AD-A150 159 MURRELLS INLET SOUTH CAROLINA NAVIGATON PROJECT GENERAL DESIGN MEMORANDUM(U) CORPS OF ENGINEERS CHARLESTON SC CHARLESTON DISTRICT 02 DEC 75 1/4

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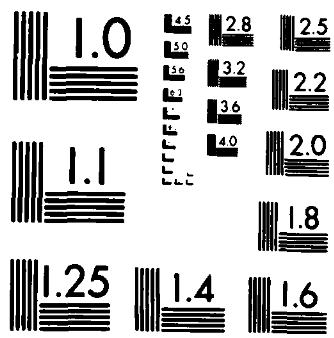
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DESIGN MEMORANDUM NO. 1

MURRELLS INLET, SOUTH CAROLINA
NAVIGATION PROJECT

GENERAL DESIGN MEMORANDUM

U.S. ARMY ENGINEER DISTRICT, CHARLESTON

CORPS OF ENGINEERS

Charleston, South Carolina

December , 1975

COPY NO.

DEPARTMENT OF THE ARMY
CHARLESTON DISTRICT, CORPS OF ENGINEERS
P O BOX 919
CHARLESTON, S C 29402

SAVCD-J

2 December 1975

SUBJECT: Murrells Inlet, South Carolina Design Memorandum 1 - General Design Memorandum

Division Engineer, South Atlantic
ATTN: SADVY

1. Transmitted are 23 copies of subject design memorandum, submitted for approval in accordance with applicable provisions of ER 1110-2-1150, dated 1 October 1971, and as revised 22 July 1974 by change 7, SAD Supplement 1 to ER 1110-2-1150, and DvR 1110-1-5, dated 4 April 1973. Also inclosed is one copy of the transcript of the public meeting held on 29 May 1975.

2. Attention is invited to the paragraph 120 of the section entitled, Schedules for Design and Construction. These proposed schedules were established to cause timely initiation of project construction in early FY 1977. The schedules are considered justified to serve the best interests of the Government because they would expeditiously facilitate the inlet stabilization and termination of annual (recently bi-annual) emergency dredging. These dredging efforts have been expensive, hazardous and produced short-lived results.

3. The final EIS will be submitted on or about 20 January 1976.

4. It is recommended that this General Design Memorandum be approved as the basis for the preparation of plans and specifications and for the request of construction funds in FY 1977 budget.

HARRY S. WILSON, JR.
Colonel, Corps of Engineers
District Engineer

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MURRELLS INLET

SOUTH CAROLINA

GENERAL DESIGN MEMORANDUM

SCHEDULE FOR SUBMISSION OF FUTURE DESIGN MEMORANDA

This General Design Memorandum is submitted in accordance with applicable provisions of ER 1110-2-1150, dated 1 October 1971, as revised through Change No. 7, 22 July 1974. Due to the nature of this navigation project and coverage herein, this design memorandum will be the basis for preparation of the plans and specifications and the submission of feature design memoranda will not be required.

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TEXT

[illegible] 30 Mar 76

EXHIBITS

TABLES

EXHIBITS

3. South Jetty

Total Length of Jetty (Excl. Sand Dike)	3,290'
Type of Construction	Quarrystone
Jetty Head:	
Length	150'
Crest Elevation	+9' MLW
Crest Width	18'
Side Slopes	1V on 2H
Armor Stone I Size	6-10 tons
Jetty Trunk:	
Length	3,140'
Crest Elevation	+9' MLW
Crest Width	15'
Side Slopes	1V on 2H
Armor Stone II Size	4-7 tons

4. South Sand Dike

Length	2,850'
Crest Elevation	+10' MLW
Crest Width	100'
Side Slopes	1V on 25H

5. Navigation Channels

	Entrance	Inner
Length	3,000'	15,440'
Bottom Width	300'	90'
Project Depth	-10' MLW	-8' MLW
Allowable Overdepth	2'	2'
Side Slopes	1V on 4H	1V on 4H

6. Auxilary Channel (To Oaks Creek)

Length	625'
Bottom Width	200'
Depth	-6' MLW
Allowable Overdepth	0
Side Slopes	1V on 4H

7. Deposition Basin

Dimensions	100' x 930' x 570' x 660' x 1300'
Depth	-20' MLW
Allowable Overdepth	0
Side Slopes	1V on 4H
Capacity	600,000 Cu. Yds.

8. Estimate of Project First Costs

01. Lands and Damages	$ 815,000
09. Channels	2,075,000
10. Jetties	9,153,000
14. Recreation Facilities	259,000
30. Engineering & Design	$ 990,000
31. Supervision & Administration	574,000
Total Project First Cost	$13,866,000

9. Annual Economic Charges - Total $ 1,363,400

10. Annual Benefits

Navigation	1,902,100
Recreation	34,500
Redevelopment	88,000
Total	$ 2,024,600

11. Benefit-Cost-Ratio 1.48

PLATES

APPENDICES

MURRELLS INLET NAVIGATION PROJECT
GEORGETOWN COUNTY, SOUTH CAROLINA

GENERAL DESIGN MEMORANDUM

PERTINENT DATA

DESIGN DETAILS

1. North Jetty	
Total Length of Jetty (Excl. Sand Dike)	3,365'
Type of Construction	Quarrystone and Concrete Sheet Pile
Jetty Head:	
Length	150'
Crest Elevation	+9' MLW
Crest Width	18'
Side Slopes	1V on 2H
Armor Stone I Size	6-10 tons
Jetty Trunk	
Length	1,335
Crest Elevation	+9' MLW
Crest Width	15'
Side Slopes	1V on 2H
Armor Stone II Size	4-7 tons
Concrete Sheet Pile (Weir Section)	
Length	1,608'
Top Elevation	+2.2 MLW
Pile Size	1' x 4' x 18' long
Concrete Sheet Pile (Terminal Section)	
Length	272'
Top Elevation	Varies from +2.2' to +9' MLW
2. North Sand Dike	
Length	500'
Crest Elevation	+10' MLW
Crest Width	100'
Side Slopes	1V on 10H

MURRELLS INLET NAVIGATION PROJECT
GEORGETOWN COUNTY, SOUTH CAROLINA

GENERAL DESIGN MEMORANDUM

PROJECT AUTHORIZATION

1. Under the provisions of Section 201 of the Flood Control Act of 1965, a project for improvement and stabilization of Murrells Inlet, Georgetown County, South Carolina was authorized by a resolution adopted by the Committee on Public Works of the United States Senate on 18 November 1971; and by a resolution adopted by the Committee on Public Works of the United States House of Representatives on 10 November 1971 as follows:

Senate Resolution

> RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, that pursuant to the provisions of Section 201 of Public Law 298, Eighty-ninth Congress, the project providing for navigation improvements of Murrells Inlet, Georgetown County, South Carolina, is hereby approved substantially in accordance with the recommendations of the Secretary of the Army in House Document Numbered 137, Ninety-second Congress, at an estimated cost of $4,346,000, except that the costs of operation and maintenance of the general navigation features shall be borne by the United States.

House Resolution

> Resolved by the Committee on Public Works of the House of Representatives, United States, that pursuant to the provisions of Section 201 of Public Law 89-298, the following project for Navigation is hereby approved substantially in accordance with the recommendations of the Secretary of the Army in House Document Numbered 92-137, at an estimated Federal cost of $4,346,000, except that the costs of operation and maintenance of the general navigation features shall be borne by the United States.

DESCRIPTION OF AUTHORIZED PLAN

2. Navigation facilities. The authorized plan for navigation improvement consists of the following: dredging an entrance channel, 300 feet wide and 12 feet deep through the offshore bar, a distance of approximately 3,300 feet; an inner channel, 90 feet wide and 10 feet deep from the entrance channel to the major berthing area at the old Army crash boat dock in the village of Murrells Inlet, a distance of

15,700 feet, where it would terminate with a turning basin; a 16-acre diked disposal area to accommodate shoal material found unsuitable for beach nourishment; a jetty on the north side of the inlet approximately 3,300 feet long, having a low weir section over which littoral materials pass en route to a deposition basin; a south jetty, approximately 2,300 feet long; and sand transition dikes connecting the jetty structures to the shore. In addition to maintenance of the upper portion of the channel, proper operation of the plan requires that approximately 100,000 cubic yards of sand be removed annually from the deposition basin and entrance channel. This material would be used for nourishment of the downdrift beach. An overdepth of two feet is allowed as the usual dredging tolerance to cover inaccuracies in the dredging process.

3. Recreation facilities. The main recreational feature in the authorized project is an 8-foot wide fishing walkway to be constructed along the entire length of the south jetty. For public access, an existing road from Huntington Beach State Park would extend from the present parking area to the proposed south jetty. Public accommodations in the park would be readily available for fishermen using the walkway.

LOCATION AND DESCRIPTION OF PROJECT AND TRIBUTARY AREAS

4. The project is located in the northern section of Georgetown County, South Carolina about 19 miles northeast of the City of Georgetown and 13 miles southwest of the City of Myrtle Beach. The inlet is the ocean entrance to several tidal streams in the Murrells Inlet - Garden City estuarine area. Mean tide range if 4.4 feet and spring tide range is 5.3 feet. Huntington Beach State Park is located just south of the inlet. It has public beach areas, picnicking and camp sites with full facilities. To the north of the inlet is Garden City, an unincorporated beach community. Inlet Point, immediately adjacent to the north side of the Murrells Inlet, is being developed as a vacation, recreational, and residential area. The development has a system of Venice-type canals that provide water access through Main Creek to the ocean for people living on the landward side of the barrier spit.

5. Channels. The channel leading to the migrating inlet is obstructed by a shifting offshore bar and the inlet throat is obstructed by extensive sand shoals attending migration of the inlet. This condition constitutes an unstable channel without adequate depths to permit unrestricted navigation through the inlet and offshore bar. Prior to the performance of limited emergency dredging, the normal controlling depth was less than three feet with numerous occurrences, under extreme conditions, of depths less than two feet. Under the authority of Section 3 of the River and Harbor Act of 1945 (P. L. 79-14), emergency dredging was completed in 1966, 1967 and repeated again in the summer of 1968 and the spring of 1973. Section 67 of the Water Resources Development Act of 1974 (P. L. 93-251) authorized the Chief of Engineers to perform emergency dredging until the authorized navigation project is constructed.

The inlet was dredged in 1974 and 1975 under the authority of the Water Resources Development Act of 1974. These emergency dredgings have been only partially effective with user complaints received soon after each operation. Charter and party boat operators have expressed their dissatisfaction, with the short duration of deep water through the inlet after emergency dredging, during meetings with the District Engineer, District personnel and their elected officials. The limited effectiveness of the emergency dredging is further evidenced by the frequency with which it must be performed to maintain minimal depths over the outer bar. In 1975, local interests were successful in causing the Corps sidecaster dredge MERRITT to return and perform additional dredging.

6. The nearest Federally improved harbor is Georgetown Harbor, South Carolina at Winyah Bay, about 22 road miles to the south. Cape Fear River in North Carolina, which is about 60 miles upcoast, is the nearest Federally improved inlet to the north. Little River Inlet is about 34 miles from Murrells Inlet at the North Carolina - South Carolina state line and connects the Intracoastal Waterway with the Atlantic Ocean. This inlet has a severe shoaling problem with a normal controlling depth of about three feet, mean low water, and has been authorized for improvement similar to Murrells Inlet.

7. Inlet and shoreline changes. The movement of littoral drift contributes to changes in the inlet as well as the shoreline. As sand enters the inlet, spits are formed causing a contraction of the inlet throat, erosion of the opposite shore, and migration of the inlet. The predominant direction of littoral movement is southerly, therefore, most of the inlet migration has been in that direction. Average annual recession of the shoreline near Murrells Inlet has been 1.3 feet or approximately 7,000 cubic yards per mile during the 94-year period 1872 to 1966.

8. Bridges. There are no bridge crossings of navigation channels at Murrells Inlet. Utilization of shores southwestward of the inlet as a state park, and the presence of vast tidal marsh areas adjacent to inner channels make it highly improbable that bridges will be constructed across navigation channels in the foreseeable future.

9. Terminal and transfer facilities. There are five marinas and numerous private docks located about the Murrells Inlet harbor. These are adequate to handle existing and near future traffic. Besides docking facilities, marinas offer many boating necessities such as fuel, oil, groceries, water, and repair services on a non-discriminatory basis. There are several public boat ramps in the area. Facilities are expected to be expanded and new ones added as demands for services outstrip capacity.

10. Commercial seafood catches are generally off-loaded from private docks to refrigerated trucks. Catches are then transported to processing and distribution centers located at Myrtle Beach and Georgetown, South Carolina, where rail outlets are available. Most of the seafood brought into Murrells Inlet commercially is utilized by restuarants serving the "Grand Strand". Processing interests have expressed their desire to construct facilities at the inlet.

11. Existing Corps of Engineers projects. There are no existing Federal projects in the project area.

12. Tributary area. Murrells Inlet is part of the "Grand Strand", a rapidly growing national resort and South Carolina's most popular vacation spot. The "Strand" consists of 50 miles of resort beaches along South Carolina's northeast shore. The population of the area in 1972 was estimated to be about 40,000 permanent residents, with about 212,000

tourists visiting the area on busy weekends. About 75 percent of this tourist trade is attracted from the Carolinas and Virginia, but almost all eastern states are represented at the "Grand Strand".

LITTORAL DRIFT

13. General. Breaking waves create a longshore or littoral current. This current is predominately southwestward at Murrells Inlet, and is more visible in the breaker zone than in deeper water. This current or movement carries the beach sand, which is in suspension due to turbulence of the breaking waves, along the shore parallel to the beach. The sand moved in this manner is known as littoral drift.

14. Estimates of littoral drift. The survey report estimated the littoral drift movement as 250,000 cubic yards per year (southward) and 150,000 cubic yards per year (northward). These estimates were based on data from other sites such as the Georgetown Harbor jetty system and Masonboro Inlet, North Carolina. Georgetown Harbor jetties are 24 miles southwest of Murrells Inlet, while Masonboro Inlet is about 81 miles northeast of Murrells Inlet.

15. The estimate of littoral drift for this memorandum has been arrived at by employing two additional estimating methods. One method consists of estimating the volumetric accretions to the north lip of the inlet between various surveys. The other method estimates the littoral drift from wave climate data. The results of two methods are presented below.

16. Method 1 (volumetric accretions). By estimating the volumetric accretions to the north side of the inlet (following periods when the north side has been growing southward), the net southward littoral drift rate can be computed. Such estimates are generally on the low side, since not all the littoral material goes in at the north lip. Some of the littoral drift may accumulate in the offshore bar or enter into the interior channels. If the inlet is stable as to location and cross sectional area, the net littoral drift is zero since the volume moving north and south is equal. The net littoral drift is southward at Murrells Inlet and it is estimated to range between 90,600 and 131,500 cubic yards per year. The computations for this method are presented in Appendix D, Design Data.

17. Method 2 (energy flux). This method is based on the assumption that longshore transport rate depends on the longshore component of energy flux in the surf zone. Using this method, the southward moving material is 186,360 cubic yards per year and the northward moving material is 53,970 cubic yards per year. The computations for this method are presented in Appendix D, Design Data.

18. Littoral drift rates. The best estimate that can be made with available data is as follows:

Southward moving material	186,000 cu/year
Northward moving material	54,000 cu/year
Net (southward) material	132,000 cu/year
Total littoral drift	240,000 cu/year

CURRENT NEEDS AND DEVELOPMENT OBJECTIVES

19. The types of water-related development needs that were considered in this study are navigation and recreation.

20. Navigational needs. Local interests need a stable channel from the inner harbor through the inlet throat and across the ocean bar. The improved channel would permit unrestricted passage preventing delays, hazardous navigation conditions, and loss of revenue.

21. Difficulties attending navigation. Principle difficulties result from inadequate depths across the ocean and inner bars and continual shifting of the bar channel. Channel alignment shifts so rapidly and so often that it is difficult for the Coast Guard to maintain channel markers in proper positions. During periods of low tide or high seas or swells, the bars are extremely hazardous if not impassable. Local interests report that at least one boat has been lost in recent years when rescue parties were unable to traverse the inlet to render assistance. Numerous grounding, resulting in considerable damage to the vessels, occur throughout the year.

22. Existing boats. Currently there are approximately 380 boats of various classes harbored at Murrells Inlet. Numerous boats are hauled into the area for day use and would be equivalent to about 1,300 like vessels permanently harbored at the inlet. Most are utilized for recreation but some are used during the tourist season for charter fishing and in the offseason for commercial fishing. During the 1974 season one shrimp trawler operated out of Murrells Inlet. This 40-foot vessel was able to work part time here because of its relatively shallow draft of four feet. A tabulation of boats using the harbor by class and use is given in Table 1.

Table 1
BOATS OPERATING FROM MURRELLS INLET
(Dec 1974)

Class	Number of Boats Permanent	Number of Boats Transient 1/
Outboards	220	1,220
Sailboats	18	
Auxiliary Sailboats	12	
Inboards	75	90
Cruisers	30	
Charter Boats	24	
Shrimp Trawler	1	
TOTAL	380	1 310

1/ Equivalent boats, for discussion see "Recreational Boating Activities at Murrells Inlet", Appendix E.

23. Projected use. If no project is forthcoming, charter boats currently using the inlet would likely be forced to quit operating for economic reasons. In this event, recreational benefits from the inlet would reach a low within 5 years after corrective works are declared infeasible, while in the same period commercial use should become non-existent.

24. Construction of a project would encourage the boats formerly using the inlet to resume operations. The charter fleet then would grow at a rate reflecting the demand for this type of recreation which is currently estimated at 3.3 percent per year but is expected to taper off to about 2.6 percent by the end of the 50-year project life. These additions to the fleet are expected to come from new boats or idle boats still located at Murrells Inlet. The annual growth rate is expected to be slightly less for the private operated segment of the recreation fleet. It is anticipated that the existing and future boating facilities used by the private fleet will reach a saturated condition by the year 2005; therefore, no growth of that fleet is expected after 2005. Projections of the number of boats by class for the 50-year life of the project are shown in Table 2. Economic projections are presented in detail in Appendix E.

Table 2
FLEET PROJECTIONS

Class of Boat	Number of Boats: Present (1974) Actual	Present (1974) Probable Without Nav. Problem	End of 50-year Project Life: Without Project	End of 50-year Project Life: With Project
Personal Pleasure Craft	1,665	1,690	2,429	3,903
Commercial Party and Charter Boats	24	31	0	138
Commercial Shrimp Trawlers	1	2	0	3
TOTALS	1,690	1,723	2,429	4,044

25. Prior to World War II, 20 full-time commercial fishing boats operated from the inlet; therefore, it is reasonable to expect that a commercial fishing fleet will again be based here if navigation through the inlet is unobstructed. This view is strengthened by the fact that numerous expressions of interest in locating the inlet are received each year from fishing, shrimping, and associated support industries. If Murrells Inlet is improved, it will be used as a harbor of refuge for local deep draft boats and other boats not normally based at the Inlet.

26. Recreational needs. The need for water-oriented recreational opportunities in the Murrells Inlet area has been recognized for some time. A fishing walkway placed on the south jetty at the northern end of Huntington Beach State Park should be very popular. The U. S. Fish and Wildlife Service stated that the combination of the deepened channel flanked by the jetties is expected to attract large numbers of marine sport fish. It is estimated that 20,000 people will fish from the walkway annually and another 6,000 sightseers will use this facility each year.

ALTERNATIVES CONSIDERED

27. Several possible solutions to the problem of providing a stabilized channel of sufficient depth and width for regular use by commercial and recreational fishing vessels were considered. Since experience has shown that it is not economically or physically feasible to maintain the channel by dredging alone, a proper solution must also include structural controls with provisions for sand bypassing.

Structural controls considered include jetties, offshore breakwaters, and conventional and special facilities for sand bypassing. An optimum project was selected by maximizing benefits through comparison of cost and benefits for incremental project requirements related to variarions in project depths. Five different plans were tested with physical models to determine the best location and arrangement of structural control appurtenances.

28. Non-structural controls. Construction and maintenance of the required channels were considered using a program of dredging in lieu of structural controls. In February 1975, private dredging contractors were contacted by Charleston District and asked if they would consider dredging in Murrells Inlet with a pipeline dredge. All contractors responded that dredging in Murrells Inlet was too hazardous and not feasible for a pipeline dredge. The contractors provided the following reasons for not dredging with a pipeline dredge: insurance is void once they go in open ocean waters; the only access to Murrells Inlet from the intracoastal waterway is at Georgetown or Little River Inlet (also an unstable, shallow inlet), which would require the dredge to be towed in the open sea for about 50 miles; a large dredge would require from 6 to 8 feet of water in which to work and would be unable to seek refuge inside Murrells Inlet during stormy weather by the shallow depths; a small portable dredge would not require the water depths that a large dredge would but a small dredge's pumping capacity would render its operation useless due to rapid shifting of sand in the inlet; and the design of a pipeline dredge renders it useless in areas of strong wave actions (ladder fixed to dredge thereby transferring all the force of cutterhead hitting bottom during heavy seas to dredge superstructure).

29. In September 1975, a private consulting engineering firm was employed by Georgetown County to prepare plans and specifications to perform pipeline dredging at Murrells Inlet. The funds for this dredging was to be obtained from the Coastal Plains Regional Commission. A large number of private dredging firms were contacted by the private engineering firm. These dredging companies were requested to signify their interest in undertaking a dredging operation in Murrells Inlet. The response to this inquiry was the same as received earlier by the district office; no interest in this work. Two out-of-state dredging firms actually sent representatives to look at the area, and then decided that the work could not be done with their equipment.

30. Presently Charleston District is performing emergency dredging in the inlet using the Corps of Engineer sidecasting dredge, "MERRITT". Even the use of this small sidecasting dredge has not been without incident The MERRITT has run aground in the inlet on shoals that formed in areas it had previously dredged in the preceeding weeks.

31. The technology does not presently exist in the private or government dredging fleets to adequately maintain Murrells Inlet. The Corps of Engineers is not authorized to construct new dredges that could have capability of dredging Murrells Inlet; and the private sector appears not to

be interested in undertaking the design of a prototype dredge capable of this operation without Federal funds. For the reasons stated in this and preceding paragraphs, dredging without structural controls is considered to be uneconomical and physically infeasible.

32. Dredging without structural controls also does not provide the following beneficial purposes of a jetty system: wave attenuation to provide hazard free navigation; training device to control channel alignment; current constraint to eliminate cross-currents; and exclusion of littoral drift from the channel. The inability of maintaining a channel without structural controls to exclude the littoral drift from the channel further aggravates the dredging problems. Littoral drift begins to move into the dredged channel as soon as the dredge makes its pass. Based on present dredging technology and the inability of dredging only to provide the benefits of a jetty system, a dredging only scheme for Murrells Inlet is not considered to be a viable alternate solution to the recommended solution (dredging with structural controls).

33. Structural alternatives. Structural alternatives considered included provisions for (1) intercepting, trapping and bypassing sands moving alongshore (2) sheltering using vessels from wave action, and (3) maintaining stable channel dimensions and alignments. Schemes for intercepting and trapping of sand were either by making the updrift jetty a complete littoral barrier, causing the sand to form against or by providing a weir in the updrift jetty over which sands flow into a deposition basin located within the jetty confinement. With the former scheme, sands forming the fillet against the impermeable jetty would be exposed to ocean forces and would have to be bypassed using a permanently installed hydraulic plant, a conventional hydraulic dredge requiring offshore breakwater protection or a submarine type, jet educator system (not yet perfected). These sand bypassing methods are discussed in more detail in paragraphs 85 through 93. The latter scheme for sand interception and entrapment would require periodic employment of a conventional hydraulic dredge operating within the protected jetty system to remove entrapped sands from the deposition basin to downdrift beaches. Considering the previous described actions, the best project arrangement was found to be the construction of jetties extending from the barrier beaches on each side of a dredged inlet channel and the sand-bypassing scheme employing an overflow weir and deposition basin.

INVESTIGATIONS

34. Reports prior to project document report. A Preliminary-Examination Report of the inlet was transmitted to Congress in 1949 in compliance with an item in the River and Harbor Act approved 2 March 1945. The report indicated that rock jetties would be required for stabilization of an improved inlet channel and that additional cost would be

incurred for dredging, barricading breaks in the barrier island, which no longer exist, and possibly for preventing increased erosion at Pawleys Island Beach. It was found that the prospective benefits from the desired improvements were insufficient to warrant expenditure of the required funds. Therefore, an unfavorable recommendation relative to further consideration of navigation improvements at Murrells Inlet was made.

35. Project document report. The report was prepared in compliance with a resolution adopted by the Committee on Public Works of the United States Senate on 31 August 1965; with a resolution adopted by the Committee on Public Works of the United States House of Representatives on 5 May 1966 as follows; and includes application of Public Law 89-72:

Senate Resolution

"Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on Murrells Inlet, South Carolina, transmitted to Congress by the Secretary of the Army on March 11, 1949, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time."

House Resolution

"Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Murrells Inlet, South Carolina, transmitted to Congress by the Secretary of the Army on March 11, 1949, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time."

Public Law 89-72

Authority for the inclusion of an evaluation of recreation and fish and wildlife elements is contained in the Federal Water Project Recreation Act, Public Law 89-72, 89th Congress, S. 1229, July 9, 1965.

36. Purpose and extent of project document study. Investigations, surveys, and studies made in connection with this report were conducted to determine the needs, economic justification, and advisability of

providing a stabilized channel through the inlet with depths necessary to enable free and unhindered navigation by present and prospective users. The scope of this study primarily concerns boating activities at Murrells Inlet, S. C., and their relationship to the economy. Hydrographic surveys of inner channels, the throat of the inlet, and offshore areas were made. Past and present boating activities were inventoried and evaluations of the benefits and costs of various solutions to the navigation problems were made.

37. Public meetings. A meeting was held during the survey study in the auditorium of Murrells Inlet Elementary School, Murrells Inlet, South Carolina on 16 February 1967. About 500 persons attended, including representatives of Federal and State agencies, and local interest from nearby counties and towns. All statements emphasized the need for a safe, stable and unobstructed navigation channel through the inlet. Also during the survey study, a late-stage public meeting was held at the same place as the initial meeting on 5 March 1970. About 230 persons attended this meeting including other agencies and local interests. The purpose of the meeting was to present the District Engineer's plan for improving the navigability of Murrells Inlet before it was submitted to higher authority for review. A post authorization meeting was held again at Murrells Inlet on 29 May 1975. The attendance was about 90. The purpose of the meeting was to furnish information as to the nature of the planned improvements and the status of the planning effort, and to solicit the views of all concerned regarding the project. Throughout the study, there has been mostly proponents at these meetings with very little opposition and a great deal of Congressional interest. Congressman John S. McMillan attended the first two meetings and Congressman John W. Jenrette attended the 1975 meeting. United States Senators Strom Thurmond and Ernest F. Hollings and former Congressman Edward L. Young, have actively supported the project and provided help in obtaining emergency dredging at Murrells Inlet.

38. Studies for General Design Memorandum. Studies relating to the Murrells Inlet project which followed project authorization are described in the following paragraphs.

39. Field surveys. The field surveys included: obtaining soil samples, jet probings, taking cross-sections, offshore sounding, measurements of current velocity and current direction, water sampling and establishing horizontal control. Under Corps of Engineer sponsorship, the National Ocean Survey has placed recording tide gages throughout the estuary to establish tidal data. Also a wave gage was installed on nearby Springmaid Beach pier to produce sufficient wave data for the model study and jetty design. Hydrographic surveys were taken of the channel and offshore ocean bottom for preliminary planning and for the model study.

40. Aerial photography, topographic mapping and ground control. The entire Murrells Inlet area was photographed using color aerial film. Topographic maps were made at scales of one inch equals 400 feet and one

inch equals 200 feet with a contour interval of one foot. A planimetric map was made of the entire area at a scale of one inch equals 800 feet. Included in the mapping was controlled aerial mosaics at scales of one inch equals 200 feet, one inch equals 400 feet, and one inch equals 800 feet. Complete horizontal and vertical ground control was established to produce the required precision of mapping.

41. Materials investigation. Field sampling of in situ soils was made to determine the adequacy of these materials for jetty and dike foundations, for dike construction and beach nourishment, and to verify the existence of easily dredged materials along proposed channel alignments. Soil samples were collected during the survey report study and in 1975 during the GDM study. Methods of sample collection and testing are discussed in section, Geology and Soils.

42. Real estate appraisals. The real estate studies included the accumulation of available land maps, determination of estate and appraisal of land to be acquired.

43. Relocations investigations. The road relocation studies included field examination of the project area, coordination of relocation needs with the South Carolina Highway Department, the South Carolina Department of Parks Recreation and Tourism, and with local interest, and planning for needed relocations with estimates of cost. Roads affected by the project are S. C. Highway 65 which is an asphalt paved secondary road along the ocean shoreline at Garden City Beach and two-lane paved roads in Huntington Beach State Park to the south of Murrells Inlet.

44. Model study. A physical model of Murrells Inlet and estuary was constructed at the Waterways Experiment Station (WES) to examine the effects of currents and wave conditions on different arrangements of project appurtenances under simulated prototype conditions. The Jetty Plan Selection (Appendix A) presents a documentation of the process used to arrive at the plan of improvement for Murrells Inlet. Preliminary testing of five considered plans using surface currents permitted selection of two plans for full model testing. One plan is essentially the same as described in the project document and the other is similar but located and aligned a little more to the south. The jetty and channel alignment, as recommended, in this report will be model tested. The results of the model testing program and any revisions to the recommended plan of improvement as a result of the testing, will be appropriately reported to higher authority for review and approval.

45. Recreational studies. Recreational facilities include a fishing walkway on the south jetty and a comfort station as well as expanded parking facilities at the present Huntington Beach State Park parking lot. Recreational resources are discussed in Appendix B.

46. Environmental studies. Ecology studies were performed by the South Carolina Wildlife and Marine Resources Department under contract to the Charleston District, U. S. Army Corps of Engineers.

47. Economic studies. An economic analysis was made to determine current costs and benefits, final project formulation, and cost allocation for the recommended plan of improvement.

PLAN FORMULATION

48. The recommended plan of improvement was developed utilizing appropriate engineering and economic principles in combination with applicable Federal law and policy. The plan is considered the most feasible project to meet existing and projected needs by maximizing net benefits through efficient utilization of the natural resources. Planning was directed to achieve national economic development, environmental quality, regional development, and social well-being. Each of the plans of improvement considered include an entrance channel 300 feet wide and an inner channel 90 feet wide with channel depths determined by maximizing benefits. The inner channel would extend to the major berthing area at the old Army crash boat dock where it would terminate with a turning basin. A diked disposal area would be provided for the material dredged from the inner channel not suitable for beach nourishment. Several different types of structural control and recreational fishing walkway for inclusion in the proposed plan of improvement was also considered.

49. Dredging alone. One plan of improvement that was considered was a program of dredging without structural controls. Emergency dredgir operations at the inlet with the Corps-owned side casting dredge MERRITT proved this approach to be inefficient in obtaining desirable depths. This plan was also considered more undesirable to the environmental quality of the inlet than plans with structural controls since the more frequent dredgings required would cause more disruption of benthic populations Social well-being of the local people and other users of the project would benefit less with non-structural control because an undependable entrance channel to the ocean would discourage growth of the commercial fishing and charter-boat operations, and associated businesses in the area. Without jetties there would be no fishing walkway to increase the recreational opportunity at Murrells Inlet. It was concluded that some type of structural control is required.

50. Jetty systems. Single jetties and double jetties with and without offshore breakwaters and sand-bypassing facilities were considered in formulating the best plan. Since each of these alternatives would accomplish the desired results with about the same environmental impacts, the selection of the best project simply became a matter of economics. Jetties or offshore breakwaters would improve economic development and social well-being in the Grand Strand area by providing adequate access to the ocean for the existing and projected fleet.

51. Optimum navigation project. The best structural control for the navigation project is concluded to be the weir jetty system since it is clearly the least expensive and most satisfactory solution. The optimum navigation project was determined through maximization of benefits. Maximum benefits are achieved by incrementally adding higher levels of improvement until the incremental cost of the addition equals the incremental benefits received. This is also the point where benefits

exceed costs by the largest amount. Several levels of improvements were compared by increasing channel project depths in two-foot increments. The length of jetties is based upon entrance channel length which is a function of depth. Therefore, incremental increases in jetty length are required for each higher level of improvement. Recreational boating and commercial fishing operations, which are now regulated by the tidal cycles, would realize increasing benefits due to greater channel project depths until these depths reach a level that would be adequate for the deepest draft vessels expected to use the inlet. Annual benefits from reduction of vessel maintenance also varies with channel project depth. Entrance channel depths that were compared ranged from eight feet to 14 feet and inner channel depths were two feet less for each level of improvement. The optimum project was determined to have an entrance 10 feet deep and an inner channel 8 feet deep.

52. Fishing walkway. The best plan for providing recreational fishing from jetties was determined to be construction of an asphalt walkway for the entire length of the south jetty. Included in this plan is expansion of the existing parking area in Huntington Beach State Park and provision of sanitary facilities at the parking area. Public access to the south jetty will be limited to foot traffic in order to assure that the island will remain in its present natural state as much as practicable. The two jetties will attract fish and the walkway will provide access to large numbers of fishermen without boats.

COORDINATION

53. Federal, State, and local agencies were consulted during preauthorization studies and this coordination was updated during the preparaion of this memorandum. In a letter dated 15 October 1975 (Exhibit 1), Federal, State and local agencies were requested to comment on the project.

54. Environmental Protection Agency (EPA). In a 31 October 1975 letter (Exhibit 2), EPA commented that the proposed plan should have no significant adverse long-term effects on water quality or the associated environment. EPA expressed concern that beach access to fishing walkway may lead to destruction or erosion of the natural dunes.

55. United States Fish and Wildlife Service (USF&W). This agency in a letter dated 13 June 1975 (Exhibit 3) commented on the plan presented at the public meeting held at Murrells Inlet on 29 May 1975. In their letter, USF&W recommended that a totally non-wetland site be used as a disposal site in lieu of the marsh area proposed in the survey report and that the disposal area be properly diked. USF&W also stated that if a suitable upland site is not available then the USF&W and the National Marine Fisheries Service would not oppose ocean disposal of dredged material during the winter months. USF&W was concerned that construction be scheduled so as to not disturb the least terns during their nesting activities.

56. In a letter dated 24 October 1975 (Exhibit 4), the local field representative of USF&W concurred in the project plan as presented in Exhibit 1. This letter expressed concern for well being of the least tern rookery located in the beach dune community. It was recommended that routing of the beach trail to jetty fishing walkway be coordinated with Brookgreen Gardens manager, Huntington Beach State Park naturalist, S. C. Wildlife and Marine Resources Dept. and the USF&W.

57. United States Department of Health, Education and Welfare. In their letter dated 10 November 1975 (Exhibit 5), this agency advised that there are no comments to offer on the project.

58. United States Coast Guard, Department of Transportation (USCG). Coordination with USCG was initiated in 1968 for the purpose of estimating the cost of aids to navigation for the proposed jetty project at Murrells Inlet. USCG's response (Exhibit 6) to our request included the number and type of navigation aids needed, an itemized estimate of cost for placing and maintaining these aids, and a map showing their locations. In a letter 28 July 1975 (Exhibit 7), USCG updated the costs for the navigation aids.

59. Bureau of Outdoor Recreation (BOR). In a letter dated 29 October 1975 (Exhibit 8), BDR commented that the changes in the authorized project should increase the outdoor recreation opportunity.

60. Soil Conservation Service, United States Department of Agriculture. In a letter dated 4 November 1975 (Exhibit 9), the State Conservationist stated that his staff has reviewed the project as presented in Exhibit 1; and they have no comments.

61. National Marine Fisheries Service (NMFS). In a letter dated 14 November 1975 (Exhibit 10), NMFS was requested to furnish a current estimate of maximum sustained yield of the fishery off Murrells Inlet. In a letter dated 4 December 1975 (Exhibit 11), NMFS replied that the information requested is currently unavailable.

62. South Carolina Department of Parks, Recreation and Tourism (PRT). PRT operates and maintains Huntington Beach State Park which is located immediately to the south of the proposed jetty project. In 1968, that agency requested the Corps to investigate the feasibility of providing a fishing walkway on the proposed south jetty and PRT agreed to consider contributing the local share of the walkway costs. In a letter dated 6 November 1969, PRT said that they were in full accord with the navigation plan for Murrells Inlet and stated their belief that a fishing walkway would be a great benefit. They concurred with our estimate of approximately 26,600 users of the walkway annually. PRT asked that a meeting be arranged with the Corps to coordinate the recreational plans for development of the northeast portion of Huntington Beach State Park. A meeting and a field inspection of that portion of the park was held on 22 December 1969. Several representatives of PRT including the park

superintendent met with Corps people and South Carolina Senator Claymon C. Grimes of Georgetown at Huntington Beach and discussed the long-range plans for the park. These plans included the development of Drunken Jack Island. PRT suggested that the access road to the jetty walkway be routed through that island instead of along the beach as planned. After contacting PRT in 1970, they expressed concern that special attention be given to preserving the valuable marsh in the vicinity of the project. Then, at the public meeting held at Murrells Inlet on 29 May 1975, PRT again fully endorsed the jetty project but urged that the Corps make assurances that construction and operation of the jetties would not cause erosion of the Park's coastline and that the plans for the fishing walkway be modified in accordance with the current PRT Master Plan for Huntington Beach State Park. This plan assures that Drunken Jack Island will remain in its present state; that public access to the walkway will be limited to foot traffic via a route from the present vehicle parking area up the beach to the jetty walkway; and that necessary sanitary facilities will be provided for users of the fishing walkway. In a letter dated 6 October 1975 (Exhibit 12), PRT commented that the project takes into account all items that were discussed at previous meetings and that they see no objection to the project by PRT.

63. State of South Carolina Water Resources Commission (SCWRC). Throughout the preauthorization and General Design Memorandum Studies, SCWRC has participated with the Corps in developing the proposed project plan and has been helpful in coordinating all the State agencies' comments into non-conflicting views of the proposed plans. By letter dated 17 December 1968, SCWRC recommended that a disposal site, other than the proposed marsh, be adopted as part of the project plans. The reason given for objecting to the use of local tidelands stems from a concern that legal maneuvering between tital claimants will prevent timely acquisition. SCWRC also supports the idea of diking disposal areas. The Attorney General for South Carolina requested in 1971, that the Corps contact him before arrangements are made to acquire the 16 acres designated as a disposal area in order that legal steps can be taken to assure that the rights of the State to this property are protected. In a letter dated 7 November 1975 (Exhibit 13), SCWRC stated that they have no objections to the project.

64. Georgetown County Health Department (GCHD). This agency also opposes the use of the 16-acre disposal area which is near Alex's Marina at Murrells Inlet. The reason for GCHD's objection is the problem that may be created with mosquitoes. In April 1970, GCHD stated that in Georgetown County, the main problem of mosquito control was from disposal areas such as this one. They state that in order to maintain an adequate recreational area at Murrells Inlet, a disposal area in this vicinity would be infeasible.

65. State Clearinghouse, Office of Governor. In a letter dated 3 November 1975 (Exhibit 14), the State Clearinghouse inclosed comments received from the State Archeologist, the Wildlife and Marine Resources Department, and the Highway Department. The State Archeologist recommended that Charleston District discuss the project with him in order to determine if an archeological survey is necessary in the project area. The

State Highway Department commented that the beach restoration program for the beaches in conjunction with the navigation improvements will greatly benefit the public. The Wildlife and Marine Resources Department was in general agreement with the project and they offered the following suggestion: that the public should be encouraged to use the beach as access to the fishing walkway in order to avoid disturbing the least tern nesting site.

66. South Carolina Wildlife & Marine Resources Department, Office of Conservation & Management. This office recently completed the environmental studies for the project under contract to Charleston District. In their letter dated 23 October 1975 (Exhibit 15), the Office of Conservation and Management forsees no problems due to the increased jetty length or the enlargement of the deposition basin. They also commented that construction be avoided in wetland areas if at all possible, and that effluent from comfort station should be prevented from entering the wetlands or creeks.

67. South Carolina Department of Health and Environmental Control (DHEC. In a letter dated 21 October 1975 (Exhibit 16), DHEC recommended that the Georgetown County Health Department be kept informed of pumping schedules so mosquito control efforts could be effected in the disposal area.

68. South Carolina State Highway Department. The Highway Department in a letter dated 5 November 1975 (Exhibit 17) state that they had no basis for comments.

69. Brookgreen Gardens. Brookgreen Gardens is the owner of the land upon which Huntington Beach State Park is situated. In a letter dated 10 October 1975 (Exhibit 18), the director of the gardens commented that the drawings furnished by Charleston District will assist the trustees of the gardens in responding to land acquisition requests associated with the project.

HYDROGRAPHY

70. Tidal currents. Since there is little upland discharge or fresh-water inflow, currents in the inner channel are primarily generated by tides. The mean tide range at Murrells Inlet is 4.5 feet and spring tide range is 5.3 feet (the spring tide is the tide which rises highest and falls lowest and occurs when the earth, sun, and moon are aligned). From the base model tests (i.e. existing conditions) the maximum surface currents were 2.3 feet/second and occurs about one hour into the ebb tide. The maximum flood tide current as determined by the model was about 2.0 feet/second. The model study indicated that there would be a slight change in the tidal prism. The heights of the high tides after construction of the project would be about the same as preproject conditions, but the low tide elevations would be approximately 0.5 feet lower than existing conditions.

71. Currents and waves. In the design of the entrance channel, consideration was given to the direction and strength of tidal currents, littoral currents, and predominant waves. The resultant currents alternately assist and retard the movements of vessels. If these currents are too high, navigation is difficult and if they are low, suspended material drops out forming shoals. Improved channel velocities are expected to range from zero at high or low tide to about 2.5 to 3.0 feet/second during the changing tide. Maximum velocities were obtained from surface current measurements made in the model study.

GEOLOGY AND SOILS

72. Regional physiography and geology. The Murrells Inlet area lies along the eastern margin of the Atlantic Coastal Plain Physiographic Province. This province is underlain by sedimentary deposits varying in geologic age from Cretaceous to Recent. These deposits are thickest near the coast and thin out toward the Fall Line in a northwesterly direction. The eastern margin of the coastal plain is characterized by its Pleistocene Age marine cut terraces. These terraces were formed during the transgression and regression of the sea during the interglacial and glacial periods. These terraces extend inland for about 90 miles and range in altitude from sea level to 270 feet above sea level. The youngest of these, the Pamlico, includes the land from the recent shoreline to an abandoned shoreline 25 feet above sea level. This terrace and recent deposits form the topography in the vicinity of Murrells Inlet. The surface deposits are sands and silts derived from erosion of older sediments.

73. Site geology. The Murrells Inlet area is underlain by sands of the Pamlico of the Pleistocene Epoch. These sands overlie older deposits of similar composition of possible Pliocene Age. These older sands in turn overlie a complex series of interbedded shales, limestones and sandstones of Paleocene Age. These are believed to be the Black Mingo formation. Other Tertiary period formations which lie between the Pliocene and Paleocene have been removed by erosion. The surface sediments are of recent origin and at the inlet, are composed primarily of fine sands. Refer to detailed description of soils encountered at the site in Appendix C.

74. Subsurface investigations.

a. Pre-1975 investigations. Field sampling of in situ soils was made for the survey report (1970) to determine the adequacy of these materials for jetty and dike foundations, for dike construction and beach nourishment, and to verify the existence of easily dredged materials along proposed channel alignments. Jet probings were washed to refusal using a 3/4-inch diameter pipe nozzle on a centrifugal pump driven by a 6 horsepower gasoline engine. Equipment capacity limited the penetration in hard sands to twenty feet or less. Subsurface samples were obtained using a 3-inch hand auger and both underwater and dry surface samples were taken by brushing the top materials aside before scooping. Locations of sampling points are shown on Plates 2 and 3. Logs of jet probings and auger borings are presented on Exhibit D, Appendix C.

b. 1975 borings. Nine borings (M-series) were made in March 1975, four on the south side of the inlet, one in the center of the proposed channel, and three on the north side of the channel. The standard penetration method was used for advancing the borings and additionally two borings, M14 and M18, were cored using NX-size diamond tools. A rotary drilling rig mounted on an amphibious all terrain vehicle was used to drill those borings done offshore while a truck-mounted drill rig was used on the land borings. Two petrologic tests were run for mineral identification, and one paleontologic test was run to determine the geologic age of the lowest formation encountered. Soil samples were tested by the South Atlantic Division Lab. Logs of borings, photographs of rock core, and petrologic test results are presented in Appendix C. In addition, three bottom grab samples were taken in the interior channel in July 1975.

75. Laboratory testing.

a. Survey report testing. Gradations and material classifications of five samples were determined at South Atlantic Division Laboratories for the Survey Report material studies.

b. 1975 testing. Gradations, material classifications and moisture contents of representative drive boring samples were determined by South Atlantic Division Laboratories. The interior channel grab samples were tested by SADL for gradation and environmental quality parameters.

RECREATION RESOURCES

76. Huntington Beach State Park borders on the south side of Murrells Inlet and proposed recreation features of the project are being included in the master plan for the development of the park. These features include an eight-foot wide asphalt walkway on top of the south jetty along the entire length of the jetty. The walkway will be used primarily by sightseers and fishermen. These activities are considered compatible with other recreational features enjoyed in Huntington Beach State Park such as surf fishing, crabbing, hiking, beach combing, picnicking, swimming, sunbathing, camping, photography and nature study. Other facilities in the park include camp grounds, picnic areas, playgrounds, minature golf course, trading post and concession stand. An average of 20,000 fishermen and 6,000 sightseers are expected to use the walkway with annual benefits estimated at $34,500. First cost of the walkway is estimated at $285,000 with annual charges of $26,500. These costs include an enlarged parking area and a comfort station at the end of the existing access road which terminates within a mile of the proposed jetty site. The parking area and walkway will be connected by a trail along the beach front. Local interests will be required to contribute 50% of the first cost and all of the maintenance cost of the parking area, comfort station and walkway.

ENVIRONMENTAL ANALYSIS

77. Environmental setting without the project. Murrells Inlet is a shallow coastal inlet which is used as a harbor for private and commercial sport fishing boats. Because of its proximity to the ocean and lack of significant freshwater inflow, water salinity is high, ranging from 29.9 to 31.5 parts per thousand (PPT) in the estuary. The inlet is bordered by sandy beaches near the mouth and most of the inner channel is bordered by smooth cordgrass salt marsh. Animal life in the area is characteristic of that found in estuarine and beach and dune communities along the South Carolina cost. The inlet and associated tidal creeks provide habitat for flounder, seatrout, mullet, red drum, Spanish mackerel, spot, and invertebrates such as blue crabs, oysters, and shrimp. The marshes provide habitat for fiddler crabs, mud crabs, marsh periwinkle, raccoon, clapper rail, herons, and egrets. Typical beach inhabitants are blue crabs, horseshoe crabs, and various pelecypod and gastropod mollusks in the beach subtidal area; wedge shells, mole crabs, and burrowing worms in the intertidal zone; and beach fleas and ghost crabs in the beach berm. The beach zone is also utilized by numerous shorebirds, gulls and terns for nesting and feeding. The brown pelican is the only endangered species occurring in the area. There are no historical resources located within the area of project influence. The human population is predominantly located in the villages of Murrells Inlet and Garden City Beach and the greatest source of income is derived from recreation and tourism. The State of South Carolina operates Huntington Beach State Park which borders the south side of the project. Recreational activities in the area include swimming, fishing, camping, sightseeing, and boating.

78. Environmental impacts of the proposed action. The project will provide a safe navigation channel and harbor of refuge which will benefit commercial and recreational boating interests and the local economy. Channel dredging both initial and maintenance will disrupt benthic populations through mechanical disturbance and smothering, but since the composition of bottom material will be little changed, repopulation of disturbed areas through migration from unaffected areas will occur soon after dredging is completed. Some animals may be smothered during jetty construction and others will be covered by beach nourishment materials. Turbidities will temporarily increase in the vicinity of the dredge and disposal areas. Recent studies made by the Waterways Experiment Station indicate that changes in salinities and the tidal regimen due to construction of the jetty system and channel dredging will be negligible. Prototype salinity data collected by the Waterway Experiment Station is included as Exhibit 19. All but about 11,000 of the estimated 1,140,000 cubic yards of dredged materials to be removed initially will be used for jetty construction or placed in a beach disposal area located north of the inlet. The 11,000 cubic yards of unsuitable material (high percentage of silt or clay) dredged from the upper part of the channel will be placed in a diked upland disposal area. Maintenance dredging of channels and deposition basin will require removal of 203,000 cubic yards of material

annually. All but about 3,000 cubic yards will be bypassed to replace sand blocked from the natural littoral drift by the jetties. Wildlife species inhabiting the upland disposal area will be displaced and plant species destroyed by the deposition of dredged materials. This diked area would create habitat for the production of mosquitoes. The two jetties will attract sport and food fishes and the fishing walkway on the south jetty will provide access to fishermen without boats.

79. Alternatives to the proposed action. Alternatives to the proposed action include no action; channel improvement without structural control; modified structural controls. Channel improvement without structural controls is not considered economically or physically feasible. Modified structural controls do not maximize benefits. The alternative of no action would leave the project area unchanged and would eventually result in the abandonment of Murrells Inlet for all boating except small craft which could negotiate the shallow outer bar during favorable weather. The recreation and navigation benefits to be derived from the proposed project would be foregone.

80. Environmental studies. Environmental studies were accomplished under a contract with the South Carolina Wildlife and Marine Resources Department. The study was designed to:

a. Provide an estimate of the biological productivity of the area with a view to preventing or minimizing any adverse project effects on biological systems.

b. Provide a basis for an assessment of changes in biological communities during and following construction of this and other similar projects.

c. Provide the basic information needed for the preparation of a revised environmental impact statement.

81. Preparation and coordination of the environmental statement. A final EIS for this project was filed with the Council on Environmental Quality (CEQ) in 1970, the year the National Environmental Policy Act was signed. This EIS was representative of EIS's prepared during that period and consisted of a very brief presentation in general terms of the environmental impacts. No objections to this EIS were ever received and it was accepted by CEQ. However, in the intervening period, the concept of what an EIS should be has expanded considerably and the EIS filed in 1970 is no longer considered to be adequately responsive to CEQ's guidelines. Consequently, after the project was authorized and funds were received for pre-construction planning in FY 74, the decision was made to prepare a new EIS. The new draft EIS was completed and distributed to the public for review and comment on 6 November 1975. Coordinated EIS forwarded to SAD in January 1976.

ACCESS ROADS

82. The project area can be reached from Georgetown, South Carolina, by traveling northeast on U. S. Highway No. 17 for 17 miles to the entrance to Huntington Beach State Park and then through the park on a two-lane asphalt paved road for about two miles to an existing parking area located about one mile from the shoreward end of the proposed south jetty. There are no roads from the parking area to the jetty site. The nearest access would be along the beach. The park road is in good shape but the thin pavement could not withstand the amount of traffic and loads that trucks carrying rock for jetty construction would exert without considerable remedial work at Government expense. This road crosses a marsh causeway. The causeway and a culvert under the roadway have withstood heavy truck traffic and is considered sufficiently strong to hold up against the expected construction traffic.

83. From Myrtle Beach, the most direct route to the project area is on U. S. Highway No. 17 southwest for about 11 miles to where Secondary State Highway No. 51 turns off towards the Atlantic Ocean; one mile on Highway 51 to Garden City Beach and Ocean Boulevard (South Carolina Secondary Highway No. 65); and then on Ocean Boulevard, which parallels the ocean about a hundred feet from the highwater shoreline, for three miles southward to the entrance of Inlet Harbor Subdivision; and continue downcoast on the asphalt paved road through the private subdivision for 0.4 of a mile to the end of the road which presently reaches to within about 500 feet of the proposed north jetty. Traffic is restricted through Inlet Harbor Subdivision by a check station at its entrance. This road would probably be damaged by heavy equipment during jetty construction and would require remedial work at Government expense. S. C. Highway 51 has one bridge that would be crossed on this route. It is a concrete structure supported with timber piles and is considered sufficiently strong to support the expected construction loads. Other alternate routes between Highway 17 and Ocean Boulevard are Secondary State Highway Nos. 154, 71, 517, 214, and 70 all within about three miles and north of Highway 51 at Garden City Beach. These connection roads are all about the same length and all are good for legal load travel. The South Carolina State legal gross weight of vehicles and loads are shown below:

a.	Single-unit vehicle with two axles	35,000 lbs.
b.	Single-unit vehicle with three axles	46,000 lbs.
c.	Single-unit vehicle with four or more axles	63,000 lbs.
d.	Combination of vehicles with three axles	50,000 lbs.
e.	Combination of vehicles with four axles	65,000 lbs.
f.	Combination of vehicles with five or more axles	73,280 lbs.

AIDS TO NAVIGATION

84. The number, location, and cost of the required navigational aids were furnished by Commander, Seventh Coast Guard District on 11 June 1968, and were updated by him on 28 July 1975. Itemization of aids are shown in Table 3.

TABLE 3

ITEMIZATION OF AIDS

(OCTOBER 1975 PRICE LEVEL)

Number	Type of Aid	Quantity	First Cost of Establishing or Relocation	Annual Maintenance Cost
2	Lighted Bell Buoy	1	Established in 1972	---
None	Left Range	1	$32,000	$ 4,800
4	Light	1	14,000	700
4,6,8				
10,12,13				
15,18,19				
21,23,25				
27,28,30				
31,32,33	Day beacons	18	11,000	1,800
9,11,14				
17,20,22				
24,26,29	Lights	9	58,000	8,700
TOTAL		30	$115,000	$16,000

85. Natural bypassing. In the natural state, the inlet, the gorge through the inlet, the offshore bar, and the adjoining shores are strongly influenced by the sand moving in the littoral zone. This material moves along the shore in both directions, usually at different times. If during some period the littoral drift volumes are about equal from both directions, the inlet will be stable as to location and if sand can cross the inlet, its cross-sectional area will also be stable. Volumes of sand from one or both directions disproportionately large relative to the inlet's tidal prism can lead to closure. Generally, more sand moves in one direction than the other. The shore from which the greater volume comes is called the "updrift shore", and the other shore is referred to as the "downdrift shore". In this case, the inlet lip on the updrift shore migrates in the direction of the dominant drift (towards the downdrift shore) by volume accretions proportional to the difference in volume. The inlet is failing to bypass material from the predominant drift direction, but maintains cross-sectional area stability by encroaching on the downdrift shore.

86. There are several variations of natural bypassing. In larger inlets, the incoming material may be temporarily held in inner bars or a "middleground" shoal, and later may be conveyed to a downdrift part of the outer bar or the downdrift beach directly. In smaller inlets, most of the sand is probably moved directly across the outer bar and brought back inshore by refraction effects.

87. Jetty effects on natural bypassing. Jetties constitute a littoral barrier. Since jetties are intended to fix the location of a navigation channel, they stop the migration of the updrift inlet lip. For this reason, the construction of jetties would require the bypassing of littoral material to the downdrift shores equal to the gross drift rates. They also impound sand in fillets on the outer sides of both jetties with their navigational function of keeping sand out of the navigation channel. As the sand fillet reaches the outer end of the jetty, it is generally in water too deep to allow it to move directly across the outer bar and to the opposite shore, and it either enters the channel or is swept to sea. In some cases, the deposition of sand just inside the jetty is sought and it is bypassed from this location by dredges operating in the lee of the jetty. Generally, it is undesirable to allow the sand fillet to extend beyond the outer end of the jetty, since it is then lost to the shore system. Theoretically, it would be desirable to bypass material accumulating in both fillets, limiting the growth seaward of these fillets. In practice, however, where there is a large difference in the drift coming from both directions, enough control over the shores experiencing deficiencies of sand, both updrift and downdrift of the jetties, can be exerted by bypassing the gross amount of material coming from the dominant direction. Ideally, this should be done at times when the littoral drift is downward (away from the downdrift jetty) and discharge should be at a point removed from the downdrift jetty for a sufficient distance so that tidal currents would not sweep the sand back toward the jetty.

88. Estimates of volume of littoral material to be bypassed cannot be made with the confidence desired. Paragraphs 13 to 18 discuss the methods used in estimating the northward and southward littoral drift rates. Estimates of the growth of the north (updrift) lip of Murrells Inlet between surveys of 1934 and 1966 yield a value ranging between 91,000 and 132,000 cubic yards a year as the net southward predominance. Estimates based on the wave climate indicate that about 186,000 cubic yards a year are moving southward and that about 54,000 cubic yards a year are moving northward. The net southward figure of 132,000 cubic yards a year is in agreement with the upper spit growth estimate. Such estimates have frequently been low in the past and it is believed that a total southward movement of 200,000 yards a year should be assumed to require bypassing at Murrells Inlet. The actual value which can be known only in the future, is more important to maintenance and operating costs than to capital costs. An assumed littoral drift rate that turns out to be too high would not involve the irrevocable commitment of capital costs.

89. Artificial bypassing. The discrete elements of an artificial sand bypassing system are the following: (1) a littoral barrier, (2) deposition control structures (to accumulate littoral material in a place convenient for removal), (3) littoral drift accumulation areas, (4) equipment for removing and transporting sand (from an accumulation area to a sand deficient shore), and (5) a suitable shore discharge point. It is convenient to discuss the various presently employed methods of sand bypassing as components of such a system.

90. Littoral barrier. This is the jetty, which gives rise to the need for sand bypassing and which also accumulates sand in the fillets on both sides.

91. Deposition control structures. There are three such structures in present use: (1) the jetty itself, (2) the jetty and an offshore breakwater, and (3) a weir-jetty. The offshore breakwater is located just updrift of the jetty. The breakwater effectively impounds the sand arriving updrift of the jetty and provides calm water from which a pipeline dredge can operate. The weir-jetty is a low sill built into the shoreward end of the jetty. This weir permits littoral sands in the surf to pass over the jetty into a deposition basin.

92. Littoral drift accumulation areas. These are the areas where sand is allowed to accumulate. They must have a wave environment suitable for the removal equipment. The types of areas are: (1) a sand fillet alongside the jetty, (2) the area landward of an offshore breakwater, (3) a deposition basin between the jetties adjacent to the weir-jetty, and (4) an area just inside the seaward end of a jetty, sheltered by the other jetty.

93. Equipment for removing and transporting sand. The presently used equipment consists of the following: (1) land-based equipment (trucks,

scrapers, cranes, etc.), (2) pipeline dredges, and (3) fixed bypassing plants. Land-based equipment has been used in some locations to remove and transport sand from an accretion area to a deficient shore. This method is used where the inlet is bridged and the distance from the accretion area to the deficient shore is reasonable. Pipeline dredges can remove material from an accumulation area behind and offshore breakwater, from a deposition basin between the jetties, or from within the ends of sheltered jetties. Fixed bypassing plants are permanent installations, consisting of an intake pipe, a pump, a discharge line, and some means of moving the intake pipe. The earliest types removed sand from an accretion fillet alongside the jetty with a crane-supported suction line of limited radius. The fixed bypassing plants were later modified to include a tracked trestle to traverse the length of the jetty. The so-called "jet-eductor" is presently under development. This is a pump operating on the venturi effect; water pumped through a constriction pulls sand into a discharge stream. This is a flexible system, nearly independent of the wave climate, that is capable of removing sand from an unsheltered jetty fillet and pumping it to a downdrift beach.

94. Shore discharge point. The point of discharge (of bypassed material) on the downdrift beach is a design factor. Unless there is a critically eroding area near the downdrift jetty, the discharge point should be sufficiently removed from the downdrift jetty that tidal currents cannot sweep sand back toward the jetty. The bypassed material will be placed into the littoral stream by discharging it in the surf zone (below the mean low water line). Bypassed material can also be placed on eroding updrift beaches. The actual placement of the bypassed material will be determined by monitoring the beaches in the project area.

95. Selection of bypassing system. The fixed bypassing plant was not selected because of the limited reach of the suction line, maintenance problems associated with a structure located in the beach environment, and the necessity for operating personnel. Land based equipment was not considered due to the lack of direct access across the inlet. A weir-jetty and a deposition basin from which sand is removed by a pipeline dredge is the bypassing system selected for this project. Deposition basin will be sized to store a three-year accumulation of littoral drift (200,000 cy/yr annual rate). This storage capacity will allow flexibility in the dredging schedule.

CONSTRUCTION PROCEDURE

96. General. The following construction procedure is presented to verify the feasibility of construction and to provide a basis for computing the estimate for this report. However, the contractor will be permitted to develop and use a different construction procedure with prior approval of the Contracting Officer.

97. Order of work. The north jetty and weir section would be constructed first and then the south jetty to provide protection for subsequent dredging of the entrance channel and deposition basin. Sand dike construction would be accomplished next and concurrent with the entrance channel and deposition basin dredging utilizing suitable pumped material. Inner channel and turning basin dredging and construction of the comfort station could be accomplished at the contractors option. However, the contractor would be encouraged to perform as much of his dredging as possible during periods which would minimize adverse effects on marine and estaurine organisms in the project area. The contractor would also be encouraged to schedule the construction of the jetties and sand dikes to minimize the adverse effects on nesting wildlife and the recreating public. Construction of the walkway on the south jetty would be deferred as long as possible to permit prior shifting and settling of the jetty Alternative methods for jetty construction would be to build them from the land or the ocean or a combination of the two methods. Construction from the land could proceed by starting with ramps on the landward end to accommodate trucks and crane in placing materials for the initial jetty section Continuation of jetty construction would be accomplished by trucks and crane using a haul road built on top of the jetties as construction progresses seaward. This scheme could be more conveniently employed in building the south jetty. Construction from the ocean could proceed by transporting the stone to the site by barge and by placing it using barge-mounted cranes.

98. Jetty construction. The stone for jetty construction is available from quarries located within a 250 mile radius in South Carolina, North Carolina or Georgia. Stone would probably be delivered to the project site from the quarry either by truck only or by rail to railheads at Georgetown, S. C., where trucks or barges would complete the delivery. The one-way distance from the railheads to the site is about 20 miles by land or 41 miles by water. The larger stone would be hauled with tractor-trailer rigs while the smaller rock would be handled by conventional dump trucks. Rock and other construction material and equipment for the north jetty would be brought to the project site through Garden City Beach on Ocean Boulevard (S. C. Highway 65) and then through a private subdivision to the landward end of the proposed jetty. Access for construction of the south jetty would be through Huntington Beach State Park. The rock would be stockpiled on land near the mean high water line. Work on the jetties would start on the landward end and progress oceanward. In order to minimize scour during jetty construction, the contractor would be required to maintain the foundation blanket stone, a minimum of 200 feet ahead of the remaining jetty construction. This distance of blanket stone would be maintained until the seaward limit of the foundation blanket is reached. A barge, which would be needed for this type operation, could be floated to the site via the Atlantic Intracoastal Waterway. Winyah Bay at Georgetown and the ocean. Front end loaders would transport the rock from the stockpile to a barge and built-up crane that can operate in water up to about 12 feet

would take the rock from the barge and place it along the proper jetty alignment. The front-end loader is also designed to operate in shallow water thereby making it unnecessary to beach or dock the barge for loading.

99. Weir construction. Materials handling and construction of the weir would be accomplished with essentially the same equipment used for jetty construction but with appropriate modification for jet placement of weir piling. The weir section would be constructed starting from landward end. In order to minimize scour during the sheet pile weir construction, the contractor would be required to maintain the foundation blanket stone, a minimum of 200 feet ahead of the remaining weir construction. This distance of blanket stone would then continue during the stone jetty construction as described in paragraph 98. Construction of the north jetty would follow weir construction to permit effective connection or transition between the jetty and weir. The source for the prestressed weir piling is considered to be available within a 200 mile radius of the project. Delivery to the project site would probably be by semi-trailer truck.

100. Channels and deposition basin. The construction of the proposed channels and deposition basin could most feasibly be accomplished by hydraulic cutterhead pipeline dredging. The most likely route to the inlet for the dredge would be by ocean through Winyah Bay. After the jetties are in place, the dredge would be protected from severe wave action while dredging the entrance channel and deposition basin. About half of this dredged material would be used to construct the sand dikes and the excess material would be used to reinforce the barrier beaches updrift and downdrift of the inlet. A pipeline dredge could also be used to construct the inner channel and turning basin. Most of the material is suitable for beach nourishment and would be pumped to nearby Garden City Beach. The dredged material that has a high percent of silt or clay and may not be suitable for placement on the beach would be pumped to an appropriate diked area for disposal.

101. Jetty walkway construction. An asphalt walkway is proposed for the entire length of the south jetty. Construction would begin at the landward end and the walkway would have eight feet of width so that dump trucks carrying building material and equipment would back out onto the jetty as the walkway progressed oceanward. The large voids between the armor stone that would be present thoughout the jetty would be filled with chinking rock to the top of the structure and capped with about six inches of hot mix asphalt. Because of unsatisfactory experience at Jacksonville District inlet projects, no handrail is planned along the walkway. A parking area and comfort station would be constructed about one mile south of the jetty walkway in Huntington Beach State Park.

CONSTRUCTION MATERIALS

102. Quarrystone. Several active quarries in South Carolina, Georgia and North Carolina are known to produce suitable dense, hard and durable stone of the sizes and in the quantities needed for the jetties. The two nearest quarries that can produce all stone sizes are Camak Quarry (near Camak, Georgia), a distance of 270 miles; and Cayce Quarry (near Cayce, South Carolina), a distance of 170 miles. Other quarries are located within 25 to 100 miles of the two quarries listed above, and at greater distances in western North Carolina. The two quarries listed above are currently approved sources of quarrystone for jetty projects in Jacksonville District and Savannah District. Railheads are available at Georgetown, South Carolina, 20 miles from the site and Myrtle Beach, South Carolina, 15 miles from the site. Barge loading can be accomplished at Georgetown, South Carolina.

a. Armor stone. Primary consideration will be given to stone quality, specific gravity and access to rail or water in considering sources for the 6 to 10-ton armor stone. Durable stone with specific gravity (SSD) in the range of 2.64 to 2.66 is readily available in the weights required for the designed armor stone on railroad transportation lines. A shell limestone quarry located on water near New Bern, North Carolina, (about 205 miles from the site) can produce durable stone in the weight range required for the armor stone, however, specific gravities (SSD) as low as 2.4+ would make larger stone sizes necessary to achieve design weights. Transportation of armor stone by truck is considered unlikely considering the stone weight, size, and haul distance.

b. Core stone and riprap. Stone of suitable durability and with weights in the core stone and riprap design range can be produced from several quarries in addition to those mentioned above. These additional quarries are within a 180 to 250 mile distance from the project site. The specific gravity of the core stone and riprap will be in the same range as the armor stone.

c. Foundation stone. A limestone quarry located near Jamestown, South Carolina, (about 35 miles from the site) can produce foundation stone with a specific gravity (SSD) in the range of 2.38 to 2.40. The New Bern quarry mentioned above can produce shell limestone foundation stone with a specific gravity (SSD) in the same range. Foundation stone with higher specific gravity can be produced by the same quarries as mentioned for the core stone.

103. Sand. Sufficient sand is available from required excavation of the inlet channel, deposition basin and inner channel to construct the sand dikes by pump dredge. More detailed subsurface investigations of materials to be dredged are planned prior to preparation of plans and specifications.

104. Pre-stressed concrete sheet pile. A pre-stressing plant is located in Wilmington, North Carolina, approximately 105 miles from the site. Its present capacity is 400 linear feet of piling per day. Other plants are located in Charleston, South Carolina, Raleigh and Durham, North Carolina.

105. Timber and lumber. Both untreated and preservative-treated wood products are available through local firms. Two creosoting firms are located in Wilmington, North Carolina, and one is located in Charleston, South Carolina.

106. Asphalt. The materials for the asphalt mixes would come from approved sources. There are at least two hot-mix plants within 20 miles of the jobsite which should be capable of producing asphalt mixes that would meet the job specifications.

REAL ESTATE REQUIREMENTS

107. General. Local interests are required to provide all lands, easements, and rights-of-way required for construction and maintenance of the project. This project proposes the use of submerged lands which are publicly owned and lands above the local mean high water mark which

are privately owned. All lands required for the construction of structures should be obtained in fee or perpetual easement as described in the paragraphs below; other lands required for project construction and maintenance should be acquired by easement. Lands required in connection with the project are shown on Plates 1, 2 and 3.

108. North jetty and sand dike. The portion of the jetty located on submerged lands is publicly owned land and will not require acquisition. A 6+ acre parcel of privately owned land will be acquired in fee for the terminus of the jetty and sand dike. This area will provide sufficient space for the structure and a 100-foot wide strip for future maintenance. This area is shown on Plate 2.

109. South jetty and sand dike. The portion of the jetty located on submerged lands is publicly owned land and will not require acquisition. A 14+ acre parcel of privately owned land (Huntington Island Beach State Park) will be acquired by a perpetual easement for the terminus of the jetty and sand dike. This area will provide sufficient space for the structure and a 100-foot wide strip for future maintenance. It is proposed to acquire this land by perpetual easement; since the trust establishing Brookgreen Gardens stipulates that no land be sold. Brookgreen Gardens was established as a trust by the Huntington family and Brookgreen leases the land to the South Carolina Department of Parks, Recreation and Tourism for use as a state park. It is believed that a perpetual easement would provide the Government all rights necessary to construct, operate and maintain the jetty. This area is shown on Plate 2. It is anticipated that there will be no cost for this easement.

110. Deposition basin. All lands required for the deposition basin are submerged and publicly owned. No acquisition is necessary.

111. Entrance and inner channels. These channels will be located on submerged lands in the Atlantic Ocean and Main Creek. The right-of-way for these channels are publicly owned and will not require acquisition.

112. Parking area and comfort station. These facilities will be located on 1.5+ acres of land leased by the State of South Carolina for use as Huntington Beach State Park from the Trustees of Brookgreen Gardens. The land was leased in 1960 for 50 years without fee. Since these facilities are to be constructed on 50 percent cost-shared basis with local sponsor and maintained by park personnel, an easement for the 50-year project life should be obtained for this construction. This area is shown on Plates 1 and 2, Appendix B. It is anticipated that there will be no cost for this easement.

113. Disposal area. A 16-acre highland tract (see Plate 1) for the disposal of dredged material unsuitable for placement on the beach front should be acquired by a disposal easement for the 50-year project life. A 4+ acre beach front parcel of privately owned land (see Plate 3) for the disposal of dredged material suitable for placement on the beach should be acquired by a disposal easement for a 5-year period.

114. Pipeline easements. An easement for a 5-year period should be obtained on 1.5+ acres of privately owned land for dredge pipeline access to the beach disposal area. The required pipeline easement areas are adjacent to the beach disposal area as shown on Plate 3. A perpetual easement should be obtained on 0.2+ acres of privately owned land for drege pipline access to the ocean for sand bypassing operations (see Plate 3). An easement for a 50-year period should be obtained on 1.1+ acres of privately owned land (see Plate 1) for dredge pipeline access to the highland disposal area.

115. Drainage ditch easement. An easement for a 50-year period should be obtained to allow clearing and maintenance of an existing drainage ditch. This ditch would be used as a discharge canal for runoff from the highland disposal area. This existing ditch (see Plate 1) is located along the southern edge of the highland disposal area and extends some 1,600 feet to Parsonage Creek.

116. Construction areas. A seven acre area adjacent to the north jetty and a five acre area near the south jetty should be acquired as a temporary work area easement for a 5-year period. These areas are shown on Plate 2. It is anticipated that there will be no cost for the south jetty construction area easement.

117. Vehicular access to jetties. A pepetual easement should be obtained over Huntington Beach State Park roads and land and other private roads and land for the purposes of construction, operation and maintenance of the project. It is anticipated that there will be no cost for these easements.

RELOCATIONS

118. No relocations are required.

SCHEDULES FOR DESIGN AND CONSTRUCTION

119. Design work for contract plans and specifications of the different project features can be prepared in three sections; jetty system (including weir and walkway), channel dredging (including deposition basin, sand dikes and disposal area), and recreation facilities (parking area and comfort station). This has been done in order to initiate construction at the earliest date after the appropriation of construction funds. The work has been divided into separate features to permit an orderly sequence of construction. It is proposed to discuss and provide sufficient design data for all project features in this General Design Memorandum for approval preparatory to initiation of the respective contract plans and specifications. Submission of plans and specifications and award of contracts are contingent upon the approval time required for the respective activities as shown in the network analysis diagram on Plate 6.

120 It is planned that final design and specifications for all project features begin in June 1976 and the plans and specifications for various features be submitted for approval as follows:

Jetty system (including sheet-pile weir)	Oct 1976
Parking area and comfort station	Oct 1976
Channels, deposition basin, sand dikes and disposal area	Oct 1976

Advertising would be initiated upon approval of the plans and specifications in sufficient time for construction to begin in January 1977. It is estimated that about two years will be required to complete the project construction.

121 The President's budget for Fiscal Year 1976 contains funds for completion of preconstruction planning. Delays experienced in the completion and approval of this memorandum will necessitate a carryover of funds into Fiscal Year 1976 transition quarter. No funds were previously appropriated for the transition quarter. Carryover funds will be used to initiate and complete plans and specifications in the transition quarter. Upon completion and approval of the preconstruction planning, the project would be available for construction subject to an appropriation of funds for Fiscal Year 1977. The President's Fiscal Year 1977 budget recommended no civil works new construction starts.

DESCRIPTION OF PROPOSED PLAN OF IMPROVEMENT

122. General. The proposed plan provides for the construction of a north jetty with a low weir section, south jetty, sand dikes, littoral drift deposition basin, entrance and inner channels, and recreation facilities (parking area, comfort station and fishing walkway on south jetty). The north and south jetties, sand dikes, deposition basin, and entrance channel are shown on Plate 2. Inner channel alignment is shown on Plate 3. The proposed plan is based on a jetty alignment -Plan 1B, which has undergone preliminary model testing at WES. Further testing of this plan is presently underway and if modifications are found to be necessary, they are planned to be made in the contract plans prior to approval. The results of the model study testing will be incorporated as a supplement to the General Design Memorandum. Appendix A, Jetty Plan Selection describes the process that was used in selecting this plan.

123. North jetty. The proposed jetty would be constructed of prestressed concrete sheet piles from the shoreward end of an existing sand dune following the slope of the natural beach from elevation +9.0 feet down to elevation +2.2 feet for a distance of 272 feet, then of prestressed concrete sheet piles (low weir section) at elevation +2.2 feet for a distance of 1,608 feet, and then of quarrystone to the -10-foot ocean contour, a length of about 1,485 feet. Total length of the north jetty is 3,365 feet. The jetty top elevations would be +9 feet for the quarrystone sections and +2.2 feet for the prestressed pile weir section

and vary from +2.2 to +9.0 feet for the shoreward terminal section. The weir section would allow the passage of littoral drift traveling essentially between the shoreline and the -4-foot contour. The quarrystone portion of the jetty is divided into three parts: a head section and two trunk sections. The jetty head consists of the outer 150 feet of the jetty; this section will have two armor layers of 6-10 ton stones, a maximum crest width of 18 feet and side slopes of 1 vertical on 2 horizontal. The jetty trunk (from the head to -6 feet contour) will have two armor layers of 4-7 ton stones, a maximum crest width of 15 feet and side slopes of 1 vertical on 2 horizontal. The jetty trunk (from the shoreward end to -6 feet contour) will have a single armor layer of 4-7 ton stones, a maximum crest width of 15 feet and side slopes of 1 vertical on 2 horizontal.

124. South jetty. The proposed jetty would be constructed from a new sand dike terminating at the -2 feet contour to the -10 feet ocean contour. The jetty would be constructed entirely of quarrystone for a distance of 3,290 feet. The top elevation of the jetty would be +9 feet. The jetty will consist of three sections: a head section and two trunk sections. The crest widths, armor stone sizes and side slopes for these south jetty sections are the same as described for the north jetty.

125. Sand dikes. Sand dikes would be constructed from the shoreward ends of the stone jetties to the existing dune line at +10 feet elevation. The sand dikes would connect the jetties to the existing high land. The south dike would extend from an existing dune line to -2 feet ocean contour, a length of about 2,850 feet. The north dike would consist of strengthening (by widening) an existing sand dune for a distance of 500 feet. The dikes would have a crest width of 100 feet and side slopes of 1 vertical on 10 horizontal for north dike and 1 vertical on 25 horizontal for south dike. The dikes would be constructed of hydraulic, granular fill dredged from the channels and deposition basin and placed by the discharge line of a dredge. Upon completion of construction, the sand dikes will be planted with sea oats or other salt-tolerant plant species to aid in erosion control.

126. Profiles and typical sections of the jetties and sand dikes are shown on Plate 4.

127. Deposition basin. Following the construction of the jetties, a deposition basin would be dredged with a pipeline dredge between the north jetty and northern limit of the entrance channel to trap littoral material moving southward over the weir section. The basin would be dredged to a depth of -20 feet and would have a capacity of 600,000 cubic yards. The side of the basin adjacent to the weir would be 1,300 feet; the other dimensions are commensurate with the required basin capacity. The capacity of the deposition basin will be large enough to hold a three year amount of the estimated southward littoral drift of 200,000 cubic yards per year.

128. Entrance channel. The entrance channel will extend from the -10 feet ocean contour to a point within the jetties, a length of 3,000 feet. The entrance channel will be 300 feet wide and 12 feet deep. An allowable overdepth of 2 feet will be permitted to compensate for dredging inaccuracies. An additional overdepth of 2 feet to facilitate future maintenance in areas of hard bottom material will not be required. While beach sands are known to compact very hard due to the vibratory action of the surf, it is believed that any shoal material (littoral drift) would also compact just as hard. The compaction of the shoal material to the same degree as the in situ material would negate any possible benefits from advance maintenance overdepth. Side slopes of 1 vertical on 4 horizontal are expected initially after the box-cut dredging of the channel. Due to the wave action in the entrance channel, the ultimate side slope will probably be 1 vertical on 10 horizontal. The distance between the edge of the channel and the jetty toe are sufficient to allow the ultimate side slope of 1 vertical on 10 horizontal.

129. Inner channel. The inner channel will extend from the entrance channel through Main Creek to the old Army crash boat dock, a length of 15,110 feet, where it would terminate with a turning basin 300 feet long and 150 feet wide. The inner channel will be 90 feet wide and 8 feet deep. An allowable overdepth of 2 feet will be permitted to compensate for dredging inaccuracies. An additional overdepth of 2 feet to facilitate future maintenance in areas of hard bottom material will not be required. Side slopes of 1 vertical on 4 horizontal are expected after the box-cut dredging of the channel. Since there is little or no wave action in the inner channel, it is believed that this slope would be stable and be maintained.

130. Auxiliary channel. The auxiliary channel will extend from the entrance channel to the -6 foot contour at the mouth of Oaks Creek, a length of 625 feet. The auxiliary channel will be 200 feet wide and 6 feet deep. An allowable overdepth of 2 feet will be permitted to compensate for dredging inaccuracies. This channel will be dredged initially; there will be no annual maintenance.

131. Disposal area. A 16± acre disposal area will be located on highland for the disposal of dredged material unsuitable for placement on the beach (sand with high silt or clay content). A 1± acre disposal area will be located on the beach front for the disposal during initial construction only) of dredged material suitable for placement on the beach, after construction, this dredged material will be placed in the surf zone as part of the sand bypassing operation.

132. Recreation facilities. An 8-foot wide fishing walkway of asphaltic concrete will be located on the crest of the south jetty. The walkway will extend from the sand dike to the jetty head, for a length of about 3,230 feet. A parking area for 100 vehicles will be located adjacent to an existing parking area at Huntington Beach State Park. A comfort station will also be provided adjacent to the existing parking area. A complete discussion of the proposed recreation facilities is contained in Appendix B, Recreation Resources. Recreation facilities are shown on Plates 1 and [illegible] Appendix B.

DESIGN

[illegible] [illegible] jetties. No foundation stability or settlement [illegible] [illegible]. Based on the subsurface investigations, and [illegible] [illegible] and side slopes of the jetty, it is believed that [illegible] [illegible] foundation or structure shear failure. It is estimated [illegible] settlement would be about 1 foot. It is [illegible] [illegible] of the foundation settlement would occur during construction. [illegible] for foundation and internal consolidation, the jetty would [illegible] 1 foot (to elevation +10 feet). This jetty height is considered adequate to prevent overtopping during a normal [illegible] [illegible] determining the armor stone size for jetty sections [illegible] are included in Appendix D, Design Calculations.

[illegible] [illegible] design [illegible] jetty section. Parameters for hurricane Hazel which struck the Carolina Coast in 1954 are very close to the standard project hurricane. Procedures outlined in paragraph 3.75, [illegible] Protection Manual were used to determine wave parameters for the standard project hurricane. Table 4 gives the standard project hurricane parameters used in these calculations and Table [illegible] the results of the wind wave computations over the continental [illegible]. Neglecting refraction and using the most critical [illegible] computed significant wave height was 12 feet with a maximum wave of [illegible] feet. The still water level would be at elevation [illegible] feet M.L.W., which would be 10 feet above the jetties. Since dynamic wave forces are concentrated around the stillwater level the jetties would [illegible] be subjected to the most damaging forces of the maximum wave in the standard project hurricane. Although the depths below mean low water vary from approximately -2 to -10 feet for both the north and south jetties, during the course of a hurricane the accompanying storm surge would increase these depths so that both the head and trunk portions of the jetties would be subjected to the significant wave. Therefore, the 12 foot significant wave was used for design of the head and trunk portions of the jetties. Table 6 and 7 give the [illegible] data for Myrtle Beach, S. C. The two months of wave [illegible] at Myrtle Beach have been extended to a year of record by [illegible] [illegible] gage which is located 57.8 miles north of Myrtle [illegible] [illegible] presented in Table [illegible].

Table 4

STANDARD PROJECT HURRICANE PARAMETERS

Central Pressure	27.17 in. Hg
[illegible] Pressure	29.92 in. Hg
Radius of Maximum Wind	31.0 Naut. Miles
Maximum [illegible] Wind Speed	111.0 MPH
Forward Speed	11 Knot

[illegible] Mar [illegible]

Table 5

Wind Wave Computations over the Continental Shelf
For the Standard Project Hurricane

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	[illegible]	[illegible]	[illegible]	d_T	F_e	H_o	T_o	$\frac{T_o^2}{dT}$	K_s	A	k_f	H'_o	F'_e	T'_o	$\frac{(T'_o)^2}{dz}$	K_{s2}	H	N	H_{max}
65	600	[illegible]	[illegible]	680	[illegible]	46.06	14.46	.307	.998	.03	1.000	46.06	84.2	14.5	.34	.996	46	551	81
60	132	695	[illegible]	[illegible]	84.2	46.06	14.46	.563	.963	.10	.398	45.97	83.9	14.4	1.52	.917	42	552	75
55	114	[illegible]	[illegible]	[illegible]	84.2	46.06	14.46	1.63	.920	.79	.310	41.92	69.7	13.8	1.60	.920	39	578	69
50	114	[illegible]	[illegible]	119	[illegible]	43.39	14.03	1.65	.921	.86	.300	39.05	60.5	13.3	1.49	.917	36	[illegible]	64
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13.58	1.68	.922	.94	.290	36.16	51.9	12.8	1.61	.920	[illegible]	622	60
[illegible]	[illegible]	[illegible]	[illegible]	99	[illegible]	[illegible]	13.12	1.74	.924	1.09	.270	32.94	43.1	12.23	1.54	.919	30	652	54
[illegible]	[illegible]	[illegible]	[illegible]	58	[illegible]	34.32	[illegible]	1.79	.926	1.27	.360	29.94	35.6	11.66	1.70	.923	28	684	50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31.99	12.05	1.77	.925	1.34	.345	27.03	29.0	11.06	1.46	.916	25	720	45
[illegible]	[illegible]	[illegible]	[illegible]	30	34.0	29.27	11.52	1.66	.921	1.28	.330	24.88	24.6	10.62	1.49	.917	23	750	41
[illegible]	[illegible]	76	65	70	29.6	27.31	11.13	1.77	.925	1.57	.320	22.39	19.9	10.08	1.56	.918	21	791	37
15	53	65	67	66	24.9	25.05	10.66	1.73	.924	1.62	.320	20.54	16.7	9.65	1.39	.915	19	826	34
10	43	67	59	63	21.7	23.38	10.30	1.68	.922	1.65	.315	19.06	14.4	9.30	1.47	.916	17	857	32
5	27	59	44	52	19.4	22.12	10.02	1.93	.932	2.32	.760	16.81	11.2	8.70	1.73	.924	15	913	29
0	12	[illegible]	31	38	16.2	20.22	9.58	2.41	.953	4.06	.320	12.53	6.2	7.54	1.50	.917	12	1,056	21

Table 6

WAVE CLIMATOLOGY FOR MYRTLE BEACH, SOUTH CAROLINA FOR 1 MONTH - JAN 75
DISTRIBUTION OF SIGNIFICANT HEIGHT VS PERIOD (IN OBSERVATIONS PER 1000 OBS)
FOR 62 OBSERVATIONS OF NON-CALM CONDITIONS- 0 OBSERVATIONS OF CALM CONDITIONS HAVE NOT BEEN INCLUDED

SIGNIFICANT HEIGHT

PERIOD (SECS)	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13 +	TOTAL	ACC. TOTAL	ROW AVG
0.0 - .9																	0.00
1.0 - 1.9																	0.00
2.0 - 2.9		32													32	32	1.50
3.0 - 3.9		49	32												81	113	1.90
4.0 - 4.9			32												32	145	2.50
5.0 - 5.9		32	65	32											129	274	2.50
6.0 - 6.9		16	48	16											81	355	2.50
7.0 - 7.9	16	16	16												48	403	1.50
8.0 - 8.9	16	242	81												339	742	1.69
9.0 - 9.9	16	113													129	871	1.38
10.0 -10.9	16	81													97	968	1.33
11.0 -11.9																968	0.00
12.0 -12.9	16	16													32	1000	1.00
13.0 -13.9																1000	0.00
14.0 -14.9																1000	0.00
15.0 -15.9																1000	0.00
16.0 -16.9																1000	0.00
17.0 -17.9																1000	0.00
18.0 -18.9																1000	0.00
19.0 -19.9																1000	0.00
20.0 -20.9																1000	0.00
21.0 +																1000	0.00
TOTAL	81	597	274	48												1000	1.79
ACC. TOTAL	81	677	952	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	
COL. AVG.	9.70	8.09	6.32	5.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.63 period		

AVERAGE SIGNIFICANT WAVE HEIGHT = 1.81 FT
VARIANCE OF SIGNIFICANT WAVE HEIGHT = .32 FT SQ
STANDARD DEVIATION OF SIG. HEIGHT = .57 FT

AVERAGE WAVE PERIOD = 7.69 SEC
VARIANCE OF WAVE PERIOD = 5.74 SEC SQ
STANDARD DEVIATION OF PERIOD = 2.40 SEC

(FOR THE ABOVE 6 LINES, CALM IS COUNTED AS 0.0 FEET FOR WAVE HEIGHT AND IS OMITTED FOR WAVE PERIOD)

RECORD OBTAINED WITH A CONTINUOUS WIRE WAVE GAGE LOCATED AT SPRINGMAID BEACH PIER
DATA OBTAINED BY ANALYSIS OF A 1024-SECOND DIGITAL RECORD.

Table 7

WAVE CLIMATOLOGY FOR MYRTLE BEACH, SOUTH CAROLINA FOR 1 MONTH - FEB 75
DISTRIBUTION OF SIGNIFICANT HEIGHT VS PERIOD (IN OBSERVATIONS PER 1000 OBS)
FOR 105 OBSERVATIONS OF NON-CALM CONDITIONS- 0 OBSERVATIONS OF CALM CONDITIONS HAVE NOT BEEN INCLUDED

PERIOD (SECS)	SIGNIFICANT HEIGHT 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13 +	TOTAL	ACC. TOTAL	RG. AVG
0.0 - .9																	0.00
1.0 - 1.9																	0.00
2.0 - 2.9	10	19													29	29	1.17
3.0 - 3.9		67	29												95	124	1.80
4.0 - 4.9		10	48												57	161	2.33
5.0 - 5.9		76	105	48											229	410	2.36
6.0 - 6.9	10	76	57												143	552	1.83
7.0 - 7.9		19	57												76	629	2.25
8.0 - 8.9	38	210	67												314	943	1.59
9.0 - 9.9		38													38	981	1.50
10.0 -10.9		19													19	1000	1.50
11.0 -11.9																1000	0.00
12.0 -12.9																1000	0.00
13.0 -13.9																1000	0.00
14.0 -14.9																1000	0.00
15.0 -15.9																1000	0.00
16.0 -16.9																1000	0.00
17.0 -17.9																1000	0.00
18.0 -18.9																1000	0.00
19.0 -19.9																1000	0.00
20.0 -20.9																1000	0.00
21.0 +																1000	0.00
TOTAL	57	533	362	48												1000	1.90
ACC. TOTAL	57	590	952	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	
COL. AVG.	7.17	6.98	6.24	5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.65		

AVERAGE SIGNIFICANT WAVE HEIGHT = 1.91 FT AVERAGE WAVE PERIOD = 6.63 SEC
VARIANCE OF SIGNIFICANT WAVE HEIGHT = .45 FT SQ VARIANCE OF WAVE PERIOD = 3.51 SEC SQ
STANDARD DEVIATION OF SIG. HEIGHT = .67 FT STANDARD DEVIATION OF PERIOD = 1.87 SEC
(FOR THE ABOVE 3 LINES, CALM IS COUNTED AS 0.4 FEET FOR WAVE HEIGHT AND IS OMITTED FOR WAVE PERIOD)

RECORD OBTAINED WITH A CONTINUOUS WIRE WAVE GAGE LOCATED AT SPRINGMAID BEACH PIER
DATA OBTAINED BY ANALYSIS OF A 1024-SECOND DIGITAL RECORD.

Table 8

ESTIMATED ANNUAL WAVE CLIMATE FOR
MURRELLS INLET, S.C.

Location	Significant Wave Height, feet							
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8
	Cumulative Frequency Data (1)							
Holden Beach, N.C.[2]	100	90.3	42.9	19.9	7.0	2.4		
Myrtle Beach, S.C.[3]	100	93.1	36.6	4.8				
	Annual Cumulative Frequency							
Holden Beach, N.C.[4]	100	95.5	45.1	16.7	5.8	3.2	1.3	0.4
Myrtle Beach, S.C.[5]	100	92.0	38.0	9.0	2.0	0.4	0.1	
Histogram, Myrtle Beach, S.C.[6]	80	54.0	20.0	7.0	1.6	0.3	0.1	

NOTES
1. From two months of wave records at each location (Jan-Feb 1975). Figures are the percentages of waves that are higher than the lower figure of the class interval heading.
2. Holden Beach is 37.8 miles north of the Myrtle Beach Gage.
3. In the period shown (Jan-Feb 1975), the wave climate was somewhat milder at Myrtle Beach.
4. From 1 year of wave records (April 72 through March 73).
5. Derived from plotted cumulative-frequency curve, lying somewhat between the extrapolated cumulative frequency curves for the 2-month records of Holden and Myrtle Beaches, and allowing for (an apparent) milder wave climate at Myrtle Beach.
6. Gives percentage of waves that might be expected within the indicated height ranges.

135. Wave transmission through jetties. In order to determine the potential wave climate between the jetties the outer 1,300 to 1,500 feet of the jetties were considered permeable. The shoreward portion of each jetty was not considered in the analysis. An estimate of wave transmission through the outer jetties was obtained by using Figures 7-36, Volume II of the Shore Protection Manual. From the limited data given in Figures 7-36, it was concluded that during high tide at Murrells Inlet and for waves incident and striking near parallel to the structures, wave reduction coefficients, H_T/Hi, would range in value from 0.55 to 0.15. The larger value of reduction coefficients applies to the outer end of the jetties in the deeper water. The actual transmitted wave at Murrells Inlet should be less that Figures 7-36 indicates since the data are for a value of $h/d_s = 1.033$. During mean high tide at Murrells Inlet h/d_s varies from 1.54 to 1.28 depending upon the location along the jetties. Waves approaching essentially perpendicular to the jetties could travel virtually undiminished up the channel until refracted and broken in the shallow water. Further attempts to determine the relative wave climate between the jetty by performing a defraction analysis was not attempted since the outer portion of the jetties are permeable and thus not amenable to that type of analysis.

136. Wave runup. The effect of wave runup on the south jetty was investigated to determine if the fishing walkway elevation was high enough to prevent overtopping during a normal wave climate. Wave runup was calculated with the aid of Figures 7-20 of the Shore Protection Manual which related relative runup (R/H'_o), wave steepness (H'_o/T^2) and structure side slope. The curve for runup on a permeable rubble structure having 1 on 2 side slopes was used in the analysis. Various wave heights and period were tested. All computations were based on a mean high tide and runup computations were made for depth of water above the -5 and -10 mean low water depth. The results of the analysis indicate that the walkway would not be subjected to runup and overtopping by a wave equal to or less than the 4 feet, and only slight overtopping would occur for a 5-foot wave. Table 8 shows that only 2.5 percent of the annual wave climate fall in the class interval of waves greater than 4 feet. Appendix D gives the tabulated results of the runup analysis.

137. Prestressed concrete sheet pile. Criteria, assumptions, and calculations for sheet pile design are presented in Appendix D.

138. Height of weir section. Factors considered in the selection of weir height are: (1) provision of an opening in the stone jetty for passage of littoral drift into the deposition basin, (2) provision of suitable wave climate for commerical & recreational boats and for marine equipment to operate safely when removing littoral material from the deposition basin, and (3) also some restriction of flows which will increase velocity and reduce shoaling. Mean high water is at +4.5 feet, and a weir at this elevation would allow the passage of no littoral material. Conversely, a weir at mean low water (elevation 0.0 feet) would provide

no protection for boats or marine construction equipment, and would not provide any self-clearing velocities of that section of the entrance channel. In order to satisfy these requirements, the weir elevation is set at +2.2 feet (mean tide level).

139. Navigation channels. The dimensions of charter boats operating out of Murrells Inlet vary from 20 to 95 feet long, 9 to 25 feet wide, and 2.5 to 6.5 feet draft. Approximately one half of the vessels draw more than 4.0 feet of water. The design vessel for the channel design is selected as one that has a length of 60 feet, a beam of 20 feet, and a draft of 5.0 feet.

140. Depths and widths of entrance and inner channels are based on criteria contained in the following:

a. EM 1110-2-1607, Tidal Hydraulics

b. Report No. 3, Committee on Tidal Hydraulics, Evaluation of Present State of Knowledge of Factors Affecting Tidal Hydraulics and Related Phenomena

c. CERC Publication: SR2, Small Craft Harbors: Design, Construction, and Operations, DEC. 1974.

Calculations for entrance and inner channel dimensions are presented in Appendix D.

141. Auxiliary channel. This channel is provided to allow a direct route for tidal flows into and out of Oaks Creek. Surface current photographs of the project taken by WES showed that tidal flows took a circuitous path and could cause erosion problems at the south sand dike. The exact depth of this channel is not important, providing a channel across the bar is the governing factor. A depth of six feet was selected as the depth necessary for a dredge to operate. The channel widths of 200 feet is about one-half the natural bank to bank width of Oaks Creek and should be adequate for good tidal flows. The auxiliary channel tested at WES was 300 feet wide. WES has been instructed to decrease this width to 200 feet in the final testing.

142. Jetty spacing. The jetty spacing was determined from hydraulic, navigation and structure requirements. A primary hydraulic requirement is to maintain self cleaning of the entrance channel. From the O'Brien formula the inlet area at mean tide should approximate the following:

$$1000\ (\text{volume of tidal prism})^{0.85}$$
$$1000\ (7.64\ \text{square mile-foot})^{0.85} = 5{,}640\ \text{square feet}$$

This cross sectional area (5,640 square feet) should be provided through the inlet. Since the north and south jetties are only parallel between bottom contours -6 and -10 feet, this is where the cross sectional area should equal 5,640 square feet. The cross sectional area of the entrance channel, with side slopes of 1 vertical on 4 horizontal and an existing ocean bottom elevation of -8 feet, is 5,240 square feet. As can be seen the entrance channel itself can provide the area required for the tidal prism.

143. The hydraulic requirement is not the only consideration in selecting a jetty spacing. Due to wave action in the entrance channel, the initial channel side slopes of 1 vertical on 4 horizontal may become 1 vertical on 10 horizontal ultimately. To account for the possibility of flatter side slopes and channel meandering, the spacing from the bottom edge of the channel to the centerline of jetties is established as 300 feet. This dimension provides approximately 200 feet between the top of channel cut (side slopes = 1 vertical on 10 horizontal) and the toe of the jetty foundation blanket. This distance would also provide space for boats to anchor for sport fishing without encroaching in the navigation channel. The jetty spacing of 900 feet (centerline to centerline of jetties) was model tested (surface current photographs) by WES and this spacing proved to be satisfactory. The construction of the jetties with a more narrow spacing would not cause any monetary savings, since the jetties would require lengthening to extend to high land on the north and south sides of the inlet.

144. Sand dikes. Sand dikes are provided to tie the jetty system into existing high land. The selected crest width of 100 feet is twice as wide as the existing dune. Dike side slopes are 1 vertical on 10 horizontal for the north dike and 1 vertical on 25 horizontal for the south dike. Existing beach slopes vary from 1 vertical on 10 horizontal to 1 vertical on 20 horizontal.

145. Recreation facilities. Criteria, assumptions, and calculations for the parking area, comfort station and fishing walkway are presented as an attachment to Appendix B.

MONITORING OF PROJECT EFFECTS

146. General. The construction of jetties at Murrells Inlet will affect the adjoining beach areas. In order to know what effects will be caused by the project, a monitoring program should be undertaken as part of the project. Existing geographical features should be monitored in addition to the project features or structures. The following items should be observed: deposition basin, entrance and inner channels, outer bar, sand fillets, adjacent to jetties, adjoining beaches, and jetty and weir structure. A brief report should be prepared annually to present the current results of the monitoring program. Since it will require several years to accumulate enough data to evaluate the effects of the project on the adjoining coastline; the annual reports will be limited in scope. A project evaluation report should be prepared at about six years after construction completion as stated in paragraph 151. The monitoring program should continue for a minimum of ten years after project completion. Annual cost of the monitoring program is estimated at $14,000.

147. Monitoring pl[illegible] [illegible] the [illegible] items of the monitoring plan are normally carried out during dredging operations and this information should be made available for this program. In connection with dredging operations, it is assumed that before and after surveys will be made for each dredging of the deposition basin, entrance and inner channels. Another assumption is that a record will be kept of the silty material actually placed in highland disposa[illegible]. For material other than silt removed from the inner channel, it is planned to pump this material (sand) onto the Garden City Beach as beach nourishment.

148. Sand samples should be taken before dredging the inner channel to obtain grain size distribution (GSD). A record should be kept of the quantity of material placed on the beach between stations. It will not be necessary to take before and after beach profiles, since material will be removed from navigation channel and there will be no beach widening objective. Some of this material will probably find its way into the deposition, and the GSD could be used in determining its presence in the basin.

149. Material removed from the deposition basin will be placed on the beaches either north or south of the inlet. At the time of the before dredging survey, se[illegible] samples should be collected for GSD analysis. After placement of the material on the beach, samples should be collected for GSD analysis to obtain the actual GSD of material placed. This would be helpful in determining sorting losses of sand used for beach nourishment.

150. Sand samples (for GSD analysis) should also be obtained from the adjoining beaches for about five miles north and south of the inlet. These samples may be obtained during beach profile surveys, and the initial samples should be taken prior to placement of any beach fill material. As a maximum, samples should be obtained from the following locations: dune face, mid berm, foreshore slope (above MLW), at or near mean low waterline, -3 feet MLW, -6 feet MLW, -9 feet MLW, and at the end of beach profile. If the cost of these sampling is prohibitive, then a minimum of three samples should be taken: mid berm, foreshore slope (above MLW), and at [illegible] feet MLW.

151. After the second dredging of the deposition basin (about six years after project construction), an evaluation report of the weir-jetty should be prepared. This report would also evaluate the monitoring plan and recommend changes in frequency or items to be monitored. The report should also discuss the following:

a. Amount of sand passing over the weir per year.

b. Character of the sand depositing in the basin.

c. Amounts of sand that deposit in the basin from different sources (e.g. littoral drift, entrance channel, inner channels, etc.)

d. Function of the basin, does material remain in basin or cause shoaling in the channels.

e. Stability of entrance channel; is there any meandering, shoaling, tendency to undermine the jetties.

f. Growth of sand fillets at north and south jetties.

g. Effects of jetties on nearby shores.

h. Volumes of sand placed on nearby shores; also location and character of material.

i. Modifications or revisions to the structures or project operation.

152. A summary of the monitoring plan is presented in Table 9. A discussion of the monitoring plan proposed for the various project features and operation is presented in paragraphs 153 through 162.

153. <u>Effect of jetties</u>. In order to check the effect of the jetties on the nearby beaches, beach profiles should be taken of the beach. These profiles should be spaced over a distance of about 10 miles north and south of the inlet. The northern limit of the beach profiles would be Myrtle Beach State Park, and the southern limit would be Midway Inlet (this is not 10 miles and could be extended to Pawleys Island, if problems develop). These profiles should be taken once a year during the same month, preferably in June.

154. North of the inlet, beach profiles should be taken from a baseline on shore to a point about 3,000 feet offshore. Profiles should be spaced about one mile apart for the first five miles and then two miles apart (last profile at Myrtle Beach State Park) for a total of seven profiles.

155. South of the inlet, the first profile should be about 1,000 feet south of the south jetty; then next four profiles should be about one mile apart (the last profile should be at N. Litchfield Beach); then one profile at the south end of Litchfield Beach; and the last profile about 1,000 feet north of Midway Inlet. This is a total of seven profiles.

156. Aerial photographs should be taken each year, to coincide with the beach profiles, of Murrells, Midway and Pawleys Inlets. These photographs would be taken at low tide.

157. <u>Sand bypassing</u>. Information should be accumulated to estimate the quantity of sand that comes over the weir, how much gets into the basin, and what quantity of sand gets into the entrance channel. The amount of material that will be accumulating adjacent to the jetties should also be investigated.

158. A hydrographic survey of the deposition basin should be performed at one-year intervals. The first survey will be the after dredging survey for construction of the basin. Surveys performed during periodic dredging of the basin will also be utilized. The entrance channel should be surveyed yearly. This would be useful in detecting any channel migration.

TABLE 9
MURRELLS INLET
SUMMARY OF PROJECT MONITORING PLAN

Item	Extent	Frequency
HYDROGRAPHIC SURVEYS:		
Deposition Basin	Whole basin	Annual
Entrance Channel	Entire channel	Annual
Interior Channel	Entire channel	Biennial
Outer Bar	2000 feet on each side of jetties 1000' seaward	Once during the 1st 5 years
LAND SURVEYS:		
Sand Fillet Profiles	Parallel & 500' from jetties to MLW line	Biannual for 1st 3 years; then annual
Beach Profiles	7 along north beach 7 along south beach	Annual
Jetty, levels	Both jetties	Biennial
PHOTOGRAPHS:		
Aerial	Pawleys Inlet, Midway Inlet & Murrells Inlet	Annual
Jetty	Both jetties	Annual
SAND SAMPLING:		
Deposition Basin	10 surface samples	Annual
Entrance Channel	5 surface samples	Annual
Interior Channel	10 surface samples	Annual
Outer Bar	10 surface samples	Annual
Beach Nourishment Areas	10 surface samples for each area	Only when sand is being placed, near end of the nourishment
Sand Fillets at Jetties	6 surface samples	Biannual for 1st 3 years; then annual
Beach Profiles	112 surface samples	Annual

159. Beach profiles should be taken 500 feet along the beach from the north and south jetties in order to define the growth of sand fillets next to the jetties. These profiles would extend from a baseline to the low waterline. The frequency of the fillet surveys should be every six months for the first three years (at the time of June surveys and then in December). After this initial three year period, the sand fillet profiles could be taken along with the normal beach profiles during June on a yearly basis.

160. Structural condition of jetties. Upon completion of the jetties, a series of photographs should be taken of each jetty, starting at the end and then at 500 feet intervals. These photographs should be taken from the same location at yearly intervals for the first five years and thereafter every five years.

161. At approximately two year intervals, profiles should be taken along the tops of the jetties, using the same marked points on the stone each time. These profiles should be obtained for first ten years after completion of construction. This should be a sufficient surveillance period to reveal any structural problems.

162. Outer bar. A complete hydrographic survey of the outer bar should be performed after project completion and then at about five year intervals. The survey would encompass an area 2,000 feet north and south of the jetties and about 1,000 feet seaward of the jetties. This survey would be helpful in checking the effectiveness of the sand bypassing system, and in estimating the quantity of sand lost to the shore system.

OPERATION AND MAINTENANCE

163. Dredging. The most significant aspect of operation and maintenance for this project is maintenance dredging that would be accomplished about every three years. Such dredging would average 203,000 cubic yards of material annually. These annual quantities include sand bypassing of 200,000 cubic yards (estimated annual southward drift rate) and inner channel maintenance dredging of 3,000 cubic yards. The estimated annual northward drift rate of 54,000 cubic yards would be trapped by the south jetty. It is believed that bypassing the annual southward drift of 200,000 cubic yards would be sufficient to replenish the shores experiencing sand deficiencies, both up and down drift of the jetties. If after the project is in operation, a need arises to bypass the littoral material trapped by the south jetty; the material could be moved by land-based equipment, such as draglines and trucks, or the jet-eductor pump (presently under development). Because of the flow restriction created by the jetties, the entrance channel would have sufficient tidal currents to be self-maintained and, therefore, no maintenance dredging would be needed for that channel. Disposal material from the inner channel would be pumped by pipeline dredge to the same general area as for the initial construction. The littoral drift that has passed over the jetty-weir and into the deposition basin would be used to stabilize the adjacent shorelines. Sand bypassing would be done by pipeline dredge with the sand being used to nourish the adjacent shoreline downdrift of the inlet in Huntington Beach State Park, or

upcoast if required. Sand bypassing would be accomplished by discharging the littoral material into the surf zone (below the mean low water line). The sand bypassing operation would be scheduled to minimize the effects on nesting wildlife and the recreating public.

164. Jetties. Included under this project feature are the two jetties and sand dikes. No major rehabilitation of these structures should be required since toe protection will be provided for the jetties where scour is most likely to occur. As scour occurs, this apron of toe protection stone drapes the sand slope thereby holding foundation sands in place, preventing settlement of the rubble structure. It is estimated that jetty maintenance should not exceed an average of one percent of the construction cost each year.

165. Aids to navigation. Navigation aids which consist of channel markers would be maintained by the Coast Guard.

166. Roads. No permanent roads will be provided for access in connection with operation and maintenance of the project. Access would be by water or by land along the beach using all-terrain type vehicles.

167. Recreational facilities. Maintenance of the walkway to be constructed on the south jetty is expected to be relatively high since the pavement would probably have to be replaced about every 25 years. Storm waves breaking on the jetty may cause some shifting of the stones under the asphalt pavement, thereby breaking up the pavement. It was determined that maintenance of the comfort station would be less if it were located in the vicinity of an existing parking area instead of at the jetty since there would be better access for maintaining the facility and vandalism would be reduced. The South Carolina Department of Parks, Recreation, and Tourism would be responsible for maintaining all the recreational facilities including the walkway, the comfort station, and a parking area for walkway users.

COST ESTIMATES

168. Cost estimates. Estimated cost of Murrells Inlet Navigation Project is based upon quantity estimates derived from field surveys, land appraisals, and foundation investigations. Estimated quantities include an allowance of 10 per cent to account fpr settlement and bottom scour during construction. Cost estimates are based on past experience and current contract prices applied to the estimated quantities. Costs covering contingencies, engineering and design, and supervision and administration are included in the estimates. A summary cost estimate of project first cost is presented in Table 10. A detailed cost estimate of Murrells Inlet is given in Table 11.

169. Comparison with prior estimates. A comparison between the current estimate (price levels October 1975) and the latest approved estimate (PB-3, effective date 1 October 1975) is given in Table 12. The PB-3 estimate, although dated 1 October 1975, was prepared a few months in advance of the approval date. The current estimate was prepared after the PB-3 estimate and reflects current unit prices as of 1 October and design changes. The project document estimate is also

TABLE 10

SUMMARY OF PROJECT COST ESTIMATE

(October 1975 Price Level)

Cost Account Number	Item or Feature	Current Cost Estimate
01.	Lands and Damages	$ 815,000
09.	Channels and Canals	2,075,000
10.	Breakwaters and Seawalls	9,153,000
14.	Recreation Facilities	259,000
30.	Engineering and Design	990,000
31.	Supervision and Administration	574,000
	TOTAL PROJECT COST	$13,866,000

TABLE 11

MURRELLS INLET GDM
COST ESTIMATES

(October 1975 Price Level)

Cost Account	Feature	Unit	Quantity	Unit Cost	Total Cost
01.	LANDS AND DAMAGES				
	Fee Title				
	North Jetty and Sand Dike	L.S.	Job		$318,000
	Easements				
	Highland Disposal Area	L.S.	Job		217,000
	Highland Pipeline	L.S.	Job		38,000
	Drainage Ditch	L.S.	Job		5,000
	Beach Disposal	L.S.	Job		60,000
	Pipeline, Bypass	L.S.	Job		34,000
	North Construction Area	L.S.	Job		44,000
	Subtotal				$716,000
	Contingencies				99,000
	Account 01. Total				$815,000
09.	CHANNELS AND CANALS				
	Mobilization and Demobilization	L.S.	Job		150,000
	Excavation, Unclassified:				
	Inner Channel	C.Y.	190,000	$ 1.15	219,000
	Auxiliary Channel	C.Y.	30,000	1.10	33,000
	Entrance Channel	C.Y.	320,000	1.10	352,000
	Deposition Basin	C.Y.	600,000	1.50	900,000
	Disposal Area Preparation	L.S.	Job		35,000
	Aids to Navigation	L.S.	Job		115,000
	Subtotal				$1,804,000
	Contingencies, 15%				271,000
	Account 09. Total				$2,075,000
10.	BREAKWATERS AND SEAWALLS				
.1	North Jetty				
	Armor Stone I (6-10 ton)	Ton	10,100	$ 52.00	$ 525,000
	Armor Stone II (4-7 ton)	Ton	38,700	31.00	1,200,000
	Core Stone	Ton	12,500	29.00	363,000
	Toe Protection	Ton	12,600	29.00	365,000
	Foundation Blanket	Ton	24,100	28.00	675,000
	Concrete Sheet Pile Weir	L.F.	1,880	300.00	564,000
	Account 10.1 Subtotal				$3,490,000

TABLE 11
(cont.)
MURRELLS INLET GDM
COST ESTIMATES

(October 1975 Price Level)

Cost Account	Feature	Unit	Quantity	Unit Cost	Total Cost
.2	South Jetty				
	Armor Stone I (6-10 ton)	Ton	9,800	$32.00	$ 314,000
	Armor Stone II (407 ton)	Ton	67,200	31.00	2,083,000
	Core Stone	Ton	22,000	29.00	638,000
	Toe Protection	Ton	11,800	29.00	342,000
	Foundation Blanket	Ton	36,500	28.00	1,022,000
	Account 10.2 Subtotal				$4,399,000
.3	Sand Dikes Erosion Control	L.S.	Job		70,000
	Account 10. Subtotal				7,959,000
	Contingencies, 15%				1,194,000
	Account 10. Total				$9,153,000
14.	RECREATION FACILITIES				
	Fishing Walkway	L.F.	3,230	$50.00	$ 162,000
	Comfort Station	L.S.	Job		40,000
	Parking Lot	S.Y.	3,900	6.00	23,000
	Subtotal				$ 225,000
	Contingencies, 15%				34,000
	Account 14. Total				$ 259,000
	Subtotal (Items 09., 10. and 14)				$11,487,000
30.	ENGINEERING AND DESIGN (5%)				574,000
	Model Study				416,000
31.	SUPERVISION AND ADMINISTRATION (5%)				574,000
	TOTAL PROJECT COST				$13,866,000

R2 30 Mar 76

TABLE 12

COMPARATIVE ESTIMATE OF TOTAL INITIAL PROJECT COST
MURRELLS INLET, SOUTH CAROLINA
(ALL COSTS IN $1,000)
(FEDERAL AND NON-FEDERAL)

Item No.	Item	Project Document Estimate	Latest Approved Estimate (Effective Date 1 Oct 1975)	Current Estimate (Oct 1975)
01.	Lands and Damages	$ 602.8	$ 865	$ 815
09.	Channels and Canals	628.5[1]	1,299[1]	2,075[1]
10.	Breakwaters and Seawalls	3,382	5,983	9,153
14.	Recreation Facilities	142.7	259	259
30.	Engineering and Design	385.9	726	990
31.	Supervision & Administration	265.1	368	574
		$5,407	$9,500	$13,866

Current Estimate (Oct 1975) NON-FEDERAL COSTS (Cash Contribution and Land and Damages) $1,768,700

(Reimbursement for 6.1% of cost of Navigation Facilities, 50% of Cost of Recreation Facilities and All Lands Required)

(1) Includes Cost of Aids to Navigation

shown in this table. The total overall cost of the project as presented in this design memorandum has increased approximately \$4,366,000 above the latest approved estimate. The project document estimate is at 1969 price levels. The increase of the project cost presented in the current estimate over that in the PB-3 estimate is primarily caused by the following: lengthening of the north jetty by 65 feet; lengthening of the south jetty by 990 feet; and increasing the size of the deposition basin sixfold from 100,000 to 600,000 cubic yards. The increase in cost account 09, channels and canals, is \$776,000 which is due to the addition of 500,000 cy to the capacity of the deposition basin and a 23,000 cy increase in inner channel dredging caused by changing site conditions. The increase in cost account 10, Breakwater and Seawalls, is \$3,170,000 which is due to extending the terminal point of the north and south jetties to the -10 foot ocean contour from the -4 foot and -2 foot ocean contours, respectively. While cost account 14, Recreation Facilities has not experienced any cost change, the facilities to be provided have changed. The cost decrease due to the deletion of the fishing walkway access road, culvert and handrail have been offset by the cost increase due to the addition of a comfort station and parking area enlargement. The total non-Federal cost is \$1,768,700 In a letter dated 4 November 1975 (Exhibit 21), Local interests have provided assurances that they will provide the estimated non-Federal cost of the project.

BENEFITS

170. Benefits described herein attributable to the described project are the difference between net benefits received with and without the project. Future benefits have been discounted to present worth values and discounted over a 50-year evaluation period using a 6 1/8 percent discount interest rate. Murrells Inlet is unstable with the present controlling depth of the waterway at about two to three feet above mean low water. This depth is inadequate for operation of the existing and projected fleet of commercial and recreational boats, which require about 10 feet mean low water depth at the ocean entrance and about 8 feet mean low water depth in the interior channels for safe navigation. Tangible navigation benefits of \$1,902,100 per year are derived from enhanced recreational boating and commercial charter boat operations, increased commercial seafood landings, reduction of vessel damage, and provision of an all-tide harbor of refuge during storms. The estimated average annual benefits attributable to the fishing walkway are \$34,500. The average annual redevelopment benefits expected to accrue from project construction are estimated \$88,000. Total annual benefits creditable to the Murrells Inlet navigation project are \$2,024,600 The benefit-cost ratio, using the above benefits and the annual costs from Table 14 (\$1,363,400), is 1.48. For details on estimates of benefits, see Appendix E.

APPORTIONMENT OF COST

171. Allocation of benefits. Allocation of project benefits are computed to determine what proportion of the navigation facilities first

costs, exclusive of navigation aids, lands for general navigation facilities, and disposal areas, will be apportioned to the Federal and non-Federal interests. Total benefits accruing to the project from the elimination of vessel damage are assumed to accrue to commercial vessels only. Harbor of refuge benefits to transients who happen to be in the area during storms are allocated entirely to commercial fishing operations since it is unlikely that transient vessels seeking refuge will be employed in anything other than a commercial venture. About 24 boats harbored at Murrells Inlet would receive harbor of refuge benefits. Allocation of benefits to general and local interests is shown in Table 13.

Table 13

ALLOCATION OF ANNUAL BENEFITS

Type of Benefit	Allocated Benefits		
	Total	General	Local
Party boating	$ 966,600	$ 966,600	$ 0
Charter boating	212,500	212,500	0
Recreational boating	232,500	116,250	116,250
Commercial fishing	430,900	430,900	0
Elimination of vessel damage	46,800	46,800	0
Harbor of refuge	13,000	13,000	0
TOTAL ANNUAL BENEFITS	$1,902,100	$1,785,850	$116,250
PERCENT OF TOTAL ANNUAL BENEFITS	100.0$	93.9%	6.1%

172 Apportionment of costs First and average annual costs of both the navigation project and fishing walkway are apportioned to Federal and non-Federal interests as shown in Table 14.

LOCAL COOPERATION

173 Local sponsor. The local sponsor is the Georgetown County Council whose address is P. O. Drawer C, Georgetown, South Carolina 29440. Council members are as follows:

Alfred B. Schooler, Chairman
J. D. Munnerlyn
H. E. Hemingway
C. J. Beck
I. S. Bellamy

Table 14

APPORTIONMENT OF COST

APPORTIONMENT OF FIRST COST, NAVIGATION FACILITIES

Item	Percent Apportionment	First Cost	Apportioned First Cost
FEDERAL			
Corps of Engineers, general navigation facilities	93.9%	$12,577,000	$11,809,800
Coast Guard, aids to navigation	100.0%	145,000	145,000
TOTAL, FEDERAL			$11,954,800
NON-FEDERAL			
Cash contribution, general navigation facilities	6.1%	$12,577,000	$ 767,200
Lands and acquisition, general navigation facilities	100.0%	815,000	815,000
Acquisition and development of disposal area	100.0%	44,000	44,000
TOTAL, NON-FEDERAL			$ 1,626,200
TOTAL NAVIGATION PROJECT FIRST COST			$13,581,000

APPORTIONMENT OF FIRST COST, FISHING WALKWAY

Item	Percent Apportionment	First Cost	Apportioned First Cost
FEDERAL			
Fishing walkway	50.0%	$ 285,000	$ 142,500
NON-FEDERAL			
Fishing Walkway	50.0%	285,000	142,500
TOTAL FISHING WALKWAY FIRST COST			$ 285,000

Table 14
(cont.)

APPORTIONMENT OF COST (cont'd)

APPORTIONMENT OF AVERAGE ANNUAL COSTS, NAVIGATION FACILITIES

Item	Percent Apportionment	Average Annual Cost	Apportioned Average Annual Cost
FEDERAL			
Corps of Engineers, general navigation facilities:			
Interest and amortization	93.9%	$ 811,000	$ 761,500
Maintenance	100.0%	427,000	427,000
Monitoring program	100.0%	14,000	14,000
Coast Guard, aids to navigation			
Interest and amortization	100.0%	$ 9,400	$ 9,400
Maintenance	100.0%	16,000	16,000
TOTAL, FEDERAL			$1,227,900
NON-FEDERAL			
Cash contribution, general navigation facilities			
Interest and amortization	6.1%	$811,000	49,500
Maintenance	0.0%	427,000	0
Monitoring program	0.0%	14,000	0
Lands and acquisition, general navigation facilities - interest and amortization	100.0%	$ 52,600	$ 52,600
Acquisition and development of disposal area			
Interest and amortization	100.0%	4,000	4,000
Maintenance	100.0%	3,000	3,000
TOTAL, NON-FEDERAL			$ 109,100
TOTAL NAVIGATION AVERAGE ANNUAL COST			$1,337,000

Table 14
(cont.)
APPORTIONMENT OF COST (cont'd)

APPORTIONMENT OF AVERAGE ANNUAL COSTS, FISHING WALKWAY

Item	Percent Apportionment	Average Annual Cost	Apportioned Average Annual Cost
FEDERAL			
Interest and amortization	50.0%	$ 18,400	$ 9,200
Maintenance	0%	8,000	0
TOTAL, FEDERAL			$ 9,200
NON-FEDERAL			
Interest and amortization	50.0%	$ 18,400	$ 9,200
Maintenance	100.0%	8,000	8,000
TOTAL, NON-FEDERAL			$ 17,200
TOTAL FISHING WALKWAY ANNUAL COST			$ 26,400

174. Requirements. The authorizing legislation requires local interest to:

a. Provide without cost to the United States all necessary lands, easements, rights-of-way required for construction and subsequent maintenance of the improvements and for aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and also necessary retaining dikes, bulkheads, and embankments therefor or the cost of such retaining works;

b. Hold and save the United States free from damages that may result from construction and maintenance of the project including management and maintenance of jetty fishing facilities:

c. Accomplish without cost to the United States alterations and relocations as required in sewer, water supply, drainage, and other utility facilities;

d. Provide, maintain, and operate without cost to the United States and adequate public landing or wharf with provisions for the sale of motor fuel, lubricants, and potable water, open and available to all on equal terms;

e. Provide and maintain without cost to the United States depths in berthing areas and local access channels commensurate with project depths;

f. Establish regulations prohibiting discharge of pollutants into the waters of the channels and harbor by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State and local authorities responsible for pollution prevention and control;

g. Contribute in cash 16.7 percent of the construction cost of navigation features, including engineering and design and supervision and administration of all work to be provided by the Corps of Engineers, a contribution now estimated at $653,000 to be paid in a lump sum prior to start of construction, or in installments prior to start of pertinent work items in accordance with construction schedules as required by the Chief of Engineers, the final apportionment of cost to be made after actual costs have been determined;

h. Contribute at least 50 percent of the costs associated with the jetty fishing, including engineering and design and supervision and administration (such costs now estimated at $81,000), which contribution may consist of carrying out an agreed-upon portion of the development, or a lump-sum cash contribution prior to construction of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers, the final apportionment of costs to be made after actual costs have been determined;

i. Operate and maintain for the life of the project the jetty fishing facilities including access roadway and parking facilities; and

j. Provide access to the jetty fishing facilities to all on equal terms.

175. Compliance. Local interests have given assurances of cooperation for the execution of the project subject to the appropriation and availability of funds. A meeting was held on 5 August 1975 with the local sponsor to discuss the requirement of local assurances. The specific matters discussed were the acquisition of lands for an alternate disposal area, jetty construction sites, and access roads to the project site. In a letter dated 23 October 1975 (Exhibit 20), the District Engineer informed the sponsor of the local cooperation requirements and requested that they provide their assurances to fulfill these requirements. A draft local cooperation agreement was also furnished with this letter for the sponsor's review. The sponsor, Georgetown County, provided their assurances of fulfilling the local cooperation requirements ina letter dated 4 November 1975 (Exhibit 21). The State of South Carolina has agreed to help the County provide the cash contribution.

176. Local ordinances. The attorney for the Georgetown County Council has given assurances that there are no statutes, ordinances, or regulations which would restrict construction of the authorized project.

177. Section 221 agreement. Local sponsor will be required to execute a binding agreement as provided for in Section 221, Public Law 91-611 prior to initiation of construction. A draft of this agreement is included as Exhibit 22.

DEPARTURE FROM PROJECT DOCUMENT PLAN

178. General. The plan of improvement recommended in this report is basically the same as that presented in the project document and described in paragraphs 2 and 3. The modifications to the authorized plan are considered to be within the discretionary authority of the Chief of Engineers to approve. A discussion of the modifications are presented in the following paragraphs.

179. North jetty. The jetty has been lengthened 65 feet in order to terminate the jetty at the -10 foot ocean contour instead of at -4 foot contour. The lengthening of the jetties was recommended by WES. The ocean bottom at -4 foot is still subject to wave action with the resultant movement of littoral material.

180. South jetty. The jetty has been lengthened 990 feet in order to terminate the jetty at the same point as the north jetty (approximately -10 feet contour) and to extend the shoreward end of the jetty past the inlet gorge to the -2 foot contour. It was felt that it would be difficult if not impossible to construct a sand dike of hydraulic fill across an inlet gorge with maximum depth of -6 feet.

180a. Navigation channels The entrance and inner channels have decreased in length, 300 feet and 260 feet, respectively. The depths of entrance and inner channels have also been decreased by 2 feet to 10 feet and 8 feet, respectively. The decrease in channel lengths result from terminating the entrance at the -10 foot ocean contour and minor changes in inner channel alignment due to changes in bathymetry. Project navigation benefits will optimize at a 10-foot entrance channel and an 8-foot inner channel. A request will be made to higher authority to classify the 2-foot decrease in entrance and inner channel depths as inactive.

181. Deposition basin. The basin has been increased in plan area and the bottom elevation has been deepened from -12 feet to -20 feet. The basin capacity has been increased from 100,000 cubic yards to 600,000 cubic yards. In a preconstruction planning conference held at the South Atlantic Division office on 12 August 1975, conferee from the Coastal Engineering Research Center recommended the basin capacity be equal to the southward littoral drift for three years. The project document plan called for a basin large enough to hold the net southward littoral drift per year. The proposed basin capacity of 600,000 cubic yards would allow flexibility in the project maintenance dredging program, whereas the 100,000 cubic yard basin capacity would require dredging every year.

182. Auxiliary channel. A channel 625 feet long, 200 feet wide and 6 feet deep would be provided from the entrance channel to the -6 foot contour at the mouth of Oaks Creek. This channel was recommended by WES to allow better tidal flow into and out of Oaks Creek. Surface-current photography taken at WES showed that due to the construction of the south jetty; tidal flows into the out of Oaks Creek became circuitous and could cause eddy currents at the south sand dike with resultant erosion.

183. Recreation facilities. The protective handrail on the fishing walkway has been deleted based on the experiences of Jacksonville District with handrail installations on fishing walkways in Florida. The handrail has been found to be difficult to install and maintain due to size of the armor stone. Handrails have also been removed by fisherpersons and others. The 8-foot wide walkway is considered to be a safe width without the handrail. Jacksonville District has had no reports of injury to any of the numerous users of the walkway. The access road to south jetty for the fishing walkway users has been deleted at the request of S. C. Department of Parks, Recreation and Tourism and the Trustees of Brookgreen Gardens (see paragraph 112, Real Estate requirements). The access road proposed in project document would have required construction in salt marsh; and an alternate route along the beachfront would have disturbed a least tern rookery. The project document plan provided a parking area near the south jetty. This parking area has been relocated adjacent to an existing parking area at Huntington Beach State Park, about one mile from the south jetty. The location of the parking area is in agreement with a master plan for

development of the park. A comfort station has been added and is located adjacent to the parking area. This comfort station will attend to the sanitation needs of the fishing walkway users and other park visitors. The comfort station also fits in with the park master plan.

184. Disposal area. A highland disposal area of 16± acres has been recommended in lieu of the 16-acre disposal area located in marshland. The disposal area was relocated for environmental considerations.

ASSESSMENT OF EFFECTS SUMMARY

185. A profile showing the sociological, economic and environmental implications of the proposed project and the alternatives considered during project formulation has been prepared in response to Section 122 of the River and Harbor and Flood Control Act of 1970. This profile is summarized in Table 15.

STATEMENT OF FINDINGS

186. This report was reviewed and evaluated, in light of the overall public interest, the documents concerning the proposed action, as well as the stated views of other interested agencies and the concerned public, relative to determining the need and advisability, including the various practical alternatives, of constructing the Murrells Inlet Navigation Project. Full consideration has been given to all comments received from interested agencies, organizations and the general public at the public meeting of 29 May 1975, relative to the proposed Murrells Inlet Project.

187. The Murrells Inlet Project was authorized in November 1971 under Section 201 of the 1965 Flood Control Act in accordance with recommendations of the Chief of Engineers in House Document No. 91-137. The recommended project includes a 10' x 300' entrance channel; an inner channel 8' x 90'; a jettied entrance; sand transition dikes connecting the jetties to the shore; and a fishing walkway on the south jetty. Section 67 of the Water Resources Development Act of 1974 modified the project to provide for periodic maintenance dredging as deemed necessary by the Chief of Engineers to maintain channel depths sufficient to permit free and safe movement of vessels until such time as the authorized project is constructed. The Corps of Engineers is currently attempting to provide an entrance channel of 8 feet deep (MLW) and 100 feet wide across the bar and 6 feet by 100 feet in the inner channel annually, using a Corps-owned sidecasting dredge.

188. The possible consequences of alternatives have been studied for environmental, social well-being, and economic effects, including regional and national economic development and engineering feasibility.

189. In evaluation of the recommended plan and other viable alternatives, the following points were considered pertinent:

a. Environmental. None of the alternatives have significant permanent adverse environmental effects. Although adverse environmental impacts would be localized and temporary in nature, the magnitude of these impacts would be greatest under the authorized plan and the dredging only plan.

TABLE 15

ASSESSMENT OF EFFECTS SUMMARY

Consideration	No Action	Dredging Without Structural Features	Dredging With Structural Features (Recommended Project)
Social			
1. Population			
a. Density	No significant impact.	Possible increase as commercial and recreational use of the inlet increases.	Same as dredging alone.
b. Displacement of people	No significant impact.	No significant impact.	No significant impact.
2. Community growth	Possible decrease due to reduced recreational and commercial use of the inlet.	Possible increase associated with increased commercial and recreational use of the inlet.	Probable increase associated with increased commercial and recreational use of the inlet.
3. Community cohesion	No impact.	No impact.	No impact.
4. Aesthetic values	The inlet would probably close and erosion of the island could be aesthetically displeasing.	No significant change in aesthetic values.	The inlet should remain open and there should be a build-up of sand caused by the presence of the jetties. Presence of jetties may be aesthetically displeasing to some people.
5. Historical/Archaeological Structures or Remains	No impact.	No impact.	No impact.

TABLE 15 (cont.)

ASSESSMENT OF EFFECTS SUMMARY

Consideration	No Action	Dredging Without Structural Features	Dredging With Structural Features (Recommended Project)
Economic			
1. Local government	Possible decrease in revenue as the inlet closes and recreational and commercial use of the inlet declines.	Local costs of continued maintenance of the inlet are $150,000 annually 1/ Local revenues would probably remain relatively unchanged.	Initial non-Federal costs would be $1,768,700. Probable increase in local revenue due to increase in both commercial and recreational use of the inlet. Annual maintenance cost will be $11,000.
2. Property values	Possible decline in property value as the inlet closes and erosion continues.	Property values should continue to increase at the present rate.	With the probable increase in commercial and recreational use of the inlet, property values should increase.
3. Public facilities	No significant impact.	Possible increase in the use of existing facilities and a demand for additional facilities.	Same as dredging alone
4. Public service	No significant impact.	Possible increase in usage of public services.	Same as dredging alone.
5. Regional growth	Possible slight decrease due to decreased use of the area.	Possible increase as the commercial and recreational use of the area increases.	Same as dredging alone.

TABLE 15 (cont.)

ASSESSMENT OF EFFECTS SUMMARY

	Consideration	No Action	Dredging Without Structural Features	Dredging With Structural Features (Recommended Project)
	Economic (cont.)			
6.	Employment & labor force	As the inlet closes, the demand for the existing labor force will probably decline somewhat and employment may decline.	Possible increase in employment. No significant impact on labor force.	With increased commercial and recreational use of the inlet, the demand for the labor force will probably increase and employment opportunities will likely increase.
7.	Business & industrial growth	Possible decline in business growth due to decreased usage of the inlet.	Business growth should increase as the use of the inlet increases.	Same as dredging alone.
8.	Displacement of farms	No impact.	No impac	No impact.
	Environmental Effects			
1.	Man-made resources	Possible loss of some structures if erosion contirues.	Existing and future structures would be afforded some protection from erosion as a result of placement of dredged materials on eroding beaches.	Existing and future structures would be protected from further erosion.
2.	Natural resources	No significant impact.	Minor impacts associated with the actual dredging and the deposition of the dredged material. 1,003,000 C.Y. of material are to be dredged annually.	Similar impacts to dredging alone but some minor additional impacts associated with the construction of the stone jetties. 1,140,000 C.Y. of material will be dredged initially and 205,000 C.Y. will be dredged annually.

TABLE 15 (cont.)

ASSESSMENT OF EFFECTS SUMMARY

Consideration	No Action	Dredging Without Structural Features	Dredging With Structural Features (Recommended Project)
Environmental Effects (cont.)			
3. Pollution aspects			
a. Air	No significant impact.	Slight increase in pollutants during actual construction.	Same as dredging alone.
b. Water	No significant impact.	Increased turbidity during dredging operations but of short duration.	Same as dredging alone.
c. Noise	No significant impact.	Increase in noise level during actual construction.	Same as dredging alone.

1/ Based on assumption that local costs are directly proportional to percentage of local benefits to total benefits.

b. Engineering feasibility. The recommended plan is the most practical means of providing a channel in this inlet. The alternative of dredging alone provides only a temporary solution to the problem because of rapid shoaling created by natural conditions.

c. Economic. The recommended plan of improvement has a greater first cost, but would be less expensive to maintain than the dredging alone alternative. The economic benefit to the area is more than sufficient to justify the recommended project.

d. Social well-being. Although none of the alternatives would have a significant effect on social well-being, the recommended plan has the greastest potential in this area. The creation of new jobs to insure adequate employment for the area residents is dependent on the inlet staying open to commercial and recreational boating. The recommended plan would provide the greatest assurance of a navigable channel which would contribute to the security and health of fishermen and provide increased recreational opportunities.

e. Application of 404b guidelines. The interim final guidelines of the Environmental Protection Agency for the discharge of dredged or fill material (40 CFR 230, September 5, 1945) have been applied in evaluating the proposed action.

190. It was concluded that the proposed action is based on thorough analysis and evaluation of practicable alternative courses of action for achieving the stated objectives, that whenever adverse effects are found to be involved, they cannot be avoided by following reasonable alternative courses of action which would achieve the project purposes; that where the proposed action had an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations of national policy, statutes, and administrative directives; and that on balance, the total public interest should best be served by the implementation of the recommended plan.

RECOMMENDATIONS

191. It is recommended that the proposed plan of improvement described in paragraphs 122 through 132 of this design memorandum for the design and construction of the Murrells Inlet Navigation Project be adopted with major features as follows:

192. North jetty (including weir section), an overall length of 3,365 feet; south jetty, an overall length of 3,290 feet, about 3,350 feet of sand dikes; a deposition basin with a bottom elevation of -20 feet and capacity of 600,000 cubic yards; an entrance channel, 300 feet wide, 10 feet deep and 3,000 feet long; an inner channel, 90 feet wide, 8 feet deep and 15,440 feet long, terminating with a turning basin 300 feet long and 150 feet wide; an auxiliary channel to Oaks Creek, 200 feet wide, 6 feet deep and 625 feet long; and recreation facilities consisting of 100 car parking area, comfort station, and 8-foot wide fishing walkway on the south jetty, 3,230 feet long.

193. It is further recommended that the material presented in this design memorandum be used as the basis for the preparation of plans and specifications.

EXHIBITS

SANGC 15 October 1975

Regional Administrator
Environmental Protection Agency
Suite 300
1421 Peachtree Street, N. E.
Atlanta, Georgia 30309

Dear Sir:

We are in the final phase of preconstruction planning for the Murrells Inlet, South Carolina navigation project. The presently proposed plan of improvement is essentially the same one that was authorized by the Congress of the United States in 1971. The plan calls for a 300-foot wide channel, 12 feet deep, extending from that depth in the Atlantic Ocean through the outer bar to an inner channel 90 feet wide and 10 feet deep. The inner channel would follow Main Creek approximately 15,400 feet to a turning basin in the vicinity of the former Army Crash Boat Dock. A deposition basin would be integrated into the entrance channel to collect littoral sands crossing the weir section of the northern jetty of a two-jetty system constructed to protect the entrance channel. Material thus collected would be pumped by hydraulic dredge to the adjacent beaches. The recreational project would include a fishing walkway on the south jetty. A map showing the planned construction is attached.

Changes in the authorized project include the relocation of the disposal area required to accommodate shoal material that is unsuitable for beach nourishment and the change of access to the recreational fishing walkway. Most of objections to the original project were related to the ecological effects of using a marsh disposal area. The proposed new location of the disposal area is on high ground. The access road to the south jetty for the fishing walkway users has been deleted at the request of the South Carolina Department of Parks, Recreation and Tourism and the Trustees of Brookgreen Gardens, owners of this property. The parking area that was planned to be constructed near the south jetty has been relocated adjacent to an existing parking area at Huntington Beach

State Park, about one mile from the south jetty. A comfort station has been added and is located adjacent to the parking area. Access to the walkway from the parking area will be by foot along a beach-front trail.

The north jetty has been lengthened from 3,300 feet to 3,635 feet or 305 feet and the south jetty from 2,300 feet to 3,985 feet, an increase of 1,685 feet. The deposition basin has been increased in plan area and deepened from 12 feet below mean low water to 20 feet below mean low water. This increased the basin capacity from 100,000 cubic yards to 600,000 cubic yards.

Your evaluation and comments concerning this proposed project would be greatly appreciated. To allow time to include your comments in the General Design Memorandum it would be desirable to get your reply by 31 October 1975.

Sincerely,

1 Incl
As stated

HARRY S. WILSON, JR.
Colonel, Corps of Engineers
District Engineer

Letter and inclosure also sent to:

Regional Administrator
Environmental Protection Agency
Suite 300
1421 Peachtree Street, N. E.
Atlanta, Ga. 30309

Commander
Seventh Coast Guard District
1203 Federal Building
51 S. W. First Avenue
Miami, Fla. 33130

Regional Director
PHS Region IV, DHEW
50 Seventh Street, N. E.
Atlanta, Ga. 30323

Regional Director
Fish and Wildlife Service
USDI
17 Executive Park Drive, N. E.
Atlanta, Ga. 30329

Mr. Curt Laffin
Bureau of Sport Fisheries & Wildlife
U. S. Fish & Wildlife Service
P. O. Box 12559
Charleston, S. C. 29412

Regional Director
Bureau of Outdoor Recreation
148 Cain Street
Atlanta, Ga. 30303

State Conservationist
Soil Conservation Service
240 Stoneridge Drive
Columbia, S. C. 29210

(continued)

Office of the Governor
State Planning and
Grants Division
915 Main Street
Columbia, S. C. 29201

Mr. Clair P. Guess, Jr.
Executive Director
S. C. Water Resources Commission
P. O. Drawer 164
Cayce, S. C. 29033

Mr. [illegible] Whitten
State [illegible]
Division of Administration
Edgar [illegible] Brown Building
Colu[illegible] S. C. 29201

Execu[illegible] Director
S. C. [illegible]tion Control Authority
J. Mari[illegible] Building
Columbia [illegible] C. 29201

Dr. Lamar E. Priester
S. C. Department of Health
and Environmental Control
2600 Bull Street
Columbia, S. C. 29201

Dr. James A. Timmerman, Jr.
Executive Director
S. C. Wildlife & Marine
Resources Department
P. O. Box 167
Columbia, S. C. 29202

Mr. Charles M. Bearden
S. C. Wildlife & Marine
Resources Department
P. O. Box 12559
Charleston, S. C. 29412

Mr. Charles E. Lee, Director
S. C. Department of Archives
& History
P. O. Box 11669
Columbia, S. C. 29211

Mr. [illegible] V. Cobb
State Highway Engineer
S. C. Highway Department
Columbia, S. C. 29202

Waccamaw Regional Planning Commission
P. O. Box 448
Georgetown, S. C. 29440

Waccamaw Regional Planning and
Development Council
1001 Front Street
Georgetown, S. C. 29440

Horry County Planning and
Promotion Commission
P. O. Box 263
Conway, S. C. 29526

Georgetown County Health
Department
Georgetown S. C. 29440

16 OCT 1975

16 OCT [illegible]

Exhibit 1
page 3 of 4

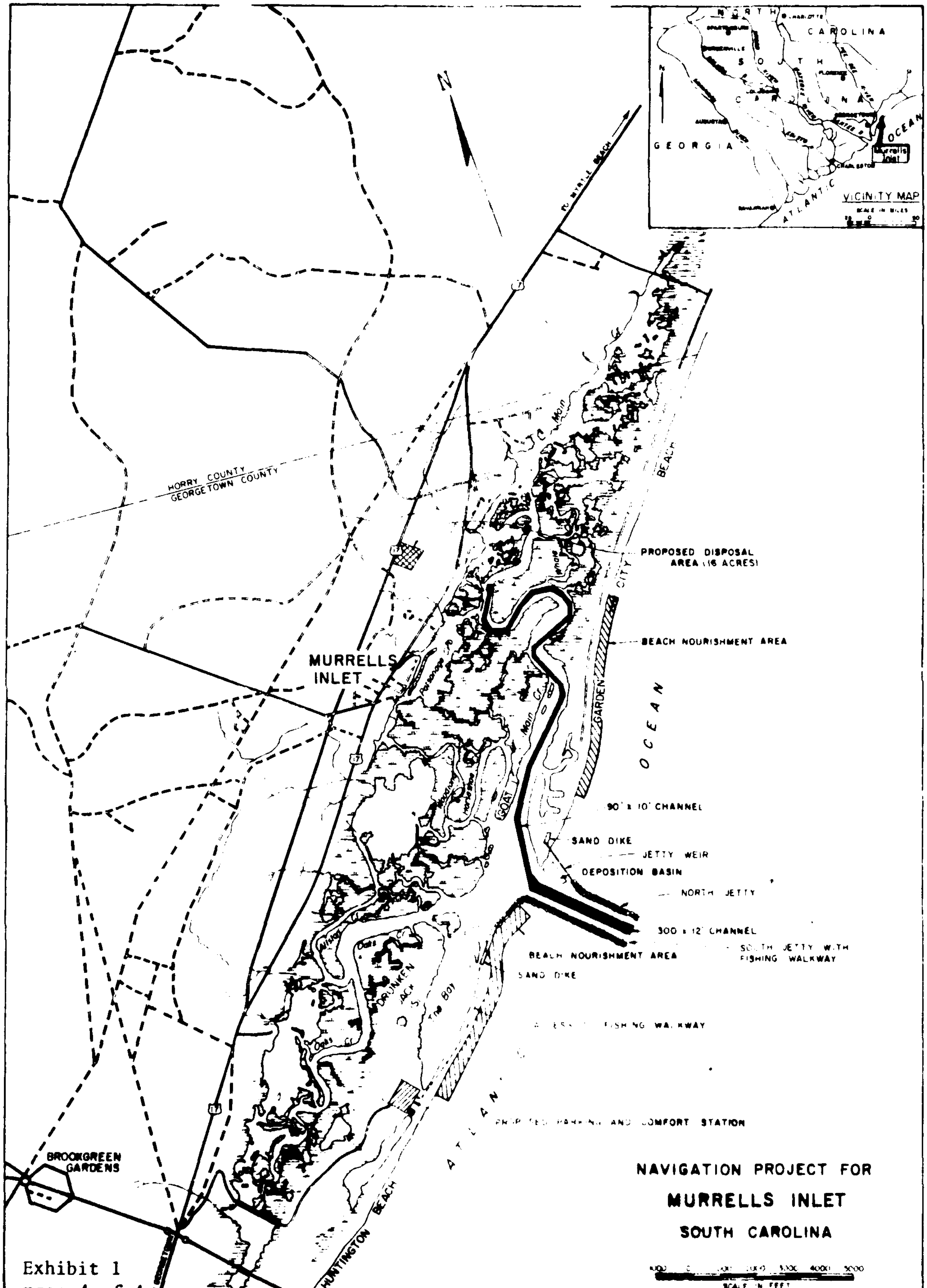


Exhibit 1
page 4 of 4

INCLOSURE 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
1421 PEACHTREE ST., N.E.
ATLANTA, GEORGIA 30309

October 31, 1975

Colonel Harry S. Wilson, Jr.
District Engineer
U. S. Army, Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Re: SANGC Murrells Inlet, South Carolina,
Navigation Project

Dear Colonel Wilson:

This is in response to your letter of October 15, 1975, relating to the proposed plan of improvement for Murrells Inlet Navigation Channel, South Carolina.

The project has been reviewed by this office for its effect on water quality and the associated environment in accordance with applicable State and Federal laws and regulations.

Our review indicates that by changing the plans to eliminate marsh disposal and by utilizing beach nourishment and upland disposal of the spoil, there will be no significant adverse long-term effects on water quality or the associated environment. However, there has been some question raised about the location of the fishing access walkway leading to the south jetty. By locating this walkway along the dune line, grasses may be destroyed which could lead to the destruction or erosion of the dunes in a severe storm.

Aside from this feature of the project we have no objection to the plans as proposed.

Sincerely yours,

Arthur G. Linton, P. E.
Federal Activities Coordinator
Enforcement Division

Exhibit 2

United States Department of the Interior
FISH AND WILDLIFE SERVICE
17 EXECUTIVE PARK DRIVE, N. E.
ATLANTA, GEORGIA 30329

JUN 13 1975

District Engineer
U.S. Army Corps of Engineers
P.O. Box 919
Charleston, South Carolina 29402

Dear Sir:

This is in response to your request for comments on the authorized navigation and inlet stabilization project at Murrells Inlet, Georgetown County, South Carolina. Your request was made at the public meeting held in Murrells Inlet on May 29, 1975. Our comments are submitted in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

As indicated by you at the meeting the proposed 16 acre saltmarsh disposal area near the turning basin is unacceptable to environmental agencies and an alternative plan is being sought.

By letter of February 14, 1969, the Fish and Wildlife Service and the National Marine Fisheries Service, then known as the Bureau of Commercial Fisheries, recommended the sand spit north of the inlet be used for dredged material disposal. This would still be ecologically acceptable but real estate development has encroached on the spit. It is therefore now recommended that a totally non-wetland site be sought on the mainland. If the local sponsor is unable to acquire a suitable upland site, the Fish and Wildlife Service and the National Marine Fisheries Service would not oppose direct ocean disposal on the nearby Atlantic Ocean beach. If you choose a plan to dispose of dredged material on the closest portion of beach, we recommend it be done during the "off season" winter months when both recreation and biological activity would be lowest.

A least tern rookery (nesting area) is located south of Murrells Inlet on the Brookgreen Gardens beach property (see attachment). Inasmuch as least terns are colonial ground nesting birds and very susceptible to human activity in and around their nesting colonies their numbers have nearly been eliminated on the west coast due to nesting area destruction. Therefore, it is requested that as the Murrells Inlet project progresses and work is done along Huntington Beach such activity be coordinated with our

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

Exhibit 3
page 1 of 3

Charleston office and/or with the [illegible] of Brookgreen Gardens so that work can be scheduled or rerouted [illegible] not disturb the least terns during their nesting activities.

This report has been coordinated [illegible] reviewed by the National Marine Fisheries Service, Mr. Harold [illegible] Allen, Acting Regional Director, St. Petersburg, Florida, concurs in [illegible] recommendations and has authorized me to sign this letter for [illegible]. The above views and recommendations constitute the report [illegible] the Department of the Interior and National Marine Fisheries Servi[illegible]

We [illegible] the opportunity to [illegible] this project and may offer additional comments as our studies [illegible]

[illegible] yours,

[illegible]

Regi[illegible] Director

Attachment

28 OCT 1975

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P. O. Box 12559
Charleston, South Carolina 29412

October 24, 1975

District Engineer
U. S. Army Corps of Engineers
P. O. Box 919
Charleston, S. C. 29402

Dear Sir:

This is in response to your letter of October 15, 1975, requesting our comments concerning recent revisions to the Murrells Inlet, South Carolina navigation project. Our comments are submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The revisions are: (1) relocation of the disposal area for unsuitable beach material from marsh to upland; (2) change of access to the recreation fishing walkway from road access to foot access via a beachfront path; (3) elimination of the proposed south jetty parking area and relocating it adjacent to the existing parking area one mile south of the south jetty; (4) lengthening the north and south jetties and deepening the deposition basin.

The U. S. Fish and Wildlife Service concurs with all these revisions. We are, however, concerned for the well being of the least tern rookery located in the beach dune community between the newly relocated parking area and the proposed recreational fishing pier on the south jetty. This rookery could be adversely disturbed by visitors using the proposed beachfront trail; therefore, routing of this trail will be critical. To minimize adverse impacts on the rookery we recommend that trail routing be coordinated with the Brookgreen Garden manager, the Huntington Beach State Park naturalist, the South Carolina Wildlife and Marine Resources Department and the U. S. Fish and Wildlife Service.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

Exhibit 4

We appreciate having been asked to comment on these revisions and will comment further if requested to do so.

Sincerely yours,

Curtis A. Laffin

Curtis A. Laffin
Biologist in Charge

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
REGION IV
50 7TH STREET N.E.
ATLANTA, GEORGIA 30323

November 10, 1975

OFFICE OF THE
REGIONAL DIRECTOR

Harry S. Wilson
Colonel, Corps of Engineers
District Engineer
Department of the Army
Charleston District Corps of Engineers
P.O. Box 919
Charleston, S.C. 29402

Subject: Preconstruction Planning for the
Murrells Inlet, South Carolina
Navigation Project.

Dear Mr. Wilson:

We have received your letter of October 15, 1975. The data submitted has been reviewed and this is to advise you that there are no comments to offer on your preliminary study.

Sincerely yours,

Philip P. Sayre
Regional Environmental Officer
DHEW -- Region IV

RECEIVED IN DISTRICT OFFICE UNSIGNED.

Exhibit 5

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (o-2)
Seventh Coast Guard District
Room 1018, Federal Building
51 SW. 1st Avenue
Miami, Fla. 33130

3260
11 June 1968
Serial: 2904

From: Commander, Seventh Coast Guard District
To: District Engineer, Corps of Engineers, Charleston District, Charleston, South Carolina

Subj: Navigation Study for Murrells Inlet, South Carolina

Ref: (a) Your ltr SANGC of 29 May 1968

1. In accordance with the request of reference (a) for an itemized estimate of the cost for placing and maintaining aids to navigation for subject inlet, two enclosures are submitted:

Enclosure 1 - Navigation aids plotted and numbered on map supplied showing Murrells Inlet from the Atlantic Ocean to the turning basin.

Enclosure 2 - Itemization of the above aids in columnar form as requested showing numbers, quantity and cost of establishing and maintaining.

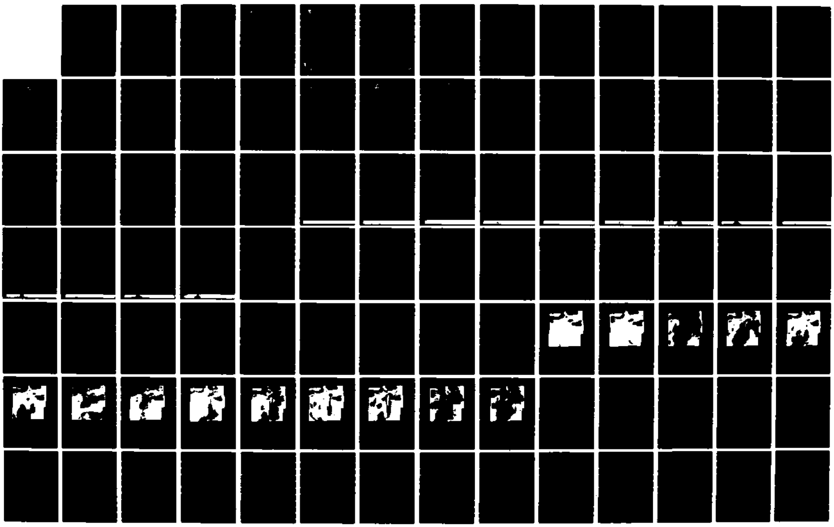
A. F. Parker

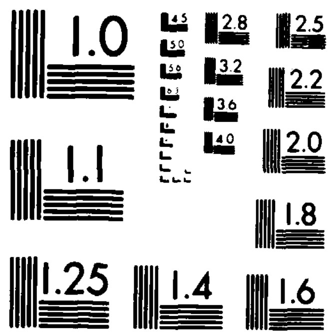
A. F. PARKER
By direction

Encl: (1) Murrells Inlet aids
(2) Itemization of aids

AD-A150 159 MURRELLS INLET SOUTH CAROLINA NAVIGATON PROJECT GENERAL 2/4
DESIGN MEMORANDUM(U) CORPS OF ENGINEERS CHARLESTON SC
CHARLESTON DISTRICT 02 DEC 75

UNCLASSIFIED F/G 13/2 NL

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1.1
1.25
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1.8
2.0
2.2
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4.0

ITEMIZATION OF AIDS

1	2	3	4	5	6	7
Number	Item (Type of aid)	Quantity	Unit Cost (Establishing or relocating)	Cost (3 X 4)	Annual Main.Cost (Per unit)	Annual Main. Cost (3 X 6)
2	Ltd Buoy	1	$9,000.00	$ 9,000.00	$ 540.00	$ 540.00
None	Lt. Range	1	$16,000.00	$16,000.00	$2400.00	$2400.00
3	Light	1	$ 6,700.00	$ 6,700.00	$ 335.00	$ 335.00
4,6,8, 10, 12, 13, 15, 18, 19, 21, 23, 25, 27, 28, 30, 31, 32, 33	Daybeacon	18	$ 300.00	$ 5,400.00	$ 45.00	$ 810.00
9, 11, 14, 17, 20, 22, 24, 26, 29	Lights	9	$ 3,200.00	$28,800.00	$ 480.00	$4320.00
TOTAL		30		$65,900.00		$8405.00

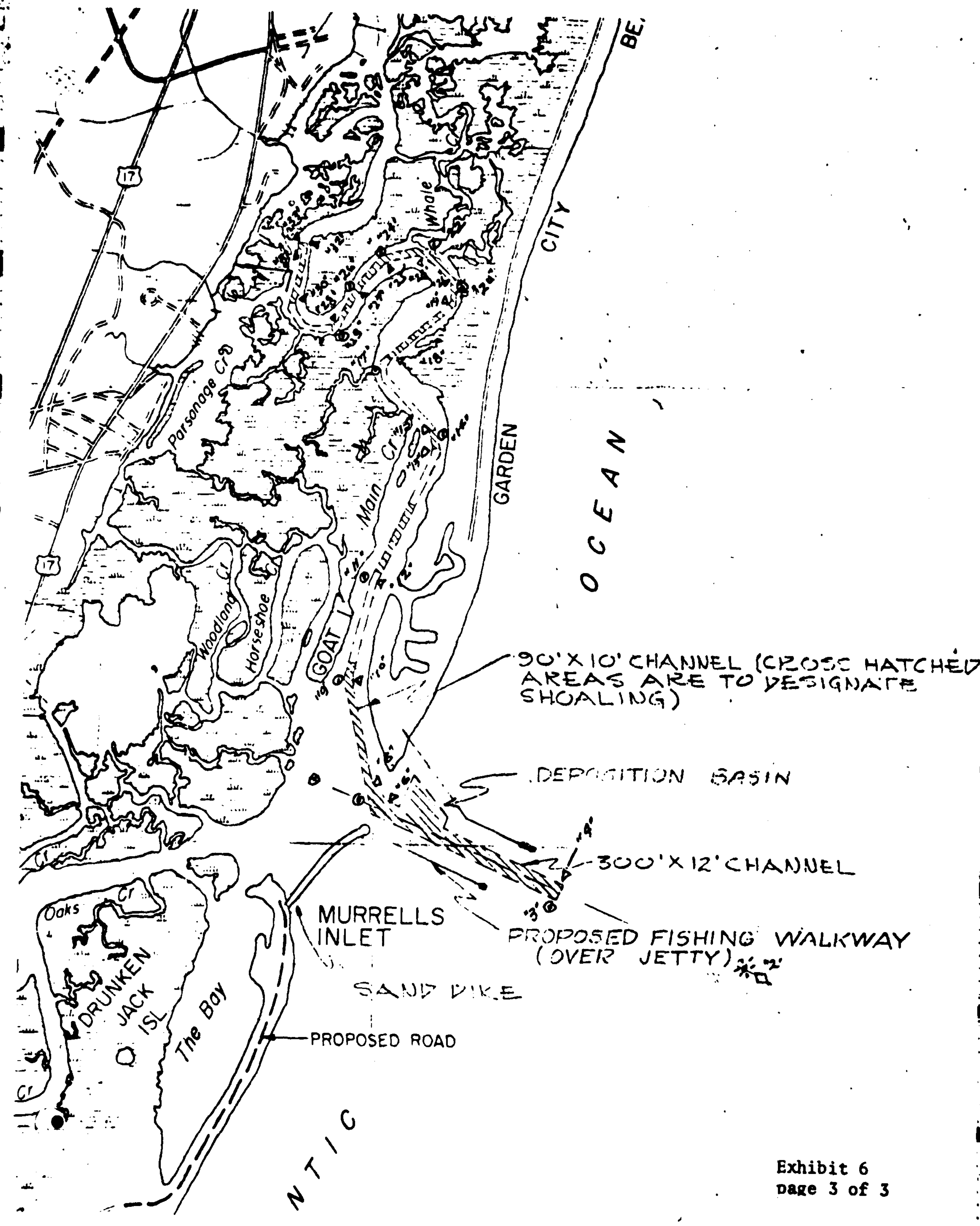


Exhibit 6
page 3 of 3

30 JUL 1975

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER oan
Seventh Coast Guard District
51 SW. 1st Avenue
Miami, Fla. 33130
Phone:(305) 350-5621

3260
Serial: 2375
28 July 1975

From: Commander, Seventh Coast Guard District
To: Corps of Engineers, Charleston

Subj: Navigation Study for Murrells Inlet, S.C.

Ref: (a) Your ltr SANGC of 17 July 1975

1. Murrells Inlet Lighted Bell Buoy M I(LLNRS 11.10/225.10) was established in 1972 and may be removed from this report.

2. All other costs, material and tender time, have risen 50% and the listing for establishment and maintenance may be altered accordingly.

J. A. INGRAM
By direction

Exhibit 7

United States Department of the Interior

BUREAU OF OUTDOOR RECREATION
SOUTHEAST REGIONAL OFFICE
148 Cain Street
Atlanta, Georgia 30303

IN REPLY REFER TO:
4120

OCT 29 1975

Colonel Harry S. Wilson, Jr.
District Engineer
Charleston District
Corps of Engineers
Charleston, South Carolina 29402

Dear Colonel Wilson:

We have reviewed the information on the Murrells Inlet, South Carolina navigation project provided by your October 15, 1975, letter. The proposed changes in the authorized project, coordinated with the South Carolina Department of Parks, Recreation and Tourism and the Trustees of Brookgreen Gardens, should effect an increase in the variety and extent of public outdoor recreation opportunity.

Sincerely yours,

for Paul D. Adams
Robert M. Baker
Regional Director

Exhibit 8

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

240 Stoneridge Drive, Columbia, South Carolina 29210

November 4, 1975

Colonel Harry S. Wilson, Jr.
District Engineer
Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

Members of my staff have reviewed the information furnished in your letter of October 15 regarding the Murrells Inlet navigation project plan.

We have no comments on the proposed project.

Sincerely,

G. E. Huey
State Conservationist

Exhibit 9

SANGC 14 November 1975

Mr. William H. Stevenson
Regional Director
National Oceanic and Atmospheric
Administration
National Marine Fisheries Service
Duval Building
9450 Grandy Boulevard
St. Petersburg, Florida 33702

Dear Mr. Stevenson:

We are presently completing our preconstruction planning for the authorized Murrells Inlet Navigation Project and require a current estimate of the possible annual catches of shrimp and finfish for vessels which would operate out of the completed stabilized inlet.

Attached for your information are copies of previous correspondence with your former headquarters.

Copies of our draft General Design Memorandum (GDM) and the draft Environmental Impact Statement were mailed to your Washington headquarters on 6 November 1975. Projections of the types and numbers of boats expected to use Murrells Inlet are shown in the GDM on Page 15, Table 2, and in Appendix E, Table 15.

In order for this project to remain on a schedule which would allow construction to begin in FY 1977, we are required to finalize the GDM within the next three weeks. I would, therefore, greatly appreciate your furnishing, during the week of 24 November 1975, your current estimate of the maximum sustained yield of the fishery off of Murrells Inlet. If you need any additional information, please call our Mr. Austin Owen at (803) 577-4351 (FTS) or 577-4171, Ext. 351 (commercial).

14 NOV 1975

Sincerely,

HARRY S. WILSON, JR.
Colonel, Corps of Engineers
District Engineer

3 Incl
1. Sketch
2. Ltr. of 14 Nov 69
3. Ltr. of 6 Jan 70

Blind copy furnished:
National Marine Fisheries Service
Beaufort, N. C. 28516

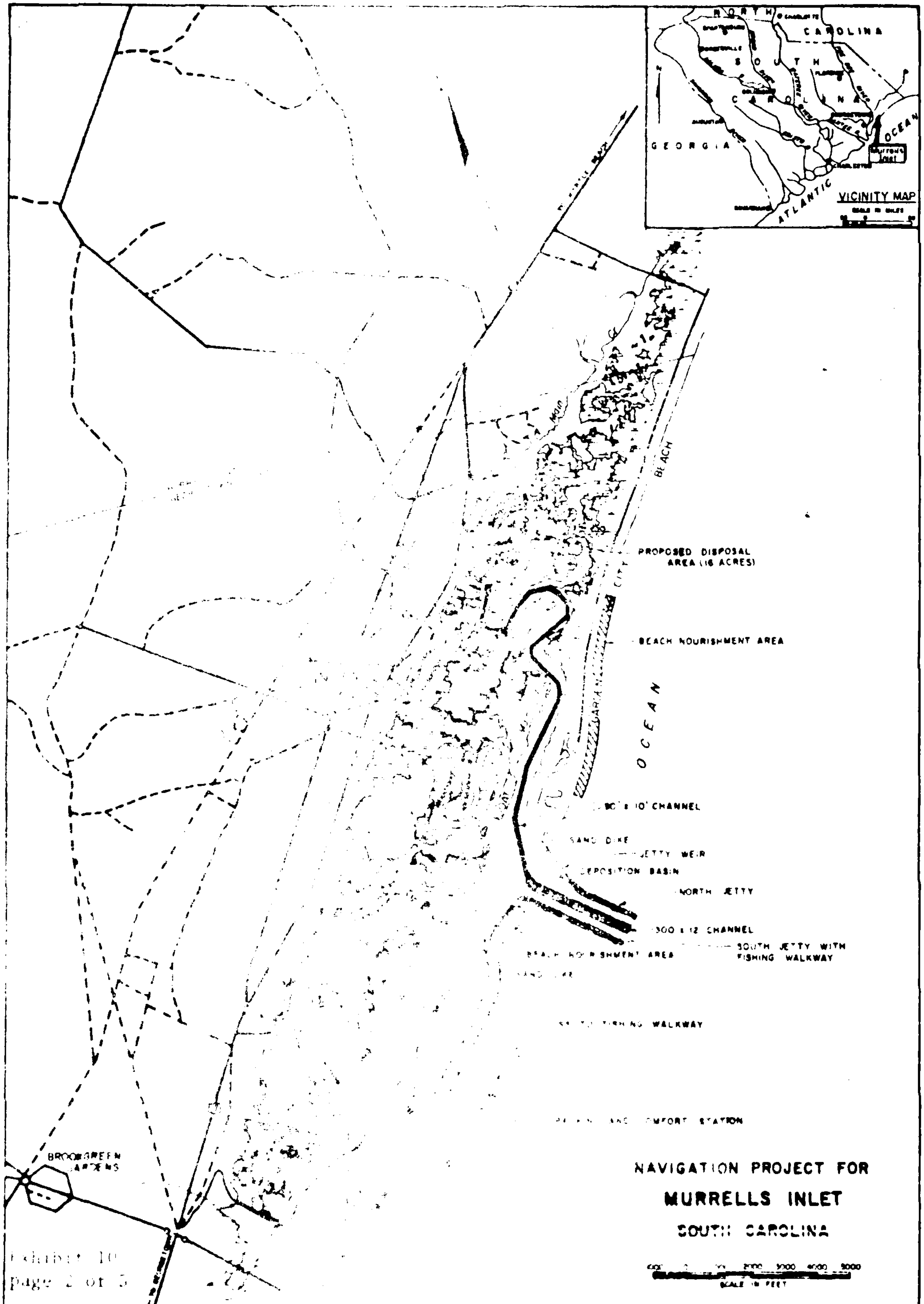


Exhibit 10
page 2 of 5

SANGC 14 November 1969

Mr. C. Edward Carlson
Regional Director
Bureau of Sport Fisheries
and Wildlife
U. S. Fish and Wildlife Service
809 Peachtree-Seventh Building
Atlanta, Georgia 30323

Dear Mr. Carlson:

We are now finalizing the navigation plan we expect to recommend for Murrells Inlet. The plan calls for a 300-foot wide channel 12 feet deep extending from that depth in the Atlantic Ocean through the outer bar to an inner channel 90 feet wide and 10 feet deep. The inner channel would follow Main Creek approximately 15,100 feet to a turning basin in the vicinity of the old Army Crash Boat Dock. Channels would be widened at bends and a deposition basin would be integrated into the entrance channel to collect littoral materials crossing the weir section of the northern jetty of a two-jetty system constructed to protect the entrance channel. Materials thus collected would be pumped by hydraulic dredge to the downdrift beach. A map showing the planned construction is attached.

Justification for construction of this project is based to a large extent on projected commercial fishing activities for the Inlet. With adequate fishing resources available, we have estimated that the commercial fishing operations from Murrells Inlet would result in the following catches:

SANGC
Mr. C. Edward Carlson

13 November 1969

Projected Annual Catches at Murrells Inlet
Catches in Short Tons

Year	Shrimp	Finfish
1968	0	256
1975	100	1,000
1980	112	1,210
1985	122	1,460
1990	133	1,780
1995	133	2,110
2000	133	2,520
2005	133	2,970
2010	133	3,480
2015	133	4,000
2020	133	4,600

Your evaluation of the ability of nearby fishing grounds to produce these quantities is requested. If our figures appear unrealistic, please advise us of the maximum reliable yield that, in your judgment, can be expected from these grounds.

Sincerely,

1 Incl
As stated

BURKE W. LEE
Colonel, Corps of Engineers
District Engineer

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
PEACHTREE-SEVENTH BUILDING
ATLANTA, GEORGIA 30323

January 6, 1970

District Engineer
U.S. Army, Corps of Engineers
P.O. Box 919
Charleston, South Carolina 29402

Dear Sir:

By letter of November 14, 1969, (SANGC), you requested our comments on the projected annual catches at Murrells Inlet which you intend to use in the justification of the project. We have contacted the Bureau of Commercial Fisheries for its advice in this matter. It feels that the projected shrimp catches should be reduced by 10 percent, and the finfish catches by 40 to 50 percent.

Sincerely yours,

C. Edward Carlson

C. Edward Carlson
Regional Director

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Duval Building
9450 Gandy Boulevard
St. Petersburg, FL 33702

December 4, 1975 FSE21/AM

Colonel Harry S. Wilson, Jr.
District Engineer, Charleston District
Department of the Army, Corps of Engineers
P.O. Box 919
Charleston, SC 29402

Dear Colonel Wilson:

Please reference your November 14, 1975, letter requesting information regarding our current estimate of the maximum sustained yield of the fishery off Murrells Inlet, South Carolina. Unfortunately, the information requested is currently unavailable. In order to derive the information you seek, catch and effort data over a number of years is needed. Current catch statistics for Murrells Inlet are being compiled by:

Mr. Ray Rhodes
Fishery Statistician
SC Wildlife & Marine Resources Dept.
Charleston, SC 29401

If we can be of further assistance please contact us.

Sincerely,

William H. Stevenson
Regional Director

Exhibit 11

PRT

October 6, 1975

Mr. Jack J. Lesemann, Chief
Engineering Division
Charleston District Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Re: Murrells Inlet Navigation Project

Dear Mr. Lesemann:

This will acknowledge receipt of your letter of October 1, 1975 containing the two drawings on the proposed recreation plan for this project.

These drawings apparently have taken into account all the items that we discussed at the several meetings on this project, therefore I see no objection to this plan by the South Carolina Department of Parks, Recreation and Tourism.

I am assuming that you sent copies of the same drawings to Mr. Gurdon Tarbox, Director of Brookgreen Gardens, as they are the people that actually own the property we lease for Huntington Beach State Park. Their approval will also be necessary on this plan.

Sincerely,

Pearce Thomson

Pearce Thomson
Engineering & Planning Coordinator

BPT/rcl

cc: Mr. Ray Sisk, State Park Director
Mr. Gurdon Tarbox, Director, Brookgreen Gardens

South Carolina Department of Parks, Recreation & Tourism
Box 113, Edgar A. Brown Building • 1205 Pendleton Street • Columbia, South Carolina 29201

Exhibit 12

State of South Carolina
Water Resources Commission

Clair P. Guess, Jr.
Executive Director

November 7, 1975

Colonel Harry S. Wilson
Department of the Army
Charleston District, Corps of Engineers
Post Office Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

In reference to your letter of October 15, 1975 concerning the Murrels Inlet navigation project, the Water Resources Commission wishes to state that we have reviewed this proposal and can find no objections.

Very truly yours,

Clair P. Guess, Jr.
Executive Director

CPGJr:rhv

Exhibit 13

P. O. Box 4515 / 3830 Forest Drive / Columbia S. C. 29240 / (803) 758-2514

State of South Carolina

Office of the Governor

JAMES B. EDWARDS
GOVERNOR

November 3, 1975

DIVISION OF ADMINISTRATION
Edgar A. Brown Building
Columbia, South Carolina 29201

Colonel Harry S. Wilson, Jr.
District Engineer
Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Subject: Murrells Inlet Navigation Project

Dear Colonel Wilson:

The State Clearinghouse has circulated the proposed plan of improvement for Murrells Inlet, South Carolina. Enclosed are comments received from the State Archeologist, the Wildlife and Marine Resources Department, and the Highway Department.

Please contact Dr. Stephenson to discuss the archeological considerations and consider the recommendation by Wildlife and Marine Resources Department in your General Design Memorandum.

Please let me know if I can be of any further assistance.

Sincerely,

Elmer C. Whitten, Jr.
State Clearinghouse

ECWjr/cs
Enclosure

Exhibit 14
Page 1 of 4

South Carolina
Wildlife & Marine
Resources Department

James A. Timmerman, Jr., Ph.D.
Executive Director
Edwin B. Joseph, Ph.D.
Director of
Marine Resources Center

October 28, 1975

OCT 31 1975

Elmer Whitten
Office of the Governor
Division of Administration
Edgar A. Brown Office Building
Columbia, South Carolina 29201

Re: Murrells Inlet Navigation Project

Dear Mr. Whitten:

We have reviewed the proposed plans for the Murrells Inlet navigation project of the U. S. Army Corps of Engineers and make the following comments.

Since we encourage the Corps of Engineers to seek upland disposal areas for placement of dredged material and to use this material, when suitable, for nourishment of South Carolina beaches, we were gratified to learn that both measures would be employed in the current project. We commend the Corps of Engineers for their environmental concern in this matter.

Generally, the project is agreeable from our standpoint, however, we offer one suggestion. We recommend the beachfront trail to the south jetty be deleted from the proposed plans because an existing least tern nesting site on the south side of the inlet may be adversely impacted by heavy human traffic in the area generated by this trail. People should be encouraged to use the beach zone in this area for access to the fishing walkway and avoid disturbing the nesting site. Perhaps, the Department of Parks, Recreation, and Tourism could post "restricted area" signs around the nesting site to protect the area from human interference.

We appreciate having been asked to comment on this project.

Sincerely,

James A. Timmerman, Jr.

James A. Timmerman, Jr.
Executive Director

JATjr:lsb

P. O. Box 12559 Charleston, South Carolina 29412 Telephone (803) 795-6350

SOUTH CAROLINA
STATE HIGHWAY DEPARTMENT
DRAWER 191
COLUMBIA, S. C. 29202

OCT 27 1975
DIVISION OF
ADMINISTRATION

October 24, 1975

From: Assistant Bridge Engineer-Maintenance

To: Bill McIlwain - Program Coordinator

Subject: Beach Erosion Control - Proposed Navigation Project for Murrells Inlet - Georgetown County

Reference is made to a letter to Mr. Elmer Whitten of the State Clearinghouse, Division of Administration, from the Charleston District Corps of Engineers, dated October 15, 1975, concerning a proposed navigation project for Murrells Inlet and for the State to evaluate and make comments concerning this proposed project.

The Department feels that the planned beach restoration program for the surrounding beaches in conjunction with the proposed navigation improvements of Murrells Inlet will greatly benefit the public and the beach property owners. This area has experienced a tremendous amount of beach erosion, and consequently a considerable amount of property loss.

The Department has constructed many groins in this area and we feel that the Corps of Engineers' beach nourishment program and our groin system will work together to help stabilize this area for many years to come.

C. L. Matthews

UNIVERSITY OF SOUTH CAROLINA
COLUMBIA, S.C. 29208

INSTITUTE OF ARCHEOLOGY AND ANTHROPOLOGY

OCT 30 1975
...ION OF
...ATION

October 29, 1975

Mr. Elmer C. Whitten, Jr.
State Clearinghouse
Division of Administration
1205 Pendleton Street
Columbia, South Carolina 29201

Dear Mr. Whitten:

I have your memorandum of October 20th regarding the Murrel's Inlet, Corps of Engineers project, copy attached. I have the following comments to make:

1. There are archeological sites in and around this project area in our records. We would anticipate that there would be others that might be affected by the project.

2. The dredging operations in Murrel's Inlet and Main Creek might be subject to destruction of underwater antiquities.

3. I think it would be necessary for us to discuss the project with the applicant before we could make a consideration of just how much, if any, archeological survey would be required before this project could be cleared for archeological resources. It is difficult to tell from the written statement just how extensive the dredging might affect the creek bottom in that area and what might be other effects of the project.

4. It is almost certain that some archeolocal survey will be required before clearance for archeological resources can be given.

Sincerely yours,

Robert L Stephenson

Robert L. Stephenson
Director and State Archeologist

RLS:mls

Enclosure

South Carolina
Wildlife & Marine
Resources Department

[illegible] A. Timmerman, Jr., Ph.D.
Executive Director
Edwin B. Joseph, Ph.D.
Director of
Marine Resources Center

October [illegible]3, 1975

Colonel Harry Wilson
Department of the Army
Charleston District, Corps of Eng[illegible]
P. O. Box 919
Charleston, South Carolina

Dear Colonel Wilson:

This is with reference to your letter of 15 October concerning proposed changes in the Murrells Inlet Navigation Project.

Our general comments and recommendations pertaining to this project are included in the recently completed "Murrells Inlet Environmental Studies Report" (Contract DACW60-75-C-0016). The following remarks concern the proposed changes in the project which you have outlined.

We concur with the relocation of the [illegible] acre disposal area, and commend your selection of an upland site in lieu of the formerly proposed marsh area adjacent to Main Creek.

From an environmental standpoint, we can foresee no major problems related to the proposed modifications in jetty length or in the proposed enlargement of the deposition basin.

The exact location of the proposed parking lot in relation to the wetlands lying to the west of Huntington Beach is not clearly definable on the small map included with your letter. We would like to recommend that any wetland areas be avoided, if at all possible. Also, we would like to stress that the comfort station be designed and located in such a manner to prevent any [illegible]ility of effluent entering adjacent wetlands or tidal creeks, as these waters [illegible] presently classified as SA and open to shellfish harvesting.

Thank you for the opportunity to comment [illegible] project.

Sincerely,

Charles M. [illegible]
Office of [illegible] Management

CMB/pgr

Exhibit 15

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

E. KENNETH AYCOCK, M.D., M.P.H., COMMISSIONER
J. MARION SIMS BUILDING — 2600 BULL STREET
COLUMBIA, SOUTH CAROLINA 29201

October 21, 1975

Colonel Harry S. Wilson
Charleston District, Corps of Engineers
P. O. Box 919
Charleston, S. C. 29402

Dear Colonel Wilson:

Thank you for your letter of October 15 in which you outline the changes in the plans for the Murrell's Inlet navigation project.

We are happy to see that most of the dredged material is to be used in beach nourishment. If no other method of disposal is available for material unsuitable for beaches than to place it in a disposal area, the Georgetown County Health Department should be kept informed of pumping schedules so they may intensify mosquito control efforts, and the disposal area should be designed in such a way as to minimize the resulting mosquito problems.

Sincerely,

L. A. Williams, Jr., Director
Division of Vector Control

LAW,jr/ch

Exhibit 16

SOUTH CAROLINA
STATE HIGHWAY DEPARTMENT
COLUMBIA 29202

November 5, 1975

Colonel Harry S. Wilson, Jr.
District Engineer
U. S. Army Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

This concerns your letter of October 15, relative to the Murrells Inlet Navigation project in which you requested our comments and evaluation.

We have reviewed the information contained in your letter and the attached map and could find no basis for comments as it would relate to any existing or planned highways in the area.

We appreciate this opportunity to review your pre-construction plans.

Sincerely yours,

Paul W. Cobb

Paul W. Cobb
State Highway Engineer

Exhibit 17

BROOKGREEN GARDENS

A SOCIETY FOR THE SOUTHEASTERN FLORA AND FAUNA

MURRELLS INLET S C 29576

TELEPHONE

PAWLEYS ISLAND (803) 237-4657

[illegible] 1975

Mr. Jack [illegible]
Chief, Engineering [illegible]
Department of the Army
Charleston District, [illegible] Engineers
PO Box 919
Charleston, S.C. [illegible]

Dear Mr. Lesemann:

Thank you for the copies [illegible] plans for the proposed Murrells Inlet [illegible]. These drawings will help me explain to the Brookgreen Gardens' Trustees the land requirements for this project.

When Brookgreen Gardens is approached by Georgetown County regarding the acquisition of this property, either by easement or deed, the Trustees will be in a position to make a prompt response.

Sincerely,

Gurdon L. Tarbox, Jr.

Gurdon L. Tarbox, Jr.
Director

GLT/at

Exhibit 18

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO WESHH

11 April 1975

MEMORANDUM FOR RECORD

SUBJECT: Murrells Inlet, S. C., Prototype Salinity Data

Prototype salinity data were obtained on 2 May 1974 at approximately 1-hour intervals. Samples were taken at surface, mid-depth, and bottom at six ranges with three or four stations per range. Samples were analyzed the same day using a Beckman salinometer. The inclosed tabulation (Incl 1) gives high and low salinity values for each station and depth. Source salinity is in the range from 31.1 to 31.3 PPT. Salinity ranges in the estuary are from 29.9 to 31.5 PPT with values from surface to bottom not varying greater than 1.0 PPT. Fresh water inflow is exclusively by surface runoff. The above data is consistent with the fact that the estuary is a tidal lagoon system supplied by the ocean only. Since there is no salinity wedge, no fresh water inflow, and since the tidal lagoon is a well mixed system, modeling of the salinity regime for Murrells Inlet is not necessary. Changes in salinities due to construction of a jetty system and channel dredging should be negligible.

W. Wade Mallard

1 Incl
as

W. WADE MALLARD
Engineer
Wave Dynamics Division

Murrells Inlet Model
Prototype Salinities Taken 2 May 1974

Range & Station	Surface & Bottom	High Salinity	Low Salinity
1-A	Surface	31.3	30.9
1-A	Bottom	31.1	30.7
1-B	Surface	31.2	30.7
1-B	Bottom	31.1	30.8
1-C	Surface	31.3	30.3
1-C	Bottom	31.1	30.7
2-A	Surface	30.5	30.0
2-A	Bottom	30.5	30.2
2-B	Surface	30.9	30.2
2-B	Bottom	30.9	30.2
2-C	Surface	30.6	30.0
2-C	Bottom	30.8	29.9
3-A	Mid/Depth	30.4	29.9
3-B	Mid/Depth	30.5	
3-C	Mid/Depth	30.4	29.9
3-D	Surface	30.2	30.0
3-D	Mid/Depth	30.4	30.0
4-A	Surface	30.8	
4-A	Mid/Depth	31.2	31.0
4-A	Bottom	30.8	
4-B	Surface	31.0	30.[illegible]
4-B	Mid/Depth	31.3	30.8
4-B	Bottom	30.7	30.2
4-C	Surface	31.3	30.8
4-C	Mid/Depth	31.3	31.0
4-C	Bottom	30.2	
5-A	Surface	30.5	30.1
5-A	Mid/Depth	30.4	
5-A	Bottom	30.5	30.2
5-B	Surface	30.5	30.1
5-B	Mid/Depth	30.2	30.1
5-B	Bottom	30.5	30.1
5-C	Surface	30.5	30.2
5-C	Mid/Depth	30.5	30.2
5-C	Bottom	30.5	30.2
6-A	Mid/Depth	31.4	31.0
6-B	Mid/Depth	31.4	31.1
6-C	Mid/Depth	31.5	31.1

SANGE-D 23 October 1975

Mr. Alfred B. Schooler
Chairman
Georgetown County Council
P.O. Drawer C
Georgetown, South Carolina 29440

Dear Mr. Schooler:

At a meeting held at Capt. Dick's Marina, Murrells Inlet, South Carolina on 19 September 1975, Mr. Connell of my staff discussed the local cooperation requirements with Messrs. Bellamy and McDaniel of the Georgetown County Council. The various items of local cooperation that are to be provided by Georgetown County, as local sponsor of the Murrells Inlet project, were also outlined in a letter to you dated 11 August 1975.

Briefly these requirements are as follows: provide all lands required for the construction including suitable disposal areas; a cash contribution of 6.4% of the cost of the general navigation facilities and 50% of the cost of the recreation facilities with the local shares presently estimated at $987,200 and $172,500, respectively; and maintain without cost to the United States the recreation facilities. The requirements of local cooperation are presented in detail in the inclosed draft local cooperation agreement. A final version of this agreement is required by Section 221 of Public Law 91-611 to be executed by Georgetown County prior to the initiation of any construction.

The inclosed draft agreement should be reviewed by appropriate officials to see if the County can execute the final version at the proper time. My office is presently preparing a final design report on the Murrells Inlet navigation project, and it will be necessary to include a letter of assurance from Georgetown County that it will fulfill the required items of local cooperation. The letter should list all relevant local cooperation requirements and non-Federal responsibilities; state that a review has been made of the draft local cooperation agreement; and state an intent to execute the final agreement when required. In order to avoid delay of our final design report, please furnish us the letter by 5 November 1975.

24 OCT 1975

SANGE-D 23 October 1975
Mr. Alfred B. Schooler

If you have any questions concerning the Murrells Inlet navigation project, please contact our Mr. Richard Connell (803-577-4171, Ext. 318) or if I can be of assistance to you please let me know.

Sincerely,

1 Incl
As stated

HARRY S. WILSON, JR.
Colonel, Corps of Engineers
District Engineer

COUNCIL
ALFRED B. SCHOOLER
CHAIRMAN
J. D. MUNNERLYN
H. E. HEMINGWAY
C. T. BECK
L. S. BELLAMY

Georgetown County Council
P. O. DRAWER C
Georgetown, S. C.
29440

MRS. EMILY S. SAWYER
CLERK COUNTY COUNCIL

November 4, 1975

Colonel Harry S. Wilson
Department of the Army
U.S. Corps of Engineers
P.O. Box 919
Charleston, S. C. 29402

Dear Colonel Wilson:

Georgetown County, as local sponsor of the Murrells Inlet project, will provide the following items of local cooperation: provide all land required for the construction including suitable disposable area; a cash contribution of 6.4% of the cost of the general navigation facilities and 50% of the cost of the recreational facilities with the local shares presently estimated at $987,200 and $172,500, respectively; and maintain without cost to the United States, the recreational facilities.

A review has been made of the draft local cooperation agreement and Georgetown County Council does intend to execute the final agreement when required by the District Engineer.

If I can be of any assistance to you in this matter, please do not hesitate to contact me.

Yours very truly,

Alfred B. Schooler

Alfred B. Schooler, Chairman
Georgetown County Council

ABS/lgt

Exhibit 21

D R A F T

AGREEMENT BETWEEN
THE UNITED STATES OF AMERICA
AND
GEORGETOWN COUNTY, SOUTH CAROLINA
FOR LOCAL COOPERATION IN
THE MURRELLS INLET NAVIGATION PROJECT

THIS AGREEMENT, entered into the _____ day of _________ 19__, by and between the UNITED STATES OF AMERICA (hereinafter called the "Government"), represented by the Contracting Officer executing the agreement, and Georgetown County, South Carolina, (hereinafter called the "County").

WHEREAS, the Congress of the United States has provided for the authorization of navigation projects with an estimated Federal first cost of construction of less than $10,000,000 in Section 201 of the Flood Control Act o 1965 (Public Law 89-298); and

WHEREAS, the manner prescribed for the authorization of such project is the adoption of resolutions by the Public Works Committee of the House of Representatives and the Senate of the United States; and

WHEREAS, the Public Works Committee of the House of Representatives adopted such a resolution on 10 November 1971, and the Public Works Committee of the Senate adopted a similar resolution on 18 November 1971, both resolutions providing for navigation improvement of Murrells Inlet, Georgetown County, South Carolina, substantially in accordance with the recommendations of the Secretary of the Army in House Document numbered 137, Ninety-second Congress, except that the costs of operation and maintenance of the general navigation features shall be borne by the United States; and

WHEREAS, the County hereby represents that it has the authority and capability to furnish the non-Federal cooperation required by the Federal legislation authorizing the Project and by other applicable law.

NOW, THEREFORE, the parties agree as follows:

1. The County agrees that, if the Government shall commence construction of the Murrells Inlet Navigation Project, located wholly within Georgetown County, South Carolina, substantially in accordance with Federal legislation authorizing such Project, as cited above, the County shall, in consideration of the Government's commencing construction of such Project, fulfill the requirements of non-Federal cooperation specified in such legislation, to wit:

a. Provide without cost to the United States all necessary lands, easements, and rights-of-way required for construction and subsequent maintenance of the improvements and for aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and also necessary retaining dikes, bulkheads and embankments therefor;

b. Hold and save the United States free from damages that may result from construction and maintenance of the project including management and maintenance of jetty fishing facilities, except damages due to the fault or negligence of the United States or its contractors;

c. Accomplish without cost to the United States alteration and relocations as required in sewer, water supply, drainage, and other utility facilities;

d. Provide, maintain, and operate without cost to the United States an adequate public landing or wharf with provisions for the sale of motor fuel, lubricants, and potable water, open and available to all on equal terms;

e. Provide and maintain without cost to the United States depths in berthing areas and local access channels commensurate with project depths;

f. Take action to establish regulations prohibiting discharge of pollutants into the waters of the channels and harbor by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State and local authorities responsible for pollution prevention and control;

g. Contribute in cash 6.1 percent of the construction cost of navigation features, including engineering and design and supervision and administration of all work to be provided by the Corps of Engineers, a contribution now estimated at $767,200 to be paid in a lump sum prior to start of construction, the final apportionment of cost to be made after actual costs have been determined;

h. Contribute in cash 50 percent of the costs associated with the jetty fishing, including engineering and design and supervision and administration, a contribution now estimated at $142,500 to be paid in a lump sum prior to construction of the work, the final apportionment of costs to be made after actual costs have been determined;

i. Operate and maintain for the life of the project the jetty fishing facilities including access roadway and parking facilities; and

j. Fulfill the requirements of non-Federal cooperation as specified in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) approved 2 January 1971, which, by reference, is made a part hereof.

2. The County furnishes as part of this agreement an assurance (Exhibit A) that it will comply with Title VI of the Civil Rights Act of 1964 (78 Stat. 241) and Department of Defense Directive 550.11 issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations.

3. The County hereby gives the Government a right to enter upon, at reasonable times and in a reasonable manner, lands which the County owns or controls for access to the Project, for the purpose of inspection, and for the purpose of operating, repairing, and maintaining the Project, if such inspection shows that the County for any reason is failing to repair and maintain the Project in accordance with the assurances hereunder, and has persisted in such failure after a reasonable notice in writing by the Government delivered to the County. No operation, repair, and maintenance by the Government in such event shall operate to relieve the County of responsibility to meet its obligations as set forth in paragraph 1 of this Agreement or to preclude the Government from pursuing any remedy at law or equity.

4. This agreement is subject to the approval of the Secretary of the Army or his authorized representative.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

By ______________________________
Colonel, Corps of Engineers
District Engineer
U. S. Army Engineer District, Charleston
Contracting Officer

Date ______________________________

THE COUNTY OF GEORGETOWN,
IN THE STATE OF SOUTH CAROLINA

By ______________________________

Title Chairman
Georgetown County Council

Attested By ____________________

Title Clerk
Georgetown County Council

This contract has been reviewed and is approved for legal sufficiency as a binding legal obligation on Georgetown County, South Carolina, consistent with Section 221 of Public Law 91-611 (Flood Control Act of 1970).

APPROVED:

By ______________________________
Georgetown County Attorney

Date ______________________________

APPROVED:

By ______________________________
Secretary of the Army or his
Authorized Representative

Date ______________________________

MURRELLS INLET NAVIGATION PROJECT,
GEORGETOWN COUNTY, SOUTH CAROLINA

ASSURANCE OF COMPLIANCE WITH THE DEPARTMENT OF DEFENSE DIRECTIVE UNDER TITLE VI OF THE CIVIL RIGHTS ACT OF 1964

Georgetown County, South Carolina (hereinafter called the County) HEREBY AGREES THAT it will comply with Title VI of the Civil Rights Act of 1964 (Public Law 88-352, 78 Stat. 241) and all requirements imposed by or pursuant to the Department of Defense Directive 5500.11 issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, to the end that, in accordance with Title VI of that Act and the Directive, no person in the United States shall, on the ground of race, color, sex, or national origin be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the County received Federal financial assistance from the Department of the Army and HEREBY GIVES ASSURANCE THAT it will immediately take any measure necessary to effectuate this agreement.

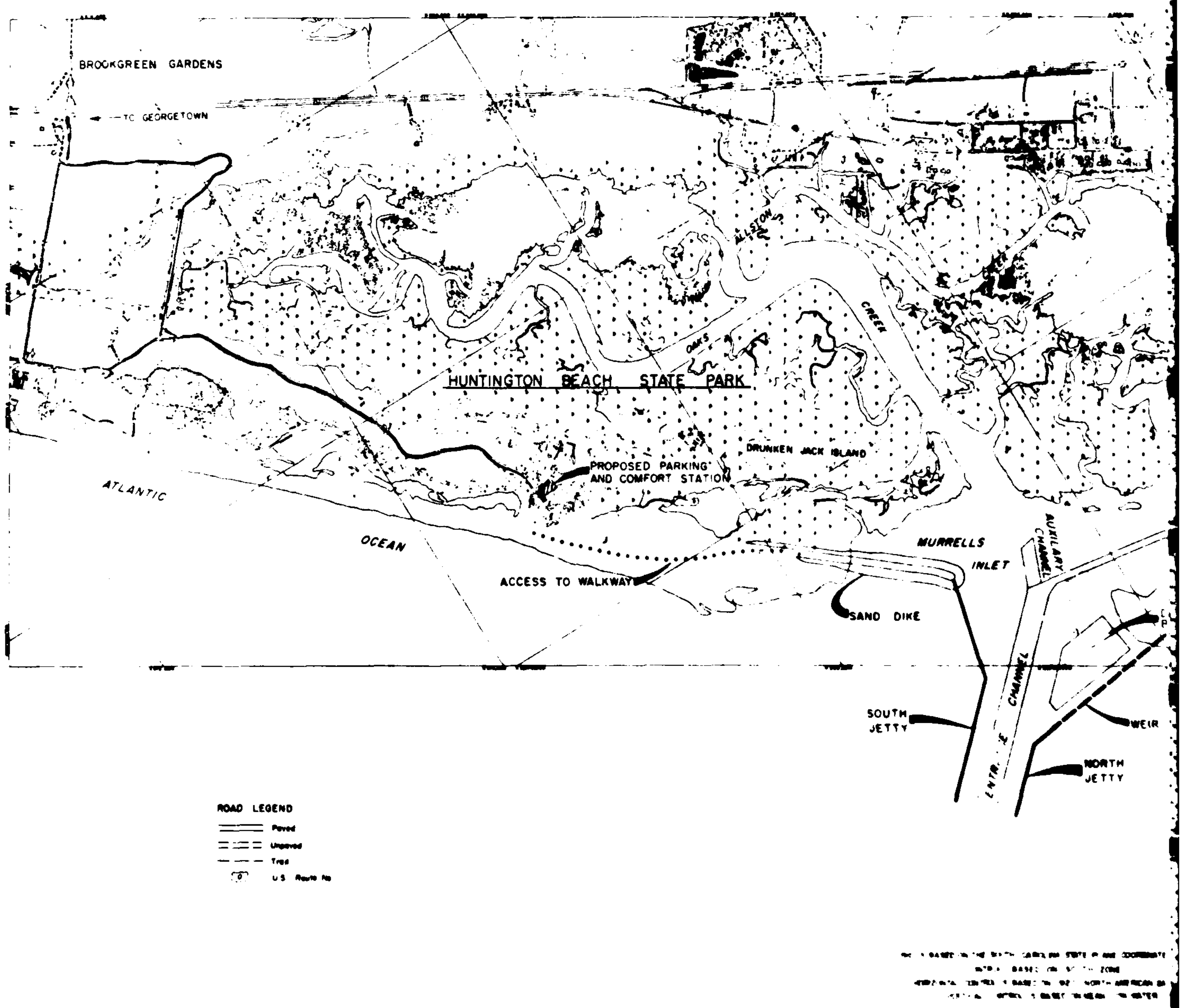
If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the County by the Department of the Army, assurance shall obligate the County, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the County for the period during which the Federal financial assistance is extended to it by the Department of the Army.

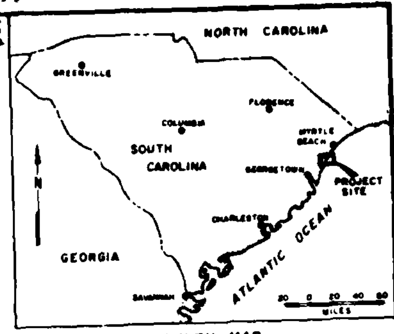
THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contracts, property, discounts, or other Federal financial assistance which were approved before such date. The County recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the County, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign this assurance on behalf of the County.

Date ____________________ By ____________________

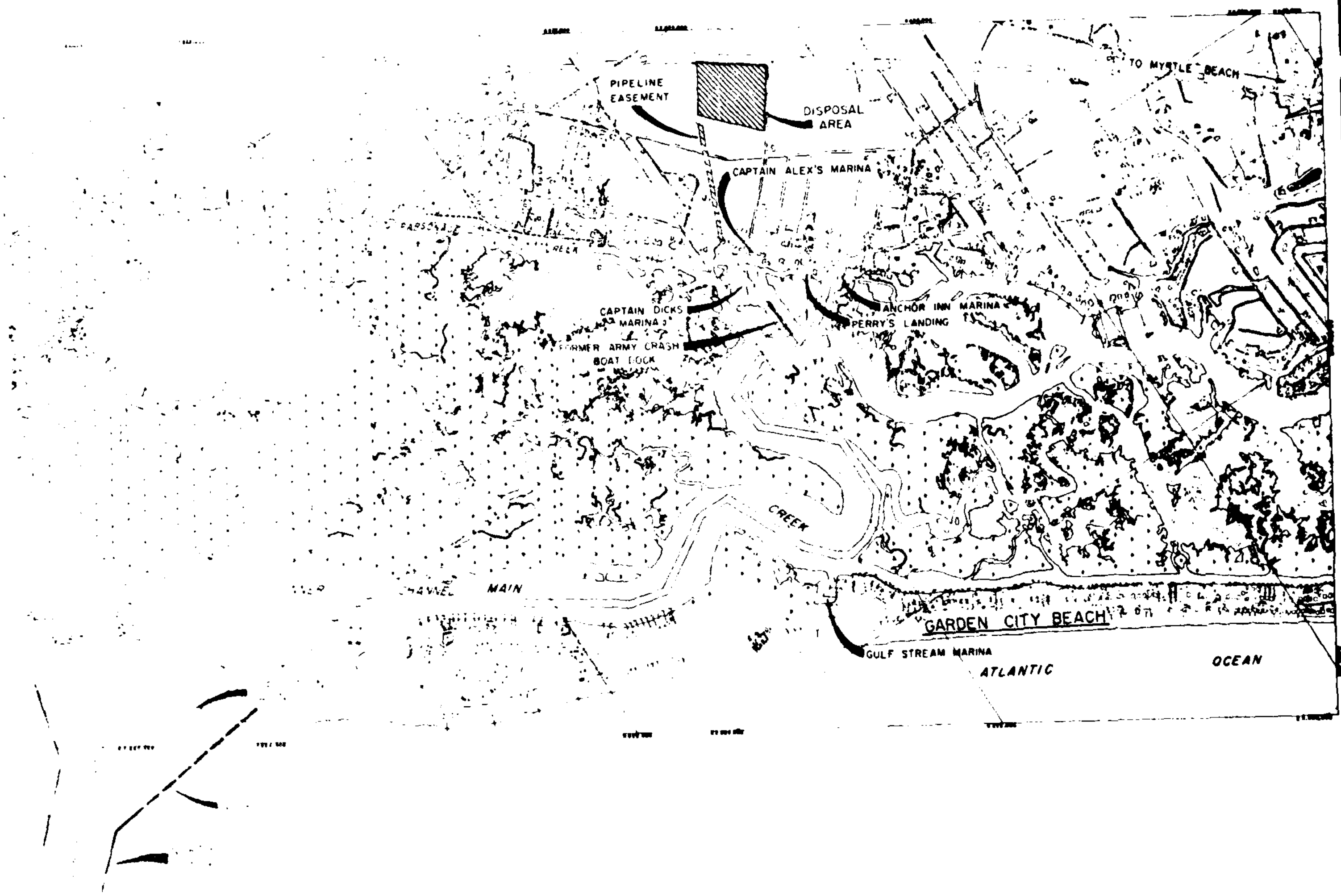
Chairman
Georgetown County Commission

Exhibit A


BROOKGREEN GARDENS
TO GEORGETOWN
ALLSTON
OAKS
CREEK
HUNTINGTON BEACH STATE PARK
DRUNKEN JACK ISLAND
PROPOSED PARKING AND COMFORT STATION
ATLANTIC
OCEAN
ACCESS TO WALKWAY
SAND DIKE
MURRELLS
INLET
AUXILIARY CHANNEL
CHANNEL
SOUTH JETTY
WEIR
NORTH JETTY
ROAD LEGEND
Paved
Unpaved
Trail
U.S. Route No.



VICINITY MAP

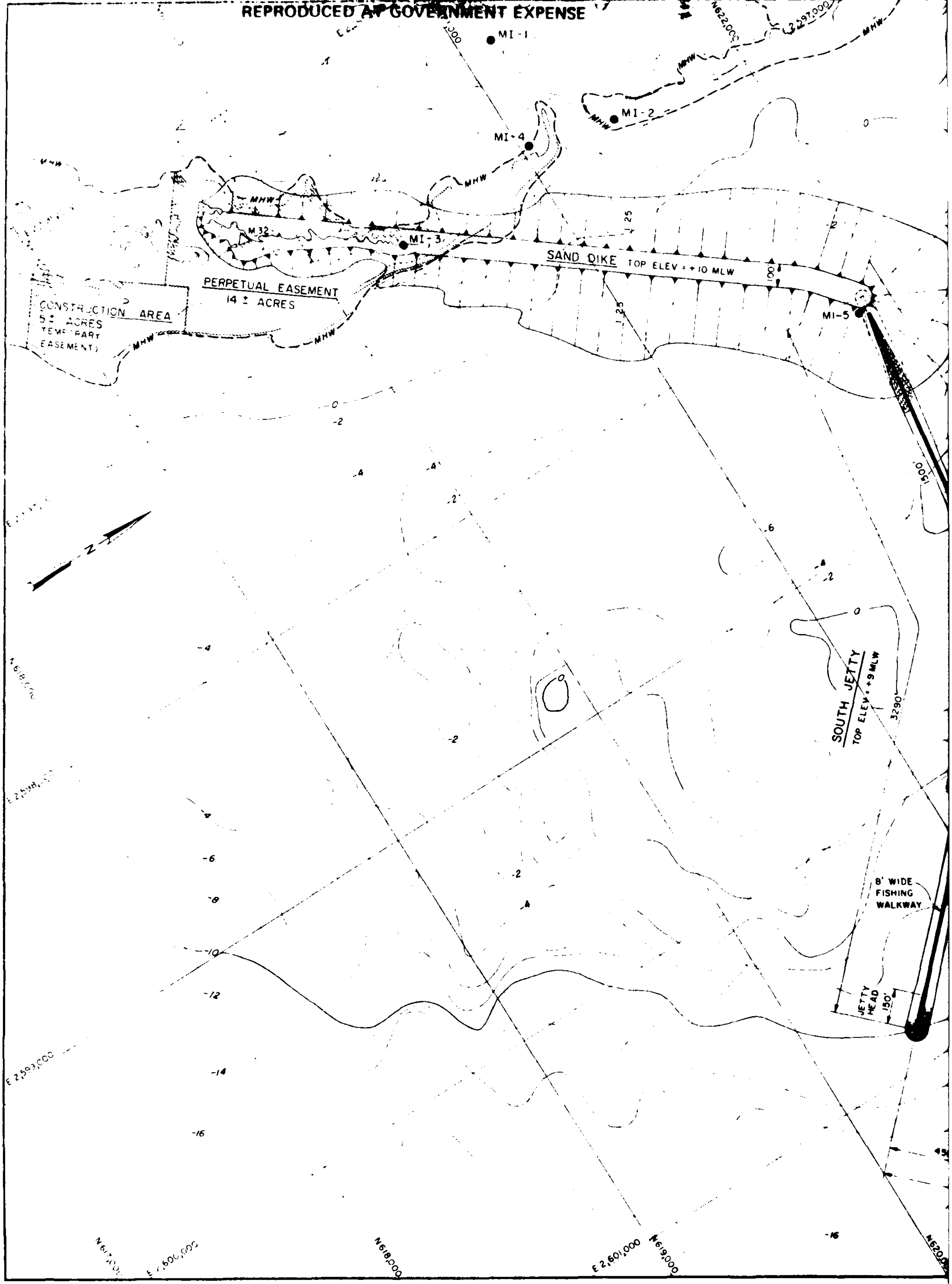


SCALE IN FEET

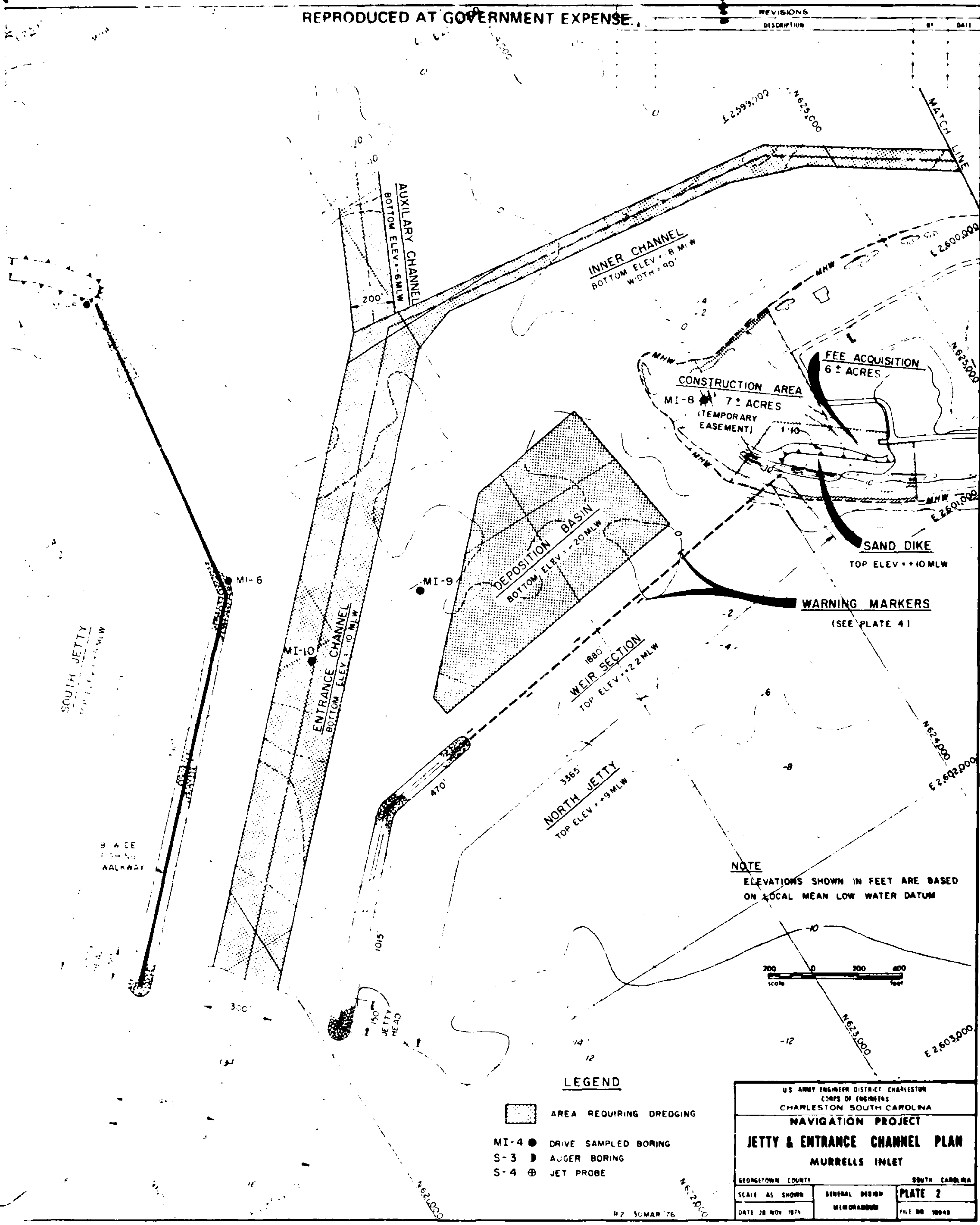
800 0 800 1600 2400

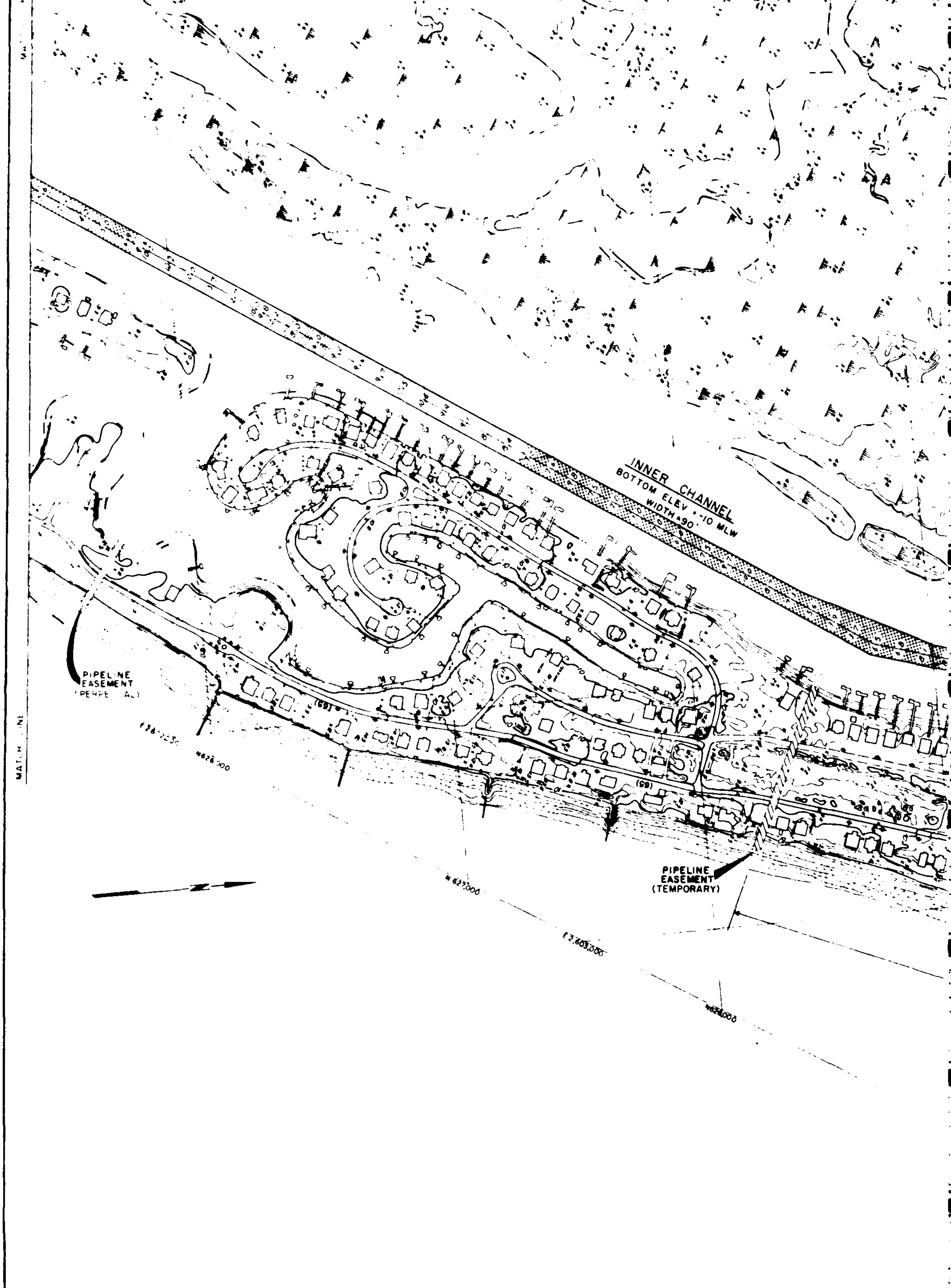
DRAWN BY ELL CHKD BY SDH DESIGNED BY CHIEF PROJECT ENGINEERING SECT SUBMITTED BY CHIEF, GENERAL ENGR BRANCH RECOMMENDED BY CHIEF, ENGINEERING DIVISION APPROVED BY COLONEL, CORPS OF ENGINEERS DISTRICT ENGINEER	U.S. ARMY ENGINEER DISTRICT, CHARLESTON CORPS OF ENGINEERS CHARLESTON, SOUTH CAROLINA NAVIGATION PROJECT **GENERAL PLAN** **MURRELLS INLET** GEORGETOWN COUNTY SOUTH CAROLINA SCALE AS SHOWN — GENERAL DESIGN MEMORANDUM — PLATE 1 DATE 28 NOV 1975

R2 30 MAR '76

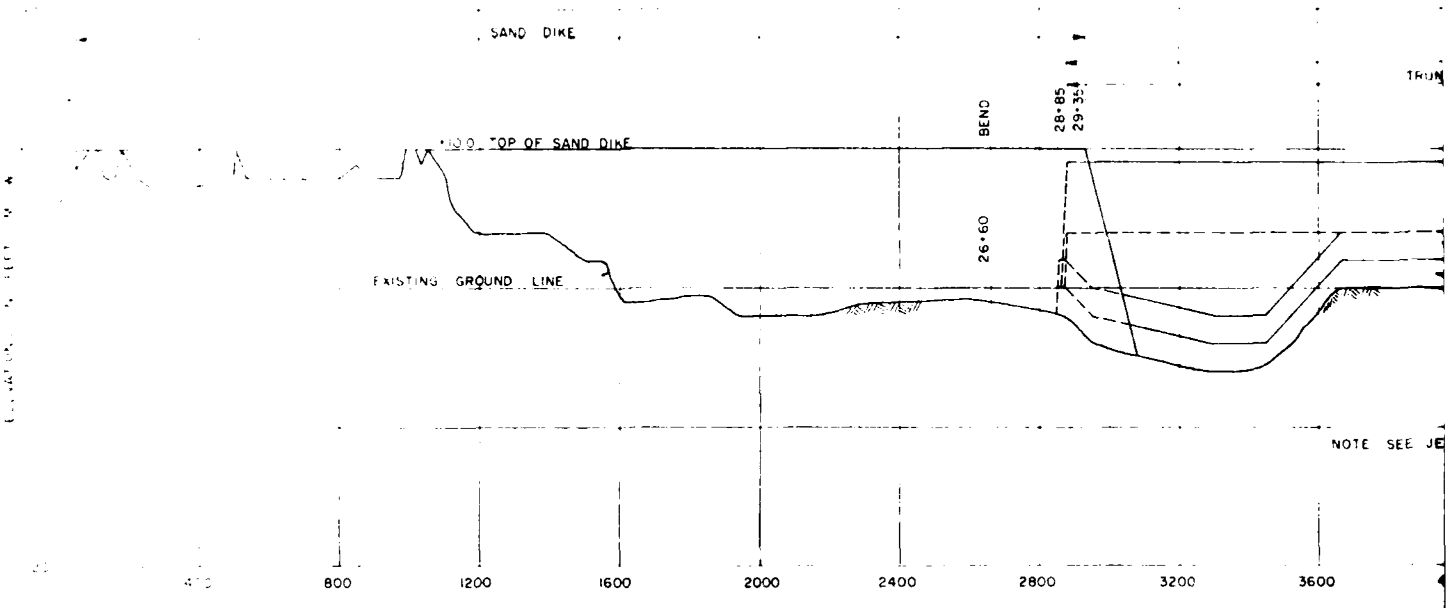


MI-1
MI-2
MI-4
MI-3
MI-5
M32
MHW
SAND DIKE TOP ELEV = +10 MLW
PERPETUAL EASEMENT
14 ± ACRES
CONSTRUCTION AREA
5 ± ACRES
TEMPORARY
EASEMENT)
SOUTH JETTY
TOP ELEV +9 MLW
8' WIDE
FISHING
WALKWAY
JETTY
HEAD
150'
1500'
3290'
N
E 2,600,000
E 2,601,000
E 2,599,000
N618,000
N619,000
N620,000
N 622,000

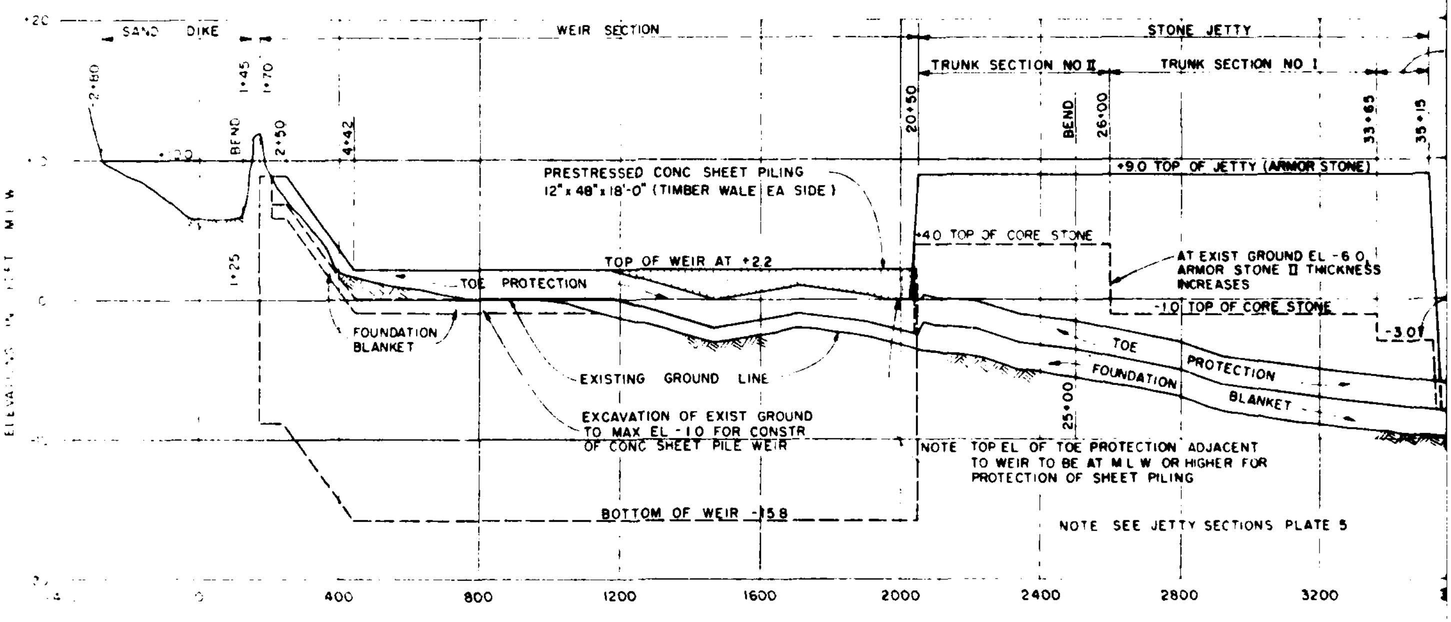

REVISIONS
DESCRIPTION
BY
DATE
MATCH LINE
E 2,599,000
N 625,000
AUXILARY CHANNEL
BOTTOM ELEV -6 MLW
200'
INNER CHANNEL
BOTTOM ELEV -8 MLW
WIDTH 90'
E 2,600,000
MHW
FEE ACQUISITION
6 ± ACRES
CONSTRUCTION AREA
MI-8
7 ± ACRES
(TEMPORARY EASEMENT)
N 625,000
E 2,601,000
SAND DIKE
TOP ELEV +10 MLW
WARNING MARKERS
(SEE PLATE 4)
DEPOSITION BASIN
BOTTOM ELEV -20 MLW
MI-9
MI-6
SOUTH JETTY
MI-10
ENTRANCE CHANNEL
BOTTOM ELEV -10 MLW
1880
WEIR SECTION
TOP ELEV +2.2 MLW
3365
NORTH JETTY
TOP ELEV +9 MLW
470'
N 624,000
E 2,602,000
WALKWAY
NOTE
ELEVATIONS SHOWN IN FEET ARE BASED ON LOCAL MEAN LOW WATER DATUM
1015'
200
0
200
400
300'
150' JETTY HEAD
N 623,000
E 2,603,000
LEGEND
AREA REQUIRING DREDGING
MI-4 ● DRIVE SAMPLED BORING
S-3 AUGER BORING
S-4 ⊕ JET PROBE
N 622,000
R2 30 MAR '76
U.S. ARMY ENGINEER DISTRICT CHARLESTON
CORPS OF ENGINEERS
CHARLESTON SOUTH CAROLINA
NAVIGATION PROJECT
JETTY & ENTRANCE CHANNEL PLAN
MURRELLS INLET
GEORGETOWN COUNTY
SOUTH CAROLINA
SCALE AS SHOWN
GENERAL DESIGN MEMORANDUM
PLATE 2
DATE 28 NOV 1975


INNER CHANNEL
BOTTOM ELEV -10 MLW
WIDTH 90'
PIPELINE
EASEMENT
PIPELINE
EASEMENT
(TEMPORARY)
N 627,000
E 2,603,000
N 628,000
(69)
(69)


REVISIONS
DESCRIPTION
BY
FORMER ARMY CRASH BOAT DOCK
TURNING BASIN
S-2
S-5
S-7
S-4
S-6
S-3
S-8
BEACH DISPOSAL AREA 4± ACRES (TEMPORARY EASEMENT)
PIPELINE EASEMENT (TEMPORARY)
NOTE
CHANNEL PROFILE TAKEN BY FATHOMETER, AUGUST 1975 (HORIZONTAL CONTROL APPROX.)
400
U.S. ARMY ENGINEER DISTRICT CHARLESTON
CORPS OF ENGINEERS
CHARLESTON SOUTH CAROLINA
NAVIGATION PROJECT
INNER CHANNEL PLAN
MURRELLS INLET
GEORGETOWN COUNTY
SOUTH CAROLINA
SCALE AS SHOWN
GENERAL DESIGN MEMORANDUM
PLATE 3
DATE 26 NOV 1975
FILE NO. 10040

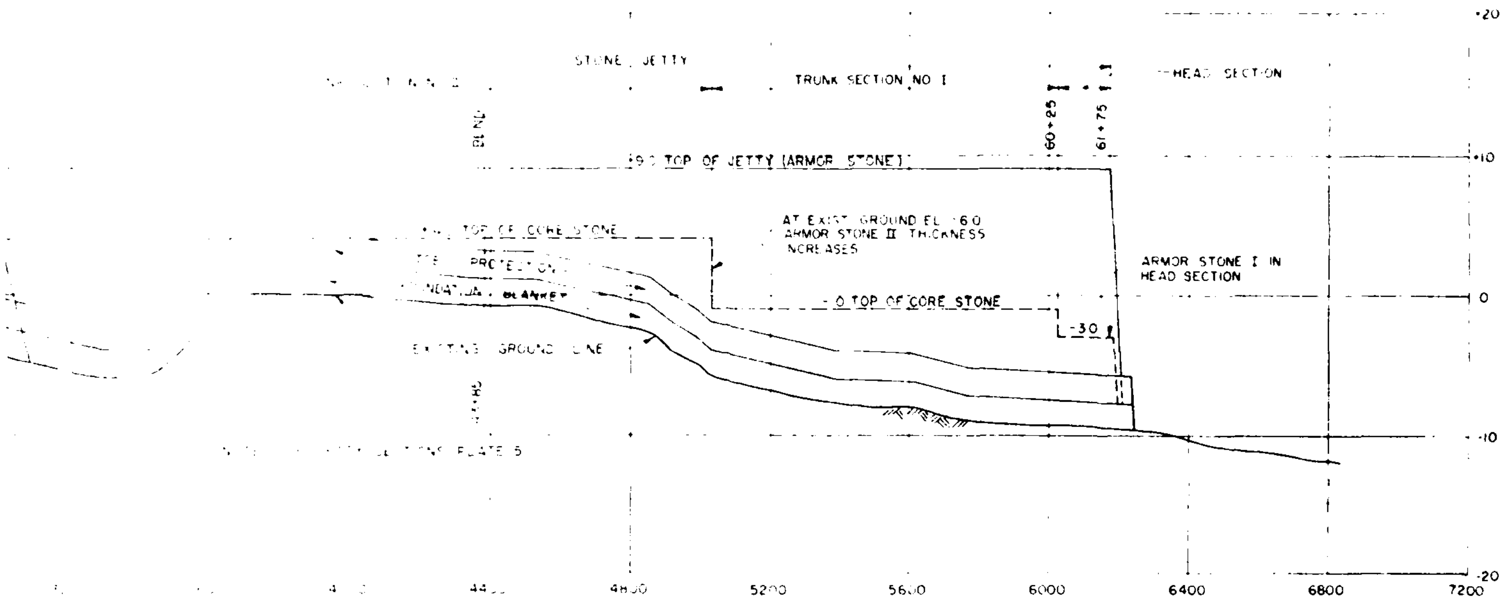


SOUTH JETTY PROFIL

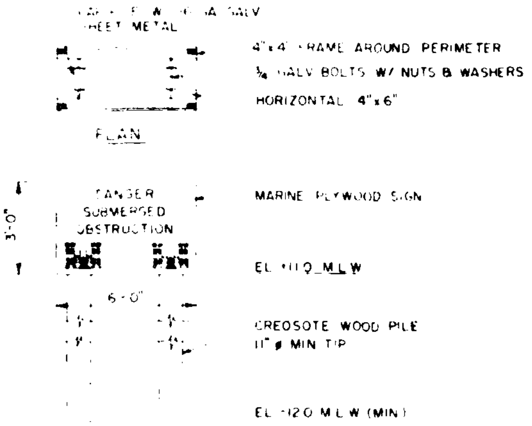


NORTH JETTY PROFILE

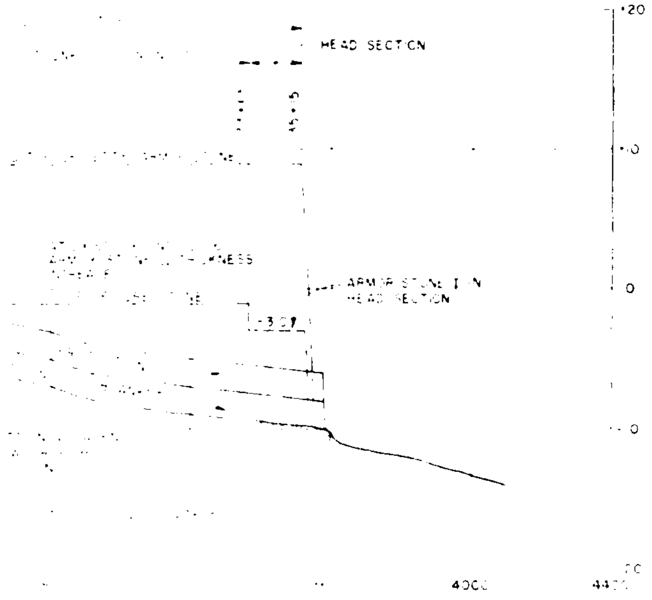
SYMBOL	REVISIONS DESCRIPTION	BY	DATE



SOUTH JETTY PROFILE



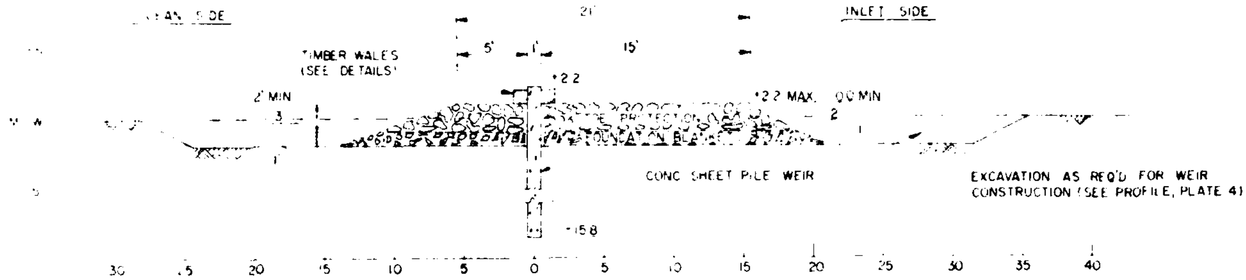
WARNING MARKER
AT WEIR SECTION
N.T.S.



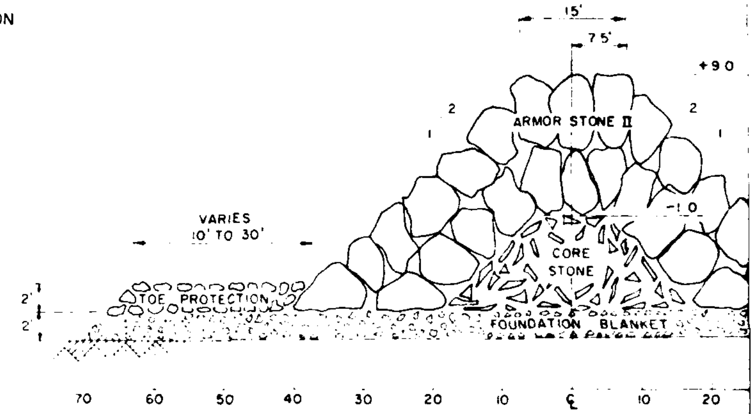
U.S. ARMY ENGINEER DISTRICT, CHARLESTON
CORPS OF ENGINEERS
CHARLESTON, SOUTH CAROLINA

NAVIGATION PROJECT
JETTY PROFILES
MURRELLS INLET

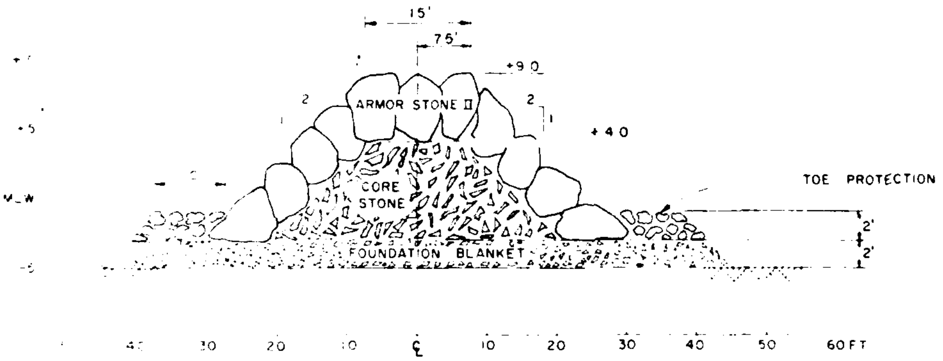
GEORGETOWN COUNTY		SOUTH CAROLINA
SCALE: AS SHOWN	GENERAL DESIGN MEMORANDUM	PLATE 4
DATE: 28 NOV 1975		FILE NO. 10048



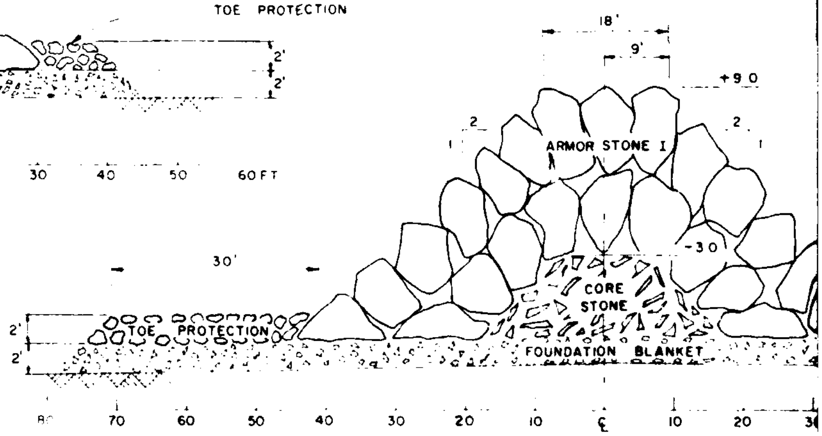
TYPICAL WEIR SECTION



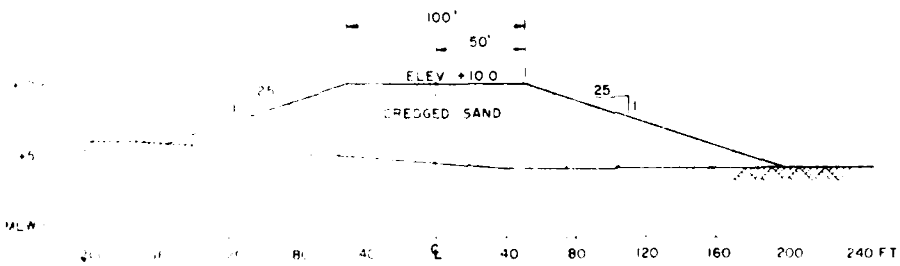
TYPICAL TRUNK SECTION
TYPE I



TYPICAL TRUNK SECTION
TYPE II



TYPICAL HEAD SECTION

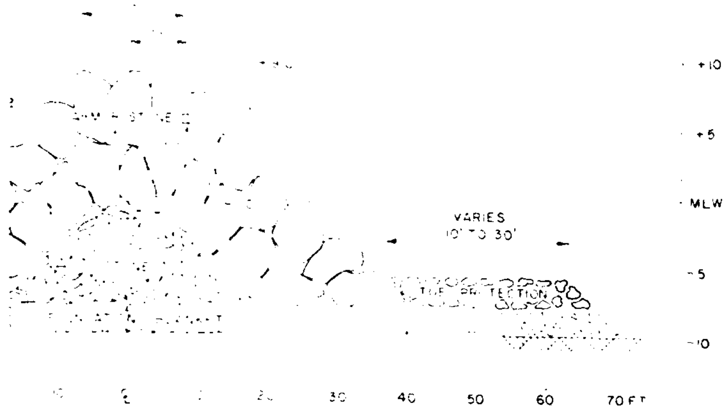


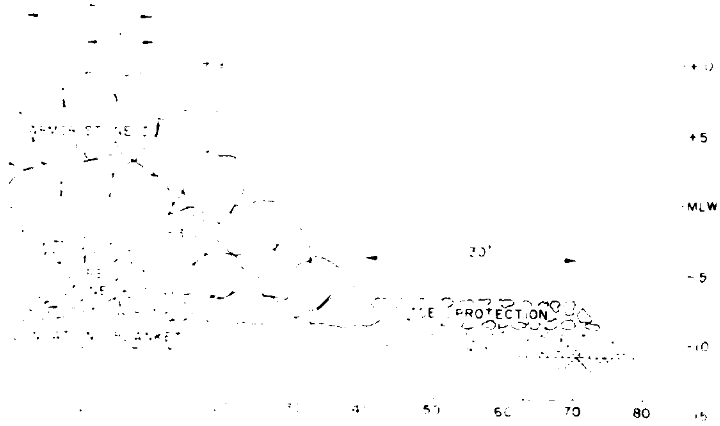
TYPICAL SAND DIKE SECTION

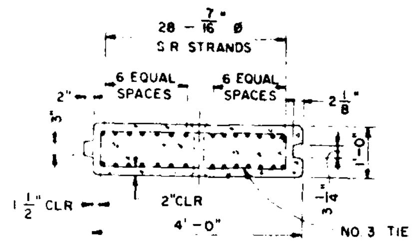
TYPE
ARMOR I
ARMOR II
CORE
TOE PROTECTI
FOUNDATION BLA

* ASSUMED SPECIFIC

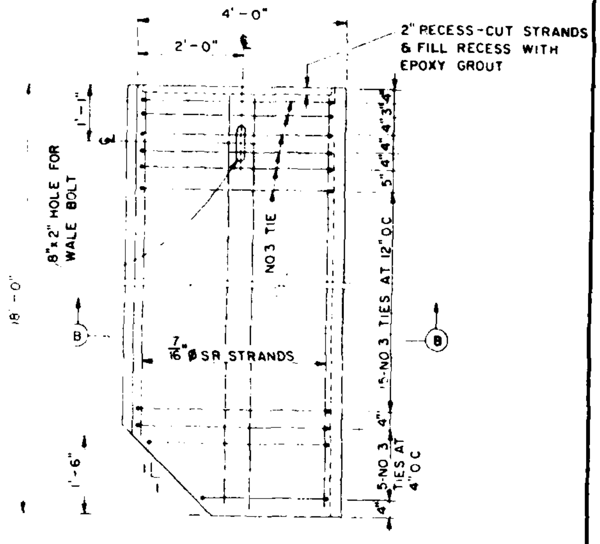
REVISIONS		
DESCRIPTION	BY	DATE



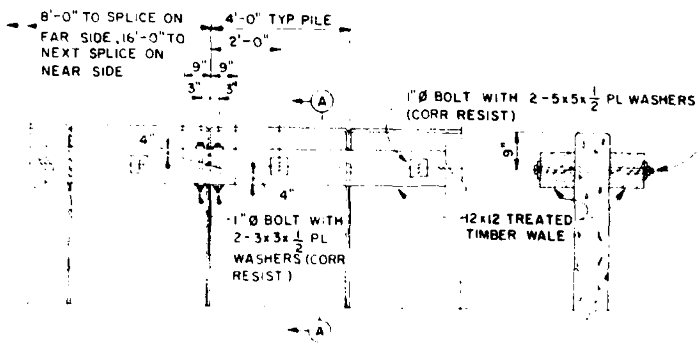




SECTION B–B



SHEET PILE ELEVATION



WALE SPLICE ELEVATION

SECTION A–A

DETAILS OF PRESTRESSED SHEET PILE WEIR

JETTY STONE*

	WEIGHT TONS	SIZE INCHES
[illegible]	[illegible]	[illegible]
[illegible]	4 [illegible]	[illegible] – 60
[illegible]	[illegible]	5 – [illegible]
[illegible]	–	[illegible] – 24
[illegible]	–	025 – 6.0

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

NAVIGATION PROJECT

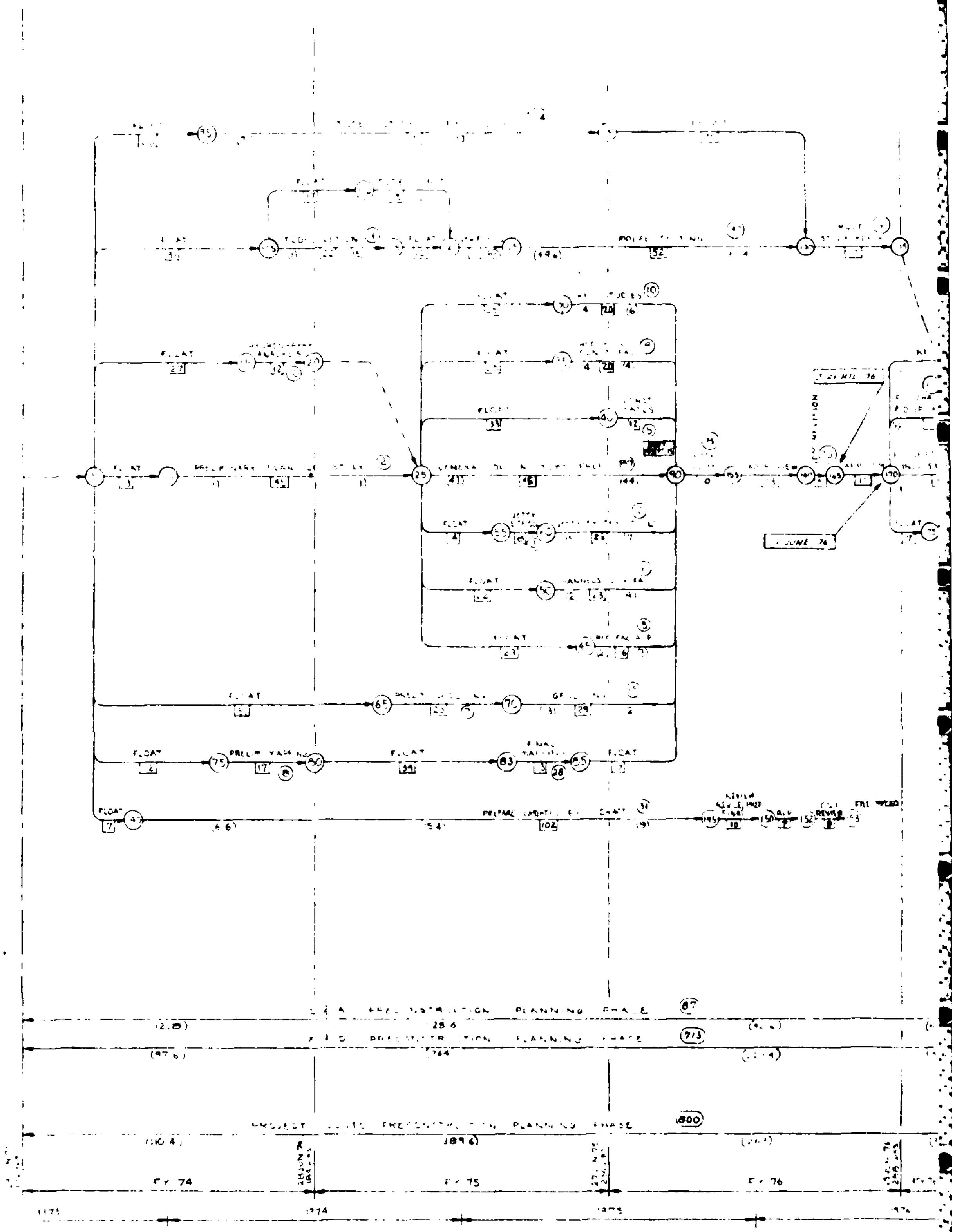
JETTY SECTIONS

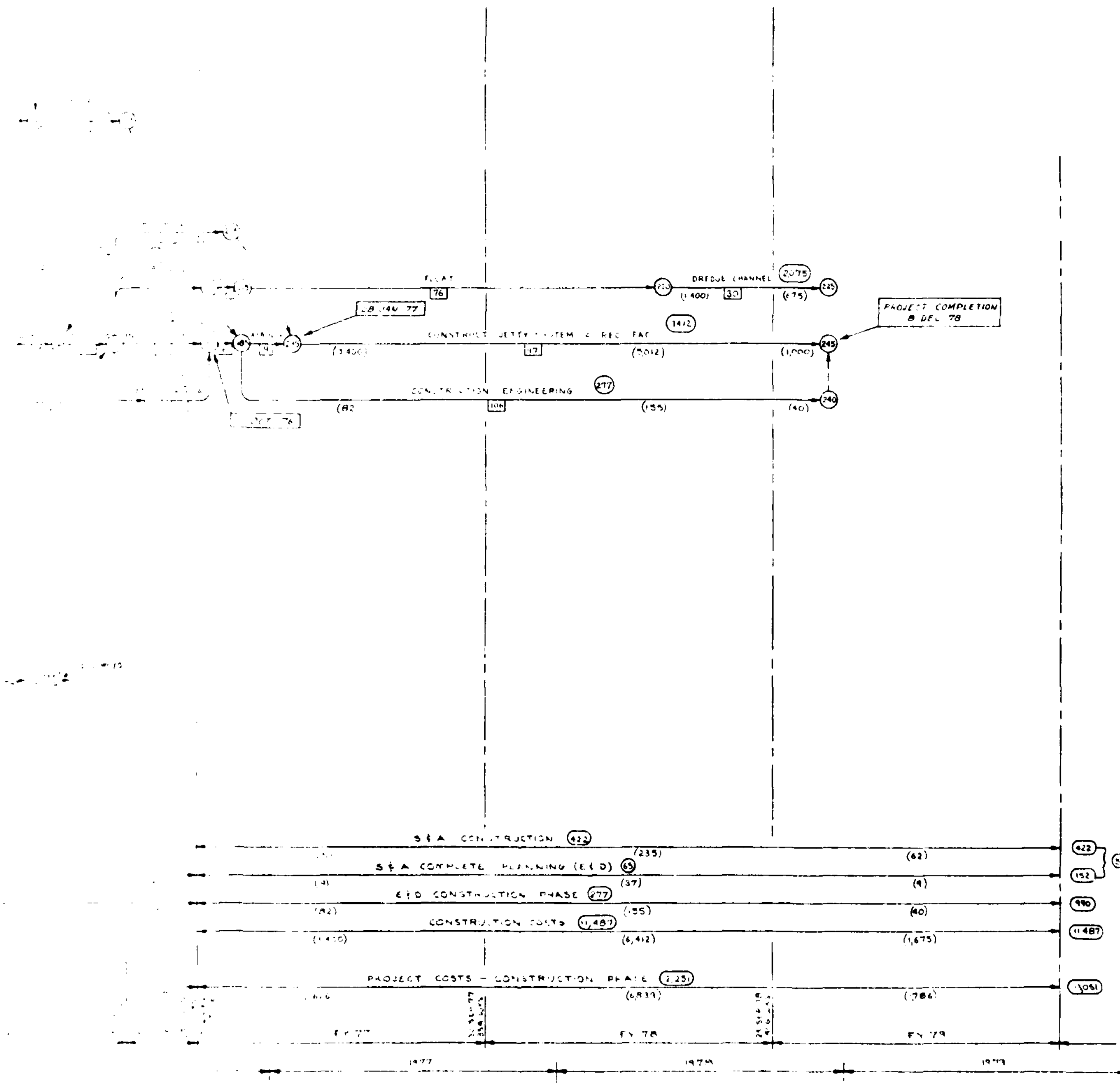
& SHEET PILE WEIR DETAILS

MURRELLS INLET

GEORGETOWN COUNTY — SOUTH CAROLINA

SCALE AS SHOWN	GENERAL DESIGN MEMORANDUM	PLATE 5
DATE 20 NOV 1975		FILE NO 10040


FLOAT
FINAL
FY 74
FY 75
FY 76
1974
1975


DREDGE CHANNEL
PROJECT COMPLETION 8 DEC 78
CONSTRUCT JETTY SYSTEM & REC FAC
CONSTRUCTION ENGINEERING
S & A CONSTRUCTION
S & A COMPLETE PLANNING (E & D)
E & D CONSTRUCTION PHASE
CONSTRUCTION COSTS
PROJECT COSTS - CONSTRUCTION PHASE
FY 78
FY 79

2

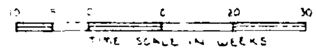
PROJECT COST ESTIMATE

OCTOBER 1975 PRICES
(FED FUNDS & NON FED CONTRIBUTIONS)

03	CHANNELS & CANALS	2,075
10	BREAKWATERS & SEAWALLS	4,153
14	RECREATION FACILITIES	254
30	ENGINEERING & DESIGN	440
31	SUPERVISION & ADMINISTRATION	574
	TOTAL (IN THOUS DOL)	15,051

LEGEND

APP	APPROVE
DM	DESIGN MEMORANDUM
GDM	GENERAL DESIGN MEMORANDUM
PS	PLANS & SPECIFICATIONS
EIS	ENVIRONMENTAL IMPACT STATEMENT
E&D	ENGINEERING & DESIGN
S&A	SUPERVISION & ADMINISTRATION
RE	REAL ESTATE
NTP	NOTICE TO PROCEED
A&A	ADVERTISE & AWARD
CEQ	COUNCIL ON ENVIRONMENTAL QUALITY
ACQ	ACQUISITION
COMP	COMPLETE



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

MURRELLS INLET
SOUTH CAROLINA

NETWORK ANALYSIS
(TIME SCALED)

SCALE: 1" = 10 WKS		
DATE 24 NOV 1975	SHEET 1 of 1	

PLATE 6

3

APPENDIX A

JETTY PLAN SELECTION

TABLE OF CONTENTS

TEXT

FIGURES

APPENDIX A

JETTY PLAN SELECTION

1. General. The purpose of this appendix is to document the process used to arrive at the plan of improvement for Murrells Inlet. Murrells Inlet, an opening through the barrier beach, is approximately [illegible] wide. The location of the rock jetties, sand dikes, and low weir structure will be within this distance. To aid in the design of a jetty system for Murrells Inlet, a model of the inlet was constructed at the U. S. Army Waterway Experiment Station (WES), at Vicksburg, Mississippi.

2. Model study. A fixed bed model was constructed to [illegible] and 1:60 vertical scales. Field data for design of the model was furnished to WES by Charleston District. Figure A-1 shows the model [illegible] and locations of tidal stations used in model design. Construction of the model was completed in January 1975; and model verification was initiated in February 1975 and completed in June 1975. On [illegible] 1975, Charleston District met with WES to discuss the testing program. The testing program that WES initially proposed was to test two different jetty plans (progressive 15 day tide, wave and shoaling tests). Only two plans could be tested for the funds and time available. Testing of additional jetty plans would extend the scheduled model testing completion date of September 1975. In order to investigate [illegible] plans, WES proposed the use of time exposure photography of surface currents. Photographs could be taken of model surface currents for a twelve-hour period for various jetty plans. Comparison of the photographs would aid in deleting jetty alignments from further testing and assist in selecting two plans for further testing.

3. Preliminary testing. In a 14 April 1975 letter, WES presented seven jetty alignments for preliminary testing using surface current photographs taken every hour (prototype) for one tidal cycle. The plans are shown on Figures A-2 through A-11. From the seven alignments presented, Charleston District selected plans 1, 2, 4, 6 and 7 for preliminary testing. A brief description of the plans follows:

- Plan 1 - Same as presented in survey report.
- Plan 2 - Same as Plan 1 without low weir section in north jetty.
- Plan 3 - Jetties oriented more normal to the coastline; north and south jetties of equal length terminating in deeper water than survey report.
- Plan 4 - Same as Plan 3 low weir section in north jetty and auxiliary channel to Oaks Creek.
- Plan 5 - Same as Plan 4 without auxiliary channel to Oaks Creek.
- Plan 6 - Same as Plan 3 with auxiliary channel to Oaks Creek.
- Plan 7 - North and south jetties shifted southward to take advantage of existing deeper water near south shore of inlet. Low weir section in north jetty.

4. Surface current photography. On 19 June 1975, WES met with Charleston District to present the results of the preliminary testing. Selected surface current photographs for the base test (inlet without any improvement) and plans 1, 1A, 2, 4, 6 and 7 are presented in Figures A-12 through A-25. Plots of the tidal elevations for various tide stations for the base test and Plans 1 and 7 are presented in Figures A-26 through A-49. The two plans selected for further testing (progressive 15-day tide, wave and shoaling tests) are designated 1B and 7. Plan 1B is a modification of Plan 1 and a discussion of the change is presented in paragraph 4d. Surface currents are shown by the movement of confetti placed in the model. Time exposure photographs of the movement of the confetti shows ebb and flood tides, approximate value of surface currents, and other details such as the existence of eddy currents. A brief discussion of the surface current testing for the base test and various plans follows:

a) Base test. Prior to testing any of the proposed improvement plans, a base test of existing conditions was conducted. The results of the base test, when compared with a proposed improvement plan, served as the basis for determining the changes caused by the improvement plan. Tidal elevations were measured at eight gages shown on Figure A-1. Time-exposure photographs were made hourly (prototype) intervals of confetti floating on the water surface. A bright light was flashed near the end of the time-exposure, resulting in a dot near the end of each confetti streak, thus indicating the direction of movement. A velocity scale is furnished in the photographs so that surface current velocities can be determined by measuring the length of the confetti streaks. Only the photographs made at the time of strength of flood (hour 7) and strength of ebb (hour 10) are presented in this appendix; however, a complete set of photographs (13 for each test) are available at Charleston District. Hour 0 is the time that the moon passes the 79th meridian (location of Murrells Inlet); hours are not directly related to ebb or flood. Base test photographs (hours 9 and 10) show eddy current at north sand spit.

b) Plan 1. Same as project plan presented in survey report with the following change: deposition basin is larger and a channel into the basin cut by a dredge is provided. This test was run with the basin empty; test should also be run with basin full. This plan blocks flow into and out of Oaks Creek. Flow into and out of Oaks Creek is very circuitous and could cause problems. This could cause scour at the south jetty and sand dike. Surface currents are also strong toward left side of entrance channel, this could cause migration of the channel.

c) Plan 1A This is a modification of Plan 1; a connecting channel between Oaks Creek and the entrance channel was added by WES to help flow into and out of Oaks Creek. Photographs show that this channel does help the Oaks Creek flow. A comparison of hour 2 for Plans 1 and 1A shows that the Oaks Creek auxiliary channel lessens the possibility of scour at the south sand dike. There was some discussion on the width of the Oaks channel; and WES felt that channel could be made smaller possibly to 150 feet. Depth should be at least 6 feet to allow dredge access.

d) Plan 1B. This is a modification of Plan 1A, which reduces the width of the auxiliary channel into Oaks Creek from 300 feet to 200 feet, and extends the south jetty. This plan is shown on Figures A-4 and A-5. This plan was conceived during the 19 June 1975 meeting at Charleston District. Surface current photographs will not be taken for this plan. Tidal elevation plots will be obtained during the full scale tests. This plan should behave similar to Plan 1A.

e) Plan 2. This is the same as Plan 1 without the low weir section on the north jetty. Photographs show that Oaks Creek flow is still very difficult. Flow impinges on left side of channel. Velocities past end of jetties are lower at ebb with this plan than with Plan 1. This may cause a shoal. Hour 5 photograph shows eddy currents between Oaks Creek and Woodland Creek; this would indicate the start of new shoal. This is not seen on Plans 1 and 1A.

f) Plan 4. Direction of jetties with respect to the coastline is different than Plans 1, 1A and 2. The jetties in Plans 1, 1A and 2 are angled downcoast while, with this plan, the jetties appear more normal to the coastline. The north and south jetty lengths are equal in this plan. Plan 4 also provides a connecting channel to Oaks Creek. Plans 1, 1A and 2 have the north jetty longer than the south jetty. Velocities in the interior channel appear high; this could cause some problems with small boat navigation. The interior channel could be widened from 90 to 150 feet for some distance from the inlet. This would probably lower velocities. Hour 6 shows a problem with flow around the ends of the jetties; however, it is less than in Plans 1, 1A and 2. This plan would probably have less problems with scour at jetty ends. The lessening of scour at the jetty ends could also be accomplished with Plans 1, 1A and 2 by lengthening the jetties. Some of this is also due to the orientation of the jetties.

g) Plan 6. Same as Plan 4 without the low weir section. Flow through the jetties appears to be centered more in this plan than in Plan 4. This is probably due to the absence of the low weir section.

h) Plan 7. Similar jetty alignment as Plans 1, 1A and 2 except with Plan 7 jetties are moved downcoast toward Huntington Beach. This takes better advantage of the existing channel through the inlet. North and south jetties are longer than in Plans 1, 1A and 2. Hour 9 photograph shows flows very close to the south jetty. A connection to Oaks Creek is provided without dredging a special channel. Hour 6 and 7 photographs show flows around south jetty end that could cause scour problems.

5. A review of the photographs showed that Plans 1A and 7 appear to be the best. As discussed earlier in paragraph 4d, Plan 1A will be modified and the modified plan designated as Plan 1B will be tested further. WES was directed by Charleston District to test Plan 1B first and then Plan 7. Tests will consist of generating a progressive 15-day tide for

eight constituents and comparison of prototype constituents at each tide station to model data; wave tests consisting of 5 and 8-second waves with wave heights of 3 and 6 feet generated from the east, southeast and south; and shoaling tests. The complete results of the model tests are not available for this report. The model testing results will be added as a supplement to this report and will be taken into consideration during further design studies. The selected plan for design in the GDM is Plan 1B shown on Figures A-4 and A-5.

6. Hurricane test. After completion of the tests described in paragraph 5 above, the selected plan will be subjected to hurricane surge. Design data on the hurricane storm was provided to WES by SAD. The results of the hurricane effects test will not affect the project design and will be included in the supplement to the GDM on model testing.

7. Selected plan. Plan 1B shown on Figures A-4 and A-5 is the selected plan for this General Design Memorandum.

MURRELLS INLET
MODEL LIMITS

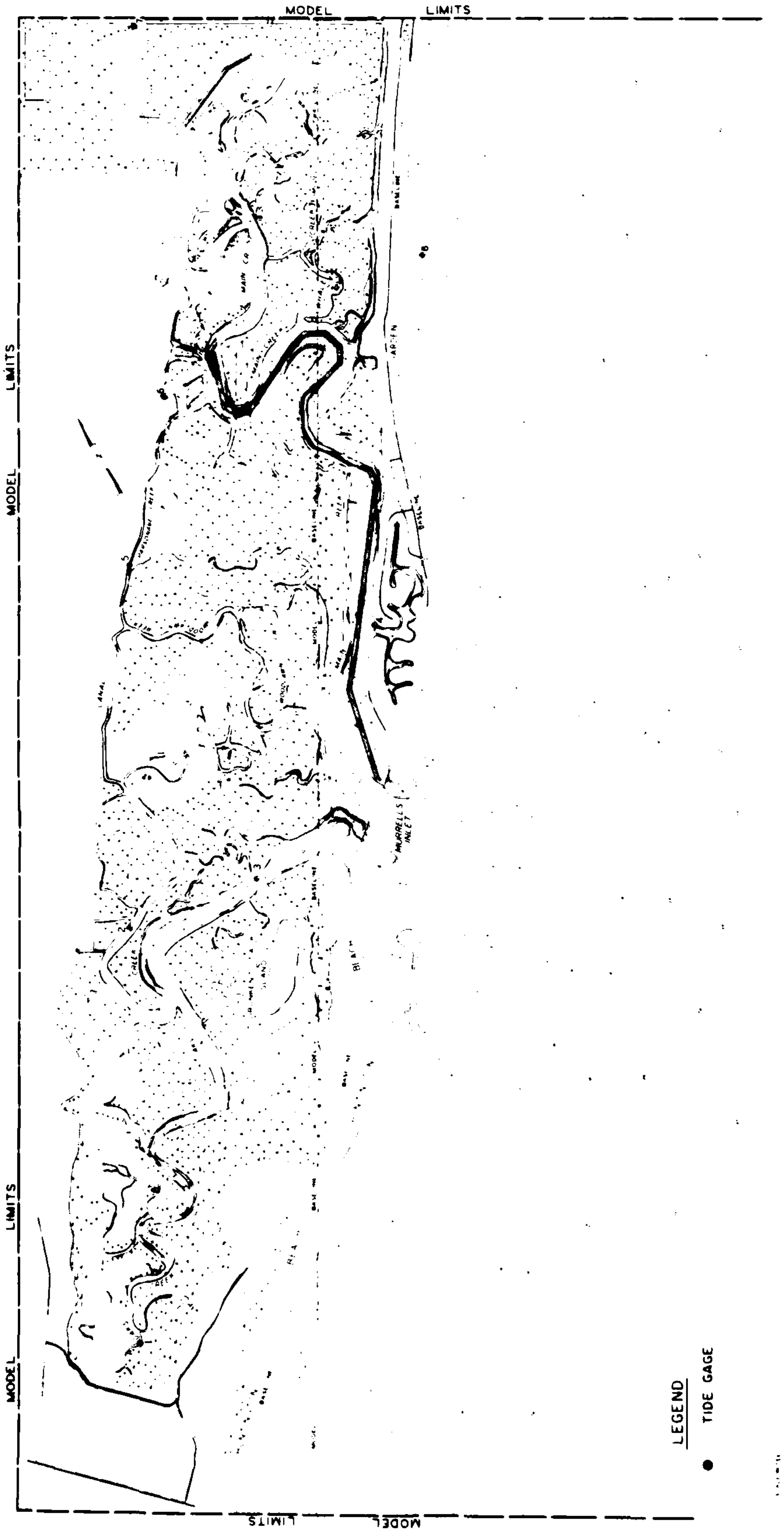


FIGURE A-1

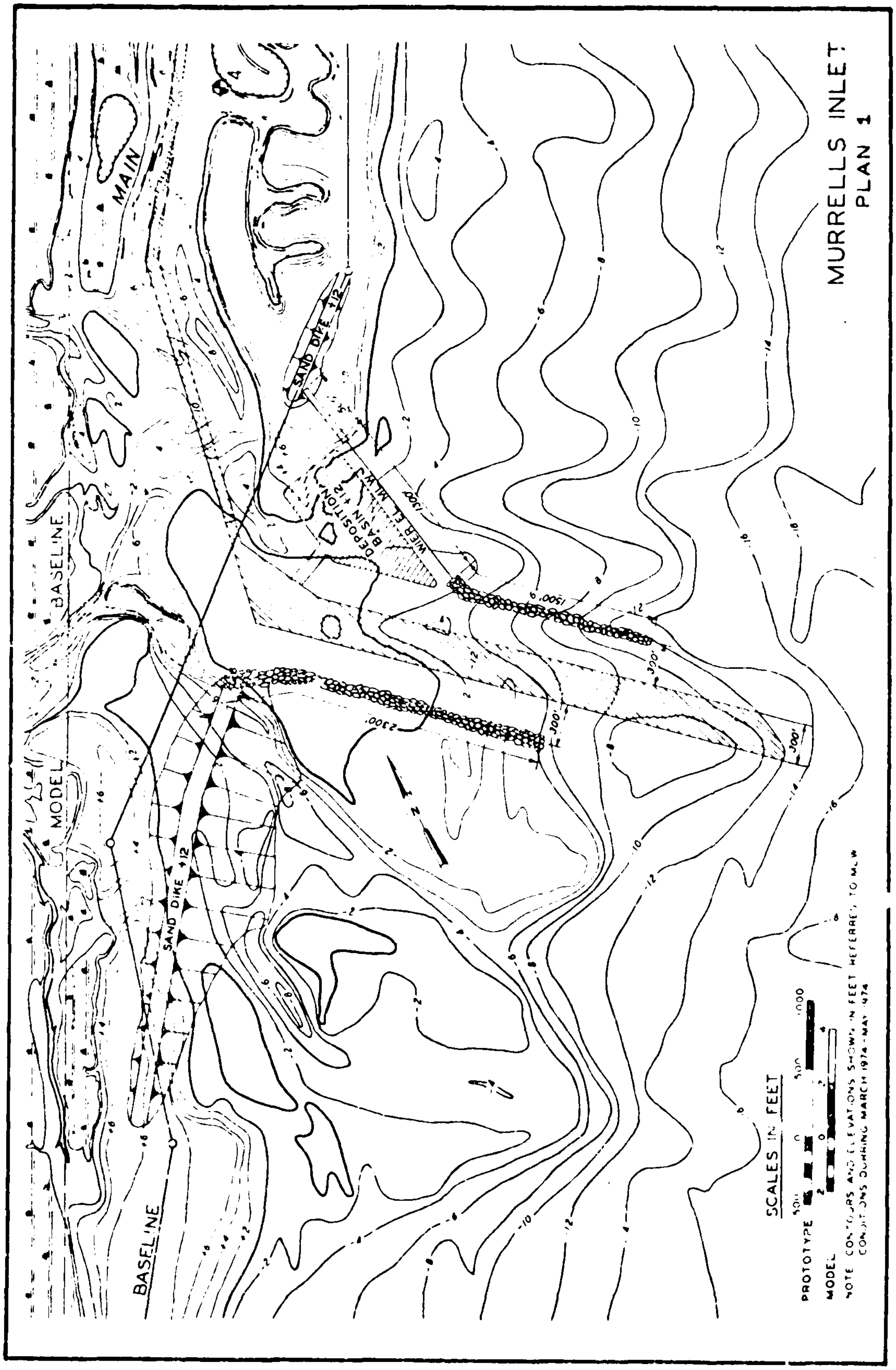

MURRELLS INLET
PLAN 1
MAIN
BASELINE
MODEL
BASELINE
SAND DIKE +12
SAND DIKE +12
DEPOSITION BASIN +12
SCALES IN FEET
PROTOTYPE 500 0 500 1000
MODEL 2 0 2 4
NOTE: CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MLW
CONDITIONS DURING MARCH 1974 - MAY 1974

FIGURE A-2

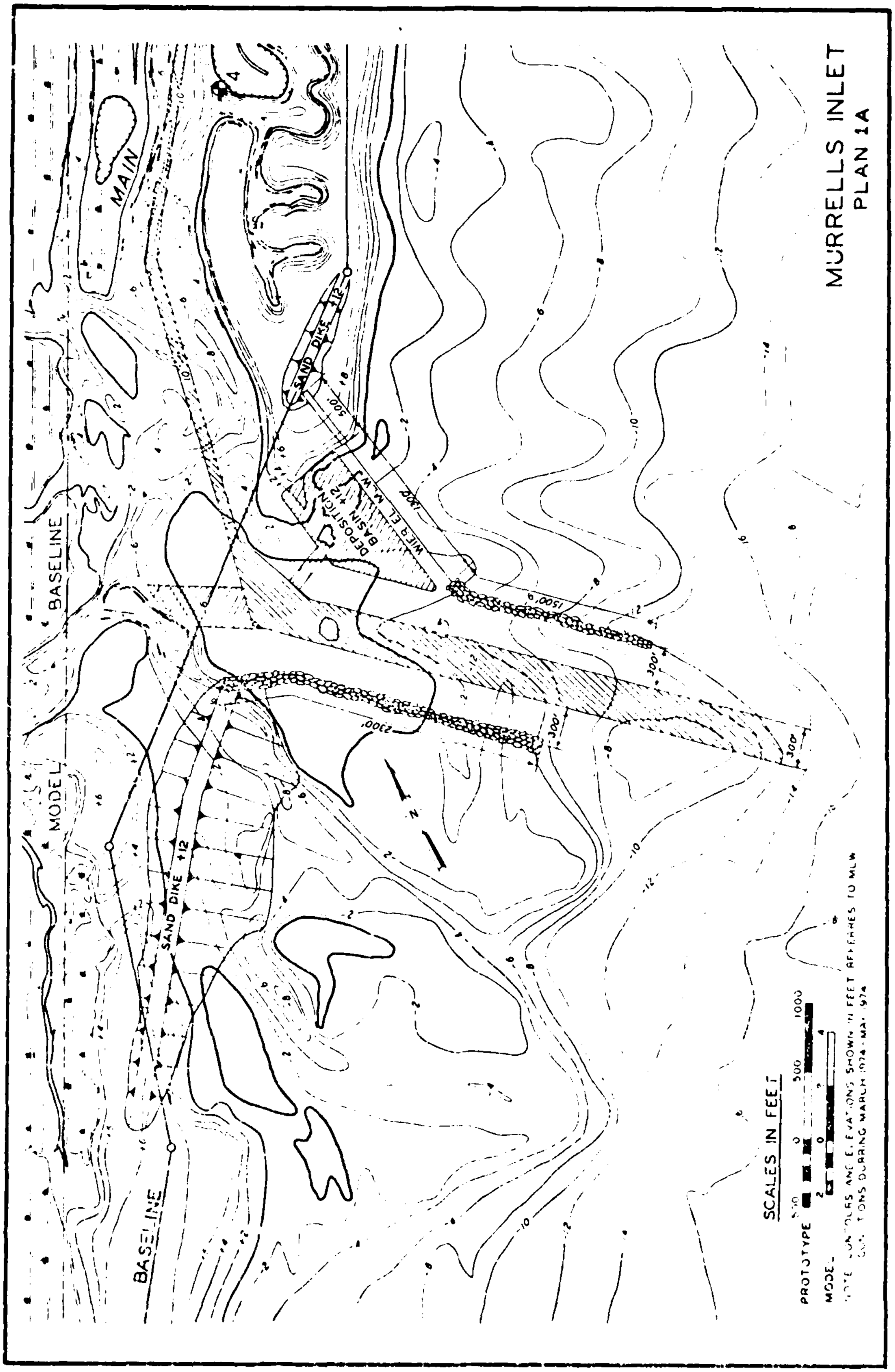

MURRELLS INLET
PLAN 1A
MAIN
BASELINE
MODEL
BASELINE
SAND DIKE +12
SAND DIKE +12
DEPOSITION BASIN
SCALES IN FEET
PROTOTYPE
MODEL

FIGURE A-3

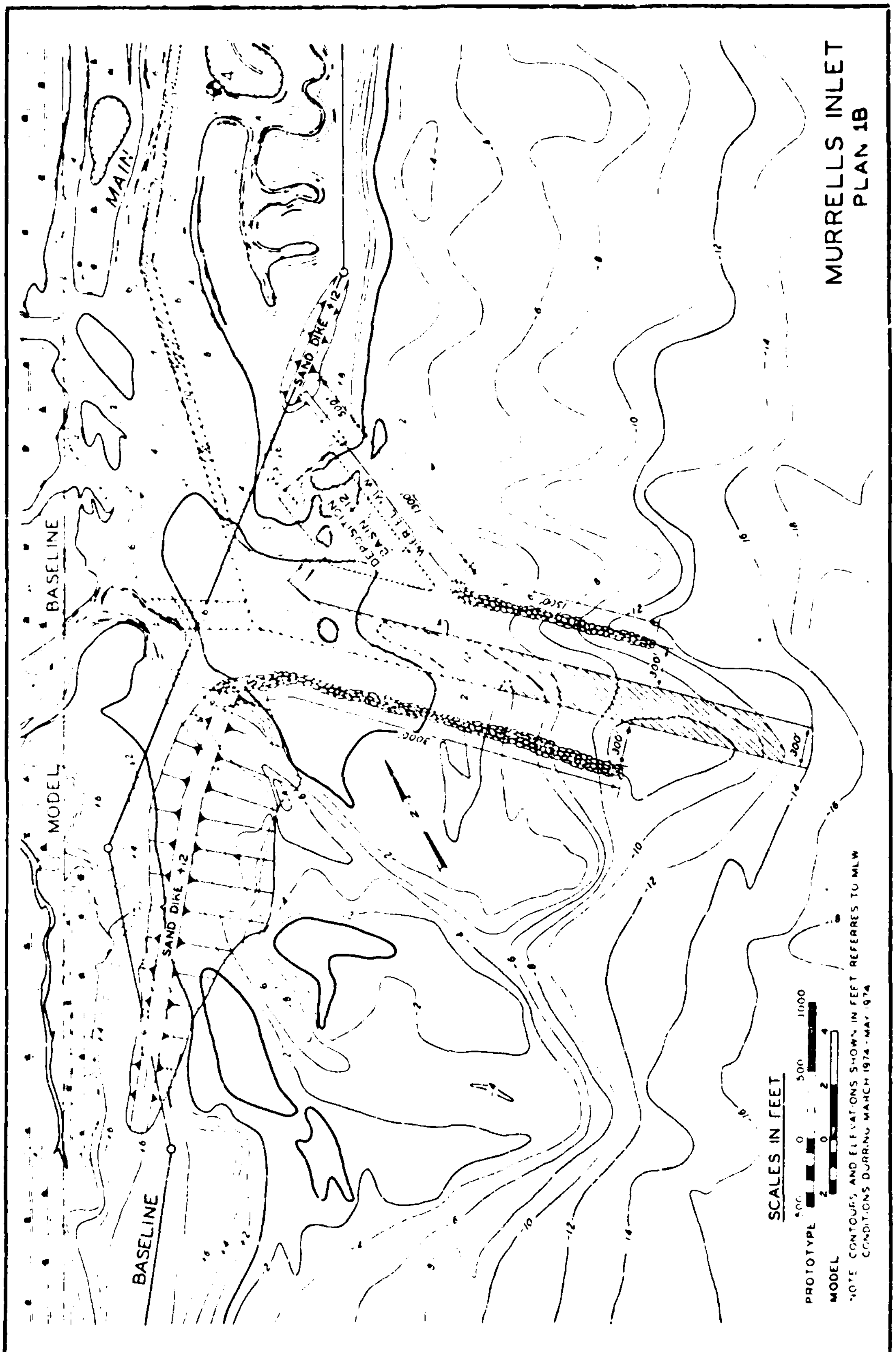

MURRELLS INLET
PLAN 1B
BASELINE
MODEL
MAIN
SAND DIKE +12
DEPOSITION BASIN
SCALES IN FEET
PROTOTYPE
MODEL
NOTE: CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MLW
CONDITIONS DURING MARCH 1974-MAY 1974

FIGURE A-4

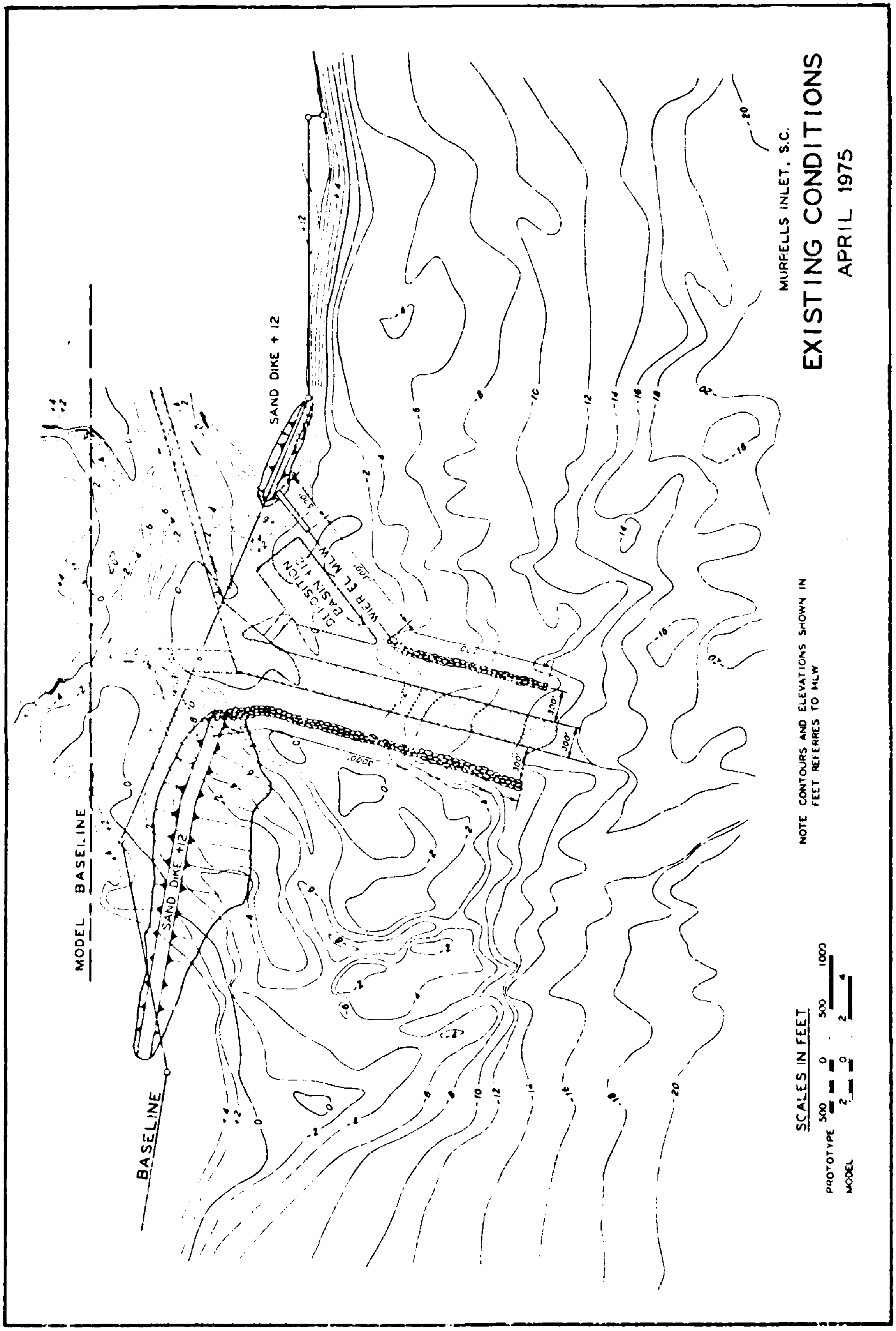

MURRELLS INLET, S.C.
EXISTING CONDITIONS
APRIL 1975
NOTE: CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRES TO MLW
SCALES IN FEET
PROTOTYPE
MODEL
MODEL BASELINE
BASELINE
SAND DIKE + 12
SAND DIKE +12
WIER EL MLW
DEPOSITION BASIN

FIGURE A-5

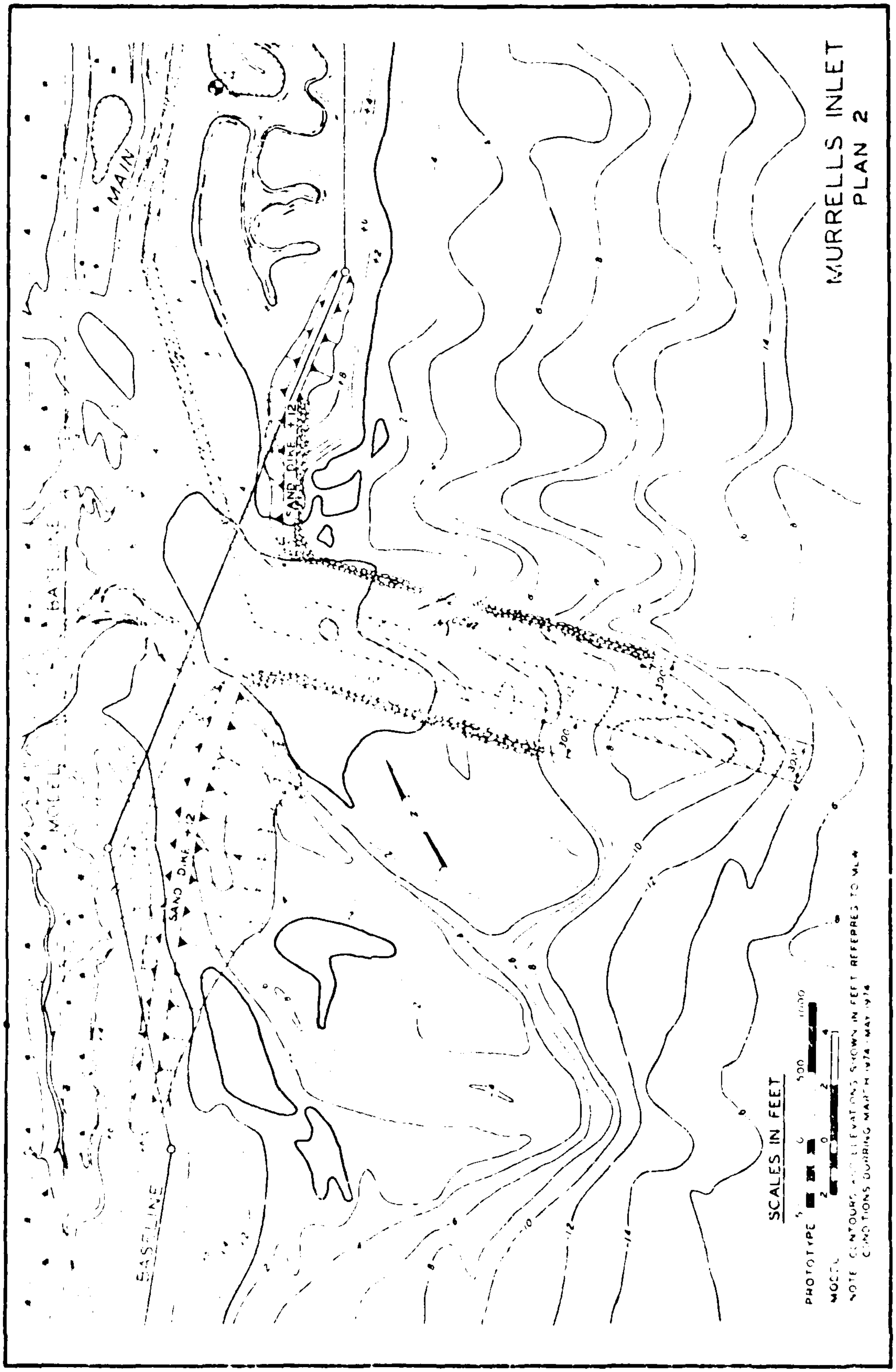

MURRELLS INLET
PLAN 2
SCALES IN FEET
PROTOTYPE
MODEL
BASELINE
SAND DIKE +12
SAND DIKE +12
MAIN

FIGURE A-6

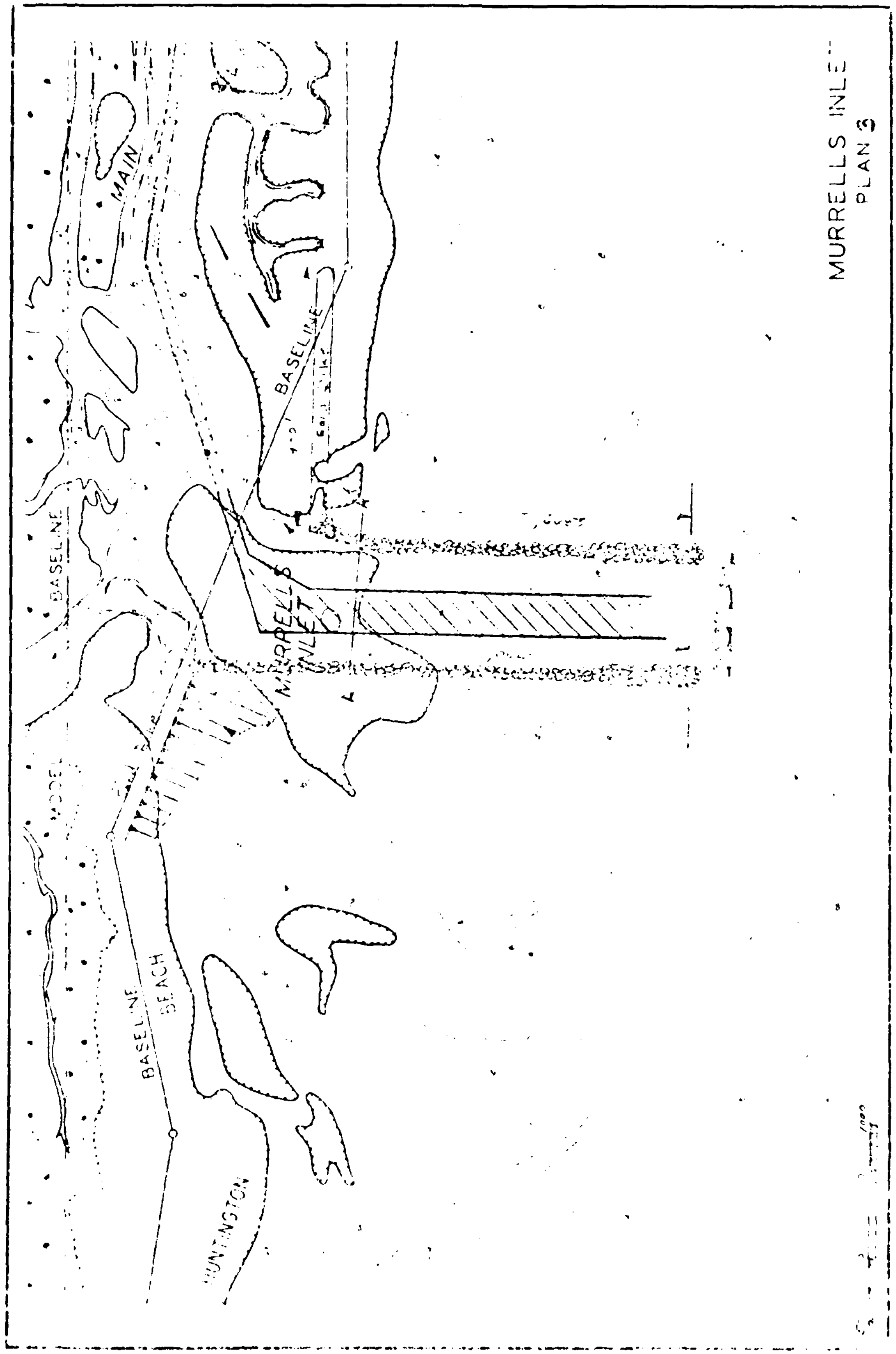

MURRELLS INLET
PLAN 3
MAIN
BASELINE
BASELINE
MURRELLS INLET
BEACH
BASELINE

FIGURE A-7

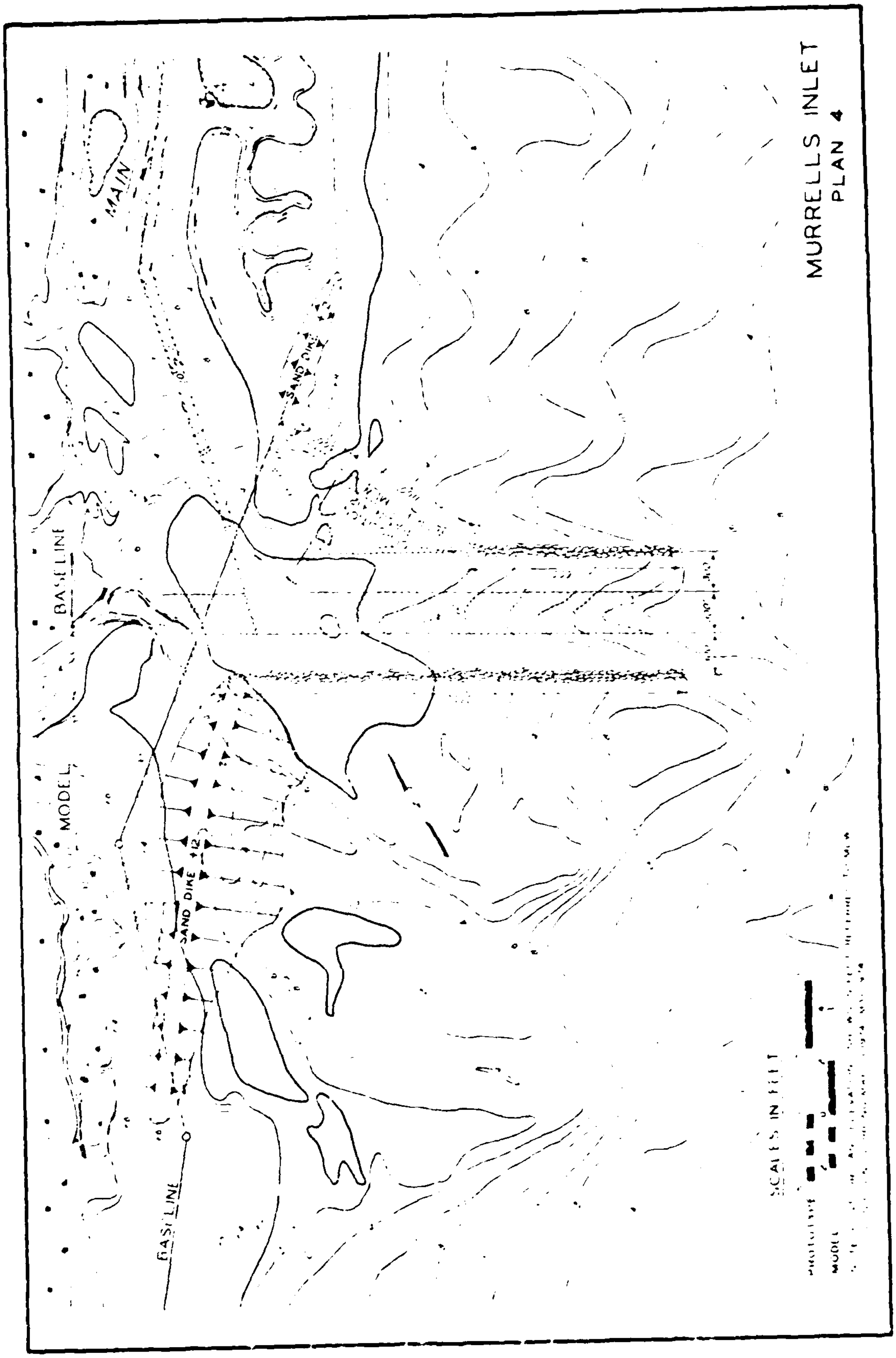

MURRELLS INLET
PLAN 4
MAIN
BASELINE
MODEL
SAND DIKE
+12
SCALES IN FEET

FIGURE A-8

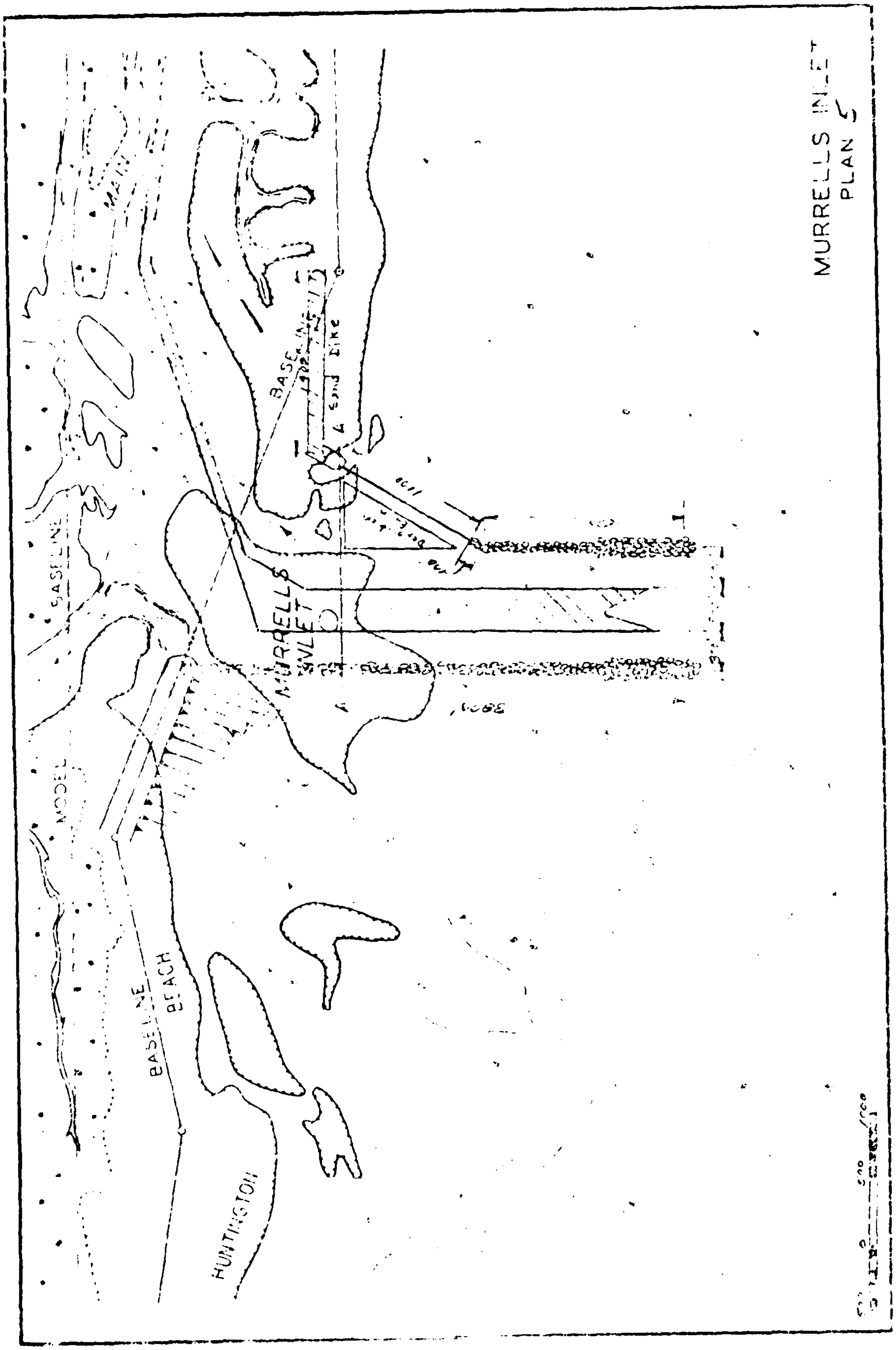

MURRELLS INLET
PLAN
MURRELLS INLET
BASELINE
BASELINE
MAIN
MODEL
BASELINE
BEACH
HUNTINGTON

FIGURE A-9

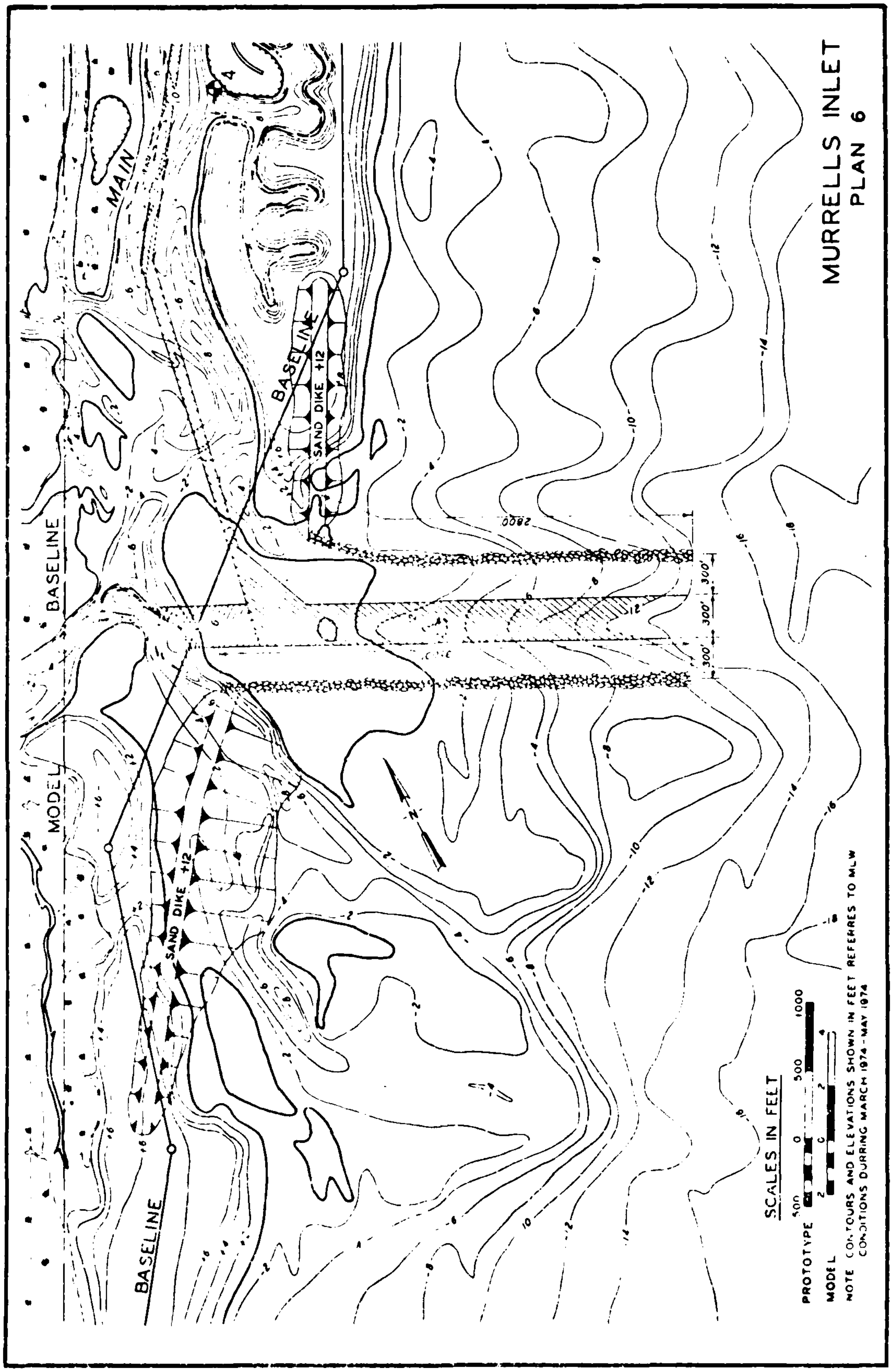

MURRELLS INLET
PLAN 6
BASELINE
MODEL
BASELINE
BASELINE
MAIN
SAND DIKE +12
SAND DIKE +12
SCALES IN FEET
PROTOTYPE
MODEL
NOTE CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRES TO MLW CONDITIONS DURRING MARCH 1974 - MAY 1974

FIGURE A-10

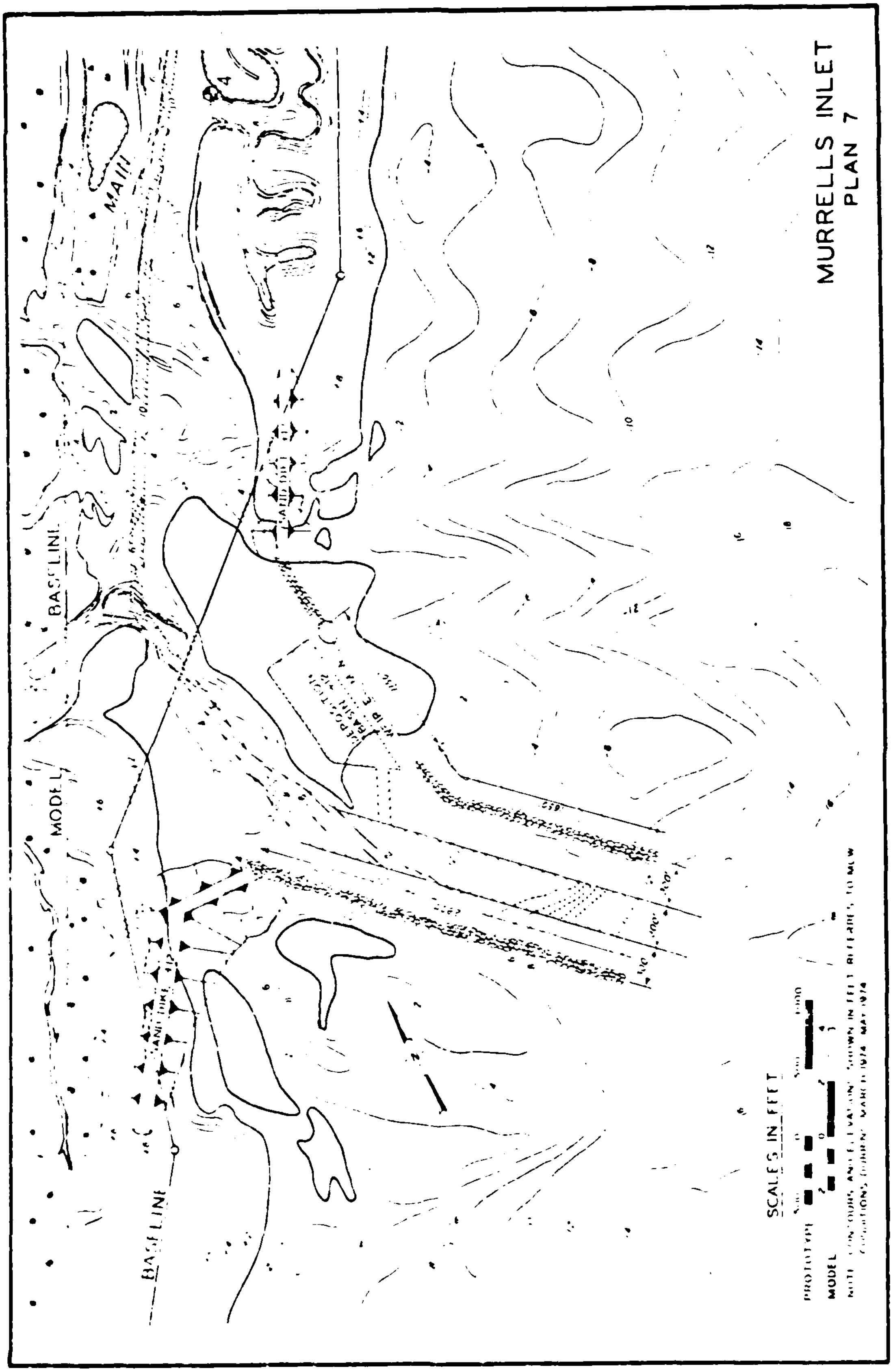

MURRELLS INLET
PLAN 7
BASELINE
MODEL
MAIN
BASELINE
SCALES IN FEET
PROTOTYPE
MODEL

FIGURE A-11

VELOCITY SCALE

4 6 8

SURFACE CURRENT PATTERNS
BASE TEST
HOUR 7

Figure A-12

SURFACE CURRENT PATTERNS
BASE TEST
HOUR 10

Figure A-13

SURFACE CURRENT
PATTERNS
PLAN 1

Figure A-14

VELOCITY SCALE
2 0 2 4 6 8 FPS

SURFACE CURRENT
PATTERNS
PLAN 1
HOUR 10

Figure A-15

VELOCITY SCALE
2 0 2 4 6 8 FPS

SURFACE CURRENT
PATTERNS
PLAN 1A
HOUR 7

Figure A-16

VELOCITY SCALE

SURFACE CURRENT
PATTERNS
PLAN 1A

Figure A-17

SURFACE CURRENT
PATTERNS
PLAN 2
HOUR 7

Figure A-18

SURFACE CURRENT
PATTERNS
PLAN 2

Figure A-19

SURFACE CURRENT PATTERNS
PLAN 4
HOUR 7

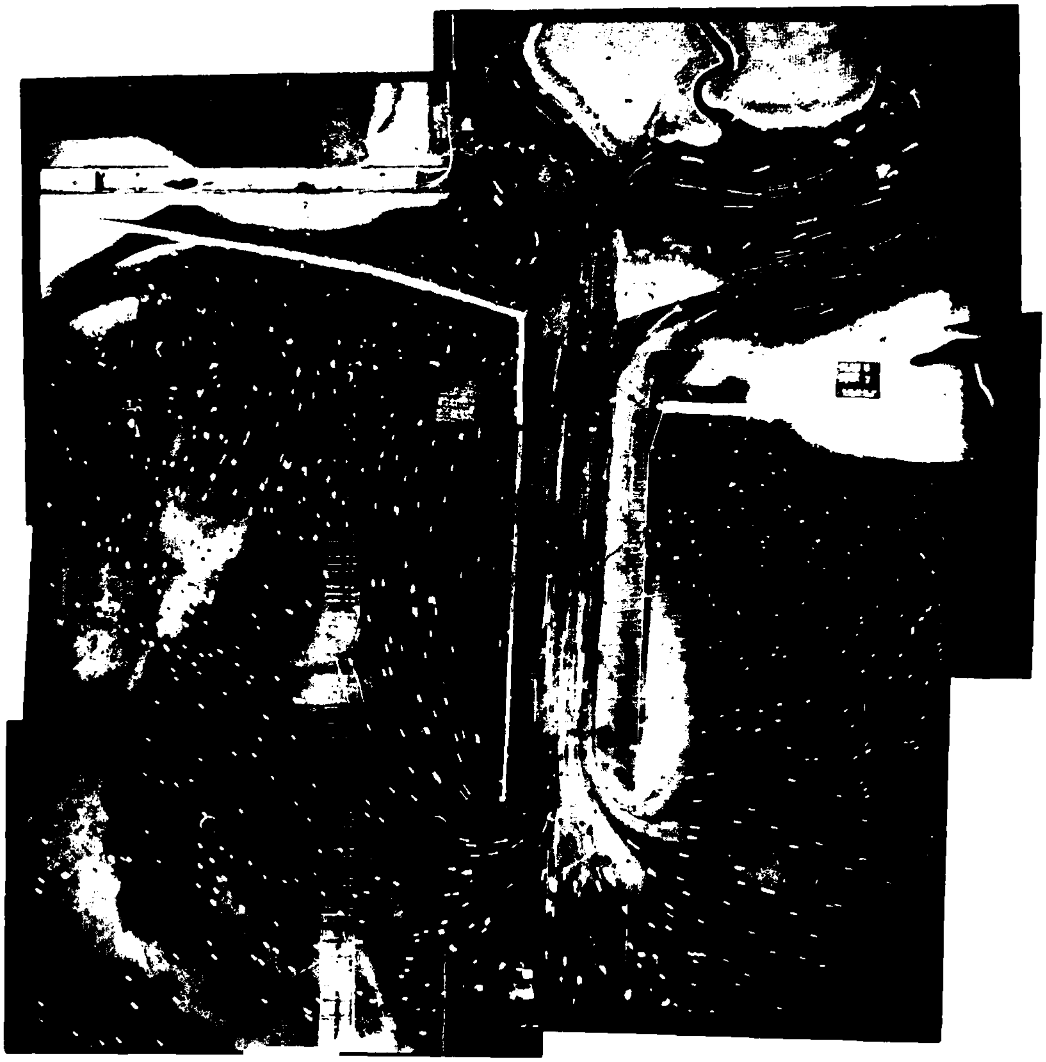
Figure A-20

VELOCITY SCALE

4 6 8

SURFACE CURRENT
PATTERNS
PLAN 4
HOUR 10

Figure A-21



VELOCITY SCALE

2 0 2 4 6 8 FPS

SURFACE CURRENT PATTERNS

PLAN 6

HOUR 7

Figure A-22

VELOCITY SCALE

2 0 2 4 6 8 FPS

SURFACE CURRENT PATTERNS

PLAN 6

HOUR 10

Figure A-23

VELOCITY SCALE

2 0 2 4 6 8

SURFACE CURRENT
PATTERNS
PLAN 7
HOUR 7

Figure A-24

SURFACE CURRENT
PATTERNS
PLAN 7

Figure A-25

Base Test

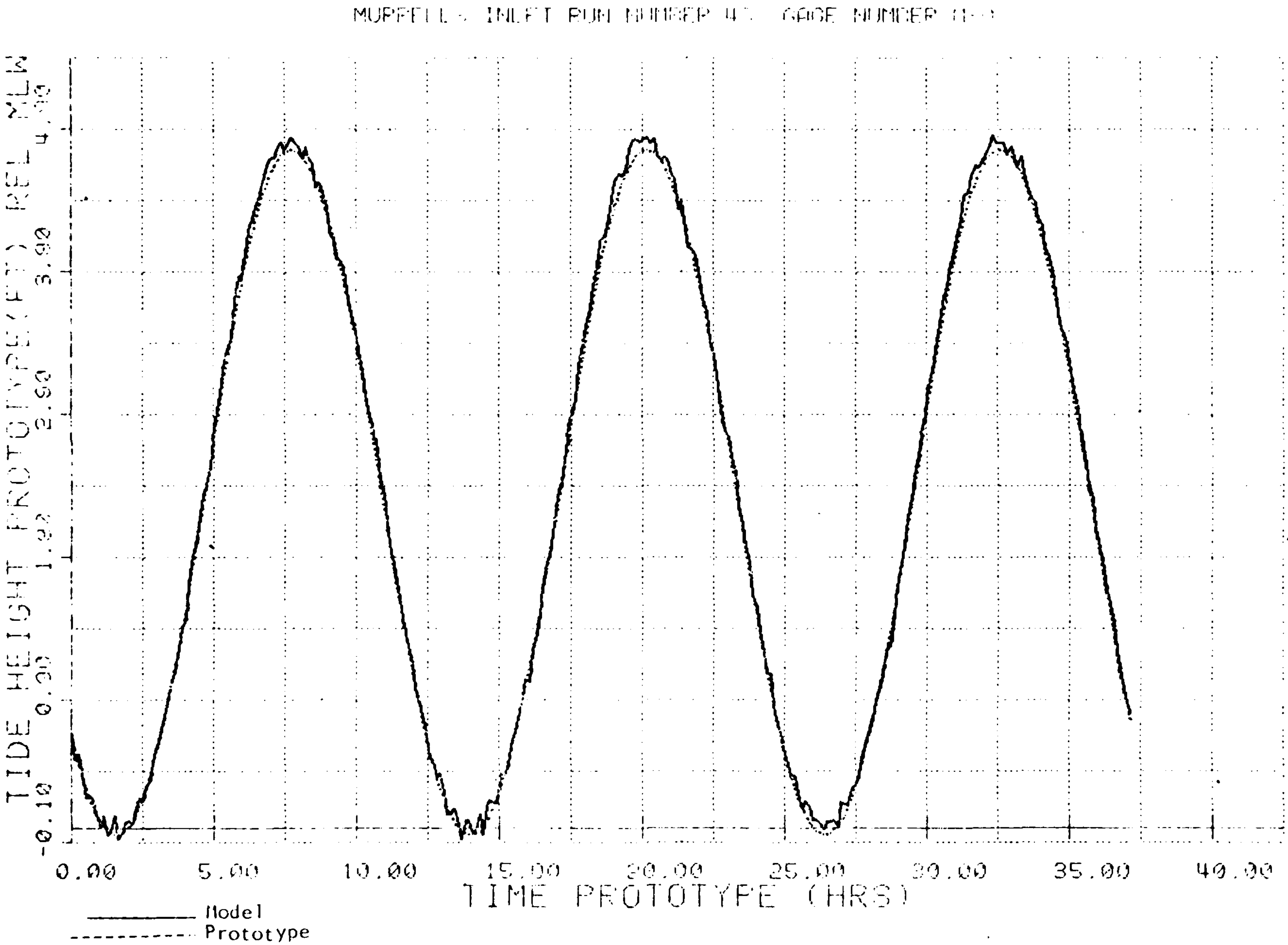


Figure A-26

Base Test

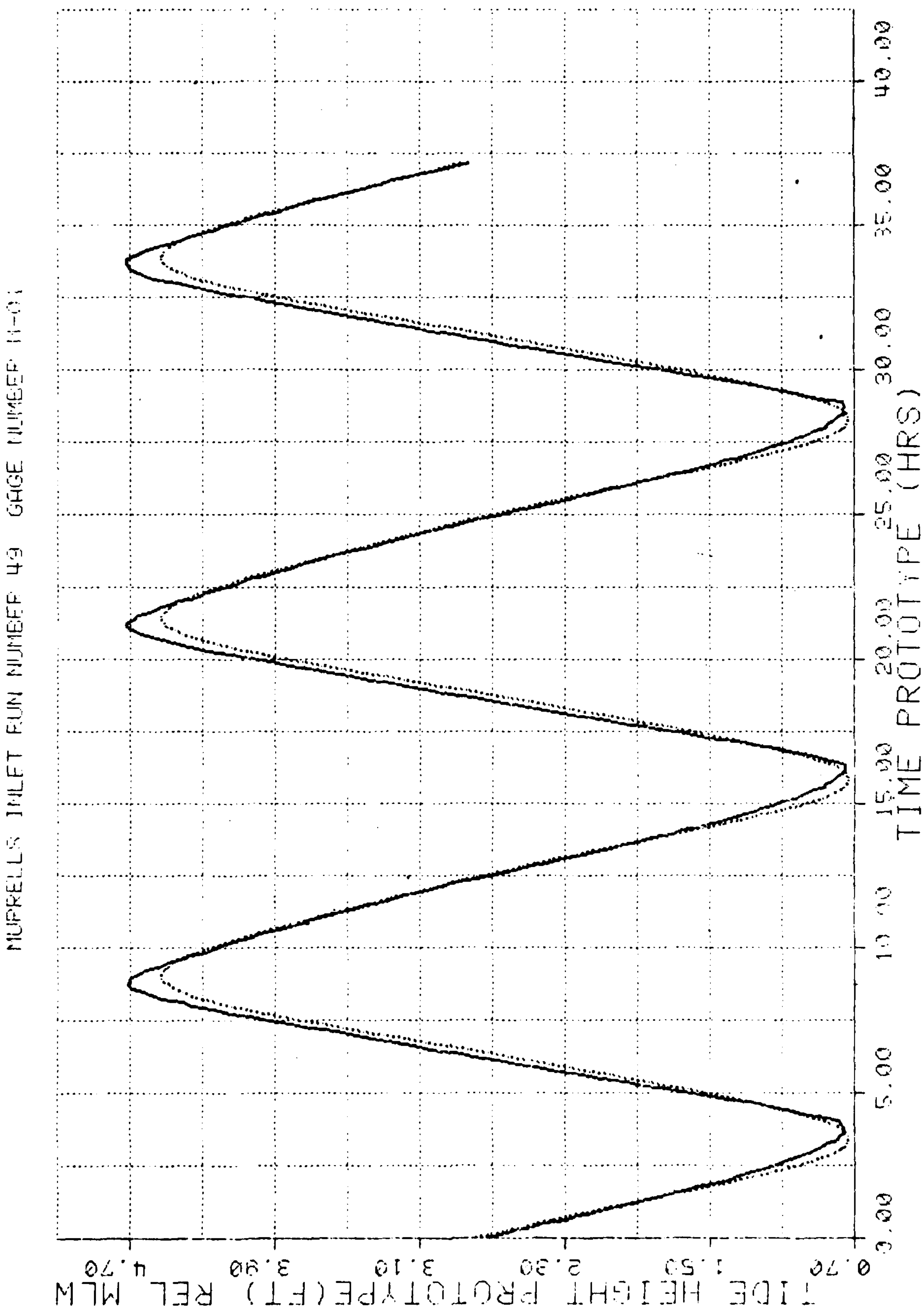


Figure A-27

Base Test

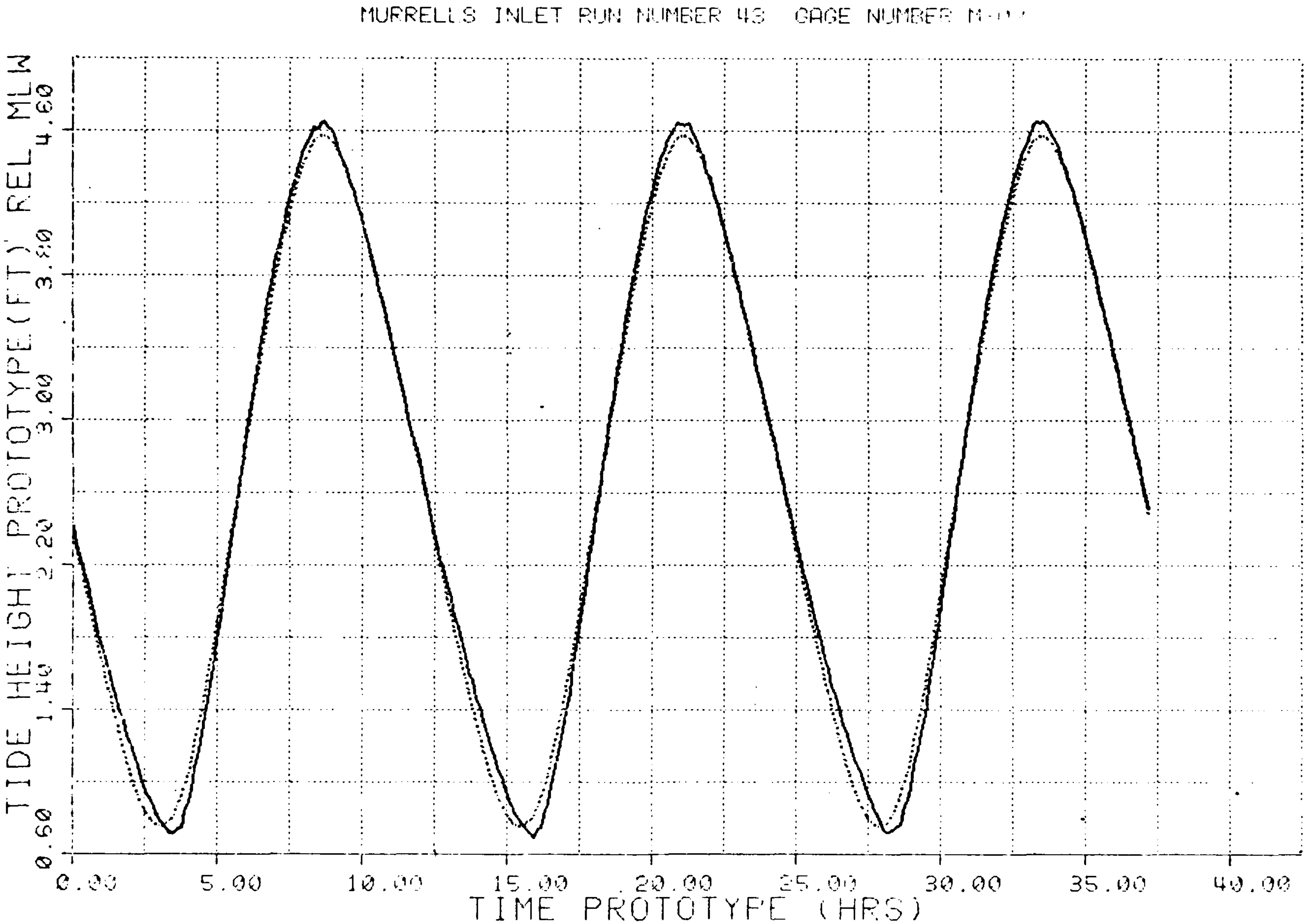


Figure A-28

Base Test

MURRELLS INLET RUN NUMBER 43 GAGE NUMBER M-03

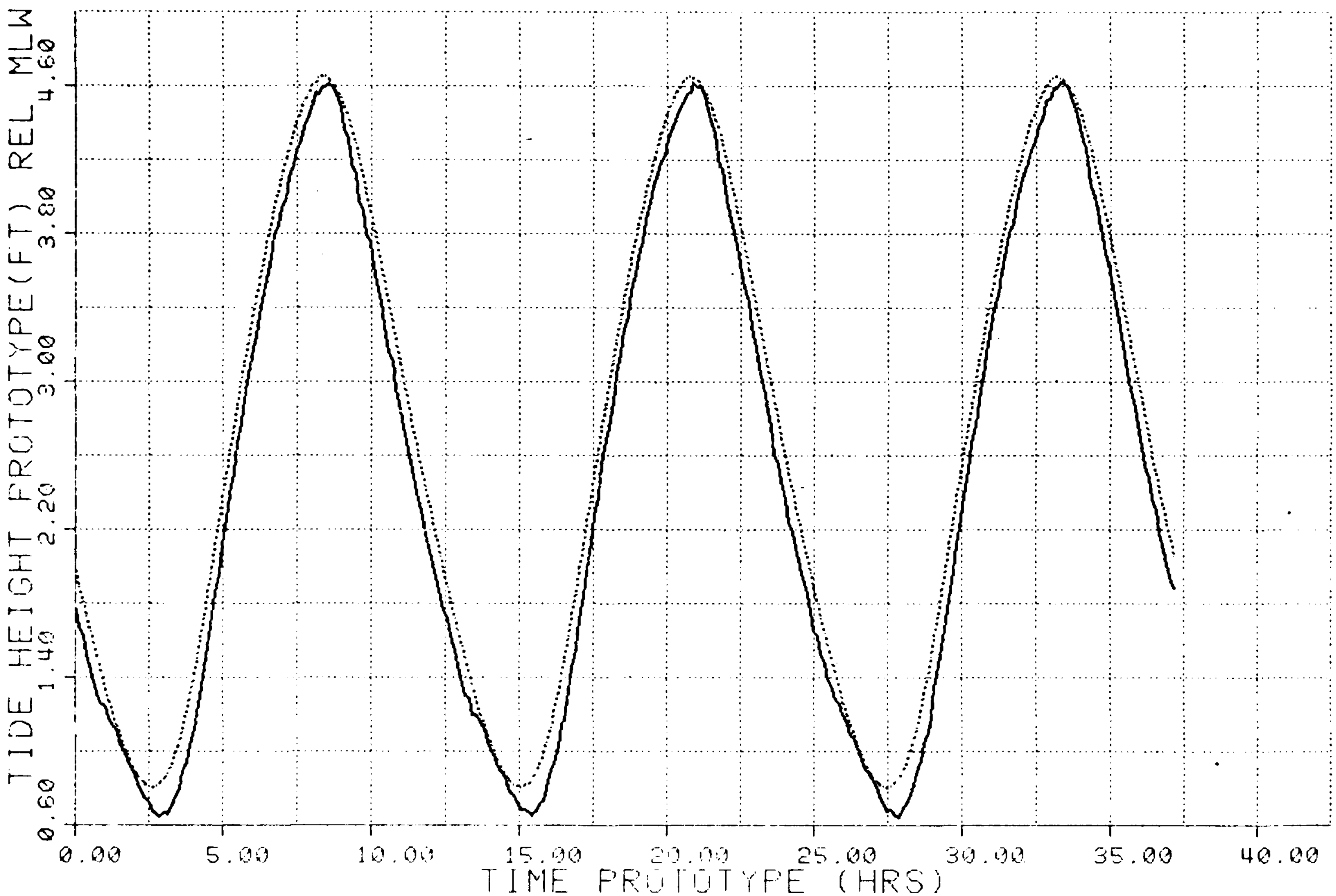


Figure A-29

Base Test

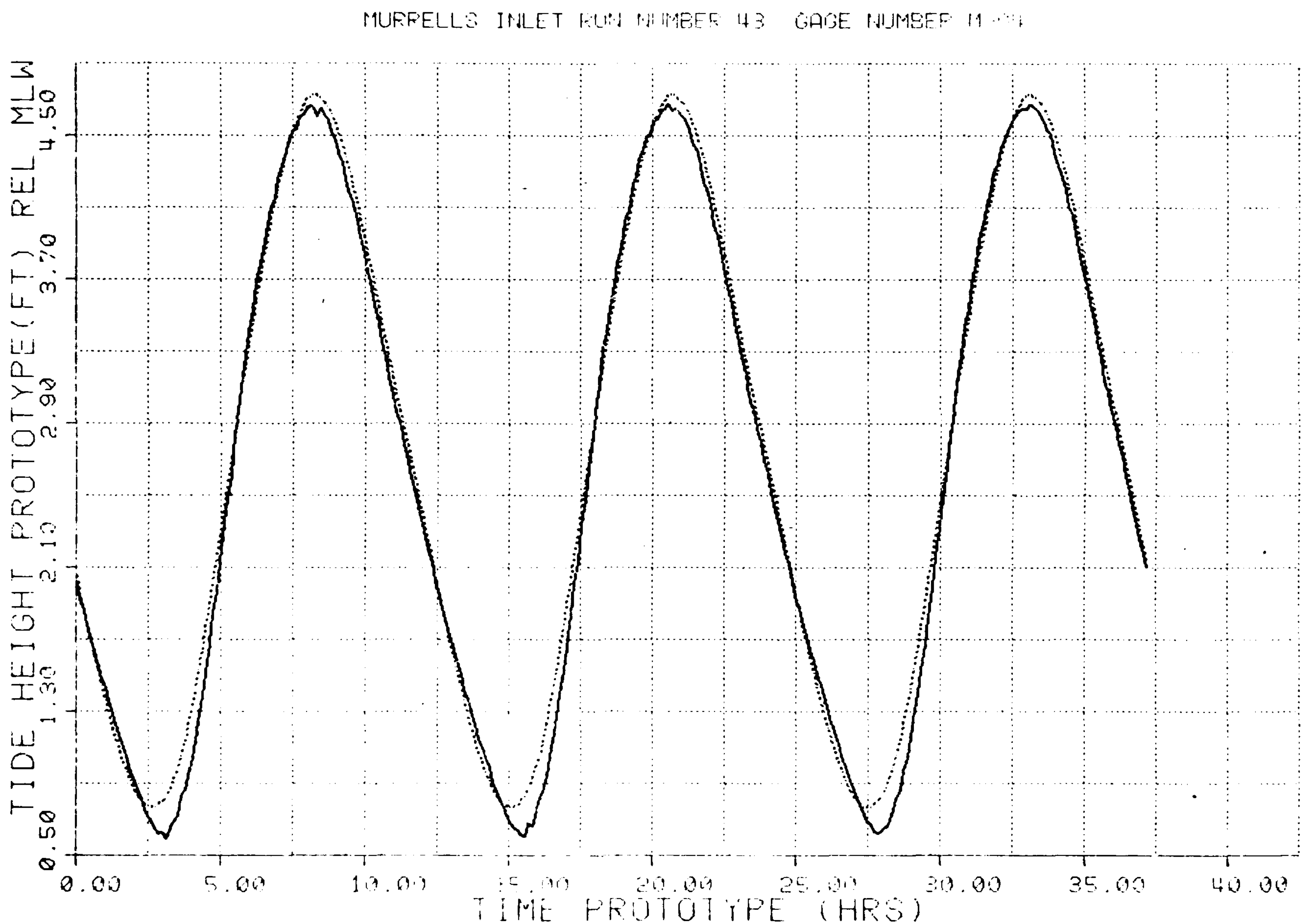


Figure A-30

Base Test

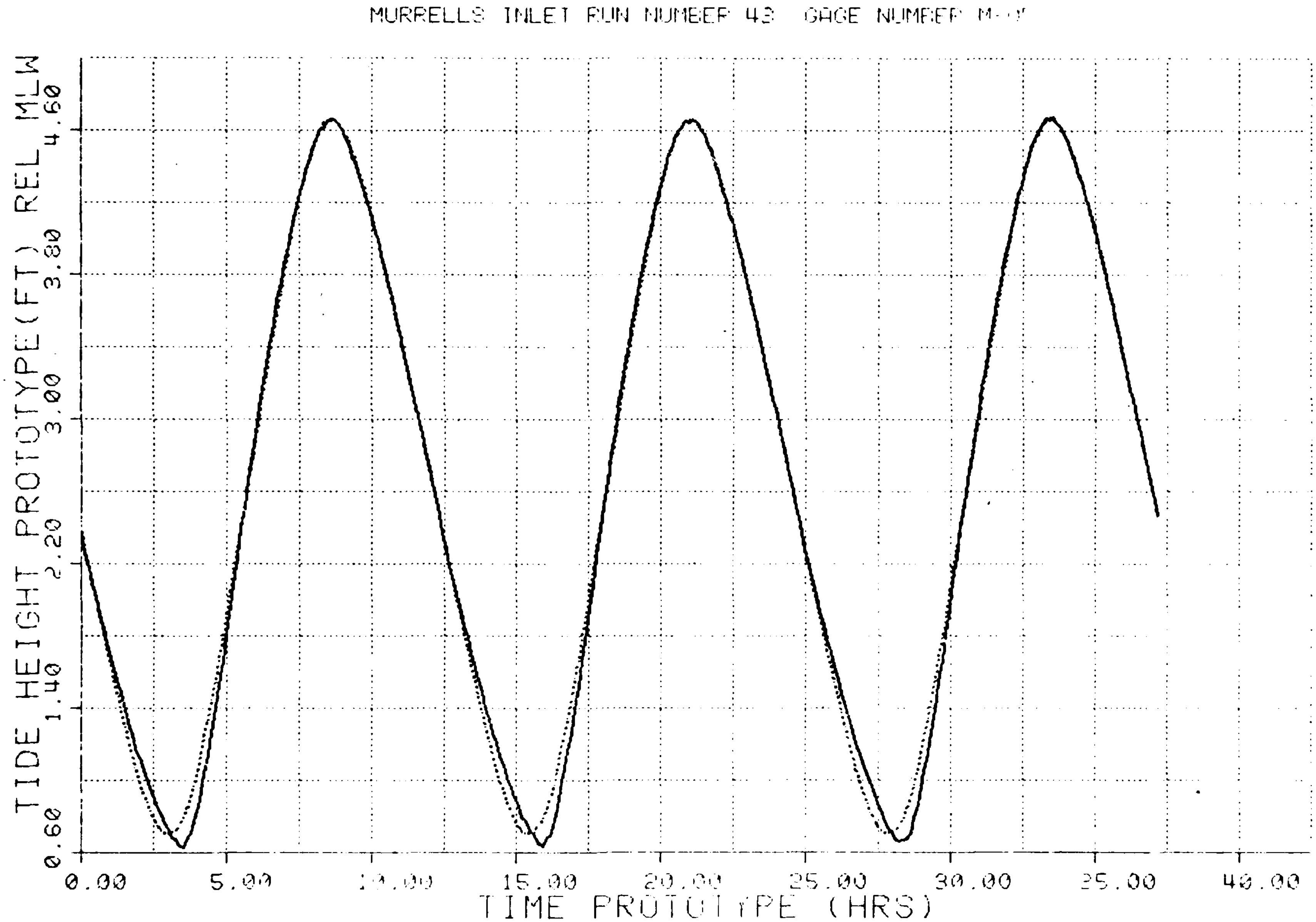
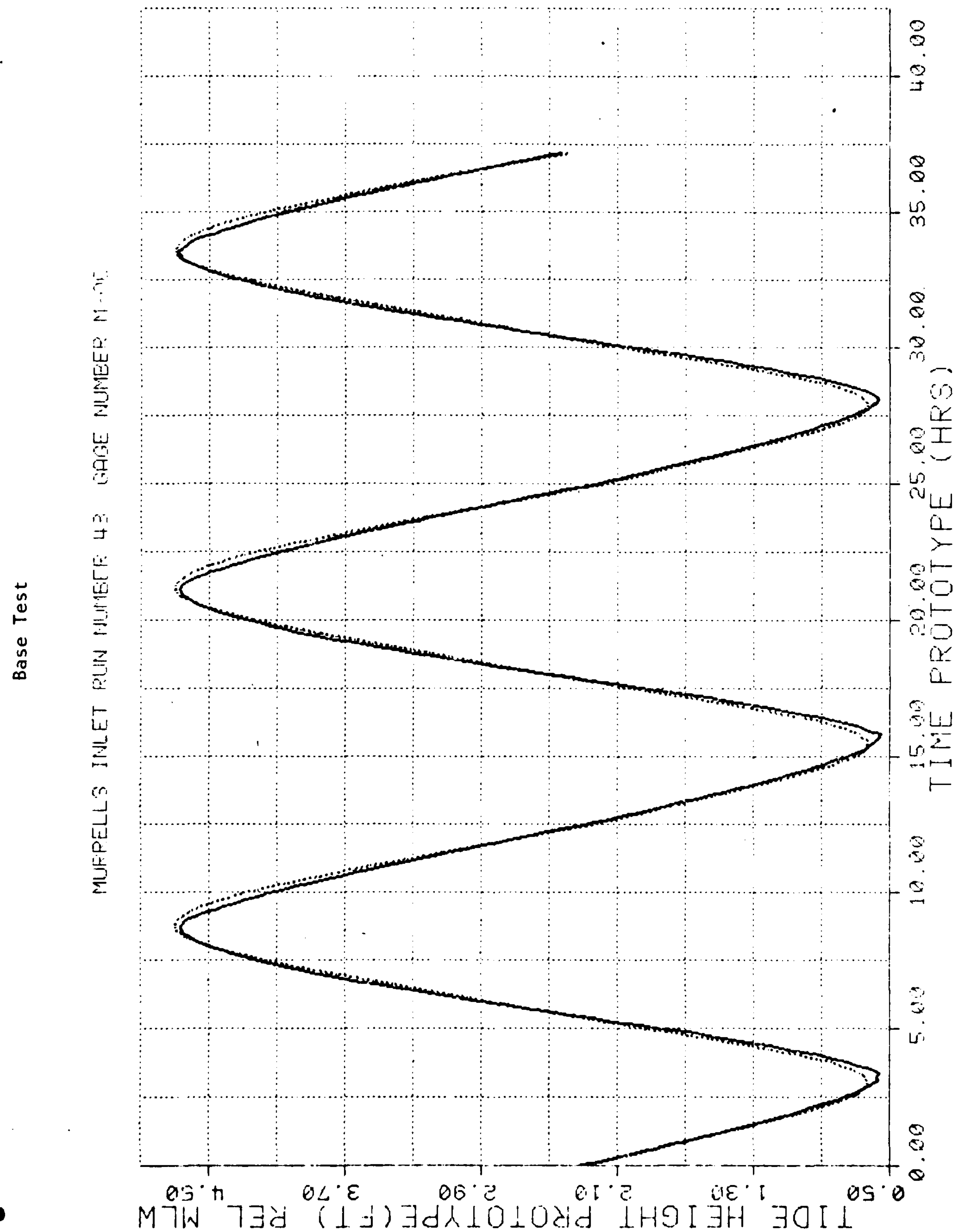


Figure A-31



Base Test
MURRELLS INLET RUN NUMBER 43 GAGE NUMBER
TIDE HEIGHT PROTOTYPE(FT) REL MLW
0.50
1.30
2.10
2.90
3.70
4.50
TIME PROTOTYPE (HRS)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00

Figure A-32

Base Test

MURRELLS INLET RUN NUMBER 49 GAGE NUMBER M-07

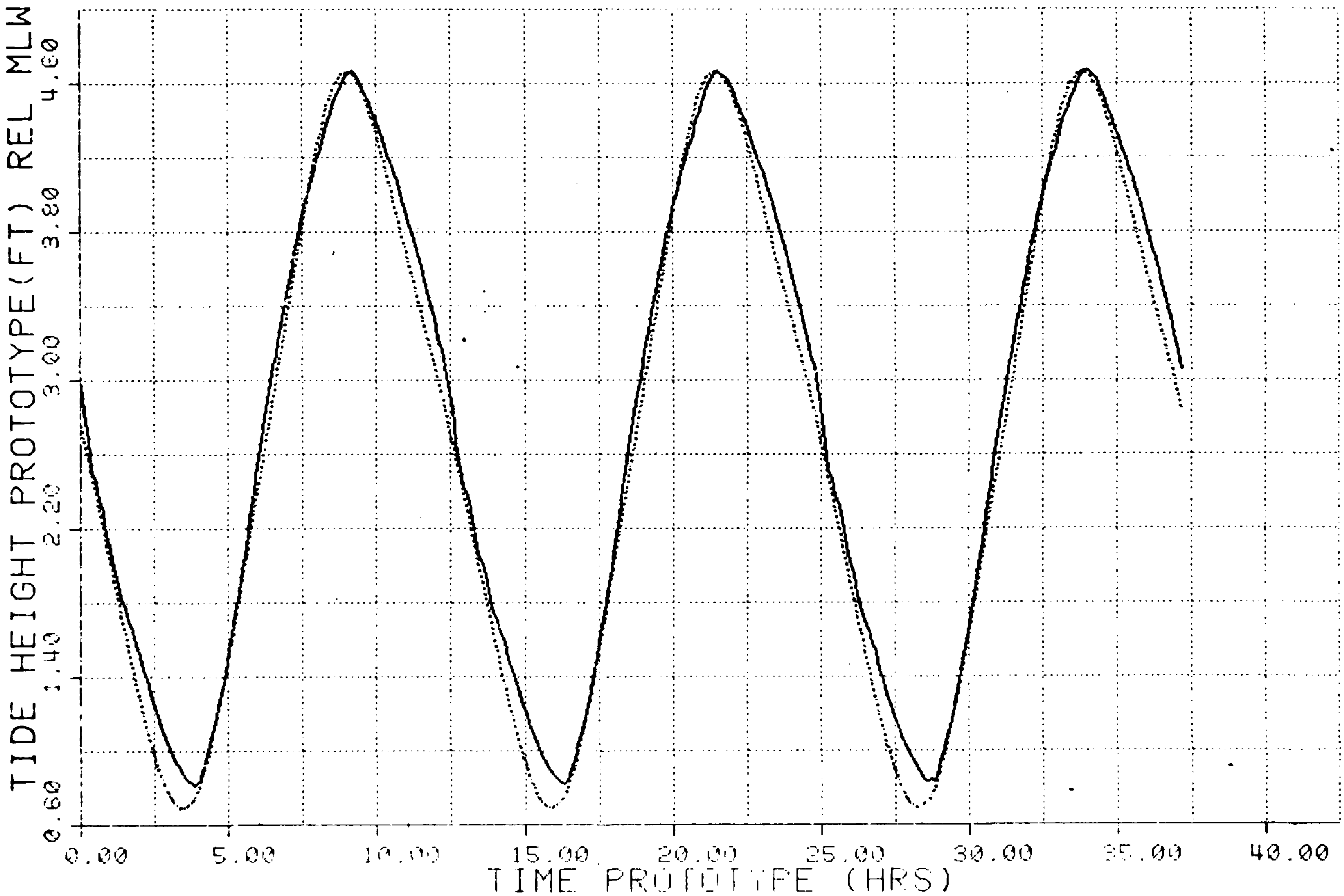


Figure A-33

Plan 1

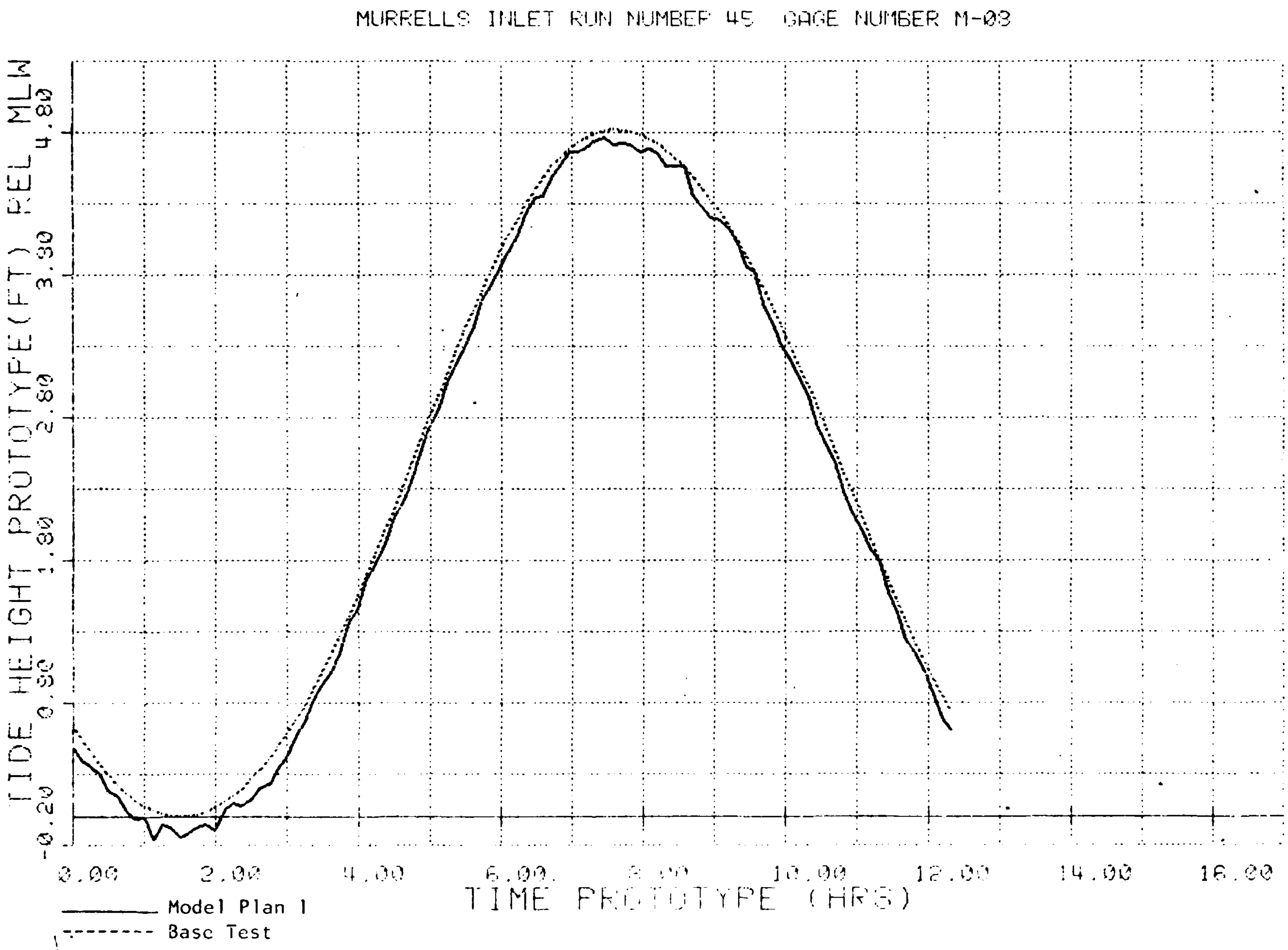


Figure A-34

Plan 1

MURRELLS INLET RUN NUMBER 45   GAGE NUMBER M-01

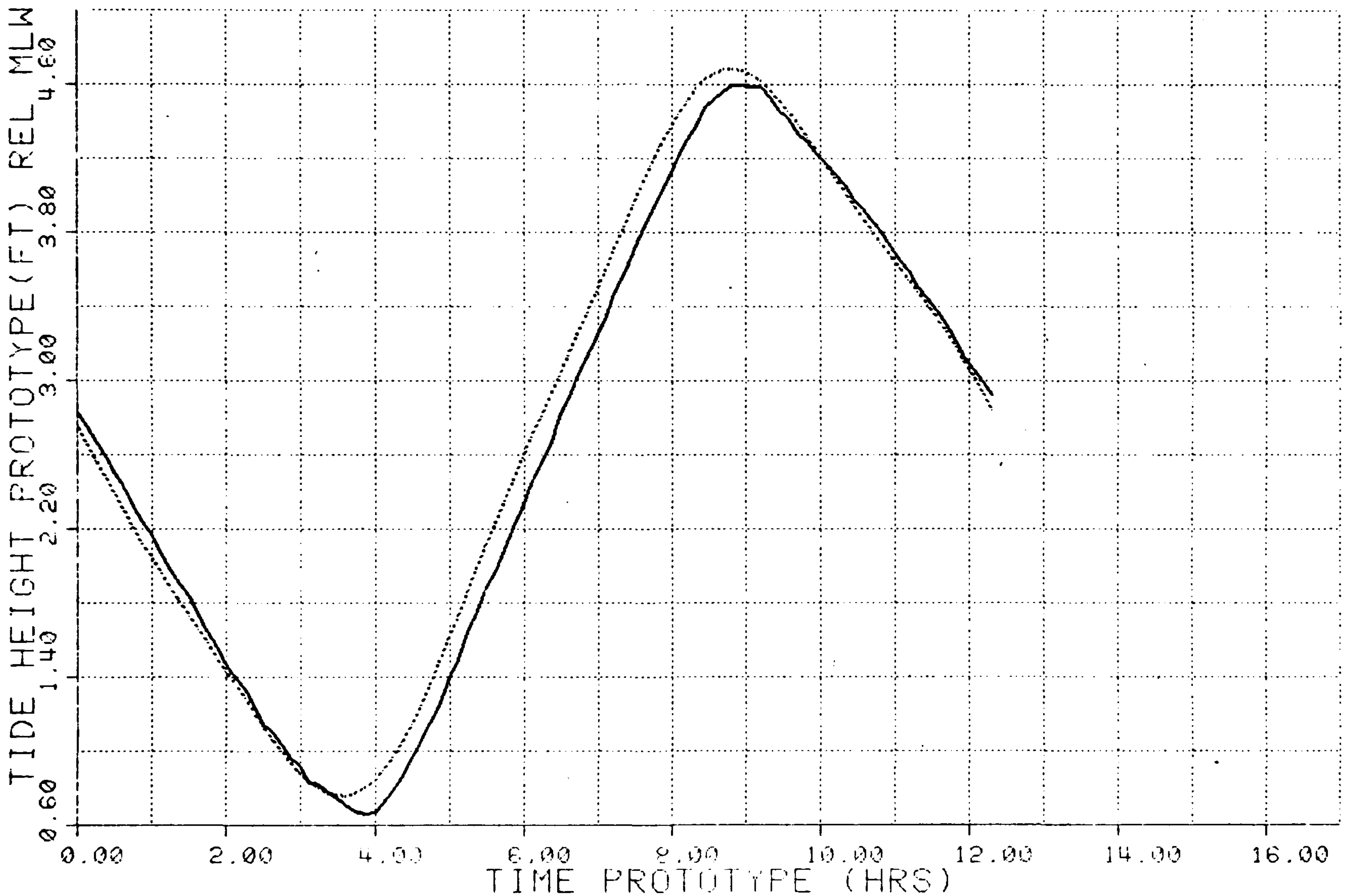


Figure A-35

Plan 1

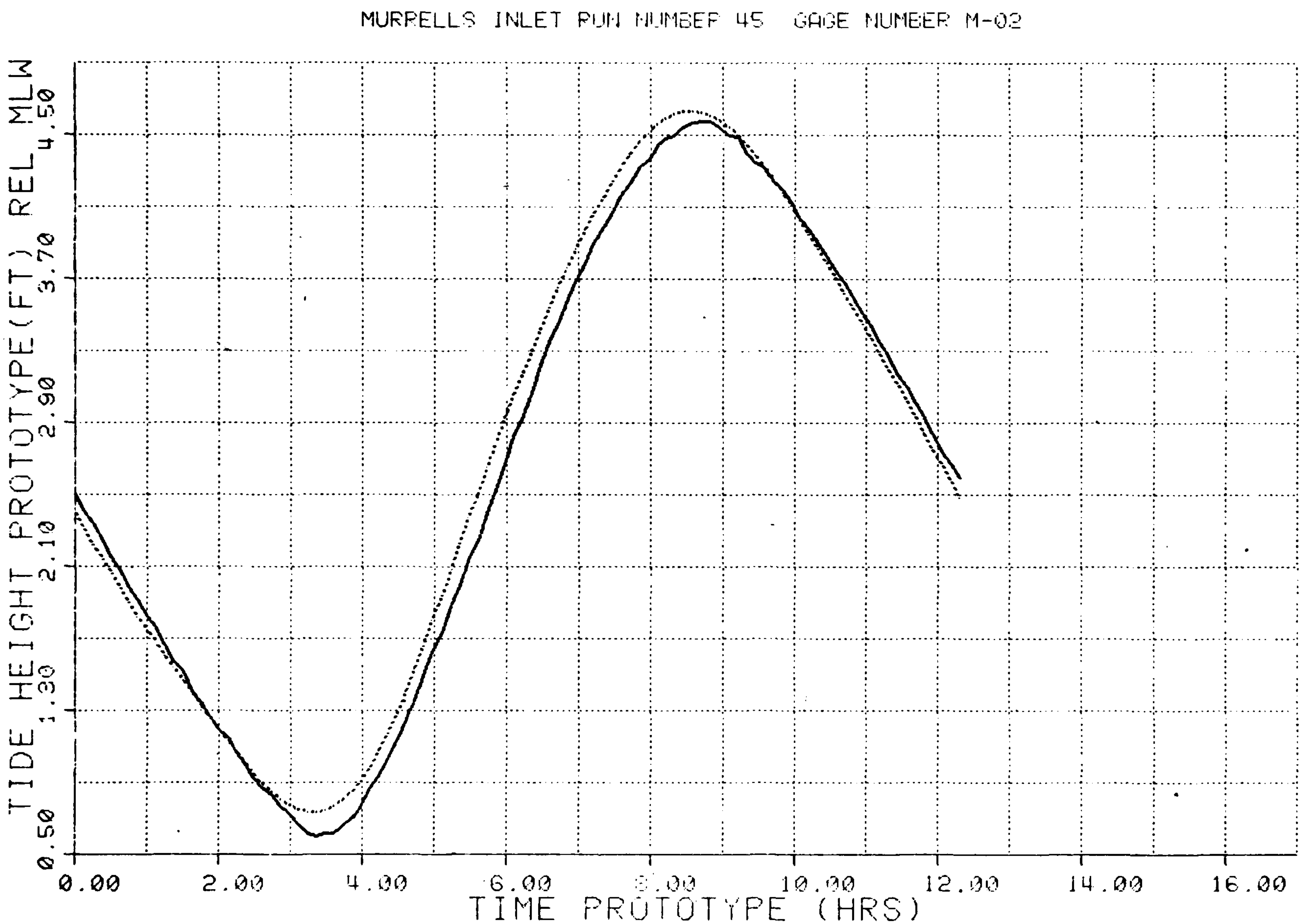


Figure A-36

Plan 1

MURRELLS INLET RUN NUMBER 45 GAGE NUMBER M-03

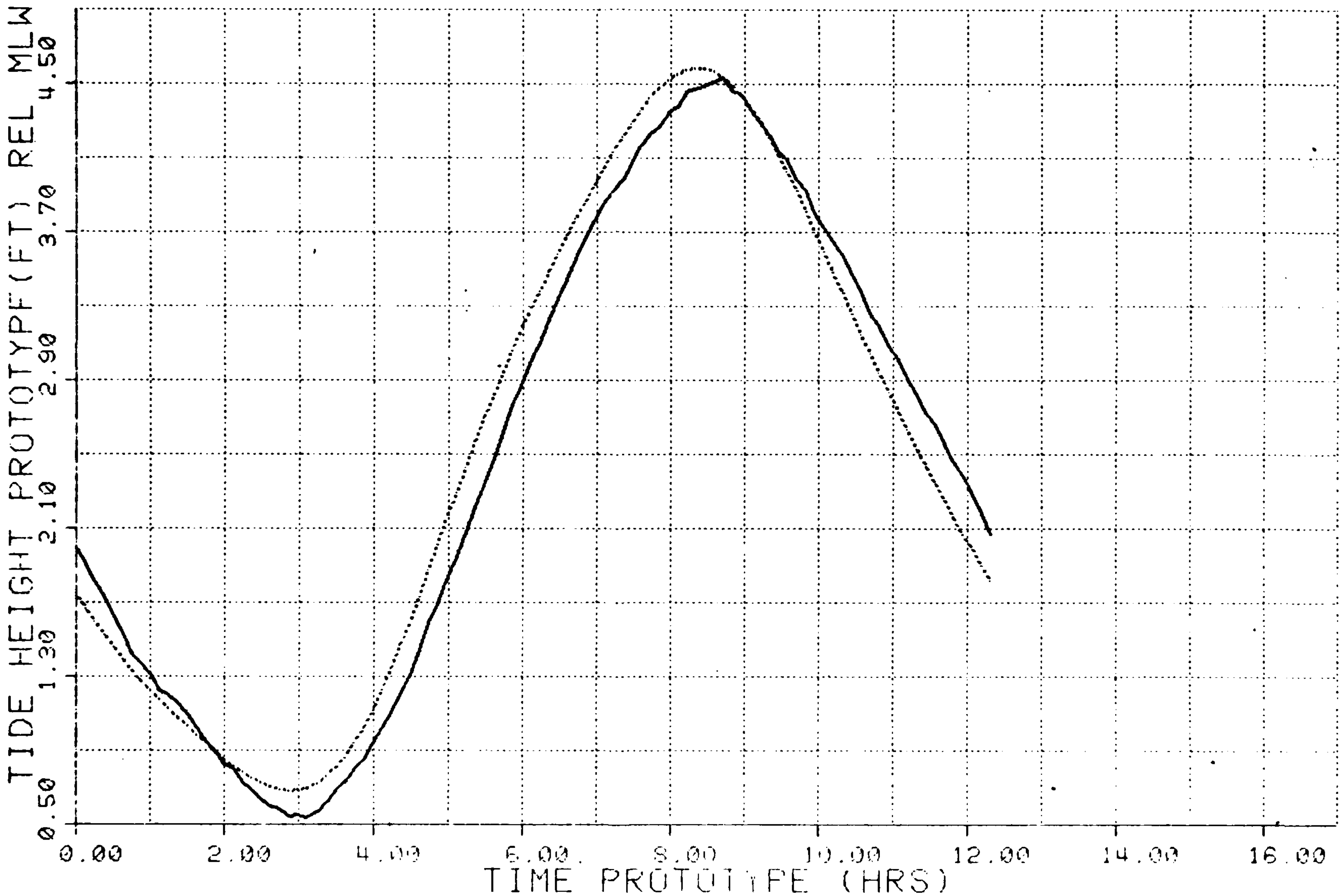


Figure A-37

Plan 1

MURRELLS INLET RUN NUMBER 45 GAGE NUMBER M-04

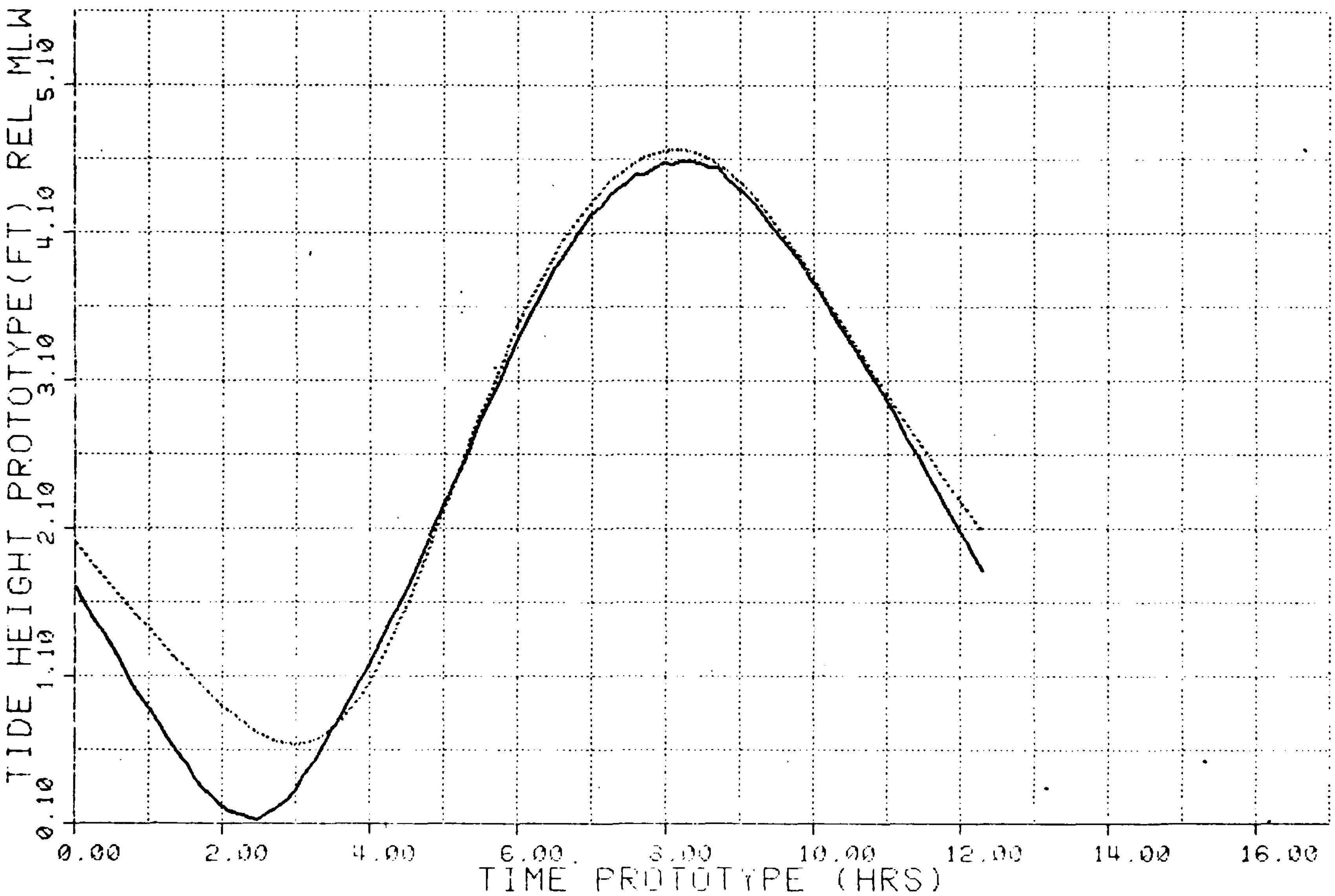


Figure A-38

Plan 1

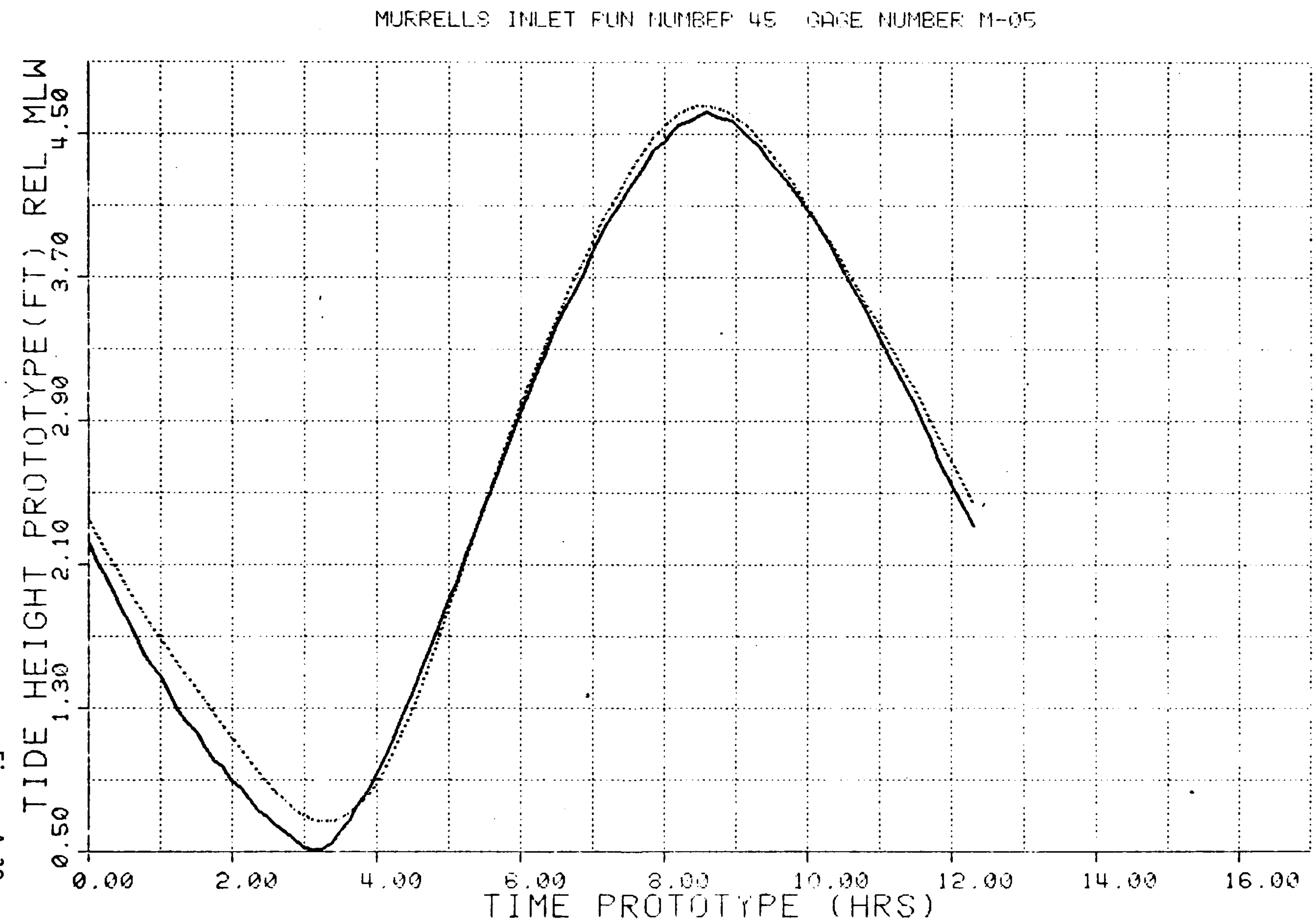


Figure A-39

Plan 1

MURRELLS INLET RUN NUMBER 45 GAGE NUMBER M-06

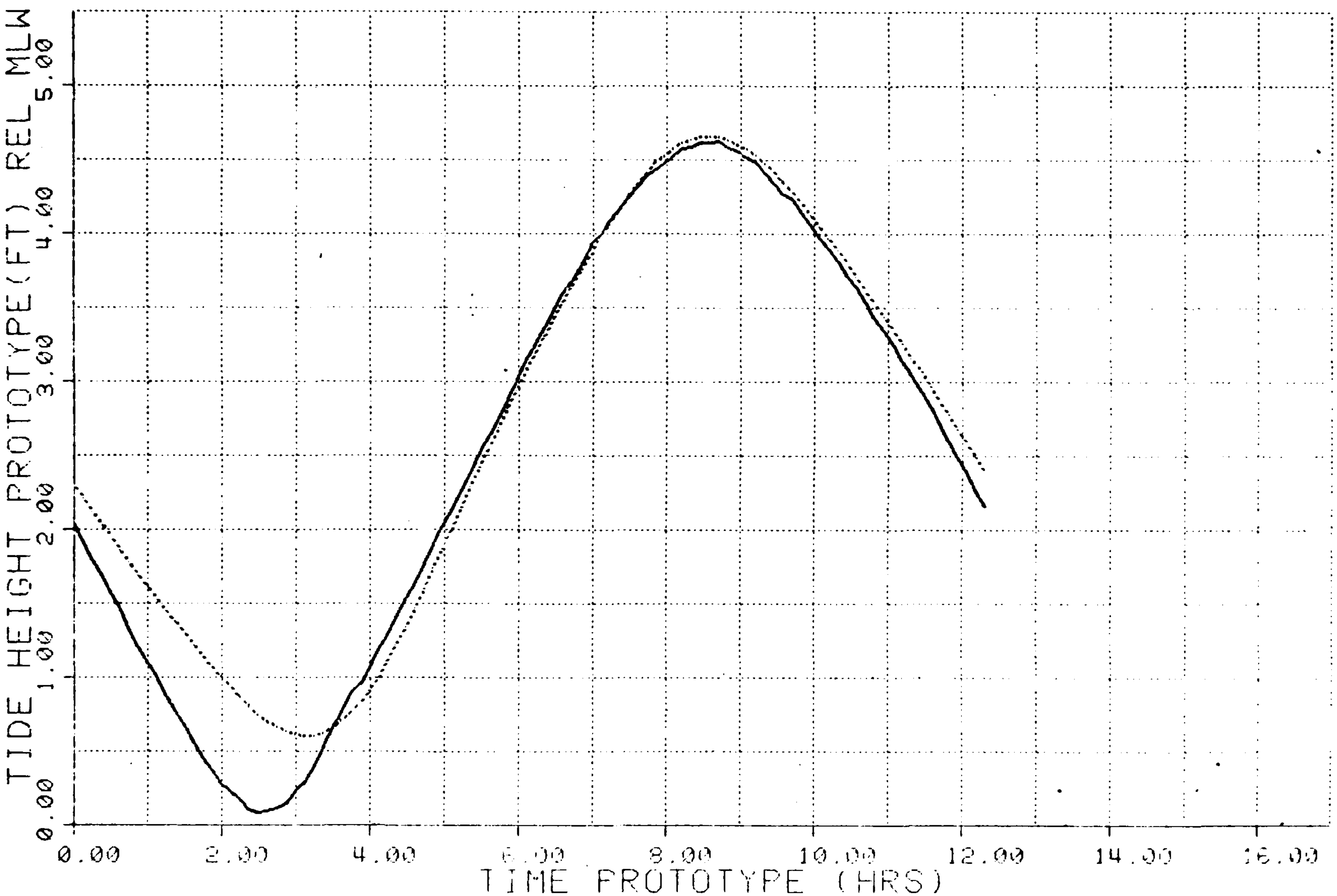


Figure A-40

Plan 1

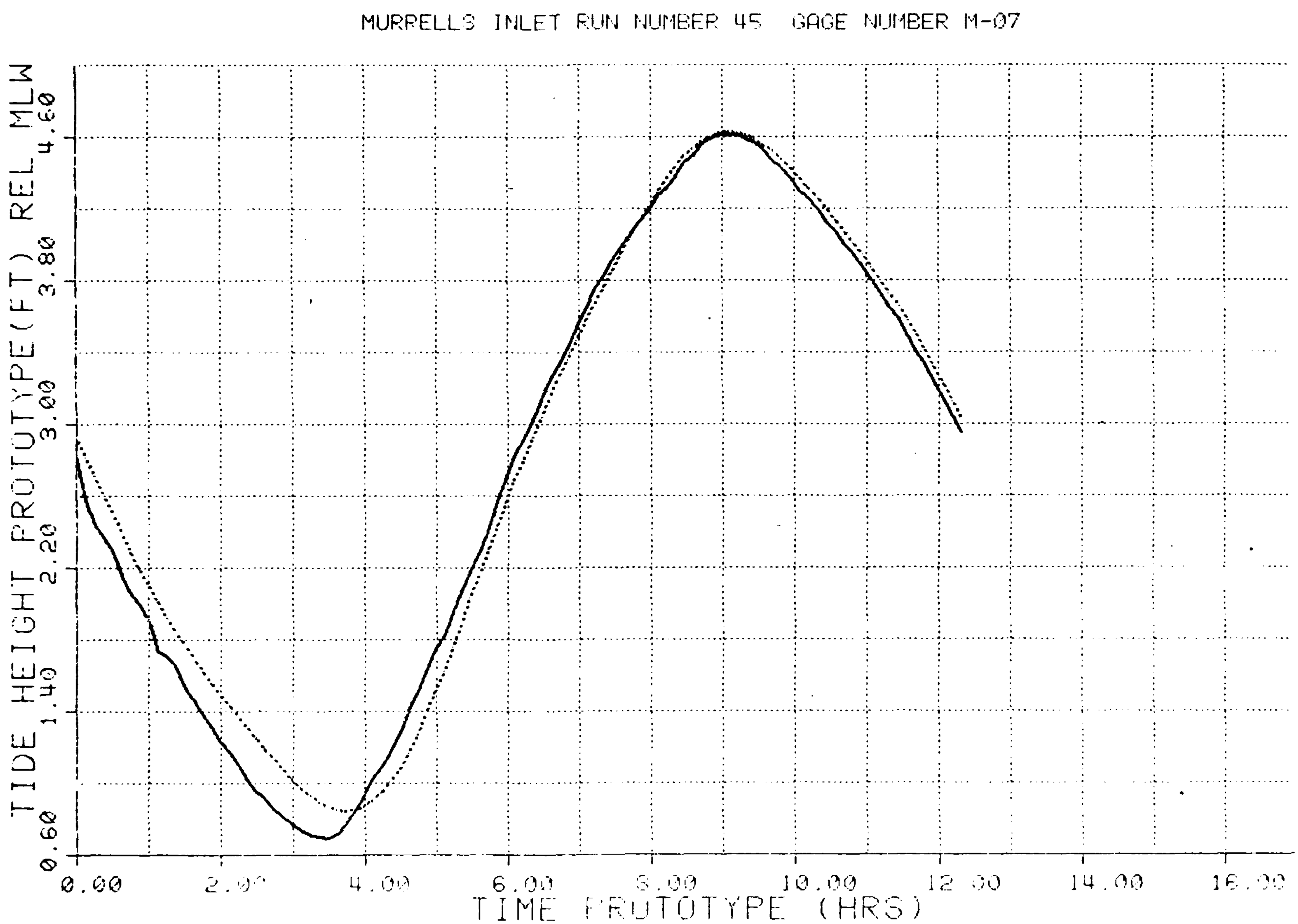


Figure A-41

Plan 7

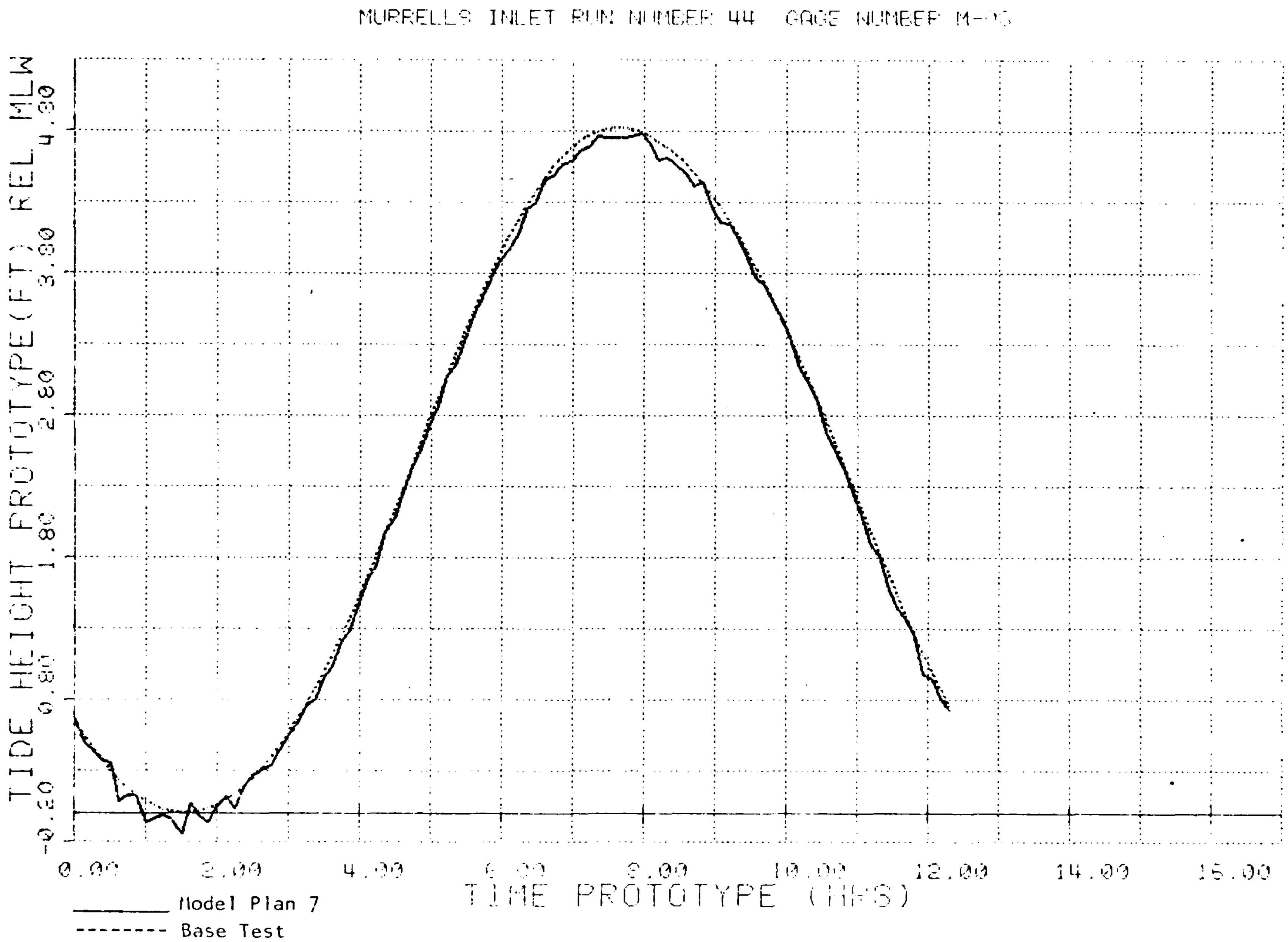


Figure A-42

Plan 7

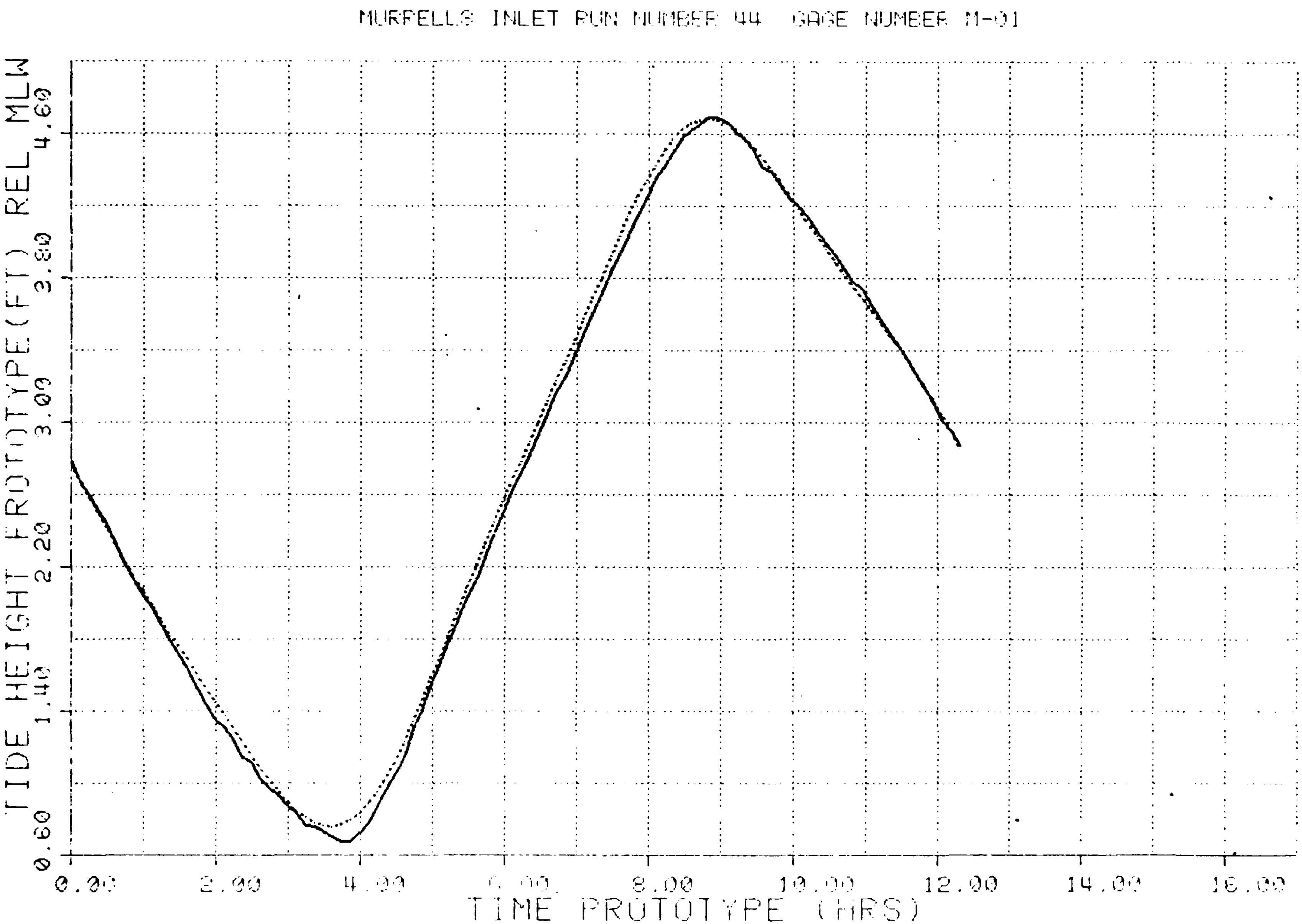


Figure A-43

Plan 7

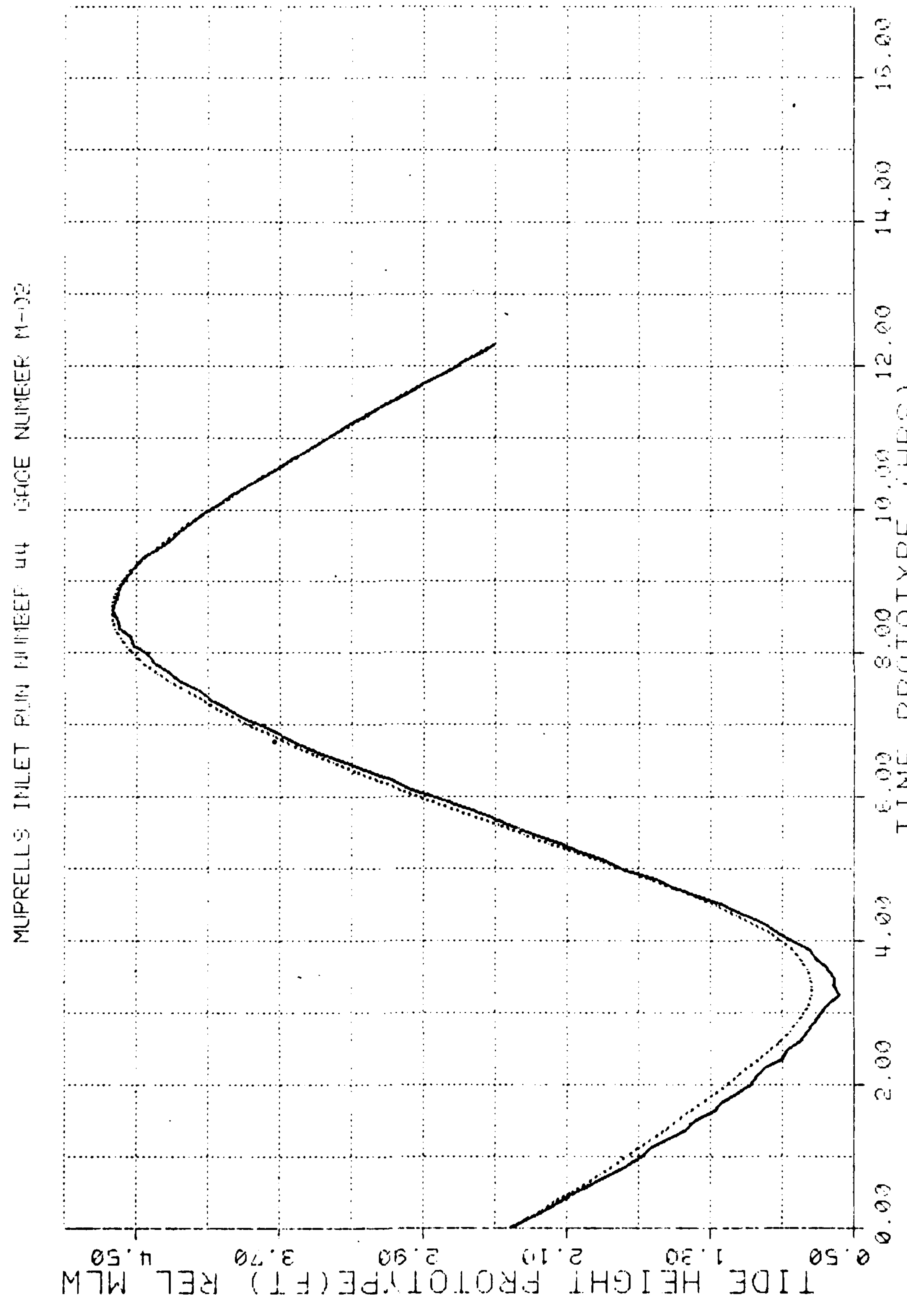
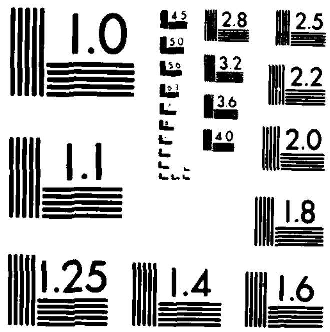


Figure A-44

AD-A150 159 MURRELLS INLET SOUTH CAROLINA NAVIGATON PROJECT GENERAL DESIGN MEMORANDUM(U) CORPS OF ENGINEERS CHARLESTON SC CHARLESTON DISTRICT 02 DEC 75 3/4

UNCLASSIFIED F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Plan 7

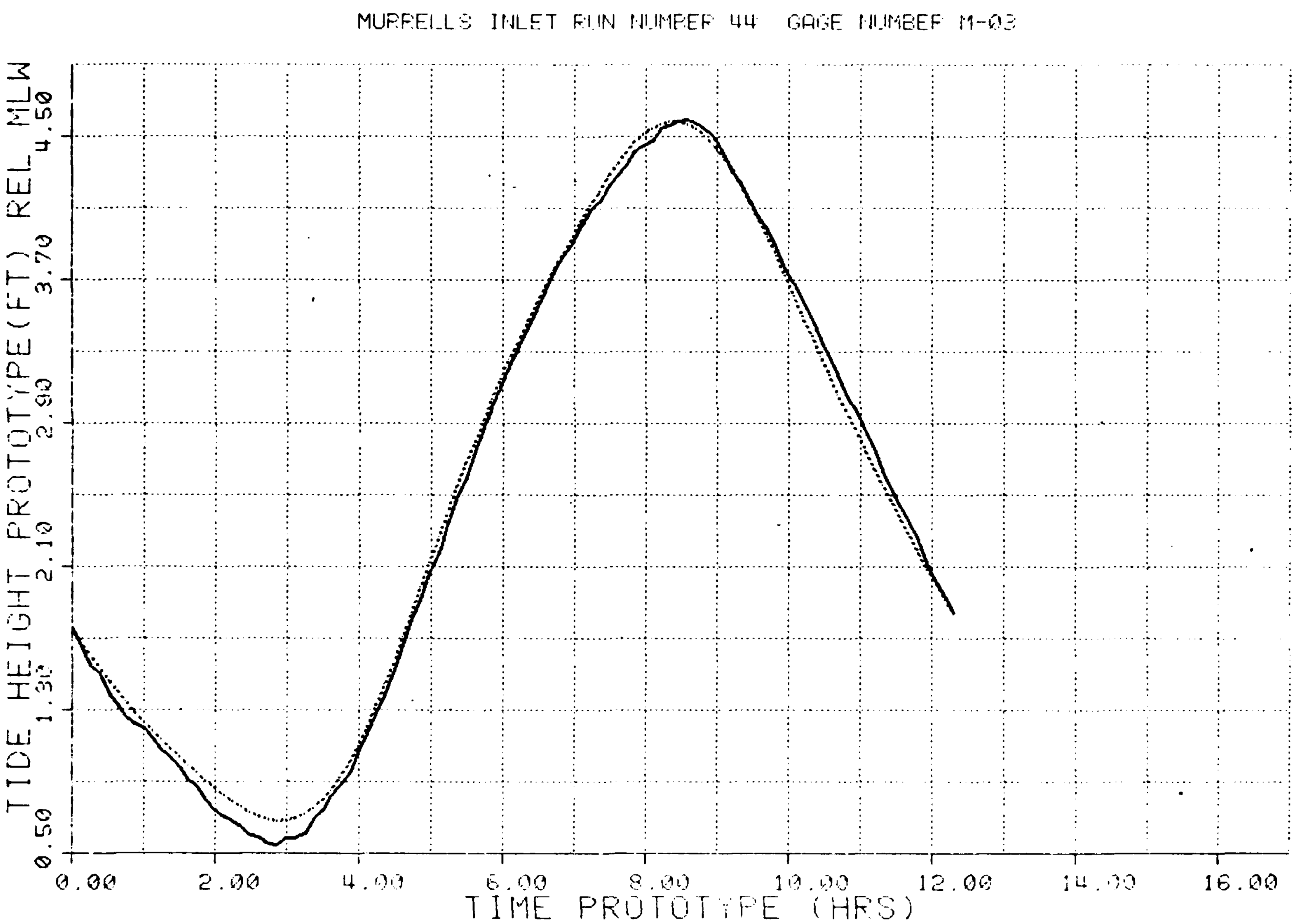


Figure A-45

Plan 7

MURRELLS INLET RUN NUMBER 44 GAGE NUMBER M-04

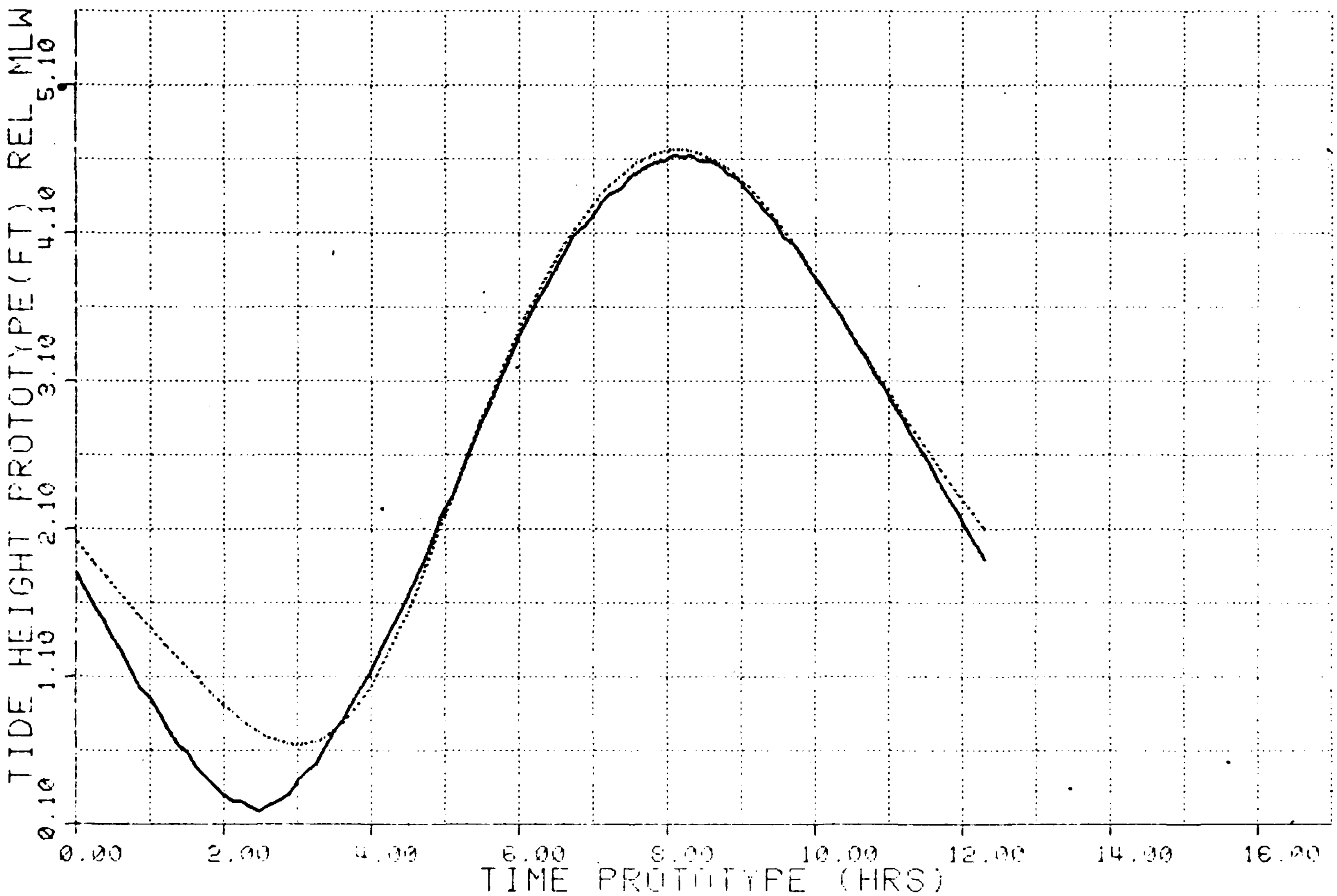


Figure A-46

Plan 7

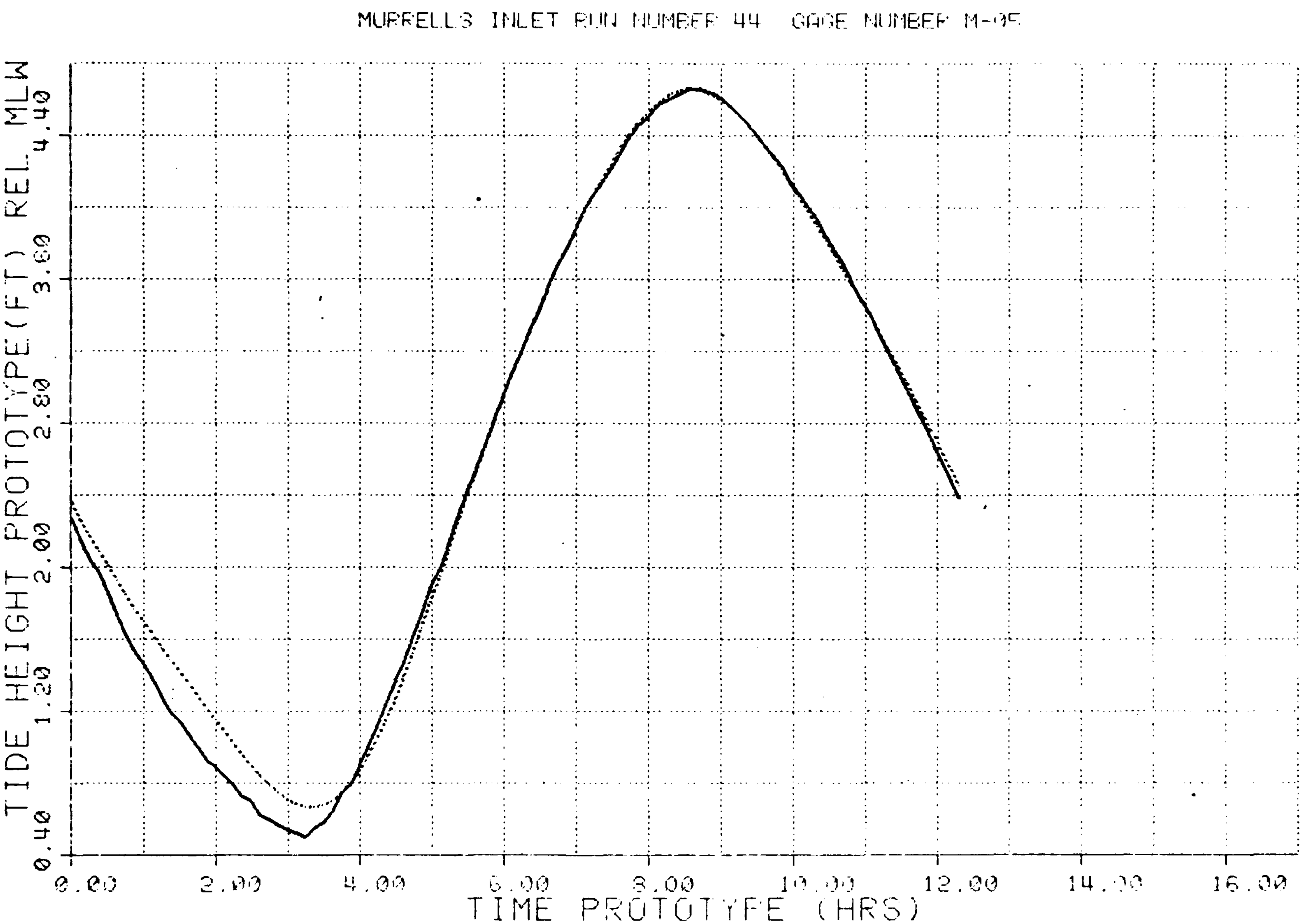


Figure A-47

Plan 7

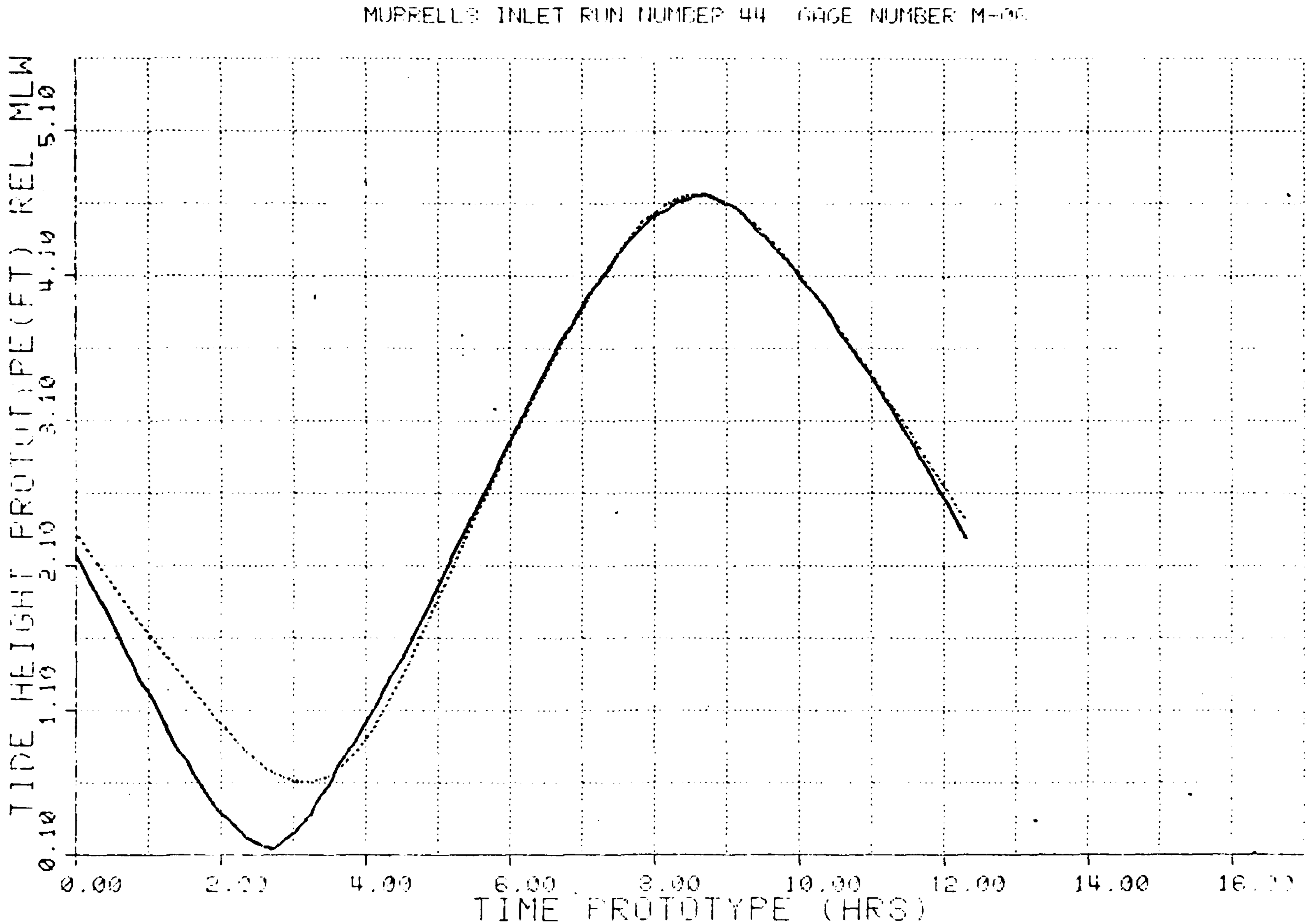


Figure A-48

Plan 7

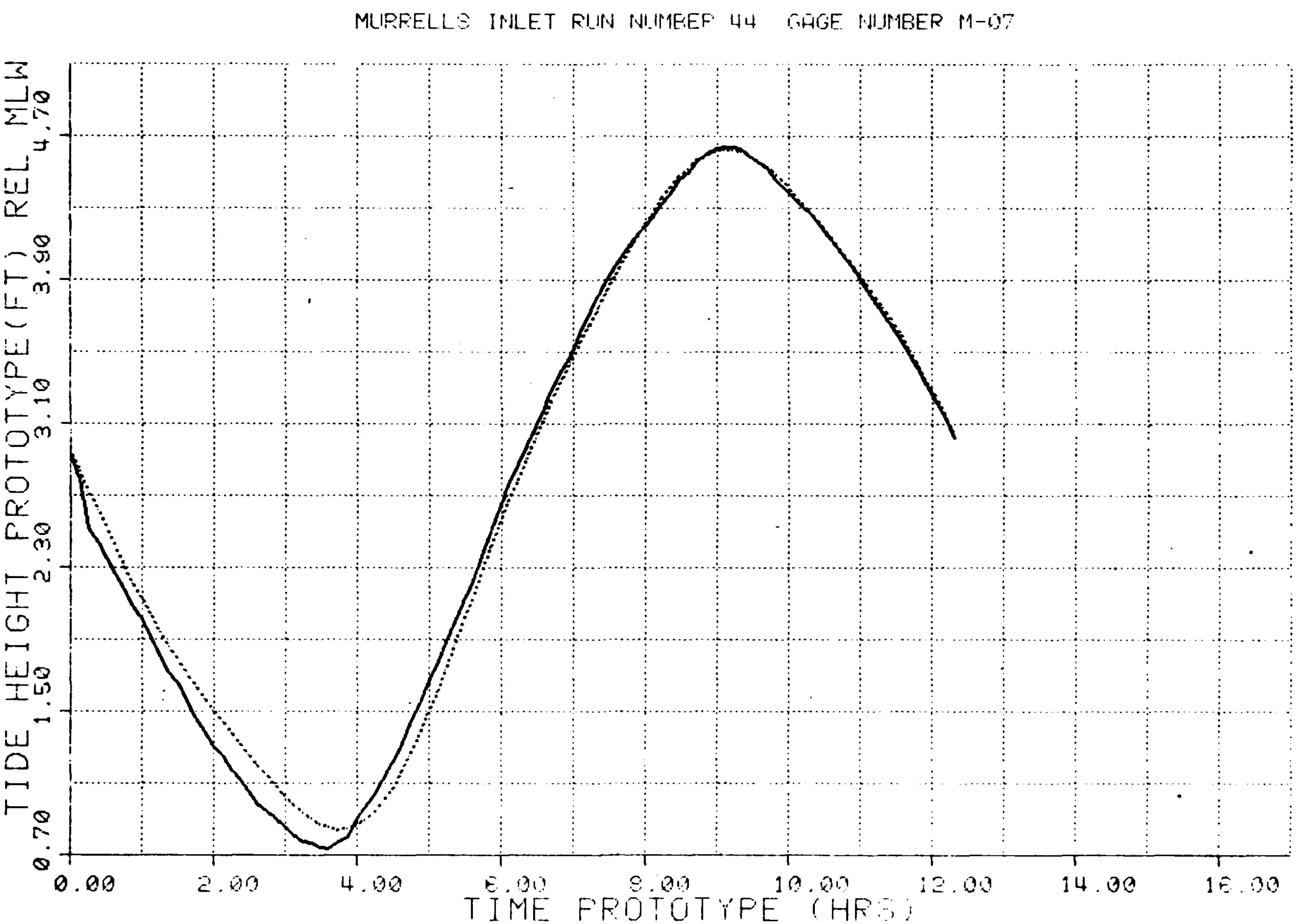


Figure A-49

APPENDIX B

RECREATION RESOURCES

TABLE OF CONTENTS

Text

APPENDIX B

RECREATION RESOURCES

INTRODUCTION

1. Authority for recreational development. Authority to participate with non-Federal interests in the provision of basic recreational facilities required for public health, safety, and access to significant project-related recreational resources is contained in Section 4 of the 1944 Flood Control Act, as amended by Sections 4, 209, and 207 of the Flood Control Acts of 1946, 1954, and 1962, respectively. Basic legislation is further affected by the Land and Water Conservation Fund Act (P.L. 88-578) and the Federal Water Project Recreation Act (P.L. 89-72) of 1965.

2. Purposes. This appendix presents a plan, based on the desires of local interest, for the provision of a fishing walkway atop the proposed south jetty of the authorized Murrells Inlet Project. It also considers sanitary facilities to service the users.

3. Background. Previous studies on Murrells Inlet include the authorizing document as contained in HD 92-137, 92nd Congress, 1st Session. The walkway plan presented in this document would develop 26,600 visitor days annually. This plan included an access road and parking area to the project site. Items of local cooperation for this plan required (a) a local share cash contribution in the amount of 50 percent of the recreational fishing walkway construction cost which share was estimated at $81,000 and (b) provide without cost to the United States, maintenance of the fishing walkway and associated access and parking facilities.

DESCRIPTION OF PROJECT AREA

4. Geographic. Murrells Inlet is an opening through the barrier beach along the coast of South Carolina about 19 miles northeast of the City of Georgetown and 13 miles southwest of the City of Myrtle Beach. Barrier beaches extend about 4 miles each side of the Inlet and vary in widths from 100 to 1,000 feet. The Inlet is the ocean entrance to several tidal streams in the Murrells Inlet - Garden City estuarine area. Mean tide range is 4.5 feet and spring tide range is 5.3 feet. The channel leading to the migrating inlet is obstructed by a shifting offshore bar and the inlet throat is obstructed by extensive sand shoals attending migration of the inlet. This condition constitutes an unstable channel without adequate depths to permit unrestricted navigation through the inlet and offshore bar.

5. Venice-type canals have been constructed on the north side of the inlet to within about 250 feet, in several places, of the ocean high-water shoreline. These canals provide water access for building lots on the landward side of the barrier spit. Canals are walled making them

resistant to erosion of a new inlet through the barrier by washing during periods of storm surge tide. Along the shore of the Atlantic Ocean an endless number of summer homes dot the shoreline. The public road servicing these houses terminates at a guarded entrance to a private subdivision approximately one-half mile from the proposed north jetty.

6. Huntington Beach State Park is located on the south side of Murrells Inlet. This park has two camping areas, picnic area, parking lots, playgrounds, concession stand, trading post, toilet facilities, minature golf course and an access road to within a mile of the proposed jetty.

7. Climate. Climate of the coastal area of South Carolina is strongly influenced by the Atlantic Ocean. Its moderating effect tends to prevent extr. es of temperature. Mild winters and warm summers are the rule. Summer temperatures usually range from 70 to 90 degrees. Water temperature during the summer is very warm, being 79 degrees in June and reaching 82 degrees in July and August. Beach activity peaks during this period. Winter temperatures vary from the mid-thirties in the mornings to high fifties in the afternoon. Water temperature drops to 50 degrees. The air and water temperatures in winter discourage swimming, but other recreation can be enjoyed throughout the year. Severe weather occurs in the form of hurricanes, tropical storms, and tornadoes. Generally, these storms cause heavy rain, moderately strong winds and some damage. Tropical weather activity is most likely in July through October.

8. Topography. Huntington Beach's three miles of fine sandy beach is part of the Grand Strand, a fifty-mile stretch of sandy beaches. The Grand Strand extends southwesterly along the coast from the North Carolina State line to Winyah Bay. Huntington Beach State Park also comprises a 2,500-acre tract of estuarine seashore land. The site contains sand beaches, picturesque sand dunes, protected inlets, marshlands, fresh water ponds and extensive maritime forests. It is characterized by scenic and wildlife values.

9. Accessibility. Access to the walkway will be accomplished by the use of existing developed roads in the park which end at a parking area approximately one mile from the walkway. The beachfront would thence serve as a walking trail to the fishing walkway. The parking area would require expansion since the proposed project would increase greatly the visitors to this segment of the park.

10. Historic, scenic, natural and archeological areas. The park site, along with Brookgreen Gardens, has a long history. It is in the heart of the old rice plantation country. The original settlers were the Allstons of Charleston, S. C., who came to the area in the 1720's. The Allstons owned the land for about eighty years and sold it to John J. Ward of Charleston. In 1870, Dr. Louis C. Hasell acquired Brookgreen. His family held it until 1920, when they sold it to Dr. J. A. Hood of Sumter, who purchased it for use as a hunting club. Between 1920 and 1930, the land changed hands six times. Archer M. and Anna Hyatt Huntington bought the plantation in July of 1931 and established Brookgreen

Gardens, a Society for Southeastern Flora and Fauna; founded for the purpose of exhibiting the preserving native flora and fauna of South Carolina and objects of art. In 1960, Anna Huntington and the Brookgreen trustees leased for fifty years without fee, the acreage east of Highway 17 for use as a state park. The state park was to make the area available to the public and uphold the purpose of Brookgreen Gardens. The park was originally administered by South Carolina's Forestry Commission and in 1967 was transferred to the newly created Department of Parks, Recreation and Tourism. The park site itself is characterized by scenic and wildlife values. Its natural elements include the sand beach, picturesque sand dunes, protected inlets, marshlands, fresh water ponds and extensive forest areas.

RECREATION MARKET AREA

11. General. The Waccamaw Region, in which Murrells Inlet Project is located, lies in the northeastern corner of the State and is made up of Georgetown, Horry and Williamsburg Counties. The unusual environment of this area provides physically unique areas in which many rare plants and animals exist. Within Georgetown County, Huntington Beach lies twenty miles south of Myrtle Beach and fifteen miles north of Georgetown. The small town of Murrells Inlet, three miles north on U. S. Ocean Highway 17, is the nearest town. Brookgreen Gardens, with its outstanding collection of American sculpture, lies directly across the highway and serves as a complementary botanic, wildlife, education and recreation resource.

12. Existing population. Murrells Inlet is part of the Grand Strand, a rapidly growing, national resort and South Carolina's most popular vacation spot. The "Strand" consists of 50 miles of resort beaches along South Carolina's northeast shores. The population of the area in 1972 was estimated to be about 40,000 permanent residents with about 212,000 tourists visiting the area on busy weekends. About 75 percent of the tourist trade is attracted from the Carolinas and Virginia, but almost all eastern states are represented at the Grand Strand.

13. Socio-economic characteristics. Tourism is the major industry of this coastal area. The tourist industry, which supports the recreational development in the Grand Strand is dependent on the over twelve million people of the Carolinas and Virginia. Strip development occurs from Murrells Inlet to Little River. The majority of this development consists of hotels, motels, restaurants, public and privately owned campgrounds and numerous tourist attractions.

14. Changes in leisure time. Manufacturing provides the primary source of employment for the workers in the three-state area. As worker productivity increases, work weeks will become shorter and more leisure time will be available. If past trends continue, people will demand more recreational activities to fill their leisure time.

15. Interstate demand. A high frequency of day-use from other states can be anticipated especially from North Carolina and Virginia because of the project's proximity to the Myrtle Beach area. The interstate travelers are expected to be the highest during the summer seasonal period from June through August. Visitors during the off-season (Oct-Mar) will come mostly from the immediate area. Visitors from any other states will be infrequent with the exception of North Carolina. U. S. 17 is the major interstate automobile route, however, I-95 comes within 70 miles of the project area and is connected to Myrtle Beach by U. S. 501.

16. People interest. A minimum of recreation interest in connection with the proposed walkway was shown at the public meeting of 29 May 1975. The South Carolina Department of Parks, Recreation and Tourism; however, has shown a great deal of interest in the proposed walkway as the part of their master plan in the development of Huntington Beach State Park. The proposed walkway would blend in nicely with the current recreational activities enjoyed in the immediate area such as surf fishing, crabbing, sunbathing, hiking, camping and beachcombing. The prime interest for the walkway is fishing in the proposed channel; however, sightseeing is also expected to be of great importance.

17. Demand. In well-developed areas along the Strand, privately operated fishing piers are available and well-established. These piers are readily accessible by automobile and have conveniences such as bait and tackle shops, restrooms and concession stands. The average annual visitation at each of these piers is close to 70,000 people per pier. Using these piers as a guide, it was assumed that with good access the proposed walkway would attract 26,600 fishermen annually. However, since automobile access ends a mile from the project, it is estimated that 17,000 fishermen will use the proposed pier initially and 22,000 by 2000. An additional 6,000 sightseers will also use the jetty. Many of the users of the walkway will came by boat and tie up at the jetty.

18. Project capability (capacity). The maximum practical carrying capacity of the jetty will not only be limited by the length of the jetties but by the capacity of the parking area as well. Also considered was the weather, other activities, and the present visitation of Huntington Beach State Park. It was concluded that a maximum practical annual carrying capacity for Murrells Inlet walkway is estimated to be 120,000 visits.

19. Meeting needs. The market area of Huntington Beach State Park has a high level of low income people. The development of this project will provide an opportunity to fish with sufficient safety at locations which were previously limited to fishermen with boats.

DETERMINING ATTENDANCE

20. General. It is conservatively estimated that 17,000 fishermen will use the walkway in 1980 and 22,200 by 2000. In addition to the fishermen, an additional 6,000 persons will use the jetty walkway annually for

sightseeing purposes. These attendance figures were based on attendance to existing privately owned fishing piers in the area and jetties along the Atlantic and Gulf Coast. The fishing piers average about 66,600. Based on the accessibility safety factors, remoteness to motels and hotels, it is estimated that the jetty would attract approximately 30 percent of the privately owned pier. It is also believed that approximately one percent of park visitors other than fishermen would also use the jetty walkway primarily for sightseeing purposes.

RECOMMENDED PLAN OF DEVELOPMENT

21. General. The recommended plan of improvement provides for an 8-foot wide fishing walkway constructed on the south jetty along its entire length; an enlarged parking area for the walkway and the other activities in this segment of the park area, and a toilet facility located in the general vicinity of the parking area, as shown on Plate 1 to the appendix. Existing public accommodations in Huntington Beach State Park include restrooms, hot showers, changing stalls, vending machines, concession stand, campsites and trading post. The proposed recommendations are included as part of master plan for Huntington Beach State Park. The recreation facilities are shown on Plates 1 and 2. Design assumptions for these facilities are attached to this appendix.

22. Types of activities. The recreation activities generated by the walkway are limited to jetty fishing and sightseeing. These activities are considered compatible with other recreational features enjoyed in and adjacent to the project area. These activities include fishing of all types (surf, pier, bay, ocean) crabbing, pleasure boating, hiking, beach combing, picnicking, swimming, sunbathing, all types of camping (primative, tent, trailer, and motor home) and all facets of photography and nature study.

23. Proposed recreation development. Facilities required to provide continued quality recreation for the activities listed above were divided into two phases of development: initial and future.

a. Initial development. Initial development will be limited to that required to develop full use of the proposed walkway, enlargement of the parking area and toilet facilities.

b. Future development. Future development will not require Federal participation but will consist of completing the master plan of Huntington Beach State Park by State agencies. This includes hiking trails, observation tower, etc.

c. Facility load. The demand on the walkway is based on the attendance it is expected to receive on an average weekend day. The facilities will be designed and arranged to accommodate this demand. Table 1 shows the methodology used in formulating the expected weekend day attendance. The anticipated attendance was determined for both the initial (1980) and ultimate (2000) phases.

TABLE 1

COMPUTATION OF WEEKEND PAY ATTENDANCE

Year	Annual Attendance	Weekend Day Attendance
1980 (initial)	17,000	$\frac{17{,}000 \times .75^{*} \times .75^{***}}{20^{**}} \div 2^{****} = 239$
2000 (future)	22,000	$\frac{22{,}000 \times .75 \times .75}{20} \div 2 = 309$

* = 75 percent of annual

** = 20 weeks in the recreation period (May-September)

*** = 75 percent of weekly attendance on weekends

**** = 2 weekend days

24. Parking area. Based on the daily visitation rate of 309 persons, 2 persons per car and a turnover rate of 1.5 cars per parking space; the required parking spaces are:

$$\text{Parking spaces} = 309 \text{ persons} \times \frac{1 \text{ car}}{2 \text{ persons}} \times \frac{1 \text{ space}}{1.5 \text{ cars}}$$

$$= 103$$

Say 100 spaces

It is estimated that 100 additional parking spaces will be sufficient to handle the increase in traffic generated by the proposed improvement. Since sightseers should have a higher occupancy rate per car and turnover rate than fishermen, it is believed that the existing 50 car and new 100 car parking areas will be adequate to accommodate all visitors to the area.

25. Walkway. A fisherman every 5 feet would allow over 500 fishermen, using the walkway at relative comfort at any one period of time. When fish are biting, over twice this many could be crowded on the jetty. The capacity of the jetty greatly surpasses the average projected weekend attendance.

26. Comfort station. A four-stall toilet facility is considered adequate to service the people using this segment of the park. The comfort station was located in the vicinity of the parking area in lieu of a location nearer the project for the following reasons:

a. Lack of access to properly maintain the facility at jetty.
b. Availability of electricity and water at parking area.
c. Vandalism would be less at parking area due to remoteness of jetty site.
d. Parking area facility would serve visitors other than walkway users more conveniently.
e. Parking area site follows the Huntington Beach State Park master plan.

Consideration was given to the location of a minimal sanitary facility (portable) near the sand dike. The distance between the jetty and the comfort station at the parking area would support the need for such a facility. South Carolina Department of Parks, Recreation and Tourism was approached concerning the portable facility and they were opposed. They felt that a facility so far removed from the park proper would be rendered inoperable by vandalism within a short time. Facilities located in the main section of the park suffer from vandalism; and these facilities are watched more closely than could be expected of a remote location. Park personnel stated that such a facility not readily accessible by vehicle would place too heavy a burden on their limited resources. For the above reasons a sanitary facility closer to the fishing walkway was not included in the proposed development.

27. Habitat improvement. The proposed walkway will have no beneficial or adverse effect on the fish and wildlife in the area. Access to the walkway will be by an unimproved trail along the beach between the high and low tide zone and will not benefit or adverely affect existing wildlife populations.

COORDINATION

28. General. Preliminary coordination with affected Federal, State, and local agencies was accomplished to insure that the recreation plan is compatible with their plans for existing and future development. The South Carolina Department of Parks, Recreation and Tourism who operate Huntington Beach State Park, is the only agency affected by the proposed plan of improvement. The final plan is in accordance with their development of a master plan for Huntington Beach State Park.

COSTS

29. General. The following tables show the first cost and annual charges for the proposed recreational facilities recommended in this appendix. Maintenance for the walkway would be relatively high as it takes into account that the pavement would have to be replaced every 25 years due to the major storms in the area.

TABLE 2

ESTIMATES OF FIRST COST

RECREATION

(Oct. 1975 Price Levels)

Item	Unit	Quantity	Unit Cost	Cost
Fishing walkway	LF	3,230	$50.00	$162,000
Comfort Station	LS	Job		40,000
Parking lot	SY	3,900	6.00	23,000
Subtotal				$225,000
Contingencies, 15%				34,000
Total Construction Cost				$259,000
Engineering and design (5%)				13,000
Supervision and administration (5%)				13,000
Total First Cost				$285,000

Apportionment of First Cost	
Federal (50%)	$142,500
Non-Federal (50%)	142,500

TABLE 3

ESTIMATE OF ANNUAL CHARGES

RECREATION FACILITIES

(50-Year Project Economic Life, 6-1/8% Interest Rate)

Item	
Federal	
Interest	$ 8,730
Amortization	470
Total	$ 9,200
Non-Federal	
Interest	$ 8,730
Amortization	470
Maintenance	8,000
Total	$17,200
Total Annual Charge	
Federal	$ 9,200
Non-Federal	17,200
Total	$26,400

BENEFITS

30. General. Estimated benefits, attributable to the proposed fishing walkway for the south jetty, are based on the reported income from the operation of privately owned fishing piers in the area. The Fish and Wildlife Service estimated that an average of 66,500 persons use each of these piers per year paying an average fee of about $1.50 per day to fish. The jetty would be longer but would not be usable for about 48 hours per month due to high tides and waves and primary fishing waters are considered limited to the inlet side. Road access would come within a mile of the jetty. Taking these factors into consideration, a walkway on the south jetty would attract about 30 percent of the number of fishermen as do the fishing piers for an average of approximately 20,000 visitations yearly. In addition to the fishermen, an approximate 6,000 additional sightseers are expected to use the jetty annually.

Table 4
ANNUAL BENEFIT

Item	Unit	Unit Cost	Quantity	Benefit
Fishing Walkway				
Fishing	Man-days	$1.50	20,000	$30,000
Sightseeing	Man-days	.75	6,000	4,500
Total Benefits				$34,500

31. Intangible benefit. Other visitors to the park will also receive benefit from the improvement other than the users of the walkway visitors themselves. Surf fishermen, sun bathers, beach combers, etc. who will use the north beach of the park will benefit from the enlarged parking lot and toilet facilities. These benefits have not been used in the justification of the walkway.

32. B/C ratio. The fishing walkway has annual charges of $26,400 and annual benefits of $34,500 for a B/C ratio of 1.31.

RECREATION FACILITIES
DESIGN ASSUMPTIONS

1. Comfort station. The comfort station design is from a standard plan obtained from the South Carolina State Department of Parks, Recreation and Tourism. This building would match the existing picnic shelters and other facilities of the park. Maintenance would be the responsibility of the Department of Parks, Recreation and Tourism after construction.

2. Power supply. The Department of Parks, Recreation and Tourism has power at the picnic shelters which would be extended to the well pump and comfort station. Power will only be needed for lighting in the comfort station and the water pump.

3. Water supply. It is assumed that about 250 persons will use the comfort station during peak weekends requiring about 10 gallons of water per person. This would amount to 1.7 gallons per minute; however, since this demand would be over an eight-hour period at least 5 gallons per minute should be provided. To meet peak demands, the system would be sized to supply at least 25 gpm for short periods of time. It is proposed to provide water with a 4-inch well located near the comfort station. The water system would consist of a well pump, a high pressure supply main to a 1,000 gallon pressure tank, a pressure switch on the pump and an air compressor and relief valve or other acceptable means for maintaining the correct air-water ratio in the pressure tank.

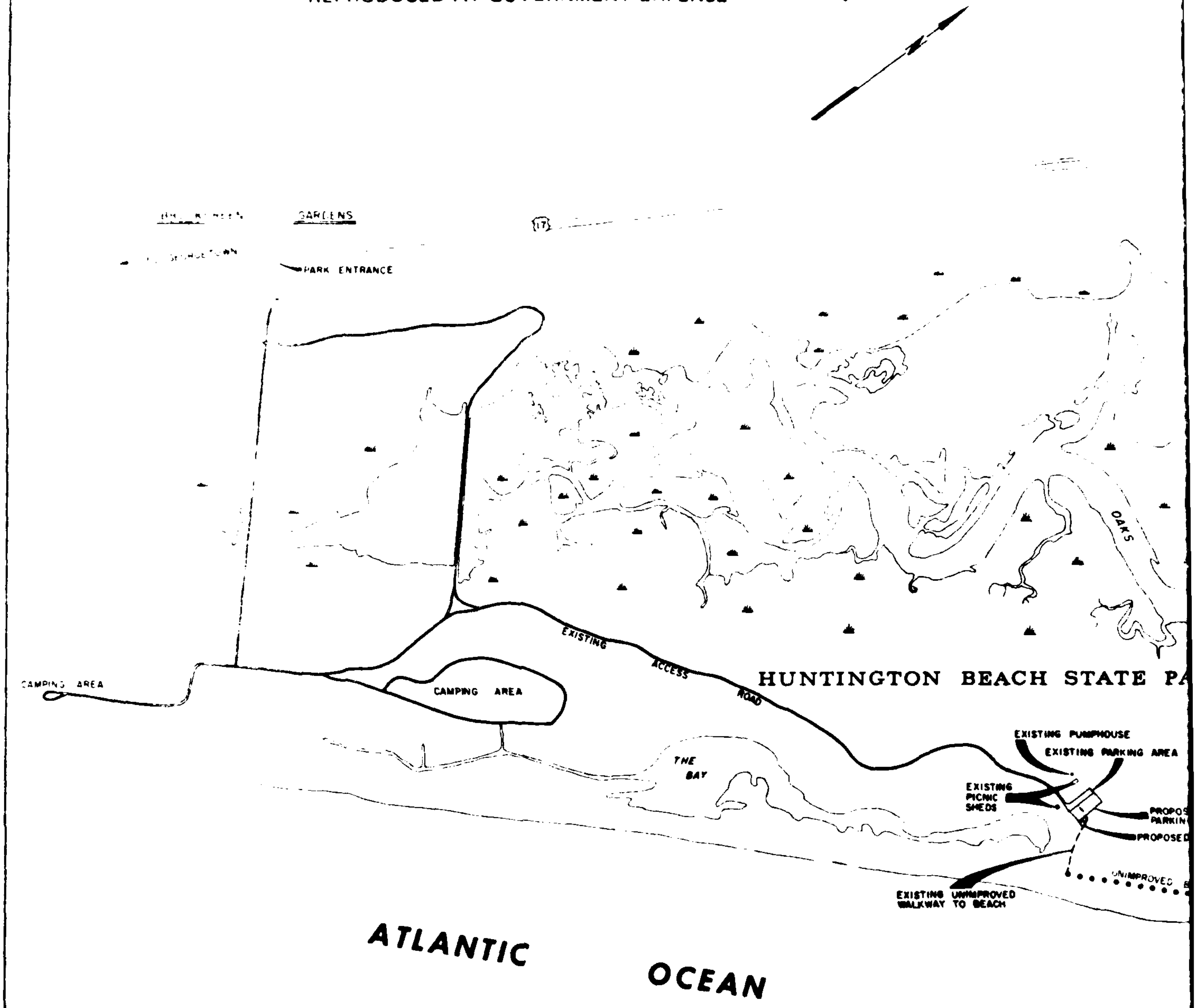
4. Sewage disposal. Sewage flow would be about two thirds of the water demand which would be 1,700 gallons per day. It is proposed to provide a 2,300 gallon (1,700 gallon plus 33% for sludge storage) septic tank with 300 linear feet of tile field.

5. Parking. Parking would be provided for 100 cars as set forth in the Recreation Resources Appendix. Based on recommended stall and aisle sizes for 90° parking (9' x 18' stalls, 27' center aisles) the lot would be 126' x 275' including the 25' end aisles. This new parking area would be adjacent to the existing parking lot. As with the comfort station, the Department of Parks, Recreation and Tourism will be responsible for maintenance.

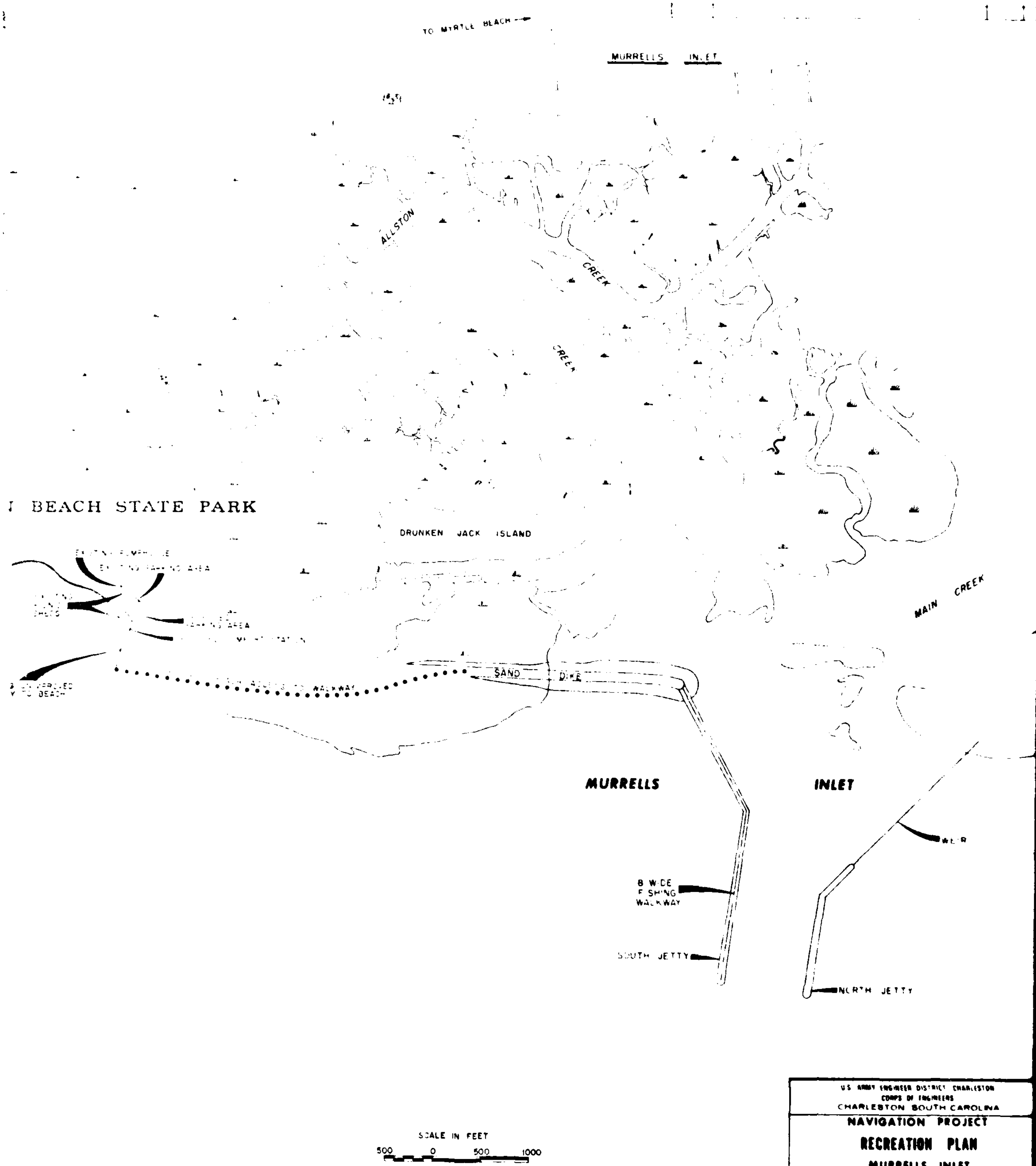
6. Pavement design. Pavement design is in accordance with U. S. Army TM 5-822-2 and TM 5-822-5 and assuming parking would be predominately cars and light trucks, the parking area is given a class F designation, Category I, with a design index of 1. With a subgrade CBR of 14, the required total thickness of base would consist of a 4-inch limerock base course and a 1-1/2-inch double surface treatment. All materials and construction procedures will follow the requirements of the "South Carolina State Highway Standard Specifications (1973)" for aggregate base course and double surface treatment.

7. Fishing walkway. The fishing walkway would be 8 feet wide and extend the entire length of the south jetty. Any voids between the

armor stone under the walkway would be filled with stone and a grouting mix conforming to the South Carolina State Highway Department Specifications for Sand-Asphalt Base Course. This sand-asphalt mixture would be placed at a temperature of approximately 450°F to allow the mixture to flow easily and fill any voids left in the filler stone. After the grouting mix is placed it will be covered with a minimum of 4" of asphaltic concrete (hot plant mix) also conforming to South Carolina Highway Department Specifications.


GARDENS
PARK ENTRANCE
CAMPING AREA
CAMPING AREA
EXISTING ACCESS ROAD
HUNTINGTON BEACH STATE
OAKS
THE BAY
EXISTING PUMPHOUSE
EXISTING PARKING AREA
EXISTING PICNIC SHEDS
EXISTING UNIMPROVED WALKWAY TO BEACH
ATLANTIC OCEAN

REVISIONS



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

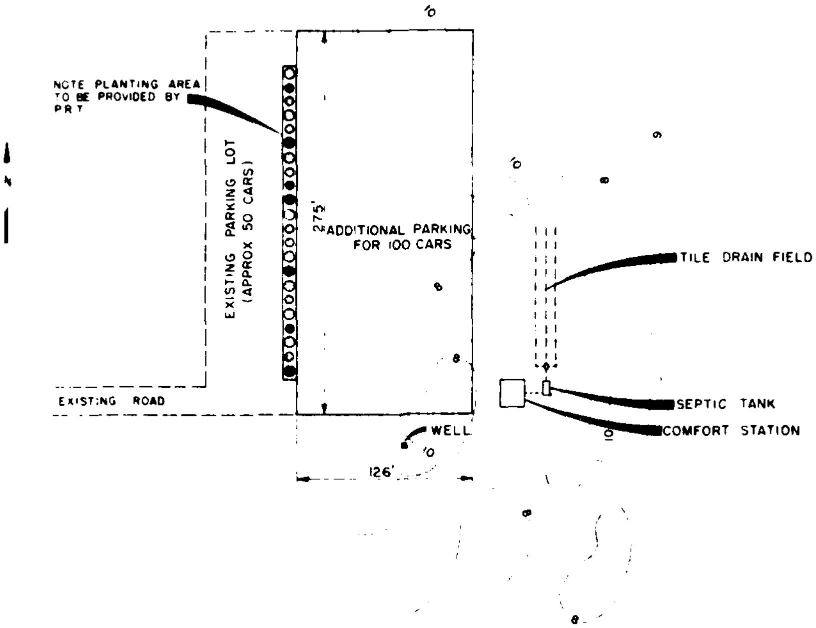
NAVIGATION PROJECT

RECREATION PLAN

MURRELLS INLET

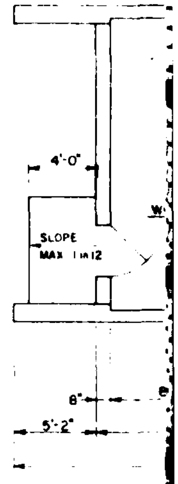
GEORGETOWN COUNTY SOUTH CAROLINA

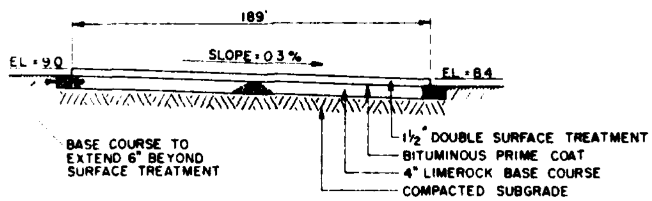
SCALE AS SHOWN	GENERAL DESIGN MEMORANDUM	PLATE 1 APPENDIX B
DATE 20 NOV 1975		FILE NO. 10048



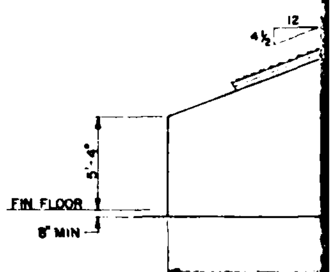
SITE PLAN
PARKING LOT & COMFORT STATION

50 0 50 100
SCALE IN FEET





PARKING LOT SECTION
NOT TO SCALE



REPRODUCED AT GOVERNMENT EXPENSE

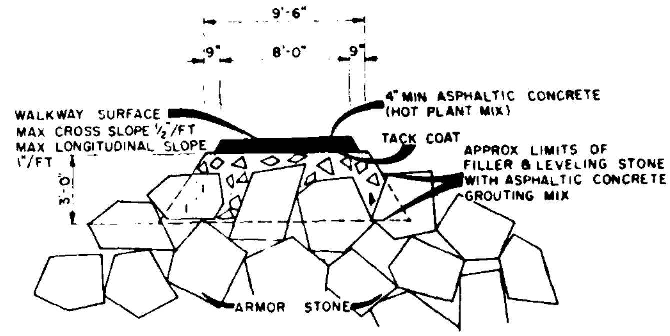
REVISIONS		
DESCRIPTION	BY	DATE

PLAN
COMFORT STATION

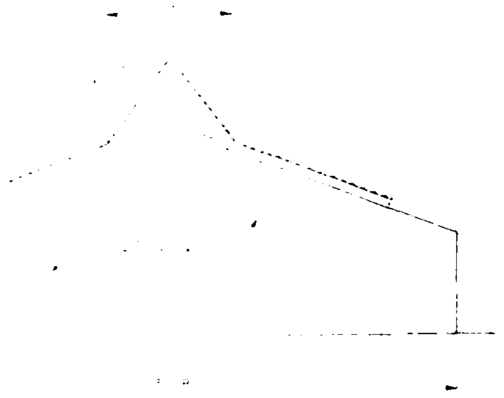
SCALE IN FEET

SIDE ELEVATION
SAME BOTH SIDES

0 2 4 6 8 10
SCALE IN FEET



FISHING WALKWAY SECTION
ON SOUTH JETTY
NOT TO SCALE



END ELEVATION
SAME BOTH SIDES

SCALE IN FEET

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

NAVIGATION PROJECT

RECREATION DETAILS

MURRELLS INLET

GEORGETOWN COUNTY — SOUTH CAROLINA

SCALE AS SHOWN	GENERAL DESIGN MEMORANDUM	PLATE 2 APPENDIX B
DATE 28 NOV 1975		FILE NO. 10940

APPENDIX C

GEOLOGY AND SOILS

Geology and Soils of Murrells Inlet

Outline

Figures

Exhibits

I. Introduction and Purpose: The purpose of this report is to describe briefly the regional geology of the Murrell's Inlet area and to report on the findings of a drilling and testing program conducted for this study.

II. Methods of Investigation: Nine borings were made in March 1975, four on the south side of the inlet, one in the center of the proposed channel, and three on the north side of the channel. The standard penetration method was used for advancing the borings and additionally two borings, M14 and M18, were cored using NX-size diamond tools. A rotary drilling rig mounted on an amphibious all terrain vehicle was used to drill those borings done offshore while a truck mounted drill rig was used on the land borings. Two petrologic tests were run for mineral identification, and one paleontologic test was run to determine the geologic age of the lowest formation encountered. Soil samples were tested by the South Atlantic Division Lab and are described elsewhere. A review of all published geologic literature covering the area was made. The most comprehensive of the geologic literature was C. Wythelooks "Geology of the Coastal Plain of South Carolina."

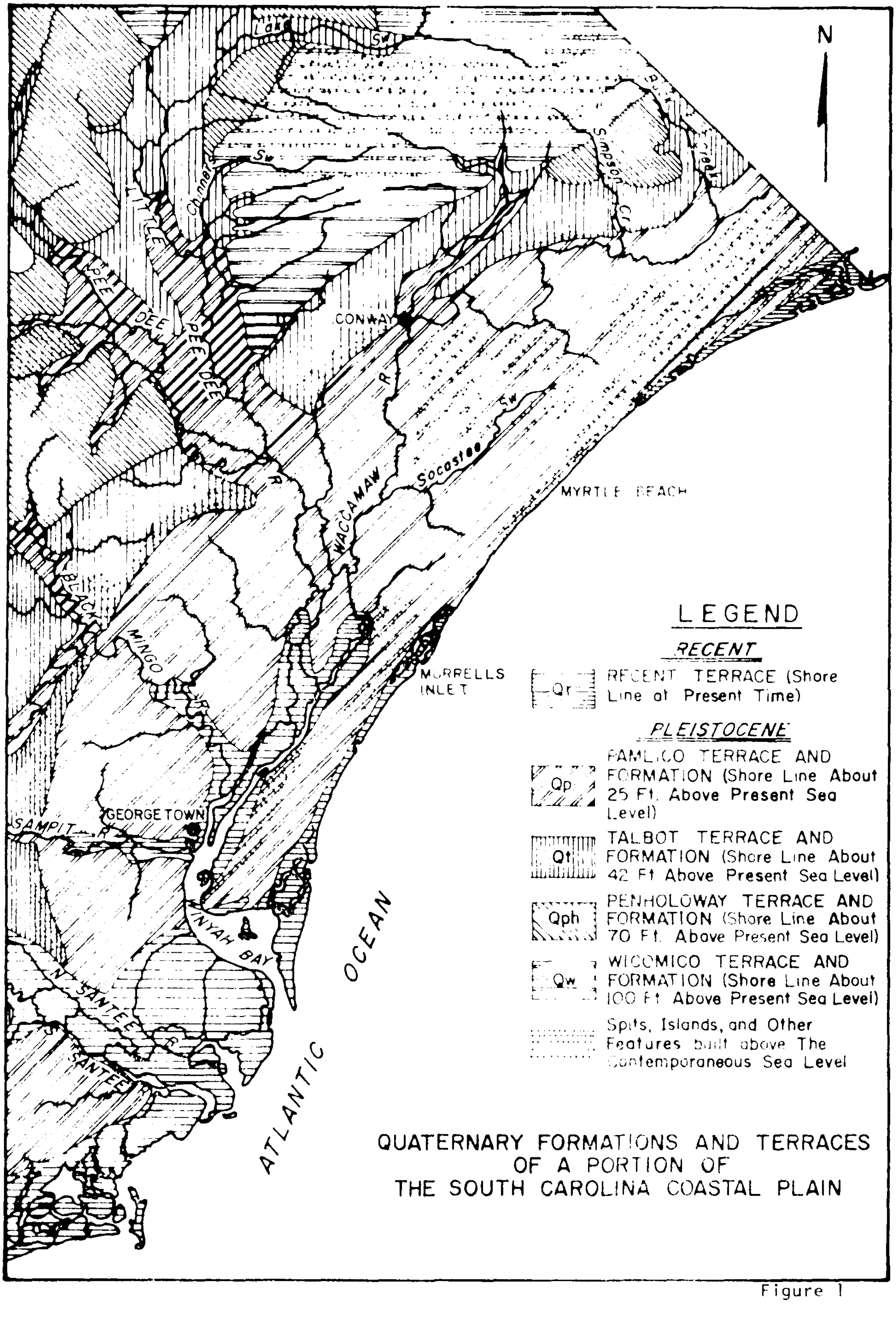
III. Regional Physiography and Geology. The Murrell's Inlet area lies along the eastern margin of the Atlantic Coastal Plain Physiographic Province. This province is underlain by sedimentary deposits varying in geologic age from Cretaceous to Recent. These deposits are thickest near the coast and thin out toward the Fall Line in a northwesterly direction. The eastern margin of the coastal plain is characterized by its Pleistocene Age marine cut terraces. These terraces were formed during the transgression and regression of the sea during the interglacial and glacial periods. These terraces extend inland for about 90 miles and range in altitude from sea level to 270 feet above sea level. Seven of these terraces are generally recognized (See Figure 1). The youngest of these, the Pamlico includes the land from the recent shoreline to an abandoned shoreline 25 feet above sea level. This terrace and recent deposits form the topography in the vicinity of Murrell's Inlet. The surface deposits are sands and silts derived from erosion of older sediments.

IV. Site Topography. The topography in the vicinity of the inlet is characterized by the recent barrier beaches, northeast trending low islands and ridges and back beach tidal creeks. The north jetty will tie into the southern point of Garden City Beach while the south jetty will tie into the northern most point of Huntington Beach State Park. The south abutment was indicated on the Brookgreen Quadrangle of 1947 to be an island, however, the inlet which separated this abutment from the main part of Huntington Beach has since been filled. There appears to be very rapid erosion and deposition on both sides of Murrell's Inlet, with much dredging and filling taking place on the northern abutment. The inlet is separated from the mainland by a wide salt marsh and tidal creek area.

V. Site Geology. The surface and near surface deposits consist predominantly of sand; silty and clayey and poorly graded (SM, SC and SP)* with less common finer silts and clays, (MH and CL). Minor gravels were found in boring M18 and shells and shell fragments are common in all borings. The majority of the sands are silty and fine grain (SM). Borings M11 and M12 were taken for the approach dike on the south abutment and both found somewhat different conditions than the other borings. Both had much lower resistance to the standard penetration test and both contained a thick dark grey silty clay (MH) stratum below 8 to 9 feet of silty sand (SM). In other borings, neither a clay stratum was found at this shallow a depth nor were the blow counts as low. Since these two borings are further toward the landward side, it is probable that they indicate the presence of a filled tidal creek or salt marsh. The upper part of the remaining borings consisted of sand of varying types with high resistance to the standard penetration test. The two deep borings M14 and M18 found these sands extending to depths of 54.0 feet and 46.6', respectively. Below these depths interbedded dark colored clays, shales, limestones and sandstones were encountered. The very poor core recovery in M14 made it impossible to correlate the strata below top of rock with M18. However, due to the rpaid lateral changes in composition, it is doubtful if any precise correlation could have been made. A shale sample was taken from boring M18 for paleontological examination. It was found to be of Paleocene Age which indicates the Black Mingo formation. (See Figures 2 and 3 for pictures of the core from M18 and Appendix C for the Paleontology Report.) This indicates that much of the younger sediments of Tertiary Age have been eroded away. The exact age of the sands overlying these shales and limestones cannot be determined but they are possibly of Pliocene Age with a surface covering of Pleistocene to Recent reworked material. Within the area of the proposed entrance channel, dredging will be carried out primarily in these sands. One boring M16 fell in the center of the channel and found medium to fine, silty to poorly graded sands. Shell fragments are common and blow counts are high. The jetties and approach dikes will be constructed on similar sands. The results of the petrologic examination are included as Exhibit B. These tests found a grey, very impure, sandy glauconitic limestone interbedded with shales and a grey calcareous sandstone. The limestones and shales were hard and well indurated whereas the sandstone was soft and poorly indurated.

VI. Summary. The Murrell's Inlet area is underlain by sands of the Pamlico of the Pleistocene Epoch. These sands overly older deposits of similar composition of possible Pliocene Age. These older sands in turn overlie a complex series of interbedded shales, limestones and sandstones of Paleocene Age. These are believed to be the Black Mingo formation. Other Tertiary period formations which lie between the Pliocene and Paleocene have been removed by erosion. The surface sediments are of recent origin and at the Inlet, are composed primarily of fine sands.

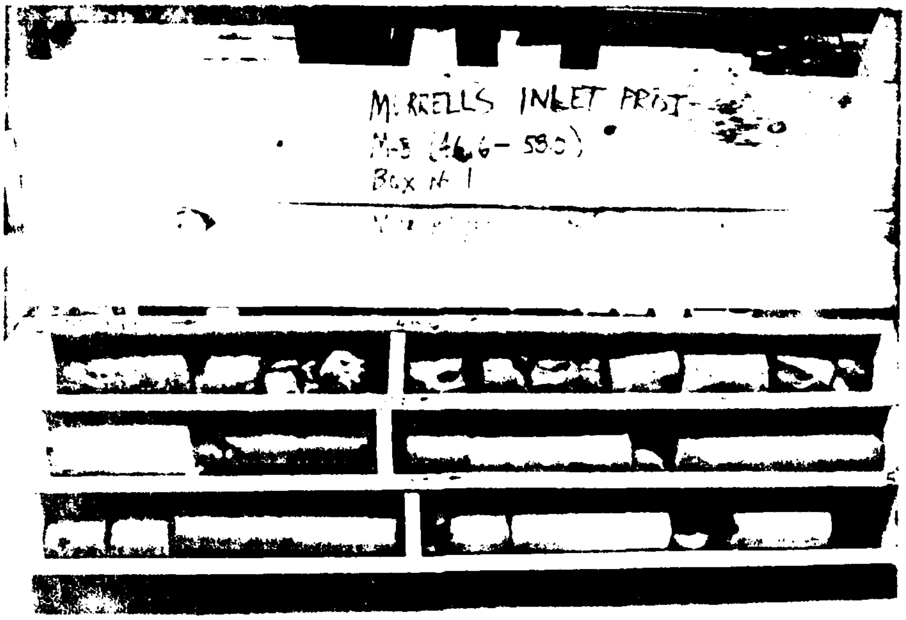
* Unified Soil Classification



QUATERNARY FORMATIONS AND TERRACES OF A PORTION OF THE SOUTH CAROLINA COASTAL PLAIN

Figure 1

FIGURE 2



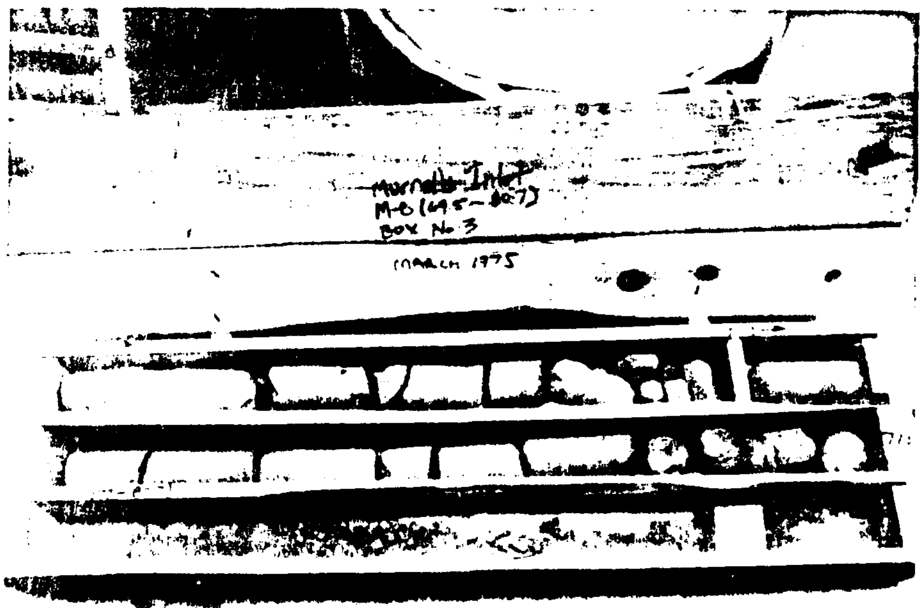


Exhibit A

Boring Logs

MI-1, 2, 3, 4, 5, 6, 8, 9 and 10

Hole No MI-1

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Charleston District	SHEET 1 of 1 SHEETS

1. PROJECT Murrells Inlet Entrance Channel and Jetty System	10. SIZE AND TYPE OF BIT
	11. DATUM FOR ELEVATION SHOWN: Mean Low Water
2. LOCATION (Coordinates or Station) See Plan-South of Channel	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
3. DRILLING AGENCY Savannah District	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: 5
4. HOLE NO (As shown on drawing title and file number) MI-1	14. TOTAL NUMBER CORE BOXES
5. NAME OF DRILLER Parden	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	16. DATE HOLE STARTED / COMPLETED
	17. ELEVATION TOP OF HOLE
7. THICKNESS OF OVERBURDEN	18. TOTAL CORE RECOVERY FOR BORING
8. DEPTH DRILLED INTO ROCK	19. SIGNATURE OF INSPECTOR C. DAVIS
9. TOTAL DEPTH OF HOLE 25.5'	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		SM-Gray Silty Fine Sand		1	
MLW						9
	5					9
						13
					2	20
						11
	10		MH-Dark Gray Silty Clay		3	8
						5
						9
	15				4	10
						6
						7
	20				5	
						10
-21.8	25					11

NOTE: ... Soil ...

Blows per foot ... 140 lb. ...

Hole No. MI-2

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Charleston District	SHEET 1 OF 1 SHEETS

1. PROJECT Murrells Inlet Entrance Channel and Jetty System
2. LOCATION (Coordinates or Station) See Plan - South of Channel
3. DRILLING AGENCY Savannah District
4. HOLE NO. (As shown on drawing title and file number) MI-2
5. NAME OF DRILLER
6. DIRECTION OF HOLE X VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE 25.5'
10. SIZE AND TYPE OF BIT 1 3/8" ID Splitspoon
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Mean low water
12. MANUFACTURER'S DESIGNATION OF DRILL Failing 314
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 5 — UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER
16. DATE HOLE — STARTED 10 MAR 1975 — COMPLETED 10 MAR 1975
17. ELEVATION TOP OF HOLE +6.7 MLW
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR C. Davis

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g BLOWS
	0		SM-Gray Silty Fine Sand		1	Scale 1"=5' 3, [illegible], 8
MLW	5				2	12, 12
	10		MH-Gray Silty Clay		3	10, 7, [illegible], [illegible]
	15				[illegible]	[illegible], 7, 7
	20				5	5, 6, 6, [illegible]
-18.8	25					7

NOTE: Soils field classified in accordance with the Unified Soil Classification System.

[illegible] NOTE:
[illegible] drive 1 [illegible]" ID [illegible] w/140 lb. hammer falling [illegible]".

Hole No. MI-3

DRILLING LOG

DIVISION	South Atlantic
INSTALLATION	Charleston District
SHEET 1 OF 1 SHEETS	
1. PROJECT	Murrells Inlet Entrance Channel and Jetty System
2. LOCATION (Coordinates or Station)	See Plan-South Dike
3. DRILLING AGENCY	Savannah District
4. HOLE NO. (As shown on drawing title and file number)	MI-3
5. NAME OF DRILLER	Parden
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	25.5'
10. SIZE AND TYPE OF BIT	1 3/8" ID Splitspoon
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	Mean low water
12. MANUFACTURER'S DESIGNATION OF DRILL	Failing 314
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 5 / UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: 8 MAR 1975 / COMPLETED: 8 MAR 1975
17. ELEVATION TOP OF HOLE	+5.6
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	C. Davis

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	BLOWS
	0		SM-Gray Silty Fine Sand		1	Scale 1"=5'	7
							12
							23
MLW	5						30
					2		26
							23
	10						34
			W/Clay Layers		3		20
							26
	15						25
			SP-Fine and Medium Sand w Shell Fragments		–		24
							31
	20						33
					5		30
							37
							34
-19.9	25						41

NOTE: Soils field classified in accordance with the Unified Soil Classification System.

BLOWS PER FOOT:
Number required to drive 1 3/8" ID splitspoon w/140 lb. hammer falling 30".

Hole No. MI-4

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Charleston District	SHEET 1 OF 3 SHEETS

1. PROJECT: Murrells Inlet Entrance Channel and Jetty System	10. SIZE AND TYPE OF BIT: 1 3/8" ID Splitspoon
2. LOCATION (Coordinates or Station): See Plan-South of Channel	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): Mean low water
3. DRILLING AGENCY: Savannah District	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): MI-4	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 7; UNDISTURBED
5. NAME OF DRILLER: Purden	14. TOTAL NUMBER CORE BOXES: 1
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE: STARTED 9 March 75; COMPLETED 9 March 75
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE: +6.9
9. TOTAL DEPTH OF HOLE: 76.9'	18. TOTAL CORE RECOVERY FOR BORING: 17.3 %
	19. SIGNATURE OF INSPECTOR: C. Davis

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	BLOWS
	0		SM-Gray, Silty fine sand		1	Scale 1"=5'	3
							8
							10
	5				2		30
MLW							35
							37
	10				3		40
							48
							51
							40
	15				4		33
							34
							46
	20						35
					5		35
							21
	25						27
							20
-20.1			SC-Gray, Calcareous clayey fine sand W/cemented layers.		6		21
							14
	30						

Continued on Sheet #2

NOTE: Soils field classified in accordance with the Unified Soil Classification System.

BLOWS PER FOOT:

[illegible]

p. 4

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE +6.9 MLW **Hole No.** MI-4

PROJECT Murrells Inlet Entrance Channel and Jetty System INSTALLATION Charleston District SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	BLOWS
	30						
			SC-Gray, Calcareous clayey sand				12
							13
							22
	35						24
							27
							27
	40						30
							28
							27
	45						29
							31
							30
							31
	50						35
							37
-47.1							40
	55		CL-Dark gray, silty clay W/thin sand lenses		7		50
							51
							47
	60					Scale Change at 60.0'	52
							46
	62		Sandstone, dark gray, hard 63.0' to 63.6'				60
-56.1			TOP OF ROCK 63.0'				100/0.0
			Shale, dark gray, hard and soft layers		BOX 1	Pull #1 Continued	
	64		Continued on Sheet #3				

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE +6.9 MLW **Hole No.** MI-4

PROJECT Murrells Inlet Entrance Channel and Jetty System | INSTALLATION Charleston District | SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	64		Shale, dark gray, soft W/thin sand lenses very low core recovery			Pull #1 63.0' to 69.4' Run 6.4' Rec 2.4' CL 4.0'
	66			37		
	68					
	70					Pull #2 69.4' to 75.4' Run 6.0' Rec 0.0' CL 6.0'
	72			0		
	74					
	76			JAR 8		Splitspoon 53
-70.0	76.9		BOTTOM OF HOLE 76.9'			

Hole No. MI-5

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Charleston District	SHEET 1 OF 1 SHEETS

1. PROJECT: Murrells Inlet Entrance Channel and Jetty System	10. SIZE AND TYPE OF BIT: 1 3/8" ID Splitspoon
2. LOCATION (Coordinates or Station): See Plan - South Dike	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): Mean low water
3. DRILLING AGENCY: Savannah District	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): MI-5	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5; UNDISTURBED
5. NAME OF DRILLER: Parden	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 8 March 75; COMPLETED 8 March 75
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE: +1.5 MLW
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE: 25.5'	19. SIGNATURE OF INSPECTOR: C. Davis

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g) BLOWS
	0					
MLW			SM-Gray Silty Fine Sand W/ Shell Fragments		1	Scale 1"=5' 13
						13
						15
	5				2	23
						28
						31
	10		W/Clay Layers			20
					3	19
						18
	15					19
					4	21
						24
	20					30
					5	33
						37
						40
-24.0	25					46

NOTE: Soils field classified in accordance with the Unified Soil Classification System.

BLOWS PER FOOT: Number required to drive 1 3/8" ID splitspoon w/140 lb. hammer falling 30".

Hole No. MI-6

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Charleston District	SHEET 1 OF 1 SHEETS

1. PROJECT: Murrells Inlet Entrance Channel and Jetty System	10. SIZE AND TYPE OF BIT: 1 3/8" ID Splitspoon
2. LOCATION (Coordinates or Station): See Plan - Center of Channel	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): Mean low water
3. DRILLING AGENCY: Savannah District	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): MI-6	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 7; UNDISTURBED
5. NAME OF DRILLER: Parden	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 1 March 75; COMPLETED 1 March 75
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE: -0.3 MLW
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING
9. TOTAL DEPTH OF HOLE: 25.5'	19. SIGNATURE OF INSPECTOR: R. Lawson

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g) BLOWS
	0					Scale 1"=5'
			SM-Tan and Gray silty fine sand W/ shell Fragments		1	10
						40
	5					47
					2	50
						77
			SP-Gray fine and medium sand W/ shell fragments		3	37
	10					52
			SM-Dark gray silty fine and medium sand W/ shell fragments		4	55
						77
	15		SP-Gray and tan medium sand W/ shell fragments		5	32
						67
						63
	20					95
					6	72
			Fine sand W/shell fragments			92
			SM-Gray fine sand W/Shell fragments		7	38
-25.2	25					BOTTOM OF HOLE 25.5' 36

NOTE: Soils field classified in accordance with the Unified Soil Classification System:

BLOWS PER FOOT:
Number required to drive 1⅜" ID splitspoon with 140 lb. hammer ...

Hole No. MI-8

DRILLING LOG

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Murrells Inlet, S.C.	SHEET 1 OF 4 SHEETS

1. PROJECT Murrells Inlet Entrance Channel and Jetty System	10. SIZE AND TYPE OF BIT 1 3/8" ID Splitspoon
2. LOCATION (Coordinates or Station) See Plan - North Dike	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Mean low water
3. DRILLING AGENCY Savannah District	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 314
4. HOLE NO. (As shown on drawing title and file number) MI-8	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 18 — UNDISTURBED
5. NAME OF DRILLER Parden	14. TOTAL NUMBER CORE BOXES 3
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED 1 March 75 — COMPLETED 1 March 75
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE +6.1 MLW
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 80.7'	19. SIGNATURE OF INSPECTOR R.J. Conley

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		SM-Tan, silty fine sand		1	Scale 1"=5' 9 9 20
MLW	5		SP-Tan, Poorly graded sand W/shell fragments		2	18 35
	10		GP-Poorly graded gravel & shell fragments, Tan		3	47 35
	15		SM-Gray, silty fine & medium grain sand silty fine sand W/shell fragments		4	95 62 76 68 70 30
	20		GP-Tan, poorly graded gravel & shell fragments		5	26 50 58
	25		SM-Gray silty fine & medium sand silty fine sand		6	59 64 70 75
	30		Continued on Sheet #2			

NOTE: Soils field classified in accordance with the Unified Soil Classification S...

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: +6.1 MLW | **Hole No.** MI-8

PROJECT: Murrells Inlet Entrance Channel & Jetty System | INSTALLATION: Charleston District | SHEET 2 OF 4 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	BLOWS
	30						
			SM-Gray, silty fine sand W/shell fragments		7		66
					8		90
					9		100
	35				10		27
					11		24
					12		14
	40				13		23
					14		22
					15		30
	45				16	Scale Change at 45.0'	30
			Black				
					17		80
-40.5			TOP OF ROCK 45.6'		18		100/0.1
	47		Shale, black, hard to medium hard, with thin fine sand lenses. varies with sand content. Upper 1.5' broken 48.6' to 51.6' about eight horizontal breaks, most from 48.6' to 49.5'.			Pull #1 46.6' to 52.2' Run 3.6' Rec 3.6'	
	49			100			
					BOX 1		
	51						
			Limestone, gray to black hard cannot be penetrated with knife or broken by hand. Thin shale lenses. Glauconitic			Pull #2 52.2' to 55.8' Run 3.6' Rec 3.6'	
	53						
			Shale, black, moderately hard	100			
			Limestone, gray, hard				
	55		Shale, black, moderately hard				

Continued on Sheet #3

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE +6.1 MLW **Hole No.** MI-8

PROJECT Murrells Inlet Entrance Channel and Jetty System INSTALLATION Charleston District SHEET 3 OF 4 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
a	55 b	c	d	e	f	g
			Limestone, gray, hard to very hard. Glauconitic			Pull #2 Continued
						Pull #3 55.8' to 62.7' Run 6.9' Rec 6.0' CL 0.9'
	57		Core loss, core end indicates grinding			
			Shale, dark gray, moderately hard			
	59		**Limestone**, dark gray, very glauconitic, hard to very hard 5 low angle breaks	87		
	61		Shale, dark gray to black, sandy lenses, low angle bedding moderately hard. 9 low angle shale partings.		BOX 2	
	63		63.3 Paleontologic Sample			Pull #4 62.7' to 72.7' Run 10.0' Rec 10.0'
-58.8	65		Limestone, dark gray, very sandy glauconitic, hard to very hard, Few breaks to 70.2' 65.7' to 66.1' thin shale zone	100		
	67		67.8' to 68.3' sample taken.			
	69					
			moderately hard			
	71					

----Continued on Sheet #4----

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE +6.1 MLW					Hole No MI-8
PROJECT Murrells Inlet Entrance Channel and Jetty System		INSTALLATION Charleston District				SHEET 4 OF 4 SHEETS
ELEVATION a	DEPTH b 71	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g
			Sandstone, gray, moderately hard, highly glauconitic (phosphorite?) moderately broken, about 3 per foot			Pull #4 Continued
	73					Pull #5 72.7' to 80.7' Run 8.0' Rec 8.0'
	75			100	BOX 3	
			soft, can be crushed by hand, sample 76.0' to 76.2'			
	77		77.0' to 80.7' core missing from box.			
	79					
-74.5						BOTTOM OF HOLE 80.7'

Hole No. MI-9

DRILLING LOG

DIVISION	South Atlantic
INSTALLATION	Charleston District
SHEET	1 OF 1 SHEETS
1. PROJECT	Murrells Inlet Entrance Channel and Jetty System
2. LOCATION (Coordinates or Station)	See Plan - North Dike
3. DRILLING AGENCY	Savannah District
4. HOLE NO. (As shown on drawing title and file number)	MI-9
5. NAME OF DRILLER	Parden
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	25.5'
10. SIZE AND TYPE OF BIT	1 3/8" ID Splitspoon
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	Mean low water
12. MANUFACTURER'S DESIGNATION OF DRILL	Failing 314
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 17 / UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: 1 March 75 / COMPLETED: 1 March 75
17. ELEVATION TOP OF HOLE	-0.2 MLW
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	R. Lawson

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g BLOWS
MLW	0		SP-Tan, fine and medium sand W/shell fragments			Scale 1"=5'
					1	10
					2	12
			Gray and Tan		3	15
	5				4	20
			SM-Gray, silty fine and medium sand W/shell fragments		5	20
					6	26
	10				7	68
					8	66
					9	67
	15				10	72
					11	53
					12	36
	20				13	32
					14	38
					15	40
					16	[illegible]
-25.3	25 / 25.5		BOTTOM OF HOLE 25.5'		17	49

NOTE: Soils field classified in accordance with the Unified Soil Classification System.

BLOWS PER FOOT:
Number required to drive 1⅜" [illegible] 140 lb. hammer [illegible] 30".

Hole No. MI-10

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Charleston District	SHEET 1 OF 1 SHEETS

1. PROJECT	Murrells Inlet Entrance Channel and Jetty System
2. LOCATION (Coordinates or Station)	See Plan-North Jetty
3. DRILLING AGENCY	Savannah District
4. HOLE NO. (As shown on drawing title and file number)	MI-10
5. NAME OF DRILLER	Parden
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	24.0'
10. SIZE AND TYPE OF BIT	1 3/8" ID Splitspoon
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	Mean low water
12. MANUFACTURER'S DESIGNATION OF DRILL	Failing 314
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 7 / UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: 7 March 75 / COMPLETED: 7 March 75
17. ELEVATION TOP OF HOLE	-0.5 MLW
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	C. Davis & R. Lawson

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	BLOWS
MLW	0					Scale 1"=5'	
			SM-Gray and Tan silty fine sand W/shell fragments				9
					1		20
					2		22
	5						43
							30
					3		45
	10						36
					4		50
							53
	15						90
					5		80
							90
					6		60
	20						60
					7	NOTE:Unable to continue hole due to incoming tide.	60
							60
-23.5	24						

NOTE: Soils field classified in accordance with the Unified Soil Classification System.

BLOWS PER FOOT:

Number requir[illegible] drive 1[illegible]" ID [illegible] lb. hammer [illegible].

p. 14

Exhibit B

Petrographic Report

U.S. ARMY ENGINEER DIVISION LABORATORY, SOUTH ATLANTIC CORPS OF ENGINEERS MARIETTA, GEORGIA PETROGRAPHIC REPORT		DISTRICT Savannah PROJECT Murrells Inlet Entrance Channel, S. C. CONTRACT NO.
SOURCE Murrells Inlet Entrance Channel & Jetty System, Murrells Inlet, S. C.	LAB NO. 52/3099 & 100	DATE REPORTED 21 April 1975
DATE RECEIVED 8 April 1975	REQ. NO. SAS-ENG-MI-1.	WORK ORDER NO. 9219

NX CORES, MURRELLS INLET, SOUTH CAROLINA

Petrographic and/or X-ray diffraction analyses have been made in accordance with CRD-C 127-67 and/or EM 1110-2-2000. Thin section studies, petrographic oil immersion studies, and megascopic examination have been performed as necessary for evaluation procedures and photomicrographs of thin sections, where applicable, appear as figures in the report. X-ray diffraction techniques, if applicable to this testing, include ethelene glycol and heat treatment of sedimented slides as corroborative diagnostic tests to the powder press technique, and X-ray diffractograms appear as plates. Other tests necessary for this investigation are described in the report.

Detailed petrographic descriptions and pertinent remarks regarding acceptance of individual rock types, soils, or fine aggregate and other earth materials are included in the tables. The summary below presents key data resulting from the testing.

5 —— Incl
2 Figures
3 Plates
~~Tables~~

SUMMARY

Petrographic and X-ray diffraction analysis of 2 NX Cores from Murrells Inlet, South Carolina for classification purposes are described in detail below:

Sample No. 1, (Lab. No. 52/3099), Boring MI-8, 67.8 ft. depth - Limestone

The NX Core from 67.8 ft. depth of boring MI-8 is comprised of grey, fine grained, dense, massive bedded, sandy, glauconitic, fossiliferous limestone (See Figure 1). Average mineral composition approximates the following (See Plates 1 and 2):

AVERAGE MINERAL COMPOSITION

70% . . . . . Calcite
12% . . . . . Quartz
8% . . . . . Glauconite
5% . . . . . Amorphous Opal (Diatoms)
5% . . . . . Other

REPORTED BY: ☐ PHONE ☐ WIRE	TESTED BY J.N.	CHECKED BY R.J.S.
DATE ______	SAMPLED BY R. Lawson	

SAD FORM 1417
7 May 73

Previous editions of this form are obsolete.

App B

The white, angular quartz and green, polylobate, glauconite clasts of average 1 mm grain size occur along with calcite shells of pelecypods, (up to 12 mm size) in a fine micritic calcite matrix (See Figure 2). The opaline material occurring in the groundmass with the micritic calcite is microscopic in size and probably consists of broken diatom tests; the presence of this material is apparent from the X-ray diffractogram of the acid insoluble residue, (See Plate 2). The sample is free of clay minerals and comprised of materials deposited in a current agitated environment.

Sample No. 2, (Lab. No. 52/3100), Boring MI-8, 76-0-76.2 ft. depth
Glauconitic Sandstone

The NX Core from 76.0 - 76.2 ft. depth of boring MI-8 is comprised of grey, medium grained, clastic textured, poorly indurated, dolomitic, calcareous, glauconitic sandstone. Average mineral composition approximates the following (See Plate 3).

Average Mineral Composition

62%	Quartz
10%	Glauconite
12%	Dolomite
8%	Calcite
5%	Amorphous Opal (Diatoms)
3%	Other (Feldspar, Phosphate, etc.)

The sandstone is friable and poorly indurated. Clasts consist of white, angular quartz, green, polylobate glauconite, brown fine grained, dolomite, shell fragments and local phosphatic fish teeth. The matrix material is calcite mud (micrite) and microscopic opaline material. The unconsolidated or poorly indurated sandstone is comprised of materials from a current agitated environment.

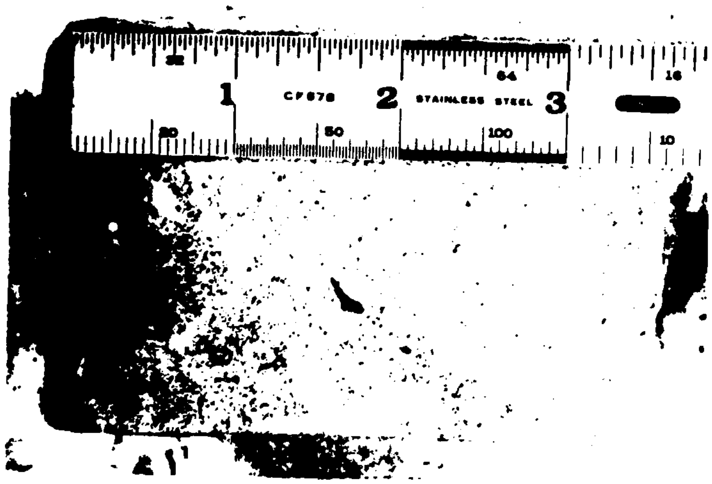


Figure 1. Sandy limestone core from 67.8 ft depth of hole MI-8, Murrells Inlet. Clasts of calcite, quartz, glauconite and shells occur in a micritic calcite matrix.

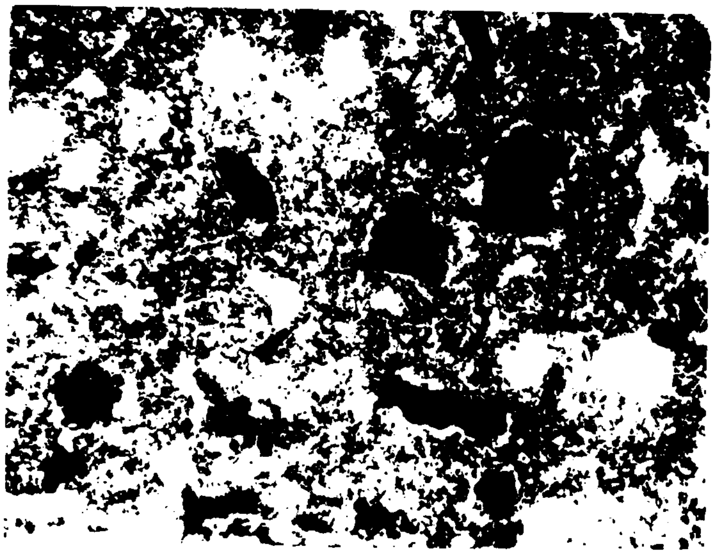


Figure 2. Photomicrograph (50X, Crossed Nicols) of thin section of NX core from hole MI-8, 67.8 ft. depth, Murrells Inlet showing clasts of quartz and glauconite in a fine grained carbonate matrix. Dark clasts are green glauconite granules.

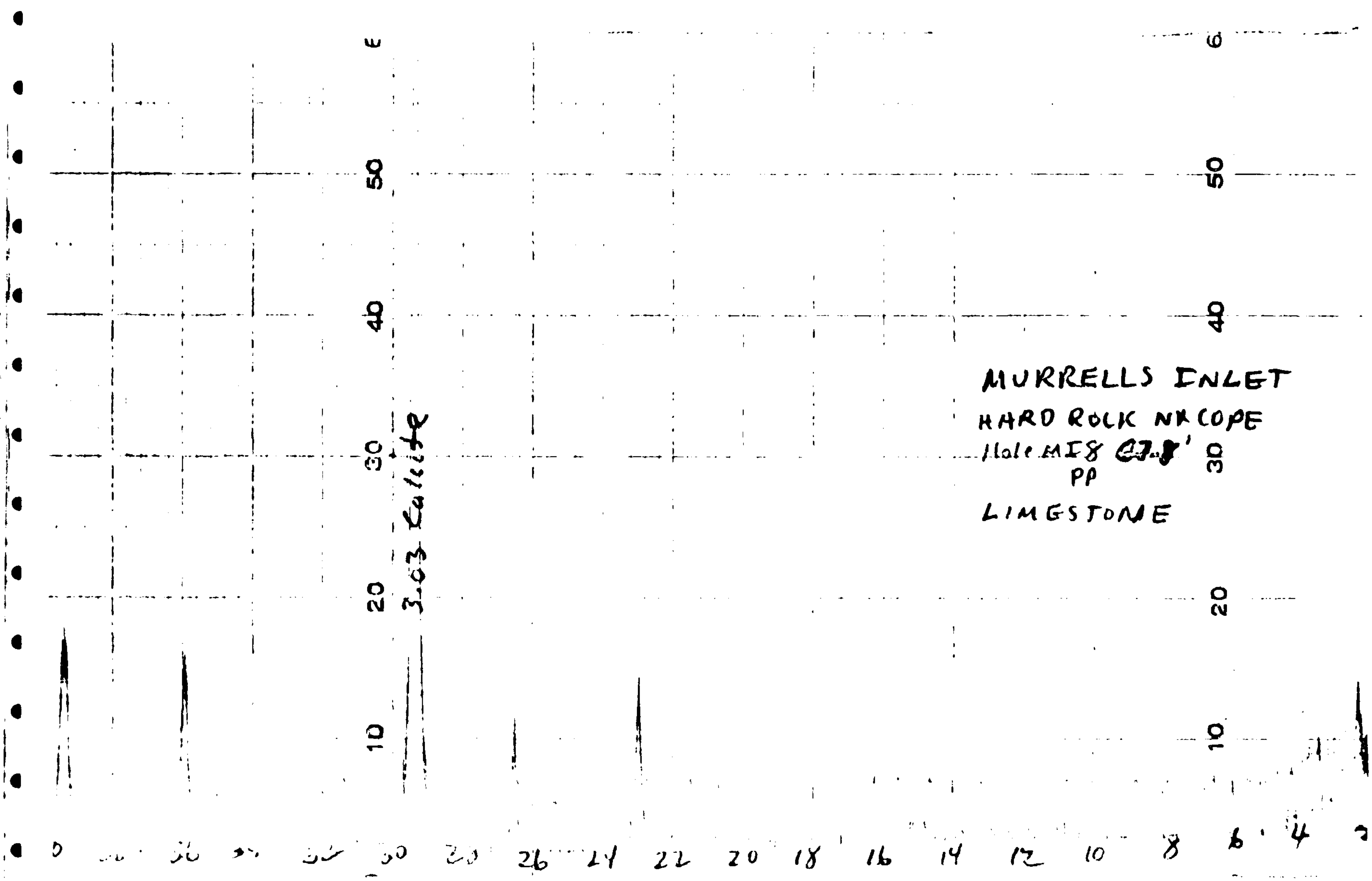


Plate I, X-Ray diffractogram of powder press samples of hard rock, NX core of limestone from 67.8 ft. depth of hole MI-8 at Murrells Inlet.

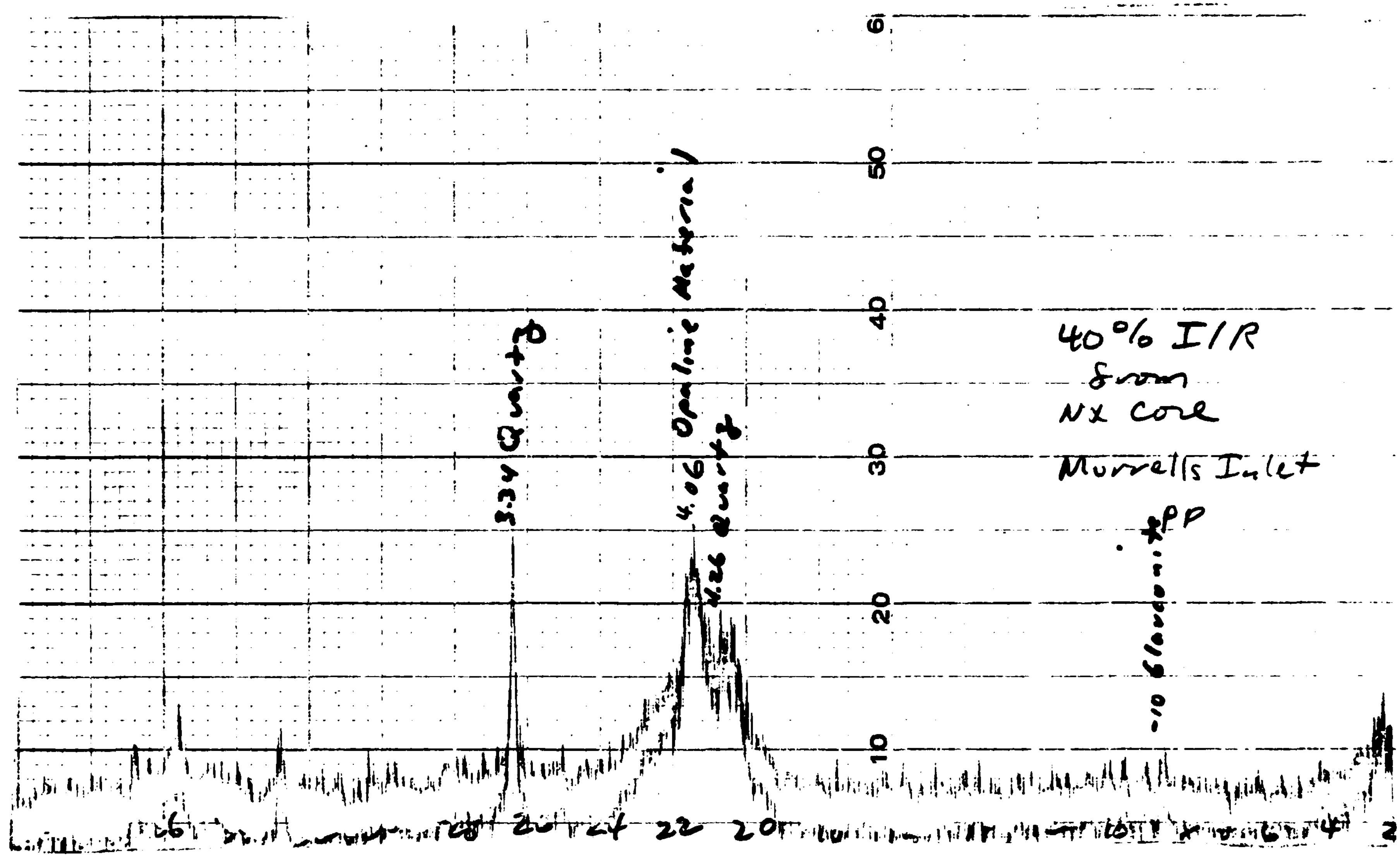


Plate 2 - X-ray diffractogram of non-carbonate fraction of sandy limestone from 67.8 ft. depth of hole MI-8, Murrells Inlet. The broad peak between 20-24 degrees two theta is largely opaline material.

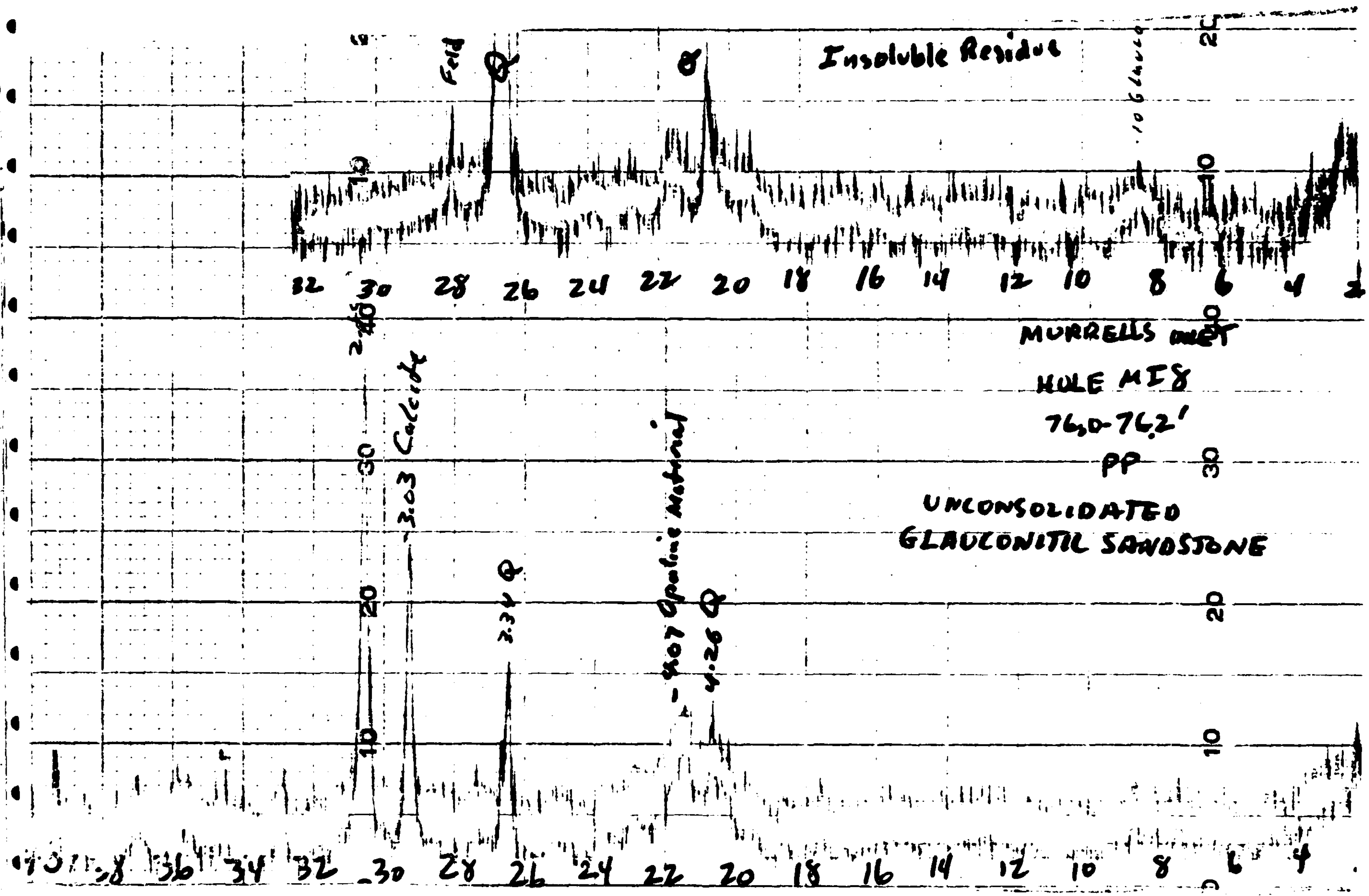


Plate 3 - X-Ray diffractograms of powder press samples of unconsolidated sandstone (bottom) and insoluble residue of sandstone (top) from 76.0 - 76.2 ft. depth of hole MI-8 from Murrells Inlet.

Exhibit C

Paleontologic Report

core: MI 8

top of hole: not given

depth: 63.3 to 63.5

Description: hard, solid claystone, difficult to break down:

microfossils abundant

Fauna:

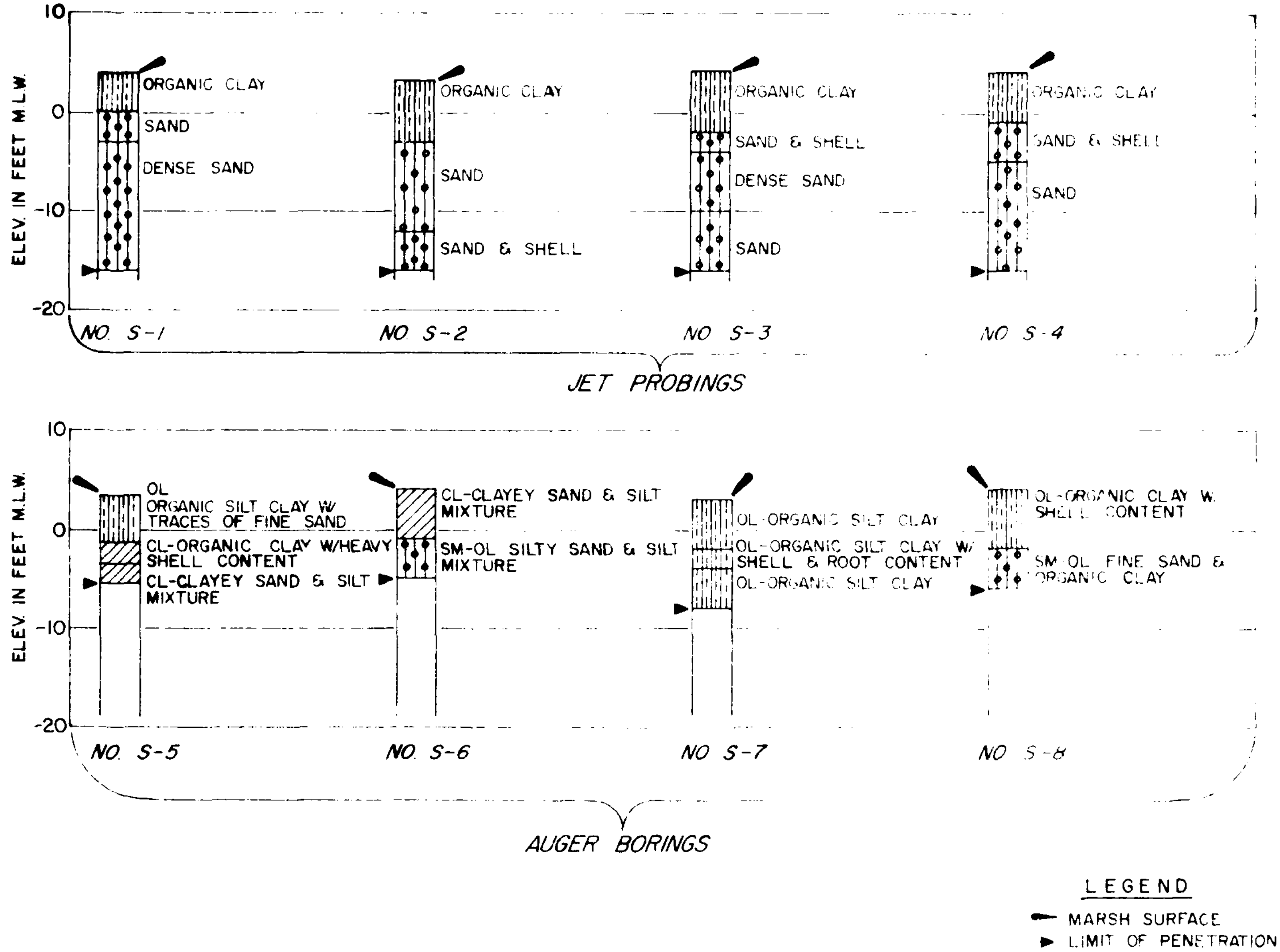
Ostracoda	
Haplocytheridea stuckeyi Stephenson	Paleocene
Foraminifera	
Robulus midwayensis (Plummer)	Paleocene
Nodosaria affinis Reuss	U. Cretaceous to Eocene
Siphogenerinoides eleganta (Plummer)	Paleocene
Guttulina problema Orbigny	Paleocene
Globigerina sp. abundant	

Conclusions: Age is Paleocene; belongs to the Black Mingo Formation. The fine grained matrix and abundant *Globigerina* suggest off-shore deposition.

Lyle D. Campbell
Box 8-0, 074 U.S.C.
Columbia, S.C. 29208

Exhibit D

Logs of Borings



LOGS OF BORINGS

MURRELLS INLET, S.C.

EXHIBIT D

APPENDIX D

DESIGN CALCULATIONS

APPENDIX D

DESIGN CALCULATIONS

TABLE OF CONTENTS

BY STUTTS DATE AUG 75 SUBJECT MURRELLS INLET, S.C. SHEET NO. 1 OF 2
CHKD. BY ______ DATE ______ ARMOR STONE CALCULATION JOB NO. ______

REF: 1) EM 1110-2-2904
2) TECH REPORT No. 4, SHORE PROTECTION PLANNING & DESIGN B.E.B.
3) SHORE PROTECTION MANUAL, C.E.R.C.

ASSUMES SEAWARD END TERMINATES @ WATER DEPTH

$-10'$ MLW

MHW = +4.4 $\qquad d: 10 + 4.4 = 14.4'$

STONE SIZE DETERMINATION

ASSUMPTION:

1. DESIGN WAVE HEIGHT $H = 12'$ AND IS EQUAL TO THE SPH SIGNIFICANT WAVE.
2. ENTIRE LENGTHS OF EACH JETTY WILL BE SUBJECTED TO THE DESIGN WAVE BECAUSE OF STORM SURGE.
3. STRUCTURE SUBJECT TO BREAKING WAVE
4. $\gamma_w = 64$ Lb/FT^3
5. $\gamma_r = 160$ Lb/FT^3
6. $S_r = 160/64 = 2.5$
7. N = 2 No. OF STONES IN ARMOR LAYER
8. $K_D = 2.5$ HEAD BREAKING WAVE, ROUGH ANGULAR, RANDOM
   $= 3.5$ TRUNK " " " " "

NOTE: FOR HEAD SECTION OF JETTY RECOMMENDED VALUES OF K_D VARY WITH SIDE SLOPES VALUE OF 2.5 SELECTED FOR DESIGN.

JETTY HEAD: $W_r = \dfrac{\gamma_r H^3}{K_D (S_r - 1)^3 \cot\alpha} = \dfrac{160(12)^3}{K_D(2.5-1)^3 \cot\alpha}$

R2 30 MAR 76

BY STUTTS DATE AUG 75 SUBJECT MURRELLS INLET, S.C. SHEET NO. 2 OF 2
CHKD. BY ____ DATE ____ ARMOR STONE CALCULATION CONT. JOB NO. ____

	K_D	COT α	W_r (LB)	W_r (TON)	APPROX. DIAMETER (FT)
	2.9	1.5	18832	9.4	5.6
USE	2.5	2.0	16384	8.2	5.4
	2.0	3.0	13653	6.8	5.0

WHEN COVER LAYER THICKNESS IS TWO QUARRY STONES THE STONE COMPRISING THE PRIMARY COVER LAYER CAN RANGE FROM ABOUT .75 W TO 1.25 W WITH ABOUT 75% WEIGHING MORE THAN W.

JETTY TRUNK

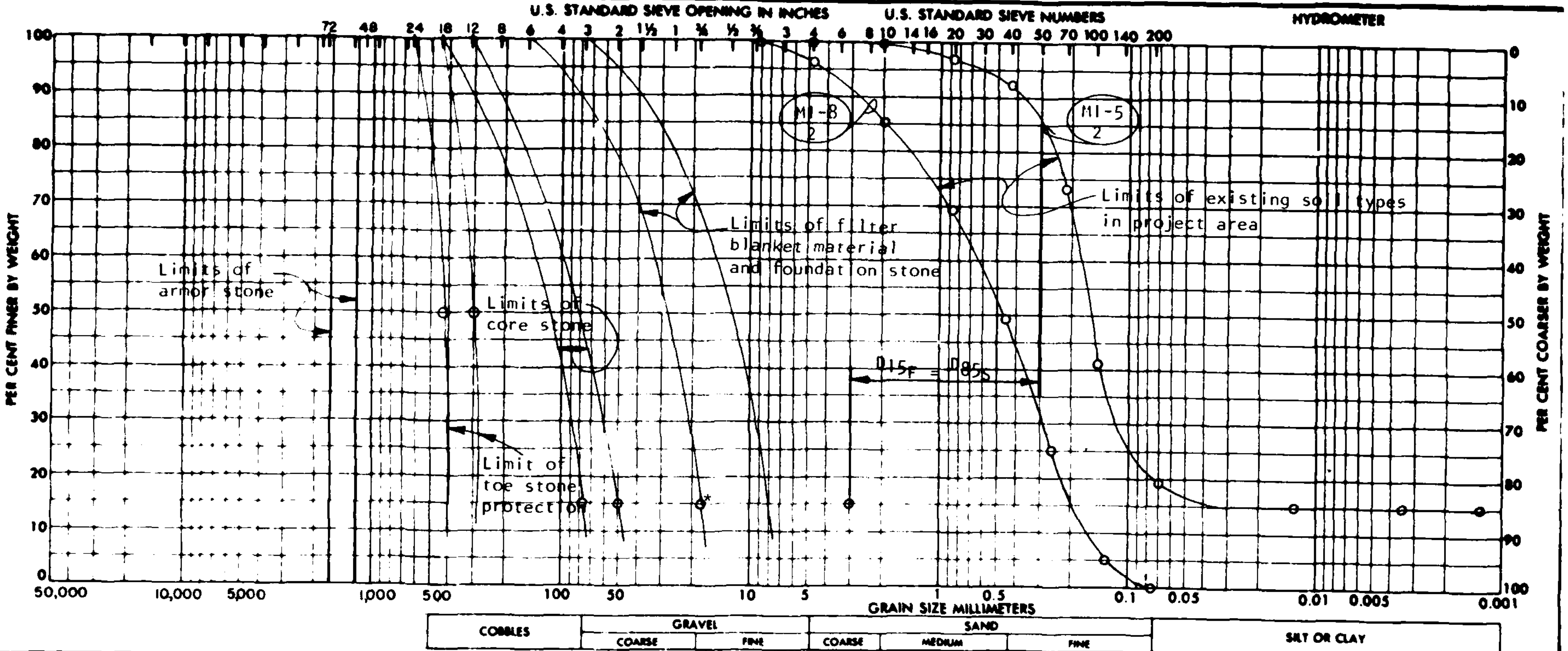
	K_D	COT α	W_r (LB)	W_r (TON)	APPROX. DIAMETER (FT)
		1.5	15603	7.8	5.3
USE	3.5	2.0	11703	5.8	4.8
		3.0	7802	3.9	4.2

FOR SELECTED VALUES OF K_D THE STONE WEIGHT IN THE HEAD SECTION OF THE JETTY MAY VARY FROM 6 TO 10 TONS WITH THE APPROXIMATE DIAMETERS RANGING FROM 4.8 FT. TO 5.7 FT. IN THE TRUNK SECTION INDIVIDUAL STONE WEIGHTS MAY VARY FROM 4 TO 7 TONS AND HAVE DIAMETERS RANGING FROM 4.2 TO 5.1 FEET.

Core Stone, Foundation Stone and Filter Blanket:

The core stone and foundation stone-filter blanket were selected in accordance with EM 1110-2-1601 and material availability. However, the limits of the foundation-filter blanket were increased due to its placement in an ocean environment. The limits of each stone type in the jetty system are shown on attached Figure . All available suppliers are expected to produce stone (generally granite) having a specific weight of 160 pounds per cubic foot (SSD). The limits of the stone types are as follows:

Stone Type	Diameter (in.)
Foundation Stone & Filter Blanket	0.25" - 6.0"
Core Stone	1.5" - 18.0"
Toe Stone Protection	12.0" - 24.0"
Armor Stone	50.0" - 70.0"



SAMPLE NO	REMARKS	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
*Larger	D15 size than filter criteria due to placement in ocean environment.						

PROJECT Murrells Inlet

Channelization

AREA

BORING NO MI-5, 6, 8, 9, 10

DATE 12 September 1975

GRADATION CURVES

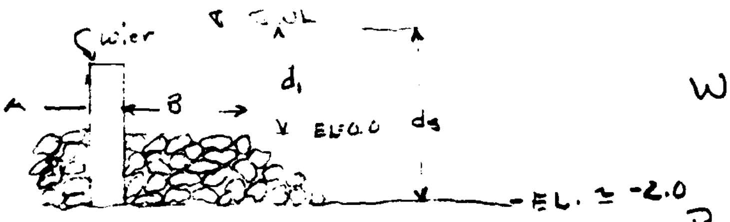
FORM 2087 REPLACES WES FORM NO 1241, SEP 1962, WHICH IS OBSOLETE

Design of Rubble Toe Protection
Jetty Weir Section

Methods outlined in Section 7.38 of the Shore Protection Manual were used in sizing the stone for the toe protection of the jetty weir section. The mean weight of the individual armor units was computed to be 210 lbs. for a 11.0 ft. breaking wave.

BY Smith DATE Aug 75 SUBJECT Murrells Inlet, S.C. SHEET NO. 1 OF
CHKD. BY DATE Toe protection Wier Section JOB NO.

Ref. Shore Protection Manual, CERC



$$W = \frac{w_r H^3}{N_s^3 (S_r - 1)^3}$$

$$B = .4 d_s$$

W = Mean weight of armor unit
w_r = Unit weight of rock = 160 lbs/ft^3
H = design wave Height
S_r = Specific gravity of rubble = w_r/w_w = 2.5
w_w = 64 lbs/ft^3
N_s = design stability Number - see fig. 7-99

	SWL (FtMLW)	d_1 (FT)	d_s (FT)	H_f (FT)	N_s^3	W (lbs)
	2	2	4	3.1	115	2
	4	4	6	4.7	225	22
	6	6	8	6.2	300 *	38
	8	8	10	7.8	300	75
	10	10	12	9.4	300	132
USE	12	12	14	11.0	300	210
	14	14	16	12.5	300	308

Note: * No attempt was made to extrapolate design curve. all weights above SWL = 6 ft should be Conservative.

Recommended value of B = 5 ft

Recomended Value for lee side protection A = 15 ft
see Justification wier design write up.

Murrells Inlet, S. C.
Wave Run Up on Permeable Rubble Slope

SWL = 4.4' MLW

T = 5 Sec.

d_s = 9.4 ft.

L_o = 5.12 $(5)^2$ = 128 ft.

d/L_o = 9.4/128 = .0734

H/H'_o = .965

H	H'_o	H'_o/gT^2	R/H'_o	R
2	2.07	.00257	1.07	2.21
3	3.11	.00386	1.00	3.11
4	4.14	.00514	.91	3.77
5	5.18	.00643	.84	4.35

SWL = 4.4' MLW

T = 6 Sec.

d_s = 9.4

L_o = 5.12 $(6)^2$ = 184 ft.

d/L_o = .051

H/H'_o = 1.019

H	H'_o	H'_o/gT^2	R/H'_o	R
2	1.83	.00158	1.10	2.01
3	2.75	.00237	1.08	2.97
4	3.67	.00312	1.05	3.85
5	4.59	.00396	0.99	4.54

Murrells Inlet, S. C.
Wave Run Up on Permeable Rubble Slope

SWL = 4.4' MLW

T = 7 Sec.

d_s = 9.4 ft.

L_o = $5.12\ (7)^2$ = 254.8 ft.

d_s/L_o = 9.4/254.8 = .0369

H/H'_o = 1.081

H	H'_o	H'_o/gT^2	R/H'_o	R
2	1.85	.00117	1.09	2.02
3	2.78	.00176	1.10	3.06
4	3.70	.00234	1.09	4.03
5	4.62	.00293	1.06	4.90

SWL = 4.4' MLW

T = 8 Sec.

d_s = 9.4

L_o = $5.12\ (8)^2$ = 327.7 ft.

d_s/L_o = 9.4/327.7 = .0287

H/H'_o = 1.139

H	H'_o	H'_o/gT^2	R/H'_o	R
2	1.76	.00085	1.05	1.85
3	2.63	.00128	1.08	2.84
4	3.51	.00173	1.10	3.86
5	4.39	.00213	1.09	4.78

Murrells Inlet, S. C.
Wave Run Up on Permeable Rubble Slope

SWL = 4.4' MLW

T = 5 Sec.

d_s = 14.4 ft.

L_o = 128 ft.

d_s/L_o = .1125

H/H'_o = .9242

H	H'_o	H'_o/gT^2	R/H'_o	R
2	2.16	.00268	1.07	2.31
3	3.25	.00404	0.99	3.22
4	4.33	.00538	0.90	3.90
5	5.41	.00672	0.82	4.44

SWL = 4.4' MLW

T = 6 Sec.

d_s = 14.4 ft.

L_o = 184 ft.

d_s/L_o = .0783

H/H'_o = .9573

H	H'_o	H'_o/gT^2	R/H'_o	R
2	2.09	.0018	1.10	2.30
3	3.13	.0027	1.07	3.35
4	4.18	.0036	1.02	4.26
5	5.22	.0045	0.95	4.96

Murrells Inlet, S. C.
Wave Run Up on Permeable Rubble Slope

SWL = 4.4' MLW

T = 7 Sec.

d_s = 14.4 ft.

L_o = 254.8 ft.

d_s/L_o = .0565

H/H'_o = 1.003

H	H'_o	H'_o/gT^2	R/H'_o	R
2	1.99	.00126	1.08	2.15
3	2.99	.00190	1.10	3.29
4	3.99	.00252	1.07	4.27
5	4.98	.00316	1.04	5.18

SWL = 4.4' MLW

T = 8 Sec.

d_s = 14.4 ft.

L_o = 327.7 ft.

d_s/L_o = .0439

H/H'_o = 1.047

H	H'_o	H'_o/gT^2	R/H'_o	R
2	1.91	.00093	1.06	2.02
3	2.87	.00139	1.09	3.13
4	3.82	.00185	1.10	4.20
5	4.78	.00232	1.08	5.16

Selection of Jetty Crest Elevation

1. The +9.0 feet MLW top elevation of the jetties was set by the top elevation of the core stone in the zone where the existing ocean bottom is above -6.0 feet. Shoreward of the -6.0 foot ocean contour the core stone is brought to elevation +4.0 feet MLW to retard the migration of sand through the jetties. Armor stone in 4-7 ton range would have an average dimension of 5 feet. Since one layer of capstone is used in this jetty trunk section, the resulting jetty crest elevation is +9.0 feet MLW. The jetty head and the jetty trunk would be located on ocean bottom contours greater than -6.0 feet. At this depth of water, wave action would not disturb the bottom as much as in shallower depths, thereby causing less sand movement.

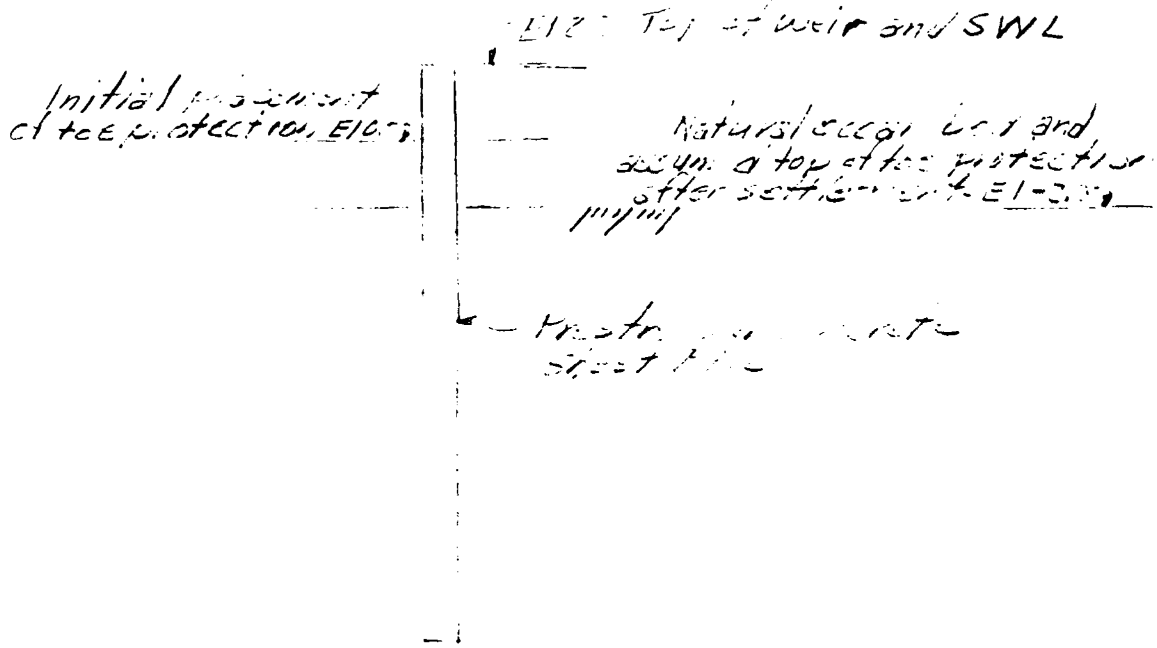
2. Section 135 in the main body of this report discusses wave transmission through the jetties. The effect of crest elevation on wave transmission can be seen in Figures 7-36 and 7-37 of Volume II of the Shore Protection Manual. For layer values of $h_{/ds}$ the wave transmission ratio, $Ht_{/Hi}$ is significantly reduced. A jetty crest elevation of 9.0 feet MLW would keep wave transmission to within acceptable limits for a large percentage of the time.

MURRELLS INLET GDM
WEIR DESIGN

1. Design Considerations. Experience at other installations has shown that a scour trough is likely to develop along the weir. The existing natural ocean bed along the weir profile varies from El +1.0 to El -3.0. Spring tide range is El 4.9 giving a normal maximum depth of 7.9 feet at the outer end. Bottom slopes seaward of the weir are relatively flat (1:100). These conditions would support a maximum height of approximately 7 feet. (S.P.M. 7.122) Depth of scour below the natural bed could be equal to or greater than the above wave height; however, a somewhat lesser scour depth would be more likely since the weir does not extend high enough to block a 7 foot wave. To control this possible scour and thereby eliminate having to design a relatively long exposed section of sheet pile above the eroded ground line, rock toe protection will be placed on each side of the weir. Installation of the toe protection will closely follow the sheet pile installation. Width of toe protection on the ocean side will be 5 feet. It is expected that when final stable conditions are reached this side will be covered by the sand fillet that builds up to the weir crest. Toe protection on the channel side will be 15 feet wide. This will armor and stabilize the width needed to develop the full passive resistance of the soil on the channel side of the sheet pile. This protection will also help dissipate the turbulent forces that occur on the channel side when breaking waves cross over the step in the bottom surface created by the weir.

2. Design wave forces. Dynamic forces due to breaking waves are assumed to be concentrated at the still water level in accordance with the Minikin formula (S.P.M. 7.331). Maximum forces occur with the still water level at the top of the weir (El +2.2). With a flat slope seaward of the weir and a given depth at the weir the breaker height varies only slightly with varying wave periods as shown in Figure 7-4, S.P.M. But, Figure 7-75 shows that for a given breaker height, depth, and ground slope the wave forces increase rapidly as the period decreases. Limited observation records for the wave gage at Springmaid Beach Pier near Myrtle Beach show that waves 3 to 4 feet high occur with periods as low as 5 seconds. A minimum period of 5 seconds will be used for computing maximum wave forces on the sheet pile weir. The natural bed will be assumed at El -2.0 and it will be further assumed that the toe protection, initially placed to El 0.0, has settled also to El -2.0 giving an exposed weir design height of 4.2 feet.

BY A. Knight DATE 25 Aug ?? SUBJECT Myrrells Inlet-GDM SHEET NO. 1 OF ____
CHKD. BY ________ DATE ________ Sheet Pile Weir JOB NO. ____



References: Shore Protection Manual (CERC)
EM 1110-2-2906

Design Assumptions:

1. Unit weight of soil in sea water - 60 #/ft³
2. ϕ Angle of submerged soil - 32°
3. Active pressure - $P_a = 60 \tan^2(45 - \frac{\phi}{2}) = 18.4$ #/ft²/ft
4. Passive pressure - $P_p = 60 \tan^2(45 + \frac{\phi}{2}) = 195.3$ #/ft²/ft

$P_p - P_a = 177$ #/ft²/ft

BY A. Knight DATE 25 Aug 75 SUBJECT Murrels Inlet-GDM Sheet Pile Weir SHEET NO. 2 OF
CHKD. BY DATE JOB NO.

Design Breaking Wave:

SWL = El +2.2 = Top of Weir

Assumed natural bed at El -2.0 (see profile)

Nearshore slope: $m = 0.01$ (1:100)

$d_s = 4.2'$ $T = 5$ sec (min)

$\frac{d_s}{gT^2} = 0.0052$ From Fig. 7-4 (SPM) $\frac{H_b}{d_s} = 0.85$

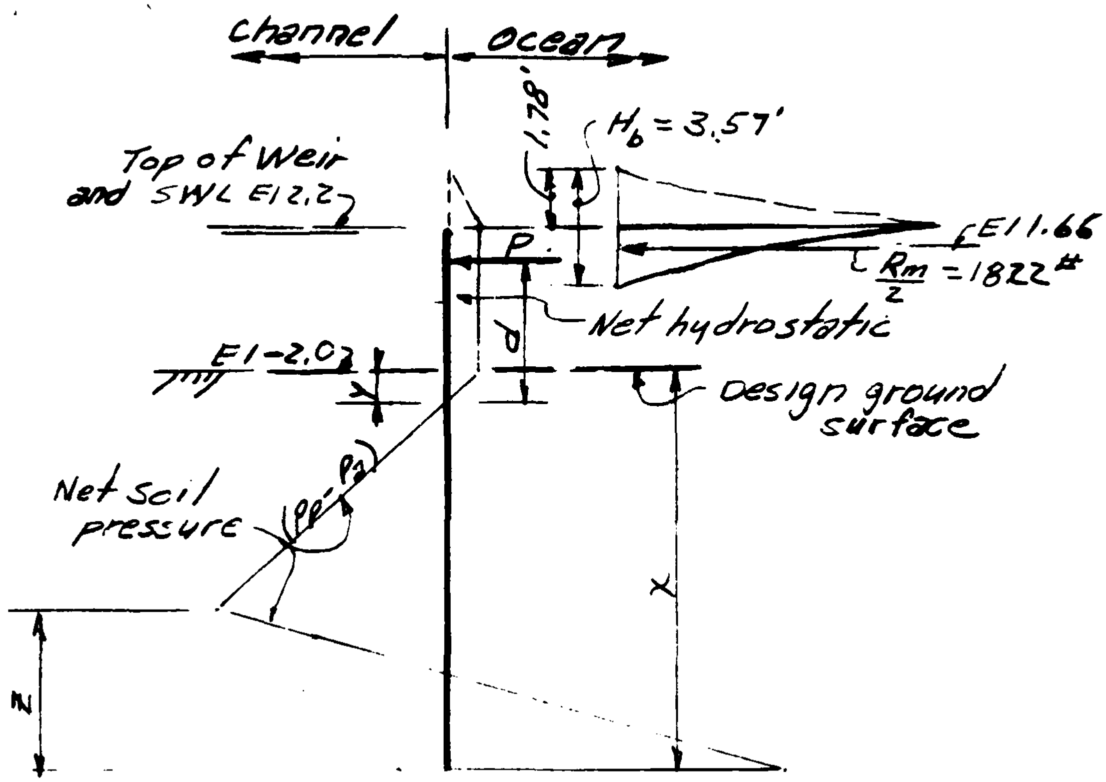
$H_b = .85(4.2) = \underline{\underline{3.57'}}$

$\frac{d_s}{T^2} = 0.168$ From Fig 7-75 (SPM) $\frac{P_m}{wH_b} = 13.4$

$P_m = 13.4(64)(3.57) = 3062$ PSF

$R_m = \frac{3062(3.57)}{3} = \underline{\underline{3643\#}}$

BY A. Knight DATE 25 Aug '75 SUBJECT Murrells Inlet - GDM SHEET NO. 3 OF
CHKD. BY DATE Sheet Pile Weir JOB NO.



LOADING DIAGRAM

Net hydrostatic = 1.78(64) = 114 PSF

$$y = \frac{114}{177} = 0.64'$$

Resultant of forces above "Y"

	1822	@ 4.30	7835
114(4.2)	479	@ 2.74	1312
$114(\frac{.64}{2})$	36	@ 0.43	16
P =	2337#	@ 3.92' = d	9163 '#m

ΣM about bot. of pile = 0 ΣM 2906

$$6P(d+x-y) - (P_p - P_a)(x-y)^3 + \frac{[(P_p-P_a)(x-y)^2 - 2P]^2}{[2(P_p-P_a)(x-y) + P_p(h+y) - P_a y]} = 0$$ NOTE h=0

$$(14022)(3.28+x) - 177(x-0.64)^3 + \frac{[177(x-0.64)^2 - 4674]^2}{354(x-0.64)+113} = 0$$

By successive Trials: x = 13.2'

Total pile length = 13.2 + 4.2 = <u>17.4</u>' Min.

<u>Use 18' Long Pile</u>

Find z:

$$z = \frac{(P_P - P_a)(x-y)^2 - 2P}{2(P_P - P_a)(x-y) + P_P(h+y) - P_a H}$$ EM 2906

$h = 0$

$$z = \frac{177(12.56)^2 - 4674}{354(12.56) + 177(0.64)} = 5.10'$$

Locate point of zero shear - below "Y"

$\frac{177}{2} l^2 = 2337.$ $l = 5.14'$

$$M_{max} = 2337\,(9.06) - \frac{177(5.14)^3}{6}$$
$$= 21173. - 3913 = \underline{\underline{17{,}260}}\ '^{\#}$$

Conc - $f'_c = 5000$ psi $f_c = .35 f'_c = 1750$ psi

steel - ult $f_{pu} = 250{,}000$ psi

Initial prestress = 175,000 psi

Effective stress after losses $f_{se} = 140{,}000$ psi

$\frac{M}{S} - \frac{P}{A_c} = 0$ and $\frac{M}{S} + \frac{P}{A_c} \leq 1750$

$\therefore \frac{2M}{S} = 1750$ and $\frac{M}{S} = 875$

$S_{req'd} = \frac{(17260)(12)}{875} = 237\,in^3 = \frac{bt^2}{6}$

$t_{req'd} = \sqrt{\frac{6(237)}{12}} = 10.9''$ use $\underline{\underline{t = 12''}}$

Actual $S = \frac{12(12)^2}{6} = 288\,in^3$

$f_b = \frac{(17260)(12)}{288} = 719$ psi

$P_{req'd} = 12(12)(719) = 103560\ ^{\#}/FT$

For 4' wide section: $A_{ps} = \frac{4(103560)}{140000} = 2.96\ \square''$

$\frac{7}{16}''\phi$ 7-wire strand: $A_s = 0.109\ \square''$

$\frac{2.96}{0.109} = 27.2$ use $\underline{\underline{28\text{-}\frac{7}{16}}}''\phi$ strands

Page 1 of

Project MURRELLS INLET, SOUTH CAROLINA

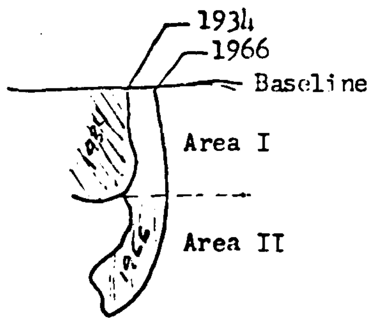
Computation LITTORAL DRIFT RATES

Computed THURMAN T. MORGAN 5 AUG 75 Checked by

METHOD 1 (VOLUMETRIC ACCRETIONS)

Data on Southward growth of North Lip of Murrells Inlet, S. C.

Year (Survey)	Intervening years	Distance from BL to S. end of lip, ft	Spit length change, ft (+ is southward)	Change: ft/yr	Remarks
1872		8,300			
	54		-6,000		Breakthrough, disregard
1926		2,300			
	8		6,000	75.0	
1934		2,900			
	9		-300		Northward movement or breakthrough-disregard
1943		2,600			
	23		2,200	95.6	
1966		4,800			



Area and volumetric estimates were made of the accretion between the surveys of 1934 and 1966. Accretions were in the form of a widened shore (Area 1), and added length to the inlet lip (1,900 ft). The results of these estimates are given below: (Interval is 32 yrs)

Increment:	Area ft^2	Volume (CY) Estimated	Rule of Thumb[1]
Area I	850,687	566,889	850,687
Area II	1,763,180	1,233,891	1,763,180
Total	2,613,867	1,800,780	2,613,867
cy/yr		56,274	81,683

FOOTNOTE 1 - FROM S.P.M., A CHANGE OF 1 SQ. FT. OF BEACH AREA IS EQUAL TO 1 CUBIC YARD OF BEACH MATERIAL

Project MURRELLS INLET, SOUTH CAROLINA
Computation LITTORAL DRIFT RATES
Computed by THURMAN T. MORGAN Date 5 AUG 75

METHOD 1 (CONTINUED)

NOTE THAT THE CHANGE CAN BE ASSOCIATED WITH THE 1934-1966 CHANGE IN SPIT LENGTH OF 1,900 FT. OR 59.4 FT./YEAR, WHILE THE GREATEST RATE OF SPIT GROWTH OCCURRED BETWEEN 1943 AND 1966. IN THE PERIOD BETWEEN 1943 AND 1966, IT GREW AT A RATE OF 95.6 FT./YEAR.

ASSUMING THE ANNUAL VOLUMETRIC ACCRETIONS ARE DIRECTLY PROPORTIONAL TO CHANGES IN LENGTH-GROWTH RATES, THE CUBIC YARD PER YEAR FIGURES (56,274 AND 81,683) CAN BE MULTIPLIED BY A FACTOR 1.61 (95.6/59.4).

APPLYING THIS FACTOR (1.61), TO OBTAIN

90,601 CY/YR. AND 131,500 CY/YR.

MURRELLS INLET, SOUTH CAROLINA
LITTORAL DRIFT RATES
THURMAN T. MORGAN 5 AUG 75

METHOD 2 (ENERGY FLUX)

This involves data on the frequency of waves from various directions and of various heights. To get the height frequency data anx analysis was made of a years records of waves at Holden Beach, N. C. Direction frequency was inferred from shipboard swell-direction observations nearby. With the estimated percentage frequency of waves of various heights and from various directions, the method shown on p. 4-106 of the shore protection manual was used to estimate the littoral drift. This is the so-called "energy flux method", and is called method 3.

The Following basic data was used:

Percent of waves of height shown from the directions shown:

	NE	E	SE	S	Other[1]
DW angle to shore:	15°	60°	-75°	-30°	
H_o					Calms and waves from other directions, as noted on shipboard
1	12	8	6	4	
2	6	5	3	2	
3	3	2	1	1	
4	1	1			
total	23	16	10	7	44

Computation, as shown on p. 4-106, SPM, yielded the following: (in cubic yards/year):

Southward moving material	186,360
Northward moving material	53,970
Net (southward)	132,390
Total drift	240,330

MURRELLS INLET, S.C.
CHANNEL DIMENSIONS
R.J.C. 8 SEPT 75

ENTRANCE CHANNEL

REF. EM 1110-2-1607, TIDAL HYDRAULICS

DESIGN VESSEL — L = 60 FT., W = 20 FT. + D = 5.0 FT.

DESIGN IS BASED ON THE FOLLOWING ASSUMPTION: FULL VESSEL SPEED PERMITTED; SEVERE WAVE ACTION POSSIBLE; SEA WATER OF NORMAL OCEAN SALINITY; AND SANDY BOTTOM.

DESIGN VESSEL, STATIC DRAFT	5.0'
NOMINAL SQUAT	1.0'
ROLLING + PITCHING	2.0'
CLEARANCE	2.0'
ENTRANCE CHANNEL DEPTH	10.0'

REF. A.) COMM. ON TIDAL HYDRAULICS RPT. NO. 3
B.) CERC PUBLICATION: SR 2

FROM REF. A, FOR 2 LANE TRAFFIC EA. MANEUVERING LANE —

2 × 1.8 × 20' = 72'

CLEARANCE EQUAL TO BEAM OF LARGEST VESSEL

20'

BANK CLEARANCE

2 × 1.5 × 20' = 60'

WIDTH = 152' SAY 150'

FROM REF. B, page 59 — IT IS RECOMMENDED TO PROVIDE A NAVIGABLE WIDTH OF 300' FOR FIRST 1000 BOATS.

FROM REF. A, A WIDTH OF 150 FT. IS ACCEPTABLE; BUT IN ORDER TO ACCOUNT FOR CURRENTS, WIND,

MURRELLS INLET, S.C.
CHANNEL DIMENSIONS
R.J.C. 8 SEPT .75

AND VESSELS UNDER TOW THE REQUIRED WIDTH IS:

ENTRANCE CHANNEL WIDTH = 300'

INNER CHANNEL

REF. – COMM. ON TIDAL HYDRAULICS RPT. NO. 3

FROM PARAGRAPH X-36 — MIN. WIDTH FOR 2-WAY TRAFFIC EQUALS 5 times beam of Largest VESSEL

MIN. WIDTH = 5 × 20' = 100'

FROM PARAGRAPH X-72 — THE WIDTH OF CHANNELS IN WIDE WATERWAYS ORDINARILY WILL NOT BE IN EXCESS OF 100 FT., EVEN IF CURRENTS ARE IN EXCESS OF 5 KNOTS; THE EXCEPTION WOULD BE IN CASES WHERE THE TRAFFIC DENSITY IS UNUSUALLY HIGH.

THE PROPOSED INNER CHANNEL will be Located IN A WIDE WATERWAY WITH MAX. CURRENTS OF 3 KNOTS. THE TRAFFIC DENSITY IS CONSIDERED TO BE MODERATE. EXPERIENCE WITH THE INTRACOASTAL WATERWAY SHOWS THAT 2-WAY TRAFFIC CAN OPERATE SAFELY IN A 90-FOOT CHANNEL. THEREFORE:

INNER CHANNEL WIDTH = 90'

R2 30 MAR 76

MURRELLS INLET, S.C.
CHANNEL DIMENSIONS
R.J.C. 8 SEPT. 75

INNER CHANNEL CONTINUED

DESIGN DEPTH IS BASED ON A HIGHLY DEVELOPED AREA, REDUCED SPEED REQUIRED, NO WAVE ACTION, SEA WATER OF NORMAL OCEAN SALINITY, AND SANDY BOTTOM.

DESIGN VESSEL, STATIC DRAFT	5.0'
NOMINAL SQUAT	1.0'
ROLLING & PITCHING	0.0'
CLEARANCE	2.0'
INNER CHANNEL DEPTH	8.0'

WIDENING IN TURNS

REF. – COMM. ON TIDAL HYDRAULICS RPT. NO.3

FROM PARAGRAPH X-64, CHANNEL TURNS ARE WIDENED BY THE APEX OR CUTOFF METHOD USING THE FOLLOWING CRITERIA:

WHERE DEFLECTION ANGLE IS 40° OR LESS

WIDENED WIDTH = 1.5 × NORMAL CHANNEL WIDTH
= 1.5 × 90 = 135'

WHERE DEFL. ANGLE IS GREATER THAN 40°

WIDENED WIDTH = 1.68 × NORMAL CHANNEL WIDTH
= 1.68 × 90 = 150'

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MURRELLS INLET, S.C.
CHANNEL DIMENSIONS
R.J.C. 8 SEPT 75

TURNING BASIN

THE DESIGN OF THE TURNING BASIN IS DEPENDENT ON THE VESSEL LENGTH. SINCE THERE ARE VESSELS OPERATING IN THE PROJECT AREA WITH LENGTHS LARGER THAN THE DESIGN VESSEL, THE VESSEL LENGTH THAT IS USED FOR TURNING BASIN DESIGN IS THE LENGTH OF THE LARGEST VESSEL WHICH IS 100 FEET. THIS WILL NOT CAUSE ANY INCREASED DREDGING.

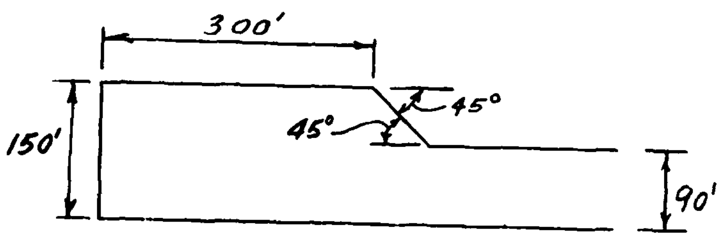
REF. – EM 1110-2-1607, TIDAL HYDRAULICS

TOTAL WIDTH = 1.5 × DESIGN VESSEL LENGTH
= 1.5 × 100
= 150 FEET

MIN. LENGTH OF SHORT SIDE = 1.5 × DESIGN VESSEL LENGTH
= 150 FEET

SHAPE IS TRAPEZOIDAL WITH LONG SIDE TANGENT TO EDGE OF CHANNEL. THE ENDS WILL MAKE ANGLES OF 45° WITH EDGE OF CHANNEL. SHORT SIDE LENGTH IS INCREASED TO 300 FT. TO PROVIDE ADDITIONAL MANUVERING AREA.

TURNING BASIN: W = 150'; SHORT SIDE L = 300'



R2 30 MAR 76

APPENDIX E

PROJECT JUSTIFICATION

APPENDIX E

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TABLES

EXHIBITS

FIGURES

APPENDIX E

PROJECT JUSTIFICATION

ECONOMIC PROJECTIONS

1. Purpose and scope. The purpose of the following projections is to obtain some indication of the probable economic growth of the tributary areas to Murrells Inlet. This is needed to estimate project benefits accruing to commercial charter boating and recreational boating activities, and commercial fishing at their present development level, and such additional values accruing to future development. The major economic parameters relevant to future development at Murrells Inlet are considered to be:

   a. population,
   b. personal income,
   c. earnings from wholesale and retail trade,
   d. total employment
   e. employment in amusement and recreation services,
   f. earnings from amusement and recreation services,
   g. lodging, restaurant and recreation business,
   h. commercial recreation, and
   i. total boat registration.

Historical and projected values of these indicators are presented in Table 1 to 9 and the project annual growth rates are summarized in Table 10. Table 11 shows the estimated growth rates for boating activities and commercial fishing at Murrells Inlet based on the economic indicators discussed herein.

2. Source of data and price levels. All monetary values have been expressed in terms of 1967 constant dollars. Projection references used in this study are:

a. Water Resources Council, "1972 OBERS Projections, Regional Economic Activity in the U. S., 1929 to 2020", April 1974, Series "E" (7 Volumes).

b. Social Sciences Advisory Committee for Virginia, North Carolina, and South Carolina, "Population Projections Developed After Studying the Growth Rates and Comments from Committee Members", October 1969, and

c. Corps of Engineers, Charleston District: Appendix D, "Economic Projections", a part of the Review of Reports on Reedy River, South Carolina, September 1969.

d. Copeland, Lewis C., "Travelers and South Carolina Business During 1968--An Economic Analysis", The University of Tennessee, for Travel Division, South Carolina Department of Parks, Recreation and Tourism.

3. Other historical data. Other historical data have been abstracted from publications of the U. S. Census Bureau, Department of Commerce; U. S. Army Engineer Division, South Atlantic, Corps of Engineers; and the S. C. Wildlife Resources Department, Division of Boating. Census Bureau data include:

a. "U. S. Census of Population", "County and City Data Book",
b. "Statistical Abstract of the United States",
c. "Historical Statistical Abstract of the United States", and
d. "Historical Statistics of the United States, Colonial Times to 1957".

4. Method of analysis. Projection of parameters has been made by a process of successive disaggregation of projections from the national level to the two-county level which would be most affected by a project at Murrells Inlet (Georgetown and Horry). BEA Area 30 consists of nine South Carolina counties: Georgetown, Horry, Marion, Williamsburg, Dillon, Florence, Darlington, Chesterfield, and Marlboro. Projections (to the year 2020) for successively smaller areas were made with regard to their expected performance relative to the larger areas of which they are a part.

5. Population. Population projections through 2020 for all the economic areas in Table 1 were taken from the references listed in paragraph 2 of this appendix. The "E" series projections assumes a birth rate which will eventually (the middle of the 21st century) result in no further population growth except for immigration. The projections are also assumed to be free of the effects of wars.

Table 1
PERMANENT POPULATION: HISTORICAL AND PROJECTED

Year	United States	Virginia, No. Carolina, and So. Carolina	So. Carolina	BEA Area 030	Georgetown and Horry Counties [1/]
1940	131,955,000	8,196,000	1,902,000	364,000	78,300
1950	151,237,000	9,496,000	2,113,000	396,400	91,600
1960	179,985,000	10,941,000	2,373,000	407,800	103,000
1970	203,858,000	12,340,000	2,596,000	401,600	103,500
1980	223,532,000	13,849,000	2,818,000	436,900	116,600
1990	246,039,000	15,720,000	3,121,000	474,700	126,200
2000	263,830,000	17,073,000	3,319,000	491,900	130,600
2010	281,368,000	18,375,000	3,502,000	502,800	134,100
2020	297,146,000	19,614,000	3,666,000	513,800	136,800
		Annual Growth Rate (in percent)			
1940-1950	1.4	1.5	1.1	0.9	1.6
1950-1960	1.8	1.4	1.2	0.3	1.2
1960-1970	1.3	1.2	0.9	No growth	0.1
1970-1980	0.9	1.2	0.8	0.8	1.2
1980-1990	1.0	1.3	1.0	0.8	0.8
1990-2000	0.7	0.8	0.6	0.4	0.3
2000-2010	0.6	0.7	0.5	0.2	0.3
2010-2020	0.5	0.7	0.5	0.2	0.2

[1/] Projected numbers are preliminary breakdowns furnished by BEA for review and are subject to change.

6. <u>Personal income</u>. Personal income is a measure of the purchasing power of persons residing in the different economic areas. Table 2 shows the personal income for these areas for selected years in 1967 dollars.

Table 2
TOTAL PERSONAL INCOME: HISTORICAL AND PROJECTED
(In 1967 Dollars)

Year	United States ($ million)	Virginia, No. Carolina and So. Carolina ($ million)	So. Carolina ($ million)	BEA Area 030 ($ thou)	Georgetown and Horry Counties 1/ ($ thou)
1950	312,148	14,029	2,609	357,900	82,898
1960	448,251	20,051	3,711	497,900	126,484
1970	708,584	36,237	6,790	887,800	224,492
1980	1,068,496	56,227	10,322	1,397,700	398,400
1990	1,517,173	84,068	15,126	2,038,900	556,500
2000	2,154,266	122,775	21,772	2,902,900	804,700
2010	3,013,754	175,827	30,782	4,051,800	1,122,500
2020	3,931,928	235,515	40,697	5,277,300	1,465,900
		Annual Growth Rate (in percent)			
1950-1960	3.7	3.6	3.6	3.4	4.3
1960-1970	4.7	6.1	6.2	6.0	5.9
1970-1980	4.2	4.5	4.3	4.6	5.9
1980-1990	3.6	4.1	3.9	3.8	3.6
1990-2000	3.6	3.9	3.7	3.6	3.5
2000-2010	3.4	3.7	3.5	3.4	3.4
2010-2020	2.7	3.0	2.8	2.7	2.7

1/ Projected numbers are preliminary breakdowns furnished by BEA for review and are subject to change.

The [illegible] Horry and Georgetown Counties should have a slightly higher rate of growth in per capita income than BEA Area 030. In the tabulation below, the first row is the OBERS-E projection of per capita personal income for Area 030; the second row is its U. S. relative; the [illegible] row is the per capita personal income for Horry and Georgetown Counties as implied by Tables 1 and 2; and the fourth row is the average annual growth rate of the per capita personal income for these two counties for the decade ending with the indicated year.

([illegible] dollars)

	1970	1980	1990	2000	2010	2020
BEA 030	2,211	3,100	4,200	5,900	7,800	10,200
U. S. Relative	.64	.67	.70	.72	.76	.78
Horry & Georgetown Counties	2,169	3,117	4,410	6,162	8,371	10,716
Annual growth rate, preceding decade, percent	5.8	4.6	2.6	3.4	3.1	2.5

7. Earnings from wholesale and retail trade. Earnings are considered to be the sum of wages and salaries, other labor income and proprietors' incomes in wholesale and retail trade. They are closely related to disposable personal income. In 1970, they were about 13 percent of total personal income for the United States. They have been projected to about 10 percent of the projected total personal income in 2020. South Carolina earnings from wholesale and retail trade amounted to about 11 percent of the State's total personal income in 1970 and have been projected to be about [illegible] percent of the State's total personal income in 2020.

8. [illegible] rate for employment is expected to continue [illegible] growth rate. These rising participation rates [illegible] to the rising participation rates in the female [illegible] population. Among males, there are declining rates [illegible] and in the group over 60 [illegible] total employment and annual growth [illegible] Table [illegible].

9. [illegible] services. Amusement and recreation [illegible] charge fees for amusement [illegible] Table 5, it refers to employment [illegible] motion picture establishments [illegible] employment was 0.38 percent of

Table 3
EARNINGS FROM WHOLESALE AND RETAIL TRADE: HISTORICAL AND PROJECTED
(In 1967 Dollars)

Year	United States ($ million)	Virginia, No. Carolina and So. Carolina ($ million)	So. Carolina ($ million)	BEA Area 030 ($ mil.)	Georgetown and Horry Counties 1/ ($ mil.)
1950	48,774	1,862	337	51.3	15.0
1962	67,566	2,752	474	70.9	20.8
1970	93,080	4,297	758	106.4	31.2
1980	133,912	6,422	1,121	158.4	46.0
1990	179,102	8,982	1,564	218.9	63.7
2000	243,455	12,509	2,173	300.2	87.3
2020	409,485	21,887	3,784	507.1	147.6
	Annual Growth Rate for Indicated Period (in percent)				
1950-1962	2.8	3.3	2.9	2.7	2.8
1962-1970	4.1	5.7	6.0	5.2	5.2
1970-1980	3.7	4.1	4.0	4.1	4.0
1980-1990	3.0	3.4	3.4	3.3	3.3
1990-2000	3.1	3.4	3.3	3.2	3.2
2000-2020	2.6	2.8	2.8	2.7	2.7

1/ Projected numbers are preliminary breakdowns furnished by BEA for review and are subject to change.

Table 4
TOTAL EMPLOYMENT: HISTORICAL AND PROJECTED

Year	United States	Virginia, No. Carolina, and So. Carolina	So. Carolina	BEA Area 030	Georgetown and Horry Counties [1/]
1940	45,376,000	2,803,000	661,000	118,800	24,050
1950	57,475,000	3,536,000	772,000	135,800	30,730
1960	66,373,000	4,015,000	862,000	129,700	31,990
1970	79,307,000	5,039,000	1,033,000	144,300	34,300
1980	96,114,000	6,136,000	1,235,000	176,700	46,500
1990	106,388,000	6,916,000	1,369,000	193,400	50,700
2000	117,891,000	7,674,000	1,498,000	207,800	54,300
2010	128,018,000	8,148,000[2/]	1,561,000[2/]	212,400[2/]	57,200
2020	130,534,000	8,623,000	1,624,000	217,100	57,000
		Annual Growth Rate (in percent)			
1940-1950	2.4	2.4	1.6	1.3	2.5
1950-1960	1.4	1.3	1.1	No growth	0.4
1960-1970	1.8	2.3	1.8	1.1	0.7
1970-1980	1.9	2.0	1.8	2.0	3.1
1980-1990	1.0	1.2	1.0	0.9	0.9
1990-2000	1.0	1.0	0.9	0.7	0.7
2000-2010	0.8	0.6	0.4	0.2	0.5
2010-2020	0.2	0.6	0.4	0.2	No growth

[1/] Projected numbers are preliminary breakdowns furnished by BEA for review and are subject to change.
[2/] Interpolated numbers.

the total employment in South Carolina; in 1960, 0.44 percent; and is projected to be 0.67 percent in the year 1980. This trend of an increasing share of the total employment by amusement and recreation services is found throughout the smaller economic areas shown in Table 5. After 1980 annual growth rates decline with all economic areas showing less than one percent growth for each 10-year period. The projected employment for the United States using census "E" data was used to convert the original employment projections of the smaller areas using census "C" data to more current "E" data.

Table 5
EMPLOYMENT IN AMUSEMENT AND RECREATION SERVICES:
HISTORICAL AND PROJECTED

Year	United States	Virginia, No. Carolina and So. Carolina	So. Carolina	BEA Area 030	Georgetown and Horry Counties
1940	403,002	14,923	2,479	286	62
1950	501,640	21,357	3,361	497	115
1960	525,543	22,110	3,778	529	134
1970	650,862	30,730	5,949	1,027	261
1980	805,000	40,892	8,257	1,176	303
1990	863,000	42,996	8,442	1,228	327
2000	912,000	44,329	8,588	1,224	330
2010	940,000	44,729	8,569	1,285	356
2020	905,000	42,238	8,070	1,249	350
	Annual Growth Rate for Indicated Period (in percent)				
1940-1950	2.2	3.6	3.1	5.7	6.3
1950-1960	0.5	0.3	1.2	0.6	1.5
1960-1970	2.2	3.3	4.6	6.9	6.9
1970-1980	2.1	2.9	3.3	1.4	1.5
1980-1990	0.7	0.5	0.2	0.4	0.8
1990-2000	0.6	0.3	0.2	No growth	0.1
2000-2010	0.3	0.1	No growth	0.5	0.8
2010-2020	No growth	No growth	No growth	No growth	No growth

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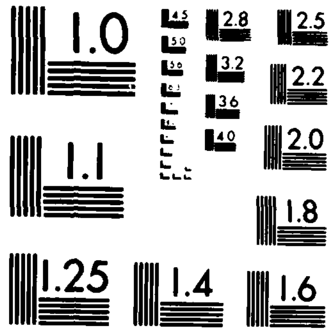


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

10. Earnings from amusement and recreation services. Table 6 gives historical and projected earnings from amusement and recreation services (SIC Groups 78 and 79) for the United States and smaller areas. Projections are generally consonant with the 1972 OBERS-E projections. The growth rate of earnings is generally greater than the growth rate of employment. Earnings for Georgetown and Horry Counties were taken as a proportion of the BEA Area 030 and they increase at a slightly higher rate than those for BEA Area 030, as does employment.

Table 6
EARNINGS FROM AMUSEMENT AND RECREATION SERVICES: HISTORICAL AND PROJECTED
(in 1,000 1967 dollars)
(SIC 78 & 79)

Year	United States	Virginia, No. Carolina and So. Carolina	So. Carolina	BEA Area 030	Georgetown and Horry Counties
1950	1,705,576	72,614	11,427	944	218
1960	2,159,981	90,872	15,528	1,328	336
1970	3,724,629	175,856	34,028	4,301	1,093
1980	5,345,000	271,500	54,800	6,000	1,550
1990	7,187,000	358,100	70,300	8,300	2,210
2000	9,644,000	468,600	90,800	11,200	3,020
2010	13,263,000	631,100	120,900	15,200	4,210
2020	15,962,000	745,000	142,400	18,100	5,070
	Annual Growth Rate for Indicated Period (in percent)				
1950-1960	2.4	2.3	3.1	3.5	4.4
1960-1970	5.6	6.8	8.2	12.5	12.5
1970-1980	3.7	4.4	4.9	3.4	3.6
1980-1990	3.0	2.8	2.5	3.3	3.6
1990-2000	3.0	2.7	2.6	3.0	3.2
2000-2010	3.2	3.0	2.9	3.1	3.4
2010-2020	1.9	1.7	1.7	1.8	1.9

11. Lodging, restaurant, and recreation business. Table 7 gives historical sales and receipts in the loding, restaurant, and recreation businesses (SIC Groups 70, 58, and 79). SIC (Standard Industrial Code) Group 79 consists of amusement and recreation services, except motion pictures. This includes a variety of establishments; such as bowling alleys, golf courses, amusement parks, charter boating, etc. Growth in Group 79 establishment receipts is shown separately in Table 8. The figures for South Carolina show the effect of the Grand Strand area, South Carolina's most popular vacation area, which experienced a large growth in the tourist business in recent years. Based on data by the S. C. Department of Parks, Recreation and Tourism, the total tourist expenditures for the Strand were $48.5 million and $125 million in 1963 and 1969, respectively, giving an average annual growth of about 17 percent for this 6-year period. The Greater Myrtle Beach Chamber of Commerce has estimated that tourist business will be about $170 million in 1975, which would represent a 5.3 percent rate of annual growth since 1969.

Table 7
GROWTH OF THE LODGING, RESTAURANT, AND RECREATION BUSINESS
(in 1967 dollars)
(SIC 58, 70 and 79)

Year	United States in $ million	South Carolina: Rounded to nearest $ million	South Carolina: Percent of U. S. Total
1948	19,600	82	0.42
1954	22,800	107	0.47
1958	25,000	117	0.49
1960	26,800	134	0.50
1962	28,800	152	0.53
1964	31,400	176	0.56
1966	36,500	212	0.58
1968	41,100	250	0.61
Annual Growth Rate for Indicated Period (in percent)			
1948-1958	2.5	3.6	
1958-1968	5.1	7.9	

12. Commercial recreation. Table 8 gives historical figures of sales and receipts in commercial recreation and entertainment establishments, except movies; that is, for SIC Group 79 establishments. Thus, these figures are a subset of those shown in Table 7, which gives the total for SIC Groups 70, 58, and 79 establishments. SIC Group 79 includes party and charter boat fishing, along with a variety of sports and amusements. Commercial recreation receipts for the State in 1968 were about 7 times those in 1948, while for the United States the 1968 receipts were only about 3.5 times those for 1948. It is apparent that the commercial recreation business is one of the largest benefactors of the increased tourist business illustrated in Table 7.

Table 8
GROWTH OF COMMERCIAL RECREATION
(in 1967 dollars)

Year	United States in $ million	South Carolina: Rounded to nearest $ million	South Carolina: Percent of U. S. Total
1948	1,690	5	0.30
1954	2,480	10	0.40
1958	3,050	12	0.39
1960	3,720	16	0.43
1962	4,060	19	0.47
1964	4,620	24	0.52
1966	5,870	29	0.49
1968	5,980	32	0.54
Annual Growth Rate for Indicated Period (in percent)			
1948-1958	6.1	9.1	
1958-1968	7.0	10.3	

13. Total boat registration. Statistics on boat registration are given in Table 9. Prior to 1973 only boats with motors over 10 horsepower were registered, but in 1973, and later, all motorized boats are registered. If it is assumed that there is a linear correlation between the number of registered boats in Horry and Georgetown Counties and the two counties' per capita personal income, the number of boats in any given year can be derived from an expression of the form: $Y=a + bX$, in which "a" is the regression constant, "b" is the regression coefficient, and "X" is the per capita personal income for the year of interest. A rather good correlation is shown when such data is plotted for the inclusive years 1960-1970. With a correlation coefficient of 0.9818, a trend line having the form: $Y=-1410 + 2.384X$ can be obtained, which gives the number of boats. It should be noted that the number of registrations indicated is on the basis of the old registration criterion· on the basis of the new standard, the number of boats should be about 60 percent greater (for Horry and Georgetown Counties). Details of the projection are shown below, and summarized in Table 10.

	Data for Horry and Georgetown Counties			
Year	PCPI (The 2 Co's)	Boats	Annual Growth Rate, in Percent 1/	Boats per 100 Population
1970	2,169	4,200		4.06
1980	3,417	6,740	4.84	5.78
1990	4,410	9,100	3.06	7.21
2000	6,162	13,300	3.84	10.18
2010	8,371	18,500	3.40	13.79
2020	10,716	24,100	2.67	17.62

1/ For the preceding decade. Growth from 1973-74 = 9.8%. The equivalent annual growth rate for the period 1970-2020 = 3.6%.

According to the above projection, Georgetown and Horry Counties could have about 24,100 registered boats in the year 2020.

Table 9
GROWTH IN BOAT REGISTRATION
(Historical)

Year	United States (in thousands)	Virginia, No. Carolina and So. Carolina (in thous.)	So. Carolina (in thous.)	Georgetown and Horry Counties (in hundreds)
1960	2,500	103	30	17
1961	3,100	127	36	20
1962	3,500	145	42	24
1963	3,500	147	46	27
1964	3,800	165	48	28
1965	4,100	175	50	28
1966	4,100	184	54	29
1967	4,500	200	58	31
1968	4,700	220	62	33
1969	4,900	203 1/	69	37
1970	5,100	221	74	42
1971	5,500	240	80	47
1972	5,900	266	88	52
1973	6,300	346 2/ (293) 3/	129 2/ (97) 3/	89 2/ (57) 3/
1974	-	-	142 (106) 3/	98 (63) 3/

1/ Represents a change in registration procedure in N. C. and Virginia, not an actual decrease in the number of boats registered.

2/ Boat registration requirements broadened to include all motorized boats. Formerly, only those boats with 10 HP motors or larger needed to be registered.

3/ Approximate number of boats registered with 10 or more horsepower motors using the previous year's growth rate.

Table 9 (continued)
GROWTH IN BOAT REGISTRATION
(continued)

Year	United States	Virginia, No. Carolina and So. Carolina	So. Carolina	Georgetown and Horry Counties
	Annual Growth Rate for Indicated Period (in percent)			
1960-61	24	23.3	20	17.6
1961-62	12.9	14.2	16.7	20.0
1962-63	0	1.4	9.5	12.5
1963-64	8.5	12.2	4.3	3.7
1964-65	7.9	12.1	4.2	0
1965-66	0	5.1	8.0	3.6
1966-67	9.8	8.7	7.4	6.9
1967-68	4.4	10.0	6.9	6.5
1968-69	4.3	-7.7[1/]	11.2	12.1
1969-70	4.1	8.9	7.2	13.5
1970-71	7.8	8.6	8.1	11.9
1971-72	7.3	10.8	10.0	10.6
1972-73	6.8	30.1[2/]	46.6[2/]	71.2[2/]
1973-74	-	-	10.3	9.8

1/ Represents a change in registration procedure in N. C. and Virginia, not an actual decrease in the number of boats registered.

2/ Boat registration requirements broadened to include all motorized boats. Formerly, only those boats with 10 HP motors or larger needed to be registered.

3/ Figures in parenthesis are the annual growth rates that would have been obtained if registration rules had not changed.

14. Summary of growth rates. Historical and projected growth rates for the major economic parameters are summarized in Table 10.

Table 10
SUMMARY OF PROJECTED ANNUAL GROWTH RATES (IN PERCENT) FOR VARIOUS INDICATORS
(Horry and Georgetown Counties)

Indicator	Recent Historical Annual Rates	Growth Rates 1970-1980	1980-1990	1990-2000	2000-2010	2010-2020	Equivalent rate/year 1970-2020 1/
Permanent Population	1940-50: 1.6 1950-60: 0.1	1.2	0.8	0.3	0.3	0.2	0.56
Total Personal Income	1960-70: 5.9	5.9	3.6	3.5	3.4	2.7	3.80
Per Capita Pers. Income	1960-70: 5.8	4.6	2.6	3.4	3.1	2.5	3.20
Total Employment	1960-70: 0.7	3.1	0.9	0.7	0.5	0.0	1.05
Employment, Amuse. & Rec. Services (SIC 78 & 79)	1960-70: 6.9	1.5	0.8	0.1	0.8	0.0	0.60
Earnings, Amuse. & Rec. Services (SIC 78 & 79)	1960-70: 12.5	3.6	3.6	3.2	3.4	1.9	3.10
Earnings, Wholesale & Retail Trade	1962-70: 5.2	4.0	3.3	3.2	2.7	2.7	3.18
Receipts: Lodging, eating & Rec. Est's 2/ (SIC 58, 70 & 79)	1958-68: 7.9 (S.C.)	6.3	3.9	4.3	3.5	2.5	4.10
Receipts: Com. Rec. Est's 2/ (SIC 79)	1958-68: 10.3 (S.C.)	8.2	5.3	5.2	4.0	2.5	5.00
Boat Registrations, Horry & Georgetown Counties	1973-74: 9.8	4.84	3.06	3.84	3.40	2.67	3.60

1/ E.G.: $0.56 = 100 \left[\left\{ (1.012)(1.008)(1.003)(1.003)(1.002) \right\}^{0.2} - 1 \right]$

2/ Projected to have 2010-2020 growth rate equal to per capital personal income growth rate.

15. Application of projections. Economic projections and growth rates of these projections, which are presented in this appendix, were used to estimate the growth rate of commercial charter boating and recreational boating activities and commercial fishing at Murrells Inlet. Estimated growth rates for indicated periods are shown in Tables 11a and 11b.

Table 11a
ESTIMATED ANNUAL GROWTH RATES IN PERCENT FOR BOATING ACTIVITIES AT MURRELLS INLET, S. C.

Period (Years after project is constructed or declared infeasible)	Commercial Boats		Private Boats6/	
	Party Boats1/	Charter Boats2/	Except Cruisers3/	Cruisers4/
WITH PROJECT:				
0-10	3.2	3.4	2.7	3.1
10-20	2.8	2.9	2.6	2.8
20-30	4.0	2.8	2.4	2.9
30-40	3.2	2.6	1.9	2.6
40-50	2.7	2.6	1.7	2.5
WITHOUT PROJECT:				
0-5	5/	5/	0.6	5/
5-50	0	0	0.6	0

1/ The relevant indicator for this growth rate has been assumed to be the growth rate in registered boats in Horry and Georgetown Counties.
2/ Growth in charter boating clientele has been assumed to be indicated by the expected growth in S. C. per capita income.
3/ Expected to be related to the expected growth in boat registrations in Horry and Georgetown Counties, but one percentage point less (annual rate) for each period, owing to the present development of Murrells Inlet.
4/ Cruisers are vessels similar to those used for charter boat operations. They are owned mostly by S. C. residents, and hence the indicator used has been S. C. per capita personal income.
5/ In the absence of a project, or cessation of the present emergency maintenance predicated on a project, it is expected these boats would be largely gone in five years. In this period they are assumed to decline by one-fifth of the total each year.

6/ While projections (with project) are shown for 50 years, actual limits of capacity are assumed to be reached in about 30 years.

Table 11b
ESTIMATED ANNUAL GROWTH RATES (IN PERCENT) FOR THE VALUE OF THE MARKETABLE CATCH FROM COMMERCIAL FISHING AT MURRELLS INLET, S. C.

Period (Years after project is constructed or declared infeasible)	Value of Marketable Catch 1/		
	Shrimp	Fin-fish	
	Total Market 2/	Distant Market 2/	Local Market 3/
WITH PROJECT:			
0-10	1.0	1.0	5.0
10-20	1.0	1.0	5.0
20-30	1.0	1.0	4.5
30-40	1.0	1.0	3.0
40-50	1.0	1.0	2.5
WITHOUT PROJECT:			
0-5	0	4/	4/
5-50	0	0	0

1/ Assumes an immediate increase in the finfish catch for the local market upon completion of the project, with all the increase for the next 5 years going to the distant market.
2/ Projected at a growth rate slightly greater than that of total U. S. population.
3/ The local market is assumed to consist of Horry and Georgetown Counties. The annual percent growth rates in SIC 58, 70 and 79 for the five decades are: 5.1, 4.1, 3.9, 3.0 and 2.5. The annual percent growth rates in SIC 79 receipts for the five decades are: 6.7, 5.2, 4.6, 3.0 and 2.5. The growth rates shown in this column are a judgmental average of these.
4/ See footnote 5, Table 11a.

Note: While projections (with project) are shown for 50 years, actual limits are assumed to be reached earlier. Profit from ocean shrimping is considered to remain constant after about 20 years, anticipating shrimp farming. The limit of finfish catches is expected to occur after about 25 years after project construction, to allow for a conservative estimate of the maximum reliable yield of the grounds.

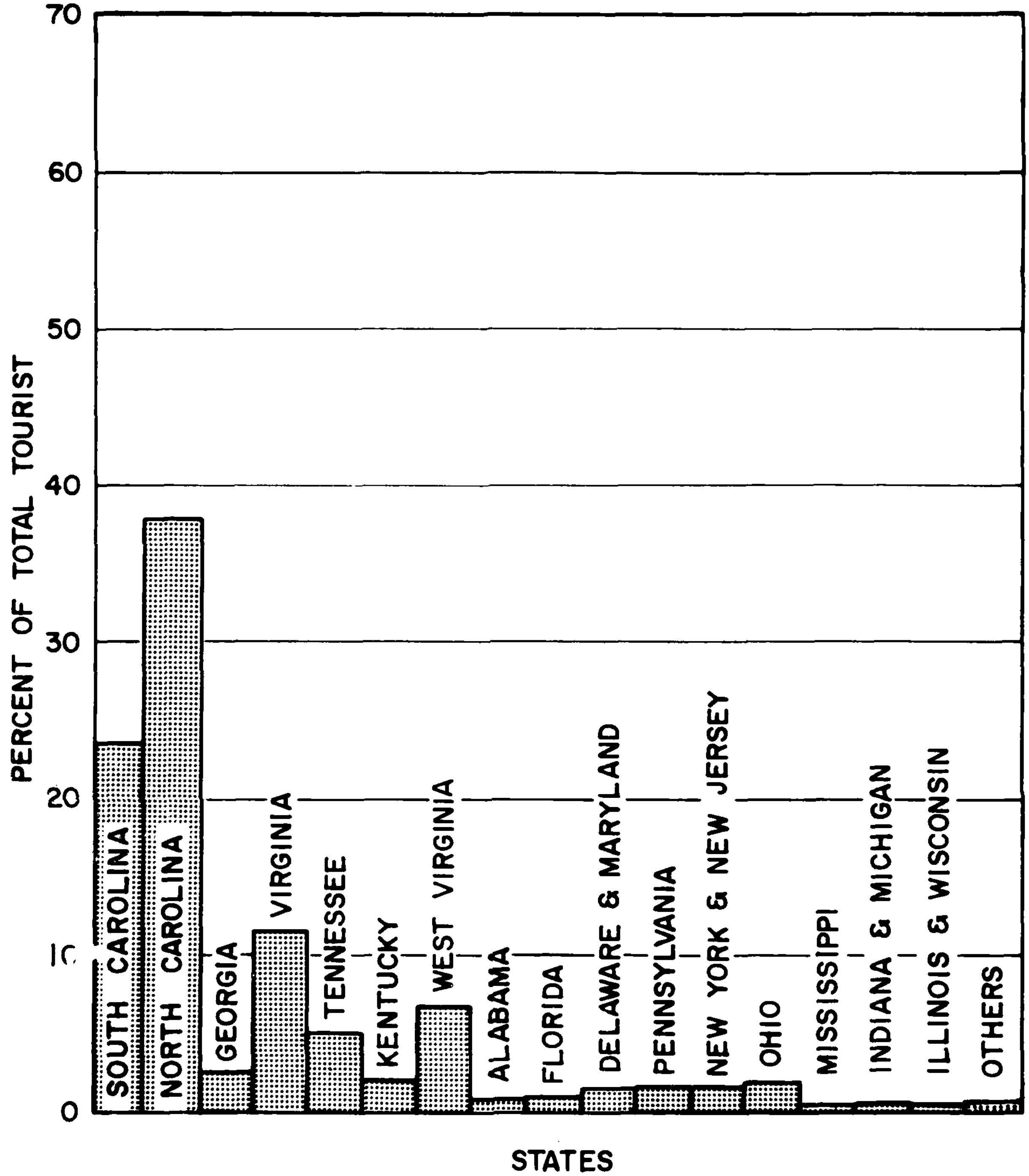
ESTIMATE OF PROJECT BENEFITS

16. General. Benefits attributable to the proposed project at Murrells Inlet would be derived from expanding recreational and commercial boating and fishing activities, from reduced vessel damage, and from its availability and use as a harbor of refuge. Estimated benefits attributable to the proposed fishing walkway would be from the provision of jetty fishing opportunities for those without boats. Redevelopment benefits would be derived from providing work for the area's unemployed during construction of the project. Computations are made on the basis of instructions contained in Engineering Manuals 1120-2-101, 1120-2-104, and 1120-2-113.

17. The Grand Strand. South Carolina's Grand Strand is a 50-mile seashore vacationland and residential area extending along the shores of Long Bay from Litt e River Inlet at the North Carolina - South Carolina border to Pawleys Island. Long Bay is the second of two large bays formed in the Atlantic Coastline below the Outer Banks of North Carolina. Its crescent shore sweeps from the Frying Pan Shoals extending oceanward at the mouth of the Cape Fear River to the headland and ocean shoal at the entrance to Winyah Bay. Strand beaches are composed of fine white sands and are interrupted only occasionally by small inlets. None of these inlets is large enough to handle the deep draft shipping oftentimes responsible for water pollution along other reaches of the nation's seacoast.

18. Tributary area. Myrtle Beach is at the hub of South Carolina's Grand Strand. Its fame has a magical attraction, shared in by the whole strand area, for attracting tourists from the Carolinas and Virginia, much as Atlantic City, New Jersey, attracts visitors from New England, New York, New Jersey, Pennsylvania, Delaware, and Maryland. During the summer, the population of the strand ranges from 130,000 to more than 212,000 people on busy weekends. The origin of tourist trade is presented graphically by state on Exhibit E-1.

19. Transportation. U. S. Highway 17, which parallels the ocean front along the entire strand, connects the area with all northern and southern points. U S. Highway 378, 501, and 521 provide connections to west, mid-west, and southwest localities. At an average speed of 50 miles an hour, it takes only 19½ hours to reach the area from Toronto, Canada, 18 hours from Chicago, 17 hours from St. Louis, 14½ hours from New York, 6½ from Atlanta, and only around 2 hours from either Charleston or Columbia, S. C. Transportation interests serving the strand include Piedmont Airlines, Southern Airways, Inland Airlines, Inc., Seaboard Coast Line Railroad and Queen City Trailways and other Trailways and Greyhound bus lines. Local transportation includes a bus company, taxi service, and car rental agencies.



Origin Of Tourist Trade
by State
At Grand Strand

Exhibit E-1

20. Climate. The climate for the area is temperate, moderated considerably by the nearness of the ocean and the Gulf Stream. Summers are warm and humid with temperatures of 100° or higher averaging less than once a year. The summer is the rainiest season with about 41% of the annual rainfall. These rains, aside from occasional tropical storms, are generally of a shower or thundershower nature, producing variable amounts over scattered areas.

21. The fall season passes through the warm "Indian Summer" to the pre-winter cold spells which begin late in November. From late September to early November, the weather is mostly sunny, and extremes of temperatures are rare. The fall, however, is the period of maximum threat to the coast from hurricane.

22. The winter months, December through February, are mild with rainfall averaging 18% of the annual total. The winter rainfall is generally of a more uniform type, although a few thundershowers do occur. There is small chance of an occasional snow flurry, with the best possibility of its occurrence in January. Temperatures of 20° or less along the coast are infrequent.

23. Spring brings rapid changes from windy and cold in March to warm and pleasant in May. The spring rainfall represents about 20% of the total annual rain, and is a period when tornadoes and severe local storms generally occur.

24. Average temperatures during hours of greatest outdoor recreation are as follows:

Table 12

TEMPERATURE DATA

Month	Mean Temperature 10 A.M. to 4 P.M.	
	Air	Water
January	54.1	50.1
February	59.7	51.7
March	61.3	54.5
April	69.0	65.1
May	74.2	73.5
June	79.4	79.1
July	82.4	82.0
August	83.0	79.5
September	78.7	78.6
October	71.7	69.8
November	61.6	59.0
December	54.6	51.8

25. Accommodations. Sleeping accommodations for more than 140,000 persons are available for the touring public at hotels, guest houses, motor courts, apartments and cottages along the strand. In addition to this more than 8,500 travel trailer spaces and campsites are available at privately-owned or state parks. Many fine restaurants, stores, and shops of all kinds are available to satisfy the most exacting taste. Other business and professional services are available to fulfill the needs of the people.

26. Recreation and entertainment. In addition to gently sloping beaches, the Grand Strand offers twenty-three championship golf courses, numerous driving ranges, par-three and miniature golf courses, several modern amusement parks, pavilions and amusement attractions. Those who prefer spectator pastimes can choose a motion picture, a folly or review show, stock car racing, a tour of Brookgreen Gardens or of nearby plantations, or some evening entertainment from the great variety offered. Recreation opportunities include water skiing, surfing, swimming, sailing, cruises, hunting and fishing. Fishermen can cast their lines in the surf from 13 ocean piers, in inland water or in the ocean from private boats or from one of the many vessels composing the large deep sea fishing fleet. Many visitors to the strand are guided to a fishing experience during their visit by the $40,000 in prizes offered in the Grand Strand Fishing Rodeo. Almost all ocean fishing from boats originates from the two fishing villages situated near opposite ends of the strand. The most popular of these is Murrells Inlet which is a little closer to the center of action than the other village, Little River.

27. South Carolina salt water record fish caught at Murrells Inlet include: channel bass, 75 pounds; common pompano, 6 pounds, 11 ounces; spadefish, 9 pounds, 1 ounce; cutlass fish, 1 pound, 8 ounces; and orange filefish, 19 inches long.

28. Recreational boating activities at Murrells Inlet. There are five marinas and numerous private docks located about the Murrells Inlet harbor where charter trips can be arranged and small boats rented. Many private boats, located at the inlet or hauled by trailer, are served by these facilities. Although a few other boats are trailered, most of the transients are outboards and inboards. Outboards shown in Table 15 include 220 local boats and an equivalent of 1,220 transient boats brought by trailer. About 75 of the inboards are local and an equivalent of 90 transient. The actual number of transients is about 2,620 boats, including outboards and inboards, but these boats only use the inlet about one-half of permanent boat use. Since trailered boats that use Murrells Inlet are assumed to be there one-half of the time, one-half of the trailered boats using the area can be regarded as being permanently there. This is the meaning of the term "equivalent transient boats". These boats are used for fishing, crabbing, oystering, shrimping and for hunting marsh hens and ducks. Water skiing and just pleasure riding are popular. Charter trips in the ocean may be arranged on one of the following boats:

Table 13

PARTY BOAT AND CHARTER BOAT OPERATIONS AT MURRELLS INLET, S.C.
(1974)

No.	Boat Name	Loaded Draft 1/ (feet)	Length (feet)	Passengers	Type of Fishing	Depreciated Value of Boat
	PARTY BOATS					
1	New Inlet Princess	6.5	95	125	Bottom	$350,000
2	Carolina Princess	4.5	77	70	Bottom	300,000
3	Flying Fisher	4.5	70	77	Bottom	200,000
4	Captain Alex	4.5	65	43	Bottom	160,000
5	Inlet Princess	5.0	65	70	Bottom	100,000
6	South Wind	5.0	65	70	Bottom	120,000
7	Captain Bill	4.5	65	49	Bottom	175,000
8	Tom-A-Gator	4.5	63	39	Bottom	100,000
9	Flying Fisher II	4.5	62	49	Bottom	100,000
10	Summer Song	4.5	55	40	Bottom	100,000
11	Sea Horse	4.5	42	30	Bottom	50,000
12	Eager Beaver III	4.5	40	30	Bottom	40,000
	CHARTER BOATS					
13	Sugar Tango	4.0	46	6	Trolling	55,000
14	Johnny Lewis	3.5	38	6	Trolling	35,000
15	The Witt	3.5	38	6	Trolling	35,000
16	Snapper II	3.5	38	6	Trolling	35,000
17	The Other Woman	3.0	36	6	Trolling	30,000
18	Darthopper	3.0	34	6	Trolling	30,000
19	Star Fire	2.5	31	6	Trolling	30,000
20	Golden Girl III	2.5	31	6	Trolling	40,000
21	Sea Striker	3.0	31	6	Trolling	18,000
22	Helen D	2.5	30	6	Trolling	15,000
23	Streaker	2.5	24	6	Trolling	15,000
24	Sandpiper	2.5	20	6	Trolling	10,000

1/ Actual depth required would include in addition to the boat draft allowances for drag, squat, pitch and roll, and bottom clearance.

29. Numerous other boats formerly operated from the area but had to cease operating when their earnings decreased to unacceptable levels due to difficulties experienced in navigating the inlet bar. At least four other vessels would have been lost to the fleet if an emergency channel had not been provided by the United States in 1966, 1967, 1968, 1973 and 1974. These vessels are New Inlet Princess, Carolina Princess, Flying Fisher and Helen D. Emergency dredging and anticipation of the jetty project being constructed has caused steady growth of recreational boats for the past five years. Boats taken from the fleet in spite of emergency efforts were as follows:

Table 14

BOATS FORMERLY OPERATING FROM MURRELLS INLET THAT HAVE QUIT OPERATING BECAUSE OF NAVIGATION PROBLEMS

No.	Boat	Type of Fishing	Loaded Draft 1/ (feet)	Length (feet)	Passengers	Depreciated Value of Boat
	PARTY BOATS					
1	Popeye	Bottom	5.0	65	60	$130,000
2	Rascal	Bottom	4.5	65	49	130,000
3	Tiki Tu	Bottom	5.0	65	60	130,000
4	Thunderbird I	Bottom	4.5	65	40	130,000
5	Adventure	Bottom	4.5	50	40	100,000
	CHARTER BOATS					
6	Peach Bay	Trolling	4.0	50	6	100,000
7	Angies	Trolling	4.0	38	6	76,000

1/ Actual depth required would include in addition to boat draft, allowance for drag, squat, pitch and roll, and bottom clearance.

30. Boat projections without a project. In addition to the boats listed above, approximately 25 other smaller boats have stopped using the inlet. These are shown in Table 18b. If no project is forthcoming, charter boats currently using the inlet will likely be forced to quit operating for economic reasons. Their loss will cast a shadow on all the business ventures related to boat rentals causing a significant decline in their income. The number of boats operated for the personal pleasure of their owners will probably increase at essentially the population growth rate.

31. Boat projections with a project. Construction of a project would encourage the return of most of the charter fleet that is now idle in the Murrells Inlet area. New boats would be added to this fleet at a rate reflecting the demand for this type of recreation. Expected growth rates for all boats which were discussed earlier in this appendix are currently averaging about 3.0 percent per year. Myrtle Beach and other portions of the Grand Strand are probably experiencing a period of accelerated growth in tourism and recreation. Their growth rate is expected to taper off with the years with an average rate over 50 years at about 1.6 percent per year. Growth rates of charter boats, with a project, are expected to decline from the 3.4 percent/year during the first ten years of project life to 2.9, 2.8, 2.6, and 2.6 percent/year in following decades. Party boats were projected at 3.2, 2.8, 4.0, 3.2, and 2.7 percent/year for each 10-year period. The annual growth rate of the private fleet (excluding the larger cruisers) is expected to decline from 2.7 percent to 1.6 percent over the 50 years of project life. The cruisers are expected to increase at 3.1 percent/year for the first 10 years after project construction and to decrease to 2.5 percent/year for the last 10 years. In determining growth rates consideration was given to projections of related parameters such as population, income, retail sales, employment, commercial recreation, and boat registration (discussed in first section of this appendix). The boat projections shown in Table 15 reflect an estimated saturation point in available docking space and parking area at launching ramps to occur at about 4,000 boats. Since the smaller boats are the most numerous and earliest affected by a shortage of parking and launching sites, their growth has been assumed to stop about 30 years after project construction. To insure that there will be an effective demand for the year 2020 projected party and charter boats at Murrells Inlet, a supply and demand analysis has been made and is shown on Table 15a and 15b. The supply has generally been assumed to be a function of the various (projected) boats and the available fishing piers. To place Murrells Inlet in proper perspective, the analysis has been made for both Horry and Georgetown Counties. The demand (for 2020) has been assumed to be a function of the population of the two counties, the included Grand Strand area, and the average summer population of Grand Strand tourists, and their fishing participation rates. Table 15b indicates that the 2020 demand will slightly exceed the 2020 supply.

32. Docking space at Murrells Inlet. Most of the recreational boats are docked at the 450 existing private docks in the area while the commercial boats and some of the private cruisers operate from the five Murrells Inlet marinas. An inventory of existing, proposed, and possible docking spaces along the project channel which would be used by commercial boats and some cruisers is shown as Table 16. These docking spaces would be adequate for the number of boats projected.

Table 15

PROJECTIONS OF RECREATIONAL AND COMMERCIAL CHARTER AND PARTY BOATS EXPECTED TO USE MURRELLS INLET BY CLASS AND DECADE (WITH PROJECT)

Class of Boat	Existing Conditions 1974	Years After Project is Constructed 0 2/	10	20	30	40	50
Outboards	1,440 1/	1,571	2,051	2,651	3,359	3,359	3,359
Sailboats	18	20	26	34	42	42	42
Auxiliary Sailboats	12	14	18	24	30	30	30
Inboards	165 1/	183	239	309	391	391	391
Cruisers	30	34	46	61	81	81	81
Party Boats	12	16	22	29	43	59	77
Charter Boats	12	15	21	28	37	47	61
TOTALS	1,689	1,853	2,423	3,136	3,983	4,009	4,041

1/ Transient Boats make up about 1,220 of these outboards and 90 of the inboards. The same ratio of transients to locals is assumed to continue for the projected number of boats shown.

2/ This is the total number of boats in Tables 18a and 18b which were used to estimate benefits for the initial year of the project.

Table 15a

ESTIMATE OF ANGLER-DAYS SUPPLY FOR HORRY AND GEORGETOWN COUNTIES, SALT-WATER FISHING, YEAR 2020 1/

Item	In 18 Summer-Season Weeks: All Weekend Days (36)	In 18 Summer-Season Weeks: Each Weekend Day
Murrells Inlet:		
MI boats other than party and charter: 2/ 12,608 x 36	453,888	12,608
Maximum use of party and charter boats: 3/ 4,601 x 36	165,636	4,601
Subtotal, Murrells Inlet	619,524	17,209
Remainder of the two counties:		
Maximum use of 13 fishing piers 4/	648,375	18,010
Use of new fishing jetty 5/	20,000	556
Use of remaining 2-county registered boats, other than party and charter 6/	1,526,893	42,414
Use of party and charter boats at Little River, S. C. 7/ 3,111 x 36	111,996	3,111
Total for the two counties:	2,926,788	81,300

1/ Based on 18 weeks summer season with 36 weekend days.
2/ See Table 15--boats and anglers/boat: Outboard-3,359(3); Sail-42(0); Auxiliary Sail-30(3); Inboards-391(5); Cruisers-81(6). Total = 12,608 anglers/day.
3/ Projected party boats = 77, x 55/boat = 4,235; charter boats = 61, x 6 boat = 366. Total 4,601.
4/ Using present 13 fishing piers, at 66,500 angler-days/pier, and assuming 75% on summer weekend days.
5/ Taken at 30% of each fishing pier.
6/ Remaining boats (24,100 - 3,903 = 20,197). Assuming 3/boat, and not more than 70% of boats in use at one time: 20,197 x 0.70 x 3 x 36.
7/ Presently estimated 2020 party boats = 51, x 55/boat = 2,805; charter boats 51 x 6 = 309. Total - 3,111.

Table 15b

ESTIMATE OF ANGLER-DAYS DEMAND FOR HORRY AND GEORGETOWN COUNTIES, SALT-WATER FISHING, YEAR 2020

Item	In 18 Summer-Season Weeks: All Weekend Days (36)	In 18 Summer-Season Weeks: Each Weekend Day
Horry and Georgetown Counties less Grand Strand:1/		
54,800 x 3.3 x 0.75 x 0.75	101,722	2,826
Grand Strand, permanent population:2/		
82,000 x 6.63 x 0.75 x 0.75	305,809	8,495
Grand Strand, Tourists:3/		
287,360 x 0.25 x 36	2,586,240	71,840
Total, both counties:	2,993,771	83,161

1/ Projected 2020 population of the 2 counties is 136,800. The population of the Grand Strand, according to the Waccamaw Regional Planning Council estimates, will be 60% of this, or 82,000 (rounded). The average Grand Strand summer population was about 171,000 in 1970, or a ratio of about 5.83 to the 1970 Grand Strand permanent population (29,324); this ratio is expected to fall to 4.5 by 2020, at which time the permanent Grand Strand population will be 82,080. Hence the average summer population in 2020 should be about 369,360; the tourists would then be 369,360 - 82,000 = 287,360. The figure 54,800 = 136,800 - 82,000. The participation rate of 3.3 assumes half that of Grand Strand residents. Assumes 75% of fishing in summer, and 75% of that on weekend days.

2/ As above, except that the participation rate for fishing is 6.63 from the 1975 SCORP Report for Florida, in absence of specific rates for South Carolina.

3/ Surveys indicate the average tourist stays about one week; hence the indicated number is available each week for fishing. It is assumed that 25% of the tourists fish.

Table 16

INVENTORY OF DOCKING SPACE
AT MURRELLS INLET, S. C.

Area No.	Location	No. of Docking Spaces 1/ Existing	Proposed	Possible 2/
1	Gulf Stream Marina	33 3/	89 4/	-
2	Highground south of Gulf Stream Marina in the Inlet Point Development	-	-	45
3	Anchor Inn Marina	10	30	3
4	Between Anchor Inn Marina and Perry's Landing	-	-	10
5	Perry's Landing	9	-	5
6	Between Perry's Landing and Capt. Alex's Marina	-	-	33
7	Captain Alex's Marina	10	20	8
8	Old Crash Boat Dock	-	-	74
9	Captail Dick's Marina	24	54	7
10	Betty Jo Sing's Proposed Marina	-	4	4
11	Undeveloped shoreline below Betty Jo Sing property	-	-	20
	TOTAL	86	197	209

1/ Assuming each boat will require 1.5 times its width or an average of 30 feet.

2/ These are spaces along the project inner channel that could be developed into docking areas without major channel improvements or disruption of other developments.

3/ This is the space that will be left after the removal underway (Nov 75) of about 10 spaces to make room for a new dock.

4/ Under construction in November 1975.

33. Launching ramps at Murrells Inlet. Many boats are hauled by boat trailer and utilize the five existing launching ramps at Murrells Inlet. The maximum number of trailered craft that would be hauled to these ramps in one day is estimated at 60 percent of the 1,310 equivalent transient boats discussed in paragraph 28 of this appendix. This would be about 850 existing boats that are launched in one peak day. Of the 3,359 outboards and 391 inboards that are projected for 30 years after project construction in Table 15, about 3,000 will be transient type boats. No growth in the number of transient boats is expected after 30 years. Making the same assumption that 60 percent of these transients would be launched at the inlet on a peak day, the expected maximum usage of ramps 30 years hence would be (0.60 x 3,000) 1,800 boats. As shown in Table 17, adequate parking space for vehicles and boat trailers are available or is expected to become available when the need for these facilities are realized.

Table 17
EXISTING AND PROPOSED PUBLIC
LAUNCHING RAMPS AT MURRELLS INLET, S.C.

Ramp No.	Location	Max. No. of Parking Spaces for Vehicle and Boat Trailer		
		Existing	Future	Total
1	Gulf Stream Marina	350	150 1/	500 6/
2	Woodland Avenue Ramp 2/	300	-	300
3	Hughes' Landing	150	150 3/	300
4	Smith's Landing	250	-	250
5	Cedar Hill Landing	20	-	20
6	Captain Alex's Marina	-	300	300
7	Old Air Force Marina 4/	-	100	100
8	Betty Jo Sing's Marina 5/	-	50	50
	Total	1,070	750	1,820

1/ Building permit for this expansion has been approved.
2/ Ramp not paved but extensively used by small boats at no cost. Parking space along roads is included in this total.
3/ Space is available to double parking area if it is needed.
4/ This property, which has a ramp, is being developed for condominiums; 36 units are complete and 75 more are under construction. The ramp would be used exclusively by condominium occupants and about 100 boats will eventually use this ramp since dock space for that many boats would not be available.
5/ Application for building permit was made in June 1975 but has not been granted.
6/ An additional ramp would be required in order to launch the total of 500 boats during the desired-use time.

Table 18a

ESTIMATE OF RECREATIONAL BOATING BENEFITS TO USERS OF MURRELLS INLET, S.C. IN THE FIRST YEAR AFTER PROJECT CONSTRUCTION

Class of boat	Number of boats	Average depreciated value per boat ($)	Average net annual return in % of depreciated value (max) (%)	Average net annual return for hire per boat (max) ($)	Percent of potential value 1/		Boating value ($)		Total annual net benefit ($)
					Present condts.	With project	Present condts.	With project	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Outboards	1,555	$ 1,000	15	$ 150	75	98	174,900	228,500	53,600
Sailboats	19	1,000	12	120	75	100	1,700	2,300	600
Auxiliary Sailboats	13	3,000	9	270	35 2/	97	1,200	3,400	2,200
Inboards	178	2,000	10	200	60	92	21,400	32,800	11,400
Total Small Recreational Boats							199,200	267,000	67,800
Cruisers	32	13,000	9	1,170	45	90	16,800	33,600	16,800
TOTAL RECREATIONAL BOATS							216,000	300,600	84,600

1/ Precent of potential value is derived and discussed in Paragraph 57, vessel operational effectiveness.
2/ This type sailboat has a deep draft (about 7 feet) and thus is severely restricted by the present controlling depth at channels.

Table 18b

ESTIMATE OF ADDITIONAL PROBABLE RECREATIONAL BOATING BENEFITS TO BE ACCRUED IN THE FIRST YEAR AFTER CONSTRUCTION OF PROJECT1/

Class of boat	Number of boats	Average depreciated value per boat ($)	Average net annual return in % of depreciated value (max) (%)	Average net annual return for hire per boat (max) ($)	Percent of potential value2/		Boating value ($)		Total annual net benefit ($)
					Present condts.	With project	Present condts.	With project	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Outboards	16	$ 1,000	15	$ 150	0	98	$0	$ 2,400	$ 2,400
Sailboats	1	1,000	12	120	0	100	0	100	100
Auxiliary Sailboats	1	3,000	9	270	0	97	0	300	300
Inboards	5	2,000	10	200	0	92	0	900	900
Total Small Recreational Boats								3,700	3,700
Cruisers	2	13,000	9	1,170	0	90	0	2,100	2,100
TOTAL RECREATIONAL BOATS								$ 5,800	$ 5,800

1/ Based on previous growth rates, these benfits would have accrued had navigation remained unrestricted during recent years.
2/ Same note as Table 18a, note 1/.

Table 18c

ESTIMATE OF COMMERCIAL PARTY AND CHARTER BOATING BENEFITS TO USERS OF MURRELLS INLET, S. C. IN FIRST YEAR AFTER PROJECT CONSTRUCTION

Boat Name	Depreciated Value	Net Annual 1/ Return for Hire (Max.)	Loaded Draft (Ft.)	Channel Depth Required: W/O Project Under Hazardous Conditions (Ft.)	Channel Depth Required: With Project Under Ideal Conditions (Ft.)	Percent of Potential Value 2/: W/O Project	Percent of Potential Value 2/: With Project	Boating Value ($): W/O Project	Boating Value ($): With Project	Total Annual Net Benefits ($)
PARTY BOATS										
New Inlet Princess	$350,000	$87,500	6.5	8.5	11.5	7%	68%	$ 6,120	$ 59,500	$ 53,380
Carolina Princess	300,000	75,000	4.5	6.5	9.5	44	100	33,000	75,000	42,000
Flying Fisher	200,000	50,000	4.5	6.5	9.5	44	100	22,000	50,000	28,000
Captain Alex	160,000	40,000	5.0	7.0	10.0	35	98	14,000	39,200	25,200
Inlet Princess	100,000	25,000	5.0	7.0	10.0	35	98	8,750	24,500	15,750
South Wind	120,000	30,000	4.5	6.5	9.5	44	100	13,200	30,000	16,800
Captain Bill	175,000	43,750	4.5	6.5	9.5	44	100	19,250	43,750	24,500
Tom-A-Gator	100,000	25,000	4.5	6.5	9.5	44	100	11,000	25,000	14,000
Flying Fisher II	100,000	25,000	4.5	6.5	9.5	44	100	11,000	25,000	14,000
Summer Song	100,000	25,000	4.5	6.5	9.5	44	100	11,000	25,000	14,000
Sea Horse	50,000	12,500	4.5	6.5	9.5	44	100	5,500	12,500	7,000
Eager Beaver III	40,000	10,000	4.5	6.5	9.5	44	100	4,400	10,000	5,600
								$159,220	$419,450	$260,230
CHARTER BOATS										
Sugar Tango	$ 55,000	$13,750	4.0	6.0	9.0	52%	100	$ 7,150	$13,750	$ 6,600
Johnny Lewis	35,000	8,750	3.5	5.5	8.5	60	100	5,250	8,750	3,500
The Witt	35,000	8,750	3.5	5.5	8.5	60	100	5,250	8,750	3,500
Snapper II	35,000	8,750	3.5	5.5	8.5	60	100	5,250	8,750	3,500
The Other Woman	30,000	7,500	3.0	5.0	8.0	68	100	5,100	7,500	2,400
Darthopper	30,000	7,500	3.0	5.0	8.0	68	100	5,100	7,500	2,400
Star Fire	30,000	7,500	2.5	4.5	7.5	76	100	5,700	7,500	1,800
Golden Girl III	40,000	10,000	2.5	4.5	7.5	76	100	7,600	10,000	2,400
Sea Striker	18,000	4,500	3.0	5.0	8.0	68	100	3,060	4,500	1,440
Helen D	15,000	3,750	2.5	4.5	7.5	76	100	2,850	3,750	900
Streaker	15,000	3,750	2.5	4.5	7.5	76	100	2,850	3,750	900
Sandpiper	10,000	2,500	2.5	4.5	7.5	76	100	1,900	2,500	600
								$57,060	$87,000	$29,940

1/ This is the product of the depreciated value times the average net return in % of the depreciated value. The % is taken as 25% which is adjusted in accordance with paragraph 10 (e), EM 1120-2-113, to allow for more continuous operation and service to a larger segment of the public. This is believed to be a realistic estimate of the net return on investment of such vessels. See Tables 20b and 20c.

2/ From Table 28.

Table 18d

ESTIMATE OF ADDITIONAL PROBABLE COMMERCIAL BOATING BENEFITS TO BE ACCRUED IN THE FIRST YEAR AFTER PROJECT CONSTRUCTION

Boat Name	Depreciated Value	Net Annual 1/ Return for Hire (Max.)	Loaded Draft (Ft.)	Channel Depth Required: W/O Project Under Hazardous Conditions (Ft.)	Channel Depth Required: With Project Under Ideal Conditions (Ft.)	Percent of Potential Value 2/: W/O Project	Percent of Potential Value 2/: With Project	Boating Value ($): W/O Project	Boating Value ($): With Project	Total Annual Net Benefits ($)
PARTY BOATS										
Popeye	$130,000	$32,500	5.0	7.0	10.0	0	98	0	$ 31,850	$ 31,850
Tiki Ju	130,000	32,500	5.0	7.0	10.0	0	98	0	31,850	31,850
Rascal	130,000	32,500	4.5	6.5	9.5	0	100	0	32,500	32,500
Thunderbird I	130,000	32,500	4.5	6.5	9.5	0	100	0	32,500	32,500
Adventure	100,000	25,000	4.5	6.5	9.5	0	100	0	25,000	25,000
								0	$153,700	$153,700
CHARTER BOATS										
Peach Bay	$100,000	$25,000	4.0	6.0	9.0	0	100	0	$ 25,000	$ 25,000
Angles	76,000	19,000	4.0	6.0	9.0	0	100	0	19,000	19,000
								0	$ 44,000	$ 44,000

1/ Same note as Table 18c, note 1/.
2/ From Table 28.

Table 19

ANNUAL BENEFITS FROM IMPROVED OPERATIONS

MURRELLS INLET S. C. FOR SELECTED YEARS OF PROJECT LIFE

Type of Benefit	Years After Completion of the Project						
	Base Year	5	10	20	30	40	50
Recreational Boating (Small Boats)							
With Project	$270,700	$309,300	$353,300	$456,700	$579,000	$579,000	$579,000
Without Project	199,200	205,200	211,500	224,500	238,400	253,100	268,700
Annual Net Benefits	$ 71,500	$104,100	$141,800	$232,200	$340,600	$325,900	$310,300
Average Annual Small Boating Benefits						$179,100	
Recreational Boating (Cruisers)							
With Project	$ 35,700	$ 41,600	$ 48,400	$ 63,900	$ 85,000	$ 85,000	$ 85,000
Without Project	16,800	0	0	0	0	0	0
Annual Net Benefits	$ 18,900	$ 41,600	$ 48,400	$ 63,900	$ 85,000	$ 85,000	$ 85,000
Average Annual Cruising Yacht Benefits						$ 53,400	
TOTAL ANNUAL RECREATIONAL BENEFITS						$232,500	
Party Boating							
With Project	$573,150	$670,900	$ 785,400	$1,035,100	$1,532,300	$2,099,600	$2,740,500
Without Project	159,220	0	0	0	0	0	0
Annual Net Benefits	$413,930	$670,900	$ 785,400	$1,035,100	$1,532,300	$2,099,600	$2,740,500
Average Annual Party Boating Benefits						$ 966,600	
Charter Boating							
With Project	$131,000	$154,800	$ 183,000	$ 243,600	$ 321,000	$ 415,000	$ 536,400
Without Project	57,060	0	0	0	0	0	0
Annual Net Benefits	$ 73,940	$154,800	$ 183,000	$ 243,600	$ 321,000	$ 415,000	$ 536,400
Average Annual Charter Boating Benefits						$ 212,300	
TOTAL ANNUAL COMMERCIAL BOATING BENEFITS						$1,178,900	

1/ Initial benefits are taken from Tables 18a and 18b.

36. Commercial fishing at Murrells Inlet. Difficulties in navigating Murrells Inlet have limited the development of commercial fishing to essentially an off-season operation of the recreational fleet. During recent years numerous attempts to operate from the area by other commercial interests have been aborted when delays and damages proved too costly. In 1967, six shrimp trawlers attempted to use harbor facilities when brown shrimp were running off Litchfield Beach a short distance to the south. These too only made a few port calls before seeking a harbor having more reliable access. During the 1974 season one shrimp trawler, "The Charlene", operated out of Murrells Inlet. This 40-foot vessel was able to work part time here because of its relatively shallow draft of four feet.

a. Commercial catches. Landings and values of catches, by species, were determined from interviews with local boat owners, boat operators, and publications from the Bureau of Commercial Fisheries of the U. S. Fish and Wildlife Service. Average catches of edible finfish off Murrells Inlet are given in Table 20 which follows:

Table 20
VALUE OF ANNUAL CATCH AT MURRELLS INLET (1974)

Species	Annual Catch (pounds)	Price per pound	At-dock value of catch
Sea bass	200,000	$0.39	$ 78,000
King whiting	167,000	0.16	26,700
Groupers	96,000	0.51	49,000
Flounders	69,000	0.24	16,600
Croakers	59,000	0.10	5,900
Sharks	36,000	0.11	4,000
Spot	26,000	0.11	2,900
Red snapper	20,000	1.04	20,800
Spotted sea trout	12,000	0.37	4,400
King mackerel	8,000	0.55	4 400
Vermilion snapper	2,000	0.50	1,000
Spanish mackerel	2,000	0.18	500
Gray sea trout	2,000	0.39	800
Total finfish	699,000	$0.31	$214,900

Less significant catches of edible finfish caught by Murrells Inlet boats include bluefish, black drum, redfish, and eels. About 800,000 pounds of mullet and most of South Carolina's 400,000 pounds of spot were taken by beach-nets between Murrells and Little River Inlets. Shellfish landed in the estuarine waters at Murrells Inlet include blue crabs, shrimp, clams, and oysters. No significant catches of shrimp were made by the one trawler located at Murrells Inlet. For benefit estimates, a base-year unit price of $0.34 per pound has been used for finfish, in accordance with the trend line shown in Exhibit G-3. The unit price of shrimp was $1.01 per pound, heads-off, for the year 1972, $1.79 in the year 1973, and $0.95 in 1974. A three-year catch-weighted average price of $1.32 (1972-1974, incl.) has been used as a base-year average, as shown in Exhibit A-2.

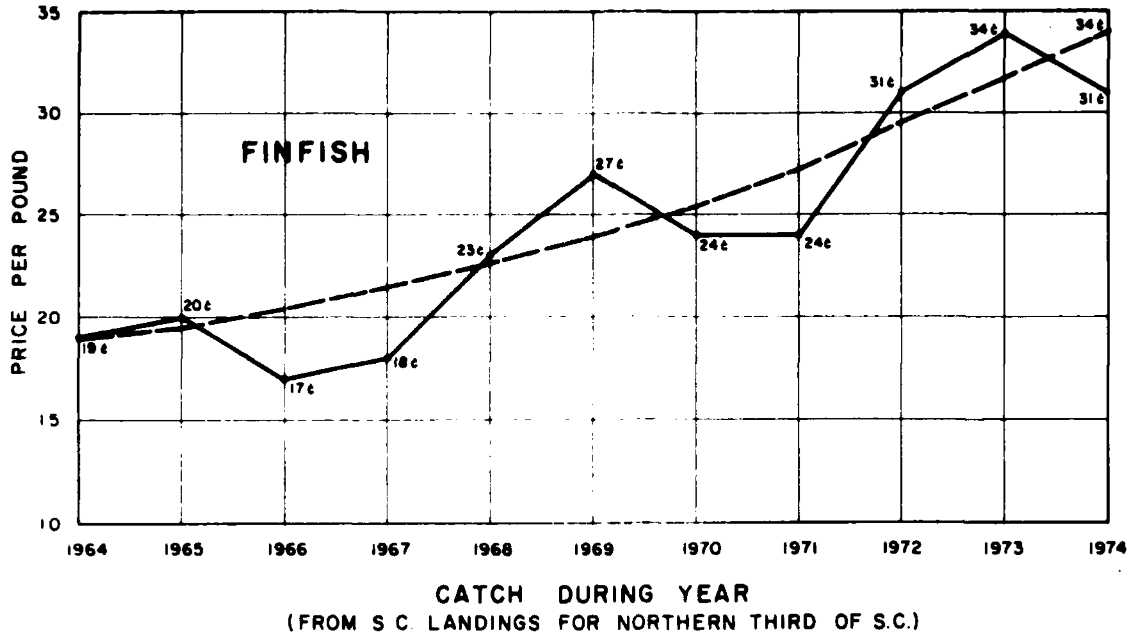
b. Seafood market. Catches made by the fleet are consumed for the most part in more than 100 restaurants along the Grand Strand, one of which is shown in a photograph in the main body of this report with patrons waiting outside in line. Restaurants which previously prided themselves by serving fresh local seafood, have had to seek supplies elsewhere as the result of the failure of the local commercial fleets to stay abreast of demands--this failure being caused by similar navigation problems developing at the two ports of supply, Murrells Inlet and Little River Inlet.

c. Vessel operating costs. Commercial catches are assumed to involve three vessel types. Shrimp are caught by a typical shrimp trawler, the characteristics and costs of which are given in Table 20a. Finfish are assumed to be caught, in the winter months, by a typical party boat (Table 20b-1), and by a typical charter boat (Table 20c).

d. Net return from catches. The net return, defined as the gross value of the catch to the fisherman, less the costs of making the catch, has been expressed as a percentage of the gross value of the catch. For the base year (1974) this is estimated to be 26 percent of shrimp (Table 20a), and 33 percent of finfish, the lesser of the two percentages (33 and 35.3) shown in Tables 20b-1 and 20c.

37. Projected commercial activity. All of the vessels operated for commercial fishing are expected to relocate within five years unless the inlet channel is enlarged and stabilized either by man-made works or by nature.

38. Construction of the recommended project will result in an immediate increase in the fleet as new operators come into the area to exploit the resource and market. Catches by those already operating from the village should also increase when operations are no longer hampered by delays. Production of finfish should more than double from the present 699,000 pounds a year to 1,997,000 pounds a year immediately after construction due to the increased vessel operational effectiveness due to improved channels and addition of jetties. More shrimpers will begin using the harbor as their permanent base of operation to exploit the brown and white variety found in South Carolina's waters. Interest has already been expressed in the establishment of a fishery smokehouse


FINFISH
PRICE PER POUND
35
30
25
20
15
10
19¢
20¢
17¢
18¢
23¢
27¢
24¢
24¢
31¢
34¢
34¢
31¢
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
CATCH DURING YEAR
(FROM S C LANDINGS FOR NORTHERN THIRD OF S.C.)

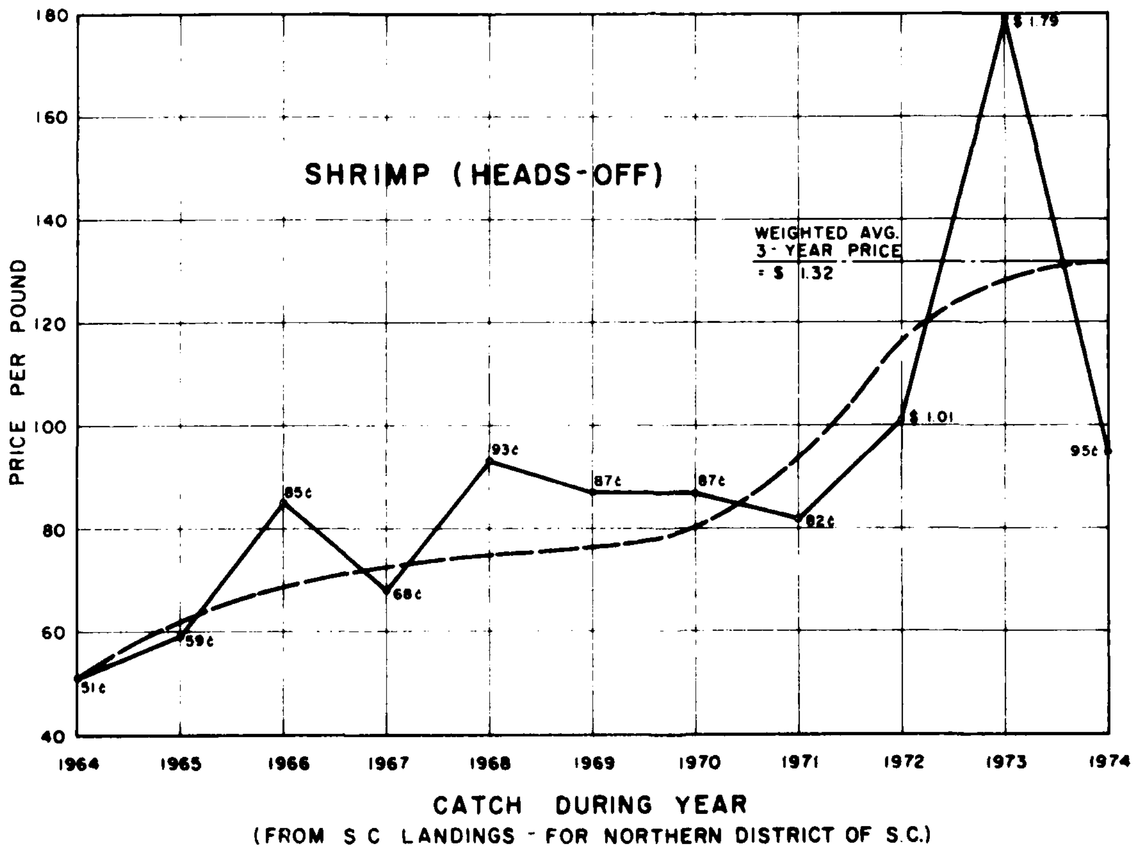

SHRIMP (HEADS-OFF)
PRICE PER POUND
180
160
140
120
100
80
60
40
WEIGHTED AVG.
3-YEAR PRICE
= $ 1.32
51¢
59¢
85¢
68¢
93¢
87¢
87¢
82¢
$ 1.01
$ 1.79
95¢
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
CATCH DURING YEAR
(FROM S C LANDINGS - FOR NORTHERN DISTRICT OF S.C.)

Exhibit E-2

Table 20a

COST AND REVENUE ESTIMATES FOR TYPICAL SHRIMP TRAWLER1/

Characteristics of Assumed Boat	1971 Calendar Year2/	Base Year3/
Shrimping days/year	170	170
Catch, lb/yr, heads-off	98,564	82,000 4/
Avg price, $/lb, heads-off	0.86	1.32
A-Gross Returns, $	84,470	108,240
Net Returns5/, $	74,474	96,760
VARIABLE COSTS: $		
Galley (mainly groceries)	832	1,148
Ice	1,512	1,814
Gear repairs	2,139	2,567
Fuel & Oil	2,880	6,400
Vessel repairs	5,648	6,700
Deheading and Packing	9,996	11,480
Crew Share6/	29,790	38,704
B-Total Variable Costs	52,797	68,813
FIXED COSTS:		
Licenses	85	85
Property taxes	766	766
Miscellaneous	890	890
Insurance	2,068	2,068
Depreciation	6,518	6,518
C-Total Fixed Costs	10,327	10,327
OPPORTUNITY COSTS: $		
D-Operator's Labor7/	700	735
E-Total Investment8/	7,093	7,093
SUMMARY:		
Operating Cost (B+C+E)	70,217	86,233
Profit (A-B-C-D-E)	13,553	21,272
F-Return to Investment (A-B-C-D)	20,646	28,365
Percent return to investment (F÷$70,930)	29	40
Percent return on Gross Val. of Catch(F÷A)	24	26

1/ Analysis is for a 68-foot, double-rigged trawler, with a 350HP V12 Deisel engine, with market value of $70,930.
2/ From detailed analysis for 1971, as shown on p. 101 of the S.C. Wildlife and Marine Resource Dept. publication: "Development of an Expanded Commercial Fisheries Statistics Program for South Carolina". Nov. 1974.
3/ Base year is taken as 1974, with normalized cost, price and catch values. Costs generally increased about 20 percent, except deisel fuel increased from 13.5¢/gal to 30.0¢/gal, and deheading and packing from about 11.7¢/lb to 14.0¢/lb
4/ The 1971 S.C. Catch of 10,752,618 pounds (head-on) in 1971, was unusually large. Hence the per-vessel catch has been reduced to about 83% of the 1971 value, assuming an average future S.C. catch of about 8,925,000 pounds (heads-on).
5/ Gross returns less deheading and packing costs.
6/ Forty percent of Net Returns.
7/ Evidently an alternatively earnable increment (350 hours at $2.00/hr, in 1971, and $2.10, in 1974).
8/ This is a minimum attractive rate of return (10%) on investment, and could have been regarded as "interest" in the "fixed cost" item.

Table 20b

COST AND REVENUE ESTIMATES FOR TYPICAL PARTY BOAT

Characteristics of Assumed Boat	Amount
OPERATED AS PARTY BOAT:	
Boat is assumed to engage in party boat operations for 6 months of the year, going to the blackfish banks 70 percent of these days, or 126 days. A day of fishing is 11 hours. There are thus 1,386 operating hours. Boat capacity is assumed to be 50 passengers, each paying $15 per day. Average passenger load assumed to be 35 (70% of capacity).	
Length = 65 feet	
Depreciated value	$100,000
ANNUAL FIXED COSTS:	
Interest: 10% x 100,000	10,000
Depreciation: 9% x 100,000	9,000
Property taxes	800
Insurance	2,000
Fishing tackle, etc.	500
TOTAL	$ 22,300
VARIABLE COSTS PER OPERATING HOUR:	
Fuel (110 x $0.30/11)	$ 3.00
Oil: 1 qt/hr at $0.50	.50
Maintenance and repair, boat and gear	1.50
Wages of crew: 1 @ $3.50; 2 @ $2.50	8.50
TOTAL	$13.50
VARIABLE COSTS PER YEAR: 1,386 x $13.50	$ 18,711
TOTAL ANNUAL COSTS	$ 41,011
REVENUE: 35 x $15 x 126 =	$ 66,150

ANNUAL RETURN ON INVESTMENT:

$$\frac{66{,}150 - 41{,}011}{100{,}000} = 25.1\%$$

(This allocates all fixed charges to party boat fishing. Actually during part of the year this boat will probably be finfishing commercially.)

Table 20b-1

COST AND REVENUE ESTIMATES FOR TYPICAL PARTY BOAT

Characteristics of Assumed Boat	Amount
WHILE BEING USED FOR OFF-SEASON FINFISHING	
Length: 65 ft	
Depreciated Value	100,000
FIXED COSTS1/	
Interest (10% x 100,000/12)	833
Depreciation (9% x 100,000/12)	750
Property Taxes ($800/12)	67
Insurance ($2,000/12)	167
Licenses ($100/12)	8
Miscellaneous (traps, etc.)	570
Total	2,395
Fixed cost/hr ($2,395/330)	7.26
VARIABLE COSTS PER OPERATING HOUR2/	
Fuel (150 x $0.30/11)	4.10
Oil (1 qt/hr at $0.50)	.50
Maintenance and Repair (boat & gear)	1.50
Ice (300 lb blocks) (3 x $2.50/11)	.68
Wages of Crew (2 x $3.50)3/	7.00
Total variable costs/operating hour	13.78
Total Costs per Operating Hour	21.04
Value of hourly catch to fisherman ($0.34 x 1000/11)	30.91
Per cent return on gross value of catch: ($30.91 - $21.04/$30.91)	31.9%

1/ Assumed seasonal catch is 30,000 lb/vessel, at rate of 1,000 lb/fishing day. About 30 fishing days (1 month) within the period November - January, inclusive. Assumes 11 operating hours/day, or a total of 330 operating hours. Fixed costs are based on one month, but owners probably regard most of these as written off during the sportsfishing season.

2/ Assumes about 700 HP engine, using about 150 gallons of deisel fuel a day.

3/ Crews usually paid a percentage of profit. This rate is considered to include groceries.

Table 20c

COST AND REVENUE ESTIMATES FOR TYPICAL CHARTER BOAT

Characteristics of Assumed Boat	Amount
Length = 35 feet	
Engine: 280 HP diesel	
Depreciated value (average value for boats this size - Table 13)	$33,000
FIXED ANNUAL COSTS:	
Interest: 10% x 33,000	3,300
Depreciation: 9% x 33,000	2,970
Property taxes: $270/year	270
Insurance: $670/year	670
Licenses	100
Traps, fishing gear, etc.	1,000
TOTAL	$ 8,310
VARIABLE COSTS:	
Per operating day (11 hours)	
Fuel: 95 gal x $0.30/gal	$ 28.50
Oil: 1 qt/hr @ $0.50	5.50
Maintenance and repair, boat and gear	10.00
Crew wages: 1 @ $3.50/hr; 1 @ $2.50/hr	66.00
TOTAL	$110.00
VARIABLE COSTS PER YEAR:	
Operating as charter boat: 6 months, 70% of days operating = 6 x 30 x 0.70 = 126 days	$13,860
Operating as commercial fisher: during 3-month period (Nov-Jan), 30 actual fishing days	3,300
ANNUAL REVENUES:	
As charter boat: $250 x 126 days	$31,500
As commercial fisher:	
(500 lb/day) x ($0.34/lb) x (30 days)	5,100
TOTAL	$36,600

(cont'd)

Table 20c (cont'd)

COST AND REVENUE ESTIMATES FOR TYPICAL CHARTER BOAT

Characteristics of Assumed Boat	Amount
NET ANNUAL RETURN ON INVESTMENT:	
Combined operations:	
$\frac{(\$36,600) - (\$8,310 + \$13,860 + \$3,300)}{\$33,000}$	= 33.7%
As charter boat: Since main employment is as charter boat, all fixed costs are charged to this operation--commercial fishing nets more than its variable costs:	
$\frac{\$31,500 - (\$8,310 + \$13,860)}{\$33,000}$	= 28.3%
As commercial fishing boat:	
$\frac{\$5,100 - \$3,300}{\$33,000}$	= 5.5%
ANNUAL NET RETURN, AS COMMERCIAL FISHING VESSEL, AS A PERCENT OF THE GROSS VALUE OF THE CATCH:	
$\frac{\$5,100 - \$3,300}{\$\ 5,100}$	= 35.3%1/

SENSITIVITY TO ASSUMED CATCH:

Catch (lb/day)	% Return on Gross Value of Catch
400	19.1
500	35.3
600	46.0
700	53.8

1/ Assuming, as before, that the charter boat operator considers fixed costs allocable to the recreational fishing operation.

in the village to process a part of the expected finfish catch for distribution to gourmets throughout the nation. Processing and packing plants are also expected to spring up as the local suppliers compete for distant markets. Within five years after construction annual production should approach 100 short tons of shrimp and 2.7 million pounds of finfish. The impact of commercial operations on the economy can be visualized from data presented in Table 21.

39. After the initial surge, the production of shrimp should level as a direct result of the harvest being near maximum levels. Demand for the product will grow at a rate of one percent or slightly higher than the population growth rate projected for the nation as a whole. Even without an increase in the catch the value of the catch should increase at this same rate until such time as they can be produced in marketable quantities in a controlled environment. Shrimp farming is believed to be at least 20 years off. From that time on, the profit from ocean shrimping is considered to remain constant.

40. The production of finfish is expected to parallel the growth of markets with some of the increased production being accomplished through the development of new gear and methodology, and by additions to the fleet. Growth in production to satisfy the local market was predicted by considering economic projection of related parameters to be 5.0 percent per year for the first 20 years and 4.5 percent for the next 4 years of project life at which time catches would approach the maximum reliable yield of fishing grounds. Growth in production for disposal at distant markets was predicted at one percent per year up until the time grounds would be fished to capacity (about 4 years after project is completed). U. S. Fish and Wildlife estimated in 1970 that the maximum reliable yield of local fishing grounds were 120 short tons of shrimp and 2,760 short tons of finfish. These yields were confirmed in November 1975 by the South Carolina Wildlife and Marine Resources Department, Commercial Fisheries Management Section. The local market would consume 2,460 short tons of finfish and 300 short tons would be to distant markets.

41. Additional activity may also develop as a result of acceptance of fish protein concentrates as a means of combating starvation and malnutrition in underdeveloped countries. This product can be produced from species of fish found in large quantities along the South Carolina coast at approximately 2 cents a pound. Recent experiments with this food stuff in Biafra, Nigeria, indicated that concentrated fish protein is superior to milk protein--a factor that should encourage its early acceptance.

Table 21

ANNUAL PROFIT FROM COMMERCIAL FISHING
(WITH NO CHANNEL RESTRICTION)

Fish Class	Annual catch in pounds: Present users: Without project	Annual catch in pounds: Present users: With project 1/	Annual catch in pounds: After 5 yrs. with project	Average price per pound	Net % return	Total at-dock profit: Present users: Without project	Total at-dock profit: Present users: With project	Total at-dock profit: After 5 yrs. with project
Finfish								
Local Market	699,000	1,997,000	1,997,000	$0.34	33%	$78,400	$224,100	$224,100
Distant Market	0	0	500,000	0.34	33%	0	0	56,100
Total Finfish	699,000	1,997,000	2,497,000	0.34	33%	$78,400	$224,100	$280,200
Shrimp (heads-off) 2/	0	0	200,000	1.32	26%	0	0	68,600
TOTAL	699,000	1,997,000	2,697,000			$78,400	$224,100	$348,800

1/ This increase is due to the relief of channel restrictions. Existing charter boats, which can safely operate only 35 percent of the time now, are being used during the off-season for commercial fishing. The increase in their catch is computed as 699,000 pounds ÷ 0.35 = 1,997,000 pounds.

2/ These are the figures without channel restriction; with the remaining restriction of the proposed project (12-foot entrance channel) the profit after 5 years would be $67,200 ($68,000 x 0.98).

42. <u>Analysis of the prospective use of Murrells Inlet and alternative harbors for commercial shrimping</u>. By making certain assumptions about the method of operation of the local shrimping industry and analyzing the economics involved, it is possible to show that there is, for each competing port within a vicinity, a certain area in proximity to the port which can be fished profitably only by vessels harbored at that port. The assumptions which will be made are:

a. The average working day (cruising and trawling) is 13.5 hours.
b. Revenues are generated only in the trawling phase of the operation.
c. Normal trawling is 11.5 hours per day.
d. Shrimp are uniformly distributed along a reach extending from Georgetown to Little River, 3 to 5 miles offshore.
e. The normal method of operation is to cruise from a sheltered harbor through the ocean inlet to the fishing grounds, trawl for the maximum possible time, and cruise back to port.

43. To develop these areas of exclusive profitable operation one must determine the minimum time, in each operating day which must be devoted to trawling for profitable operation. This time can then be subtracted from the total time available to ascertain the remaining time available for cruising to and from the fishing grounds. This time will determine the range of profitable operation for alternative harbors. The minimum time per operating day which must be devoted to trawling in order to realize the same return on investment as the typical shrimp trawler, shown in Table 20a of this appendix, can be determined by dividing the typical days expenditures by the average hourly net rate of earnings from Table 20a. Total operating costs are \$86,233/year, time in operation is 13.5 hours/day, 170 days/year or 2,295 hours/year. The average hourly net rate of expenditures is then \$86,233/year divided by 2,295 hour/year or \$37.57/hour. Also from Table 20a, net returns for the base year are \$96,760. Time expended in generating these revenues (trawling) is 11.5 hours/day, 170 days/year, or 1,955 hours/year. The net rate of earnings for a typical shrimp trawler in the base year is then \$96,760/year divided by 1,955 hours/year of \$49.49/hour. The minimum time in trawling required is then:

$$\text{Trawl} = \frac{\$37.57/\text{hour} \times 13.5\ \text{hours/day}}{\$49.49/\text{hour}} = \begin{array}{l}10.25\ \text{hours/day} \\ \text{or about } 10\ \text{hours/day}\end{array}$$

If approximately 10 hours of each 13.5 hour day must be devoted to trawling, then 3.5 hours per day can be allotted to cruising to and from the fishing grounds.

44. In the case of Murrells Inlet, 0.7 hours is required for a round trip from port to the inlet, leaving 2.8 hours available for ocean cruising to and from fishing grounds. This would allow a vessel harbored at Murrells Inlet to travel 14 miles one way (28 miles round trip) from the inlet at 10 m.p.h. before dropping her nets to trawl for the minimum 10 hours. If, in addition to this distance is added 10 hours of trawling

(5 hours out, 5 hours back) at 2 m.p.h., the profitable shrimping range for Murrells Inlet is extended to 24 miles (14 miles cruising plus 10 miles trawling). By similar calculations the range for Winyah Bay, 25 miles to the south would be only 12 miles due to the excessive time required in attaining the ocean inlet there. The range for Little River Inlet, 35 miles to the north would be 20 miles. This analysis is presented graphically in Figure 1.

45. This figure illustrates both the exclusive and advantageous areas for profitable one-day fishing from Murrells Inlet in relation to its closest rival ports, Little River Inlet to the north and Winyah Bay to the south. Areas are delineated based on a 10 miles per hour cruising speed and 2 miles per hour trawling speed. The solid circles show the outer limits of the area within which a boat can operate assuming it cruises from its dock to the ocean point of origin, commences trawling immediately upon reaching that point, continues trawling out from and back to the ocean point of origin and cruises back to its dock to complete a 13.5 hour fishing day. The small-dashed circles show the limits to which a boat can cruise if it is to accomplish, in areas beyond this circle, the minimum amount of trawling considered necessary for a profitable fishing day 10 hours. The large-dashed circles show the outer limits of the area within which a boat can operate assuming it cruises from its dock directly to a point on the small-dashed circle, commences trawling along the same radius out to the back from a point on the large-dashed circle (10-hour trawl) and then cruises directly back to its dock. Based on these limits for various types of profitable one-day operations, the cross-hatched area represents an exclusive area of operation for Murrells Inlet and the larger hatched area represents the area of economic advantage for Murrells Inlet. Boats from the two nearby ports cannot operate profitably within the cross-hatched area without temporarily using Murrells Inlet facilities or finding an unusually high concentration of shrimp. The normal shrimp trawling area is shown by shading.

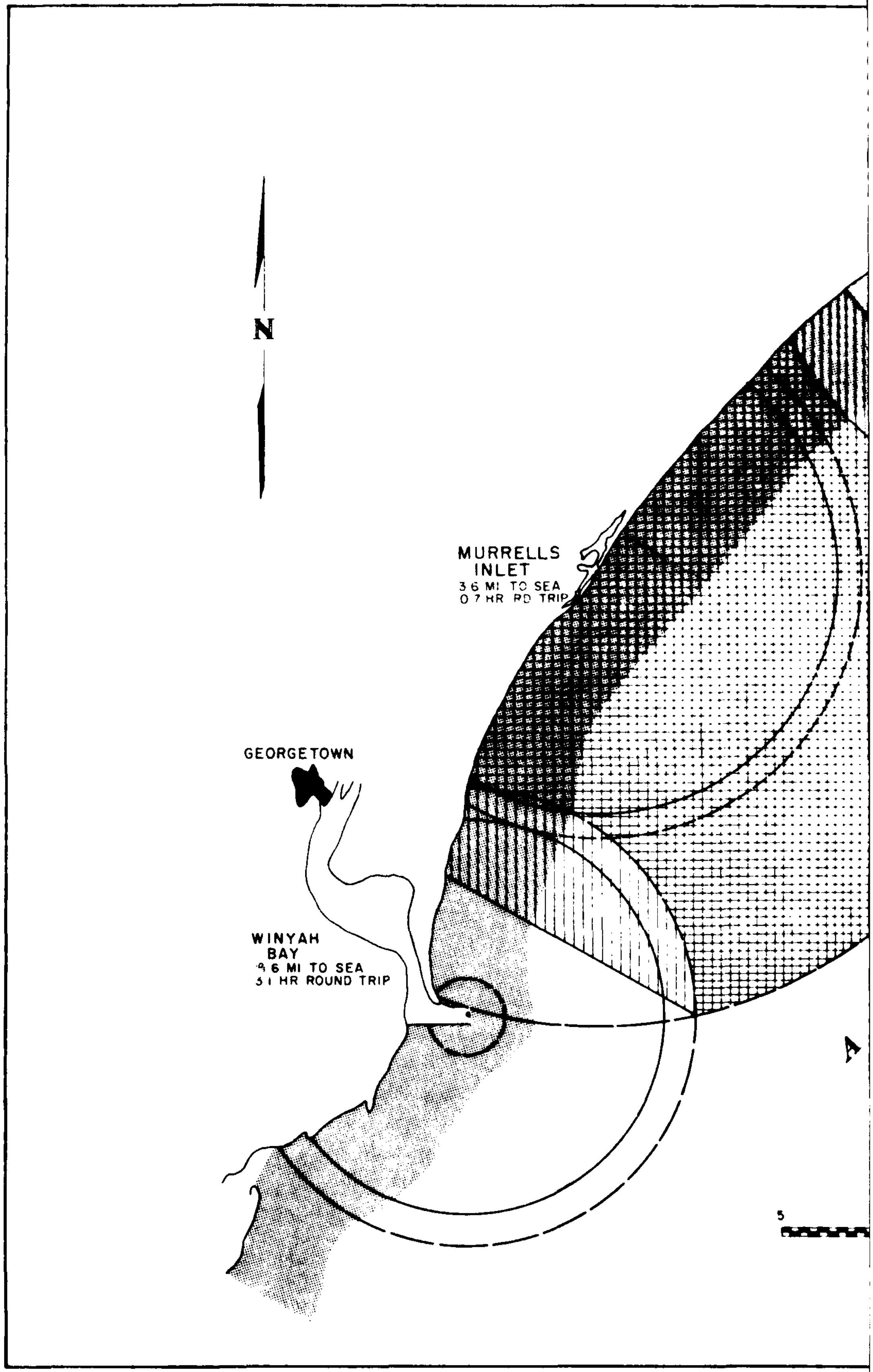
46. Analysis of prospective finfishing activities at Murrells Inlet, S. C. A very productive reef parallels the coastline of Long Bay at depths ranging from about 10 to 50 fathoms. Most of the commercial fish caught here are of the bottom-fish variety. Bottom fish of commercial importance are found in the reef area but to date are virtually unharvested. Commercial trips for the taking of bottom fish last two to three days, with two-day trips being more common. Thus, these operations are essentially different from one-day trawling expeditions in that productive fishing time is gained by reducing the number of trips made to and from fishing grounds. In a normal multiple day trip, the vessel would cruise to the fishing grounds, fish the remainder of that day, anchor or drift at night, fish the morning and faternoon of the next day, and return to port before darkness occurs. Fish of the bottom variety are currently taken with traps and handlines, but new devices such as electric reels are being developed and should result in a greater commercial interest in these varieties. Catches for

three-day trips generally range between 1500 and 6000 pounds with 2000 and 3000 pounds being the average take. Since bottom fishing grounds are farther out and trips are of multiple day duration, an exclusive area for ports cannot be conveniently defined. However, since these fishing grounds are more conveniently located to ports situated north of Winyah Bay, and the next commercial fishing port to the north, having free and unhindered access, is Southport, North Carolina, it seems reasonable to expect that a new type of commercial fleet will develop that can operate profitably out of Murrells Inlet, assuming this inlet is provided with a safe stable ocean access. Murrells Inlet has the added advantage of being close to Myrtle Beach, the center of the Grand Strand, and the major market for seafood caught in the area.

47. Estimates of benefits from commercial fishing at Murrells Inlet. Benefits attributable to commercial fishing interests are computed as the difference between the projected profit of the operation with and without corrective works. Development of an impressive fisheries operation at the inlet has been curtailed by formidable navigation problems. Removal of these curtailments will allow the fishery industries to develop unhindered in their endeavor to supply the needs of available markets. Projections of profits and benefits from commercial operations over a fifty-year period are shown in Table 22. When discounted at 6 1/8 percent, the average annual equivalent benefits are $464,100.

48. Benefits due to elimination of vessel damages. Considerable damages have resulted to vessels from groundings on shifting bars. For the year 1974 boat operators and owners at Murrells Inlet reported $52,000 in damages to vessels making contact with the entrance bar. These damages include bent shafts, propellers, and rudders, paint scraped from hulls, and other boat parts damaged when either striking bars or when being towed off. These damages only include labor and parts for boat repairs and do not consider normal boat maintenance, lost fishing time while boats are being repaired, or bodily injury to boatmen. An upward trend in vessel damage in recent years is attributed in large part to a worsening shoaling problem. It is assumed that all the vessel damage relating to shoaling conditions will be eliminated after the proposed project is completed. The annual benefits to elimination of this damage is therefore at least $52,000. Table 23 shows the reported damage during 1975.

49. Harbor of refuge benefits. Weather records indicate that about 10 storms severe enough to require leaving fishing grounds can be expected during a season at Murrells Inlet. It is assumed that an average of 10 deep draft shrimp trawlers, and 30 party and charter boats that operate from Murrells Inlet will use the inlet as a refuge. It is further assumed that the Murrells Inlet-based boats would, without a project, be unwilling, at such a time, to risk transit of the bar, and it is further assumed that each vessel would save 1½ hours running time over an alternative refuge. The hourly cost of a shrimp trawler, using the data


N
MURRELLS
INLET
3 6 MI TO SEA
0 7 HR RD TRIP
GEORGETOWN
WINYAH
BAY
9 6 MI TO SEA
3 1 HR ROUND TRIP
A
5

REPRODUCED AT GOVERNMENT EXPENSE

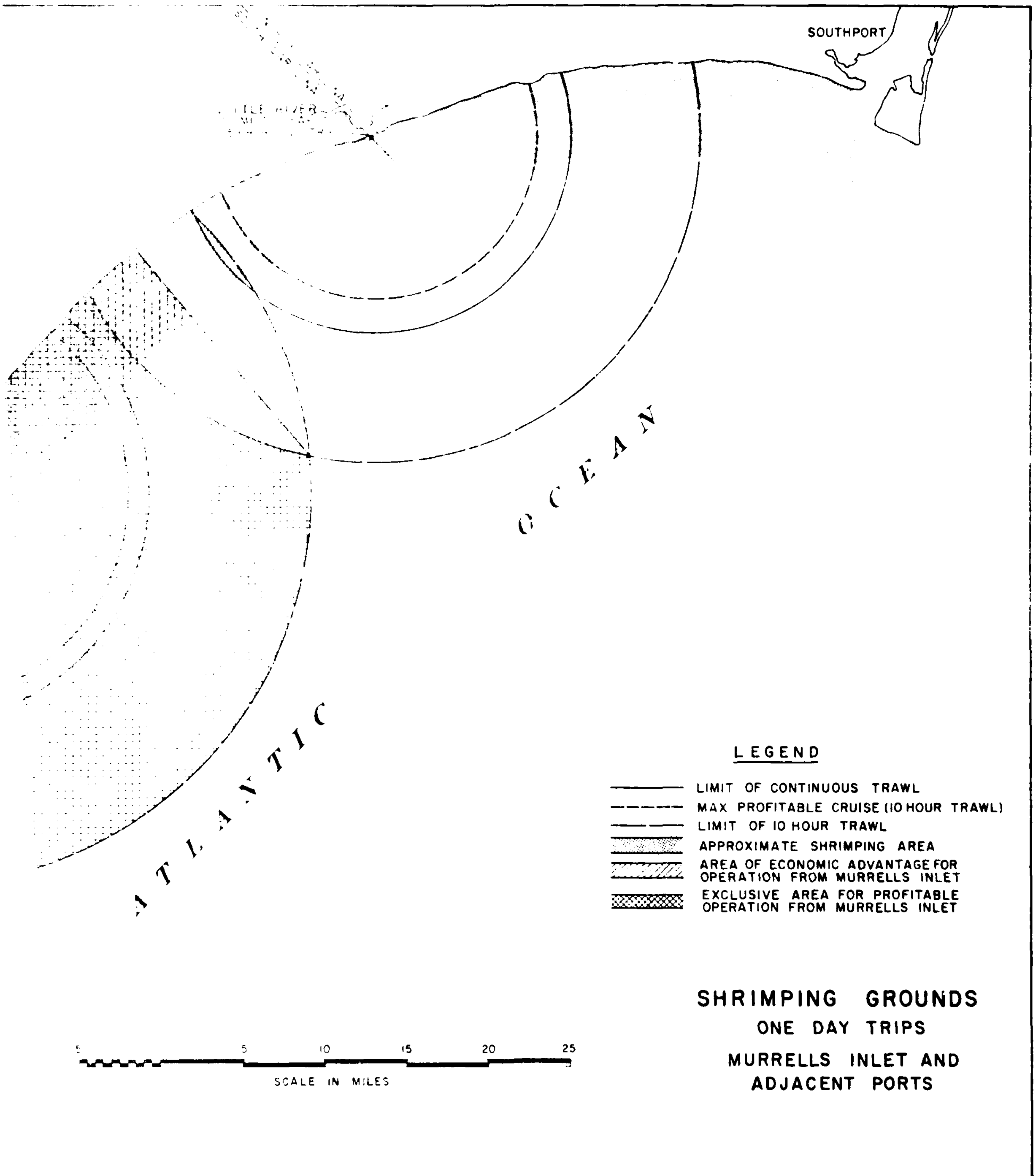


FIGURE 1

2

Table 22

ANNUAL BENEFITS FROM IMPROVED COMMERCIAL FISHING AT MURRELLS INLET, S C. FOR SELECTED YEARS OF PROJECT LIFE

	Years After Completion of the Project						
Type of Benefit	Base Year	5	10	20	30	40	50
Finfish, Local Market							
With Project	$224,100	$224,100	$286,000	$465,900	$551,300	$551,300	$551,300
Without Project	78,400	0	0	0	0	0	0
Annual Net Benefits	$145,700	$224,100	$286,000	$465,900	$551,300	$551,300	$551,300
AVERAGE ANNUAL BENEFITS (FINFISH, LOCAL MARKET)						$334,900	
Finfish, Distant Market							
With Project	$ 0	$ 56,100	$ 59,000	$ 65,100	$ 68,000	$ 68,000	$ 68,000
Without Project	0	0	0	0	0	0	0
Annual Net Benefits	$ 0	$ 56,100	$ 59,000	$ 65,100	$ 68,000	$ 68,000	$ 68,000
AVERAGE ANNUAL BENEFITS (FINFISH, DISTANT MARKET)						$ 54,600	
Shrimp							
With Project	$ 0	$ 67,200	$ 70,600	$ 78,000	$ 78,000	$ 78,000	$ 78,000
Without Project	0	0	0	0	0	0	0
Annual Net Benefits	$ 0	$ 67,200	$ 70,600	$ 78,000	$ 78,000	$ 78,000	$ 78,000
AVERAGE ANNUAL BENEFITS (SHRIMP)						$ 64,600	
TOTAL AVERAGE ANNUAL COMMERCIAL FISHING BENEFITS						$464,100	

Table 23

REPORTED DAMAGE TO VESSELS
AT MURRELLS INLET, S. C.
(1974 Season) 1/

Vessel No.	Vessel Name	Damage Description	Down Time (days)	Estimated Repair Cost
1	New Inlet Princess	Prop. & prop. shaft damage	30	$30,000
2	Carolina Princess	Prop. & shaft damage	5	1,000
3	Flying Fisher	Damage to bottom, prop. and shaft	17	5,500
4	Captail Alex	Damage to rudder and prop. shaft	19	4,700
5	Inlet Princess	Damage to rudder, prop. and prop. shaft	12	3,000
6	Captail Bill	Prop. and shaft damage	4	1,000
7	Summer Song	Damage to prop. and shaft and paint scraped from hull	11	3,000
8	Sugar Tango	Prop. damage	2	500
9	Snapper II	Three props damaged	(No report)	2,000
10	The Other Woman	Prop. damage	2	300
11	Golden Girl III	Prop. and shaft damage	7	1,000
12	Sea Striker	Prop. damage	(Infrequent)	(No report)
	Total			$52,000

1/ No reports from other boats at Murrells Inlet.

in Table 20a, with 170 shrimping days and a 13.5 hour day, are $86,233 - (170 x 13.5) = $37.57, while the hourly costs of party and charter boats (averaged, Tables 20b, 20b-1, & 20C) are $16.06. Hence, the savings, or benefits, as a harbor of refuge would be ($37.57 per hr. x 10 boats + $16.06 per hr. x 30 boats) x 10 storms per yr. x 1.5 hrs. = $13,000.

50. Fishing walkway benefits. Estimated benefits, attributable to the proposed fishing walkway for the south jetty, are based on the reported income from the operation of privately owned fishing piers in the area. The Fish and Wildlife Service estimated that an average of 66,500 persons use each of these piers per year paying an average fee of about $1.50 per day to fish. The jetty would be longer but would not be usable for about 48 hours per month due to high tides and waves, and primary fishing waters are considered limited to the inlet side. Walkway users will have a considerable walk if they come by land since the access road is about one mile from the jetty. Taking these factors into consideration, a walkway on the south jetty would attract about 30 percent of the number of fishermen as do the fishing piers for an average annual visitation of 20,000. In addition, about 6,000 sightseers are expected to visit the jetty annually. The unit value for sightseeing was taken as one-half the value for fishing or $0.75 per day. The fishing walkway annual benefits were computed at $30,000 for fishing and $4,500 for sightseeing or a total of $34,500. These benefits are used in the evaluation of the justification of the fishing walkway with parking area and toilet facility and are not included in the estimated benefits for the general navigation project.

51. Redevelopment benefits. There are 3 counties within commuting distance of the project area that have been designated redevelopment areas by the Economic Development Administration, under Title IV of the Public Works and Economic Development Act of 1965. These are Williamsburg, Georgetown, and Marion Counties. The average annual figures for 1973 give these counties a total civilian work force of 44,100 and unemployed of 2,450, which is an unemployment rate of 5.5 percent. Redevelopment benefits consist of the labor income accruing to those who would be unemployed in such areas, except for the construction of the project.

52. It is estimated, for the type of work contemplated by the project, labor requirements and locally usable labor would be as below:

	Percent		Redevelopment
Type Labor	Required	Supplied Locally	Factor (percent)
Skilled	60	20	12
Semi-skilled	10	40	4
Unskilled	30	80	24
			40

53. The redevelopment benefits attributable to the initial construction are as derived in Table 24.

Table 24

ANNUAL REDEVELOPMENT BENEFITS
FOR CONSTRUCTION OF MURRELLS INLET PROJECT

Item	Value in $
Contract Cost1/	$11,354,000
Labor Cost2/	3,406,200
Annual Redevelopment Benefits	88,000

1/ Contract Costs--excludes lands, easements and rights-of-way, aids to navigation, and indirect costs.

2/ Labor cost for this type of work taken at 30 percent (see bulletin 1390, BLS, "Labor and Material Requirements for Civil Works Construction by the Corps of Engineers").

3/ This is: $3,406,200 x 0.06456 x 0.40.

54. Summary of estimated annual benefits. A summary of the estimated annual benefits previously discussed is shown in Table 25 below:

Table 25

SUMMARY OF ESTIMATED ANNUAL BENEFITS

Item	Annual Benefits
NAVIGATION FACILITIES	
Party Boating	$ 966,600
Charter boating	212,300
Recreational boating	232,500
Commercial fishing	430,900
Elimination of vessel damage	46,800
Harbor of refuge	13,000
TOTAL ANNUAL BENEFITS (Navigation Project)	$1,902,100
RECREATION FISHING WALKWAY	34,500
TOTAL PROJECT ANNUAL BENEFITS (w/o Redevelopment Benefits)	$1,936,600
REDEVELOPMENT BENEFITS	$ 88,000
TOTAL PROJECT ANNUAL BENEFITS	$2,024,600

PROJECT FORMULATION AND ECONOMIC JUSTIFICATION

55. Improvement desired. Local interests have requested a stable channel from the inner harbor through the inlet throat and across the ocean bar. The improved channel would permit unrestricted passage preventing delays, hazardous navigation conditions, and loss of revenue. A recreational fishing walkway was also requested by local interest.

56. Alternate solutions considered. Several possible solutions to the problem of providing a stabilized channel of sufficient depth and width for regular use by commercial and recreational fishing vessels were considered. Each of these plans of improvement include an entrance channel 300 feet wide and an inner channel 90 feet wide with channel depths determined by maximizing benefits. The inner channel would extend to the major berthing area at the old Army crash boat dock where it would terminate with a turning basin. A diked disposal area would be provided for the material dredged from the inner channel not suitable for beach nourishment. A recreational fishing walkway for inclusion in the proposed plan of improvement was also considered. Structural and non-structural alternatives are discussed below.

a. Non-structural controls. Construction and maintenance of the required channels was considered using a program of dredging in lieu of structural controls. Emergency dredging operations at the inlet with the Corps-owned side casting dredge MERRITT proved this approach to be uneconomical and physically infeasible. It was concluded that some type of structural control is required.

b. Structural alternatives. Structural alternatives considered included provisions for intercepting, trapping and bypassing sands moving along shore, for sheltering using vessels from wave action, and for maintaining channel alignment. Jetties springing from the barrier beach on both sides of the inlet were found to be the best solution for maintaining specified alignments and for providing a sheltered approach. Intercepting and trapping of sand can be accomplished either by making the updrift jetty a complete littoral barrier, causing a sand fillet to form against it, or by providing a weir in the updrift jetty over which sands flow to a deposition basin located within the harbor. Sands trapped in the deposition basin could be pumped hydraulically downdrift with a conventional dredge. Sands forming the fillet against the impermeable jetty would be exposed to ocean forces and would have to be bypassed using a permanently installed bypassing plant, a submarine dredge (not yet perfected), or a conventi nal hydraulic dredge for which breakwater protection is provided. Each of these alternatives would accomplish the desired results, making selection of the best project purely a matter of economics. The best plan is concluded to be the weir jetty system since it is clearly the least expensive satisfactory solution. Details of this plan are discussed in the design appendix.

c. Fishing walkway. The best plan for providing recreational fishing from jetties was determined to be construction of an asphalt walkway for the entire length of the south jetty. Included in this plan is a parking area and toilet facility at Huntington Beach State Park.

57. Vessel operational effectiveness for project optimization. Recreational boating and commercial fishing operations, which are now regulated by the tidal cycles, would realize increasing benefits due to greater channel project depths until these depths reach a level that would be adequate for the deepest draft vessels expected to use the inlet. Wider channels which are proposed would also contribute to greater channel effectiveness. The smaller boats would not be affected by channel depth to the extent that deep-draft boats would but would benefit more from construction of jetties which would provide protected waters when crossing the ocean surf-zone. Jetty lengths vary with the different plans, therefore, some difference would be expected in the vessel operational effectiveness even for the small recreational boats. The effects of wave action at the inlet would be more restrictive on the recreational boats than commercial boats with similar drafts due to the inexperience of many of the recreational craft skippers. Also, commercial operators must operate under less than ideal conditions, even with damage to their boats, in order to make a profit. Annual benefits from reduction of vessel maintenance also varies with channel project depth. In order to determine the optimum project, boat operational effectiveness for different degrees of project improvements were computed as shown in Table 26. The derivation of the percents of vessel operational effectiveness is explained in the following paragraph.

Table 26

VESSEL OPERATIONAL EFFECTIVENESS
FOR DIFFERENT TYPE BOATS

Class Boat	Existing (3.5-ft.)	Vessel Operational Percent Effectiveness for Improved Entrance Channel Depths of: 8-ft.	10-ft.	12-ft.	14-ft.
Recreational Boats 1/					
Outboards	75	97	98	100	100
Sailboats	75	97	100	100	100
Auxiliary sailboats	35 2/	79	97	100	100
Inboards	60	86	92	100	100
Cruisers	45	82	90	100	100
Commercial Boats					
Shrimp trawlers (7-ft. draft)	4	44	83	98	100
Party boats					
New Inlet Princess	7	35	68	100	100
Carolina Princess	44	68	100	100	100
Flying Fisher	44	68	100	100	100
Captain Alex	35	60	98	100	100
Inlet Princess	35	60	98	100	100
South Wind	44	68	100	100	100
Captain Bill	44	68	100	100	100
Tom-A-Gator	44	68	100	100	100
Flying Fisher II	44	68	100	100	100
Summer Song	44	68	100	100	100
Sea Horse	44	68	100	100	100
Eager Beaver III	44	68	100	100	100
Charter boats					
Sugar Tango	52	76	100	100	100
Johnny Lewis	60	87	100	100	100
The Witt	60	87	100	100	100
Snapper II	60	87	100	100	100
The Other Woman	68	98	100	100	100
Darthopper	68	98	100	100	100
Star Fire	76	100	100	100	100
Golden Girl III	76	100	100	100	100
Sea Striker	68	98	100	100	100
Helen D	76	100	100	100	100
Streaker	76	100	100	100	100
Sandpiper	76	100	100	100	100

1/ Jetty protection from wave action would have a greater effect on recreational boats due to the problems small boats would have with wave-action and the inexperience of the skipper.
2/ This type sailboat has a deep draft and thus is severely restricted by the present controlling depth.

58. Tidal cycle analysis. Tables 27 and 28 show day-by-day for a typical month the number of hours (Table 27) that a typical shrimp trawler could operate, and (Table 28) that a typical headboat or charter boat could operate. The percentages at the bottom of the tables represents the fraction of the maximum possible operating time that is available for the vessel that requires the number of feet of tide indicated. For instance, see Table 27. Assume an entrance channel depth of 10 feet (below MLW) has been provided. A trawler requiring 2 feet of tide could operate 83% of the total possible time. This is a vessel requiring 12 feet of water; that is, it is a 7-foot draft shrimp trawler with the ideal underkeel clearance for safe operation. On the other hand, suppose we are thinking of an 8-foot entrance channel to be provided; then this same boat, which requires 12 feet of water, requires 4 feet of tide, and from that column it will be found that it can operate only 44% of the available time. The construction of these tables requires certain operating rules for the various types of vessels; these are stated as footnotes. It will be noted that the boat requiring zero feet of tide is one that could use the inlet at MLW. This will not give 100 percent effectiveness since the low tide drops below MLW. This will not give 100 percent effectiveness since the low tide drops below MLW on certain days of the month. Under ideal conditions, the total depth of water required would be the total of the vessel's loaded draft, plus ½ foot for drag, ½ foot for squat, 2 feet for pitch and roll (since the controlling depth is in the entrance channel), and 2 feet of minimum bottom clearance, for a total of 5 feet addition to the boat draft. The boats at Murrells Inlet are actually operating under hazardous conditions, with not more than 2 feet of water under the keel, and are suffering considerable damages as a result. When the small assumed shrimping activity develops at Murrells Inlet it is expected that the trawlers will be of the 7-foot draft, since the trend is for larger vessels. The total depths required for commercial boats are:

		Channel Depth Required With Desirable Underkeel Clearances for-	
	Loaded Draft	Ideal Conditions	Hazardous Operation
Shrimp trawlers	7.0 feet	12.0 feet	9.0 feet
Party boats	5.0 feet	10.0 feet	7.0 feet
Charter Boats	3.5 feet	8.5 feet	5.5 feet

DELETED

Table 27

AVAILABLE SHRIMPING HOURS PER DAY 1/

FOR A TYPICAL MONTH 2/

AT MURRELLS INLET, S. C.

June 1965 (DAY)	FEET OF TIDE REQUIRED AT MEAN LOW WATER 0	+1	+2	+3	+4	+5	+6
1	13.5	11.5	6.0	0.0	0.0	0.0	0.0
2	13.5	13.5	9.5	0.0	0.0	0.0	0.0
3	13.5	13.5	10.0	0.0	0.0	0.0	0.0
4	13.5	13.5	13.5	12.5	12.5	0.0	0.0
5	13.5	13.5	13.5	13.5	13.5	0.0	0.0
6	13.5	13.5	13.5	13.5	13.5	0.0	0.0
7	13.5	13.5	13.5	13.5	13.5	0.0	0.0
8	13.5	13.5	13.5	13.5	13.5	13.5	0.0
9	13.5	13.5	13.5	13.5	13.0	12.5	11.5
10	13.5	13.5	13.5	13.0	12.0	0.0	0.0
11	13.5	13.0	10.0	6.0	0.0	0.0	0.0
12	12.5	8.0	6.5	0.0	0.0	0.0	0.0
13	9.5	8.0	6.0	0.0	0.0	0.0	0.0
14	13.0	10.0	7.0	0.0	0.0	0.0	0.0
15	13.5	10.0	7.0	6.0	0.0	0.0	0.0
16	13.5	13.5	12.5	12.0	0.0	0.0	0.0
17	13.5	13.5	13.5	13.0	0.0	0.0	0.0
18	13.5	13.5	13.5	13.5	0.0	0.0	0.0
19	13.5	13.5	13.5	13.5	13.5	0.0	0.0
20	13.5	13.5	13.5	13.5	13.5	0.0	0.0
21	13.5	13.5	13.5	13.5	13.0	0.0	0.0
22	13.5	13.5	13.5	13.5	12.5	0.0	0.0
23	13.5	13.5	13.5	12.5	11.5	0.0	0.0
24	13.5	13.5	13.5	13.0	12.0	0.0	0.0
25	13.5	13.0	13.0	12.5	11.5	0.0	0.0
26	13.5	13.0	13.0	12.5	0.0	0.0	0.0
27	13.5	12.5	12.5	12.0	0.0	0.0	0.0
28	13.5	12.0	12.0	7.0	0.0	0.0	0.0
29	13.5	10.0	8.5	6.5	0.0	0.0	0.0
30	12.5	8.5	8.5	6.0	0.0	0.0	0.0
Total Hours	398.5	372.5	344.5	279.5	179.0	26.0	11.5
No. Trips Made	30	30	30	24	14	2	1
Hrs. Spent in Travel	45.0	45.0	45.0	36.0	21.0	3.0	1.5
Trawling Time	353.5	327.5	299.5	243.5	158.0	23.0	10.0
Max. Possible Trawling Time	360.0	360.0	360.0	360.0	360.0	360.0	360.0
% of Max. Possible Trawling Time	98%	91%	83%	68%	44%	6%	3%

1/ Maximum 13.5 hours available per day (0530 to 1900 hours) or 405 hours per month; travel time to and from the fishing ground of 1.5 hours; and no-go time of 5.5 hours or less. Departure time may vary by one hour to 0500 hours and return time also by one hour until 1930 hours.

2/ Tide table data for June 1965 was used since the mean tide for that month is about average for the year.

Table 28

AVAILABLE PARTY AND CHARTER BOAT OPERATION HOURS PER DAY[1/] FOR A TYPICAL MONTH (JUNE 1965)[2/] AT MURRELLS INLET, S. C.

June 1965 (DAY)	FEET OF TIDE REQUIRED AT MEAN LOW WATER						
	0	+1	+2	+3	+4	+5	+6
1	10.5	9.0	0.0	0.0	0.0	0.0	0.0
2	11.0	9.5	0.0	0.0	0.0	0.0	0.0
3	10.5	0.0	0.0	0.0	0.0	0.0	0.0
4	11.0	11.0	0.0	0.0	0.0	0.0	0.0
5	11.0	11.0	11.0	0.0	0.0	0.0	0.0
6	11.0	11.0	11.0	10.0	0.0	0.0	0.0
7	11.0	11.0	11.0	11.0	11.0	0.0	0.0
8	11.0	11.0	11.0	11.0	11.0	11.0	0.0
9	11.0	11.0	11.0	11.0	11.0	11.0	11.0
10	11.0	11.0	11.0	11.0	11.0	0.0	0.0
11	11.0	11.0	11.0	0.0	0.0	0.0	0.0
12	11.0	9.0	0.0	0.0	0.0	0.0	0.0
13	10.5	0.0	0.0	0.0	0.0	0.0	0.0
14	10.0	0.0	0.0	0.0	0.0	0.0	0.0
15	10.0	0.0	0.0	0.0	0.0	0.0	0.0
16	10.5	0.0	0.0	0.0	0.0	0.0	0.0
17	11.0	9.0	0.0	0.0	0.0	0.0	0.0
18	11.0	11.0	0.0	0.0	0.0	0.0	0.0
19	11.0	11.0	11.0	0.0	0.0	0.0	0.0
20	11.0	11.0	11.0	9.5	0.0	0.0	0.0
21	11.0	11.0	11.0	11.0	0.0	0.0	0.0
22	11.0	11.0	11.0	11.0	11.0	0.0	0.0
23	11.0	11.0	11.0	11.0	11.0	0.0	0.0
24	11.0	11.0	11.0	11.0	0.0	0.0	0.0
25	11.0	11.0	11.0	11.0	0.0	0.0	0.0
26	11.0	11.0	11.0	11.0	10.0	0.0	0.0
27	11.0	11.0	11.0	9.0	0.0	0.0	0.0
28	11.0	11.0	11.0	10.5	10.0	0.0	0.0
29	11.0	11.0	10.5	0.0	0.0	0.0	0.0
30	10.5	0.0	0.0	0.0	0.0	0.0	0.0
Total Hours	325.5	256.5	197.5	149.5	86.0	22.0	11.0
No. Trips Made	30	24	18	14	8	2	1
Hrs. Spent in Travel	135.0	108.0	81.0	63.0	36.0	9.0	4.5
Fishing Hours	190.5	148.5	116.5	86.5	50.0	13.0	6.5
Max. Possible Fishing Hours	195.0	195.0	195.0	195.0	195.0	195.0	195.0
% of Max. Possible Fishing Hours	98%	76%	60%	44%	26%	7%	3%

1/ Maximum 11.0 hours available per day (0700 to 1800 hours) or 330 hours per month; travel time to and from fishing grounds of 4.5 hours; and no-go time of 8.5 hours or less. Time of departure and return can vary by one-half hour (departure 0630, return 1830 hours).

2/ Tide table data for June 1965 was used since the mean tide for that month is about average for the year.

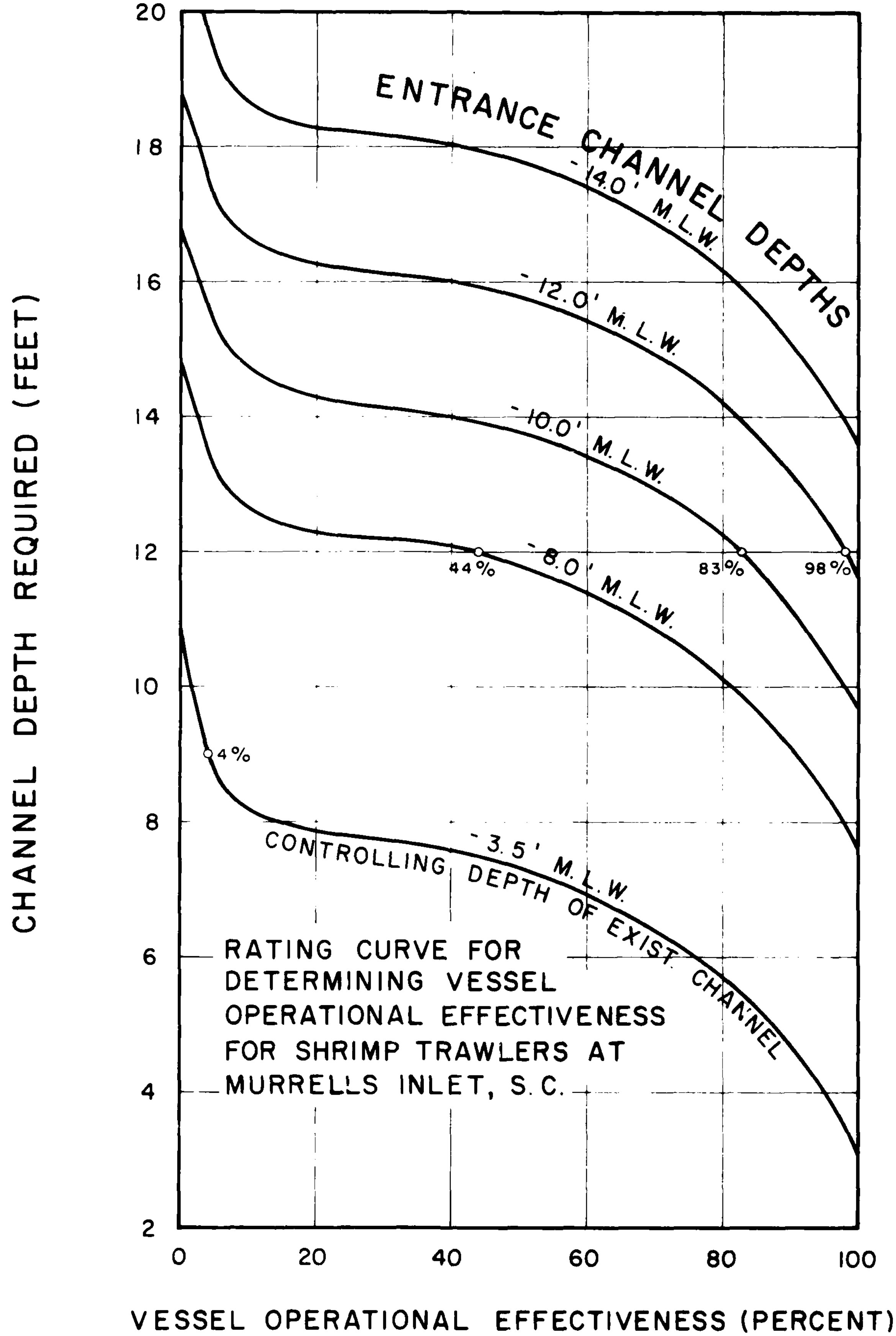

ENTRANCE CHANNEL DEPTHS
-14.0' M.L.W.
-12.0' M.L.W.
-10.0' M.L.W.
-8.0' M.L.W.
-3.5' M.L.W.
CONTROLLING DEPTH OF EXIST. CHANNEL
44%
83%
98%
4%
RATING CURVE FOR
DETERMINING VESSEL
OPERATIONAL EFFECTIVENESS
FOR SHRIMP TRAWLERS AT
MURRELLS INLET, S.C.
CHANNEL DEPTH REQUIRED (FEET)
20
18
16
14
12
10
8
6
4
2
0
20
40
60
80
100
VESSEL OPERATIONAL EFFECTIVENESS (PERCENT)

FIGURE 2

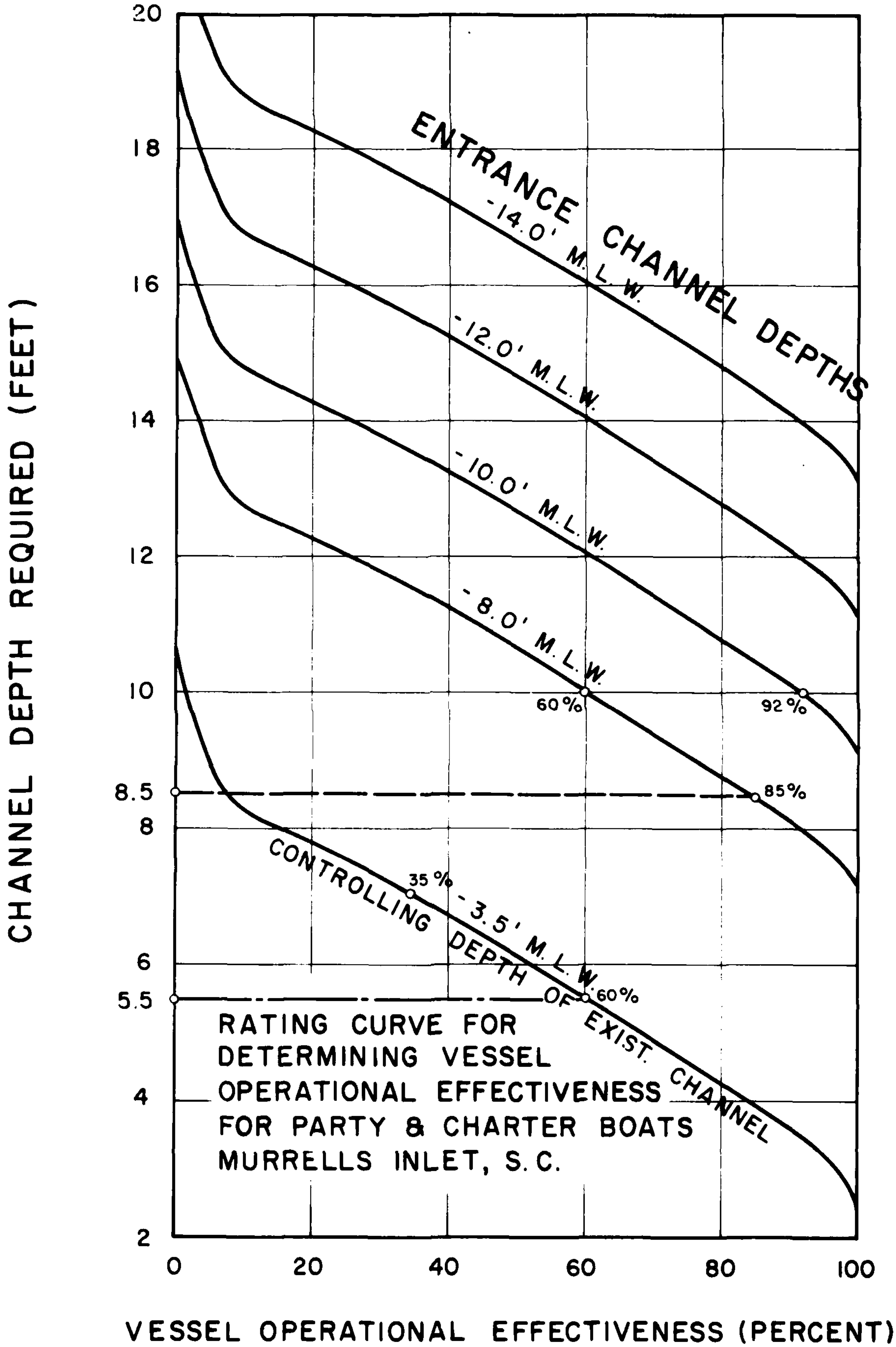

ENTRANCE CHANNEL DEPTHS
-14.0' M.L.W.
-12.0' M.L.W.
-10.0' M.L.W.
-8.0' M.L.W.
-3.5' M.L.W.
CONTROLLING DEPTH OF EXIST. CHANNEL
60%
92%
85%
35%
60%
CHANNEL DEPTH REQUIRED (FEET)
VESSEL OPERATIONAL EFFECTIVENESS (PERCENT)
20
18
16
14
12
10
8.5
8
6
5.5
4
2
0
20
40
60
80
100
RATING CURVE FOR
DETERMINING VESSEL
OPERATIONAL EFFECTIVENESS
FOR PARTY & CHARTER BOATS
MURRELLS INLET, S.C.

FIGURE 3

59. Levels of improvement considered. For the navigation facilities, several levels of improvement were compared by increasing channel project depths in two-foot increments. Since the length of jetties is relative to entrance channel depths, longer jetties would be required for each higher level of improvement. The reason the annual maintenance dredging does not vary significantly between the four plans is because most of the dredging (200,000 cubic yards) is for sand bypassing which does not change with the four plans. Of the 203,000 cubic yards of material in Plan B to be removed on an average annual basis, only 3,000 cubic yards of inner channel maintenance dredging will vary between plans. The considered levels of improvement are described in Table 29.

Table 29

CONSIDERED LEVELS OF IMPROVEMENT FOR NAVIGATION FACILITIES

Item	Plans of Improvement			
	A	B	C	D
PERTINENT DATA				
Entrance channel depth	8 feet	10 feet	12 feet	14 feet
Inner channel depth	6 feet	8 feet	10 feet	12 feet
Initial dredging (C.Y.)	970,000	1,140,000	1,370,000	1,640,000
Annual maintenance dredging (C.Y.)	202,000	203,000	212,000	218,000
North jetty length (ft.)	2,945	3,365	3,685	3,825
South jetty length (ft.)	2,750	3,290	3,610	3,750
PROJECT FIRST COSTS	$10,347,000	$13,581,000	$16,046,000	$17,558,000
AVERAGE ANNUAL COSTS	$ 1,099,000	$ 1,337,000	$ 1,526,000	$ 1,640,000
BENEFITS				
Party boating	$ 619,700	$ 966,600	$1,019,200	$1,019,200
Charter boating	$ 182,800	$ 212,300	$ 212,300	$ 212,300
Recreational boating	219,800	232,500	250,100	250,100
Commercial fishing	294,600	430,900	464,100	465,500
Elimination of vessel damage	41,100	46,800	52,000	52,000
Harbor of refuge	13,000	13,000	13,000	13,000
TOTAL ANNUAL BENEFITS (Navigation Facilities)	$1,371,000	$1,902,100	$2,010,700	$2,012,100

60. Determination of optimum project. It was determined through maximization of benefits that Plan B provides the optimum navigation facilities. Fishing walkway benefits and redevelopment benefits were not included in the determination of the optimum navigation project. The location of the state park and other considerations led to the selection of a fishing walkway on the south jetty as providing the optimum recreational facilities. Maximum benefits are achieved by incrementally adding higher levels of improvements until the incremental cost of the addition equals the incremental benefits received. This is also the point where benefits exceed costs by the largest amount. Benefits-to-cost ratios and excess of benefits over costs are shown in Table 30.

Table 30

DETERMINATION OF OPTIMUM PROJECT

Plan (Entrance channel depth)	Annual Benefits	Annual Costs	Benefit-to-cost ratios	Excess of benefits over costs
NAVIGATION FACILITIES				
A (8-feet)	$ 1,371,000	$1,099,000	1.25:1	$275,000
B1/ (10-feet)	1,902,100	1,337,000	1.42:1	568,100
C (12-feet)	2,010,700	1,526,000	1.32:1	487,700
D (14-feet)	2,012,100	1,640,000	1.23:1	375,100
FISHING WALKWAY	$ 34,500	$ 26,400	1.31:1	$ 8,100

1/ Recommended plan of improvement for the navigation facilities

APPENDIX F

POST AUTHORIZATION CHANGE

SACEN-GP 2 December 1975

POST AUTHORIZATION CHANGE

1. Project: Murrells Inlet, South Carolina

2. Authorization:

   a. Act - Section 201 of Flood Control Act of 1965, Public Law 89-298
   b. Date - 27 October 1965
   c. Project Document No. - House Document 92-137, dated 29 June 1971

3. Nature of change: A $4,366,000 increase in the total cost of the project (exclusive of price level changes). A $849,600 increase in navigation benefits (exclusive of price level changes). A decrease of 2 feet in the authorized entrance and inner channel depths.

4. B/C Ratio: Previous - 1.4
   New - 1.5
   As Authorized - 1.7

5. Interest rate: Previous - 5 7/8
   New - 6 1/8
   As Authorized - 4 7/8

6. Date of previous estimate: July 1974 (last testified to Congress)

7. Costs:

	Federal	Non-Federal	Total
As Authorized	$ 3,468,000	$1,939,000	$ 5,407,000
Previous Estimate	6,902,000	1,410,000	8,312,000
Price Level Increase	1,018,000	170,000	1,188,000
Other Changes	4,177,300	188,700	4,366,000
New Estimate	12,097,300	1,768,700	13,866,000 1/

1/ October 1975 price levels and annual economic costs are $1,363,400

8. Benefits:

	Previous	New	As Authorized
Navigation	$1,025,000	$1,902,100	$752,000
Recreation	39,000	34,500	40,000
Redevelopment	-	88,000	-
Total	$1,064,000	$2,024,600	$792,000

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9. Reason for change:

a. Increase in project cost: Project cost increase is due to the lengthening of the north jetty from 3,300 to 3,365 feet ($195,000); lengthening of the south jetty from 2,300 to 3,290 feet ($2,975,000); increasing the capacity of the deposition basin from 100,000 to 600,000 cubic yards ($750,000); and increases in engineering and design and supervision and administration due to applying rate of 5% to construction cost and increase in model study costs ($446,000).

b. Increase in navigation benefit: Benefit increase is due to an increase in boating at Murrells Inlet ($537,800); an increase in value of boats ($302,400); an increase in vessel damage ($4,700); and increased usage as a harbor of refuge ($4,700).

c. Decrease in authorized depths: Economic studies for the General Design Memorandum showed that the project benefits and costs optimized at an entrance channel depth of 10 feet in lieu of 12 feet and an inner channel depth of 8 feet in lieu of 10 feet.

10. Comments:

a. The jetties were lengthened by extending them to the ocean bottom contour equal to the entrance channel depth (-10 feet mean low water) in order to exclude littoral drift from the channel. The jetties terminated in about -4 feet mean low water in the project document plan. The ocean bottom at -4 feet mean low water is still affected by wave action which could allow the movement of littoral drift into the entrance channel.

b. The deposition basin was increased in size to store a three-year accumulation of the gross amount of southward littoral drift at 200,000 cubic yards per year instead of the net amount of southward littoral drift at 100,000 cubic yards per year. It is obvious that the deposition basin should be sized to store the southward littoral rate. The deposition basin is sized to store a 3-year amount of annual southward littoral drift to allow more flexibility in the maintenance dredging and operation of the project.

c. The increase in the overall project cost has increased the non-Federal cost of project. In a letter dated 23 October 1975, the District Engineer informed the local sponsor, Georgetown County, of the increased non-Federal cost of the project. The sponsor in a letter dated 4 November 1975 stated their assurance to provide all the necessary items of local cooperation including the non-Federal cash contribution.

d. Previous benefit is based on the navigation benefit presented in survey report escalated for price level increases. New benefit reflects an increase in boating at the inlet; an increase in boat values; and an increase in damage to vessels.

e. A request will be made to higher authority to reclassify the 2-foot depth increment from "active" to "inactive".

END

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