



**US Army Corps  
of Engineers**  
Jacksonville District

# Water Resources Development in Puerto Rico and the U.S. Virgin Islands 1998



**About the cover.....**



*Foundation preparation work is completed at the Portugues Dam, Ponce, Puerto Rico. Grouting is underway with a scheduled completion date of October 1999.*



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**Water Resources Development  
by the  
U.S. Army Corps of Engineers  
in  
Puerto Rico and the U. S. Virgin Islands**



**1998**

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# Civil Works Overview



*Shore Protection Project of the San Juan National Historic Site at San Juan, Puerto Rico.*

## Introduction

From 1775 to the present, the U.S. Army Corps of Engineers has served the Nation in peace and war. The Corps traces its history to June 18, 1775, when the Continental Congress appointed Colonel Richard Gridley as Chief of Engineers of the Continental Army, under General George Washington. The original Corps was the Army's engineering and construction arm until it mustered out of service at the close of the Revolutionary War in 1783.

In 1802, Congress re-established a separate Corps of Engineers within the Army. At the same time, it 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 and 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 building in Washington, D.C., and elsewhere. Meanwhile, the Corps of 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 led succeeding administrations and Congresses to assign new water-related missions to the Corps 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; reimbursable 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, 1990 and 1992—a growing role in environmental protection.

*The Corps has a long and illustrious history in maintaining navigation of the nation's waterways and providing flood protection for communities.*



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## Authorization and Planning Processes for Water Resources Projects

Corps of Engineers water resources activities are normally initiated by non-Federal interests, authorized by Congress, funded by a combination of Federal and non-Federal sources, constructed by the Corps under the Civil Works Program, and operated and maintained either by the Corps or by a non-Federal sponsoring agency.

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 U.S. Army 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 non-Federal 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, in the Water Resources Development Act of 1986, established 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 such as locks and dams. Such projects are funded in part from the Inland Waterway Trust Fund, which in turn is funded by waterway fuel taxes.

Normally, the study process for a water resource problem starts with a brief reconnaissance study to determine whether a project falls within the Corps' statutory authority and meets national priorities. Should that be the case, the Corps district where the project is located will carry out a full feasibility study to develop alternatives and select the best possible solution. This process normally includes public meetings to determine the views of local interests on the extent and type of improvements desired. The Federal, state, and other agencies with interests in a project are partners in the planning process.

Before making recommendations to Congress for project authorization, the Corps ensures that the proposed project's benefits will exceed costs, its engineering design is sound, the project best serves the needs of the people concerned, and that it makes the wisest possible use of the natural resources involved and adequately protects the environment.

Once the Corps of Engineers district completes its feasibility study, it submits a report, along with a final environmental impact statement, 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 non-Federal project sponsor must provide funds. A Federal budget recommendation for a project is 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 Act, which must be passed by both Houses of the Congress and signed by the President.

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## Navigation

Corps of Engineers involvement in navigation projects dates to the early days of the United States, when rivers and coastal harbors were the primary paths of commerce in the new country. 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.

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 U.S. Army Corps of Engineers remains one of the most important parts of the Nation's transportation system. The Corps maintains the nation's waterways as a safe, reliable and economically efficient navigation system. The 12,000 miles of inland waterways maintained by the Corps carry one sixth of the nation's inter-city cargo. The importance of the Corps mission in maintaining depths at more than 500 harbors, meanwhile, is underscored by an estimated one job in five in the United States being dependent, to some extent, on the commerce handled by these ports.

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## Flood Control and Flood Plain Management

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

After a series of disastrous floods affecting wide areas in the 1920s and 30s, Congress determined, in the Flood Control Act of 1936, that the Federal Government would participate in the solution of flooding problems affecting the public interest that were too large or complex to be handled by states or localities. Corps authority for flood control work was thus extended to embrace the entire country. The Corps turns most of the flood control projects it builds over to non-Federal authorities for operation and maintenance once construction is completed.

The purpose of flood control work is to prevent damage through regulation of the flow of water and other means. Prevention of flood-related damages can be accomplished with structural measures, such as reservoirs, levees, channels and floodwalls that modify the characteristics of floods; or non-structural measures, such as flood plain evacuation, floodproofing and floodway acquisition, that alter the way people would use these areas and reduce the susceptibility of human activities to flood risk.

Corps flood control reservoirs are often designed and built for multiple-purpose uses, such as municipal and industrial water supply, navigation, irrigation, hydroelectric power, conservation of fish and wildlife, and recreation.

The Corps fights the Nation's flood problems not only by 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 citizens. 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 to new buildings and facilities, such as adopting and enforcing zoning ordinances, building codes, and subdivision regulations. The Flood Plain Management Services Program provides assistance to other Federal agencies and to State agencies in the same manner.

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## Shore and Hurricane Protection

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. Hurricane protection work was added to the erosion control mission in 1955, when Congress directed the Corps to conduct investigations along the Atlantic and Gulf Coasts to identify problem areas and determine the feasibility of protection.

While each situation the Corps studies involves different considerations, Corps engineers always consider engineering feasibility and economic efficiency along with the environmental and social impacts. Federal participation in a shore protection project varies, depending on shore ownership, use and type and frequency of benefits. (If there is no public use or benefit,

the Corps will not recommend Federal participation.) Once the project is complete, non-Federal interest assume responsibility for its operation and maintenance.

Eighty-two Federal shore protection projects along the coasts of the Atlantic, Pacific, Gulf of Mexico and the Great lakes protect a total of 226 miles of shoreline. Total investment in these projects since 1950 has been \$674 million, of which \$405 million was provided by the Federal government, the rest by non-Federal sponsors.

One shore protection method popular in seaside communities is beach nourishment-- the periodic replenishment of sand along the shoreline to replace that lost to storms and erosion. Authorized nourishment projects usually have a nourishment period of 50 years. In addition, Section 145 of the Water Resources Development Act of 1976 authorizes placement of beach quality sand from Corps dredging projects on nearby beaches. Under Section 933 of the Water Resources Development Act of 1986, local sponsors pay the Federal government 50 percent of the additional costs of this sand placement sand.

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## 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 today, it is non-Federal interests who develop hydro-power facilities at Corps projects without Federal assistance. The Corps, however, can plan, build and operate 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 24 percent of the Nation's hydroelectric power, or three percent of its total electric energy supply.

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## Water Supply

Corps involvement in water supply dates back to 1853, when it began building the Washington Aqueduct, which provides water to the nation's capital city and some of its suburbs to this day.

Elsewhere in the nation, 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, who must agree to pay the cost. The Corps also supplies water for irrigation, under the Flood Control Act of 1944. This act provided that the Secretary of War, upon the recommendation of the Secretary of the Interior, could allow use of Corps reservoirs, provided that the users agree to repay the government for the water.

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## Environmental Quality

The Corps carries out the Civil Works Programs in consistency with many environmental laws, executive orders and regulations. Perhaps primary among these is the National Environmental Policy Act (NEPA) of 1969. This law requires Federal agencies to study and consider the environmental impacts of their proposed actions. 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 provides for periodic review of compliance with all environmental laws and regulations in its Operation and Maintenance Program through implementation of the Environmental Review Guide for Operations. The Corps must also comply with these environmental laws and regulations in conducting its regulatory programs.

NEPA procedures ensure that public officials and private citizens may obtain and provide environmental information before Federal agencies make decisions concerning the environment. In selecting alternative project designs, the Corps strives to choose options which minimize environmental impact.

The Water Resources Development Act of 1986, Section 1135, authorizes the Corps to propose modifications of its existing projects—many of them built before current environmental requirements were in effect—for environmental improvement. Proposals the Corps has made 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 fish.

In recent years the Corps of Engineers has planned and recommended environmental restoration actions at Federal projects to restore environmental conditions.

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## Continuing Authorities

Continuing authorities are items of legislation giving responsibility to the Secretary of the Army and the Chief of Engineers for authorization and funding of certain work items. The objective is to make a fast response to relatively small problems. The various authorities are discussed in the following paragraphs and the summary table in the back of this report.

**SMALL FLOOD CONTROL PROJECTS** (Section 205, Flood Control Act of 1948, as amended). Provides for construction of small flood control projects not specifically authorized by Congress when, in the opinion of the Chief of Engineers, such work is advisable. The Federal share in such projects may not

exceed \$5 million, and must constitute a complete solution to the flood problem involved so as not to commit the United States to additional improvements to ensure effective operation. Such projects are subject to the same requirements of feasibility and economic justification as the larger projects which require specific authorization by Congress.

**SMALL NAVIGATION PROJECTS** (Section 107, 1960 River and Harbor Act, as amended). This legislation authorizes the U.S. Army Corps of Engineers to construct small river and harbor improvement projects not specifically authorized by Congress. The Federal share in such projects may not exceed \$4 million, and the projects must be complete in themselves and not commit the United States to any additional improvement to ensure successful operation. Such projects are also subject to the same requirements of feasibility and economic justification as the larger projects which require specific authorization by Congress.

**SMALL SHORE PROTECTION PROJECTS** (Section 103, River and Harbor Act of 1962, as amended). This Act authorizes the U.S. Army Corps of Engineers to construct shall beach restoration and protection projects not specifically authorized by Congress. The Federal share of the cost must not exceed \$2 million for a single project, and the project must not be dependent on additional improvement for success. Such projects are also subject to the same requirements of feasibility and economic justification as the larger projects which require specific authorization by Congress.

**SNAGGING AND CLEARING FOR FLOOD CONTROL** (Section 208, 1954 Flood Control Act). The U.S. Army Corps of Engineers is authorized, under this Act, to spend up to \$500,000 on any single stream or tributary during any one fiscal year for removal of accumulated snags and other debris, and for the clearing and straightening of stream channels when, in the opinion of the Chief of Engineers, such work is justified in the interest of flood control.

**SNAGGING AND CLEARING FOR NAVIGATION** (Section 3, River and Harbor Act of 1945). This act authorizes the U.S. Army Corps of Engineers to undertake emergency work to clear or remove unreasonable obstructions from rivers, harbors, and other waterways in the interest of navigation.

**EMERGENCY BANK PROTECTION FOR HIGHWAYS AND PUBLIC WORKS.** The general authority of Section 14 of the 1946 Flood Control Act, as amended, provides for funding up to \$1,000,000 for any given locality, for any fiscal year, for the construction, repair, restoration, and modification of emergency streambank and shoreline protection works to prevent damage to highways, bridges, public works, churches, hospitals, schools and other nonprofit public services. Requests should be submitted in writing by agencies of governments, providing details on the requested assistance.

**MITIGATION OF SHORE DAMAGE TO NAVIGATION WORKS.** Section 111 of the River and Harbor Act of 1968 authorizes the U.S. Army Corps of Engineers to spend up to \$2 million in initial construction funds at a project location

without requiring Congressional authorization. This expenditure would be for navigation and construction of the projects for the prevention or mitigation of shore damages attributed to Federal navigation works.

**ENVIRONMENTAL PROTECTION.** Section 1135 (b) of the Water Resource Development Act of 1986, as amended). The objective of the Section 1135 program is to improve the quality of the environment. The proposed study must be for modifications in the structures or operations of a permanent project constructed by the Secretary of the Army and must be consistent with the authorized project purposes. The project modification should be for restoration of habitat that could be expected to sustain modern historic fish and wildlife resources. The project modification report prepared during the feasibility phase requires Headquarters approval, and the project modification is subject to a \$5 million Federal limit.

**BENEFICIAL USES OF DREDGED MATERIAL.** Section 204, Water Resources Development Act of 1992, as amended, authorizes projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in connection with dredging an authorized Federal navigation project. Non-Federal sponsors are responsible for 25% of the project cost and 100% of the cost of operation, maintenance, replacement, and rehabilitation. There is an annual appropriations limit of \$15 million. For projects with an estimated Federal cost of less than \$5 million, divisions have approval authority. Larger projects are approved by headquarters.

**AQUATIC ECOSYSTEM RESTORATION.** Section 206 of the Water Resources Development Act of 1996 authorizes the Secretary to carry out aquatic ecosystem restoration projects that will improve the quality of the environment, are in the public interest, and are cost-effective. Individual projects are limited to \$5 million in Federal cost. Non-Federal interests must contribute 35% of the cost of construction and 100% the cost of operation, maintenance, replacement, and rehabilitation. The program has an annual program limit of \$25 million.

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## **Support for Others Program**

The Support for Others (SFO) Program is the Corps reimbursable support program. Projects are studied, designed or constructed with 100 percent Non-Federal funds. It is authorized by the Intergovernmental Cooperation Act, 31 U.S. Code 6505 and the Economy Act, 31 U.S. Code 1535. Most of our customers are Federal agencies who account for approximately 90 percent of the total workload funding. Other customers include state, local, territorial, tribal and foreign governments. Under the SFO program, the Corps provides quality engineering, environmental, construction management, real estate, research and development and other related services. Our main objective is to conduct the SFO program in partnership, not in competition, with the private sector. We rely heavily on the talents of private firms to execute the SFO mission. The Corps functions as an extension of the agency's staff providing Federal

presence and government oversight to protect the taxpayers' interests. This capability can relieve the agency of the burden of hiring and training specialists to perform these functions. In this respect, the Corps offers proven Federal contract management experience and effectiveness to assist other agencies in the execution of their missions.

The Corps negotiates an interagency agreement (IA) or memorandum of agreement (MOA) with the customer before starting work. These agreements include, but are not limited to, a scope of work, lines of communication, reporting procedures, and identification of roles and responsibilities. The customer's needs are the main focus when developing and tailoring the agreements. Additionally, there is no obligation under the agreements for our customers to provide work to the Corps. It is at the customer's discretion. This provides an extra incentive for the Corps to provide quality service.

As Federal agencies downsize and reduce their engineering capability, the Corps SFO program provides these agencies with Corps management and technical expertise. This ensures continuity of Federal oversight on agency projects and programs. Our customers provide full funding for the effort, and retain control and legal responsibility for their program. The Corps executes within the terms of a given scope of work, agreed upon between the agency and the Corps, helping to ensure quality and timely project completion within an established budget.

Supporting others enables the Corps to maintain and enhance its capabilities. The diversity of work allows us to apply design and construction expertise in new and innovative ways. This serves to expand our skill base, thus strengthening our ability to carry out traditional civil works and military roles.

The Corps surveys its customers to measure their satisfaction with responsiveness, quality, cost and timeliness. In general, our customers indicate a high level of satisfaction with our performance. Our goal is to apply our capabilities to assist others in the execution of their missions; not to take away their work. Many agencies do not possess technical expertise to fulfill the in-house engineering needs of their programs. Furthermore, many do not have the staff too effectively, manage environmental, engineering or construction work being conducted by private firms under contract. The Corps can fill that void.

The Office of Management and Budget (OMB) recognizes the value of the work performed by the Corps under the SFO program. It supports the program by providing full-time-equivalent (FTE) resources specifically for this mission. The Administration considers the SFO program an example of a business-like practice and supports it in the National Performance Review with the recommendation to "maximize the use of the Corps planning, engineering and contract management capabilities in support of other Federal agency programs".

The U.S. Virgin Island portion of the program is estimated at \$70 million with a bulk of the funding identified for the regional wastewater treatment facilities in the Mangrove Lagoon area of St. Thomas. Currently, the USVI and Federal

courts are in discussion over the contents of the consent order and may instead upgrade existing facilities instead of construction of a new regional facility. Four work assignments have been completed. These provided emergency generator units (EGUs) for St. Thomas & St. John, EGUs for St. Croix, rehabilitation of the four major pump stations on St. Croix, and rehabilitation of the wastewater treatment plant (WWTP) on St. Croix. Ongoing work includes inspections for the Cruz Bay WWTP on St. John.

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## Regulatory Programs

The Corps of Engineers regulates construction and other work in navigable waterways under Section 10 of the Rivers and Harbors Act of 1899, and has 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"). A third authority involves permits for transport of dredged material to the ocean for disposal under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972. Under these laws, those who seek to carry out such work must first receive a permit from the Corps.

The "Section 404" program is the principal way by which the Federal government protects wetlands and other aquatic environments. The program's goal is to ensure protection of the aquatic environment, and maintain the navigable capacity of the nation's waters, while allowing for necessary economic development.

The permit evaluation process includes a public notice and a public comment period. Applications for complex projects may also require a public hearing before the Corps makes a permit decision. In its evaluation of applications, the Corps is required by law to consider all the relevant factors involving public interest. These may include economics, environmental concerns, historical values, fish and wildlife, aesthetics, 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, mostly for minor activities which require little or no environmental impact. Individual Corps districts have also issued regional permits for certain types of minor work in specific areas. Individual who propose work that falls under one of these general or regional permits need not go through the full standard individual permit process. However, many general permit authorizations do involve substantial effort by the Corps, and often require project-specific mitigation for the activities authorized by the permit. 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.

In Puerto Rico and the U.S. Virgin Islands the Antilles office has delegated authority for all permit and enforcement decisions except permit denials, preparation of regulatory Envi-

ronmental Impact Statement, and signature authority on certain correspondence required by interagency coordination agreements (specifically those pertaining to Section 404 (q) of the Clean Water Act).

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## Recreation

The Flood Control Act of 1944, the Federal Water Project Recreation Act of 1965, and language in specific project authorization acts authorize the Corps to construct, maintain, and operate public park and recreational facilities at its projects, and to permit others to build, maintain, and operate such facilities. The water areas of Corps projects are open to public use 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 4,300 sites at its lakes and other water resource projects. More than 370 million visits per year are recorded at these sites. State and local park authorities and private interests operate nearly 2,000 of these areas at Corps projects.

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## Planning Assistance to States

The planning assistance program is carried out in accordance with Section 22 of the 1974 Water Resources Development Act (WRDA). For the purposes of the program, a state is defined as a state, Indian tribe, Puerto Rico, or U.S. Virgin Islands. The Chief of Engineers is authorized to cooperate with states in the preparation of plans for the development, utilization, and conservation of water and related resources of drainage basins, watersheds, and ecosystems, located within the boundaries of the states and Indian tribes. Assistance is provided on the basis of state requests rather than through Congressional study authorization. Within personnel and funding capabilities, the districts shall cooperate with states by providing planning assistance in accordance with established regulations.

Typical studies are at reconnaissance level of detail and do not include design for project construction. The Corps negotiates an agreement with the state before starting work.

The maximum Federal amount to be expended in any one fiscal year for any state is \$500,000. Section 319 of the 1990 WRDA requires 50-50 cost sharing under this program. The U.S. Virgin Islands are exempt from cost-sharing in the first \$200,000 for any given fiscal year.

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## Emergency Response and Recovery

The Corps provides emergency response to natural disasters under Public Law 84-99, which covers flood control and coastal emergencies. It also provides emergency support to 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 carry out disaster preparedness; advance measures; emergency operations such as flood fighting, rescue and emergency relief activities; rehabilitation of flood control works threatened or destroyed by flood; and protection or repair of federally authorized shore protection works threatened or damaged by coastal storms. This act also authorizes the Corps to provide emergency supplies of clean water in cases of drought or contaminated water supply. After the immediate flooding has passed, 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 and prior to a Presidential Disaster Declaration.

Under the Stafford Act and Federal Disaster Response Plan, the Corps of Engineers, as designated by the Department of Defense, is responsible for providing public works and engineering support in response to a major disaster or catastrophic earthquake. Under this plan, the Corps, in coordination with FEMA, will work directly with state authorities in providing temporary repair and construction of roads, bridges, and utilities, temporary shelter, debris removal and demolition, water supply, etc. The Corps is the lead Federal agency tasked by FEMA to provide engineering, design, construction and contract management in support of recovery operations.

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## National Estuary Program

Congress created the National Estuary Program in 1987 under the provisions of Section 320 of the Clean Water Act. The act authorized the development of Comprehensive Conservation and Management Plans (CCMP) for estuaries of national significance. The Environmental Protection Agency has the lead in the program, while the U.S. Army Corps of Engineers is an active partner and participant in the development of the CCMPs.

The San Juan Bay National Estuary Program was initiated in fiscal year 1993. The bay has a variety of uses, and many demands are placed upon it. Jacksonville District is represented on the management committee.

As requested by the management committee, the District, with technical support from the U.S. Army Waterways Experiment Station (WES), provided a scope of work with time and cost estimates for the development of a numerical model for use as a tool in the assessment of potential alternatives to improve circulation and in the development of effective management plans for the estuarine system. As recommended by SJBNEP's management and policy committees and the San Juan Bay Estuary Program (SJBEP) office, an Interagency Agreement (IA) between the EPA and the District was executed April 1995, initiating model development and testing. The modeling efforts are being undertaken at WES with management through the District. The study is scheduled for completion in July 1999.

# Navigation Projects and Studies



*Puerto Nuevo Terminal at San Juan Harbor.*

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## Arecibo Harbor, P.R.

The harbor is on the north shore of Puerto Rico about 40 miles west of San Juan Harbor. The existing project, adopted by the River and Harbor Act of August 26, 1937, provides for construction of a stone breakwater 1,200 feet long, extending from Point Morrillos to Cocinera Rock; dredging an entrance channel 25 feet deep at mean low water and 400 feet wide, flared to 650 feet of its length to form a maneuvering area of the same depth and 900 feet wide, fronting the proposed deep water terminal.

The project was completed in 1944 at a cost of \$1,128,075, excluding \$288,000 of contributed funds. A deep water terminal, constructed by non-Federal interests, was completed in May 1952. Damaged sections of the breakwater were restored at a cost of \$1.7 million from November 1983 to January 1985 by placing 42,000 tons of armor stone and extending its length to 1,260 feet. A maintenance dredging contract will be awarded in FY-00. Total maintenance cost through September 30, 1995 was \$4,301,431.

Traffic in 1997 was 95,000 tons.

### Project Data

Authorizing Act	River and Harbor Act of 1937	
Cost	Through FY-95	
Federal	\$1,128,075	
Non-Federal	\$288,000	
Federal operation/maintenance costs to September 30, 1995	\$4,301,431	
Non-Federal operation/maintenance costs to September 30, 1995	\$0	
Total authorized Project length	0.3 miles	
Features:	Depth (ft)	Width (ft)
Entrance channel	25	650
Inner channel	25	400
Turning basin	25	900
Breakwater (length)	1,200	

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## Christiansted Harbor, St. Croix, U.S.V.I.

The harbor is on the north coast of the island of St. Croix, V.I., about 146 miles southeast of San Juan Harbor, P.R., and about 22 miles south of St. Thomas. The project authorization provides for an approach channel 25 feet deep at mean low water and 300 feet wide from deep water in the Caribbean Sea approximately 5,700 feet to a turning basin of the same depth, about 600 feet wide and 900 feet long. An economic restudy in 1957 of the 25-foot project found that project construction was not economically justified. The Chief of Engineers' report dated June 30, 1961, modified the authorized project to provide a 16-foot depth channel and turning basin and placed the 25-foot depth project in an inactive status. The 25-foot project was deauthorized by Congress in 1986. The 16-foot depth project was completed in 1963 at a cost of about \$303,317. Total operation and maintenance costs as of September 30, 1995, were \$58,595.

In 1997 traffic was 888,000 tons.

### Project Data

Authorizing Act	House document 771/80/2 of May 17, 1950	
Cost	Through FY-95	
Federal	\$303,317	
Non-Federal	\$0	
Federal operation/maintenance costs to September 30, 1995	\$58,595	
Non-Federal operation/maintenance costs to September 30, 1995	\$0	
Total authorized project length	1.25 miles	
Features	Depth (ft)	Width (ft)
Entrance Channel	16	300
Turning basin	16	600

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## Mayaguez Harbor, P.R.

The harbor is on the west coast of Puerto Rico, about 110 miles by water from San Juan Harbor. The project was authorized by the Public Works Administration on September 6, 1933, completed in 1934, and then adopted by the River and Harbor Act of August 30, 1935. The construction project provides for an approach channel 2,200 feet long to the deep water terminal 30 feet deep, 1,000 feet wide at the outer end, decreasing uniformly in width to 500 feet opposite the westerly end of the terminal, and continuing with the same distance of about 1,250 feet. Recent surveys indicate the need for maintenance dredging of the Federal channel. The existing project cost is \$168,903 for new work.

In 1997 traffic was 424,000 tons.

### Project Data

Authorizing Act	River and Harbor Act of 1935	
Cost	Through FY-95	
Federal	\$168,187	
Non-Federal	\$0	
Federal operation/maintenance costs to September 30, 1995	\$1,061,561	
Non-Federal operation/maintenance costs to September 30, 1995	\$0	
Total authorized project length	3,450 ft	
Features	Depth (ft)	Width (ft)
Entrance channel	30	500-1,000
Inner channel	30	500

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## Ponce Harbor, P.R.

The harbor is on the south-central coast of Puerto Rico, about 150 miles by water southwest of San Juan Harbor. The project was authorized by resolutions of the Senate and House Public Works Committees on October 1, 1976, and September 23, 1976, respectively, under provisions of Section 201 of Public Law 89-298. The project authorization provides for the following: a 600-foot-wide by 36-foot-deep channel from the Caribbean Sea to Ponce Harbor, thence a 400-foot-wide by 36-foot-deep channel into the harbor, and a 36-foot-deep irregular-



*Left: Aguadilla Harbor Breakwater Project.*



*Above: Crown Bay Channel, St. Thomas, U.S. Virgin Islands.*

shaped basin with a turning diameter of 950 feet; and deauthorization of the 18-foot project area outside the authorized project limits.

Construction dredging started in December 1988 and was completed in April 1989. Total project cost was \$3,066,975. Ponce municipality provided the non-Federal share of \$1.2 million. The Project provides deeper water access to new and proposed terminal development and permits deeper draft ships to use those facilities.. Total length of the project is 3.4 miles. The project benefit-to-cost ratio is 7.5 to 1.

The total Federal cost of work on the existing harbor to date is \$2,227,928 and total maintenance costs have been about \$1,779,270 through 30 September 1995.

The 1997 traffic was 948,000 tons.

<b>Project Data</b>	
Authorizing Act	Senate and House Resolution, 10/1/76 and 9/23/76 respectively, under Sec 201 of PL 89-298
Cost	Through FY-95
Federal	\$2,227,928
Non-Federal	\$274,068
Federal operation/maintenance costs to September 30, 1995	\$1,779,270
Non-Federal operation/maintenance costs to September 30, 1995	\$717,304
Total authorized project length	3.4 miles
Features	Depth (ft)    Width (ft)
Entrance channel	36                  600
Inner channel	36                  400
Turning basin	36                  950

### **Crown Bay Channel, St. Thomas, U.S.V.I.**

Improvements to the St. Thomas Harbor will provide deep water access to expanded terminal facilities recently built by the Virgin Islands Port Authority. The authorized project is modified to provide a channel to Crown Bay with project depths of 38 feet in the outer channel and 36 feet in the turning basin. PL 99-662 authorized the improvements to Crown Bay Channel. The total project cost for the NED Plan is \$8,920,000. This provides for a 29-foot turning basin and a 31-foot entrance channel, to include bulkhead replacement and dredging of berthing areas.

Traffic in 1997 was 383,000 tons.

<b>Project Data</b>		
Authorizing Act	Public Law 99-662 dated Nov 17, 1986, WRDA of 1986	
Cost	Estimated Cost	Thru
	of Project	FY-98
Federal	\$ 2,920,000	\$ 109,000
Non-Federal	\$ 5,370,000	\$ 0
Federal operation/maintenance costs to September 30, 1998		\$ 0
Non-Federal operation/maintenance		

costs to September 30, 1995		\$0
Total authorized project length		1.2 miles
Features	Depth (ft)	Width (ft)
Entrance channel	38	500
Turning basin	36	1200

### **San Juan Harbor, P.R.**

San Juan Harbor is located within the San Juan metropolitan area along the north coast of Puerto Rico. It is the island's principal port, handling over 75 percent of the Commonwealth's non-petroleum waterborne commerce and is the harbor on the north coast affording protection in all types of weather. Over 14 million tons of waterborne commerce have moved through the harbor annually since 1990.

The harbor deepening project, which was authorized for construction in 1986 by PL 99-662, would result in benefits derived from transportation savings for deeper draft vessel shipments.

The authorized project calls for deepening the Bar Channel to 48 feet and the harbor channels to various depths, generally up to 40 feet. The Sabana Approach would be added to the Federal project and the turning basins and wideners would be enlarged and deepened.

Preconstruction Engineering and Design was initiated in 1989. A ship simulation study was conducted and its results indicate that the extent of widening in interior channels can be reduced, which will result in significant reductions in the projects costs. In addition, it was found that the bar channel should be deepened from 48 feet to a stepped channel from 51 to 56 feet deep. A General Reevaluation Report (GRR) was completed in March 1994 containing recommendations on the revised scope of the project. Construction of navigation improvements began in March 1998.

The total construction cost of the GRR recommended project, including engineering/design and construction management is \$44 million. The Federal share of the current authorized project would amount to \$27.3 million and the non-Federal share would be \$16.6 million. Deepening of the cruise ship channel, San Antonia Channel, extension and anchorage Area E have been deferred because they are not currently economically justified.

The total cost for previous new work is estimated at \$13,744,968. The total cost of maintenance was \$21,531,047 through September 1995.

In 1997, 14,067,000 tons of commerce moved through the harbor.

<b>Project Data</b>		
Authorizing Act	Public Law 99-662 dated Nov 17, 1986, WRDA of 1986	
Cost	Estimated Cost	Through
	of Project	FY-95
Federal	\$43,000,000	\$13,744,968
Non-Federal	\$18,500,000	\$0

Federal operation/maintenance costs to September 30, 1995		\$21,502,135
Non-Federal operation/maintenance costs to September 30, 1995		\$0
Total authorized project length		8.6 miles
Features	Depth (ft)	Width (ft)
Entrance channel	51-56	800
Inner channel	32-40	250-800

### **Aguadilla Harbor, P.R.**

The harbor is located in the city of Aguadilla on the northwest coast of Puerto Rico approximately 32 miles west of Arecibo and 17 miles north of Mayaguez. The U.S. Army Corps of Engineers approved the project for construction on February 17, 1993, under the authority of Section 107 of the 1960 River and Harbor Act, as amended.

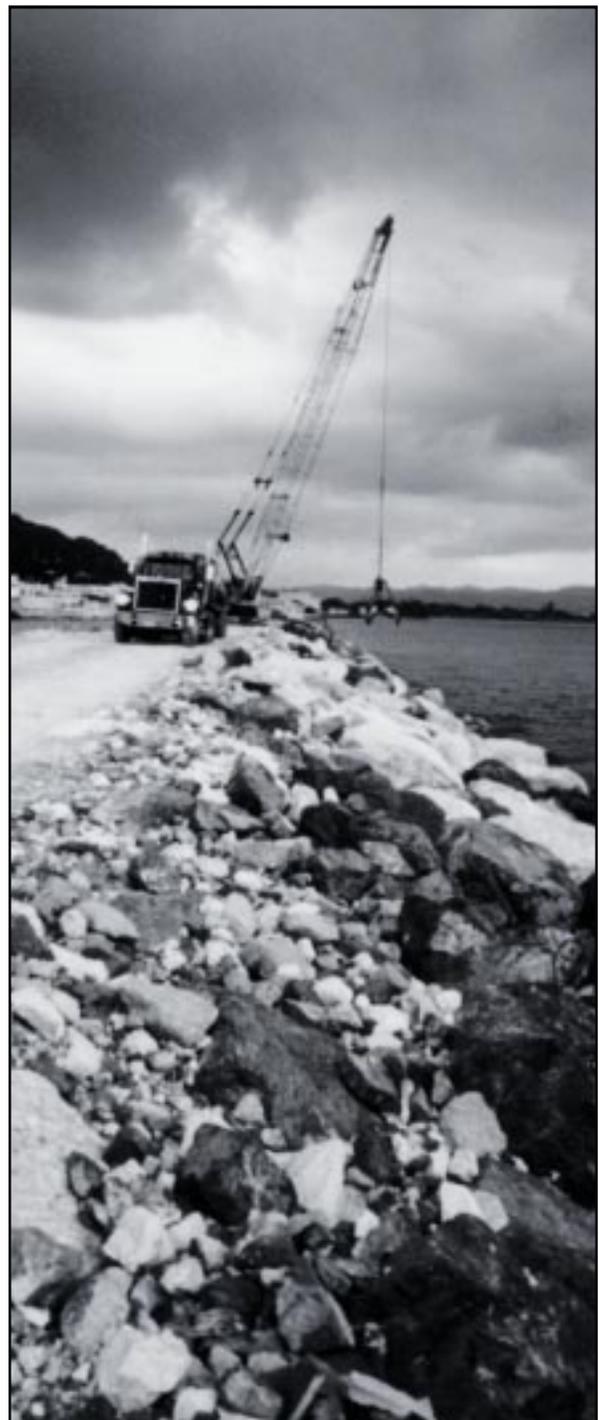
Local fishermen currently use small boats that can be easily hauled on shore for storage. This project provides a sheltered harbor and enables fishermen to use larger boats and modern technology to fish year round, thus significantly increasing their annual harvest. Project implementation involved the construction of a 970-foot long breakwater that created 7 acres of protected harbor.

The project provides for the following: an attached breakwater approximately 970 feet long with a 23-foot crown width and elevations ranging from 6 to 10 feet above mean low water with the breakwater extending out from shore in a southerly direction; a turning basin 125 feet wide by 125 feet long and 9 feet deep (mean low water) located east of the attached breakwater; an impoundment area 300 feet long by 300 feet wide by 15 feet deep (mean low water) adjacent to and south of the southern terminus of breakwater; and an entrance channel 150 feet wide by 9 feet deep (mean low water) extending from the 9-foot mean low water contour in the Caribbean Sea to the turning basin. No dredging work was initially required by the plan. Recreational features include a walkway on top of the breakwater.

Construction of the project was completed in July 1995 at a cost of \$4.5 million, of which \$1.6 million was the non-Federal cost. The non-Federal project sponsor is the municipality of Aguadilla. A maintenance dredging contract will be awarded in August 1999.

#### Project Data

Authorizing Act	Sect 107, 1960 River and Harbor Act as amended. Chief of Engineers approved report February 17, 1993	
Cost	Estimated Cost of Project	Through FY-95
Federal	\$3,435,000	\$2,956,000
Non-Federal	\$1,817,000	\$1,615,000
Federal operation/maintenance costs to September 30, 1995		\$0
Total authorized project length		0.2 miles
Features	Depth (ft)	Width (ft)
Entrance channel	9	150
Turning basin	9	125
Breakwater (length)		970



## Small Navigation Studies

Punta Tuna, Maunabo, P.R.	Determine feasibility of providing a breakwater to obtain a sheltered commercial fishing harbor.	The reconnaissance study phase is complete. The sponsor has elected to defer the initiation of the detailed study phase.
Buena Vista, Humacao, P.R.	Determine feasibility of providing a breakwater to obtain a sheltered commercial fishing harbor.	The reconnaissance study phase was completed in February. The feasibility study phase was initiated in May 1992. The study was terminated in December 1993 due to lack of economic feasibility.
Island of Vieques, P.R.	Determine feasibility of providing navigation features for a proposed port facility on the Island of Vieques.	The reconnaissance study phase was completed. The feasibility cost sharing agreement was signed in July 1993. Feasibility phase studies were initiated in September 1993 and terminated in December 1997 due to lack of economic justification.
Arroyo Harbor, P.R.	Determine feasibility of providing navigation features for an existing commercial fishing harbor.	The reconnaissance study phase was initiated but no funds are available for completion.

# Flood Control Project and Studies



*Rio de la Plata at Toa Alta, Puerto Rico*

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## Portugues and Bucana Rivers at Ponce, P.R.

This project was authorized by the Flood Control Act of December 30, 1970, as follows: Portugues Dam and Reservoir, Cerrillos Dam and Reservoir, and channel improvements at Ponce. The multiple-purpose project consists of enlargement of about 9.1 miles of channel (1.7 miles of high velocity concrete channel and 7.4 miles of earth channel with revetted side-slopes) and construction of two dams with uncontrolled emergency spillways. The project will provide essentially Standard Project Flood (SPF) protection, a dependable water supply for the city of Ponce and public recreational facilities for the lakes and channels.

The Cerrillos Dam is a zoned rockfill embankment approximately 1,555 feet long and 323 feet high with a crest elevation of 634.7 feet, mean sea level (m.s.l.). It has a crest width of 32.8 feet and required approximately 7 million cubic yards of fill. Its reservoir will provide 47,900 acre-feet of storage, of which 17,065 acre-feet would be for flood control and 25,200 acre-feet for water supply and water quality.

The Portugues damsite is located on the Portugues River approximately 3 miles from the city of Ponce. The proposed thin-arch dam will be approximately 1,505 feet long and 271 feet high with a crest elevation of 587.2 feet, m.s.l. It will have a crest thickness of 12 feet, a base thickness of 40 feet and will require approximately 247,500 cubic yards of concrete. Its reservoir will provide 25,467 acre-feet of storage, of which 8,626 acre-feet would be for flood control and 14,000 acre-feet for water supply.

The estimated water supply yield is 11.1 million gallons per day (m.g.d.) from the Portugues Reservoir and 22.0 m.g.d. from the Cerrillos Reservoir. The initial construction will construct a flood control only dam to a height of 219.6 feet. An additional 51 feet will be added when the need for water supply occurs. The channel works are about 97 percent complete. Construction of the Cerrillos Dam and Spillway was completed in the summer of 1991. Construction of the Portugues Dam began in 1995.

The non-Federal sponsor is required to provide all lands and relocations for the channels and reservoirs and to operate and maintain the project after completion. In addition, the non-Federal sponsor must reimburse the Federal Government for all costs allocated to water supply and for one-half of the separable costs allocated to recreation.

The estimated cost of new work is \$574.3 million which includes \$430.3 million in Federal funds, and a non-Federal cost of \$144.0 million. The sponsor for the project is the Puerto Rico Department of Natural and Environmental Resources.

Estimated annual benefits (October 1988) are as follows:

Flood Control.....	\$22,209,000
Water Supply.....	\$12,412,000
Recreation.....	\$ 1,088,000
Area Redevelopment.....	\$ 1,299,000
Total.....	\$37,008,000

Estimated annual costs, including interest and amortization, operation and maintenance, and major equipment replacement cost, total \$8,360,000.

Three day-use recreation areas on the Lower Ponce Channels are part of this project. They are: Ceiba Park, a mini-park in downtown Ponce; Constancia Park, at the confluence of the two river channels; and Bucana Beach Park, on the Caribbean, east of the mouth of the river. Ceiba Park was completed in 1988, and construction of Constancia park was completed in 1994. Construction on Bucana Beach Park is currently being scheduled.

Construction of the Cerrillos Dam was completed in 1992. Filling and monitoring operations continued until August 1997, until it was transferred to the sponsor for maintenance and operation. Construction of the five recreation sites at the Cerrillos Dam are being scheduled.

Foundation preparation work is underway at the Portugues Dam site. The left abutment has been prepared and test grouting is underway. A contract to prepare the right abutment was awarded in 1996. Completion of grouting and initiation of the main dam construction contract are scheduled for 1999 and 2001 respectively.

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## Rio Puerto Nuevo Flood Control Project, P.R.

Construction of the project was authorized in the 1986 Water Resources Development Act and evolved from the study completed in 1984. Engineering and design work was initiated in fiscal year 1987. Construction was initiated in August 1995. The first contract is scheduled for completion in 1999 at a cost of about \$40 million. The second contract was awarded in October 1998.

The proposed improvements will provide 100-year flood protection to a major portion of the San Juan Metropolitan Area by enlarging 11.2 miles of channel along Rio Puerto Nuevo and tributaries. Rectangular lined concrete channels will extend for 8.5 miles and an earthen channel with side slopes will extend 2.7 miles. Debris basins will be placed on the upstream end of channel improvements along Rio Puerto Nuevo and Quebrada Guaracanal.

The improvements will require modification of 25 bridges and replacement of five bridges. A mitigation plan includes replanting mangroves at a 1.5 to 1 ratio.

The estimated total cost of the project is \$429.7 million (\$322.1 Federal, \$107.6 non-Federal) with a benefit to cost ratio of 2.4 to 1. The non-Federal sponsor for this project is the Puerto Rico Department of Natural and Environmental Resources.

The recreational component of this project includes a bicycle/walking trail, benches, landscaping, overpasses, and foot bridges.



*Rio Grande de Loiza and tributary  
Rio Caguitas at debris basin PR-156.*

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### **Rio Guanajibo at Sabana Grande, P.R. (Sec. 205)**

Extensive flooding by the Rio Guanajibo affected many residential developments and industrial areas in Sabana Grande. The small flood control project, requested by the Mayor and the Department of Natural and Environmental Resources, involved raising the existing levee, lining its banks with filter cloth, and building a gabion revetment 1 foot thick along 2.8 kilometers.

The project was completed in 1989 at a cost of \$4.2 million.

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### **Rio Cibuco at Vega Baja, P.R. (Sec. 205)**

Most of the eastern and northern sectors of the town of Vega Baja are subject to flooding from the Rio Cibuco. The proposed project improvements would protect more than 600 families, the industrial park and numerous public facilities. Proposed improvements include levees with culverts and a detention area for interior drainage.

Project implementation included construction of the following flood control items: a 2,595 foot long levee in the eastern section of town; a 4,337 foot long levee in the northern section of town; and a 34.9 acre recreation area. In addition, PR Highway 688 was raised three meters to cross over the eastern levee and two meters to cross over the northern levee.

The non-Federal sponsor is the Department of Natural and Environmental Resources. Project construction was initiated in 1994 and was completed in 1996 at an estimated cost of \$3.7 million.

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### **Rio de la Plata, P.R.**

The Rio de la Plata basin drains an area of 624 square kilometers. Heavy rains combine with steep slopes to produce heavy discharges over short durations. Flooding affects more

than 12,000 families and numerous public buildings and facilities in the coastal area. Between 1974 and 1993, the area has been declared a flood disaster area by the President six times.

The project was authorized by the 1990 Water Resources Development Act. The authorized improvements will provide SPF levee protection to Dorado and Toa Baja with 100-year channel protection to Toa Alta. Preconstruction Engineering Design (PED) has been initiated and was completed in 1994. The project cost sharing agreement was executed in June 1995. Construction is expected to begin in FY00.

The total cost of this Department of Natural and Environmental Resources sponsored project is currently estimated at \$96.7 million. The Federal share of that total is \$63.3 million and the non-Federal share is \$33.4 million.

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### **Rio Grande de Loiza, P.R.**

Flooding along the Rio Grande de Loiza and its main tributaries Rio Cagintas, Rio Bairoa and Rio Gurabo affect some 4,145 families, 26 industrial plants, over 325 commercial establishments, and 92 public buildings and facilities in the vicinity of the city of Caguas and the town of Gurabo. Expected average annual equivalent damages are estimated at \$18.6 million.

This project was authorized in the 1992 Water Resources Development Act and evolved from a study completed in 1991. Preconstruction Engineering and Design (PED) work was initiated in October 1991 and was completed in September 1996. Execution of the Project Cost Sharing Agreement and initiation of land acquisition by the sponsor are scheduled for fiscal year 2001. Construction is anticipated to begin in fiscal year 2003.

The project would provide 25-year protection to areas adjacent to Rio Cagintas and 100-year protection from flooding of Rio Bairoa, Rio Gurabo, and Rio Grande de Loiza. It would include the construction of 4.5 miles of lined channels, 0.6 mile

of levees, and two debris basins for Rio Cagintas and Rio Bairou and 3 miles of levees along Rio Grande de Loiza and Rio Gurabo.

The total estimated cost of the project is \$186.7 million and the benefit-to-cost ratio is 1.9 to 1. The Department of Natural and Environmental Resources, the sponsor for this project, would be responsible for paying \$48.4 million of this total.

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### **Savan Gut, St. Thomas. U.S.V.I. (Sec.205)**

The Savan Gut channel runs through a residential community and a historic business and shopping district of Charlotte Amalie. Problem flooding has occurred at the Jane E. Tuitt Elementary School and the business district south of Back Street.

In response to a request from the Virgin Islands Department of Public Works, the Corps conducted a flood control study under the authority of Section 205 of the 1948 Flood Control Act, as amended. Work was divided into two phases. Phase I covers the area between Charlotte Amalie Harbor and Back Street, along Gutts Gade. Construction of Phase I was initiated in June 1987 and completed in December 1990 at a cost of \$5.4 million. Work consisted of the construction of 844 linear feet of concrete box culvert that ranged from 3-12 feet deep by 10-20 feet in width.

Plans and specifications for Phase II have been completed. The Sponsor is procuring necessary real estate. Primary features of Phase II include: 1,520 feet of concrete box culvert which will extend just north of the Jane E. Tuitt Elementary School, a catchment basin, three drop structures, replacement of the Antoni Strade Bridge, a trapezoidal earth channel north of the new bridge, and a linear park along the top of the concrete box culvert. The estimated cost of Phase II is \$7.7 million. Construction is scheduled to begin in 2000.

Construction of the project runs through the business district and involves historic structures. The Phase I contract provided for seismographic monitoring of the sheetpile driving operations and archaeological on-site monitoring to ensure recovery of any archaeological resources. Similar monitoring will be required during Phase II, since the Phase II work continues through two Historic Districts.

The 1990 Water Resources Development Act increased Federal participation for this project to \$10 million. The non-Federal sponsor is the Virgin Islands Department of Public Works. The Federal Highway Administration also participated in the funding of Phase I.

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### **Turpentine Run, St. Thomas, U.S.V.I.**

The Turpentine Run channel is located east of the Charlotte Amalie, the capital, in the Nadir region of St. Thomas. High discharges from Turpentine Run have caused flooding problems within the Nadir development.

In response to a request from the Virgin Islands Department of Public Works, the Corps conducted a flood control study under the authority of Section 205 of the 1948 Flood Control Act, as amended. The recommended plan calls for the replacement of the existing concrete channel with a new channel having greater capacity. Improvements will begin at the north end of the Nadir development and end at a discharge point at Mangrove Lagoon. The non-Federal sponsor will be replacing the Bovoni Road bridge in conjunction with this project.

Plans and specifications are complete. The estimated cost is \$7.5 million with Federal participation limited by law to a total of \$5 million. Construction is on hold pending funding approval from Headquarters.

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### **Estate Mon Bijou, St. Croix, U.S.V.I. (Sec. 205)**

This is a small flood control project funded under the Corps' Continuing Authorities Program with a total cost of approximately \$5.7 million. The Assistant Secretary of the Army (Civil Works) granted construction approval November 26, 1991. Previous concerns expressed by the Washington Level Review Center over the flood damages shown in the report have been resolved. Plans and specifications (P&S) have been completed for the channel. In March 1993, the local sponsor provided design funds for incorporation of bridges, cattle crossing, and farm watering pond into the P&S. All real estate requirements for these features including the channel have been identified and provided to the sponsor. An award of a construction contract is currently unscheduled due to financial difficulties of local sponsor. However, recent bond sales have resulted in funding becoming available to the sponsor to once again proceed with acquisition of real estate necessary to construct this project.

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### **Rio Grande de Arecibo at Arecibo, P.R.**

The town of Arecibo is located on the north coast of Puerto Rico approximately 40 miles west of San Juan. The drainage basin covers 272 square miles characterized by steep mountains and the associated high velocity runoff. The worst flood of record occurred in 1899 and resulted in the loss of over 500 lives. Extensive floods occurred in May and October 1985. Although they were estimated at 10-year events, most of the urban area was inundated with over 3 feet of water. This area was also affected by the January, 1992, storm with several highways damaged. The recommended project includes a floodwall and 2 miles of levee along the Arecibo River; channel improvements, a plug, and channel diversion on the Santiago River; and a short levee on the Tanama River.

Total estimated project cost is \$23.1 million: \$12.5 million Federal cost and \$10.6 million non-Federal cost. This project was authorized in the 1996 Water Resources Development Act. PED is scheduled for completion in September 1999. Execution of the PCA and initiation of land acquisition by the sponsor are scheduled for fiscal year 2000. Construction is anticipated to begin in year 2002.

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## **Rio Guanajibo at Mayaguez, Hormigueros and San German, P.R.**

The Rio Guanajibo Basin, in the southwestern part of the island, drains into the Mona Passage and includes portions of the municipalities of Mayaguez, Cabo Rojo, Hormigueros, San German, Maricao, and Sabana Grande with a population of over 225,000. Total catchment area is 369 square kilometers. There are no major water resources development works in the watershed. Discharges of the Rio Guanajibo and its tributaries represent a serious threat to life and property in the towns of San German, Hormigueros, Mayaguez, and Cabo Rojo. These towns experienced devastating flooding during the passage of tropical storm Eloise in September 1975. The recommended project includes levees, floodwalls with mitigation measures in the southern portion of Hormigueros and Mayaguez, and channel improvements for the town of San German.

Total estimated project cost is \$32.4 million: \$21.2 million Federal cost and \$11.2 million non-Federal cost. Preconstruction engineering and design (PED) was initiated in June 1997.

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## **Rio Anton Ruiz at Punta Santiago, P.R. (Sec. 205)**

The Rio Anton Ruiz basin drains an area of 15.4 square miles into the Caribbean Sea. Topography of the basin is very steep in the upland section, while the area near the coast is flat, including the partially submerged lagoon areas and mangrove (*Pterocarpus*) forests. Punta Santiago, also known as Playa de Humacao, is a densely urbanized area with a population of about 10,000 inhabitants. There are over 3,100 residences, and 95 commercial and public facilities. The project involves building approximately 2.1 miles of levees and interior collector channel around the community and a diversion channel to provide the SPF level of protection. The plan also includes wetlands mitigation. The project will cost about \$3,918,000.

Construction of this project is scheduled to begin in FY00.

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## **Rio Grande de Manati at Barceloneta, P.R.**

The Rio Grande de Manati rises at an elevation of about 800 meters above mean sea level in the central region of Puerto Rico. It flows generally northwest about 90 kilometers and discharges into the Atlantic Ocean about 55 kilometers west of San Juan. The Rio Grande de Manati watershed covers a total of 202 square miles. The overflow of this river results in frequent severe flooding of the entire town of Barceloneta (population 6,000 people). Flood waters during the floods of 1985 reached over one meter throughout most of the town and resulted in flood damages of over \$2.5 million. The recommended project consists of 5,200 meters of levee around the town of Barceloneta, and includes channel diversion and interior drainage facilities.

At the request of the sponsor, specific authorization was sought as the scope of this project exceeded the limits of the Continuing Authorities Program. Authorization was obtained in WRDA-99. Plans and specifications were initiated in May 1995 and approved in September 1997. Total estimated project cost is 14.5 million: \$9.5 million Federal cost and 5.0 million non-Federal cost.

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## **Estate La Grange, St. Croix, U.S.V.I.**

The study area lies in the Estate La Grange suburb of Frederiksted, St. Croix. The La Grange Gut Basin is located in the western part of the island of St. Croix, is 7.5 kilometers long and covers an area of 13.5 square kilometers. Several small streams join La Grange Gut in the lower part of the basin. Flooding along La Grange Gut is a recurring problem: every few years there is significant flooding in the area due to low pressure weather fronts, storms and hurricanes. The recommended project consists of channel improvements to the lower portion of La Grange Gut, a levee and interior drainage canal to the town of Frederiksted, St. Croix. Plans and Specifications were completed in 1997. Construction is on hold pending Headquarters funding approval.

The estimated project cost is \$2,034,000.

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## **Juan Mendez, San Juan, Puerto Rico Sec. 208 (Snagging and Clearing Project)**

The Juan Mendez Canal is a small drainage system in Metropolitan San Juan that empties adjacent to the Martin Pena Canal into San Jose Lagoon. A large shoal in the mouth of the canal block the flow and causes frequent major flooding to about 290 residential and commercial structures in the vicinity. The plan calls for excavating 13,000 cubic yards of material from a 1,400 foot long stretch of earth channel. All material, once sufficiently dried, was to be placed in a local landfill.

The construction contract was awarded in July 1997 and was completed in November 1997. The total cost of the project was \$435,300 of which \$311,500 was Federally funded.



*Juan Mendez Canal, San Juan, Puerto Rico.*

## Other Flood Control Studies

### PUERTO RICO

LOCALITY	PURPOSE	APPROXIMATE DATE OF COMPLETION
Rio Nigua at Salinas, P.R.	Provide facilities for flood control protection for the entire town of Salinas and adjacent communities.	Feasibility study completed 1996. Plans and specifications are scheduled for completion in FY00.
Rio Matilde at Ponce, P.R.	Provide improvements for protection against floods to the western portions of Ponce.	Pending Congressional funding to initiate reconnaissance study.
Rio Bayamon at Bayamon, P.R.	Provide improvements to flood control channel for protection against floods to largest residential developments in Metropolitan area of Bayamon.	Pending Congressional funding to initiate reconnaissance study.
Rio Yaguez at Mayaguez, P.R.	Provide improvements for protection against floods to large portions of the town of Mayaguez.	Pending Congressional funding to initiate reconnaissance study.
Rio Nigua at Arroyo, P.R.	Extensive flooding by Rio Nigua has affected residential and commercial developments in the area.	Pending Congressional funding to initiate reconnaissance study.



*Rio Grande de Manati at Barceloneta, Puerto Rico.*

## Small Flood Control Studies (Sec. 205)

### PUERTO RICO

LOCALITY	PURPOSE	APPROXIMATE DATE OF INITIATION OR COMPLETION
Rio Fajardo, Fajardo, P.R.	Provide protection to more than 800 families and 62 commercial facilities along the southern portion of Fajardo from flooding problems caused by Rio Fajardo.	The DPR was completed in 1995. Plans and Specifications are scheduled for completion in FY00.
Rio Guamani, Guayama, P.R.	Frequent overflow of Rio Guamani results in extensive damages to the town of Guayama affecting more than 1,000 families.	DPR completed in 1996. Plans and Specifications was initiated in FY98.
Rio Descalabrado, Santa Isabel, P.R.	Provide flood protection to more than 500 families and 15 commercial facilities in the vicinity of Santa Isabel.	DPR completed in 1996. Plans and Specifications will be initiated in FY01.
Rio Loco Guanica, P.R.	Provide protection to more than 1,300 families, 130 commercial establishments, and 26 public facilities that are currently subject to flooding.	DPR completed in 1996. Report is under revision and scheduled for completion in DEC 1999.
Rio El Ojo de Agua, Aguadilla, P.R.,	Provide protection to about 100 commercial and residential structures in the downtown area of Aguadilla, currently subject to frequent flooding from the Rio El Ojo de Agua.	DPR scheduled for completion in 1999.
Rio Culebrinas, Aguada and Aguadilla, P.R.	Provide protection to more than 600 houses and 130 commercial and public facilities that currently experience flooding from the overflow of Rio Culebrina and Cano Madre Vieja.	DPR scheduled for completion in 1999.
Rio Cano La Cacula, Aguadilla, P.R.	Provide protection to more than 170 commercial and residential structures currently within the Cano La Cacula flood plain.	A negative reconnaissance report was completed in 1993.
Rio Jacaguas	Flooding along Rio Jacaguas causes damage at the communities of Arus, Manzanilla and Otra.	A negative reconnaissance report was completed in 1995.
Rio Cidra at Adjuntas, P.R.	Provide flood protection to more than 180 families and 30 commercial facilities in the town of Adjuntas.	A negative reconnaissance report was completed in 1995.
Rio Culebra at Aguada, P.R.	Provide flood protection to more than 350 families and 55 commercial facilities in the town of Aguada.	Initiated reconnaissance report in 1995. Report completion pending Federal funding.
Rio Grande de Patillas at Patillas, P.R.	Provide flood protection to more than 140 families and 110 commercial facilities in the town of Patillas.	Reconnaissance report completed in 1999. DPR is scheduled to be initiated in FY00.
Rio Yauco at Yauco, P.R.	Provide flood protection to more than 265 families and 85 commercial facilities in the town of Yauco.	A negative reconnaissance report was completed in 1995.

**Small Flood Control Studies (Sec. 205)  
U.S. VIRGIN ISLANDS**

<b>LOCALITY</b>	<b>PURPOSE</b>	<b>APPROXIMATE DATE OF INITIATION OR COMPLETION</b>
Estate La Grange, St. Croix U.S.V.I.	Large flood peaks cause extensive and frequent damages to the north section of Frederiksted due to inadequate flood control facilities.	A DPR was completed in 1993.
Sototown, St. Thomas U.S.V.I.	Reduce flooding problems in the Sototown area.	Reconnaissance study was completed in 1994.

# Shore Protection Projects



*Lindbergh Bay, St. Thomas, U.S. Virgin Islands*

## El Tuque Beach P.R. (Sec. 103)

El Tuque Beach is located on the south coast of Puerto Rico about 5 miles west of Ponce. Continued shore recession threatened park facilities and reduced available beach space. Municipal officials requested a beach study under Section 103 of the 1962 River and Harbor Act for the area to determine corrective measures needed and the degree of possible Federal aid.

The project was completed in December 1984 at a cost of \$1,020,000. Construction work commenced August 1982 and consisted of placing 60,000 cubic yards of sandy material on a 2,900-foot offshore breakwater.

### Project Data

Authorizing Act	Authorized by the Chief of Engineers Dec 1979 under Sec 103 of the River and Harbor Act of 1962		
Cost	Through FY-95		
Federal	\$1,396,730		
Non-Federal	\$405,519		
Federal operation/maintenance costs to September 30, 1995	\$0		
Non-Federal operation/maintenance costs to September 30, 1995	\$0		
Features	Width (ft)	Length(ft)	Initial Fill
Protective Beach	50	1,900	60,000 (cu. yd.)
Groins (3)	---	110-160	2,865 (tons stone)
Breakwater	---	750	18,200 (tons stone)

## Punta Salinas, P.R. (Sec. 103)

The Punta Salinas Peninsula was transferred to the Commonwealth in 1972, with minimum beach facilities developed by the United States Navy years ago. Advanced erosion of its east and west shores threatened to breach the peninsula from the east. Local officials requested maximum Federal aid under Section 103 authority in beach improvements needed to protect the park and to increase recreational use of the beaches. The Punta Salinas Beach Study was completed in 1978, and the project was approved in September 1979. Work involved placing 58,000 cubic yards of sand on the beach, construction of a 250-foot anchor groin, and a 2,500-foot armor stone revetment. Construction of a second groin at the southern end of the beach fill was deferred until a need is demonstrated. The non-Federal sponsor, the Puerto Rico Recreation Development Company, provided the required 30 percent non-Federal share of funding.

The project was completed in October 1983 at a cost of \$1,283,511.

### Project Data

Authorizing Act	Authorized by the Chief of Engineers Sept 4, 1979 under Sec. 103 of the River and Harbor Act of 1962		
Cost	Through FY-95		
Federal	\$923,511		
Non-Federal	\$360,000		
Federal operation/maintenance costs to September 30, 1995	\$0		
Non-Federal operation/maintenance costs to September 30, 1995	\$0		
Features	Width(ft)	Length(ft)	Initial Fill
Protective Beach	140	1,400	58,000 (cu. yd)
Groins (2)	----	250	10,500 (tons stone)
Revetment	----	2,500	5,500 (tons stone)

## Pinones, ( Highway 187), Puerto Rico

The Corps originally performed emergency shoreline protection for about a one half mile stretch of coastline that had been damaged at a cost of \$359,993. Continued attack from storm surge and waves have left Highway 187 in the Pinones area flooded and badly damaged several times yearly. During these periods a local school and surrounding neighborhoods are isolated. This highway also serves as a main evacuation route. The development of a section 103 shore protection project was expedited at the request of the Puerto Rico Department of Transportation. The construction contract was awarded in September 1997 and will be completed in 1999. The project consists of elevating a one mile length of highway in the Punta Maldnado area and armoring its seaward slope to protect it from wave attack. Also included is the creation of 0.2 acres of mangrove habitat to mitigate permanent losses as a result of project construction.

### Project Data

Authorizing Act	Authorized by the Chief of Engineers 1 July 1997 under Sec 103 of the River and Harbor Act of 1962		
Cost	Estimate Cost	Through	
	of Project	FY-97	
Federal	\$2,000,000	\$669,000	
Non-Federal	\$5,404,000	\$240,000	
Federal operation/maintenance costs to September 30, 1995	\$0	\$0	
Non-Federal operation/maintenance costs to September 30, 1995	\$10,000	\$0	
Features	Width(ft)	Length(ft)	Initial Fill
			(cu. yd.)
Elev. 2-lane Hwy	40	5,530	114,000
Armor stone	varies	4,828	40,000

**Cyril E. King Airport Access Road,  
St. Thomas, U.S.V.I.**

The project provides protection to 800 feet of the King Airport access road at Lindbergh Bay; St. Thomas, U.S.V.I., by the construction of a stone revetment to Elevation +7.5 m.s.l. The revetment will consist of two layers of fairly uniform armor stone (with a median weight of 800 pounds) over a foot thick layer of bedding stone and filter fabric. The remnants of structures were cleared from the site prior to construction.

The project was approved for construction in October 1992. Construction began in 1993 and completed in April 1994.

**Project Data**

Authorizing Act	Authorized by the Office of the Chief of Engineers Oct 2, 1992 under Sec 14 of the River and Harbor Act of 1946		
Cost	Estimated Cost	Through	
	of Project	FY-95	
Federal	\$500,000	\$500,000	
Non-Federal	\$0	\$0	
Non-Federal operation/maintenance costs to September 30, 1995		\$0	
Features	Width(ft)	Length(ft)	Quantity
Protective Revetment	35	800	5,500 (tons stone)

**Barrio Barrero, Rincon, P.R.**

A seawall protecting the municipal road was damaged by storm action and was susceptible to possible failure. An emergency shoreline protection project was initiated to restore the structural integrity of the seawall. Work consisted of repairing 62 lineal feet of seawall and planting protection stone along 100 feet of the seawall. The project was completed in January 1987, at a total cost of \$269,359 with the municipality of Rincon providing the non-Federal share of \$22,000.

**Project Data**

Authorizing Act	Authorized by the Office of the Chief of Engineers Aug 13, 1985 under Sec 14 of the River and Harbor Act of 1946		
Cost	Through FY-95		
Federal	\$247,359		
Non-Federal	\$22,000		
Federal operation/maintenance costs to September 30, 1995	\$0		
Non-Federal operation/maintenance costs to September 30, 1995	\$0		
Features	Width(ft)	Length(ft)	Quantity
Rehabilitate Seawall	4	160	150 (tons stone)



*Highway 187 construction, Pinones, Puerto Rico*

# Small Shore Protection Studies

LOCALITY	PURPOSE	APPROXIMATE DATE OF COMPLETION
Boca de Cangrejos, P.R. (Isla Verde Beach)	Isla Verde public beach has experienced erosion that also endangers Highway 187.	The final Detailed Project Report was completed in February 1993. Shortly thereafter, the Commonwealth Dept. of Transportation raised the bridge and constructed a revetment for the HW187 bridge crossing at Boca de Cangrejos. The Corps and the Commonwealth concurred that the study be terminated.
Vega Baja Beach Vega Baja, P.R.	Erosion has reduced the available recreational beach and has threatened portions of Highway 686.	Draft Detailed Report was completed in April 1991. The study was completed in 1992. A recommendation was made to convert the study to a Congressionally authorized study due to the scope of the problem. Funds were received in March 1998 to re-initiate the study.
Patillas, P.R.	Site inspection revealed an erosion problem along 1.2 miles of shorefront along Coastal Highway 3. DOT has developed a plan to relocate the road.	Reconnaissance Report was completed in 1991. The study was terminated in 1992.
Northside Drive Frederiksted, St. Croix, U.S.V.I.	Site inspection revealed an erosion problem occurring along Northside Drive. Insufficient economic justification exists for Federal participation.	Reconnaissance Report was completed in 1991. The study was terminated in 1992.

# Support for Others Program



*Aqua-Park in Fort Buchanan, Puerto Rico*

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**Department of Defense (DOD), Defense Environmental Restoration Program (DERP)**

The purpose of the DERP program is to provide for the environmental restoration of currently active DOD facilities or formerly used defense sites (FUDS). With over 700 FUDS properties, Jacksonville District has the largest program of its type in the southeast. Our personnel are busy identifying and managing the remediation of FUDS sites throughout Florida, Puerto Rico and the U.S. Virgin Islands. The FY 99 DERP-FUDS program is currently estimated at nearly \$3 million.

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**Department of Defense (DOD), Department of the Army – Ft Buchanan, Puerto Rico**

Since the end of the Spanish American War, the Corps of Engineers has had a continuous presence in Puerto Rico. Historically, one of our major customers on the island has been Ft. Buchanan – one of the Army's most strategic bases in the Caribbean. For FY 99, Jacksonville District is completing work at the Community Club Center, the Golf Course Club House, and facilities for the relocation of the U.S. Army South from Panama to Ft. Buchanan. Design and construction for the total FY 99 program at Ft Buchanan is expected to exceed \$13 million.

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**Department of Housing and Urban Development (HUD), Modernization and Development Program.**

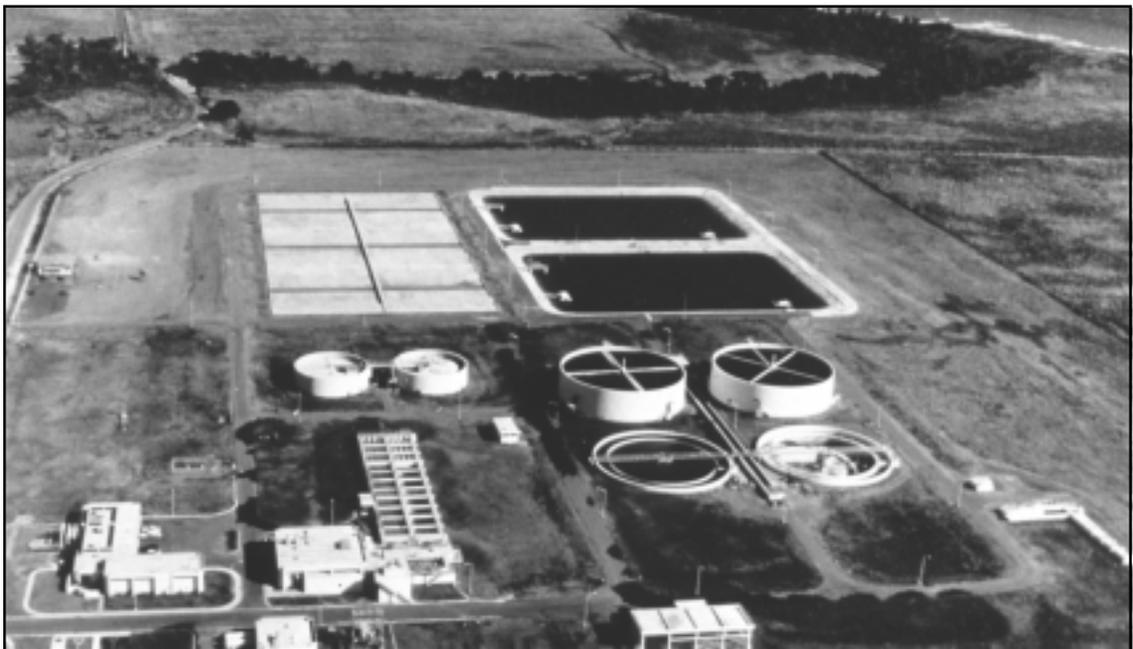
The Corps provides support to HUD via Modernization and Development Programs. The Corps performs physical inspections, contract administration reviews, drawing and specification reviews and final inspections of HUD renovation grants with local Public Housing Authorities. Our projections for the HUD program in FY 99 are \$318,000 in Puerto Rico and \$110,000 in Florida.

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**Department of Housing and Urban Development (HUD), HUD-VIHA Program.**

A Memorandum of Agreement was entered in April 1991, between the U.S. Department of Housing and Urban Development (HUD), the Virgin Island Housing Authority (VIHA), the Federal Emergency Management Agency (FEMA) and the Corps of Engineers (COE) for rehabilitation work at public housing sites in St. Croix. Work involves rehabilitation of some 561 units at the following four housing sites: Basin Triangle, Marley Homes, John F. Kennedy and Williams' Delight. The Corps' services include preparing the design and awarding and managing the construction contracts.

Funding for this work is provided by FEMA for all the damage related to Hurricane Hugo and by HUD for modernization and rehabilitation in public housing projects. A supplement to this agreement was concluded to include work at the Louis E. Brown public housing site. All work has been completed except for the JFK Terrace public housing site, which is scheduled to be complete in 1999. The FY 99 program is expected to be \$466,000.



*Guayama wastewater treatment plant, Guayama, Puerto Rico (EPA Construction Grants Program)*

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## Department of Interior (DOI), National Park Service (NPS)

Jacksonville District completed restoration work on the El Morro Fortress located in San Juan, Puerto Rico, during FY 97. Demolition of the Armed Bunker at El Morro is scheduled for Design and Construction in the near future. Flood control work at the Fort Caroline National Park in Jacksonville, FL is ongoing. FY 97 expenditures for these projects were \$2.7M. The estimated workload for FY 98 is \$300K. SAJ also supports NPS at the Everglades National Park (ENP) in Florida on modified water deliveries. The plan of improvements consists of structural modifications and additions to the existing project required to enable water deliveries for the restoration of more natural hydrologic conditions in the ENP. FY 98 expenditures were approximately \$11.5M.

This project consists of the restoration and protection of the San Juan National Historic Site, located in the city of San Juan, P.R. The site includes the Spanish-built San Cristobal Fortress (3 bastions); coastal walls (4 bastions); the city walls (6 bastions); Casa Blanca, a palatial complex built for Juan Ponce de Leon, first governor of Puerto Rico under Spain; and El Morro, the oldest and most strategic of the fortresses that formed San Juan's defense system.

El Morro occupies the headlands at the harbor entrance, rising some 140 feet above the sea. Its mission was to close the harbor entrance with its firepower. Construction began in 1539 (81 years before the Pilgrims landed at Plymouth) and, as it stands today, the fortress was finally completed between 1775 and 1787. The remaining fortifications extend to the south along the bay from El Morro to the San Juan Gate and eastward to their present termination at San Juan Bastion.

The San Juan National Historic Site is administered by the National Park Service. The fort and historical area were included in the 1984 list of World Heritage Monuments and Structures of United Nations Educational, Scientific and Cultural Organization (UNESCO).

In October 1974, Congress authorized the Secretary of Interior to conduct studies, in cooperation with the Secretary of the Army, to determine the cause and extent of damage to the historic structures of San Juan National Historic Site. Extensive investigations in response to this congressional charge have been undertaken for the National Park Service by the Corps of Engineers. The structures have suffered from erosion and wave action over the centuries. Some repairs have been made in the past to portions of the walls, but the effort was only to alleviate localized problems. The main causes of the damages have been determined to be erosion due to direct wave attack and erosion of sand layers between rock layers causing recession of the shoreline and formation of caves, which in some cases extend underneath the walls of the fort structures.

The initial construction contract (September 1977 to August 1978) provided for emergency protection for cavities under Santa Elena Bastion. Cavities were filled with rock and con-

crete, a collapsed section of wall foundation was repaired and resurfaced with matching stone, and stone revetment was constructed around the bastion for protection against future erosion and undermining of the walls. Construction also included emergency filling with concrete of a large cave under the north wall of El Morro. Contract cost was \$898,000.

The second contract (October 1978 to January 1981) consisted of a continuation of the stone revetment, foundation treatment pressure grouting, and construction of an access trail below the city walls, and included filling two large caves at La Princesa with concrete to protect the bastion walls from possible failure. Contract cost was \$2.8 million.

The third contract (February 1979 to September 1980) consisted of construction of retaining walls and slope protection of the north slope of El Morro. This contract was modified to fill a huge cave, which had developed on the lower north slope of El Morro contiguous to the blowhole. Contract cost was \$870,000.

The fourth contract (May 1981 to January 1983) included Construction of several concrete gravity retaining walls at La Princesa, construction of 600-foot-long concrete toe wall along the base of San Cristobal's sea walls below Santa Teresa, construction of foundation projection with concrete filled grout bags around Devil's Sentry Box at San Cristobal, and filling several caves and undermined areas with concrete along the shoreline between La Princesa and San Cristobal. This contract also included geotechnical exploration and excavation behind the wall at Casa Rosa Scarp where some movement of the existing fort wall has occurred. Contract cost was \$1.6 million.

The fifth contract (November 1983 to November 1986) involved constructing at Casa Rosa Scarp, a pile and panel retaining wall with tic backs, and a concrete wall facing attached to the back sides of the fort wall and support by cast-in-place concrete piles. The space between the retaining wall and the wall facing was spanned by voided precast slab units covered with fill and sod. Work included restoring damaged counterforts with the wall facing. Contract cost was \$878,420.

The sixth contract (November 1984 to April 1985) entailed construction of approximately 500 feet of stone revetment between Santa Elena Bastion and the south end of El Morro West Wall, and completing the access trail at Casa Rosa fort wall. The work included sealing exposed sand layers along El Morro North Wall, construction of approximately 300 feet of concrete facing along the vertical cliffs of El Morro West Wall I, filling several caves and cavities with concrete, and providing a system of rock bolting to stabilize the existing rock layers. Contract cost was \$1,684,760.

The seventh contract (July 1986 to September 1988) consisted of a stockpiling of approximately 1 16,000 tons of stones of different weights ranging within 0.35 ton to 34.75 tons. These stones were used for the construction of El Morro Point Breakwater. Construction contract cost was \$6.8 million.

The eighth contract (September 1987 - October 1991) was completed in October 1990. This contract work consisted primarily of construction of a breakwater around El Morro Point, with a stone revetment extending from San Fernando Bastion to north of San Antonio Bastion. The 750 foot long breakwater was built 300 feet from the shoreline and protrudes 2 feet above the water surface. This contract also included filling voids and caves with concrete, and caulking and grouting open seams. Construction contract cost was \$9.3 million.

The last project consisted of protective works along the El Morro West Wall, where active erosion was taking place. Work in this area consisted of construction of a stone revetment along the toe of the cliffs, construction of a sheet pile wall to protect the historic features along the top of the cliffs, and shot-crete facing with rock anchors to stabilize the existing sheer cliff. This work stabilized and protected the shoreline and cliffs. Contract work also included restoration and protection of the Floating Battery and Honeymoon Cottage and slope protection at Devil's Sentry Box and San Sebastian Bastion. The project was completed in December 1997.

The sponsor has recently requested the Corps to assist in demolition and removal of the radio bunker located in the dry moat at El Morro.

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### **Department of Justice (DOJ), Immigration and Naturalization Service (INS)**

In December 1996, the INS asked the Corps of Engineers to propose a new business strategy and relationship designed to bring unparalleled support to INS in the planning, programming, design, and construction of INS facilities. The Corps succeeded in winning this mission in competition with General Services Administration, who submitted a similar proposal. The INS Service Center is located at the Fort Worth District and serves as INS's gateway to the Corps, allowing INS a single point of contact for their program management. The Center is responsible for representing the interests of INS within the Corps, for determining the best source of project execution among Corps Districts, and ensuring that the project is injected into the executing District's project management system. The Center tracks projects, with regards to both physical and financial status, provides periodic reports to INS, and serves as liaison between INS and the local Districts.

Jacksonville District provided support to the INS at Ramey, Puerto Rico, with emergency roof repairs and support building construction. We also awarded a site preparation contract at the Krome (Miami, Florida) Detention Center. For FY 99, we are continuing work at the Krome Center with the scheduled advertisement of an \$8 million high security dormitory. The total expenditures scheduled for FY 99 are \$6.1 million.

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### **Department of Transportation (DOT), Federal Aviation Administration (FAA)**

During FY 98, the Corps executed environmental compliance and occupational safety and health assessments for all nine FAA regions. Data was gathered and analyzed using a software program written by the Corps, design/construction contracts were managed, USTs were removed and replaced, contamination was cleaned up, PCB and asbestos surveys and abatement projects were conducted, and landfills were closed. Jacksonville District recently completed the upgrade of underground storage tanks at various locations throughout Florida, Puerto Rico and the U.S. Virgin Islands. We are currently working with FAA to schedule additional work in FY 99.

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### **U.S. Coast Guard (USCG)**

Jacksonville District continues to support Coast Guard facilities throughout Florida and the Caribbean through construction of fuel storage tank, office and pier facilities and dredging of access channels and turning basins. Maintenance dredging at Bayoro Harbor, Florida, was completed in FY 98. FY 99 expenditures are estimated at \$500K.

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### **Environmental Protection Agency (EPA), Brownfields**

Brownfields are a new initiative, which began in FY 97. This program reviews underutilized properties in urban settings that are not being redeveloped due to the actual or perceived presence of environmental contamination. In FY 98, Jacksonville District provided Brownfield guidance to the cities of Clearwater, Jacksonville, Miami and Puerto Rico Industrial Development Company. FY 99 expenditures are forecast at approximately \$200K.

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### **Environmental Protection Agency (EPA), Construction Grants**

The Corps has been providing construction oversight for EPA's Waste Water Treatment Construction Grants program. The program is slowly being phased out, but the Jacksonville District still provides valuable support in the U.S. Virgin Islands as construction on funded projects continues.

The Environmental Protection Agency and U.S. Army Corps of Engineers Interagency Agreement of 1978 assigned to the Jacksonville District substantial responsibility for inspection and construction management of the EPA financed Construction Grants Program. The EPA-CE agreement provides for the monitoring of the construction of sanitary sewage systems including treatment plants, interceptor and trunk sewers, and ocean outfalls and other attendant facilities.



*Removal of underground storage tanks located at St. Croix FAA Site.*

The agreement was revised in March 1981. The Corps was given the additional assignment to act as EPA's agent in performing active program management. This consisted of being responsible for design and construction phase of projects and activities. Assignment of program management in addition to other construction engineering functions previously assigned removes EPA from day-to-day operations except for administration of non-assignable tasks, as specified by regulation, and for conducting program monitoring and oversight.

The Corps has review and approval authority for each task to which it is assigned to assure that all Federal requirements promulgated in the Federal Register, the Code of Federal Regulations, and other program guidance issued by EPA, are satisfied.

Since 1978, the Jacksonville District has been responsible for construction program policy, bidability and constructability reviews, and change order review and approval. The Corps' Antilles Area Office staff has been responsible for pre-construction management as well as inspections, and construction management in Puerto Rico and the U.S. Virgin Islands.

The objective of the program is to assure that EPA grant assisted wastewater treatment projects are constructed in accordance with the highest standards of engineering practice and in compliance with applicable Federal regulations.

Program magnitude in Puerto Rico and the U.S. Virgin Islands is estimated at \$600 million, with involvement as follows:

From 1978 to the present, over 100 EPA construction grants have been completed and closed out in the Commonwealth of Puerto Rico. The current program includes 37 grants with a total estimated cost of \$139 million. This program in Puerto Rico will continue through 1999 and possibly beyond depending on EPA funding.

The U.S. Virgin Islands program is estimated at \$71 million. One project was completed in early 1987. Four work assignments are currently underway with the status ranging from grant approval to final design with a total estimated value of \$3.5 million. Total expenditures for FY 99 are estimated at \$960,000.

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## **Environmental Protection Agency (EPA), Superfund**

Since 1982, the Corps has supported the Superfund program by conducting remedial designs and remedial actions (construction), primarily by contract, for Superfund-financed projects. The Corps performs reviews, prepares studies, and provides enforcement oversight and real estate, remote sensing, and geographical information systems support under this program. The State of Florida has almost half of all Superfund sites located in the entire southeast. In Florida, we are currently working on Superfund sites in Jacksonville, Ft Lauderdale, Orlando and Tampa. In Puerto Rico, you will find our personnel busy at the Barceloneta and Juncos Landfill sites. Our Superfund program for FY 99 is forecast at over \$11.4 million.

*Below: Ordnance removal, DERP FUDS Program, Camp O'Reilly, Puerto Rico.*



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## **Federal Emergency Management Agency (FEMA), Emergency Broadcast Stations (EBS)**

The Corps is working on a nationwide program to bring all Emergency Broadcast Station (EBS) underground and above ground storage tanks into environmental compliance. In addition, the Corps is performing Quality Assurance (QA)/ Quality Control (QC) of documents. Jacksonville District has recently completed storage tank work at radio stations located in Ponce and Mayaguez, Puerto Rico. Expenditures in FY 99 are estimated at \$200,000.

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## **Federal Emergency Management Agency (FEMA), Rapid Response/Emergency Operations**

The Corps recently performed emergency disaster relief for Hurricane Fran, the California flood, the Upper Plains flood, the Arkansas tornadoes, Hurricane Mitch in Central American, and Hurricane Georges in Puerto Rico. Jacksonville District recently awarded contracts for site assessment of debris at collection facilities, household and hazardous waste collection and disposal, and collection and transportation of construction and demolition debris containing asbestos for disaster relief as a result of Hurricane Georges. Expenditures for the Hurricane Georges work are expected to exceed \$300 million. Due to its geographic location, Jacksonville District has had more experience with hurricane disasters than any other Corps district. Our goal is to utilize this experience when responding to natural disaster victims throughout Florida and the Caribbean.

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## **Puerto Rico Aqueduct and Sewer Authority (PRASA)**

On March 20, 1986, the Puerto Rico Aqueduct and Sewer Authority (PRASA) officially requested that the Corps provide technical support in the management of a program to implement several regional wastewater treatment systems.

The work concept was a fast track, turnkey mode. The U.S. Army Corps of Engineers responsibilities included design review; construction quality assurance; and technical oversight of the system start-up, operation and maintenance. Technical training of PRASA personnel was also to be among the Corps' duties. This training was to provide PRASA with the expertise needed for similar future jobs.

The U.S. Army Corps of Engineers assisted PRASA with the construction of the Guayama and Humacao regional plants. The two regional systems were built totally with funds from the Puerto Rico government, and the Corps was reimbursed for its services.

The Guayama Waste Water Treatment Plant (WWTP) provides a secondary treatment. It has a capacity of 10 million gallons per day (m.g.d.) with provisions being made to increase

to 20 m.g.d. The Guayama plant is now operational. The cost of the Guayama WWTP was \$32 million. The 2-year O&M period under contract was completed in August 1991. The facilities have been transferred to the owner, PRASA.

The Humacao WWTP provides secondary treatment and has a capacity of 8.3 m.g.d., with provisions being made to expand to 13.0 m.g.d. This plant is now completed and transferred to the owner, PRASA. The estimated cost of the Humacao plant was \$70 million.

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## **Puerto Rico Environmental Quality Board (PREQB)**

In August 1993 the Jacksonville District entered into an agreement with EPA Region II and the Puerto Rico Environmental Quality Board to provide technical assistance to public water supply systems in Puerto Rico which were not in compliance with drinking water standards. Specifically, the scope of work called for a preliminary engineering report to assess the operation and treatment, if any, often so-called non-Puerto Rico Aqueduct and Sewer Authority (non-PRASA) aqueducts. These are isolated rural aqueducts serving small rural communities throughout Puerto Rico. They are concentrated in the central mountainous municipalities. Though 97 percent of the total population of Puerto Rico is served by PRASA, there are still approximately 300 non-PRASA aqueducts serving approximately 80,000 persons. Generally, volunteers of the community operate and manage the aqueducts. A total of twenty-five of these aqueducts are scheduled for assessment during FY-99. The FY 99 program is expected to be \$1 million.

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## **Dept of Transportation - Federal Aviation Administration - Southern Region Support**

A Memorandum of Agreement was entered in August 1990 between the U.S. Department of Transportation - Federal Aviation Administration (FAA), Southern region and the U.S. Army Corps of Engineers, South Atlantic Division, for environmental compliance and restoration work. The work is associated with environmental management, fuel storage tank management and hazardous material/waste management programs for the FAA facilities throughout Florida, Puerto Rico, the U.S. Virgin Islands and the Antilles. The Corps' services include preparing environmental audits, remedial designs, and awarding and managing remedial action (construction) contracts.

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## **Agua-Guagua Project, Martin Pena Channel, San Juan P.R.**

A Corps study, completed in 1978, evaluated preliminary plans for an environmental demonstration project to enhance water and environmental quality along the Martin Pena Canal.

In 1982, a Memorandum of Understanding was signed with the Puerto Rico Department of Transportation and Public Works authorizing the Corps to conduct engineering and design studies for the waterway development portion of mass transportation facilities associated with the Agua-Guagua project. Under this agreement the Corps also provided construction management of the channel improvement portion.

Phase I construction began in 1984 and was completed in April 1986 at a cost of \$9.4 million. Work consisted of dredging a 10-foot-deep by 200-foot-wide channel and construction of 4,000 feet of concrete retaining bulkhead.

Phase II construction started in December 1986 and was completed in February 1988. This phase involved dredging and construction of approximately 9,000 lineal feet of piles at a final cost of \$10.4 million.

The environmental disturbance resulting from dredging and construction was offset by two environmental enhancement activities. A 67-acre mudflat was built north of the channel entrance to the bay utilizing 74,000 cubic yards of material pumped from the bottom. Also, 5 acres were degraded and planted with mangroves to compensate for those removed for construction.

Funding for this project was provided by the government of Puerto Rico and the Urban Mass Transit Administration.. Land-related phases of the Agua-Guagua Project were completed by the Puerto Rican government and the project was inaugurated in March 1991. The project is operated by the Puerto Rico Ports Authority.

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## **Assistance To EPA On Public Aqueducts**

In August 1993 the Jacksonville District entered into an agreement with EPA Region II to provide technical assistance to public water supply systems in Puerto Rico which were not in compliance with drinking water standards. Specifically, the scope of work called for a preliminary engineering report to assess the operation and treatment, if any, of ten so-called non-Puerto Rico Aqueduct and Sewer Authority (non-PRASA) aqueducts. These are isolated rural aqueducts serving small rural communities throughout Puerto Rico. They are concentrated in the central mountainous municipalities. Though 97 percent of the total population of Puerto Rico is served by PRASA, there are still approximately 300 non-PRASA aqueducts serving approximately 80,000 persons. Generally, volunteers of the community operate and manage the aqueducts. A total of twenty-five of these aqueducts are scheduled for assessment during FY-94.

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## **Martin Pena Environmental Enhancement Project, San Juan, Puerto Rico**

A Memorandum of Agreement (MOA) executed in February 1996 between the Jacksonville District U.S. Army Corps of Engineers and the Puerto Rico Department of Natural and Environmental Resources (DNER). All funds for work performed will be provided by DNER.

The Martin Pena Canal is a tidal canal approximately 3.8 miles long connecting San Juan Bay and the San Jose Lagoon in Metropolitan San Juan. The drainage area of the canal is about 2,500 acres. In 1988 the first 2.0 miles from San Juan Bay eastward to Munoz Rivera Avenue was dredged to 200 feet wide by 10 feet deep to provide a navigation channel for an intermodal passenger transport service. Vertical kingpile walls line both sides of the channel. Urban development has encroached into the remaining unimproved portion of the canal and untreated discharge of local household and industrial wastes have left the canal in very poor condition. The DNER has contracted the Jacksonville Corps of Engineers to prepare a Design Memorandum (DM) to continue the dredging of the Martin Pena 1.8 miles to the San Jose Lagoon. Three preliminary alternatives will be investigated: a shallow existing channel clean out, an earth trapezoidal channel which would maximize the conveyance through proposed new 200-foot wide bridges, and a vertical king pile wall rectangular channel similar to the channel constructed for the Agua Guagua. One of these plans, selected by DNA, will be developed in the Design Memorandum in sufficient detail, including identification of suitable disposal areas, environmental impacts, and real estate requirements, to be able to more directly into the next phase, preparation of plans and specifications.

The surveys, preliminary geotechnical and water/sediment quality sampling and testing were completed in April 1997. A summary assessment of the three alternative plans was submitted to the sponsor in November 1997. By letter dated 2 March 1998, DNER selected the king pile wall alternative because WES model results showed that this plan provided the most improvement to overall water quality of the San Juan Bay Estuary System. Final Geotechnical and Water Quality field work and testing have been completed. Detailed design work for the Design Memorandum (DM) is underway. The draft DM is scheduled for completion in September 1999.

Funding:

Design Memorandum Cost Estimate	\$ 989,000
Allocated FY-96	\$ 400,000
Budgeted FY-97	\$ 580,000
Carryover into FY-98	\$ 480,000
Balance to Complete	\$ 0

# Special Projects And Studies

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## Esperanza Peninsula (Catano Bay), P.R.

The Esperanza Peninsula is a long sand spit protruding from the Catano shoreline in Esperanza Ward which was created out of dredged material from the Federal navigation channels. The peninsula prohibits the exchange of clean outer bay water with the southern portion of the inner bay and has contributed to the decline of water quality and productivity in that area. This project proposes to open flushing channels in the peninsula to allow for bay waters to flush across the peninsula, improving water quality and productivity in the basin. Several inlet structures could be constructed to allow prevailing winds, bay currents, and surge to flush the inner embayment. Dredged material from construction of the flushing channels could be placed near the outer, mangrove covered tip of the peninsula to increase the area of vegetated shallows and intertidal mud flats. The ecosystem restoration report for the proposed project modification is scheduled for completion in 1999.

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## Puerto Rico Cooperative Studies

The Puerto Rico Cooperative Study was funded as planning assistance to a state and included two large special studies, the Ponce Regional Water Resources Management Urban Study and the Islandwide Water Supply Study. Funding for this section was eliminated in 1981 but the studies conducted are still used in Puerto Rico as a basis for water resources programming decision.

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## Ponce Regional Water Resource Management Study

This study investigated the water and related land resources problems of 14 municipios on the south coast of the island. It addressed water supply needs, flooding problems, water-based recreational needs and opportunities for environmental enhancement. The study, conducted in cooperation with the Puerto Rico Department of Natural and Environmental Resources, was completed in 1979.

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## Islandwide Water Supply Study

The study presented a comprehensive evaluation of Puerto Rico's water supply condition, as well as identification of present and future water needs under different socioeconomic development scenarios, up to the year 2020. It identified possible water supply systems and how these could be planned, constructed, operated or otherwise improved to meet the needs for municipal, industrial and agricultural water uses. Major elements of these plans have been incorporated into action, and the document served as basis in other detailed planning efforts by the Puerto Rican Government. A four-volume final report was issued in 1981

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## Hurricane Hugo Recovery Assistance in Puerto Rico and the U.S. Virgin Islands

On 17 and 18 September 1989, Puerto Rico and the U.S. Virgin Islands suffered the direct impact of Hurricane Hugo (a Category IV hurricane) with damage so severe that it resulted in Presidential emergency declarations for Puerto Rico and the U.S. Virgin Islands. The Corps' team demonstrated its capacity to mobilize and respond rapidly and effectively to a disaster. The variety of missions and recovery work conducted by the Corps for FEMA, in coordination with non-Federal officials, attested to the capacity of the staff to assist in all types of work.

A Corps first nationwide was achieved in Puerto Rico when Corps staff in response to the Governor's request mobilized immediately to provide water under the Corps Post Response Authority. Two days after the hurricane, the Corps was delivering potable water to hospitals, homes for the elderly and other priority areas in the San Juan Metropolitan Area, eastern Puerto Rico and Vieques. By September 30, 1989, more than 2.1 million gallons of water had been transported by the Corps in coordination with non-Federal officials.

Corps Damage Assessment teams gathered the data utilized by FEMA to support their initial disaster declaration and to determine the municipalities affected. In Puerto Rico, the Corps also removed two vessels which caused navigation problems in San Juan Harbor. The total Corps emergency missions for Puerto Rico totaled \$1,097,804.

The U.S. Virgin Islands suffered massive damage, particularly St. Croix where a Corps Emergency Operations Center (EOC) was established immediately following the hurricane. Corps employees from 20 divisions and districts were assigned to work in the massive recovery effort. Another EOC was established in St. Thomas to provide technical assistance to the Territorial Government.

Missions in the U.S. Virgin Islands included covering 2,700 homes with four million square feet of temporary plastic roofing; providing emergency power supply; securing pumps and fiberglass water tanks and water distribution; carrying out emergency repairs to public buildings; providing technical assistance for the restoration of power; removing and disposing of debris from public roads, private roads, private lands and public waters; replacing a major water storage tank; rehabilitating and repairing several hundred public project units; monitoring construction of mobile home sites and supporting with design and studies of areas to be rebuilt. All work has been completed with the exception of the Louis E. Brown public housing site, which will be completed in July 1996.

The total Corps emergency missions for the U.S. Virgin Islands total \$61,440,354.

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## **HUD-VI MOA Support**

A Memorandum of Agreement was entered in April 1991, between the U.S. Department of Housing and Urban Development (HUD), the Virgin Island Housing Authority (VIHA), the Federal Emergency Management Agency (FEMA) and the Corps of Engineers (COE) for rehabilitation work at public housing sites in St. Croix. Work involves rehabilitation of some 561 units at the following four housing sites: Basin Triangle, Marley Homes, John F. Kennedy and Williams' Delight. The Corps' services include preparing the design and awarding and managing the construction contracts.

Funding for this work is provided by FEMA for all the damage related to Hurricane Hugo and by HUD for modernization and rehabilitation in public housing projects. A supplement to this agreement was concluded to include work at the Louis E. Brown public housing site. All work has been completed except for the Louis E. Brown public housing site which is scheduled to be complete in July 1996.

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## **Planning Assistance To States**

Section 22 of the Water Resources Development Act of 1974 provides authority for the Corps to provide technical assistance for water resource problems. The work is cost shared on the basis of 50 percent Federal funds and 50 percent non-Federal funds.

Several Commonwealth agencies have utilized this program to request specific technical services. For FY99, the Puerto Rico Department of Natural and Environmental Resources requested the following: to prepare flood damage assessment reports; provide seminars on introduction to hydrology and hydraulics utilizing HEC computer models; and perform an assessment of the erosion problem along Highway 187. In FY98 the Municipality of Carolina requested the following: IWR training; review water supply proposal; complete water demand projections; and provide technical assistance in identifying potential water supply projects.

# Aquatic Plant Control

## Aquatic Plant Control (Puerto Rico)

Aquatic plant management operations in Puerto Rico are funded by the U.S. Army Corps of Engineers under the cooperative Aquatic Plant Control (APC) Program authorized by the Rivers and Harbors Act of 1965, as amended. The law authorized a comprehensive program of the control and progressive eradication of waterhyacinth, alligatorweed, Eurasian watermilfoil and other noxious aquatic plant growth where such growth constitutes or poses major economic problems in waters of the United States. The focus of Puerto Rico APC Program is in the combined interest of flood control, drainage, navigation, agriculture, fish and wildlife conservation and public health and safety.

The cost sharing requirement is 50 percent Federal 50 percent non-Federal for both planning and operational costs. Total Federal program expenditure is not to exceed \$12 million annually for the United States. Federal funds appropriated are allocated by the Chief of Engineers on a priority basis, as determined by local conditions and the availability of non-Federal funds.

Control operations on the island are directed primarily toward waterhyacinth, water lettuce and aquatic grasses. Program planning began in 1974 and the program has been operational since 1982. The Department of Natural and Environmental Resources, the designated non-Federal sponsor, conducts all control operations. Operations are also conducted in smaller rivers in addition to a number of flood control canals.

The cost of the program to September 30, 1998, excluding research, has been about \$3,649,233 Federal and non-Federal funds. The program was not funded for FY-99.

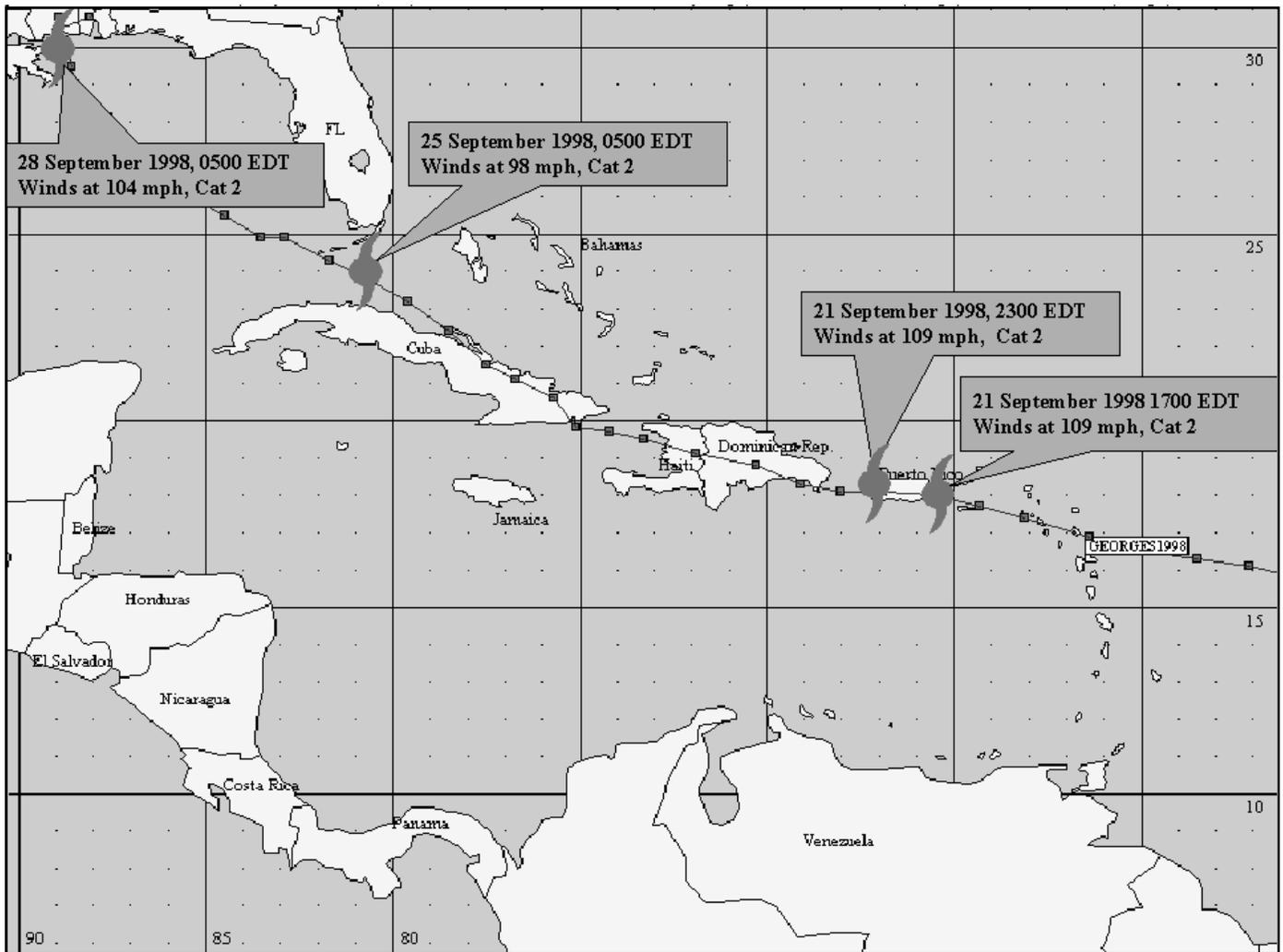


*Above: Corps personnel and local technicians examine a large hyacinth plant in Puerto Rico.*



*Left: Water hyacinth and alligatorweed infest a canal in San Juan, Puerto Rico.*

# Flood Plain Management Services Program



*Weather map track of Hurricane Georges as it tore through Puerto Rico, heading for the mainland of the U.S. in September 1998.*

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## General

Flood plain management studies are made to: (a) provide information on floods and flood hazards, including areas subject to flooding, in a clear, concise and useful form; (b) encourage, optimum and prudent use of the stream valleys by providing the Commonwealth of Puerto Rico and U.S. Virgin Islands agencies a factual basis for reducing future flood damages and hazards through well-planned use of flood plains; (c) publicize available information for the guidance of private citizens and interests on the use and hazards of using the flood plains; and (d) reduce future expenditures for the alleviation of flood problems arising from improper use of the flood plain area.

Several Flood Plain Information Reports were prepared for Puerto Rico and the U.S. Virgin Islands. A typical report included maps or mosaics, profiles, charts, tables, photographs, and a narrative describing the extent, depth and duration of flooding by floods of the past and those that may reasonably be expected in the future. The reports also contain general criteria for guidance in the use of flood plain areas, and provide engineering data for use by non-Federal interests in planning to ameliorate the flood hazard. Many of these reports cover areas that have subsequently been covered by flood insurance studies. The flood insurance studies are available at the Puerto Rico Planning Board. The program has been discontinued in favor of preparing flood insurance studies for FEMA.

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## Completed Flood Plain Information Studies

Title	Completion Date
Rio de Bayamon, P.R.	1965
Rio Cagintas, P.R.	1969
Rio Cibuco and Rio Indio, P.R.	1973
Rio Guayanilla, P.R.	1967
Rio Humacao, P.R.	1965
Rio de la Plata, P.R.	1965
Rio Manati, P.R.	1967
Rio Matilde, P.R.	1977
Rio Maunabo, P.R.	1970
St. Thomas, St. Croix, St. Johns, Virgin Islands-Tidal Areas	1975

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## Completed Special Flood Hazard Information Studies

Title	Completion Date
Rio Grande de Arecibo, P.R.	1972
Rio Bayamon and Hondo, P.R.	1973
Rio Cagintas, P.R. Floodway	1974
Rio Cibuco, P.R. Floodway	1974
Rio Espiritu Santo, P.R. Floodway	1976
Rio Fajardo, P.R.	1973
Rio Grande de Loiza, P.R. Floodway	1975
Demarara, St. Thomas, V.I.	1977

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## Flood Insurance Studies

In an attempt to provide adequate flood protection and relief to victims of flood disaster, Congress, in 1968, signed into law legislation creating the National Flood Insurance Program. This federally subsidized program was designed to protect property owners who, up to that time, were unable to get flood insurance coverage through the private insurance industry. The program made flood insurance available to individuals at affordable rates for the first time. In return for the Federal subsidy, state and local governments were encouraged to adopt certain minimum land use measures to reduce or avoid future flood damage within their flood-prone areas.

The Flood Disaster Protection Act of 1973 greatly expanded the available limits of flood insurance coverage and imposed two new requirements on property owners and communities. First, after March 1, 1974, property owners, in communities where flood insurance is being sold, were required to under the National Flood Insurance Act of 1968 (Public Law 90-448), the Federal Emergency Management Agency (FEMA) was authorized to establish and carry out a National Flood Insurance Program. Under this Act, FEMA may make studies and investigations to establish the risk premium rates for flood insurance in communities and is authorized to use the services of the U.S. Departments of the Army, Interior, Agriculture, and Commerce, and the Tennessee Valley Authority, on a reimbursable basis, to the maximum extent feasible. The U.S. Army Corps of Engineers assists FEMA in this program.

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## Completed Flood Insurance Studies For FEMA

Title	Completion Date
Caguas, Caguas Municipio Consolidated Report for Puerto Rico (Quebrada Margarita, Caguas, Anasco, and Valle Hermoso Development, Mayaguez	Jul 1972    Dec 1973
Rio Espiritu Santo Basin	Jan 1976
Rio Grande de Arecibo Basin	Sep 1977
Rio Matilde Basin	Feb 1978
Rio Cibuco Basin	Aug 1978
Rio Guayanilla Basin	Aug 1978
Rio Bayamon Basin	Feb 1979
Rio Grande de Loiza and Rio Herrera Basins	Jul 1979
Rio Tallaboa Basin	Aug 1979
Rio Maunabo Basin	Oct 1979
Rio Grande de Manati Basin	Apr 1980
Rio Lajas Basin	Feb 1982
Rio Majada	Mar 1982

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## Hurricane Evacuation Studies

Section 206 of the Flood Control Act of 1960 (Public Law 86-645) also authorizes the U.S. Army Corps of Engineers to conduct emergency evacuation studies. In Puerto Rico and the U.S. Virgin Islands, this has allowed the allocation of resources for planning activities related to hurricane preparedness. The Puerto Rico Department of Natural and Environmental Resources and the State Civil Defense are the lead cooperating agencies. The National Weather Service is also an active participant. The U.S. Virgin Islands Territory Emergency Management Agency (VITEMA) is the lead agency. The studies are jointly funded by the Federal Emergency Management Agency and the U.S. Army Corps of Engineers.

The San Juan Metropolitan Area Evacuation study data, available in June 1989, was successfully used by Commonwealth officials for deciding to evacuate floodable areas prior to the passage of Hurricane Hugo in September 1989. The Storm Surge Atlas for the U.S. Virgin Islands proved invaluable to VITEMA and other agencies prior to the passage of Hurricane Marilyn in September 1995.

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## Completed Hurricane Evacuation Studies

Title	Completion Date
San Juan Puerto Rico Hurricane Evacuation Study (Metropolitan San Juan and municipalities of Loiza, Carolina, San Juan, Guaynabo, Catano, Toa Baja, and Dorado)	May 1990
South Coast of Puerto Rico (Twelve municipalities)	Aug 1993
East Coast of Puerto Rico (Nine municipalities)	Jul 1996
U.S. Virgin Islands	Feb 1997

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## Active Studies

Title	Estimated Completion Date
North Coast of Puerto Rico (Nine municipalities)	Sep 2000
West Coast of Puerto Rico (Nine municipalities)	Sep 2000

## Hurricane Georges Recovery Effort

During the evening of 21 September 1998, Hurricane Georges struck the U.S. Virgin Islands (USVI) of St. Croix and St. Thomas and the Island of Puerto Rico (PR). On 22 September 1998, the U.S. Army Corps of Engineers (Corps), the Federal Emergency Management Agency (FEMA), island officials and other Federal agencies immediately began the recovery effort in Puerto Rico and the U.S. Virgin Island following damage left overnight by Hurricane Georges. Emergency declarations were signed on 21 September provided Federal funding for recovery efforts even before disaster assessments were made.

Hurricane Georges made landfall on the U.S. Virgin Islands and Puerto Rico a strong Category II storm. Early reports indicated several deaths on Puerto Rico and some building failures, but less damage than expected on the U.S. Virgin Islands. Preliminary damage assessments were made immediately. After the hurricane hit the Dominican Republic and Haiti it moved over the northern coast of Cuba and struck the lower Florida Keys on 25 September. Estimated maximum winds in the Keys were estimated to be 105 mph. After moving north northwesterly over the Gulf of Mexico, Georges made its final landfall near Biloxi, Mississippi, early on 28 September with 105 mph winds. Georges stalled over land and weakened that day.

The islands of Puerto Rico, St. Thomas and San Juan proved to be a challenging arena in which to conduct emergency operations. The limited resources, extreme terrain and remoteness of this disaster area resulted in an increased amount of obstacles to overcome. The damage in the Florida Keys produced widespread but temporary power outages in the lower Keys. Damage to structures was significant on Big Pine Key and lessened considerably west and east of the Key. Storm surges of six to seven feet above sea level were measured in Big Pine Key. The storm surge tapered to one to two feet in the upper keys. Along the northern gulf coast, the coastal areas of Mississippi, Alabama and Florida were hit with torrential rainfall and maximum sustained winds of 105 mph. The storm surge peaked at approximately 10 feet above sea level near Pascagoula, Mississippi.

The manner in which the South Atlantic Division responded to Hurricane Georges, emphasizes the needs of emergency training, planning, and the preparedness prior to the event. The Georges response was unique due to the wide spread impact of the storm. Corps resources from all over the county reported to assist with the recovery effort. Throughout this event many of the Corps' new emergency response initiatives were implemented, including the Readiness 2000 (R2K) program and the first full implementation of the Planning and Response Teams (PRT).



*Hurricane Georges' trail of damage in the town of Mayaguez, Puerto Rico, September 25, 1998.*

## NAVIGATION

### SUMMARY OF STATISTICAL DATA

NAME OF PROJECT	LOCATION	EARLIEST AUTHOR.	LENGTH (1)	WIDTH	TONNAGE 1997	TOTAL COST TO DATE THRU 30 SEPT 98 (2)
Arecibo Harbor	Puerto Rico	1937	0.3 mi.	Varies	95,000	\$ 5,717,506
Aguidilla Harbor	Puerto Rico	1993	0.1 mi.	Varies	No traffic reported	\$ 4,571,000
Mayagues Harbor	Puerto Rico	1935	0.6 mi.	Varies	424,000	\$ 1,229,748
Ponce Harbor	Puerto Rico	1925	3.4 mi.	Varies	948,000	\$ 4,998,570
San Juan Harbor	Puerto Rico	1917	8.6 mi.	Varies	14,067,000	\$ 35,247,103
Christiansted Harbor	Virgin Islands	1950	1.25 mi.	Varies	888,000	\$ 361,912
Crown Bay Channel	Virgin Islands	1986	1.2 mi.	Varies	383,000	\$ 109,000

(1) Approx.length of all channels

(2) Includes new work, maintenance cost and local contributions

## FLOOD CONTROL PROJECTS

### SUMMARY OF STATISTICAL DATA

NAME OF PROJECT	LOCATION	EARLIEST. AUTHOR.	PROJECT WORKS	CONSERVATION POOL (ACRES)	EST. TOTAL COST
Rios Portugues and Bucana	Puerto Rico	1970	2 dams and channels	72,100	\$ 574,300,000
Sabana Grande	Puerto Rico	1986	levee and gabion revetment		\$ 4,200,000
Savan Gut	Virgin Islands	1982	Phase I- 844 ft of concrete box culvert. Phase II - 1,500 ft of concrete box culvert, catchment basin, bridge replacement, channel		\$ 13,100,000
Rio Grande De Loiza	Puerto Rico	1992	channels and levees		\$ 186,700,000
Rio Puerto Nuevo	Puerto Rico	1986	channel enlargement		\$ 427,700,000
Rio de la Plata	Puerto Rico	1966	channels and levees		\$ 96,700,000

## SHORE PROTECTION PROJECTS

### SUMMARY OF STATISTICAL DATA

NAME OF PROJECT	LOCATION	LENGTH	EARLIEST AUTHOR.	PERCENT COMPLT.	FEDERAL SHARE	LOCAL SHARE	COST TO DATE	REMARKS
Punta Salinas	Puerto Rico	0.3 mi	1979	100	\$ 923,511	\$ 360,000	\$ 1,283,511	Section 103 Project
El Tuque	Puerto Rico	0.55 mi	1979	100	\$ 1,396,730	\$ 405,519	\$ 1,802,249	Section 103 Project
Rincon	Puerto Rico	100 ft	1985	100	\$ 247,359	\$ 22,000	\$ 269,359	Section 103 Project
Highway 187, at Pinones	Puerto Rico	0.45 mi	1985	0	\$ 669,000	\$ 240,000	\$ 909,000	Section 14 Project
Cyril E. King, St. Thomas	U.S.V.I.	800 ft	1992	100	\$ 500,000	\$ 0	\$ 500,000	Completed 1994

**CONTINUING AUTHORITIES PROGRAM SUMMARY**

PUERTO RICO & U.S. VIRGIN ISLANDS

PROJECT	AUTHORITY-SEC & YEAR OF FC OF R&H ACT	FEDERAL COST LIMITATION/ PROJECT	TOTAL ANNUAL OVERALL FEDERAL APPROPRIATION LIMITATIONS FOR EACH PURPOSE
Small Flood Control Projects	Sec 205, 1948 FC Act, as amended	\$ 5,000,000	\$ 40,000,000
Small Navigation Projects	Sec 107, 1960 R&H Act, as amended	\$ 4,000,000	\$ 35,000,000
Small Shore Protection Projects	Sec 103, 1962 R&H Act, as amended	\$ 2,000,000	\$ 30,000,000
Snagging and Clearing for Flood Control	Sec 208, 1954 Flood Control, as amended	\$ 500,000	\$ 7,500,000
Emergency Bank Protection for Highways and Public Works	Sec 14, 1946 FC Act, as amended	\$ 1,000,000	\$ 12,500,000
Planning Assistance to Puerto Rico & U.S. Virgin Islands	Sec 22, 1974 Water Resource Develop- ment Act, as amended	\$ 500,000 (1)	\$ 6,000,000
Mitigation of Shore Damages	Sec 111, 1968 R&H Act, as amended	\$ 2,000,000 (2)	\$ --
Project Modifications for Improvement of the Environment	Sec 1135, 1986 WRDA, as amended	\$ 5,000,000 (3)	\$ 25,000,000
Snagging and Clearing for Navigation	Sec 3, 1945 R&H Act, as amended	\$ 0	\$ 1,000,000

(1) Maximum expenditure in any one state.

(2) Projects with a Federal cost above \$2,000,000 require Congressional authorization.

(3) Projects with costs above \$5,000,000 require Congressional authorization. Costs are shared 75% Federal and 25% non-Federal.

# Glossary

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**Acre-foot:** An area of one acre covered with water to a depth of one foot. One acre-foot equals 43,560 cubic feet or 325,851 gallons.

**Advance engineering and design work (AE&D):** Work done by Corps of Engineers' offices in preparing a project for construction.

**Appropriation:** The setting aside of money by Congress, through legislation, for a specific use.

**Authorization:** House and Senate Public Works Committee resolutions or specific legislation that provides the legal basis for conducting studies or constructing projects. The money necessary for accomplishing the work is not a part of the authorization but must come from an appropriation by Congress.

**Bank and channel stabilization:** The process of preventing bank erosion and channel degradation.

**Basin:** (1) Drainage area of a lake or stream, such as a river basin; (2) a naturally or artificially enclosed harbor for small craft, such as a yacht basin.

**Beam:** The maximum port-to-starboard width of a ship, boat, or other vessel.

**Closure structure:** A structure built along low points of a levee or floodwall such as a street or railroad intersection to prevent flood waters from flooding the area protected by the levee or floodwall.

**Confluence:** The place where streams meet.

**Control dam:** A dam or structure with gates to control the discharge from the upstream reservoir or lake.

**Dam:** A barrier constructed across a valley for impounding water or creating a reservoir.

**Damages prevented:** The difference between damages that would occur without the project and the damages occurring with the project in place.

**Deep-draft harbor:** A harbor designed to accommodate commercial cargo vessels having drafts greater than about 15 feet.

**Degree of protection:** The amount of protection that a flood control measure is designed for as determined by engineering feasibility, economic criteria, social, environmental, and other considerations.

**Dike:** An embankment to confine or control water and/or soil.

**Diversion channel:** (1) An artificial channel constructed around a town or other point of high potential flood damages to divert flood water from the main channel to minimize flood damages; (2) a channel carrying water from diversion dam.

**Downstream:** In the direction of the flow of a stream toward the sea.

**Draft:** The vertical distance from the waterline to the bottom of a floating vessel.

**Dredged material:** The material removed in excavation or dredging in access canals, boat or navigation channels, drainage ditches, and lakes.

**Earth-fill dam:** A dam, the main section of which, is composed principally of earth, gravel, sand, silt, and clay.

**Environmental assessment (EA):** A planning report that presents the first thorough examination of alternative plans to positively demonstrate that the environmental and social consequences of a Federal action were considered. If the EA concludes that the proposal is a major Federal action significantly impacting on the quality of the human environment, or if it determines that the project will be environmentally controversial, an environmental impact statement will be required.

**Environmental impact statement (EIS):** A report required by Section 102(2)(c) of Public Law 91-190 for all Federal actions which significantly affect the quality of the human environment or are environmentally controversial. The EIS is a detailed and formal evaluation of the favorable and adverse environmental and social impacts of a proposed project and its alternatives.

**Flank levee:** A levee constructed nearly perpendicular to the streamflow.

**Flood capacity:** The flow carried by a stream or floodway at bank-full water level. Also, the storage capacity of the flood pool at a reservoir.

**Flood crest:** The highest or peak elevation of the water level during a flood in a stream.

**Flood plain:** Valley land along the course of a stream that is subject to inundation during periods of high water that exceeds normal bank-full elevation.

**Floodproofing:** Techniques for preventing flood damage to the structure and contents of buildings in a flood-hazard area.

**Floodwall:** Wall; usually built of reinforced concrete, to confine streamflow to prevent flooding.

**Freeboard:** (1) Vertical distance between the normal maximum level of the surface of the liquid in a conduit, reservoir, tank, canal, etc.; (2) an allowance in protection above the design water surface level.

**Groin:** A wall-like structure built perpendicular to the shore to trap sand and prevent beach erosion.

**Guide pier:** A structure that extends from the entrance to a lock, used to guide vessels safely into the lock.

**Habitat:** The total of the environmental conditions that affect the life of plants and animals.

**Headwaters:** (1) The upper reaches of a stream near its source; (2) the region where ground waters emerge to form a surface stream; (3) the water upstream from a structure.

**Impoundment:** The collection or confinement of water, as if in a lake.

**Jetty:** On open water, a structure extending into a body of water designed to prevent shoaling of a channel by littoral material and to direct stream or tidal flow. Usually built in the mouth of a river to help deepen and stabilize a channel.

**Left or right bank of river:** The left-hand or right-hand bank of a stream when the observer faces downstream.

**Levee:** A dike or embankment, generally constructed closest to the banks of the stream, lake, or other body of water, intended to protect the landside from inundation or to confine the streamflow to its regular channel.

**Lift:** The difference in elevation between the upstream and downstream water surface levels in a lock and dam system.

**Lift station:** A small wastewater pumping station that lifts the wastewater to a higher elevation when the continuance of the sewer at a reasonable slope would involve excessive depths of trench.

**Light-draft craft:** A small boat, usually recreational, having a draft of about 20 feet or less.

**Littoral drift:** Material such as sand that is swept along the littoral zone by waves and current.

**Littoral zone:** The narrow area, including the land and water, bordering the shoreline.

**Lock:** An enclosed part of a canal, waterway, etc., equipped with gates so that the level of the water can be changed to raise or lower boats from one level to another.

**Lock operation:** Locks fill and empty by gravity, with no pumps required to raise or lower the water level. To raise the water level, valves are opened above the uppergates and water flows into the lock through tunnels in both lock walls. This process is reversed to lower water in the lock. Valves are opened below

the lower gates and water drains out of the lock through the tunnels. Gates at both ends of the lock open and close electrically after the proper water level has been reached.

**Maneuvering channel:** A channel intended to facilitate maneuvering of vessels into and out of slips.

**Meander:** The name given to the winding course of a stream or river.

**Miter gates:** A type of gate commonly used to trap the water in a lock chamber.

**Mouth of river:** The exit or point of discharge of a stream into another stream, or lake, or the sea.

**Pier:** A structure which extends from the shore out into the lake and serves primarily for mooring and landing of boats. Also, the term is sometimes used synonymously with jetty.

**Pile dike:** A dike constructed of posts or similar piling driven into the soil.

**Pool:** A small and rather deep body of quiet water, as water behind a dam.

**Preconstruction planning:** Planning before construction, usually done during a project's post-authorization stage.

**Recurrence interval:** The average time interval between actual occurrences of a flood of a given magnitude.

**Rehabilitation:** A major repair job. Usually involves considerable reconstruction of already existing structures.

**Reservoir:** A pond, lake, tank, basin, or other space, either natural or created in whole or in part by the building of a structure such as a dam, that is used for storage, regulation, and control of water for power, navigation, recreation, etc.

**Revetment:** (1) A facing of stone, concrete, sandbags, etc., to protect a bank of earth from erosion; (2) a retaining wall.

**Riprap:** A layer, facing, or protective mound of randomly placed stones to prevent erosion, scour, or sloughing of a structure or embankment. The stone so used for this purpose is also riprap.

**River basin:** A water resource basin is a portion of a water resource region defined by a hydrological boundary that is usually the drainage area of one of the lesser streams in the region.

**River tow:** An assemblage of one or more barges propelled by a towboat in a riverine waterway.

**Rock dike:** An embankment built principally of rock.

**Sediment load:** The total sediment composed of suspended load and bed load transported by a stream. The suspended load is composed of fine sediment transported in suspension while bed load is composed of relatively coarse material transported along or near the bottom.

**Self-liquidating facilities:** Facilities provided by non-Federal interests at a project site in addition to facilities that are part of the federally cost-shared project features. These facilities are considered to be self-liquidating in that they can be paid for through user fees charged the public. These facilities might include such things as a public wharf, mooring facilities, parking areas, etc.

**Shoal area:** Patches of sand, gravel, or other hard bottom lying at shallow depths.

**Slack water area:** (1) In tidal waters, the area where tidal current velocity is at a minimum; especially the moment when a reversing current changes direction and its velocity is zero; (2) in streams, a place where there is very little current.

**Slough:** (1) A small muddy marshland or tidal waterway which usually connects other tidal areas; (2) a tideland or bottomland creek. A side channel or inlet, such as from a river or bayou, that may be connected at both ends to a parent body of water.

**Spillway:** A waterway or a dam or other hydraulic structure used to discharge excess water to avoid overtopping of a dam.

**Spoil material:** (See "Dredged material").

**Stage:** The elevation of the water surface above or below an arbitrary datum.

**Standard project flood (SPF):** A flood that may be expected from the most severe combination of meteorological and hydrological conditions that are reasonably characteristic of the geographical region involved, excluding extremely rare combinations.

**Stop-log closure:** Logs, planks, cut timber, or steel or concrete beams fitting into end guides between walls or piers to close an opening in a dam or conduit to the passage of water. The logs are usually placed one at a time.

**Streambed:** A channel occupied or formerly occupied by a stream.

**Swale:** (1) A slight depression, often wet and covered with vegetation; (2) a wide, shallow ditch, usually grassed or paved.

**Tainter gate:** A semicircular gate that opens and closes through pivoting on a shaft and is used to control the flow of water over spillways.

**Tributary:** A stream or other body of water that contributes its water to another stream or body of water.

**Turning basin:** A widened area in a navigation channel or harbor area intended to allow vessels to turn around.

**Upstream:** At or toward the source of a stream.

**Watershed:** The whole surface drainage area that contributes water to a collecting river or lake.

**Wing dam:** A wall, crib, row of pilings, stone jetty, or other barrier projecting from the bank into a stream for protecting the bank from erosion, arresting sand movement, or for concentrating the low flow of a stream into a smaller channel.

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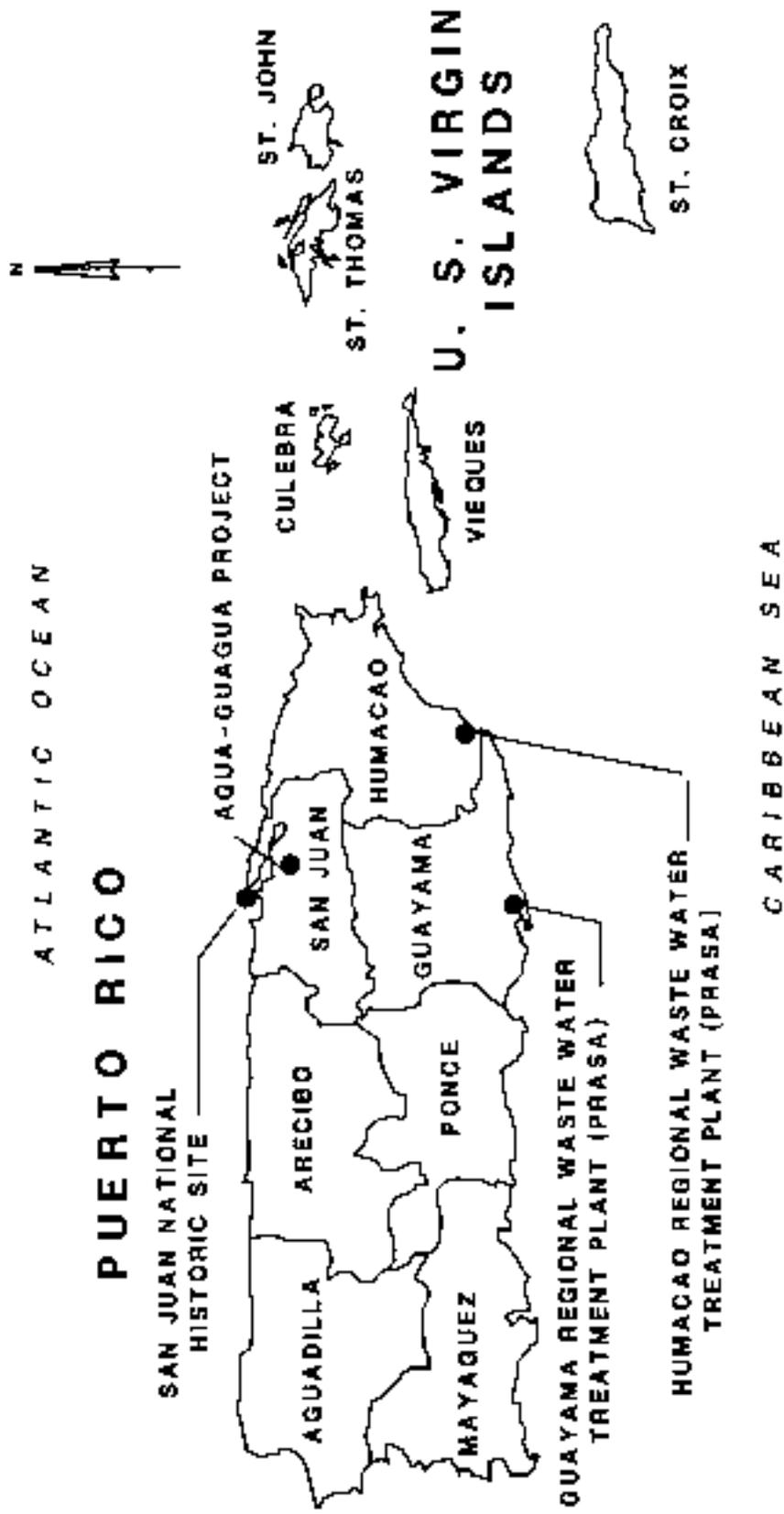
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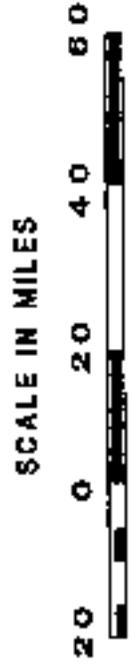
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### SPECIAL PROJECTS

LEGEND

- ▲ SHORE PROTECTION
- LOCAL FLOOD PROTECTION
- NAVIGATION
- MUNICIPALITY

SUPPORT FOR OTHERS IN  
PUERTO RICO  
AND THE  
U. S. VIRGIN ISLANDS



ATLANTIC OCEAN

# PUERTO RICO

RIO CIBUCO AT VEGA BAJA

BARRIO BARRERO RINCON

AGUADILLA HARBOR

ARECIBO HARBOR

AGUADILLA

PUNTA SALINAS

EL TERRAPLEN

CULEBRA

ST. THOMAS

MAYAGUEZ HARBOR

ST. JOHN

## U. S. VIRGIN ISLANDS

EL TUQUE

CHRISTIANSTED HARBOR

VIEQUES

RIO GUANAJIBO AT SABANA GRANDE

CARIBBEAN SEA

ST. CROIX

U. S. ARMY  
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AUTHORIZED FEDERAL PROJECTS  
COMPLETED

CIVIL WORKS PROJECTS IN  
PUERTO RICO  
AND THE  
U. S. VIRGIN ISLANDS

LEGEND

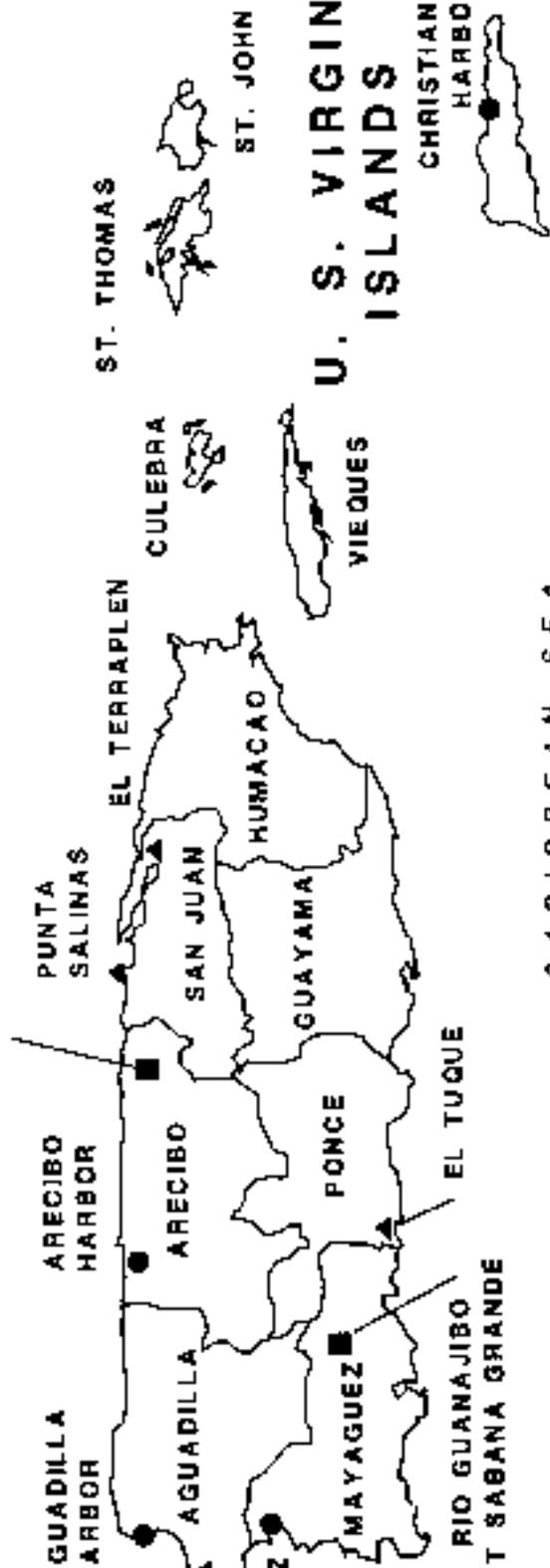
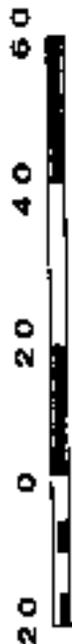
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■ LOCAL FLOOD PROTECTION

● NAVIGATION

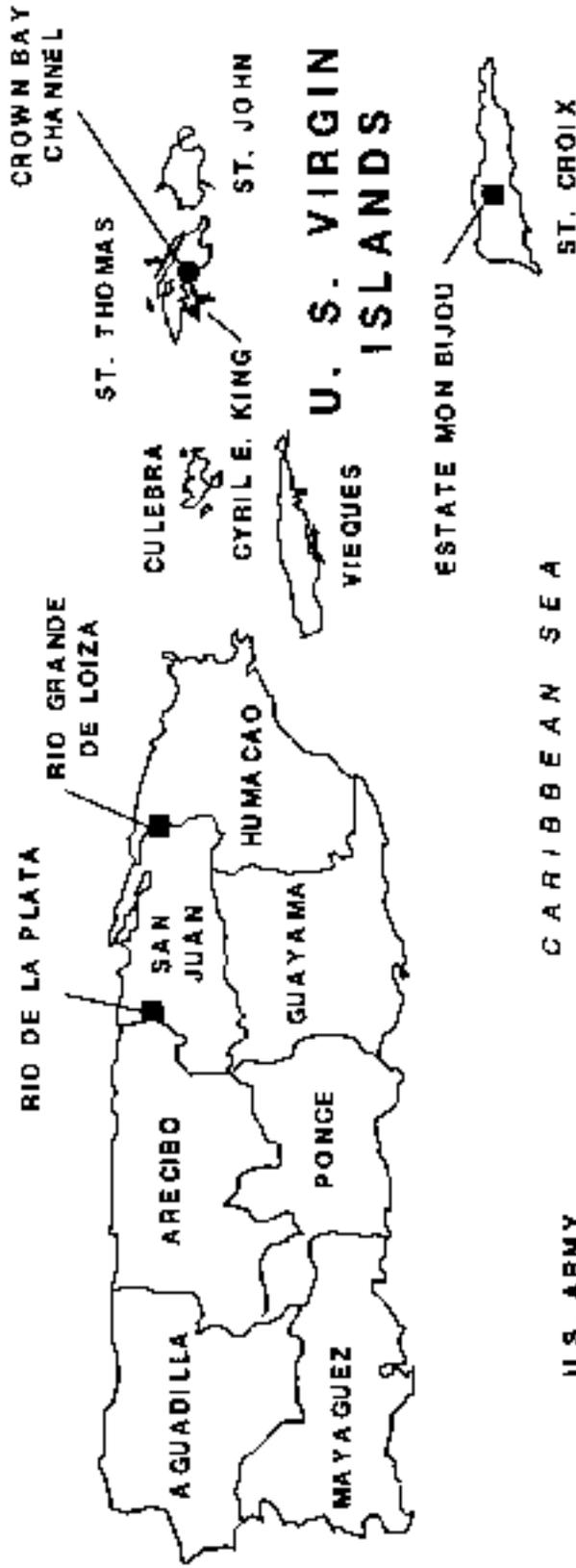
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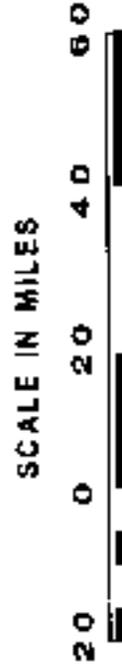
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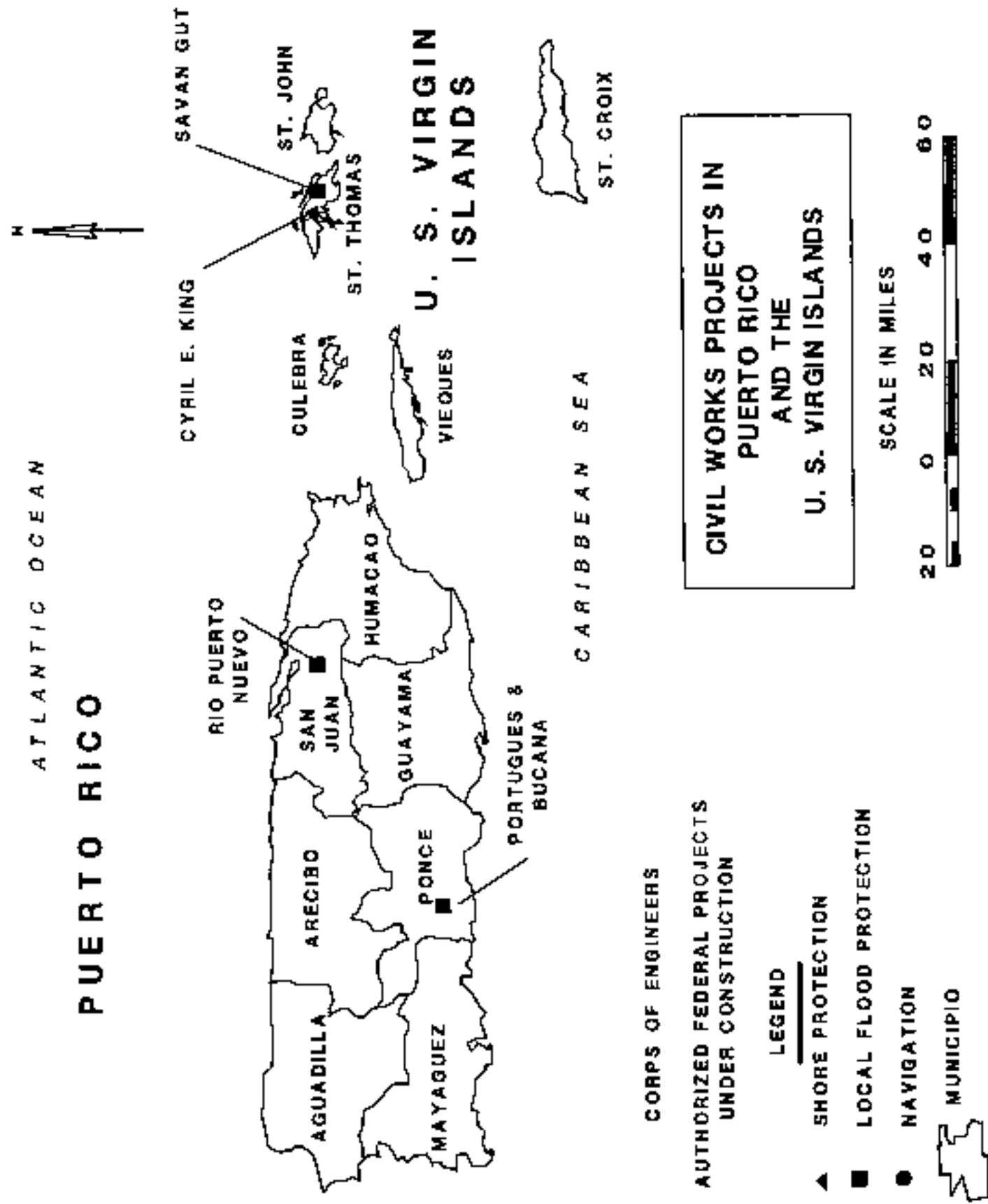
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### LEGEND

- ▲ SHORE PROTECTION
- LOCAL FLOOD PROTECTION
- NAVIGATION
-  MUNICIPIO

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PUERTO RICO  
AND THE  
U. S. VIRGIN ISLANDS**



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SAN JUAN

HUMACAO

GUAYAMA

PORTUQUES & BUCANA

CARIBBEAN SEA

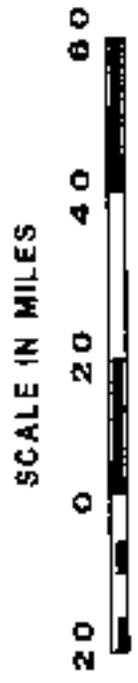
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### LEGEND

- ▲ SHORE PROTECTION
- LOCAL FLOOD PROTECTION
- NAVIGATION
- ▭ MUNICIPIO

CIVIL WORKS PROJECTS IN PUERTO RICO AND THE U. S. VIRGIN ISLANDS







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