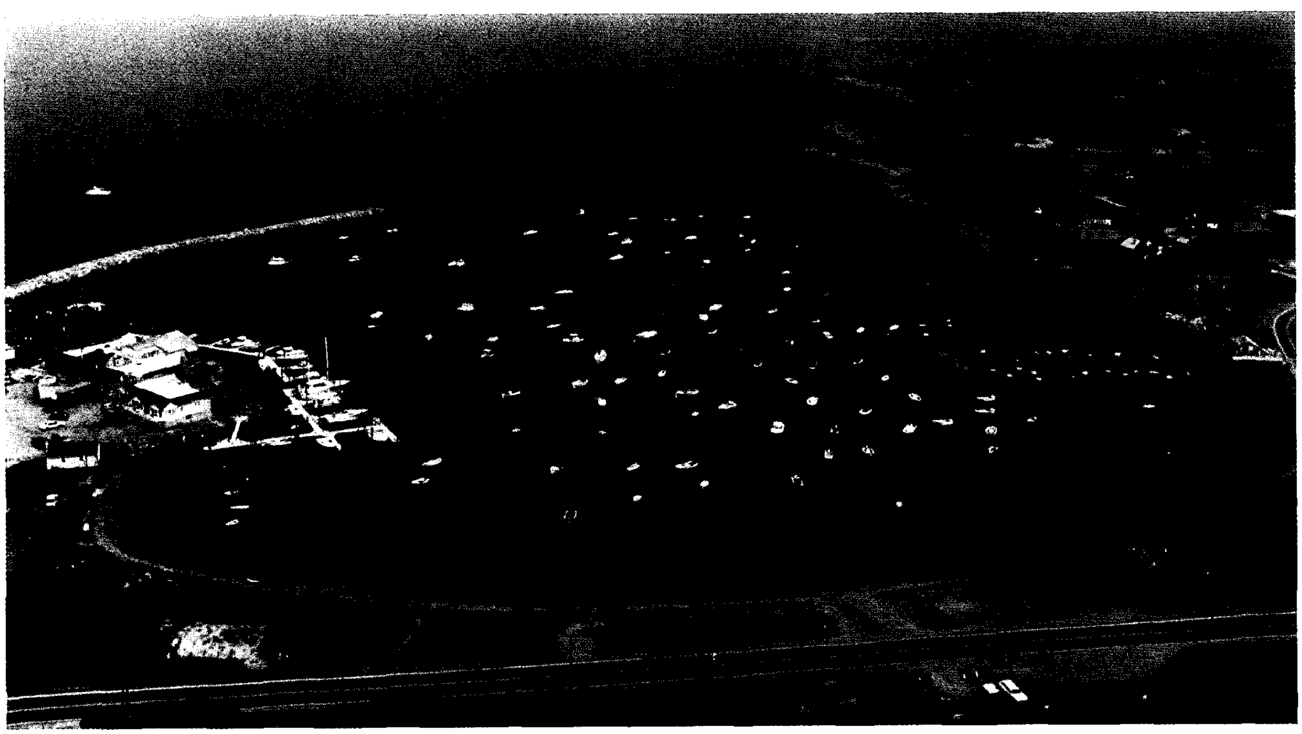
Warren River

Rising in southeastern Massachusetts, the Warren River flows southerly across the Massachusetts-Rhode Island state line for about 7.5 miles before emptying into the head of Narragansett Bay between Bristol and Rumstick Necks, about seven miles southeast of Providence. The Corps' project is located along the lower two miles of the river, between Barrington and Warren. The Warren River is used by fishing vessels, recreational craft, and a boat-building firm.

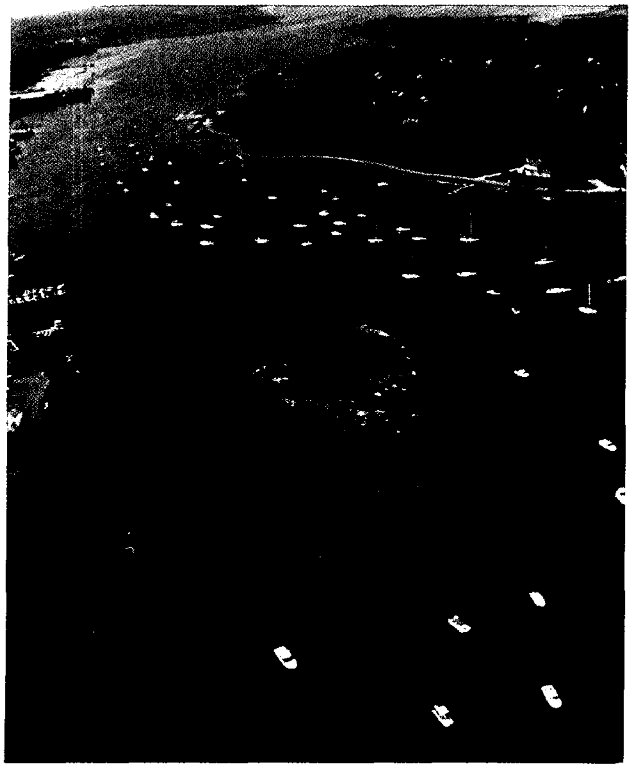
Completed in 1887, the project involved removing a rocky reef south of Little Island, near the confluence of the Warren and Barrington Rivers, and a submerged boulder (formerly called Bushworth Rock) opposite Warren's lower waterfront. The removal of these obstructions provides a natural 12-foot depth in the lower two-mile-long channel of the Warren River.

Warwick Cove

Warwick Cove in Warwick is a narrow inlet lying immediately west of Warwick Neck that extends about 1.5 miles northward from Greenwich Bay. Situated about nine miles south of Providence, Warwick Cove is used by a large recreational fleet and small quahog and fishing fleets.



Sakonnet Harbor in Little Compton.



The Warren River flows between Warren on the left and Barrington on the right. Little Island lies in the foreground.

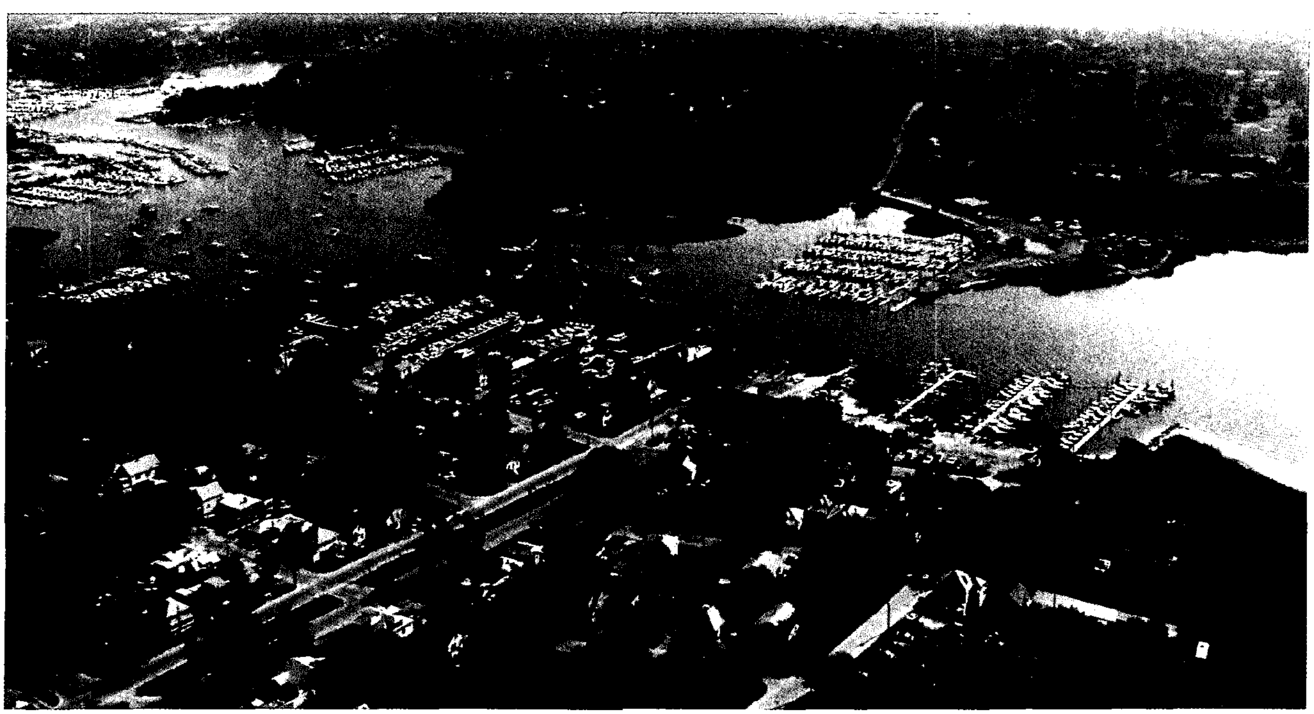
The project consists of:

- A six-foot-deep channel extending approximately 1.8 miles from Greenwich Bay to the public landing at the head of the cove. The channel is 150 feet wide from deep water in Greenwich Bay through the lower portion of the cove, then narrows to 100 feet to the head of the cove.
- Four six-foot-deep anchorage areas totalling 13 acres in area. An anchorage two acres in area was dredged at the entrance to the cove on the west side of the channel, across from the public landing in Oakland Beach State Park in Warwick; two anchorages, each five acres in area, were dredged on each side of the channel in the lower half of the cove; and an anchorage one acre in area was dredged at the cove's upper end, across from the public landing.

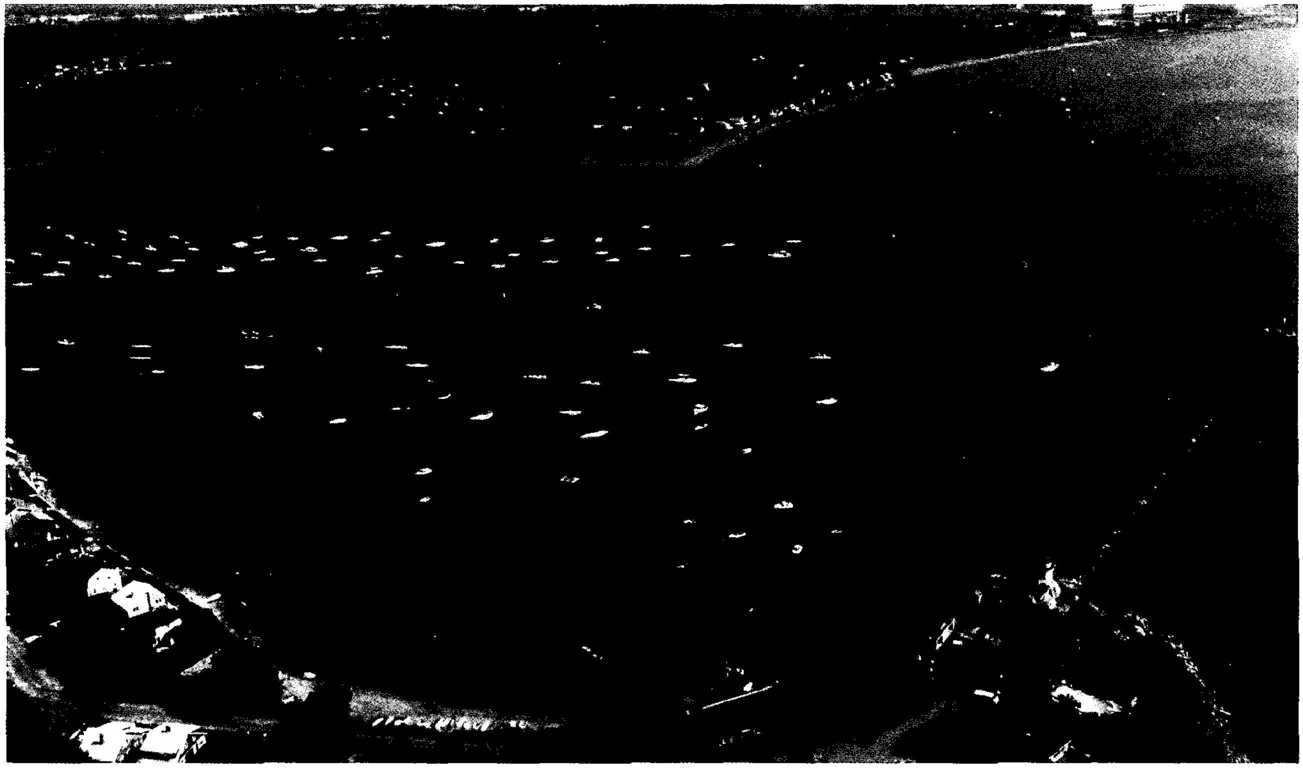
The work in Warwick Cove, completed in 1966, was constructed as a small project under Section 107 of the Continuing Authorities Program.

Wickford Harbor

Wickford Harbor is located in the Wickford section of North Kingstown in western Narragansett Bay, about two miles southwest of Quonset Point and 17 miles south of Providence. Wickford Harbor consists of an outer harbor and three small coves—Wickford Cove, Fishing Cove, and Mill Cove. The harbor is used extensively by oyster and lobster boats, small oil tankers and barges, and recreational craft.



Warwick Cove



Wickford Harbor in North Kingstown.

The project consists of:

- Two stone breakwaters at the entrance to Wickford Harbor. The north breakwater, located off Sauga Point, is about 1130 feet long, and the south breakwater, located off Poplar Point, is about 825 feet long.
- A 0.8-mile-long channel through Wickford Cove, ending at the Hamilton Avenue Bridge. The channel has a depth of nine feet and a width of 60 feet, wider at the bends.
- A 2600-foot-long channel, 12 feet deep and 100 feet wide, extending from the outer harbor through Fishing Cove and into Mill Cove.
- A six-foot-deep anchorage, 250-300 feet wide and 10 acres in area, adjacent to the head of the channel in Mill Cove and east of Rabbit Island.

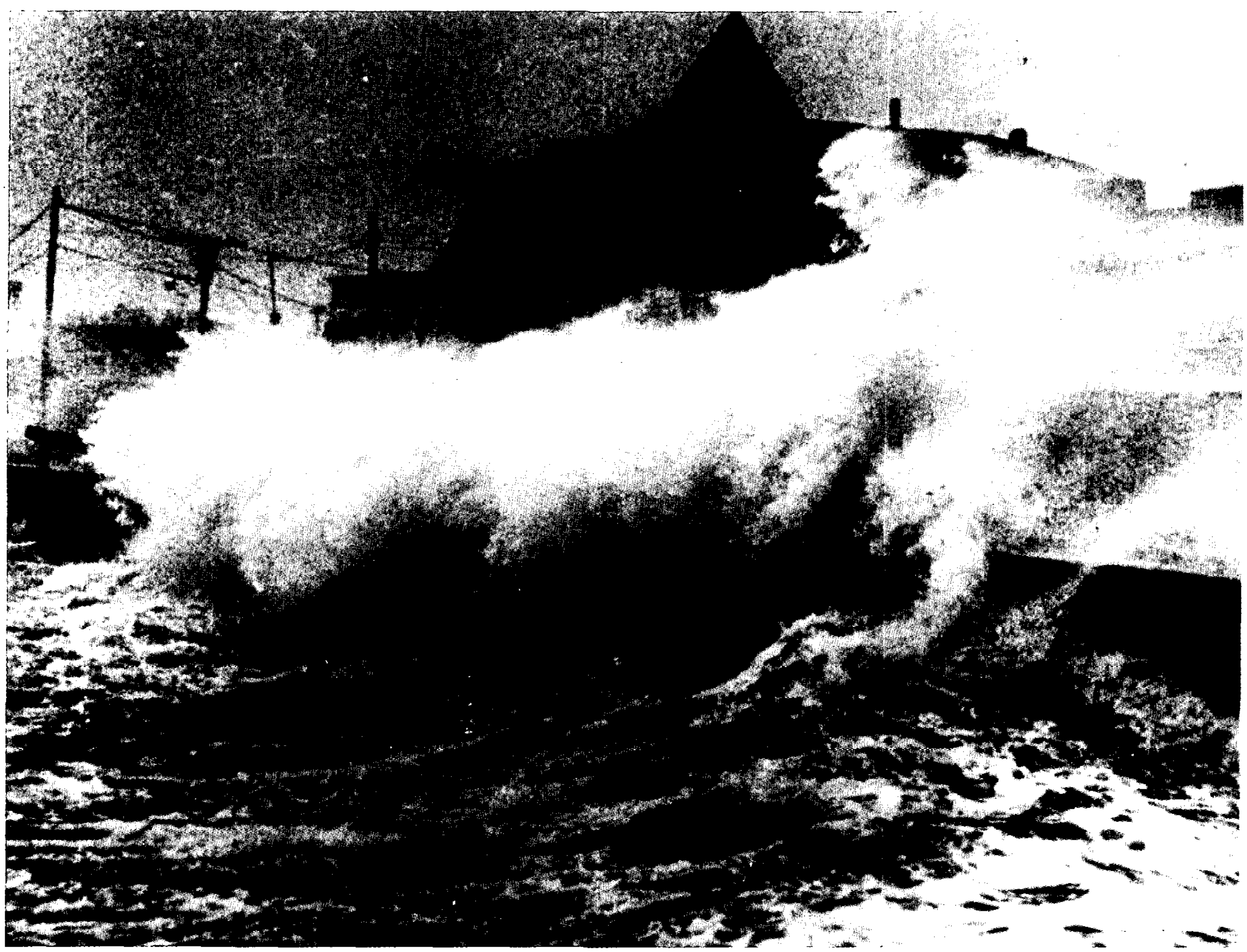
The 0.8-mile-long channel through Wickford Cove was completed in 1900. The remainder of the work was completed in 1963 as a small project under Section 107 of the Continuing Authorities Program.

Shore and Bank Protection

Rhode Island's shoreline, including Block Island and Narragansett Bay, is approximately 340 miles long. About 280 miles are privately owned, 50 miles are owned by state and local government, and 10 miles are owned by the federal government. There are about 724 miles of rivers and streams in the state, the lowest number of all the New England states.

The Corps has constructed five shore and bank protection projects in Rhode Island to stem erosion of the shoreline and riverbanks. Four of these projects were built to protect the shoreline and one was constructed to strengthen an inland streambank. Total construction costs amount to $2.4 million.

The following pages describe the Corps' shore and bank protection projects in Rhode Island.



The shore can take a beating from storm driven winds and waves. In September 1961, Hurricane Esther raised havoc with Rhode Island's Narragansett Pier, slamming waves against the seawall and flooding adjacent streets. (Copyright 1961 The Providence Journal Company*).*

Shore and Bank Protection Projects in Rhode Island

Clear River, Burrillville

Cliff Walk

Misquamicut Beach

Oakland Beach

Sand Hill Cove Beach

Clear River, Burrillville

The Clear River originates in the northwest corner of the state and flows easterly for eight miles to its confluence with the Branch River. Located about 15 miles northwest of Providence in the Harrisville section of Burrillville, the project site is situated on the Clear River's northern bank, directly behind the Burrillville Ambulance Association (BAA) building and immediately upstream of the Railroad Avenue Bridge. The BAA is a nonprofit volunteer organization that provides emergency medical care and transport for town residents.

In 1965, private interests constructed a 140-foot-long stone retaining wall behind the BAA building to control erosion of the river's northern bank and safeguard the BAA building. Eventually, about 60 feet of the wall weakened and collapsed, allowing riverbank erosion to creep within six feet of the BAA building. If this section of wall had been left unrepaired, severe flooding would have structurally undermined the BAA building and the adjoining parking lot.

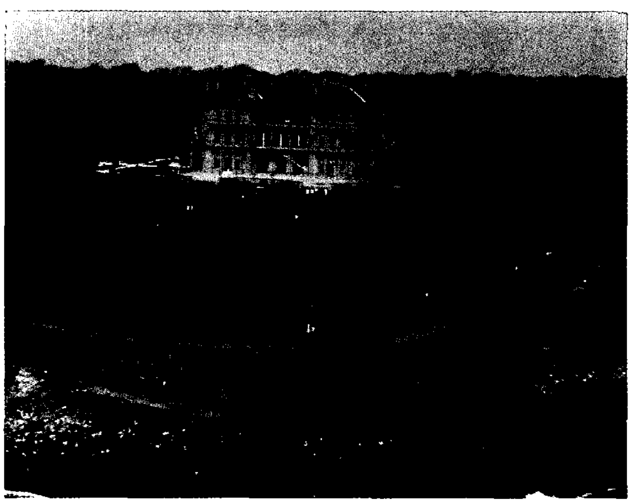
The Corps responded to the problem by replacing the 60 feet of failed wall with a 15-foot-high stone retaining wall, and removing a wooden footbridge and its abutment that had restricted the river flow and contributed to the erosion process.

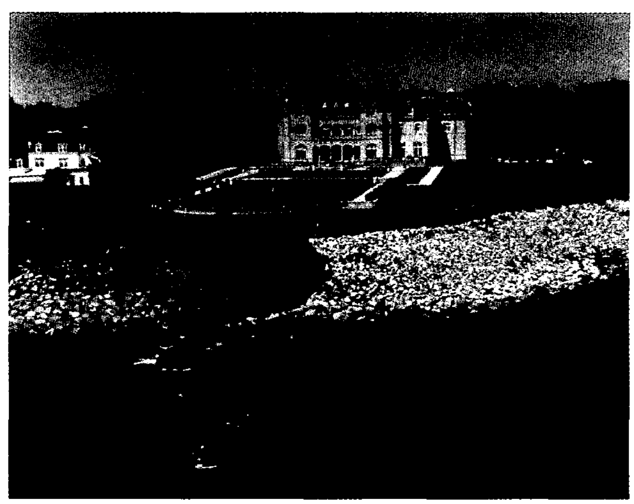
The project was constructed between September-October 1986 at a cost of $161,000.

Cliff Walk

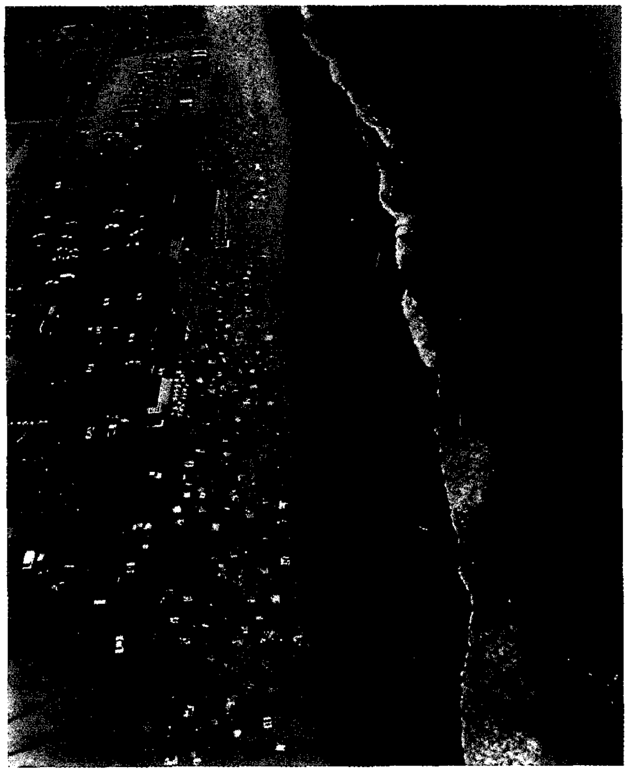
Cliff Walk in Newport is a popular scenic and historical walkway bordering the edge of eroding bluffs and cliffs along the city's southeastern shoreline. Extending 3.5 miles southerly from Newport (Eastons) Beach, around Lands End, and ending near Bailey Beach, Cliff Walk overlooks Rhode Island Sound and traverses privately-owned land surrounding many of Newport's showplace mansions. The public footpath is situated about three miles east of Brenton Point in Newport and 25 miles south of Providence.

The project originally called for the construction of shore protection measures along much of the the walkway's 18,000 feet. Due to a limitation of local funding available at that time, only 70 percent of the project was completed. The completed work covered a total area of approximately 9200 feet between Newport Beach and the west property line of the Marble House at Sheep Point. This work involved constructing stone breakwaters and stone slope protection, repairing existing seawalls, using fill to strengthen Cliff Walk's intermittent reaches, and grading and surfacing the walk. This part of the project began in May 1971 and was completed in September 1972 at a cost of $1.4 million. The uncompleted 30 percent, much of which was situated near Salve Regina College, was placed in an "inactive" status until such time as additional local funding was available.





Cliff Walk in Newport (above left), a popular scenic and historical walkway bordering the edge of eroding bluffs and cliffs, traverses privately-owned land surrounding many of Newport's showplace mansions. Also located on this public footpath is Salve Regina College (above right).



Misquamicut Beach in Westerly.

Oakland Beach in Warwick.

In the early 1980's, local officials indicated a desire and willingness to resume construction of that part of the unfinished project situated near Salve Regina College. After receiving appropriate funding in 1982, the Corps completed design plans for the additional work. However, because the city planned to use funding provided by the National Park Service to construct the work, further Corps' involvement was precluded. The Corps gave its design plans to the city in 1984, allowing Newport to complete construction on this additional segment. This part of the project was completed in 1985.

Misquamicut Beach

Misquamicut Beach is located in the Misquamicut section of Westerly, about five miles east of the Rhode Island-Connecticut state line.

The project involved widening 3250 feet of beach to 150 feet by the direct placement of sand, and installing nearly 4075 feet of sand fences. Work was completed in 1960 at a cost of $44,000.

Oakland Beach

Oakland Beach, part of Oakland Beach Park, is located in Warwick along the northern shore of Greenwich Bay. Bordered by Brush Neck Cove on the west and Warwick Cove on the east, Oakland Beach Park offers the public a variety of recreational opportunities, such as swimming, boating, fishing, clamming, and sporting activities.

The project involved widening a total of 200 feet of beach along each side of the existing seawall by the direct placement of sand; constructing five stone groins; and constructing stone slope protection in front of the seawall.

The work at Oakland Beach cost $740,000 and was completed in 1981 as a small project under Section 103 of the Continuing Authorities Program.

Sand Hill Cove Beach

Sand Hill Cove Beach in Narragansett is located immediately east of the entrance to Point Judith Pond. It is about 31 miles south of Providence.

The project, completed in 1955 at a cost of $122,000, involved widening one mile of beach an additional 65 feet by the direct placement of sand, construction of five stone groins and construction of a steel bulkhead behind the eastern half of the beach. The bulkhead forms a barrier that prevents beach sand from moving inland.

Sand Hill Cove Beach in Narragansett. The Corps constructed the five stone groins and widened one mile of the beach by the direct placement of sand.

STUDIES

Studies

Before taking measures to resolve a water resources problem, the Corps will study the affected area to determine if a project is feasible. The study examines a wide range of potential solutions based on their economic and engineering practicality, acceptability, and impact on the environment.

Listed below are areas in Rhode Island where the Corps has examined (during the period 1987-91) the feasibility of building major projects for flood damage reduction, navigation, or shore and bank protection purposes.

Flood Damage Reduction

Pawcatuck River Basin and Narragansett Bay

Because of heavy damages suffered in southeastern New England during the storm of March 1968, Congress directed the Corps to study ways to reduce flooding in the Pawcatuck River Basin and Narragansett Bay area. In its flood damage reduction study, Congress also asked the Corps to examine navigation, water supply, recreation, and other related water uses.

From this study came the proposed Big River Reservoir Project in Coventry and West Greenwich. This multipurpose project would involve the construction of a dam and reservoir on the Big River tributary of the Pawtuxet River that would reduce flood damage, supply water for municipal and industrial use, and provide recreational benefits. Once completed, the project would yield 27 million gallons of water per day. In 1986, Congress authorized the construction of the Big River Project, but to date no funds have been appropriated for its design or construction.

(Also from this study came the Pawtuxet River Flood Damage Reduction Project in Warwick, which was completed in July 1985.

Navigation

Block Island Harbor of Refuge

A Congressional resolution for a study of potential navigation improvements at Block Island Harbor of Refuge was passed by the U.S. Senate Committee on Environment and Public Works on April 24,1990. The Federally funded reconnaissance study will start late in FY1993 and be completed within one year.

Point Judith Pond and Harbor of Refuge

At the request of local officials, the Corps studied the feasibility of making improvements to Point Judith Pond and Harbor of Refuge in the interest of commercial and recreational navigation. A feasibility report, completed under Section 107 of the Continuing Authorities Program in 1989, recommended improvements around the West Bulkhead area in Galilee as the basis for project plans and specifications.

The proposed project would involve widening the existing West Bulkhead channel from 150 to 200 feet and extending this same channel into the North Basin area at a width of 150 feet and a depth of 10 feet.

The project is inactive at time due to the state's inability to find a disposal site for previously dredged material currently occupying the dewatering area needed for this dredging operation.

Shore and Bank Protection

Bullock Neck

The Corps completed a reconnaissance study of erosion problems at Bullock Neck in East Providence. Conducted under Section 103 of the Continuing Authorities Program, the study found no plans of improvement which were economically justified. Further study is not warranted.

City Park Beach and Conimicut Point Beach

The Corps studied the feasibility of constructing shore protection projects at two Warwick beaches under Section 103 of the Corps' Continuing Authorities Program. The proposed plans call for widening of City Park Beach and Conimicut Point Beach by the direct placement of sand and construction of groins to reduce erosion.

Further study for strengthening these beaches has been terminated because of the low priority assigned by the Corps of Engineers to projects having predominantly recreational benefits.

APPENDIX

Communities with Corps Projects

The communities listed below have either Corps' lands or Corps-built projects lying within their borders. The listing indicates the project name, its purpose (Flood Damage Reduction, Navigation, or Shore and Bank Protection), and the page number in this booklet where the project is described.

Community	Project Name	
Barrington	Bullocks Point Cove (Navigation)	38
	Providence River and Harbor (Navigation)	43
	Warren River (Navigation)	45
Bristol	Providence River and Harbor (Navigation)	43
Burrillville	Clear River (Shore and Bank Protection)	50
Cranston	Pawtuxet Cove (Navigation)	41
	Providence River and Harbor (Navigation)	43
East Greenwich	Greenwich Bay (Navigation)	39
East Providence	Bullocks Point Cove (Navigation)	38
	Providence River and Harbor (Navigation)	43
	Seekonk River (Navigation)	45
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Glossary

Anchorage—an area dredged to a certain depth to allow boats and ships to moor or anchor.

Bedrock—rock of relatively great thickness lying in its native location.

Breakwaters—structures, usually built offshore, that protect the shoreline, harbor, channels, and anchorages by intercepting the energy of approaching waves.

Bulkheads—steel sheet piling or timber walls that prevent sliding of the land and protect the streambank or shoreline from erosion.

Conduits—concrete tunnels or pipes that divert floodwaters around or under potential flood damage sites.

Culverts—large pipes, usually constructed below bridges and other water crossings, that allow water to pass downstream and provide support to the crossing.

Dikes—earthfill barriers that confine floodwaters to the river channel, protecting flood prone areas.

Drainage Area—the total land area where surface water runs off and collects in a stream or series or streams that make up a single watershed.

Drop Structure—a device in a stream or channel that prevents water from rising above a certain elevation. Once water reaches a certain level, excess water passes over the structure and is diverted to another body of water.

Earthfill—a well graded mixture of soil containing principally gravel, sand, silt, and clay, which is used with other materials to construct dams, dikes, and hurricane protection barriers.

Environmental Assessment—an examination of the positive and adverse impacts on the environment of a proposed water resources solution and alternative solutions.

Environmental Impact Statement—a detailed environmental analysis and documentation of a proposed water resources solution when the proposed solution is expected to have a significant effect on the quality of the human environment or the area's ecology.

Feasibility Study—a detailed investigation, conducted after the reconnaissance study is completed, that recommends a specific solution to a water resource problem.

Floodplain—the land adjoining a river, stream, ocean, or lake that is likely to be flooded during periods of excess precipitation or abnormal high tide.

Floodproofing—structural measures incorporated in the design of planned buildings or alterations added to existing ones that lessen the potential for flood damage. For example, existing structures could have their basement windows blocked, or structures in the design stage could be built on stilts or high foundations.

Floodwalls—reinforced concrete walls that act as barriers against floodwaters and confine them to the river channel, protecting flood prone areas. Floodwalls are usually built in areas with a limited amount of space.

Gabion Wall—a retaining wall constructed of stone-filled wire mesh baskets.

Groins—structures that extend perpendicular from the shore in a fingerlikemanner to trap and retain sand, retarding erosion and maintaining shore alignment and stability.

Hurricane Protection Barriers—structures built across harbors or near the shoreline that protect communities from tidal surges and coastal storm flooding. They are often constructed with openings for navigational purposes.

Intake Structure—found at the entrance to a conduit or other outlet facility, an intake structure allows water to drain from a reservoir or river and is equipped with a trash rack or other feature that prevents clogging from floating debris.

Jetties—structures that stabilize a channel by preventing the buildup of sediment and directing and confining the channel's tidal flow. Jetties are usually built at the mouth of rivers and extend perpendicular from the shore.

Outlet Works—gated conduits, usually located at the base of a dam, that regulate the discharge of water.

Pumping Station—a structure containing pumps that discharges floodwaters from a protected area over or through a dike or floodwall and into a river or ocean.

Reconnaissance Study—a preliminary study that examines a wide range of potential solutions to a water resources problem, each of which is reviewed for its economic and engineering practicality, acceptability, and impact on the environment.

Recreation Pool—any permanent body of water impounded by a dam that offers recreational opportunities or promotes fishery and wildlife habitat.

Retaining Walls—walls made of stone, reinforced concrete, precast concrete blocks, or gabion that support streambanks weakened by erosion.

Revetment—a facing of stone or concrete constructed along a backshore or riverbank to protect against erosion or flooding.

Sand Drain—a layer of pervious materials, such as sand and gravel, placed beneath the downstream section of a dam that carries seepage to the dam's downstream limits and out into the stream.

Sand Replishment—quantities of sand placed on a shoreline to restore or widen a beach's dimensions. Sand replenishment strengthens beaches affected by erosion, protects the backshore from wave action, and stops the inland advance of water.

Seawall—a reinforced concrete wall built along a shoreline to protect against erosion or flooding.

Snagging and Clearing—the removal of accumulated snags and debris, such as fallen trees, dead brush, and silt, from river and stream channels. Snagging and clearing improves a channel's flow capacity and eliminates a potentially dangerous flood situation.

Spillway—a channel-shaped structure, usually made of concrete or excavatedin rock, that allows water exceeding the storage capacity of a reservoir to pass through or around a dam instead of overtopping it.

Stone Slope Protection—a layer of large stones, usually underlain by a layer of gravel bedding, designed to prevent erosion from streamflow, wave attack, and runoff.

Stoplog Structure—a designed opening in a floodwall or dike that allows the passage of water during non-flood periods but closes during flood periods to prevent flooding downstream. Stoplog structures can be made of wood or steel or concrete beams.

Training Dike—a structure extending from the shore into the water that redirects the current, preventing sediment from settling and ensuring that adequate depths are maintained.

Training Wall—a structure built along channel banks to narrow the channel area, thereby controlling the velocity of the flow of water and preventing the buildup of sediment. Training walls and training dikes have the same purpose: to ensure adequate depths are maintained.

Vehicular Gate—an opening in a dike or floodwall that allows rail cars or other vehicles to pass over the structure during nonflood periods. Vehicular gates can be closed during flood periods by either stoplogs or large steel gates.

Weir—a concrete structure designed as part of the spillway that allows water to flow from the reservoir and over the spillway.

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