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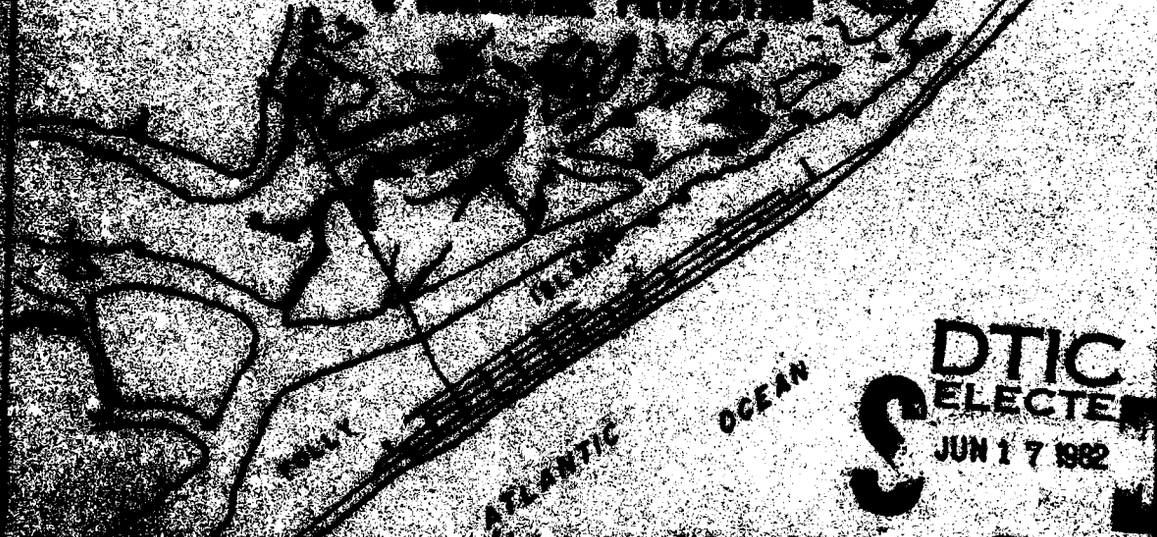
FOLLY BEACH

SOUTH CAROLINA

BEACH EROSION
CONTROL STUDY



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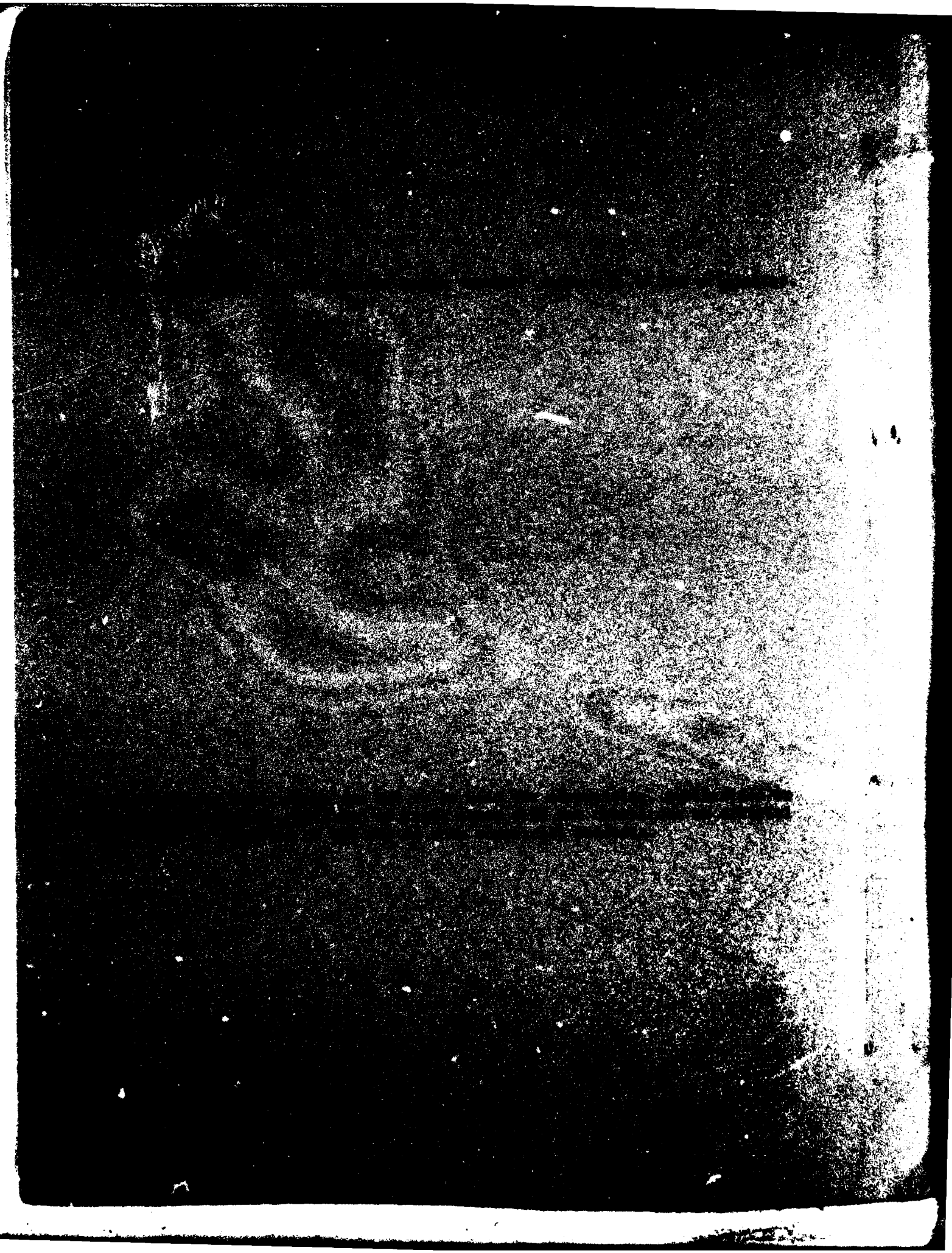
CORPS OF ENGINEERS
Charleston, South Carolina



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Encroachment of the Atlantic Ocean on Folly Beach has destroyed both private and public works along most of the shore line. Homes, roads, erosion control structures, and valuable beachfront land have suffered severely. Most of the dry beach also has been lost in recent years. The purpose of this report is to evaluate the problems with respect to beach erosion at Folly Beach and its vunerability to storm damage and to select and recommend the best course of action to remedy the problems. The plan recommended

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in the report provides for beach restoration and periodic nourishment for a 16,860 feet reach of Folly Beach which man made improvements are in the greatest jeopardy.

Syllabus

The purpose of this beach erosion and hurricane protection study was to investigate the 6.2 miles of Folly Island ocean beaches in order to determine the extent of damages by erosion of the shoreline and to develop the most suitable plan for the protection of this beach.

Folly Island beach is subject to severe damage from wave attack during hurricanes and during northeasters. The former generally occur during the months of July through October but are infrequent events. The latter occur during the months of October through April with each season producing one or more significant events.

The best solution was determined to be a structural plan for beach development in combination with non-structural measures that have been established in the study area. The most practicable structural plan consists of a beach berm having a width of 25 feet at an elevation of four feet above mean sea level and a gradually sloping beach face to provide a combined recreational beach width of 61 feet at the time of placement. Based on historical erosion rates, the recreational beach width would average 50 feet between renourishment periods. The prospective beach would be maintained by periodic sand renourishment every five years. The estimated total first cost of the improvement is $2,393,000. The total annual cost, including interest and amortization, is estimated at $396,300.

It is therefore recommended that, subject to certain conditions of non-Federal cooperation, the foregoing plan of improvement be adopted as a Federal project, at a presently estimated first cost to the United States of $722,500 with an annual periodic beach renourishment cost to the United States of $85,200. Non-Federal costs are estimated at $1,670,500 for plan implementation and $136,700 annually for periodic sand replacement.

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FOLLY BEACH, SOUTH CAROLINA
FEASIBILITY REPORT
FOR BEACH EROSION CONTROL AND
HURRICANE PROTECTION

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FOLLY BEACH, SOUTH CAROLINA

FEASIBILITY REPORT
FOR BEACH EROSION CONTROL AND
HURRICANE PORTECTION

The Study And Report

Water areas have special appeal to man and contribute greatly to his pleasure. To many along the Atlantic shore, the beach is the place to go for a refreshing swim, sunbathing, or a walk along the strand. Much of the relaxation needed for today's high-tempo living is furnished by ocean beach areas. However, beautiful sandy beaches adjacent to the ocean are generally limited from standpoints of availability and width, and these relatively narrow beaches are subject to erosion by wave action. Apart from this, human misery and damage to property are often companions of storms which buffet the coastline. These factors of coastal erosion and structural storm damage are present to an important degree in the Atlantic Coast resort area of Folly Beach, South Carolina.

PURPOSE AND AUTHORITY

The purpose of this study is to evaluate the problems with respect to beach erosion at Folly Beach and its vulnerability to storm damage; to investigate the various structural and non-structural alternatives; to determine cost sharing between the Federal Government and local interests; and to select and recommend the best course of action to remedy the problems.

The study was requested by local interest through their representatives in Congress. Recognizing the above problems and the economic

and aesthetic importance of ocean beaches, the Committee on Public Works of the Senate adopted a resolution on 15 June 1972 requesting that the Secretary of Army direct the Chief of Engineers to make such a study of Folly Beach and vicinity.

SCOPE OF STUDY

The study is focused on the six miles of Folly Island coastline in Charleston County, South Carolina. The location of Folly Island is shown on Plate 1. Investigations were made of the area to determine damages, either by erosion of the coastline or by storm tides and waves; measures for protecting the area or preventing the damages; the accompanying costs and benefits; the selection of the most feasible plan; and related matters, including coordination with concerned agencies and the public. The studies were made in the depth and detail needed to permit plan selection and to establish its feasibility.

STUDY PARTICIPANTS AND COORDINATION

The District Engineer coordinated the study with appropriate Federal, State, and local agencies. This office requested and received comments concerning problem identification and possible solutions from such agencies as U. S. Fish and Wildlife Service; National Park Service; U. S. Coast Guard; U. S. Environmental Protection Agency; U. S. Public Health Service; National Oceanic and Atmospheric Administration; South Carolina Wildlife and Marine Resources Department; S.C. Highway Department; S.C. Department of Parks, Recreation, and Tourism; and Charleston County Park, Recreation, and Tourist Commission. Several local environmental groups also participated in the study. Moreover, public meetings were held on 8 April 1976, 29 November 1977, and 7 December 1978 to afford interested parties and the general public an opportunity to express their views concerning the improvements desired and the need and advisability of their execution.

THE REPORT

In the interest of clarity of presentation and reference, the report has been arranged into a main report with four appendices.

The main report is a general non-technical presentation giving the results of the feasibility study. It presents a broad view of the overall study for the benefit of both general and technical readers. Included are a description of the study area; the problems and needs for protective measures; formulation of a plan for meeting these needs; a summary of project economics indicating the benefits, costs, and justification; the division of project responsibility between Federal and non-Federal interests; a summary of environmental, social and economic effect assessment; and recommendations for implementing the selected plan. Maps showing general locations (Plate 1), predicted 50-year shorelines (Plates 2 through 6) and the recommended plan (Plate 7) are inclosed at the end of the Main Report.

The four appendices to the report present supporting data and details covering the features of the feasibility report:

Appendix 1 is a technical report with all basic data needed to support conclusions made in the Phase 1 Report. This appendix has the same general outline as the formulation and evaluation part of the main report, but in greater detail. It is the key document for the technical reviewer.

Appendix 2 contains the Environmental Impact Statement.

Appendix 3 contains all pertinent correspondence in connection with the study, including comments from interested agencies.

Appendix 4 contains a reference list for coordination as required by Section 404 of Public Law 92-500.

PRIOR STUDIES AND REPORTS

In 1935, a beach erosion report on Folly Beach was submitted by the Beach Erosion Board (renamed Coastal Engineering Research Center) in cooperation with the Sanitary and Drainage Commission of Charleston County. In this report, the Board proposed three methods of protection but refrained from making any recommendation as to the adoption of any specific one of the methods given, as it was considered that the selection must necessarily be made by local interests. The problem area at that time was on the southwestern portion of Folly Island where storms of September 1933 and May 1934 destroyed the first row of houses. The proposed plans were:

Plan A - Restoration of eroding beaches;
Plan B - Construction of bulkheads and groins; and
Plan C - Beach restoration with groin construction.

All of the cost of these improvements were to be paid for by local interests.

A study of Charleston Harbor Jetties, 1935, was done by the Charleston District, U.S. Army Corps of Engineers, to become a part of the Shore Protection Board, OCE report entitled "Report on Jetties." The study was made to determine the effect of the Charleston Harbor jetties on adjacent shorelines. Concluded from these studies is that usually the effect of the jetties extend only about one mile above and below the jetties. Folly Beach is about six miles southwest of the Charleston Harbor jetties.

An appraisal report, Investigation on Hurricanes and Associated Problems Along the South Carolina Coast, was prepared by the U.S. Army Corps of Engineers, office of the District Engineer, Charleston, S.C. It was submitted in January 1957 and approved July 1957. The investigation indicated the need for further study and report with a view

toward effecting protective measures for minimizing loss of human life, damage to property and health hazards, and for improving hurricane forecast and warning services.

A hurricane survey interim report on Folly Beach was printed as House Document No. 302, 89th Congress, 1st Session, on 7 October 1965. It was concluded in this report that protective works to prevent hurricane damage were not economically justified.

In 1968, the U.S. Army Corps of Engineers, Charleston District, completed the Folly Beach Detail Project Report on Beach Erosion Control. This report evaluated a problem reach on the northeastern end of Folly Beach, known locally as East Folly Shores. This one-half-mile reach immediately downcoast from the United States Coast Guard Loran Station, was recommended for a Federal small beach nourishment project. A tentatively recommended project called for initial placement of a five-year supply of sand or about 45,500 cubic yards at an estimated first cost (1967 dollars) of $52,000. Costs were to be shared with 55 percent being allocated to a non-Federal sponsor and 45 percent to the Federal Government. The project was economically feasible but the local sponsor (Folly Beach Township Commission) was unable to provide the items of local cooperation.

A Beach Erosion Inventory of Charleston County, South Carolina report was written by the University of South Carolina and printed in March 1975 as the South Carolina Sea Grant Technical Report Number 4. It provides a preliminary summary of beach erosional-depositional trends for Charleston County. These trends were measured from sequential vertical aerial photographs covering the period 1939 to 1973. The report states that Folly Beach is primarily dominated by erosional trends.

Resources And Economy of Study Area

A general understanding of the resources and development trends of the study area is helpful in identifying its problems and needs and formulating the various solutions thereto.

DEVELOPMENT AND ECONOMY

Charleston County has a well diversified economy. The principal economic activities of the area can be related to the availability of several natural resources. A temperate climate, along with favorable topography and soil conditions are conducive to both agriculture and silviculture, which are engaged heavily in the county and account for the greatest land use. A coastal location with several navigable rivers makes Charleston a favorable place for import/export shipping and related port and terminal activities. The South Carolina Ports Authority is presently planning further port facilities in hopes of improving the economic development of the county and the state.

Also, attributable to the geographical and geological situation of Charleston County are several military and government installations, including Air Force and Navy Bases, which employ a large sector (approximately one-third) of the work force in the area. The coastal location also affords opportunities for area residents in several fisheries, both commercial and recreational, including shrimping, finfishing, oystering, clamming and crabbing. The historical background and fine architecture of Charleston, in addition to the beauty and aesthetic appeal of the Lowcountry's beaches, marshes and rivers, combine to make Charleston extremely popular with tourists. Tourism, recreation, and associated services provide 12,000 jobs and 45 million dollars per year in personal income to residents of the Charleston area. In fact, tourism-related employment is second only to Government employment within the county. In the immediate vicinity of Folly Island, which is located in Charleston County about 10 miles south of the City of Charleston, recreation, tourism and fisheries are of primary importance, both in terms of income and local employment.

Folly Island is the second island south of the entrance channel to Charleston Harbor and is typical of barrier islands. (See Plate 7 which is located at the end of this main report.) Its alignment

is from northeast to southwest. Bounded on the northeast end by Lighthouse Inlet, on the east by the Atlantic Ocean, on the southwest end by Stono River, and on the northwest side by Folly River, the island is approximately six miles long and at the widest part is about one-half mile across. A comparatively flat beach of fine sand fronts the ocean side. The mean tide range is 5.2 feet and spring tide range is 6.1 feet. Along the developed sections, immediately shoreward of the sandy beach, elevations range from 6 to 15 feet above mean sea level. Access to the island from peninsular Charleston is by S.C. Highway No. 171 with six bridge crossings, two of which are drawbridges.

The resort development extends along the ocean side of the island for a distance of 4.9 miles (see Plates 2 through 6). A U.S. Coast Guard Loran Station is located at the northeastern end of the island, and at the southwestern end a narrow spit extends about 0.7 mile downcoast of existing development. This latter reach, known as the Bird Key Area, is being considered for development by a number of investors.

Considerable marsh area adjoins Folly River along the northern half of the island, and palmetto, pine, and deciduous growth abound on higher ground. The development of Folly Island began about 1920, and is a typical seashore development, having mostly frame buildings consisting principally of cottages, homes, concessions, and small shops. An amusement park and a fishing pier are located on the island near the center of the beach. All of the island is in private ownership except for about 32 acres on which the Loran Station of the U.S. Coast Guard is located.

Charleston County beaches are heavily used by Charleston residents. Folly Beach, which draws about 60 percent of its day-users from Charleston County, is widely regarded to be more of a public beach than the county's other beaches. Isle of Palms and Sullivan's Island to the north and Kiawah Island and Seabrook Island below Folly Island are the other developed beaches in the county. Kiawah and Seabrook Islands are essentially restricted to the public. Public parking space is very

limited on Isle of Palms and Sullivan's Island. Folly Beach's proximity to the City of Charleston makes it a prime recreation area, despite an eroding beach and lack of existing facilities such as parking and comfort stations.

ENVIRONMENTAL SETTING AND NATURAL RESOURCES

Charleston County is at the center of what is known locally as the Carolina Lowcountry. The name fits. Elevations are typically less than twenty feet above mean sea level and relief is extremely limited. The study area lies on the lower coastal plain bordering the Atlantic Ocean and was once a submerged portion of the Continental Shelf. The coastline in this region is composed of a chain of barrier islands; these islands are usually between two and ten miles long and often less than one mile wide. They are fronted by gently sloped sandy beaches on the seaward side of the island and backed by vast expanses of extremely productive salt marsh. Folly Island is one of more than a dozen such islands in Charleston County. Separating these islands from each other are broad tidal rivers (such as the Stono River) which drain the interior. Tributary to these major rivers, flowing laterally between the islands and the mainland, are series of dendritic tidal creeks which alternately flood and drain the marshes. Folly River is the main artery for such a system of creeks located behind Folly Island, and Lighthouse Creek is a small tidal stream at the western end of the island. As one proceeds inland, the larger estuaries taper into meandering brackish rivers penetrating into low wooded lots and farmland. Continuing further upstream, relief increases gradually. At some locations in the interior of the county, there are small series of rolling hills, which are relics of beach dunes from previous stands of the sea.

The geologic formations of the Coastal Plain Provinces are comprised of layers of unconsolidated sands and gravels underlain by layers of loams, clays and marls of different ages, all lying nearly horizontal. Soil borings in Folly River, Stono Inlet at the west

end of the island, and Lighthouse Inlet at the east end produced fine silty sand to a depth of about 20 feet below mean low water, with silt content increasing as the distance from the ocean increased. Scoop samples were taken from the dry beach and to minus nine feet, mean low water, in the ocean off Folly Beach; the material was generally found to be fine clean sand with a high shell content. Analyses of these materials are included in Appendix 1.

The climate of the Lowcountry's barrier islands is marine subtropical. The mean average annual temperature near Folly Island is 66°F. with an average high temperature in July of 81°F. and an average low of 49°F. in February. Relative humidity in the area is around 75 percent, but the discomforting effect of this high humidity is moderated by an afternoon sea breeze. Precipitation occurs chiefly as rainfall, averages about 50 inches per year, and is fairly well distributed throughout the year. Between dawn and dusk, the sun shines an average of 65 percent of the time in Charleston during the year, but during May and September may be seen as much as 90 percent of the time. These conditions provide Charleston County with a relatively long growing season of 295 days per year. These conditions further allow human comfort the year round and provide a situation that is well suited for outdoor recreation and tourism.

There are some 4,000 acres of salt marsh in the immediate planning area. These wetland areas play a very important role in the ecology of the area, providing habitat for waterfowl, nursery areas for juvenile stages of many important species of fish and shellfish, water quality improvement, and primary biological production which supports a host of marine life in adjacent coastal waters.

There are public oyster grounds and private leases for oysters and clams in the planning area. Crabbers also fish Folly and Stono Rivers extensively. Shrimp are taken recreationally. The area is a favorite among local fishermen who catch many different species of fish in and around this estuary.

In short, the major natural resources of the study area are: a temperate climate; topography and soils conducive to agriculture and silviculture (which are important to the county but of little significance within the immediate planning area); geological features such as a coastal location with sheltered high ground areas having access to the ocean via navigable rivers; an ocean itself which harbors an abundance of biological and mineral resources; long stretches of gently sloped beaches for walking and bathing; and a vast expanse of extremely productive salt marshes which serve as nursery areas for a variety of marine organisms and in turn support large commercial and recreational fisheries.

HUMAN RESOURCES

Historically, Charleston County has been the most populous county in the state. However, in the past decade both Richland and Spartanburg Counties in the upcountry have come to be about equal in population to that of Charleston County.

The population in Charleston County has grown from 216,382 in 1960 to 247,565 in 1970 and 262,400 in 1975. This population is expected to reach 271,000 by 1980. At the same time, the population of James Island has grown from 13,872 in 1960 to 24,197 in 1970, 25,525 in 1975 and is expected to reach 28,090 in 1980. The population of Folly Island has been more stable. In 1960, there were 1,137 permanent residents in the Township of Folly Beach; in 1970, there were 1,157 persons and in 1975, the population was 1,500. An indication of historical and projected future growth in population, per capita income, and employment in the study area is given in Table 1.

It is estimated that Folly Island's resident population increases to about 4,500 persons during the summer months and on peak days visitors to this island may exceed 30,000. Figure 1 shows high usage being made of the beach during the 4th of July holiday in 1972. Erosion along most of Folly Island has severely hampered the development of this resort.

TABLE 1

Population, Income and Employment for Charleston SMSA including Berkeley, Charleston and Dorchester Counties[1/]

ITEM	YEAR							
	1959	1970	1980	1990	2000	2010	2020	2030
Population	274,909	336,837	389,000	421,000	457,000	477,500	497,500	515,200
Total Personal Income (Thousands of 1967 Dollars)	451,033	909,500	1,487,000	2,121,400	3,114 700	4,358,100	5,775,200	7,475,000
Per capita income (1967 $)	1,641	2,700	3,825	5,039	6,808	9,127	11,608	14,510
Total Employment	94,533	127,950	161,800	175,500	196,900	210,900	213,500	221,500
Employment/Population Ratio	0.34	0.38	0.42	0,42	0.43	0.44	0.43	0.43
Total Earnings	388,437	784,130	1,252,400	1,745,900	2,518,900	3,485,600	4,586,700	5,905,600
Government	159,244	347,346	517,200	710,600	1,012,600	1,380,000	1,839,300	2,362,200
Manufacturing	59,228	121,892	205,400	284,600	395,500	526,300	644,000	767,700
Wholesale & Retail Trade	57,343	102,107	161,500	218,200	306,600	414,800	527.500	649,600
Services	41,924	86,284	170,300	263,600	418,600	637,900	892,600	1,240,176

1/ From projections Economic Activity in South Carolina, Series E Population, December 1975, SADPD-75-1.

SOUTHWEST OF PAVILION
4 JULY 1972

FIGURE 1

LAND USE ANALYSIS

Only a small percentage of land within the immediate planning area is above mean high water. The predominant use of high ground areas is for low density residential purposes. With the Town of Folly Beach, which incorporates all of the island, there are approximately 1,500 acres of land, half of which is marsh land. Of the remaining 750 acres of high ground, 327 acres remain undeveloped, leaving about 420 acres of developed land. Residential properties occupy 204 acres or about half the presently developed land. There are 1,329 housing units at Folly Beach; most (80%) are single family cottages. Reflecting the resort nature of this shore community, only one-third of these units are occupied on a year-round basis.

The second largest category of land use on Folly Island is transportation rights-of-way. The town has a roadnet that occupies 120 acres of land. There are presently about 325 off-street parking spaces not including private driveways.

Commercial properties occupy only about 20 acres and consist mostly of retail establishments, such as grocery stores, filling stations, restaurants and arcades located in the center of the island.

Some eight acres of this beach front area including the existing boardwalk and fishing pier has been bought by a church group and they are developing it into a family recreational area open to the general public. Tennis and basketball courts, a swimming pool and waterslide will be built. Existing public facilities, including bath houses, comfort stations and parking spaces are being expanded.

On the northeast end of the island, the U.S. Coast Guard occupies 32 acres from which it operates electronic aids to navigation. The southwest end of the island is presently undeveloped. This 55-acre parcel is a narrow recurved spit which consists of a mile long primary and secondary dune system backed by salt marsh and the Folly River. Southwest of this

end of Folly Island, across a series of sand flats, lies an extremely small island, Bird Key, which serves as a rookery for several species of shorebirds.

Problems And Needs

In general, the citizens of the Town of Folly Beach want to preserve the small town atmosphere offered by the community while improving the quality of life of its citizens. This envisions increased employment opportunities, increased property values, and development of a tax base sufficient to support desired services. Realization of these objectives will only be achieved after a proper solution is effected to deal with the destruction wrought by ocean waves.

Stabilization of the shore is needed to protect existing and future development against damage from erosion and to insure the availability of adequate beach for recreational use. Encroachment of the ocean has destroyed both private and public works along most of the ocean shoreline. Homes, roads, erosion control structures, and valuable beachfront lands have suffered severely. Much of the dry beach area also has been lost in recent years.

PRIOR CORRECTIVE ACTIONS AND EXISTING STRUCTURES

On the northeast end of Folly Island, at the Loran Station, the U.S. Coast Guard has constructed a combination groin-retaining wall structure which apparently has significantly reduced erosion at that site. The timber wall and much of the six timber and rock groins have been covered with sand, and vegetation is migrating oceanward beyond the wall along most of this reach. Coast Guard stabilization structures consist of a timber seawall around the east end of the island from which six groins spring oceanward, and a combination training breakwater structure composed of segments of stone and of fabric sandbags on the inlet side. Photographs of these structures are displayed in Attachment C-2 of Appendix 1.

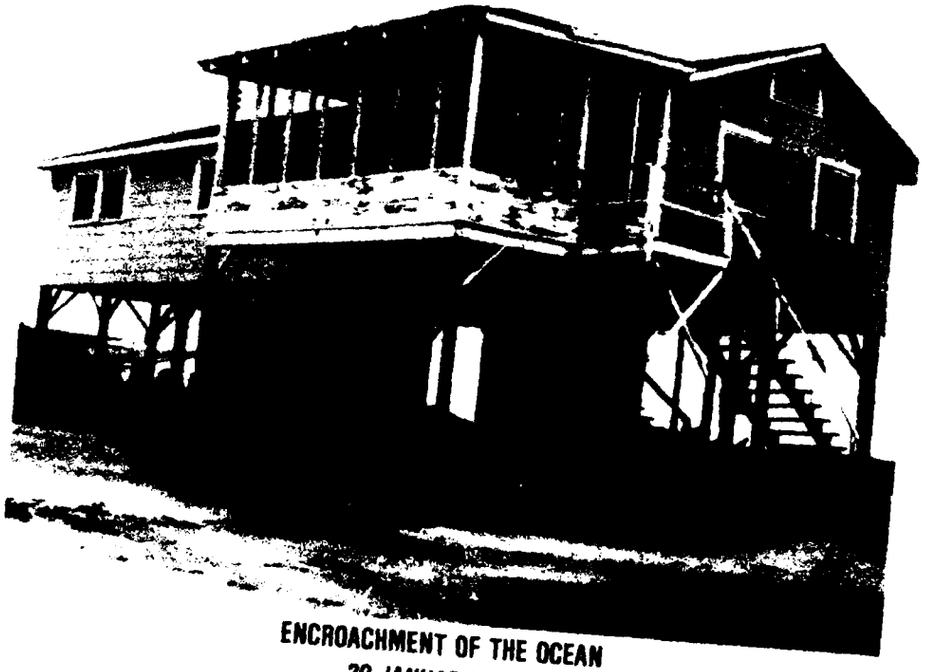
FOLLY BEACH BUSINESS DISTRICT

RECREATIONAL PAVILION AREA

FIGURE 2

DAMAGE FROM HURRICANE GRACIE
29 SEPTEMBER 1959

FIGURE 3



ENCROACHMENT OF THE OCEAN
30 JANUARY 1978

FIGURE 4

ENDANGERED ACCESS
JANUARY 1978

FIGURE 5

DUNE EROSION
JANUARY 1978

FIGURE 6

The South Carolina Highway Department has constructed and is maintaining 41 timber and rock groins along the developed coastline of Folly Beach from the Loran Station to the northeast to within about 4,000 feet of the southwest end of the island. Photographs of these structures are shown on Figure 7 and their locations may be seen on Plates 2 through 6. A rock revetment approximately 1,200 feet long has also been constructed between Groins 16 and 18 where erosion narrowed the island to the point that a breakthrough might occur, severing the northeast end from the remainder of the island. This revetment is shown in the top picture of Figure 8 and on the right side of Plate 2.

Beachfront property owners are using many different type structures to protect their property. These include: concrete sheetpile, asbestos corrugated sheetpile, timber seawalls, rock revetment, rubber tire walls, sand-fencing, and one property owner is experimenting with concrete block breakwaters constructed just oceanward of the mean high water line. Some of these structures are shown in Figures 8 through 10. Property owners have had varying degrees of success with their erosion control efforts. One problem stems from the piecemeal way in which these structures are constructed. Some property owners are unable or unwilling to attempt to control the erosion of their property while others cannot agree with their neighbors on a best "solution". The City of Folly Beach is attempting to organize beachfront property owners so that an integrated erosion control system can be constructed. Currently, they are seeking state and county help in constructing a continuous seawall and placing approximately 700,000 cubic yards of sand on 22,000 linear feet of ocean shoreline. The City plans to use the same borrow areas that are considered for use in the Federal project. Such a project would only serve as a stop-gap measure for the preservation of high ground until such time as a more permanent solution is effected through Federal programs.

THE CONTINUING PROBLEM

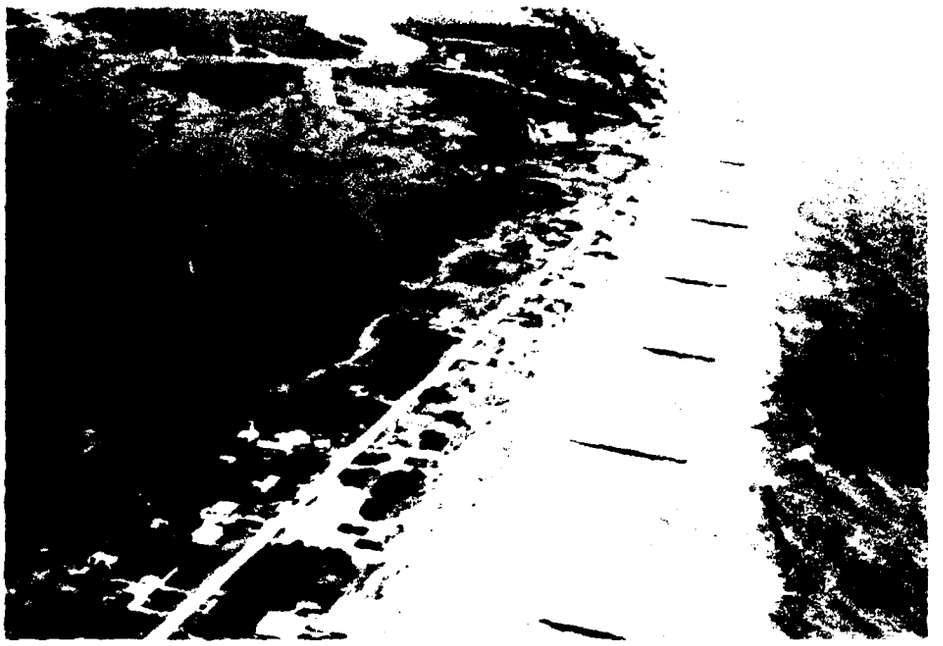
Future Shoreline Positions. To gain insight into the future, historical shoreline change rates measured at the seven selected locations on Folly Island were used to predict future positions of the shoreline. Possibilities were plotted on the January 1977 aerial photographs (Plates 2 through 6) so that the hazards to development, existing

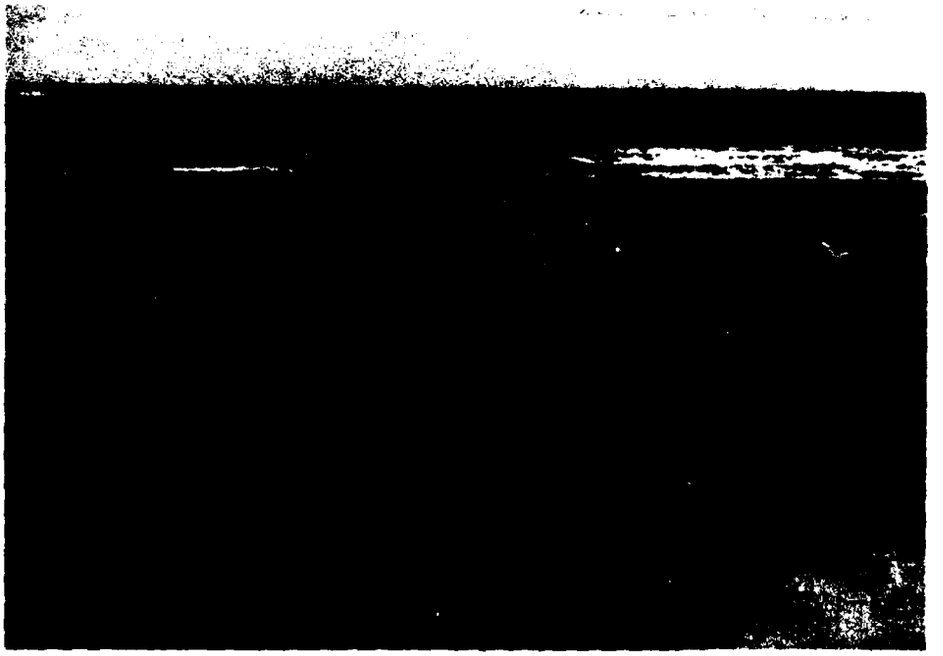
at that time, could be reasonably determined. Both the long term rates (based on 128 years of record - 1849 to 1977) and short term rates (based on 22 years of record - 1955 to 1977) are displayed. Since beach restoration and nourishment would more nearly simulate the natural beach, the long term erosion rate is considered more applicable to determine annual nourishment requirement. The man-made structures which have greatly influenced the short term erosion rate would be mostly covered by the beach fill.

Beach Problems. Had there been no efforts to control the erosion at Folly Beach, the condition of the beach in the future would be essentially the same as it has been in the past. Man, in his attempts to hold the high land, has placed artificial barriers to the erosive energy of incoming waves. These structures have at best resulted in a temporary solution to the problem they were meant to solve; however, the erosion of the beach strand and berm goes on, often at an accelerated rate because of the reflective nature of corrective structures. As the beach continues to erode, less and less area is available for recreational use while foundations supporting protective structures become more and more exposed to the forces of the ocean. For that matter, the whole structures' exposure increases as the erosion continues.

With the passage of time, many of the structures will fail from the piping of materials from behind. This process is apparent at the Pavilion area seawall. The beach fronting this wall has been lowered by erosion to such an extent that cracks in the construction joints, which are not sand tight, are exposed to pulsating hydraulic forces for a considerable portion of the normal tide cycle. Sand has piped out through these cracks and failures are apparent in the concrete slab walks which are supported on wall backfill.

Should this piping be allowed to continue, all of the backfill, which resists the overturning forces of the sea as well as serving as a base for walks and some of the buildings, will ultimately pipe away.





TIMBER AND ROCK GROINS

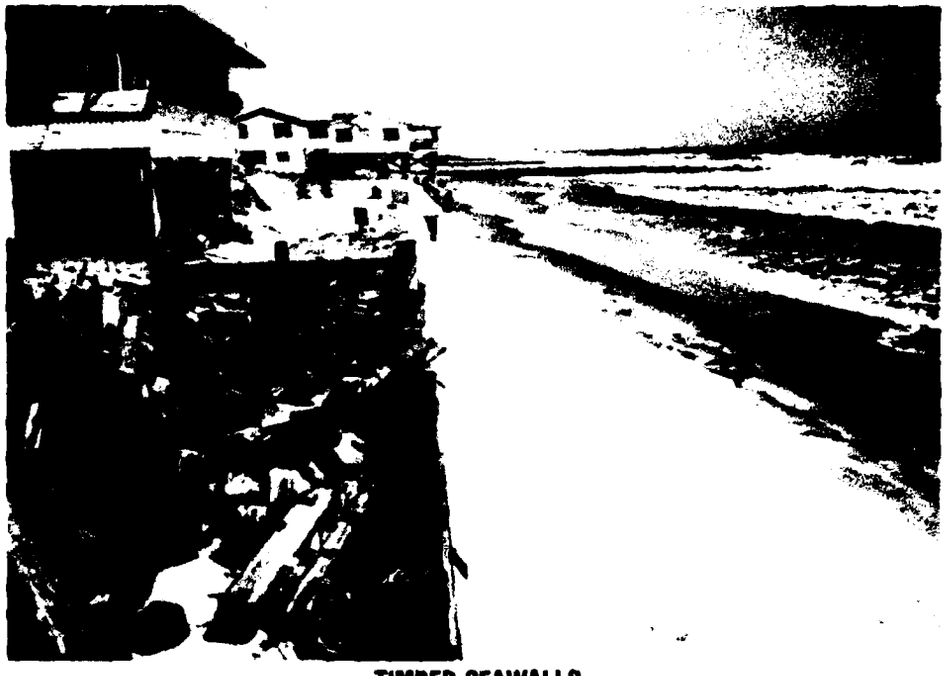
FIGURE 7

ROCK AND RIP RAP REVETMENT

FIGURE 8

CONCRETE SEAWALLS

FIGURE 9



TIMBER SEAWALLS

FIGURE 10

When this happens, the wall will probably fall, leaving an exposed headland. This will erode at an accelerated rate until that segment of shore better conforms to the alignment updrift and downdrift. Proof of this geomorphic phenomenon is shown in photographs of lesser private structures along the beach (see Figure 10 which precedes this page).

Failure of protective structures allows nature to create a higher and wider beach than that normally found fronting such structures before failure. This, of course, is achieved with a loss of high land and of the appurtenances constructed thereon.

IMPROVEMENTS DESIRED

During the course of this study, individuals and groups were afforded many opportunities to express their desires concerning corrective works for hurricane surge and shore erosion problems. Three formal public meetings were held to afford the general public a structured opportunity for participation in accomplishing the tasks which had to be performed in the formulation of a solution to these problems. These meetings were held in March 1976, November 1977 and December 1978. Viewpoints varied, widely depending upon the hazard to one's property, pocketbook, and/or one's recreational opportunities. Four distinct perspectives were apparent. These were classed as the Back Island Citizen, Front Beach Owner, Visiting Day User, and Dynamite Hole Viewpoints.

Back Island Citizen's Viewpoint. In general, the back island citizens selected the Town of Folly Beach as their place of residence because it is widely separated from the nearby larger community and offers an opportunity for an independent life style. These citizens would like to see the erosion stopped and hurricane damage to improvements prevented, but will not tolerate a significant increase in their tax liability.

Front Beach Owner Viewpoint. Front beach property owners are interested mainly in preserving their land and the appurtenances constructed thereon. As far as the beach strand is concerned, this special interest group would be satisfied with enough beach to meet their personal needs and the needs of those who rent their cottages and apartments. Recognizing that the opportunity for Federal assistance along private shores is contingent upon public use, this group is willing to encourage widespread public use of the beach. Merchants in the business district also support widespread usage of the beach as a means of stimulating business.

Visiting Day User Viewpoint. Most of the beach users during the season come from many areas of South Carolina and from other states. A majority of these day users come from Berkeley, Charleston and Dorchester Counties. They are concerned primarily with problems of low quality and crowded beaches; hazards to bathers caused by groins, other protection works and root stubble; difficult access to the beach; lack of parking; and lack of sanitary facilities for beach strands distant from the central business district.

"Dynamite Hole" Viewpoint. The last identifiable group comes from no specific locality and/or special interest group. These are the people who are convinced, without factual evidence, that a dynamite hole was blown in the south jetty at the entrance to Charleston Harbor by the Corps of Engineers. They are vocal in expounding the liability of the United States Government for eradicating erosion along Folly and Morris Islands at no cost to the local people as restitution for damages caused by the "dynamite hole". This group contends that closure of the "dynamite hole" will immediately resolve the erosion problem. This group has been referred to 19th century Annual Reports of the Chief of Engineers which record the intentional design and construction of the low sections incorporated in both of the jetties protecting the entrance to Charleston Harbor. The design appears to be working and it is the Corps' position that the jetties are not affecting changes in the Folly Beach shoreline to any discernible degree. The low weir sections "dynamite hole", are discussed in more detail in Section C of Appendix 1.

From the preceding, it is apparent that the viewpoint as to what is a proper solution to the erosion problem is influenced mainly by individual point of perspective. Boiling all of these viewpoints down, it is concluded that the people want a cost and environmentally effective solution that will receive significant Federal funding. They also feel that the non-Federal cost should be supplied by the direct beneficiaries of the work with little or no additional tax burden or direct cost burden being placed on non-beneficiaries. As far as hurricane surge protection is concerned, most would consider approval of this type of protection only if the Federal Government picks up the tab, and if the structure satisfying the purpose doesn't block views and/or interfere with private land use and beach access.

Formulating a Plan

Formulating a plan that will satisfy the needs for beach erosion control, hurricane protection, and solutions to related problems at Folly Beach involves the consideration of several alternative measures. Each potential solution was considered on the basis of its economic, environmental, and social impacts. In order to formulate the best alternative plan of improvement, it is imperative to consider all appropriate alternative plans and assess all project effects - tangible and intangible, favorable and unfavorable. Details of the plans considered and the formulation process are given in Section G of Appendix 1.

FORMULATION AND EVALUATION CRITERIA

Federal policy on multiobjective planning, derived from both legislative and executive authorities, established and defines the national objective for water resource planning, specifies the range of impact that must be assessed and sets forth the conditions and criteria which must be applied when evaluating plans. Plans must be formulated with due regard to benefits and costs, both tangible and intangible, and effects on the environmental and

social well-being of the region; and the plans must be institutionally feasible.

The planning criteria uses a framework established in the Water Resource Council's "Principles and Standards for Planning Water and Related Land Resources", which requires the systematic preparation and evaluation of alternative solutions to problems, under the objectives of National Economic Development (NED) and Environmental Quality (EQ). The process also requires that the impacts of a proposed action be measured and the results displayed or accounted for in terms of contributions to four accounts: NED, EQ, Regional Development (RD), and Social Well-Being (SWB). The formulation process must be conducted without bias as to structural and non-structural measures.

Formulation and evaluation of the plans of improvement for Folly Beach including all possible alternatives, were based on technical, economic, and intangible criteria summarized in the following paragraphs. Such criteria permit the selection of that plan that best responds to the problems and needs of the area.

Technical Criteria

Technical criteria used for the formulation and evaluation of alternative solutions to the problems of Folly Beach are consistent with established Corps of Engineers Regulations. These regulations provided guidance for carrying out the various tasks of multiobjective planning, consistent with the Water Resource Council's Principles and Standards and related policies.

Economic Criteria

The economic criteria which were applied in formulating a plan are those specified by the Principles and Standards. Economic benefits were developed in accordance with instructions contained in related Engineering Regulations. Additional economic criteria used to develop the recommended plan include the following:

a. A National Economic Development (NED) Plan was formulated to maximize the net economic benefits while addressing project objectives.

b. Tangible benefits exceeded cost for the NED Plan.

c. All prices applied to estimated construction quantities are based on April 1979 estimates.

d. A project life expectancy of 50 years and an interest rate of 6-7/8% were used in computing project costs and benefits.

e. Estimated construction time of the project is less than two years, therefore, no interest was included during construction.

Environmental and Other Criteria

The following environmental criteria and intangibles were considered in formulating a plan.

a. An Environmental Quality Environmentally Oriented (EQ) Plan was formulated with the goal of making the most significant contribution to preserving, maintaining, restoring and/or enhancing the cultural and natural resources of the study area.

b. All alternatives considered were compatible insofar as was practical with the surrounding environment.

c. All efforts were made to avoid detrimental environmental effects and whenever feasible, mitigating features were considered for such effects.

d. Public health, safety and social well-being were considered when formulating all alternatives.

e. Public acceptance of various alternatives was considered in formulating each plan and feasible alternatives were coordinated with interested agencies and individuals through correspondence, public meetings and other procedures.

POSSIBLE SOLUTIONS

Several alternative measures to satisfy the problems and needs of the area are possible; however, some of these measures are not practical or economical. Possibilities include:

a. Nonstructural measures such as zoning and building code regulations, flood proofing of both individual buildings or groups of buildings and permanent or temporary evacuation of flood plain areas and/or active erosion zones, and relocation of structures from these zones.

b. Structural measures such as seawalls, revetments, offshore breakwaters, and nourishment of the beach;

c. "Do-nothing" alternative which perceives the continuation of existing conditions; and

d. A combination of structural and nonstructural measures.

Zoning and building code regulations are legal measures that could be implemented and enforced by the regulating agency concerned to effectively reduce the flood damage potential of an area in accordance with a planned program of development and land use. Such action would be desirable in order to preclude possible future development that would suffer large damages. Table 2 summarizes the alternatives considered in each stage of the planning process.

PLANS CONSIDERED FURTHER

Analysis of possible solutions indicated nonstructural measures, other than those presently being implemented, to be of limited benefit and point to structural measures as being the best means of meeting the needs of the study area. The best non-structural plan was found to be relocation of beach front buildings and allowing the shoreline to continue

TABLE 2

SUMMARY OF ALTERNATIVES

	ALTERNATIVE	STAGE 1	STAGE 2	STAGE 3
NON-STRUCTURAL	Relocation of Structures	X	X	X
	Evacuation Planning	X		
	Flood Insurance [1/]	X		
	Zoning & Mod. of Bldg. Codes	X	X	
	Regulation of Flood Plain [1/]	X		
	Floodproof Structures	X		
	Grass Existing Beach	X		
	No Growth	X		
	Do Nothing (No Action)	X	X	X
STRUCTURAL	Beach Development	X	X	X
	Beach Revetment	X		
	Seawall	X		
	Offshore Breakwater	X	X	
	Beach & Dune Development	X	X	X
	Dynamite Hole Closure	X		

[1/] The City of Folly Beach is participating in the National Flood Insurance Program and has implemented corresponding flood plain regulations.

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eroding. In view of the planning objectives, and the technical economic and socio-economic criteria, beach development and beach and dune development alternatives are the best all around solutions. Other structural measures: revetment, seawalls, and offshore breakwaters were found to be more expensive and less enviromentally desirable. Accordingly, along the "No Action" and "Relocation of Structures" plans, these two structural plans were selected for consideration in greater detail.

Relocation of Structures. The best non-structural plan was found to be relocation of beach front buildings and allowing the shoreline to continue to erode. Based on the predicted long term future shoreline shown on the aerial mosaic (Plates 2 through 6) about 260 buildings would need to be relocated. The present cost of relocating these structures and purchasing new lots is estimated at $3,502,000 and the value of these buildings that would be lost to erosion over the life of the project without relocation is estimated at $6,425,000. Comparing the annual cost of relocating, $73,000, with the resulting average annual losses of buildings without relocation, $79,000, the benefit to cost ratio for the relocation plan is 1.08; thus, this alternative is economically feasible. It is not, however, favored by those locals directly affected by erosion and the danger of storm wave damage.

Do Nothing (No Action) Plan. The "No Action" alternative perceives the continuation of existing conditions and no new solution for existing problems. This option, although not favored by local study sponsors, avoids both the monetary investment and potential adverse impacts associated with structural improvements. Effects of the "No Action" plan provides a basis for evaluating impacts of the other plans.

Beach Development Alternative. The beach development alternative was evaluated through the analysis of six different options which differ only in scale. These optional plans are designated as plans A-0 through

A-5. The location of beach protected by each plan is shown on Figure 11 and pertinent physical dimensions are summarized in Table 3. Figure 12 displays typical sections for the "Beach" and "Beach and Dune" plans, respectively.

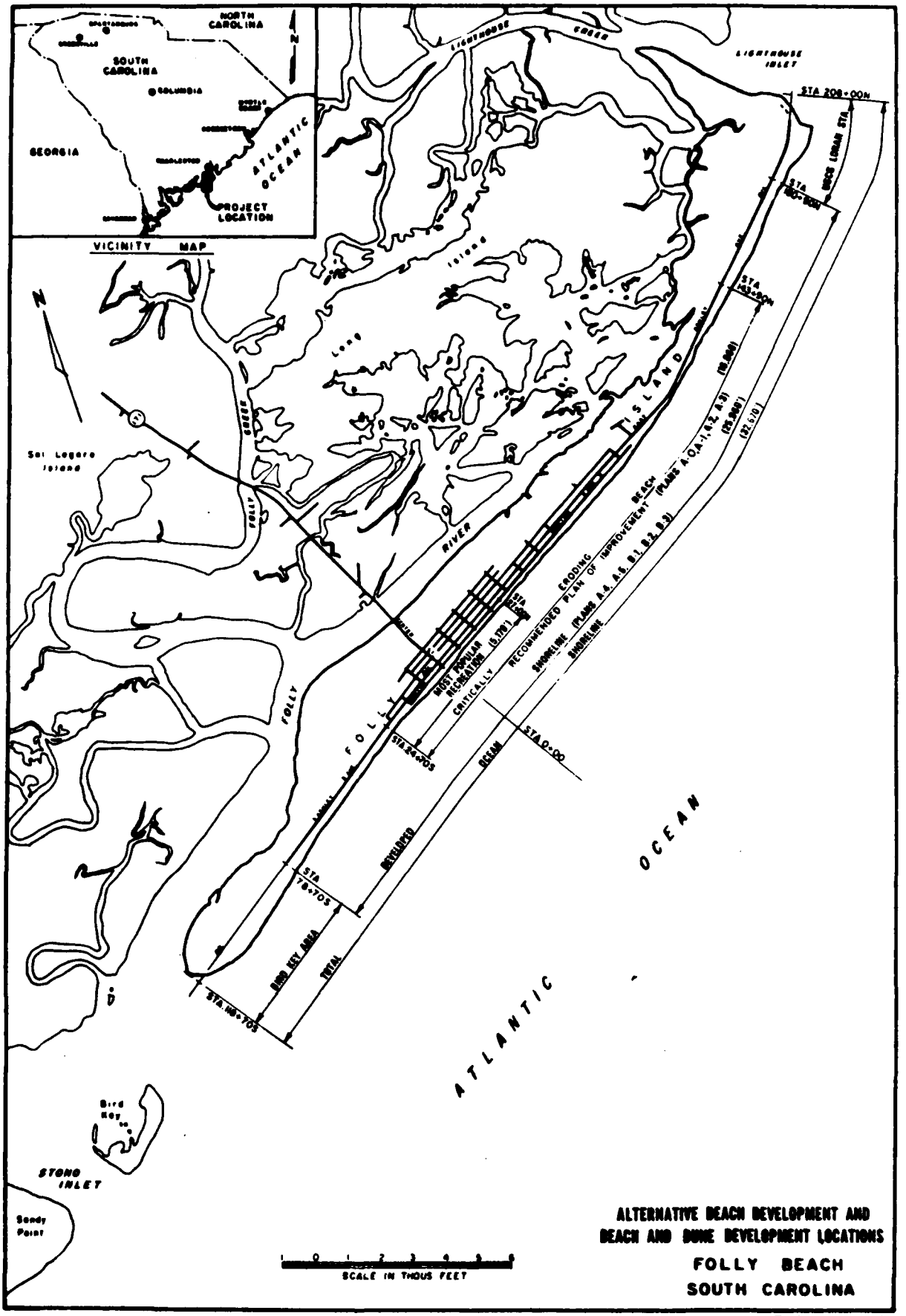
The Beach Development Plans would involve borrowing sand from offshore and restoring the beach to a fuller, wider section. Since natural erosion would continue, the beach would require periodic nourishment by pumping in more sand. A minimal beach berm elevation of four feet above mean sea level and a minimal dry-beach width which will average 50 feet between periodic nourishment operations was determined through stage frequency and design analysis as that necessary to effectively resist attack by normal wave action and the effects of frequent storms. The usable dry-beach was considered to be the expanse between the hold line and mean high water. Where a dune is incorporated in the protective scheme, the usable dry-beach would be the expanse between the oceanward toe of the dune and the beach face at mean high water.

Plan A-0 is considered to be the minimal plan since the length of shoreline improved (17,000 feet) is currently experiencing critical erosion, thus any shorter length would not be appropriate. The berm width for the shoreline protected by this plan would average 50 feet between renourishment periods (5 years) but the flat berm at elevation 4 feet, msl is expected to erode to zero feet width at the time renourishment is due. Therefore, smaller plans than A-0 would not solve even the most critical erosion problem at Folly Beach and thus were not further considered.

Beach and Dune Development Alternative. Three beach and dune development plans, designated as B-1 through B-3, Figure 12, were analyzed in Stage 3. The three plans encompass the same reach of beach, Station 78+70S to 180+90N, as shown on Figure 11. The main difference in these plans is in the degree of protection provided by the three different dune heights. (Table 3).

The main difference between the beach and dune development plans and the beach development plans is the provision of an artificial dune system. Derivation of the minimal widths of dune and beach berms necessary for storm protection was based on an analysis of design storm parameters and estimated corresponding erosion rates. Dune shore and seaward slopes of 1-vertical and 5-horizontal, and storm berm and beach nourishment fill slopes of 1-vertical to 30-horizontal were selected for stability.

After establishing horizontal dimensions on the basis of design analysis, vertical requirements were evaluated. Determination of the

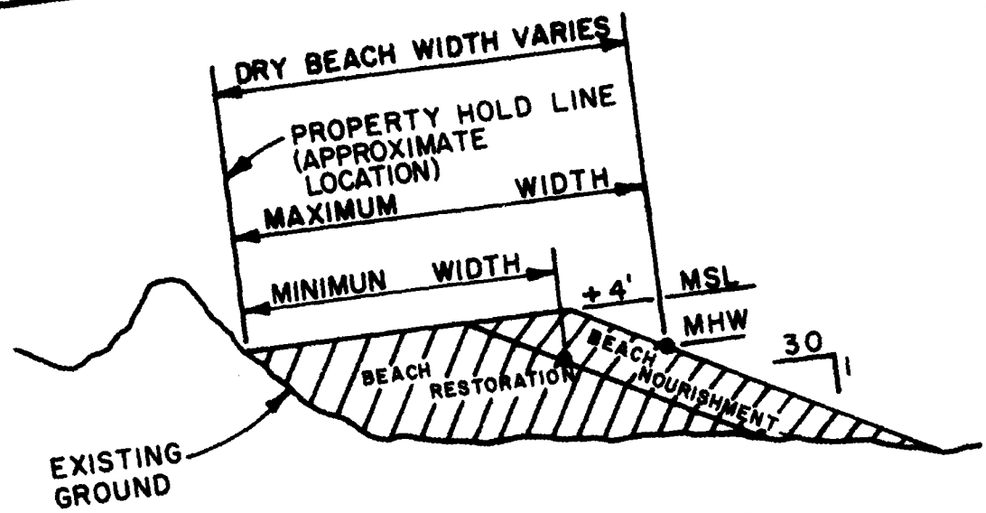


ALTERNATIVE BEACH DEVELOPMENT AND BEACH AND DUNE DEVELOPMENT LOCATIONS

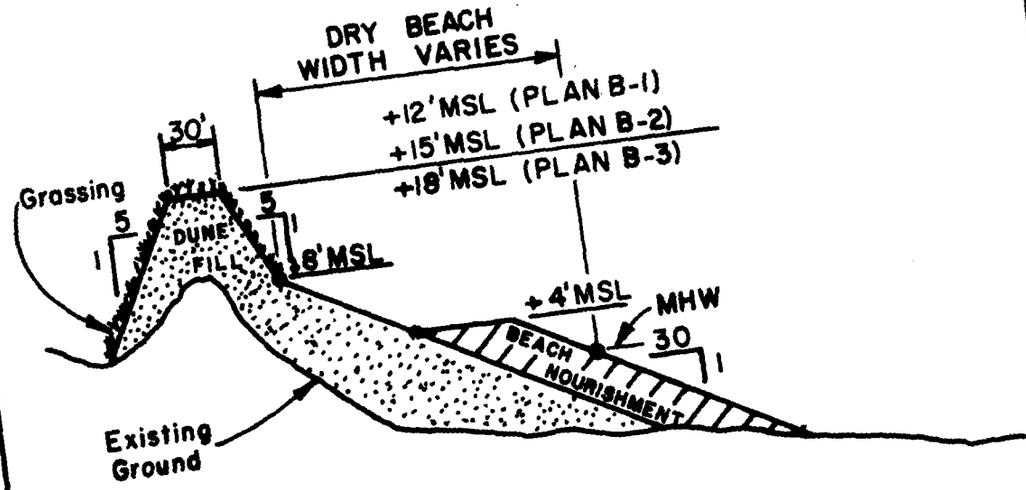
FOLLY BEACH

SOUTH CAROLINA

FIGURE 11



BEACH DEVELOPMENT



BEACH AND DUNE DEVELOPMENT

TYPICAL SECTIONS OF CONSIDERED PLANS AT FOLLY BEACH, S.C.

NOTE:
0' MSL = 2.4' MLW

REV. 28 MAR. '80 FIGURE 12

TABLE 3

SUMMARY OF BEACH DEVELOPMENT AND BEACH AND DUNE DEVELOPMENT PLANS

Plan	STA 24+70S to 27+00N Avg. Berm Width (ft)	STA 27+00N to 143+90N Avg. Berm Width (ft)	STA 143+90N to 180+90N Avg. Berm Width (ft)	STA 24+70S to 78+70S Avg. Berm Width (ft)	STA 78+70S to 180+90N Dune Heights (ft msl)
A-0	50	50			
A-1	100	50	---	---	
A-2 [1/]	150	50			
A-3 [1/]	150	100			
A-4	100	50	50	50	
A-5 [1/]	150	100	50	50	
B-1 [1/]					12
B-2 [1/]					15
B-3 [1/]					18

[1/] Plan will require lengthening existing groins seaward for beach widths greater than 100 feet.

optimum dune elevation required a comparison of estimated costs for varying storm protection levels with benefits for each level of improvement. Dune heights of 12 feet m.s.l., 15 feet m.s.l., and 18 feet m.s.l. were analyzed. These would provide wave damage protection from storms with frequencies of occurrences of 25, 50, and 100 years, respectively.

The estimated annual equivalent benefits, annual charges, benefits to cost ratio, and excess benefits to cost are given in Table 4. It can be seen here that Plan A-4 of the beach development plans and B-1 of the beach and dune development plans have the greatest excess benefits to cost of the two types of structural plans remaining in the iterative process.

Flood Plain Management Alternatives. The best non-structural plan was found to be relocation of beach front buildings and allowing the shoreline to continue eroding. Based on the predicted long-term future shoreline shown on aerial mosaic, Plates 2 through 6, about 260 buildings would need to be relocated. The value of these buildings average about $25,000 each. Comparing the annual cost of relocation, $73,000, with the resulting average annual building losses without relocation, $79,000, the benefit to cost ratio is 1.08 and the excess benefits over annual cost is $6,000.

This plan and the do-nothing alternative would avoid potential adverse impacts associated with structural improvement; both of these non-structural plans, however, are not favored by local interest.

Selecting a Plan

BASIS FOR SELECTION

The selection of the best plan of improvement for Folly Beach involved the comparison of the various alternatives which met the formulation and evaluation criteria outlined earlier. Consideration was given to

TABLE 4

COMPARISON OF COSTS AND BENEFITS 1/

Plan	Annual Benefit	Avg. Annual Cost	Benefit to Cost Ratio	Excess Benefits to Cost
Beach Development Plans				
A-0	$ 887,200	$ 396,300	2.2	$ 490,900
A-1	953,700	419,800	2.3	533,900
A-2	977,500	460,400	2.1	517,100
A-3	966,300	523,100	1.8	443,200
A-4	1,060,600	521,000	2.0	539,600
A-5	1,060,600	620,500	1.7	440,100
Beach and Dune Development Plans				
B-1	$1,051,000	$ 996,200	1.06	$ 54,800
B-2	1,086,500	1,264,100	0.9	0
B-3	1,105,200	1,589,400	0.7	0

1/ Figures are rounded to the nearest $100.

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environmental effects, social well-being, the regional development and the national economic development. During the selection process, all alternatives were presented to the public at a public meeting held at Folly Beach on 29 November 1977. The transcripts of the three public meetings are on file for public review in the Charleston District office.

System of Accounts. The System of Accounts (S of A) shown as Table 5 is a display requirement of the Water Resource Council, "Principles & Standards" and is an integral part of the planning process. The System of Accounts displays all significant beneficial and adverse contributions of each alternative carried through the final planning stage and provides a useful tool to assist in the selection process. The S of A also satisfies the display requirements of Section 122, Public Law 91-611, River and Harbor and Flood Control Act of 1970. Table 5 displays the breadth and detail of the assessment and evaluation of all alternative plans. Table 12 summarizes Table 5 and presents the crucial planning consideration underlying each alternative. Table 12 is presented later in this report in the section entitled "Statement of Findings."

IDENTIFICATION OF "NED" AND "EQ" PLANS

The NED Plan. The Principles and Standards require the designation of National Economic Development (NED) Plan. This plan is described as the plan which best addresses the planning objectives in a way which maximizes net economic benefits. Plan A-4, which addresses beach development only, maximizes net economic benefits as is shown in Table 4. This plan, therefore, is selected as the NED Plan.

The EQ Plan. The Principles and Standards also require the designation of an Environmental Quality Plan (EQ Plan). This plan is described as the plan which will make a positive contribution to the environment and the most significant contribution to preserving, maintaining, restoring, or enhancing cultural and natural resources. The existing conditions of the study area weighed heavily in selecting an EQ Plan. Plan B-1, which addresses Beach and Dune Development, is selected as the EQ Plan. This

TABLE 5 - SYSTEM OF ACCOUNTS

(For Explanation of Terms, see Footnotes at end of Table.)

ACCOUNTS AND EFFECTS	PLAN A-0 (RECOMMENDED) LOCATION OF IMPACT: WITHIN THE STUDY AREA	PLAN A-0 (RECOMMENDED) LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality	PLAN A-4 (NED) LOCATION OF IMPACT: WITHIN THE STUDY AREA	PLAN A-4 (NED) LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality	PLAN B-1 (EQ) LOCATION OF IMPACT: WITHIN THE STUDY AREA	PLAN B-1 (EQ) LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality	RELOCATION OF STRUCTURES (EO 11988) 2/ LOCATION OF IMPACT: WITHIN THE STUDY AREA	RELOCATION OF STRUCTURES (EO 11988) 2/ LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality	NO ACTION LOCATION OF IMPACT: WITHIN THE STUDY AREA	NO ACTION LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality
1. National Economic Development																																
a. Beneficial Impacts																																
(1) Beach Erosion - Annual	$ 209,500		1	6		9	$ 304,000		1	6		9	$ 304,000		1	6		9														
(2) Recreation-Annual	681,500		1	6		9	760,600		1	6		9	738,100		1	6		9														
(3) Hurricane Wave Damage	0		1	6		9	0		1	6		9	12,900		1	6		9	$ 79,100 12/													
(4) Total NED Benefit -Annual	$ 891,000		1	6		9	$1,064,600		1	6		9	$1,055,000		1	6		9														
b. Adverse Impacts			1	6																												
(1) Project First Costs	$2,554,000		1	6		9	$3,601,000		1	6		9	$9,026,000		1	6		9														
(2) Annual Capital Costs	181,700		1	6		9	256,400						700,300																			
(3) Annual OMR Costs	225,600		1	6		9	277,800		1	6		9	309,100		1	6		9														
(4) Total Annual Cost	$ 407,300		1	6		9	$ 534,200						$1,009,400						$ 73,300 13/													
c. Net NED Benefits	$ 483,700		1	6		9	$ 530,400		1	6		9	$ 45,600		1	6		9	$ 5,800													
2. Environmental Quality	WITHIN THE STUDY AREA						WITHIN THE STUDY AREA						WITHIN THE STUDY AREA						WITHIN THE STUDY AREA						WITHIN THE STUDY AREA							
a. Environmental Quality Enhanced																																
(1) Esthetics	Three miles of critically eroded beach would be restored which would enhance scenic qualities.		1	6		9	Three miles of critically eroded beach plus two additional miles of eroded beach would be restored. Scenic enhancement would be greater than A-0.		1	6		9	Same as Plan A-4. Approximately 4 mi. of additional vegetated dunes would enhance natural beauty & provide visual isolation of beach from traffic & commercial activity. Unsightly seawalls & revetments would be covered by dune system.		1	6		9	No enhancement of beach. No enchancement of dunes. Decline in visitation rate may reduce litter & traffic congestion problems.		2	5		9	No enhancement of beach. No enhancement of dunes Decline in visitation rate may reduce litter & traffic congestion problems.		2	5		9
(2) Man-made Resources	No additional enhancement. Threat of wave & hurricane damage would be reduced but to a smaller degree than for A-4 or B-1.		1	6		9	No additional enhancement. Threat of wave & hurricane damage would be reduced more than for A-0 but less than for B-1		1	6		9	Threat of wave & hurricane damage would be reduced more than for A-0 or A-4		1	6		9	No Positive contribution.						No positive contribution					
(3) Natural Resources	Improved storm protection would encourage maintenance & improvement of homes & commercial establishments, but to a smaller degree than A-4 or B-1.		2	5		9	Improved storm protection would encourage maintenance & improvement of homes & commercial establishments to a greater extent than A-0 but a smaller degree than B-1.		2	5		9	Protection from 25-year storm would result		1	6		9														
	Three miles of critically eroded beach would be restored.		1	6		9	Three miles of critically eroded beach plus two additional miles of eroded beach would be restored.		1	6		9	Improved storm protection would encourage maintenance & improvements of homes & commercial establishments to a greater extent than A-0 or A-4.		2	5		9	No enhancement of beach. No enhancement of dunes						No positive contribution. No enhancement of beach. No enhancement of dunes.					
(4) Air Quality	No additional enhancement.						No additional enhancement.						Same as Plan A-4 Approx. 4 miles of add'l vegetated dunes would provide habitat for rodents, rabbits, birds.		1	6		9														
(5) Noise	No enhancement.						No enhancement.						Some benefit to island vegetation would result in add'l salt spray protection		1	6		9	Decline in visitation rate may reduce auto emissions		2	5		9	Decline in visitation rate may reduce auto emissions.		2	5		9
	No enhancement.						No enhancement.						(4) No enhancement. (5) Noise from auto traffic & commercial activities would be partially isolated by recreational beach & dune system		1	6		9	Decline in visitation rate may reduce traffic & people noise		2	5		9	Decline in visitation rate may reduce traffic noise		2	5		9
b. Environmental Quality Degraded																																
(1) Esthetics	Litter & trash on landscape may increase in proportion to higher visitation rate. Effects would be less severe than A-4 or B-1.		2	5		9	Litter & trash on landscape may increase in proportion to higher visitation rate. Effects would be more severe than A-0 but less than B-1		2	5		9	Litter & trash on landscape may increase in proportion to higher visitation rate Effects would be more severe than A-0.		2	5		9	No enhancement of beach No enhancement of dunes. Pilings and foundations left from relocated structures may be unsightly		2	6		9	No negative contribution No negative contribution Unchecked erosion would perpetuate construction by property owners of unsightly seawalls revetments etc		2	6		9
	Traffic congestion may increase in proportion to higher visitation rate. Effects would be less severe than A-4 or B-1.		2	5		9	Traffic congestion may increase in proportion to higher visitation rate. Effects would be more severe than A-0 but less than B-1		2	5		9	Traffic congestion may increase in proportion to higher visitation rate Effects would be more severe than A-0.		2	5		9														
	No negative contribution.						No negative contribution.						No negative contribution																				
(2) Man-made Resources	No negative contribution.						No negative contribution.						No negative contribution						Threat of wave and hurricane damage would continually worsen		1	5		9	Threat of wave & hurricane damage will continually worsen.		1	5		9
(3) Natural Resources	Benthic communities of borrow and beach fill areas would suffer temporary population reductions Recovery should occur in 6 to 18 months. Adverse effects would be less severe						Benthic communities of borrow and beach fill areas would suffer temporary population reductions Recovery should occur in 6 to 18 months Adverse effects would be more severe						Benthic communities of borrow & beach fill areas would suffer temporary population reductions Recovery should occur in 6 to 18 months Adverse effects would be more severe than												No negative contribution					

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TABLE 5 - SYSTEM OF ACCOUNTS (CONT'D)

(For Explanation of Terms, see Footnotes at end of Table.)

ACCOUNTS AND EFFECTS	PLAN A-1 (RECOMMENDED) LOCATION OF IMPACT	Timing	Uncertainty	Exclusivity	Actuality	PLAN A-4 (NED) LOCATION OF IMPACT	Timing	Uncertainty	Exclusivity	Actuality	PLAN B-1 (EQ) LOCATION OF IMPACT	Timing	Uncertainty	Exclusivity	Actuality	RELOCATION OF STRUCTURES (EO 11988) LOCATION OF IMPACT	Timing	Uncertainty	Exclusivity	Actuality	NO ACTION LOCATION OF IMPACT	Timing	Uncertainty	Exclusivity	Actuality
2. Environmental Quality	WITHIN THE STUDY AREA					WITHIN THE STUDY AREA					WITHIN THE STUDY AREA					WITHIN THE STUDY AREA					WITHIN THE STUDY AREA				
(3) Natural Resources (Cont'd)	than A-4 or B-1 due to smaller required volume to fill. No negative contribution. No negative contribution.	1	6		9	than A-0 but less severe than B-1. No negative contribution. No negative contribution.	1	6		9	A-0 or A-4. Existing dune vegetation may be damaged or destroyed in some areas as a result of construction. Vegetation would be replaced as part of the proposed action. No negative contribution.	1	6		9	Existing dunes and dune vegetation may suffer damage or destruction if erosional trends continue unchecked. Amount of dry beach area would continue to diminish if erosional trends continue unchecked	2 1	5 6		9 9	Existing dunes and dune vegetation may suffer damage or destruction if erosional trends continue unchecked. Amount of dry beach area would continue to diminish if erosional trends continue unchecked.	2 1	5 6		9 9
(4) Water Quality	Temporary turbidity from project construction would occur in area of dredging & near beach fill sites. Effects would be less severe than A-4 or B-1 since smaller quantities of material would be involved.	1	6		9	Effects similar to A-0 but more severe. Effects less severe than B-1	1	6		9	Effects similar to A-0 but more severe than A-0 or A-4.	1	6		9	No negative contribution.					No negative contribution.				
(5) Air Quality	Auto emissions would increase in proportion to higher visitation rate. Effects would be less severe than A-4 or B-1.	2	5		9	Auto emissions would likely increase more than for B-1.	2	5		9	Auto emissions would increase to a greater extent than for A-0 or A-4.	2	5		9	No negative contribution					No negative contribution.				
(6) Noise	Noise from traffic and human activity would increase in proportion to higher visitation rate. This plan would lead to lower peak noise levels than A-4 or B-1.	2 2	5 5		9 9	Effects would be similar to A-0. Noise would be a greater problem than for A-0 but less than for B-1.	2	5		9	Effects would be similar to A-0. Noise would be more severe than for A-0 or A-4.	2	5		9	No negative contribution					No negative contribution				
	WITHIN THE STUDY AREA / WITHIN THE REST OF THE NATION					WITHIN THE STUDY AREA / WITHIN THE REST OF THE NATION					WITHIN THE STUDY AREA / WITHIN THE REST OF THE NATION					WITHIN THE STUDY AREA / WITHIN THE REST OF THE NATION					WITHIN THE STUDY AREA / WITHIN THE REST OF THE NATION				
b. Beneficial Impacts																									
*(1) Community Cohesion	Increase but less than A-4 or B-1. / Negligible	2	5		9	Increase more than A-0 but less than B-1. / Negligible	2	5		9	Increase more than A-0 or A-4. / Negligible	2	5		9	No positive effects. / Negligible	2	5		9	No positive effects. / Negligible	2	5		9
*(2) Community Growth	Slight increase but less than A-4 or B-1. / Negligible	2	5		9	Increases more than A-0 but less than B-1. / Negligible	2	5		9	Increases more than A-0 or A-4. / Negligible	2	5		9	No positive effects. / Negligible	2	5		9	No positive effects. / Negligible	2	5		9
(3) Recreational Opportunities	Increases but less than A-4 or B-1. / Negligible	1	6		9	Increases more than A-0 but less than B-1. / Negligible	1	6		9	Increases more than A-0 or A-4. / Negligible	1	6		9	No positive effects. / Negligible	1	6		9	No positive effects. / Negligible	1	6		9
c. Adverse Impacts																									
*(1) Community Cohesion	No adverse effects. / Negligible	2	5		9	No adverse effects. / Negligible	2	5		9	No adverse effects. / Negligible	2	5		9	Decreases / Negligible	2	5		9	Decreases / Negligible	2	5		9
*(2) Community Growth	No adverse effects / Negligible	2	5		9	No adverse effects. / Negligible	2	5		9	No adverse effects / Negligible	2	5		9	Decreases / Negligible	2	5		9	Decreases / Negligible	2	5		9
(3) Recreational Opportunities	No adverse effects / Negligible	1	6		9	No adverse effects. / Negligible	1	6		9	No adverse effects. / Negligible	1	6		9	Decreases / Negligible	1	6		9	Decreases / Negligible	1	6		9
*(4) Displacement of People and Community Disruption	No adverse effects. / Negligible	1	6		9	No adverse effects. / Negligible	1	6		9	No adverse effects. / Negligible	1	6		9	Decreases / Negligible	1	6		9	Decreases / Negligible	1	6		9
4. Other Economic Effects																									
a. Beneficial Impacts																									
*(1) Tax Revenues	Increases tax revenues but to lesser degree than A-4 or B-1. / Negligible	1	6		9	Increases tax revenues above A-0 but less than B-1. / Negligible	1	6		9	Provide greater revenues than A-0 or A-4. / Negligible	1	6		9	No positive effects. / Negligible	1	6		9	No positive effects / Negligible	1	6		9
*(2) Property Values	Increases property values but to lesser degree than A-4 or A-1. / Negligible				9	Increases property values above A-0 but less than / Negligible	2	6		9	Increases property values above that of A-0 or A-4 / Negligible					No positive effects / Negligible					No positive effects / Negligible	2	6		9

TABLE 5 - SYSTEM OF ACCOUNTS (CONT'D)

(For Explanation of Terms, see end of Table.)

ADDENDUM AND EFFECTS	PLAN A-1 (RECOMMENDED) LOCATION OF IMPACT: WITHIN THE STUDY AREA	PLAN A-1 (RECOMMENDED) LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality	PLAN A-4 (NED) LOCATION OF IMPACT: WITHIN THE STUDY AREA	PLAN A-4 (NED) LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality	PLAN B-1 (NED) LOCATION OF IMPACT: WITHIN THE STUDY AREA	PLAN B-1 (NED) LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality	RELOCATION OF STRUCTURES (EO 11988) LOCATION OF IMPACT: WITHIN THE STUDY AREA	RELOCATION OF STRUCTURES (EO 11988) LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality	NO ACTION LOCATION OF IMPACT: WITHIN THE STUDY AREA	NO ACTION LOCATION OF IMPACT: WITHIN THE REST OF THE NATION	Timing	Uncertainty	Exclusivity	Actuality
6. Other Economic Effects																																
a. Beneficial Impacts (Cont'd)																																
(3) Public Service	No positive effects.	Negligible	2	6		9	No positive effects.	Negligible	2	6		9	No positive effects.	Negligible	2	6		9	No positive effects.	Negligible	2	6		9	No positive effects.	Negligible	2	6		9
(4) Regional Growth	Encourages regional growth but less than A-4 or B-1.	Negligible	2	5		9	Encourages regional growth more than A-2 but less than B-1.	Negligible	2	5		9	Encourages regional growth more than A-0 or A-4.	Negligible	2	5		9	No positive effects.	Negligible	2	5		9	No positive effects.	Negligible	2	5		9
(5) Employment/Labor Force	Increases employment/ labor force but less than A-4 or B-1.	Negligible	2	5		9	Increases employment/ labor force more than A-0 but less than B-1.	Negligible	2	5		9	Increases employment/ labor force more than A-0 or A-4.	Negligible	2	5		9	No positive effect.	Negligible	2	5		9	No positive effects.	Negligible	2	5		9
(6) Business and Ind Activity	Increases business & Ind activity but less than A-4 B-1.	Negligible	2	5		9	Increases business & Ind activity more than A-0 but less than B-1.	Negligible	2	5		9	Increases business & Ind activity more than A-0 or A-4.	Negligible	2	5		9	No positive effects.	Negligible	2	5		9	No positive effects.	Negligible	2	5		9
b. Adverse Effects																																
*(1) Tax Revenues	Will increase to meet items of local cooperation.	Require tax revenues but	1	6		9	Will increase tax to meet cost of local cooperation greater than A-0, less than B-1.	Negligible	1	6		9	Will increase taxes above A-0 or A-4.	Negligible	1	6		9	Decreases	Negligible	1	6		9	Decreases	Negligible	1	6		9
*(2) Property Value	No adverse effects.	Negligible	2	6		9	No adverse effects.	Negligible	2	6		9	No adverse effects.	Negligible	2	6		9	Decreases	Negligible	2	6		9	Decreases	Negligible	2	6		9
*(3) Public Facilities	Higher costs to furnish facilities to meet inc visitation demand.	Negligible	1	6		9	Increase in demand for public facilities above A-0 less than B-1.	Negligible	1	6		9	Increase in demand for public fac. above A-0 or A-4.	Negligible	1	6		9	Decreases	Negligible	1	6		9	Decreases	Negligible	1	6		9
*(4) Public Service	Higher cost to meet increase visitation demands.	Negligible	2	6		9	Higher public service cost than A-0 but less than B-1.	Negligible	2	6		9	Higher public service cost than A-0 or A-4.	Negligible	2	6		9	Decreases	Negligible	2	6		9	Decreases	Negligible	2	6		9
*(5) Regional Growth	No negative effect.	Negligible	2	5		9	No negative effects.	Negligible	2	5		9	No negative effects.	Negligible	2	5		9	Negligible	Negligible	2	5		9	Negligible	Negligible	2	5		9
*(6) Employment/Labor Force	No negative effects.	Negligible	2	5		9	No negative effects.	Negligible	2	5		9	No negative effects.	Negligible	2	5		9	Decreases	Negligible	2	5		9	Decreases	Negligible	2	5		9
*(7) Business and Ind Activity	No negative effects.	-	2	5		9	No negative effects.	-	2	5		9	No negative effects.	-	2	5		9	None	-	2	5		9	None	-	2	5		9
*(8) Displacement of Farms	None	-					None	-					None	-					None	-					None	-				

Footnotes:

Timing

1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty

4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10 & 50%.
6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry, fully monetized in NED account.
8. Overlapping entry, not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

12. EO 11988 Best non-flood plain alternative selected, as directed by Flood Plain Management Executive Order No 11988.
13. Estimated benefits from the elimination of expected structural losses from storms & beach erosion.
14. Estimated annual cost to relocate 259 endangered structures and contents to an erosion free beach.

* ASTERISK denotes items specifically mentioned in Section [illegible] of Public Law 91-611 for evaluation.

SHEET NO. [illegible] OF [illegible] SHEETS

is based upon its prevention of loss of existing man-made and natural resources in the zone of expected erosion while effecting the restoration and vegetation of a dune line. This artificially restores a natural feature which provides limited wildlife habitat and screens the commercial and residential development from the view of recreationists who use the beach.

SELECTING PROCESS

Plan selection is the designation of the most desirable alternative based on results of detailed study. This selection is also influenced by the public response to the various plans considered and institutional constraints affecting plan implementation.

The structural plans considered for implementation, "Beach Development" and "Beach and Dune Development" plans have a high degree of acceptability with local interests. Plan A-4 has the most excess benefits to cost of the "Beach Development" plans, however, Plan A-0 is considered the more viable because of the lower non-Federal investment required. Plan B-1 has the best benefits to cost ratio of all the "Beach and Dune Development" plans but it is economically marginal. All of these plans require a substantial increase in first cost and non-Federal participation when compared to the "Beach Development" plans. The No-Action plan and the Relocation of Structures plan are deplored by those directly affected by erosion.

For structural plans considered in the final planning stages, cost sharing between Federal and non-Federal interest, based on shore ownership and use, is shown in Table 6. The non-Federal amounts shown include five percent of the total initial project costs to be paid by the State of South Carolina. This front-end loading is part of President Carter's new cost sharing policy. Cost apportionment for the selected plan of improvement is discussed in later paragraphs.

TABLE 6

COST APPORTIONMENT (IN $1,000)

Plans	Initial Cost			5-Year Renourishment & Dune Maint.		
	Total	Federal	Non-Federal	Total	Federal	Non-Federal
A-0	2,393	722	1,671	1,292	496	796
A-1	2,723	853	1,870	1,292	506	786
A-2	3,292	1,057	2,235	1,292	510	782
A-3	4,171	1,356	2,815	1,292	509	783
A-4	3,410	969	2,441	1,596	573	1,023
A-5	4,805	1,400	3,405	1,596	573	1,023
B-1	9,634	5,028	4,606	1,778	568	1,210
B-2	13,283	7,136	6,147	1,823	568	1,255
B-3	17,729	9,644	8,085	1,871	568	1,303

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THE SELECTED PLAN

In view of the overall evaluation, design criteria and planning objectives, the plan previously designated "minimal plan", Plan A-O, is selected for implementation. This plan in combination with non-structural endeavors that have been established in the study area will provide for meeting the existing and future needs for erosion control and recreation. Details of the minimal plan are presented in Section H of Appendix 1, which is entitled "The Selected Plan".

The Selected Plan

The preceding section summarized plan formulation and identified the plans with the best potential for resolving the problems and needs of the study area. The following pages present a description of the selected plan, including its accomplishments and effects as well as its significant design, construction, operation and maintenance aspects.

DESCRIPTION

The selected plan provides for beach restoration and periodic nourishment for that 16,860-foot developed reach of Folly Beach in which manmade improvements are in greatest jeopardy. This reach would have a berm width of 25 feet. The berm would be constructed to an elevation of four feet above mean sea level and would be fronted by a beach having its face slope at about 30-horizontal to 1-vertical. The beach fill section would provide an average usable width above the mean high water line of 50 feet. The slope of the beach face would be formed by natural forces during and subsequent to material placement. Machines may be necessary to slope the berm depending upon the skill of the contractor in placing material. Plate 7 shows the location and design sections of the selected plan.

In those areas where fill is to be placed landward of the "hold line", such placement would be made to effect proper drainage. Where possible, runoff would be directed landward to avoid the erosion of sheet flow on the berm and beach face.

Initial construction would consist of dredging approximately 684,000 cubic yards of material to place 536,000 cubic yards on the beach. The amount of beach fill required for initial construction is based on profiles surveyed in April 1977. Material placed would satisfy three purposes: beach restoration, private fill, and sacrificial nourishment. These are depicted on Plate 7 at the end of this report. As the material is being placed, it is subjected to the natural sorting of waves, tides, and currents. Approximately one-half of the material would come from the southwestern direction using Stono Inlet ocean bars as the source. The other half would come from Lighthouse Inlet ocean bars, northeast of Folly Island. Laboratory tests of this borrow material indicate that 1.4 times that quantity needed on the beach would have to be taken from these borrow areas.

Periodic renourishment would be required at approximately five-year intervals. Each of these efforts would require the borrowing of approximately 354,000 cubic yards from the same self-restoring sources. Materials dredged from shoals occurring in the Folly River small navigation project would be utilized when practical for initial construction and renourishment efforts. Material taken from Charleston Harbor entrance channel via hopper dredge may also be utilized if pumpout capability is developed sufficiently to make this operation economical.

PLAN ACCOMPLISHMENT

The addition of sand to the present beach would provide a wider beachfront that can accommodate a larger number of visitors. This would act as an added attraction to the area, encouraging an increase in local and tourist visitation. It is estimated that the available beach area in 1980 without the proposed plan would be only about seven acres. With the proposed plan, the available beach area (from landward end of the artificial berm to mean high waterline) would be approximately 19 acres. Estimated selected plans are discussed in Section E of Appendix 1.

Direct beneficiaries of the improvement would be the property owners and commercial interests along the shorefront who would receive protection from erosion; resident beach users and tourists, originating mainly from the State of South Carolina. Overall beneficiaries are numerous and widespread, being essentially the general public, although they are concentrated generally in the greater Charleston metropolitan area.

ENVIRONMENTAL EFFECTS

Implementation of the recommended plan would produce several beneficial effects, including improved appearance of the beach, increased recreational dry beach area, and improved protection of shore structures against erosion.

Accompanying adverse impacts would be temporary and minor. Water quality would be slightly degraded in the vicinity of the dredge cutterhead and adjacent to the nourishment site as localized increases in turbidity and possible reductions in dissolved oxygen occur. No significant biotic impacts should be generated by these conditions and water quality shoud return to normal within several days after project completion.

Mortality of benthic organisms and associated population reductions would also occur in borrow areas and beach nourishment sites, but colonizers of the same or similar species from nearby areas should reestablish viable populations in the affected areas within a period of several months.

Physical and biological effects of project maintenance would be similar to those of project construction but of a smaller magnitude. Project implementation would not significantly affect any rare or endangered species nor would it cause significant irreversible commitment of natural resources.

CONSTRUCTION

Estimated time of initial construction and renourishment is less than one year per effort. During each construction effort, techniques would be employed that result in minimum losses to winnowing and in minimum machine work to shape the artificial berm. Performance of the artificial fill would be evaluated at a regular interval to determine the appropriate timing for renourishment efforts.

In order to provide for abatement and control of any environmental pollution arising from construction activities, the contractor and his subconctractors would be required to comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

OPERATION AND MAINTENANCE

Management of the recreational use of the beach including life-guards, trash removal and police and rescue services would be the responsibility of non-Federal public agencies.

Economics of Selected Plan

METHODOLOGY

The tangible economic justification of the proposed improvements can be determined by comparing the equivalent average annual charges (i.e., interest, amortization, and maintenance costs), with an estimate of the equivalent average annual benefits which would be realized over the 50-year period of analysis selected. Appropriate values given to costs and benefits at their time of accrual are made comparable by conversion to an equivalent time basis using an appropriate interest rate. A rate of 6-7/8 percent applicable to public projects was used

in this report. Interest during construction was not costed as the estimated construction period doesn't exceed two years. Recreational benefits are based on estimates of population and growth, beach use supply and demand, added opportunities created by the Selected Plan, and unit values of these opportunities.

ESTIMATED FIRST COSTS

Estimated first costs are based on the quantities previously discussed herein. For alternative comparison and for display of the Selected Plan, materials placed on the beach were assumed to have been taken in equal amounts from Stono Inlet and from Lighthouse Inlet. The estimated unit cost of dredging, transporting and placing this material is $2.40 per cubic yard. Mobilization and demobilization costs, using this borrow scheme, is estimated at $120,000. Should all of the material be taken from only one of these borrow areas, the unit cost and the mobilization and demobilization cost would both be greater due to the longer pumping distance. If all the required borrow sand would be taken from Lighthouse Inlet the unit cost would be $3.00, and mobilization and demobilization cost would be $150,000. Using only Stono Inlet, these costs would be $3.20 and $160,000 respectively.

The initial cost of the monitoring program is estimated to be $7,000. This includes surveys, sand sample collection and analysis, and preparation of a report.

Estimated first costs of the Selected Plan are separated into "Federally Shared Costs", which would be cost shared between Federal and non-Federal interest, and "Non-Federal Cost" which would not be shared since this fill material would be placed on private property and will be totally a local cost. These separable costs were used in Cost Apportionment shown in Table 12. First Cost Estimates are shown in Table 7.

TABLE 7

ESTIMATED FIRST COST OF SELECTED PLAN

Item	Cost
FEDERALLY SHARED FIRST COST 1/ (Federal & non-Federal Costs)	
Mobilization and Demobilization	$ 120,000
Beach Fill (634,000 cubic yards @ $2.40 per cu yd.	1,522,000
Contingencies @ 20%	328,000
Total Federally Shared Construction Cost	$1,970,000
Engineering and Design @ 5% of Construction Cost	98,000
Supervision and Administration @ 6% of Const. Cost	118,000
Beach Monitoring Program Cost	7,000
TOTAL FEDERALLY SHARED FIRST COST	$2,193,000
NON-FEDERAL FIRST COST (No Cost Sharing)	
Beach Fill (50,000 cu.yds. @ $2.40 per cu. yd.	$ 120,000
Contingencies @ 20%	24,000
Total non-Federal Construction Cost	144,000
Engineering and Design @ 5% of Construction Cost	7,000
Supervision and Administration @ 6% of Const. Cost	9,000
Lands	40,000
TOTAL NON-FEDERAL FIRST COST	$ 200,000
TOTAL PROJECT FIRST COST	$2,393,000

1/ These costs will be shared by Federal and non-Federal interests according to the percentage of shoreline ownership and use by public and private interests.

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PERIODIC RENOURISHMENT COSTS

Estimated costs of each renourishment effort made on an average of once every five years during the 50-year project life are shown in Table 8. Costs shown include the Federal share and the non-Federal share of total renourishment costs. Cost sharing between these two entities is shown in Table 11 after the discussions on "Cost Apportionment".

TABLE 8

ESTIMATED RENOURISHMENT COSTS,
FEDERAL AND NON-FEDERAL (5-Year Periods)

ITEM	COST
Mobilization and Demobilization	$ 120,000
Beach Fill, 354,000 cy @ $2.40	850,000
Contingencies (20%)	194,000
Total Construction Cost	$1,164,000
Engineering and Design (5%)	58,000
Supervision and Administration (6%)	70,000
TOTAL 5-YR NOURISHMENT COST	$1,292,000

ANNUAL COST

An amortization period of 50 years was used with an interest rate of 6-7/8 percent for both the Federal and non-Federal contributions. No interest during construction has been included since construction should take less than two years. Estimated average annual charges are given in Table 9.

Average annual cost of the monitoring program is based on surveys and sand sampling being done prior to placement of initial fill, once per year for the first five years, once during year 7 and 10 and every five years thereafter until the end of the 50-year project life.

TABLE 9

ESTIMATED AVERAGE ANNUAL CHARGES

ITEM	COST
FEDERALLY SHARED	
Interests and Amortization on First Cost ($2,193,000 1/ x 0.071317)	$ 156,400
Beach Renourishment ($1,292,000 2/ x 0.071317 x 2.408384 3/)	221,900
Beach Monitoring Program ($7,000 x 0.0713117 x 7.469034 4/)	3,700
TOTAL FEDERALLY SHARED	$ 382,000
NON-FEDERAL (NO COST SHARING)	
Interest and Amortization on First Cost ($200,000 5/ x 0.071317)	$ 14,300
TOTAL AVERAGE ANNUAL COST	$ 396,300

1/ From Table 7, minus monitoring cost.

2/ From Table 8

3/ Present worth of nine maintenance operations at 5-year intervals:

$$\frac{\text{(Present Worth 6-7/8\% - 45 yr. EPS)}}{\text{(Compound Amount 6-7/8\% - 5 yr. EPS)}} = \frac{(13.815484)}{(5.736412)} = 2.408384$$

4/ Present Worth of 16 monitoring operations = 7.469034

Post construction monitoring involving 15 operations is computed as:

7,000 x 0.071317 x 6.46903 = $3,200

5/ From Table 7

BENEFITS

Estimates for monetary benefits are based on April 1979 price levels. These are classed as (1) prevention of losses to real property, (2) enhancement of private lands, and (3) preservation and supply of recreational opportunities. Losses to real property break out into two sub-classes, land losses prevented and building damage prevented including contents. Details on the methodology employed in quantifying benefits are given in Section E of Appendix 1. A summary of the benefits quantified monetarily is given in Table 10.

TABLE 10

MONETARY BENEFITS

Class	Annual Benefit
Protection of Real Property:	
Land	$ 119,200
Buildings	51,700
Enhancement of Private Land	34,800
Recreation	681,500
TOTAL	$ 887,200

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BENEFIT-COST RATIO

In order for a proposed project to be justified from an economic viewpoint, the average annual benefits for the plan should equal or exceed the average annual project cost. All monetary values are based on a common dollar value and are expressed in comparable terms to the fullest extent possible. A benefit-cost-ratio of 2.2 was computed as follows:

$$\frac{\text{Benefit}}{\text{Cost}} = \frac{\$\ 887{,}200}{\$\ 396{,}300} = 2.2$$

Division of Plan Responsibility

As previously noted, the responsibility for various non-structural measures, such as zoning and building codes, and for flood proofing individual structures is non-Federal, although technical advice can be furnished. This does not preclude the possibility that assistance may be available from other Federal programs. The division of responsibilities for the selected beach development plan are discussed in the following pages.

Legislative and administrative policies have established the basis for Federal and non-Federal sharing of responsibilities in the construction, operation, and maintenance of Federal water resources projects. Significant in this regard are the sharing of first costs for construction and the responsibilities as well as the costs for renourishment. These are discussed in the following paragraphs. Other general non-Federal responsibilities, such as indemnifying the United States, and continuing public use of the project shores are not discussed but are set forth in the "Recommendations".

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There is an unsatisfied need for public facilities in the study area. Shortages exist in the supply of adequate parking spaces, bath houses and comfort stations, and/or public transportation for beach users. Beach access is currently provided at street ends and is considered to be adequate. Non-Federal interest would be required to insure that a sufficient number of these access points remain open. There is presently about 325 off-street parking spaces, 750 private driveways, and 3,752 spaces on the city streets which could be used by visitors to the proposed beach-fill project. An analysis of parking spaces needed, in order for project beach capacities to be utilized revealed that 92 additional parking spaces would need to be constructed on the north eastern segment of the project area or public transportation provided to make up this shortage. Local interests have plans for a shuttle bus system. (See pages H-6 through H-9 of Section H, Appendix 1 for details of Associated Public Facilities). They are also in the process of adding bathhouses and comfort stations to the central portion of the project area. This portion of Folly Beach would have adequate sanitary facilities with the existing and proposed new works. However, five additional comfort stations with outside showers will be required to service the remainder of the project area. These would be spaced at about one-half mile intervals in order to limit the walking distance to these facilities. Costs of providing these needs have not been included in project cost estimates as these items are considerd self-liquidating. In view of the recognized unsatisfied need, non-Federal interest would be required to provide facilities to satisfy unmet needs associated with the proposed public beach development project.

COST APPORTIONMENT

The policy of Federal aid in the restoration and protection of shores against erosion is set forth in Public Law 87-874, River and Harbor Act of October 1962, which amended Public Law 286, 84th Congress.

Under the provisions of Public Law 87-874, Federal participation in the construction cost of beach erosion control, exclusive of land and damage items, is limited to specified percentages dependent upon the ownership and use of the shores. For public shores, sharing ranges from 50 percent to 70 percent. For private owned but publically used beach which currently is the case at Folly Beach, sharing of project cost by the Federal Government is limited to 50 percent multiplied by the ratio of public benefits to total benefits. Recreational beach use benefits are the only public benefits accrued to the recommended project. Of the $887,200 of annual benefits projected for the project, $205,700 are derived from the protection and enhancement of real property and $681,500 from recreational use of the beach. The Federal contribution of project cost to be shared between Federal and non-Federal interest is computed to be 38.4 percent and non-Federal is 61.6 percent. Costs to be shared include public beach restoration, periodic nourishment, and a beach monitoring program.

In some cases in the initial restoration of the beach, sand will be added on private property landward of the property holding line. The cost of this private lot restoration would be the responsibility of non-Federal interest. Also, land, easements, and rights-of-way, are solely a non-Federal cost. When periodic beach nourishment is considered as part of the most suitable and economical remedial measure, and is construed as also fulfilling a construction role, it is eligible for the same percentage of Federal aid as the initial project construction cost. Five-year renourishment costs of $1,292,000 would be $496,100 Federal and $795,900 non-Federal. This amounts to average annual equivalent charge of $85,200 Federal cost and $136,700 Federal.

In addition to other non-Federal cost, application of President Carter's new cost sharing policy results in the State of South Carolina paying a cash contribution of five percent of initial project cost. This five percent front-end loading is estimated at $119,600 for the recommended project. Cost apportionment for the recommended project is shown in Table 11.

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TABLE 11
COST APPORTIONMENT
FOR SELECTED PLAN[2/]

ITEM	PERCENT APPORTIONMENT	TOTAL COST	APPORTIONMENT COST
SHARED FIRST COST			
Federal Share	38.4%	$2,193,000[1/]	$ 842,100
Non-Federal Share	61.6%	$2,193,000	$1,350,900
NON-FEDERAL ONLY			
Private Restoration and Lands	100.0%	$ 200,000	$ 200,000
EFFECTS OF PRESIDENTIAL PROPOSAL			
State Share	5.0%	$2,393,000	$ 119,600
Federal Credit	5.0%	$2,393,000	(-119,600)
TOTAL FEDERAL SHARE OF FIRST COST			$ 722,500
TOTAL NON-FEDERAL SHARE OF FIRST COST			$1,670,500

[1/] Includes $7,000 for monitoring prior to construction.
[2/] Cost sharing under existing legislation, not including the President's cost-sharing policies (5% front-end loading), is estimated at $842,100 Federal cost and $1,550,900 non-Federal cost.

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FEDERAL RESPONSIBILITIES

The presently estimated Federal share of the total first cost of the Folly Beach project is $722,500. The Federal Government is responsible for the preparation of plans and specifications and for construction of the project. The estimated Federal share of 5-year renourishment operations cost is $496,100 and of the average annual cost for post construction, project monitoring is $1,400.

NON-FEDERAL RESPONSIBILITIES

The presently estimated non-Federal share of the total first cost of the proposed project is $1,670,500. In addition, the non-Federal interests must share in the renourishment cost in the amount of $795,900 each five years and must provide the non-Federal share of the project monitoring program, $2,300 for each year of the 50-year project life after construction. The local sponsor must also meet the local cooperation requirements as outlined in the section entitled "Recommendations."

Plan Implementation

The steps necessary to provide a restored beach, with periodic renourishment at Folly Beach can be summarized as follows:

Review of the report by such higher authorities as the Corps of Engineers' South Atlantic Division, the Board of Engineers for Rivers and Harbors, and the Office of the Chief of Engineers.

After his review, the Chief of Engineers will seek formal review and comment by the Governor of South Carolina and interested Federal agencies.

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Following the above state and interagency review, the final report of the Chief of Engineers would be forwarded to the Secretary of the Army for further review and coordination with the Bureau of the Budget regarding the relationship of the project to the program of the President. He would then forward the report, with his recommendations, to the Congress.

Congressional authorization for construction of the proposed project would then be required.

After funding, a Phase I Report would be prepared to confirm, update, and revise, when necessary, the original feasibility analysis.

Assuming no significant changes or controversies, design would continue with the preparation of the Phase II Report, and any required feature design memoranda.

If the Congress appropriates the necessary initial funds, formal assurances of local cooperation would be requested from non-Federal interests.

Plans, specifications, and an engineering estimate of cost would then be prepared by the District Engineer, bids invited, and a contract awarded. At this time, the necessary local actions, including payment of the cash contribution, would be required.

Following completion of initial construction of the project, local interests would be responsible for overseeing public use of the beach and appropriate for making contributions toward beach renourishment, when appropriate.

It is not possible to accurately estimate a schedule for the above steps. However, once the project is authorized and initially funded, it is possible to complete design and construction in about two and one-half years if subsequent appropriations are forthcoming

as needed. Actual construction is expected to take less than a year and would probably be accomplished during the off-season to minimize effects on the tourist trade.

Views of Non-Federal Interest

The considered plans of improvement were coordinated with various state, local and non-governmental interests. Coordination was also made in the form of three public meetings held in Folly Beach on 8 March 1976, 29 November 1977, and 7 December 1978. Statements by those interests are contained in Appendix 3. Complete transcripts of the public meeting are in the files of the Charleston District office.

Review by Other Federal Agencies

Letters and comments received from other Federal agencies are contained in Appendix 3.

Statement of Findings

The documents concerning the proposed action and the stated views of other interested agencies and concerned public have been reviewed and evaluated in light of the overall public interest, relative to the various practicable alternatives in providing the needed erosion control protection and recreation opportunities at Folly Beach. The possible consequences of plan alternatives have been studied according to environmental, social well-being, and economic effects, including regional and national development and engineering feasibility. In evaluation, the following points were considered pertinent:

The project would provide an adequate degree of erosion protection for the affected areas.

The selected plan has strong local support, however, the source of local funding may be a problem in light of the high non-Federal cost.

Care was taken in the design of the project to minimize adverse environmental effects, and to mitigate, where possible, for those adverse environmental effects which could not be avoided. The selected project produces net environmental gains for the project area.

The project is sized close to the optimum economic capacity, is functionally adequate and economically justified.

Recreational aspects of the project are economically justified and are desired by the local people.

In addition to the above, the following table summarizes significant impacts of alternative plans and is considered pertinent to the selection and evaluation of the selected plan.

The proposed action, as developed in the "Formulating a Plan" and "The Selected Plan" sections, is based on thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objective. The selected plan is consonant with national policy, statutes, and administrative directives, and the total public interest should best be served by implementation of the selected plan.

Recommendations

It is recommended that the selected plan described in this report be authorized for construction as a Federal project for beach erosion control, with such modifications as in the discretion of the Chief of Engineers may be advisable, at a first cost to the United States presently estimated at $772,500 exclusive of the cost of preauthorization studies with an annual renourishment participation cost presently estimated at $85,200 and post construction, beach monitoring cost sharing of $1,400 annually. These costs are exclusive of amounts to be contributed by non-Federal interests prior to construction and for subsequent renourishment; such local contributions are identified separately in this report. The exact amount of Federal and non-Federal contributions shall be determined by the Chief of Engineers prior to project construction, in accordance with the local cooperation requirements.

It is further recommended that if the project is authorized for construction and local interests construct useful portions of the project prior to the availability of Federal funds, the local interests be reimbursed or credited for the Federal share of the work performed by them on the project. This reimbursement or credit for local expenditure, upon Federal funds becoming available, would be contingent upon approval of the work by the Chief of Engineers as being in accordance with the authorized project prior to commencement of work on detailed plans and specifications and arrangements for the prosecution of the work. The amount of reimbursement or credit would be based on a determination of the reduction in cost of the Federal project resulting from local interest's work, such determination to be made at the time of the Federal construction. Payment would be based on the lesser of either the unit cost under the Federal contract or actual cost.

TABLE 12 - SUMMARY SYSTEM OF ACCOUNTS

(FOR EXPLANATION OF ABBREVIATIONS, SEE NOTES AT END OF TABLE)

A. PLAN DESCRIPTION	PLAN A-0 (RECOMMENDED) BEACH DEVELOPMENT PLAN STA 244+70E TO STA 143+90N	PLAN A-4 (NED) BEACH DEVELOPMENT PLAN STA 78+70E TO STA 180+90N	PLAN B-1 (EQ) DUNE AND BEACH DEVELOPMENT PLAN STA 78+70 TO STA 180+90N	RELOCATION OF STRUCTURES (EO 11988) 2/ NON-STRUCTURAL PLAN STA 78+70E TO STA 180+90N
B. SIGNIFICANT IMPACTS				
1. Environmental	1. Environmental	1. Environmental	1. Environmental	1. Environmental
*a. Esthetic Values	a. AT-BL	a. AT-BL	a. AT-BL	a. BL
*b. Manmade Resources	b. BL	b. BL	b. BL	b. BL
*c. Natural Resources	c. AT-BL	c. AT-BL	c. AT-BL	c. AL
*d. Water Quality	d. AT	d. AT	d. AT	d. N
*e. Air Quality	e. AL	e. AL	e. AL	e. N
*f. Noise	f. AL	f. AL	f. AL	f. N
2. Social	2. Social	2. Social	2. Social	2. Social
*a. Community Cohesion	a. BL	a. BL	a. BL	a. AT
*b. Community Growth	b. BN	b. BN	b. BN	b. AL
c. Recreational Opportunities	c. BL	c. BL	c BL	c. AL
*d. Displacement of People and Community Disruption	d. N	d. N	d. N	d. AT
3. Other Economic Effects	3. Other Economic Effects	3. Other Economic Effects	3. Other Economic Effects	3. Other Economic Effects
*a. Tax Revenues	a. BL	a. BL	a. BL	a. AL
*b. Property Values	b. BL	b. BL	b. BL	b. AL
*c. Public Facilities	c. BL	c. BL	c. BL	c. AL
*d. Public Service	d. BL	d. BL	d. BL	d. N
*e. Regional Growth	e. N	e. N	e. N	e. N
*f. Employment/Labor Force	f. BL	f. BL	f. BL	f. N
*g. Business and Ind. Activity	g. BN	g. BN	g. BN	g. AL
C. PLAN EVALUATION				
1. Contribution to Planning Objectives				1. Contribution to Planning Objectives
a. Erosion Control	a. BL (less than A-4 or B-1)	a. BL (greater than A-1, less than B-1)	a. BL (greater than A-0 or A-4)	a. N
b. Recreational Booth	b. BL (less than A-4 or B-1)	b. BL (greater than A 1, less than B-1)	b. BL (greater than A-0 or A-4)	b. AL
c. Hurricane Protection	c. BN-L	c. BN-L	c. BL	c. BL
d. Tourist Based Economy	d. BL (less than A-4 or B-1)	d. BL (greater than A-1, less B-1)	d. BL (greater than A-0 or A-4)	d. AL
2. Relationship to Four National Accounts				2. Relationship to Four National Accounts
a. NED				a. NED
(1) Beneficial (Annual Benefits)				
(a) Erosion Control	$ 209,500	$ 304,000	$ 304,000	
(b) Recreation	681,500	760,600	730,100	
(c) Hurricane Wave Damage Prevention	0	0	12,900	
(d) Total	$ 891,000	$ 1,064,600	$1,055,000	$ 79,100 3/
(2) Adverse (Annual Charges)				
(a) Interest and Amortization	$ 181,700	$ 256,400	$ 700,300	
(b) Operation and Maintenance	225,600	277,800	309,100	
(c) Total	$ 407,300	$ 534,200	$1,009,400	$ 73,300 4/
(3) B/C Ratio	2.2	2.0	1.05	1.1
b. EQ				b. EQ
(1) Soundness	AT	AT	AT	AN
*(2) Water Quality	AT	AT	AT	N
(3) Recreation	AT-BL	AT-BL	AT-BL	AL

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Provided that non-Federal interests will:

a. Provide without cost to the United States all necessary lands, easements, rights-of-way and relocations required for construction of the project, including that required for periodic nourishment;

b. Hold and save the United States free from claims for damages which may result from construction and subsequent maintenance of the project, except damages due to the fault or negligence of the United States or its contractors;

c. Assure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based during the 50-year economic life of the project;

d. Assure maintenance and repair, and local share of periodic beach nourishment during the economic life of the project as required to serve the intended purposes;

e. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;

f. Provide any appurtenant facilities required for realization of recreational benefits;

g. Comply with the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646);

h. Comply with Title VI of the Civil Rights Act of 1964 (PL 88-352);

i. Establish prior to construction a property "hold line", which will separate public from private property when beach restoration projects are constructed; and

j. Provide a cash contribution for beach erosion control, including periodic nourishment for the 50-year project life, equal to the percentage

TABLE 12 - SUMMARY SYSTEM OF ACCOUNTS (CONT'D)

	PLAN A-0 (RECOMMENDED) BEACH DEVELOPMENT PLAN STA 74+05 TO STA 143+90N	PLAN A-4 (NED) BEACH DEVELOPMENT PLAN STA 78+70S TO STA 180+90N	PLAN B-1 (EQ) DUNE AND BEACH DEVELOPMENT PLAN STA 78+70 TO STA 180+90N	RELOCATION OF STRUCTURES (EO 11988) 3/ NON-STRUCTURAL PLAN STA 78+70S TO STA 180+90N
C. PLAN EVALUATION				
1. Relationship to Four National Accounts				
b. EQ (Cont'd)				b. EQ (cont'd)
*(4) Esthetics	AT-BL	AT-BL	AT-BL	(4) B
*(5) Air Quality	AL	AL	AL	(5) B
*(6) Noise	AL	AL	AL	(6) B
c. SOC	BL	BL	BL	c. B
d. RD	BN	BN	BN	d. B
D. PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA				
1. Acceptability	Above A-4 or B-1 because of lower local costs.	Above B-1 but less than A-0 because of local costs	Less than A-0 and A-4 because of local costs.	1. Low-not responsive to desires.
2. Certainty	Beach erosion and recreation needs partially met	Beach erosion and recreation needs partially at.	Beach erosion and Recreation needs partially met	2. Beach erosion and recreation need not met.
3. Completeness	All stages to acheive plan are included.	All steps to acheive plan are included.	All steps to acheive plan are included.	3. All steps to achieve plan are included.
4. Effectiveness	Ranks third of final plans.	Ranks second of final plans.	Ranks first of final plans.	4. Ranks fourth of final plans.
5. Equity	Benefits accrue primarily within study area.	Benefits accrue primarily within study area.	Benefits accrue primarily within study area.	5. Continuing reduction
6. Reversibility	Can be recovered by not maintaining.	Can be reversed by not maintaining.	Can be reversed by not maintaining.	6. Less than other place
7. Stability	Stable if properly maintained.	Stable if properly maintained.	Stable if properly maintained.	7. Stable if properly maintained.
8. NED Benefit/Cost Ratio	2.1	1.9	1.0	8. 1.1
E. IMPLEMENTATION RESPONSIBILITY				
1. First Cost				
a. Federal	$ 771,200	$1,021,700	$5,094,100 1/	
b. Non-Federal	1,782,800	2,579,300	4,731,900 1/	
c. Total	$2,554,000	$3,601,000	$9,826,000	
2. Annual Charge				
a. Federal	$ 150,100	$ 184,700	$ 340,600 1/	$ 58,688
b. Non-Federal	257,200	349,500	668,800 1/	14,700
c. Total	$ 407,300	$ 534,200	$1,009,400	$ 73,388

KEYED: B - Beneficial Impact
A - Adverse Impact
N - Nominal Impact
T - Temporary
L - Long Term
* Significant impacts specified in Section 122 of PL 91-611

1/ Cost sharing could not be computed by Separable Cost - Remaining Benefit Method since the hurricane increment of cost is not economically justified. The costs shared assuming dune cost will be shared 20-30 (Fed-non-Fed) and the cost for beach nourishment which protects the dune will be shared the same as other beach development plans.

2/ Most non-flood plain alternative selected as directed by Flood Plain Management Executive Order No. 11988.

3/ Estimated benefits from the elimination of expected structural losses from storms and beach erosion.

4/ Estimated annual to relocate 250 endangered structures and contents to non-erosion free site.

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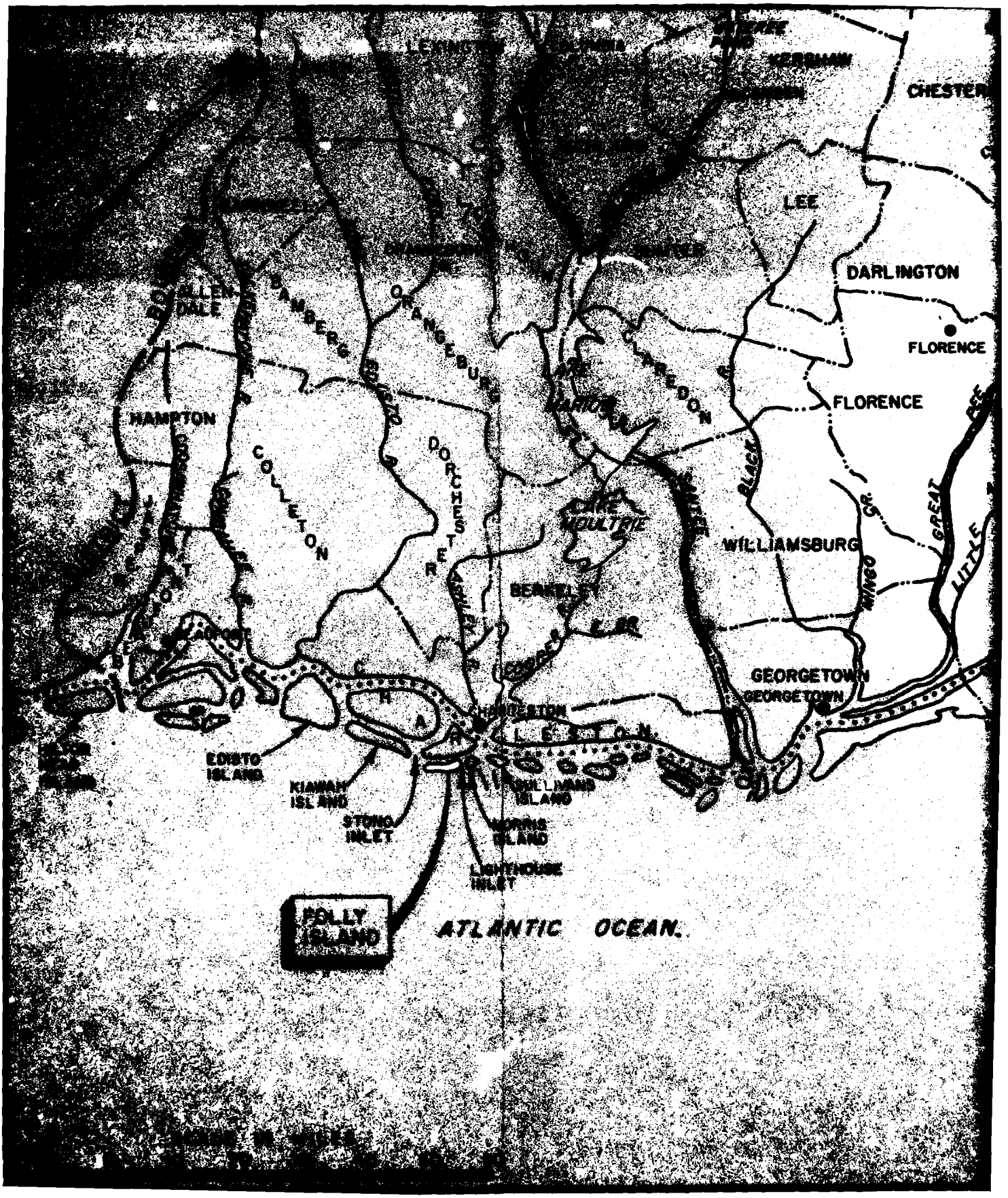
of the construction cost allocated to this function exclusive of lands, easements, rights-of-way, private fills, alterations and relocations, the percentage to be in accordance with existing law based on shore ownership and use existing at the time of construction, which contribution is presently estimated at $1,670,500 or 69.8 percent of the total first cost of the proposed project and $795,900 or 61.6 percent of the 5-year renourishment cost and $2,300 or 61.6 percent for each year of the monitoring program after construction. Non-Federal construction cost estimates includes a five percent state contribution of the construction cost.

k. The President, in his June 1978 water policy message to Congress, proposed several changes in cost-sharing for water resource projects to allow states to participate more actively in project implementation decisions. These changes include a cash contribution from benefiting states of five percent of construction (first) costs associated with non-vendible outputs and 10 percent of costs associated with vendible outputs.

Application of this policy to the Folly Beach project requires a cash contribution from the state of $119,600 of an estimated $2,393,000 (five percent of $2,393,000 total estimated first costs of construction assigned to non-vendible project purposes, based on April 1979 price levels). This contribution is in addition to other items of local cooperation usually required for shore projects including cost participation based on shore ownership and use. The total non-Federal first cost would be $1,670,500. I recommend construction authorization for the Folly Beach project in accordance with the President's proposed cost-sharing policy.

William W. Brown

WILLIAM W. BROWN
Colonel, Corps of Engineers
District Engineer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COLLETON
DORCHESTER
BERKELEY
CHARLESTON
EDISTO ISLAND
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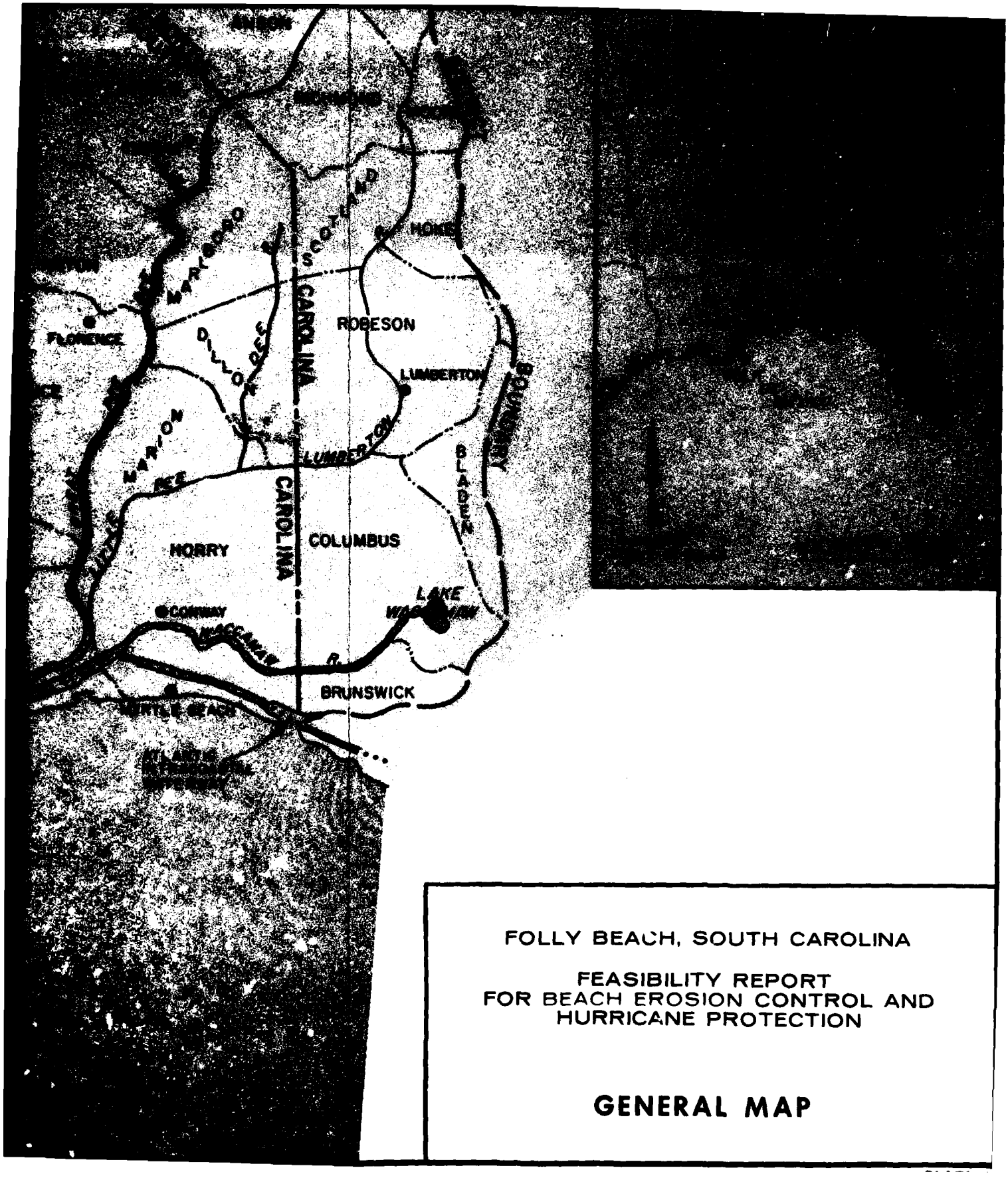
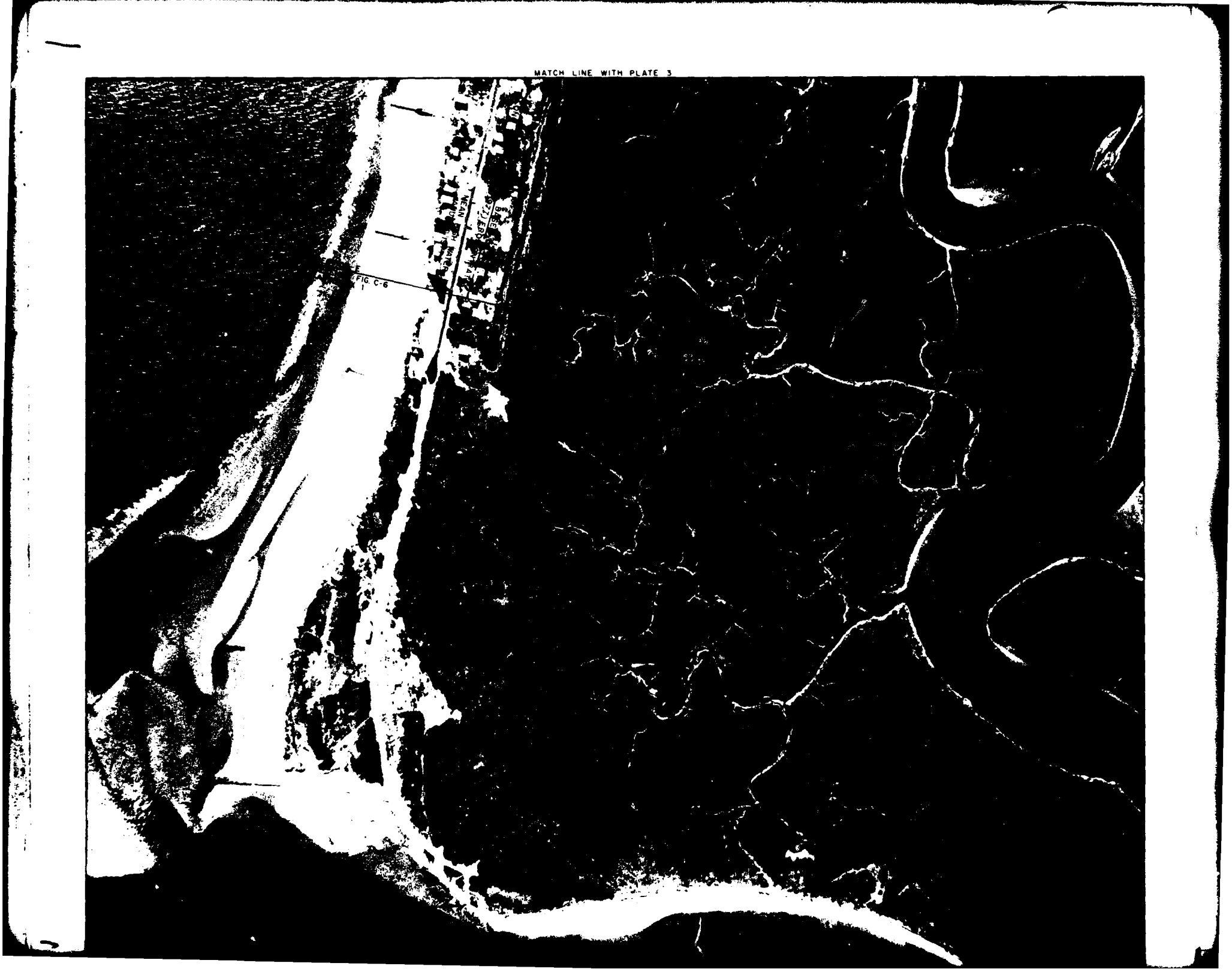
SULLIVANS ISLAND
WADMALAW ISLAND
LIGHTHOUSE INLET
FOLLY ISLAND
ATLANTIC OCEAN.



FOLLY BEACH, SOUTH CAROLINA

FEASIBILITY REPORT
FOR BEACH EROSION CONTROL AND
HURRICANE PROTECTION

GENERAL MAP


MATCH LINE WITH PLATE 3
FIG C-6

NOTES

1. THE INDICATED PREDICTED SHORELINE ASSUMES THAT THERE WILL BE NO ADDITIONAL STRUCTURAL CONTROL OF EROSION.
2. DATE OF AERIAL PHOTOGRAPH JANUARY 1972

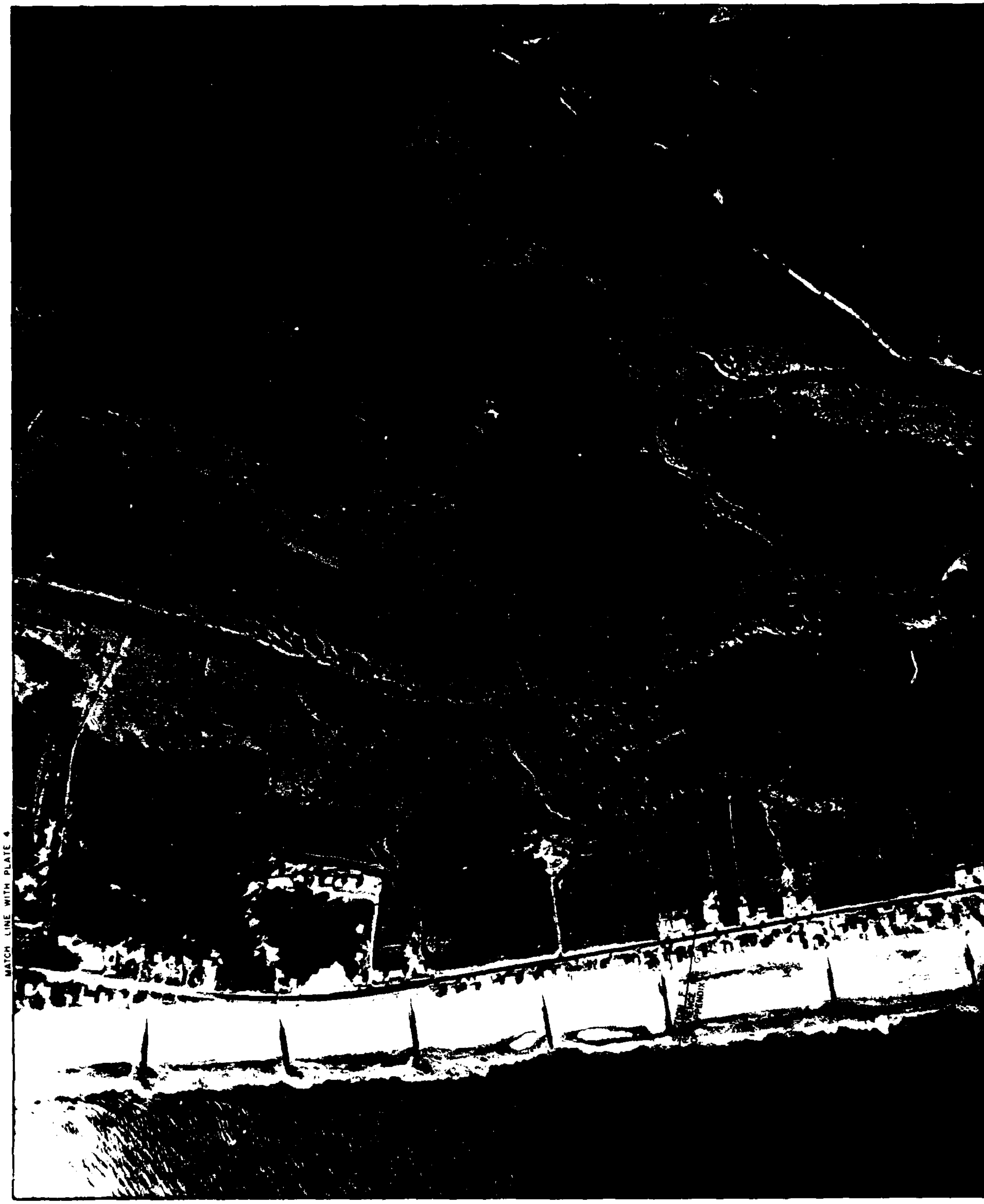
U.S. ARMY ENGINEER DISTRICT, CHARLESTON
CORPS OF ENGINEERS
CHARLESTON, SOUTH CAROLINA

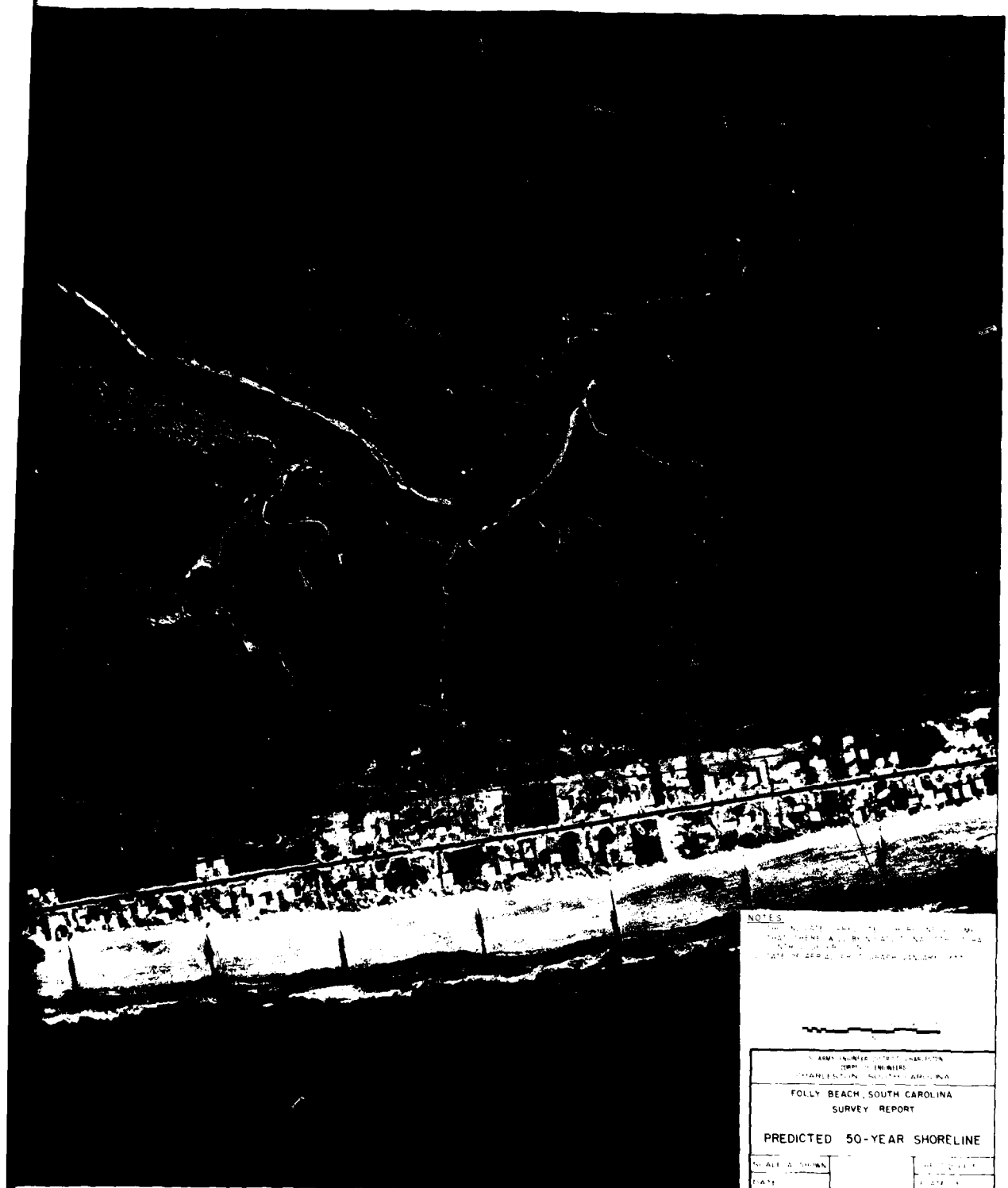
FOLLY BEACH, SOUTH CAROLINA
SURVEY REPORT

PREDICTED 50-YEAR SHORELINE

SCALE AS SHOWN		SHEET 1 OF 5
DATE		PLATE 2

1 2


MATCH LINE WITH PLATE 4



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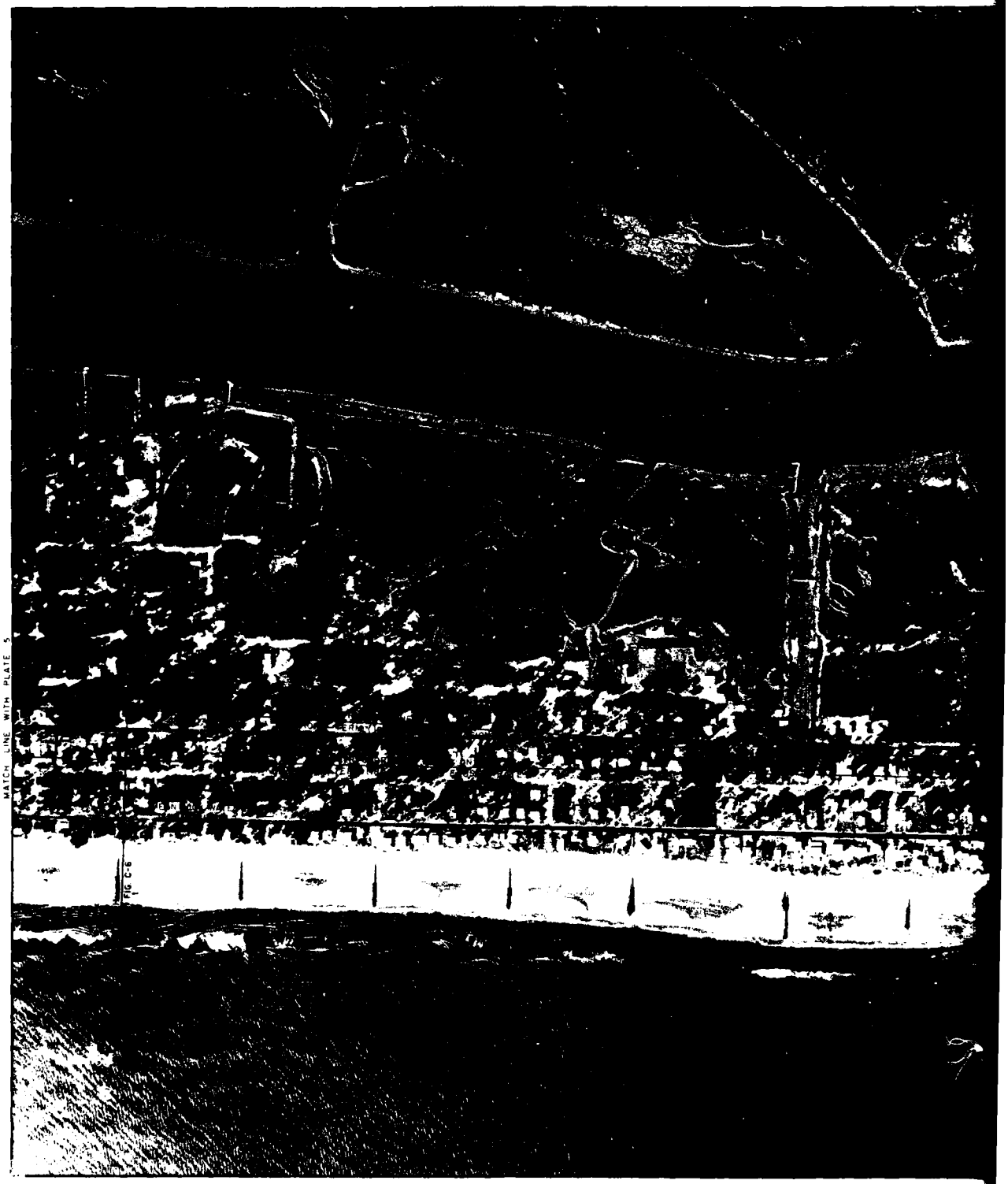
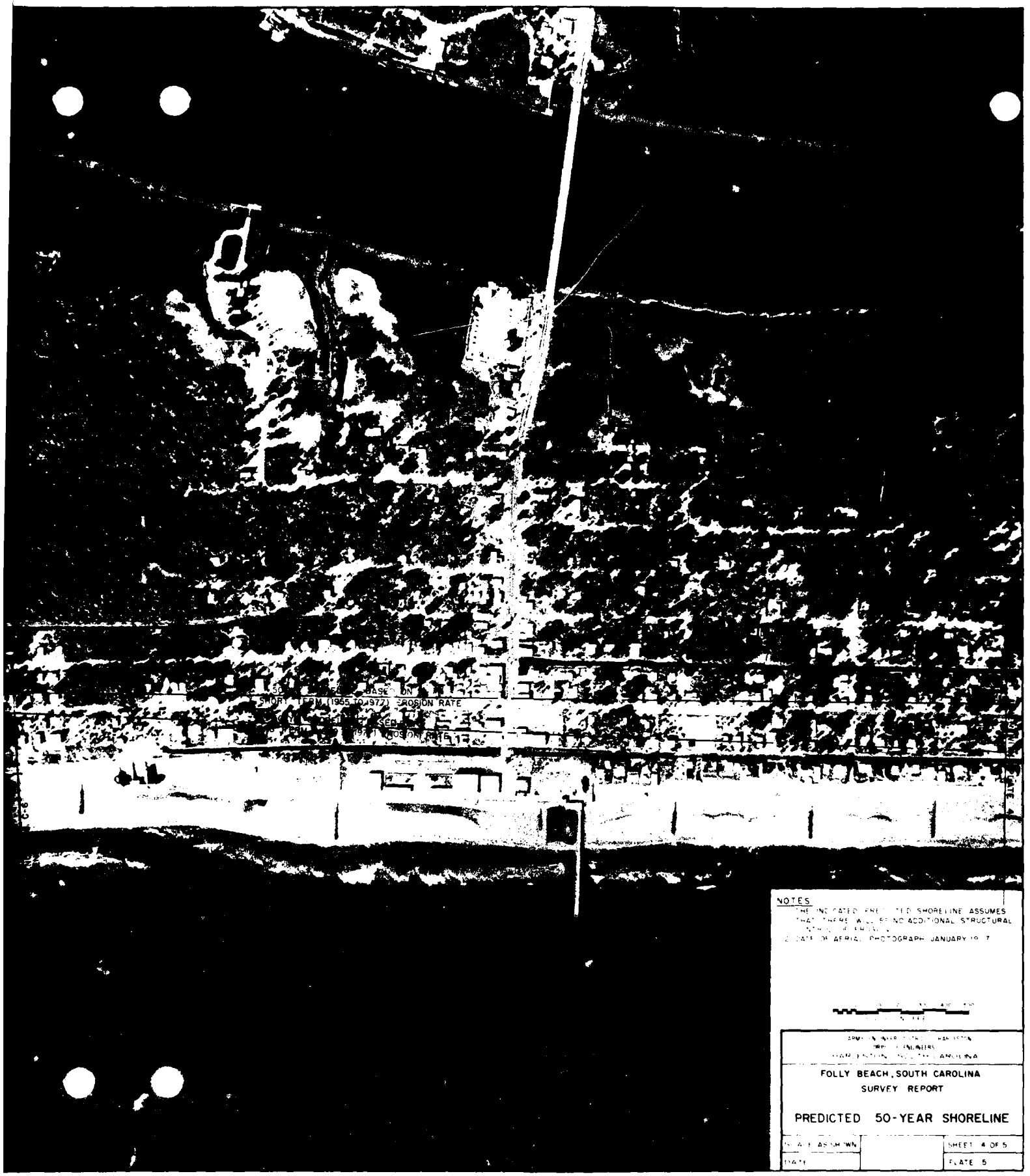
FOLLY BEACH, SOUTH CAROLINA
SURVEY REPORT

PREDICTED 50-YEAR SHORELINE


MATCH LINE WITH PLATE 5
FIG 0-6



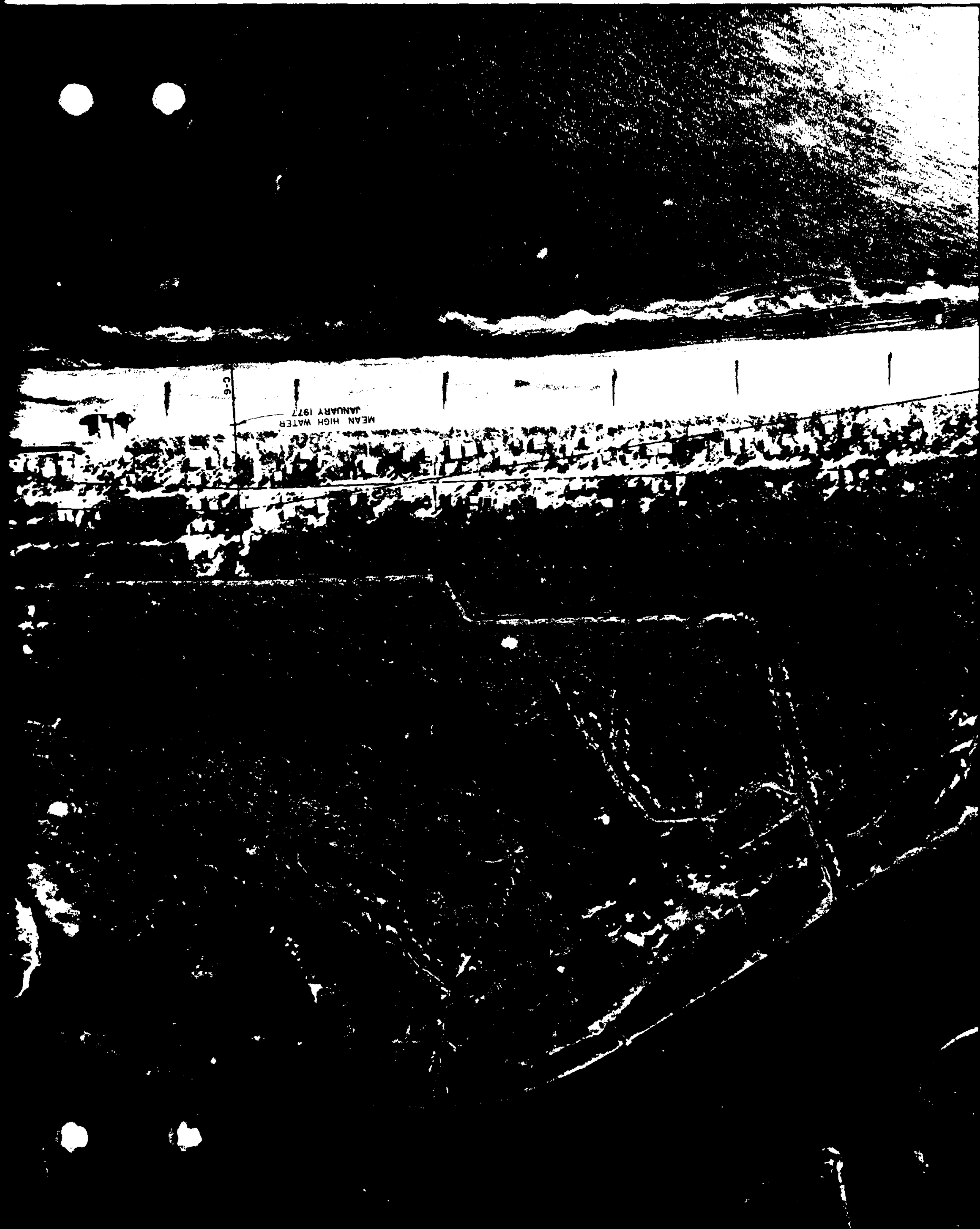
NOTES

1. THE INDICATED PREDICTED SHORELINE ASSUMES THAT THERE WILL BE NO ADDITIONAL STRUCTURAL MEASURES OF CONTROL.
2. DATE OF AERIAL PHOTOGRAPH JANUARY 19 7

FOLLY BEACH, SOUTH CAROLINA
SURVEY REPORT

PREDICTED 50-YEAR SHORELINE

SCALE AS SHOWN		SHEET 4 OF 5
DATE		PLATE 5



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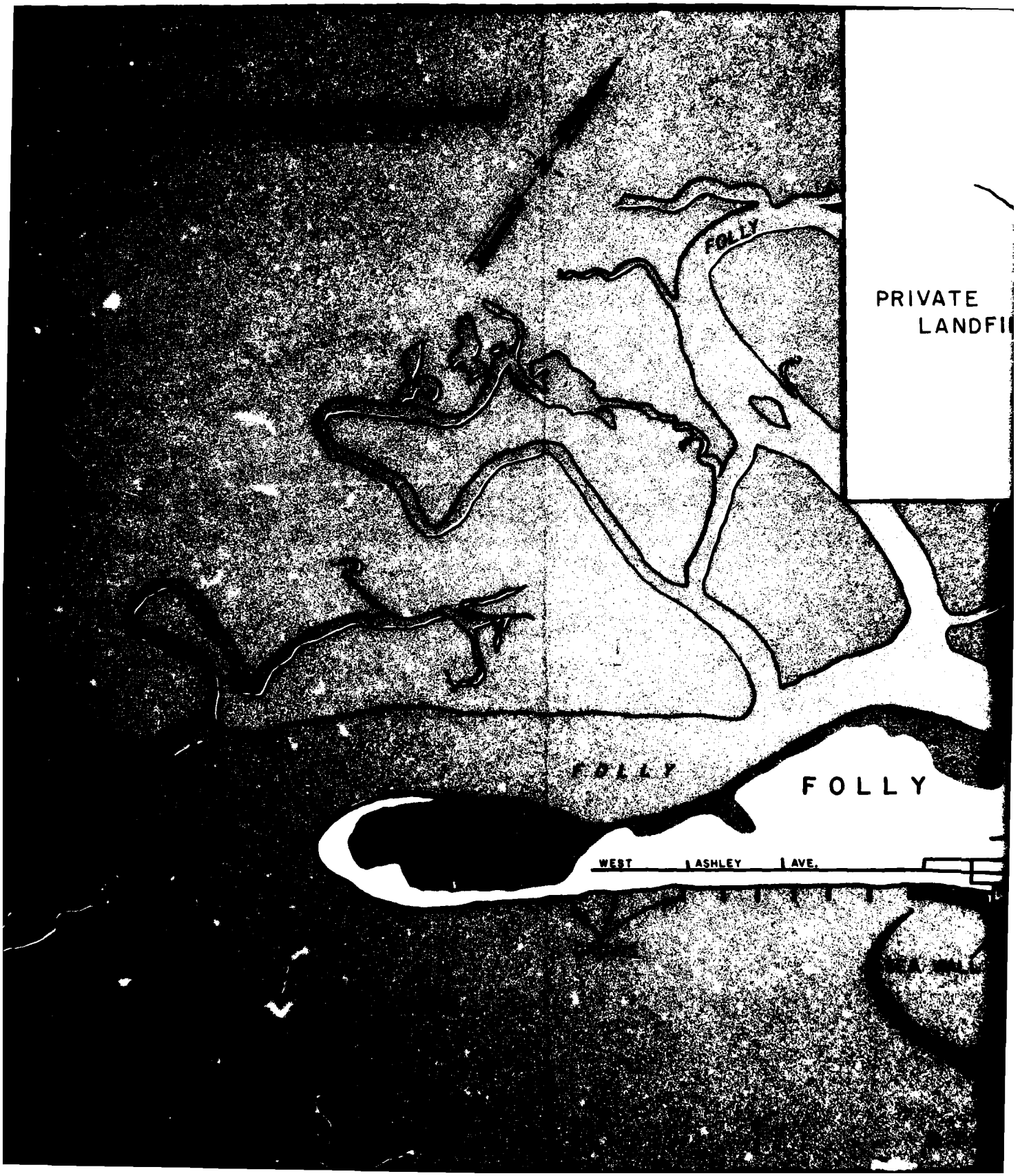
PENDIX

FOLLY BEACH, SOUTH CAROLINA
SURVEY REPORT

PREDICTED 50-YEAR SHORELINE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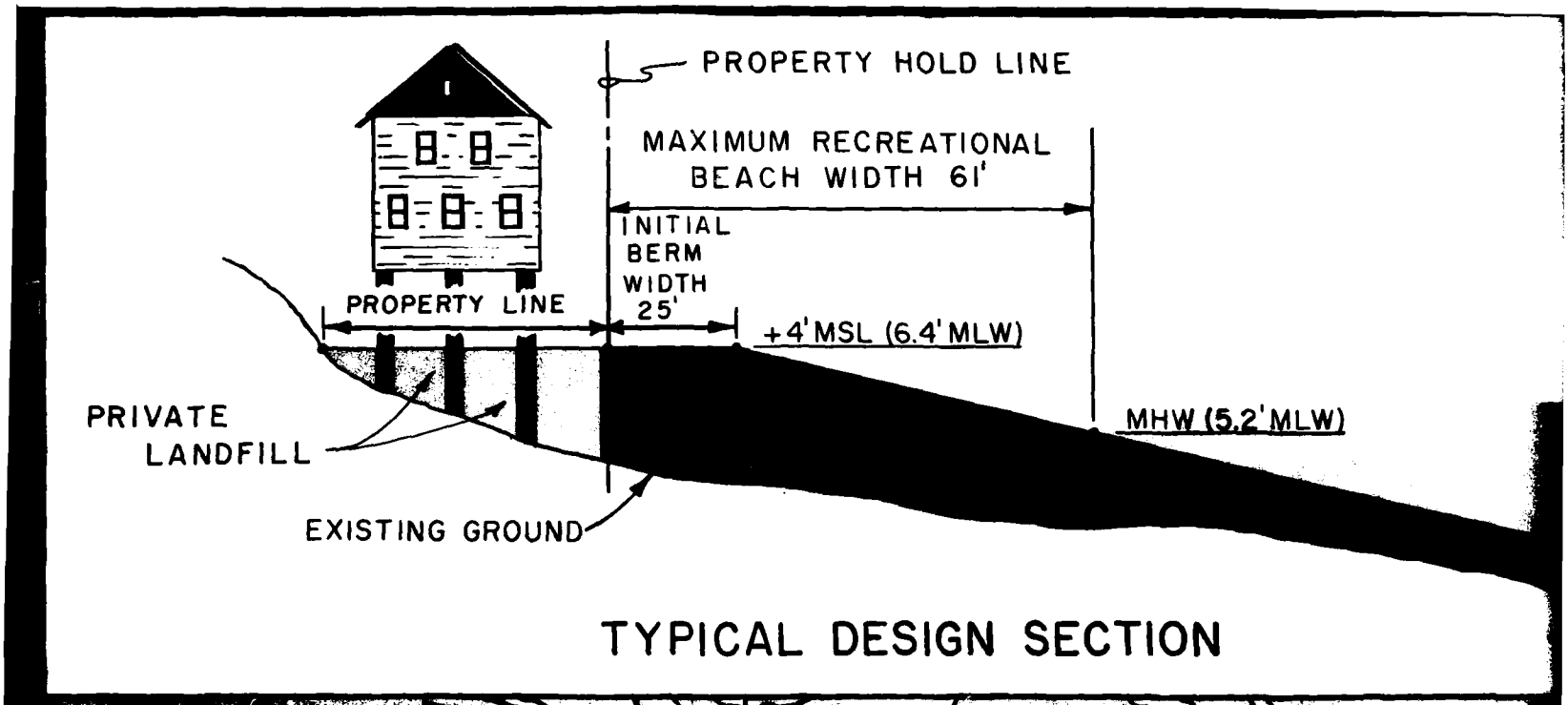
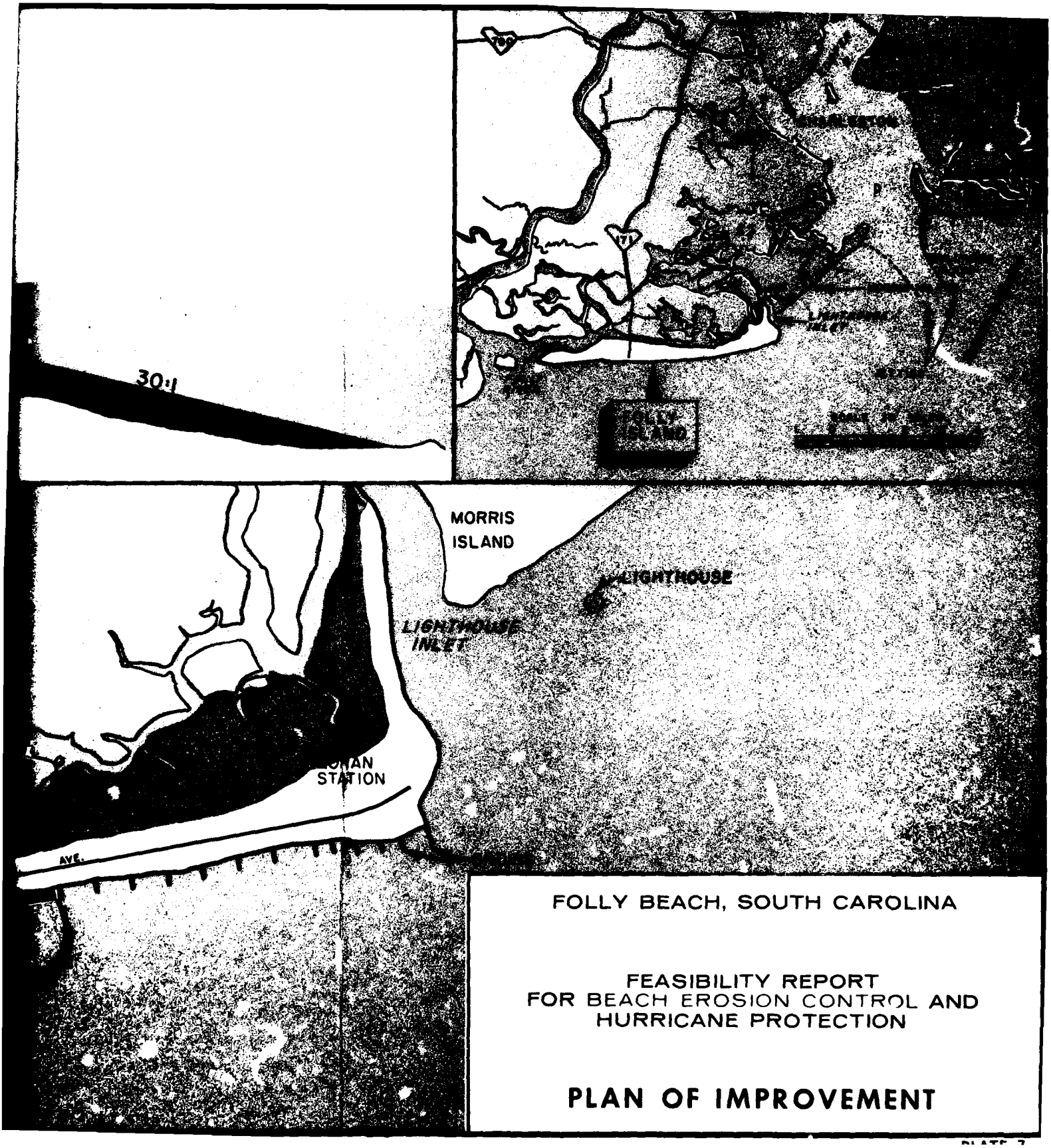


TYPICAL DESIGN SECTION



FOLLY BEACH, SOUTH CAROLINA

FEASIBILITY REPORT
FOR BEACH EROSION CONTROL AND
HURRICANE PROTECTION

PLAN OF IMPROVEMENT

PLATE 7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