JANUARY 1994
(REVISED APRIL 1995)
(REVISED SEPTEMBER 1995)
(REVISED OCTOBER 1995)
(REVISED AUGUST 1996)

PALM BEACH COUNTY, FLORIDA, FROM MARTIN COUNTY LINE TO LAKE WORTH INLET AND FROM SOUTH LAKE WORTH INLET TO BROWARD COUNTY LINE

SHORE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM ADDENDUM FOR OCEAN RIDGE SEGMENT

WITH FINAL SUPPLEMENT TO THE ENVIRONMENTAL IMPACT STATEMENT

PALM BEACH COUNTY

FLORIDA

PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
(FROM MARTIN COUNTY LINE TO LAKE WORTH INLET AND FROM SOUTH LAKE WORTH INLET TO BROWARD COUNTY LINE)

GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE OCEAN RIDGE SEGMENT WITH SUPPLEMENT TO THE ENVIRONMENTAL IMPACT STATEMENT

Prepared For

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SYLLABUS

This report summarizes the detailed planning and engineering for construction of the Palm Beach County Shore Protection Project, Ocean Ridge segment. Details of the engineering investigations and design are contained in Appendix 1. The economic analysis is summarized in Appendix 2. Real estate requirements for construction are summarized in Appendix 3. Pertinent correspondence is presented in Appendix 4.

This report is an addendum to the 1987 General Design Memorandum (GDM) for beach erosion control projects within Palm Beach County, Florida. The 1987 GDM for Palm Beach County provides for restoration of 1.6 miles of Atlantic shoreline in Ocean Ridge, Florida with periodic renourishment of the restored beach. The plan described within this report was determined to be the NED plan based on the most recent physical and economic data available. The proposed NED plan provides restoration of 1.42 miles of Atlantic shoreline with periodic renourishment and a field of eight groins along the northernmost 1,800 feet of the project shoreline. The groins will provide for reduced nearshore hardbottom impacts and increased shoreline stability.

Initial restoration of the Ocean Ridge shoreline will require approximately 784,300 cubic yards of material. Periodic renourishment, including overfill, will require approximately 433,800 cubic yards of material every six years. An offshore, shore-parallel borrow area will be used for both initial restoration and future periodic renourishment. The borrow area is located approximately 1,700 feet offshore of the Ocean Ridge shoreline and extends approximately 12,400 feet south from South Lake Worth Inlet.

The total first cost of the NED plan excluding interest during construction is $7,141,600. The annual cost including interest and amortization of the first cost is $567,050. Benefits generated by the project include $1,168,600 in storm damage reduction, $241,100 in loss of land prevented, $393,000 in incidental recreation and $321,300 in incidental downdrift benefits. The total annual benefits less the total annual costs equal the net benefits amounting to $1,064,400. The benefit-to-cost ratio is 2.0.

The Federal share of the initial costs of construction is $4,263,800 or 59.70 percent. The Federal share of the cost of each future periodic renourishment is $2,173,000 or 62.25 percent of the total $3,490,500. The total non-Federal responsibility of the initial work is $2,877,800. The non-Federal responsibility for each periodic renourishment is $1,317,500.

PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE
OCEAN RIDGE SEGMENT

PERTINENT DATA

PHYSICAL DATA

Initial Fill Length	1.42 Miles
Initial Fill Volume	
Fill Behind ECL	76,000 Cubic Yards
Design Fill Volume	274,500 Cubic Yards
Advance Nourishment	289,200 Cubic Yards
Overfill	144,600 Cubic Yards
TOTAL INITIAL FILL QUANTITY	784,300 Cubic Yards
Borrow Area - Initial Fill	Offshore Ocean Ridge
Berm Height	10 Feet (MLW)
Berm Width (measured from the ECL)	0 Feet
Future Periodic Nourishment	433,800 Cubic Yards
Nourishment Interval	6 Years
Borrow Area - Periodic Nourishment	Offshore Ocean Ridge

FINANCIAL DATA

First Cost	
Initial Fill	$3,740,720
New Groins	956,780
Existing Groins	400,000
Mitigation	302,820
Lands	103,260
Contingencies	931,520
Engineering and Design	520,100
Construction Management	186,400
TOTAL FIRST COST	$7,141,600
Interest Rate	7 3/4 %
Annual Cost	
Initial Restoration	$ 567,050
Future Nourishment	476,950
Groin Maintenance	15,600
TOTAL ANNUAL COST	$1,059,600

FINANCIAL DATA (Continued)

Benefits	
Storm Damage Reduction	$1,168,600
Prevention of Loss of Land	241,100
Recreation	393,000
Downdrift	321,300
TOTAL ANNUAL BENEFITS	$2,124,000
NET BENEFITS	$1,064,400
BENEFIT-TO-COST RATIO	2.0

COST APPORTIONMENT

FEDERAL COST-INITIAL CONSTRUCTION	Percent	Amount
Dredging	61.82	$2,486,950
Fill Behind ECL	24.73	69,400
Groins	62.75	979,100
Mitigation	62.75	218,520
Administrative Costs-Lands	0.00	0
Planning, Engineering & Design	62.75	375,320
Construction Management	62.75	134,510
TOTAL FEDERAL COST-INITIAL WORK	59.70	$4,263,800
PERCENT FEDERAL PARTICIPATION - EACH FUTURE NOURISHMENT	62.25	
NON-FEDERAL COST-INITIAL CONSTRUCTION		
Dredging	38.18	$1,534,280
Fill Behind ECL	75.27	211,190
Structures	37.25	581,210
Mitigation	37.25	129,720
Administrative Costs-Lands	100.00	118,750
Planning, Engineering & Design	37.25	222,800
Construction Management	37.25	79,850
TOTAL NON-FEDERAL COST-INITIAL WORK	40.30	$2,877,800
PERCENT NON-FEDERAL PARTICIPATION - EACH FUTURE RENOURISHMENT	37.75	

PALM BEACH COUNTY, FLORIDA
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PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE OCEAN RIDGE SEGMENT

INTRODUCTION

1. The purpose of this report is to reaffirm the basic planning decisions, update environmental impacts, advance the level of engineering and design, and reconfirm the economic feasibility of the authorized shore protection project segment at Ocean Ridge, Palm Beach County, Florida. The plan presented in the report, when approved, will be the basis for preparation and approval of plans and specifications.

SCOPE

2. This report is an addendum to the 1987 General Design Memorandum (GDM) (USACE, 1987) for beach erosion control projects within Palm Beach County, Florida. This report summarizes the design, economics and environmental setting of the Ocean Ridge segment of the 1962 Palm Beach County Shore Protection Project. The investigations made during the preparation of this report involved an update and expansion of previous data and findings. Results presented in this report represent the most recent and detailed physical and economic data available for the project area. Consequently, the scope of technical analysis is sufficient for final design of the project features and the preparation of accurate cost estimates. Studies and analyses were in accordance with guidance for the preparation of post authorization studies presented in Engineering Regulation 1110-2-1150. Hydrographic, topographic, magnetometer, geologic, and real estate appraisal data were collected during this study. Items of work during the study included a detailed coastal processes analysis including SBEACH and GENESIS shoreline change modeling, an environmental impact analysis including determination of nearshore hardbottom impacts, and an economic efficiency evaluation of the project.

THE AUTHORIZED PROJECT

AUTHORIZATION AND DESCRIPTION

3. This project was authorized 23 October 1962 by Public Law 87-874. The project described by House Document (HD) 164/87/I, provided for Federal participation in the costs of beach erosion control along two segments of the

Palm Beach County, Florida Atlantic shoreline. The project segments were (1) from the Martin County line to Lake Worth Inlet and (2) from South Lake Worth Inlet to the Broward County line. Ocean Ridge is located within the South Lake Worth Inlet to Broward County line segment.

4. The authorized project described in HD-164/87/1 calls for a seaward extension of the mean high water line of approximately 100 feet, a berm elevation of 10.0 feet mean low water (MLW), and 4 years of advance nourishment.

5. The 1987 GDM for Palm Beach County provides for a 50 ft berm extension at the 9.0 ft mean sea level (MSL) elevation along 1.6 miles of Ocean Ridge, Florida beachfront. The initial construction volume was to be 770,000 cubic yards including 8 years of advance nourishment. The borrow material for the project was to be taken from an offshore, shore-parallel borrow area.

6. As part of the 1962 Palm Beach County Shore Protection Project, project segments have been constructed in Delray Beach, Boca Raton, and Jupiter/Carlin. These project segments were constructed by the local sponsor with later reimbursement of the Federal share of project costs.

7. The current authorized limit of Federal participation for the Ocean Ridge segment of the Palm Beach County Shore Protection Project is 10 years from completion of the initial nourishment. Following the first rencurishment (six years after initial nourishment), the project sponsor will request an extension of Federal cost sharing under the authority of Section 934 of PL 99-662.

PROJECT LOCATION

8. The Ocean Ridge project segment is located along the Atlantic shoreline of the Town of Ocean Ridge in Palm Beach County, Florida. The Town of Ocean Ridge is approximately 30 miles south of the Palm Beach/Martin County line and approximately 15 miles north of the Palm Beach/Broward County line. Vicinity and location maps are provided in Figure 1.

ITEMS OF PROJECT COOPERATION

9. Palm Beach County is the non-Federal sponsor of the Ocean Ridge segment of the Federal shore protection project. Palm Beach County has indicated by letter attached (Appendix 4) that they will enter into a Project Cooperation Agreement (PCA) with the U.S. Army Corps of Engineers as the non-Federal project sponsor. The terms of the PCA as provided in the authorizing document are summarized below:

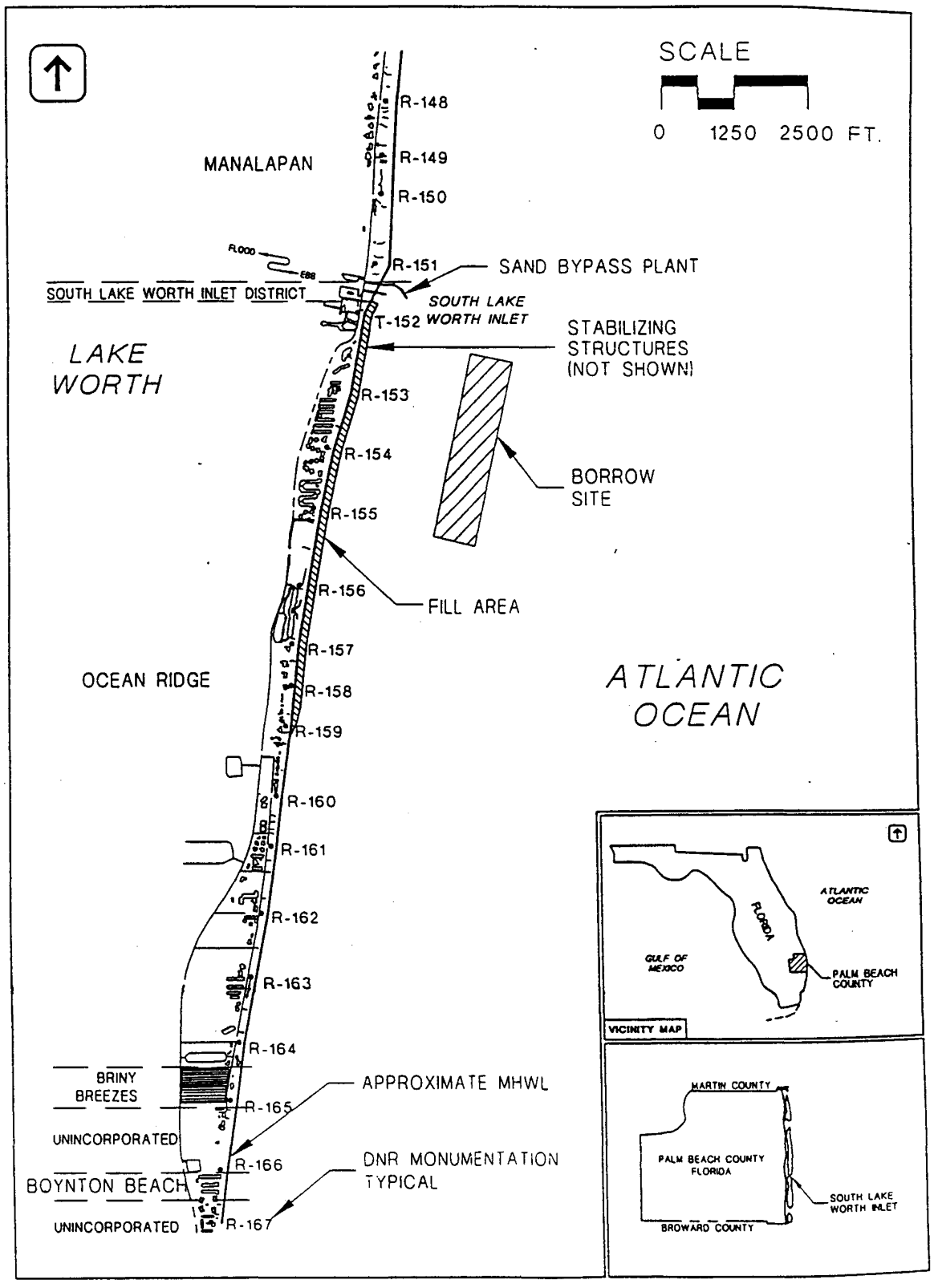


Figure 1: LOCATION MAP

a. Obtain approval by the Chief of Engineers, prior to commencement of work on the project, of detailed plans and specifications, and arrange for prosecution of the work on the project;

b. Provide without cost to the United States all lands, easements, and rights-of-way required for construction;

c. Furnish assurances satisfactory to the Secretary of the Army that they will;

(1) Maintain the project features during their economic life as may be required to serve their intended purpose, and nourish the beach at suitable intervals;

(2) Bear all costs incurred for the establishment of an Erosion Control Line in the project area and all costs for placement of material on property not open to the public;

(3) Maintain continued public ownership of the publicly owned shores upon which a part of the recommended Federal participation is based and their administration for public use during the economic life of the project.

MODIFICATIONS TO THE ITEMS OF PROJECT COOPERATION

10. The Water Resources Development Act of 1986 (Public Law 99-662) specifies new cost sharing for water resource projects, including shore protection. Allocation of project costs in accordance with current law and policy is discussed in detail later under cost apportionment.

11. Section 103 (j)(i) of the Act specifies that the non-Federal interests shall provide all lands, easements, rights-of-way, and disposal areas necessary for construction, and perform all necessary relocations. Section 103(i) also specifies that the value of any contributions under the preceding sentence shall be included in the non-Federal share of the project cost.

12. Section 103(j)(1) of the Act specifies that a project shall be initiated only after non-Federal interests have entered into binding agreements with the Secretary of the Army to pay 100 percent of the operations, maintenance, and replacement and rehabilitations costs of the project, to pay the non-Federal share of the costs of construction, and to hold and save the United States free from damages due to the construction or operation and maintenance of the project, except for damages due to the fault or negligence

of the United States or its contractors. A Project Cooperation Agreement (PCA) will be entered for construction of this project if approved by the Assistance Secretary of the Army (Civil Works).

13. Section 103(j)(2) of the Act specifies that the agreement specified in Section 103(j)(1) shall be in accordance with the requirements of Section 221 of the flood control Act of 1970.

14. Section 402 of the Act, as amended by Section 14 of the Water Resources Development Act of 1988, requires that "before construction of any project for local flood protection or any project for hurricane or storm damage reduction, the non-Federal interests shall agree to participate in and comply with applicable Federal flood plain management and flood insurance programs. An item of local cooperation was added to insure compliance with Section 402. The PCA will reflect this requirement.

15. The items of project cooperation have been revised to reflect the current legislation and are presented as follows:

a. Provide to the United States all necessary lands, easements, and rights-of-way, and relocations including suitable borrow and disposal areas as determined by the Chief of Engineers to be required for construction of the project, including that required for periodic renourishment at a presently estimated cost of $118,750;

b. Provide a cash contribution presently estimated at $2,633,580 for beach erosion control based on the appropriate percentage of the final construction cost allocated to this function, inclusive of costs for lands, easements, rights-of-way, alterations, and relocations, and exclusive of the costs of fill placed behind the erosion control line, the percentage to be in accordance with existing law and based on shore ownership and use existing at the time of implementation;

c. Pay cash contributions in a lump sum prior to the start of construction or, as may be permitted by the Chief of Engineers, in installments prior to the start of pertinent project units or sections and in accordance with his construction schedules;

d. Provide all costs of construction for placement of fill on private lands and share in the costs of construction for placement of fill on public lands landward of the Erosion Control Line (ECL). The current estimate of

non-Federal costs for fill placed landward of the ECL is $211,190.

e. Provide a cash contribution for periodic renourishment presently estimated at $138,040 equal to 37.75 percent of the cost of each renourishment, such contribution to be made prior to each renourishment operation, and the final percentage to be based on shore ownership and use existing at the time of construction;

f. Hold and save the United States free from damages due to the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterment, except for damages due to the fault or negligence of the United State or its contractors;

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

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

i. Agree to pay 100 percent of the operation, maintenance, and replacement and rehabilitation costs of the project, or functional element thereof;

j. Participate in and comply with applicable Federal flood plain management and flood insurance programs prior to initiation of construction and during the economic life of the project;

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by the Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987, Public Law 100-17, and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, and maintenance, of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

l. Comply with applicable Federal and State laws and regulations, including Section 601 of Title VI of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.II issued pursuant thereto and published in Part 300 of Title 32, case of Federal Regulations, as well as Army Regulations 600-7, entitled "Nondiscrimination on the Basis of Handicap in

Programs and Activities Assisted or Conducted by the Department of the Army";

m. Maintain and repair the protection measures and/or structures during the economic life of the project as required to serve the intended purposes and in accordance with regulations prescribed by the Secretary of the Army;

n. Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the Local Sponsor owns or controls for access to the project for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project;

o. Perform, or cause to be performed, such investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, on lands necessary for project construction, operation, and maintenance; and,

p. To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

PROJECT SPONSORSHIP

16. The Palm Beach County Board of County Commissioners is the sponsor for the project. The project is being administered for the Commissioners by the Palm Beach County Department of Environmental Resources Management.

PROJECT DESIGN AND ECONOMIC EFFICIENCY

INTRODUCTION

17. The Ocean Ridge project segment described in the 1987 GDM provides for restoration of 1.6 miles of Atlantic shoreline. The purpose of this report is to reevaluate the Ocean Ridge project segment using current pricing levels, field data, policy and law. Details of the engineering analysis are presented in Appendix 1. Details of the economic analysis area presented in Appendix 2. A summary of the planning, engineering, and modifications to the authorized project are discussed in the following paragraphs.

PLANNING OBJECTIVES AND CONSTRAINTS

18. The "Economic and Environmental Principles and Guideline for Water Related Land Resources Implementation Studies" (The Principles and Guidelines or P&G) are the primary guidelines for planning by federal agencies involved in water resources development (USWRC, 1983). Although each project and project setting present unique problems and opportunities, a consistent set of decision criteria was used to determine participation in project planning and construction. There are three basic criteria: (1) that there be an economically justified and environmentally acceptable project, (2) that Federal participation be otherwise warranted, and (3) that the project meets current Department of Army priorities.

FEDERAL OBJECTIVE

19. The Federal objective is to contribute to national economic development (NED) consistent with protecting the Nation's environment, pursuant to national environment statutes, applicable executive orders, and other Federal planning requirements. Federal planning concerns other than economic include environmental protection and enhancement, human safety, social well being, and cultural and historical resources. Environmental and safety considerations are of primary importance.

PLAN FORMULATION

20. An assortment of project plans were examined in the 1987 GDM as possible solutions to the erosion and storm damage problems in Palm Beach County. The plans were formulated to ensure that all reasonable alternatives were evaluated. Non-structural alternatives investigated included zoning changes, building code modifications, a moratorium on construction, condemnation of land and structures, and a no-growth program. Structural alternatives included seawalls, revetments, beach fill with periodic renourishment, beach fill with periodic renourishment stabilized with groins, and beach nourishment stabilized by submerged artificial rock outcroppings. The no-action plan was also examined, but it was unacceptable to the project sponsor.

21. A plan that reasonably maximizes NED benefits consistent with the Federal objective, was formulated and was identified by the 1987 GDM as the NED plan. This plan includes a 1.6 mile protective beach with periodic renourishment, The purpose of this addendum to the 1987 GDM is to re-examine the physical features of this plan based on current Federal laws and regulations. Modifications that

could potentially affect optimization of the costs and benefits of the authorized project were considered. Modifications to the authorized project were formulation in consideration of four criteria:

(1) Completeness. The extent to which a given modification of the authorized project provides and accounts for all necessary investments or other actions to ensure that realization of storm damage reduction.

(2) Effectiveness. The extent to which a given modification of the authorized project contributed to a solution to the shoreline erosion and storm damage problems and provides protection from damages.

(3) Efficiency. The extent to which a given modification of the authorized project is the most cost effective means of providing storm damage protection, consistent with protecting the Nation's environment.

(4) Acceptability. The viability of a given modification to the authorized project and its acceptance by the project sponsor, the State of Florida and the public.

MODIFICATIONS TO THE AUTHORIZED PROJECT

22. Project Description. The Ocean Ridge project segment described in the 1987 GDM provides for the restoration of 1.6 miles of Atlantic shoreline. The restored beach would have a berm width of 50 feet at an elevation of +9.0 feet mean sea level. The initial restoration with 8 years of advance nourishment was estimated to require the placement of 770,000 cubic yards of material. Each future periodic renourishment would require 501,000 cubic yards of material. These volume estimates are based on 1979 filed conditions and an overfill factor of 1.06 for material from an offshore borrow area.

23. Project Length Modifications. The length of the Ocean Ridge project described in the 1987 GDM is 1.6 miles, or 8,450 feet. The northern limit of the restored beach is 300 feet south of the south jetty at South Lake Worth Inlet. The southern limit of the restored beach is at Corrine Street, at approximately Florida Department of Environmental Protection (FDEP) monument R-160. This southern limit is immediately adjacent to an expansive nearshore hardbottom area. Allowing for mitigation, the incremental cost to construct the from R-159 to R-160 exceeds the incremental

increase in storm damage and loss of land benefits (see discussion on maximizing net benefits p. 2-28, Appendix 2). To reduce nearshore hardbottom impacts, mitigation costs, and maximize net storm damage reduction benefits, the southern limit of the project was moved 1,050 feet northward to approximately R-159. Additionally, the northern end of the project was moved 120 feet northward. This places the northern project limit 180 feet south of the south jetty. The northern project limit was relocated as part of the design of the project's groin field. Relocation of the northern limit of the project, along with the attendant structures will simultaneously provide for reduced hardbottom impacts and project stability along the project's north end. With these modifications the project length is 1.42 miles, or 7,520 feet.

24. Project Berm Modifications. The berm elevation in the 1987 GDM is 9.0 ft mean sea level (MSL). The proposed berm elevation is 9.0 ft National Geodetic Vertical Datum (NGVD) (9.44 ft MSL) and is considered to be equivalent to the authorized elevation. The berm elevation was selected to coincide with the natural berm elevation within the project area. The berm width in the 1987 GDM is 50 feet, measured from the intersection of the 9 ft MSL elevation with the existing profile. The authorized project provided for a 100 ft extension of the mean high water line (MHWL). The proposed extension of the MHWL is about 50 feet, on average.

25. Structures. The project described in the 1987 GDM provides for beach restoration with periodic renourishment. The proposed project will add a field of eight groins along the northernmost 1,800 feet of the project. The groins will allow for reduced nearshore hardbottom impacts and renourishment costs as compared to the authorized plan.

26. Renourishment Interval. The renourishment interval for the project described in the 1987 GDM is 8 years. The renourishment interval of the proposed project is 6 years.

27. Potential Sand Sources. Two borrow areas were considered as potential sand sources for the project; (1) the ebb tidal shoal of South Lake Worth Inlet and (2) an area offshore and parallel to the Ocean Ridge shoreline. The sand material from the ebb tidal shoal was identified as a source of beach compatible material. The ebb tidal shoal is not recommended as a borrow area, however, because a similar suitable sand source was identified offshore of the Ocean Ridge shoreline as a more cost-effective borrow source. The offshore borrow area containing beach compatible material is located directly offshore of the project shoreline.

THE NED PLAN

PLAN DESCRIPTION

28. The NED plan for the Ocean Ridge shoreline provides for the initial restoration of a protective beach along 1.42 miles (7,520 feet) of shoreline. The restored beach will establish the 9 ft NGVD design berm at the erosion control line. This is approximately equivalent to extending the MHWL 50 feet, on average. The restored beach is to be maintained by both periodic renourishment and a field of eight groins along the northernmost 1,800 feet of the project. The northern limit of the project is 180 feet south of the South Lake Worth Inlet south jetty. The southern limit is located at FDEP monument R-159. Approximately 784,300 cubic yards of sand will be placed during initial construction. Periodic renourishment will require placement of approximately 433,800 cubic yards of sand every six years.

VOLUME OF MATERIAL

29. Fill Behind the Erosion Control Line. The State of Florida requires that the project sponsor establish an Erosion Control Line at the existing mean high water line prior to implementation of a shore protection project (Chapter 161 F.S.). The purpose of the line is to delineate the boundary between upland riparian owners and State-owned bottom lands. Plates 1 through 4 show the location of the Erosion Control Line. The design section for the project is to be placed seaward of this line. Some sand placement landward of the project is needed for a smooth transition from the project to the existing 9.0 ft NGVD elevation. The volume of material required landward of the Erosion Control Line along the 1.42 mile project area is 76,000 cubic yards.

30. Design Fill Volume. The design fill volume is that portion of the beach fill placed seaward of the Erosion Control Line. The design fill volume was determined using the design mean high water shoreline extension, berm elevation and a composite beach profile. The composite beach profile is an average of several profiles measured along natural sections of the Ocean Ridge shoreline. The design fill volume is 274,500 cubic yards. Once constructed, the design volume will be maintained by advance nourishment, periodic renourishment and a field of eight groins.

31. Advance Nourishment. Advance nourishment will be placed during initial construction to offset erosion anticipated after the project's construction. The volume of advance nourishment is determined by historical ("background") volume loss rates along the project area, end

losses associated with the project itself, and the renourishment interval.

32. The historical erosion rate along the 7,520 ft project shoreline was computed to be 37,500 cubic yards per year (cy/yr). The project's anticipated end losses resulting from the perturbation to the shoreline which the beach fill represents was estimated to be approximately 18,500 cy/yr. Combined with the historical volumetric loss rate of 37,500 cy/yr, the expected volumetric loss rate from the project (not including losses due to material textural differences) is 56,000 cy/yr.

33. Environmental impacts to nearshore hardbottom along the northern 2,300 feet of project shoreline require that the shoreline be stabilized with a system of shore stabilizing structures to reduce the advance nourishment volume. Some advance nourishment will be placed within the structure field to provide a transition from no advance nourishment at the northern section of the structure field to fully developed advance nourishment at the southern section of the structure field. The advance nourishment will be placed over an effective shoreline length of 5,950 feet. With the stabilizing structures, six years of advance nourishment will require 289,200 cubic yards of material, including end losses.

34. Future Renourishment Volume. After construction of the initial project, performance monitoring of the placed material will be conducted to determined with greater accuracy future periodic renourishment requirements. For the purposes of this report, it is considered that the future periodic renourishment volume is the same as the advance nourishment volume, and the offshore borrow area would be used for all future renourishments. Both advance nourishment and future renourishment volumes take into account continued sand bypassing at South Lake Worth Inlet.

35. Overfill Volume. The overfill volume is the additional quantity of material necessary to account for the textural differences between the native beach and borrow area material. The overfill volume is determined by multiplying the overfill ratio by the required advance nourishment and renourishment volumes. The overfill ratio is only applied to the advance nourishment and renourishment volumes because the design beach is generally not exposed to the sorting action of nearshore waves and currents. The overfill ratio for the offshore borrow area, determined by the modified SPM method (USACE, 1984), is 1.50. Applying this overfill ratio to the required advance nourishment and future renourishment volume of 289,200 cubic yards, an additional 144,600 cubic yards of material will be added to the total project volume.

36. Borrow Source. The project borrow area is located approximately 1,700 feet offshore of the Ocean Ridge shoreline and extends approximately 12,400 feet southward from South Lake Worth Inlet. The borrow area averages 750 feet in width. The average water depth through the borrow area is 33 ft NGVD. The mean grain size of the borrow area material is 0.26 millimeters with a shell content of 55 percent by weight. The computed volume of material within the borrow area is approximately 5.2 million cubic yards. This estimate is based upon an average dredging depth of 15 feet below the ambient seabed. This volume exceeds the volumetric requirement of the 50-year project by 66 percent. A complete description of the borrow area and the sediment characteristics of the borrow area and native beach material is contained within Appendix 1.

37. Magnetometer Survey. A magnetometer survey was conducted across two potential borrow areas offshore of the Ocean Ridge shoreline. These areas include a portion of the ebb tidal shoal of South Lake Worth Inlet and an area extending approximately 1,000 feet offshore and extending approximately 14,000 feet south from South Lake Worth Inlet. The study was conducted to determine the location of ferrous materials that may pose hazards to dredging operations or may have historical and/or archeological significance. The cultural resource magnetometer survey was conducted in compliance with the National Historic Preservation Act of 1966, as amended, and the Advisory Council on Historical Preservation Regulations (36 CFR 800). The results of the survey are contained within the report titled "Underwater Archeological Background Study, Remote Sensing Survey and Anomaly Identification for the Town of Ocean Ridge Shore Protection Project" prepared by Karell Archeological Services (1993).

38. No significant anomalies were identified across the ebb tidal shoal. A large anomaly cluster was identified within the limits of the proposed borrow area. This cluster is represented by anomalies 1 and 2 on Plate 5 of sub-appendix 2 and represents a substantial mass of magnetic material. Diver inspections concluded that the magnetic material was not historically significant and dredging the borrow area will have no effect on cultural resources. However, unless the objects are removed, dredging operations should avoid this area to prevent damage to equipment.

39. The findings of the magnetometer survey and diver investigation suggest that no submerged cultural resources of archeological or historical interest are located in the survey area. The Jacksonville District determined that significant cultural resources are not located in the proposed borrow area. No further archeological investigation of the study area is required prior to construction of the proposed project. The State Historic

Preserve Office (SHPO) concurred with the District's no effect determination in a December 10, 1993 letter.

GROINS

40. To reduce nearshore hardbottom impacts and increase shoreline stability along the northernmost 1,800 feet of the project shoreline, a system of groins will be constructed thereby precluding the requirement for advance nourishment at that location. Replacing the advance nourishment volume with groins will maintain the minimum design beach cross-section while reducing the amount of nearshore hardbottom impacts from about 11.6 acres to 6.4 acres of long term impact and 2.9 acres of short term impact.

41. Groin field configurations of 5, 6, 7, 8, 9 and 10 groins were considered to determine the optimum project configuration. The performance each configuration was analyzed considering both the results of GENESIS modeling and historical shoreline and volume change data for the project shoreline. Results from the optimization analysis suggest that the eight-groin alternative will maximize shoreline stability along the northernmost section of the project shoreline while minimizing nearshore hardbottom impacts.

42. Dimensions. The location, spacing, and physical dimensions of the groins were determined using procedures outlined in the Shore Protection Manual (USACE, 1984). The spacing and physical dimensions of the groin field were designed to (1) maintain the minimum design beach cross-section, (2) minimize nearshore hardbottom impacts, and (3) allow bypass material from the fixed sand transfer plant to be transported over and around the seaward ends of the groins.

43. Design of the groin lengths considered (1) the minimum width of the design beach cross-section (2) the expected equilibrated slope of the beach cross-section and (3) the seawardmost location the equilibrated toe-of-fill (i.e., nearshore hardbottom impacts). Groin lengths will vary from approximately 110 to 180 feet. The longer groins will be located at the northern end of the groin field where erosional stress is higher. The average distance between groins will be approximately 240 feet. The northernmost groin (groin no. 1) will be located at the northern project limit which is approximately 180 feet south of the inlet. It is noted that the northern project limit is the property boundary between Palm Beach County and the South Lake Worth Inlet District. The Inlet District elected not to participate in the Federal Shore Protection Project and requested that no portion of the project be constructed upon

or seaward of their property. The inlet district has only recently been abolished by the legislature on May 24, 1996.

44. A T-head will be constructed at the seaward end of each groin. The T-heads will serve to reduce the potential for the generation of rip currents along the groin stems and protect the seaward terminus of the groins. Because the erosional stress is higher along the northern portion of the groin field than along the southern end, the dimensions of the T-heads will vary. The northernmost four groins will have 90 ft T-heads and the southernmost four groins will have 50 ft T-heads.

45. The groins will be of rubble mound construction to minimize wave reflection and the generation of rip currents. The side slopes of the groins will be 1V:2H. The groins will be primarily comprised of two layers of armor stone with a central section of core and chinking stone. The core and chinking stone will be placed, where possible, to partially sand tighten portions of the structures. The cross-section of the landward portions of the groins is not large enough to allow for placement of sufficient core and chinking material to provided for a sand-tight core. However, this portion of the groins will be buried by sand from the design beach and mechanical bypassing discharge. Because the cross-sectional area of the seaward ends of the groins is larger, sufficient core and chinking material will be placed to provide reasonable sand tightness.

46. Foundation Conditions. The structures will be underlain by sand and exposed bedrock. The elevation of the bedrock formation, throughout the structure field, varies from approximately -2 to -7 ft NGVD. Most of the structures will be constructed directly upon bedrock. A geotextile fabric and bedding stone layer will be constructed to prevent significant foundation settlement.

47. Fixed Sand Transfer Plant Discharge Locations. Material bypassed by the fixed sand transfer plant is currently discharged within the limits of the proposed groin field. As part of the proposed project, material will continue to be discharged within the limits of the groin field; however, modifications to the existing discharge configuration may be necessary. Continued placement of material from bypassing operations is central to the performance of the structure field.

48. Removal of Existing Structures. Ten derelict groins of varying design have been identified for removal or modification as part of the proposed project. Groins will be either removed completely or cut-off at grade and buried by the project fill in accordance with the FDEP permit. As a minimum, all derelict structures will be lowered to an elevation not less than 3 feet below the design beach grade.

ENVIRONMENTAL CONSIDERATIONS

49. Nearshore hardbottom impacts are the primary environmental concern with implementation of the project. Three areas of nearshore hardbottom exist along the Ocean Ridge shoreline. Approximately 9.4 acres of low to medium relief hardbottom are located continuously along 2,300 feet of shoreline between South Lake Worth Inlet and R-154. A smaller area of low relief hardbottom, estimated to be approximately 2.3 acres, is located at R-156. An estimated 37 acres of low to medium relief hardbottom with areas of high relief hard-bottom are located between R-160 and R-167. The project length was reduced and a field of eight groins was included in the project design to reduce unavoidable nearshore hardbottom impacts predicted to occur as a result of the 1987 GDM project fill. Without these modifications, approximately 17 acres of nearshore hardbottom would be covered by the project fill. Inclusion of these modifications reduces the hardbottom impact. Even with these modifications nearshore hardbottom mitigation will be required due to unavoidable impacts. The amount of mitigation is based upon using two mitigation ratios depending upon duration of impacts. See sections 3.25 and 5.12 of the Draft Supplemental Environmental Impact Statement for a discussion of calculation of impacts and mitigation amounts. The State of Florida Department of Environmental Protection and U.S. Fish and Wildlife Service require that unavoidable impacts to fish and wildlife habitat be mitigated.

50. Additional environmental concerns include turbidity from dredging operations, disturbance of sea turtle nesting and habitat, and benthic infauna recovery within the borrow and fill areas. All environmental permits will be obtained prior to construction and all work will be conducted within the limits of allowable impact.

51. A detailed discussion of the project's potential environmental impacts are addressed in the Supplement to the Environmental Impact Statement.

MITIGATION PLAN

52. Section 906(b)(1) of Public Law 99-662 states that after consultation with appropriate Federal and non-Federal agencies, the Secretary of the Army is authorized to mitigate damages to fish and wildlife resulting from any water resources project under his jurisdiction, whether completed, under construction, or to be constructed.

53. Unavoidable impacts to nearshore hardbottom are expected and will require mitigation. For planning purposes, the project was expected to require creation of

approximately 3.5 acres of artificial reef to compensate for impacts to nearshore hardbottom. The exact level of mitigation required for the project will be determined after the project has been constructed. Pre- and post-construction reef surveys will be conducted to document exposed nearshore hardbottom along the project area. Two post-construction surveys will be conducted: one immediately after construction and the second will be one year after construction in order to allow the beach fill to equilibrate. The surveys will include aerial imaging, mapping and groundtruthing of the exposed hardbottom areas. The level of hardbottom exposed immediately after construction and one year after construction will be compared to that exposed immediately prior to construction. The difference between the pre- and post-construction acreage will determine the amount of impact. FDEP has issued a permit requiring mitigation.

54. The mitigation will be constructed approximately 500 feet offshore between FDEP monuments R-152.5 and R-153.5 and between R-156 and R-157 in about 10 to 15 feet of water. The mitigation will be constructed of limestone boulders and clean concrete. Some level of mitigation may be provided by the shore protection structures to be constructed along the northern section of the project. The amount of mitigation provided by these structures will be assessed in the post-project reef survey.

55. Artificial reefs composed of limestone boulders were constructed in the nearshore in the general vicinity of the project in August, 1994. These reefs have been colonized with nearshore species and are can be considered to be a mitigation bank. The mitigation bank currently contains credits that are increasing in value and is expected to be used to offset impacts to nearshore hardbottom habitat. Credits from the mitigation bank will be available for the project at the time the mitigation is required. Assessments will be conducted one year after nourishment to determine if additional habitat needs to be created to meet Federal requirements. FDEP has determined that the reefs offset 2.1 acres of mitigation requirements. Credit for 0.45 acres of habitat will be given for construction of the groins. Additional low relief reef will be constructed to meet FDEP permit conditions

56. Purchasing credits from a mitigation bank is generally more cost effective than attempting to construct new hardbottom habitat and eliminates many uncertainties. Since the availability of credits from the mitigation bank is not definite, a conservative cost estimate must be developed using the cost of constructing new hardbottom habitat.

CONSTRUCTION

57. The project features will be constructed in three phases. During the first phase, the shore protection structures will be constructed and all derelict, existing structures will be removed or modified. If possible, all structure work will be conducted from shore. Rock material for the new structures will be trucked to the site. Similarly, all rubble will be trucked away for upland disposal. Construction of the groins and removal or modification of the existing derelict groins will be completed within 3 to 4 months.

58. The second phase of construction will include the placement of the beach fill. The beach fill sand will be pumped with a 27 to 30 inch hydraulic dredge from the offshore borrow area through a floating/submerged pipeline to the project area. Assuming a production rate of 273,440 cubic yards per month, the time required for placing the initial beach fill volume is 2.7 months.

59. Equipment access for both structure construction and beach fill work will be located at Ocean Inlet Park and Boynton Beach Oceanfront Park. Stockpile and storage areas will be available adjacent to the two equipment access locations.

60. Construction of any additional nearshore mitigation may occur before construction and will be completed within two years after nourishment. Some "up front" mitigation has been constructed in the form of approximately 2.1 acres of artificial reef.

REAL ESTATE REQUIREMENTS AND RELOCATIONS

61. Lands, Easements, Rights-of Way, and Borrow Areas. Temporary construction easements are needed from the upland property owners to place dredge material on private lands behind the Erosion Control Line. Temporary easements will be required for the two construction staging and access areas. Permanent easements are needed from upland property owners to construct sections of the groins on private lands (landward of the Erosion Control Line). Temporary construction easements are needed from the upland property owners to remove or modify existing groins. A consent-of-use is needed from the State of Florida to dredge material from the borrow area, place material on State owned bottom lands (seaward of the Erosion Control Line), and an easement from the State is needed to construct the seaward section of the groins on State owned bottom lands. The cost of all easements is 100 percent non-Federal. The project sponsor is responsible for obtaining all easements. A detailed

evaluation of easement requirements is contained in Appendix 3.

62. Utility Relocations. There are no utility relocations associated with this project.

PROJECT SCHEDULE

63. The project construction is scheduled to begin in January, 1997. Initial construction will include the removal of the derelict groins, construction of new groins and placement of the beach fill material. Some artificial reef for mitigation of project impacts was constructed by the project sponsor in 1994. Construction of all project features (less mitigation) is to be completed by May, 1997. The construction schedule includes time for mobilization and demobilization of all construction equipment. The remaining amount of mitigation should be completed within two years of construction.

ENVIRONMENTAL MONITORING PLAN

64. A monitoring plan will be implemented to document any impacts that the shore protection project may have on the surrounding environment. The monitoring plan provides for nearshore and offshore hardbottom monitoring during and after construction, water quality monitoring during construction, sea turtle monitoring during and after construction, and benthic infauna monitoring throughout the borrow area after construction. Table 1 presents a summary of proposed project monitoring tasks and costs.

65. The Palm Beach County Department of Environmental Resource Management will perform and/or oversee all environmental monitoring programs. Details of the each monitoring program are included in the Supplement to the Environmental Impact Statement.

PHYSICAL MONITORING PLAN

66. Physical monitoring of the project will be conducted to document the performance of the beach fill and provide data for estimating future renourishment volumetric requirements. An "as-built" survey will be conducted by the project contractor to establish a base survey to which future beach profile data will be compared. Profile data will be collected at regular intervals to monitor project volume and width changes. Aerial photography will be collected to monitor longshore changes in the beach fill. When the berm width nears or becomes less than that required for the project design section, renourishment operations can be

TABLE 1
SUMMARY OF MONITORING COSTS

ITEM	COST	TIME OF MONITORING
PHYSICAL MONITORING		AFTER EACH RENOURISHMENT
BEACH PROFILE SURVEYS	$21,800	SIX MONTHS
ANALYSIS AND REPORT TO STATE	$47,000	ONE YEAR
		ANNUALLY AFTER YEAR 1
SUBTOTAL PHYSICAL MONITORING	$68,800	
ENVIRONMENTAL MONITORING		
1.) PRE-CONSTRUCTION		PRIOR TO EACH RENOURISHMENT
TURBUDITY	$7,000	
INFAUNA	$12,000	
GRAIN SIZE & ORGANIC	$2,400	
NEARSHORE REEF	$10,000	
OFFSHORE REEF	$100,000	
SEA TURTLE	$10,000	
REPORT TO STATE	$14,000	
SUBTOTAL	$155,400	
2.) CONSTRUCTION		AT EACH RENOURISHMENT
TURBUDITY MONITORING	$45,000	
SEA TURTLE	$2,000	
OFFSHORE REEF	$67,000	
REPORT TO STATE	$15,000	
SUBTOTAL	$129,000	
3.) POST-CONSTRUCTION		AFTER EACH RENOURISHMENT
TURBUDITY MONITORING	$4,000	YEAR 1
INFAUNA	$44,000	YEARS 1, 2, & 4
GRAIN SIZE & ORGANIC	$7,200	YEARS 1, 2, & 4
NEARSHORE REEF	$15,800	YEARS 1, 2, & 4
OFFSHORE REEF	$54,600	YEARS 1, 2, & 4
SEA TURTLE	$30,000	YEARS 1, 2, & 3
REPORT TO STATE	$15,000	
SUBTOTAL	$170,600	
SUBTOTAL ENVIRONMENTAL MONITORING	$455,000	
TOTAL MONITORING	$523,800	
CONTINGENCY (15%)	$78,570	
TOTAL	$602,370	

initiated. Periodic renourishment will be performed as needed subject to the availability of county, state, and Federal funds, approvals and permits.

ECONOMICS OF THE NED PLAN

COST ESTIMATES

67. The project cost estimates are based on October, 1993 price levels. Engineering, design, supervision and administration (EDS&A) costs were developed from contract agreements between the county and the consulting engineer for initial construction. EDS&A costs for future construction were assumed to be 13 percent of construction costs. The cost estimates include a 15 percent contingency for all items. A summary of the cost estimate for initial construction is presented in Table 2.

68. Interest and Amortization of First Costs. Interest and amortization of the project costs are determined by multiplying the initial work capital recovery factor for the specified interest rate (0.079401 for a 7 and 3/4 percent interest rate and a 50-year project life) times the costs of the work accomplished during initial construction. Interest and amortization of the initial cost of construction is estimated to be $567,050.

69. Interest During Construction. Interest during construction accounts for the costs of capital incurred during the construction period. The cost of a project to be amortized is the investment incurred up to the time that the project begins to produce benefits, or the time when it is placed in operation. The investment cost at that time is the sum of construction and other initial costs plus interest during construction. Interest during construction for the project was computed in accordance with accounting practices which provide for interest from the middle of the month in which expenditures are made to the in-service date of the function or separable unit thereof. The in-service date is the first of the month following availability for service. Interest during initial construction was estimated to be $96,020.

70. Annual Cost of Future Beach Renourishment. The average cost of each future beach renourishment is $3,491,800. The equivalent annual cost of future beach renourishment at 7 and 3/4 percent is $476,950.

71. Annual Cost of Groin Maintenance. The groin field was designed for a 10-year storm surge event with no damage. Because the 10-year event is expected to be exceeded during

TABLE 2

OCTOBER 1993 PRICE LEVEL

PROJECT COST SUMMARY - NED PLAN
OCEAN RIDGE SHORE PROTECTION PROJECT
INITIAL CONSTRUCTION

ACCOUNT CODE		QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY 15%	TOTAL PROJECT COST	PERCENT FEDERAL	AMOUNT FEDERAL
01/17.--.--	BEACH REPLENISHMENT	1	JOB	LS	$3,740,714	$561,107	$4,301,822	59.42%	$2,556,344
02/06.--.--	FISH AND WILDLIFE FACILITIES	1	JOB	LS	$302,808	$45,421	$348,229	62.75%	$218,514
03/10.--.--	BREAKWATERS AND SEAWALLS	1	JOB	LS	$1,356,776	$203,516	$1,560,292	62.75%	$979,083
SUBTOTAL CONSTRUCTION COST					$5,400,298	$810,045	$6,210,343	60.45%	$3,753,942
01.--.--	LANDS AND DAMAGES	1	JOB	LS	$103,261	$15,489	$118,750	0.00%	$0
30.--.--	PLANNING, ENGINEERING AND DESIGN	1	JOB	LS	$520,100	$78,015	$598,115	62.75%	$375,317
31.--.--	CONSTRUCTION MANAGEMENT (S&A)	1	JOB	LS	$186,400	$27,960	$214,360	62.75%	$134,511
SUBTOTAL NON-CONSTRUCTION COST					$809,761	$121,464	$931,225	54.75%	$509,828
TOTAL CONSTRUCTION COST - INITIAL CONSTRUCTION					$6,210,059	$931,509	$7,141,568	59.70%	$4,263,770
INTEREST DURING CONSTRUCTION							$96,020		
TOTAL INVESTMENT COST							$7,237,588		

the 50-year project life, future maintenance of the groin field will be required.

72. The future maintenance requirements and costs were calculated using a probabilistic approach. The approach involves the development of a relationship between expected structure damage and storm events which exceed the design storm event. Using Table 7-9, page 7-211 of the Shore Protection Manual (SPM, 1984), the expected structure damage for a storm event exceeding the design storm can be estimated. A probabilistic relationship between structure damage and the occurrence of a storm which exceeds the design storm is determined by tabulating damage estimates for various storm frequencies greater than the design storm. Total damages are computed by integrating the annual probability of damage over the life of the project. The cost to repair annual is assumed to be a percentage of the initial construction cost of the groin field. From this analysis, the annual maintenance cost for the groin field is 1 percent of the initial groin field construction cost, or $15,600.

BENEFITS SUMMARY

73. The primary purpose of the Palm Beach County Shore Protection Project (Ocean Ridge segment) is to prevent physical damages. The Ocean Ridge project will provide protection to over $57 million in upland development and infrastructure. The infrastructure includes Highway A1A which is an important regional hurricane evacuation route. Physical loss of land is prevented and incidental recreation benefits are generated by increased recreational usage of the project beach. The value of these benefits is summarized in Table 3. Detailed project benefit analyses are included in Appendix 2.

ECONOMIC JUSTIFICATION

74. A summary of the project's benefits and costs are presented in Table 3. Average annual equivalent estimates of benefits and costs were computed using an 7 and 3/4 percent interest rate and a 50-year project life. The NED plan is economically justified with a benefit-to-cost ratio of 2.0:1.

Table 3

ECONOMIC SUMMARY - NED PLAN

ITEM	INTEREST RATE 7.75%
TOTAL PROJECT COSTS (Construction)	
Interest and Amortization	$567,050
Future Beach Nourishment	$476,950
Future Groin Maintenance	$15,600
TOTAL ANNUAL PROJECT COSTS	$1,059,600
PRIMARY BENEFITS	
Storm Damage Prevention	$1,168,600
Loss of Land	$241,100
INCIDENTAL BENEFITS	
Recreation	$393,000
Downdrift	$321,300
TOTAL PROJECT BENEFITS	$2,124,000
NET PROJECT BENEFITS	$1,064,400
BENEFIT-TO-COST RATIO	2.0

SECTION 902 LIMIT

75.

To be Supplied by

Jacksonville District

U.S. Army Corps of Engineers

PLAN IMPLEMENTATION

COST ALLOCATION

76. Section 103(d) of the Water Resources Development Act of 1986 (Public Law 99-662) specifies that the cost of construction of beach erosion control projects be assigned to the appropriate purpose(s) specified in Section 103(c) of the Act. These purposes are normally hurricane and storm damage reduction and/or separable recreational, and shared in the same percentages as to the purposes to which the costs are assigned, except that no costs are assigned to incidental recreation. Hurricane and storm damage reduction project are cost shared at 65 percent Federal, and separable recreation projects are cost shared at 50 percent Federal. Cost sharing for beach erosion control projects must also consider shore protection ownership and use. Additional guidance on cost sharing for shore protection projects is provided in Engineering Regulation (ER) 1165-2-130 date June 15, 1989. A summary of shore ownership and level of Federal participation for the 1.42 mile project area is presented in Table 4.

77. The Federal project consists of the project being built seaward of the Erosion Control Line (ECL). The location of the Erosion Control Line is shown on Plates 1 through 4. All construction landward of the Erosion Control Line on private property is 100 percent non-Federal. Normally, non-Federal public shores are dedicated to park and conservation areas, and the benefits of protecting such shores will be based on loss of recreation outputs, with cost sharing 50 percent Federal and 50 percent non-Federal. Public parks in the project area are cost shared at 50 percent Federal/non-Federal since the primary project output for this shorefront is recreation. The cost sharing is 65 percent Federal and 35 percent non-Federal for protection of privately owned shores resulting in public benefits. Sporadically spaced, undeveloped private lands are cost shared 65 percent Federal and 35 percent non-Federal when they comprise less than 15% of the total shoreline and the area seaward of the project is open to the public.

78. The apportionment of project costs was determined for both linear and non-linear costs. The volume of design fill placed along any given reach of the project shoreline varies considerably. The cost to construct the design section is therefore a non-linear cost. Private and public properties were divided into reaches and assigned a profile and design beach cross-section that best represented the section of shoreline and design beach of each reach. The design beach volume and the appropriated Federal share of the design volume for each reach was computed and is presented in Table 4. The Federal share of the design

Table 4: Apportionment of Costs.

DNR PROFILE MONUMENT (A)	LOT DESCRIPTION (B)	LOT WIDTH (feet) (C)	SHORELINE DESCRIPTION (D)	WITHIN PROJECT LIMITS (E)	WITHIN 1/4 MILE OF ACCESS (F)	SHORE 1/ OWNERSHIP & PROJECT PURPOSE (G)	LEVEL OF FEDERAL PARTICI-PATION (H)	FEDERAL PARTICI-PATION TIMES LOT WIDTH (I)	DESIGN VOLUME (CY) (J)	
R-151	PUBLIC	235	DEVELOPED	Y	Y	II-A	65%	152.8	9,275	
Subtotal		235					65%	152.8	6029	FEDERAL SHARE OF VOLUME
T-152	PUBLIC	50	DEVELOPED	Y	Y	II-A	65%	32.5		
	PUBLIC	60	DEVELOPED	Y	Y	II-A	65%	39.0		
	PUBLIC	110	DEVELOPED	Y	Y	II-A	65%	71.5		
	PUBLIC	70	DEVELOPED	Y	Y	II-A	65%	45.5	22,112	VOLUME IN REACH
	PUBLIC	85	DEVELOPED	Y	Y	II-A	65%	55.3		
	PRIVATE	150	DEVELOPED	Y	Y	II-A	65%	97.5		
	CONDO	320	DEVELOPED	Y	Y	II-A	65%	208.0		
	CONDO	240	DEVELOPED	Y	Y	II-A	65%	156.0		
Subtotal		1,085					65%	705.3	14,373	FEDERAL SHARE OF VOLUME
R-153	CONDO	385	DEVELOPED	Y	Y	II-A	65%	250.3		
	CONDO	210	DEVELOPED	Y	Y	II-A	65%	136.5	39,212	VOLUME IN REACH
	CONDO	255	DEVELOPED	Y	Y	II-A	65%	165.8		
	CONDO	200	DEVELOPED	Y	Y	II-A	65%	130.0		
Subtotal		1,050					65%	682.5	25,488	FEDERAL SHARE OF VOLUME
R-154	CONDO	740	DEVELOPED	Y	Y	II-A	65%	481.0	43,434	VOLUME IN REACH
	CONDO	515	DEVELOPED	Y	Y	II-A	65%	334.8		
Subtotal		1,255					65%	815.8	28,232	FEDERAL SHARE OF VOLUME
R-155	CONDO	195	DEVELOPED	Y	Y	II-A	65%	126.8		
	PUBLIC	250	UNDEVELOPED	Y	Y	II-B	50%	125.0		
	PUBLIC	210	UNDEVELOPED	Y	Y	II-B	50%	105.0	45,580	VOLUME IN REACH
	PUBLIC	210	UNDEVELOPED	Y	Y	II-B	50%	105.0		
	PUBLIC	290	UNDEVELOPED	Y	Y	II-B	50%	145.0		
	PUBLIC	170	UNDEVELOPED	Y	Y	II-B	50%	85.0		
Subtotal		1,325					52%	691.8	23,796	FEDERAL SHARE OF VOLUME

Table 4: Apportionment of Costs (continued)

DNR PROFILE MONUMENT (A)	LOT DESCRIPTION (B)	LOT WIDTH (feet) (C)	SHORELINE DESCRIPTION (D)	WITHIN PROJECT LIMITS (E)	WITHIN 1/4 MILE OF ACCESS (F)	SHORE 1/ OWNERSHIP & PROJECT PURPOSE (G)	LEVEL OF FEDERAL PARTICI-PATION (H)	FEDERAL PARTICI-PATION TIMES LOT WIDTH (I)	DESIGN VOLUME (CY) (J)	
R-156	PUBLIC	660	DEVELOPED	Y	Y	II-A	65%	429.0		
	PUBLIC	200	DEVELOPED	Y	Y	II-A	65%	130.0	38,069	VOLUME IN REACH
	PUBLIC	165	DEVELOPED	Y	Y	II-A	65%	107.3		
Subtotal		1,025					65%	666.3	24,745	FEDERAL SHARE OF VOLUME
R-157	PUBLIC	45	DEVELOPED	Y	Y	II-A	65%	29.3		
	SFR	120	DEVELOPED	Y	Y	II-A	65%	78.0		
	SFR	120	DEVELOPED	Y	Y	II-A	65%	78.0	42,761	VOLUME IN REACH
	SFR	130	DEVELOPED	Y	Y	II-A	65%	84.5		
	SFR	260	DEVELOPED	Y	Y	II-A	65%	169.0		
Subtotal		675					65%	438.8	27,794	FEDERAL SHARE OF VOLUME
R-158	SFR	120	DEVELOPED	Y	Y	II-A	65%	78.0		
	SFR	300	DEVELOPED	Y	Y	II-A	65%	195.0		
	SFR	120	DEVELOPED	Y	Y	II-A	65%	78.0	28,260	VOLUME IN REACH
	SFR	60	DEVELOPED	Y	Y	II-A	65%	39.0		
	PRIVATE	10	UNDEVELOPED	Y	Y	II-B	65%	6.5		
	SFR	60	DEVELOPED	Y	Y	II-A	65%	39.0		
	SFR	50	DEVELOPED	Y	Y	II-A	65%	32.5		
Subtotal		720					65%	468.0	18,369	FEDERAL SHARE OF VOLUME
R-159	SFR	150	DEVELOPED	Y	Y	II-A	65%	97.5	5,798	VOLUME IN REACH
Subtotal		150					65%	97.5	3,769	FEDERAL SHARE

Table 4: Apportionment of Costs (continued)

DNR PROFILE MONUMENT (A)	LOT DESCRIPTION (B)	LOT WIDTH (feet) (C)	SHORELINE DESCRIPTION (D)	WITHIN PROJECT LIMITS (E)	WITHIN 1/4 MILE OF ACCESS (F)	SHORE 1/ OWNERSHIP & PROJECT PURPOSE (G)	LEVEL OF FEDERAL PARTICI-PATION (H)	FEDERAL PARTICI-PATION TIMES LOT WIDTH (I)	DESIGN VOLUME (CY) (J)	OF VOLUME
TOTALS FOR PROJECT		7,520	FT SHORELINE LENGTH				62.75%	4,718.5	175,840	FEDERAL SHARE
		1.42	MILES							OF VOLUME

THE SUM OF COLUMN (J) DIVIDED BY 7,520 FT = 63.58 PERCENT WHICH IS THE FEDERAL SHARE OF CONSTRUCTION COSTS SUCH AS ADVANCE NOURISHMENT COSTS, WHICH ARE LINEARLY DISTRIBUTED ALONG THE PROJECT.

THE TOTAL FEDERAL SHARE OF VOLUME DIVIDED BY THE TOTAL DESIGN VOLUME OF 274,500 IS EQUAL TO 64.06 PERCENT, WHICH IS THE FEDERAL SHARE OF NON-LINEAR PROJECT COSTS SUCH AS DESIGN VOLUME.

1/SHORELINE AND PROJECT PURPOSE As defined in (ER 1165-2-130)	MAXIMUM LEVEL OF FEDERAL PARTICIPATION IN CONSTRUCTION COSTS
I. FEDERALLY OWNED	100.00%
II. PUBLICILY AND PRIVATELY OWNED - PROTECTION RESULTS IN PUBLIC BENEFITS	
A. Hurricane and storm damage reduction.	65.00%
B. Loss of land or incidental recreation.	65.00%
C. Seperable recreation.	50.00%
III. PRIVATELY OWNED, USE LIMITED TO PRIVATE INTERESTS	0.00%
IV. PRIVATELY OWNED, UNDEVELOPED	0.00%

volume is 175,840 cubic yards, or 64.06 percent, of the 274,500 cubic yards required by the design beach.

79. The linear project costs are those which are uniformly distributed throughout the length of the project (i.e., advance nourishment, periodic renourishment and overfill costs). Linear costs are also costs applied to the project as a whole, such as mobilization and demobilization, turbidity monitoring, contingencies, engineering and design, contract supervision and contract administration. The linear Federal cost share is 62.75 percent. Table 4 presents the results of the cost sharing analysis.

80. The initial cost of the groin field is distributed linearly throughout the project because it will act to stabilize the northern terminus of the project, transmit bypassed material to the entire project and decrease nearshore hardbottom impacts. Therefore, the structures will serve to maintain the entire project and are considered a linear project cost. Future cost to maintain the groin field will be a 100 percent non-Federal responsibility.

81. The cost of fill placed behind the Erosion Control Line on private property is also a non-Federal responsibility. The cost of establishing the State required Erosion Control Line is a non-Federal cost. Once this line has been approved by the Florida Cabinet, all project lands fronting the developed private shore within the project are considered open to use by the public. The cost sharing for developed private lands shown in Table 4 is based on the assumption that the Erosion Control Line will be approved by the Florida Cabinet prior to project construction. Periodic renourishment is considered "construction" for cost sharing purposes.

82. Final apportionment is based on current law and conditions of shore ownership and use at the time of construction or subsequent renourishment. Cost sharing for non-linear costs (i.e., the quantity of design volume) would be based on the last physical survey of shoreline conditions prior to construction. This survey is normally the contract plans and specifications survey.

FEDERAL RESPONSIBILITY

83. The project will be constructed by Palm Beach County with subsequent reimbursement of the Federal share of project costs. The U.S. Army Corps of Engineers will be responsible for review and approval of the pre-construction, engineering and design reports/documents, project construction monitoring, final inspections, a post-construction audit, and for Federal funding. An Operation and Maintenance Manual (O&M Manual) for the project will

also be prepared by the Jacksonville District and provided to the project sponsor. The total cost of initial project construction excluding interest during construction is $7,141,600. Table 5 presents the Federal cost share of each project feature of initial construction. The Federal share of the project cost without interest during construction is $4,263,800, or 59.70 percent. Table 6 presents the Federal cost share of each project feature of future periodic renourishment. The Federal share of the cost of each future periodic renourishment is $2,173,000, or 62.25 percent of the total $3,490,500. Federal funds are normally budgeted for the year following completion of project construction.

NON-FEDERAL RESPONSIBILITY

84. The non-Federal sponsor will construct the project features and nearshore mitigation and conduct the pre- and post-construction monitoring. The non-Federal sponsor will also provide the entire cost of all material placed on private land behind the Erosion Control Line. The total non-Federal responsibility of the initial work is $2,877,800, or 40.30 percent. The non-Federal responsibility for each periodic renourishment is $1,317,500, or 37.75 percent. The equivalent annual cost of $15,600 required for future maintenance of the groin field will be a 100 percent non-Federal responsibility. The project sponsor will obtain all necessary permits and lands easements and rights-of-way (LERR) required for the project.

OTHER NON-FEDERAL REQUIREMENTS

85. Other general non-Federal responsibilities, such as continuing public use of the project beach for which benefits are claimed in the economic justification of the project, and controlling water pollution to safeguard the health of bathers, must also be assumed by the non-Federal sponsor before the project can be constructed. Items of non-Federal responsibility are discussed on Page 2 of the main text. The delineation of Federal and non-Federal responsibility will be defined in the Project Cooperation Agreement.

PROJECT COOPERATION AGREEMENT

86. The Project Cooperation Agreement (PCA) for this project is currently being prepared. The PCA includes the items of project cooperation described earlier.

TABLE 5

OCTOBER 1993 PRICE LEVEL

PROJECT COST SHARING SUMMARY - NED PLAN
OCEAN RIDGE SHORE PROTECTION PROJECT
CONTRACT 1 - INITIAL RESTORATION AND ADVANCE NOURISHMENT

ACCOUNT CODE		QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY 15%	TOTAL PROJECT COST	PERCENT FEDERAL	AMOUNT FEDERAL
01/17.--.--	BEACH REPLENISHMENT								
01/17.00.01	MOB/DEMOB	1	JOB	699,040	$699,040	$104,856	$803,896	62.75%	$504,445
01/17.00.70	BEACHFILL								
01/17.00.70	FILL BEHIND ECL - PUBLIC	29,340	CY	3.21	$94,192	$14,129	$108,320	64.06%	$69,390
01/17.00.70	FILL BEHIND ECL - PRIVATE	46,660	CY	3.21	$149,795	$22,469	$172,264	0.00%	$0
01/17.00.70	DESIGN BEACH	274,500	CY	3.21	$881,240	$132,186	$1,013,426	64.06%	$649,201
01/17.00.70	ADVANCE NOURISHMENT	289,200	CY	3.21	$928,432	$139,265	$1,067,697	62.75%	$669,980
01/17.00.70	DESIGN OVERFILL	144,600	CY	3.21	$464,216	$69,632	$533,848	62.75%	$334,990
01/17.00.70	TOTAL BEACHFILL	784,300	CY		$3,216,914	$482,537	$3,699,452	60.23%	$2,228,005
01/17.00.99	ASSOCIATED GENERAL ITEMS								
01/17.00.99	ENVIRONMENTAL MONITORING	1	JOB	LS	$239,400	$35,910	$275,310	62.75%	$172,757
01/17.00.99	POST-PROJECT MONITORING	1	JOB	LS	$170,600	$25,590	$196,190	62.75%	$123,109
01/17.00.99	TURBIDITY MONITORING	1	JOB	LS	$45,000	$6,750	$51,750	62.75%	$32,473
01/17.00.99	PHYSICAL MONITORING	1	JOB	LS	$68,800	$10,320	$79,120	62.75%	$49,648
	SUB-TOTAL CONSTRUCTION COST				$3,740,714	$561,107	$4,301,822	59.42%	$2,556,344
01/01.--.--	LANDS AND DAMAGES	1	JOB	LS	$103,261	$15,489	$118,750	0.00%	$0
01/30.--.--	PLANNING, ENGINEERING AND DESIGN	1	JOB	LS	$427,200	$64,080	$491,280	62.75%	$308,278
01/31.--.--	CONSTRUCTION MANAGEMENT (S&A)	1	JOB	LS	$106,800	$16,020	$122,820	62.75%	$77,070
	SUBTOTAL NON-CONSTRUCTION COST				$637,261	$95,589	$732,850	52.58%	$385,348
	TOTAL COST - CONTRACT 1						$5,034,672	58.43%	$2,941,692

TABLE 5 (continued)

OCTOBER 1993 PRICE LEVEL

PROJECT COST SHARING SUMMARY - NED PLAN
OCEAN RIDGE SHORE PROTECTION PROJECT
CONTRACT 2 - CONSTRUCT NEARSHORE MITIGATION

ACCOUNT CODE		QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY 15%	TOTAL PROJECT COST	PERCENT FEDERAL	AMOUNT FEDERAL
02/06.--.--	FISH AND WILDLIFE FACILITIES								
02/06.03,--	WILDLIFE FACILITIES & SANCTUARY								
02/06.03,73	HABITAT AND FEEDING FACILITIES								
02/06.03,73	MOB/DEMOB	1	JOB	LS	$41,501	$6,225	$47,726	62.75%	$29,948
02/06.03,73	CONSTRUCT NEARSHORE HABITAT	3.5	ACRE	74,659	$261,307	$39,196	$300,503	62.75%	$188,566
02/06.03,73	TOTAL WILDLIFE FACILITIES & SANCTUARY				$302,808	$45,421	$348,229	62.75%	$218,514
02/06.00,99	ASSOCIATED GENERAL ITEMS								
	SUB-TOTAL CONSTRUCTION COST				$302,808	$45,421	$348,229	62.75%	$218,514
02/01.--.--	LANDS AND DAMAGES								$0
02/30.--.--	PLANNING, ENGINEERING AND DESIGN	1	JOB		$17,400	$2,610	$20,010	62.75%	$12,556
02/31.--.--	CONSTRUCTION MANAGEMENT (S&A)	1	JOB		$14,900	$2,235	$17,135	62.75%	$10,752
	SUBTOTAL NON-CONSTRUCTION COST				$32,300	$4,845	$37,145	62.75%	$23,308
	TOTAL COST - CONTRACT 2						$385,374	62.75%	$241,822

TABLE 5 (continued)

OCTOBER 1993 PRICE LEVEL

PROJECT COST SHARING SUMMARY - NED PLAN
OCEAN RIDGE SHORE PROTECTION PROJECT
CONTRACT 3 - CONSTRUCT GROINS AND NEARSHORE BREAKWATERS

ACCOUNT CODE		QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY 15%	TOTAL PROJECT COST	PERCENT FEDERAL	AMOUNT FEDERAL
03/10.--.--	BREAKWATERS AND SEAWALLS								
03/10.00.01	MOB/DEMOB	1	JOB	50,000	$50,000	$7,500	$57,500	62.75%	$36,081
03/10.00.46	GROINS								
03/10.00.46	CONSTRUCT GROINS	12,850	TON	64.67	$831,052	$124,658	$955,709	62.75%	$599,708
03/10.00.46	FOUNDATIONS	1	LS	75,725	$75,725	$11,359	$87,083	62.75%	$54,645
03/10.00.46	TOTAL STRUCTURES				$906,776	$136,016	$1,100,292	62.75%	$690,433
03/10.00.99	ASSOCIATED GENERAL ITEMS								
03/10.00.99	REMOVE/MODIFY EXISTING GROINS	1	JOB		$400,000	$60,000	$460,000	62.75%	$288,650
	SUB-TOTAL CONSTRUCTION COST				$1,356,776	$203,516	$1,560,292	62.75%	$979,083
03/01.--.--	LANDS AND DAMAGES								$0
03/30.--.--	PLANNING, ENGINEERING AND DESIGN	1	JOB	LS	$75,500	$11,325	$86,825	62.75%	$54,483
03/31.--.--	CONSTRUCTION MANAGEMENT (S&A)	1	JOB	LS	$64,700	$9,705	$74,405	62.75%	$46,689
	SUBTOTAL NON-CONSTRUCTION COST				$140,200	$21,030	$161,230	62.75%	$101,172
	TOTAL COST - CONTRACT 3						$1,721,522	62.75%	$1,080,255

TABLE 6

OCTOBER 1993 PRICE LEVEL

RENOURISHMENT PROJECT COST SHARING SUMMARY - NED PLAN
OCEAN RIDGE SHORE PROTECTION PROJECT
CONTRACTS 4 THROUGH 11 - RENOURISHMENTS 1 THROUGH 8

ACCOUNT CODE		QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY 15%	TOTAL PROJECT COST	PERCENT FEDERAL	AMOUNT FEDERAL
04/17.--.--	BEACH REPLENISHMENT								
04/17.00.01	MOB/DEMOB	1	JOB	699,040	$699,040	$104,856	$803,896	62.75%	$504,445
04/17.00.70	BEACHFILL								
04/17.00.70	ADVANCE NOURISHMENT	289,200	CY	3.21	$928,432	$139,265	$1,067,697	62.75%	$669,980
04/17.00.70	DESIGN OVERFILL	144,600	CY	3.21	$464,216	$69,632	$533,848	62.75%	$334,990
04/17.00.70	TOTAL BEACHFILL	433,800			$2,091,688	$313,753	$2,405,441	62.75%	$1,509,414
04/17.00.99	ASSOCIATED GENERAL ITEMS								
04/17.00.99	ENVIRONMENTAL MONITORING	1	JOB	LS	$239,400	$35,910	$275,310	62.75%	$172,757
04/17.00.99	POST-PROJECT MONITORING	1	JOB	LS	$170,600	$25,590	$196,190	62.75%	$123,109
04/17.00.99	TURBIDITY MONITORING	1	JOB	LS	$45,000	$6,750	$51,750	62.75%	$32,473
04/17.00.99	PHYSICAL MONITORING	1	JOB	LS	$68,800	$10,320	$79,120	62.75%	$49,648
	SUB-TOTAL CONSTRUCTION COST				$2,615,488	$392,323	$3,007,811	62.75%	$1,887,402
04/01.--.--	LANDS AND DAMAGES	1	JOB	LS	$24,000	$3,600	$27,600	0.00%	$0
04/30.--.--	PLANNING, ENGINEERING AND DESIGN (14%)	1	JOB	LS	$369,528	$55,429	$424,958	62.75%	$266,661
04/31.--.--	CONSTRUCTION MANAGEMENT (S&A) (1%)	1	JOB	LS	$26,155	$3,923	$30,078	62.75%	$18,874
	SUBTOTAL NON-CONSTRUCTION COST				$419,683	$62,952	$482,636	59.16%	$285,535
	TOTAL COST						$3,490,447	62.25%	$2,172,936

FINANCIAL ANALYSIS

87. A financial analysis is required for any plan being considered for construction in the Federal Civil Works program that involves non-Federal cost sharing. The ultimate purpose of the financial analysis is to ensure that the non-Federal sponsor understands the financial commitment involved and has a reasonable plan for meeting that commitment. The financial analysis includes the non-Federal sponsor's statement of financial capability, the non-Federal sponsor's financing plan, and an assessment of the sponsor's financial capability.

88. Project Sponsor Financing Plan and Financial Statement. The project sponsor is preparing its financing plan and the statement of financial capability. The Palm Beach County statement of financial capability and financing plan will be contained within the PCA Appendix following review of the GDM by the county and the Town of Ocean Ridge.

89. State Financing Plan. The project sponsor's financing depends on the contribution of funds provided by the State of Florida. Chapter 161 of the Florida Statutes authorizes the State of Florida to provide funds to county governments for shore protection projects. State funding of $1,875,000 has been included for the Ocean Ridge project in the State Fiscal Year budget for 1993. These funds have been placed in escrow.

90. Financial Assessment. The Palm Beach County Board of Commissioners is empowered by Chapter 161 of the Florida Statutes to act as the county's beach and shore preservation authority. Such powers specifically include the authority to make contracts and enter into agreements, to acquire and hold lands and property by any lawful means, to exercise the power of eminent domain, and to construct, acquire, operate, and maintain shore protection works and facilities. The county has the authority to tax property or issue bonds to meet the costs of the county's beach and shore preservation program.

91. Chapter 161 also provides for State financial assistance in funding beach erosion control and shore preservation projects. Any county may make application to the Division of Beaches and Shore of the Florida Department of Environmental Protection for State funds for these projects. For Federal projects, the State is authorized to fund up to 75 percent of the non-Federal construction and maintenance costs of projects authorized by the Congress of the United States, subject to certain restrictions. The State is authorized to expend funds from the Erosion Control Trust Fund account for such projects.

92. The Palm Beach County Board of Commissioners has the authority and financial capability to provide the required non-Federal cash contribution for project construction and to fulfill the other items of project cooperation. The county, through assistance and authority of the Florida Department of Environmental Protection and the Trustees of the State Internal Improvement Trust Fund, is required to establish an Erosion Control Line to resolve the issue of state vs. private riparian rights.

DEPARTURES FROM THE AUTHORIZED PLAN

93. Changes have occurred since the Palm Beach County Shore Protection Project General Design Memorandum was completed in 1987. These changes include physical, economic, and cost apportionment differences. Table 7 summarizes differences between the 1987 GDM and the proposed NED plan for the Ocean Ridge segment.

PHYSICAL CHANGES

94. Project Length. The project described in the 1987 GDM provides for the restoration of 1.6 miles of Atlantic shoreline which extends from 300 feet south of South Lake Worth Inlet to R-160. The overall project length has been reduced from 1.6 to 1.42 miles (8,450 to 7,520 feet) to reduce nearshore hardbottom impacts and the associated mitigation costs. The south end of the project was moved 1,050 feet northward to R-159. The northern end of the project was moved 120 feet northward. This places the northern end of the project 180 feet south of the South Lake Worth Inlet south jetty. This length varies from the plan presented in the 1987 GDM by 0.18 miles, or 930 feet.

95. Design Beach. The design berm elevation is +9.0 ft NGVD which is considered equivalent to the design berm elevation of the authorized project and the design berm presented in the 1987 GDM. The design berm width is the minimum width of beach, seaward of the Erosion Control Line, which shall be maintained for the life of the project. The NED project will establish the +9 ft NGVD design berm at the Erosion Control Line. This is defined as the 0 foot design berm. This project will extend the MHW shoreline approximately 50 feet, on average. The design beach volume has increased from 253,000 to 274,500 cubic yards.

96. Advance Nourishment. The advance nourishment requirement for the NED plan is 433,800 cubic yards (including 144,600 cubic yards of overfill volume). This is 83,200 cubic yards less than that provided by the plan presented in the 1987 GDM. The reduction in advance

Table 7

Summary of Changes to the Authorized Plan.

		1987 GDM PROJECT	NED PLAN
PHYSICAL DATA:			
BEACH FILL LENGTH (MILES)		1.60	1.42
BERM ELEVATION (FT, NGVD)		9	9
BERM WIDTH (FT)		50	0
INITIAL VOLUME			
	FILL BEHIND ECL (CY)	0	76,000
	DESIGN FILL (CY)	253,000	274,500
	ADVANCE NOURISHMENT (CY)	473,000	289,200
	OVERFILL (CY)	44,000	144,600
TOTAL INITIAL FILL (CY)		770,000	784,300
RENOURISHMENT VOLUME (CY)		501,000	378,000
RENOURISHMENT INTERVAL (YRS)		8	6
GROINS		0	8
FINANCIAL DATA:			
PRICE LEVELS		1986	1995
INTEREST RATE		8-7/8	7-3/4
COSTS (1000's of $)			
	INITIAL COST	4,976	7,238
	(including interest during construction)		
	RENOURISHMENT COST	3,361	3,491
	AMORTIZED INITIAL COST	448	567
	ANNUAL COST OF RENOURISHMENT	330	477
	ANNUAL COST OF GROIN MAINTENANCE	0	16
	TOTAL ANNUAL COST	778	1,060
BENEFITS (1000's of $)			
	STORM DAMAGE PREVENTION	3,905	1,169
	LOSS OF LAND	35	241
	RECREATION	227	393
	DOWNDRIFT	0	321
	EROSION CONTROL STRUCTURES	33	0
	TOTAL	4,200	2,124
NET BENEFIT		3,422	1,064
BENEFIT-TO-COST RATIO		5.4	2.0
COST APPORTIONMENT:			
FEDERAL RESPONSIBILITY			
INITIAL CONSTRUCTION			
	AMOUNT	2486	4264
	PERCENT	50.00%	59.70%
ANNUAL NOURISHMENT			
	AMOUNT		2173
	PERCENT		62.25%
NON-FEDERAL RESPONSIBILITY			
INITIAL CONSTRUCTION			
	AMOUNT	2490	2878
	PERCENT	50.00%	40.30%
ANNUAL NOURISHMENT			
	AMOUNT		1318
	PERCENT		37.75%

nourishment resulted from a decrease in overall project length, a decrease in length of shoreline requiring advance nourishment, and a decrease in the renourishment interval from eight to six years.

97. The overfill ratio for the material from the offshore borrow area is 1.50. The overfill ratio for the 1987 plan is 1.06. The increased overfill ratio resulted from more precise delineation of the project borrow area and more detailed core-boring sampling. Additionally, native beach material collected from within the project limits was used to estimate the overfill requirement.

98. Groins. The proposed NED plan provides for eight groins along the northernmost 1,800 feet of the project. These groins will serve to reduce nearshore hardbottom impacts from approximately 12 to 9.3 acres and increase shoreline stability along the northernmost 1,800 feet of the project. Neither the authorized project nor the 1987 GDM project provide for shore protection structures.

99. Groin Removal. Ten derelict groins will be removed or lowered at least 3 feet below the design beach grade as part of the proposed NED plan. Neither the authorized project nor the 1987 GDM project provide for the removal or modification of derelict groins.

100. Mitigation. The proposed NED plan provides for the construction of approximately 3.5 acres of artificial reef as compensation for nearshore hardbottom impacts. Neither the authorized project nor 1987 GDM project provide for mitigation of hardbottom impacts.

FINANCIAL CHANGES

101. Costs. The project cost has increased substantially due to several factors. The factors related to the increased cost includes cost of mitigation for nearshore hardbottom impacts and removal of existing groins. These items were not included in the authorized project or in the GDM. The initial project costs increased from $4,976,000 to $7,141,600. The cost of the proposed project excludes interest during construction.

102. Benefits. The average annual storm damage benefits decreased from $3,905,000 to $1,168,600. Average annual loss of land benefits increased from $35,000 to $241,100 per year. This is due to a re-evaluation of the shoreline change rate along the project shoreline. Recreation benefits increased from $227,000 to $393,000 per year primarily due to increased public access and parking along the project shoreline. Incidental downdrift benefits were considered in this report. The average annual

downdrift benefits for the proposed project are $321,300. In summary, total project average annual benefits decreased from $4,200,000 to $1,064,400. The benefit-to-cost ratio decreased from 5.4 to 2.0.

COST APPORTIONMENT

103. The Federal interest in the project has increased from 50.0 to 59.70 percent for initial construction and from 50.0 to 62.25 percent for periodic renourishment. The increase in the Federal share is due to increased public beach access and parking along the Ocean Ridge shoreline.

STUDY SUMMARY

104. This report summarizes the preconstruction studies conducted to prepare the Ocean Ridge Segment of the Palm Beach County Shore Protection Project for construction. Based on these studies, the following was concluded:

1) Storm damage is negatively impacting 1.42 miles of Atlantic shoreline at Ocean Ridge. Along this section of shoreline, storms threaten $57 million of developed shorefront property.

2) Implementation of the shore protection project must consider adverse impacts to areas of nearshore hardbottom. Approximately 11.6 acres of nearshore hardbottom are located within the project limits.

3) The most cost effective and environmentally sensitive means available to prevent or reduce structural damages is to construct the shore protection project with the project modifications recommended in this report.

4) The project sponsor supports construction of the project described in this report.

COASTAL BARRIER IMPROVEMENT ACT

105. The proposed modifications to the authorized shore protection project do not include any recommendations which would result in any new Federal expenditures or financial assistance prohibited by the Coastal Barrier Improvement Act of 1990 (PL 101-591).

COASTAL ZONE MANAGEMENT ACT

106. The Coastal Zone Management (CZM) Act of 1972, as amended (PL 92-583), requires all Federal activities inside or outside a state's coastal zone to be consistent with the state's coastal zone management plan if the activities affect natural resources, land uses, or water uses within the coastal zone. Prior to project construction, the State of Florida will review proposed project work to determine if it is consistent with the state's coastal zone management plan.

FLOOD PLAIN DEVELOPMENT

107. The Ocean Ridge project segment is in the base flood plain (100-yr flood) and has been evaluated in accordance with Executive Order 11988. Relocation of the proposed project outside the flood plain would not be responsive to the shore protection problems and needs of the Town of Ocean Ridge and was not considered further. A non-flood plain alternative for the potential development would be to restrict all future development to those areas outside the flood plain or elevated above the flood plain. Potential flood plain development with the project would be restricted as a result of local ordinances and State law which regulate all construction seaward of the 100-year storm impact line. Any induced potential damage as a result of project implementation would be minimal. The project would have minimum impact on the natural and beneficial values of the flood plain. In the without project flood plain (that area immediately adjacent to the proposed project), there will be minimal loss of natural resources due to potential development. Implementation of any non-structural plans that would minimize potential damage to, or within the flood plain beyond those laws and regulations already adopted by local and State interests are not solutions to the erosion and storm damage problems of the Town of Ocean Ridge.

SECTION 14 OF THE 1988 WATER RESOURCES DEVELOPMENT ACT

108. Palm Beach County, the project sponsor, and the Town of Ocean Ridge have enrolled and are in compliance with the National Flood Insurance Program. Therefore, this project is eligible to receive Federal funding. Compliance with this Act will be added to the PCA.

CONCLUSIONS

109. Consideration has been given to all significant aspects of the authorized project in the overall public interest, including engineering feasibility, economic, social, and environmental effects. The modifications to the authorized project described in this report provide the optimum solution for protection of upland development at Ocean Ridge, Florida.

RECOMMENDATIONS

110. It is recommended that the authorized plan for the Ocean Ridge Segment of the Palm Beach County shore protection project be modified in accordance with the selected plan herein, with such modifications as in the discretion of the Chief of Engineers may be advisable.

DISCLAIMER

111. The recommendations contained herein reflect the information available at this time and current Department of the Army policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent to the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority as proposals for project modification and/or implementation funding.

NOTES:

1. DATE OF AERIAL PHOTOGRAPHY APRIL 30, 1987.

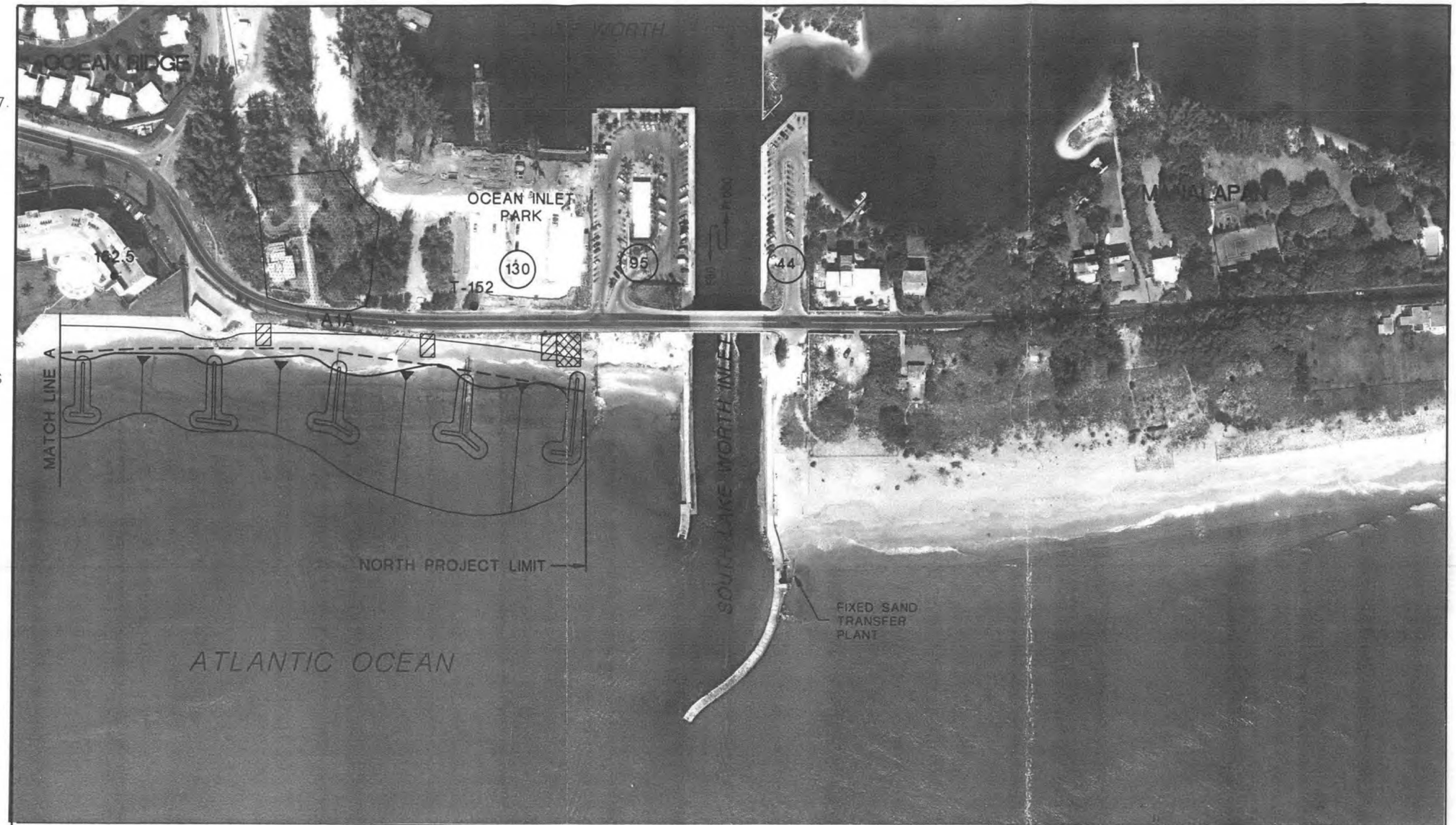
2. DESIGN CROSS-SECTIONS AND PLAN VIEW ARE BASED ON FEBRUARY, 1993 PROFILE SURVEY. EROSION CONTROL LINE SURVEY CONDUCTED NOVEMBER, 1993.

3. CONSTRUCTION BERM WIDTH WILL VARY ALONG ENTIRE PROJECT LENGTH.

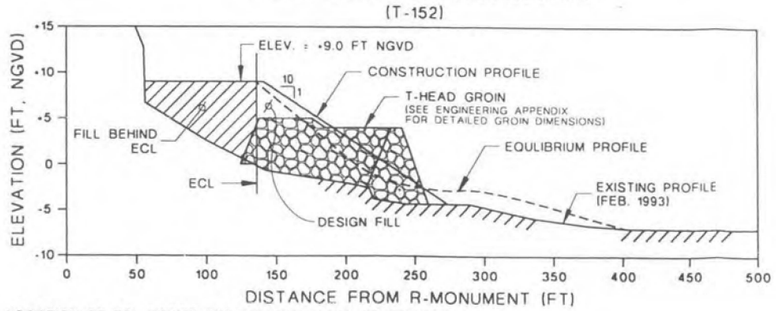
4. ALL DIMENSIONS AND FACTUAL INFORMATION ARE BASED ON SURVEY DATA. THE AERIAL PHOTOGRAPHY IS SHOWN FOR VISUAL REFERENCE ONLY.

LEGEND

- (NO.) NUMBER OF PUBLIC PARKING SPACES
- PUBLIC BEACH ACCESS
- CONSTRUCTION ACCESS
- CONSTRUCTION STAGING AREA
- PROFILE MONUMENTS

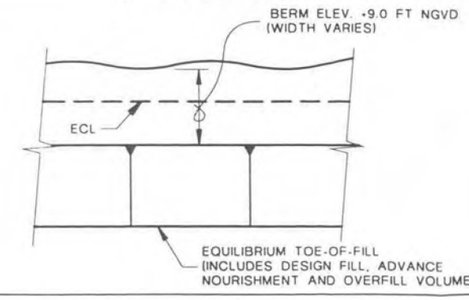


TYPICAL BEACHFILL CROSS-SECTION
(T-152)



NOTE: LOCATION OF ECL VARIES THROUGHOUT LIMITS OF PROJECT

PLAN VIEW LEGEND



SCALE

0 100 200 FEET

PALM BEACH COUNTY, FLORIDA
BEACH EROSION CONTROL PROJECT
NED PLAN
OCEAN RIDGE SEGMENT
SCALE AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
TO ACCOMPANY GENERAL DESIGN MEMO.,
, DATED:
FILE NO.

PLATE 1

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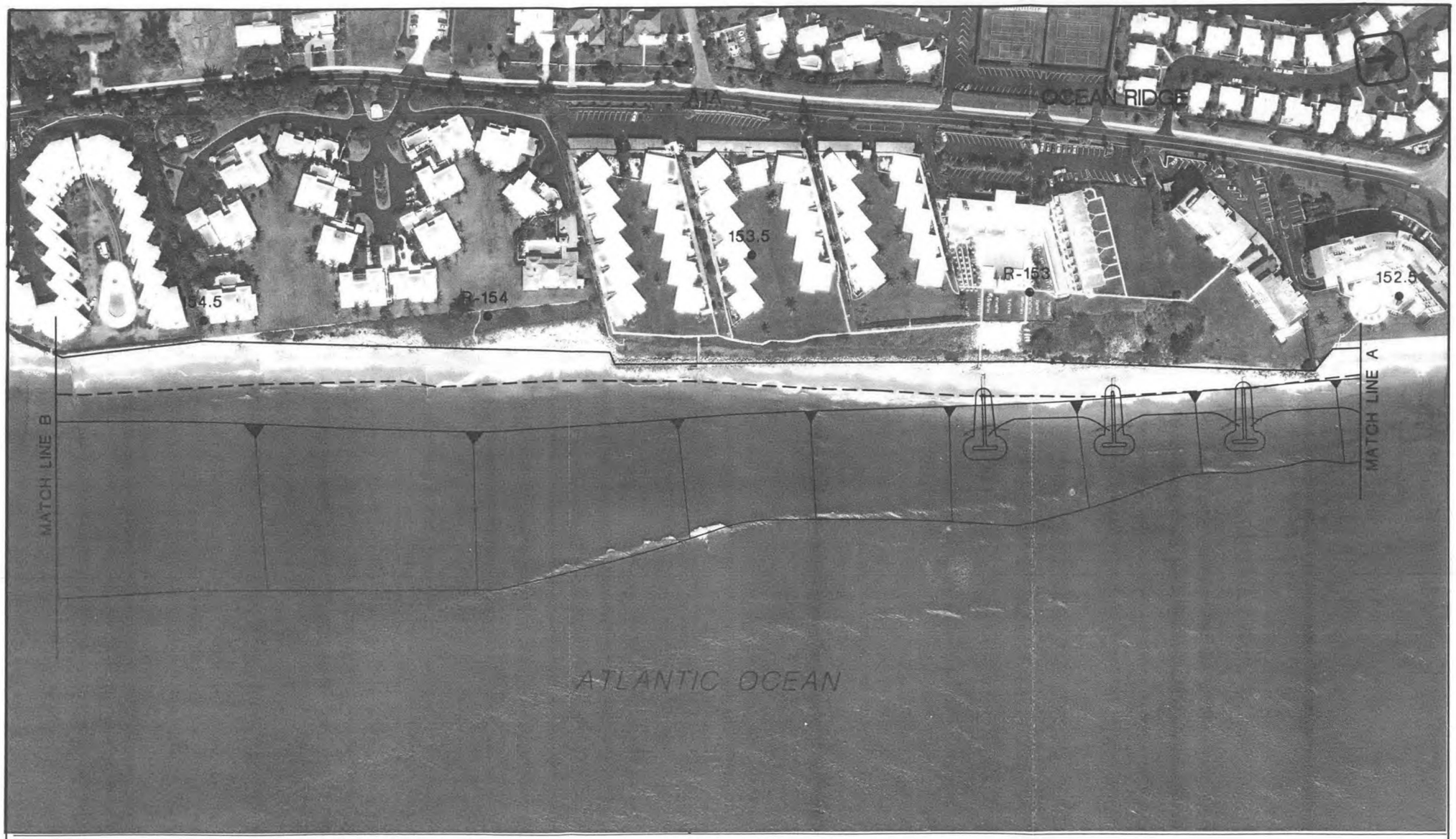
- (NO.) NUMBER OF PUBLIC PARKING SPACES
- PUBLIC BEACH ACCESS
- CONSTRUCTION ACCESS
- CONSTRUCTION STAGING AREA
- PROFILE MONUMENTS
- ECL
- EQUILIBRIUM FILL CONDITIONS



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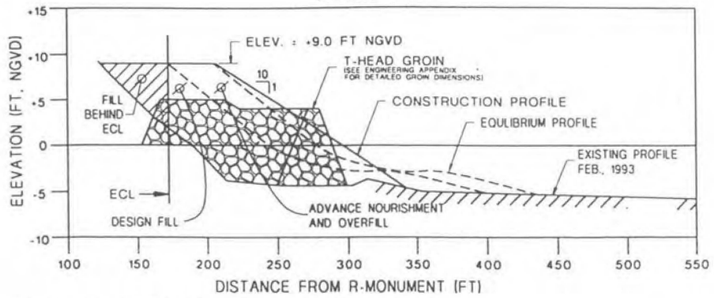
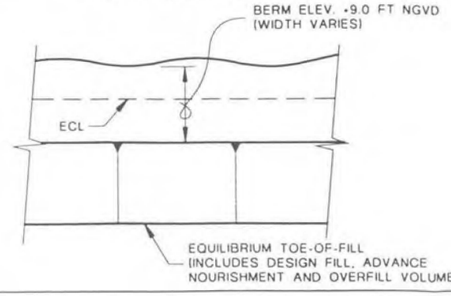
(R-153)



NOTE: LOCATION OF ECL VARIES THROUGHOUT LIMITS OF PROJECT

PLAN VIEW LEGEND



SCALE

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PALM BEACH COUNTY, FLORIDA
BEACH EROSION CONTROL PROJECT
NED PLAN
OCEAN RIDGE SEGMENT
SCALE AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
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PLATE 2

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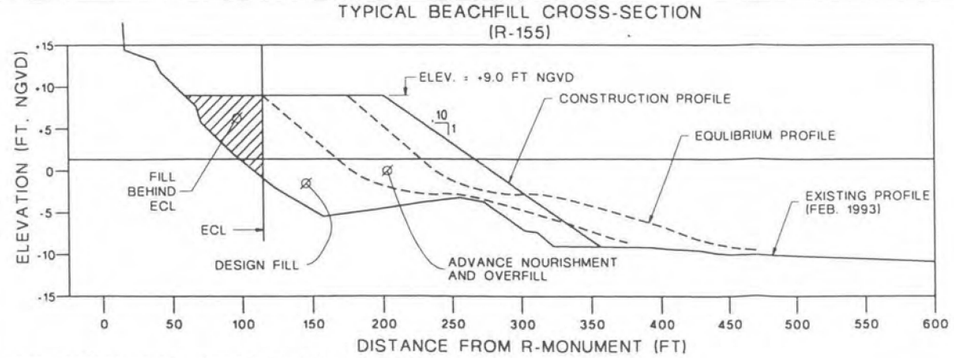
4. ALL DIMENSIONS AND FACTUAL INFORMATION ARE BASED ON SURVEY DATA. THE AERIAL PHOTOGRAPHY IS SHOWN FOR VISUAL REFERENCE ONLY.

LEGEND

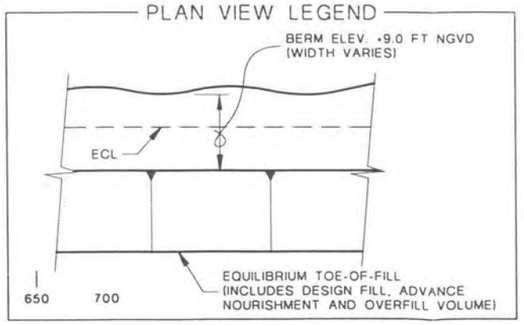
- (NO.) NUMBER OF PUBLIC PARKING SPACES
- PUBLIC BEACH ACCESS
- CONSTRUCTION ACCESS
- CONSTRUCTION STAGING AREA
- PROFILE MONUMENTS

TYPICAL BEACHFILL CROSS-SECTION (R-155)



NOTE: LOCATION OF ECL VARIES THROUGHOUT LIMITS OF PROJECT

PLAN VIEW LEGEND



SCALE

PALM BEACH COUNTY, FLORIDA
BEACH EROSION CONTROL PROJECT
NED PLAN
OCEAN RIDGE SEGMENT
SCALE AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
TO ACCOMPANY GENERAL DESIGN MEMO.
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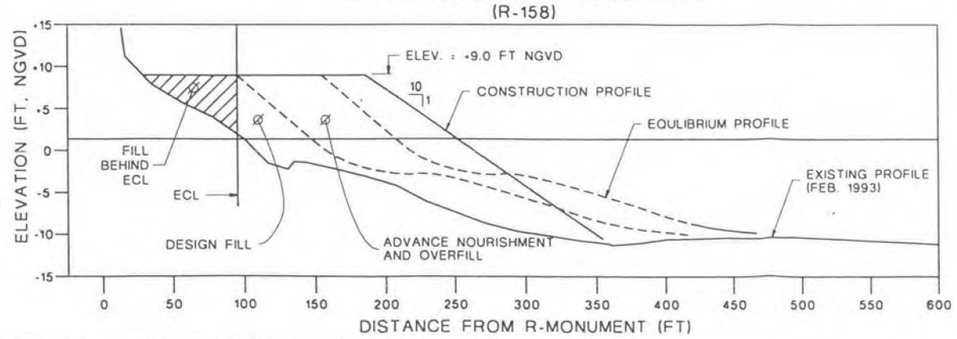
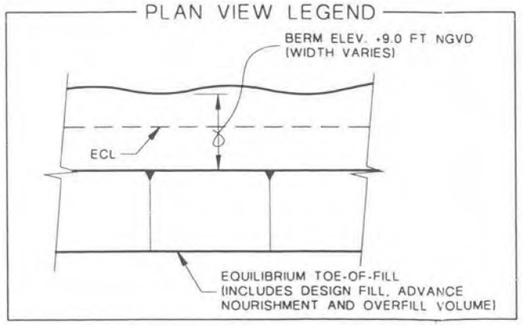
- PUBLIC BEACH ACCESS
- CONSTRUCTION ACCESS
- CONSTRUCTION STAGING AREA
- PROFILE MONUMENTS

TYPICAL BEACHFILL CROSS-SECTION
(R-158)



NOTE. LOCATION OF ECL VARIES THROUGHOUT LIMITS OF PROJECT

PLAN VIEW LEGEND



SCALE

PALM BEACH COUNTY, FLORIDA
BEACH EROSION CONTROL PROJECT
NED PLAN
OCEAN RIDGE SEGMENT
SCALE AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
TO ACCOMPANY GENERAL DESIGN MEMO.,
, DATED:
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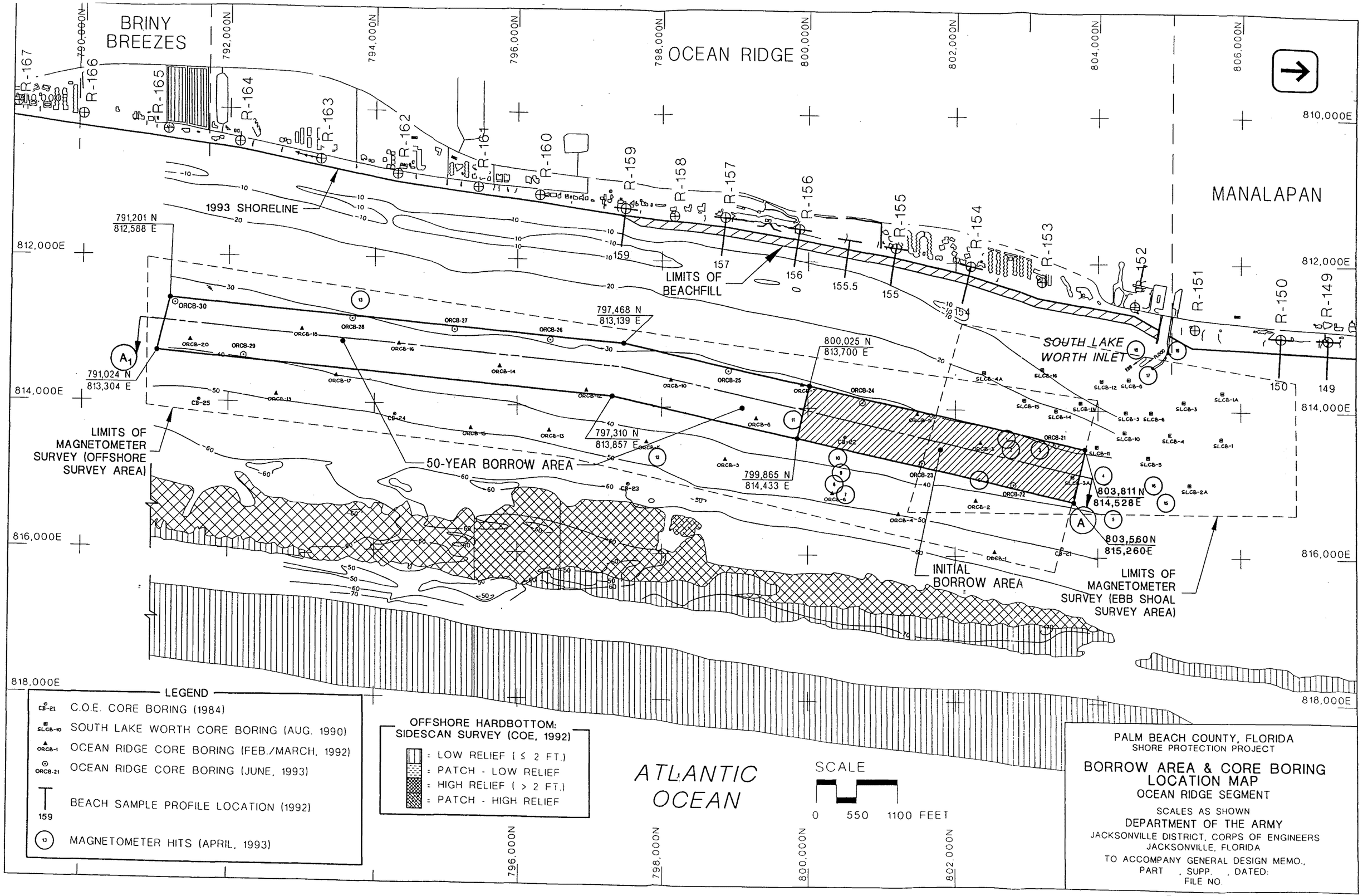
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790,000N
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155.5
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SOUTH LAKE WORTH INLET
791,201 N
812,588 E
791,024 N
813,304 E
797,468 N
813,139 E
797,310 N
813,857 E
800,025 N
813,700 E
799,865 N
814,433 E
803,811 N
814,528 E
803,560 N
815,260 E
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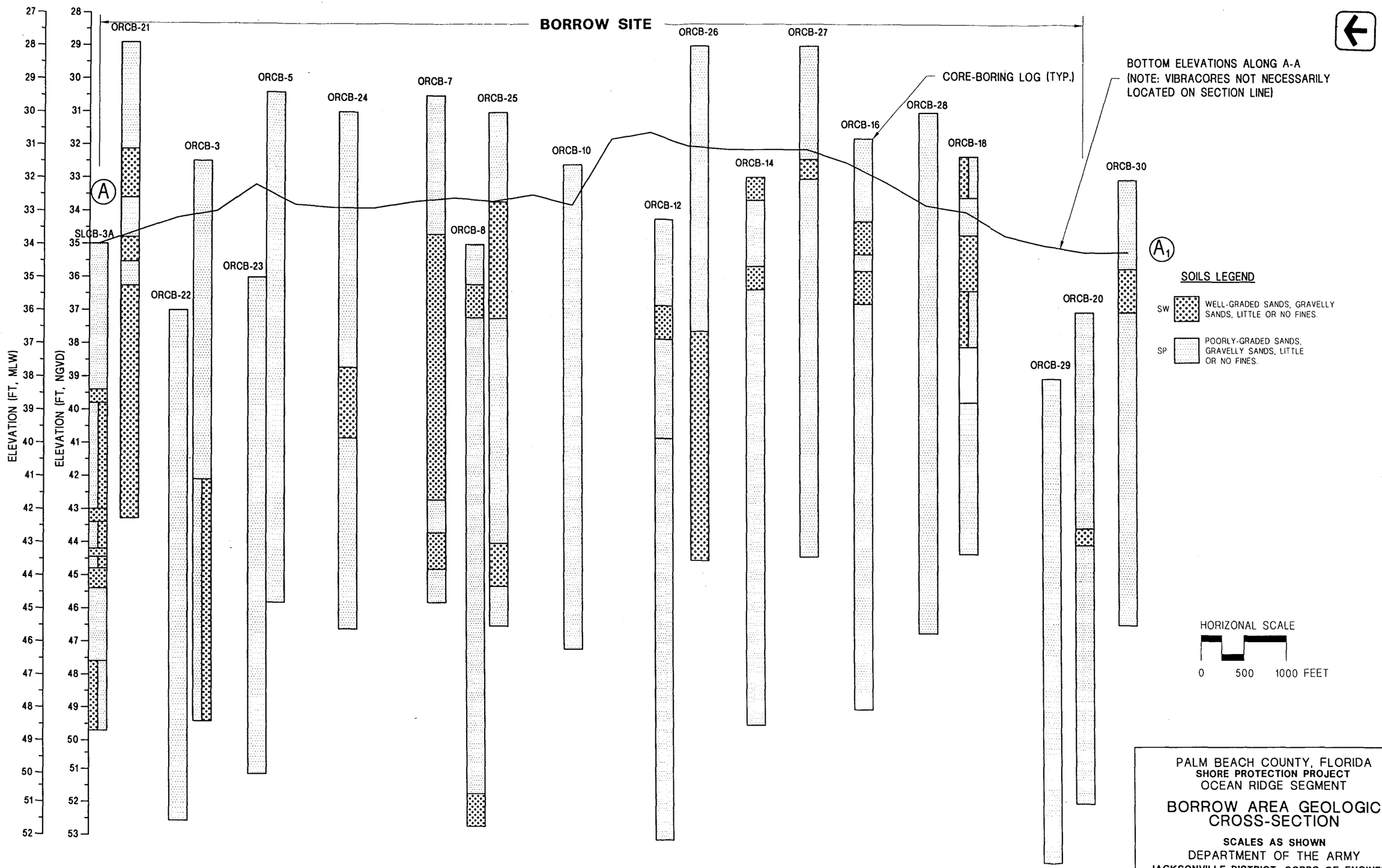
INITIAL BORROW AREA
LIMITS OF MAGNETOMETER SURVEY (OFFSHORE SURVEY AREA)
LIMITS OF MAGNETOMETER SURVEY (EBB SHOAL SURVEY AREA)
ATLANTIC OCEAN
SCALE
0 550 1100 FEET
LEGEND
C.O.E. CORE BORING (1984)
SOUTH LAKE WORTH CORE BORING (AUG. 1990)
OCEAN RIDGE CORE BORING (FEB./MARCH, 1992)
OCEAN RIDGE CORE BORING (JUNE, 1993)
BEACH SAMPLE PROFILE LOCATION (1992)
MAGNETOMETER HITS (APRIL, 1993)
OFFSHORE HARDBOTTOM: SIDESCAN SURVEY (COE, 1992)
: LOW RELIEF (≤ 2 FT.)
: PATCH - LOW RELIEF
: HIGH RELIEF (> 2 FT.)
: PATCH - HIGH RELIEF
PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
BORROW AREA & CORE BORING LOCATION MAP
OCEAN RIDGE SEGMENT
SCALES AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
TO ACCOMPANY GENERAL DESIGN MEMO., PART , SUPP. , DATED:
FILE NO.

PLATE 5



BORROW SITE SECTION A-A$_1$

PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
OCEAN RIDGE SEGMENT

BORROW AREA GEOLOGIC CROSS-SECTION

SCALES AS SHOWN

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

TO ACCOMPANY GENERAL DESIGN MEMO.,
PART , SUPP. , DATED:
FILE NO.

SHORE PROTECTION PROJECT, PALM BEACH COUNTY, FLORIDA, FROM MARTIN COUNTY LINE TO LAKE WORTH INLET AND FROM SOUTH LAKE WORTH INLET TO BROWARD COUNTY LINE

OCEAN RIDGE SEGMENT

FINAL

SUPPLEMENT TO THE ENVIRONMENTAL IMPACT STATEMENT

August 8, 1996

PREPARED BY:

Palm Beach County
Department of Environmental Resources Management
3323 Belvedere Road, Bldg. 502
West Palm Beach, Florida 33406-1548
Telephone: (561) 233-2400
Telefax: (561) 233-2414

FINAL
SUPPLEMENT TO THE ENVIRONMENTAL IMPACT STATEMENT
OCEAN RIDGE SEGMENT

The responsible lead agency is the U.S. Army Corps of Engineers, Jacksonville District. The local sponsor is the Palm Beach County Board of County Commissioners, West Palm Beach, Florida.

ABSTRACT: This Final Supplement (SEIS) to the countywide Environmental Impact Statement (EIS) provided in the 1987 General Design Memorandum (GDM) describes the recommended plan for beach restoration south of South Lake Worth Inlet, southern Palm Beach County, Florida, an area identified as critically eroded in the GDM for erosion control projects in Palm Beach County (United States Army Corps of Engineers (USACE), 1987). The recommended project includes a 784,300 cubic yard, 1.42 mile long beach restoration project which incorporates eight T-head groins within the northerly 1,800 feet of the project. The structural aspect of the project is designed to stabilize the eroded shoreline immediately south of the South Lake Worth Inlet. The fill aspect of the project is also designed to help stabilize the shoreline, and will provide protection to upland property, feed sand to southerly beaches, and provide a wider beach for public recreation and sea turtle nesting.

This Final SEIS describes the need for the recommended project and provides more detailed information on the environmental consequences of constructing the recommended project. The project is proposed to fulfill specific planning objectives including a reduction of damages to upland structures resulting from storm tides and waves, enhancement of a recreational beach, protection of an income base derived from tourism, mitigation of the adverse effects of South Lake Worth Inlet on littoral drift, improved ability of coastal plant and animal species to withstand storm impacts, and to maintain (and possibly enhance) the existing suitable nesting habitat for sea turtles.

The environmental consequences of the project will depend on the quality of the sediments in the borrow site, the season in which construction occurs, the location of the borrow site with respect to adjacent offshore reefs, and the location and extent of nearshore hardbottom at the time of construction. The 27-38 foot deep offshore borrow site was selected based upon proximity to the fill area while providing a reasonable buffer distance to the natural reefs. The compatibility of the fill with the existing beach sand will determine the rate and extent of recolonization and recovery of that area by infaunal invertebrates as well as the use of the beach by nesting sea turtles. The borrow area has a mean sand grain size of 0.26 mm compared to the native beach of 0.32 mm mean sand grain size. Re-establishment of the benthic community at the borrow site will follow the recovery of that site to pre-dredging conditions. The recommended project will cover exposed nearshore hardbottom in the project area. A conservative planning level estimate for impacts is approximately 6.4 acres within the equilibrium toe of fill and 2.9 acres additional short term impacts possible. The resident community on these reefs will be displaced or covered and the temporary or transitory species will be displaced from the area until the hardbottom becomes re-exposed due to erosion. A Florida Department of Environmental Protection permit condition requires 4.55 acres of mitigation including 2.1 acres constructed in 1994. A monitoring plan will be developed to evaluate impacts to the nearshore hardbottom communities and determine if additional mitigation is necessary. Groin construction may occur during sea turtle nesting season, while the construction of the beach fill is scheduled outside of peak sea turtle nesting season.

PLEASE SEND COMMENTS
TO THE DISTRICT ENGINEER
WITHIN 45 DAYS OF PUBLICATION
OF THE FINAL SEIS IN THE
FEDERAL REGISTER

If you would like further information
on this statement, please contact:
Mr. Michael Dupes, CESAJ-PD-ER
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232
Telephone: (904) 232-1689

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2. State Water Quality Certification
3. State Coastal Construction Control Line Permit

1.00 SUMMARY

1.01 Major Conclusions and Findings. The proposed project is located in southeastern Palm Beach County, in Southeastern Florida (Fig. 1). Beaches at the proposed project site are in a state of critical erosion and shoreline recession. The processes which generated this condition continue to degrade the beaches. Detailed examination and economic analysis showed that construction of a feeder beach would best meet planning objectives in a cost effective manner while accommodating the requirements of national environmental statutes. The proposed project meets Florida Department of Natural Resources[1] (FDNR) 1988 criteria of a recommended "feeder beach" project and would restore the beaches for approximately 6 years, at which time a maintenance nourishment project would be necessary. The project has been planned and designed to reduce environmental impacts while mitigating the effects of the South Lake Worth Inlet on the littoral system. The recommended project will reduce expected storm induced damage, re-establish beaches suitable for recreational and sea turtle nesting activity, and help the local sponsor maintain an income base derived from tourism.

1.02 Recommended Plan and Rationale. The recommended plan is to dredge about 784,300 cubic yards of sand from a borrow site in 27-38 feet of water located offshore of the project area which was selected to avoid impacts to nearby deep reefs. This sand will be used as beach fill from 180 feet south of the South Lake Worth Inlet south jetty (220 ft north of FDNR survey monument T-152) southward to 120 feet south of FDNR survey monument R-159, a total of about 1.42 miles. Eight T-head groins will be installed within the northerly 1,800 feet of the project. The groin field is designed to add stability to the eroded shoreline immediately south of the South Lake Worth Inlet. The fill aspect of the project is also designed to help stabilize the shoreline, and will provide protection to upland property and biota, feed sand to southerly beaches, and provide a wider beach for public recreation and sea turtle nesting.

1.03 Beneficial/Adverse Impacts: Physical. The recommended plan will approach the planning objectives by reducing expected storm damage; reducing the adverse effects of South Lake Worth Inlet on littoral drift; improving the recreational beach; and protecting the tourist based income. The primary physical benefit of the project is to prevent storm damage and to stabilize the shoreline within the project limits. Sand placed within the project limits will also feed the downdrift beaches to the south and reduce the need for other beach nourishment projects (and associated environmental impacts) in Palm Beach County. The wider, more stable beach will also provide more nesting habitat for sea turtles.

1.04 Beneficial/Adverse Impacts: Environmental. Previously proposed projects had anticipated nearshore hardbottom impacts of 11.29 acres (Continental Shelf Associates [CSA], 1984:104), and the proposed offshore borrow areas provided finer sands and were too close

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[1]FDNR and Federal Department of Environmental Regulation (FDER) have recently merged into Florida Department of Environmental Protection (FDEP).

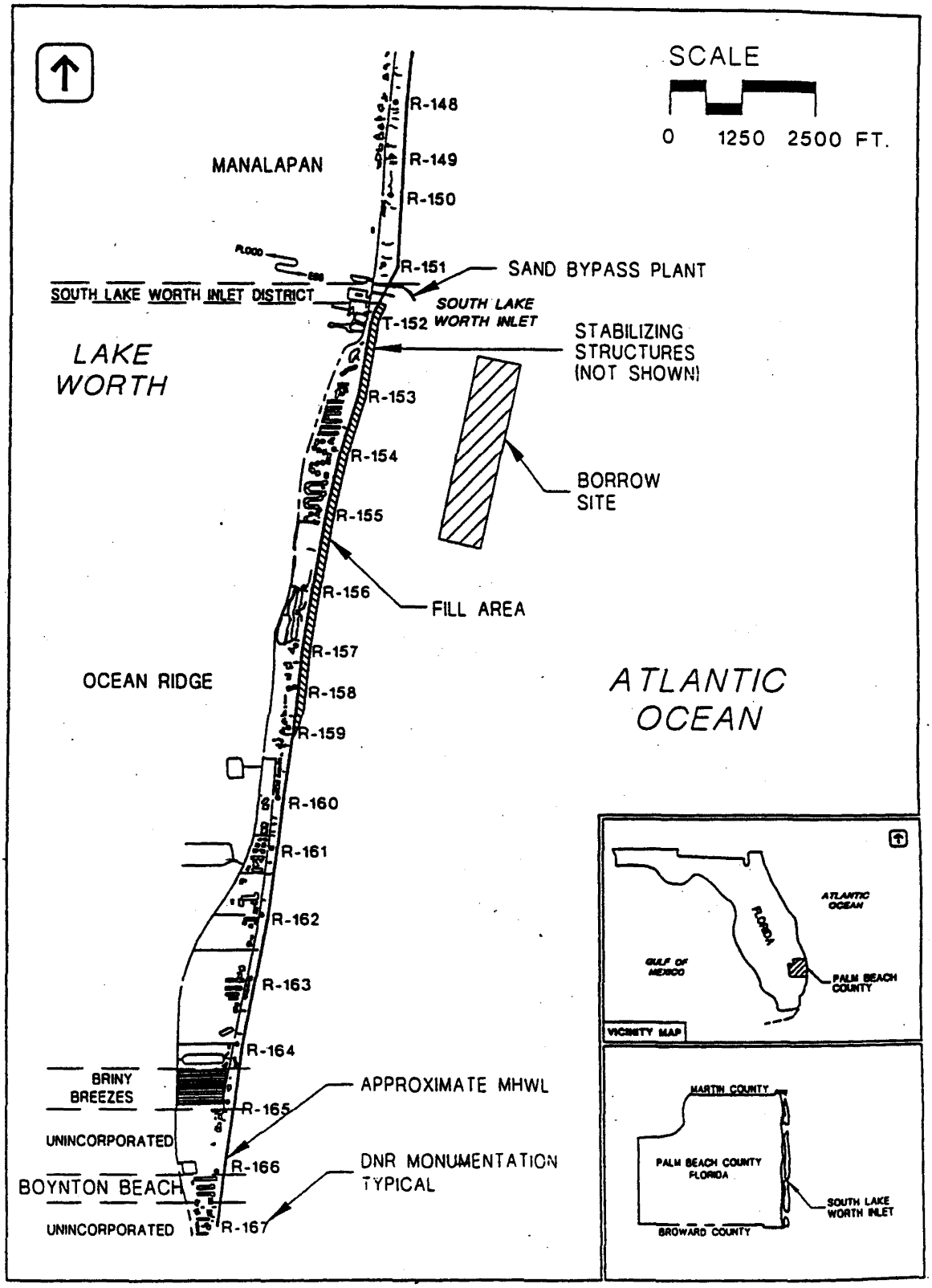

Figure 1: LOCATION MAP

to reefs (Florida Department of Environmental Regulation[2] (FDER), in a 2/12/82 report, anticipated "inevitable" reef impacts). Environmental impacts associated with the presently proposed project have been minimized by implementing a number of management strategies which include: 1) scheduling the fill aspect of the project outside of peak sea turtle nesting season (late fall, winter, and early spring) to minimize impacts to nesting and hatching sea turtles; (2) designing fill limits to reduce impact to the nearshore hardbottom; 3) locating the borrow site to avoid offshore reefs; (4) utilizing the best borrow material available to reduce impacts to water quality, hardbottom and softbottom benthic communities, fishes, and sea turtles, and (5) constructing groins to stabilize the beach and beach fill, serving both to restrict the fill from encroachment onto the nearshore hardbottom, reduce sand loss in the highly erosive north end, as well as to maximize the renourishment interval. As described in the sand search (see geotechnical appendix of the GDM Addendum for the Ocean Ridge segment), the material in the borrow area contains a relatively low level of silts and clays (1.5%). A mixing zone variance has been requested and received to allow elevated turbidity levels in the immediate area of the project.

1.05 The immediate environmental impact to the borrow site will be a temporary defaunation of the benthic community. Re-establishment of the benthic community at the borrow site will follow the recovery of the site to pre-dredging conditions. Compatibility of the borrow material with the native beach profile is an important factor to recolonization of previously existing benthic communities and the continued use of the beach and nearshore zone by higher trophic level organisms (e.g., fish, turtles, shorebirds, plants).

1.06 The recommended project will place fill on nearshore hardbottom within the fill area at the time of construction. The permanent residents associated with this nearshore hardbottom will be displaced or covered and the temporary or transitory species will be displaced until the hardbottom becomes re-exposed due to erosion of the feeder beach profile. Hardbottom that remains uncovered will serve as a refuge for displaced mobile species and a recruitment source for recolonization of buried hardbottom that becomes uncovered due to the expected erosion of the feeder beach. Based on 1994 conditions, approximately 6.4 acres of hardbottom is located within the equilibrium toe of fill (ETOF). Another 2.9 acres of hardbottom could experience short term impacts from construction assuming the northern 1,100 feet of the fill area is filled with sand at the time of construction. An option being considered would be to allow the north end to be filled with sand as part of the operation of the sand transfer plant. This would reduce impacts since the coarser beach sand will assume a steeper slope. The impacts stated above may be a worst case scenario since 1994 had the most hardbottom exposed within the fill limits since 1983. An 11 year analysis of hardbottom acreage resulted in 3.1 acres of long term impacts and 3.2 acres of short term impacts (based on a time average analysis. The actual impact will be quantified, analyzed, and will be mitigated by creation of artificial nearshore hardbottom. Approximately 2 acres of artificial reef have already been constructed in the Ocean Ridge vicinity.

1.07 Specific impacts to fish communities are not well known but will be commensurate with the level of impact to the hardbottom. No significant impacts are expected for juvenile and

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[2]FDNR and Federal Department of Environmental Regulation (FDER) have recently merged into Florida Department of Environmental Protection (FDEP).

adult fishes important to commercial and recreational fisheries. No impacts to sea turtles are expected other than compaction of the beach fill which may affect reproductive success. Construction of beach fill is scheduled to occur outside peak nesting season. No significant impacts to manatees are expected provided the recommended safeguards for boat and dredge operation are followed and the seagrass beds inside the inlet are unaffected (e.g. by prolonged turbidity)

1.08 Section 404(b) Evaluation Report Determinations. The selected plan has been evaluated in accordance with Section 404(b) of Public Law 92-500 and has been determined to be consistent with the public interest. A Section 404(b) Evaluation Report has been prepared and is included as Appendix A.

1.09 Areas of Controversy. The U.S. Fish and Wildlife Service (USFWS) and Florida Department of Environmental Protection (FDEP) have expressed concern over the impact of the project on nearshore hardbottom. The previously proposed beach nourishment project received an "intent to deny" by FDER, due to concerns over impact to water quality and marine resources. These concerns are addressed below in Section 3. FDEP has also expressed concern over the justification of groins to stabilize the north end of the fill area.

1.10 Unresolved Issues. The issue of how much mitigation is substantially resolved. FDEP has issued a water quality certification permit which requires 4.55 acres of mitigation. The USFWS has indicated that this plan is an acceptable alternative to their plan provided impacts are not significantly greater than predicted. The Town of Manalapan's concerns regarding sand management at the inlet are being addressed through an interlocal agreement with Palm Beach County and Ocean Ridge.

1.11 Coastal Zone Management Act Consistency Evaluation. Appendix B summarizes the Corps' analysis showing the selected plan to be in conformance with the Florida Coastal Zone Management Program.

1.12 Effects on Florida Coastal Management Program. The effect of the proposed project on the coastal zone would be to enhance the zone's appearance and suitability for beach recreation and to restore some of the coastal zone's ability to provide protection against storms. The proposed project has been reviewed with respect to the applicable regulations and statutes of the Florida Coastal Zone Management Program, listed in Appendix B. The Environmental Impact Statement and State review under existing processes comprises the Federal consistency determination and notification procedure. If the above described protection measures are found to ensure that no lasting adverse effects occur on water quality or environmental resources, the proposed project will be consistent with Florida's Coastal Zone Management Program.

1.13 Coastal Barrier Resources Act (CBRA). The purpose of the Coastal Barrier Resources Act is to minimize the loss of human life, wasteful expenditure of Federal revenues, and the damage to fish, wildlife, and other natural resources associated with the coastal barriers along the Atlantic coast by restricting future Federal expenditures and financial assistance which may

have the effect of encouraging development of these coastal barriers. A review of the units comprising the Coastal Barrier Resources System in the countywide GDM/EIS showed no identified units in Palm Beach County.

1.14 Marine Protection, Research and Sanctuaries Act. Since the dredge material (i.e., fill) is from an offshore site, the Marine Protection, Research and Sanctuaries Act (MPRSA, or "Ocean Dumping Act") is not applicable to this particular proposed shore protection project.

1.15 River and Harbor Act. The resources listed in Section 122 of the 1970 River and Harbor Act, P.L. 91-611 have been considered in this SEIS and are discussed in Section 4.

1.16 Clean Air Act. This project has been determined to be in compliance with the Clean Air Act (CAA) and is exempt from the United States Environmental Protection Agency's General Conformity Rule since direct and indirect emissions fall below de minimis levels as discussed in paragraph 5.60.

1.17 Relationship of the Recommended Plan to Environmental Requirements. Table 1 indicates the relationship of the plan to Federal and State environmental policies.

2.00 NEED FOR AND OBJECTIVES OF ACTION

2.01 Purpose and Need. The countywide general design memorandum (GDM) for beach erosion control projects in Palm Beach County (USACE, 1987:20, A-18) identified the area south of Ocean Ridge as a problem area. The Palm Beach County Board of County Commissioners (BCC), the local sponsor, has shown a commitment to an erosion control program which restores the County's coastline. The Florida Department of Natural Resources (FDNR, 1988) has recommended the construction of feeder beaches, which includes the present project. Specific planning objectives include a reduction of damages to public and private upland structures resulting from storm tides and waves; a reduction of the effects of the South Lake Worth Inlet on littoral drift; an improved ability of coastal plant and animal species to withstand storm impacts; enhancement of a recreational beach; and protection of an income base derived from tourism.

2.02 Study Authority. The countywide Environmental Impact Statement (EIS) contained in the Palm Beach County GDM (USACE, 1987:1-2) states the authority for shore protection projects throughout the County as follows:

> a. The shore protection project for the Atlantic coast of Palm Beach County from the Martin County line to Lake Worth Inlet and from South Lake Worth Inlet to the Broward County line was authorized 23 October 1962 (P.L. 87-874) and is described in House Document 164/87/1.

Table 1. Relationship of the Proposed Project to Environmental Protection Statutes and Other Environmental Requirements.

Federal Acts Project Compliance	
Archeological and Historic Preservation Act, as emended, 16 U.S.C. 469, et seq. P.L. 93-291	Full Compliance
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq. P.L. 91-604	Full Compliance
Clean Water Act, as amended, (Federal Water Pollution Control Act) 33 U.S.C. 1251, et seq. P.L. 92-500	Full Compliance
Coastal Barrier Resources Act, 16 U.S.C. 3501, et seq. P.L. 97-348	Not Applicable
Coastal Zone Management Act, as amended, 16 U.S.C. 1451, et seq. P.L. 92-583	Full Compliance
Endangered Species Act, as amended, 16 U.S.C. 1531, et seq. P.L. 93-205	Partial Compliance[1]
Estuary Protection Act, 16 U.S.C. 1221, et seq. P.L. 90-454	Full Compliance
Federal Water Project Recreation Act, as amended, 16 U.S.C. 460-1(12), et seq. P.L. 89-72	Full Compliance
Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661, et seq. P.L. 85-624	Full Compliance
Land and Water Conservation Fund Act, as amended, 16 U.S.C. 4601-4601-11, et seq. P.L. 88-578	Not Applicable
Marine Mammal Protection Act 16 U.S.C. 1361, 1361, et seq. P.L. 92-522	Full Compliance
Marine Protection, Research and Sanctuaries Act, 33 U.S.C. 1401, et seq. P.L. 92-532	Full Compliance
National Historic Preservation Act, as amended, 16 U.S.C. 470a, et seq. P.L. 89-655	Full Compliance
National Environmental Policy Act, as amended, 42 U.S.C. 4321, et seq P.L. 91-190.	Partial Compliance[1]
River and Harbor Act, 33 U.S.C. 401, et seq.	Full Compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq. P.L. 83-566	Not Applicable
Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271, et seq. P.L. 90-542	Not Applicable

Executive Orders Project Compliance	
Floodplain Management (E.O. 11988)	Full Compliance
Protection of Wetlands (E.O. 11990)	Full Compliance
Protection and Enhancement of Environmental Quality (E.O. 11514, amended E.O. 11991)	Full Compliance
Protection and Enhancement of the Cultural Environment (E.O. 11593)	Full Compliance
Federal Compliance with Pollution Control Standards	Full Compliance

Table 1. Relationship of the Proposed Project to Environmental Protection Statutes and Other Environmental Requirements, continued.

Other Federal Policies	
CEQ Memorandum of August 11, 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA	Not Applicable
CEQ Memorandum of August 10, 1980. Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory	Not Applicable
Migratory Bird Treaties and Other International Agreements listed in the Endangered Species Act of 1973 as amended, Section 2(a)(4)	Full Compliance
State Policies	
Florida Coastal Management Program	Full Compliance

Definitions:

Full Compliance: Having met all requirements of the statute, Executive Order, or other environmental requirements for the current stage of planning (either pre or postauthorization).

Partial Compliance: Not having met some of the requirements that normally are met in the current stage of planning. Partial compliance entries should be explained in appropriate places in the report and/or Environmental Impact Statement and referenced in the table.

Non-Compliance: Violation of a requirement of the Statute, Executive Order, or other environmental requirement. Non-compliance entries should be explained in appropriate places in the report and/or Environmental Impact Statement and referenced in the table.

Not Applicable: No requirements for the Statute, Executive Order, or other environmental requirement for the current stage of planning.

[1] All plans in compliance following approval of the Supplemental Environmental Impact Statement.

b. The shore protection project for the Atlantic coast of Palm Beach County from Lake Worth Inlet to South Lake Worth Inlet was authorized on 3 July 1958 (P.L. 85-500) and is described in House Document 342/85/2.

2.03 The FDNR beach management plan for the State of Florida (FDNR, 1988) recommended the use of "feeder" beaches, as an alternative to beach restoration, using offshore borrow sites for fill material. The feeder beach concept is to place sand on the beach at strategic locations (e.g., south of inlets), to "feed" the downdrift shoreline via longshore sediment transport.

2.04 The project site described within this Supplemental Environmental Impact Statement (SEIS) was essentially identified in the FDNR beach management plan (FDNR, 1988:XII-14), but referenced then as two projects: PB-6 from T-152 to R-155 and PB-7 from R-155 to R-160 (see also paragraph 3.015). In developing the beach management plan, FDNR was directed by legislatively mandated study requirements, as outlined in Section 161.161 of the Florida Statutes. These study requirements included evaluating the establishment of feeder beaches as an alternative to direct beach restoration and recommending the location of such feeder beaches and the source of sand.

2.05 The approach of Palm Beach County has been to incorporate the findings and studies of the USACE and FDNR along with the County's concerns into a comprehensive program. The County established a beach program in the early 1970's to formulate solutions to the erosion problem along the coastline. The County's 1974 Concept Development Report defines eight reaches of shoreline which are in need of erosion control measures. In a 1983 Resolution, R-83-764, the BCC reaffirmed a commitment to halt erosion and stabilize the beaches of Palm Beach County. The BCC requested that all Federal beach erosion control projects continue on an active basis and reaffirmed the County as the local sponsor for such projects. In the Palm Beach County Comprehensive Plan, the goal of the Coastal Management Element is to preserve, protect, and enhance coastal resources, to protect human life, limit public expenditures in areas subject to destruction by natural disasters, and discourage development activities that would damage or destroy coastal resources. The objective of the Coastal Management Element is to attain these goals by providing a more natural movement of littoral sand, re-establishing damaged dunes and beaches, minimizing anticipated damage resulting from storms, providing for additional recreational beach activity, and improving the quality of the nearshore and coastal environment. A major focus of the Coastal Management Element is to address the erosional impacts of inlets.

2.06 The rates of erosion along 2.6 miles of shoreline from the South Lake Worth Inlet to Briny Breezes has been estimated (CSA, 1984:ii) to be 300,000 cy per year between 1974 and 1981. The GDM for Palm Beach County (USACE, 1987:D-18, Table D-6) estimated approximately 62,500 cy/yr (based on renourishment of 500,000 cy every 8 years) for 1.6 miles of shoreline. The draft GDM Addendum for the Ocean Ridge Segment (USACE, 1995b:11) for this project estimates that the historical erosion rate along the project shoreline is 37,500 cubic yards per year.

2.07 Public Concerns. The primary concern in this particular project area and throughout Palm Beach County is the ongoing shoreline erosion and increased vulnerability of upland development to storm related damage. The erosion problem along the coastline is a threat to both private residential and public recreational properties in Palm Beach County. The BCC, as outlined in paragraphs 2.01 and 2.05, is committed to a comprehensive erosion control program to restore the County's coastline. This includes protection of existing beaches and dunes through Coastal

Protection section 9.1 of the Palm Beach County Unified Land Development Code, sand management at inlets, and the restoration of beaches and dunes through the County's Shoreline Protection Program.

2.08 Planning Objectives. As outlined in the countywide EIS (USACE, 1987), the specific planning objectives for this project include: a reduction of inlet impacts, a reduction of expected storm related damage, re-establishment of beaches suitable for current and future recreational activity, maintaining a suitable beach (sand) habitat for sea turtle nesting and support of invertebrate and shorebird species, and maintaining an income base derived from tourism. Management measures include land use modifications (e.g., additional public parking, resulting from land purchase and conversion from private residential to public use), construction of a "feeder" beach nourishment project, construction of a series of T-head groins for protection, and future maintenance of the shoreline.

3.00 ALTERNATIVES

3.01 Previous Projects. **Maintenance dredging of sand traps** in the South Lake Worth Inlet has resulted in the placement of 32,500 cy of sand on 1200 feet of shoreline south of the inlet in 1973 and about 37,000 cy of sand in 1989 (see FDNR permit #DBS87201PB and FDER permit # 501424939). A boat channel was constructed in 1993 to connect a dock at Ocean Inlet Park with the ICW (see FDNR permit #DBS910299PB and FDER permit #502073046), which resulted in placement of 4,029 cy of fill immediately south of the inlet. The sand transfer plant (FDNR permit #DBS 65-65) places about 70,000 cy of sand on the south beach each year.

3.02 No **beach nourishment projects** have previously occurred at this location, although there have been previous efforts to implement such a project (FDER application #50-028505-9).

3.03 **Other shoreline projects** that have been constructed in the vicinity include a dune restoration project fronting private properties in Manalapan, about ½ mile north of the inlet, in 1986. A 990 cy dune restoration project (FDNR permit #PB183) was also completed at Boynton Beach Oceanfront Park in 1990. Seawalls and groins have been constructed in Manalapan between R-138 and R-146½ and in Ocean Ridge between the inlet and R-159, respectively. A new 774 ft. sheet pile bulkhead replaced a failed one at Ocean Inlet Park (FDNR permit #PB 458 EW), in April 1992. The project was constructed by Palm Beach County, immediately south of the inlet, and was designed to protect the adjacent roadway. Toe scour protection is still being considered, and may be implemented, modified, or omitted pending the degree of implementation of the proposed shoreline protection project.

3.04 Plans Eliminated from Further Consideration. A number of alternatives were considered in the countywide GDM before arriving at the recommended plan. These alternatives can be generally classified as either structural or non-structural. The following non-structural alternatives were considered: no action (NS-1), re-zoning of the beach area (NS-2), modification of building codes (NS-3), construction control line restrictions (NS-4), moratorium on construction (NS-5), flood insurance (NS-6), evacuation planning (NS-7), establishment of a no-growth program (NS-8), relocation of structures out of impact zones (NS-9), flood proofing of structures (NS-10), condemnation of land and structures (NS-11) and various combinations of the preceding non-structural alternatives (NS-12). All of these options were rejected during development of the

discussed in paragraph 2.08. In particular, these options failed to protect the income base derived from tourism or provide suitable beach for recreation, sea turtle nesting, invertebrate habitat and shorebird utilization.

3.05 The following structural alternatives were also considered: revetments (S-1), beach nourishment using offshore borrow material (S-2), beach nourishment stabilized by offshore breakwaters (S-3), beach nourishment with maintenance material from inlets and the ICW (S-4), beach nourishment stabilized by groins (S-5), beach nourishment stabilized by submerged artificial rock outcropping (S-6), seawalls (S-7), stabilization of beaches and dunes by vegetation (S-8), upgrading or construction of sand transfer plants (S-9), and various combinations of the preceding structural alternatives (S-10), Six of these alternatives were eliminated from further consideration in the countywide GDM. The reasons for elimination of each alternative are summarized below:

(1) revetments (S-1) are a temporary solution which transfers the erosion problem further down the beach,

(2) beach nourishment stabilized by offshore breakwaters (S-3) was precluded in the countywide GDM because of cost, State regulations and environmental concerns,

(3) beach nourishment stabilized by submerged artificial rock outcroppings (S-6) was an intermediate plan but rejected due to cost,

(4) seawalls (S-7) were rejected due to high initial costs and expected loss of recreational beach if constructed,

(5) upgrading of the sand transfer plant (S-9) was not considered further at South Lake Worth Inlet due to the inability of an upgraded plant to offset the existing sand deficit, and

(6) the structural combinations plan (S-10) consisted of parts of S-2, S-5, and S-9 but was eliminated from the countywide GDM because "S-5 and S-9 cannot be considered current conditions" (USACE, 1987).

3.06 The remaining three structural alternative S-2 (beach nourishment with offshore sand), S-4 (beach nourishment with inlet and ICW sand), S-5 (beach nourishment stabilized by groins), and S-8 (stabilization with vegetation) were considered in greater detail in the development of this project since they partially meet all of the planning objectives and are discussed below along with the no-action alternative.

3.07 No-Action Alternative. Analysis in the countywide GDM showed that the no-action alternative did not address any of the planning objectives. However, this alternative is carried throughout the plan formulation process as a basis of comparing the effects of other alternatives. Studies by Olsen & Associates and Palm Beach County indicate that without project, upland development, State Road A1A, parks, dunes, dune vegetation and upland property would be damaged by extreme storm events.

3.08 Plans Retained for Further Consideration. The four structural alternatives retained for further consideration included beach nourishment using offshore borrow area (S-2), beach nourishment with maintenance material from inlets and ICW (S-4), beach nourishment stabilized by groins (S-5) and stabilization of beaches and dunes with vegetation (S-8).

3.09 The beach nourishment with maintenance material from the inlet and ICW alternative (S-4) is already being implemented. The South Lake Worth Inlet District periodically dredges the sand trap located inside South Lake Worth Inlet. The ICW in the vicinity of the inlet is proposed to be dredged by the USACE to maintain navigational depths. Both of these projects use the oceanic shoreline immediately south of the inlet as a spoil area.

3.10 The stabilization of beaches and dunes alternative (S-8) has been implemented to a limited extent and will be considered as part of this project. Boynton Beach, in a separate local project, has completed restoration of damaged dunes at Boynton Beach Oceanfront Park between FDNR monuments R-156 and R-157. The dune restoration project included exotic plant removal, fill placement, revegetation, and repair of dune walkovers. That project is separate from the proposed Federal shore protection project. Dune restoration to be considered as part of the Federal project includes exotic plant removal and reestablishment of pioneer zone vegetation.

3.11 Previous Plans Considered. A 2.6 mile, 1.5 million cy nourishment project was proposed in the past (c. 1980, see: A.V. Strock, 1981:v). The project was designed to increase dry beach width an average of 150 feet from the mean high water line (MHWL), utilizing sand from a 10,000 X 600 ft. rectangular borrow site 2,000-2,800 feet offshore, in 30-50 feet of water. The project was proposed beginning at the South Lake Worth Inlet and extending southward 2.6 miles to encompass the town of Ocean Ridge, Briny Breezes, and the municipal beach at Boynton Beach. The FDER expressed concern over turbidity on the offshore reefs and burial of portions of the nearshore hardbottom; an intent to deny the project application (DER #50-028505-9) was issued (see: CSA, 1984:4,6). The beach nourishment project was then modified to extend from the south side of the South Lake Worth Inlet, southward for a distance of 0.9 mile. Estimated average additional beach width for the modified project was 87 feet. A volume of 450,000 cy of sand was proposed from an offshore borrow site. Proposed revisions included the splitting of the borrow site into two parts to avoid patch reefs (CSA, 1984:4 & CSA's Fig. 2) and upgrading the existing sand transfer plant with jet pumps. The project was not constructed due to environmental objections by FDER and others.

3.12 In 1981, Arthur V. Strock & Associates (A.V. Strock, 1981:18-21) considered **structural alternatives** such as revetments, seawalls and bulkheads, offshore breakwaters, groins, nourishment options, vegetation, inlet modifications (including closing), and sand transfer plant improvements. Strock listed concerns with many options and concluded that "Beach restoration with vegetation has been chosen as the best alternative", with continuation of the sand transfer plant.

3.13 **Erosion control structures** have previously been considered or proposed for this area. Arthur V. Strock & Associates (1981:18-19) considered offshore breakwaters, but pointed out that they were discouraged by the State of Florida. A nearshore breakwater/artificial reef was also

recommended by Continental Shelf Associates (CSA, 1984:104), together with beach nourishment, improvements to the sand transfer plant and other items.

3.14 Several options of the earlier project were evaluated by CSA (1984:87). **Nourishment options** evaluated included no action, aragonite, offshore borrow site, borrow site within the ICW, and jet pumps associated with other sand transfer plant improvements. **Erosion control options** examined included no beach nourishment, beach revegetation, breakwaters and artificial reefs, and artificial seaweed. The option proposed by CSA was beach nourishment using sand from offshore sites, the addition of nearshore breakwaters/artificial reefs (for erosion control as well as mitigation for impacted hardbottom), enhancement of the sand transfer plant, and dune revegetation.

3.15 In 1987, the Corps of Engineers recommended a beach nourishment project between endpoints about 300 ft and 8,700 ft south of the south jetty. Initial fill requirements were 770,000 cy with 8-yr renourishment of 501,000 cy, both from an offshore sand source. The project would have created a 50-ft wide berm at +10 ft MLW. The State of Florida has "authorized" two projects in this area: a 300,000 cy feeder beach project along 3,000 ft south of the inlet and a 450,000 cy project between 3,000 ft and 7,860 ft south of the inlet (FDNR, 1988).

3.16 Recommended Plan. The recommended plan is to construct a feeder beach (beach nourishment) project that involves dredging material from an offshore borrow site located in 27-38 feet depths and placing about 784,300 cubic yards of sand along the beach beginning 210 feet north of FDNR monument T-152 and ending 120 feet south of FDNR monument R-159, a total of about 1.42 miles or 7,520 feet (Fig. 2). The borrow area configuration for the recommended project differs from previous plans in that it is contiguous and is closer inshore. The borrow site is located to protect nearby deep reefs, to avoid affecting shoreline wave regimes, to provide a good source of sediments compatible with the native local beach sands, and is located in an area where there are no cultural resources. The recommended plan incorporates 8 T-head groins to provide for long term stabilization of the shoreline and to reduce impacts to the nearshore hardbottom. The recommended plan differs from the currently authorized project due to the different borrow area, better quality sand, shorter project length, and use of groins to stabilize the shoreline and improve storm protection to the beach and upland property.

3.17 Five shore protection design alternatives were proposed by Olsen Associates (1993), one option was selected by Environmental Resources Management (alternative #5) and permit applications were submitted by the local sponsor. After concerns were raised by permitting agencies, numerical modeling using GENESIS was performed to evaluate physical performance and hardbottom impacts of 7 alternatives (see GDM Addendum Appendix 1, Engineering Design and Cost Estimates; (USACE, 1995b)). Hardbottom impacts were grossly approximated based upon 1992 nearshore hardbottom conditions and ranged from 16.5 acres for a project extending from T-152 to R-160 (as proposed in the 1987 GDM) to roughly 3.0 acres for a project with groins, a long north taper and a shortened south limit at R-159. Further refinement resulted in selection of a design which used 8 T-head groins spanning 1,800 feet of shoreline and 784,300 cy of beach compatible sand.

3.18 Using this proposed plan, an equilibrium toe of fill (ETOF) was calculated to provide more detailed estimates of potential impacts. An analysis of the most recent aerial imagery taken August 1994 resulted in a determination that the amount of nearshore hardbottom to experience long term direct impacts by the project would be 6.4 acres with an additional 2.9 acres of construction related short term direct impacts. This is based upon 1 observation and is a "snapshot" of conditions. To more accurately estimate the "average" level of impact over time, maps depicting hardbottom locations for seven years between 1983 and 1994 were used (Appendix D). Estimated fill impacts were calculated for both short and long term impacts for each year. The average amount of hardbottom in each category was weighted based upon the time intervals between observations to calculate a "time average". The time averaged amount of nearshore hardbottom that is expected to experience **long term negative impacts is 3.1 acres**. The time averaged amount of nearshore hardbottom that is expected to experience **short term impacts during and immediately after construction is an additional 3.2 acres**. Therefore, the estimates based on 1994 conditions can be considered a worst case situation while the time averaged values for 11 years would be considered typical conditions. Refer to section 5.12 for additional information on how these values were derived.

3.19 Beach nourishment with dredge material from maintenance of the inlet is already being implemented to a limited extent. The South Lake Worth Inlet District has dredged the interior sand trap twice, once in 1973 (32,500 cy) and again in 1989 (37,000 cy). The sand transfer plant provides sand periodically, but can only operate on days which northeasterly winds provide sand movement to the proximity of the plant. Both of these ongoing projects use the oceanic shoreline immediately south of South Lake Worth Inlet as a spoil area.

3.20 Analysis of Impacts of Selected Plan and No-Action Plan on Significant Resources. This project has been evaluated based upon impacts to environmental and socioeconomic resources mentioned in Section 122 of the River and Harbor Act of 1970, P.L. 91-611 and those resources identified by the public as being of interest. Table 2 compares the effects of the selected plan and no-action plan on each of the resources.

3.21 Construction of the selected alternative will result in enhancement of storm protection and some recreational benefits along this section of shoreline but would be achieved at the cost of losses and temporary stress to the nearshore environment. The creation of additional beach and additional nearshore habitat could be considered a trade-off for environmental losses.

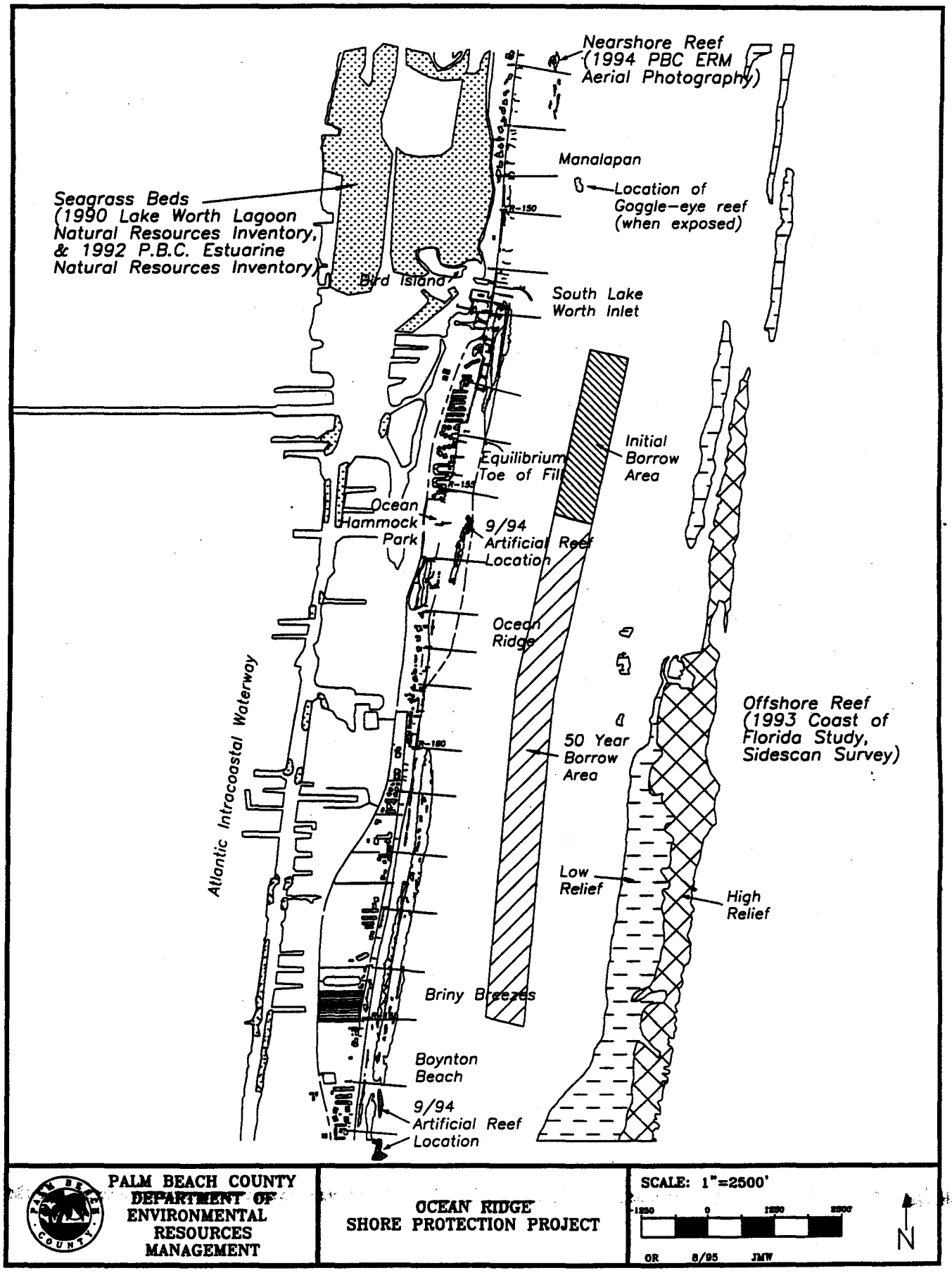

Figure 2 Environmental Resources in Project Vicinity

Table 2. Summary of Effects on Resources Identified in Section 122 of the River and Harbor Act of 1970, P.L. 91-611

	NO ACTION	SELECTED PLAN
Air quality	No effect.	Some decrease as number of visitor trips increase
Noise level changes	Slight decrease in tourism drops.	Increase due to larger crowds and more traffic; temporary increase during construction.
Water quality	No effect.	Temporary turbidity during construction and maintenance.
Manmade resources	Highways, buildings, and beach facilities subject to damage as beach erodes.	Protect structures from flooding and wave damage due to storms; and more coastal armoring.
Natural resources	Continued loss of beach/dune habitat to erosion.	Temporary disruption of beach, nearshore and ebb tidal shoal ecosystems.
Aesthetic values	Natural beach characteristics preserved but beach will narrow and portions of dunes may be eroded; remnants of concrete groins exposed.	Temporary unsightliness during construction and nourishment; wider, darker beach with dune protected; burial of intertidal outcrops and tidepools; additional armoring (groins).
Community cohesion	No effect.	Increase leisure opportunity; may intensify local govt. conflicts.
Public facilities	Continued erosion eventually affects existing facilities.	Increased need for public facilities as crowds and traffic increases; provides wider recreational beach.
Public services	Continued erosion eventually affects existing services.	Potential increased need for public safety services and water supply, sewer service, and other utilities as area develops and use increases.
Employment	Continued erosion causes job availability in beach areas to diminish.	Some jobs during construction; slight increase in service industry as visitation increases.

Table 2 (continued)

	NO ACTION	SELECTED PLAN
Taxes	Slight decrease in tourist tax revenue; avoid expenditure for construction buy may need to pay for repairs to public facilities due to storm damage.	Expenditure for project construction and maintenance; slight increase in tourist tax revenue; increase expenditure for public facilities and services as area develops.
Property values	Possible decline in project area	Stabilized beach should enhance beachfront property values.
Displacement of people, farms and business	No effect.	No effect.
Desired community and regional growth	Continued erosion may discourage additional coastal development.	Stabilized beach may induce additional coastal development.
Fish and wildlife	Erosion of beach/dune habitats.	Stabilization of beach/dune habitats; short term reduction in fish and invertebrate populations; nearshore impacts offset by artificial reef construction.
Threatened or endangered species	Increased erosion of sea turtle nests.	Potential for reduced erosion of sea turtle nest; compaction and scarp formation will affect sea turtle nesting and hatching success; slight increase in risk of manatee/vessel collision.
Recreation	Erosion reduces beach width and opportunities for sunbathing, volleyball and other beach activities.	Increased recreational beach width; temporary disruption of snorkeling, fishing, boating during construction and until after mitigation reefs are constructed.

3.22 Mitigation Alternatives. Environmental resources in the project area are described in Section 4 of this SEIS and potential impacts are discussed in Section 5. The following paragraphs discuss measures to be considered in developing a mitigation plan.

3.23 General mitigation alternatives typically include options such as (in preferential order): in-kind mitigation onsite, in-kind offsite, and offsite mitigation. Mitigation which does not approach being "like for like" will not be considered. The mitigation plan must address several issues: (1) like-for-like, (2) loss:replacement ratio, (3) timing of construction, (4) cost, (5) capability to construct an artificial reef, and (6) location.

(1) **"like-for-like"** mitigation would involve construction of hardbottom habitat at the depths which will be impacted or covered by the project. Such mitigation would likely be short-lived as it would also be impacted by the present and/or subsequent nourishment projects or perhaps experience natural burial and exposure as the present hardbottom does. Although this would replace what may be lost, the financial feasibility of creating ephemeral habitat would likely not be entertained, but rather creation of similar habitat in a more stable location.

(2) **loss:replacement ratio** recommended by USFWS in the Coordination Act Report (USFWS, 1994a) was 0.5 to 1. This was based on an earlier design with long term impacts limited to the hardbottom within the ETOF and was based on constructing a reef that had twice as much relief as the natural nearshore hardbottom impacted. Closer examination of the current design has resulted in identification of additional short term impacts outside the ETOF as a result of initial fill placement just south of the inlet. It is expected that the fill will be rapidly eroded from the hardbottom offshore of the ETOF and should be gone within months. A proposed mitigation ratio for this short term impact is 0.1 acre created for every acre of impact. (The rationale for this value is the duration of impact should be no more than (and probably much less than) one year which is 1/6 of the 6 year renourishment interval. If the ratio of 0.5 to 1 is for long term impacts, then if follows that an acceptable ratio for short term impacts may be 1/6th of 0.5 or 0.083. This value was then rounded to 0.1 to simplify calculations.)

(3) **timing of construction** of any hardbottom would most desirably be "up front", i.e., pre-project, before the impact to the natural hardbottom. Advanced construction would provide additional habitat to which displaced individuals could retreat as impacts were occurring. The problem in implementing this procedure is not knowing how much hardbottom of what type to construct due to not knowing with certainty what level of impact will occur, and to what geographic extent. Should an insufficient amount and/or type of reef be created pre-project, costs would substantially increase having to re-mobilize equipment, re-contract, etc., to complete or correct the mitigative task post-project. The concern of generating additional habitat pre-project becomes less significant if sufficient exposed hardbottom near the fill area is not impacted. This existing nearshore natural hardbottom would then serve as a refuge for displaced fauna.

(4) **cost** of the mitigation depends upon the amount of mitigation to be conducted, the type and location of material to be used, the proximity to shore, and season of construction (which affects sea state, construction duration, safety, etc.). Cost of construction of an artificial reef has been included in the GDM Addendum for this project.

(5) **capability** to construct the artificial reef has been demonstrated by the Artificial Reef Program administered by the local sponsor, PBCERM. The County has already constructed nearshore artificial reefs in the vicinity of the project which may be used as mitigation credit. Palm Beach County has the technical and financial capability to construct an after-the-fact mitigation project after it has been determined exactly how much impacts have occurred..

(6) **location** of the mitigation project is being considered between FDNR survey markers T-152.5 to R-153.5, and/or from R-155.5 to R-157. These locations:

(a) provide a stable platform to support an artificial reef (these areas have had exposed hardbottom in the past), therefore providing exposure of greater longevity,

(b) would provide an area which has a similar depth regime, wave action, currents, light availability, etc.,

(c) would not be impacted by fill from subsequent beach nourishment and inlet/ICW maintenance projects,

(d) would be bypassed by the ebb-tidal shoal, which exists offshore, extends southward and ties back into the beach at and south of FDNR survey markers R-155 to R-156, and

(e) would extend the existing persistently exposed hardbottom.

An artificial reef was constructed in 1994 (FDER and FDNR permit #502066066) offshore of Ocean Hammock Park (FDNR survey marker R-155.5) and south of Gulfstream Park (FDNR survey markers R-166 through R-167.5), to serve as potential mitigation for this project.

3.24 Mitigation Plan. Due to the complexity of predicting the level of project impact on nearshore hardbottom and associated fish and wildlife (see paragraph 5.12), post-project impact assessment and mitigation is the alternative of choice. The post-project nearshore hardbottom survey (mapping and aerial imaging) would occur 1 year post-project, to allow the beach fill to come to equilibrium. The difference in acreage from pre-project to post-project would determine the level of impact. An artificial reef would be constructed after the actual levels of impact have been determined based on this method. Impact assessment would occur one

year after nourishment, with construction of mitigative habitat no later than two years after nourishment.

3.25 A conservative estimate of the amount of nearshore hardbottom that would experience relatively long term impact is based upon 1994 conditions and are estimated to be 6.4 acres with an additional 2.9 acres experiencing short term impacts immediately after construction for a total potential impact of 9.3 acres. These values were used in the GDM to compute mitigation costs but probably reflect a worst case situation. Using a mitigation ratio of 0.5 acres created for every 1 acre of long term impact and 0.1 acres created for every 1 acre of short term impact yields a planning level estimate that 3.5 acres of mitigation may be required [(6.4 A. x 0.5)+(2.9 A. x 0.1)=3.5)] See section 5.12 for more details on calculation of impacts and mitigation amounts.

3.26 The nearshore hardbottom most likely to be impacted (see paragraph 5.17) is an area which normally experiences natural and artificial burial and re-exposure. True "like-for-like" mitigation would require creation of artificial substrate which also experiences periodic burial. To create such habitat would diminish its effectiveness at providing alternative habitat. Hardbottom will be created, if necessary, utilizing limestone boulders and/or a combination of concrete and limestone modules configured to approximate the habitat impacted by the project. This artificial reef would remain exposed throughout the year and would not be affected by subsequent beach fill. In this manner, the impacted species will be the most likely to experience long-term benefit from the mitigative effort.

3.27 Recommendations for mitigation have been made by the USFWS in the draft Coordination Act Report dated July 1994 and the USFWS Biological Opinion dated May 26, 1994 (USFWS, 1994a: 10-11, see Attachment 1). The recommendations are addressed below:

A. <u>Reef Mitigation</u>

1. Aerial photos will be taken just prior to beach construction and 1 year after construction to determine actual amount of nearshore hardbottom buried.

2. The USFWS estimated that 2 acres would be buried based upon 1992 nearshore hardbottom maps and an earlier project design and recommends that 0.5 acres of artificial reef be deployed prior to dredging. Using the current project design, data from 1994 (which has the highest amount of hardbottom within the toe of fill), and a lower mitigation ratio for short term impacts (as discussed in section 3.25 above, it is estimated that 3.5 acres of artificial reef may need to be created to offset impacts. Approximately 2 acres of nearshore artificial reef was constructed in 1994; some of which may serve as alternative refuge for organisms displaced during construction. After nourishment, the amount of impacts will be determined and the amount of mitigation to created will be based upon the mitigation ratios and any credits from the artificial reef constructed in 1994.

3. A mitigation ratio of 0.5:1 was recommended based upon the assumption that the artificial reef will have twice as much surface area above the scour zone as the natural nearshore hardbottom. Depending upon the rugosity (surface irregularity) of the rock used to construct the artificial reef it is possible that surface area will be more than twice that of the natural nearshore hardbottom which is generally flat with relatively low relief. Two mitigation ratios will be used for this project as discussed above in section 3.25.

4. For the mitigative effort to most closely approximate the habitat lost, the primary focus will be toward efforts which will accommodate those species which have been impacted. If the habitat created is of interest to divers and snorkelers, that recreational benefit would also be recognized, but is secondary to mitigation for impacted species and their habitat. Consideration will be given to reef design with the knowledge that snorkelers will be accessing the mitigative reef.

5. The artificial reef is proposed to be constructed of limestone boulders. The size and method of placement of the boulders (stacked modules vs. random placement) will be determined after evaluation of the artificial reef constructed in 1994 is completed.

6. The USFWS recommended construction of the mitigation reef inshore of the natural hardbottom exposed at R-156 to provide reef that is accessible to recreational divers and snorkelers and to possibly inhibit the seaward migration of sand onto the natural reef. This may not be feasible because the current design depicts the equilibrium toe of fill (ETOF) extending roughly 150 ft beyond the seaward edge of the natural reef. It is proposed to construct the mitigation area further offshore to reduce or eliminate any impacts within the ETOF on the artificial reef. Areas that are expected to have sufficient bedrock covered by a thin layer of sand may exist offshore of T-152.5 to R-153.5 and R-156 to R-157. Additional investigations will be necessary to confirm these locations.

7. A monitoring program for the artificial reef will be developed and implemented.

8. The monitoring program will be coordinated with the USFWS to promote a better understanding of the design effects on reef communities and facilitate an increasingly effective artificial reef construction, monitoring and maintenance strategy.

9. The cost of mitigation will be shared between the Federal and State governments and the local sponsor.

3.28 Mitigation Summary. An analysis of the project impact to nearshore hardbottom will be conducted during the year after construction. The analysis will compare pre-project conditions with post-project conditions and will identify the level of impacts immediately after construction, the level of impact 1 year after construction and the impacts associated with creation of groins. An artificial reef using limestone boulders will be created post-project to the extent determined by impact analysis utilizing a comparison of pre- and post-project extent of nearshore hardbottom, less that amount of habitat generated by the artificial reefs built in 1994 and the groins which may serve as habitat. In the Coordination Act Report, the USFWS has recommended equal surface area replacement, with an areal extent ratio of 0.5 to 1 (i.e., half the acreage, twice the relief). This ratio will be used to mitigate long term impacts while a ratio of 0.1:1 will be used to mitigate short term impacts. A possible mitigation site is located about 500 feet offshore of T-152.5 to R-153.5 and R-156 to R-157 (see Figure 3). Two artificial reefs have already been constructed (FDER and FDNR permit #502066066) in the nearshore at R-155.5 and R-166 to R-167.

The preceding discussion (paragraphs 3.22 through 3.28) was based upon information consistent with the permit applications submitted to FDEP. Since this DSEIS has been circulated, the FDEP has issued a water quality certification that requires 4.55 acres of mitigation and does not require monitoring to determine final mitigation amounts. The FDEP has given credit for 2.1 acres of artificial reef already constructed and 0.45 acres of habitat created when the groins are constructed. An additional 2.0 acres of low relief artificial reef will be constructed of a combination of limestone and concrete to meet the FDEP permit requirements. The USFWS has indicated that this plan is an adequate alternative to the mitigation plan described above and in their biological opinion provided that impacts are not significantly greater than predicted impacts based upon 1994 conditions. Refer to the FDEP permit in Attachment 2 for details.

4.00 AFFECTED ENVIRONMENT

4.01 General Environmental Conditions. A detailed environmental assessment (EA) was performed by PBCERM with a 3.86 mile long study area including Manalapan, Ocean Ridge and Gulfstream (PBCERM, 1994). Much of the information that follows compares/contrasts this **EA study area** with the smaller 1.42 mile **project area**. The project borrow area is seaward of the fill area, south of South Lake Worth Inlet, and is characterized by a fine sandy bottom. The borrow area configuration avoids patch reefs in the area. The project fill area begins 180 feet south of South Lake Worth Inlet to 120 feet south of FDNR survey monument R-159, a distance of about 1.42 miles, and is comprised of sandy beaches and nearshore sandy bottom with extensive nearshore hardbottom in the northerly section of that reach (FDNR survey markers T-152 to R-153.5 and occasionally to R-154), and additional acreage offshore of Boynton Public Beach (offshore of FDNR survey marker R-156). Figure 2 depicts the location of submerged environmental resources in the vicinity of the project.

4.02 Dune Environment. The primary dune within the project area varies in height from approximately 15 to 20 feet relative to the National Geodetic Vertical Datum (NGVD). It is generally narrow, where it exists, and has been eliminated in many places by construction of seawalls/revetments from the inlet southward about 3,900 feet to approximately 150 feet north of FDNR survey marker R-155. About 50% of the dunes in the proposed project area have been

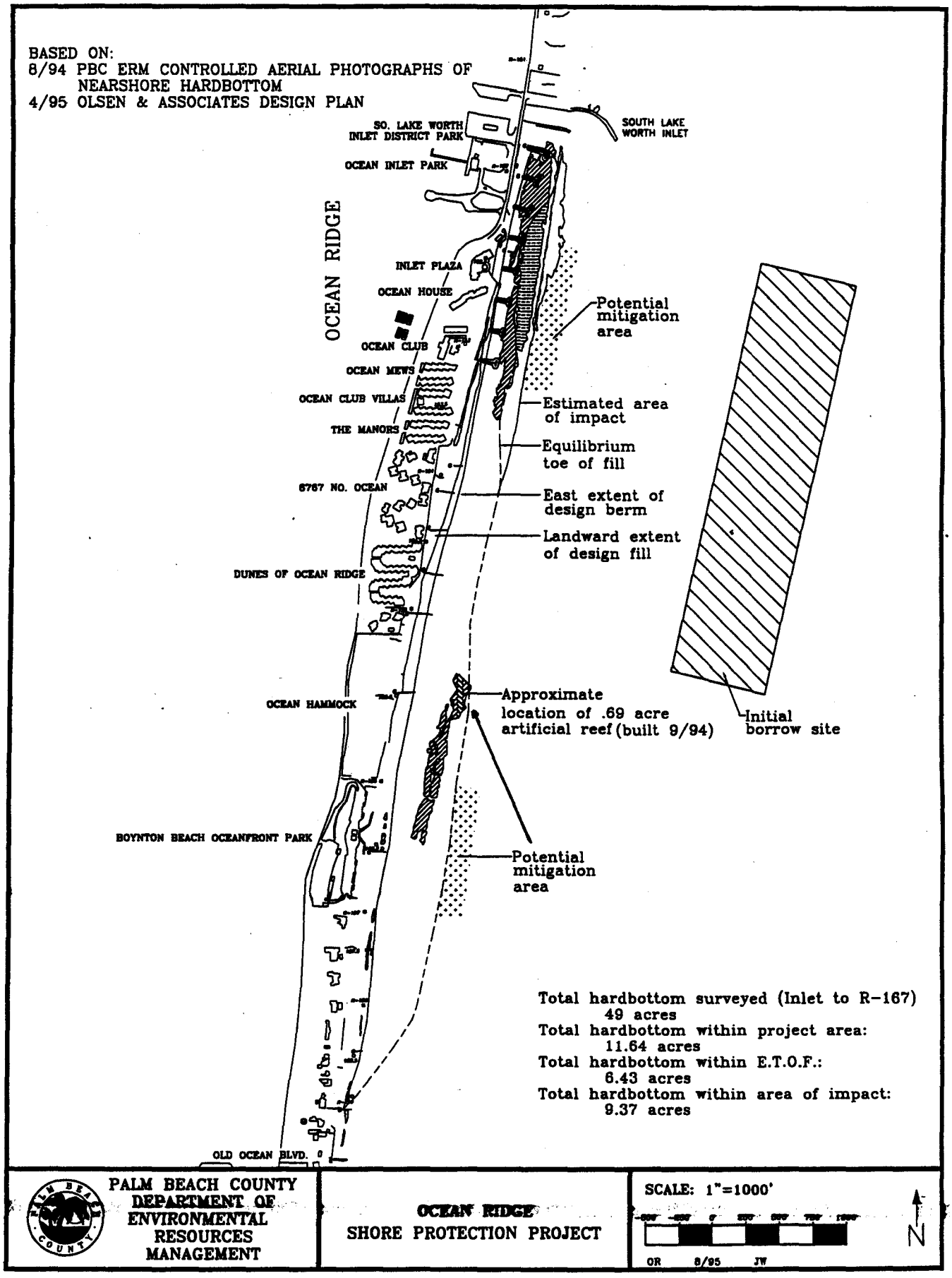

Figure 3 Nearshore Hardbottom, Artificial Reef and Toe of Fill Locations

eliminated by shore parallel armoring. Typical dune vegetation that remains is listed below (see paragraphs 4.16 and 4.17).

4.03 Ocean Hammock Park is an 11 acre parcel from about 200 feet south of FDNR marker R-155, southward to FDNR marker 156, a distance of about 1,130 feet. The area still possesses an east/west width of about 300 feet of undeveloped land, and is one of only three remaining coastal hammocks in Palm Beach County. The undeveloped park has a wide pioneer zone and well-established scrub and forest zones.

4.04 The crest and back side of the dunes remaining in the project area have been impacted or eliminated by development of the parks, roads, condominiums, and encroachment of exotic plants. At Ocean Inlet Park, on the south side of the inlet where Palm Beach County constructed a 774 foot long seawall, a very narrow band (~20 ft wide) of dune vegetation was planted between the seawall and the roadway. At Boynton Beach Oceanfront Park (FDNR markers R-156 to R-157, just south of Ocean Hammock Park), portions of the dune crest and backdune have been retained, and walkovers allow beach access while protecting the foredune.

4.05 Beach and Nearshore Environment. The beach is generally narrow, and rather steeply sloped (approximately 1v:8h, for the dry beach between +10 feet NGVD and MHWL) and primarily contains medium and fine sediments composed of quartz particles and carbonates. The mean sand grain size of the native beach profile (toe of dune to -12 feet water depth) in the project area is 0.32 mm with a silt content of <1% (Olsen, 1993). The mean sand grain size for the dry beach is 0.36 mm, with 0.08% silt/clay (defined as the amount of material passing through a #200 U.S. Standard sieve). Beach berm elevations in the Ocean Ridge vicinity are about +5 to +7 feet NGVD (FDNR surveys, 1990b). The beach and nearshore environment in the project area is influenced by several factors including: ebb and flood of tidal waters through the inlet with a mean tidal range of about 3 ft. and inlet current velocities of about 5 ft/sec (Olsen, 1990a:33; 1990b); waves average 2.4 ft in height (Olsen, 1990a:C-7); daytime air temperatures typically range from 45° to 96° F (7.2° to 35.5° C); and seawater temperatures typically average 65° to 86° F (18.3° to 30° C).

4.06 Nearshore Hardbottom Environment. The nearshore bottom is composed primarily of sand and areas of hardbottom, some of which is partially overlain by sand, the thickness and extent of which varies. This nearshore hardbottom is persistent in the northerly inshore sections (T-152 to R-154) of the EA survey area, as well as the southerly portions (R-160 to R-167) of Ocean Ridge. A reach of predominantly sandy bottom has persisted from R-154 to R-159 (Appendix D), with some hardbottom offshore of R-156. The tides, weather, and variable wave regime create daily changes in the location and degree of wave impact on the bottom. These factors and the shifting sands of the nearshore create an environment in a constant state of change.

4.07 Continental Shelf Associates (CSA, 1984:ii, 28) delineated a total of 49 acres of nearshore hardbottom within 600 feet of shore, between FDNR survey markers T-152 and R-165, in November of 1983. This incorrect acreage (pers. comm. P. Mikkelsen, ERM and J. Thompson, CSA) was divided into two sections: 25 acres to the north of FDNR survey marker R160, and 24

acres to the south. This incorrectly reported acreage was in part responsible for the previous level of concern for hardbottom impacts and FDER's "intent to deny" letter (see paragraph 3.05). Analysis by ERM of the same Nov. 1983 aerial (Appendix D) yielded 10.41 acres from the inlet to R-159 and 18.12 acres from R-159 to R-167, for a total of 28.53 acres.

4.08 The northerly area of nearshore hardbottom has changed from 19 acres in 1965 to 21 acres in 1973, to the 10 acres in 1983; no previous acreage was given for the southerly nearshore hardbottom area. The hardbottom changes in acreage was concurrent with the estimated (A.V. Strock, 1981) loss of 300,000 cu. yds. of sand per year from the 2.6 mile region from the inlet to Briny Breezes, 1974-1981. Vertical relief ranged from 2 inches to 2 feet. It was reported (CSA, 1984:vi) that "Completing the beach nourishment project proposed in 1983 will cover approximately 11.29 acres (4.57 ha) of nearshore beach rock and subject the remaining 13.71 acres (5.53 ha) to increased sedimentation"; however, this high level of burial and additional impact was based on the incorrectly high calculations of nearshore outcrop acreage mentioned above.

4.09 Aerial video and/or still photography was taken, when conditions allowed, (see Table 3) to provide additional data. Digital analysis was conducted of controlled altitude, vertical aerial photography conducted on 11/?/83, 2/16/85, 8/17/91, 8/20/92, 3/30/93, 7/22-23/93 and 8/9/94.

4.10 Field surveys were conducted by ERM in 1991, 1992 and 1993 to determine the areal extent of hardbottom offshore of the project area (defined as the landward and seaward limits of hardbottom including the sand bottom interspersed between individual outcrops). Diving observations were made along transects perpendicular (i.e., on established bearings) to shore at FDNR survey monuments. Average and maximum relief above the sand and the percent of actual hardbottom exposed within the areal extent of hardbottom (defined as hardbottom only and excluding sandy areas) was logged. Historical data was also examined in an effort to determine exposure locations, persistence and trends. Maps were computer generated from the data to determine hardbottom/sand mosaic acreage offshore of the project area.

4.11 The total hardbottom was calculated from August 1994 controlled aerial photos to be 11.64 acres within the proposed project area (inlet to R-159), with a total of approximately 49 acres within the entire 3.86 mile EA survey area (T-147 to R-167). These values have fluctuated somewhat over the past 10 years (Fig. 4), with the project area acreage being very consistent, ranging from 9.52 acres to 12.34 acres and averaging approximately 10.7 acres (Table 4). The primary changes have been observed at R-156 where the amount of hardbottom has increased from 0.04 acres in 1991 to 2.01 acres in 1994 (Fig. 5).

4.12 The nearshore hardbottom in this area can be generally described as low-relief platforms. These platforms were typically flat, with the surface at some locations being marked with solution holes of a foot or less in diameter and usually less than a few inches in depth into the rock. The relief varied along it's length, being typically low (½ foot) but 2-3 ft relief with ledges existed along the transect at FDNR marker R-154. The greatest relief is usually found along the edge of the hardbottom and tends to be highest along the landward portion of the reef.

Table 3. Ocean Ridge Environmental Survey and Report Dates Summary.

DATE	SURVEY IMPLEMENTED/MATERIAL AVAILABLE	SOURCE	REEF VIS.
MISC. DATES:			
2/__/68	Aerial photo, North Palm Beach-Boynton	DOT	poor
__/__/73	Aerial video & photo (DNR CCCL)		
5/14/81	ECL survey (types of uplands)	Strock	poor
5/26/81	Nearshore hardbottom survey by Walter Goldberg (report: 6/1/82)	Goldberg	
8/81	Environmental Assessment report by A.V. Strock & Assoc.		
9/3-4/81	Nearshore hardbottom survey by A.V. Strock & Assoc. (report: 11/81)	Strock	
11/81	Nearshore hardbottom survey (of 9/3-4/81) report by A.V. Strock & Assoc.	Strock	
12/81	Nearshore hardbottom survey by A.V. Strock & Assoc. (report:4/26/82)	Strock	
2/12/82	FDER field survey in response to permit application (report: 8/11/82)	FDER	
3/23/82	Nearshore hardbottom survey by PBCHD (J. Barry) & FDER (L. O'Donnell, D. Deis, H. Rudolph)		
3/26/82	Offshore reef survey by PBCHD (J. Barry, R. Clinger), FDER (L. O'Donnell) & Strock & Assoc. (T. Campbell, R. Spadoni)		
4/26/82	Nearshore hardbottom report (letter to PBC/R. Clinger) regarding September 1981 and December 1981 surveys.	Strock	
6/1/82	Report (letter to PBC/Robert Clinger) of Goldberg's 5/26/81 nearshore hardbottom survey	Goldberg	
8/11/82	Permit Application Appraisal Report (references 2/12/82 survey)	FDER	
8/30/82	Nearshore hardbottom survey, R. Liberti, J. Barry, D. Deis, L. O'Donnell		
10/6/82	Nearshore hardbottom survey, A.V. Strock & Assoc., FDER (Tallahassee & West Palm Beach staff), and PBCHD		
10/7/82	Offshore reef survey, A.V. Strock & Assoc., FDER (Tallahassee & West Palm Beach, and PBCHD)		
10/11/82	Nearshore hardbottom and offshore reef report by Walter Goldberg	Goldberg	
10/6/82	Hydrographic review by FDER (P. Sterling), PBC, & Strock & Assoc. (report: 10/20/82)	FDER	
10/20/82	"Hydrographic review Addendum" DER interoffice memo, RE: 10/6/82 site visit (P. Sterling to file)	FDER	
12/23/82 & 1/5/83	Nearshore hardbottom survey by FDER staff (D. Deis, K. McCarron; report:12/27/82)	FDER	
12/27/82	Nearshore hardbottom report (interoffice memo) from 12/23/82 & 1/5/83 survey	FDER	
	[NOTE: dates are contradictory... report pre-dates second survey]	FDER	
11/83	Controlled altitude, vertical still photos, PBC coastline, 1:300	CSA (4/84)	
6/13/83	Nearshore hardbottom field observation and report (PBC, FDER, Strock & Assoc)	Strock	
12/83	Offshore u/w survey (DNR# R-156, R-159, R-162)	CSA (4/84)	
1/26/84	Nearshore hardbottom survey (DNR #T-152 to R-160)	CSA (4/84)	
4/4/84	Environmental Assessment report by Continental Shelf Associates	CSA	
2/16/85	Controlled altitude, vertical still photos, PBC coastline, 1:300	ERM	
7/01/86	Aerial video	PBCHD	good
__/__/87	Aerial video (USACOE)	PBCHD	fair
1987	Countywide nearshore hardbottom survey (Vare, 1991)	Vare	
11/10/88	Nearshore hardbottom survey, u.w + video (DNR #T-152 to R-156)	ERM	
6/13/89	Aerial photo & video	ERM	excellent
7/28/89	Coastal Construction Control Line (CCCL) aerial survey	FDNR	
11/15/89	Nearshore hardbottom survey, underwater onsite (DNR #T-152 to R-152.5)	ERM	
1990:			
4/02/90	Aerial photo & video	ERM	good
8/90	Offshore reef side scan survey by Ocean Probe	OCEAN PROBE	
8/29/90	Aerial video	ERM	excellent
9/26/90	Aerial video	ERM	fair
10/16/90	Aerial video	ERM	good
10/23/90	Aerial video	ERM	
11/06/90	Nearshore hardbottom survey, video (DNR #R-155 to R-160)	ERM	
11/07/90	Nearshore hardbottom survey, video (DNR #R-153 to R-154)	ERM	
7/90	Beach profile survey	FDNR	

Table 3. Ocean Ridge Environmental Survey and Report Dates Summary, continued.

DATE	SURVEY IMPLEMENTED/MATERIAL AVAILABLE	SOURCE	REEF VIS.
1991:			
11/14/91	Aerial video	ERM	good
4/04/91	Still shoreline photography, 4 sites: inlet, R-156, R-161, R-166	ERM	
4/18/91	Aerial video	ERM	good
4/24/91	Aerial video	ERM	good
8/07/91	Nearshore hardbottom survey: algae		
8/13,15,20-22/91	Nearshore hardbottom survey, u.w. (DNR #R-147 to R-167)	ERM	
8/17/91	Controlled altitude, vertical still photos, PBC coastline, 1:300	ERM	excellent
8/30/91	Nearshore hardbottom survey	ERM	
9/3/91	Nearshore hardbottom groundtruthing of Aug. 17, 1991 aerials, from T-152 to R-154, R-162 to R-165	ERM	
10/04/91	Still shoreline photography, 4 sites: inlet, R-156, R-161, R-166		
11/26/91	Nearshore hardbottom survey	ERM	
1992:			
4/13/92	Still shoreline photography, 4 sites: inlet, R-156, R-161, R-166	ERM	
8/18/92	Nearshore (8 ft. depth) soft bottom infaunal benthos samples	ERM	
8/18/92	Goggle-eye offshore reef overview & underwater video	ERM	
8/19/92	Offshore (40 ft. depth) soft bottom infaunal benthos samples	ERM	
8/20/92	Controlled altitude, vertical still photos, PBC coastline, 1:300	ERM	excellent
8/21/92	Nearshore hardbottom transect surveys	ERM	
8/31/92 - 9/1/92	Native beach sand collection	ERM	
9/92 - 6/93	Offshore archeological and magnetometer field survey	KARELL ARCH. SVC.	
10/23/92	Still shoreline photography, 4 sites: inlet, R-156, R-161, R-166	ERM	
1993:			
2/__/93	Offshore reef side scan survey by USACOE (for Coast of Florida study)	USACOE/CSA	
3/30/93	Controlled altitude, vertical still photos, PBC coastline, 1:300	ERM	excellent
4/28/93	Still shoreline photography, 4 sites: inlet, R-156, R-161, R-166	ERM	
6/28/93	Offshore vibracore samples taken, #ORCB-21 to ORCB-30	ERM	
7/22-23/93	Controlled altitude, vertical still photos, PBC coastline, 1:300	ERM	excellent
8/24/93	Underwater video & still photos of nearshore hardbottom within proposed project ETOF only	ERM	fair
8/27/93	Shoreline still photography, at 11 sites: inlet to R-167		
10/06/93	Offshore archeological and magnetometer survey report printed	KARELL ARCH. SVC.	
10/19-22/93	Offshore reef location groundtruthing (of 2/93 sidescan)	USACOE, CSA	
10/25/93	Still shoreline photography, 4 sites: inlet, R-156, R-161, R-166		
1994:			
8/09/94	Controlled altitude, vertical still photos, PBC coastline, 1:300	ERM	fair

Abbreviations:

DOT	Department of Transportation, Florida
DNR #	Florida Dept. Natural Resources (now FDEP) survey monument numbers
ERM	Palm Beach County Dept. of Environmental Resources Management
PBCHD	Palm Beach County Health Department

Table 4. Temporal Analysis of Ocean Ridge Nearshore Hardbottom Acreage.

PHOTOGRAPHY DATE	TOTAL SURVEY AREA: R-147 TO R-167						PROJECT AREA: INLET TO R-159					
	TOTAL NSHB (ACRES)	AVG. NSHB AREA (ACRES)	X	EXPOSURE DURATION (DAYS)	=	HARDBOTTOM EXPOSURE (ACRE-DAYS)	PROJECT NSHB (ACRES)	AVG. NSHB AREA (ACRES)	X	EXPOSURE DURATION (DAYS)	=	HARDBOTTOM EXPOSURE (ACRE-DAYS)
Nov. 1983	28.53						10.41					
		29.20		458		13,374		9.97		458		4,564
Feb. 16, 1985	29.87						9.52					
		31.32		2,374		74,354		10.64		2,374		25,247
Aug. 17, 1991	32.77						11.75					
		38.15		369		14,077		11.51		369		4,247
Aug. 20, 1992	43.53						11.27					
		43.39		222		9,633		10.48		222		2,327
Mar. 30, 1993	43.25						9.69					
		38.73		114		4,415		11.81		114		1,346
July 22-23, 1993	33.92						12.34					
		46.13		383		17,666		10.67		383		4,085
Aug. 9, 1994	49.00						11.64					
TOTALS:				3,920		133,518				3,920		41,816
TIME AVERAGED ACRES:						34.06						10.67

Note: "NSHB" = Nearshore Hardbottom

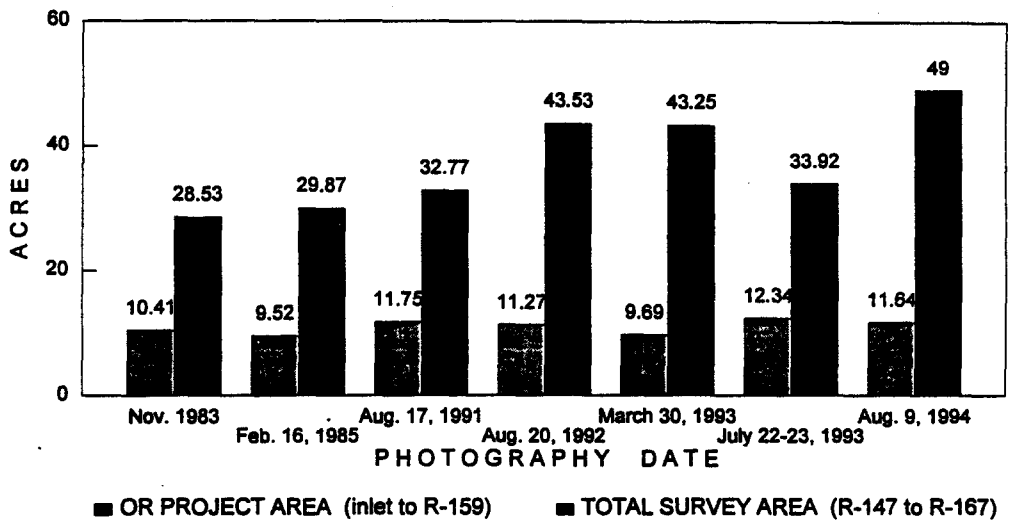

Figure 4. Ocean Ridge Nearshore Hardbottom Acreage

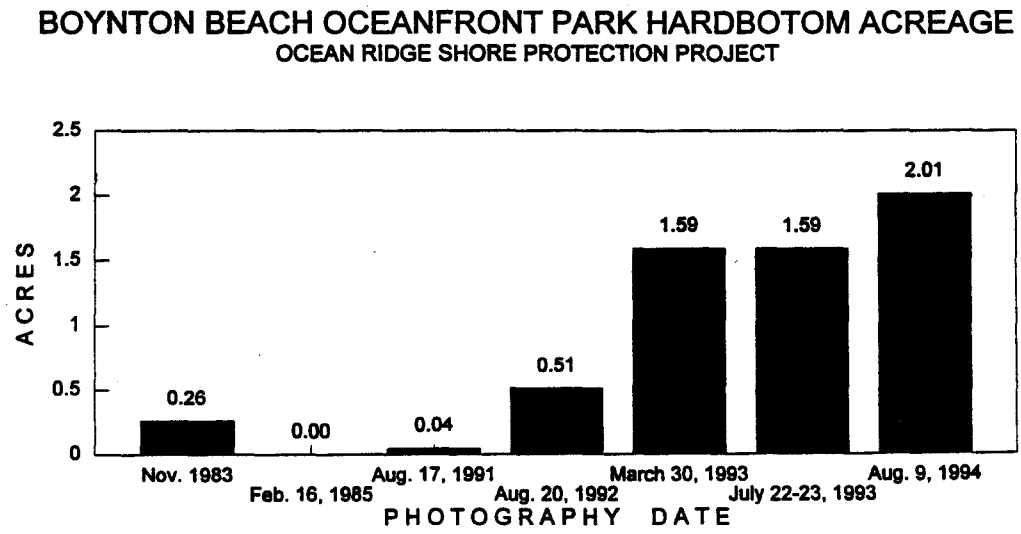

Figure 5. Boynton Beach Oceanfront Park Nearshore Hardbottom Acreage

4.13 Inlet Related Features. The ebb and flood of the tidal waters through the South Lake Worth Inlet flushes the northerly end of the project area with oceanic and estuarine waters with varying degrees of velocity associated with tidal currents. The presence of the inlet is primarily responsible for the shoreline erosion immediately south of the inlet. The north jetty restricts longshore sand transport from the north. On incoming tides sand is flushed into the inlet by the westerly currents entering the inlet, and sand is forced offshore by easterly currents exiting the inlet on low tides. Current speeds diminish with increased distance away from the restrictive limits of the inlet, causing the water to drop its sediment load. Shoaling therefore results both inside and offshore of the inlet. Some of the sand entering may be recovered by periodic maintenance dredging of the inlet and Intracoastal Waterway. Much of the beach sands directed offshore are lost from the littoral system. Some of the offshore, subtidal shoal sands migrate southward typically outside of the nearshore hardbottom, re-joining the shoreline at about FDNR survey markers R-155 to R-156.

4.14 The region of the Lake Worth estuary inside the inlet contains large shoals which support extensive seagrass beds (Dames & Moore, 1990: Fig. 9H), particularly to the north. Much of the sandy bottom of this region was created and/or augmented by shoaling due to sand movement into the lagoon via the inlet. These shoals were once considered as a sand source for beach renourishment, but the option was dismissed due to the presence of extensive seagrass beds.

4.15 Fish and Wildlife Resources.

4.16 Dune Community. The crest and back side of the dune have been impacted by development of roads, parks, condominiums, single family residences and encroachment of exotic plants. In most locations, invasive exotic plant species, such as St. Augustine grass (*Stenotaphrum secundatum*) and beach naupka (*Scaevola frutescens*), dominate the dune crest and back dune (PBCERM, 1991). The undeveloped area in the Ocean Hammock Park supports remnant Coastal Strand and Maritime Hammock communities which are among the most rapidly disappearing plant communities in Florida (FDNR, 1990a). Remnant scrub zone vegetation, dominated by sea grapes (*Coccoloba uvifera*) is also present in the southern half of the project area. With the exception of Ocean Hammock Park, virtually all sea grapes in the project area have been impacted by hedging to allow upland property owner's a view of the ocean.

4.17 The foredune has been eliminated in most locations with the exception of Ocean Hammock Park. Where present, the vegetation includes sea oats (*Uniola paniculata*), beach bean (*Canavalia maritima*), railroad vine (*Ipomea pes-caprae*), beach star (*Remirea maritima*), spider lily (*Hymenocallis latifolia*) and beach elder (*Iva imbricata*). Some exotic plant species, such as Australian pine (*Casuarina* spp.) and Brazilian pepper (*Schinus terebinthifolius*), are found on the foredune.

4.18 Wildlife that is expected to occur in the beach dune, coastal strand and maritime hammock communities include small mammals, birds, reptiles and invertebrates. The mammals include raccoon, opossum, fox, and squirrel. Typical birds that can be observed include osprey, brown pelican, fish crows, gulls, herons, doves, terns and sandpipers. Reptiles include sea turtles, gopher tortoise, various snakes and lizards. Invertebrates expected to occur include ghost crabs, various insects and spiders (PBCERM, 1991; FDNR, 1990a).

4.19 Migratory Birds. A number of migratory birds are known to utilize the project area shoreline and the offshore waters. The project area is used by these and other birds for foraging and resting. No migratory birds are known to nest in the project area. The migratory birds most commonly observed in the project area include the sanderling, ruddy turnstone, ring-billed gull, least tern, Sandwich tern, brown pelican and yellow-crowned night heron.

4.20 Nearshore Softbottom Community. Sampling was performed by Palm Beach County Department of Environmental Resources Management (PBCERM) to characterize the softbottom benthic macroinvertebrate infaunal community. Samples (10 replicate 3 inch diameter cores, each of 0.00456 m^2 surface area) were taken by hand-coring on August 18, 1992 at a water depth of -8 ft to determine the communities associated with the shallow subtidal region. These samples yielded a total of 22 species (139 individuals) of macroinvertebrates. The community was dominated by the polychaetes *Paraonis* sp. A, *Dispio uncinata* and the bivalve *Tellina gouldi*. The remaining species included 8 that could be considered common (Table 5). Average density was 3,048 individuals/m^2.

4.21 Offshore Softbottom Community. Sampling the offshore bottom community at -40 ft was performed in an identical manner as the nearshore samples. These samples yielded a total of 33 species (949 individuals) of macroinvertebrates. The community was tremendously dominated by an ectoproct (bryozoan) and the analyses for diversity were run twice, with and without the ectoprocts listed (Table 6 and Table 7). Each ectoproct colony was counted as one individual, and accounted for 17,741 "individuals"/m^2. Eliminating the ectoprocts from consideration yielded 32 species (140 individuals). Aside from the ectoprocts, the 40 foot depth sample was also dominated by the polychaete *Paraonis* sp. A, with an amphipod, *Trichophoxus epistomus*, quite common. A polychaete (*Chone* sp. A), and two bivalves (*Periploma margaritaceum*, and *Tellina gouldi*) were also fairly common. The average density was 20,811 individuals/m^2, including and counting the ectoproct colonies as individuals, and an average of 3,070 individuals/m^2 without the ectoprocts.

4.22 Nearshore Hardbottom Community. The nearshore hardbottom found in the project area serves as an area of attachment for sessile epibiota and as habitat for mobile macrofauna (particularly fish). Field surveys were published by A.V. Strock (1981), Vare (1991), and Continental Shelf Associates (1984) to identify the biological communities using the hardbottom in the project area. Additional unpublished data was collected by ERM on 11/6,10/88, 11/06/90, 8/13,20,21,22/91, 11/26/91 and 8/24/93.

Table 5. Ocean Ridge Nearshore Softbottom Diversity, Richness and Evenness.

Diversity according to Shannon & Weaver, 1963
Species richness according to Margalef, 1958
Species evenness according to Pielou, 1966

OCEAN RIDGE: OR-SB-78A-J, August 18, 1992, 8 FT DEPTH
Composite list, from 10 replicates taken.

Number of species =	22	Species diversity =	3.24709
Number of individuals =	139	Species richness =	4.25577
		Species evenness =	0.72814

DOMINANCE SORTED SPECIES LIST

Count	Taxon	No. Ind.	% Ind.
1	*Paraonis* sp. A	33	23.74
2	*Dispio uncinata*	31	22.30
3	*Tellina gouldi*	30	21.58
4	*Leitoscoloplos fragilis*	7	5.04
5	*Trichophoxus epistomus*	6	4.32
6	*Houstorius* sp. A	4	2.88
7	*Ancinus depressus*	3	2.16
8	*Armandia* sp. A	3	2.16
9	Bivalvia undet. sp. D	3	2.16
10	Bivalvia, unidentifiable	3	2.16
11	*Olivella* sp.A	3	2.16
12	*Platyishnopus* sp. A	2	1.44
13	*Spio pettibonae*	2	1.44
14	*Albunea paretti*	1	.72
15	*Bathyporeia* sp. A	1	.72
16	~~Caridea undetermined sp. J~~	1	.72
17	Eusyllinae undet. sp. A	1	.72
18	*Leitoscoloplos* foliosus	1	.72
19	*Microspio* sp. A	1	.72
20	*Renilla* sp. A	1	.72
21	Spionidae undet. sp. B	1	.72
22	*Thalenessa* sp. A	1	.72

Table 6. Ocean Ridge Offshore Softbottom Diversity, Richness and Evenness.

Diversity according to Shannon & Weaver, 1963
Species richness according to Margalef, 1958
Species evenness according to Pielou, 1966

OCEAN RIDGE: OR-SB-79A-J, August 19, 1992, 40 FT DEPTH
Composite list, from 10 replicates taken.

Number of species = 33
Number of individuals = 949

Species diversity = 1.13939
Species richness = 4.66785
Species evenness = 0.22587

DOMINANCE SORTED SPECIES LIST

Count	Taxon	No. Ind.	% Ind.
1	Ectoprocta sp. A	809	85.25
2	*Paraonis* sp. A	56	5.90
3	*Trichophoxus epistomus*	13	1.37
4	*Chone* sp. A	8	.84
5	*Periploma margaritaceum*	7	.74
6	*Tellina gouldi*	7	.74
7	Bivalvia undet. sp. C	4	.42
8	*Dispio uncinata*	4	.42
9	*Houstorius* sp. A	4	.42
10	*Aricidia* sp. A	3	.32
11	Bivalvia undet. sp. B	3	.32
12	*Leitoscoloplos fragilis*	3	.32
13	*Tivella floridana*	3	.32
14	*Acteocina candei*	2	.21
15	*Lepidactylus* sp. A	2	.21
16	*Lucina pectinata*	2	.21
17	*Tellina versicolor*	2	.21
18	*Thalenessa* sp. A	2	.21
19	*Ampelisca* sp. A	1	.11
20	Amphipoda, unidentifiable	1	.11
21	*Aricidia philbinae*	1	.11
22	Cephalaspid sp. A	1	.11
23	*Cumella* sp. A	1	.11
24	*Divaricella quadrisulcata*	1	.11
25	*Ervilia concentrica*	1	.11
26	Eusyllinae undet. sp. A	1	.11
27	Maldanidae undet. sp. A	1	.11
28	*Olivella* sp.A	1	.11
29	*Platyishnopus* sp. A	1	.11
30	*Prionospio cristata*	1	.11
31	*Prionospio davi*	1	.11
32	*Prionospio fallax*	1	.11
33	*Strigilla* sp. A	1	.11

Table 7. Ocean Ridge Offshore Softbottom Diversity, Richness and Evenness, with Ectoprocts Eliminated from Analysis.

Diversity according to Shannon & Weaver, 1963
Species richness according to Margalef, 1958
Species evenness according to Pielou, 1966

OCEAN RIDGE: OR-SB-79A-J, August 19, 1992, 40 FT DEPTH
Composite list, from 10 replicates taken.

Number of species =	32	Species diversity =	3.63185
Number of individuals =	140	Species richness =	6.27322
		Species evenness =	0.72637

DOMINANCE SORTED SPECIES LIST

Count	Taxon	No. Ind.	% Ind.
1	Paraonis sp. A	56	40.00
2	Trichophoxus epistomus	13	9.29
3	Chone sp. A	8	5.71
4	Periploma margaritaceum	7	5.00
5	Tellina gouldi	7	5.00
6	Bivalvia undet. sp. C	4	2.86
7	Dispio uncinata	4	2.86
8	Houstorius sp. A	4	2.86
9	Aricidia sp. A	3	2.14
10	Bivalvia undet. sp. B	3	2.14
11	Leitoscoloplos fragilis	3	2.14
12	Tivella floridana	3	2.14
13	Acteocina candei	2	1.43
14	Lepidactylus sp. A	2	1.43
15	Lucina pectinata	2	1.43
16	Tellina versicolor	2	1.43
17	Thalenessa sp. A	2	1.43
18	Ampelisca sp. A	1	.71
19	Amphipoda, unidentifiable	1	.71
20	Aricidia philbinae	1	.71
21	Cephalaspid sp. A	1	.71
22	Cumella sp. A	1	.71
23	Divaricella quadrisulcata	1	.71
24	Ervilia concentrica	1	.71
25	Eusyllinae undet. sp. A	1	.71
26	Maldanidae undet. sp. A	1	.71
27	Olivella sp.A	1	.71
28	Platyishnopus sp. A	1	.71
29	Prionospio cristata	1	.71
30	Prionospio dayi	1	.71
31	Prionospio fallax	1	.71
32	Strigilla sp. A	1	.71

4.23 Attached Biota. The biological community attached to nearshore hardbottom in the project area is transitional in nature, and includes octocoral (gorgonian) component typically not found on the nearshore hardbottom in northern Palm Beach County but found more prevalently to the south. A total of 34 species of invertebrates were logged on pre-project surveys of the nearshore hardbottom. Higher densities and diversities were found just south of the inlet (T-152 to R-153). The outer nearshore hardbottom at this location supported a consistent but sparse coverage of gorgonians in 1991, which were absent on the middle and inner nearshore tracts. One species of significant commercial and recreational interest, the spiny lobster, is regularly found in this habitat.

4.24 The hardbottom exposure offshore of Boynton Beach Oceanfront Park consisted of approximately 2 acres (Aug. 9, 1994) of very low relief, with much of the outcrop covered with a thin layer (1-2 inches) of sand. The attached biota consisted of low relief algae within the inner half of the area, while the outer half typically had dense concentrations (about $10/m^2$) of small gorgonians, about 4-6 inches in height.

4.25 The macroalgal coverage was typified by low-growth plants, generally of filamentous or encrusting forms. During an ERM survey in August of 1991, 7 species of algae were noted, while a similar survey in August of 1993 generated a list of 12 species (11 of which were not on the 8/91 list); 11 species were listed by CSA (CSA, 1984:49), and 6 taxa were logged by Vare (1991), for a total of 25 different species listed from 5 surveys (Table 8). The area seems to support a similar number of species as occurs in other areas within Palm Beach County, such as Coral Cove (23 species, 1990 ERM survey; 23 species, CSA, 1985:18) or Jupiter/Carlin (25 species, 1990-1991 ERM surveys), or Jupiter Island (30 species, CSA, 1987). The Ocean Ridge survey area in general, and particularly the area south of marker R-154, is grazed very heavily. Schools of Doctorfish were often seen scouring the bottom for food. The algal coverage seems to be cropped nearly as fast as it can grow.

4.26 Fishes. CSA (1984:104) found the exposed nearshore hardbottom to be "relatively depauperate" of fish. However, the CSA survey was conducted in the winter (Jan.), while the summer (Aug.) survey by ERM staff found 2¼ times the number recorded by CSA, and logged 20 species which had not been recorded on previous surveys. Vare (1991) listed 59 species of fish from the Ocean Ridge EA survey area, while CSA (1984) listed 38 species. ERM's survey in 1988 yielded 31 species, while the subsequent ERM surveys (see Table 3) yielded 43, 87, and 88 species, respectively (Table 9). The Ocean Ridge surveys have provided a composite list of 116 species of fish associated with the nearshore hardbottom. A.V. Strock (1981:App. 4) listed 584 species of fish that may inhabit or frequent the area (the list was referenced to the "Palm Beach Area" rather than to Ocean Ridge in particular).

Table 8. Ocean Ridge Nearshore Hardbottom Algae.

SPECIES	CSA 1984	C. VARE 11/10/88	PBC ENV. RES. MGMNT. 11/90	08/07/91	08/24/93
Acanthophora sp.	-	-	-	+	-
Bryopsis sp.	-	-	+	+	-
Bryothamnion s. imbricata	+	-	-	-	+
Bryothamnion triquetrum	-	-	+	-	-
Caulerpa racemosa	-	+	-	-	-
Caulerpa sertularioides	-	+	-	+	-
Chaetomorpha linum	+	-	-	-	+
Cladophora sp.	+	-	-	-	+
Codium sp.	-	+	-	-	-
Dictyota bartayresii	-	-	+	-	-
Dictyota sp.	-	+	+	-	-
Gelidiopsis panicularis	+	-	-	+	+
Gelidium americanum	-	-	-	+	-
Hypnea spinella	+	-	-	-	+
Hypoglossum tenuifolium	+	-	-	-	+
Jania rubens	+	-	-	-	+
Lyngbya sp.	-	+	-	-	+
Padina profunda	+	-	-	-	+
Padina sp.	-	-	+	-	-
Ulva lactuca	+	-	-	-	+
Wrangelia argus	+	-	-	-	+
filamentous green alga	-	-	+	-	-
filamentous red alga	-	+	+	+	-
unidentified coralline alga	+	-	-	-	+
unidentified red alga	-	-	-	+	-
TOTAL # OF TAXA = 25	11	6	7	7	12

4.27 The composite list of 116 species of fish at Ocean Ridge is greater than at other sites studied by ERM, e.g. Coral Cove (62 species), Jupiter/Carlin Parks (77 species), and North Boca (86 species). This high number of species can be partially explained by a greater level of study effort compared to the other locations. Of the 116 species logged for Ocean Ridge, 61 species can be considered primary reef species, 21 secondary reef species (Starck, 1968), and 12 transient species, and 22 "other" species of unknown categorization.

4.28 Commercial fishermen fish for bait and food fish from the area, such as Ballyhoo (Hemiramphus brasiliensis), Balao (H. balao), Bigeye scad/goggle-eye (Selar crumenophthalmus), Blue runner (Caranx crysos), Silver porgy (Diplodus argenteus), croakers (Sciaenidae), and grunts (Pomadasyidae), black and silver mullet (Mugil spp.), threadfin herring (Opisthonema oglinum), and menhaden (Brevoortia spp.). Recreational fishermen take these species and others including snook (Centropomus undecimalis), jacks (Carangidae), snappers (Lutjanidae) and barracuda (Sphyraena barracuda). Tropical fish are also taken by divers for use in the aquarium industry. The area is used as a breeding ground for damselfishes, and several nests were present during the survey on 8/13/91 at the north end of the nearshore hardbottom system (just south of the inlet).

Table 9. Ocean Ridge Nearshore Hardbottom Fish.

TLC*	COMMON NAME	SPECIES	DATA SOURCE CSA, 1984	VARE 1991	ERM, 11/88	ERM, 08/91	ERM, 08/93	OCCURRENCE
greenj	greenies	"Greenies"	-	-	-	-	1	1
abusax	sergeant major	Abudefduf saxatilis	1	1	1	1	1	5
abutau	night sergeant	Abudefduf taurus	-	-	-	1	-	1
acapol	honeycomb cowfish	Acanthostracion polygonius	-	-	-	1	-	1
acabah	ocean surgeon	Acanthurus bahianus	1	1	-	1	1	4
acachi	doctorfish	Acanthurus chirurgus	1	1	1	1	1	5
acacoe	blue tang	Acanthurus coeruleus	-	1	-	1	1	3
aetnar	spotted eagle ray	Aetobatus narinari	-	-	-	1	-	1
aluscr	scrawled filefish	Aluterus scriptus	-	-	1	1	-	2
anisur	black margate	Anisotremus surinamensis	-	1	-	1	-	2
anivir	porkfish	Anisotremus virginicus	1	1	1	1	1	5
apomac	flamefish; cardinalfish	Apogon maculatus	-	1	-	1	-	2
arcpro	sheepshead; convict fish	Archosargus probatocephalus	-	-	-	1	-	1
balcap	gray triggerfish	Balistes capriscus	1	1	1	1	1	5
balvet	queen triggerfish	Balistes vetula	-	-	-	1	-	1
bodruf	Spanish hogfish	Bodianus rufus	-	1	-	-	-	1
canpul	orangespotted filefish	Cantherhines pullus	1	1	1	1	1	5
cansuf	ocean triggerfish	Canthidermis sufflamen	-	1	-	-	1	2
carbar	yellow jack	Caranx bartholomaei	1	1	1	1	1	5
carcry	blue runner	Caranx crysos	-	1	1	1	1	4
carhip	jack crevalle	Caranx hippos	-	-	-	1	-	1
carrub	bar jack	Caranx ruber	-	1	-	1	-	2
chacap	four-eyed butterflyfish	Chaetodon capistratus	-	1	-	-	-	1
chased	reef butterflyfish	Chaetodon sedentarius	-	1	-	-	-	1
chrsp.	chromis	sp.	-	-	-	1	-	1
dacvol	flying gurnard	Dactylopterus volitans	1	-	-	-	-	1
dasame	southern stingray	Dasyatis americana	1	-	-	-	-	1
diohol	balloonfish	Diodon holocanthus	1	-	-	-	-	1
diohys	porcupinefish	Diodon hystrix	-	1	-	1	-	2
diparg	silver porgy	Diplodus argenteus	-	-	-	1	1	2
diphol	spottail pinfish	Diplodus holbrooki	1	1	1	1	1	5
epiads	rock hind (sea bass)	Epinephelus adscensionis	-	1	-	1	-	2
equacu	high hat	Equetus acuminatus	1	1	1	1	1	5
eucarg	spotfin mojarra	Eucinostomus argenteus	1	1	-	1	-	3
eucgul	silver jenny	Eucinostomus gula	-	-	1	-	-	1
eucjon	slender mojarra	Eucinostomus jonesi	-	-	-	1	1	2
euppar	bicolor damselfish	Eupomacentrus partitus	-	-	-	1	-	1
fistab	cornetfish	Fistularia tabacaria	-	-	-	1	-	1
gercin	yellowfin mojarra	Gerres cinereus	-	1	-	1	1	3
gincir	nurse shark	Ginglymostoma cirratum	-	-	-	1	-	1
haeaur	tomtate	Haemulon aurolineatum	1	1			-	4
haecar	caesar grunt	Haemulon carbonarium	1	1	-	1	1	4
haechr	smallmouth grunt	Haemulon chrysargyreum	1	1	-	1	-	3
haefla	french grunt	Haemulon flavolineatum	-	1	1	1	-	3
haemac	spanish grunt	Haemulon macrostomum	-	-	-	1	-	1
haemel	cottonwick	Haemulon melanurum	1	1	-	1	1	4
haepar	sailors choice	Haemulon parrai	1	1	-	1	1	4

*TLC = Taxon Letter Code used to facilitate data processing.

Table 9. Ocean Ridge Nearshore Hardbottom Fish, continued.

TLC*	COMMON NAME	SPECIES	DATA SOURCE CSA, 1984	VARE 1991	ERM, 11/88	ERM, -8/91	ERM, -8/93	OCCURRENCE
haeplu	white grunt	Haemulon plumieri	1	-	-	1	1	3
haescf	bluestriped grunt	Haemulon sciurus	-	1	1	1	1	4
haesp.	unidentified grunt	Haemulon sp.	-	-	-	1	-	1
haestr	striped grunt	Haemulon striatum	-	1	-	-	-	1
halbiv	slippery dick	Halichoeres bivittatus	1	1	1	1	1	5
halgar	yellowhead wrasse	Halichoeres garnoti	-	1	-	-	-	1
halmac	clown wrasse	Halichoeres maculipinna	1	1	1	-	-	3
halrad	puddingwife	Halichoeres radiatus	1	1	1	1	-	4
harsp.	sardines	Harengula sp.	-	-	-	1	-	1
hembra	ballyhoo	Hemiramphus brasiliensis	-	-	1	-	-	1
hemsp.	halfbeak, unidentified	Hemiramphus sp.	-	-	-	1	-	1
holber	blue angelfish	Holacanthus bermudensis	-	1	-	-	-	1
holcil	queen angelfish	Holacanthus ciliaris	-	-	-	1	-	1
holisa	blue angelfish	Holacanthus isabelita	-	-	-	1	-	1
holsp.	unidentified squirrelfish	Holocentrus sp.	-	-	-	1	-	1
hypsp.	blenny	Hypleurochilus sp.	-	-	-	-	1	1
kypsec	Bermuda chub	Kyphosus sectatrix	-	1	1	1	-	3
labnuc	hairy blenny	Labrisomus nuchipinnis	1	1	1	1	1	5
lacmax	hogfish	Lachnolaimus maximus	-	1	-	1	-	2
lacqua	scrawled cowfish	Lactophrys quadricornis	1	1	-	1	1	4
lutapo	schoolmaster	Lutjanus apodus	1	1	-	-	-	2
lutgri	gray snapper; mangrove snapper	Lutjanus griseus	1	1	1	1	1	5
lutmah	mahogany snapper	Lutjanus mahogoni	-	-	1	1	-	2
lutsyn	lane snapper	Lutjanus synagris	1	1	1	1	-	4
megatl	tarpon	Megalops atlanticus	-	-	-	1	-	1
mulmar	yellow goatfish	Mulloidichthys martinicus	-	1	-	-	-	1
ocychr	yellowtail snapper	Ocyurus chrysurus	-	1	-	1	1	3
olisau	leatherjacket	Oligoplites saurus	-	-	-	1	-	1
opiwhi	dusky jawfish	Opisthognathus whitehursti	-	-	-	-	1	1
opiogl	Atlantic thread herring	Opisthonema oglinum	-	1	-	-	-	1
parmar	seaweed blenny	Parablennius marmoreus	-	-	-	1	-	1
pemsch	copper sweepers	Pempheris schomburgki	-	1	-	-	-	1
pomarc	gray (or black) angelfish	Pomacanthus arcuatus	1	1	-	1	1	4
pomfus	dusky damselfish	Pomacentrus fuscus	1	1	1	1	1	5
pomleu	beaugregory	Pomacentrus leucostictus	-	-	1	1	1	3
pompar	french angelfish	Pomacentrus paru	1	1	1	1	-	4
pomvar	cocoa damselfish	Pomacentrus variabilis	1	1	-	1	1	4
priophr	bandtail searobin	Prionotus ophryas	-	-	-	1	-	1
proacu	longsnout butterflyfish	Prognathodes aculeatus	-	-	-	-	1	1
psemac	spotted goatfish	Pseudopeneus maculatus	1	1	-	1	-	3
rhilen	atlantic guitarfish	Rhinobatos lentiginosus	1	-	-	-	-	1
rypsap	greater soapfish	Rypticus saponaceus	-	1	-	-	-	1
sarsar	Atlantic bonito	Sarda	-	-	-	1	-	1
scasp.	undet. blackstripe parrotfish	Scarus sp.	-	-	-	1	-	1

*TLC = Taxon Letter Code used to facilitate data processing.

Table 9. Ocean Ridge Nearshore Hardbottom Fish, continued.

TLC*	COMMON NAME	SPECIES	DATA SOURCE: CSA, 1984	VARE 1991	ERM, 11/88	ERM, 8/91	ERM, 8/93	OCCURRENCE
scomac	Spanish mackerel	*Scomberomerus maculatus*	-	-	-	1	-	1
scoplu	spotted scorpionfish	*Scorpaena plumieri*	-	1	-	1	1	3
selcru	bigeye scad, goggle-eye jack	*Selar crumenophthalmus*	-	-	-	1	-	1
serdum	greater amberjack	*Seriola dumerili*	-	-	-	1	-	1
spachr	redtail parrotfish	*Sparisoma chrysopterum*	1	1	-	1	-	3
sparad	bucktooth parrotfish	*Sparisoma radians*	-	1	-	-	-	1
sparub	redfin/yellowtail	*Sparisoma rubripinne*	1	1	1	1	1	5
spavir	stoplight parrotfish	*Sparisoma viride*	-	-	-	1	-	1
sphnep	southern puffer	*Sphoeroides nephelus*	1	-	-	-	-	1
sphtes	checkered puffer	*Sphoeroides testudineus*	-	-	-	1	-	1
sphbar	great barracuda	*Sphyraena barracuda*	1	1	1	1	1	5
sphpic	southern sennet	*Sphyraena picudilla*	-	-	-	1	-	1
strmar	Atlantic needlefish	*Strongylura marina*	-	1	-	-	-	1
synfoe	inshore lizardfish	*Synodus foetens*	-	-	-	1	-	1
thabif	bluehead wrasse	*Thalassoma bifasciatum*	1	1	1	1	-	4
umbcor	sand drum	*Umbrina coroides*	-	-	1	1	-	2
urojam	yellow stringray	*Urolophus jamaicensis*	-	-	-	1	1	2
unible	unidentified blenny	unidentified blenny	-	-	-	1	-	1
unicro	unidentified croaker	unidentified croaker	-	-	-	-	1	1
unigob	unidentified goby	unidentified goby	-	-	-	-	1	1
larvae	unidentified larvae	unidentified larvae	-	-	-	1	-	1
mojsp.	unidentified mojarra	unidentified mojarra	-	-	-	1	-	1
unisca	unidentified parrotfish	unidentified scarid	-	-	-	-	1	1
			====	====	====	====	====	====
			38	59	30	85	40	

*TLC = Taxon Letter Code used to facilitate data processing.

4.29 Offshore Reefs. The survey results by Continental Shelf Associates (CSA, 1984:71-80) depicted a diverse assemblage of octocorals, sponges and other invertebrates. From 3 stations, CSA logged 20 species of octocorals, 14 species of hard (scleractinian) corals, 36 species of sponges, and 8 other miscellaneous species of invertebrates and one alga (Udotea sp.). The community was determined to be representative of Palm Beach County offshore reefs, strongly influenced by turbidity, sedimentation and temperature, causing the octocorals and sponges to dominate the biota while the more sensitive hard (reef-building) corals not constituting a major segment of the community.

4.30 Water Quality. Water quality in the project area ranges from fair to good depending upon tidal cycle and stormwater discharges. The Florida Current approaches very close to shore at this location resulting in clear conditions most of the year. Nearshore water turbidity values average 1.21 Nephelometric Turbidity Units (NTUs; PBCHD, 1987) at Boynton Beach Oceanfront Park. The South Lake Worth Inlet was not designed as a "navigational" inlet, but rather was initially constructed from February 1925 to March of 1927 (Olsen, 1990a:19), primarily to relieve water quality problems in Lake Worth. As such, it's primary purpose is to allow poor-quality estuarine water to exit the inlet on outgoing tides and high-quality oceanic water to enter the inlet on incoming tides. The tidal discharge from the inlet contains high levels of nutrients and sediments derived from the approximately 100 square mile upland drainage basin which flows from the Boynton Beach canal (South Florida Water Management District canal #C-16) located approximately one mile southwest of the inlet (PBCERM, 1990).

4.31 Inlet Related Biota. Some inshore fishes and invertebrates leave the inshore waters through inlets and passes to spawn in the nearshore coastal waters. Their larvae are then transported back through the inlet into estuarine nursery areas, such as seagrass beds or mangrove roots, where they undergo development. The life cycle of the snook (Centropomus undecimalis) is typical of these fishes; large groups of snook assemble near inlets or passes during summer months; actual spawning occurs outside of the inlet in the nearshore waters, and the developing larvae are transported back into the estuary through the inlet (Gilmore et al., 1983; Seaman and Collins, 1983). The influence of engineered inlets as transport corridors for larval stages of fishes has recently been discussed in some detail (Weinstein, 1988). Researchers, however, are only beginning to understand the details of recruitment processes in coastal fish species.

4.32 Seagrass Beds. No seagrass occurs within the boundaries of the project itself, but do exist inside the inlet on flood-tidal shoals (CSA, 1984), and particularly to the north (Dames & Moore, 1990: Fig. 9H). There are four species of seagrass found including one species which has been proposed as a Federally Endangered species. The seagrasses present include Shoal Grass (Halodule wrightii), Paddle Grass (Halophila decipiens), Johnson's Grass (Halophila johnsonii) (a proposed Threatened species), and sparse Manatee Grass (Syringodium filiforme). The grassbed area also has a fine organic layer over the sand.

Table 10. Endangered, Threatened, or Rare Species and Species of Special Concern That May be Expected to Occur in the Vicinity of the Ocean Ridge Shore Protection Project.

	Federal	State
BIRDS		
Peregrine Falcon, Falco peregrinus (Tr, W, C, Es)	E	E
Piping Plover, Charadrius melodus (Tr, W, C)	T	T
Roseate Tern, Sterna dougallii (Tr, C)	T	T
Least Tern, Sterna antillarum (Tr, N, C) *	NL	T
Reddish Egret, Egretta rufescens (Tr, Es)	NL	SC
Little Blue Heron, Egretta caerulea (Tr, N, Es)	NL	SC
Snowy Egret, Egretta thula (Tr, N, Es)	NL	SC
Tricolored Heron, Egretta tricolor (Tr, N, Es)	NL	SC
American Oystercatcher, Haematopus palliatus (Tr, N, C)	NL	SC
Osprey, Pandion haliaetus carolinensis (Tr, C, Es) *	NL	SC
Eastern Brown Pelican, Pelecanus occidentalis (Tr, N, C, Es) *	NL	SC
REPTILES		
Atlantic Green Sea Turtle, Chelonia mydas (Tr, N, C) *	E	E
Atlantic Leatherback Sea Turtle, Dermochelys coriacea (Tr, N, C) *	E	E
Atlantic Hawksbill Sea Turtle, Eretmochelys imbricata imbricata (Tr, C)	E	E
Atlantic Ridley Sea Turtle, Lepidochelys kempi (Tr, C)	E	E
Atlantic Loggerhead Sea Turtle, Caretta (Tr, N, C) *	T	T
FISH		
Common snook, Centropomus undecimalis (Tr, C, Es) *	NL	SC
MAMMALS		
Right Whale, Balaena glacialis (Tr, O)	E	E
Fin Whale, Balaenoptera physalus (Tr, O)	E	E
Sei Whale, Balaenoptera borealis (Tr, O)	E	E
Humpback Whale, Megaptera novaeangliae (Tr, O)	E	E
Sperm Whale, Physeter catadon (Tr, O)	E	E
West Indian Manatee, Trichechus manatus (Tr, C, Es) *	E	E
PLANTS		
Beach Jacquemontia, Jacquemontia reclinata (C)	E	E
Burrowing Four-o'clock, Okenia hypogaea (C) *	NL	E
Beach-star, Remirea maritima (C) *	NL	E
Bay Cedar, Suriana maritima (C) *	NL	E
Coconut Palm, Cocos nucifera (C) *	NL	T
Beach-creeper, Ernodea littoralis (C)	NL	T
Sea-lavender, Mallotonia gnaphalodes (C) *	NL	T
Inkberry, Scaevola plumieri (C) *	NL	T
Black Mangrove, Avicennia germinans (Es) *	NL	SC
Red Mangrove, Rhizophora mangle (Es) *	NL	SC
Johnson's seagrass, Halophila johnsonii (Es) *	PT	NL

KEY:

E = Endangered	T = Threatened	R = Rare	PT =Pending Threatened
SC = Special Concern	NL = Not Listed	Tr = Transient	O = Offshore
W = Wintering	N = Nesting	Es = Estuarine	C = Coastal

* = Observed by PBCERM in project area

Source: Florida Game and Fresh Water Fish Commission, 1993

4.33 Threatened and Endangered Species. The South Lake Worth Inlet area provides habitat to a number of listed species. Table 10 lists endangered species, threatened species, and species of special concern that may occur in the vicinity of the project. Seventeen of the 33 listed species have been observed during surveys of the area. Nesting and feeding herons, egrets, and their allies are found within the estuarine areas within the inlet and along the ICW. Some species, including the least tern, brown pelican, osprey, and oystercatcher, feed in the coastal waters. Plovers and herons feed in the intertidal areas. Brown pelicans roost in the Australian Pines on "Beer Can Island" (also known as Bird Island), a spoil island on the north side of the interior of the inlet. Beach Jacquemontia has been observed ~1.4 miles south of the south limit of the fill area but has not been found within the project area.

4.34 Coordination and consultation with the USFWS and the National Marine Fisheries Service (NMFS) on endangered and threatened species is required as specified by the Endangered Species Act of 1973, as amended, to avoid and minimize impacts to Federal listed species. Coordination and consultation was completed in association with the county-wide GDM for Palm Beach County (USACE, 1987). Coordination was reinitiated for the Ocean Ridge segment due to the length of time since the original consultations and because of proposed modifications to the project. In a letter dated February 8, 1994, the NMFS concurred with the determination that listed species under their purview would not be adversely impacted by the project. In a letter dated February 18, 1994, the USFWS concurred that the project would not adversely affect West Indian manatee but may affect listed sea turtles and coordination under Section 7 was required. Section 7 coordination with NMFS may need to be reinitiated if the proposed listing of Johnson's seagrass as Threatened occurs before construction begins (M. Lorenz, 1995; pers. comm.).

4.35 The listed species most likely to be impacted by the proposed project are sea turtles. All sea turtles present in the western hemisphere have been reported in the coastal areas of southeast Florida. They often enter the inlet and feed in the estuarine areas (Pritchard, 1978; Fritts et al., 1983) and use nearshore hardbottom and offshore reefs to forage, rest and provide shelter (Wershoven and Wershoven, 1989; Wershoven and Wershoven, 1991; Ernest, et. al., 1989; National Academy of Sciences, 1990). The leatherback, green, and loggerhead sea turtles regularly nest along the beach in the project area with loggerheads accounting for 96.5% of the nesting (1990-1992) within the project limits. Table 11 summarizes turtle nesting activity in the project area.

4.36 The importance of beaches in the southeastern United States to the worldwide status of the loggerhead sea turtle has been described by Ross (1982) and Hopkins and Richardson (1984). Ross (1982) concluded that the aggregation of female adult loggerhead turtles nesting on the beaches of the southeast states is second only in size to that of Masirah, an island off the Oman coast, in the northwest Indian Ocean. The Masirah group numbers about 30,000 adult females and the southeastern United States group numbers approximately 25,000. These areas support the two largest loggerhead turtle nesting aggregations in the world.

Table 11. 1990-1992 SEA TURTLE NESTING DATA FOR OCEAN RIDGE AREA

REACH/ZONE	LENGTH (MI)	TOTAL NESTS	TOTAL NESTS PER MILE	C. caretta NESTS	C. caretta FC	C. caretta NESTING SUCCESS	C. mydas NESTS	C. mydas FC	C. mydas NESTING SUCCESS	D. coriacea NESTS	D. coriacea FC	D. coriacea NESTING SUCCESS	FIRST NEST CC	FIRST NEST CM	FIRST NEST DC	LAST NEST CC	LAST NEST CM	LAST NEST DC
1992																		
0-OCEAN INLET PARK	0.13	2	16	2	6	0.25	0	0	0.00	0	0	0.00						
1- INLET PARK TO MANORS	0.35	13	37	13	10	0.57	0	0	0.00	0	0	0.00	5/14	-	-	7/3	-	-
2- MANORS TO TAMARIND	0.28	36	129	34	12	0.74	2	0	1.00	0	0	0.00	5/4	8/8	-	8/8	8/18	-
3- OCEAN HAMMOCK	0.22	66	306	61	40	0.60	2	0	1.00	3	0	1.00	5/1	7/7	3/19	8/11	7/22	5/18
4-PUBLIC BEACH TO 1ST GROI	0.32	25	77	25	9	0.74	0	0	0.00	0	0	0.00	5/13	-	-	8/18	-	-
5- 1ST GROIN TO CORRINE ST	0.38	27	72	27	17	0.61	0	0	0.00	0	0	0.00	5/9	-	-	8/4	-	-
6- SO. TO ADAMS ST.	0	68	177	66	75	0	2	0	1	0	0	0	5/7	6/13	-	8/11	7/6	-
7- SO. TO BRINY GROIN	0.61	94	153	85	105	0.45	9	2	0.82	0	0	0.00	4/20	5/28	-	8/21	8/7	-
8A- SO. TO SURF RD	0.12	28	227	27	13	0.68	1	1	0.50	0	0	0.00	5/14	7/19	-	8/4	7/19	-
8B- GULFSTREAM PARK	0.11	42	376	39	10	0.80	3	2	0.60	0	0	0.00	5/8	7/18	-	9/5	7/29	-
9- ST. ANDREWS TO ROCKS	0.36	105	292	99	43	0.70	6	0	1.00	0	0	0.00	4/28	7/8	-	8/11	7/21	-
1992 TOTALS	3.27	506	155	478	340	0.58	25	5	0.83	3	0	1.00	4/20	6/13	3/19	8/21	8/18	5/18
1991																		
0-OCEAN INLET PARK	0.13	7	54	7	5	0.58	0	0	0.00	0	0	0.00	5/16	-	-	6/28	-	-
1- INLET PARK TO HAMMOCK	0.85	56	66	55	59	0.48	1	1	0.50	0	0	0.00	4/21	7/4	-	8/3	7/4	-
2- PUBLIC BEACH	0.20	31	157	29	19	0.60	2	0	1.00	0	0	0.00	5/13	6/18	-	9/1	8/1	-
3- SO. TO 1ST JETTY	0.13	14	112	13	22	0.37	1	0	1.00	0	0	0.00	5/16	6/25	-	7/22	6/25	-
4- SO. TO ADAMS ST.	0.76	76	100	74	60	0.55	2	0	1.00	0	0	0.00	4/18	6/5	-	8/13	8/21	-
5- SO. TO BRINY GROIN	0.61	123	200	120	92	0.57	3	0	1.00	0	0	0.00	4/18	5/7?	-	*8/7	6/5	-
6- SO. TO SURF RD	0.12	18	146	18	12	0.60	0	0	0.00	0	0	0.00	5/13	-	-	7/25	-	-
- GULFSTREAM PARK	0.11	28	251	28	0	1.00	0	0	0.00	0	0	0.00	5/7	-	-	9/4	-	-
7- ST. ANDREWS TO ROCKS	0.36	75	208	71	57	0.55	4	0	1.00	0	0	0.00	5/6	5/9?	-	7/30	7/31	-
1991 TOTALS	3.27	428	131	415	326	0.56	13	1	0.93	0	0	0.00	4/18	6/5	-	9/1	8/21	-
1990																		
0-OCEAN INLET PARK	0.13	5	38	5	3	0.63	0	0	0.00	0	0	0.00	4/29	-	-	8/12	-	-
1- INLET PARK TO HAMMOCK	0.85	66	78	66	72	0.48	0	0	0.00	0	0	0.00	4/16	-	-	6/5	-	-
2- PUBLIC BEACH	0.20	14	71	14	6	0.70	0	0	0.00	0	0	0.00	5/19	-	-	8/7	-	-
3- SO. TO 1ST JETTY	0.13	18	144	18	20	0.47	0	0	0.00	0	0	0.00	5/26	-	-	8/9	-	-
*4- SO. TO ADAMS ST.	0.76	109	144	105	63	0.63	4	0	1.00	0	0	0.00	4/30	5/24	-	8/21	7/25	-
*5- SO. TO BRINY GROIN	0.61	105	171	105	63	0.63	0	0	0.00	0	0	0.00	5/14	-	-	7/10	-	-
**6- SO. TO GS PARK	0.12	9	73	9	8	0.53	0	0	0.00	0	0	0.00	5/9	-	-	6/24*	-	-
- GULFSTREAM PARK	0.11	41	367	41	6	0.87	0	0	0.00	0	0	0.00	4/30	-	-	8/31	-	-
7- ST. ANDREWS TO ROCKS	0.36	71	197	69	42	0.62	2	0	1.00	0	0	0.00	5/5	5/15?	-	7/26	7/4	-
1990 TOTALS	3.27	438	134	432	283	0.60	6	0	1.00	0	0	0.00	4/16	5/24	-	8/21	7/25	-
TOTALS 90-92		1372		1325	949		44	6		3	0							
1990 to 1992 AVERAGES																		
0-OCEAN INLET PARK	0.13	5	36	5	5	0.50	0	0	0.00	0	0	0.00						
1- INLET PARK TO HAMMOCK	0.85	79	93	76	64	0.54	2	0	0.83	1	0	1.00						
2- PUBLIC BEACH	0.20	23	119	23	11	0.67	1	0	1.00	0	0	0.00						
3- SO. TO 1ST JETTY	0.13	20	157	19	20	0.50	0	0	1.00	0	0	0.00						
*4- SO. TO ADAMS ST.	0.76	84	111	82	66	0.55	3	0	1.00	0	0	0.00						
*5- SO. TO BRINY GROIN	0.61	107	175	103	87	0.54	4	1	0.86	0	0	0.00						
**6- SO. TO GS PARK	0.12	18	149	18	11	0.62	0	0	0.50	0	0	0.00						
-GULFSTREAM PARK	0.11	37	331	36	5	0.87	1	1	0.60	0	0	0.00						
7- ST. ANDREWS TO ROCKS	0.36	84	233	80	47	0.63	4	0	1.00	0	0	0.00						
													Summary of First and Last Nesting Dates					
AVERAGES 90-92	3.27	457	140	442	316	0.58	15	2	0.88	1	0	1.00	4/16	5/24	3/19	9/5	8/21	5/18

SOURCE- Marine Turtle Project, City of Boynton Beach, G. Evans and N.J. Craig
FDNR Annual Reports (for Ocean Inlet Park and Gulfstream Park)

NOTES:

CC = Caretta caretta (loggerhead); CM = Chelonia mydas (green); DC = Dermochelys coriacea (leatherback)

* = CC data for zones 4 and 5 averaged together because zone delineations questionable.

** = Data Unreliable, monitoring discontinued before end of season

? = Unusual dates, ID accurate?

False crawl (FC) and nesting success data are not accurate because survey personnel did not regularly report all false crawls.

4.37 The average number of nests in the **3.27 mile sea turtle survey** area (~T-152 to 1,020 feet south of R-167) between 1990 and 1992 has been 457 nests or 140 nests/mile (Table 11). The average number of nests within **1.30 miles of the proposed project** area (T-152 to R-158) for the same period was 127 nests (98 nests/mile). Nesting activity tends to be reduced in the north portion of the project area due to a limited amount of suitable nesting beach. This is a result of inlet effects on littoral transport, shoreline armoring and associated narrow beaches, as well as beachfront lighting. Overall, nesting activity is similar to other developed and eroding beaches in south central Palm Beach County. Nesting is much lower than on the less developed beaches in northern Palm Beach County, Hutchinson Island and Brevard County where nesting densities between 800 to 1000 nests/mile are common.

4.38 In addition to using local beaches as nesting habitat, sea turtles use other habitats in the project area depending upon species and life stage. Sea turtles are regularly observed on the offshore reefs and nearshore hardbottom in the vicinity of the project. Juvenile green turtles have been observed by County staff on the nearshore reefs (presumably feeding on the attached algae) and in the vicinity of the artificial reefs constructed in the nearshore area in 1994. Adult and subadult loggerheads and hawksbills use the offshore reefs for foraging and resting. Adult loggerheads and greens have been observed mating offshore of the project area. Lifeguards at Ocean Inlet Park have reported observing large loggerheads on the bottom of South Lake Worth Inlet.

4.39 The West Indian Manatee moves throughout the coastal and estuarine areas of southeast Florida throughout the year. The estuarine area inside the South Lake Worth Inlet has been described as important manatee habitat (Marine Mammal Commission, 1988:71). This area supports the second highest number of aerial observations of manatees in Palm Beach County (PBCERM, 1992:91). Manatees have been observed in the ocean in the project area (Dames & Moore, 1990) but are not known to use the ocean waters for feeding or resting.

4.40 Several whale species are found offshore of the project area migrating from wintering grounds to northern feeding areas. The right whale may winter off the coast of Florida (Kraus, 1985).

4.41 Ten state listed coastal plant species have been observed within or immediately adjacent to the project area (Table 10). Of these species, beach-star (Remirea maritima) and spider lily (Hymenocallis latifolia) are most common in the project area.

4.42 Johnson's seagrass (Halophila johnsonii) occurs inside the Lake Worth Lagoon adjacent to the project area. This species has been proposed for Federal listing by the National Marine Fisheries Service as a Threatened species.

4.43 Public Beaches. Continued erosion has further reduced the extent of beach available for recreational use and for sea turtle nesting from that described in the countywide GDM (USACE, 1987). Erosion has caused dunes to be essentially eliminated from the inlet southward to about FDNR survey marker R-155 (the north side of the Ocean Hammock Park), concurrent with the existence of seawalls in this area. This erosion has affected two public beaches within this area: South Lake Worth Inlet District Park (225 ft. frontage), and Ocean Inlet Park (570 ft. frontage), both of which are immediately south of the inlet and are most severely affected by erosion. Both Parks provide access from the Atlantic Ocean westward to the Lake Worth lagoon.

4.44 The Ocean Hammock Park has an undeveloped public beach, with 1,045 feet of frontage within the project fill area. Another public beach within the project area is Boynton Beach Oceanfront Park which extends from FDNR survey marker R-156 to R-157, with 975 feet of frontage, immediately south of Ocean Hammock Park.

4.45 Archeological and Historical Resources. A cultural resources investigation was conducted in conjunction with the proposed project (Koski-Karell, 1993). As part of the study, magnetometer surveys of the proposed borrow area were performed between September 1992 and June 1993. Two (2) potentially significant magnetic anomalies were found in the primary borrow area, but determined to be ferrous debris of recent vintage. There are no known archeological or cultural resources in the proposed borrow area or the project fill site. The contractor will be informed of the location of the debris and may chose to avoid the area to prevent damage to equipment

4.46 Aesthetics. Aesthetic resources were evaluated in accordance with procedures outlined in ER 1105-2-50. The Ocean Ridge shoreline is characterized by an eroded beach of variable width and dunes that range from nonexistent, to well vegetated. Upland development consists of four coastal parks, condominiums, private residences, and approximately 1,045 feet of undeveloped shoreline. The remnants of a groin field exists within the project area and are permanently to occasionally exposed due to changes in beach profiles. The most pleasing visual resource provided by the area is the clear water of the Atlantic Ocean, the remaining natural appearing beach, and the nearshore hardbottom rock outcrops.

4.47 The aesthetics of the area are also influenced by the sounds of a typical recreational beach area including human voices at the parks, condominiums, and local access points; traffic noise where State Road A1A (Ocean Blvd.) parallels the crest of the dune; shore bird calls; and the sound of the surf. Offshore, boat noise is also a common sound due to the nearby inlet.

4.48 Air Quality. The air quality in the project area is relatively good because of the lack of industrial development and the presence of the Atlantic Ocean with a prevailing sea breeze.

However, the United States Environmental Protection Agency (EPA) has designated the airshed including Dade, Broward and Palm Beach County as a non-attainment area for ozone (moderate classification). The primary reason for this is excessive emissions from the consumption of petroleum fuels (vehicles, electrical generation plants, etc.) A State implementation plan is in place to eliminate or reduce the violation of national air quality standards and achieve attainment of those standards.

4.49 Noise. The area is influenced by the sounds of a typical recreational beach area including: human voices at the parks, condominiums, the beach club, and at local access points; traffic noise where State Road A1A parallels the crest of the dune; shore bird calls; and the sound of the surf. Offshore, boat noise is also a common sound due to the nearby inlet.

4.50 Manmade Resources. Development in the project area is dominated by high density multifamily residences, parks and State Road A1A. The inlet jetties and a fishing platform on the south jetty are also manmade resources.

4.51 Community. The beaches in the project area provide the community with leisure opportunities. The community in the vicinity of the project is predominately a retirement/resort community of seasonal residents and visitors. The parks in the project area provide beach access to residents living in the more traditional residential communities located further inland.

4.52 Public Facilities and Services. Public facilities include: four parks with parking, beach access, rest rooms, showers, picnic shelters, ocean swimming, lifeguards, and concession stands. Public services provided are: recreational services, public safety activities such as police and fire protection, and utilities (water, sewer, solid waste, etc.).

4.53 Employment. Tourism is one of the primary industries in Palm Beach County. The residences and parks employ a number of people in the service industry.

4.54 Taxes. The residents pay ad valorem taxes to Palm Beach County and income tax to the Federal government. Tourists using the parks pay a Tourist Development Tax (bed tax) to the County. The construction of this project requires expenditures of County, State and Federal tax revenues.

4.55 Property Values. The property values are high with real estate (land and buildings) within the project limits valued at approximately $96.4 million and structures appraised at $60.4 million.

4.56 Displacement of People, Farms and Businesses. As stated previously, development in the area consists of condominiums and parks. There are no farms in the vicinity. There will be no displacement of people, farms or businesses as a result of this project.

4.57 Desired Community and Regional Growth. Growth patterns in Palm Beach County tend to be concentrated along the coast and the western edges of the community. County, regional and state land use planning objectives promote growth in eastern Palm Beach County provided it reduces "urban sprawl", preserves coastal resources and limits public expenditures in areas subject to destruction by natural disasters.

4.58 Recreation. The project area contains four parks and is adjacent to an inlet providing the public with numerous recreational opportunities. The most significant recreation activities are: swimming, sunbathing, snorkeling, fishing, surfing, boating, and picnicking. Other activities include: nature study, beachcombing, jogging and volleyball. There are also numerous marinas and public boat ramps nearby which provide access for recreational boaters. Boats are used for commercial and recreational fishing, diving and cruising.

5.00 ENVIRONMENTAL CONSEQUENCES

5.01 Fish and Wildlife Resources.

5.02 No-Action Alternative. If no action is taken, the project beach will continue to erode and shoreline recession will continue. This process will continue to diminish recreational beach and nesting sites for sea turtles. The adjacent evacuation route (highway A1A) will continue to be threatened. Impacts of project implementation (burial of nearshore hardbottom, turbidity, sea turtles, etc.) will be avoided.

5.03 Selected Alternative. Implementation of the selected alternative would provide recreational beach for an anticipated 6 years, benefit the dune system and is likely to provide additional nesting sites for sea turtles within the project limits as well as help stabilize existing nesting sites downdrift of the project. Short-term impacts may affect migratory birds and would affect the borrow and fill site macroinvertebrate infauna. No mitigation is necessary or proposed for short-term impacts to the invertebrate infauna. Nearshore hardbottom will be impacted but impacts have been reduced by the project design. The FDEP permit requires 4.55 acres of mitigation. A post-project impact assessment will be used to determine if actual impacts significantly exceed the level of mitigation predicted in this document.

5.04 Effects on Dune and Beach Biota. The north end of the project (inlet to R-155) essentially lacks dunes, and therefore cannot be negatively impacted. The southerly portion of the fill area, R-155 to R-159 has dunes; dependent on level of fill placement at the toe of the dune, some of the

lower vegetation at the toe and pioneer zone may be buried. This vegetation is adapted to inundation by sands and can probably withstand about a foot of coverage with no detrimental effects. The new beach sands will provide additional sand to the dunes, over time, as winds blow sand into the dune vegetation where it will be trapped, thereby further building the dunes. The additional beach widths will reduce the effects of storms on dune vegetation, including the listed coastal plant species found within the project limits.

5.05 Effects on Migratory Birds. No birds, migratory or other, are known to nest within the project area. This is probably due to the narrow beach width between upland development and the Atlantic Ocean and the high occurrence of disturbance due to development and human use of the beach. During construction, there will be some displacement of foraging and resting activities for the birds that utilize the project area. This displacement will be short-term, and there are locations nearby with characteristics similar to the project area where these activities can occur. Within the project area, there will be increased foraging opportunities for some species (particularly gulls) as a result of the discharge activity. Elevated turbidity levels within the project area have the potential to interfere with foraging by sightfeeders such as pelicans and terns. However, the requested mixing zone variance is of such limited size (500 meters from discharge point) that elevated turbidity levels (above 29 NTUs) should be limited to a small portion of the shoreline and should not result in significant impacts.

5.06 Effects on the Borrow and Fill Site Softbottom Communities. Utilization of the best available borrow material will minimize impacts to benthic infaunal communities and enhance recovery to pre-project population levels. Impacts to infaunal invertebrates at the borrow and fill sites should be short term (1 to a few years).

5.07 The benthic infauna of the borrow and fill areas have been preliminarily sampled by PBCERM and comprise a community dominated by polychaetes and crustaceans with medium density and number of species. Of the two areas, the borrow area samples had greater density and species richness (20,811 ind./m^2, 33 species), than the inshore site samples (3,048 ind./m^2, 22 species). One ectoproct (bryozoan) was particularly dominant at the borrow site; elimination of this species from the counts, yields a density similar to the inshore samples (3,070 ind/m^2). The borrow site density converts to 84,219,466 individuals/acre; with a 66.7 acre borrow area proposed, 5.6 billion macrofaunal invertebrate individuals would be impacted at the borrow site. Recolonization is expected to be fairly rapid in both areas. Recovery to pre-project community composition and species diversity will take longer.

5.08 The numerically dominant macroinfaunal species are polychaetes, amphipods, and isopods. The ability of present dominant species to out compete recruitment by opportunistic species accessing the disturbed areas will be a factor. Subsequent to recolonization, re-attainment of previous density and species richness will occur. Although this recolonization will hopefully be of the same type of animals which were impacted, the recruitment may not be of the same distribution of species and densities of individuals. Subsequent stabilization of the community to previously existing species composition will take additional time. Although the present biotic community may be one to re-establish faster than others, the controlling factor may be prior re-establishment of their desired grain size distribution.

5.09 Impacts at other beaches have been short to long-term, dependent on season of project construction and sand grain size compatibility. With a winter project and utilization of a borrow area that closely matches the native beach sand, nearshore recolonization can be expected to occur fairly rapidly. Recovery to a similar community offshore is likely to be slow (1 to 5 years or more), as the borrow area is not expected to be rapidly refilled. While the impacts to the benthic infaunal community are difficult to predict, there are no known listed species that are expected to be impacted as a result of perturbations to the borrow and fill areas.

5.10 Construction of the fill aspect of the project is scheduled to occur during the fall and winter which was a period of increased abundance and diversity of the infaunal community at another Palm Beach County site more intensively sampled (Jupiter/Carlin Park area). Dredging during this time will directly affect the highest numbers of infauna at both the borrow and fill sites compared to dredging during summer months. However, since the surrounding areas will also have the highest numbers available to provide colonists to the impacted areas, recolonization and recovery times will be minimized.

5.11 The following management strategies are being implemented and will reduce impacts to the infaunal benthos: 1) selecting the borrow area to ensure a relatively close match of fill material mean grain size to native beach mean grain size; 2) minimizing the fill movement into the deeper, more diverse areas by avoiding use of fine grain size borrow material; and 3) construction during a time when the benthic density and diversity is high, possibly yielding more rapid recolonization and promoting actual population recovery.

5.12 Effects on Nearshore Hardbottom. Based upon the most recent data (August 1994), the equilibrium toe of fill (ETOF) of the proposed project has been calculated to cover 6.4 acres of nearshore hardbottom. It is assumed that this is the amount of hardbottom that will be impacted 1 year after construction and for the purposes of this discussion will be termed "long term direct impacts". There is another potential impact that may occur during construction. If offshore borrow material is used to fill the profile in the vicinity of the groins, it is expected that the fill will extend beyond the ETOF during construction but will be scoured off the hardbottom by

currents and waves. For the purposes of this discussion this is termed "short term direct impacts". It is estimated that 2.9 acres of hardbottom could experience additional short term direct impacts for less than a year. However, the amount of hardbottom present is variable over time and dependent upon an array of factors and the above calculations represent only one "snapshot" within a range of values.

5.13 To more accurately estimate the "average" level of impact, maps depicting hardbottom locations for seven years between 1983 and 1994 were used (Appendix D). Estimated fill impacts were calculated for both short and long term impacts for each year. The average amount of hardbottom in each category was weighted based upon the time intervals between observations to calculate a "time average". This value represents the average amount of hardbottom over 11 years that can be expected to have impacts.

5.14 The time averaged amount of nearshore hardbottom that is expected to experience **long term negative impacts is 3.1 acres** (see Figure 6 and Table 12). The amount of hardbottom present between 1983 to 1994 ranged from a low of 2.6 acres in 1991 to a high of 6.4 acres in 1994. The time averaged amount of nearshore hardbottom that is expected to experience **short term impacts during and immediately after construction is an additional 3.2 acres**. The amount of hardbottom in this area between 1983 to 1994 ranged from 2.3 acres in 1991 to 3.9 acres in 1992.

5.15 Therefore, the estimates based on 1994 conditions can be considered a worst case situation while the time averaged values for 11 years would be considered typical conditions.

5.16 A truly accurate estimate of the environmental impact associated with this coverage is difficult, if not impossible, to predict due to natural fluctuations in reef exposure, spoil deposition at the north end of the project site by other agencies (South Lake Worth Inlet District; USACE), the effect of tidal currents on the fill area, inadequate equations to calculate a reliable ETOF in the presence of nearshore hardbottom, and possibilities of a perched beach. A post-project impact assessment and appropriate mitigation (as necessary) will be conducted accordingly. However, the combined effect of multiple projects (see below) on the nearshore hardbottom is nearly impossible to predict. **The following complexities hinder any accurate prediction of the environmental impact to nearshore hardbottom associated with the proposed project:**

a. **Intracoastal Waterway maintenance dredging** - Maintenance dredging of the ICW navigation project will occur periodically. An average of about 5,000 cubic yards of sediment per year is predicted to be dredged from the ICW, beginning the winter of 1995-1996, and is expected to be spoiled on the beach south of the South Lake Worth Inlet.

Table 12. Temporal Analysis of Ocean Ridge Nearshore Hardbottom Impacts (Inlet to R-159).

PHOTOGRAPHY DATE	IMPACTS WITHIN EQUILIBRIUM TOE OF FILL						SHORT TERM IMPACTS (CONSTRUCTION PHASE)						TOTAL IMPACT
	PROJECT NSHB (ACRES)	AVG. NSHB AREA (ACRES)	X	EXPOSURE DURATION (DAYS)	=	HARDBOTTOM EXPOSURE (ACRE-DAYS)	PROJECT NSHB (ACRES)	AVG. NSHB AREA (ACRES)	X	EXPOSURE DURATION (DAYS)	=	HARDBOTTOM EXPOSURE (ACRE-DAYS)	ETOF AND CONSTRUCTION (ACRES)
Nov. 1983	3.66						3.84						[illegible]
		3.14		458		1,436		3.84		458		1,756	
Feb. 16, 1985	2.61						3.83						[illegible]
		2.59		2,374		6,137		3.07		2,374		7,276	
Aug. 17, 1991	2.56						2.30						[illegible]
		3.12		369		1,149		3.09		369		1,138	
Aug. 20, 1992	3.67						3.87						[illegible]
		3.74		222		829		3.61		222		800	
Mar. 30, 1993	3.80						3.34						[illegible]
		3.90		114		444		3.54		114		404	
July 22-23, 1993	4.12						3.21						[illegible]
		5.12		383		1,959		3.14		383		1,203	
Aug. 9, 1994	6.43						2.94						[illegible]
	TOTALS:			3,920		11,954	TOTALS:			3,920		12,578	
	TIME AVERAGED ACRES:					3.05	TIME AVERAGED ACRES:					3.21	[illegible]

Note: "NSHB" = Nearshore Hardbottom

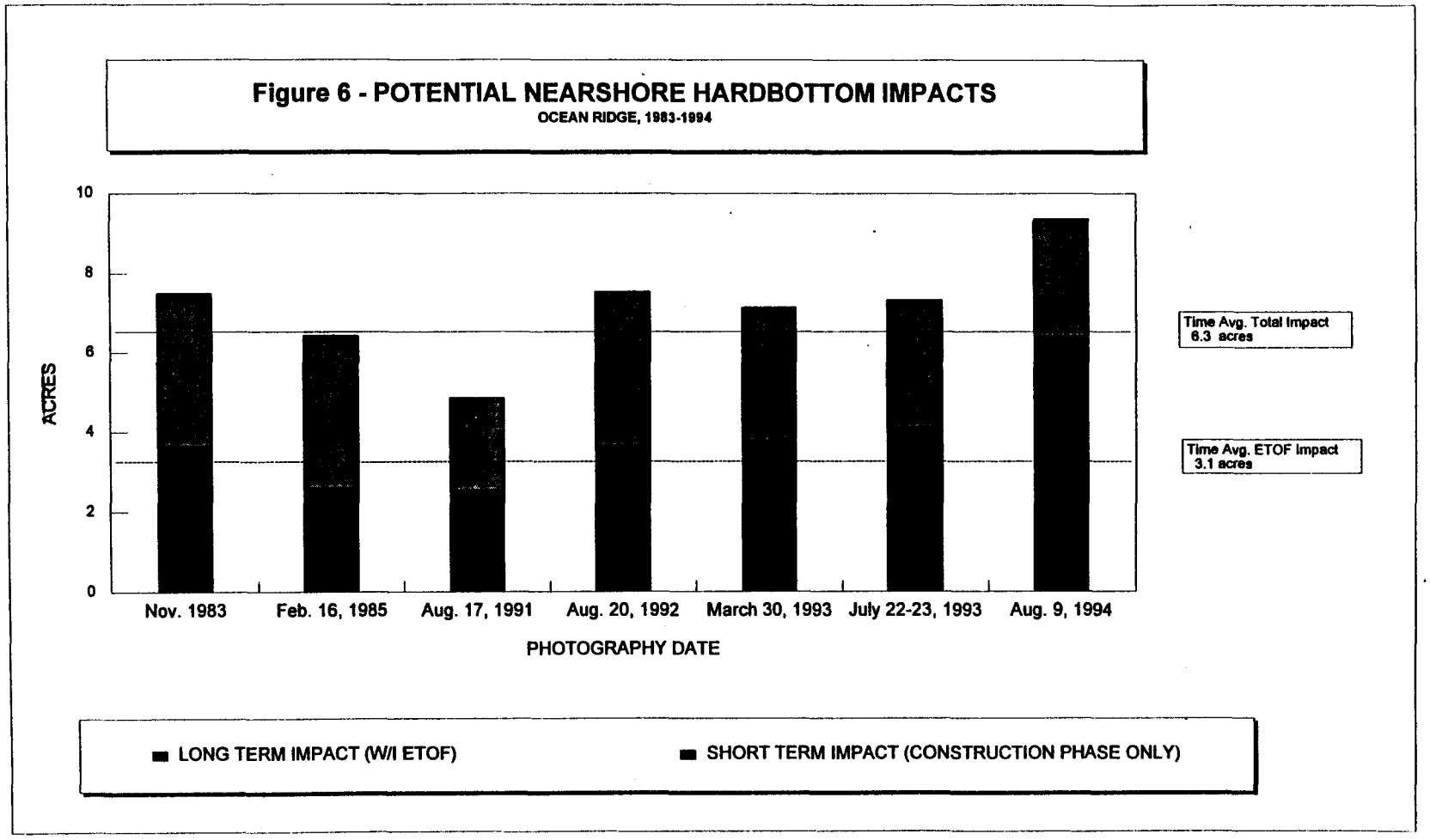
Figure 6 - POTENTIAL NEARSHORE HARDBOTTOM IMPACTS
OCEAN RIDGE, 1983-1994
ACRES
10
8
6
4
2
0
Nov. 1983
Feb. 16, 1985
Aug. 17, 1991
Aug. 20, 1992
March 30, 1993
July 22-23, 1993
Aug. 9, 1994
PHOTOGRAPHY DATE
Time Avg. Total Impact 6.3 acres
Time Avg. ETOF Impact 3.1 acres
LONG TERM IMPACT (W/I ETOF)
SHORT TERM IMPACT (CONSTRUCTION PHASE ONLY)

b. The **sand transfer plant** places about 70,000 cubic yards of sand south of the inlet, annually. Operation of the plant is periodic, unpredictable, and is dependant on local wind direction and wave climate to provide sand to the facility.

c. **South Lake Worth Inlet maintenance dredging** - Maintenance dredging of the sand trap adjacent to the South Lake Worth Inlet, by the South Lake Worth Inlet District (SLWID), has occurred in 1973 and 1989 with about 32,500 cy and 37,000 cy of sediment (respectively) placed on the beach south of the Inlet. The dredged sediments are typically coarser than the ICW sands and are spoiled on the beach immediately south of the inlet and will relax into the nearshore environment as erosion occurs. This project also partially or completely covers hardbottom to an unknown extent and adds to the complexity of predicting the amount of coverage and impact expected from the proposed Ocean Ridge Shore Protection Project.

d. **Perched beach** - The nearshore hardbottom in the project area is comprised of a series of rock outcrops extending an average of about 500 ft offshore (from HWL) with an average relief of about 1.5 ft (8/21/92). The landward edge of this feature may serve as a sill and create a perched beach. This could reduce hardbottom coverage by fill. Uncertainty associated with predicting the effects of a perched beach on the equilibrium profile adds another level of complexity to calculating the fill profile and ETOF and associated impact of the proposed project on nearshore hardbottom.

e. **Equilibrium profile equation** - The mathematical equation used to predict the equilibrium nearshore profile was developed from nearshore profiles on a sandy bottom. The presence of nearshore hardbottom with substantial vertical relief and 8 T-head groins limits the accuracy of this equation in predicting the fill profile. The uncertainty associated with using the equilibrium profile equation to estimate the actual location of the toe of fill adds to the complexity of predicting the amount of nearshore hardbottom impact due to coverage by fill sand.

f. **Equilibrium toe of fill (ETOF)** - The predicted extent of impact, or ETOF, is the most seaward point of the beach fill. At this point, the thickness of the beach fill fully tapers off and becomes infinitely small or zero. The equilibrium profile curves downward rapidly and has the greatest rate of descent as it moves seaward from the shore. The rate of descent lessens further offshore as the fill tapers off and becomes thin. Nearshore hardbottom within the ETOF may or may not be covered by the beach fill. If the thickness of proposed fill at an outcrop is less than the vertical relief of the hardbottom, the actual coverage will be limited to a reduction in both the amount of vertical relief and areal extent. This adds to the complexity of calculating the coverage of nearshore hardbottom by the proposed project.

g. **Ongoing erosion** - The erosion south of South Lake Worth Inlet is a direct result of strong tidal currents and structures at this man-made inlet. Erosion south of the inlet has an associated average shoreline recession rate of 1.9 ft/yr for the 1.6 mile project area referenced by the GDM for PBC (USACE, 1987:E-56). The erosion has probably influenced the increased exposure of the hardbottom located in the project area. Changes in erosion rates and the occurrence of localized accretion and erosion result in the hardbottom being exposed or buried in a variety of different locations for different periods of time. The amount of hardbottom exposure that can be attributed to erosion versus hardbottom exposure that "naturally"[1] occurs is unknown. This same process affects the position of the fill profile and thus the location of the ETOF. This process results in scouring of the fill from the hardbottom and reduces the duration of fill impact to the hardbottom (see discussion of short term direct impacts above).

h. **Biological and geographical studies** - Hardbottom in the project area is naturally covered and uncovered by shifting bottom sediments and by fluctuations in the shoreline position. Geographical studies performed in the proposed project area have resulted in a series of maps indicating the presence of exposed nearshore hardbottom at specific points in time. The hardbottom is continually scoured by sediment movement and often buried for various periods of time although at any one point in time there is always some hardbottom exposed in the project area. The environmental impact associated with covering a recently exposed low relief hardbottom is expected to be significantly less than covering a diverse, long lived, high relief hardbottom of equal surface area. A reduction in composition and size of the hardbottom biological community that results from fill coverage must be determined to accurately assess environmental impact. The environmental impact associated with covering (i.e., physically impacting) only a portion of the nearshore hardbottom is too complex to accurately predict prior to project construction. Studies of the immediately pre-construction and 1-year post-construction biological communities, geographical extent of the hardbottom, and hardbottom surface area exposed must be performed to determine the actual physical impacts.

i. **Non-concurrency of data** - The beach profiles upon which the ETOF was calculated were conducted in February 1993. The aerial surveys of nearshore hardbottom was conducted between 1983 and 1994. The ETOF calculation, and subsequent placement of that line over the hardbottom survey to calculate the predicted amount of impact is likely misleading. Profiles have changed with time and may also have changed the location of the ETOF, therefore affecting an accurate estimation of hardbottom impacts.

5.17 Given that accurate predictions of impacts are nearly impossible to make, the following statements can be made regarding impacts to hardbottom:

a. An undetermined amount of hardbottom will be replaced with either a sandy bottom habitat with a different associated community or a hardbottom/sand community with diminished relief and exposure. The permanent or non-mobile species will be eliminated from that portion of the hardbottom that is buried. The temporary or transitory species would be displaced from that portion of the hardbottom that is buried and will probably attempt move to portions of the hardbottom that is not affected.

b. The amount of hardbottom historically observed within the proposed project area, from 1983 to 1994, has ranged from 9.52 to 12.34 acres with a "time average" of 10.67 acres (Table 3). The "time averaged" calculations from above, 3.1 acres of long term direct impacts and 3.2 acres of short term direct impacts are predicted (Table 12). A more conservative estimate of potential worst case impacts would be based upon the 1994 map which shows 6.4 acres of long term direct impact and 2.9 acres of short term direct impact.

c. The ecological value of the hardbottom decreases as the duration of coverage by sand increases. The acreage of hardbottom exposed within the proposed project limits (both inside and outside of the impact areas) has been rather stable, while the acreage in the vicinity (R-147 to R-167) has fluctuated. Most fluctuations occur on the edges of the structure with the central areas being more persistent over time.

d. The exposure frequency of hardbottom south of the inlet is variable with greatest persistence of exposure shown offshore of FDNR survey monuments T-152 to R-153.5 and R-160 to R-164.

e. Hardbottom that is covered as a result of project construction will become re-exposed as the offshore profiles return to pre-project conditions. This is due to the fact that the project is a feeder beach which has no permanent design section and will erode back to pre-project conditions. This is expected to take approximately 6 years with some hardbottom (an average of approximately 2.3 acres) becoming re-exposed almost immediately after equilibrium is reached. While the hardbottom areas will have reduced value since they will be impacted on a more regular basis as renourishment occurs, they will not be permanently eliminated and will provide habitat when they are exposed. A simplistic analysis indicates that much of the hardbottom impacted at the time of construction will be exposed for 50% of each nourishment interval.

f. The significance of the variability in location and extent of hardbottom acreage is that any community that becomes established in this area is adapted to changing conditions. The types of organisms that survive in this environment are generally fast growing and

prolific, enabling them to rapidly re-colonize recently exposed surfaces. This community is not unique to the project area.

g. The primary cause of exposure of the hardbottom is probably erosion associated with the South Lake Worth Inlet. In spite of periodic maintenance dredging of the inlet, and operation of the sand transfer plant, sand continues to be "impounded" in the ebb tidal and flood tidal shoals, or lost from the littoral system resulting in the increased exposure of the underlying hardbottom south of the inlet.

h. Based upon the most recent observations and calculations available (8/9/94 aerial photography, plus the February 1993 beach profiles to place the ETOF), approximately 2.2 acres (11.6 acres available minus 9.4 acres impacted) of actual hardbottom within the project area will remain exposed after construction. In addition, there is substantial nearshore hardbottom habitat, roughly 37 acres, (as of 8/9/94; see Fig. 2 and Appendix D) located immediately south of the project area (R-159 to R-167) which may offer alternative refuge for some mobile displaced individuals. There are also two artificial nearshore reefs, located at R-155.5 and R-166 through R-167.5 that may also provide ~2 acres of alternative habitat.

5.18 In summary, an undetermined amount of hardbottom and associated flora and fauna will be affected by fill placement and subsequent profile equilibration; a small portion may be permanently impacted by placement of the T-head groins. Nearby unaffected habitat will serve as a refuge for the mobile species and will be a source of organisms for recolonization and recruitment as hardbottom becomes re-exposed.

5.19 To attempt to reduce impacts to the hardbottom, several options were considered. These include: 1) shifting the north project limit southward to avoid hardbottom; 2) reducing the volume of fill placed in the template; 3) altering the profile template to reduce volume of fill placed along the seaward edge, and 4) several structural options of groins, nearshore breakwaters or combinations of the two. Due to engineering and economic considerations, the only option that was deemed feasible by the consultant is the current proposal. This option will provide protection to upland structures, maintain the beach fill, and partially restrain the beach fill from impacting the nearshore hardbottom.

5.20 The USACE funds the USFWS under the Fish and Wildlife Coordination Act to survey the beach fill area for fish and wildlife resources. The USFWS states in their Coordination Act Report (USFWS, 1994a) that there was is a diverse community of fishes and invertebrates. The Service recommends impacts to the community be avoided but will accept some impacts with mitigation with a well designed artificial reef structure of equal surface area and of similar substrate placed outside the project area. While public benefits have been quantified in the GDM Addendum, the actual environmental impacts are difficult to predict for the reasons listed above. Impacts to the nearshore hardbottom have been reduced somewhat and should be relatively short-lived when compared to the benefits associated with placing additional sand into the littoral

system south of the South Lake Worth Inlet. Monitoring of pre- and post-construction conditions would be necessary to quantify actual environmental impacts to calculate mitigation acreage.

The preceding discussion (paragraphs 5.12 through 5.20) was based upon information consistent with the permit applications submitted to FDEP. Since this DSEIS has been circulated, the FDEP has issued a water quality certification that requires 4.55 acres of mitigation and does not require monitoring to determine final mitigation amounts. The FDEP has given credit for 2.1 acres of artificial reef already constructed and 0.45 acres of habitat created when the groins are constructed. An additional 2.0 acres of low relief artificial reef will be constructed of a combination of limestone and concrete to meet the FDEP permit requirements. The USFWS has indicated that this plan is an adequate alternative to the mitigation plan described above and in the Coordination Act Report provided that impacts are not significantly greater than predicted impacts based upon 1994 conditions. Refer to the FDEP permit in Attachment 2 for details.

5.21 The long-term benefits to the public outweigh the expected environmental impacts of this project. This is because this project is designed as a feeder beach that provides for placement of sand to feed downdrift beaches. Placement of sand on beaches south of inlets will correct localized erosion problems and reduce erosion further south. This process may reduce the need for other beach nourishment projects downdrift.

5.22 Effects on Offshore Reef. No direct mechanical impact on offshore reefs is anticipated due to the distance the offshore reefs are located from the borrow and fill areas. The nearest offshore reef is located about 1,440 feet east of the borrow area (See Fig. 2). The distance from the southeast corner of the borrow site to the 45-foot deep patch reef, Lynn's Reef, is 2,230 feet. The distance from the northeast corner of the borrow site to the 22-foot deep patch reef northeast of the inlet, Goggle Eye Reef, is 2,500 feet. Sedimentation of the offshore reef is not expected to be significant due to the distance of the borrow area to the reef.

5.23 Effects on Offshore Softbottom. The offshore softbottom of the borrow site will be excavated to 15 feet, creating a bottom at 45 feet in depth where it was previously 30 feet in depth. The newly exposed bottom at this depth would likely attract and support a different complement of species than existed previously. However, this will be influenced by the re-filling of the borrow pit (by sediment transport along the bottom and slumping of the side walls of the pit), as well as by the high density of infaunal invertebrates surrounding the excavated area. The borrow pit would be expected to recolonize rapidly (weeks), with actual recovery to previous community composition requiring a few to many years, probably following the return of the borrow site sediment surface to original (pre-dredging) depths.

5.24 Effects on Fishes. On the nearshore hardbottom, higher fish densities were associated with higher relief. Additional loss of hardbottom would place an increased stress on the area and the fish population (particularly herbivores).

5.25 Impacts to fishes in general are expected to be minimal. The most significant effect on fish and fisheries will be due to the permanent loss of a portion of the nearshore hardbottom within the

equilibrium toe of fill and the temporary loss of additional nearshore hardbottom with the construction toe of fill. The resultant impact to recreational and commercial fisheries is expected to be: 1) short-term displacement and loss during construction (particularly larval and juvenile life stages as well as all stages of cryptic species), and 2) temporary loss of food sources such as soft-bottom benthic infauna and hard substrate epibiota of the borrow and fill areas affected. Impacts will be reduced by: 1) the amount of hardbottom remaining and/or constructed for the project itself and for mitigation; 2) construction of the project when fish populations are expected to be lowest; and 3) selection of the best available borrow material which will result in relatively rapid benthic recolonization and minimized siltation on remaining nearshore hardbottom and nearby seagrasses.

5.26 Impacts will be primarily to those species of fish associated with the hardbottom, i.e.: "primary" reef species, with minimal temporary impacts to the "secondary" reef species. Combining several recent surveys at Ocean Ridge, 116 species of fish have been observed on and around the hardbottom areas (Table 9). Of these, 61 species (52%) are primary reef species (see Starck, 1968:8) and are also considered "hardbottom-associated" for purposes of this report. The majority of these hardbottom associated species are not directly important to a commercial or recreational fishery though they are probably ecologically significant as prey and predators in the food chain of such fishes. Recruitment of larval stage fishes may be affected if much of the hardbottom is buried. If dredging is conducted before the spring and summer settlement period and if sufficient habitat is available, impacts to larval stage fishes can be reduced.

5.27 Impacts to the hardbottom-associated fishes will be commensurate with the degree and duration of impact on hardbottom which is in itself difficult to predict (see "Effects on Nearshore Hardbottom", paragraph 5.12). The duration of short-term impacts will be dependent upon the rate of re-exposure of hard substrate buried or impacted by the fill. As the project is designed to "feed" downdrift beaches, sand will erode from the fill area and re-expose the nearshore hardbottom to return to the pre-project conditions in about 6 years. The initial impacts will, therefore, diminish with time in concert with the longshore transport of the fill, rather than exhibit persistence throughout all time. Effects on these fish may be minimized provided that some amount of hardbottom remains undisturbed or not totally buried by project fill. The fish inhabiting the existing hardbottom are expected to be displaced to these areas provided the travel distances are not excessive.

5.28 Impacts on primary reef fishes may be mitigated by creation of an artificial reef of appropriate structure to support those types of fish displaced by the project fill and/or groins. Approximately 2.1 acres of nearshore artificial reef have been constructed in the vicinity of the project and will serve to partially mitigate impacts. Additional mitigation will be constructed which would compensate for any remaining impacts. This reef should satisfy mitigation requirements for the 50 year life of the project.

5.29 Secondary short-term dredging impacts on fish assemblages would include temporary increases in turbidity, noise, and disturbance of sediment in general. Effects of turbidity on fish are difficult to evaluate as most nearshore fish are adapted to periodic short-term, storm generated turbidity. Clogging of gill membranes could occur in some less adapted species or if sediment loads remain high for extended periods of time and fish do not migrate out of the area. Noise from the dredge may alter fish movement or behavior on a temporary basis.

5.30 The level of impact from these concerns is unknown but expected to be small to minimal with no significant impacts to fish of interest to commercial and recreational fishermen. The relatively low silt/clay fraction of the borrow material should result in minimal short-term impacts from turbidity. Noise will persist only as long as dredging continues. A short-term increase in food availability may result in an increase in feeding activity by some species as invertebrates entrained in the discharge slurry are dispersed into the water column. Densities of the winter infaunal benthos (generally polychaetes, amphipods, and isopods) are expected to be at seasonal highs during the project. Their temporary loss from a relatively small area is expected to have minimal impact on fish, as an abundance of alternative feeding grounds (also at high infaunal densities) will be present.

5.31 Goggle Eye Reef, to the NNE of the inlet and 2,400 feet from the north end of the fill area, has persisted in spite of it's low relief platform. However, the reef has shown a consistent trend toward diminishing acreage (from 0.65 acres in November 1983 to 0.05 acres in July 1993 and no reef observed in the August 1994 aerial photography). The area has been highly productive, supporting large gorgonians and very large anemones, and is used by commercial fishermen for goggle eye. Minimal impacts are anticipated to this reef from sedimentation and turbidity associated with this project.

5.32 **Impact on Endangered and Threatened Species, Federally Listed.**

5.33 No-Action Alternative. If no action is taken, nesting habitat for sea turtles would continue to diminish. There would be no effect on other listed species.

5.34 Selected Alternative. Coordination with USFWS and NMFS is required and has been completed for the recommended project according to Section 7 procedures of the Endangered Species Act (Act) of 1973, as amended. Section 7(b)(4) of the Act requires that when a proposed project is found consistent with Section 7(a)(2) of the Act and the project may result in some take (death) of some individuals of the listed species, the USFWS and NMFS will issue a statement that specifies the impact (amount or extent) of such incidental taking. Also, the Act states that reasonable and prudent measures, coupled with terms and conditions to implement these measures, be provided to minimize such impacts. The Biological Opinion (USFWS, 1994b) requires the following reasonable and prudent measures for protection of sea turtles:

1. Beach nourishment will not occur during the main portion of the nesting season.

2. During periods of lower nesting activity near the beginning and end of the overall turtle nesting season, relocation of nests will be required.

3. Nourished beaches will be tilled if compaction or escarpments occur.

4. Groin construction will be scheduled to occur in the lowest nesting density beaches during the peak of the nesting season and in higher nesting density areas prior to the peak nesting season.

The Biological Opinion also lists 10 terms and conditions that must be complied with to implement the above reasonable and prudent measures.

5.35 Protection of Sea Turtles. The dredging aspect of the project has been designed to occur in winter, outside of peak sea turtle nesting season, and will have minimal impact on sea turtles. Long-term impacts associated with nesting and hatching success should be minimal due to the relative compatibility of the borrow material with the native beach sand. In addition, impacts associated with sand compaction and scarp formation (both of which can affect nesting success) will be minimized by tilling and grading. The removal of old groins and construction of T-head groins may occur during nesting season but will be scheduled to minimize impacts. If groin work cannot be avoided during the nesting season, construction will be phased to avoid the higher nesting density beaches in the south end of the groin field during peak season. The construction site will be thoroughly monitored, and is an area in which sea turtle nests that are laid are moved because of narrow, low beaches and the threat of erosion of the nests. The area is also one of relatively low nest density compared to other East Florida beaches; the density of sea turtle nests in the northerly 2,535 feet of the project area was 31 nests/mile in 1992 (Table 11).

5.36 Nelson and Dickerson (1988a) reviewed the effects of beach restoration on sea turtles. Physical changes in sand compaction, beach shear resistance, beach moisture content, beach slope, sand color, and sand grain size, shape and mineral content resulting from filling may have negative effects on the nesting activities of sea turtles. Increased false crawls (resulting in increased physiological stress), decreases in nest number, a change in sex ratios of the hatchlings, and an increase in misshaped nest cavities may result from these changes in physical characteristics of the beach. They concluded that most of the negative effects can be corrected by use of management techniques such as tilling compacted beaches, use of naturally compatible sand for restoration, and smoothing of scarp formations. Nelson and Mayes (1986) and Nelson and Dickerson (1988b) discussed the effect of hardness of recently restored beaches on sea turtle nesting and Nelson and Dickerson (1988c) studied the effect of tilling of compacted beaches on sea turtle nesting.

5.37 The use of the proposed offshore borrow site for beach fill should provide beach compatible material that should also be suitable for sea turtle nesting. The mean sand grain size of the dry native nesting beach in the project area has a mean grain size of 0.36 mm with an average silt/clay fraction of 0.08% and the borrow area has a mean grain size of 0.26 mm with an average silt/clay of 1.5%. Material of this quality is expected to require tilling, which should reduce compaction to acceptable levels.

5.38 In order to provide further protection to sea turtles, the following will be implemented: 1) that portion of the project which includes sand disposal on the beach will be constructed outside of prime turtle nesting season (May 1 to October 31); 2) dredge lighting be minimized or replaced with low pressure sodium lights; 3) lighting in the spoil area will be limited to shielded low pressure sodium lights; 4) a three year study be performed to assess nesting success, hatching success, scarp formation and compaction, and; 4) dune vegetation will be planted to enhance dune restoration.

5.39 Protection of Manatees. No significant impacts to manatees are expected. While seagrasses are located in the estuary inland of the project, there are no seagrasses or other known manatee food sources in the project area. The Lake Worth Lagoon located due west of the project is designated as critical habitat for manatees. Manatees have been seen traveling along the beaches in the project area but are expected to readily avoid the project area during construction without any negative impacts. The primary concern to manatees is increased boat and barge traffic associated with the dredging project.

5.40 Various protective measures are recommended to be in place during construction to avoid injuring or disturbing manatees. Dredging operations are of concern because of the susceptibility of the manatee to injury by boat traffic. Collisions of boats and barges with manatees have historically been one of the major causes of manatee injury and death. There is little likelihood of direct impacts from the dredge during construction, but there is potential for work boats to strike manatees while transferring between dredge and shore access points within South Lake Worth Inlet.

5.41 In order to safeguard any manatees which may be in the project area, the following contract procedures are recommended:

> The contractor will instruct all personnel associated with the construction of the project about the potential presence of manatees in the area and the need to avoid collisions with the manatees. All vessels associated with the project shall operate at "no wake" speeds (or minimum speed necessary to maintain safe navigation) at all times while in shallow waters, or channels, where the draft of the boat provides less than 3 ft clearance of the bottom. Boats used to transport personnel shall be shallow draft vessels, preferably of the light-displacement category, where navigational safety permits. All personnel should be advised that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Endangered Species Act and the Marine Mammal Protection Act. The contractor will be responsible for any manatee harmed, harassed, or killed as a result of the construction of the project. The contractor shall keep a log detailing all, collisions, damage, or killing of manatees which occur during the contract period. Any manatee deaths or injuries will be reported to the USFWS (Vero Beach Field Station).

5.42 Protection of Johnson's Seagrass. The National Marine Fisheries Service has proposed listing this species as Threatened. Until the species is listed by NMFS, the Endangered Species Act requires conferencing between the agencies to develop measures that will minimize impacts.

5.43 **Effects on Endangered, Threatened, and Rare Species and Species of Special Concern, State Listed.**

5.44 No-Action Alternative. Sea turtles may experience continued loss of nesting habitat. Loss of listed dune plants will occur as erosion of the dune continues. No significant adverse effects on other species is anticipated.

5.45 Selected Alternative. No impacts are expected on any State listed species that have not been discussed in the preceding sections. There are no reported nesting sites within the project area for the listed bird species; however, those species will be displaced from other uses (feeding, resting, etc.) of the area during construction but can easily utilize other areas for these functions. Listed plant species will be preserved and will benefit from the additional storm protection afforded by the placement of fill on the beach.

5.46 Based on these assessments of the nearshore hardbottom community, the anticipated impact to this community should not affect any protected species, other than several small colonies of the star coral Siderastrea radians. The Common Snook, Centropomus undecimalis (a species of special concern) utilizes the nearshore hardbottom habitat, but due to it's mobility, the snook would be minimally affected.

5.47 **Nearshore Water Quality.**

5.48 No-Action Alternative. Taking no action would preserve present water quality.

5.49 Selected Alternative. Significant long term impacts to water quality are not expected to occur due to the quality of sand to be used as borrow material. This project can be constructed in compliance with State and Federal water quality regulations. Chapters 62-3 and 62-4 of the Florida Administrative Code (FAC) and Section 404 of the Federal Clean Water Act, as amended, apply to dredging projects.

5.50 With Federal approval to pursue the present project (countywide GDM: USACE, 1987), exemption from Rivers and Harbors Act, Section 401 State water quality Standards would be possible. A water quality permit from the FDEP has been issued for this project indicating that the project meets Section 401 State water quality standards. Therefore, a Clean Water Act Section 404(r) exemption will not be sought in lieu of section 401 certification. A "Section 404(b)(1) Evaluation Report of Dredged Material" is attached.

5.51 Terms of the FDEP permit include a variance from FAC Rule 62-4.244(5)(c) which limits the size of mixing zones to 150 m. This variance allows a 500 m mixing zone for turbidity at the fill site, based primarily on operation during winter surf conditions.

5.52 An important consideration in controlling nearshore turbidity is the silt-clay content of the proposed fill material. The lower the silt-clay fraction, the less likely the chance of causing excessive turbidity in the adjacent waters. Due to the uniformity of sands in the proposed borrow area, a simple dredging scheme is possible: the area will be dredged to -15 feet below existing sediment surface, throughout the entire borrow area.

5.53 While the borrow area has a relatively low level of fine materials which could cause excessive turbidity impacts, the project is scheduled for construction outside the calmer summer months. Construction during the rougher weather can cause those fine materials that are present to be suspended for longer periods of time and thereby travel longer distances. For this reason and because the fact that the project is adjacent to an inlet which generate currents that will move the turbidity plume in an unpredictable manner, the County has requested a mixing zone variance to allow for a 500 meter mixing zone from the beach discharge point. The boundaries of the mixing zone will be the mouth of the South Lake Worth Inlet and 500 meters downcurrent of the beach discharge point. The mixing zone has been designed to provide protection to the nearest sensitive natural resources adjacent to the project which are the seagrass beds located inside South Lake Worth Inlet. A mixing zone variance has not been requested at the cutterhead. The standard mixing allowed by Section 62-4.244(6)(c) FAC of 150 meters should be sufficient at this point.

5.54 The impact of turbidity from beach restoration projects on surrounding biological communities has not been well documented. Increased sediment loads from the project could foul the respiratory and feeding organs of pelagic or benthic organisms. If the material remains in the water column for a period of time, it could reduce visibility and light penetration for photosynthetic plants. Courtney (1982) studied the impact of the 1981 Captiva Island, Florida, beach restoration project on the seagrass beds within a 6,000 ft radius within Redfish Pass. The project had no observed effect on turtle grass (Thalassia testudinum), manatee grass (Syringodium filiforme), and shoal grass (Halodule wrightii).

5.55 The closest seagrass beds near the Ocean Ridge project include those in the interior of Lake Worth Lagoon, 1,100 ft. from the north limit of the fill site. Johnson's seagrass (Halophila johnsonii) is present in the lagoon and is of concern since it is proposed to be listed as Federally endangered. Minimal impacts are anticipated to these beds provided the following management strategies are implemented to control turbidity levels and minimize any additional loading: 1) selection of the best available sand source; 2) implementation of a comprehensive water quality monitoring program that is effective in regulating dredging and associated turbidity; 3) construction of shore parallel dikes; 4) construction during fall, winter or spring when longshore currents are typically southward to reduce the chances of a turbidity plume entering the inlet to the north; and 5) construction during the fall, winter or spring when seagrasses enter a state of dormancy or reduced productivity.

5.56 **Public Beaches.**

5.57 **No-Action Alternative:** With no action, the presently critically eroded beaches will continue to erode and shorelines will continue to recede.

5.58 Selected Alternative. Implementation of the proposed project would preserve the remaining recreational beach and its protective functions. In addition, about 30.7 acres of dry beach would be created. Present plans are for periodic renourishment approximately every 6 years to maintain the beach. Beach users will be inconvenienced during construction of the structures, during initial placement of fill, and during future renourishment projects.

5.59 **Effects on Archeological and Historical Resources.**

5.60 No-Action Alternative. Taking no action would have no effect on archeological and historical resources.

5.61 Selected Alternative. No archeological or historical resources are known to exist in the borrow or fill area, although 2 magnetic anomalies were located in the primary borrow area; these were determined to be ferrous debris of recent vintage. . According to the cultural resources report, it was the author's opinion that the proposed project "should not affect any archeological resources" (Koski-Karell, 1993) and it is the District's determination that significant cultural resources are not located in the area of proposed impact. The magnetometer survey report prepared by Koski-Karell was received by the Jacksonville District staff and coordinated with the Florida Division of Historic Resources and State Historic Preservation Officer. In letters dated December 10, 1993 and January 10, 1994 this agency concurred with the District's determination (see Appendix C, Pertinent Correspondence). The contractor will be informed of the location of the debris and may chose to avoid the area to prevent damage to equipment.

5.62 **Aesthetics.**

5.63 No-Action Alternative. Without beach renourishment the shoreline will continue to erode. This will result in the loss of existing beach and dunes, park facilities, and a road south of the inlet. In addition, new coastal protection structures may be constructed by local interests to protect upland structures which would impact the visual aesthetics and beach dynamics of the area.

5.64 Selected Alternative. The renourishment of the beach in accordance with the design considerations mentioned below will result, over all, in an improved aesthetic quality. The placement of sand on the shore would restore the natural pleasing visual appearance of the considered 1.42 miles of shore. In addition, the construction of future coastal shoreline protection structures will not be required. However, during construction, there will be short-term construction impacts including turbidity in the immediate vicinity of the dredge and discharge point on the beach, construction equipment on the beach along with their associated sensory impacts (sight, sounds, and smell), pipeline placement on the beach, and fill retainment berms. Access to certain parts of the beach will be temporarily restricted, for safety reasons. Sand from vibracores at the borrow site is generally gray in color. Although this color is expected to lighten somewhat with placement on the beach, it may somewhat detract from the aesthetic appearance of the beach. No other adverse impacts to aesthetics are expected from nourishment of the project beach. Existing dunes will be protected and are anticipated to increase in size and stability. In conjunction with the authorized project, the local sponsor will revegetate the dune as necessary.

5.65 The construction of eight T-head groins will interrupt the natural appearance and usage of approximately the northerly 1,800 feet of project shoreline, immediately south of the inlet.

5.66 **Design Considerations**. Procedures will be implemented to limit the formation of a scarp along the new beach fill which will be sloped during construction to reflect a stabilized condition. The beach fill will be shaped and graded to absorb wave energy. The elevation of the beach berm will be set to limit frequent overtopping. This will avoid the formation of a ridge along the crest of the berm and reduce the impact of waves. Beach fill material will contain a small percentage of fines which will cause turbidity during construction. Non-functional groins within the project area will be removed to facilitate proper functioning of the new shoreline structures, and to restore a more natural visual appearance of the beach.

5.67 **Air Quality**. The Clean Air Act requires that all Federal projects be evaluated for compliance with the EPA's General Conformity Rule. A similar project (Jupiter/Carlin Shore Protection Project) was evaluated by the local approved air pollution control program administered by the Palm Beach County Health Unit (PBCHU). The projected emissions have been calculated to be well below the de minimis threshold level for both nitrogen (NOX) and volatile organic compounds (VOCs). The project was also well below 10% of the total NOX and VOC allowable emissions for Palm Beach County and was determined by the PBCHU to not be regionally significant. This project should not require a conformity determination based upon these findings (see letter in Pertinent Correspondence).

5.68 **Unavoidable Adverse Environmental Impacts**. Burial of nearshore hardbottom, loss and disruption of the benthic macroinvertebrate community in the borrow and fill areas, reduction in water clarity, increased siltation and sedimentation, increased compaction of beach, reduction in fish populations, and displacement of birds using the area for forage and resting can be considered **temporary** unavoidable impacts associated with this project.

5.69 **Irretrievable Commitment of Resources**. Construction of this project is not expected to result in an irretrievable commitment of resources. Each time the beach is scheduled to be renourished, the project must be justified to permitting and funding authorities. At each renourishment, a comparison of benefit to cost will be made in order to proceed.

5.70 **Federal, State, and Regional Objectives**. There are no known conflicts between this proposed project and federal, state or regional objectives.

5.71 **Energy Requirements**. It is calculated that the energy requirements of the project would be approximately 117,000 gallons of fuel per nourishment cycle or 819,000 gallons over the 50 year life of the project. The potential for conserving and reducing this energy requirement may occur if the construction contract is combined with other nearby nourishment projects to reduce the distance traveled for mobilization. The no-action alternative would eliminate the energy requirement. Any alternatives which increase the stability of the project (i.e., beach nourishment stabilized by structures, sand transfer plant) or reduces the negative effects that the inlet has on littoral processes would increase the renourishment interval and could result in a conservation of energy. An alternative that is already being implemented and can be expected to reduce the need

for renourishment is maintenance dredging of the ICW shoals and the sand trap in South Lake Worth Inlet.

5.72 **Natural or Depletable Resource Requirements**. Beach quality sand and limestone rock can be considered to be depletable resources which are required for the construction of this project. Diesel fuel is also a depletable resource and is discussed in the previous paragraph. Conservation of beach quality sand could be accomplished by implementing an inlet management plan designed to reduce the negative effects the inlet has on littoral processes. All of the structural alternatives that were discussed in Section 3.00 (Alternatives) and the no action alternative could result in conservation of beach sand (and possibly limestone rock) but were not selected due to other factors such as cost or inability to meet planning objectives.

5.73 **Cumulative Impacts**. This project will result in long-term benefits which should outweigh any short-term environmental losses. Monitoring has been initiated to facilitate comparison of pre-project conditions with post-project conditions in order to determine short- and long-term impacts to nearshore hardbottom, fishes, benthic infauna, water quality, and sea turtles. The information gathered from the monitoring will be used to "fine tune" this project as well as provide valuable insight to the design and implementation of other beach nourishment projects to reduce associated environmental impacts.

5.74 The proposed project is necessary to mitigate the erosive impacts of the South Lake Worth Inlet on the downdrift beaches. The project fulfills the recommendations of the FDNR in that it uses the feeder beach concept to reduce the sand deficit in the area. A major benefit of feeder beach projects is that sand is placed on the beach and designed to erode to feed sand to downdrift beaches. Placement of sand on beaches south of inlets will reduce localized erosion and reduce erosion further south. This process may reduce the need for major beach nourishment projects located in the middle of barrier islands. Reduction of the need for major nourishment projects should result in less environmental impacts over the long term.

5.75 Additional benefits include increasing the beach width thereby providing recreational and storm protection benefits to public and private property along and down-drift from this section of beach. The project also fulfills the goals of FDNR and FDER by using the best quality fill available for the project. Utilization of this fill source reduces impacts to water quality, seagrasses, benthic infauna, fishes and sea turtles. The overall environmental impacts of the project are expected to be relatively low compared to the cumulative benefits of the project.

5.76 **Periodic Renourishment**. Present plans include renourishing the project beach every 6 years with approximately 784,300 cubic yards. Additionally, sand placement south of the inlet (via the sand transfer plant) will continue to be conducted by Palm Beach County and the USACE will conduct maintenance dredging of the inland waterways near the inlet, which will reduce the need for renourishment. Renourishment impacts would likely be similar or less than those projected for the initial nourishment project. However, any burial or other impact to nearshore hardbottom would likely be to the same or similar areas as were impacted initially and mitigated for as necessary. This means there would be minimal adverse effects of renourishment impacts

since additional habitat will have been constructed and established prior to the renourishment project.

5.77 Prior to renourishment, investigations would be conducted to determine the extent and nature of potential impacts. This would include checking the amount and quality of material in the selected borrow area. Where necessary, the same precautions described in this statement to protect endangered species and minimize impacts on other species would be employed. No significant impacts to marine resources or habitats are expected during periodic renourishment, but field investigations and coordination with concerned State and Federal agencies would be performed prior to construction. Additional mitigation measures are not expected to be necessary, but would be implemented should that be the case. The estimated 6-year dredging interval between beach nourishments should allow sufficient time for recolonization and community recovery of the borrow area sediments.

6.00 LIST OF PREPARERS

Name	Discipline/ Expertise	Role in EIS Preparation	Experience
Paul Davis	Environmental Program Supervisor	Editor	11 years Palm Beach County
Paul Mikkelsen	Environmental Analyst	Community analysis	1 year Smithsonian Institution
			10 years Harbor Branch Oceanographic Institution
			3 years Florida Dept. of Natural Resources
			6 years Palm Beach County
Joyce Moody	Engineering Assistant	Resource and Project Mapping	9 years Palm Beach County

7.00 PUBLIC INVOLVEMENT

7.01 Public involvement for this Supplemental Environmental Impact Statement was initiated by the USACE, Jacksonville District with a scoping letter dated December 7, 1993. A Notice of Intent (NOI) to prepare an SEIS was published in the Federal Register on February 3, 1994. Responses to the scoping process and the NOI are included in the pertinent correspondence section of this SEIS.

7.02 Required Coordination. This Supplemental Environmental Impact Statement has been circulated to Federal, State, and local government agencies including the public and special interest groups. The comments received from these parties are in the Pertinent Correspondence section of this report.

7.03 Results of Coordination. To address the concerns of the USFWS regarding sea turtles, the terms and conditions of the Biological Opinion will be met. To address the concerns of USFWS and FDEP regarding nearshore hardbottom impacts, a minimum of 4.55 acres of artificial reef will be constructed as mitigation. To address the concerns of the FDEP, additional modeling was performed resulting in the current plan being proposed as the optimal plan for balancing shore protection needs with the desire to limit impacts to nearshore hardbottom. To address concerns raised by South Lake Worth Inlet District, the north end of the project has been moved south to avoid South Lake Worth Inlet property and the groins were redesigned.

7.04 Statement Recipients: NATIONAL

Director, Office of Federal Activities (A-104)
Environmental Protection Agency
401 M Street S.W.
Washington, DC 20024-2610 (5 cys)

Director, Department of Commerce
NOAA/CS/EC/Room 6222
14th and Constitution Avenue, N.W.
Washington, DC 20230 (4 cys)

Director, Office of Environmental Compliance
Department of Energy, Room 4G064
1000 Independence Avenue, S.W.
Washington, DC 20585 (2 cys)

Director, Federal Maritime Commission
Office of Energy and Environmental Impact
1100 L Street, N.W.
Washington, DC 20005-4013

Director, Environmental Health & Disease
Control - F29
Centers for Disease Control
1600 Clifton Road
Atlanta, GA 30333 (2 cys)

Director
Federal Emergency Management Administration
500 C Street, S.W., Room 714
Washington, DC 20472

Director, Office of Environmental Project Review
Department of the Interior, Room 4241
18th and C Streets, N.W.
Washington, DC 20240 (12 cys)

Chief, Environmental Impacts Branch
U.S. Environmental Protection Agency
26 Federal Plaza, Room 400
New York, NY 10278-0001

Executive Director
Advisory Council on Historic Preservation
1100 Pennsylvania Avenue, N.W., #809
Washington, DC 20004-2590

Director, Ecology and Conservation Office
U.S. Department of Commerce
14th & Constitution Avenue NW
HCHB SP, Room 6117
Washington, DC 20230
Attn: Donna Wieting

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Southern Region Forester
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Regional Director
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7.05 Statement Recipients: FLORIDA

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Office of Aquatic Preserves
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Florida Dept. of Environmental Protection
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West Palm Beach, FL 33405

Florida Dept. of Environmental Protection
Florida Marine Research Institute
19100 S.E. Federal Hwy.
Tequesta, FL 33469

Florida Department of Environmental Protection
Division of Environmental Resource Permitting
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State Clearinghouse
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Florida Wildlife Federation
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2600 Blair Stone Road
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West Palm Beach, FL 33406-1548

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Eastern Surfing Association
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Town Manager
Town of Ocean Ridge
6450 N. Ocean Blvd.
Ocean Ridge, FL 33435

City Manager
City of Boynton Beach
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Boynton Beach, FL. 33535

Town Manager
Town of Manalapan
600 S. Ocean Blvd.
Manalapan, FL 33462-3321

Sierra Club
c/o Tom Horton
31 Coconut Lane
Ocean Ridge, FL 33435

7.06 Agency Comments and Responses. The Draft Supplemental EIS was distributed to agencies listed in paragraphs 7.04 and 7.05; the comments received are included in Appendix C. The following agencies responded to circulation of the Draft Supplemental Environmental Impact Statement, Palm Beach County, Shore Protection Project, Ocean Ridge segment:

01/24/96 U.S. Department of Housing and Urban Development, Atlanta, GA.
01/25/96 Florida Department of State, Division of Historical Resources, Tallahassee, FL.
02/29/96 U.S. Department of Commerce, NOAA, National Marine Fisheries Service, St. Petersburg, FL.
03/01/96 Department of Community Affairs, Florida State Clearinghouse, Tallahassee, FL.
03/05/96 U.S. Department of Commerce, Washington, D.C.
03/07/96 Department of Community Affairs, Florida State Clearinghouse, Tallahassee, FL.
03/14/96 Town of Manalapan, Manalapan, FL.
03/16/96 South Lake Worth Inlet District, Lantana, FL.
03/18/96 U.S. Environmental Protection Agency, Atlanta, GA.
03/26/96 U.S. Department of Commerce, NOAA, National Geodetic Survey, Silver Spring, MD.
03/27/96 U.S. Department of Commerce, Washington, D.C.
03/28/96 U.S. Department of the Interior, Atlanta, GA.

7.07 **U.S. Department of Housing and Urban Development:** "Our review indicates there will be no significant adverse impact on any HUD programs as a result of this project."

Response: Acknowledged.

7.08 **Florida Department of State, Division of Historical Resources:** "...we note that the project borrow areas were surveyed for historic properties in 1993. Two magnetic anomalies were identified during the survey. We note that the 200' buffers areas around the anomalies will be maintained. Therefore, it is the opinion of this agency that the historic preservation concerns of this office have been adequately addressed."

Response: A previous letter from the Florida Department of State, Division of Historical Resources dated September 10, 1993 (Appendix C) indicated "that sand borrowing activities in the two areas will have no effect on any significant resources." Letters dated December 22, 1993 and January 10, 1994 (Appendix C) indicated that "no significant archaeological or historical sites are recorded for or likely to be present within the project area. Therefore, it is the opinion of this office that the proposed project will have no effect on historic properties...". Based upon these statements, a 200' buffer area for the purpose of protecting historic resources is not necessary. The dredging contractor may want to avoid the area to avoid damage to equipment but this is not a permit or contract requirement. Sections 4.44 and 5.60 of the DSEIS have been modified to eliminate mention of the 200' buffer requirement.

7.9 **U.S. Department of Commerce, NOAA, NMFS:** "However, we recommend that the mitigation ratio of short term impacts in the DSEIS mitigation plan be increased to that of long term impacts; i.e., 0.5 acre creation to 1 acre of impact."

Response: We feel that the proposed 0.1 to 1.0 (created:impacted) level of mitigation is appropriate because the area of impact is designed to be a one-time impact with the initial nourishment project, with the equilibrium toe of fill being west of the fill template. Subsequent renourishment efforts will likely only backfill the groin field (if necessary), with sand not extending to the original fill construction template. The Florida Department of Environmental Protection and the U.S. Fish and Wildlife Service have both agreed with this decision.

7.10 **Dept. Of Community Affairs, Fla. State Clearinghouse:** "Based on the information contained in the above-referenced document and the enclosed comments provided by our reviewing agencies, the state has determined that the above-referenced project is consistent with the Florida Coastal Management Program."

Response: Acknowledged.

7.11 **Town of Manalapan:** "The Town's major objection to the project is the disregard of the negative impacts on the beach in Manalapan due to the sand transfer plant's present sand pickup location and the arbitrary cubic yards of sand required to be transferred from the north side of the inlet to the south side of the inlet, regardless of the actual amount of sand in the southerly drift at the time of transfer."

Response: The sand transfer plant and its operation are not part of the proposed Federal project. The Federal project will place approximately 800,000 cubic yards of sand on the beaches of Ocean Ridge. A likely effect of the project will be that a small

quantity of sand may move onto the shoreline of Manalapan via the bypassing bar during periods of northerly drift.

7.12 **South Lake Worth Inlet District, Exhibit B:** "The following provisions contain inaccurate, incomplete or untrue statements of fact: Sections 1.01, 1.02, 1.06, 2.07, 4.13, 4.46, 5.16g, and 5.17g." "The following provisions contain wrong or incorrect conclusions or findings based upon incomplete, inaccurate or untrue facts: Sections 1.01, 4.43, and 5.02."

Response: Without specific mention of what is inaccurate, incomplete, or untrue, an appropriate response cannot be provided.

South Lake Worth Inlet District, Exhibit B: "Contrary to the second sentence of Section 1.01, the beaches in the proposed project site are not in a state of critical erosion, ...".

Response: The proposed Federal project is located in an area of critical erosion as defined by the State of Florida Department of Environmental Protection (FDEP, 1993). Shoreline changes in the project area are well documented (USACE, 1987; USACE, 1995a; USACE, 1995b; Olsen, 1990a).

South Lake Worth Inlet District:: "Contrary to Sections 1.06, 1.09, 1.10 and 2.07 areas of controversy and unresolved issues involve those matters set forth on attached Exhibits A1 and A2."

Response: The Florida Legislature abolished the South Lake Worth Inlet District effective May 24, 1996 which essentially transferred control of the inlet to the local sponsor of this project. This action eliminates any areas of controversy or unresolved issues between the District and the County regarding the project.

7.13 **U.S. Environmental Protection Agency (Purpose and Need Considerations):** "The cumulative costs, both environmental and economic, of providing future, similar protection to all these areas needs to be examined in a comprehensive manner. This is especially true as the percentage of federal funding available for potential mitigation (direct and indirect) may be altered by deficit reduction measures."

Response: The USACE completed a study titled the "Coast of Florida Erosion and Storm Effects Study, Region III, with Draft Environmental Impact Statement" in 1995 which provided a comprehensive study of engineering, environmental and economic issues that relate to shore protection projects proposed for the southeast Florida region.

7.14 **U.S. Environmental Protection Agency (Necessary Ongoing Investigations, para 1):** "However, we recommend that further coordination continue between involved Corps technical staff sections to: fully consider the impacts to the important biological resources present..."

Response: Acknowledged.

7.15 **U.S. Environmental Protection Agency (Necessary Ongoing Investigations, para 2):** "... staff should verify that the public will actually be able to access the upgraded beach after it has been constructed."

Response: The economic impact of the proposed Federal project includes recreational benefits that were developed based upon the available parking and access in the project area.

7.16 **U.S. Environmental Protection Agency (Necessary Ongoing Investigations, para 3):** "One of the basic components of the computer model, DUNE, used to determine the storm reduction benefits assumes that the amount of material eroded must equal the amount deposited. If a portion of the offshore area... has been mined of material, then it would appear that the model results could be influenced."

Response: Engineering studies including numerical modeling of sediment transport and shoreline changes were conducted in the development of the proposed Federal project. The results of those studies are contained in the General Design Memorandum (GDM). The borrow area is located seaward of the depth of closure in the inactive portion of the beach profile. The storm induced recession model, DUNE, is no longer used in the development of Federal shore protection projects. The SBEACH model is currently used which is more conservative in estimating storm induced recession.

7.17 **U.S. Environmental Protection Agency (Necessary Ongoing Investigations, para 4):** "The extent of the model "influence" (if any) should be discussed in the final document."

Response: Shoreline modeling with GENESIS was conducted from the south jetty at South Lake Worth Inlet to a point on the shoreline approximately 4,000 feet south of the proposed project.

7.18 **U.S. Environmental Protection Agency (Proposed Mitigation, para. 1):** "Moreover, the deposition of dredge material from maintenance actions throughout the county will adversely affect biota in similar impacted nearshore habitats."

Response: Acknowledged. Although several other projects throughout the county will have associated impacts to nearshore hardbottom habitat, each project should construct a commensurate level of mitigative, in-kind habitat.

7.19 **U.S. Environmental Protection Agency (Proposed Mitigation, para. 3):** "Significant losses of important hard bottom/reef fishery habitat both around the borrow site and along the nourished beach are anticipated/probable."

Response: Although reef habitat exists in the area of the borrow site, no "significant losses" to reefs in this area are anticipated, as evidenced by the absence of mitigation proposed for impacts to deep reefs. Because reef locations were considered while defining the limits of the borrow area, direct impacts are minimized; the nearest reef to the borrow area is 1,440 feet away. Indirect impacts (e.g., from turbidity emanating from the borrow site) have been minimized by designing the borrow to include not only the best sand available as determined from 21 sediment cores for the 50-year borrow area and 8 cores for the initial borrow area. Should a pocket of

unacceptably fine material be encountered, it can be avoided in preference of better quality sand in the area.

7.20 **U.S. Environmental Protection Agency (Proposed Mitigation, para. 4-7):** "... If the overall worth of mimic reefs were more precisely determined, it could lessen concern about certain adverse consequences, ...".

Response: Acknowledged, and agreed. Although the level of monitoring to answer these questions and concerns is desirable, permitting and major commenting agencies do not *require* such a level.

7.21 **U.S. Environmental Protection Agency (Proposed Mitigation, para. 8):** "From a factual standpoint it should be noted that the statement 'hardbottom that remains uncovered will serve as a refuge for displaced mobile species...', continues this line of thought. It would be more accurate to state that mobile species will compete for refuge sites on the remaining hardbottoms until some population equilibrium is reached."

Response: Actually, neither statement is from a "factual standpoint" but rather one of speculation on the condition of remaining habitat, as well as the needs of affected populations. The actual situation (fact) may be, that in such a high energy habitat, "equilibrium" is truly represented by a constant state of change both in habitat availability and the density/diversity of associated populations.

7.22 **U.S. Environmental Protection Agency (Alternative Mitigation, para. 1):** Suggestions of out-of-kind mitigation such as improvements to non-point runoff which may be affecting nearshore hardbottom habitat.

Response: As always, the top priority for any mitigative effort is to replace "like for like" or to implement "in kind" mitigation. This is especially true for loss of nearshore hardbottom habitat as this type of bottom substrate is uncommon (at best) in Florida, and is therefore a limiting resource. The South Lake Worth Inlet was primarily designed and constructed as a flushing mechanism for the interior of Lake Worth. As such, and by design, water containing high levels of nutrients and suspended sediments repeatedly flows over the nearshore reefs. However, several other agencies (South Florida Water Management District, USACE, FDEP, PBCERM) are already involved in measures to improve water quality of Lake Worth. As such, it is felt that focusing efforts toward direct habitat replacement (in-kind/like-for-like) is the type of mitigation of choice.

7.23 **U.S. Department of Commerce, NOAA, National Geodetic Survey:** "NOAA requests the U.S. Army Corps of Engineers to furnish any surveys upon completion of these multiple projects so that any related shoreline changes can be accurately detailed on future editions of affected NOS charts."

Response: No survey monumentation exists in the construction area of the proposed Federal Project. The nearest survey monumentation, which will be used to construct the project is non-Federal (Florida Department of Environmental Protection and project specific).

7.24 **U.S. Department of the Interior, Office of Environmental Policy and Compliance:** "We believe that mitigation needs should be based on actual habitat area impacted at the time of construction, independent of the amount of habitat present in the project area in the recent past." [rather than time-averaged calculation of acreage of impact]

Response: The FDEP water quality certification requires that 4.55 acres of artificial reef be constructed as mitigation for nearshore hardbottom impacts. The USFWS has indicated that this plan is an adequate alternative plan provided that impacts are not significantly greater than predicted impacts based upon 1994 conditions.

U.S. Department of the Interior: "We recommend use of the same method [as for previous projects] for monitoring immediate and one year post-construction impacts resulting from this project."

Response: Acknowledged. Similar methods will be used for nearshore hardbottom impact assessment as were used previously for the Jupiter/Carlin Shore Protection Project.

U.S. Department of the Interior: "We disagree with the logic expressed in these sections. Since 1991, a trend of increasing reef acreage within the projected toe of fill is indicated in Table 6. For purposes of calculating cost/benefit ratios, the Army Corps of Engineers (COE) uses a project life of fifty years. If the environmental costs associated with lost near shore hard bottom were to be calculated using the same project life span, this increase in reef acreage would be projected out fifty years. ..." "In conclusion, time averaging has underestimated the actual impact at the time of construction and the subsequent reduction in reef acreage which will persist throughout the project life."

Response: The Department of the Interior (DOI) seems to be contradicting itself. In a previous paragraph (mentioned above), the DOI disagrees with using a time-averaged calculation to determine possible impacts, yet in this section, uses a simple average to calculate increase in reef exposure (0.25 acres/year from 1983 to 1994) and, in spite of the variability over those years, extrapolates this number over the next 50 years. The DOI also seems to assume that the annually exposed 0.25 acres is somewhere other than within the project fill area, and is thus untouched (i.e., not re-buried) by renourishment projects scheduled every 6 years for the 50-year project life span; the annually exposed 0.25 acres would therefore be allowed to remain exposed and consistently increment at the rate of 0.25 acres/year.

This, however, is not the case. The system is much more dynamic, and with renourishment anticipated every 6 years, in conjunction with periodic dredge spoil from inlet maintenance and frequent deposition of sand across the inlet via the sand transfer plant, the hardbottom in portions of the fill area will repeatedly be exposed and re-buried. The time-average method was used to develop a planning level estimate of the average amount of reef that had been exposed within the equilibrium toe of fill for the years 1983 to 1994. This value was used only as an estimate to understand the extent of fluctuation of reef exposure and determine a long term average.

It is recognized that the amount of reef impacted at the time of construction could be higher that the amount predicted by the time-average method. Accordingly, the cost for mitigation used in the General Design Memorandum (GDM) was based upon constructing 3.5 acres of artificial reef (see Table 5 and paragraph 100 of the GDM). This value was arrived at using the most recent data (August 1994) which had the highest amount of reef exposed during the 11 year assessment period. Therefore , the GDM calculations are both the most recent information and a conservative (worst case) estimate.

While the DSEIS was being circulated for review and comments, the FDEP issued permits for the project (permit #502355609 and #DBS9A0330- see Attachments 2 and 3). The state water quality certification permit includes mitigation requirements based upon 1994 conditions and does not require post-construction monitoring to determine mitigation amounts. Specific conditions 9 and 10 require a total of 4.55 acres of mitigation for 9.3 acres of expected impact. (The 9.3 acres includes short term and long term impacts.) Credit was given for 2.1 acres of artificial reef already constructed in summer 1994 between monuments R-166 and R-167. The remaining 2.45 acres of artificial reef to be constructed includes 0.45 acres which will be provided by the groin field and 2.0 acres of low relief reef to be constructed within one year of completion of the beach fill.

The local sponsor is committed to construct an additional 2.45 acres of mitigation which is 1.05 acres more than the 3.5 acres included in the GDM cost estimates. Monitoring using pre- and post-construction reef maps will be conducted to determine actual impacts. If actual impacts significantly exceed the predicted 9.3 acres, additional mitigation will be constructed at a ratio of 0.5 to 1 (acres of artificial reef: acres of impacted reef). Paragraphs 1.10, 3.28, 5.03, and 5.20 have been changed to reflect this change in the mitigation plan.

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Appendix A

Section 404 Evaluation Report

Palm Beach County, Florida, Shore Protection Project,

Ocean Ridge Segment

Section 404 Evaluation Report
Supplement to Final Environmental Impact Statement
Palm Beach County, Florida, Shore Protection Project

1. Project Description.

a. Location. The proposed work is located 180 feet south of the South Lake Worth Inlet along a 1.42 mile reach of the Western Atlantic shoreline in the southerly end of Palm Beach County, Florida.

b. General Description. The proposed plan calls for nourishment of 1.42 miles of shoreline with about 784,300 cubic yards of beach compatible sand and periodic renourishment at 6-year intervals. The plan also calls for determination of impacts on nearshore hardbottom with a commensurate level of mitigation to be determined post-project. Eight T-head groins are planned to stabilize the shoreline south of the inlet, in the northernly 1,800 feet of the project area.

c. Authority and Purpose. The project was authorized by the House of Representatives on October 23, 1962 (P.L. 87-874) and is described in House Document 164/87/1. The purpose of the project is to decrease erosion and shoreline recession rates, to provide sand to the littoral system to feed beaches to the south, and to protect upland public property.

d. General description of Dredged and Fill Material.

(1) General characteristics of material. The borrow area sands have a mean grain size of 0.26 mm with an average silt/clay content of 1.5%.

(2) Quantity of material. About 784,300 cubic yards will be placed on the beach for this initial project. Maintenance projects of the same volume are expected to be necessary every 6 years.

(3) Source of material. The initial borrow site for the fill material is located an average of 2,250 feet offshore of the fill site, in about 33 feet of water. The initial borrow area configuration is about 3,875 feet long and about 750 feet wide, encompassing a surface area of about 66.7 acres. The 50 year borrow area is about 750 ft. x 12,400 ft. long compassing a surface area of about 213 acres.

e. Description of the Proposed Discharge Site.

(1) Size and Location. The proposed fill site is the Western Atlantic beach toward the southerly end of Palm Beach County, beginning at 180 feet south of the south jetty of the South Lake Worth Inlet, 220 feet north of FDNR monument T-152 and ending 120 feet south of FDNR monument R-159 for a total of 1.42 miles (about 7,520 ft).

(2) Type of Site. The discharge site is an oceanic, high-energy sand beach.

(3) Type of Habitat. The habitat of the fill site involves supratidal dry beach, intertidal swash zone, and subtidal sandy areas with rock outcrops.

(4) Timing and Duration of Discharge. The timing of the fill aspect of the project will avoid peak sea turtle nesting season by limiting the project to occur during the fall/winter/spring, from November 1 to April 30. The duration of discharge is expected to be about 1 month (but may extend up to 3 months if foul weather is experienced) for the initial discharge and a similar time frame for subsequent maintenance projects at 6 year intervals.

f. Description of Disposal Method. The fill sand will be pumped onto the beach by hydraulic dredge, shaped and tilled by conventional earth-moving equipment.

2. Factual Determinations.

a. Physical Substrate Determinations.

(1) Substrate Elevation and Size. The existing dry beach (+4 to +8 ft NGVD) consists of unconsolidated sands of 0.36 mm mean grain size with an average silt/clay fraction of 0.8%. The subtidal zone consists of a sandy bottom with hardbottom rock outcrops with an average relief of about 1.5 feet (8/21/92).

(2) Sediment Type. The beach fill sediment at the discharge site consists of a mix of quartz sand with calcium carbonate shell fragments.

(3) Dredged/Fill Material Movement. The project is designed as a "feeder beach" and as such material is expected to feed and stabilize the beaches to the south, from the project area (T-152 to R-159) and southward approximately 1 mile. Fill material may likely travel southward of this point, but shoreline stabilization is not expected to occur; a reduction in shoreline recession may occur.

(4) Physical Effects on Benthos. The infaunal invertebrate benthos of the fill shoreline will be buried and those of the borrow site will be excavated. Effects are expected to be short term on the beach and on the order of a year to a few years at the borrow site. Attached epifauna of the hardbottom rock outcrops will be impacted by both burial and short term turbidity. The extent of these impacts is unknown.

(5) Other Effects. Elevated turbidity levels in the nearshore swash zone will be a temporary condition.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Water Column Effects. A temporary increase in turbidity at the fill site is expected. As the beach fill quality is generally similar to that of the existing beach, there should be no long-term changes in turbidity. There will be no significant effect on salinity, water chemistry, clarity, color, odor, taste, dissolved gas levels, nutrients, or eutrophication.

(2) Current Patterns and Circulation. By design, there will be significant effects on hydrodynamics of the shoreline. The effect of groin construction is to diminish the impact of the wave on the shoreline, and decrease erosion. T-heads are being added to the groins to reduce the formation of rip currents adjacent to the groin.

(3) Normal Water-Level Fluctuations and Salinity Gradients. There will be no effect on water level fluctuations or salinity.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulate and Turbidity Levels in the Vicinity of the Discharge Site. The sand to be discharged onto the beach (0.26 mm, 1.5% fines) is finer than that of the present beach (0.36 mm/0.19% fines). No significant long-term changes in suspended particulate or turbidity levels are expected.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Light penetration in the surf zone of the fill area will be temporarily reduced during project construction and a limited period post-construction.

(b) Dissolved Oxygen. Due to anticipated extremely low levels of organic materials in the borrow/fill material, if a decrease in dissolved oxygen levels

occurs, it is expected to be slight, temporary, and predominantly at the borrow site as anoxic layers of sediment are exposed by dredging. No long-term effects will occur.

(c) Toxic Metals and Organics. Due to the clean nature and origin of the borrow/fill material, toxic materials will not be introduced into the water column, and organic content is expected to be very low.

(d) Pathogens. No pathogenic material is expected to be involved with the project.

(e) Aesthetics. The increase in surf zone turbidity and the presence of machinery during construction will be displeasing, but temporary. The presence of beach groins may be aesthetically displeasing to some, but many groins have been in place at this site.

(3) Effects on Biota.

(a) Primary Productivity and Photosynthesis. No significant or long-lasting effects are expected.

(b) Suspension/Filter Feeders. Species involved in suspension or filter feeding may experience short-term effects. Depending on the species, the level of elevated turbidity, duration of project construction, and the increased level of material in the water column may be disruptive (cnidarians and star corals) or beneficial (sabellariid polychaetes).

(c) Sight Feeders. No significant impacts are expected since sight feeders are generally mobile and can forage outside the zone of temporarily increased turbidity.

d. Contaminant Determinations. Material to be discharged has been evaluated with respect to type of sands present, their source and their similarity to sands of the fill site, the distance from possible contaminant sources, onsite bioinventories, and the constancy of free-flowing clean water over the site. The fill material therefore meets the exclusion criteria of 40 CFR 230.60 and has been reasonably determined to be free of contaminants as the potential for presence of any contaminants is extremely low.

e. Aquatic Ecosystem and Organisms Determinations. Examination of the fill material indicates that it meets the exclusion criteria and no chemical-biological interactive testing is required.

(1) Endangered and Threatened Species. In the countywide GDM (USACE, 1987), the National Marine Fisheries Service stated (letter of 11/8/82) that endangered/threatened species under their purview would not be affected. The Fish & Wildlife Service, in accordance with Section 7 of the Endangered Species Act as amended, has determined that sea turtles may be affected by this project and has indicated concerns regarding the timing of beach nourishment and the timing of the T-groin construction. In its May 26, 1994 Biological Opinion (See Attachment 1), the Service has specified conservation measures (including restricting the timing of construction) that must be followed to reduce impacts to sea turtles. Two of the conditions are unnecessarily restrictive and the local sponsor has proposed some alternative conditions which meet the intent of the biological opinion.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determinations. Although silt/clay content is relatively low (1.5%) for the borrow material, a mixing zone variance was requested by Palm Beach County. The variance would allow a mixing zone of up to 500 meters from the point of discharge.

(2) Determination of Compliance with Applicable Water Quality Standards. The discharge is not expected to violate State water quality standards for Class III waters based upon the sand grain analysis provided.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supplies. No sources for municipal or private water supplies are located in the project area, nor will any sources outside the project area be affected by the project.

(b) Recreational and Commercial Fisheries. The increased turbidities in the surf zone at the fill site will be localized and short term and will not significantly affect recreational or commercial fishing. Periodically, commercial fishermen net bait fish at the Goggle Eye Reef to the north of the South Lake Worth Inlet; no impact to this activity is anticipated.

(c) Water Related Recreation. The placement of fill will generate a temporary inconvenience for those using the beach for recreational purposes. No long-term negative effects on beach quality are expected. The project will have the positive effect of creating additional recreational beach and removing the remains of several existing (nonfunctional) groins within the project fill area. The project will bury nearshore hardbottom used for snorkeling and fish collection but some of the hardbottom will be unaffected and artificial reefs will be created to mitigate for hardbottom impacts.

(d) Aesthetics. A temporary decrease in aesthetics will occur in the form of presence of heavy equipment, pipes, and protective barriers for public safety during project construction. Aesthetics will be improved post-project with the presence of a wider beach. This wider beach will be stabilized by 8 T-head groins which will affect the view and pedestrian usage of the beach near the inlet.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. No such designated sites are in the project vicinity.

(f) Determination of Cumulative Effects on the Aquatic Ecosystem. The proposed discharge of sand will have no cumulative negative impacts that result in degradation of the natural, cultural, or recreational resources of the project area. Although some nearshore hardbottom will be buried or otherwise impacted by the placement and equilibration of fill sands, that impact will be assessed and mitigated (as necessary). As the erosion continues and the fill sands feed the beaches to the south, as designed, the project impacts to nearshore hardbottom will diminish while the mitigation continues to exist, perhaps resulting in a net gain of nearshore hardbottom over time. The project will have no cumulative impacts that result in major impairment of water resources and will not interfere with the productivity and water quality of the existing aquatic ecosystem.

(g) Determination of Secondary Effects on the Aquatic Ecosystem. No secondary effects are anticipated.

3. Findings of Compliance or Noncompliance with the Restrictions on Discharge.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States.

c. The discharge of fill materials will not cause or contribute to, after consideration of disposal site dilution and dispersion, violations of any applicable State water quality standards for Class III waters. The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. The placement of fill materials will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended.

e. The placement of fill materials will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

f. On the basis of the guidelines, the proposed disposal sites for the discharge of fill materials is specified as complying with the requirements of the Clean Water Act.

Appendix B

Coastal Zone Consistency

Palm Beach County, Florida, Shore Protection Project

Ocean Ridge Segment

Florida Coastal Zone Management Program
Federal Consistency Evaluation Procedures

The project is consistent with Florida Coastal Zone Management Program as demonstrated by the following responses.

1. Chapter 161, Beach and Shore Preservation.

The intent of the coastal construction permit program established by this chapter is to regulate construction projects located seaward of the line of mean high water and which might have an effect on natural shoreline processes.

Response: The purpose of the project is beach erosion control. Applications for permits from the Florida Department of Environmental Protection (FDEP, formerly FDNR and FDER) have been submitted (#DBS9A0330, FDEP Division of Beaches & Shores; 502355609, FDEP, Wetland Resource Regulation) and permits have been issued. A State Lands consent of use agreement and easement (#50020002N, FDNR, Bureau of Submerged Lands) and is under consideration. A permit application has also been submitted (10/4/93) to the U.S. Army Corps of Engineers, #199301676 (IP-RP). FDEP Division of Beaches & Shores has raised concerns regarding the use of rock structures and has requested consideration of an alternative that limits fill above mean high water in the area where structures are proposed. FDEP also requested additional study to demonstrate that the proposed reduction in nearshore impacts through the use of groins is justified when compared to potential impacts to longshore transport.

2. Chapters 186 and 187, State and Regional Planning.

These chapters establish the State Comprehensive Plan which sets goals that articulate a strategic vision of the State's future. Its purpose is to define, in a broad sense, goals and policies that provide decision-makers with directions for the future and provide long-range guidance for orderly social, economic, and physical growth.

Response: The proposed project is consistent with long-range goals of the State, region and County to maintain beaches for the purpose of recreation, sea turtle nesting, and protection of upland structures.

3. Chapter 252, Disaster Preparation, Response and Mitigation.

This chapter creates a state emergency management agency with the authority to provide for the common defense, to protect the public peace, health and safety, and to preserve the lives and property of the people of Florida.

Response: The proposed project is an erosion protection, storm damage reduction project. Therefore, this project would be consistent with the efforts of the Division of Emergency Management.

4. Chapter 253, State Lands.

This chapter governs the management of submerged State lands and resources within State lands. This includes archeological and historical resources, water resources, fish and wildlife resources, beaches and dunes, submerged grass beds and other benthic communities, swamps, marshes and other wetlands, mineral resources, unique natural features, submerged lands, spoil islands, and artificial reefs.

Response: The proposed project would create increased recreational beach and turtle nesting habitat. There would be an impact on the nearshore hardbottom adjacent to the beach. However, the temporary cyclic covering and uncovering would be offset by an appropriate level of mitigation to be determined by comparison of the resources affected immediately pre- and post-project construction. The proposal would comply with the intent of this chapter.

5. Chapters 253, 259, 260, and 375, Land Acquisition.

These chapters authorize the State to acquire land to protect environmentally sensitive areas.

Response: Since the affected property is already in public ownership, this chapter would not apply.

6. Chapter 258, State Parks and Aquatic Preserves.

This chapter authorizes the State to manage State parks and preserves. Consistency with this statute would include consideration of projects that would directly or indirectly adversely impact park property, natural resources, park programs, management or operations.

Response: The proposed project is not adjacent to any state parks or aquatic preserves, and thus would not affect any such lands. The project is therefore consistent with this chapter.

7. Chapter 267, Historic Preservation.

This chapter establishes the procedure for implementing the Florida Historic Resources Act responsibilities.

Response: Magnetometer surveys of the borrow area have been conducted (Koski-Karell, 1993. Underwater archeological background study, remote sensing survey, and anomaly identification for the Ocean Ridge shore protection project, Palm Beach County, Florida. Tech. rept., Karell Archeological Services, Tampa, FL.; 102 pp.) to investigate the possible presence of submerged cultural resources. No cultural resources were found, and the project was determined to have no effect on significant cultural resources. Therefore, the proposed project will be consistent with the goals of this chapter.

8. Chapter 288. Economic Development and Tourism.

This chapter directs the State to provide guidance and promotion of beneficial development through encouraging economic diversification and promoting tourism.

Response: The proposed project would provide more space for recreational beach and the protection of recreational facilities along the beach which would increase tourism for this area. Artificial reef structures would provide replacement habitat for aquatic life which is a valuable component of the recreational sport fishing and diving which occurs along this segment of beach. Therefore, the project would be consistent with the goals of this chapter.

9. Chapters 334 and 339. Public Transportation.

These chapters authorize the planning and development of a safe, balanced, and efficient transportation system.

Response: No public transportation systems would be impacted by this project. This project will provide additional storm protection to State Road A1A.

10. Chapter 370. Saltwater Living Resources.

This chapter directs the State to preserve, manage and protect the marine, crustacean, shell and anadromous fishery resources in State waters; to protect and enhance the marine and estuarine environment; to regulate fisherman and vessels of the State engaged in the taking of such resources within or without State waters; to issue licenses for the taking and processing products of fisheries; to secure and maintain statistical records of the catch of each such species; and to conduct scientific and economic studies and research.

Response: The proposed project will impact a significant amount of nearshore hardbottom. During the projected 6-year cycle of covering and uncovering that will occur due to this project, there will be an impact to this resource and the aquatic habitat that it provides. In order to mitigate this impact, an appropriate level of mitigation will be constructed that will provide cover

for fish and other invertebrates impacted. The nourishment itself may increase the amount of suitable habitat for sea turtle nesting along this segment of beach. Based on the overall impacts of the project, the project appears to be consistent with the goals of this chapter.

11. Chapter 372. Living Land and Freshwater Resources.

This chapter establishes the Game and Freshwater Fish Commission and directs it to manage freshwater aquatic life and wild animal life and their habitat to perpetuate a diversity of species with densities and distributions which provide sustained ecological, recreational, scientific, educational, aesthetic, and economic benefits.

Response: The proposed beach nourishment has been coordinated with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) for compliance with Section 7 of the Endangered Species Act. Three species of turtles listed by the USFWS (two species endangered, one threatened) use this segment of beach for nesting and at least one species uses the nearshore hardbottom for foraging. The proposed beach nourishment may increase the amount of habitat available for nesting. The impacts to nesting will be minimized to the extent possible by selection of the best available borrow material and conducting the fill aspect of the project outside peak nesting season. The construction of an artificial reef will mitigate the impacts to nearshore hardbottom attributable to the proposed project. The project would comply with the goals of this chapter.

12. Chapter 373. Water Resources.

This chapter provides the authority to regulate the withdrawal, diversion, storage, and consumption of water.

Response: This project does not involve water resources as described by this chapter. The project is designed to restore and protect an eroding public beach, by utilizing hydraulic transfer (using seawater) of sediments from an offshore oceanic site onto the beach.

13. Chapter 376. Pollutant Spill Prevention and Control.

This chapter regulates the transfer, storage, and transportation of pollutants and the cleanup of pollutant discharges.

Response: This project does not involve the transportation or discharging of pollutants.

14. Chapter 377. Oil and Gas Exploration and Production.

This chapter authorizes the regulation of all phases of exploration, drilling, and production of oil, gas, and other petroleum products.

Response: This project does not involve the exploration, drilling or production of gas, oil or petroleum product and, therefore, does not apply.

15. Chapter 380. Environmental Land and Water Management.

This chapter establishes criteria and procedures to assure that local land development decisions consider the regional impact nature of proposed large-scale development.

Response: This project is not a Development of Regional Impact and is not within an Area of Critical State Concern. Therefore, the project would be consistent with the goals of this chapter.

16. Chapter 388. Arthropod Control.

This chapter provides for a comprehensive approach for abatement or suppression of mosquitoes and other pest arthropods within the State.

Response: The project would not further the propagation of mosquitos or other pest arthropods.

17. Chapter 403. Environmental Control.

This chapter authorizes the regulation of pollution of the air and waters of the State by the FDER.

Response: A FDEP (formerly FDER) permit application (#502355609) has been issued for this project in compliance with this chapter.

18. Chapter 582. Soil and Water Conservation.

This chapter establishes policy for the conservation of the State soil and water through the Department of Agriculture. Land use policies will be evaluated in terms of their tendency to cause or contribute to soil erosion or to conserve, develop, and utilize soil and water resources both onsite or in adjoining properties affected by the project. Particular attention will be given to projects on or near agricultural lands.

Response: The proposed project is designed to restore and protect eroding public and private beach.

Appendix C

Pertinent Correspondence

United States Department of the Interior
NATIONAL PARK SERVICE
SOUTHEAST REGIONAL OFFICE
75 Spring Street, S.W.
Atlanta, Georgia 30303

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

Mr. A.J. Salem, Chief
Planning Division
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

We have reviewed the copy of the report "Underwater Archeological Background Study, Remote Sensing Survey, and Anomaly Identification for the Ocean Ridge Shore Protection Project, Palm Beach County, Florida." The report is well written and the author presents the data and documentation in an acceptable manner. We believe the recommendations are appropriate but in view of this office's lack of information and data pertinent to the area we defer to the Florida State Historic Preservation Officer concerning the acceptability of the report's conclusions and recommendations.

If sufficient copies are available, we would appreciate a copy of the final report for our library.

Sincerely,

John E. Ehrenhard 11/17/93

John E. Ehrenhard, Chief
Interagency Archeological Services Division

November 5, 1993

Planning Division
Environmental Branch

Mr. George Percy
Division of Historic Resources
Compliance Review Section
500 South Bronough
Tallahassee, Florida 32399

Dear Mr. Percy:

Enclosed is a copy of the report "Underwater Archeological Background Study, Remote Sensing Survey, and Anomaly Identification for the Ocean Ridge Shore Protection Project, Palm Beach County, Florida." This report was prepared by Karell Archeological Services for Morgan and Ekland, Inc. and Palm Beach County. The U.S. Army Corps of Engineers, Jacksonville District, is coordinating this report with your office to obtain compliance with the National Historic Preservation Act of 1966, as amended.

The study area for the enclosed report is comprised of two offshore borrow areas which are located in the Atlantic Ocean, east of Ocean Ridge. During the course of the fieldwork, the Contractor identified two potentially significant magnetic anomalies. The sources of these two anomalies were inspected by the Contractor. It was determined that the signals were produced by modern debris dating from the latter half of the 20th century. Ms. Janice Adams, archeologist with the Jacksonville District has reviewed the report and accepts the Contractor's recommendation that these anomalies are not significant cultural resources and that additional field investigations are not required for the two borrow areas.

In compliance with 36 CFR 800, the Jacksonville District requests written concurrence from your office that use of the two borrow areas discussed in the above referenced report will not affect cultural resources included in or eligible for inclusion in the National Register of Historic Places. If you have any questions or require additional information, please contact me.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosure

November 5, 1993

Planning Division
Environmental Branch

Mr. John E. Ehrenhard
National Park Service
Interagency Archeological Service Division
75 Spring Street, SW
Atlanta, Georgia 30303

Dear Mr. Ehrenhard:

Enclosed is a copy of the report "Underwater Archeological Background Study, Remote Sensing Survey, and Anomaly Identification for the Ocean Ridge Shore Protection Project, Palm Beach County, Florida." This report was prepared by Karell Archeological Services for Morgan and Ekland, Inc. and Palm Beach County. The U.S. Army Corps of Engineers, Jacksonville District, is coordinating this report with your office to obtain compliance with the National Historic Preservation Act of 1966, as amended.

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Sincerely,

A. J. Salem
Chief, Planning Division

Enclosure

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

December 7, 1993

Planning Division
Environmental Branch

TO ADDRESSEES ON THE ATTACHED LIST:

The Jacksonville District U.S. Army Corps of Engineers, is beginning to gather information to help define issues and concerns that will be addressed in a Supplement to the Environmental Impact Statement for the Ocean Ridge segment of the Palm Beach County Shore Protection Project.

The project was authorized on October 23, 1962 by Public Law 87-874. The project has been coordinated with interested Federal, State and local agencies and the public. The Final Environmental Impact Statement and General Design Memorandum (GDM) for Palm Beach County was published in April 1987. The recommended plan in the 1987 GDM called for the restoration and periodic nourishment of 1.6 miles of shoreline using a 50 foot berm width. Approximately 770,000 cubic yards of fill would be placed and would include advanced nourishment for the initial eight year nourishment interval.

An alternative design is being considered that would reduce the width of the fill in the northern end of the project by using approximately 10 low profile rock structures. The use of structures is being considered to reduce the annual expected cost of the project and to protect nearshore rock habitat that exists in the northern end of the project. The project is proposed to begin at the south jetty of South Lake Worth Inlet and extend south about 7,700 feet (1.4 miles). The borrow area for the project is located between 1,750 and 2,800 feet offshore of the fill area in about 30 to 35 feet of water. The sand will be removed from the borrow area with hydraulic dredge and pumped onto the shoreline where it will be shaped by heavy equipment. Refer to the enclosed map for the project location.

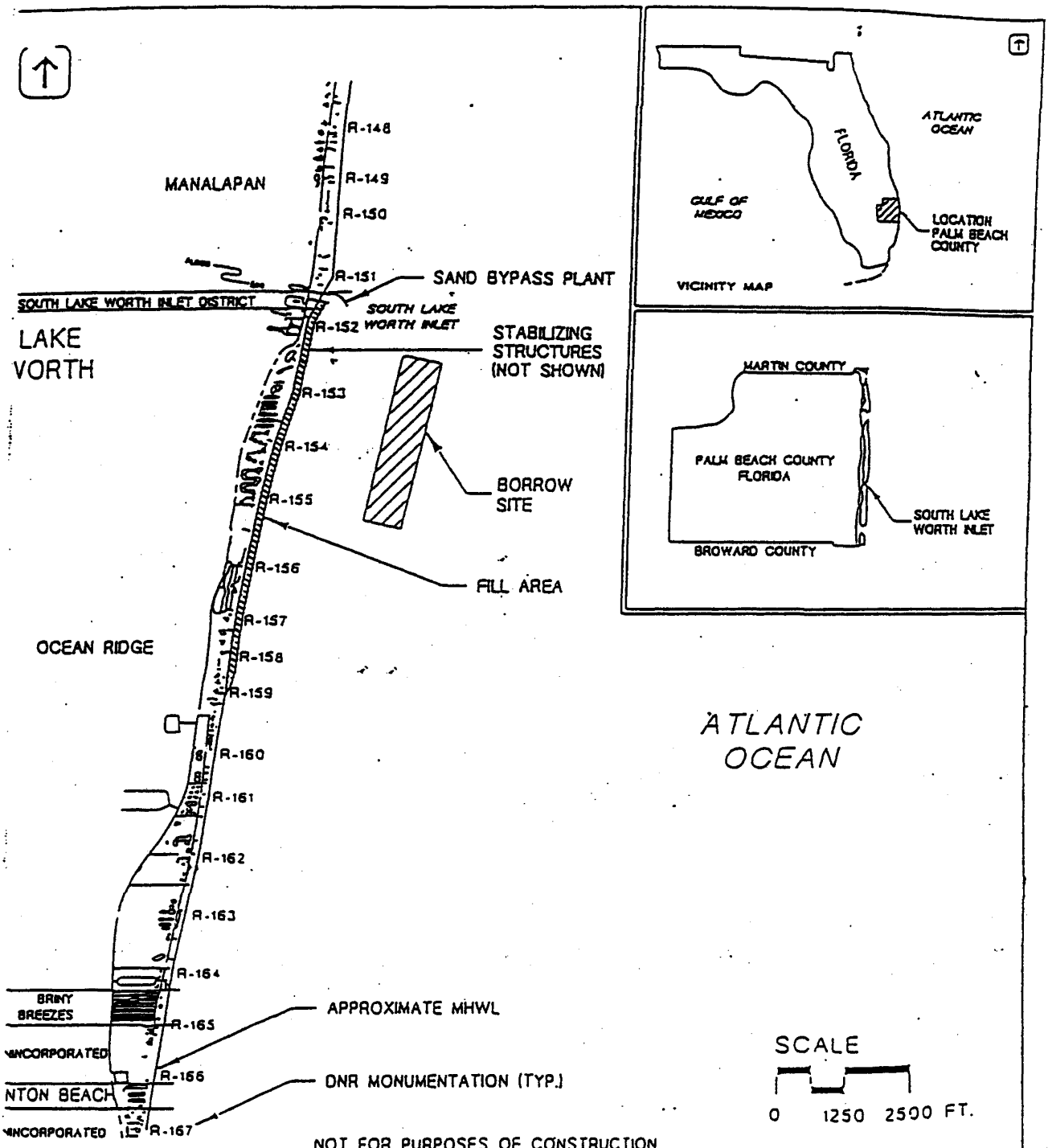
We welcome your views, comments and information about resources, study objectives and important features within the described area, as well as any suggested improvements. Letters of comment or inquiry should be sent within 45 days to the letterhead address, attention Planning Division, Environmental Branch.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosure

Fig. 1



NOT FOR PURPOSES OF CONSTRUCTION

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114
(Fax) 384-7368

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
LOCATION MAP

DATE:	APPROVED	REVISION

DATE: 6/23/93
DRAWN BY: M.R.L.
SHEET 1 OF 13

LIST OF ADDRESSEES

PALM BEACH COUNTY SHORE PROTECTION PROJECT
OCEAN RIDGE SEGMENT

FLORIDA AUDUBON SOCIETY
460 HIGHWAY 436
SUITE 200
CASSELBERRY, FLORIDA 32707

MR JOHN RAINS JR
ISAAK WALTON LEAGUE OF
5314 BAY STATE ROAD
PALMETTO, FLORIDA 33561-9712

STATE CLEARINGHOUSE
OFFICE OF PLANNING & BUDGETING
EXEC OFC OF THE GOVERNOR
THE CAPITOL
TALLAHASSEE, FLORIDA 32301-8074
(16 cys)

FLORIDA WILDLIFE FEDERATION
PO BOX 6870
TALLAHASSEE, FLORIDA 32314-6870

US DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
401 SE FIRST AVENUE
GAINESVILLE, FLORIDA 32602-6489

REGIONAL ENVIRONMENTAL OFFICER
HOUSING & URBAN DEVELOPMENT
ROOM 600-C
75 SPRING STREET SW
ATLANTA, GEORGIA 30303-3309
(2 CYS)

COMMANDER (OAN)
SEVENTH COAST GUARD DISTRICT
909 SE 1ST AVENUE
BRICKNELL PLAZA FEDERAL BLDG
MIAMI, FLORIDA 33131-3050

REGIONAL DIRECTOR
INSURANCE & MITIGATION DIVISION
FEMA
1371 PEACHTREE STREET NE
ATLANTA, GEORGIA 30303-3309

WILDERNESS SOCIETY
4203 PONCE DE LEON BOULEVARD
CORAL GABLES, FLORIDA 33416

PROFESSOR JOHN GIFFORD
ROSENSTIEL SCHOOL OF MARINE
AND ATMOSPHERIC SCIENCE
4600 RICKENBACKER CAUSWAY
MIAMI, FLORIDA 33149-1098

DR ELAINE HARRINGTON
FLORIDA CHAPTER
SIERRA CLUB
927 DELORES DRIVE
TALLAHASSEE, FLORIDA 32301-2929

ENVIRONMENTAL SERVICES INC
8711 PERIMETER PARK BLVD
SUITE 11
JACKSONVILLE, FLORIDA 32216

SOUTHERN REGION FORESTER
US FOREST SERVICE
DEPARTMENT OF AGRICULTURE
1720 PEACHTREE ROAD NW
ATLANTA, GEORGIA 30309-2405

NATIONAL MARINE FISHERIES SVC
CHIEF PROTECTED SPECIES BR
9450 KOGER BOULEVARD
ST PETERSBURG, FLORIDA 33702-2496

REGIONAL DIRECTOR
US FISH AND WILDLIFE SERVICE
75 SPRING STREET SW
ATLANTA, GEORGIA 30303-3309

FIELD SUPERVISOR
US FISH AND WILDLIFE SERVICE
PO BOX 2676
VERO BEACH, FLORIDA 32961-2676

MR HEINZ MUELLER
ENVIRONMENTAL POLICY SECTION
EPA REGION IV
345 COURTLAND STREET NE
ATLANTA, GEORGIA 30365-2401
(5 CYS)

MR GEORGE W PERCY DIRECTOR
DIV OF HISTORICAL RESOURCES
STATE HISTORIC PRESERVATION OFF
R A GRAY BUILDING
TALLAHASSEE, FLORIDA 32399

NATIONAL MARINE FISHERIES
SERVICE
ENVIRONMENTAL ASSESSMENT BR
3500 DELWOOD BEACH ROAD
PANAMA CITY, FLORIDA 32407-7499

NATIONAL MARINE FISHERIES SVC
OFFICE OF THE REGIONAL DIRECTOR
9450 KOGER BOULEVARD
ST PETERSBURG, FLORIDA 33702-24906

CL

MS SUSAN MARYNOWSKI
CARIBBEAN CONSERVATION CORP
PO BOX 2866
GAINESVILLE, FLORIDA 32602

PALM BEACH COUNTY
DEPARTMENT OF ENVIRONMENTAL
RESOURCES PROTECTION
3111 S. DIXIE HIGHWAY, SUITE 146
WEST PALM BEACH, FLORIDA 33405
(3 CYS)

MR KIRBY GREEN DIRECTOR
DIVISION OF BEACHES AND SHORES
DEPARTMENT OF ENV. PROTECTION
MAIL STATION 300
3900 COMMONWEALTH BOULEVARD
TALLAHASSEE, FLORIDA 32399

SOUTH FLORIDA WATER MGMT DISTRICT
PO BOX 24680
WEST PALM BEACH, FL 33416-4680

REGIONAL COASTAL ZONE MGMT. COORD.
TREASURE COAST REG. PLNG. COUNCIL
P.O. BOX 1529
PALM CITY, FLORIDA 33490-1529

FLORIDA DEPT. OF ENV. PROTECTION
OFFICE OF AQUATIC PRESERVES
4842 U.S. HIGHWAY #1
FT. PIERCE, FLORIDA 34982

FLORIDA DEPT. OF ENV. PROTECTION
BUREAU OF STATE LANDS
7400 H. SOUTH GEORGIA AVENUE
WEST PALM BEACH, FLORIDA 33405

FLORIDA DEPT. OF ENV. PROTECTION
~~MARINE RESEARCH INSTITUTE~~
19100 S.E. FEDERAL HIGHWAY
TEQUESTA, FLORIDA 33469

FLORIDA DEPT. OF ENV. PROTECTION
1900 SOUTH CONGRESS AVENUE
WEST PALM BEACH, FLORIDA 33406

TOWN MANAGER
TOWN OF OCEAN RIDGE
6450 NORTH OCEAN BOULEVARD
OCEAN RIDGE, FLORIDA 33435

TOWN MANAGER
TOWN OF MANALAPAN
6000 SOUTH OCEAN BOULEVARD
MANALAPAN, FLORIDA 33462

CITY MANAGER
CITY OF BOYNTON BEACH
100 E. BOYNTON BEACH BOULEVARD
BOYNTON BEACH, FLORIDA 33435

TOWN MANAGER
TOWN OF BRINEY BREEZES
5000 NORTH OCEAN BOULEVARD
BOYNTON BEACH, FLORIDA 33435

CHAIRMAN
SOUTH LAKE WORTH INLET DISTRICT
P.O. BOX 3465
LANTANA, FLORIDA 33465

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director's Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

December 10, 1993

Mr. A. J. Salem, Chief
Planning Division, Environmental
Resources Branch
Jacksonville District Corps of
Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

In Reply Refer To:
Denise M. Breit
Historic Sites
Specialist
(904) 487-2333
Project File No. 933605

RE: Cultural Resource Assessment Review Request
Underwater Archeological Background Study, Remote Sensing Survey, and Anomaly Identification for the Ocean Ridge Shore Protection Project, Palm Beach County, Florida. By Daniel Koski-Karell, October 1993.

Dear Mr. Salem:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the results of the magnetometer survey and diver verification for the referenced project and find them to be complete and sufficient. We note that nineteen magnetic anomalies were located during the course of the survey, some of which formed two clusters. The latter were diver verified and found to be representative of modern materials. Those magnetic anomalies which did not cluster appeared to be isolated objects of no significance. We concur with these results. It is the determination of this office, therefore, that sand borrowing activities in the two areas will have no effect on any significant resources.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

Laura A. Kammerer

for George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Bdb

The City of
Boynton Beach

100 E. Boynton Beach Boulevard
P.O. Box 310
Boynton Beach, Florida 33425-0310
City Hall: (407) 375-6000
FAX: (407) 375-6090

December 21, 1993

Mr. A.J. Salem, Chief
Planning Division
Jacksonville Corps of Engineers
PO Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

The City of Boynton Beach is in receipt of your letter concerning the Ocean Ridge Shore Protection Project. Attached is a copy of a letter sent to the Florida Department of Environmental Protection which documents the City's support for the project.

Should you require additional information, please do not hesitate to contact us.

Sincerely,

CITY OF BOYNTON BEACH

John Wildner
Superintendent of Parks

JW:cm
xc: J. Scott Miller, City Manager
Charles C. Frederick, Director of Recreation & Parks
Jim White, City Engineer
George Evans, Beach Supervisor

The City of
Boynton Beach

100 E. Boynton Beach Boulevard
P.O. Box 310
Boynton Beach, Florida 33425-0310
City Hall: (407) 734-8111
FAX: (407) 738-7459

September 27, 1993

Florida Department of Environmental Protection
Bureau of Coastal Engineering and Regulation
ATTN: Neal Rogers
3900 Commonwealth Blvd.
Tallahassee, FL 32399

Dear Mr. Rogers:

Subject: File #DBS9A0330

This letter is in response to your agency's request for public comment regarding the Ocean Ridge Shore Protection Project as advertised in the Palm Beach Post on September 18, 19 and 20, 1993.

Please be advised that the Boynton Beach City Commission is in favor of and supports the Ocean Ridge Protection Project.

This City owns and operates a public park and beach in the Town of Ocean Ridge known as Oceanfront Park. Over the last several years, our beach has suffered dune and boardwalk damage due to storms and erosion. The Ocean Ridge Shore Protection Project will provide much needed renourishment to our beach front which will enhance the recreational enjoyment of our patrons and assist in protecting our dune and boardwalk from severe erosion damage. Our public beach experiences in excess of 500,000 visitations annually.

The Mayor and City Commission recently agreed to provide public parking spaces for this shoreline area as a part of the County's financing plan with the State for the Ocean Ridge Shore Protection Project.

Please accept this letter on behalf of the Boynton Beach Mayor and City Commission as this city's official position supporting the Ocean Ridge Shore Protection Project.

Sincerely,

CITY OF BOYNTON BEACH

J. Scott Miller
City Manager

JSM/CCF:cm

xc: Robert Clinger, D.E.R.M.
John Abendroth. D.E.P.
Mayor and City Commission
Charles Frederick, Director of Recreation & Parks

RESOLUTION R93-23

A RESOLUTION OF THE CITY COMMISSION OF THE CITY OF BOYNTON BEACH, FLORIDA, SUPPORTING A GRANT APPLICATION OF PALM BEACH COUNTY FOR A SHORE PROTECTION PROJECT IN OCEAN RIDGE AND REQUESTING THE STATE LEGISLATURE TO PROVIDE GRANT FUNDING FOR THE PROJECT.

WHEREAS, The Ocean Ridge Shore Protection Project has been submitted to the State Legislature for funding; and

WHEREAS, the Beach Re-Nourishment Project includes our public beach, Oceanfront Park.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COMMISSION OF THE CITY OF BOYNTON BEACH, FLORIDA, THAT:

Section 1. The City Commission of the City of Boynton Beach, Florida does hereby support the grant application of Palm Beach County for a Shore Protection Project in Ocean Ridge, and urges the State Legislature to provide grant funding of $1,875,000 for the project.

Section 2. The City Commission of the City of Boynton Beach, Florida hereby directs the City Clerk to provide a copy of this Resolution, upon passage, to the Governor of the State of Florida and the Palm Beach County Legislative Delegation.

PASSED AND ADOPTED this 16 day of February, 1993.

CITY OF BOYNTON BEACH, FLORIDA

Mayor

Vice Mayor

Commissioner

Commissioner

Commissioner

ATTEST:

City Clerk

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director's Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

RECEIVED
JAN 5 1994
Florida Coastal Management Program

December 22, 1993

Ms. Janice L. Hatter, Director
State Clearinghouse
Executive Office of the Governor
Room 1603, The Capitol
Tallahassee, Florida 32399-0001

In Reply Refer To:
Denise M. Breit
Historic Sites Specialist
(904) 487-2333
Project File No. 933958

RE: Cultural Resource Assessment Request
SAI# FL9312091502C
Supplement to the Environmental Impact Statement for the Ocean Ridge Segment of the Palm Beach County Shore Protection Project
Palm Beach County, Florida

Dear Ms. Hatter:

In accordance with the provisions of Florida's Coastal Zone Management Act and Chapter 267, Florida Statutes, as well as the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the referenced project(s) for possible impact to historic properties listed, or eligible for listing, in the National Register of Historic Places, or otherwise of historical or architectural value.

A review of the Florida Site File indicates that no significant archaeological or historical sites are recorded for or likely to be present within the project area. Furthermore, because of the project location and/or nature it is unlikely that any such sites will be affected. Therefore, it is the opinion of this office that the proposed project will have no effect on historic properties listed, or eligible for listing, in the National Register of Historic Places, or otherwise of historical or architectural value. The project is also consistent with the historic preservation laws of Florida's Coastal Management Program.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

for Laura A. Kammerer

George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Bdb
xc: Jasmine Raffington, FCMP-DCA

Date: 12/13/93
Comment Due Date: 12/27/93
SAI# FL9312091502C

STATE AGENCIES	LOCAL/OTHER	OPB POLICY UNITS
Agriculture	RPC #1	Criminal Justice
Board of Regents	RPC #2	Education
Commerce	RPC #3	Environment/C & ED
X Community Affairs	RPC #4	General Government
Education	RPC #5	Health & Human Srv
X Environmental Reg	RPC #6	Revenue & Eco. Ana
X Game & Fish Comm	RPC #7	SCH
Health & Rehab Srv	RPC #8	X SCH/CON
Highway Safety	RPC #9	
Labor & Employmnt	RPC #10	
Law Enforcement	RPC #11	
X Marine Fish Comm	NWFWMD	
Natural Resources	X SFWMD	
X State	SWFWMD	
X Transportation	SJRWMD	
Trans Disad. Comm	SRWMD	
DER District		

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DEC 14 1993
Marine Fisheries Commission

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DEC 20 1993
Florida Coastal Management Program

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evaluation and is categorized as one of the following:

___ Federal Assistance to State or Local Government (15 CFR 930, Subpart F). Agencies are required to evaluate the consistency of the activity.

_X_ Direct Federal Activity (15 CFR 930, Subpart C). Federal agencies are required to furnish a consistency determination for the State's concurrence or objection.

___ Outer Continental Shelf Exploration, Development or Production Activities (15 CFR 930, Subpart E). Operators are required to provide a consistency certification for state concurrence/objection.

___ Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.

SEE REVERSE SIDE FOR INSTRUCTIONS AND ADDRESSES FOR RETURN MAILING.

To: State Clearinghouse
Executive Office of the Governor-OPB

Florida Coastal Management Director
Department of Community Affairs

From:
Division/Bureau: MFC
Reviewer:
Date: 12/16/93

EO. 12372	Federal Consistency
[X] No Comment	[X] No Comment/Consistent
[ ] Comments Attached	[ ] Consistent/Comments Attached
[ ] Not Applicable	[ ] Inconsistent/Comments Attached
	[ ] Not Applicable

TOWN OF MANALAPAN
PALM BEACH COUNTY
600 SOUTH OCEAN BOULEVARD
MANALAPAN, FLORIDA 33462-3321
Telephone (407) 585-9477
Fax 407-585-9498

December 30, 1993

Department of the Army
Jacksonville District Corps of Engineers
Planning Division
Environmental Branch
P.O. Box 4970
Jacksonville, Florida 32232-0019

To Whom It May Concern:

Subject: Your letter dated December 7, 1993, Ocean Ridge segment of the Palm Beach County Shore Protection Project.

For your consideration and review, the Town of Manalapan is submitting our comments, objections and recommendations to the Ocean Ridge Project.

The Town of Manalapan lies to the north of the South Lake Worth Inlet and extends north for approximately three (3) mile along the Atlantic Ocean. The beaches in Manalapan are extensively eroded due to the interruption of the southerly flow of sand by the Lake Worth Inlet to the north, interruption of the northerly flow of sand by the South Lake Worth Inlet to the south, and the sand transfer pump located on the north side of the South Lake Worth Inlet. Therefore, the Town's beaches are greatly affected by any changes or adjustments to the coastline either by natural events or manmade alterations.

The Town has attached a memorandum that contains objections to the project as planned, historical information that must be considered and recommendations for modifications to the project, that if incorporated, would relieve the objections by the Town.

Should the Corps determine not to implement the Town of Manalapan's revisions to the project, we may desire that the Corps hold public hearings on the project.

Should you need additional information please contact Charles H. Helm, Town Manager, at 407-585-9477.

Sincerely,

G. Kent Shortz, M.D.
Mayor

enclosures

cc: Mr. Richard Walesky, P.B.C.D.E.R.M.
Honorable Daniel O'Connell, Mayor, Town of Ocean Ridge

December 28,1993

MEMORANDUM TO: File
FROM: C. H. Helm, Town Manager
SUBJECT: Staff Report - Ocean Ridge Beach Renourishment Project

Town of Manalapan strongly objects to the work, as proposed in Ocean Ridge, as described in US Corps of Engineers Permit Application No. 199301676(IP-RP) and the State of Florida Department of Environmental Protection File Number DBS9A0330 for the following reasons.

1. A court order, now on appeal, could increase the demands for additional sand to be pumped from Manalapan's beaches until the sand lost north of the inlet equals that lost south of the inlet. Which simply means, the beaches to the north will be penalized for all inlet and excessive beach fill losses south of the inlet.

2. Past over pumping has severely eroded a large section of the Manalapan's shore line and is continuing to do so because of the inshore pump location and removal of sand below the normal bottom profile, leaving the north beach severely pumped out. Much of the north shoreline has little beach sand left east of the sea wall and the seaward bottom is largely bare rock for about 400 feet out. This leaves little to be lost except the small remaining bit of sand at the sea wall.

3. The requested Permit application work involves adding 700,000 cu yds of sand to the north section of the beach south of the inlet, greatly increasing the width of an artificially filled and bulkheaded beach already well east of the historical shore line (Fig. 1), which coupled with the shadow of the inlet, will substantially increase the already severe erosion rate in spite of the groins and other works contemplated. This will cause large losses in Ocean Ridge and an unwarranted call for sand from the north (Manalapan).

4. An extension to the south jetty which was designed and approved, but never funded or constructed, is essential to control the present strong flood current that now enters the inlet in a northerly direction around the end of the short south jetty after scouring the beach to the south and carrying large quantities of sand into the inlet where substantial loss occurs. This loss increases demand for sand from the north (Manalapan).

5. No means is provided to prevent the total of the naturally by-passed and the pumped sand from exceeding the sand arriving by normal drift into Manalapan.

6. No provision is made to frequently pump the small, shallow sand trap inside the Inlet on a regular basis to prevent over filling and the run over loss of sand that is difficult if not impossible to recover.

BASIS FOR POSITION TAKEN

The South Lake Worth Inlet was completed in 1927. Erosion south of the inlet started and in 1929/30 the McCormack sea wall with 8 groins was constructed along the MHW line from approximately 900 feet south of the inlet to a point 3195 feet south of the inlet. In April 1937, a 6" pump and 65 hp engine was installed on the north jetty which pumped 252,000 cu yds of sand through 1941; covering the groins and filling the beach nearly to the top of the sea wall (14' MSL); clearly heavy overpumping did occur. The pumping commenced again in 1945 and transferred an estimated 70,000 cu yds/yr; it was rebuilt in 1947 with an 8" pump and 250 hp engine promoting increased sand transfer. Again in 1952 a system upgrade included a 300 hp engine.

The plant was rebuilt again in 1967 with a 10" pump, a 400 hp engine and the suction boom length was doubled.

Pumping reached a peak in 1963 when 206,822 cu yds were transferred. 3000 feet of shoreline north of the inlet steadily eroded, and by 1963, the 14 year old CBS Tupper ocean front home had gradually fallen into the ocean along with a frame cottage next door, as well as several smaller structures near by. In 1964 & 1966 a crash sea wall program had to be undertaken to prevent the loss of expensive ocean front homes that had been built well back from the dune crest. This seawall program had to be extended to the north Town limits in 1981/83 and represented a cost of over $5,000,000 in 1987 dollars. The effect of the sand pump is quite obvious from Fig. 2, which was constructed from the DNR digitized data.

The bulk of the littoral drifts occur where the combination of wave turbulence and current flow are maximum. In this coastal area, this occurs from 150 to 300 feet offshore. Since the current flow cannot go through the jetty it goes around the end carrying the littoral drift with it not 300 feet landward where the pump is now located. The beach drift reaching the pump has been determined to be in the order of only 25,000 cu yds per year, the balance is mined mostly off the beaches to the north (Manalapan).

The drift passes around the end of the north jetty and does not return to the shore line via the transfer bar for a distance of some 4000 to 5000 feet south of the inlet. During flood tide a substantial portion of the drift goes in the inlet, especially with a north drift: a part of which settles in the inside sand trap; a part enters and shoals the intercoastal canal and surrounding area; and the rest is swept out during ebb tide but joins that sand carried south by the transfer bar so that the first 4000 feet of shoreline south of the inlet will be naturally deficient in littoral drift. Sand movement in the area of the channel is significantly influenced by the heavy high powered boat traffic.

The area 900 feet south of the inlet for a distance of 3500 feet has been built out with fill over 100' east of the normal shore line of 1926 and protected by a new seawall (Fig.3). An extra ordinarily large fill of 655,000 cu yds in 1962/64, included 478,024 cu yds pumped from Manalapan. The erosion rate is enormous as would be expected with this large intrusion into the ocean. Prior to this intrusion the sand pump built and maintained a growing shore line. After this fill, little or no beach could be maintained in front of the new, more seaward, seawall in spite of continued pumping.

Repeated renourishment of this area (from the inside shoal sand trap) has occurred many times in the recent past, 1961, 62, 63, 65, 67, 68, 69, 73. Most recently in 1989, about a thousand feet of beach was renourished with 34,000 cu ft. of sand only to be lost in 6 months despite sand pump operation. Over the years renourishment from the flood shoal has amounted to 510,000 cu yds, while pumping sand from the Manalapan beach has added 3,870,300 cu yds. Clearly, a beach, in the inlet shadow and built out into the ocean can not be maintained without offshore devices to correct the extreme losses. The present sand pump is some 300 feet west of the principal path of the major natural sand transfer around the end of the north jetty. If a sand transfer pump is used, it should be located as near to the end of the north jetty as possible where heavy seas carry sand from the normal drift path and around the end of the jetty. Frequently in heavy weather, sand is carried to this location through and over the jetty to lay down a sand bar inside the jetty approximately 100

feet long and 25 feet wide up to MLW, often staying for days until a shift in wind and seas carries it into the Inlet.

While the long North jetty at the inlet has backed up sand some 4000 feet to the north in the past 65 years, heavy recession has occurred from that point north mandating use of sea walls to protect the dune from being pumped away. This loss attributed to the sand pump operation was confirmed by an in-depth computer model study by the US Corps of Army Engineers in a similar proposed sand pump installation, in which it was determined that a sand pump would unacceptably damage the beach to the north (Fig. 4). Another serious loss in Manalapan occurs during the approximately 30% of the time during northerly drift when the north curved jetty and short south jetty causes the drift to be directed into the inlet during flood tide.

While we are of the opinion that the problem in Ocean Ridge was caused largely by the decision to bulkhead an unusually large transfer of sand together with a surprisingly large dredging operation in the channel and surrounding lake, many large buildings are now on that fill and it could be impractical to remove them and restore the normal shore line that could be easily maintained. For this reason we endorse the beach renourishment and the use of proper offshore devices to reduce the erosion only if the following steps are taken to develop a situation that eliminates the damage to the beaches north of the Inlet (Manalapan).

A. Move the pump suction to a sand containment pit as depicted in Fig. 5. This is similar to an arrangement at Boca Raton Inlet where a weir at MLW, near the end of the jetty, allows drifting sand to spill into the inlet channel where it is pumped by a floating dredge to the near south shore. While the north shore line has receded to the weir location, erosion has been greatly reduced in the shadow zone just south of the inlet and updrift damage is minimal.

Also at the Hillsboro Inlet a rock formation forms a north jetty quite similar to the SLWI and a natural weir near the end allows sand to spill into pockets near the channel where a small floating dredge transfers the sand accumulation to the immediate south shore. This arrangement also has worked well over the years to reduce the south shore erosion.

Both of these systems have the advantage of picking up the small beach drift, and a portion of the natural drift, which occurs just seaward of the end of the north jetty, some of which is carried behind the end of the jetty in heavy seas - a condition that can't occur at SLWI because the pump is located so far landward from the end of the jetty.

B. Complete the south jetty, this will reduce the strong currents that run along the south shoreline and scour the beach area, and it may improve the flood currents somewhat to reduce the loss of northerly drift to Manalapan as well as the loss of sand into the inlet.

C. Construct a breakwater and groins such as in the permit application, or alternatively, a continuous perched beach breakwater from the south jetty extension to a point about 3000 feet south to contain a beach in water too deep to otherwise support the sand. Renourish the beach.

D. Provide a small floating dredge with semi-permanent discharge lines to keep the inside sand trap always pumped out to avoid overflow losses.

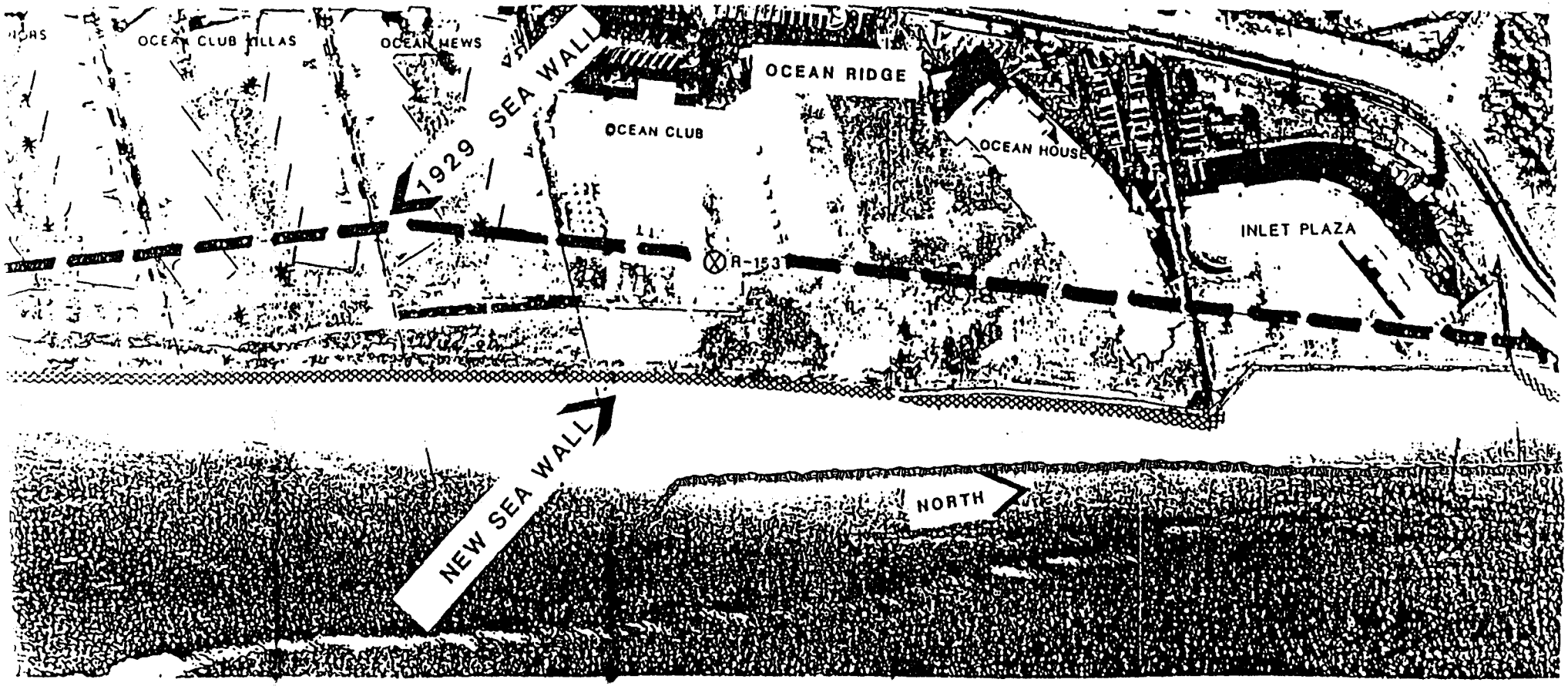

OCEAN CLUB VILLAS
OCEAN MEWS
1929 SEA WALL
OCEAN RIDGE
OCEAN CLUB
OCEAN HOUSE
INLET PLAZA
R-153
NEW SEA WALL
NORTH

FIG. 1

SAND VOLUME CHANGES 1883-1986
Based on 1 sq. ft. beach area = 1 Cu. Yrd.
All data taken from "DNR HISTORICAL SHORE LINE DATA FOR PALM BEACH COUNTY" 2-13-90

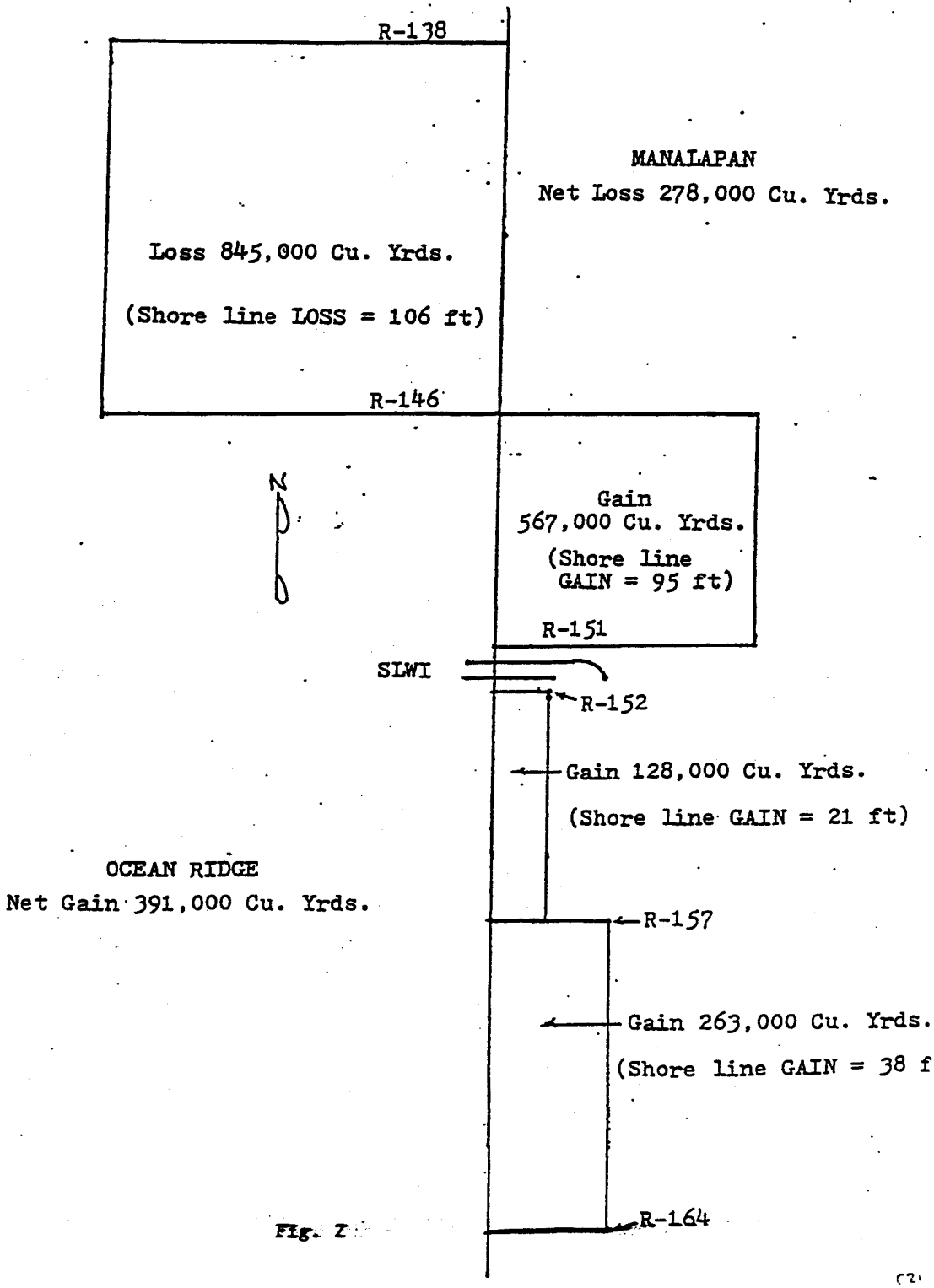


Fig. 2

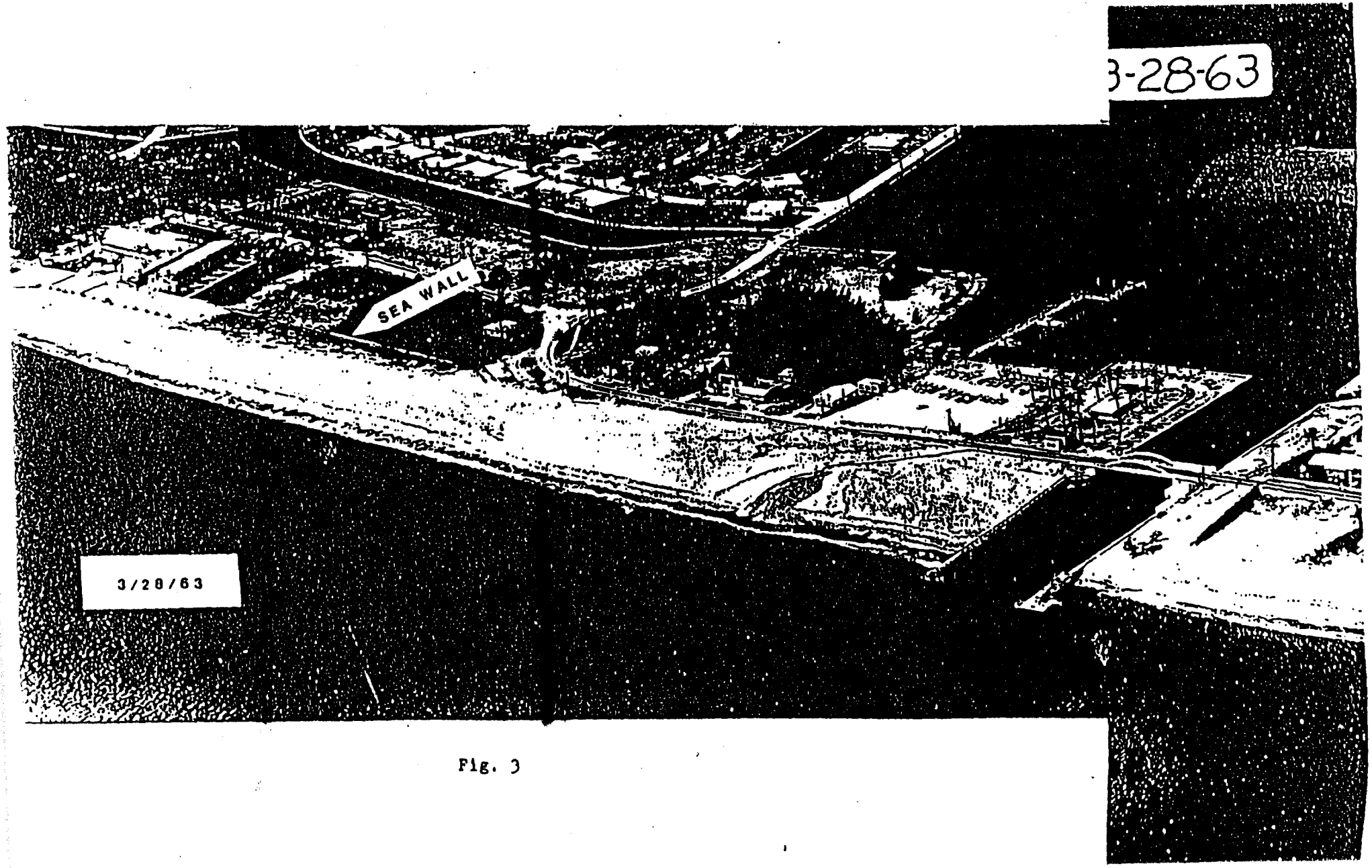


Fig. 3

ENGINEERING APPLICATION
GENERALIZED MODEL FOR SIMULATING SHORELINE CHANGE
CANAVERAL HARBOR, FLORIDA

Ed Hodgens, P.E.
U.S. Army Corps of Engineers
Jacksonville District

ABSTRACT

This paper focuses on the use of the computer model GENESIS (Generalized model for Simulating Shoreline change) for evaluation of coastal processes in a highly active area of shoreline where little hard physical field data is available.

Coastal inlets have historically contributed to shoreline erosion and the navigation channel at Canaveral Harbor, Florida, may be responsible for a significant portion of the erosion of the beaches south of the inlet. In 1962, Congress authorized the construction of a sand bypass system to transfer littoral material around the harbor to mitigate erosion losses and reduce navigation maintenance.

A General Design Memorandum (GDM) was prepared in 1989 to address the mitigation of the effects of the port on down-drift erosion. The recommended plan included the construction of a fixed shore-based sand bypass system located north of the north jetty with the capability to bypass 106,000 cubic yards to the south beaches annually. Detailed design was subsequently initiated to determine the most effective location for the bypass system. However, there is extremely limited data upon which to base a detailed coastal engineering analysis of the anticipated sediment budgets by location. Also, the cape and offshore shoals create complex wave patterns along the immediate coast which makes simplified long, sandy coast evaluations inaccurate. It was decided to model the shoreline response to bypassing by using the GENESIS numerical model.

Initial modeling indicated that the recommended GDM plan would have adverse impacts on the beaches north of the inlet. The model was then used to evaluate two alternative methods of bypassing which included a movable shore-based jet pump system and conventional dredging of a nearshore borrow area.

Presented 2-11-93 at the Florida Shore and Beach Convention at St. Petersburg, Florida.

Fig. 4

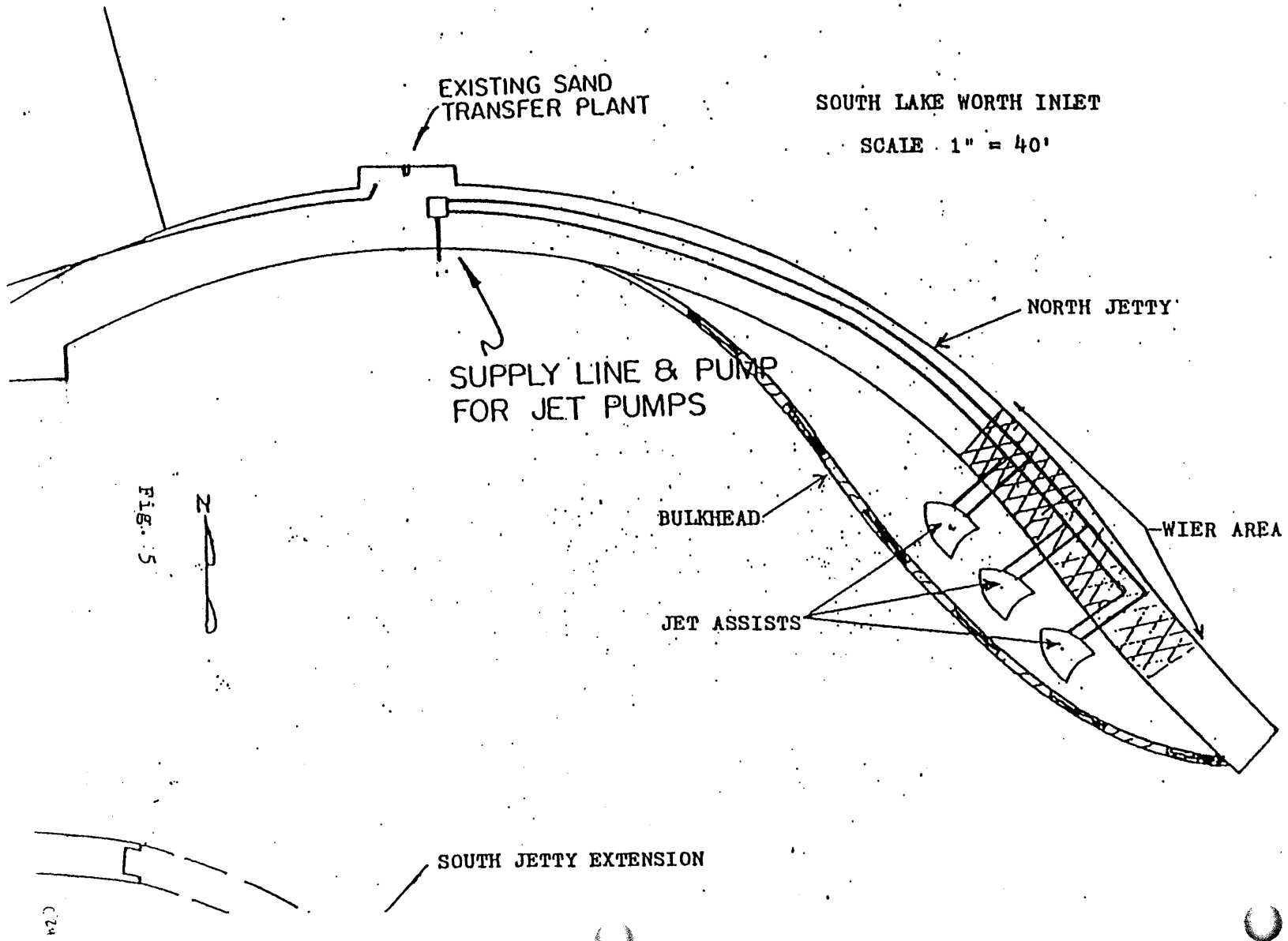

EXISTING SAND
TRANSFER PLANT
SOUTH LAKE WORTH INLET
SCALE 1" = 40'
NORTH JETTY
SUPPLY LINE & PUMP
FOR JET PUMPS
BULKHEAD
WIER AREA
JET ASSISTS
N
SOUTH JETTY EXTENSION

Fig. 5

SOUTH LAKE WORTH INLET DISTRICT

PALM BEACH COUNTY, FLORIDA

Post Office Box 3465, Lantana, Florida 33465
Tel. (407) 969-9824

Board of Commissioners:
David W. Geller, Chairman, Lantana
George R. Frost, Vice-Chairman, West Palm Beach
Thelma E. Moore, Secretary/Treasurer, West Palm Beach
Kenneth Hall, Boynton Beach
Edwin H. Shepherd, Lake Worth
James R. Warnke, Boynton Beach

Dorothy A. Lindros, Executive Secretary
James McCartney Wearn, P.A. Attorney
Gee & Jenson, E-A-P, Inc., Engineers

January 3, 1994

CERTIFIED MAIL RETURN RECEIPT REQUESTED
and
REGULAR MAIL

Regulatory Division
South Permits Branch
Jacksonville District
Corps of Engineers
Department of the Army
Post Office Box 4970
Jacksonville, FL 32232-0019

Att: Ralph W. Pasquale

Planning Division
Environmental Branch
Jacksonville District
Corps of Engineers
Department of the Army
Post Office Box 4970
Jacksonville, FL 32232-0019

Att: A.J. Salem, Chief
Planning Division

Re: Ocean Ridge segment
Palm Beach County Shore Protection Project
Permit Application No. 199301676(IP-RP)
Applicant: Palm Beach County
Public Notice

Gentlemen:

As Chairman of the South Lake Worth Inlet District, I am submitting herewith comments on the referenced Project and Application, as requested in your Public Notice dated December 2, 1993, and request for comments dated December 10, 1993 (partial copies of each attached for your reference. These comments represent those from the Board of Commissioners sitting in regular session on December 20, 1993.

We understand that the project is to dredge approximately 700,000 cubic yards of beach quality sand from an offshore borrow site seaward of the 30 ft. depth contour and to place that material along approximately 1.46 miles of Ocean Ridge's beach, beginning at the south jetty of the South Lake Worth Inlet. Additionally, the project includes the construction of five rock T-head groins and five rock breakwaters. The project has been depicted on 7 pages of permit sketches and we have the following comments, questions, or concerns:

1. With the exception of page 1 of the permit sketches, the remaining six pages are the result of reducing 13 pages of sketches submitted by the applicant. The reduction process

has rendered some of the sketches and data illegible and incomprehensible. The COE should re-issue the Public Notice with sketches at a scale appropriate to allow proper review of the project.

2. Because the proposed project seems to involve matters of ongoing litigation, it would make sense that resolution of the litigation should precede permitting and construction of the project.

3. Construction of a major nourishment project immediately south of the South Lake Worth Inlet, prior to the south jetty being completed or prior to other containment, may result in partial or total closure of the Inlet during the seasonal southeast tradewinds. This proposed action is contradictory to the Department's prior position. The Department should clarify its position before acting on the proposed application, as presented.

4. In accordance with Chapter 161.141, FAC, an erosion control line needs to be established prior to the nourishment of a beach such as the one proposed. According to the sketches, the erosion control line will follow the 1992 Mean High Water Line. We feel that processing the proposed permit should follow the establishment of the erosion control line.

5. The proposed project appears to include construction on District property. Specifically, that portion of the fill on District property, beginning at the south jetty at the north end of the project and what appears to be a proposed spur groin extending south from the south jetty, but not otherwise identified in the permits. It would be appropriate to seek District's approval, authority, and permit for those works on District property.

6. The borrow area identified in the sketches contains more than twice the amount of sand necessary to construct the project. A more specific and detailed borrow site, therefore smaller, would minimize possible adverse impacts to the natural environment.

7. The northern portion of the borrow area appears to be the foot of or contiguous to the waterward side of the Inlet ebb

tidal shoal. Disruption or interference with the ebb tidal shoal will, most likely, interrupt the natural transfer of sand around the Inlet, interrupt the shoal's shore protection, and cause erosion on the beach. Assurance should be made that such disruption or interference will not occur.

8. Plate 5 of the Sketches depicts an existing seawall incorrectly. The majority of the project is adjacent to the "McCormick Seawall" and, as an example, Monument R-153 is located on top of the seawall, clearly showing the discrepancy. Additionally, this sheet does not appear to show the beach stabilization groin field located in the surf zone of the first 1,000 ft. south of the south jetty. Also, the substantial sheet pile groins extending out from the McCormick Seawall are not shown on the sketch.

9. Nowhere in the sketches does it identify the proposed T-head groins or breakwaters as proposed structures.

10. The profile through the borrow area, depicted on page 7 of 7, should exhibit evidence of the ebb tidal shoal. We find it puzzling that the profiles lack such evidence.

11. Page 2 of 7 shows public access location points at ten locations. Understanding the importance of public access to a beach constructed utilizing public funds, we question whether showing the ten access locations as depicted, is being totally open and honest. For example, the four locations shown between Monuments R-156 and R-157 are at one Municipal Beach Park owned by the City of Boynton Beach, which charges a fee for access. What appears to be shown as four separate access locations is simply four separate beach access ramps from the same parking lot. It should also be pointed out that additional access points have no public parking within a reasonable distance and are, therefore, limited to use by adjacent local residents in this very private community.

12. The Supplement to the Environmental Impact Statement is of great importance to the Inlet District. As such, we would appreciate receiving copies of any proposed revisions to the Final EIS/GDM and would like to be advised of any meetings or hearings related to these issues.

The District appreciates the opportunity to comment on this Project and Application.

We would appreciate your respective Planning Division and Regulatory Division keeping us advised of the progress of this Project and Application. Formally, we request notice and copying on all further action and communication concerning this Project and Application.

Thank you for your consideration.

Very truly yours,

David W. Geller

David W. Geller, Chairman
South Lake Worth Inlet District

DWG/JMcCW:jz

cc: Dorothy Lindros, Executive Secretary
James McC. Wearn, Esquire, District Attorney
John S. Yeend, P.E., District Engineer

Statement (EIS), is currently on file at the U.S. Army Corps of Engineers Jacksonville District Office. Also, a supplemental EIS for this proposed project is being developed.

ENDANGERED AND THREATENED SPECIES: Coordination and Consultation, as defined under Section 7 of the Endangered Species Act, is being conducted with the U.S. Fish and Wildlife Service land the National Marine Fisheries Service by the U.S. Army Corps of Engineers, Jacksonville district, Planning Division, Environmental Resources Branch.

AUTHORIZATION FROM OTHER AGENCIES: The Florida Department of Environmental Protection (DEP): The DEP permit application number is 502355609.

Supplemental information has been forwarded to the resource agencies.

Comments regarding the application should be submitted in writing to the District Engineer at the above address within 30 days of this notice. If you have any questions concerning this application, you may contact Ralph W. Pasquale of this office, telephone 904-232-3358.

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

02 DEC 1993

Regulatory Division
South Permits Branch

PUBLIC NOTICE
Permit Application No. 199301676(IP-RP)

TO WHOM IT MAY CONCERN: This District has received an application for a Department of the Army permit pursuant to Section 10 of the Rivers and Harbors Act of 1899(33U.S.C. 403) and Section 404 of the Clean Water Act as described below:

APPLICANT: Palm Beach County
3111 S. Dixie Highway, Suite 146
West Palm Beach, Florida 33405

WATERWAY & LOCATION: The proposed project is located along 1.46 miles of shoreline adjacent to the Atlantic Ocean, immediately south of South Lake Worth Inlet, beginning approximately 400 feet north of FDEP survey monument T-152 and ending approximately 120 feet south of monument R-159, in Sections 15, 22, and 27, Township 45S, Range 43E, Ocean Ridge, Palm Beach County, Florida.

LATITUDE & LONGITUDE: Lat. 26°32'03.3"N, Long. 80°02'44.78"W. (Center of fill area)

WORK & PURPOSE: The applicant proposes to place approximately 700,000 cubic yards of beach compatible sand for beach renourishment along the specified area. The sand would be obtained from a borrow area ranging from 1,840 to 2,750 offshore of Ocean Ridge in about 27 to 38 feet of water, and about 1,800 feet from the nearest offshore reef which is in 50 feet of water. A construction berm, 5 T-head groins, 5 detached nearshore breakwaters, and a field of low-relief rubble mound structures in the northern 2,500 feet are included in the proposed project. Each stone of the structures would be individually placed to avoid impacts to the existing nearshore hardbottom. Sand would be hydraulically dredged and deposited by pipeline behind a containment dike parallel to the shoreline. Sand would then be moved and shaped by bulldozers or other earth moving equipment. Turbidity would be controlled through the use of dikes and a water quality control monitoring program which would include shutting down dredging operations if necessary until an unacceptable condition is cleared.

NOTE: This public notice is being issued based on information furnished by the applicant. However, a General Design Memorandum (USACE 1987) for Beach Erosion Control Projects for Palm Beach County Florida, which includes a county-wide Environmental Impact

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

December 7, 1993

RECEIVED
DEC 10 1993

Planning Division
Environmental Branch

TO ADDRESSEES ON THE ATTACHED LIST:

The Jacksonville District U.S. Army Corps of Engineers, is beginning to gather information to help define issues and concerns that will be addressed in a Supplement to the Environmental Impact Statement for the Ocean Ridge segment of the Palm Beach County Shore Protection Project.

The project was authorized on October 23, 1962 by Public Law 87-874. The project has been coordinated with interested Federal, State and local agencies and the public. The Final Environmental Impact Statement and General Design Memorandum (GDM) for Palm Beach County was published in April 1987. The recommended plan in the 1987 GDM called for the restoration and periodic nourishment of 1.6 miles of shoreline using a 50 foot berm width. Approximately 770,000 cubic yards of fill would be placed and would include advanced nourishment for the initial eight year nourishment interval.

An alternative design is being considered that would reduce the width of the fill in the northern end of the project by using approximately 10 low profile rock structures. The use of structures is being considered to reduce the annual expected cost of the project and to protect nearshore rock habitat that exists in the northern end of the project. The project is proposed to begin at the south jetty of South Lake Worth Inlet and extend south about 7,700 feet (1.4 miles). The borrow area for the project is located between 1,750 and 2,800 feet offshore of the fill area in about 30 to 35 feet of water. The sand will be removed from the borrow area with hydraulic dredge and pumped onto the shoreline where it will be shaped by heavy equipment. Refer to the enclosed map for the project location.

We welcome your views, comments and information about resources, study objectives and important features within the described area, as well as any suggested improvements. Letters of comment or inquiry should be sent within 45 days to the letterhead address, attention Planning Division, Environmental Branch.

Sincerely,

A. J. Salem

A. J. Salem
Chief, Planning Division

FLORIDA DEPARTMENT OF TRANSPORTATION
LAWTON CHILES
GOVERNOR
TRANSPORTATION PLANNING OFFICE - DISTRICT 4
BEN G. WATTS
SECRETARY
3400 West Commercial Blvd., 3rd Floor, Ft. Lauderdale, FL 33309-3421
Telephone: (305) 777-4601; Fax: (305) 777-4671

January 3, 1994

The State Clearinghouse
Executive Office of the Governor
Room 1603, The Capitol
Tallahassee, Florida 32399-0001

Dear Sirs:

Subject: FL9312091502C - Beach Nourishment Project
Palm Beach County
State Road AIA
WPI No. 4118743 and WPI No. 4118503

The Department has two projects, indicated above, which are located at the Boynton (Lake Worth) Inlet. Both are in conjunction with the bridge and its approaches and adjoining seawall. The first, (WPI No. 4118743), is nearly complete and involves construction of approximately 776 feet of seawall, curb and gutter and resurfacing of SR-AIA. The second, (WPI No. 4118503), is a larger project involving the reconstruction of the bridge over the inlet at a cost of over $2 million. This project is scheduled for construction in FY 1994/95. The project manager for the seawall project is Mr. Rene Aoun who can be reached at (305) 777-4641. The bridge reconstruction project is managed by Mr. Al Khah who can be reached at (305) 777-4636.

We do not envision any other impingement of the proposed U.S. Corps of Engineers Project on State Road AIA; however, we strongly urge that the Corps of Engineers project manager contact the above named staff in order to effect coordination between the Department's and the Corp's projects.

Sincerely,

FOR Gustavo Schmidt, P.E.
District Planning Manager
District 4

cc: Bill Keating
John Anderson

ICARPBC.AIA
FILE: 4280.05

RECYCLED PAPER

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Regulatory Division
South Permits Branch
199301676(IP-RP)

JAN 5 1994

RECEIVED
JAN 7 1994
ENVIRONMENTAL RESOURCES MANAGEMENT

ENV. RES. MGMT.
Forwarded
Coastal & Wetlands
Cos. Review
Pollution Control
Water Resources
Fiscal
Asst. City Admin.
Copy ☐ File ☐

Mr. Alexander Stone
Director
Project Reefkeeper
2809 Bird Avenue, Suite 162
Miami, Florida 32232-0019

Dear Mr. Stone:

Please refer to the public notice for Department of the army permit application 199301676(IP-RP) for Palm Beach county beach renourishment south of South Lake Worth Inlet.

Your letter of December 9, 1993, asked that the comment period be extended until the forthcoming Supplemental Environmental Impact Statement (EIS) for the referenced proposed project was available and could be reviewed.

It is our understanding that this EIS will not be available until May of this year. Accordingly, we have withdrawn the application and will reissue upon availability of the EIS.

Thank you for your interest in our regulatory program.

Sincerely,

Ralph W. Pasquale
Senior Project Manager

Copy furnished:

Richard E. Walesky, Palm Beach County Department of Environmental ~~Resources Management, 3111 S. Dixie Highway, Suite 146, West~~ Palm Beach, Florida 33405
NMFS, St. Petersburg
FWS, Vero Beach

January 7, 1994

Planning Division
Environmental Branch

Mr. Charles A. Oravetz
Chief, Protected Species Management Branch
National Marine Fisheries Service
9450 Koger Boulevard
St. Petersburg, Florida 33702-2496

Dear Mr. Oravetz:

This is in reference to the Ocean Ridge segment of the Palm Beach County Shore Protection Project.

Enclosed is the Biological Assessment pursuant to Section 7(a) of the Endangered Species Act. The U.S. Army Corps of Engineers has determined that the proposed action will not adversely affect any listed species under the jurisdiction of the National Marine Fisheries Service.

Your concurrence on this determination is requested. If you have any questions or need any additional information, please feel free to contact me.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosure

bcc:
CESAJ-EN-HC
CESAJ-DP-I

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director's Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

January 10, 1994

Mr. A. J. Salem, Chief
Planning Division, Environmental
Resources Branch
Jacksonville District Corps of
Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

In Reply Refer To:
Denise M. Breit
Historic Sites
Specialist
(904) 487-2333
Project File No. 933877

RE: Supplement to the Environmental Impact Statement for the Ocean Ridge Segment of the Palm Beach County Shore Protection Project
Palm Beach County, Florida

Dear Mr. Salem:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the referenced project(s) for possible impact to historic properties listed, or eligible for listing, in the National Register of Historic Places. The authority for this procedure is the National Historic Preservation Act of 1966 (Public Law 89-665), as amended.

A review of the Florida Site File indicates that no significant archaeological or historical sites are recorded for or likely to be present within the project area. Furthermore, because of the project location and/or nature it is unlikely that any such sites will be affected. Therefore, it is the opinion of this office that the proposed project will have no effect on historic properties listed, or eligible for listing, in the National Register of Historic Places. The project is also consistent with the historic preservation laws of Florida's Coastal Management Program.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

for Laura A. Kammerer

George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Bdb

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, Florida 33702

January 18, 1994

Mr. A. J. Salem
Chief, Planning Division
Department of the Army, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

This responds to your December 7, 1993, request for information regarding issues and concerns that will be addressed in a Supplement to the Environmental Impact Statement for the Ocean Ridge segment of the Palm Beach County Shore Protection Project.

Your letter states that an alternative design is being considered that would reduce the width of the fill in the northern end of the project in order to reduce costs and avoid existing nearshore rock bottom habitat in that area. In general, we support any effort to reduce or eliminate impacts to such areas which play an important role in fisheries productivity. At this time however, we have no site specific information to offer regarding the exact location or condition of the existing hard bottom areas.

We appreciate the opportunity to provide information regarding this shore protection project. Please continue to apprise us as project plans develop. If you have questions regarding these comments, please contact Ms. Shelley Du Puy of our Miami Field Office at 305/595-8352.

Sincerely,

Edwin J. Higgins

Andreas Mager, Jr.
Assistant Regional Director
Habitat Conservation Division

cc:
F/SE02
F/SE023-MIAMI

PROJECT REEFKEEPER
to protect coral reefs

RECEIVED
FEB 4 1994
ENVIRONMENTAL RESOURCES MANAGEMENT

ENV. RES. MGMT.

CT 2/6
PO 2/8
PM 2/9

January 20, 1994
Operations Center

Project ReefKeeper

OPERATIONS CENTER
Suite 162
2809 Bird Ave
Miami, Florida 33133

CARIBBEAN REGION
Suite 1271
Castillo Del Mar
a Verde, Puerto Rico 00913

PACIFIC REGION
Suite 106-542
350 Ward Avenue
Honolulu, Hawaii 96814

TIN AMERICAN REGION
Calle 60 No. 387-C
Merida, Yucatan
Mexico 97000

Mr. Ralph W. Pasquale, Permitting Officer
Regulatory Div / ACOE Jacksonville District
P.O. Box 4970
Jacksonville, FL 32232

re: Permit App. 199301676 (IP-RP)
Confirmation of Right to Review and Comment on Supplemental EIS

Dear Mr. Pasquale:

This is to verify and confirm the assurance you and Michael Dupes have given the Palm Beach Department of Environmental Resources Management that – given that the Supplemental EIS for the above referenced proposed Ocean Ridge beach renourishment project would not be completed for public review and comment prior to the expiration of the public comment period for the above-referenced application -- the Regulatory Division will, as required under NEPA, accept and respond to public comments made by Project ReefKeeper and any other concerned organizations on that Supplemental EIS once it is completed and prior to final conditioning and approval of the permit.

We will periodically check with you to ascertain when the Supplemental EIS will be available for the aforementioned review. We trust that you will maintain a record of our communications regarding this matter and that you will provide us with a copy of the Supplemental EIS once it is available.

Please respond to us at once if you have any disagreement with this information. Phone us at (305)642-9443 or fax us at (305)642-4996.

Thank you for your attention and cooperation.

Sincerely,

Alexander Stone

ALEXANDER STONE
Director

AS:hm
cc: PB Environmental Resources Mgmt
American Coastal Research & Ed
Sierra Club Treasure Coast Group
Coral Reef Society of PB
Fla Audubon Society (Leah Shad)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

January 21, 1994 F/SE013:EH

Mr. A.J. Salem
Chief, Planning Division
Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

This responds to your letter dated January 7, 1994, regarding the Ocean Ridge segment of the Palm Beach County Shore Protection Program. A Biological Assessment (BA) was submitted pursuant to the requirements for interagency consultation outlined in Section 7 of the Endangered Species Act (ESA).

We have reviewed the BA. Unfortunately, the information provided is insufficient for us to concur with your determination that populations of endangered or threatened species under our purview would not be adversely affected the proposed action.

Please provide us with details on the type of bottom to be dredged at the borrow site. Are any sea grasses or worm reefs present that might attract turtles? Also provide specifications on the hydraulic dredge type to be used. Does it have a cutting head or a suction head, what is the size of head, is it equipped with any type of turtle deflector, and what is the rate of advance over the bottom? For what months is the dredging planned, and how may that impact sea turtle nesting? Have provisions been made to ensure that minimal safe lighting, or shielded lighting, is used on the dredge and pipeline during nesting/hatching season, et cetera?

If you have any questions please contact LCDR Eric Hawk, Fishery Scientist, at 813/893-3366.

Sincerely yours,

Charles A. Oravetz

for Andrew J. Kemmerer
Regional Director

cc:
F/SE02
F/PR2

January 21, 1994

Planning Division
Environmental Branch

Mr. David L. Ferrell
Field Supervisor
U.S. Fish and Wildlife Service
P.O. Box 2676
Vero Beach, Florida 32961-2676

Dear Mr. Ferrell:

This is in reference to the Palm Beach County Shore Protection Project and the planned nourishment of the Ocean Ridge segment.

Enclosed is the Biological Assessment pursuant to Section 7(a) of the Endangered Species Act concerning potential impacts to sea turtles. The U.S. Army Corps of Engineers has determined that the planned renourishment may affect sea turtle nesting. Therefore, we are requesting that formal consultation with the Service be initiated to address potential impacts the project may have on sea turtles.

Please provide your Biological Opinion within 90 days as specified in Section 7(b)(1) of the Endangered Species Act. If you have any questions or need any further information, please do not hesitate to contact me.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosure

bcc: w/encl
CESAJ-EN-HC
CESAJ-DP-I

STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS

2740 CENTERVIEW DRIVE • TALLAHASSEE, FLORIDA 32399-2100

LAWTON CHILES
Governor

LINDA LOOMIS SHELLEY
[redacted]
Secretary

January 28, 1994

Mr. A. J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

RE: Beach Erosion Control Projects - Supplement to Environmental Impact Statement - Ocean Ridge Segment, Palm Beach County Shore Protection Project - Palm Beach County, Florida
SAI: FL9312091502C

Dear Mr. Salem:

The Florida State Clearinghouse, pursuant to Presidential Executive Order 12372, Gubernatorial Executive Order 93-194, the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended, and the National Environmental Policy Act, 42 U.S.C. §§ 4321, 4331-4335, 4341-4347, as amended, has coordinated a review of the above-referenced project.

The Department of Environmental Protection (DEP) notes that Palm Beach County has already requested a DEP permit for the referenced project. DEP has recommended that the county consider alternatives to the proposed project, including but not limited to the placement of fill above mean high water only along the segment where the rock structures are proposed. Furthermore, DEP indicates that the county has not adequately demonstrated a need for the permit. Therefore, the county has been asked to provide additional information. Please refer to the enclosed DEP comments.

The Department of Transportation (DOT) indicates that there are two DOT projects, WPI No. 4118743 and WPI No. 4118503, located at the Boynton (Lake Worth) Inlet. Therefore, the

applicant is required to coordinate project related activities with the referenced DOT personnel. Please refer to the enclosed DOT comments.

The State of Florida has completed a review of the referenced project, and based on the information available at this time, the state has determined that at this stage, the project is consistent with the Florida Coastal Management Program. However, our reviewing agencies have identified certain issues, as enclosed, which should be addressed by the applicant prior to any subsequent review of this project. Pursuant to 15 CFR 930.34 and 930.37, the applicant is required to prepare a consistency determination at each major decision point in the project for the state's review. The state's continued agreement with the project will be based, in part, on the adequate resolution of the concerns identified in all previous reviews of the project.

Very truly yours,

Linda Loomis Shelley
Secretary

LLS/jr

Enclosures

cc: Susan Goggin, Department of Environmental Protection
Neal Rogers, Department of Environmental Protection
Gustavo Schmidt, Department of Transportation
George Percy, Department of State

Florida Department of
Environmental Protection

Lawton Chiles
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Virginia B. Wetherell
Secretary

28 January 1994

Janice L. Hatter
Director, State Clearinghouse
Office of Planning and Budgeting
Executive Office of the Governor
The Capitol
Tallahassee, Florida 32399-0001

RE: COE/Scoping Request, Supplement to the Environmental Impact Statement, Ocean Ridge Segment of Palm Beach County Shore Protection Project
SAI: FL931091502C

Dear Ms. Hatter:

The U.S. Army Corps of Engineers has requested our comments on issues to be included in a Supplement to the Environmental Impact Statement (SEIS) for the above-referenced Pam Beach County Shore Protection project.

An alternative design has been presented for this project whereby ten low profile rock structures would be placed just south of the South Lake Worth Inlet in order to reduce beach fill requirements. Permits will be required for this project pursuant to Chapters 161 and 403, Florida Statutes. Palm Beach County has filed an application for a project permit with the Division of Beach and Shores, but has not adequately demonstrated that the proposed rock structures are justified, nor that approval of the permit is consistent with Section 161.041, Florida Statutes. The Bureau of Wetland Resource Management has received a complete permit application which is now under review.

Division of Beaches & Shores staff have requested that the county consider other alternatives to the proposed project including but not limited to fill above mean high water only along the segment where the rock structures are proposed. Excluding the rock structures, the Division of Beaches & Shores would recommend favorably for the beach nourishment project for this segment. Final design approval, however, must also be coordinated with the Bureau of Wetland Resource Management.

According to staff in the Division of Beaches & Shores, the County has also not adequately demonstrated that the proposed impacts to nearshore rock outcrops are the maximum allowable impacts and that the proposed reduction in potential

impacts to nearshore rock outcrops justifies the proposed rock structures and the potential impacts to longshore transport.

Department staff have also requested that the County demonstrate the methodology which was applied in evaluating the performance of the beach fill with respect to the proposed rock structures. It has also been requested that the County conduct a numerical model study of the project to evaluate the performance of the project and the potential impacts to the areas downdrift of the project.

Attached is a copy of the request for additional information sent to the County regarding their application. This requested information must be provided so that a complete application is on file with both the Division of Beaches & Shores and Bureau of Wetland Resource Management.

Questions regarding the permitting status of the proposed project should be referred to Neal Rogers, Beaches & Shores, at (904)487-4475, and John Abendroth, Wetland Resource Management, at (904)488-0130. If you have any questions regarding this letter, please call me at 488-0784.

Sincerely,

Susan Goggin

Susan Goggin
Environmental Specialist
Office of Intergovernmental Programs

NR/seg:

cc: Neal Rogers
John Abendroth

RECEIVED

JAN 7 1994

Date: 12/13/93
Comment Due Date: 12/27/93
SAI# FL9312091502C

Florida Coastal Management Program

STATE AGENCIES		Florida Coastal Management Program		OPB POLICY UNITS	
	Agriculture		RPC #1		Criminal Justice
	Board of Regents		RPC #2		Education
	Commerce		RPC #3		Environment/C & ED
X	Community Affairs		RPC #4		General Government
	Education		RPC #5		Health & Human Srv
X	Environmental Reg		RPC #6		Revenue & Eco. Ana
X	Game & Fish Comm		RPC #7		SCH
	Health & Rehab Srv		RPC #8	X	SCH/CON
	Highway Safety		RPC #9		
	Labor & Employmnt		RPC #10		
	Law Enforcement		RPC #11		
X	Marine Fish Comm		NWFWMD		
	Natural Resources	X	SFWMD		
X	State		SWFWMD		
X	Transportation		SJRWMD		
	Trans Disad. Comm		SRWMD		
	DER District				

RECEIVED
DEC 13 1993
CENTRAL OFFICE FDOT
ICAR COORDINATOR

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evaluation and is categorized as one of the following:

___ Federal Assistance to State or Local Government(15 CFR 930, Subpart F). Agencies are required to evaluate the consistency of the activity.

_X_ Direct Federal Activity (15 CFR 930, Subpart C). Federal agencies are required to furnish a consistency determination for the State's concurrence or objection.

___ Outer Continental Shelf Exploration, Development or Production Activities (15 CFR 930, Subpart E). Operators are required to provide a consistency certification for state concurrence/objection.

___ Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.

SEE REVERSE SIDE FOR INSTRUCTIONS AND ADDRESSES FOR RETURN MAILING.

To: State Clearinghouse
Executive Office of the Governor-OPB

Florida Coastal Management Director
Department of Community Affairs

EO. 12372	Federal Consistency
☐ No Comment	☐ No Comment/Consistent
☒ Comments Attached	☒ Consistent/Comments Attached
☐ Not Applicable	☐ Inconsistent/Comments Attached
	☐ Not Applicable

From:
Division/Bureau: FDOT - DIST. 4
Reviewer: Ann Anderson
Date: 1/3/94

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P.O. BOX 2676
VERO BEACH, FLORIDA 32961-2676

February 14, 1994

Colonel Terrence Salt
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Attn: Planning Division

RE: Ocean Ridge Beach Nourishment

Dear Colonel Salt:

This responds to your letter dated January 21, 1994 and attached environmental assessment in accordance with the Fish and Wildlife Coordination Act and Section 7 of the Endangered Species Act of 1973, as amended.

The Corps of Engineers determined that this action "may affect" threatened or endangered sea turtles. Based upon our preliminary review, we concur with this determination. We are, therefore, initiating consultation under Section 7 of the Endangered Species Act on this date and will complete the consultation process within 90 days. A Biological Opinion will be issued shortly after the conclusion of the consultation period. Please be advised these are our regulatory time frames, and the vast majority of consultations are completed in a much shorter period.

The Corps has also determined that the project will not adversely affect the West Indian manatee. The Service concurs with this determination. Although this does not constitute a Biological Opinion described under Section 7 of the Endangered Species Act, it does fulfill the requirements of the Act, and no further action is required with regard to the West Indian manatee.

If modifications are made in the project or if additional information involving potential impacts on listed species becomes available, please notify Chuck Sultzman or Patricia Richards of my staff at (407-562-3909).

Sincerely yours,

David L. Ferrell
Field Supervisor

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

February 8, 1994 F/SE013:EH

Mr. A.J. Salem
Chief, Planning Division
Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

This responds to your letter and supplemental information dated February 3, 1994, regarding the Ocean Ridge segment of the Palm Beach County Shore Protection Program. We have reviewed the information and the previously submitted Biological Assessment (BA). We concur with your determination that populations of endangered or threatened species under our purview would not be adversely affected by the proposed action.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity.

If you have any questions please contact LCDR Eric Hawk, Fishery Scientist, at 813/893-3366.

Sincerely yours,

Charles A. Oravetz

for Andrew J. Kemmerer
Regional Director

cc:
F/SE02
F/PR2

Board of County Commissioners
Mary McCarty, Chair
Ken L. Foster, Vice Chairman
Karen T. Marcus
Carol A. Roberts
Warren H. Newell
Burt Aaronson
Maude Ford Lee

County Administrator
Robert Weisman

Department of
Environmental Resources Manageme

August 5, 1994

Mr. A. J. Salem, Chief
Planning Division, CESAJ-PD
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

SUBJECT: COMMENTS TO OCEAN RIDGE COORDINATION ACT REPORT

Please accept these comments regarding the July 1994 draft of the U.S. Fish and Wildlife Service (USFWS) Coordination Act report for the Ocean Ridge segment of the Palm Beach County shore protection project.

Amount of Reef Within Fill Area

The report indicates that approximately 2 acres of nearshore reef will be impacted by the project. We would like to clarify that this value was based upon an estimated toe of fill (ETOF) overlain on a 1992 reef map. Analysis of more recent aerial imagery from July 1993 indicates that if the project was constructed at that time, 3.3 acres of reef would be impacted (see enclosed map). The increase in acreage was due primarily to an enlargement of the reef at R-156. Recent field observations indicate that the 1994 reef exposure is similar to that seen in 1993. Accepting the fact that exact levels of impacts are impossible to predict, it would be prudent to use a planning level estimate of at least 3 acres rather than 2 acres.

When the project design is finalized, a more detailed analysis of historic data will be conducted to more accurately define expected impacts.

Water Depths at R-156 Reef

Page 5 states that the reef at R-156 is 20′ deep. Our data shows that depths range from 8′ to 13′ NGVD at this location. We agree with the USFWS that it is generally deeper than the reef at R-152.

Reef Mitigation

We concur with recommendations A1 through A9. Recommendation A2 is for 0.5 acres of artificial reef to be deployed prior to project construction. Palm Beach County is constructing a nearshore reef mitigation bank this summer in the vicinity of the project area. Approximately 6,300 tons of limestone rocks will be placed to construct about 1.5 acres of artificial reef and will be monitored in accordance with the methods described in recommendation A7.

We strongly suggest that the U.S. Army Corps of Engineers fund the USFWS to assist in monitoring the artificial reefs as discussed in recommendation A8.

Recommendation A6 states that a mitigation site at R-156 was tentatively selected by the USFWS. We will evaluate the feasibility and likelihood of success of constructing reef inshore of the existing natural reef. We are concerned that an artificial reef at this location would be covered by fill and would not function as a reef until the fill erodes. If the time of coverage is relatively short, this recommendation will be considered. If not, we have selected the area offshore of R-153 as a mitigation site.

Sea Turtle Recommendations

We are concerned about some of the terms and conditions discussed in the Biological Opinion.

Condition #1 - We feel the construction window of November 1st through April 30th is too limited. Based upon 1992 and 1993 data, nesting in Ocean Ridge remains at very low levels (~10 nests) until approximately May 15th. After August 1st, nesting drops off with late season nesting not exceeding 10 nests. We recommend that the construction window be expanded to at least October 10th (which is 70 days after August 1st) through May 15th. This would increase the construction window by 36 days during calmer weather while still requiring that ~90% of the nests be left in situ.

Condition #2 - We recommend that the first paragraph be modified as follows: "All nests laid within the groin area prior to May 15th will be relocated. Construction of groins should begin no later than April and proceed from the southernmost groin toward the north. Relocation will continue, but as the southern groins are completed, the need for nest relocation in the south portion of the groin area ends and relocation will not continue in areas where construction is complete."

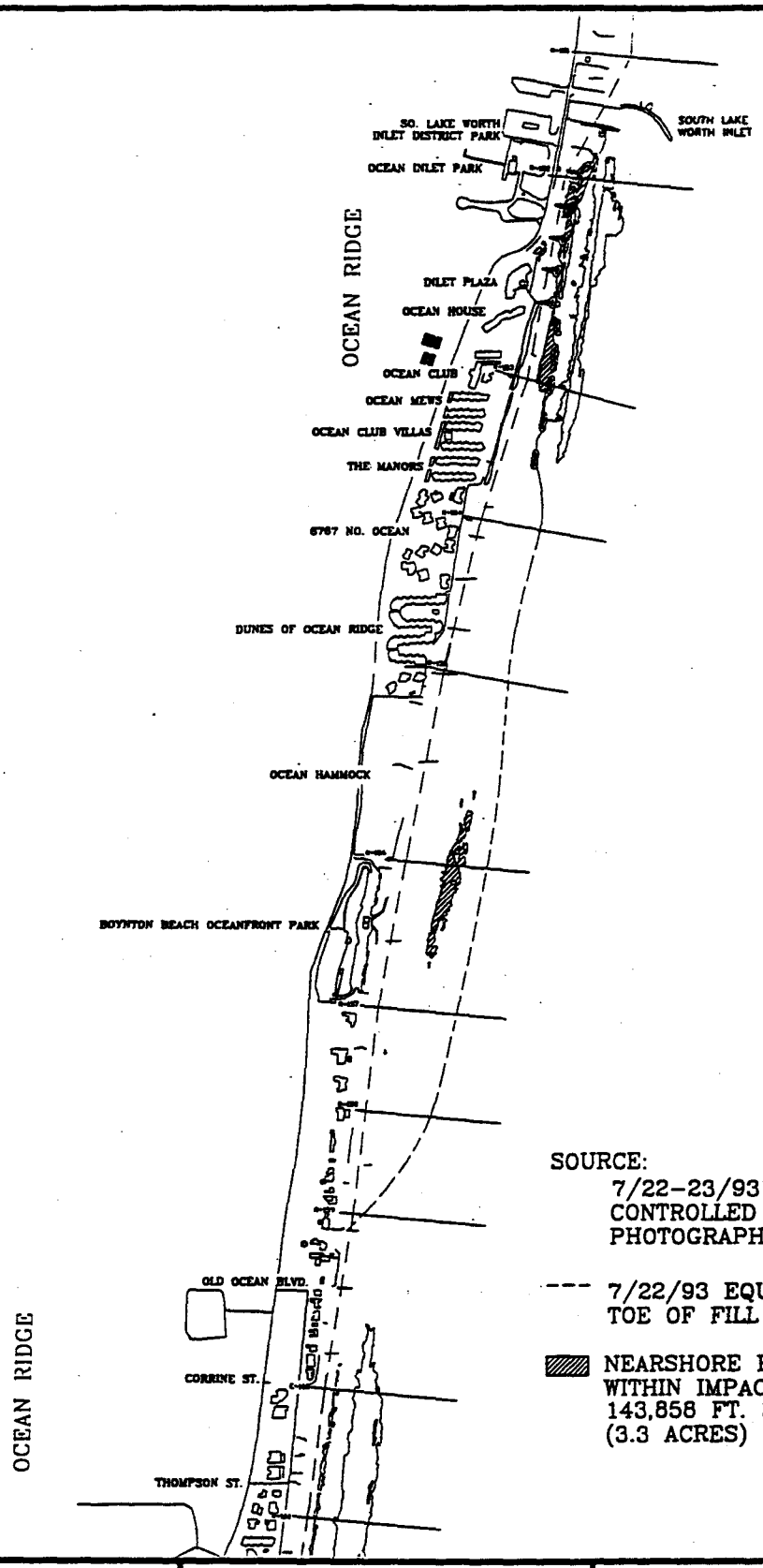
Condition #9 and the first sentence after condition #10: "dune restoration" should be changed to "beach and dune restoration."

If you have any further questions, please contact Mr. Paul Davis of this office at (407) 355-4011.

Sincerely,

James J. Barry III, Environmental Director
Coastal and Wetlands Division

JJB:PD:tmw
Enclosure



SOURCE:
7/22-23/93 PBC ERM CONTROLLED AERIAL PHOTOGRAPHY

--- 7/22/93 EQUILIBRIUM TOE OF FILL (ETOF)

NEARSHORE HARDBOTTOM WITHIN IMPACT OF ETOF
143,858 FT. SQ.
(3.3 ACRES)

PALM BEACH COUNTY DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT	OCEAN RIDGE SHORE PROTECTION PROJECT LOCATION OF NEARSHORE HARDBOTTOM WITHIN ETOF	SCALE: 1"=1200' -600 -300 0 300 600 900 1200 N
		OR 8/94 JM

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

SOUTHEAST/CARIBBEAN
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303-3388

January 24, 1996

Mr. A. J. Salem
Chief, Planning Division
Army Corps of Engineers
PO Box 4970
Jacksonville, Fl 32232-0019

Dear Mr. Salem:

This refers to your memorandum dated January 16, 1996, transmitting the Draft Supplement to the Environmental Impact Statement [DSEIS] for the Palm Beach County , Florida, Shore Protection Project, Ocean Ridge Segment.

Our review indicates there will be no significant adverse impact on any HUD programs as a result of this project.

Thank you for the opportunity to review and comment on your proposed project.

Sincerely,

Thomas A. Ficht

Thomas A. Ficht
Supervisory Environmental
Officer

PD-ER (Dupcs)

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

ER 96/92

FEB 16 1996

Mr. A. J. Salem
Chief, Planning Division
Environmental Branch
Department of the Army
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

This is in regard to the request for the Department of the Interior's comments on the Draft Supplemental Environmental Impact Statement for the Shore Projection Project (From Martin County Line to Lake Worth Inlet and from South Lake Worth Inlet to Broward County Line), Palm Beach, Florida.

This is to inform you that the Department will have comments, but will be unable to reply within the allotted time. Please consider this letter as a request for an extension of time in which to comment on the statement.

Our comments should be available about April 5, 1996.

Sincerely,

Terence N. Martin

Terence N. Martin
Team Leader, Natural Resources Management
Office of Environmental Policy & Compliance

STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS

EMERGENCY MANAGEMENT • HOUSING AND COMMUNITY DEVELOPMENT • RESOURCE PLANNING AND MANAGEMENT

LAWTON CHILES
Governor

JAMES F. MURLEY
Secretary

March 1, 1996

Mr. A.J. Salem
Department of the Army
Jacksonville District Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

RE: Beach Control Erosion Projects - Draft Supplement to the Environmental Impact Statement for Shore Protection Project, Ocean Ridge Segment - Palm Beach County, Florida
SAI: FL9601190039C

Dear Mr. Salem:

The Florida State Clearinghouse has received your notification of the above-described project, and has forwarded to the appropriate state agencies for review. In order to receive comments from all agencies, an additional fifteen days is requested for completion of the review. Therefore, the clearance letter due date for this project will be extended from March 4, 1996, to March 19, 1996. If all comments are received prior to the extended date, every effort will be made to forward the clearance letter to you at an earlier date.

Thank you for your understanding. If you have any questions regarding this matter, please contact Ms. Keri Akers, Clearinghouse Coordinator, at (904) 922-5438.

Sincerely,

Ralph Cantral, Executive Director
Florida Coastal Management Program

RDC/ka

2740 CENTERVIEW DRIVE • TALLAHASSEE, FLORIDA 32399-2100

FLORIDA KEYS AREA OF CRITICAL STATE CONCERN
FIELD OFFICE
2796 Overseas Highway, Suite 212
Marathon, Florida 33050-2227

SOUTH FLORIDA RECOVERY OFFICE
P.O. Box 4022
8600 N.W. 36th Street
Miami, Florida 33159-4022

GREEN SWAMP AREA OF CRITICAL STATE CONCERN
FIELD OFFICE
155 East Summerlin
Bartow, Florida 33830-4641

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

March 5, 1996

Mr. A. J. Salem
Chief, Planning Division
DOA, Jacksonvile District,
Corps Of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

Enclosed are comments on the Draft Environmental Impact Statement for Palm Beach County, Florida, Shore Protection Project, Ocean Ridge Segment. We hope our comments will assist you. Thank you for giving us an opportunity to review this document.

Sincerely,

Donna S. Wieting
Acting Director
Ecology and Conservation Office

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9721 Executive Center Drive N.
St. Petersburg, Florida 33702

February 29, 1996

Mr. A.J. Salem
Chief, Planning Division
Department of the Army, Corps of Engineers
Environmental Branch
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

The National Marine Fisheries Service (NMFS) has reviewed the Draft Supplemental Environmental Impact Statement (DSEIS) for the Ocean Ridge Segment of the Shore Protection Project, Palm Beach, Florida. The project involves placing about 784,300 cubic yards of material over 1.42 miles of shoreline and constructing five T-head groins in the northern 1,680 feet of the project area.

The shore protection project would adversely impact 6.4 acres of near shore hard bottom habitat for a period greater than a year and adversely impact an additional 2.9 acres of near shore hard bottom habitat for less than a year. These impact estimates are the most conservative presented in the DSEIS. Two different mitigation ratios are proposed to offset long-term hard bottom habitat impacts (greater than one year) and short-term hard bottom habitat impacts (less than one year). Long term impacts would be mitigated at a ratio of 0.5 acre created to 1 acre impacted and short term impacts would be mitigated at ratio of 0.1 acre created to 1 acre impacted. All created hard bottom habitats would be roughly twice the vertical relief of the present hard bottom habitat. All mitigation construction would begin after the project is completed so that the actual impacts could be determined. Once the actual impacts are determined, the correct mitigation acreage will be calculated.

The DSEIS mitigation plan reflects for the most part the recommendations of the Fish and Wildlife Coordination Act Report (FWCAR). The mitigation recommendations in the FWCAR are conservative and agreeable to the NMFS. We recommend that all of the reef mitigation recommendations proposed by the FWCAR be adopted by the Corps of Engineers. However, we recommend that the mitigation ratio of short term impacts in the DSEIS mitigation plan be increased to that of long term impacts; i.e., 0.5 acre creation to 1 acre of impact.

Printed on Recycled Paper

Benthic communities may eventually recover in hard bottom areas identified as short-term impact, but this recovery is likely to take much longer than one year. It is unlikely that the biomass lost on hard bottom outcrops will replace itself within a year. Consequently, a reduced benthic biomass would decrease fishery productivity due to a loss of foraging opportunities. Therefore, we suggest that a simple .5 to 1 mitigation ratio be applied for all nearshore hard bottom impacts.

If you have any questions regarding these comments, please contact Mr. John W. Iliff of our Miami Field Office at 305/595-8352.

Sincerely,

Andreas Mager, Jr.
Assistant Regional Director
Habitat Conservation Division

STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS

EMERGENCY MANAGEMENT • HOUSING AND COMMUNITY DEVELOPMENT • RESOURCE PLANNING AND MANAGEMENT

LAWTON CHILES
Governor

JAMES F. MURLEY
Secretary

March 7, 1996

Mr. A. J. Salem
Department Of The Army
Jacksonville District Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

RE: Beach Erosion Control Projects - Draft Supplement to the Environmental Impact Statement for the Shore Protection Project, Ocean Ridge Segment - Palm Beach County, Florida
SAI: FL9601190039C

Dear Mr. Salem:

The Florida State Clearinghouse, pursuant to Gubernatorial Executive Order 95-359, the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended, and the National Environmental Policy Act, 42 U.S.C. §§ 4321, 4331-4335, 4341-4347, as amended, has coordinated a review of the above-referenced project.

The Department of State (DOS) indicates that two magnetic anomalies exist within the project borrow areas. If the recommended 200-foot buffer areas are maintained around the anomalies, the DOS will be satisfied that historic preservation concerns have been adequately addressed. Please refer to the enclosed DOS comments.

Based on the information contained in the above-referenced document and the enclosed comments provided by our reviewing agencies, the state has determined that the above-referenced project is consistent with the Florida Coastal Management Program.

Thank you for the opportunity to review this project. If you have any questions regarding this letter, please contact Ms. Keri Akers, Clearinghouse Coordinator, or Ms. Jasmin Raffington, Florida Coastal Management Program, at (904) 922-5438.

Sincerely,

Ralph Cantral, Executive Director
Florida Coastal Management Program

RC/cc
Enclosures
cc: George W. Percy, Department of State

FLORIDA DEPARTMENT OF STATE
Sandra B. Mortham
Secretary of State

DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough Street
Tallahassee, Florida 32399-0250

Director's Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

RECEIVED
JAN 30 1996
State of Florida Clearinghouse

January 25, 1996

Ms. Keri Akers
State Clearinghouse
Department of Community Affairs
2740 Centerview Drive
Tallahassee, Florida 32399-2100

In Reply Refer To:
Frank J. Keel
Historic Sites Specialist
(904) 487-2333
Project File No. 960247

RE: Cultural Resource Assessment Request
SAI# FL9601190039C
Shore Protection Project, Palm Beach county, Florida, From Martin County Line to Lake Worth Inlet and From South Lake worth Inlet to Broward County Line, Ocean Ridge Segment
Palm Beach County, Florida

Dear Ms. Akers:

In accordance with the provisions of Florida's Coastal Zone Management Act and Chapter 267, *Florida Statutes*, as well as the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the referenced project(s) for possible impact to historic properties listed, or eligible for listing, in the *National Register of Historic Places*, or otherwise of historical or architectural value.

After review of the referenced document and our records, we note that the project borrow areas were surveyed for historic properties in 1993. Two magnetic anomalies were identified during the survey. We note that the recommended 200' buffers areas around the anomalies will be maintained. Therefore. it is the opinion of this agency that the historic preservation concerns of this office have been adequately addressed. The project is also consistent with the historic preservation laws of Florida's Coastal Management Program.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

Laura A. Kammerer

for George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Kfk
xc: Jasmin Raffington, FCMP-DCA

COUNTY: Palm Beach

DATE: 01/19/96
COMMENT DUE DATE: 02/02/96
CLEARANCE DUE DATE: 03/04/96
SAI#: FL9601190039C

STATE AGENCIES	LOCAL/OTHER	OPB POLICY UNITS
__ Community Affairs X Environmental Protection __ Game and Fresh Water Fish Comm __ Marine Fisheries Commission __ State __ Transportation	__ South Florida WMD	__ Environmental Policy/C & ED

JAN 1996 Office of Intergovernmental Programs

RECEIVED FEB 27 1996 State of Florida Clearinghouse

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evalutation and is categorized as one of the following:

__ Federal Assistance to State or Local Government (15 CFR 930, Subpart F). Agencies are required to evaluate the consistency of the activity.

_X_ Direct Federal Activity (15 CFR 930, Subpart C). Federal Agencies are required to furnish a consistency determination for the State's concurrence or objection.

__ Outer Continental Shelf Exploration, Development or Production Activities (15 CFR 930, Subpart E). Operators are required to provide a consistency certification for state concurrence/objection.

__ Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.

Project Description:

Draft Supplement to the Environmental Impact Statement for the Shore Protection Project, Ocean Ridge Segment - Palm Beach County, Florida.

To: Florida State Clearinghouse
Department of Community Affairs
2740 Centerview Drive
Tallahassee, FL 32399-2100
(904) 922-5438 (SC 292-5438)
(904) 487-2899 (FAX)

EO. 12372/NEPA

- [x] No Comment
- [ ] Comments Attached
- [ ] Not Applicable

Federal Consistency

- [ ] No Comment/Consistent
- [ ] Consistent/Comments Attached
- [ ] Inconsistent/Comments Attached
- [ ] Not Applicable

Note: Intent to issue permit issued in December 1995.

From:
Division/Bureau: DEP/OIP
Reviewer: [signature]

FROM: aaa TO: 904 414 0479 FEB 26, 1996 11:33AM P.06

COUNTY: Palm Beach / Egl

NA JGW 1/30/96

DATE: 01/19/96
COMMENT DUE DATE: 02/02/96
CLEARANCE DUE DATE: 03/04/96
SAI#: FL9601190039C

STATE AGENCIES	LOCAL/OTHER	OPB POLICY UNITS
__ Community Affairs __ Environmental Protection X Game and Fresh Water Fish Comm __ Marine Fisheries Commission __ State __ Transportation	__ South Florida WMD RECEIVED FEB 26 1996 State of Florida Clearinghouse	__ Environmental Policy/C & ED RECEIVED BY GFC JAN 23 1996 OFFICE OF ENVIRONMENTAL SERVICES

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Project Description:

Draft Supplement to the Environmental Impact Statement for the Shore Protection Project, Ocean Ridge Segment - Palm Beach County, Florida.

To: Florida State Clearinghouse
Department of Community Affairs
2740 Centerview Drive
Tallahassee, FL 32399-2100
(904) 922-5438 (SC 292-5438)
(904) 487-2899 (FAX)

EO. 12372/NEPA

- ☐ No Comment
- ☐ Comments Attached
- ☐ Not Applicable

Federal Consistency

- ☒ No Comment/Consistent
- ☐ Consistent/Comments Attached
- ☐ Inconsistent/Comments Attached
- ☐ Not Applicable

From:
Division/Bureau: FGFWFC / Environmental Services
Reviewer: J. Wamble
Date: 1/30/96

RECEIVED JAN 26 1996

COUNTY: Palm Beach

DATE: 01/19/96
COMMENT DUE DATE: 02/02/96
CLEARANCE DUE DATE: 03/04/96
SAI#: FL9601190039

STATE AGENCIES	LOCAL/OTHER	OPB POLICY UNITS
__ Community Affairs __ Environmental Protection __ Game and Fresh Water Fish Comm X Marine Fisheries Commission __ State __ Transportation	__ South Florida WMD	__ Environmental Policy/C & ED

RECEIVED
JAN 24 1996
MARINE FISHERIES COMMISSION

RECEIVED
JAN 31 1996
State of Florida Clearinghouse

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Project Description:

Draft Supplement to the Environmental Impact Statement for the Shore Protection Project, Ocean Ridge Segment - Palm Beach County, Florida.

To: **Florida State Clearinghouse**
Department of Community Affairs
2740 Centerview Drive
Tallahassee, FL 32399-2100
(904) 922-5438 (SC 292-5438)
(904) 487-2899 (FAX)

EO. 12372/NEPA	Federal Consistency
☐ No Comment	☐ No Comment/Consistent
☐ Comments Attached	☐ Consistent/Comments Attached
☐ Not Applicable	☐ Inconsistent/Comments Attached
	☒ Not Applicable

From:
MARINE FISHERIES COMMISSION
2540 EXECUTIVE CENTER CIRCLE WEST
SUITE 106
TALLAHASSEE, FLORIDA 32301

Division/Bureau: _____

Reviewer: _____

COUNTY: Palm Beach

DATE: 01/19/96
COMMENT DUE DATE: 02/02/96
CLEARANCE DUE DATE: 03/04/96
SAI#: FL960119003

STATE AGENCIES	LOCAL/OTHER	OPB POLICY UNITS
__ Community Affairs __ Environmental Protection __ Game and Fresh Water Fish Comm __ Marine Fisheries Commission __ State X Transportation	__ South Florida WMD RECEIVED JAN 23 1996 CENTRAL OFFICE FDOT ICAR COORDINATOR	__ Environmental Policy/C & ED RECEIVED FEB 05 1996 State of Florida Clearinghouse

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Project Description:

Draft Supplement to the Environmental Impact Statement for the Shore Protection Project, Ocean Ridge Segment - Palm Beach County, Florida.

To: Florida State Clearinghouse
Department of Community Affairs
2740 Centerview Drive
Tallahassee, FL 32399-2100
(904) 922-5438 (SC 292-5438)
(904) 487-2899 (FAX)

EO. 12372/NEPA	Federal Consistency
☑ No Comment	☑ No Comment/Consistent
☐ Comments Attached	☐ Consistent/Comments Attached
☐ Not Applicable	☐ Inconsistent/Comments Attached
	☐ Not Applicable

From:
Division/Bureau: FDOT - D4 - Planning
Reviewer: John W. Anderson Jr.
Date: 1/29/96

APPENDIX Z

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 525-010-20
STATE TRANSPORTATION PLANNER
04/95

INTERGOVERNMENTAL COORDINATION AND REVIEW ROUTING SHEET

RECEIVED
JAN 25 1996
4th DISTRICT
Director of Planning & Programs

DATE: 01/23/96

TO: Norm Feder, (D1) Ft. Myers Urban Office; Aage Schroder, D2; Marvin Stuckey, D3; Joe Yesbeck, D4; Carolyn Zeller, (D5) Orlando Urban Office; Servando Parapar, D6; David Twiddy, D7; Leroy Irwin, MS37; Rob Hebert, MS25; Ashbaker, MS46.

SAI#: FL 9601190039C

Application Description: Ocean Ridge Env. Impact

Date Response Due to Clearinghouse: 02/02/96

Please review and comment regarding the attached application in accordance with Department Procedure 525-010-205. A letter of response to the Director of the Clearinghouse and this routing sheet should be completed and returned as directed in the procedure.

The following criteria, as appropriate to the project, should be used to evaluate the application and develop your comments:

- Florida Transportation Plan
- Adopted Work Program
- Transportation Improvement Plan (TIP)
- Right of Way Preservation and Advanced Acquisition
- Transit Development Program
- MPO Comprehensive Transportation Plan and 20 year Transportation Plan
- Florida Rail System Plan
- Florida Aviation System Plan
- Local Airport Master Plan
- Florida Seaport Mission Plan
- Environment Commitments
- Unified Planning Work Program
- Level of Service
- Access Management

If comments are warranted based on other criteria, they should be included.

Work Program Item Number: NA (if applicable).

Ronnice Freeman
Central Office ICAR Coordinator, MS28

Type: GENERAL AVIATION
RAIL SEAPORTS ENVIRONMENT
TRANSIT

OUNTY: Palm Beach

DATE: 01/19/96
COMMENT DUE DATE: 02/02/96
CLEARANCE DUE DATE: 03/04/96
SAI#: FL9601190039C

STATE AGENCIES	LOCAL/OTHER	OPB POLICY UNITS
__ Community Affairs __ Environmental Protection __ Game and Fresh Water Fish Comm __ Marine Fisheries Commission __ State __ Transportation	X South Florida WMD	__ Environmental Policy/C & ED

RECEIVED
FEB 01 1996
State of Florida Clearinghouse

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Project Description:

Draft Supplement to the Environmental Impact Statement for the Shore Protection Project, Ocean Ridge Segment - Palm Beach County, Florida.

To: Florida State Clearinghouse
Department of Community Affairs
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Tallahassee, FL 32399-2100
(904) 922-5438 (SC 292-5438)
(904) 487-2899 (FAX)

EO. 12372/NEPA

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- [ ] Comments Attached
- [ ] Not Applicable

Federal Consistency

- [x] No Comment/Consistent
- [ ] Consistent/Comments Attached
- [ ] Inconsistent/Comments Attached
- [ ] Not Applicable

rom:

Division/Bureau: Comprehensive Planning

COUNTY: Palm Beach

DATE: 01/19/96
COMMENT DUE DATE: 02/02/96
CLEARANCE DUE DATE: 03/04/96
SAI#: FL9601190039C

STATE AGENCIES	LOCAL/OTHER	OPB POLICY UNITS
__ Community Affairs __ Environmental Protection __ Game and Fresh Water Fish Comm __ Marine Fisheries Commission __ State __ Transportation	__ South Florida WMD	X Environmental Policy/C & ED RECEIVED MAR 01 1996 State of Florida Clearinghouse

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Project Description:

Draft Supplement to the Environmental Impact Statement for the Shore Protection Project, Ocean Ridge Segment - Palm Beach County, Florida.

To: Florida State Clearinghouse
Department of Community Affairs
2740 Centerview Drive
Tallahassee, FL 32399-2100
(904) 922-5438 (SC 292-5438)
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EO. 12372/NEPA	Federal Consistency
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☐ Comments Attached	☐ Consistent/Comments Attached
☐ Not Applicable	☐ Inconsistent/Comments Attached
	☐ Not Applicable

From:
Division/Bureau: OPB/ENV.
Reviewer: [signature]
Date: 2/29/96

TOWN OF MANALAPAN
PALM BEACH COUNTY
600 SOUTH OCEAN BOULEVARD
MANALAPAN, FLORIDA 33462-3321
Telephone (407) 585-9477
Fax 407-585-9498

March 14, 1996

Department of the Army
Jacksonville District Corps of Engineers
P. O. Box 4970
Jacksonville, Florida 32232-0019

Attention:
Planning Division
Environmental Branch
Michael Dupes

Re: EIS No. 960024, DRAFT SUPPLEMENT, COE, FL

To Whom It May Concern:

The Town of Manalapan has reviewed the EIS No. 960024, Draft Supplement and will submit the following comments.

The Town did submit comments and objections to the project as proposed on December 30, 1993 which it would appear have not been addressed.

The Town's major objection to the project is the disregard of the negative impacts on the beach in Manalapan due to the sand transfer plants' present sand pick up location and the arbitrary cubic yards of sand required to be transferred from the north side of the inlet to the south side of the inlet, regardless of the actual amount of sand in the southerly drift at the time of transfer. The Town did submit a modification to the sand transfer plan that would resolve this objection.

Conditions have not changed since the Town's response on December 30, 1993. Therefore, the Town has attached as our comments and objections, a copy of our December 30, 1993 submittal for your consideration.

Sincerely,

G. Kent Shortz, M. D.
Mayor

TOWN OF MANALAPAN
PALM BEACH COUNTY
600 SOUTH OCEAN BOULEVARD
MANALAPAN, FLORIDA 33462-3321
Telephone (407) 585-9477
Fax 407-585-9498

December 30, 1993

Department of the Army
Jacksonville District Corps of Engineers
Planning Division
Environmental Branch
P.O. Box 4970
Jacksonville, Florida 32232-0019

To Whom It May Concern:

Subject: Your letter dated December 7, 1993, Ocean Ridge segment of the Palm Beach County Shore Protection Project.

For your consideration and review, the Town of Manalapan is submitting our comments, objections and recommendations to the Ocean Ridge Project.

The Town of Manalapan lies to the north of the South Lake Worth Inlet and extends north for approximately three (3) mile along the Atlantic Ocean. The beaches in Manalapan are extensively eroded due to the interruption of the southerly flow of sand by the Lake Worth Inlet to the north, interruption of the northerly flow of sand by the South Lake Worth Inlet to the south, and the sand transfer pump located on the north side of the South Lake Worth Inlet. Therefore, the Town's beaches are greatly affected by any changes or adjustments to the coastline either by natural events or manmade alterations.

The Town has attached a memorandum that contains objections to the project as planned, historical information that must be considered and recommendations for modifications to the project, that if incorporated, would relieve the objections by the Town.

Should the Corps determine not to implement the Town of Manalapan's revisions to the project, we may desire that the Corps hold public hearings on the project.

Should you need additional information please contact Charles H. Helm, Town Manager, at 407-585-9477.

Sincerely,

G. Kent Shortz, M.D.
Mayor

enclosures

cc: Mr. Richard Walesky, P.B.C.D.E.R.M.
Honorable Daniel O'Connell, Mayor, Town of Ocean Ridge

December 28,1993

MEMORANDUM TO: File
FROM: C. H. Helm, Town Manager
SUBJECT: Staff Report - Ocean Ridge Beach Renourishment Project

Town of Manalapan strongly objects to the work, as proposed in Ocean Ridge, as described in US Corps of Engineers Permit Application No. 199301676(IP-RP) and the State of Florida Department of Environmental Protection File Number DBS9A0330 for the following reasons.

1. A court order, now on appeal, could increase the demands for additional sand to be pumped from Manalapan's beaches until the sand lost north of the inlet equals that lost south of the inlet. Which simply means, the beaches to the north will be penalized for all inlet and excessive beach fill losses south of the inlet.

2. Past over pumping has severely eroded a large section of the Manalapan's shore line and is continuing to do so because of the inshore pump location and removal of sand below the normal bottom profile, leaving the north beach severely pumped out. Much of the north shoreline has little beach sand left east of the sea wall and the seaward bottom is largely bare rock for about 400 feet out. This leaves little to be lost except the small remaining bit of sand at the sea wall.

3. The requested Permit application work involves adding 700,000 cu yds of sand to the north section of the beach south of the inlet, greatly increasing the width of an artificially filled and bulkheaded beach already well east of the historical shore line (Fig. 1), which coupled with the shadow of the inlet, will substantially increase the already severe erosion rate in spite of the groins and other works contemplated. This will cause large losses in Ocean Ridge and an unwarranted call for sand from the north (Manalapan).

4. An extension to the south jetty which was designed and approved, but never funded or constructed, is essential to control the present strong flood current that now enters the inlet in a northerly direction around the end of the short south jetty after scouring the beach to the south and carrying large quantities of sand into the inlet where substantial loss occurs. This loss increases demand for sand from the north (Manalapan).

5. No means is provided to prevent the <u>total</u> of the naturally by-passed and the pumped sand from exceeding the sand arriving by normal drift into Manalapan.

6. No provision is made to frequently pump the small, shallow sand trap inside the Inlet on a regular basis to prevent over filling and the run over loss of sand that is difficult if not impossible to recover.

BASIS FOR POSITION TAKEN

The South Lake Worth Inlet was completed in 1927. Erosion south of the inlet started and in 1929/30 the McCormack sea wall with 8 groins was constructed along the MHW line from approximately 900 feet south of the inlet to a point 3195 feet south of the inlet. In April 1937, a 6" pump and 65 hp engine was installed on the north jetty which pumped 252,000 cu yds of sand through 1941; covering the groins and filling the beach nearly to the top of the sea wall (14' MSL); clearly heavy overpumping did occur. The pumping commenced again in 1945 and transferred an estimated 70,000 cu yds/yr; it was rebuilt in 1947 with an 8" pump and 250 hp engine promoting increased sand transfer. Again in 1952 a system upgrade included a 300 hp engine.

The plant was rebuilt again in 1967 with a 10" pump, a 400 hp engine and the suction boom length was doubled.

Pumping reached a peak in 1963 when 206,822 cu yds were transferred. 3000 feet of shoreline north of the inlet steadily eroded, and by 1963, the 14 year old CBS Tupper ocean front home had gradually fallen into the ocean along with a frame cottage next door, as well as several smaller structures near by. In 1964 & 1966 a crash sea wall program had to be undertaken to prevent the loss of expensive ocean front homes that had been built well back from the dune crest. This seawall program had to be extended to the north Town limits in 1981/83 and represented a cost of over $5,000,000 in 1987 dollars. The effect of the sand pump is quite obvious from Fig. 2, which was constructed from the DNR digitized data.

The bulk of the littoral drifts occur where the combination of wave turbulence and current flow are maximum. In this coastal area, this occurs from 150 to 300 feet offshore. Since the current flow cannot go through the jetty it goes around the end carrying the littoral drift with it not 300 feet landward where the pump is now located. The beach drift reaching the pump has been determined to be in the order of only 25,000 cu yds per year, the balance is mined mostly off the beaches to the north (Manalapan).

The drift passes around the end of the north jetty and does not return to the shore line via the transfer bar for a distance of some 4000 to 5000 feet south of the inlet. During flood tide a substantial portion of the drift goes in the inlet, especially with a north drift: a part of which settles in the inside sand trap; a part enters and shoals the intercoastal canal and surrounding area; and the rest is swept out during ebb tide but joins that sand carried south by the transfer bar so that the first 4000 feet of shoreline south of the inlet will be naturally deficient in littoral drift. Sand movement in the area of the channel is significantly influenced by the heavy high powered boat traffic.

The area 900 feet south of the inlet for a distance of 3500 feet has been built out with fill over 100' east of the normal shore line of 1926 and protected by a new seawall (Fig.3). An extra ordinarily large fill of 655,000 cu yds in 1962/64, included 478,024 cu yds pumped from Manalapan. The erosion rate is enormous as would be expected with this large intrusion into the ocean. Prior to this intrusion the sand pump built and maintained a growing shore line. After this fill, little or no beach could be maintained in front of the new, more seaward, seawall in spite of continued pumping.

Repeated renourishment of this area (from the inside shoal sand trap) has occurred many times in the recent past, 1961, 62, 63, 65, 67, 68, 69, 73. Most recently in 1989, about a thousand feet of beach was renourished with 34,000 cu ft. of sand only to be lost in 6 months despite sand pump operation. Over the years renourishment from the flood shoal has amounted to 510,000 cu yds, while pumping sand from the Manalapan beach has added 3,870,300 cu yds. Clearly, a beach, in the inlet shadow and built out into the ocean can not be maintained without offshore devices to correct the extreme losses. The present sand pump is some 300 feet west of the principal path of the major natural sand transfer around the end of the north jetty. If a sand transfer pump is used, it should be located as near to the end of the north jetty as possible where heavy seas carry sand from the normal drift path and around the end of the jetty. Frequently in heavy weather, sand is carried to this location through and over the jetty to lay down a sand bar inside the jetty approximately 100

feet long and 25 feet wide up to MLW, often staying for days until a shift in wind and seas carries it into the Inlet.

While the long North jetty at the inlet has backed up sand some 4000 feet to the north in the past 65 years, heavy recession has occurred from that point north mandating use of sea walls to protect the dune from being pumped away. This loss attributed to the sand pump operation was confirmed by an in-depth computer model study by the US Corps of Army Engineers in a similar proposed sand pump installation, in which it was determined that a sand pump would unacceptably damage the beach to the north (Fig. 4). Another serious loss in Manalapan occurs during the approximately 30% of the time during northerly drift when the north curved jetty and short south jetty causes the drift to be directed into the inlet during flood tide.

While we are of the opinion that the problem in Ocean Ridge was caused largely by the decision to bulkhead an unusually large transfer of sand together with a surprisingly large dredging operation in the channel and surrounding lake, many large buildings are now on that fill and it could be impractical to remove them and restore the normal shore line that could be easily maintained. For this reason we endorse the beach renourishment and the use of proper offshore devices to reduce the erosion only if the following steps are taken to develop a situation that eliminates the damage to the beaches north of the Inlet (Manalapan).

A. Move the pump suction to a sand containment pit as depicted in Fig. 5. This is similar to an arrangement at Boca Raton Inlet where a weir at MLW, near the end of the jetty, allows drifting sand to spill into the inlet channel where it is pumped by a floating dredge to the near south shore. While the north shore line has receded to the weir location, erosion has been greatly reduced in the shadow zone just south of the inlet and updrift damage is minimal.

Also at the Hillsboro Inlet a rock formation forms a north jetty quite similar to the SLWI and a natural weir near the end allows sand to spill into pockets near the channel where a small floating dredge transfers the sand accumulation to the immediate south shore. This arrangement also has worked well over the years to reduce the south shore erosion.

Both of these systems have the advantage of picking up the small beach drift, and a portion of the natural drift, which occurs just seaward of the end of the north jetty, some of which is carried behind the end of the jetty in heavy seas - a condition that can't occur at SLWI because the pump is located so far landward from the end of the jetty.

B. Complete the south jetty, this will reduce the strong currents that run along the south shoreline and scour the beach area, and it may improve the flood currents somewhat to reduce the loss of northerly drift to Manalapan as well as the loss of sand into the inlet.

C. Construct a breakwater and groins such as in the permit application, or alternatively, a continuous perched beach breakwater from the south jetty extension to a point about 3000 feet south to contain a beach in water too deep to otherwise support the sand. Renourish the beach.

D. Provide a small floating dredge with semi-permanent discharge lines to keep the inside sand trap always pumped out to avoid overflow losses.

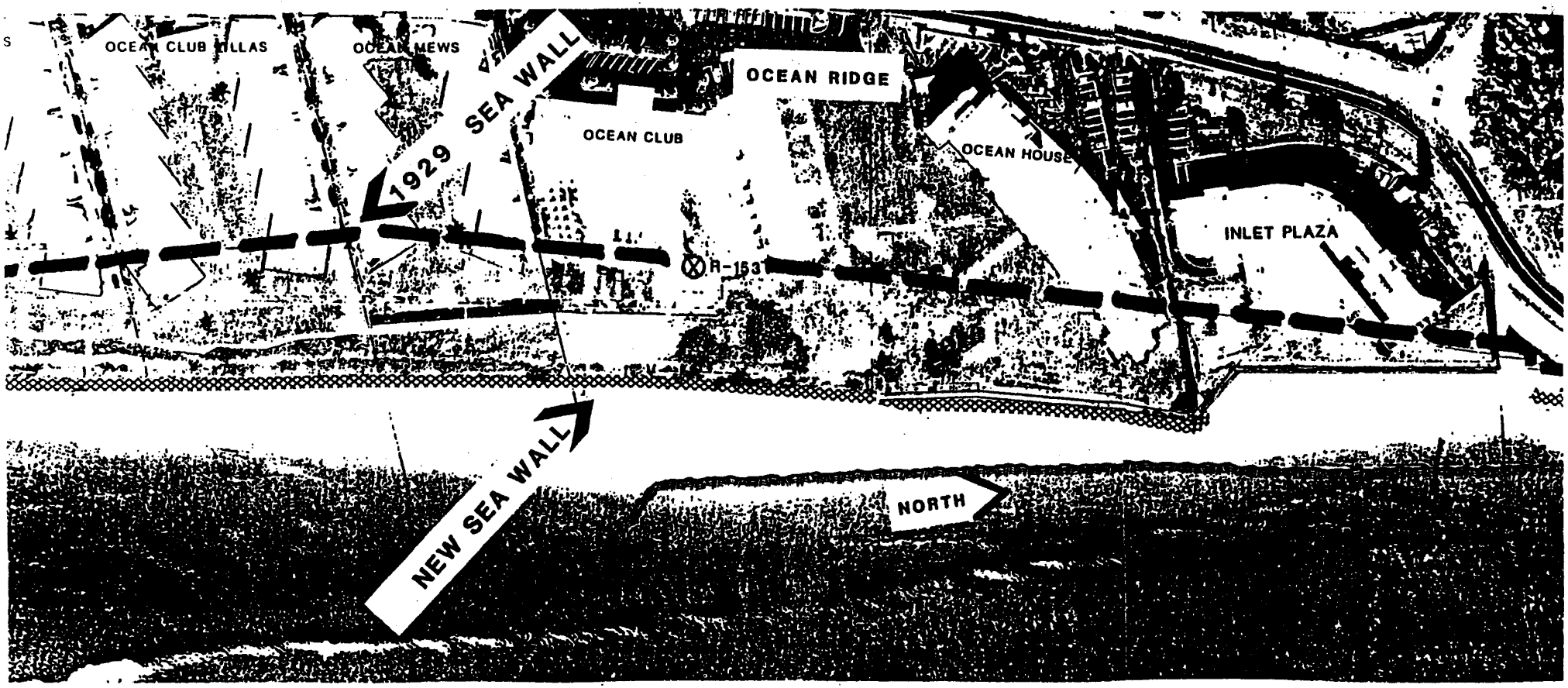
OCEAN CLUB VILLAS
OCEAN MEWS
1929 SEA WALL
OCEAN RIDGE
OCEAN CLUB
OCEAN HOUSE
INLET PLAZA
R-153
NEW SEA WALL
NORTH

Fig. 1

S. .D VOLUME CHANGES 1883-198
Based on 1 sq. ft. beach area = 1 Cu. Yrd.
All data taken from "DNR HISTORICAL SHORE LINE DATA FOR PALM BEACH COUNTY" 2-13-90

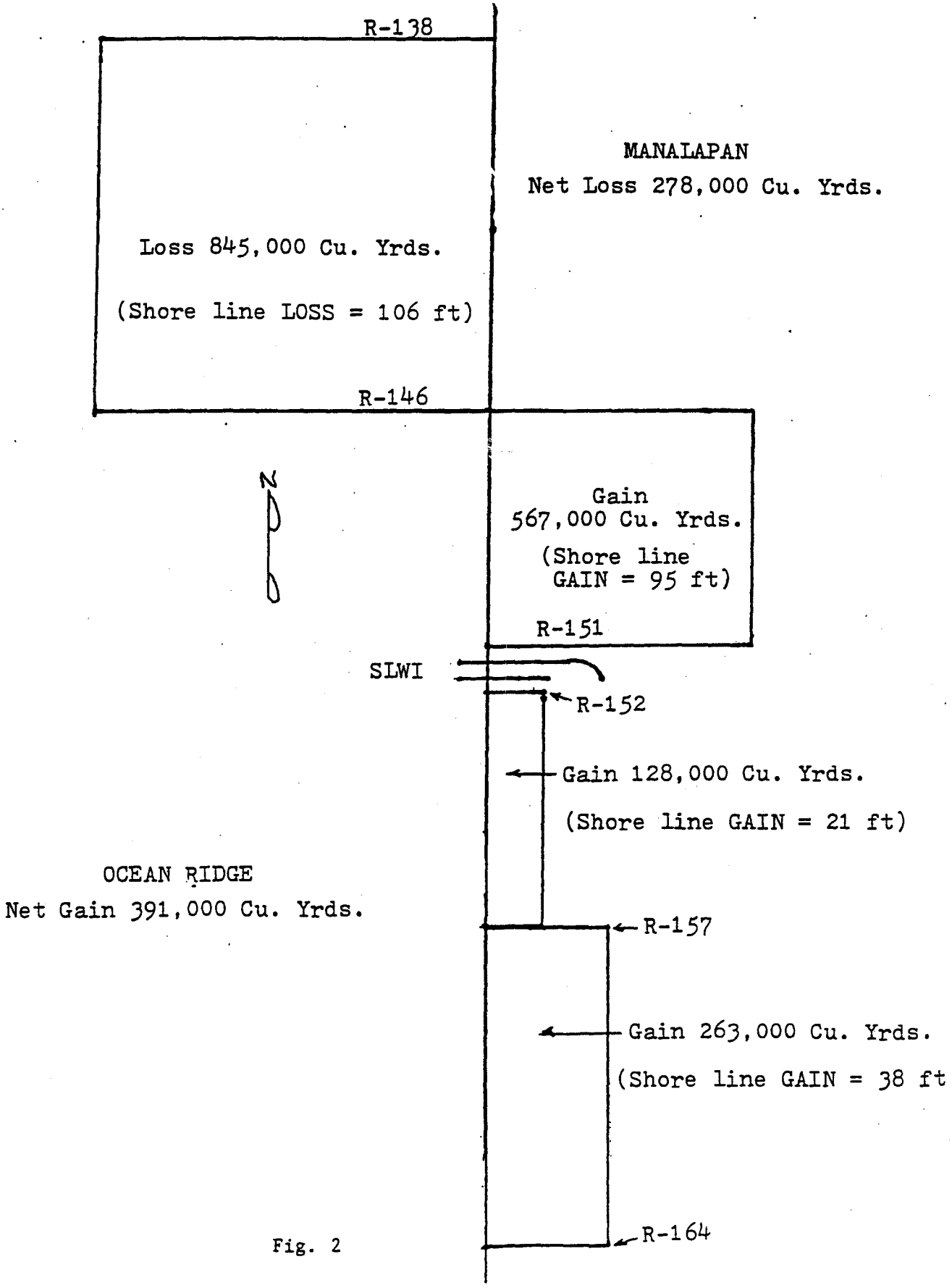

Fig. 2

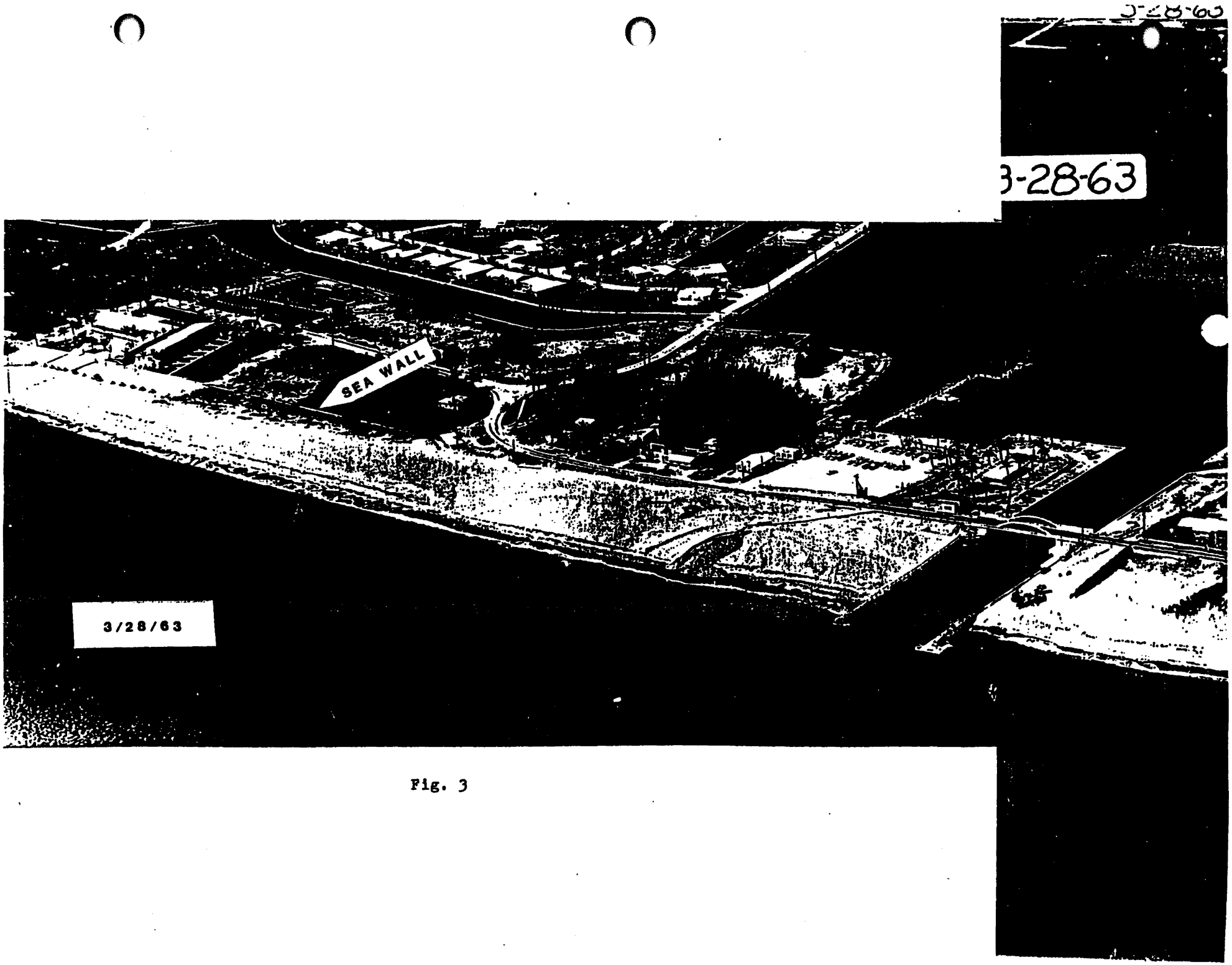

Fig. 3

ENGINEERING APPLICATION
GENERALIZED MODEL FOR SIMULATING SHORELINE CHANGE
CANAVERAL HARBOR, FLORIDA

Ed Hodgens, P.E.
U.S. Army Corps of Engineers
Jacksonville District

ABSTRACT

This paper focuses on the use of the computer model GENESIS (Generalized model for Simulating Shoreline change) for evaluation of coastal processes in a highly active area of shoreline where little hard physical field data is available.

Coastal inlets have historically contributed to shoreline erosion and the navigation channel at Canaveral Harbor, Florida, may be responsible for a significant portion of the erosion of the beaches south of the inlet. In 1962, Congress authorized the construction of a sand bypass system to transfer littoral material around the harbor to mitigate erosion losses and reduce navigation maintenance.

A General Design Memorandum (GDM) was prepared in 1989 to address the mitigation of the effects of the port on down-drift erosion. The recommended plan included the construction of a fixed shore-based sand bypass system located north of the north jetty with the capability to bypass 106,000 cubic yards to the south beaches annually. Detailed design was subsequently initiated to determine the most effective location for the bypass system. However, there is extremely limited data upon which to base a detailed coastal engineering analysis of the anticipated sediment budgets by location. Also, the cape and offshore shoals create complex wave patterns along the immediate coast which makes simplified long, sandy coast evaluations inaccurate. It was decided to model the shoreline response to bypassing by using the GENESIS numerical model.

Initial modeling indicated that the recommended GDM plan would have adverse impacts on the beaches north of the inlet. The model was then used to evaluate two alternative methods of bypassing which included a movable shore-based jet pump system and conventional dredging of a nearshore borrow area.

Presented 2-11-93 at the Florida Shore and Beach Convention at St. Petersburg, Florida.

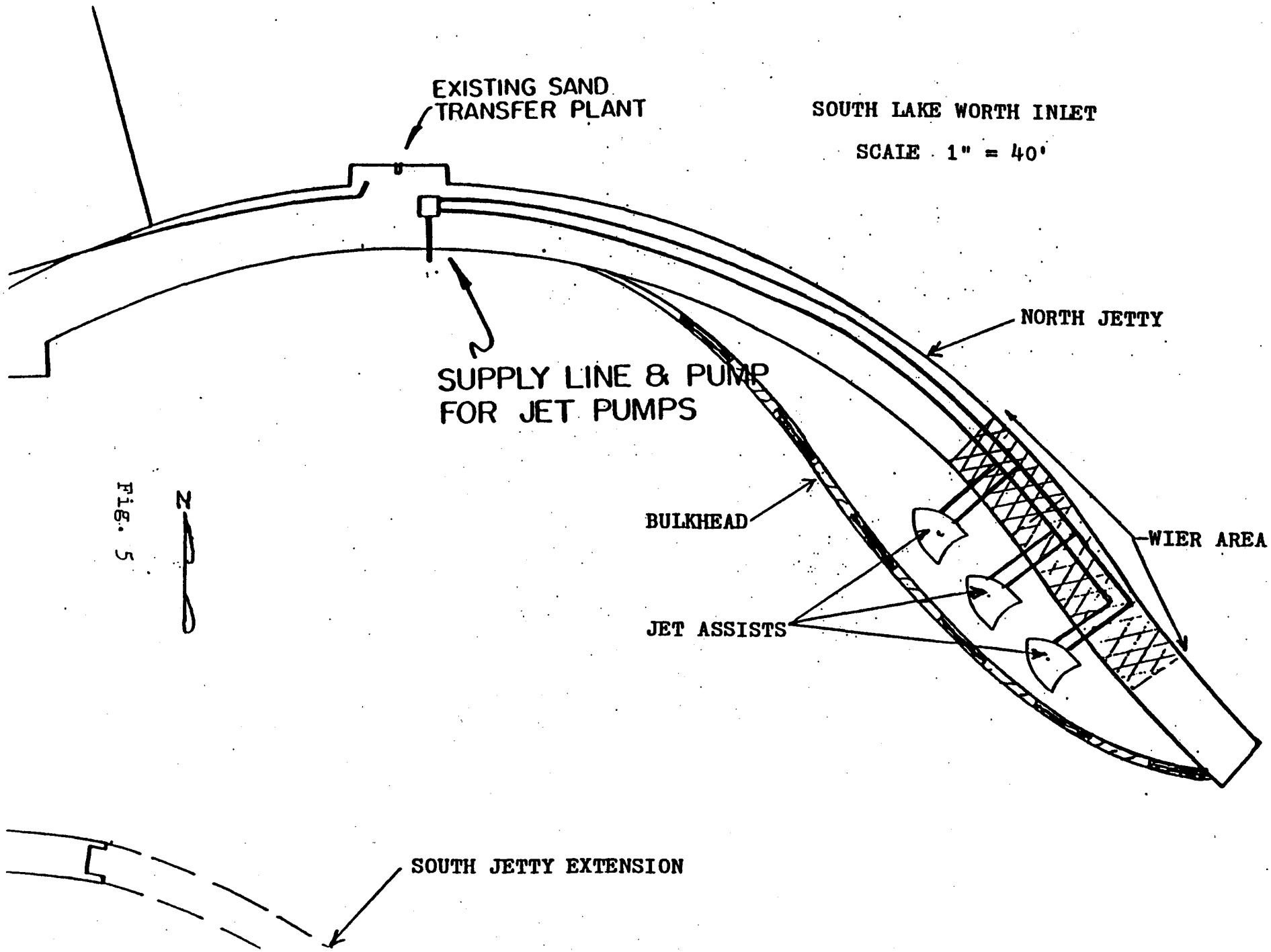
EXISTING SAND TRANSFER PLANT
SOUTH LAKE WORTH INLET
SCALE 1" = 40'
NORTH JETTY
SUPPLY LINE & PUMP FOR JET PUMPS
BULKHEAD
WIER AREA
JET ASSISTS
N
SOUTH JETTY EXTENSION

Fig. 5

SOUTH LAKE WORTH INLET DISTRICT
PALM BEACH COUNTY, FLORIDA
Post Office Box 3465, Lantana, Florida 33465
Tel: 407/969-9824 Fax: 407/969-9824

Board of Commissioners:

Aubrey K. Ewing, Chairman, Boynton Beach
George R. Frost, Vice Chairman, West Palm Beach
Thelma E. Moore, Secretary/Treasurer, West Palm Beach
David W. Geller, Lantana
Kenneth Hall, Boynton Beach
Edwin H. Shepherd, Lake Worth

Dorothy A. Lindros, Executive Secretary
James McCartney Wearn, P.A., Attorney
John S. Yeend, P.E., District Engineer (G&J)

March 16, 1996

FEDERAL EXPRESS

A. J. Salem, Chief
Planning Division
Environmental Branch
Jacksonville District Corps of Engineers
Department of the Army
400 West Bay Street
Jacksonville, FL 32202-4412

Re: Draft Supplement to the Environmental Impact Statement (DSEIS) for the Palm Beach County, Florida Shore Protection Project, Ocean Ridge Segment

Request for Extension

Dear Mr. Salem:

By and through its undersigned counsel, the South Lake Worth Inlet District (District) hereby respectfully requests an extension of time within which to provide comments on the referenced Draft Supplement. By this request, the District is seeking an extension through and including May 31, 1996. As good cause for this request, the District states:

1. The DSEIS is a basis for the Florida Department of Environmental Protection (FDEP) notice for Coastal Construction Permit No. DBS9A03330 PB. In order to negotiate and resolve District concerns over the Project, including the DSEIS and said Permit, the District has requested an extension of time to address the Permit. See January 5, 1996 and February 29, 1996 Requests for Extension, copies attached as Exhibits A1 and A2.

2. The Project, based on the DSEIS, is also a part of settlement discussions, by reason of which pending litigation and State of Florida administrative proceedings have been extended as follows:

A. The DOAH Hearing Officer in DOAH Case No. 88-0909 has extended the stay of that case until May 31, 1996 for the parties to continue settlement negotiations.

B. The Circuit Judge in the Fifteenth Judicial Circuit Court Case No. CL 87-2242 AD, on the Motion of Plaintiff Ocean Ridge (agreed to by all the defendants: District, Palm Beach County, Manalapan and certain Manalapan residents), has continued pending matters to June 4, 1996, again for the parties to continue settlement negotiations.

3. Since January 18, 1996, numerous settlement conferences have been conducted and settlement is being reviewed and negotiated by and among all these parties at this time.

4. Preliminary notes and comments are attached Exhibit B.

WHEREFORE, the South Lake Worth Inlet District respectfully requests that the time within which to file comments be extended through and including May 31, 1996, or, if this request is denied, 15 days after the notice of such denial.

Very truly yours,

James McC. Wearn
JMcCW:jz
Enclosures

HOPPING GREEN SAMS & SMITH
PROFESSIONAL ASSOCIATION
ATTORNEYS AND COUNSELORS
123 SOUTH CALHOUN STREET
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TALLAHASSEE, FLORIDA 32314
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LISA K. RUSHTON
R. SCOTT RUTH
JULIE R. STEINMEYER

OF COUNSEL
CARLOS ALVAREZ
W. ROBERT FOKES

132,561

January 5, 1996

RECEIVED
JAN - 9 1996

HAND DELIVERED THIS DATE

Kenneth J. Plante, Esq.
General Counsel
Department of Environmental Protection
3900 Commonwealth Boulevard
Tallahassee, FL 32399-2400

RE: Request for Extension of Time
Coastal Construction Permit Number DBS9A0330 PB
Palm Beach County, Florida

Dear Mr. Plante:

By and through its undersigned counsel, the South Lake Worth Inlet District (District) hereby respectfully requests an extension of time within which to file a Petition for Formal Administrative Proceedings with regard to the referenced permit. By this request, the District is seeking an extension of fourty five (45) days, through and including February 29, 1996, within which to challenge the referenced permit. This request, is made pursuant to Rules 62-103.070 and 62-101.040(3)(c), Florida Administrative Code, and as good cause for this request, the District states:

1. Coastal Construction Permit Number DBS9A0330 PB, which is the subject of this request, was issued to Palm Beach County by Final Order dated December 18, 1995 for a project known as the Ocean Ridge Shore Protection Project. This project would affect a portion of the Atlantic Ocean beach immediately south of the South Lake Worth Inlet in Palm Beach County.

2. The District received notice of the issuance of the referenced permit by a receipt of a copy of the Final Order granting the permit on December 23, 1995. Consequently, the initial 21 day notice period will expire on Monday, January 15, 1996.

EXHIBIT A1

3. Conditions contained within Permit Number DBS9A0330 PB would affect facilities owned by the district and the operation of facilities owned by the District.

4. The District is involved in negotiations with the permittee, Palm Beach County, to resolve the District's concerns with regard to these conditions, and is hopeful that these issues can be amicably resolved between the District and Palm Beach County.

5. The requested extension of time would allow these negotiations to continue, and the results thereof to be considered and, if that is their will, approved by the District's Board of Commissioners.

6. The District's Board of Commissioners meets only once each month, on the third Monday of the month. The requested extension through the end of February, 1996, would allow the District to consider the results of the negotiations at either its January or February meeting.

7. If the District and Palm Beach County are able to amicably resolve the issues raised by the referenced permit prior to the expiration of the requested extension, the District will immediately withdraw this request to allow Permit Number DBS9A0330 PB to become final at the earliest possible time.

8. Counsel for the District has discussed this request with counsel for the Department, Malease Jackson, who stated that she was not in a position to state whether or not she objects to this request.

WHEREFORE, the South Lake Worth Inlet District respectfully requests that the time within which to file a Petition for Formal Administrative Proceedings with regard to Permit Number DBS9A0330 PB be extended for fourty five (45) days, through and including February 29, 1996, or, if this request is denied, 15 days after the notice of such denial.

Sincerely,

Richard S. Brightman

cc: James McCartney Wearn, Esq.
Malease Jackson, Esq.

HOPPING GREEN SAMS & SMITH
PROFESSIONAL ASSOCIATION
ATTORNEYS AND COUNSELORS
123 SOUTH CALHOUN STREET
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R. SCOTT RUTH
JULIE R. STEINMEYER
T. KENT WETHERELL, II

OF COUNSEL
CARLOS ALVAREZ
W. ROBERT FOKES

RECEIVED
MAR - 4 1996

February 29, 1996

RECEIVED
FEB 29 1996
Dept. of Environmental Protection
Office of General Counsel

HAND DELIVERED THIS DATE

Kenneth J. Plante, Esq.
General Counsel
Dept. of Environmental Protection
3900 Commonwealth Boulevard
Tallahassee, FL 32399-2400

Re: Request for Extension of Time
Coastal Construction Permit Number DBS9A0330 PB
Palm Beach County

Dear Mr. Plante:

By and through its undersigned counsel, the South Lake Worth Inlet District ("District") hereby respectfully requests a further extension of time within which to file a Petition for Formal Administrative Proceedings with regard to the referenced Permit. By this request, the District is seeking a further extension through and including May 31, 1996. This request is made pursuant to Rule 62-103.070 and 62-101.040(3)(c), Florida Administrative Code, and as good cause for this request, the District states:

1. A January 5, 1995 request was previously made, is incorporated herein by reference, and is hereby supplemented.

2. The negotiations to resolve the District's concerns per paragraphs 4, 5, 6 and 7, inclusive of said January 5, 1996 extension request are still ongoing, as evidenced by the following:

A. The DOAH Hearing Officer in DOAH Case No. 88-0909 has extended the stay of that case until May 31, 1996 for the parties to continue settlement negotiations.

B. The Circuit Judge in the Fifteenth Judicial Circuit Court Case No. CL-87-2242 AD, on the Motion of Plaintiff Ocean Ridge (agreed to by all the defendants: District, Palm Beach County, Manalapan and certain Manalapan residents), has continued

EXHIBIT A2

pending matters to June 4, 1996, again for the parties to continue settlement negotiations.

3. Since January 18, 1996, five (5) settlement conferences have been conducted and settlement is being reviewed and negotiated by and among all these parties at this time.

WHEREFORE, the South Lake Worth Inlet District respectfully requests that the time within which to file a Petition for Formal Administrative Proceedings with regard to Permit No. DBS9A0330 PB be extended through and including May 31, 1996, or, if this request is denied, 15 days after the notice of such denial.

Sincerely,

Richard S. Brightman

RSB/hgb

cc: James McCartney Wearn, Esq.
Malease Jackson, Esq.

STATE OF FLORIDA
DIVISION OF ADMINISTRATIVE HEARINGS

FILE

BOARD OF COMMISSIONERS, SOUTH LAKE WORTH INLET DISTRICT,	)	
Petitioner,	)	
vs.	)	CASE NO. 88-0909
DEPARTMENT OF NATURAL RESOURCES,	)	
Respondent,	)	
and	)	
THE TOWN OF OCEAN RIDGE, et al.,	)	
Intervenors.	)	

FURTHER ORDER OF ABEYANCE

The Hearing Office has considered the following documents: (a) the status report filed October 23, 1995; (b) the Supplemental Status Report filed October 27, 1995; (c) the Motion For Reconsideration filed November 1, 1995; and (d) the Status Report filed November 30, 1995. By way of clarification, it is noted that the "proposed settlement agreement" mentioned in the Status Report of October 23, 1995, as being attached to that report was, in fact, not attached to the Status Report and as of the date of this order the proposed settlement agreement has not been filed with the Hearing Officer. It is also noted that there appears to be no need for the proposed settlement agreement to be filed with the Hearing Officer at this time.

Upon consideration, it is ORDERED:

1. That this case remain in abeyance until further notice.

2. That by no later than May 31, 1996, counsel for the Department of Environmental Protection (formerly Department of Natural Resources) shall state whether the case has been settled and, if not settled, the status report shall also stated whether there is any reason to further delay compliance with the order of June 20, 1995.

3. That by no later than June 7, 1996, any party who disagrees with anything stated in the Department's status report may file a supplemental status report.

DONE AND ORDERED in Tallahassee, Leon County, Florida, this 29th day of January 1996.

MICHAEL M. PARRISH
Hearing Officer
Division of Administrative Hearings
The DeSoto Building
1230 Apalachee Parkway
Tallahassee, Florida 32399-1550
(904) 488-9675 SC 278-9675

Filed with the Clerk of the
Division of Administrative Hearings
this 29 day of January 1996.

Copies furnished:

Richard S. Brightman, Esquire
David L. Powell, Esquire
Post Office Box 6526
Tallahassee, Florida 32314

Dana M. Wiehle, Esquire
Melease Jackson, Esquire
Department of Environmental Protection
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Sharon M. Pitts, Esquire
Assistant County Attorney
Palm Beach County
301 North Olive Avenue, Suite 601
West Palm Beach, Florida 33401

Case No. 88-0909
bcl

IN THE CIRCUIT COURT OF THE FIFTEENTH JUDICIAL CIRCUIT IN AND FOR PALM BEACH COUNTY, FLORIDA.

CASE NO. CL 87-2242 AD

RECEIVED

FEB 27 1996

TOWN OF OCEAN RIDGE, a
Municipal Corporation, in
its own name; and
STATE OF FLORIDA, ex rel
THE TOWN OF OCEAN RIDGE,
a Municipal Corporation,

Plaintiffs,

and

INLET PLAZA CONDOMINIUM, INC.,
a Florida Corporation, and
McCORMICK MILE BEACH CLUB, INC.,
a Florida Corporation,

Plaintiff-Intervenors,

vs.

SOUTH LAKE WORTH INLET DISTRICT,
PALM BEACH COUNTY, STATE OF
FLORIDA, BOARD OF TRUSTEES OF THE
INTERNAL IMPROVEMENT TRUST FUND,
STATE OF FLORIDA, DEPARTMENT OF
NATURAL RESOURCES,

Defendants,

and

TOWN OF MANALAPAN, THOMAS J. KELLY,
DIRK BRADY, as Trustee, PETER BLUM
and MAUREEN BLUM, his wife, and
L.C. PASLAY, and ILEEN H. PASLAY,
his wife,

Defendant-Intervenors.

_____/

MOTION FOR CONTINUANCE AND AGREED ORDER

Plaintiff, TOWN OF OCEAN RIDGE and INLET PLAZA CONDOMINIUM, INC., and McCORMICK MILE BEACH CLUB, INC., Plaintiff-Intervenors, by their undersigned attorney, respectfully move the Court to continue the hearing on Agreed Order on Defendants and Defendant-Intervenors **Motions to Set Hearings for a Determination on Entitlement to and Assessment of Attorney's Fees and Costs** now set for February 27, 1996 at 5:15 p.m., upon the following grounds:

1. Since January 18, 1996, five (5) settlement conferences have been conducted, and settlement is being reviewed and negotiated at this time.

2. The settlement includes all parties, and resolves all issues at both the Circuit Court and Division of Administrative Hearings (DOAH) levels.

3. As a result of the above, the DOAH Hearing Officer, in DOAH Case No. 88-0909, has *sua sponte* issued an extension of its stay until May 31, 1996.

4. A copy of the DOAH Further Order of Abeyance is attached hereto as **Exhibit "A"**.

5. Each of the attorneys for the Defendants and Defendant-Intervenors has agreed to the granting of a continuance in this matter with the understanding that there is no waiver or estoppel on their part; nor is there prejudice to their respective positions.

WHEREFORE, the Plaintiffs and Plaintiff-Intervenors request the Court to grant a continuance of the hearing set by Agreed Order on Defendants and Defendant-Intervenors **Motions to Set Hearings for a Determination on Entitlement to and Assessment of Attorney's Fees and Costs** to a time certain, thereby allowing the settlement process to proceed.

I HEREBY CERTIFY that a true copy of the foregoing has been furnished to those interested parties listed on the attached Service List via U.S. Mail and facsimile transmission this 21st day of February, 1996.

NICOLETTI BLOCK DUFFY PONCY & KOHN, P.A.
Attorneys for the Plaintiff, Town of Ocean Ridge, and
Intervenors, Inlet Plaza Condominium, Inc., and
McCormick Mile Beach Club, Inc.
317 Tenth Street
West Palm Beach, FL 33401
(407) 659-5300

PAUL J. NICOLETTI
Florida Bar No. 366269

AGREED ORDER

THIS MATTER having come before the Court on the motion filed by the Plaintiffs and Plaintiff-Intervenors to grant a continuance of the said hearing set by said Agreed Order, and the Court having been apprised of the facts in this matter, and upon the agreement of the parties, it is

ORDERED AND ADJUDGED that Plaintiffs' and Plaintiff-Intervenors' Motion for Continuance is hereby GRANTED, without prejudice, and:

IT IS FURTHER ORDERED AND ADJUDGED that the hearing scheduled for February 27, 1996 is hereby **rescheduled for one and one-half (1.5) hours on June 4, 1996 at 5:15 p.m.** to consider the legal issues of the entitlement of the various Defendants and Defendant-Intervenors to attorney's fees and assessable costs. Thereafter, if the Court determines that some or all of the Defendants are entitled to attorney's fees or costs or both, the Court shall consider the setting of an evidentiary hearing on the amount of attorney's fees and costs.

DONE AND ORDERED this _____ day of February, 1996, in West Palm Beach, Palm Beach County, Florida.

SIGNED AND DATED

FEB 23 1996

JUDGE MOSES BAKER

MOSES BAKER, JR.
Circuit Court Judge

Copies furnished: to those on the attached service list

COUNSEL OF RECORD
CASE NO. CL 87-2242 AD

Jane Kreusler-Walsh Esq.
503 Flagler Center
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West Palm Beach, FL 33401-5918
Facsimile No. 407-478-3111

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Brackett, Cook, et al.
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3rd Floor
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John C. Randolph, Esq.
Jones, Foster, et al.
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Malease Jackson
Depury General Counsel
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McFarlane Ausley Ferguson & McMullen
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Facsimile No. (904) 222-7560

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Potter, McClelland, et al.
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Facsimile No. 407-723-4092

Sharron M. Pitts, Esq.
Assistant County Attorney
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Facsimile No. 407-355-4398

Paul J. Nicoletti, Esq.
317 Tenth Street
West Palm Beach, FL 33401
Counsel for Appellees
Town of Ocean Ridge, Inlet
Plaza & McCormick Mile
Facsimile No. 407-659-5445

EXHIBIT B

DRAFT NOTES AND COMMENTS ON THE
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
DATED SEPTEMBER 6, 1995

1. The following provisions contain inaccurate, incomplete or untrue statements of fact: Sections 1.01, 1.02, 1.06, 2.07, 4.13, 4.46, 5.16g, and 5.17g.

2. The following provisions contain wrong or incorrect conclusions or findings based upon incomplete, inaccurate or untrue facts: Sections 1.01, 4.43, and 5.02.

3. Contrary to the second sentence of Section 1.01, the beaches in the proposed project site are not in a state of critical erosion, unless critical erosion means solely and only not wide enough to meet current standards for recreation or not wide enough to meet current standards for upland property protection; the beaches are not eroded as that term in commonly used.

4. Contrary to the second sentence of Section 1.01, the beaches in the proposed project site are not in a state of shoreline recession because consistent data and surveys from 1883 down to the present reflect that the shore and shoreline in the Project area are either stable or enjoy net accretion.

5. Contrary to Sections 1.06, 1.09, 1.10 and 2.07 areas of controversy and unresolved issues involve those matters set forth on attached Exhibits A1 and A2.

6. Contrary to Section 5.16b if the operation of the plant is unpredictable for other than natural causes, it is unpredictable due to causes within control of Palm Beach County which is this Project's sponsor and which operates and has responsibility to operate the plant under very certain specified conditions, but has failed in this responsibility on significant occasions in the past.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 4

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

MAR 18 1996

Mr. A.J. Salem
Chief, Planning Division
Jacksonville District, Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232

Subject: Draft Supplement to the Environmental Impact Statement (DSEIS) for the Palm Beach County, Florida, Shoreline Protection Project, Ocean Ridge Segment

Dear Mr. Salem:

Under the authority of Section 309 of the Clean Air Act and Section 102(2)(C) of the National Environmental Policy Act (NEPA), EPA, Region 4 has reviewed the subject document; an evaluation of the consequences of removing material from an offshore borrow site and using it to recondition a segment of the dry beach profile south of the Lake Worth Inlet (FDNR T-152 to R-159). Further, a groin field will be constructed just south of the Inlet in an effort to provide added stability to the northern end of the project. While the Ocean Ridge segment of the Palm Beach shoreline is experiencing some erosion, the rate is considerably less, viz., 37,500 versus 300,000 cubic yards/year, than the remainder of the beach south of the project.

It is anticipated that the addition of fill material will reduce damage to shoreline properties from small storm events and expand the recreational potential within the nourished reach. A management strategy to lessen the inevitable impacts to the nearshore environment, especially inundation of hard bottom habitat, will be implemented. Attempts to mitigate unavoidable adverse impacts will be accomplished via construction of artificial reefs; the extent of losses will be determined by subsequent inspection and refinement of the equilibrium profile equation.

Purpose and Need Considerations

EPA continues to be equivocal regarding the issue of pumping sand onto an eroding shoreface. Generally, we have not opposed beach nourishment when it provided a disposal site for a proximate, already authorized navigation project. The key factor, however, was whether or not biologically sensitive resources would be adversely affected through the use of this disposal method. In this particular case, the value of adjacent

structures, declining width of the recreational beach, and the perceived need to provide continued economic potential to shorefront property serve as the rationale for beach nourishment. The dollar value assigned to these factors in the benefits/costs calculations subsume the environmental losses.

This notwithstanding, we are concerned that given similar marine processes affecting other coastal communities throughout the Jacksonville District, the same protection rationale could hold true for much of the Florida coastline. The cumulative costs, both environmental and economic, of providing future, similar protection to all these areas needs to be examined in a comprehensive manner. This is especially true as the percentage of federal funding available for potential mitigation (direct and indirect) may be altered by deficit reduction measures.

Necessary Ongoing Investigations

This segment of the county-wide project manages to avoid certain problems which fostered previous concerns about the overall proposal, e.g., direct/immediate loss of seagrass resources. However, we recommend that further coordination continue between involved Corps technical staff sections to: more fully consider the impacts to the important biological resources present in this and the remainder of the project, especially as the dredged sand migrates during equilibrium processes; evaluate adjacent nearshore impacts of mining sand from the borrow sites; and better define the action's resultant physical and water quality characteristics/impacts as the entire borrow areas become subject to dredging.

Additionally, from a practical standpoint staff should verify that the public will actually be able to access the upgraded beach after it has been constructed. It has been our experience that adequate, appropriately designed parking together with passage to the beach for non-shorefront residents has proven elusive. Since a major component of the purpose/need benefits associated with this action accrue from its overall recreational potential, sufficient entry to the beach is important.

The proposed borrow site for the beach fill lies directly offshore of the project area. We assume that modelling results were consulted to determine the effects that removal of this borrow (along the 27'-38' contour) would have on the long-term sand budget (nearshore component) for this section of the shore. Namely, will excavation of this material lessen future onshore sediment movement via natural processes? One of the basic components of the computer model, DUNE, used to determine storm reduction benefits assumes that the amount of material eroded must equal the amount deposited. If a portion of the offshore area (a presumptive sand source) has been mined of material, then it would appear that the model results could be influenced.

The extent of the model "influence" (if any) should be

discussed in the final document. Our concerns in this regard are based on the possibility that the present instability may be exacerbated and/or maintenance frequency may have to be shortened. Whether the magnitude/importance of this possibility are significant remain to be determined, but need to be evaluated because of its importance to all parties.

Proposed Mitigation

Some of the environmental impacts of this proposal have been lessened via a number of management decisions, e.g., scheduling construction activities outside of the peak sea turtle nesting season. However, an undetermined amount of nearshore hardbottom communities will be buried by fill material for a period of time. Moreover, the deposition of dredged material from maintenance actions throughout the county will adversely affect biota in similar impacted nearshore habitats.

The consequences and overall significance of this functional loss of hard bottom habitat on both mobile and sessile species have been a matter of discussion among the resource agencies and the Jacksonville District for some time. Because this remains a matter of contention, additional monitoring and analysis will be conducted in an attempt to isolate and define the level of mitigation necessary to compensate for the adverse consequences from this and associated actions around Lake Worth Inlet in particular and Palm Beach County in general.

Significant losses of important hard bottom/reef fishery habitat both around the borrow site and along the nourished beach are anticipated/probable. These losses are of great interest to EPA. The mitigation plan for the "permanent" inundation caused by broadening the beach focuses on the creation of an artificial reef to mimic the type habitat lost. The overall, long-term effectiveness of this type of mitigation remains a matter of discussion.

Specifically, the utility of using artificial reefs and the replacement ratios therefor as mitigation needs to be further examined. As was noted in previous Corps of Engineers' documents, investigators routinely observe concentrations of fish around artificial reefs. However, it was also observed that commercial fishermen frequent these sites. Hence, the value of artificial reefs as attractors for adult fish appears to be demonstrated; however, their value in the overall life cycle of these same species is less apparent. If the overall worth of mimic reefs were more precisely determined, it could lessen concern about certain adverse consequences, viz., these devices serve to make selected fish populations more vulnerable by increasing catch per unit of effort.

Until this issue is examined in the scientific literature and/or through direct investigation, constructing these features should receive more thought. As the matter currently stands, we

are concerned that construction of these structures may only provide short-term benefits to fishing interests, but unknown (at least unquantified) positive impacts to the overall ecology of the species which are being targeted for mitigation effort.

Long- and short-term timed averages of 3.1 and 3.2 acres, respectively, of exposed hard bottoms are used in the mitigation calculations rather than same of 6.4 and 2.9 acres which will recurrently be covered by sand movement. The premise that after construction not all of the impacted habitat will be continuously covered by sand appears well founded; however, from a functional standpoint, the intermittent nature of its availability may well produce the same result as unbroken inundation.

There seems to be the hypothesis that nearshore populations can intermittently be denied important habitat elements without adverse effect. The significant, but unknown, element of the equation is the length of time involved until critically is reached. Population dynamics can be very difficult to project; however, often times biotic systems deal with the absence of critical elements through a loss of a subset of the affected population. Hence, we suggest the notion of using a timed average subset of the affected habitat may have flaws which are significant enough to require a general rethinking of this approach to mitigation planning.

From a factual standpoint it should be noted that the statement, "hardbottom that remains uncovered will serve as a refuge for displaced mobile species...", continues this line of thought. It would be more accurate to state that mobile species will compete for refuge sites on the remaining hardbottoms until some population equilibrium is reached. Of course, as noted above, this equilibrium will almost assuredly be achieved at reduced species diversity and population numbers than was originally the case.

Alternative Mitigation Measures

We suggest that a portion of the total environmental loss component attendant to the project be addressed by adding out-of-kind mitigation to the artificial reef system. For example, non-point run off from adjacent developed/hard surface areas could be redirected to some form of treatment within the project reach. A retention/detention type facility with oil/grease separator would lessen the adverse impacts of the current situation in which untreated runoff directly accesses the nearshore habitat. In our opinion, lessening the adverse consequences of this runoff on this sensitive/important environment could be as beneficial as just providing some additional increment of artificial hardbottom habitat in the adjacent nearshore ocean zone. This and other out-of-kind measures could be used for similar nourishment projects which are planned/authorized for other portions of the Palm Beach County shoreline. Any category of measures which can lessen the impacts of these increasingly pervasive actions needs

to be examined.

Offshore Borrow Concerns

In a larger context, we are concerned about the need for increasing volumes of maintenance material for nourishment projects within the county and elsewhere along the Atlantic coast. Selected offshore sites appear adequate to meet current needs for good quality sand comparable to the native beach material, but long-term requirements may dictate sites (or portions thereof) which are not as well-suited. This situation could become more problematic from a water quality perspective, especially if the current observed trend for increasing amounts of nourishment material proves to be a long-term disposition.

Potential Stabilization Problems

Corps of Engineers' publications often note that the use of groins/training structures to stabilize eroding shorelines produce mixed results. The final document should detail the Jacksonville District's specific experiences and successes with these and other hard structures to control beaches erosion in south Florida, especially noteworthy would be the results of the previously installed groin field from the Inlet to R-159. Unfortunately, the District's difficulties with inlet stabilization often demonstrate that these structures translate/exacerbate the erosion problem on beaches downcurrent of the structure, thereby requiring additional and evermore complex solutions.

EPA has assigned a rating of EC-2 to the proposal. That is, we have some environmental concerns regarding the long-term consequences of this action, per se, and just as importantly how it meshes with and will affect other, similar projects planned for the county's shoreline. The additional information derived from the mitigation and subsequent monitoring plan may be able to resolve this issue. Hopefully, it will also provide some insights into the larger issue of the overall environmental consequences of shoreline protection.

If we can be of further assistance in this matter, Dr. Gerald J. Miller (404-347-3776) will serve as initial point of contact in regard to NEPA matters, whereas Mr. Jose Negron (404-347-2126) should be contacted on Section 404 issues.

Sincerely yours,

Heinz J. Mueller

Heinz J. Mueller, Chief
Environmental Policy Section
Federal Activities Branch

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

March 27, 1996

Mr. A. J. Salem
Chief, Planning Division
DOA, Jacksonville District, COE
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

Enclosed are additional comments on the Draft Environmental Impact Statement for Palm Beach County, Florida, Shore Protection Project, Ocean Ridge Segment. We hope our comments will assist you. Thank you for giving us an opportunity to review this document.

Sincerely,

Donna S. Wieting
Acting Director
Ecology and Conservation Office

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
National Geodetic Survey
Silver Spring, Maryland 20910-3282

MAR 2 6 1996

MEMORANDUM FOR: Donna Wieting
Acting Director, Ecology and Conservation Office

FROM: for Captain Lewis A. Lapine, NOAA
Director, National Geodetic Survey

SUBJECT: DEIS-9601-09--Palm Beach County, Florida, Shore Protection Project, Ocean Ridge Segment

The subject statement has been reviewed within the areas of the National Geodetic Survey's (NGS) responsibility and expertise and in terms of the impact of the proposed actions on NGS activities and projects.

All available geodetic control information about horizontal and vertical geodetic control monuments in the subject area is provided on the attached diskettes. This information should be reviewed for identifying the location and designation of any geodetic control monuments that may be affected by the proposed project.

If there are any planned activities which will disturb or destroy these monuments, NGS requires not less than 90 days' notification in advance of such activities in order to plan for their relocation. NGS recommends that funding for this project include the cost of any relocation(s) required.

For further information about these monuments, please contact John Spencer; SSMC3, NOAA, N/NGS; 1315 East West Highway; Silver Spring, Maryland 20910; telephone: 301-713-3169; fax: 301-713-4175.

With regard to the U.S. coastline, the proposed Ocean Ridge beach restoration project between South Lake Worth Inlet and Boynton Beach involves dredging sand from a charted borrow site and using that sand to fill along the shore. It also involves the construction of eight T-head groins along the northern end of the project. Completion of this project will affect the depiction of the shoreline and the charted hydrography related to the borrow area.

NOAA requests the U.S. Army Corps of Engineers to furnish any surveys upon completion of these multiple projects so that any related shoreline changes can be accurately detailed on future editions of affected NOS charts. Please provide copies of any surveys within this project to: Howard Danley, NOAA, Office of Coast Survey, N/CS28, 1315 East West Highway, Silver Spring, Maryland 20910.

Attachments

The enclosed disk contains programs DSX, DSPLOT, and DSSELECT (in separate directories) which facilitate the use of the National Geodetic Survey's (NGS) data sheet file (DSDATA).

DSX.EXE extracts individual or groups of data sheets from a DSDATA file. It provides options to extract by station identifier, station name, area, and more. Various utilities are included for manipulating the data.
Print files 'DSX.DOC' and 'D_README' from directory 'DSX' on the diskette for documentation on setting up and using the program!

DSPLOT.EXE is used to plot DSX created index files (or any file in the same format) on the terminal screen.
Print file 'DSPLOT.DOC' from directory 'DSPLOT' on the diskette for documentation on using the program!

DSSELECT.EXE allows for extraction of various data items from a DSDATA file into a separate file. Ouptut format is one record per station with data items separated by a delimiter for easy database loading.
Print file 'DSSELECT.ASC' from directory 'DSSELECT' on the diskette for documentation on using the program!

NGS welcomes your suggestions and comments on the usefulness of the program. Please send your comments to:

U.S. Department of Commerce, NOAA
National Geodetic Survey, N/CG174
SSMC-3, Station 9202
1315 East-West Highway
Silver Spring, MD 20910

United States Department of the Interior

OFFICE OF THE SECRETARY
OFFICE OF ENVIRONMENTAL POLICY AND COMPLIANCE
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

March 28, 1996

ER-96/92

Colonel Terry L. Rice,
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Colonel Rice:

The Department of the Interior has completed its review of the Draft Supplemental Environmental Impact Statement (SEIS) for the Palm Beach County, Florida, Shore Protection Project at Ocean Ridge. These comments are provided for inclusion in the Final SEIS.

GENERAL COMMENTS

The Department is encouraged by the tone of the draft SEIS, which expresses concern for the loss of productive near shore reef habitat which will occur as a result of the deposition of sand on adjacent beaches. The SEIS provides a commitment to follow the Fish and Wildlife Service (FWS) Recommendations included in the Fish and Wildlife Coordination Act Report (CAR) prepared for this project.

The project has changed slightly since preparation of the CAR. Formerly, five T-head groins were proposed to be constructed in the northern 2,300 feet of the project area. The SEIS project description includes eight of these structures within the northern 1,680 feet. As these groins will provide some additional structure for attachment of sessile marine organisms and shelter for motile fishes and invertebrates, we do not object to these modifications.

The estimate of area of long-term near shore reef burial which will result from deposition of the fill has also changed, increasing from 2.0 acres estimated in July 1994 to the current estimate of 6.4 acres. These increases are the result of plan modifications and analysis of more recent (August 1994) aerial photography. An increase in near shore rock due to continued erosion has been identified through analysis of these photographs.

Total mitigation acreage needed to offset near shore reef habitat losses is proposed to be obtained through "time averaging" the near shore reef area within the toe of fill during the eleven year interval from 1983 through 1994. We believe that mitigation needs

should be based on actual habitat area impacted **at the time of construction**, independent of the amount of habitat present in the project area in the recent past.

The project sponsor, Palm Beach County, proposes to include in their mitigation package, near shore artificial reefs which were deployed in the Ocean Ridge vicinity in 1994. We do not object to including this designed reef area in Palm Beach County's mitigation package. However, it would be preferable if mitigation for a Federal Civil Works project was created as a feature of that project, making the mitigation eligible for cost-sharing (60% Federal, 40% local) to defray the project sponsor's cost of mitigation. This would leave more local monetary resources available to similar projects which are initiated strictly for habitat enhancement and are not mitigative.

SPECIFIC COMMENTS

Page 21, Section 3.28 The methods to be used for monitoring identified in this section are not specified. However, Palm Beach County has previously committed to post-project monitoring for impact assessment at Carlin Park, Palm Beach County, using ground-truthed aerial photographs. We recommend use of the same method for monitoring immediate and one year post-construction impacts resulting from this project.

Page 49, Section 5.14 and 5.15. We disagree with the logic expressed in these sections. Since 1991, a trend of increasing reef acreage within the projected toe of fill is indicated in Table 6. For purposes of calculating cost/benefit ratios, the Army Corps of Engineers (COE) uses a project life of fifty years. If the environmental costs associated with lost near shore hard bottom were to be calculated using the same project life-span, this increase in reef acreage would be projected out fifty years. Since 1983, reef impact acreage has increased from 3.66 acres to 6.43 acres in 1994, or .25 acres per year. In fifty years, if no project is implemented, reef acreage within the projected toe of fill could increase by 12.5 acres (50 yr. X .25 acres). This would lead, in fifty years, to a total of 18.9 acres.

If the project is implemented, reef acreage at that time will be reduced by a certain amount. This amount can be ascertained by comparing the most recent pre-project aerial photographs to aerial photographs taken after the new beach fill has settled, approximately one year later. Suppose through the above analysis it is found that 5.0 acres are actually buried by the beach fill. This reduction in reef acreage will persist throughout the fifty year life of the project. Thus, at the end of fifty years there would be 13.9 (18.9 - 5.0) acres of near shore reef instead of 18.9 acres. Thus, a comparison of reef acreage before and after project construction can be used to accurately identify mitigation needs. **In conclusion, time averaging has underestimated the actual impact**

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

May 20, 1996

REPLY TO
ATTENTION OF

Programs and Project Management Division
Project Management Branch

Copy 3 File

Mr. Richard E. Walesky, Director
Department of Environmental Resources Management
Building 502
3323 Belvedere Road
West Palm Beach, Florida 33406

Dear Mr. Walesky:

This is in regard to review of the Draft Supplemental Environmental Impact Statement (SEIS) for the Ocean Ridge Segment of the Palm Beach County shore protection project. Enclosed are letters providing comments from other Federal agencies, the state, the South Lake Worth Inlet District and the Town of Manalapan, for your consideration.

Also, enclosed is a copy of the March 27, 1996, letter from Ms. Donna S. Wietin of the Department of Commerce, Ecology and Conservation Office. The letter requests review of information provided in the enclosed diskettes regarding their geodetic control monuments in the vicinity of the project. The letter also requests identification of any control monuments that may be affected by the project, as well as any post construction surveys. Please provide our office with any revisions to the Draft SEIS and responses to comments that you may prepare as a result of the enclosed letters.

Should you have any questions, please contact Mr. Charles Stevens at 904-232-2113.

Sincerely,

Richard E. Bonner, P.E.
Deputy District Engineer
for Project Management

Enclosures

RECEIVED
23 1996
ENVIRONMENTAL RESOURCES MANAGEMENT

at the time of construction and the subsequent reduction in reef acreage which will persist throughout the project life.

Thank you for the opportunity to comment on the Draft Supplemental Environmental Impact Statement. If you have any questions related to fish and wildlife resources, please contact Jon Andrew, Regional Environmental Coordinator, with the Fish and Wildlife Service, at 404/679-7123; or Craig Johnson of the Fish and Wildlife Service, South Florida Ecosystem Office, at 407/562-3909.

Sincerely yours,

James H. Lee

James H. Lee
Regional Environmental Officer

Appendix D

Nearshore Hardbottom Location Maps

LEGEND

FEATURES: MAJOR SHORELINE STRUCTURES, STRUCTURES WITH NEAR ZERO ELEVATION (TENNIS COURTS AND SWIMMING POOLS FOR DIGITIZING PURPOSES), SHORE PROTECTION STRUCTURES (SEAWALLS, GROINS, DUNE WALKOVERS, JETTIES, ETC.), MAJOR COASTAL ROADWAYS, MUNICIPAL BOUNDARIES, PUBLIC PARK BOUNDARIES, DNR RANGE MONUMENTS, 1000' PROFILE AZIMUTH AT EACH MONUMENT, PROJECT LIMITS, SURVEY LIMITS AND HARDBOTTOM EXTENTS. ALSO INCLUDED IS THE MEAN HIGH WATER LINE CALCULATED FROM DNR COASTAL CONSTRUCTION CONTROL LINE SURVEYS DATED JULY 1990.

HARDBOTTOM REPRESENTED ON THESE MAPS HAS BEEN DIGITIZED USING AUTOCAD REL. 12. AREA CALCULATIONS ARE BASED ON THESE MAPS.

THE BASE MAP WAS DIGITIZED FROM DNR'S JULY 28, 1989 COASTAL CONSTRUCTION CONTROL LINE AERIAL PHOTOGRAPHS AT A SCALE OF 1"=100'.

DATE: FEBRUARY 1985

SOURCE: PBC ERM CONTROLLED AERIAL PHOTOGRAPHY

AERIAL INTERPRETATION DATA:

TOTAL HARDBOTTOM AREA WITHIN PROJECT LIMITS:
414,849 SQ. FT. (9.52 ACRES)
TOTAL HARDBOTTOM AREA SURVEYED:
1,300,987 SQ. FT. (29.87 ACRES)
TOTAL HARDBOTTOM AREA WITHIN E.T.O.F.:
113,696 SQ. FT. (2.61 ACRES)
TOTAL HARDBOTTOM AREA WITHIN AREA OF IMPACT:
280,524 SQ. FT. (6.44 ACRES)

PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
MANAGEMENT

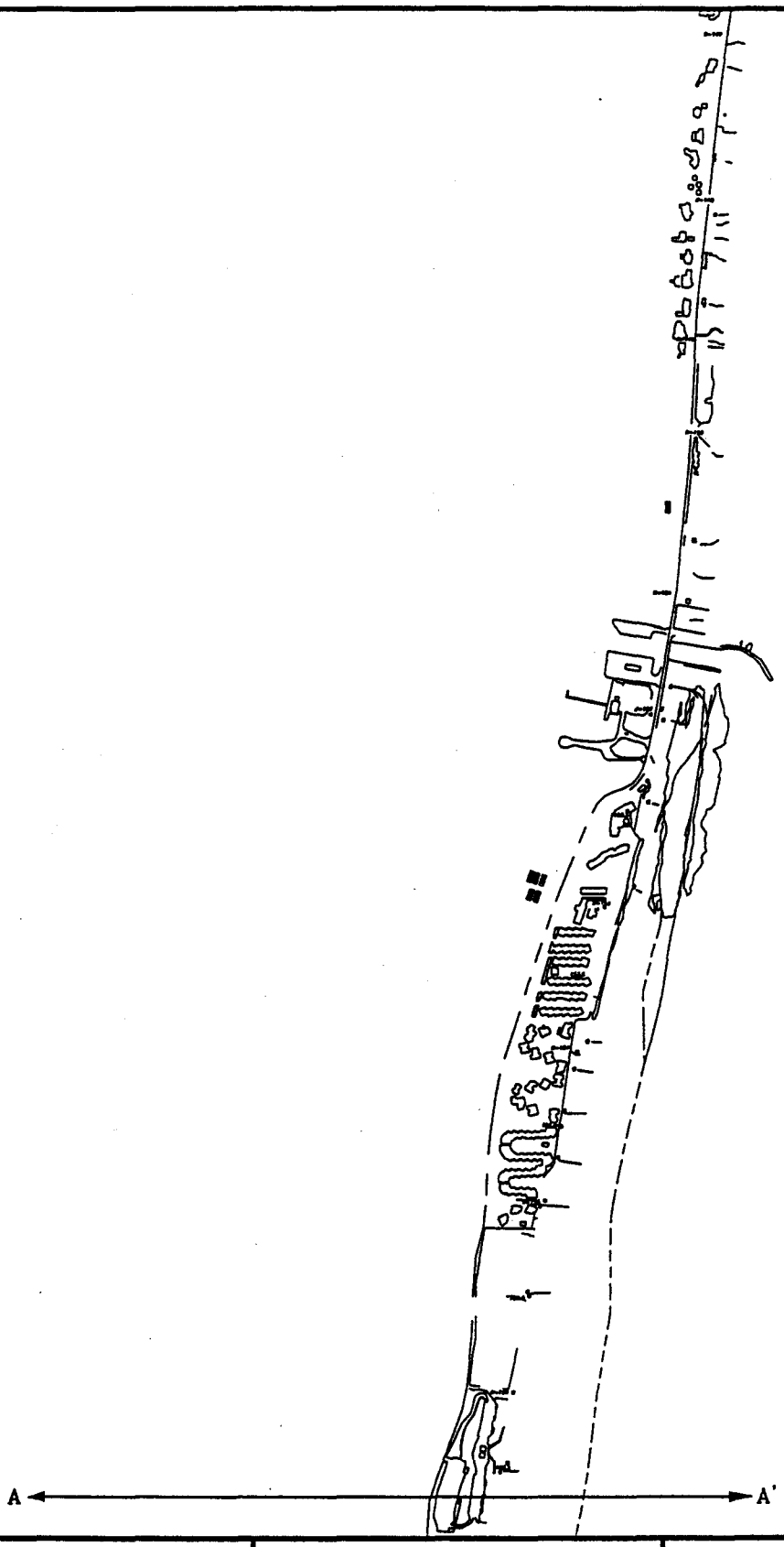
OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

-600 -300 0 300 600 900 1200

OR 06/95 JW

N



PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
MANAGEMENT

OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

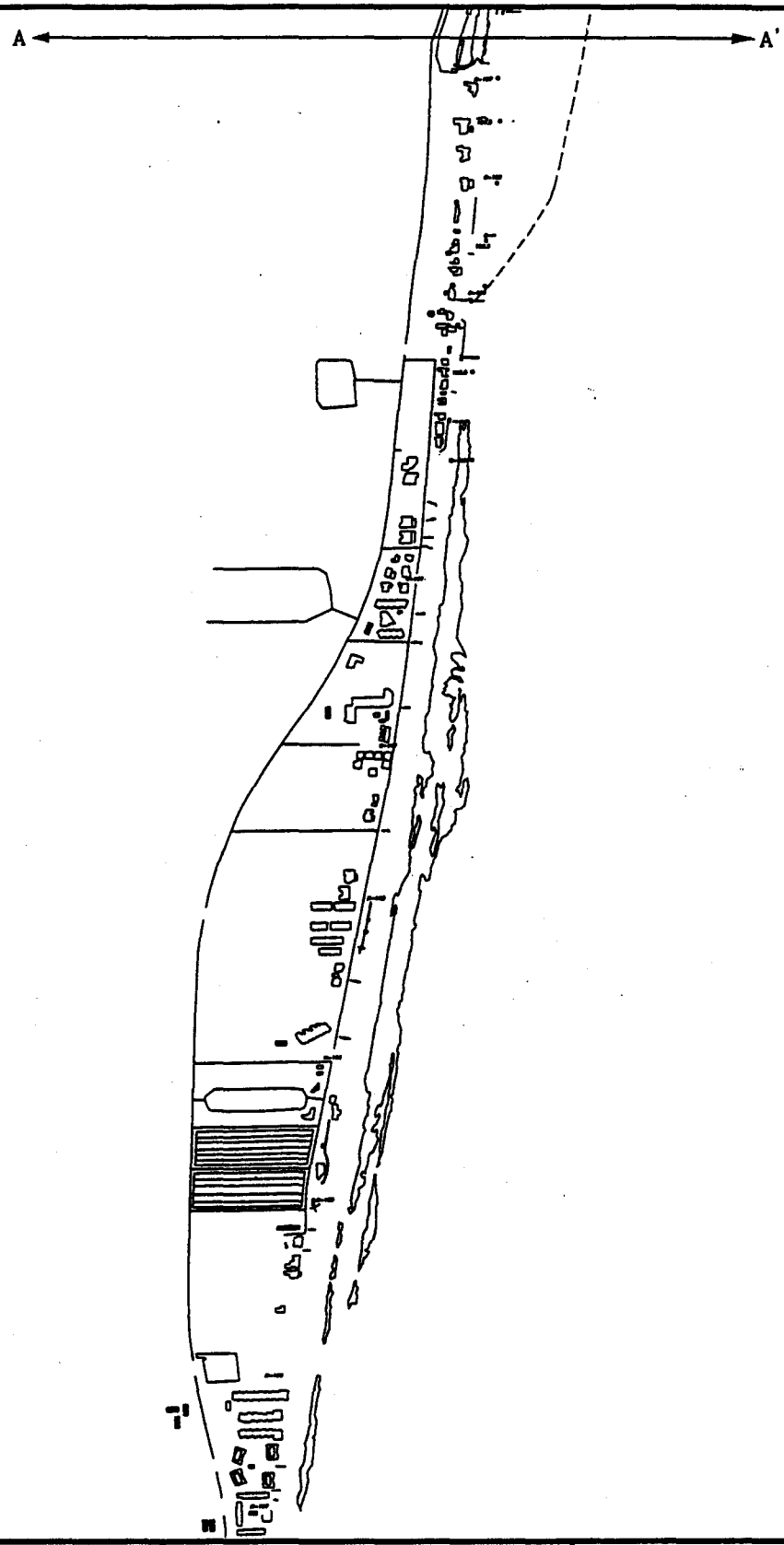
SCALE: 1"=1200'

-600 -300 0 300 600 900 1200

OR 08/95 JW

PAGE 2 OF 3
(1985)

N



PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
MANAGEMENT

OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

-600 -300 0 300 600 900 1200

OR 08/95 JW

N

PAGE 3 OF 3
(1985)

LEGEND

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THE BASE MAP WAS DIGITIZED FROM DNR'S JULY 28, 1989 COASTAL CONSTRUCTION CONTROL LINE AERIAL PHOTOGRAPHS AT A SCALE OF 1"=100'.

DATE: NOVEMBER 1983

SOURCE: PBC ERM CONTROLLED AERIAL PHOTOGRAPHY

AERIAL INTERPRETATION DATA:

TOTAL HARDBOTTOM AREA WITHIN PROJECT LIMITS:
453,403 SQ. FT. (10.41 ACRES)
TOTAL HARDBOTTOM AREA SURVEYED:
1,242,893 SQ. FT. (28.53 ACRES)
TOTAL HARDBOTTOM AREA WITHIN E.T.O.F.:
159,587 SQ. FT. (3.66 ACRES)
TOTAL HARDBOTTOM AREA WITHIN AREA OF IMPACT:
326,595 SQ. FT. (7.5 ACRES)

PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
MANAGEMENT

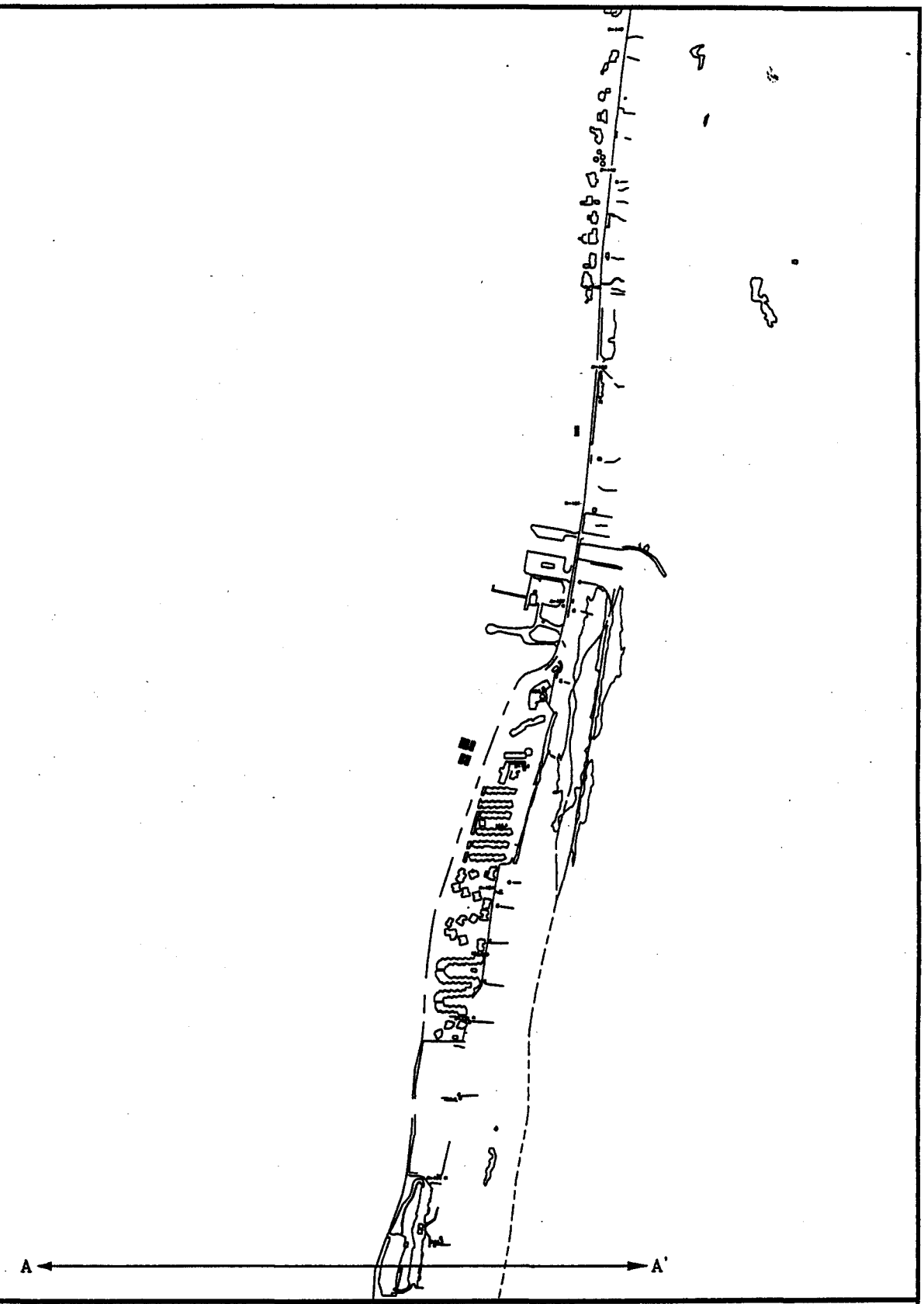
OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

-600 -300 0 300 600 900 1200

N

OR 08/95 JW



PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
MANAGEMENT

OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

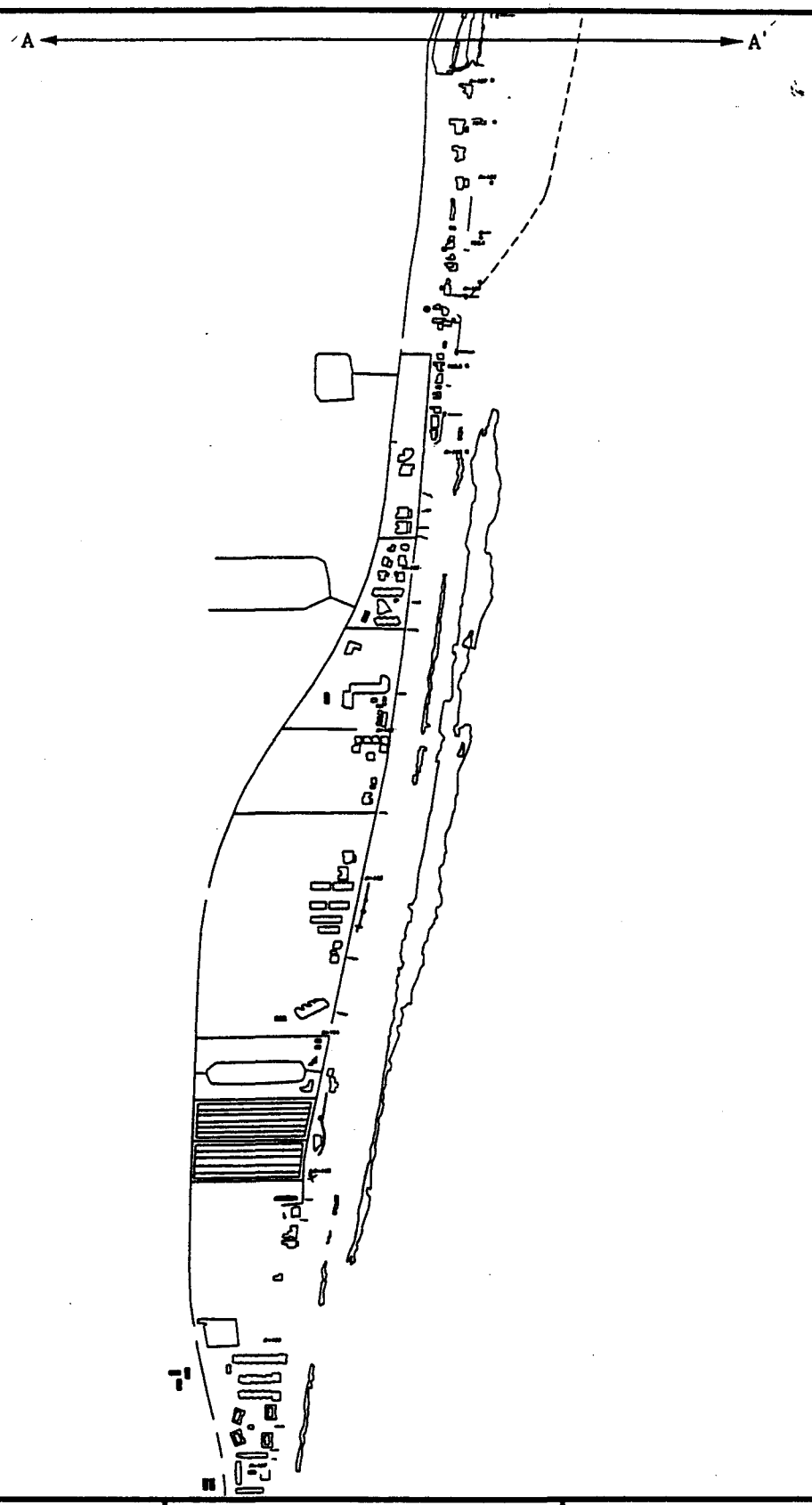
SCALE: 1"=1200'

PAGE 2 OF 3
(1983)

-600 -300 0 300 600 900 1200

OR 08/95 JW

N



PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
MANAGEMENT

OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

-600 -300 0 300 600 900 1200

OR 08/95 JW

N

PAGE 3 OF 3
(1983)

LEGEND

FEATURES: MAJOR SHORELINE STRUCTURES, STRUCTURES WITH NEAR ZERO ELEVATION (TENNIS COURTS AND SWIMMING POOLS FOR DIGITIZING PURPOSES), SHORE PROTECTION STRUCTURES (SEAWALLS, GROINS, DUNE WALKOVERS, JETTIES, ETC.), MAJOR COASTAL ROADWAYS, MUNICIPAL BOUNDARIES, PUBLIC PARK BOUNDARIES, DNR RANGE MONUMENTS, 1000' PROFILE AZIMUTH AT EACH MONUMENT, PROJECT LIMITS, SURVEY LIMITS AND HARDBOTTOM EXTENTS. ALSO INCLUDED IS THE MEAN HIGH WATER LINE CALCULATED FROM DNR COASTAL CONSTRUCTION CONTROL LINE SURVEYS DATED JULY 1990.

HARDBOTTOM REPRESENTED ON THESE MAPS HAS BEEN DIGITIZED USING AUTOCAD REL. 12. AREA CALCULATIONS ARE BASED ON THESE MAPS.

THE BASE MAP WAS DIGITIZED FROM DNR'S JULY 28, 1989 COASTAL CONSTRUCTION CONTROL LINE AERIAL PHOTOGRAPHS AT A SCALE OF 1"=100'.

DATE: AUGUST 1991 (AERIAL PHOTOGRAPHY), SEPTEMBER 1991 (FIELD SURVEY)

SOURCE: PBC ERM CONTROLLED AERIAL PHOTOGRAPHY
PBC ERM FIELD SURVEY (R-152 - R-154, AND R-161 - 165)

FIELD SURVEY DATA:

DNR MON#	RELIEF AVG	RELIEF MAX	% REEF EXPOSED
152	0.21	0.7	55.9
153	0.32	0.5	60.5
154	1.21	3.0	79.1
161	N.D.	2.0	73.2
162	N.D.	1.0	78.2
163	N.D.	1.0	56.4
164	0.32	1.0	53.8
165	1.00	2.0	63.1

AERIAL INTERPRETATION DATA:

TOTAL HARDBOTTOM AREA WITHIN PROJECT LIMITS:
511,731 SQ. FT. (11.75 ACRES)
TOTAL HARDBOTTOM AREA SURVEYED:
1,427,352 SQ. FT. (32.77 ACRES)
TOTAL HARDBOTTOM AREA WITHIN E.T.O.F.:
111,368 SQ. FT. (2.56 ACRES)
TOTAL HARDBOTTOM AREA WITHIN AREA OF IMPACT:
211,532 SQ. FT. (4.86 ACRES)

PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
MANAGEMENT

OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

-600 -300 0 300 600 900 1200

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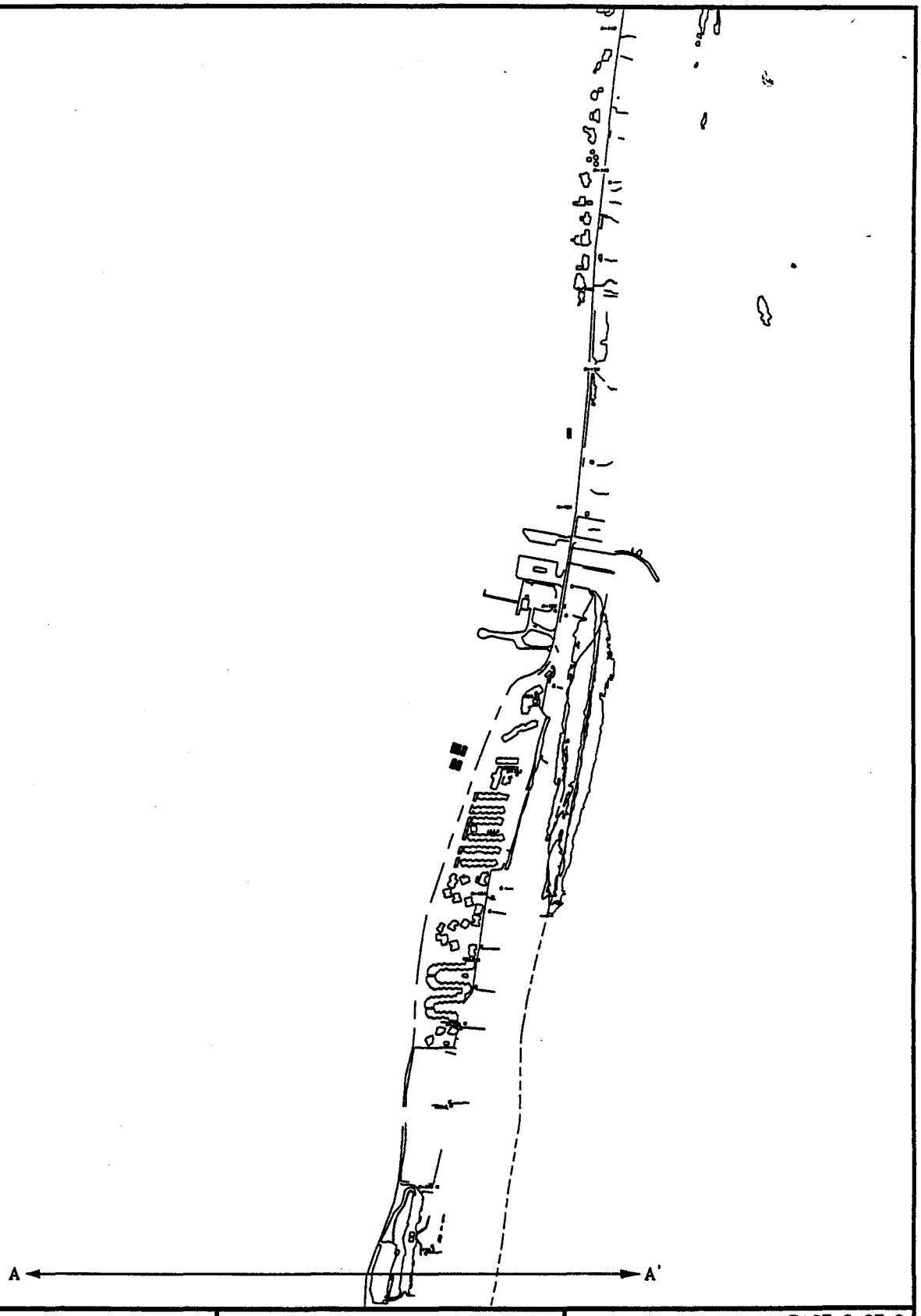
OR 08/95 JW



PALM BEACH COUNTY
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OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

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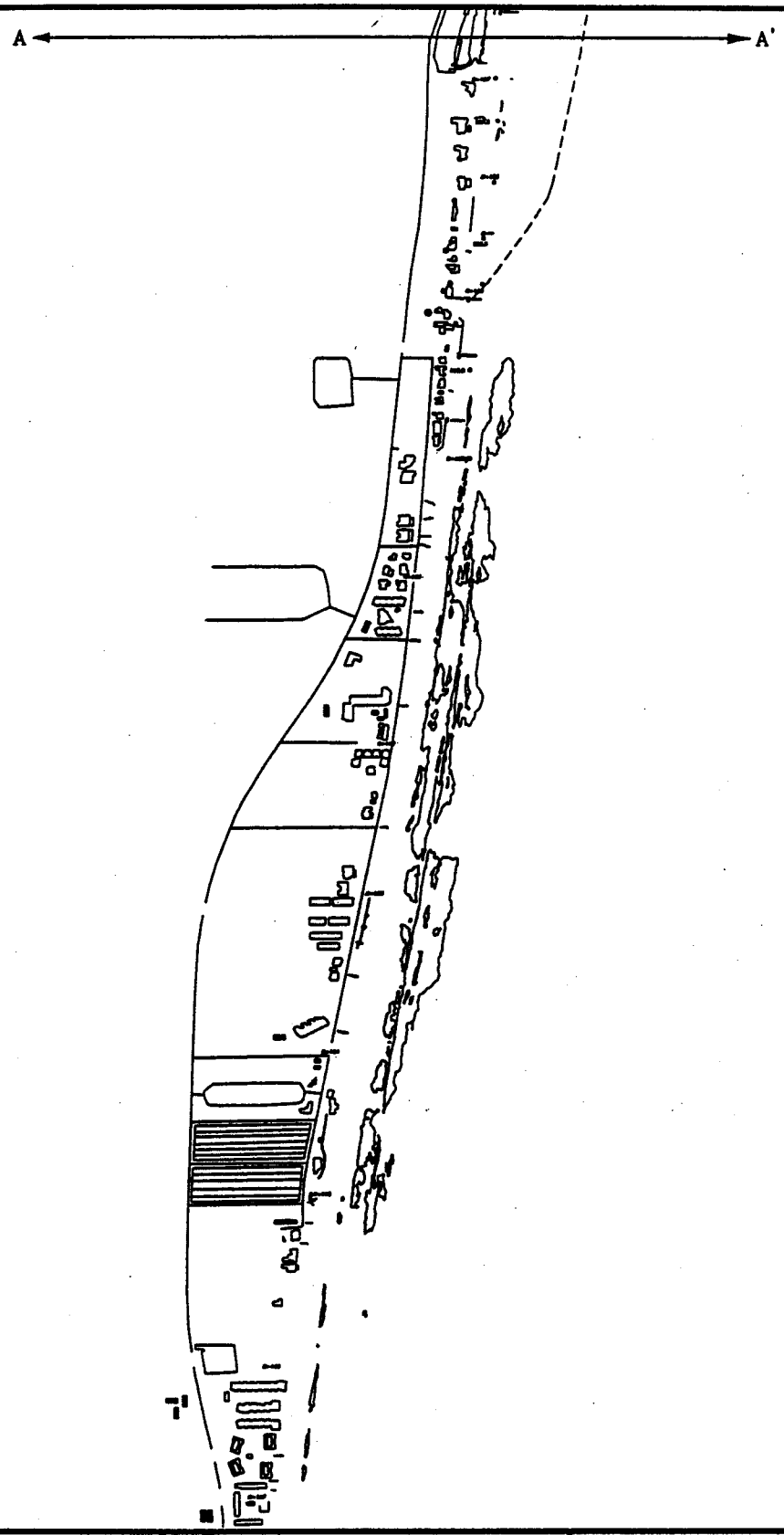

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SCALE: 1"=1200'

PAGE 3 OF 3
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FEATURES: MAJOR SHORELINE STRUCTURES, STRUCTURES WITH NEAR ZERO ELEVATION (TENNIS COURTS AND SWIMMING POOLS FOR DIGITIZING PURPOSES), SHORE PROTECTION STRUCTURES (SEAWALLS, GROINS, DUNE WALKOVERS, JETTIES, ETC.), MAJOR COASTAL ROADWAYS, MUNICIPAL BOUNDARIES, PUBLIC PARK BOUNDARIES, DNR RANGE MONUMENTS, 1000' PROFILE AZIMUTH AT EACH MONUMENT, PROJECT LIMITS, SURVEY LIMITS AND HARDBOTTOM EXTENTS. ALSO INCLUDED IS THE MEAN HIGH WATER LINE CALCULATED FROM DNR COASTAL CONSTRUCTION CONTROL LINE SURVEYS DATED JULY 1990.

HARDBOTTOM REPRESENTED ON THESE MAPS HAS BEEN DIGITIZED USING AUTOCAD REL. 12. AREA CALCULATIONS ARE BASED ON THESE MAPS.

THE BASE MAP WAS DIGITIZED FROM DNR'S JULY 28, 1989 COASTAL CONSTRUCTION CONTROL LINE AERIAL PHOTOGRAPHS AT A SCALE OF 1"=100'.

DATE: AUGUST 1992

SOURCE: PBC ERM CONTROLLED AERIAL PHOTOGRAPHY
PBC ERM FIELD SURVEY (R-152, R-153, R-155, AND R-156)

FIELD SURVEY DATA:

DNR MON#	RELIEF AVG	RELIEF MAX	% REEF EXPOSED
152	0.18	1.00	48.7%
153	0.34	2.00	67.8%
155	0.00	0.00	00.0%
156	-0.01	0.17	62.1%

AERIAL INTERPRETATION DATA:

TOTAL HARDBOTTOM AREA WITHIN PROJECT LIMITS:
491,312 SQ. FT. (11.27 ACRES)
TOTAL HARDBOTTOM AREA SURVEYED:
1,896,100 SQ. FT. (43.53 ACRES)
TOTAL HARDBOTTOM AREA WITHIN E.T.O.F.:
159,685 SQ. FT. (3.67 ACRES)
TOTAL HARDBOTTOM AREA WITHIN AREA OF IMPACT:
328,276 SQ. FT. (7.54 ACRES)

PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
MANAGEMENT

OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

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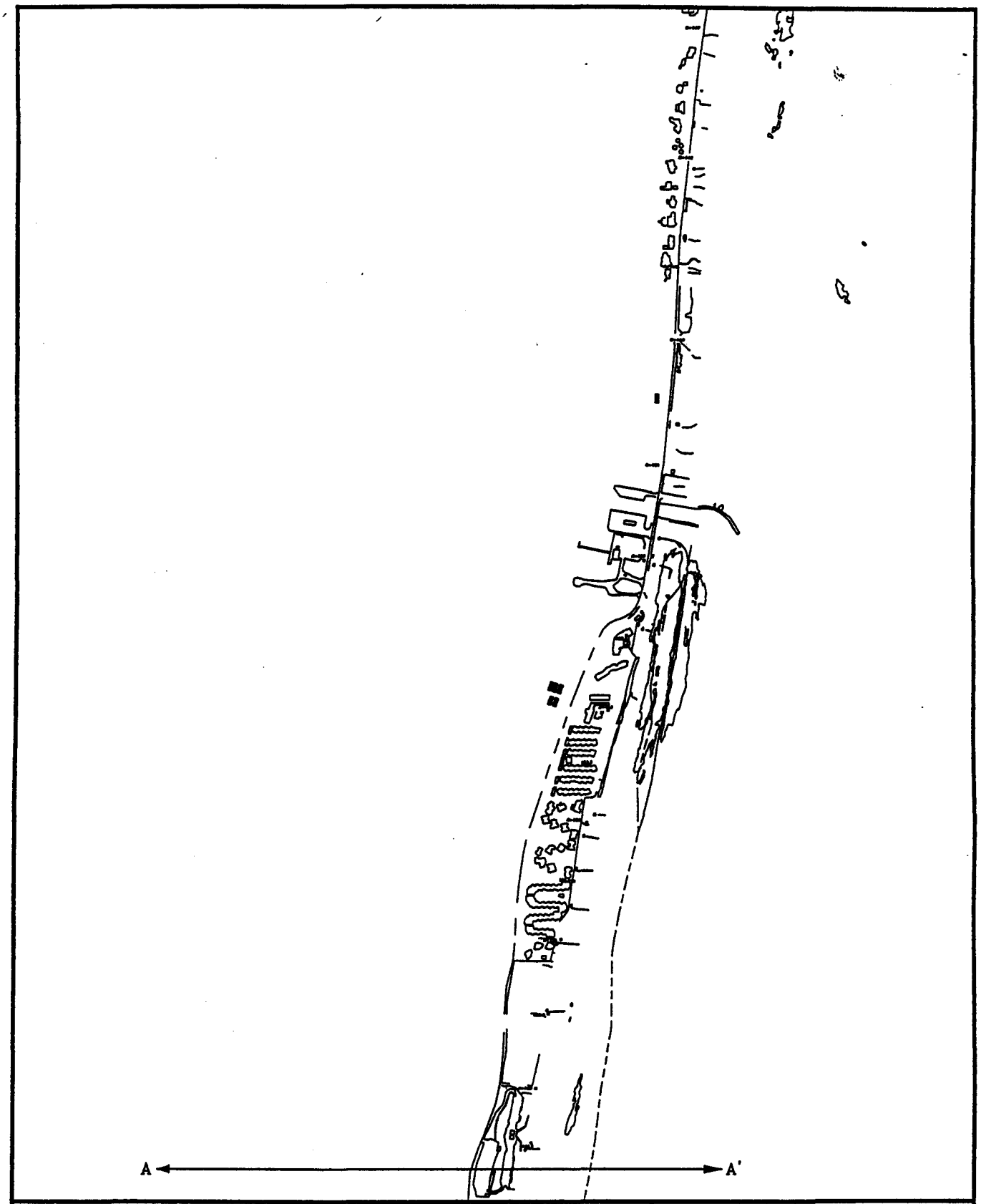

PALM BEACH COUNTY
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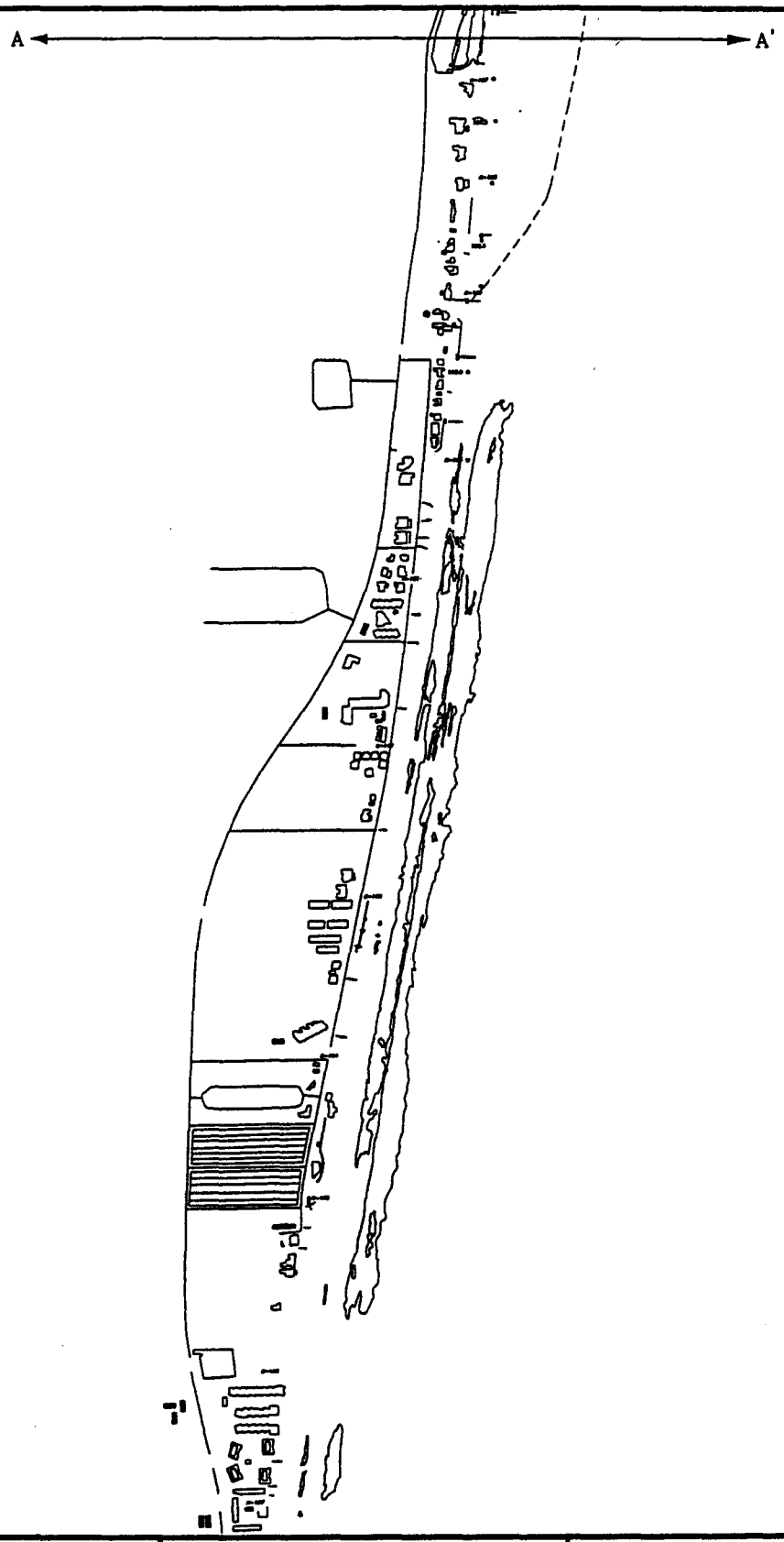

PALM BEACH COUNTY
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THE BASE MAP WAS DIGITIZED FROM DNR'S JULY 28, 1989 COASTAL CONSTRUCTION CONTROL LINE AERIAL PHOTOGRAPHS AT A SCALE OF 1"=100'.

DATE: MARCH 1993

SOURCE: PBC ERM CONTROLLED AERIAL PHOTOGRAPHY

AERIAL INTERPRETATION DATA:

TOTAL HARDBOTTOM AREA WITHIN PROJECT LIMITS:
422,263.22 SQ. FT. (9.69 ACRES)
TOTAL HARDBOTTOM AREA SURVEYED:
1,883,942.6 SQ. FT. (43.25 ACRES)
TOTAL HARDBOTTOM AREA WITHIN E.T.O.F.:
165,923 SQ. FT. (3.8 ACRES)
TOTAL HARDBOTTOM AREA WITHIN AREA OF IMPACT:
311,069 SQ. FT. (7.14 ACRES)

PALM BEACH COUNTY DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT	OCEAN RIDGE SHORE PROTECTION PROJECT LOCATION OF NEARSHORE HARDBOTTOM	SCALE: 1"=1200' -600 -300 0 300 600 900 1200 OR 08/95 JW

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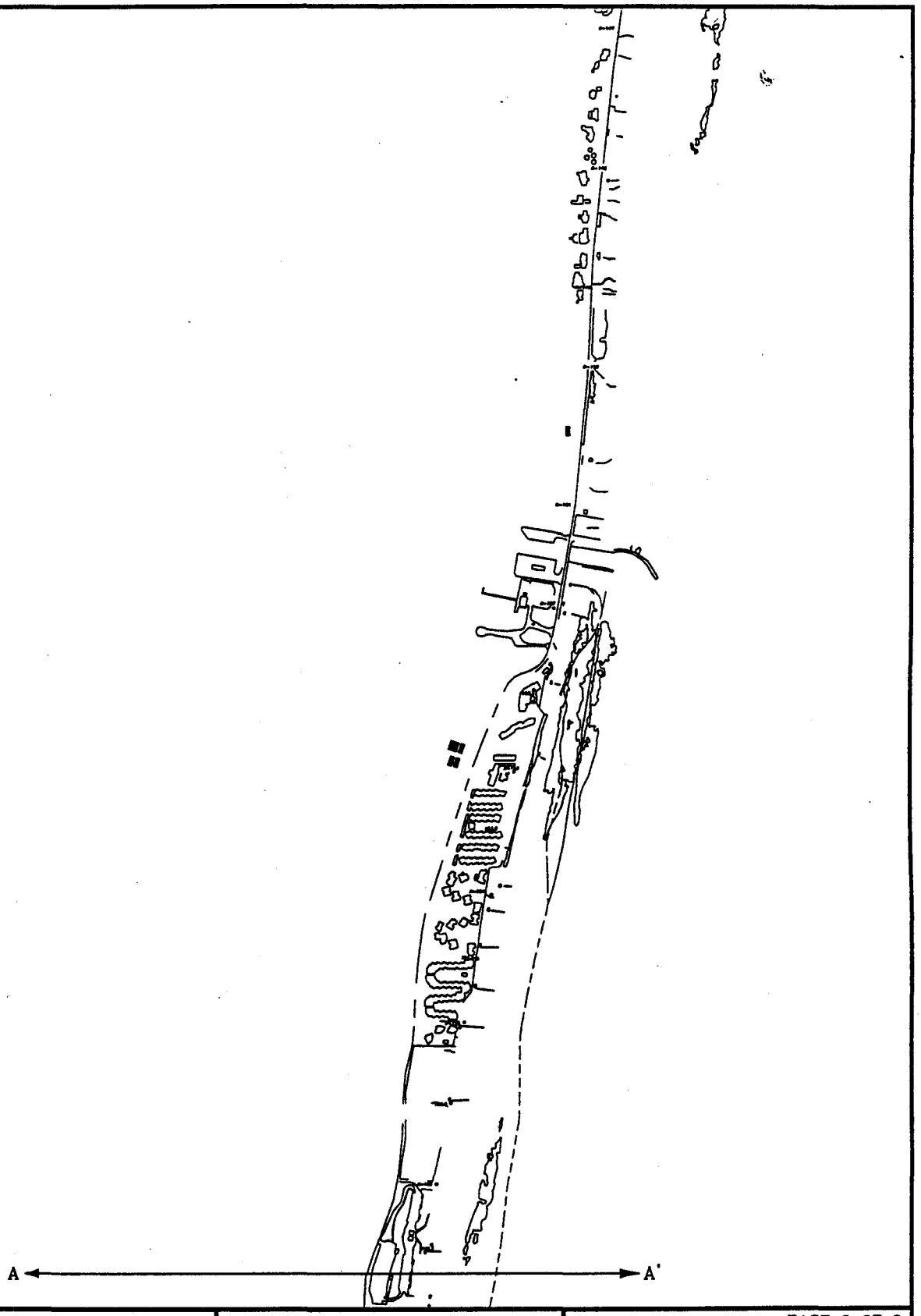

PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
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OCEAN RIDGE
SHORE PROTECTION PROJECT
LOCATION OF
NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

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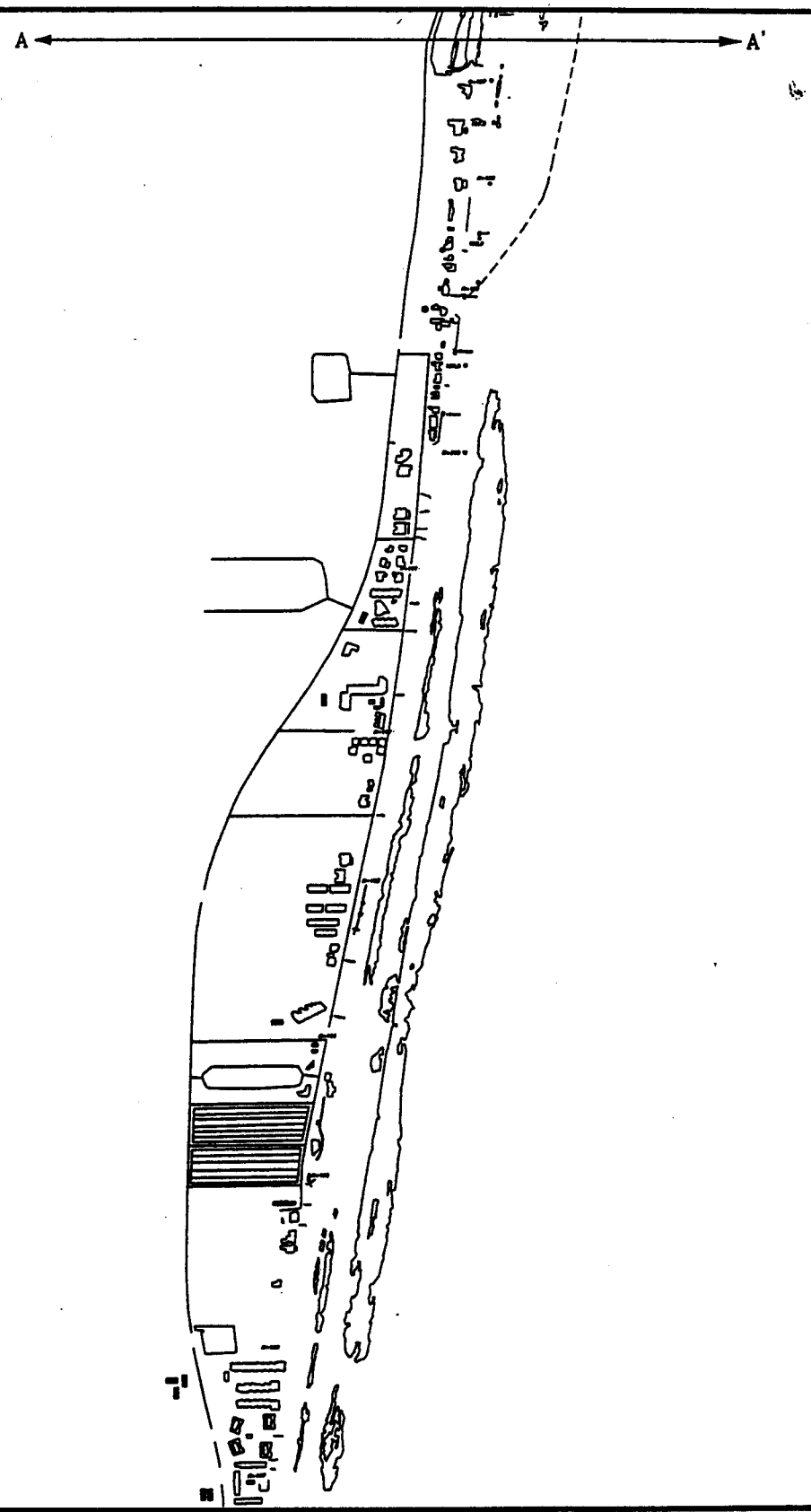

PALM BEACH COUNTY
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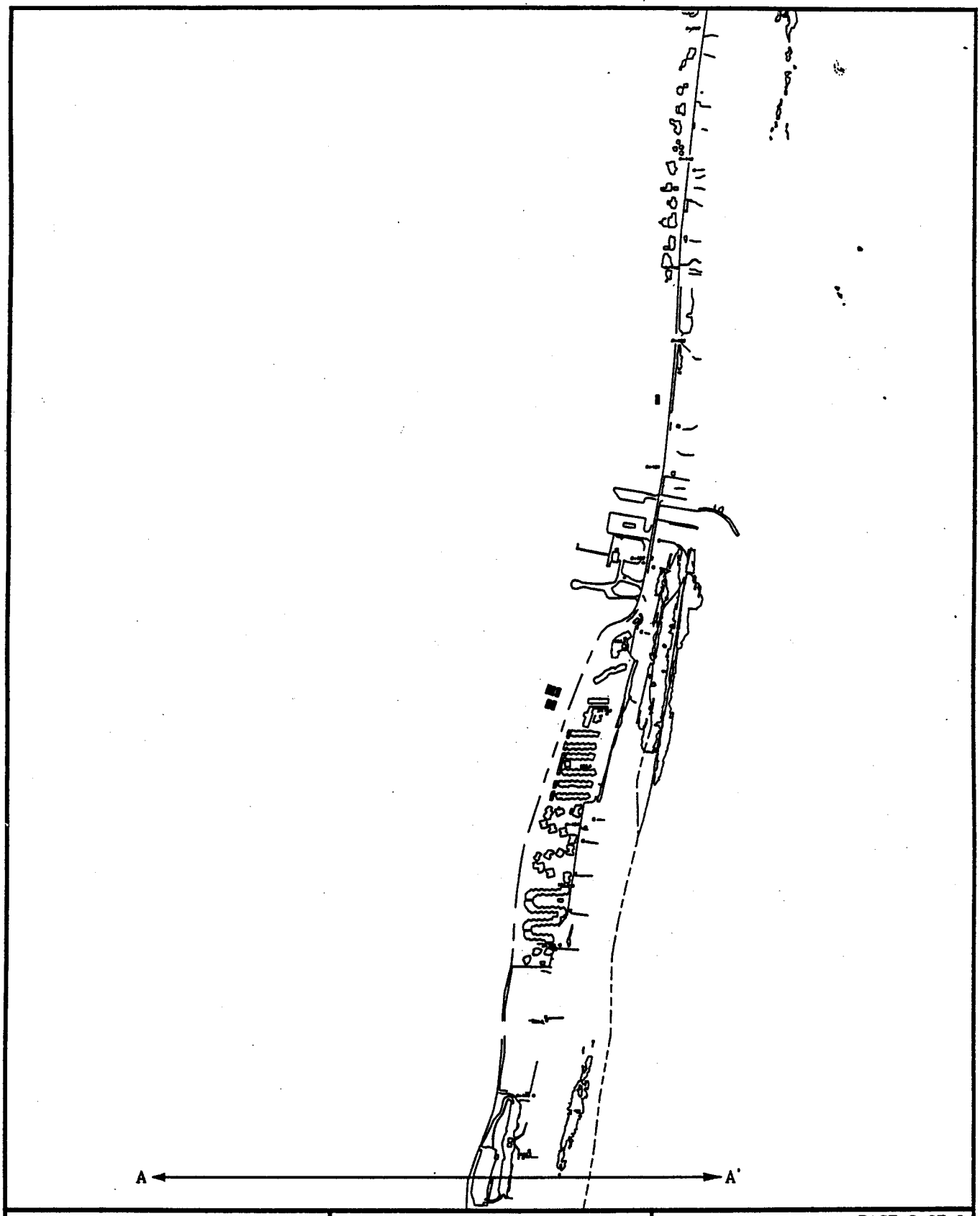
DATE: JULY 1993

SOURCE: PBC ERM CONTROLLED AERIAL PHOTOGRAPHY

AERIAL INTERPRETATION DATA:

TOTAL HARDBOTTOM AREA WITHIN PROJECT LIMITS:
537,642.57 SQ. FT. (12.34 ACRES)
TOTAL HARDBOTTOM AREA SURVEYED:
1,477,458.62 SQ. FT. (33.92 ACRES)
TOTAL HARDBOTTOM AREA WITHIN E.T.O.F.:
179,391 SQ. FT. (4.12 ACRES)
TOTAL HARDBOTTOM AREA WITHIN AREA OF IMPACT:
319,159 SQ. FT. (7.33 ACRES)

PALM BEACH COUNTY DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT	OCEAN RIDGE SHORE PROTECTION PROJECT LOCATION OF NEARSHORE HARDBOTTOM	SCALE: 1"=1200' PAGE 1 OF 3 (7/1993) -600 -300 0 300 600 900 1200 N OR 08/95 JW



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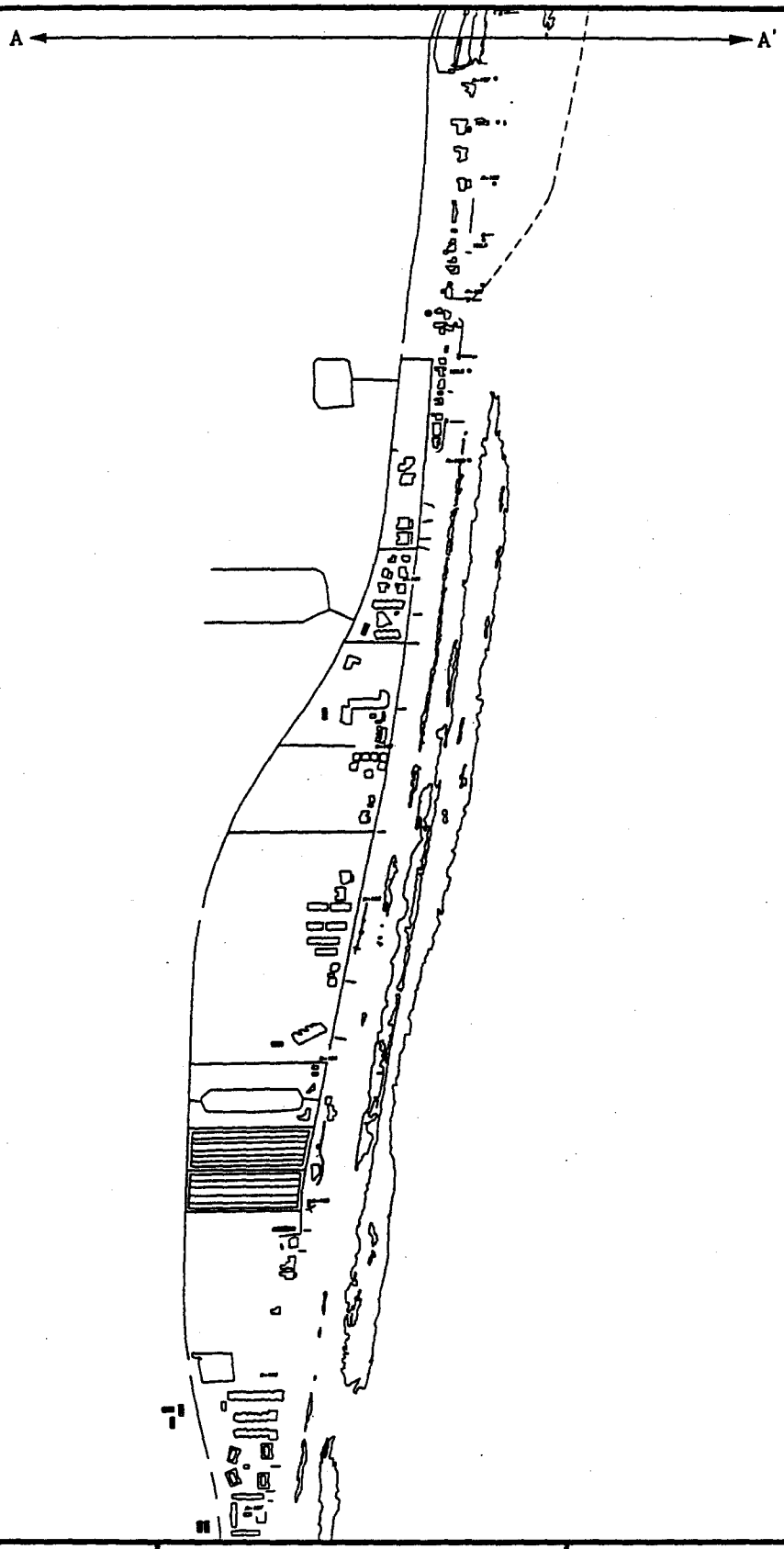

PALM BEACH COUNTY
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DATE: AUGUST 9, 1994
SOURCE: PBC ERM CONTROLLED AERIAL PHOTOGRAPHY

AERIAL INTERPRETATION DATA:

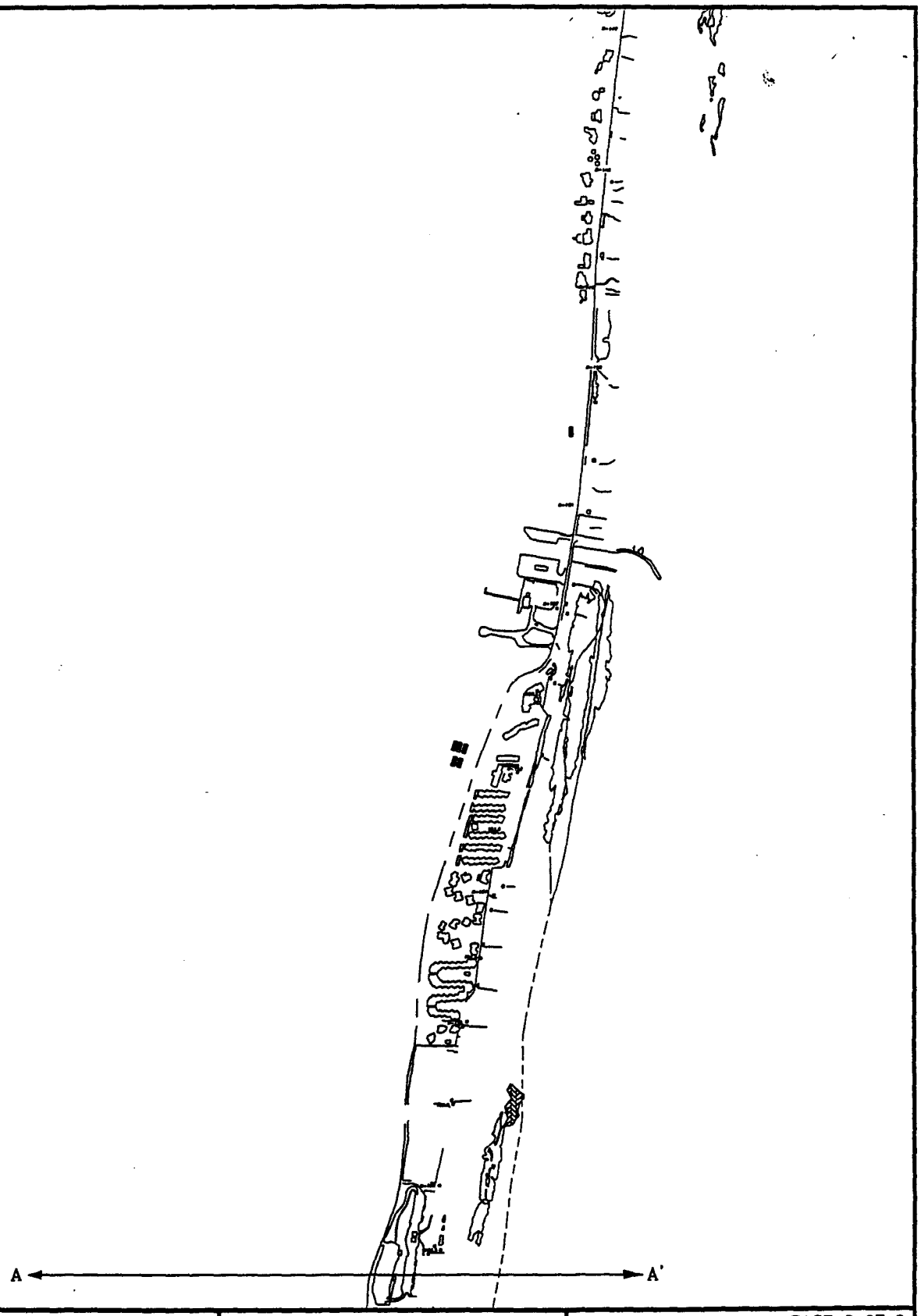
TOTAL HARDBOTTOM AREA WITHIN PROJECT LIMITS:
507,120.13 SQ. FT. (11.64 ACRES)

TOTAL HARDBOTTOM AREA SURVEYED:
2,135,345.77 SQ. FT. (49 ACRES)

TOTAL HARDBOTTOM AREA WITHIN E.T.O.F.:
280,090 SQ. FT. (6.43 ACRES)

TOTAL HARDBOTTOM AREA WITHIN AREA OF IMPACT:
408,593 SQ. FT. (9.37 ACRES)

PALM BEACH COUNTY DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT	OCEAN RIDGE SHORE PROTECTION PROJECT LOCATION OF NEARSHORE HARDBOTTOM	SCALE: 1"=1200' PAGE 1 OF 3 -600 -300 0 300 600 900 1200 OR 08/95 JW N



PALM BEACH COUNTY
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OCEAN RIDGE
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LOCATION OF
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SCALE: 1"=1200'

PAGE 2 OF 3

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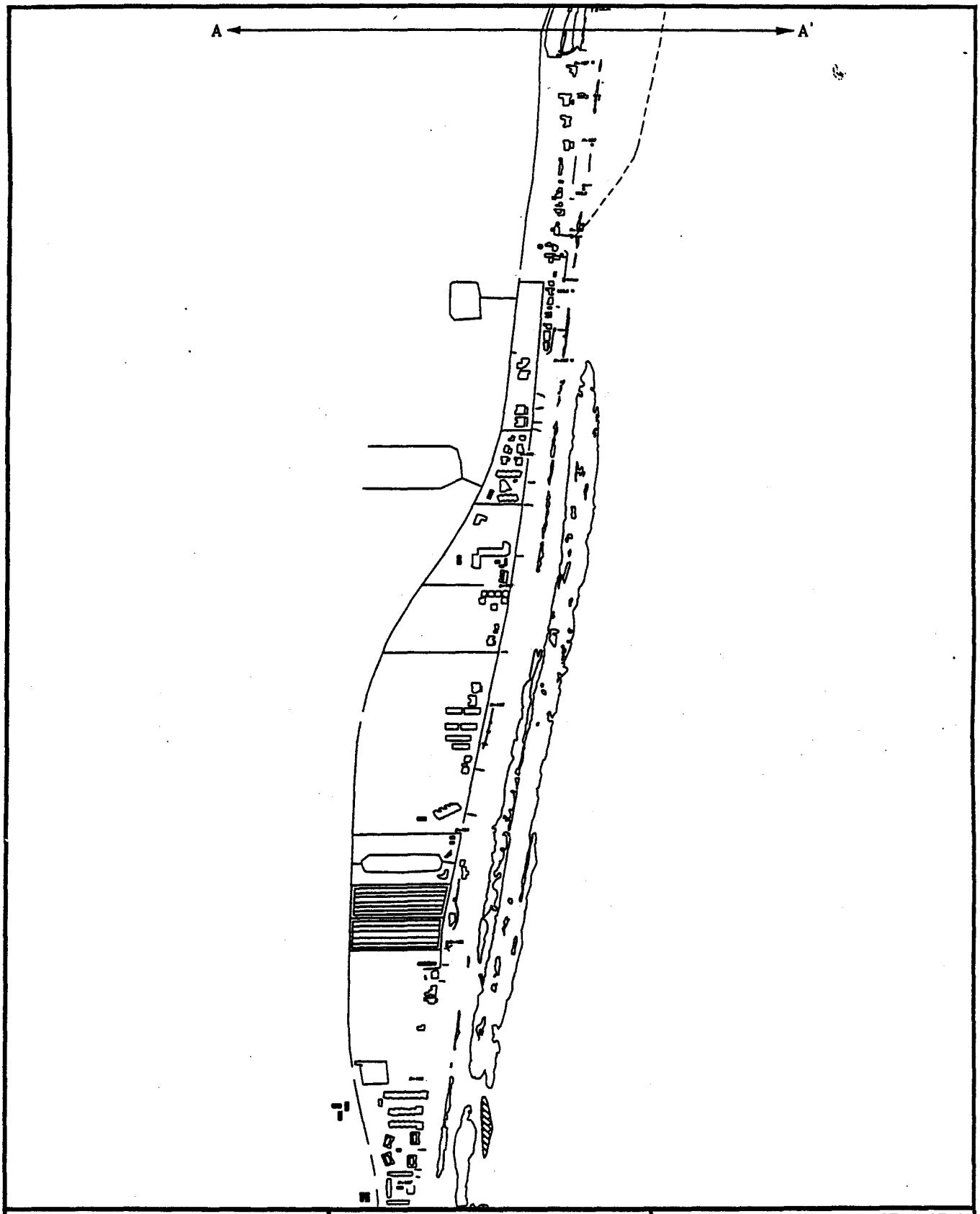

PALM BEACH COUNTY
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COMPOSITE NEARSHORE HARDBOTTOM LOCATION MAP

SOURCE: PBC ERM CONTROLLED AERIAL PHOTOGRAPHY

DATE: 11/83, 2/85, 8/91, 8/92, 3/93 AND 7/93

— — — MEAN HIGH WATER (MHW) LINE

PALM BEACH COUNTY
DEPARTMENT OF
ENVIRONMENTAL
RESOURCES
MANAGEMENT

OCEAN RIDGE
SHORE PROTECTION PROJECT
PROBABLE LOCATION OF
NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

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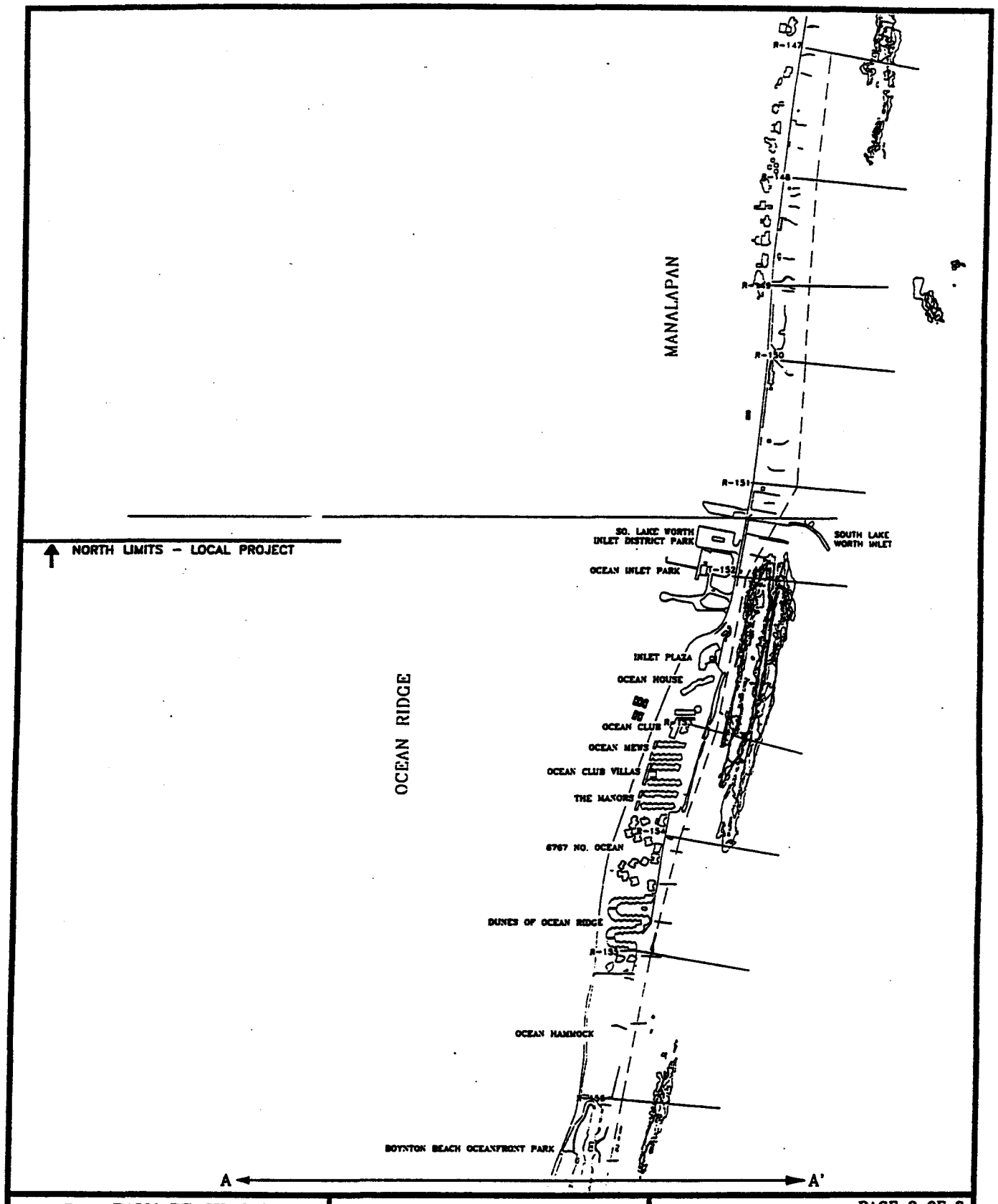

PALM BEACH COUNTY DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT

OCEAN RIDGE
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PROBABLE LOCATION OF
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SCALE: 1"=1200'

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PAGE 2 OF 3
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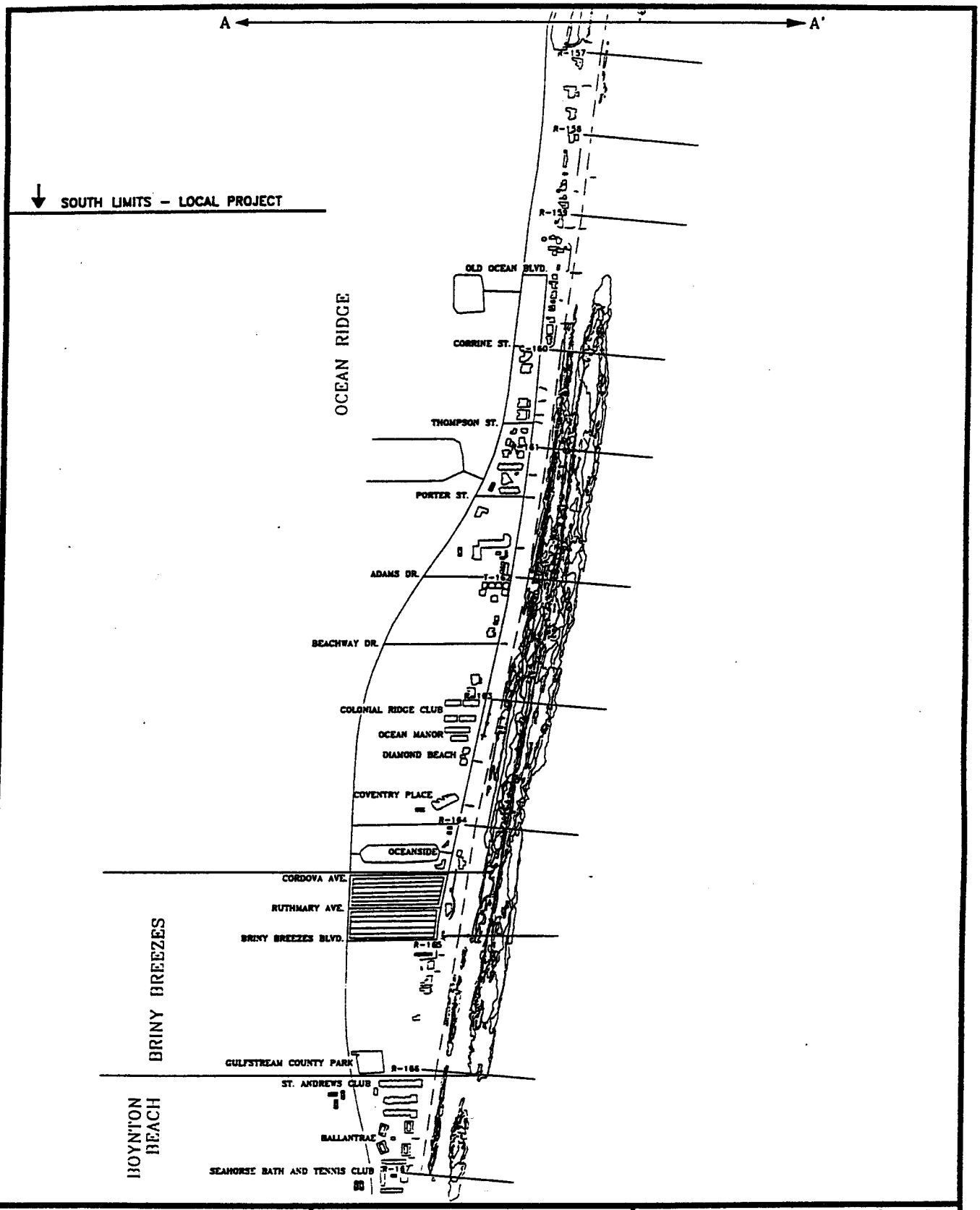

PALM BEACH COUNTY DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT

OCEAN RIDGE SHORE PROTECTION PROJECT PROBABLE LOCATION OF NEARSHORE HARDBOTTOM

SCALE: 1"=1200'

PAGE 3 OF 3 (COMPOSITE)

Attachment 1

USFWS Coordination Act Report and Biological Opinion

FISH AND WILDLIFE COORDINATION ACT REPORT

OCEAN RIDGE
PALM BEACH COUNTY, FLORIDA

Submitted to:
Department of the Army
Jacksonville District
Corps of Engineers
Jacksonville, Florida

RECEIVED
AUG 26 1994
ENVIRONMENTAL RESOURCES MANAGEMENT

U.S. Fish and Wildlife Service
Ecological Services
Vero Beach, Florida

JULY 1994

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. BOX 2676
VERO BEACH, FLORIDA 32961-2676

July 5, 1994

Colonel Terrence Salt
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Att: Planning Division

Dear Colonel Salt:

In accordance with the Fiscal Year 1994 Transfer Fund Agreement between The U.S. Fish and Wildlife Service (Service) and the Jacksonville District Corps of Engineers (Corps), this represents a Draft Fish and Wildlife Coordination Act Report on the Ocean Ridge Beach Nourishment Project. The Corps has requested an evaluation of the environmental effects of constructing 5 T-head groins and 5 breakwaters and depositing 700,000 cubic yards of dredged sand along 1.46 miles of beach at the town of Ocean Ridge, Florida. This information is needed to enable the Corps to evaluate the authorized project to determine whether or not it is consistent with current needs and criteria.

This draft report is presented in partial fulfillment of the Fish and Wildlife Coordination Act (16 U.S.C. 1531 et seq.), and does not represent the Secretary of Interior's report to Congress as required by that Act.

Copies of the report have been forwarded to the National Marine Fisheries Service, Marine Fisheries Commission and the Florida Game and Freshwater Fish Commission for their concurrence. Once concurrence is received, a copy of the Final Coordination Act will be circulated.

Sincerely Yours,

David L. Ferrell
Field Supervisor

Ocean Ridge
Palm Beach County
Beach Nourishment Project

Fish and Wildlife
Coordination Act Report

Submitted to Jacksonville District
U.S. Army Corps of Engineers
Jacksonville, Florida

Prepared by: Charles W. Sultzman, Project Biologist
and Patricia Richards, Biologist
Approved by: David L. Ferrell, Field Supervisor

Vero Beach Field Office
U.S. Fish and Wildlife Service
Vero Beach, Florida

July 1994

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IV. Fish and Wildlife Resources 1

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VI. Discussion and Impacts 8

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VIII. Fish and Wildlife Service Recommendations 10

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B. Nearshore Reefs at R-152-153
C. Nearshore Reefs at R-156

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Fig. 1. Project Limits and Location 2

EXECUTIVE SUMMARY

The Corps of Engineers (Corps) has requested a Fish and Wildlife Coordination Act Report from the U.S. Fish and Wildlife Service (Service) regarding the environmental impacts of a proposed beach nourishment project at Palm Beach County, Florida. Sand fill for the project would be obtained from a borrow area located approximately 2,000 feet offshore of the northern fill area. The fill is of high quality and no rock outcrops are located near the borrow area. Biological surveys of the area by the project sponsor and the sponsor's contractors have shown that there are rock outcrop reefs immediately offshore of the beaches proposed for renourishment. Service observations indicate there are currently approximately 2 acres of nearshore reef within the proposed fill area. Surveys by Palm Beach County indicate that reef acreage within the northern proposed fill area has fluctuated little since 1983. A recently exposed outcrop at R-156 lies in the approximate center of the project. This southern reef area, although a comparatively young community, is farther from the energy of the surf zone and supports a more diverse epifaunal community. Our observations show that both reef areas provide habitat for a diverse community of fishes and invertebrates.

The Service recommends these impacts be avoided; however, since the project lies immediately south of an inlet which deprives downdrift beaches of sand, the Service would accept some impacts with mitigation. Most of the biological functions of the existing reef may be replaceable if a well designed artificial structure of equal surface area and of similar substrate were placed outside the project area. The biological rational supporting this mitigation recommendation is provided in the report.

The groins and breakwaters, which will be deployed before sandpumping begins, will provide alternative habitat for fish displaced by the project. Due to the unpredictable nature of the impacts, Palm Beach County Department of Environmental Resources Management has recommended that aerial photographs showing the nearshore reefs at the project site be taken and groundtruthed immediately prior to and after project construction. The acreage of hard bottom buried by the beach fill and mitigation acreage would then be calculated.

The Draft Supplemental Environmental Impact Statement (SEIS) states that other than the groins and breakwaters, the project is planned for winter construction, outside sea turtle nesting season. If winter dredging is possible, few adverse impacts on sea turtles are anticipated. However, since groin and breakwater construction timing coincides with sea turtle nesting, the Service has prepared a Biological Opinion which is included as an attachment to this report.

I. INTRODUCTION

This project was authorized in 1962 by HD-164/87/1 which provided for federal participation in the costs of beach erosion control along two segments of the Palm Beach County, Florida Atlantic shoreline. The General Design Memorandum (GDM) and Environmental Impact Statement (EIS) for beach erosion control projects within Palm Beach County were published in April, 1987. Specific project plans for the Ocean Ridge segment are described in the SEIS which was published in January, 1994.

II. PROJECT DESCRIPTION

The presently considered project, which calls for the construction of a feeder beach, involves dredging 700,000 cubic yards from 27-38 foot depths offshore of the fill site and placing the sand along the beach beginning 400 feet north of Florida Department of Environmental Protection (FDEP) monument R-152 and ending 120 feet south of FDEP monument R-159, a total of about 1.46 miles (Figure 1.). The borrow area configuration for the project differs from previous plans, having been relocated to protect reefs and other resources. Silt and clay content of the sand at the borrow area is reported to be 1.5 per cent. The proposed project includes 1 spur on the south side of the south jetty of Boynton Inlet, 5 T-head groins and 5 nearshore breakwaters spanning about 2,300 feet of shoreline.

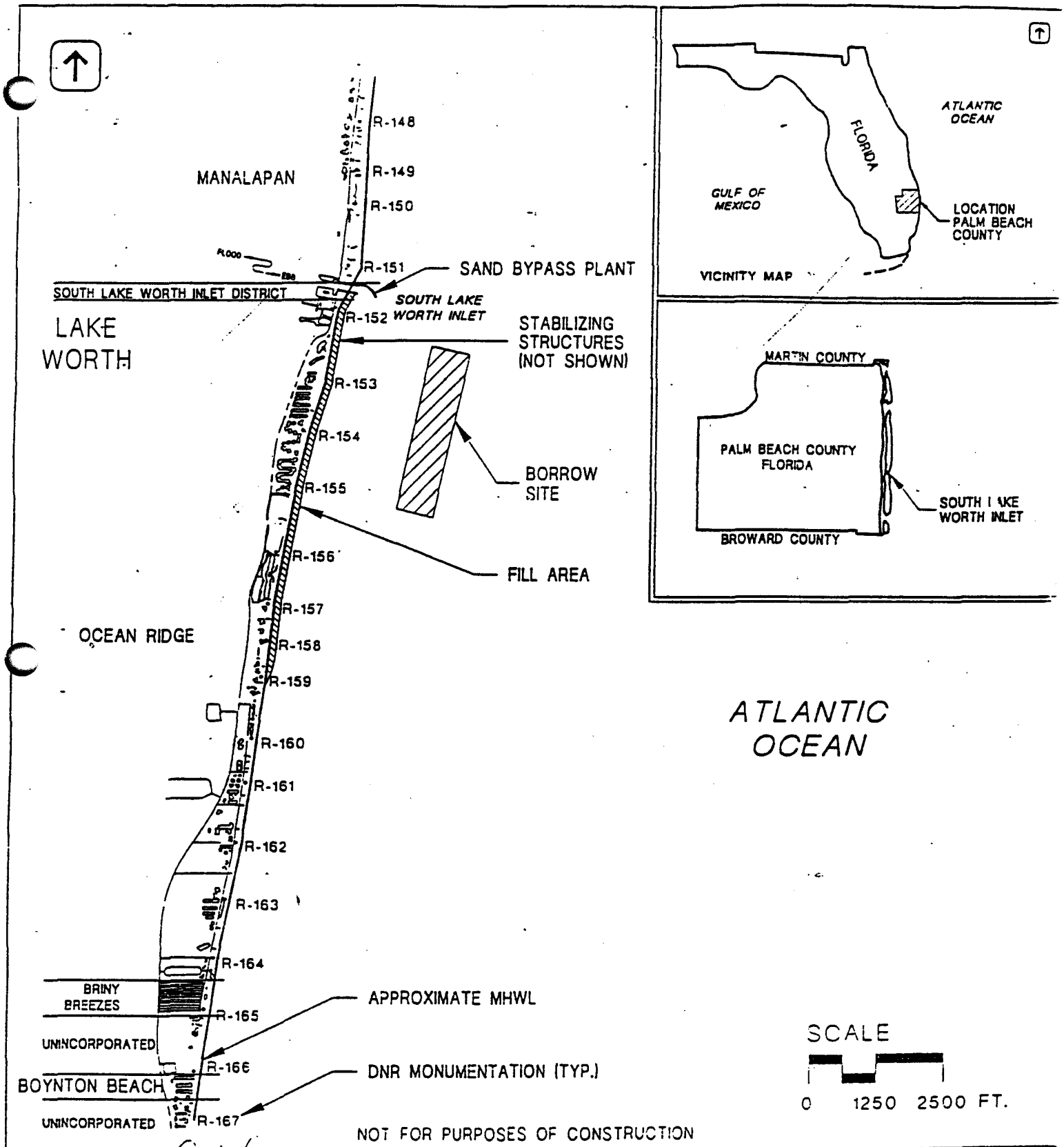
III. DESCRIPTION OF STUDY AREA

Palm Beach County is situated on the Atlantic coast of southern Florida. The coastal town of Ocean Ridge is located in south-central Palm Beach county on the Atlantic Ocean. The project site is located on the beaches immediately south of South Lake Worth (Boynton) Inlet (Fig. 1). See also the photographs of the existing beaches in appendix A.

The Gulfstream is closer to land in Palm Beach County than at any other point on the East Coast of the United States. As a result, nearshore waters tend to be warmer and clearer than those of nearby Broward and Martin Counties. The organisms which inhabit nearshore reefs are, therefore, not well adapted to survive turbid conditions and may be particularly sensitive to unnatural alterations in water quality and clarity.

IV. FISH AND WILDLIFE RESOURCES

Fish and wildlife habitats in the project area which could be affected by this beach erosion control project include the intertidal beach zone, borrow area, nearshore reefs and the supralittoral beach.



olsen associates, inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114
(Fax) 384-7388

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA

DATE	APPROVED	REVISION

DATE 6/23/93
DRAWN BY M.R.L
SHEET 1 OF 16

Fig. 1. Ocean Ridge Shore Protection Project Fill Limits

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(Dalrymple et. al.,

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NITY DESCRIPTIONS

ch Zone. The beaches of Palm Beach County are typical of other east-cen-
aches which are subject to the full force of ocean waves. These beaches
ow species diversity, but populations of individual species are often very
s such as coquina clams, ghost crabs, annelid worms, mole crabs and sand
ly specialized to survive in this high energy environment.

Numerous species of macro-invertebrates inhabit the proposed borrow ar-
lude, hydrozoan, bivalves, gastropods, annelids, crustaceans, sea cucum-
's, etc. These will be unavoidably lost during dredging. However, this habi-
e and the area will likely recover within one year (Courtenay, et. al. 1974).
(pected to inhabit this area would include penaeid shrimp, callenectid crabs,
ıle. These species should easily avoid the dredge and no adverse effects
:icipated.

fs. Coquina limestone reefs occur adjacent to and seaward of the project
; lie offshore of two seperate reaches of the proposed fill area, one at the
Boynton Inlet at R-152 through 153 and one in the middle of the project at
ı at R-156 (see Appendix B). These features have been mapped and
ılm Beach County personnel since November, 1983. Exposed hardbottom
of the project has changed little during the period while reef acreage in
ct area has increased from 0.26 to 1.59 acres.

ch. The supralittoral beach serves as nesting habitat for at least four spe-
d and endangered sea turtles.

MPORTANT SPECIES

ıs found (R-152 and 156) are located in different depths and support dif-
ı general the exposed rock provides stable substrate for sessile organ-
gh photosynthesis and filter feeding, produce basic organic material on
ɜ reef's food web is based. Carbon fixed offsite is concentrated on the
ɜeding organisms trap nutrient rich plankton which is swept past the reef
generated currents. Sessile cnidaria such as anemones and stinging
:ooplankton and other larger organisms which drift to them.

Invertebrates.

ɔod found on the reefs, fish and motile invertebrates are attracted to the
he reef. The numerous crevices, holes, and undercut ledges provide
predatory fish. It also provides a barrier to currents and substratum for
ɜrsal adhesive eggs.

Sea Turtles.

The loggerhead turtle (Caretta caretta) nests primarily on beaches from North Carolina to Florida. Approximately ninety percent of loggerhead nesting within the U.S. occurs in Florida (Murphy and Hopkins, 1984). The highest density nesting beaches in Florida occur from Canaveral National Seashore, Volusia County, south to John U. Lloyd State Recreation Area in Broward county (Conley and Hoffman, 1986). Nesting densities vary from less than one nest per kilometer (km) on the average for some beaches in the northeast, southeast, and panhandle of Florida to over 600 nests per km on some stretches of beach in south Brevard County (Ehrhart and Witherington, 1986). The most recent estimate for total annual nesting effort in the southeastern U.S. is 58,000 nests based on aerial surveys conducted in 1983 (Murphy and Hopkins, 1984). The U.S. loggerhead nesting population, one of the two most significant nesting populations in the world, may represent up to 30 percent of the worldwide loggerhead nesting population (Ross, 1982). This is in contrast to other sea turtle species where nesting occurs largely outside the U.S. The loggerhead nesting season is from late April to August, with most nesting occurring in June and July.

Green turtle (Chelonia mydas) nesting within the U.S. occurs principally along east central Florida beaches. Nesting densities are much lower than for the loggerhead and range from 1-5 nests per km on most beaches within its major nesting range, to 13-20 nests per km on high density green turtle nesting beaches in south Brevard County and south Jupiter Island in Palm Beach County (Conley and Hoffman, 1986; Ehrhart and Witherington, 1986). Nesting occurs from May to September with the peak nesting occurring in July and August.

The leatherback (Dermochelys imbricata), rarely nests in the continental U.S. Eighty-nine leatherback nests were recorded on the Florida east coast beaches in 1985 (Conley and Hoffman, 1986). Nesting begins as early as late February and ends by late July. Much of the nesting is centered in Palm Beach county but scattered nesting has been recorded on almost all Florida east coast County beaches with the most northerly record from Blackbeard Island, Georgia (Conley and Hoffman, 1986; Seyle, 1985).

The hawksbill (Eretmochelys imbricata) is a rare nester on southeastern U.S. beaches with only 1-2 nests recorded annually in Florida (Conley and Hoffman, 1986; Lund, 1985; Mcmurtray and Richardson, 1985). Nesting has been recorded for the months of June, July, August, and October and from Volusia, Martin, and Dade Counties (Dalrymple et. al., 1985; Lund 1985; McMurtray and Richardson, 1985).

V. FISH AND WILDLIFE SERVICE UNDERWATER OBSERVATIONS

On June 7-9, 1994, Service biologists inspected the reefs which would be affected by the project. In general, the two areas inspected differed in physical climate and in geomorphology. The reef offshore of R-156, as previously stated, was located in deeper

waters farther offshore where surf generated turbidity and turbulence have less of an influence than at the surfzone reefs near R-152 and 153. This has resulted in the growth of a denser epifaunal community. On the other hand, the physical structure of the nearshore edge of the outcrops at R-152 is more complex, providing more vertical relief and undercut ledges. Sabellariid worm colonies, the existing groins and associated rubble contribute to habitat complexity at R-152.

Results

Nearshore hardbottom habitats at R-152 (R-153) are characterized by higher vertical relief, more complex topography, shallower depths (0-10 feet), greater wave action and higher turbidity than areas at R-156. Crevices and overhangs provide protection for organisms such as echinoderms, mollusks and crustaceans. These organisms tend to be well-adapted to tidal changes of water levels and high wave energy. The area at R-156 is typified by low relief, deeper depths (20 feet), uniform longshore currents and relatively lower wave energy. This area is a suitable habitat for many sessile organisms, such as gorgonians and sponges, which rely on currents to provide food sources. Photographs of the area offshore of R-156 are given in appendix C. The epibenthos and invertebrates were identified to the lowest practical taxonomic level. The species and their respective locations are listed below.

Table 1. Invertebrate Species at Each Reef Location

PHYLUM	SPECIES	LOCATION
Annelida		
	Fire worm	R-156
	Sabellarid worm	R-152
Arthropoda		
	Arrow crab	R-152, R-156
	Barnacle	R-152, R-156
	Snapping shrimp	R-152, R-156
	Spiny lobster	R-152
Chordata		
	Black tunicate	R-156
Cnidaria		
	Branching vase sponge	R-156
	Bushy soft coral	R-156
	Encrusting colonial anemone	R-152
	Feather hydroid	R-156
	Fire coral	R-152, R-156
	Hydroid zoanthid	R-156
	Knobby candelabrum	R-156
	Lumpy overgrowing sponge	R-156
	Red encrusting sponge	R-152, R-156
	Sea feather	R-156

	Sea rod	R-156
	Starlet coral	R-152, R-156
	Tube sponge	R-156
Echinodermata		
	Gray sea cucumber	R-152
	Pencil urchin	R-152
	Red rock urchin	R-152
	Variable sea urchin	R-152
Ectoprocta		
	Common bugula	R-156
	Common sea mat	R-152, R-156
Mollusca		
	Atlantic wing oyster	R-156
	Spoted sea hare	R-152
	Stocky cerith	R-152
Porifera		
	Fire sponge	R-152, R-156
	Red boring sponge	R-152, R-156

A total of 31 species were positively identified at the project area, 18 species at R-152 (including R-153) and 22 species at R-156. Only 9 (29%) of these species were common to both areas. Species composition differed between the two areas due to the areas respective geomorphologies. The areas at R-152 generally supported more crevice dwelling motile organisms. The majority of organisms at R-156 were sessile, water-column feeders.

Fishes at each location were also identified. Each area differed in kind and arrangement of fish habitat. In the northern area (R-152-153) where a distinct reef to sand edge effect was evident, the inner and outer extremes of the reef held the greatest numbers and variety of fishes. Fissures in the rock at the south end of this feature provided increased sand to rock edge and vertical relief, increasing the effect. Most of the southern area (R-156) was relatively flat. The edges gradually sloped down into the sand, providing little relief. Groups of fishes were found clustered around scattered small areas where relief reached one foot or more. The fish species found at each location are given in Table 2. below.

Table 2. Fish Species at Each Reef Location.

SPECIES	LOCATION
Tarpon	R-152
Thread herring	R-152
Spotted moray	R-152
Squirrelfish	R-152, 156
White mullet	R-152
Great barracuda	R-152, 156
Common snook	R-152
Two-spot Cardinalfish	R-156
Yellow jack	R-152
Blue runner	R-156
Bar jack	R-152, 156
Gray snapper	R-152, 156
Schoolmaster snapper	R-152
Lane snapper	R-156
Tomtate	R-152, 156
French grunt	R-152, 156
Black margate	R-156
Margate	R-156
Cottonwick	R-156
Porkfish	R-152, 156
Silver porgy	R-152; 156
Smallmouth grunt	R-152
Sailor's choice	R-152, 156
Ceasar grunt	R-156
Saucereye porgy	R-156
High hat	R-152, 156
Spotted drum	R-156
Spotted goatfish	R-156
Copper sweeper	R-156
Yellowfin mojarra	R-152
Irish pompano	R-152
Mottled mojarra	R-152
Bermuda chub	R-152
Molly miller	R-152
Hairy blenny	R-152, 156
Banded butterflyfish	R-152, 156
Gray angelfish	R-156
French angelfish	R-156
Queen angelfish	R-152
Blue angelfish	R-156

SPECIES	LOCATION
Cocoa damselfish	R-152, 156
Beau Gregory	R-152, 156
Dusky damselfish	R-152
Bicolor damselfish	R-156
Sargent major	R-152, 156
Unidentified yellow damsel-fish	R-152
Slippery dick	R-152, 156
Painted wrasse	R-152
Puddingwife	R-152
Stoplight parrotfish	R-152, 156
Bluehead wrasse	R-152, 156
Blue parrotfish	R-152
Neon goby	R-156
Doctorfish	R-152, 156
Gray triggerfish	R-156
Orangespot filefish	R-152, 156
Honeycomb cowfish	R-156
Spiny puffer	R-152, 156

A total of 58 species were identified at the project area, 40 species at R-152 (including the area through R-153) and 39 species were observed at R-156. Approximately 36% of species were common to both reef areas. This, we believe, represents a significant dissimilarity between reef fish communities at the two areas.

VI. DISCUSSION AND IMPACTS

Beach zone. Since sandy beaches are populated by small, short-lived organisms with great reproductive potential, in most instances these communities recover quickly from environmental disturbances. The impacts of this beach erosion project on the beach zone fauna will depend primarily on the quality of the nourishment material. Since the sand proposed to be used for this project is of similar composition to the natural beach, recovery of the beach fauna should occur in a few months or less.

Nearshore Reef Zone. In agreement with the most recent surveys by Palm Beach County, we estimate that approximately 2 acres of nearshore reef will be buried by beach fill if this project is implemented as proposed.

Sea Turtles. The project may result in an increase in nesting suitability for endangered and threatened sea turtles. Some adverse effects may still result during construction if the project is done during the nesting season. These include:

1. Scarp development at the edge of the beach fill, rendering the beach inaccessible to nesting turtles,

2. Alterations in moisture levels or other aspects of the microhabitat within the nest cavity,

3. Alteration of unknown beach signature components which may disrupt nest site fidelity,

4. Compaction and cementation of beach sediments which causes reduced nesting success (nesting emergences/total emergence x 100), and aberrant nest cavity construction which in turn can result in broken eggs.

Project descriptions from Palm Beach County have indicated that the deposit of beach fill is intended to occur in winter, outside sea turtle nesting season. This proposal is also preferred by the Service. Except for possible post-project compaction of the fill, winter dredging would nearly eliminate deleterious effects of beach construction on sea turtles. The groins and breakwaters are proposed to be constructed during sea turtle nesting season. The Service has prepared a Biological Opinion addressing the potential for this construction to adversely affect sea turtle nesting. That Biological Opinion is included as an attachment to this report.

VII. MITIGATION

Two acres of the nearshore rock will be either buried or severely degraded by beach fill as a result of this project. As much of the reef at R-152 is devoid of epifauna and the reef at R-156 is newly exposed, epibiotic growth is recent and replaceable. This could be accomplished by providing new limestone substrate in the form of an artificial reef of equivalent surface area.

Too often, artificial reefs are created without a clearly defined purpose and without sufficient planning. The United States in particular has pursued an unsophisticated and frugal approach to artificial reef planning and construction. The use of scrap and discarded rubble, because of its low cost, is most commonly used (McGurrin, et. al., 1989) despite its inadequacy in providing suitable habitat for targeted species. In contrast, the Japanese have invested billions of dollars in developing techniques to create new habitat and increase seafood production (Grove, et. al., 1989; Sonu et. al., 1985). These efforts have been reported by Sheehy (1983), and Brock and Norris (1989) to have resulted in much more efficient reef technology. While costs per area of reef are higher, the increase in reef fish and epibenthic organism abundance per area over traditional U.S. reef technology (Sheehy, 1983; Brock and Norris, 1989) may more than offset this cost (Sato, 1985).

To correct the deficiencies in and fragmentation of the U.S. artificial reef program, the Secretary of Commerce was directed, under the provisions of the National Fishing Enhancement Act of 1984 to develop and publish a long-term National Artificial Reef Plan to promote and facilitate responsible and effective artificial reef use based on the best scientific information available. A working plan was published by the National Marine Fisheries Service in 1985 under the authorship of Richard B. Stone. To conform to the Plan each project should have a clearly defined list of species targeted for habitat enhancement and user group intended to be benefitted. In this case, the largest user groups which we expect will incur losses by the project are the local and vacationing snorkelers. Artificial reefs intended to mitigate for this project should keep benefits to these groups as the primary objective. This will require certain design features. The structures must provide a scenic, safe, and accessible replacement for the structure lost by the project.

Some features which should be incorporated into the design are: 1) extensive unshaded horizontal surface area for the attachment and growth of gorgonians and macroalgae; 2) openings near the bottom, for spiny lobster, depth of at least 2 ft. and height of no more than 1 ft.; 3) interstitial spaces of approximately 10 cubic ft.; 4) large overhanging ledges to provide shaded resting space for large fish, particularly common snook; 5) numerous projections, crevices, and holes to provide refugia for small fish and for juvenile fishes, as well as to provide additional surface area for epibiotic growth.

We have seen designs for concrete modules, similar in design to Japanese modules, which Palm Beach County Biologists are considering for construction and deployment as part of their artificial reef program. These structures incorporate many of the features

mentioned above but would be built of concrete rather than limestone. A possible solution to the potential problems associated with substrate selectivity in fouling organisms, would be to embed limestone rock in the surface of the concrete. Alternatively, the Corps, by letter dated February 27, 1990, to the City of Vero Beach, proposed as mitigation for reef loss due to the Indian River County Erosion Control project, the construction of 8 rock rubble reef structures 100 feet long by 50 feet wide by 5 feet high. If the rocks used to construct such a reef are of a variety of sizes and of sufficient diameter (2 feet minimum) to provide large interstitial spaces and if the majority of the surface area of the structure were limestone, we would consider a similar reef along with the proposed groins and breakwaters to constitute adequate habitat replacement for the losses resulting from the Ocean Ridge project. These structures would cover approximately 1 acre of the sea floor, but would be of such high relief as to place a greater proportion of the reef surface above the scour zone.
We would welcome the opportunity to work with Corps and Palm Beach County staff to develop a suitable yet economical reef design and monitor the effectiveness of that design.

VIII. FISH AND WILDLIFE SERVICE RECOMMENDATIONS

The Fish and Wildlife Service recommends that the following be included in future project planning:

A. <u>Reef Mitigation</u>

1. A new set of aerial photographs of the nearshore should be taken prior to beach construction and a precise measurement of the reef area within the toe of fill should be made. Once this is done, final mitigation acreage necessary to compensate for this burial can be calculated.

2. Under current conditions, approximately 2 acres of reef will be buried. We recommend that 0.5 acre of artificial reef is deployed prior to project construction. This will provide an alternative refuge for some of the fish displaced by the project. The breakwaters and T-groins may partially serve this purpose once the subtidal acreage of these structures is ascertained by the Service

3. Assuming that the artificial structure will have approximately twice as much surface area per acre above the scour zone as the natural reef, we recommend a mitigation ratio of no less than 0.5 to 1. This ratio does not apply to the breakwaters and T-groins if they are to be constructed of material other than limestone.

4. The artificial reef structure selected for mitigation should be designed to provide habitat for species which are of interest to local and vacationing

snorkelers. It should be constructed of natural material (i.e. limestone). Design features should include: a) extensive unshaded horizontal surface area; b) openings near the bottom for Florida lobster; d) interstitial spaces approximately 10 cubic feet; e) large overhanging ledges; f) numerous projections, crevices and holes.

5. We recommend that the designed reef consist of modules, either of limestone boulders or the limestone embedded concrete modules.

6. We expect that bed rock exists one or two feet below the sand just inshore of the exposed rock at R-156. Pending verification of this, we have tentatively selected the area as the mitigation site. The area is easily accessible to recreational divers and snorkelers being offshore of Oceanfront Park. In addition, an artificial structure may inhibit the seaward migration of beach fill, protecting the natural reef to some extent.

7. Monitoring and annual reporting to the Corps and resource agencies on the effectiveness of the mitigation should be incorporated as a project feature. Monitoring should include quantitative measurement of the macroepibenthos per square meter by wet weight of organisms which have been removed from the substrate. Comparisons should be made between total biomass, macroepifloral biomass and macroepifaunal biomass at the designed reef and at nearby natural reefs. Fin fish communities at both reef types should be censused and compared in number, species and biomass (estimated). Fish communities should also be compared at both reef types using similarity indexing. Sampling should take place once in each season for three years or until it is clear that community structure has stabilized.

8. The Service should be funded by the Corps of Engineers to participate in the monitoring of the designed reefs. This will promote a better understanding of design effects on reef communities and facilitate the development of an increasingly effective artificial reef strategy and better informed decision making for future Civil Works projects.

9. The reef mitigation plan described above should be included as a Federal project feature subject to cost-sharing (i.e. 60% Federal, 40% local) to defray the project sponsor's cost of mitigation.

B. <u>Threatened and Endangered Sea Turtles</u>

1. Service recommendations relative to threatened and endangered sea turtles may be found in the Biological Opinion attached to this report.

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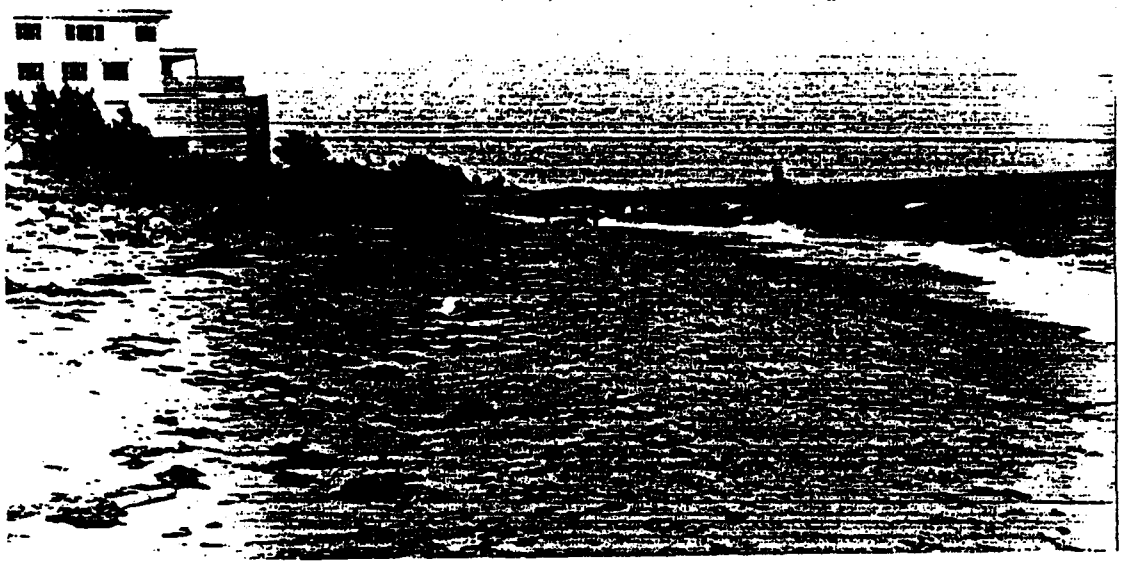
APPENDICES

Beach at R-152, South view

APPENDIX A

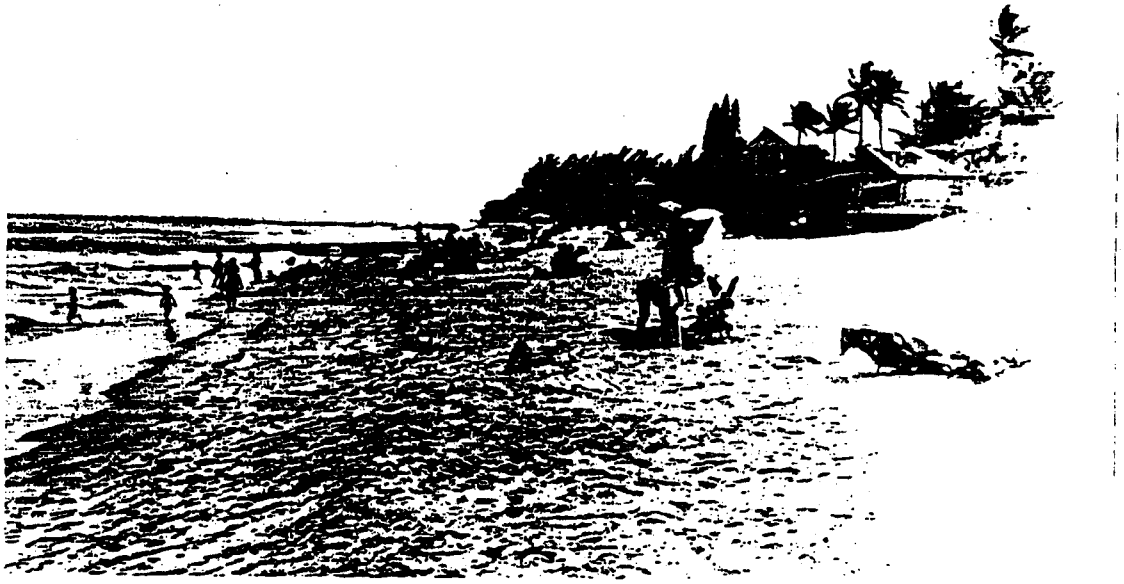


Beach at R-153, North view

Beach at R-153, South view

APPENDIX A CONTINUED

Beach at R-156, North view



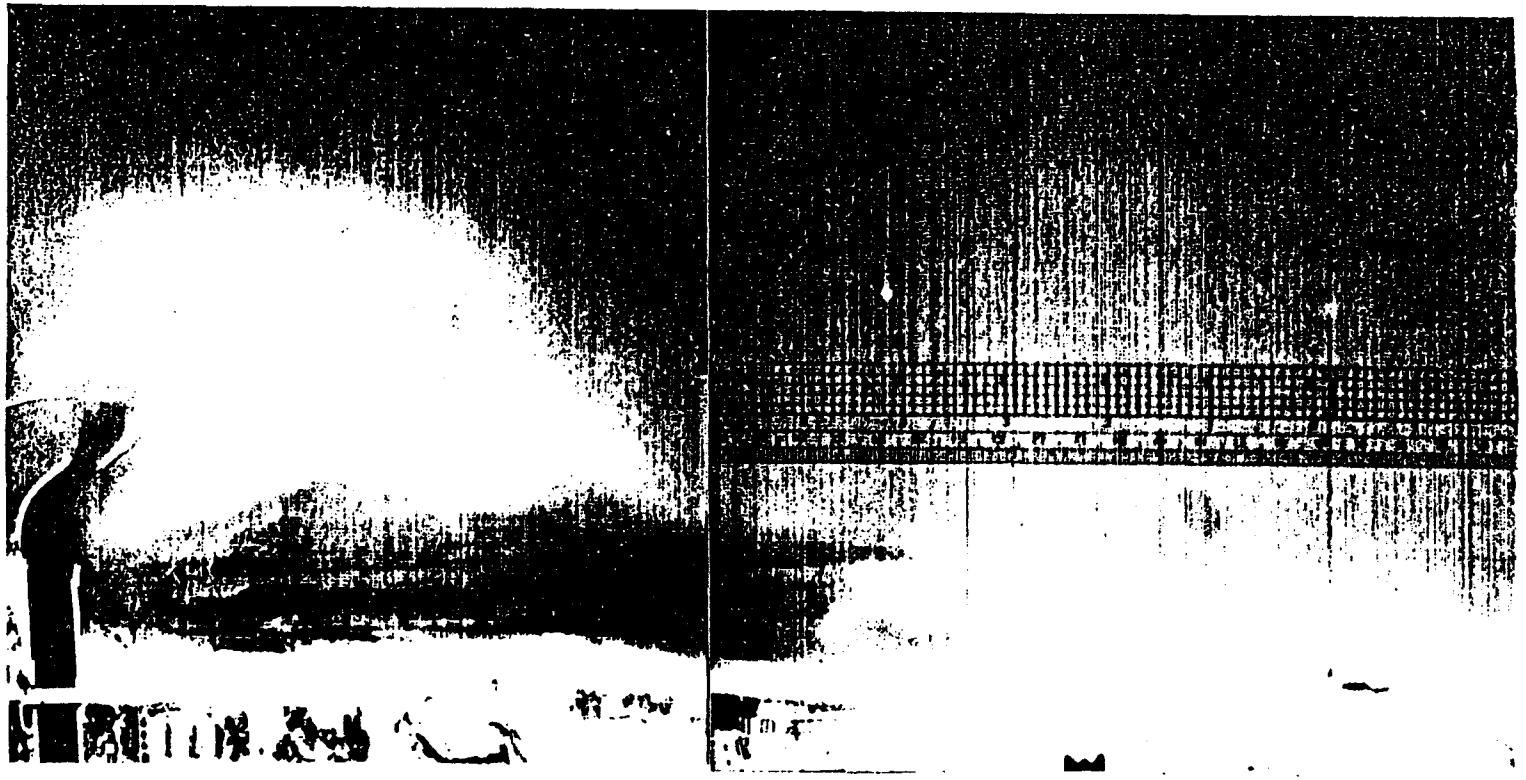
Beach at R-156, South view

APPENDIX A CONTINUED

Beach at R-157, North view

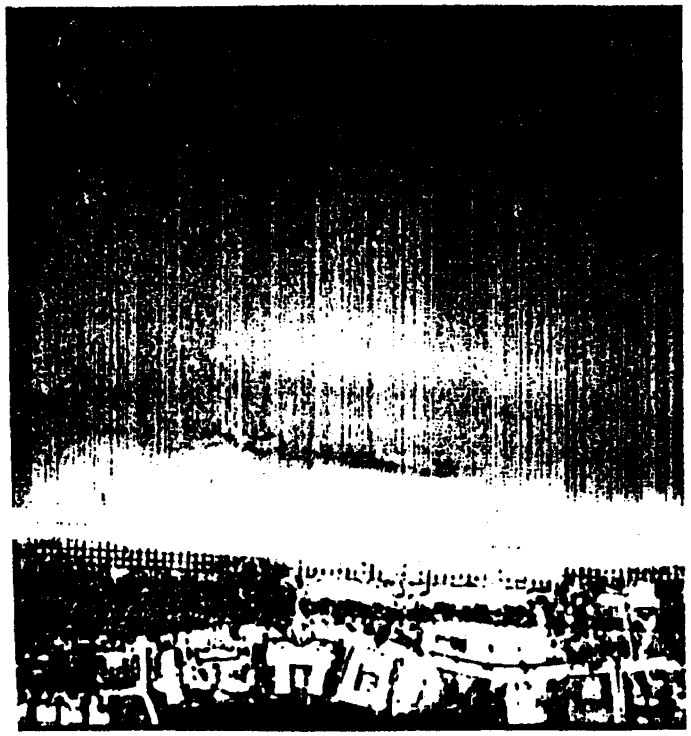
Beach at R-157, South view

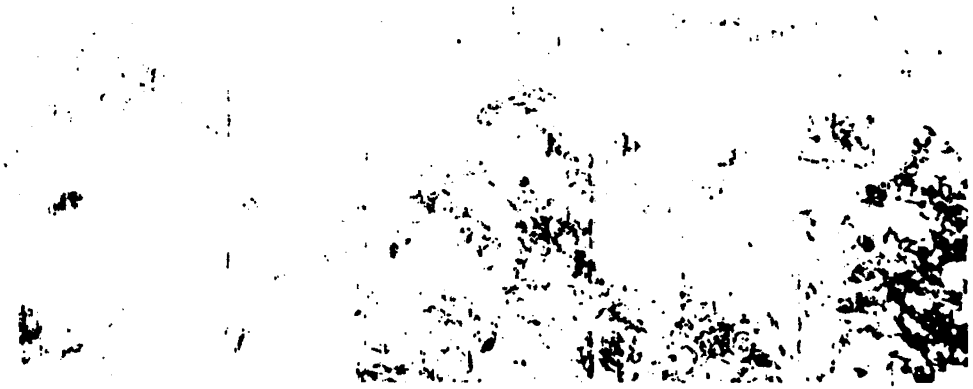
APPENDIX A CONTINUED



REEF AT R-152, R-153

APPENDIX B

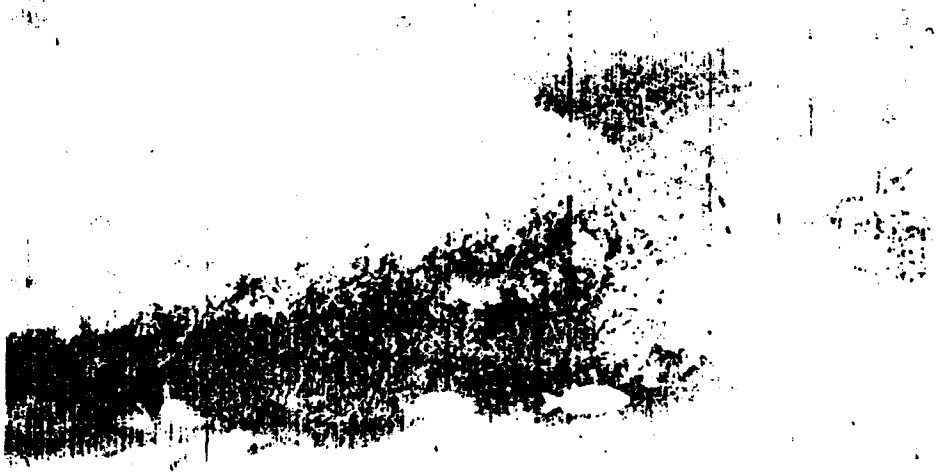




REEF AT R-156
AERIAL AND UNDERWATER PHOTO

APPENDIX B CONTINUED

Squirrel fish



High hat, cottonwick, grunts

Glassy sweepers, grunts, Cocoa damsel

Sergent major, porkfish, various grunts

Fish species at R-156
APPENDIX C

ATTACHMENTS

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P.O. BOX 2676
VERO BEACH, FLORIDA 32961-2676

May 26, 1994

Colonel Terrence Salt
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Att: Planning Division

FWS Log No.: 4-1-94-358

Dear Colonel Salt:

This responds to your letter of January 21, 1994, in accordance with Section 7 of the Endangered Species Act of 1973, as amended, on the proposed dredging for the Ocean Ridge Beach Nourishment Project, Palm Beach County, Florida.

In your letter you have determined that the project may affect threatened and endangered sea turtles. The Service concurs which your determination of may affect and has prepared the following Biological Opinion.

PROJECT DESCRIPTION

The project is located at the town of Ocean Ridge in Palm Beach County, Florida. The proposed plan calls for the placement of approximately 700,000 cubic yards of sand along 1.46 miles of beach. The northern project boundary is the south jetty at South Lake Worth Inlet (Boynton Inlet) and the southern boundary is located just south of DNR monument R-159. In addition to the placement of sand on the beach, five T-head groins and five nearshore breakwaters will be constructed in the northerly 2,500 feet of the project. The borrow area for the project is located between 1,750 and 2,800 feet offshore of the fill area in 30-35 feet of water. The material to be dredged and placed on the beach has a silt\clay content of 0.8 percent.

Dredging and filling for the project are proposed to occur during the winter, outside of the main portion of sea turtle nesting season. The breakwaters and groins are proposed to be constructed from April 1 through September 30.

FISH AND WILDLIFE RESOURCES

Fish and wildlife habitats in the project area which could be affected by the beach project include the intertidal beach zone, nearshore reefs, and the supralittoral beach which serves as nesting habitat for three species of threatened or endangered sea turtles.

Community Descriptions

Intertidal Beach Zone. The beaches of Palm Beach County are typical of other east-central Florida beaches which are subject to the full force of ocean waves. These beaches usually have low species diversity, but populations of individual species are often very large. Species such as coquina clams, ghost crabs, mole crabs and sand drum are highly specialized to survive in this high energy environment.

Nearshore Reefs. Approximately 10 acres of nearshore reefs lie within the project area. These reefs will be described in our Coordination Act Report for the overall project.

Supralittoral Beach. At least three and possibly four species of threatened and endangered sea turtles nest on the beaches within the project area. The extent to which these turtles utilize Ocean Ridge Beach and the anticipated impact of the project on sea turtles is discussed in detail in the following Biological Opinion.

CONSULTATION HISTORY

By letter dated January 21, 1994, the Corps determined that the project may affect threatened and endangered sea turtles. The Service concurs with that determination and provides the following Biological Opinion.

BIOLOGICAL OPINION

This represents the Biological Opinion of the Fish and Wildlife Service pursuant to Section 7(a)(2) of the Endangered Species Act. An administrative record of this consultation is on file in the Vero Beach, Florida, Field Office.

A. Species Affected.

Four species of sea turtles are known to nest in Florida: the loggerhead (Caretta caretta), green (Chelonia mydas), leatherback (Dermochelys coriacea), and hawksbill (Eretmochelys imbricata). The loggerhead turtle is known to be, by far, the most common nesting species at the project site. Nesting by green turtles and leatherback turtles is relatively low along Florida's Atlantic coast, but nesting by these species has been documented along the stretch of beach which may be impacted by the proposed project. Hawksbill turtles are rarely found nesting on Florida's beaches; nests have been recorded from Volusia, Brevard, Martin, and Dade Counties, but none has yet been documented for Palm Beach County. The Service has provided detailed descriptions of the biology of each of the above species of sea turtles in a recent Biological Opinion (Delray Beach, FWS Log No. 4-1-90-274).

The project area beaches are narrow and constitute low quality sea turtle nesting habitat. Palm Beach County has compiled data on sea turtle nesting density in the area for the 1990-1992 nesting seasons. These data show that for the first mile south of the Inlet, nesting density increases sharply. The first 0.13 miles totaled 2 nests or 15 nests per mile while the southern 0.22 miles totaled 66 nests equaling 306 nests per mile during the study period. All but 7 of these nests were loggerhead nests. Within the southern half of this first mile south of the Inlet, 2 green sea turtle nests and 3 leatherback nests were recorded during 1990-1992.

B. Potential Adverse Impacts.

We are concerned with the timing of the beach nourishment. We believe that even if beach nourishment is undertaken outside the peak nesting season, nourishment could occur during the beginning or toward the end of nesting season. Even with a relocation program, some nests will most likely remain undetected and subsequently buried by the nourishment material or crushed by heavy equipment. In spite of the best intentions and efforts by persons relocating nests; wind, rain, and tides can quickly obscure tracks and prevent workers from finding nests. In addition, turtles' activities can often obscure nest locations, making interpretation of the site difficult; and, depending on the experience and motivation of workers, some nests will remain undetected. Also, the physical impact of the construction equipment must be considered.

We are also concerned with the timing of construction of the T-shaped groins. Again, with construction scheduled for the peak nesting season, the shortcomings of a relocation program mentioned above are of even greater concern. These structures are proposed for the first .24 miles of beach south of the Inlet. However, as these groins will be constructed one at a time, construction activities will be restricted to a small area at any given time.

INCIDENTAL TAKE

Section 7(b)(4) of the Act requires that when a proposed agency action is found to be consistent with Section 7(a)(2) of the Act and the proposed action is likely to result in the take of some individuals of the listed species incidental to the action, the Service will issue a statement that specifies the impact (amount or extent) of such incidental taking. It also states that reasonable and prudent measures, coupled with terms and conditions to implement these measures, be provided to minimize such impacts. The Service must also specify procedures to be used to handle or dispose of any individual specimens taken. Reasonable and prudent measures are <u>non-discretionary requirements</u> of the action agency.

We have reviewed the biological information and other information relevant to this action, and based on our review, incidental take is authorized for all nests missed by a nest relocation program within the project boundary. This is inclusive of the direct impacts of nest burial and crushing and the indirect impacts of aberrant nests and broken

eggs which may result from sand compaction in nesting seasons subsequent to nourishment activities.

REASONABLE AND PRUDENT MEASURES

The Service considers the following reasonable and prudent measures are necessary and appropriate to minimize the take of threatened and endangered sea turtles:

1. Beach nourishment will not occur during the main portion of the nesting season.

2. During periods of lower nesting activity near the beginning and end of the overall turtle nesting season, relocation of nests will be required.

3. Nourished beaches will be tilled if compaction or escarpments occur.

4. Groin construction will be scheduled to occur in the lowest nesting density beaches during the peak of the nesting season and in higher nesting density areas prior to the peak nesting season.

TERMS AND CONDITIONS

Section 9 of the Endangered Species Act prohibits the taking of listed species without a special exemption. In order to be exempt from the prohibitions of Section 9 of the Act, the following terms and conditions, which implement the reasonable and prudent measures described above, must be complied with.

1. To reduce the possibility of sea turtle nest burial or crushing of eggs, beach and dune restoration will be started after November 1 and be completed before May 1.

2. All nests layed within the groin area prior to April will be relocated. Construction should begin as early in April as possible and proceed from the southernmost groin toward the north. Relocation will continue, but, as the southern groins are completed, the need for nest relocation in the south portion of the groin area ends and relocation will not continue. Thus, relocation activities will be confined to the progressively smaller area in which construction activities are still planned.

3. Nest surveys and relocations will be conducted by personnel with prior experience and training in nest survey and relocation procedures, and with a valid Florida Department of Environmental Protection permit. This is essential to reduce the number of undetected nests.

4. Eggs shall be relocated between sunrise and 10 a.m. each day and relocation will be to a nearby self-release beach site in a secure setting where artificial lights will not conflict with hatchling sea turtle orientation.

5. Prior to May 1 in the year of beach construction and prior to May 1 for three subsequent years, beach compaction will be monitored in the area of restoration. A minimum of 30 beach compaction measurements, at test depths of 15, 30, and 50 centimeters, will be taken per 1,000 continuous linear meters of beach restoration.

6. If the average of the 30 measurements at one or more of the test depths exceeds 500 cone penetrometer units (cpu), the Corps will immediately confer with the Service as to whether beach tilling to a depth of 75 cm or greater is needed. If the Service judges that tilling is needed, the tilling will be performed immediately prior to the sea turtle nesting season.

7. The March 1 to May 1 sea nest turtle nest surveyors will report any permanent escarpments that form that exceed 20 cm in height for a length exceeding 30 linear meters.

8. If such escarpments form, the applicant will immediately confer with the Service as to whether the escarpment should be leveled and whether tilling is needed to loosen the beach material.

9. The applicant will ensure that contractors doing the dune restoration work fully understand the sea turtle protection measures detailed in this biological opinion.

10. A report describing the actions taken to implement the terms and conditions of this biological opinion will be submitted to the Vero Beach Field Office within 60 days of completion of the proposed work. A report of the beach compaction averaged cpu values will be provided to the Vero Beach Field Office prior to May 1 for three years following construction.

In the event a sea turtle nest is excavated during dune restoration activities, the following procedure should be followed:

1. Immediately notify the Florida Department of Natural Resources-permitted individual responsible for nest relocation on the project for removal of the nest to the beach hatchery. Before eggs are relocated, the top of each egg will be marked with a non-toxic felt-tipped pen and individually and gently placed on 2-3 inches of moist sand in a rigid-walled container, being careful not to change the axis of the eggs. Eggs will be covered with a fine nylon mesh and then 2-3 inches of moist sand, shaded from the sun, and immediately transported to the hatchery. Eggs will be placed one at a time in the artificial nest chamber, while ensuring that the orientation of each egg remains as in the natural nest.

This concludes consultation under Section 7 of the Act, as amended. If there are modifications made to the project or if additional information becomes available relating to threatened or endangered species, re-initiation of consultation may be necessary.

If you have further questions on this matter, please contact Charles W. Sultzman of my staff(407-562-3909).

Sincerely Yours,

David L. Ferrell
Field Supervisor

cc:
EPA, Atlanta, GA
NMFS, St. Petersburg, FL
NMFS, Panama City, FL
DEP OPSM, Tallahassee, FL
FG&FWFC, Vero Beach, FL
DEP, Beaches and Shores, Tallahassee, FL
FWS, Jacksonville, FL

Attachment 2

State Water Quality Certification

RECEIVED
JUN 13 1996
ENVIRONMENTAL RESOURCES MANAGEMENT

Department of Environmental Protection

Coastal & Wetlands
Eng. Review
Mosquito Control
Water Resources
Business Mgmt
Asst. City Admin.
County Attorney
Copy ☐ File
Dg 6/13
RW

Lawton Chiles
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Virginia B. Wetherell
Secretary

PERMITTEE:
Palm Beach County
Department of Environmental
Resources Management
3323 Belvedere Road,
Building 502
West Palm Beach, Florida
33406

Permit Number: 502355609
Date of Issue: June 10, 1996
Expiration Date: June 10, 2001
County: Palm Beach
Project: Wetland Resource,
5 years

This permit is issued under the provisions of Chapters 373 and 403, Florida Statutes, Public Law 92-500, Title 62, and Rule 62-312, Florida Administrative Code. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawing(s), plans, and other documents attached hereto or on file with the department and made a part hereof and specifically described as follows:

PROJECT DESCRIPTION:
The shore protection project consists of beach restoration along 1.42 miles of shoreline, periodic nourishment from sand bypassing activities, and construction of eight T-head groins in the northern 1,800 feet of the project area. This permit is issued in conjunction with a variance, File No. VE-50-650, establishing a mixing zone extending 300 meters offshore and 500 meters downcurrent from the point of sand discharge onto the beach.

PROJECT LOCATION:
The project site is located within the Town of Ocean Ridge along 1.42 miles of Atlantic shoreline from 180 feet south of South Lake Worth Inlet to DNR monument R-159, Sections 15, 22, 27, Township 45S, Range 43E, Palm Beach County, within the landward extent of the Atlantic Ocean, Class III Waters.

GENERAL CONDITIONS:
1. The terms, conditions, requirements, limitations and restrictions set forth in this permit, are "permit conditions" and are binding and enforceable pursuant to Sections 403.141, 403.727, or 403.859 through 403.861, F.S. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violation of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may

constitute grounds for revocation and enforcement action by the Department.

3. As provided in subsections 403.087(6) and 403.722(5), F.S., the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in this permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.

6. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, are required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:

(a) Have access to and copy any records that must be kept under conditions of the permit;

(b) Inspect the facility, equipment, practices, or operations regulated or required under this permit; and

(c) Sample or monitor any substances or parameters at any location reasonable necessary to assure compliance with this permit or Department rules.

Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:

a. A description of and cause of noncompliance; and

b. The period of noncompliance, including dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance. The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Sections 403.111 and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules. A reasonable time for compliance with a new or amended surface water quality standard, other than those standards addressed in Rule 62-302.500, F.A.C., shall include a reasonable time to obtain or be denied a mixing zone for the new or amended standard.

11. This permit is transferable only upon Department approval in accordance with Rules 62-4.120 and 62-730.300, F.A.C., as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. This permit or a copy thereof shall be kept at the work site of the permitted activity.

13. This permit also constitutes Certification of Compliance with State Water Quality Standards (Section 401, PL 92-500).

14. The permittee shall comply with the following:

    a. Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.

    b. The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date of the sample, measurement, report, or application unless otherwise specified by Department rule.

    c. Records of monitoring information shall include:

        1. the date, exact place, and time of sampling or measurements;

        2. the person responsible for performing the sampling or measurements;

        3. the dates analyses were performed;

        4. the person responsible for performing the analyses;

        5. the analytical techniques or methods used; and

        6. the results of such analyses.

15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware the relevant facts were not submitted or

were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

SPECIFIC CONDITIONS:

1. The permittee is hereby advised that Florida law states: "No person shall commence any excavation, construction, or other activity involving the use of sovereign or other lands of the state, title to which is vested in the Board of Trustees of the Internal Improvement Trust Fund or the Department of Environmental Protection under Chapter 253, until such person has received from the Board of Trustees of the Internal Improvement Trust Fund the required lease, license, easement, or other form of consent authorizing the proposed use." Pursuant to Florida Administrative Code Rule 18-14, if such work is done without consent, or if a person otherwise damages state land or products of state land, the Board of Trustees may levy administrative fines of up to $10,000 per offense.

2. If historical or archaeological artifacts, such as Indian canoes, are discovered at any time within the project site the permittee shall immediately notify the district office and the Bureau of Historic Preservation, Division of Historical Resources, R. A. Gray Building, 500 S. Bronough St., Tallahassee, Florida 32399-0250.

3. At least 48 hours prior to commencement of work authorized by this permit, the permittee shall notify the Department of Environmental Protection, Bureau of Beaches and Coastal Systems in Tallahassee, and the Southeast District office in West Palm Beach, in writing of this commencement.

4. The permittee acknowledges that the beach area to be constructed is a public beach and shall be accessible to the general public. The permittee shall ensure that signs which identify portions of the nourished beach within the project area as "private" are not erected by any public or private entity.

5. The permittee shall schedule a pre-construction conference to review the specific conditions and monitoring requirements of this permit with the permittee's consultants, contractors, and construction crews prior to commencement of any work authorized by this permit. The permittee shall provide a minimum of 14 days advance written notification to the Bureau of Beaches and Coastal Systems, in Tallahassee, and to the Southeast District Office of the date, time, and location of the pre-construction conference.

6. Best management practices shall be used at all times during construction to minimize turbidity at both the borrow and fill

sites. When hydraulic pumping of fill sand onto the beach is utilized, these practices shall include constructing dikes parallel to the shore and landward of mean high water and discharging sand pumped from the borrow area along the landward side of the dikes. If sand is to be hydraulically pumped onto the beach, the opening of the discharge pipe shall be behind the dike at all times and shall be at least 50 feet from the end of the dike where sand flows out onto the beach. This condition does not apply to sand placed from the sand bypassing plant.

7. Construction at the project site shall be monitored closely to assure that turbidity levels do not exceed 29 NTUs above background levels at the edge of the mixing zone established for this project. Accordingly, an individual familiar with beach construction techniques and turbidity monitoring shall be present at the sand disposal sites at all times when fill material is discharged onto the beaches. This individual shall serve as a site supervisor and shall have authority to alter construction techniques or shut down the dredging or beach construction operations if turbidity exceeds 29 NTUs above natural background levels outside of the designated mixing zone. The names and qualifications of those individuals performing those functions shall be submitted for approval to the Bureau of Beaches and Coastal Systems in Tallahassee, with a copy to the Southeast District Office in West Palm Beach, at least 60 days prior to beginning construction. A transmittal sheet labelled **"This information submitted in accordance with the requirements of Specific Condition No. 7 of Permit No. 502355609"** shall be attached to the above-referenced information when submitted to the Department. Any individual who performs this function shall be approved by the Department before beginning to serve in this capacity.

8. To protect hardbottom areas adjacent to the borrow area and beach nourishment site, the following procedures shall be adhered to:

a. Before any dredging equipment is brought to the borrow area, the permittee shall mark the perimeter of the borrow area with buoys (lighted buoys if construction will occur at night) placed no more than 1,000 feet apart to clearly identify the limits of the borrow area. The permittee shall ensure that these buoys are maintained continuously for as long as dredging occurs at the borrow area;

b. At least 60 days before construction is planned to begin, the permittee shall submit to the Bureau of Beaches and Coastal Systems, with a copy to the

Southeast District Office, a description of the beach construction methods to be utilized and plan view drawings which show all work spaces (e.g. anchoring areas, pipeline corridors, staging areas, boat access corridors, etc.) to be used for this project. The drawings shall include mapping of any significant natural resources located in and within 1000 feet of the work spaces. Significant natural resources include hardbottom areas, rock outcroppings, and algal and seagrass beds. A transmittal sheet labelled **"This information submitted in accordance with the requirements of Specific Condition No. 8b of Permit No. 502355609"** shall be attached to the above-referenced information when submitted to the Department. Construction of the project shall not begin until the Department approves the construction methods and the locations of the work spaces and any associated impacts.

9. The beach fill is expected to impact a total of 7.3 acres of nearshore hardbottom located between the South Lake Worth Inlet and DNR monument R-154. The 2.1 acres of artificial reef constructed in September 1994 (DER File No. 502066066) and 0.45 acres of substrate provided by the construction of the groins, are considered as mitigation for this section of hardbottom. Permit No. 502066066 will be modified to reflect that this artificial reef site serves as mitigation for the impacts to the nearshore hardbottom located between the South Lake Worth Inlet and DNR monument R-154 in the current project.

10. Beach fill is expected to impact a total of 2.0 acres located directly offshore of DNR monument R-156. To offset this loss the permitee shall create 2.0 acres of low relief, artificial reef. This artificial reef shall be constructed on suitable substrate, within 2 miles of the hardbottom offshore of DNR monument R-156. Plan view drawings identifying the surveyed coordinates of the artificial reef construction sites and all work spaces must be approved by the Department prior to initiating the beach restoration work. The artificial reef shall be created within one year of completion of the beach restoration project.

11. The following procedures shall be adhered to for the construction of the artificial reef mitigation work:

a. At least 60 days prior to beginning construction of the artificial reefs, the permittee shall submit to the Bureau of Beaches and Coastal Systems, with a copy to the Southeast District Office, a plan view drawing

identifying the surveyed coordinates (1927 NAD system) of the artificial reef construction sites and all work spaces (staging areas, boat access corridors, etc.) to be used to construct the artificial reefs. The drawing shall include all hardbottom areas within 1,000 ft. of the artificial reef construction sites. The work conducted adjacent to existing hardbottom areas shall be performed in a manner to avoid impacts to existing hardbottom. All artificial reef construction equipment shall be confined to the identified, buoyed work spaces. Artificial reef construction shall not begin until the Department approves the work spaces. A transmittal sheet labeled **"This information submitted in accordance with the requirements of Specific Condition No. 11a of Permit No. 502355609"** shall be attached to the above-referenced information when submitted to the Department;

b. Prior to the placement of any reef building material in the water at the mitigation site, the limits of the reef construction area shall be marked with buoys. If this work is to be conducted at night, the buoys shall be lighted;

c. The reef building materials shall be transported to the mitigation site by barge. Materials shall be lifted over the side of the barge and placed into the proper location by a pre-approved method of placement;

d. The artificial reef materials shall consist of clean concrete and/or limestone boulders. Reef construction materials shall be inspected by the permittee or their designee prior to loading onto work barges. Debris and sources of pollution shall be removed from the material prior to its placement onto the work barges. Rebar, steel, or other similar protruding materials shall not be included in the reef construction materials;

e. The permittee shall ensure that the artificial reef has the following features: areas of unshaded horizontal surface, interstitial spaces of approximately 10 cubic feet, and overhanging ledges;

f. Following the completion of the placement of reef construction materials, the permittee shall use remote sensing techniques to survey the artificial reef sites to verify that the required reef area has been created and provides the appropriate average relief as indicated in the permit. If the remote sensing

techniques indicate the artificial reef does not meet or exceed the approved monitoring plan, the permittee shall alter the reefs as needed and conduct additional surveys to verify that the permit requirements for artificial reef construction have been satisfactorily completed.

11. Marine turtles are known to nest in the project area. To protect marine turtles, the permittee shall adhere to all of the marine turtle protection, monitoring, and reporting requirements of the coastal construction permit, File No. DBS9A0330 PB, issued by the Department's Bureau of Beaches and Coastal Systems.

12. In order to ensure that manatees are not adversely affected by the construction activities authorized by this permit, the permittee shall adhere to the following conditions:

a. The contractor instructs all personnel associated with the project of the potential presence of manatees and the need to avoid collisions with manatees. All construction personnel are responsible for observing water-related activities for the presence of manatee(s), and shall implement appropriate precautions to ensure protection of the manatee(s).

b. All construction personnel are advised that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and the Florida Manatee Sanctuary Act. The permittee and/or contractor may be held responsible for any manatee harmed, harassed, or killed as a result of construction activities.

c. <u>Prior</u> to commencement of construction, the prime contractor involved in the construction activities shall construct and display at least two temporary signs (placards) concerning manatees. For all vessels, a temporary sign (at least 8 1/2" X 11") reading **"Manatee Habitat/Idle Speed In Construction Area"** will be placed in a prominent location visible to employees operating the vessels. In the absence of a vessel, a temporary sign (at least 2' X 2') reading **"Warning: Manatee Habitat"** will be posted in a location prominently visible to land based, water-related construction crews.

A second temporary sign (at least 8 1/2" X 11") reading **"Warning, Manatee Habitat: Operation of any equipment**

closer than 50 feet to a manatee shall necessitate immediate shutdown of that equipment. Any collision with and/or injury to a manatee shall be reported immediately to the Florida Marine Patrol at 1-800-DIAL-FMP" will be located prominently adjacent to the displayed issued construction permit. Temporary notices are to be removed by the permittee upon completion of construction.

d. Siltation barriers are properly secured so that manatees cannot become entangled, and are monitored at least daily to avoid manatee entrapment. Barriers must not block manatee entry to or exit from essential habitat.

e. All vessels associated with the project operate at "idle speed/no wake" at all times while in the construction area and while in water where the draft of the vessel provides less than a four foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

f. If manatees are seen within 100 yards of the active daily construction/dredging operation all appropriate precautions shall be implemented to ensure protection of the manatee. These precautions shall include the operation of all moving equipment no closer than 50 feet of a manatee. Operation of any equipment closer than 50 feet to a manatee shall necessitate immediate shutdown of that equipment.

g. Any collision with and/or injury to a manatee shall be reported immediately to the Florida Marine Patrol (1-800-DIAL-FMP) and to the Office of Protected Species Management (904) 922-4330.

h. The contractor maintains a log detailing sightings, collisions, or injuries to manatees should they occur during the contract period. A report summarizing incidents and sightings shall be submitted to the Florida Department of Environmental Protection, Office of Protected Species Management, Mail Station 245, 3900 Commonwealth Boulevard, Tallahassee, Florida 32399 and to the U.S. Fish and Wildlife Service Office, 3100 University Boulevard, Jacksonville, Florida 32216. This report must be submitted annually or following the completion of the project if the contract period is less than a year.

MONITORING REQUIRED:

1. Water Quality

Parameter: Turbidity - Nephelometric Turbidity Units (NTUs)

BORROW SITE
Frequency: Every four hours during dredging and beach fill placement.

Location:
Background: At least 500 meters upcurrent from the dredge outside of any visible turbidity plume, at mid-depth.

Compliance: No more than 150 meters downcurrent from the dredge in the densest portion of any visible turbidity plume, at mid-depth.

BEACH NOURISHMENT SITE
Frequency: Every four hours during dredging and beach fill placement.
Location:
Background: At least 500 meters upcurrent from the discharge point, outside of any visible turbidity plume, at mid-depth.

Compliance: No more than 300 meters offshore and 500 meters downcurrent of the discharge point within the densest portion of any visible turbidity plume, at mid-depth.

Weekly summaries of all monitoring data shall be submitted to the Bureau of Beaches and Coastal Systems and to the Southeast District Office within one week of analysis with documents containing the following information: (1) permit number; (2) dates and times of sampling and analysis; (3) a statement describing the methods used in collection, handling, storage and analysis of the samples; (4) a map indicating the sampling locations; and (5) a statement by the individual responsible for implementation of the sampling program concerning the

authenticity, precision, limits of detection and accuracy of the data.

Monitoring reports shall also include the following information for each sample that is taken:

(a) time of day samples taken;
(b) depth of water body;
(c) depth of sample;
(d) antecedent weather conditions;
(e) tidal stage and direction of flow; and
(f) wind direction and velocity.

The compliance locations given above shall be considered the limits of the temporary mixing zone for turbidity allowed during construction. If monitoring reveals turbidity levels at the compliance sites greater than 29 NTUs above background turbidity levels, construction activities shall **cease immediately** and not resume until corrective measures have been taken and turbidity has returned to acceptable levels.

Monitoring reports shall be submitted to the Bureau of Beaches and Coastal Systems in Tallahassee. Failure to submit reports in a timely manner constitutes grounds for revocation of the permit. When submitting this information to the DEP, please clearly include, at the top of each page or as a cover page to the submittal: **"This information being provided in partial fulfillment of the monitoring requirements in Permit No. 502355609."**

STATE OF FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

for Virginia B. Wetherell, Secretary

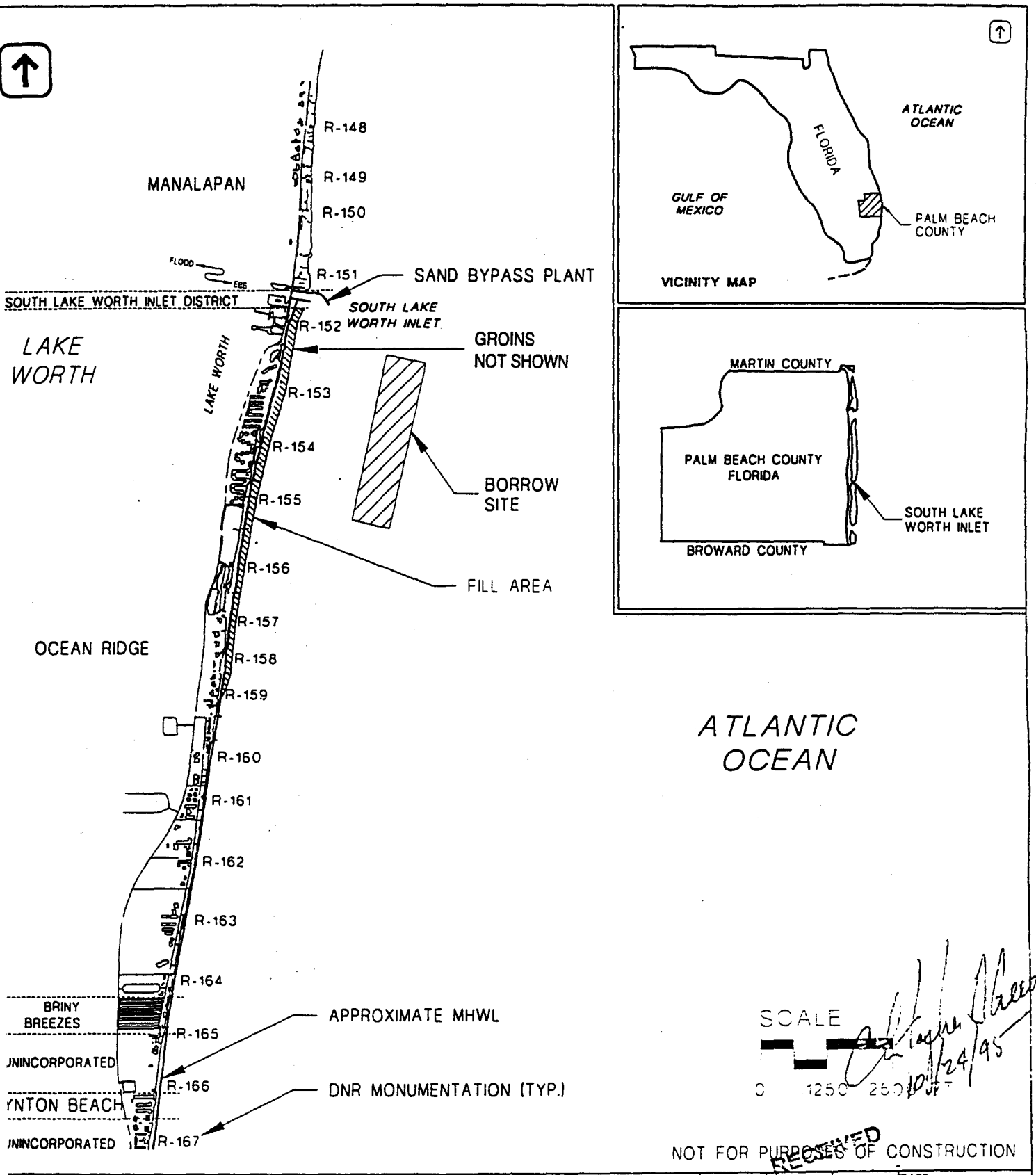
15 pages attached.

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to 120.52,
Florida Statutes, with the designated Department Clerk,
receipt of which is hereby acknowledged.

Deputy Clerk 10 Jun 1996
Date

DEP 96-0011 CS



RECEIVED

NOV 1 1995

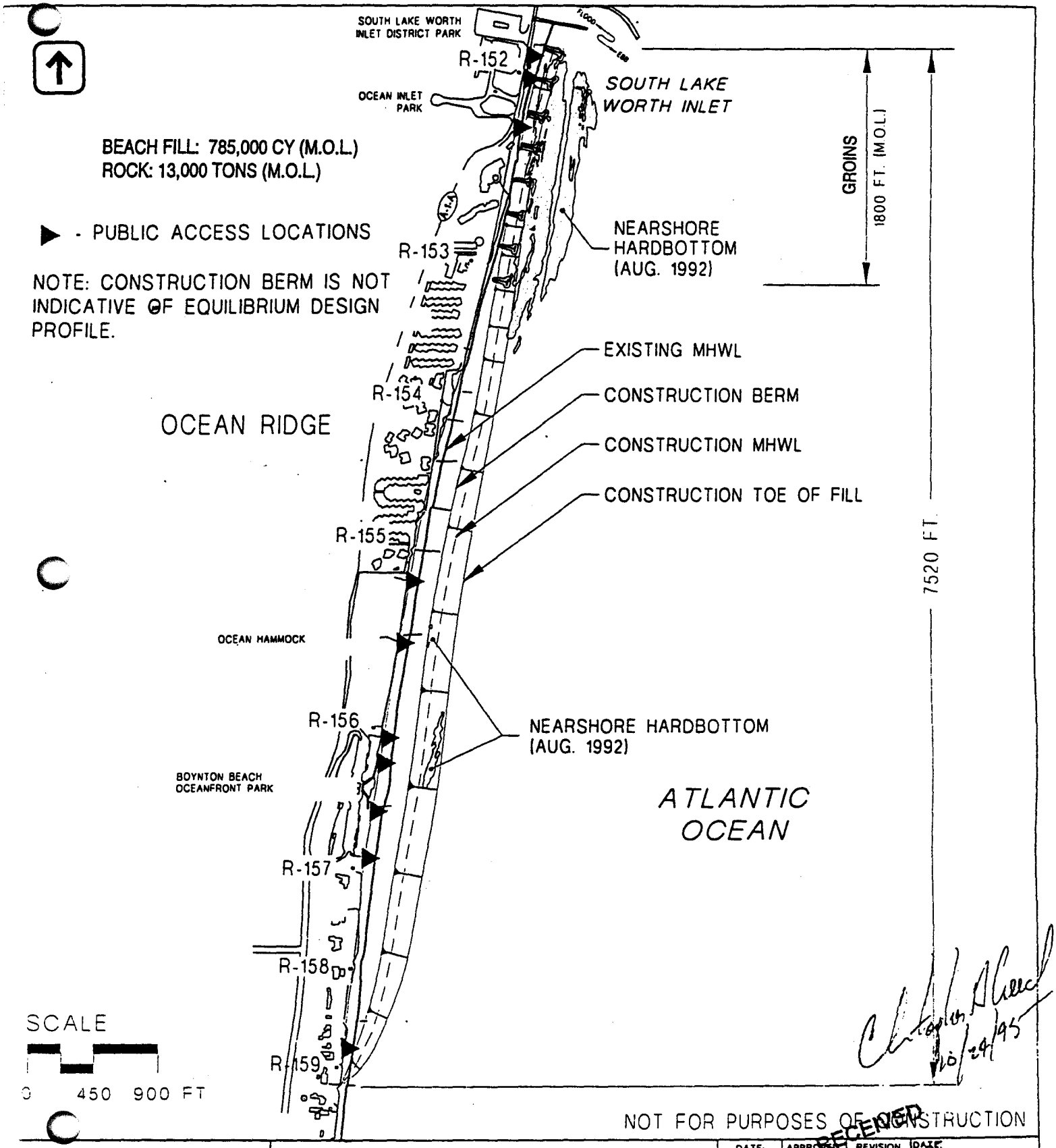
SUB LANDS

10/24/95

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114
(Fax) 384-7368

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
LOCATION MAP

DATE:	APPROVED	REVISION	DATE:
10/24/95		Removed breakwaters and added groins	6/23/93
			DRAWN BY: M.R.L.
			SHEET 1 OF 15



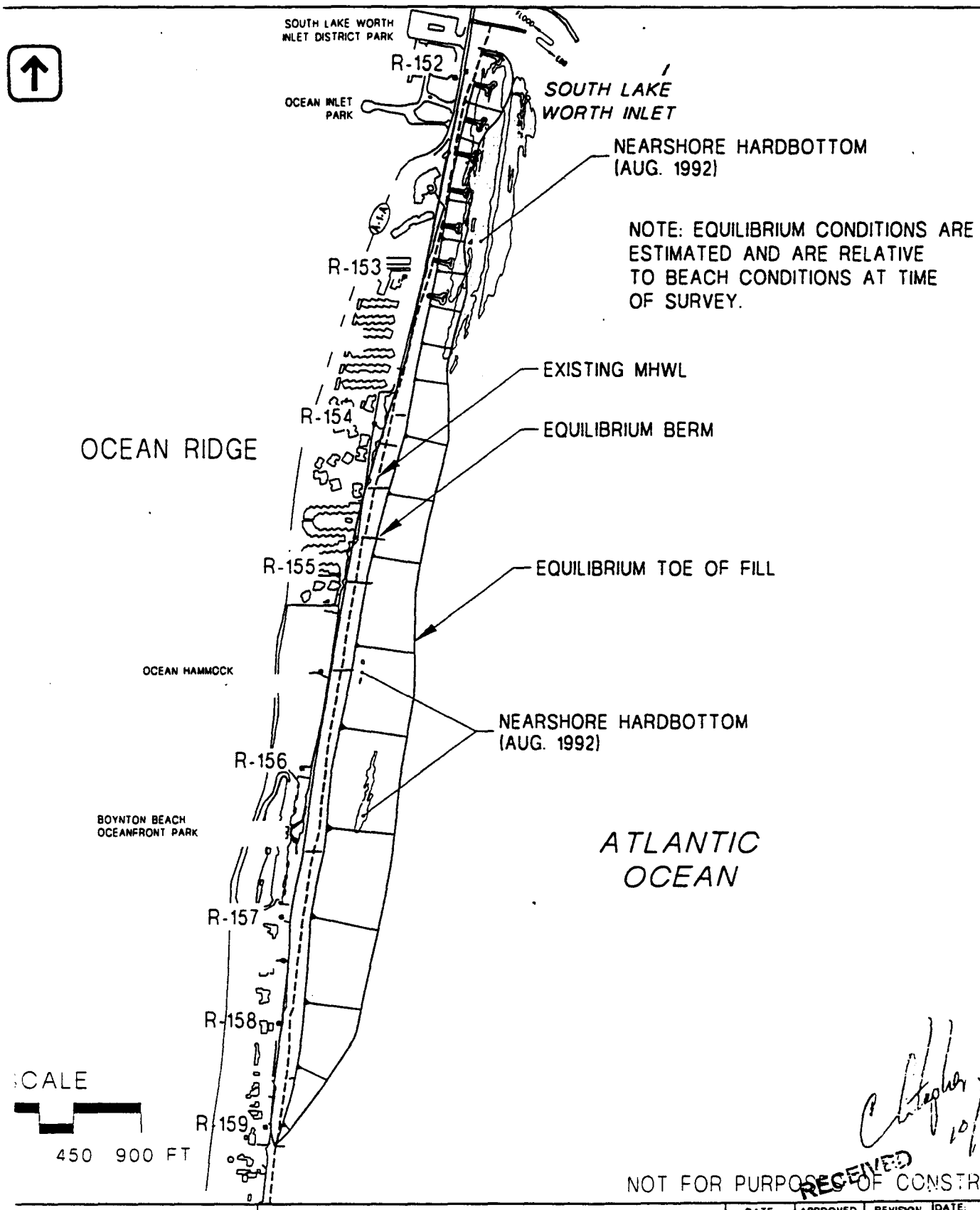
10/24/95

RECEIVED NOV 6 SUB LANDS & ENV. SES

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL. 32210
(904) 387-6114
(Fax) 384-7368

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
CONSTRUCTION FILL CONDITIONS

DATE:	APPROVED	REVISION	DATE
10/24/95	C.G.C.	Refinement breakwaters and added groins	07/22/93
			DRAWN BY: M.R.L.
			SHEET 2 OF 15

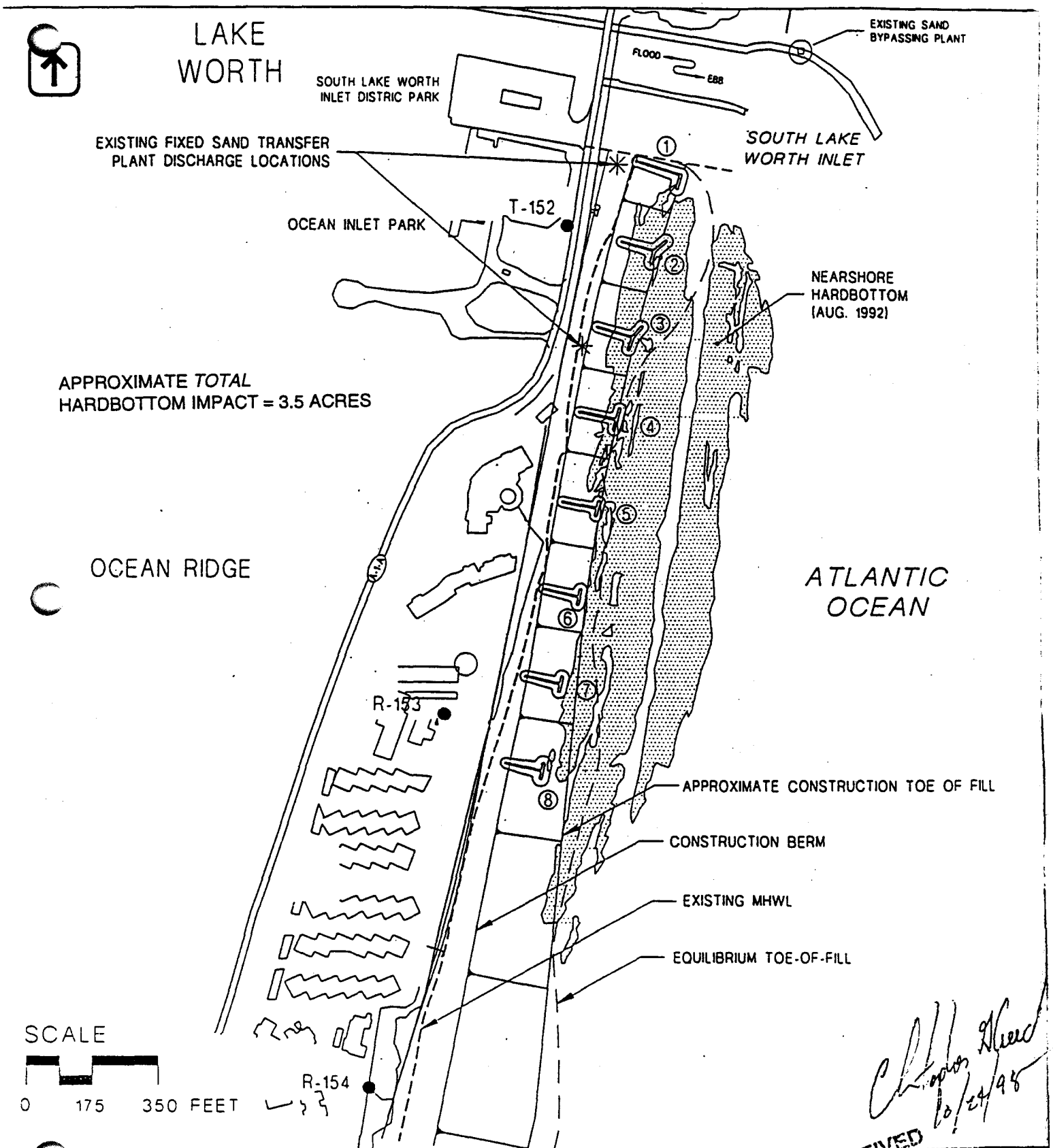


NOT FOR PURPOSES OF CONSTRUCTION

RECEIVED

Christopher A Reed 10/24/95

olsen associates, inc. 4438 Herschel Street Jacksonville, FL. 32210 (904) 387-6114 (Fax) 384-7368	**OCEAN RIDGE SHORE PROTECTION PROJECT PALM BEACH COUNTY, FLORIDA EQUILIBRIUM FILL CONDITIONS**	DATE. 10/24/95	APPROVED NOT FOR SUB LANDS	REVISION Removed breakwaters and added piers
		DATE: 6/23/93	DRAWN BY: M.R.L.	SHEET 2 OF 15



10/24/95

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL. 32210
(904) 387-6114
(Fax) 384-7368

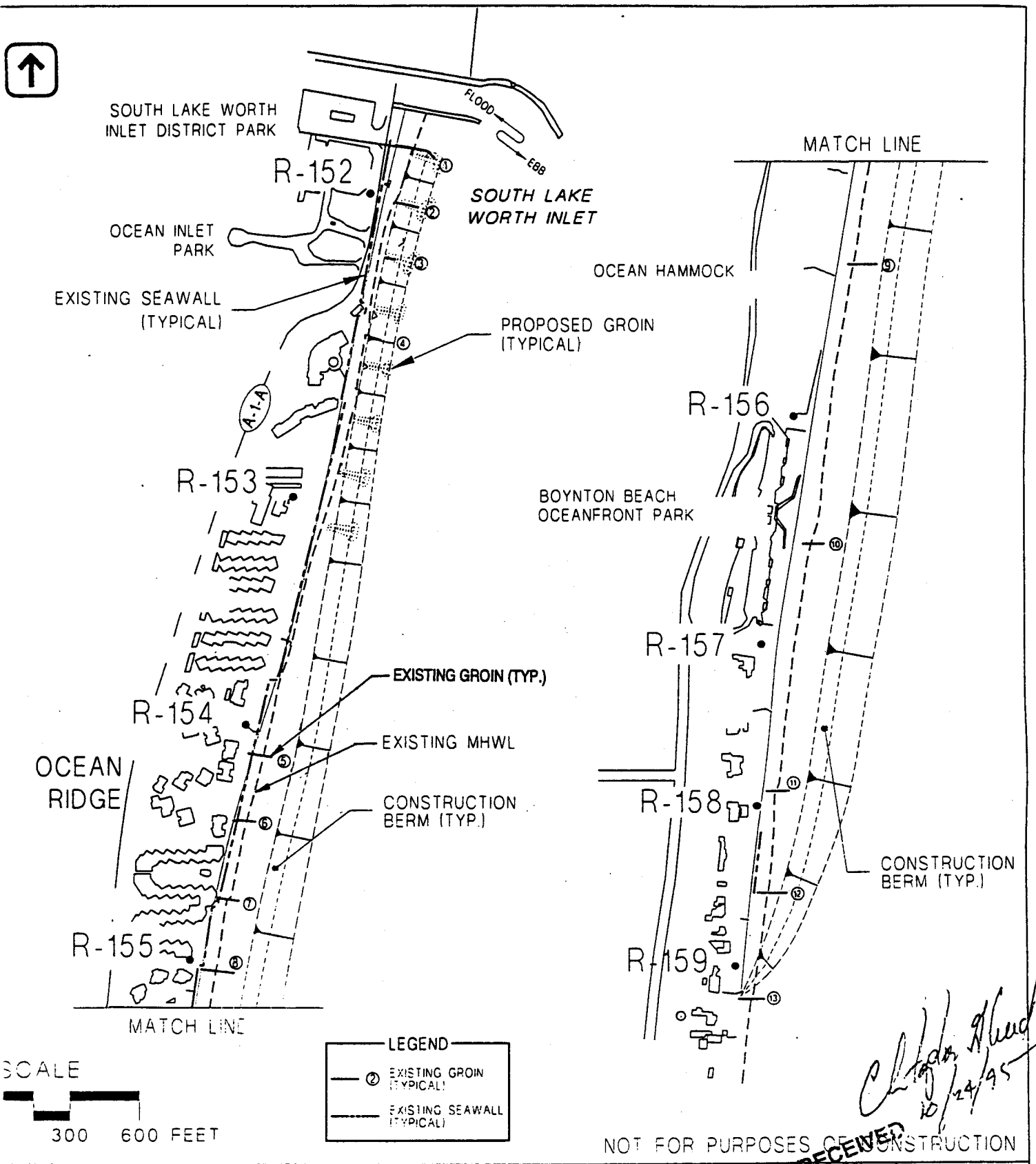
OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
STRUCTURE FIELD DETAIL

DATE:	APPROVED:	REVISION	DATE:
10/24/95	C.G.C.	-Removed breakwaters and added groins -Updated hardbottom impact estimate	05/23/93

DRAWN BY: M.R.L.

SHEET 4 OF 15

RECEIVED NOV 1995 SUBMITTALS &



NOT FOR PURPOSES OF CONSTRUCTION

RECEIVED NOV 9 '95 SUB LANDS & ENV. RE

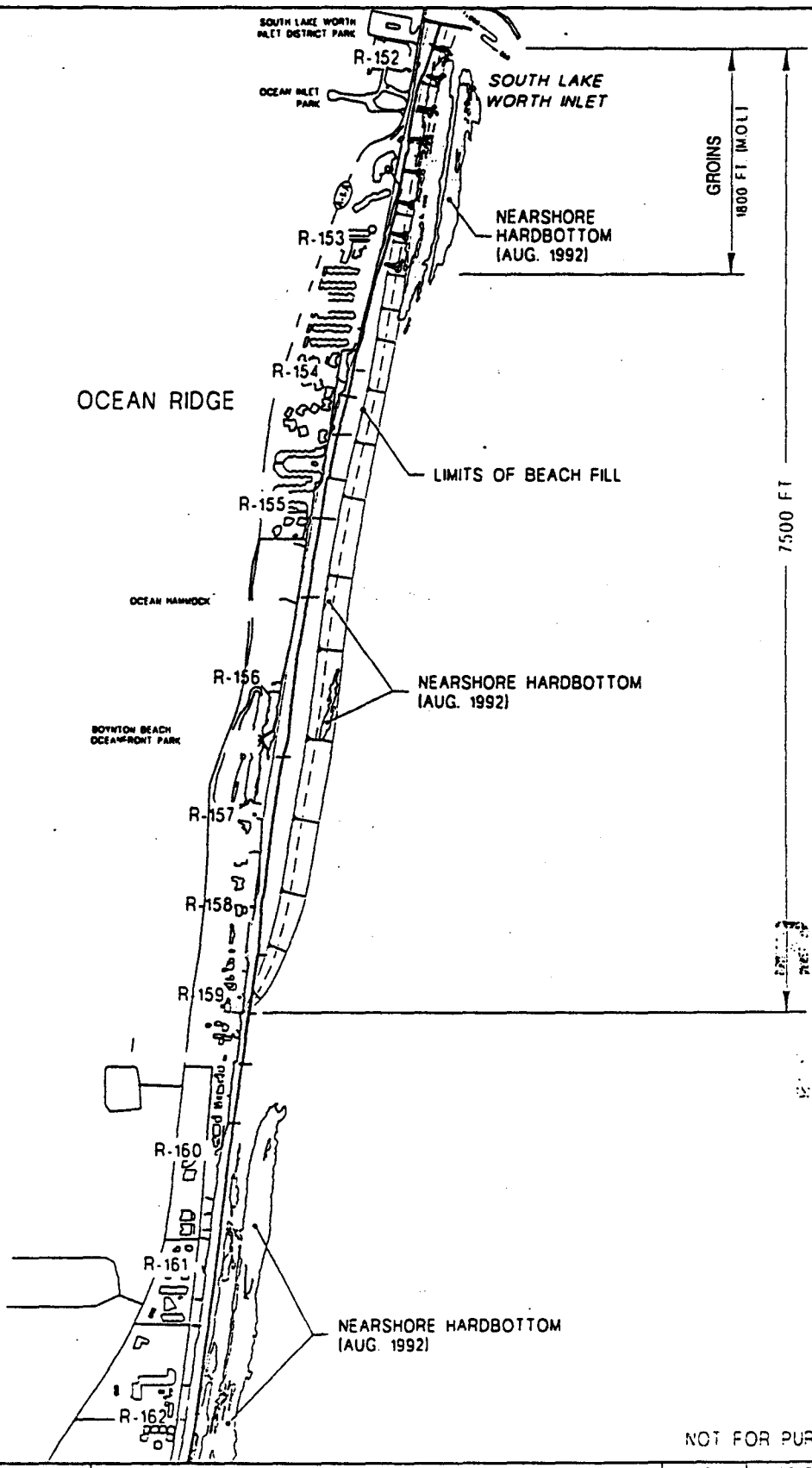
olsen associates, inc.
4438 Herschel Street
Jacksonville, FL. 32210
(904) 387-6114

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
EXISTING SHORE PROTECTION STRUCTURES

DATE:	APPROVED	REVISION	DATE
10/24/95	C.G.C.	Removed breakwaters and added groins	7/22/93

DRAWN BY: M.R.L.

SHEET 5 OF 15



ATLANTIC OCEAN

RECEIVED
NOV 6 1995
BUREAU OF BEACHES & COASTAL SYSTEMS

SCALE

0 450 900 FT

Christopher G. Reed 10/24/95

NOT FOR PURPOSES OF CONSTRUCTION

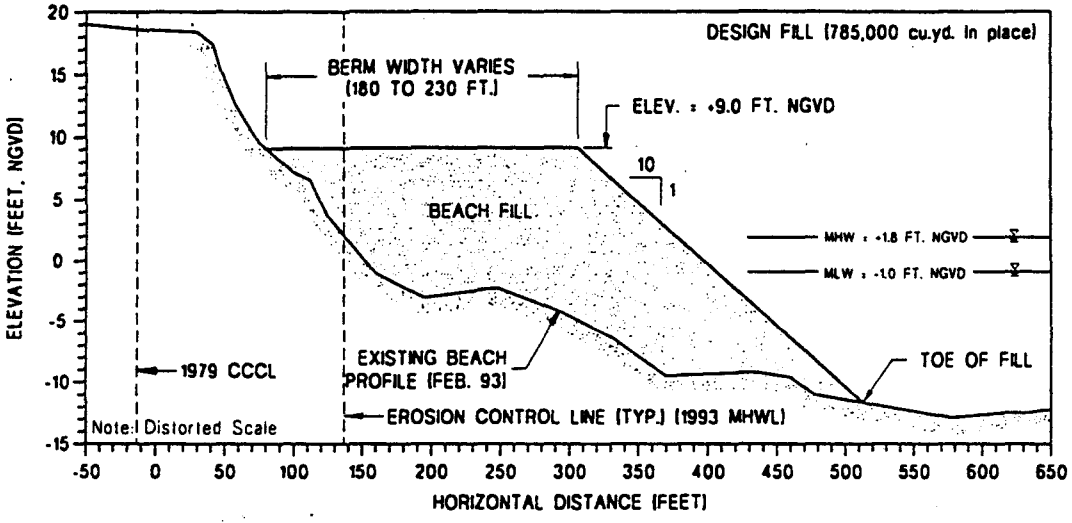
olsen associates, inc.
4438 Herschel Street
Jacksonville, FL. 32210
(904) 387-6114
(Fax) 384-7368

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
NEARSHORE HARDBOTTOM LOCATION

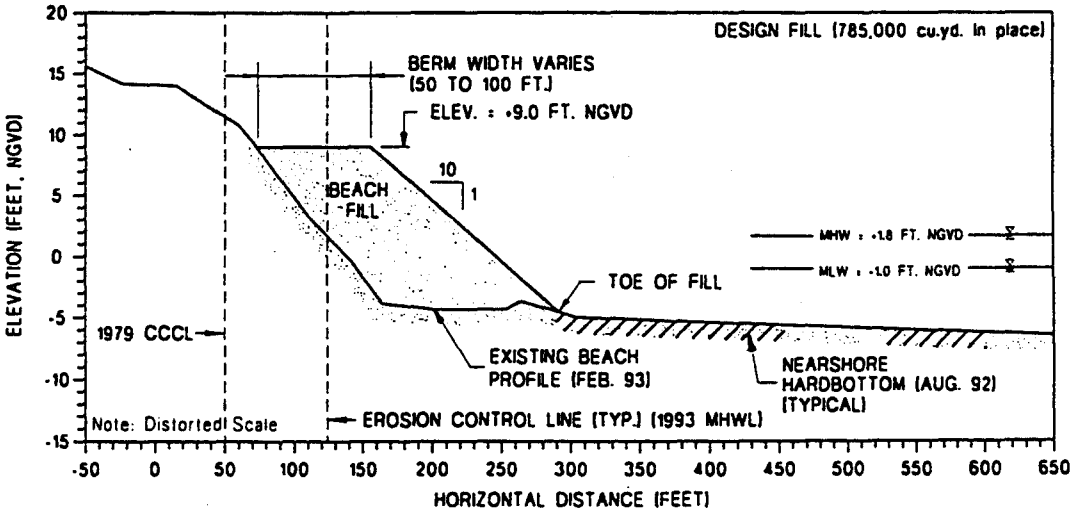
DATE	APPROVED	REVISION
10/24/95	C.G.C.	Removed breakwaters and added groins

DATE: 7/22/93
DRAWN BY: M.R.L.
SHEET

TYPICAL CONSTRUCTION PROFILE (FULLY DEVELOPED)



TYPICAL CONSTRUCTION PROFILE (WITHIN GROIN FIELD)



NOTES:

1.) DEPICTED FILL PROFILE IS NOT INDICATIVE OF RESULTANT EQUILIBRIUM BEACH PROFILE.
2.) THE PROPOSED EROSION CONTROL LINE (ECL) IS NOVEMBER, 1993 MEAN HIGH WATER LINE (MHWL).
3.) FILL WILL BE HYDRAULICALLY PLACED BY DREDGE FROM AN OFFSHORE BORROW SITE.
4.) FILLING WILL OCCUR PREDOMINATELY SEAWARD OF EXISTING UPLAND VEGETATION LINE.

10/24/95

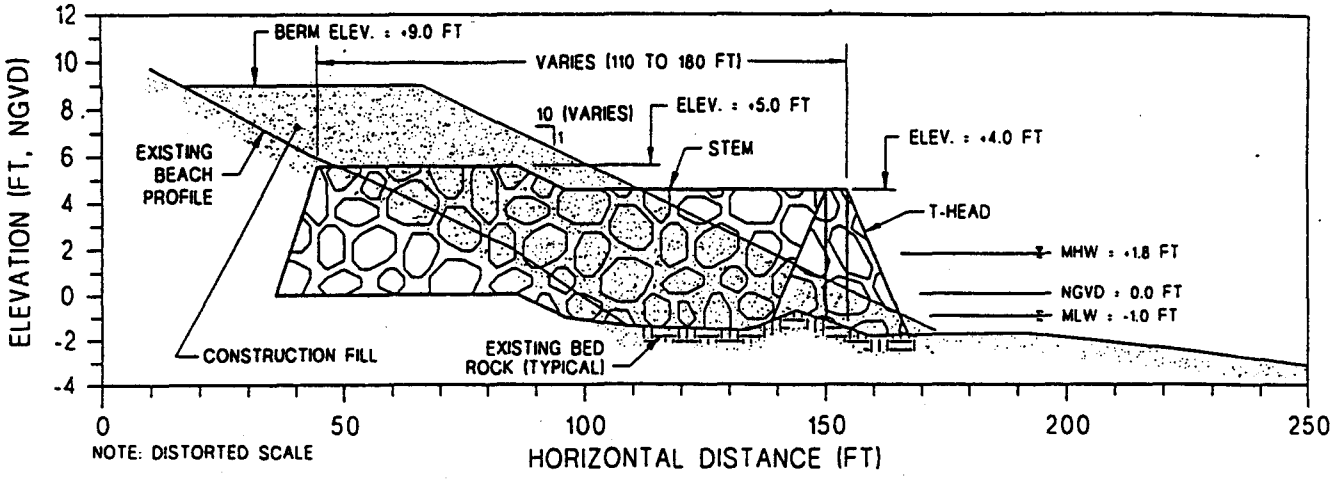
LOCATION OF THE ECL IS APPROXIMATE
NOT FOR PURPOSES OF CONSTRUCTION

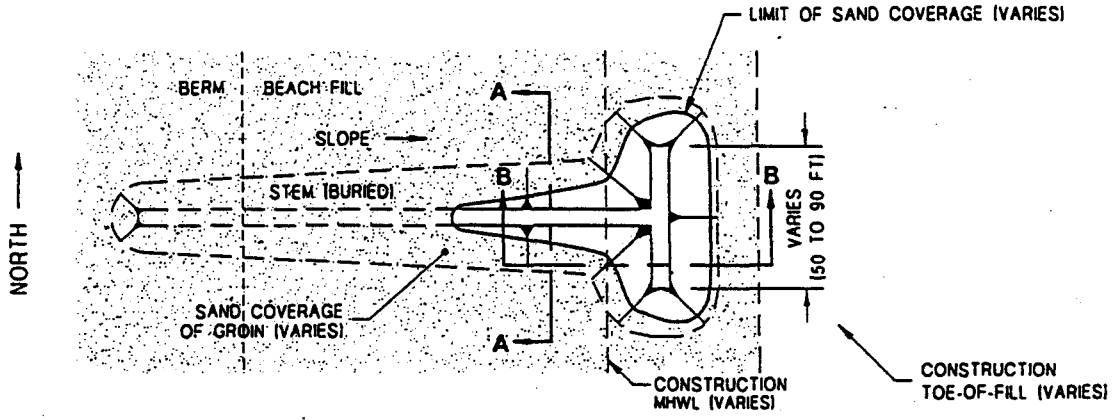
RECEIVED NOV 01 1995 SUB LANDS

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL. 32210
(904) 387-6114
(Fax) 384-7368

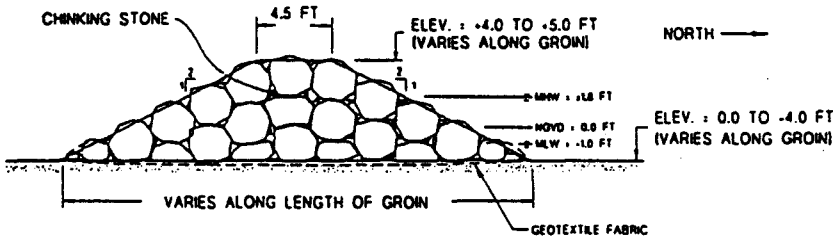
OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
TYPICAL BEACH FILL SECTIONS

DATE:	APPROVED	REVISION	DATE:
10/24/95	C.G.C.	REVISED BEACH FILL QUANTITY	6/23/93
			DRAWN BY: M.R.L.
			SHEET 7 OF 15

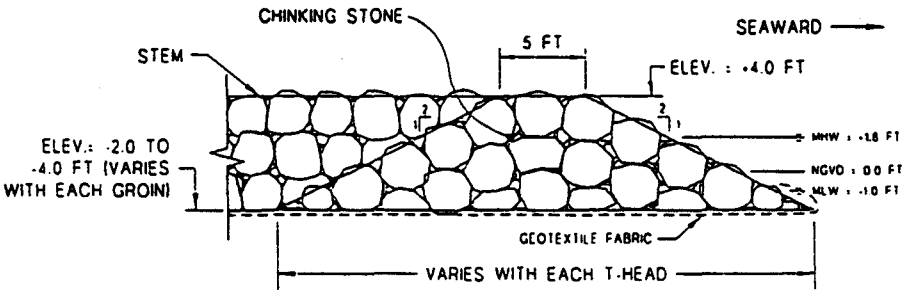




TYPICAL PLAN VIEW T-HEAD GROIN



SECTION A-A



SECTION B-B

NOT FOR PURPOSES OF CONSTRUCTION

RECEIVED NOV 03 1995 SUBLANDS

10/24/95

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL. 32210
(904) 387-6114
(Fax) 384-7368

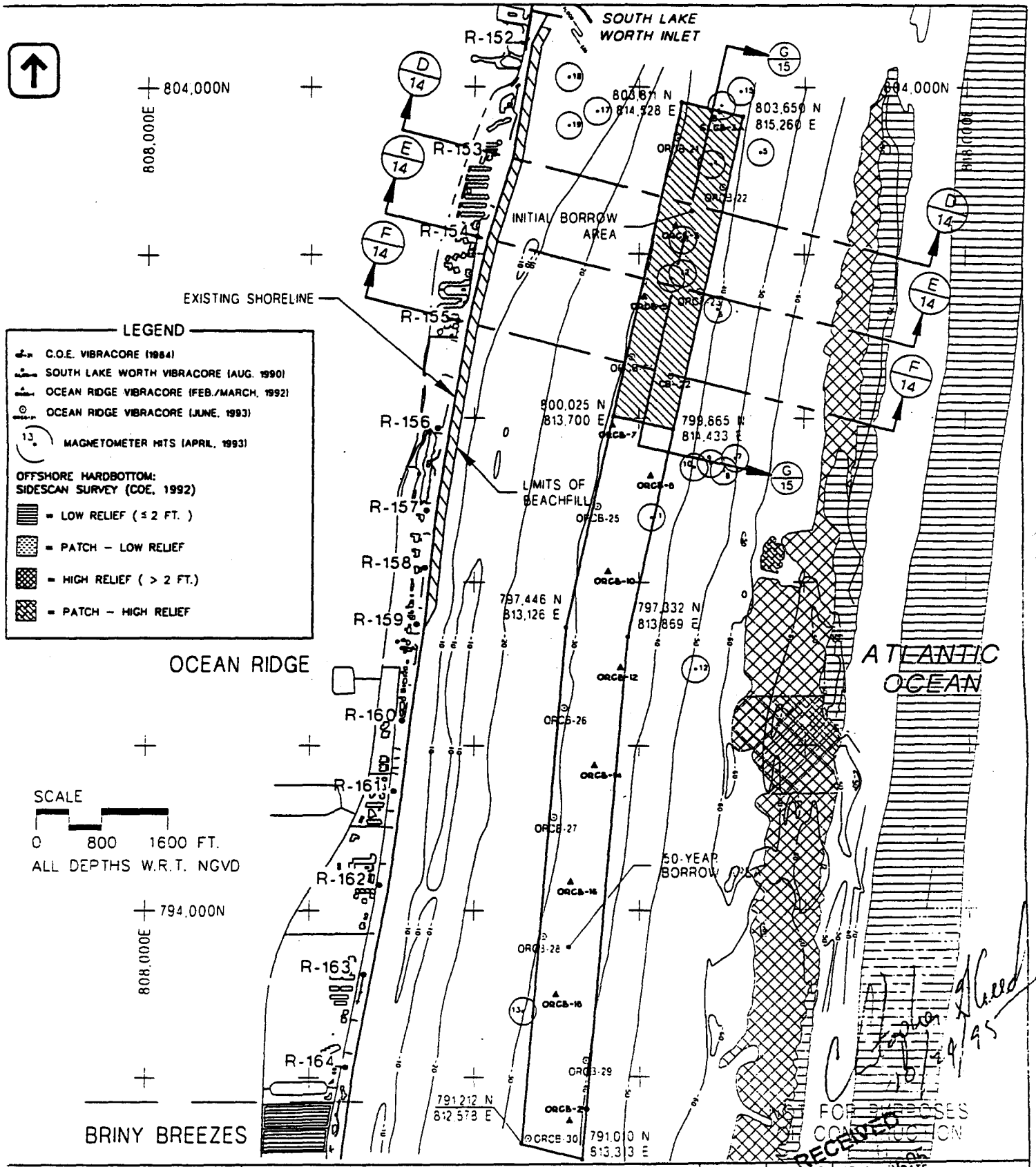
OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
TYPICAL T-HEAD GROIN

DATE:	APPROVED	REVISION
10/4/93	C.G.C.	ADDED STONE SPECIFICATIONS
10/24/95	C.G.C.	Revised groin dimensions

DATE: 6/23/93

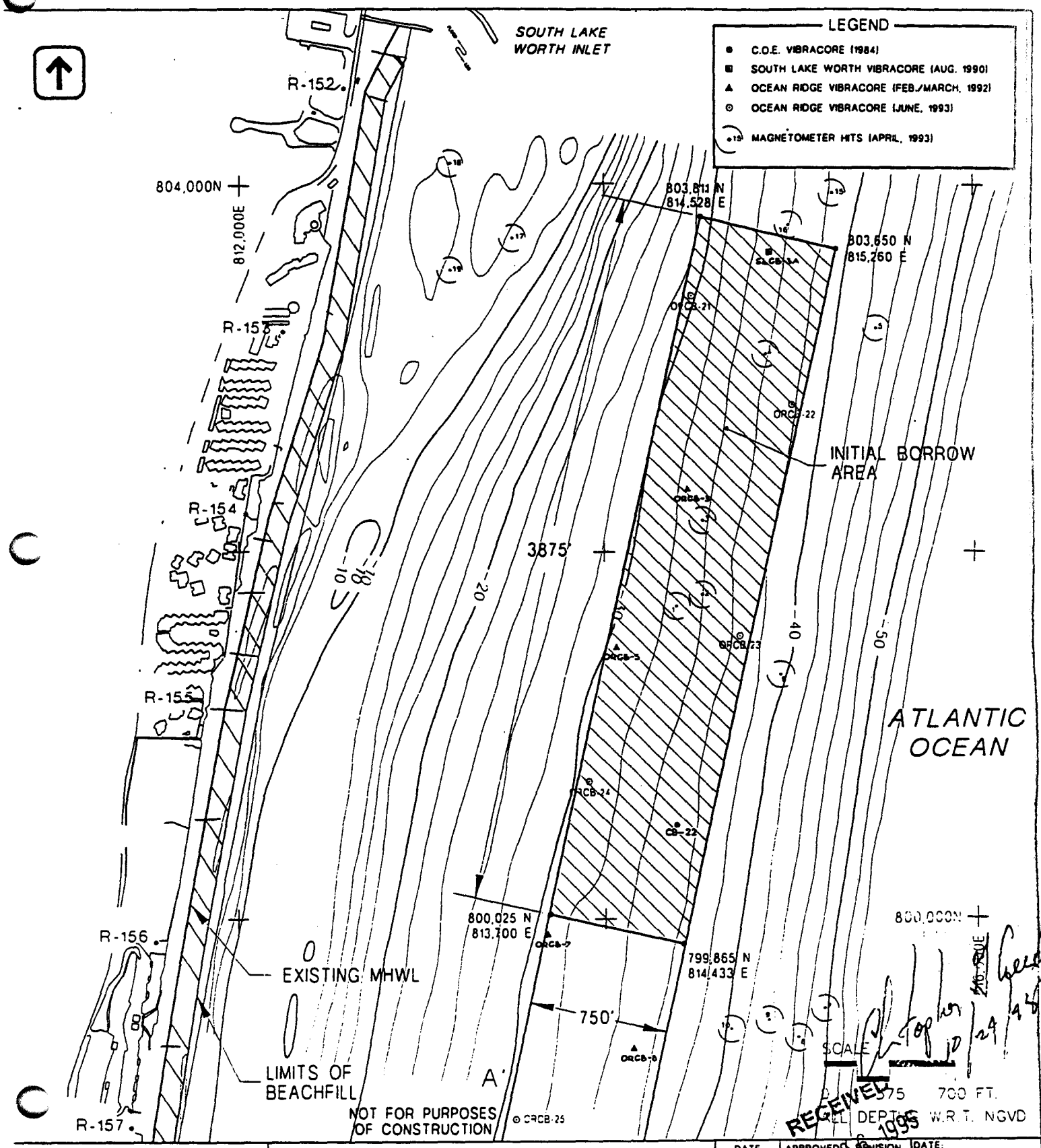
DRAWN BY: M.R.L.

SHEET 8 OF 15



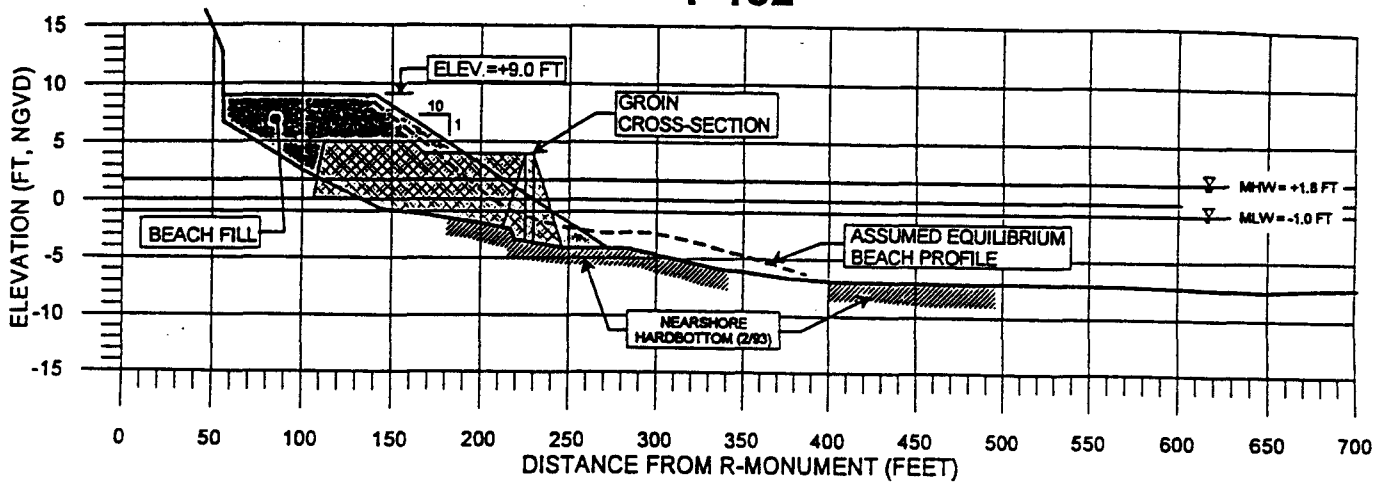
olsen associates, inc. 4438 Herschel Street Jacksonville, FL. 32210 (904) 387-6115	OCEAN RIDGE SHORE PROTECTION PROJECT PALM BEACH COUNTY, FLORIDA BORROW SITE LOCATION	DATE: 10/5/93	APPROVED: C.G.	REVISION: ADDED SECTIONS, AND CORE BORINGS
				DATE: 6/23/93
				DRAWN BY: M.R.L.
				SHEET

RECEIVED NOV 1 1993 SUB LANDS & ENV.



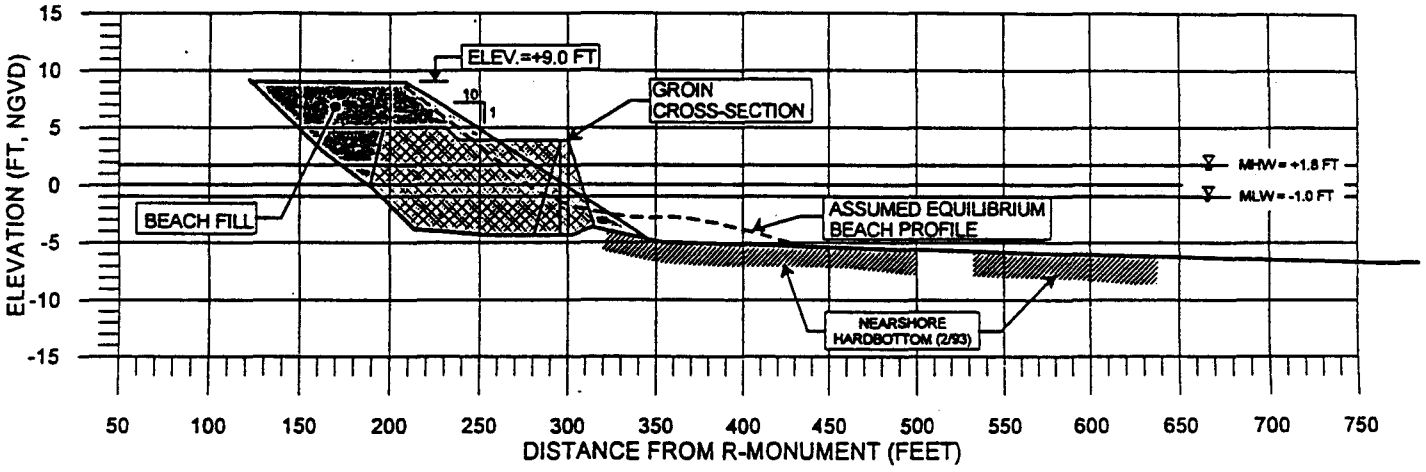
olsen associates, inc. 4438 Herschel Street Jacksonville, FL. 32210	OCEAN RIDGE SHORE PROTECTION PROJECT PALM BEACH COUNTY, FLORIDA BORROW SITE LOCATION	DATE: 10/5/93	APPROVED: E.G.C.	REVISION: ADDED CONTOURS AND CORE BORINGS	DATE: 10/23/93 DRAWN BY: M.R.L.

T-152

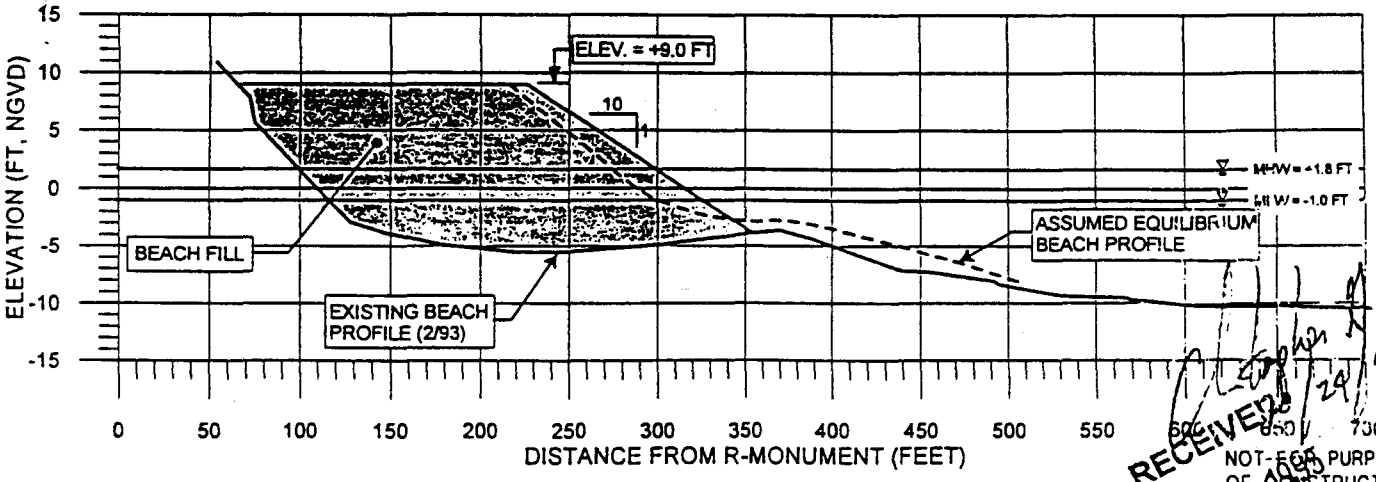


NOTE: ALL INDICATED SLOPES ARE TYPICAL.

R-153



R-154



RECEIVED 10/24/95

NOT-FOR PURPOSES OF CONSTRUCTION

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-5114

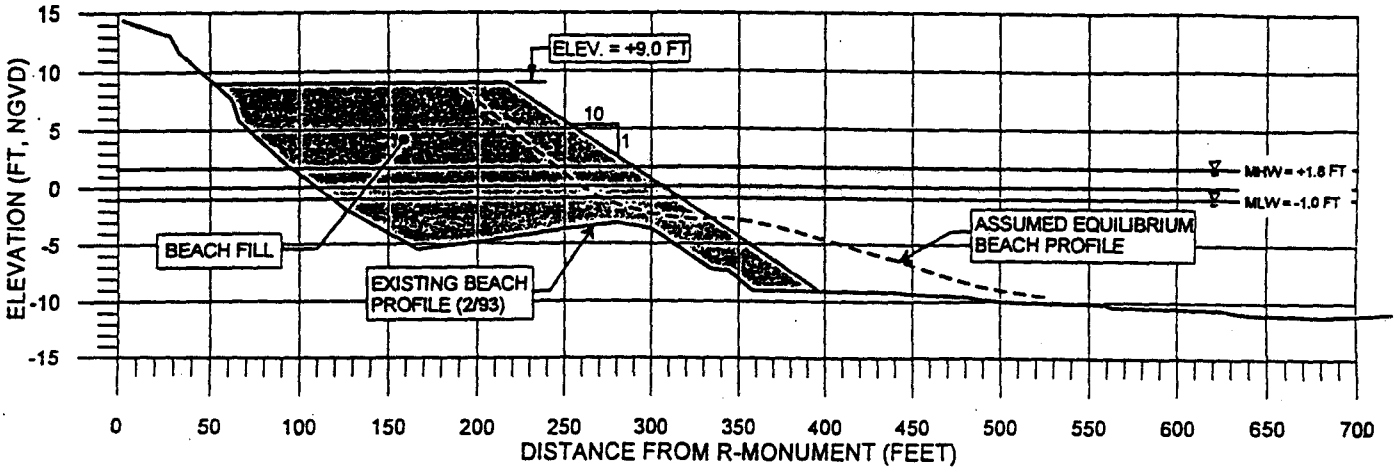
OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
DESIGN SECTIONS

DATE	APPROVED	REVISION	DATE
10/24/95	C.G.C.	Reconfigured beach fill cross-section; Removed breakwaters and added	10/23/93

DRAWN BY: M.R.L.

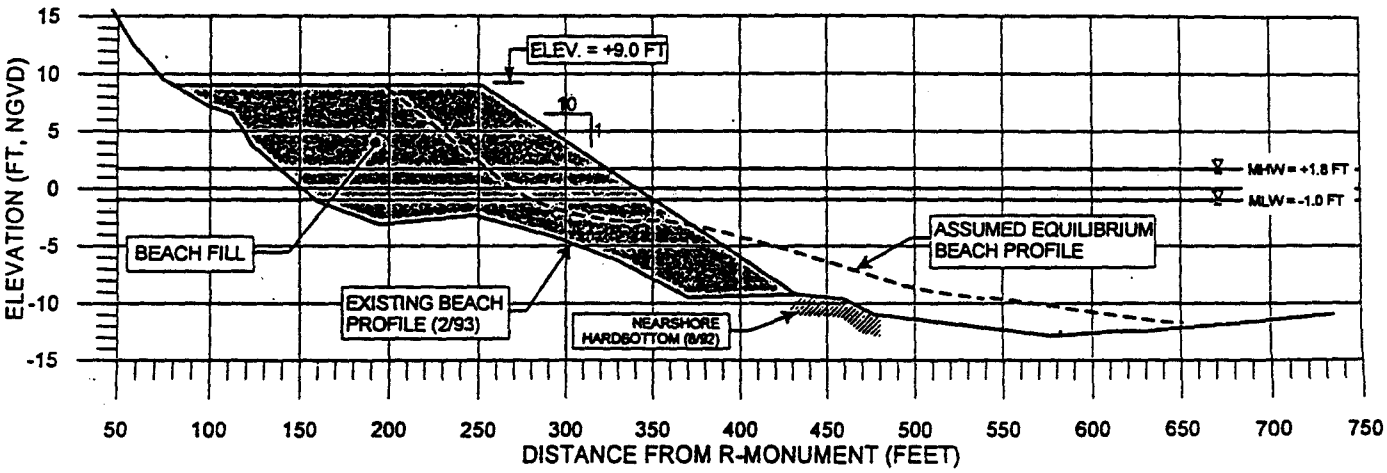
SHEET

R-155

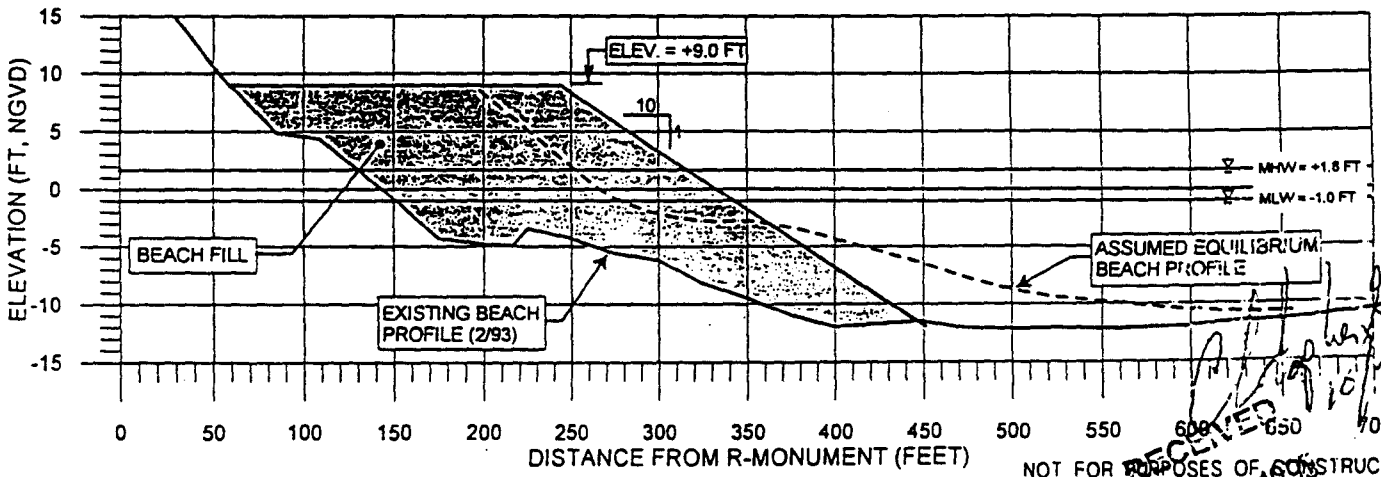


NOTE: ALL INDICATED SLOPES ARE TYPICAL.

R-156



R-157



NOT FOR PURPOSES OF CONSTRUCTION

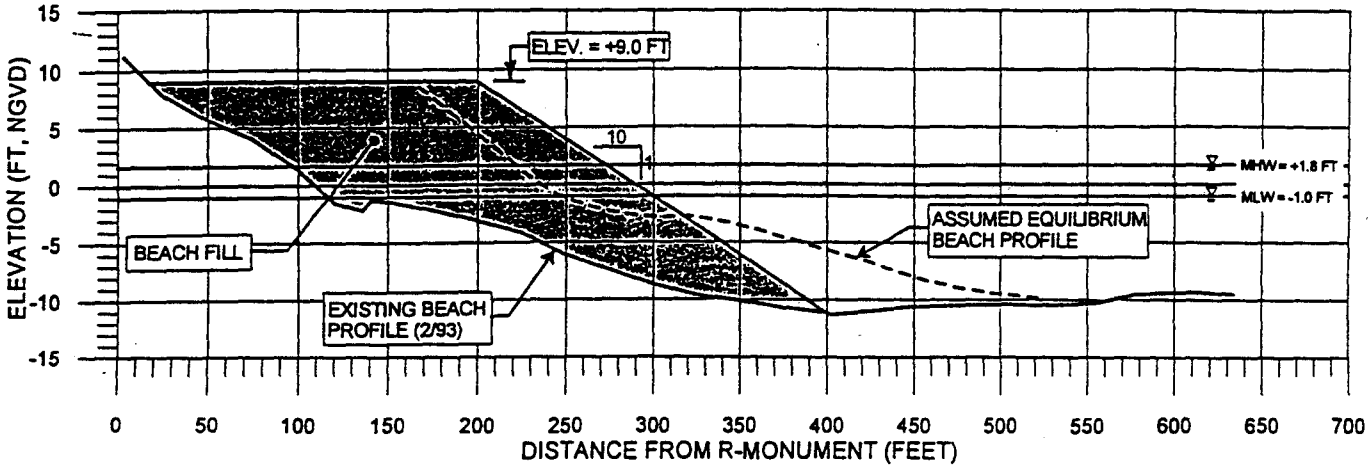
RECEIVED NOV 1995

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
DESIGN SECTIONS

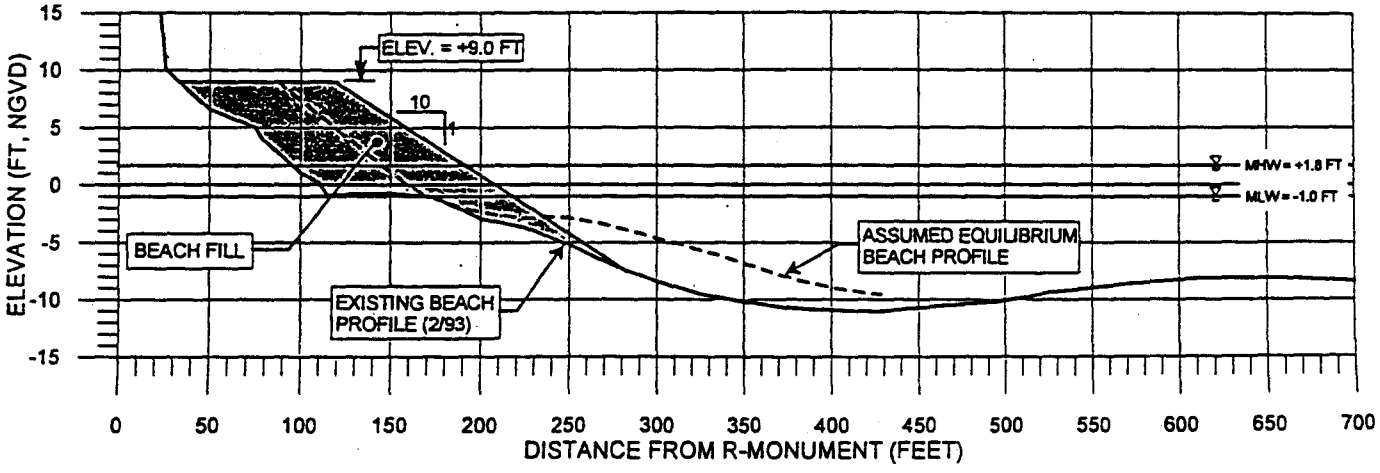
DATE:	APPROVED	REVISION	DATE:
10/24/95	C.O.N.	Reconfigured beach fills & subdivision	6/23/93
			DRAWN BY: M.R.L.
			SHEET

R-158



NOTE: ALL INDICATED SLOPES ARE TYPICAL.

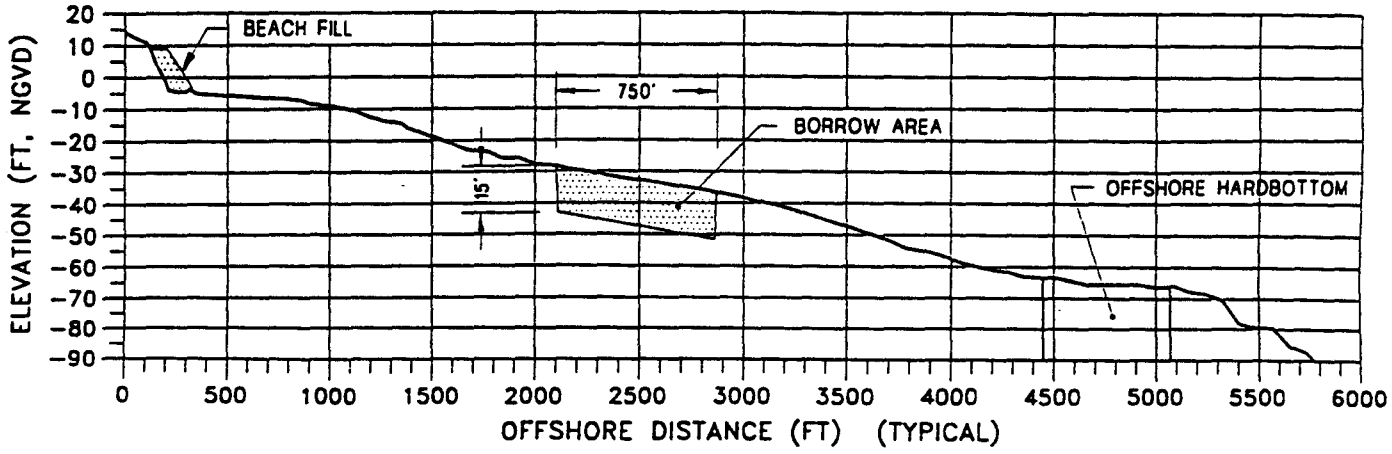
R-159



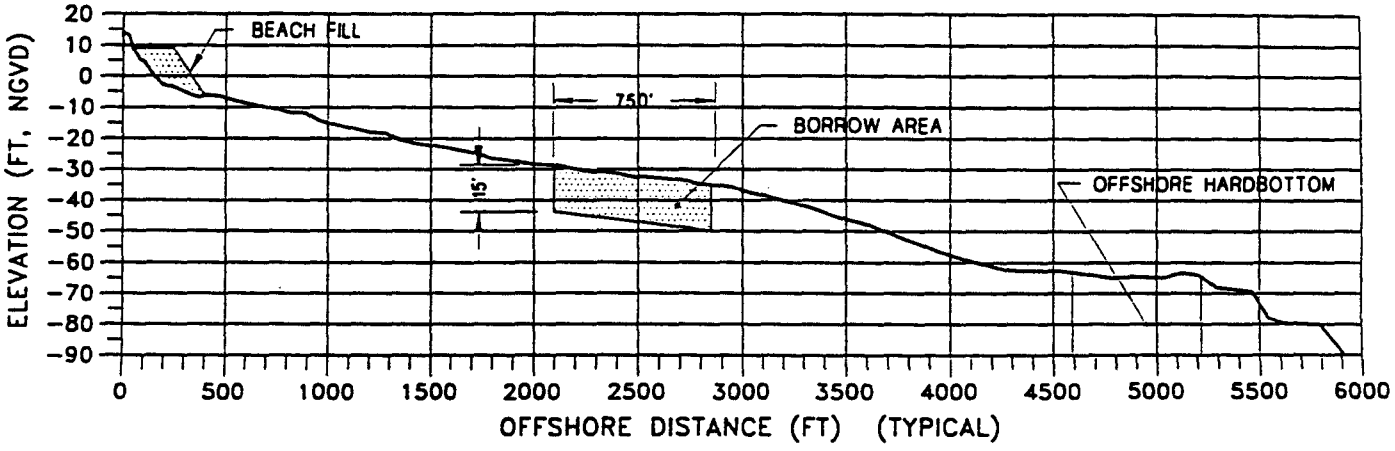
RECEIVED NOV 06 1995 SUB LANDS & ENV.

olsen associates, inc. 4438 Herschel Street Jacksonville, FL 32210 (904) 387-6114 (Fax) 386-7368	OCEAN RIDGE SHORE PROTECTION PROJECT PALM BEACH COUNTY, FLORIDA DESIGN SECTIONS	DATE	APPROVED	REVISION	DATE: 6/23/93
		10/24/95	C.G.C.	Reconfigured beach fill cross section	DRAWN BY: M.R.L.
					SHEET

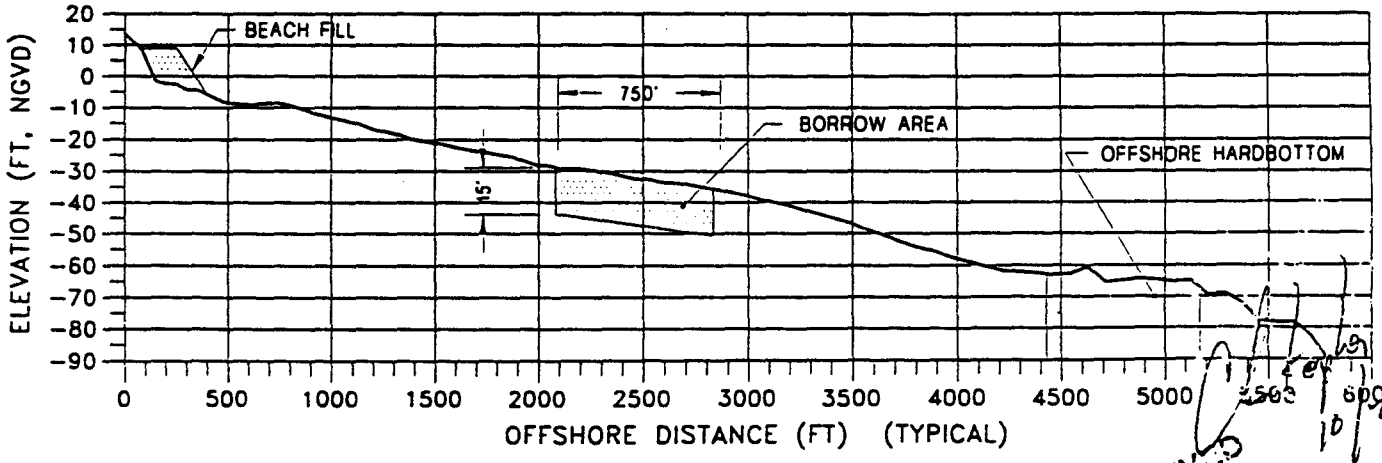
SECTION D-D BORROW AREA



SECTION E-E BORROW AREA



SECTION F-F BORROW AREA

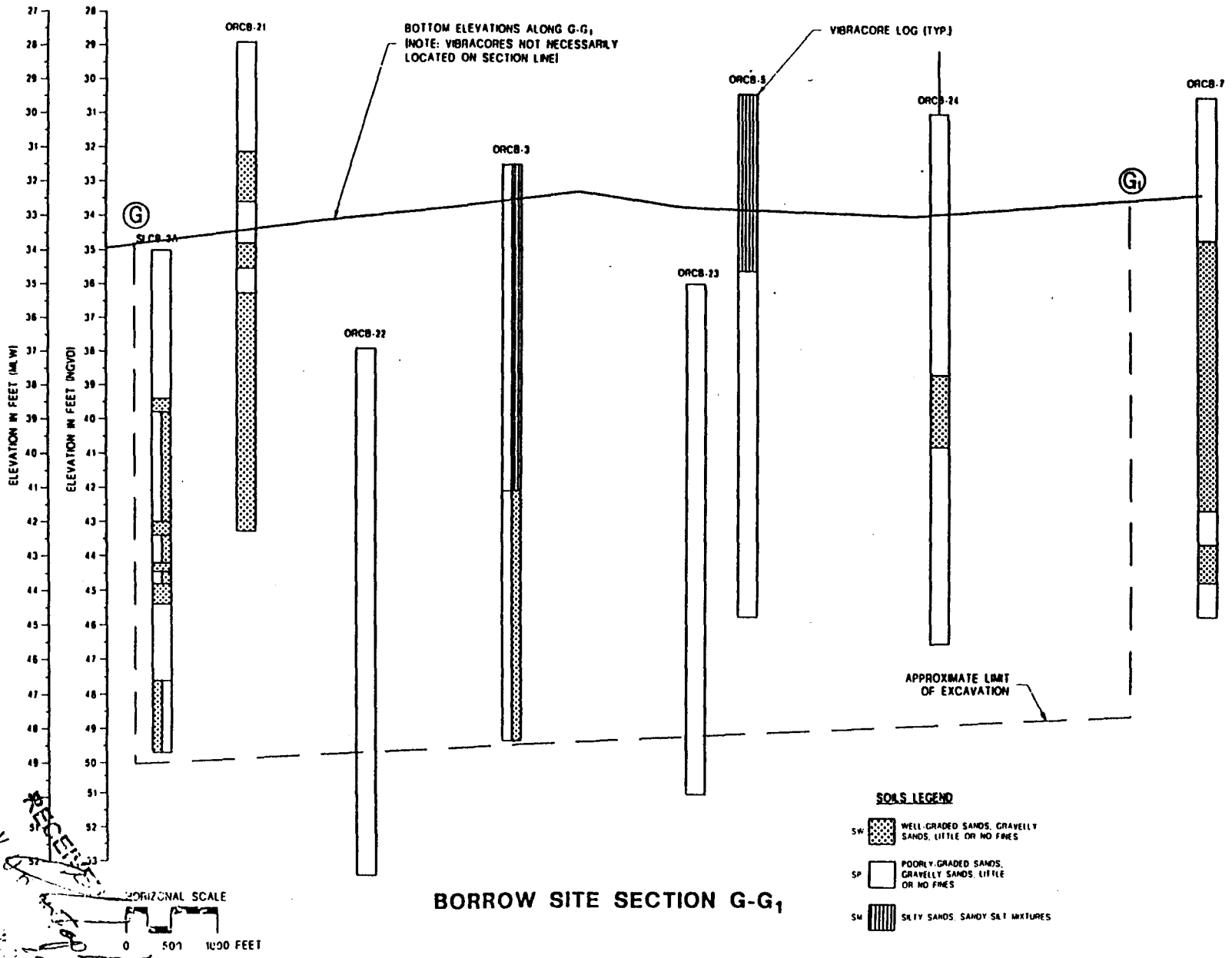


RECEIVED
NOV 0
SUB LANDS & ENV

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
BORROW AREA CROSS-SECTIONS

DATE	APPROVED	REVISION	DATE
10/4/93		ADDED CROSS-SECTIONS E AND F	6/23/93
			DRAWN BY: M.R.L.
			SHEET



BORROW SITE SECTION G-G1

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
BORROW SITE CROSS SECTION

DATE	APPROVED	REVISION	DATE	DRAWN BY	SHEET
			10/4/93	M.R.L.	

RECEIVED NOV SUB LAND

Department of Environmental Protection

RECEIVED
JUN 13 1996
ENVIRONMENTAL RESOURCES MANAGEMENT

Lawton Chiles
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Virginia B. Wetherell
Secretary

In re:

Palm Beach County
c/o Mr. Richard Walesky
Department of Environmental Resources Management
3323 Belvedere Road, Building 502
West Palm Beach, Florida 33406

DEP Variance No. VE-50-650
Palm Beach County

_____/

FINAL ORDER

On October 18, 1993, the Department received from the Department of Environmental Resources Management, a Petition for Variance, pursuant to Section 403.201(1), Florida Statutes (F.S.), and Rule 62-103.100, Florida Administrative Code (F.A.C.). The Petitioner requested relief from Rule 62-4.244(5)(c), F.A.C. This variance is sought in conjunction with Permit No. 502355609 to conduct a beach restoration project along 1.42 miles of Atlantic shoreline from 180 feet south of South Lake Worth Inlet to DNR monument R-159, with and construction of eight T-head groins in the northern 1,800 feet of the project.

After reviewing the Petition for Variance, the Department staff concluded that it satisfied the requirements and criteria set forth in Section 403.201, F.S. and Rule 62-103.100, F.A.C. A copy of the Department's letter of December 18, 1995, setting forth its findings is attached hereto and incorporated herein as

Exhibit A.

The letter of December 18, 1995, notified the Petitioner of the Department's proposed agency action and advised it of its right to a hearing pursuant to Section 120.57, F.S. On December 25, 1995, notice was given in The Palm Beach Post and on January 5, 1996 in the Florida Administrative Weekly informing the public of the Department's intended action and offering an opportunity for hearing pursuant to Section 120.57, F.S. A copy of the notices is attached as Exhibit B.

The Petitioner and interested parties having been advised of their rights under Chapter 120, F.S., and having failed or declined to file a Petition pursuant to Section 120.57, F.S., are hereby deemed to have waived those rights. Acceptance of the variance constitutes notice and agreement that the Department will periodically review this variance for compliance, including site inspections where applicable, and may initiate enforcement action for violation of the conditions and requirements thereof. It is therefore:

ORDERED by the State of Florida, Department of Environmental Protection, that the Petition of Palm Beach County, Department of Environmental Resources Management requesting a variance be and is hereby granted, subject to the conditions recommended by Department staff in Exhibit A.

Any Party to this Order has the right to seek judicial review of the Order Pursuant to Section 120.68, F.S., by the filing of a Notice of Appeal pursuant to Rule 9.110, Florida Rules of the Appellate Procedure, with the clerk of the Department in the Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400; and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date this Order is filed with the clerk of the Department.

DONE AND ORDERED this 10th day of June, 1996, in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

for Virginia B. Wetherell
Secretary
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida
32399-2400

CERTIFICATE OF SERVICE

This is to certify that this **FINAL ORDER** and all copies were mailed before the close of business on 10 June, 1996.

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to 120.52(9), Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Clerk 10 June 1996
Date

DEP 96-0010 CS

"EXHIBIT A."

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

In the matter of an
Application for Variance
By:

Palm Beach County
Department of Environmental Resource Management
3323 Belvedere Road, Building 502
West Palm Beach, Florida 33406

DEP Variance No. VE-50-650
Palm Beach ~~County~~

_____/

INTENT TO GRANT VARIANCE

The Department has reviewed the petition for a variance and the supporting documentation, filed on behalf of Palm Beach County, pursuant to Section 403.201(1), Florida Statutes (F.S.). The petitioner seeks a variance from the provision of Rule 62-4.244(5)(c), Florida Administrative Code (F.A.C.). This rule establishes the maximum mixing zone allowable for wetland resource permits at no greater than 150 meters in radius from the point of discharge of a given pollutant. The variance is sought in conjunction with Permit No. 502355609 to conduct beach restoration along 1.42 miles of Atlantic shoreline from 180 feet south of South Lake Worth Inlet to DNR monument R-159, and construction of eight T-head groins in the northern 1,800 feet of the project. The Department hereby gives notice of its intent to grant a variance establishing a temporary mixing zone of 300 meters offshore and 500 meters down current from the point of sand discharge onto the beach.

The Department issues the notice of intent to grant the variance, based upon the following findings:

1. The borrow material to be used for the beach nourishment work contains up to 4% silt (material passing through the No. 200 U.S. Standard Sieve, i.e. less than 0.075 mm in diameter);

2. The Department has determined that the proposed borrow material is suitable for beach nourishment work;

3. The water quality standard for turbidity in Class III marine waters pursuant to Rule 62-302.530(71), F.A.C., is less than or equal to 29 nephelometric turbidity units above natural background levels;

4. The applicant indicates that turbidity exceeding the water quality standard for Class III marine waters may occur under certain conditions during beach renourishment work in spite of the use of best management practices;

5. The beach nourishment work will be accomplished in a manner which minimizes the potential for elevated turbidity, including the use of construction dikes and a minimum set-back for the discharge pipe from open water at the beach;

6. There is no practicable means known to further minimize the potential for elevated turbidity using the borrow material

selected and considering hydrodynamic processes in the nearshore area at the beach nourishment site.

The ~~variance~~ is subject to the following conditions:

1. This variance is valid only if a wetland resource permit (File No.502355609) is issued for this project, and is subject to any and all conditions and monitoring requirements of the permit. The granting of this variance does not guarantee the issuance of the permit.

2. The variance is temporary and shall only be valid during beach nourishment work accomplished under the requirements of and during the term of Permit No. 502355609;

3. Given good cause by either party, the Secretary may alter the terms and conditions of the variance.

The variance is subject to the following monitoring conditions:

1. This variance shall be subject to all monitoring conditions required by Permit No. 502355609.

The attached public notice will be placed in the Florida Administrative Weekly by the Department. A copy of this public notice must be placed by the applicant in a newspaper of general circulation in the project area for one time only publication. An original, notarized affidavit of publication prepared by the publisher shall be submitted by the applicant to the Bureau of Submerged Lands and Environmental Resources within seven days of publication. Failure to publish the notice and provide proof of publication may result in the denial of the variance.

The Department will issue the variance with the attached conditions unless a petition for an administrative proceeding (hearing) is filed pursuant to the provisions of Section 120.57, F.S.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, F.S. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. Petitions filed by the permit applicant and the parties listed below must be filed within 21 days of receipt of this intent. Petitions filed by other persons must be filed within 21 days of publication of the public notice or within 21 days of their receipt of this intent, whichever first occurs.

Petitioners shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, F.S.

The Petition shall contain the following information:

(a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed;

(b) A statement of how and when each petitioner received notice of the Department's action or proposed action;

(c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;

(d) A statement of the material facts disputed by Petitioner, if any;

(e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or

proposed action;

(f) A statement of which rules or statutes petitioner contends require reversal or modification ~~of~~ the Department's action or proposed action; and

(g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this intent. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 21 days of receipt of this intent, in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will

only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

If you have any questions regarding this intent to issue, please contact Robert V. Lutz at (904) 487-1262.

Executed in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Alfred B. Devereaux Jr., Chief
Bureau of Beaches and Coastal
Systems 3900 Commonwealth
Blvd., Mail Station 315
Tallahassee, Florida
32399-3000
(904)487-1262

Copies furnished to:

Marion Hedgepeth, DEP, Southeast District
DEP, Office of General Council
U.S. Army Corps of Engineers, Jacksonville

Attachment (public notice)

CERTIFICATE OF SERVICE

This is to certify that this Intent To Grant Variance and all copies were mailed before the close of business on December 18, 1995.

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to 120.52(9), Florida Statutes, with the designated Department Clerk, receipt of this is hereby acknowledged.

Bevid Reaudh 12/18/95
Deputy Clerk Date

Attachment 3

State Coastal Construction Control Line Permit

Department of Environmental Protection

Lawton Chiles
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Virginia B. Wetherell
Secretary

ENV. RES. MGMT. 3/28
Reviewed
Coastal & Wetlands
Env. Review
Mosquito Control
Water Resources
Fiscal
Asst. City Admin.
Copy File

December 19, 1995

RECEIVED
DEC 27 1995
ENVIRONMENTAL RESOURCES MANAGEMENT

Palm Beach County
Department of Environmental Resources Management
3323 Beledere Road, Bldg. 502
West Palm Beach, Florida 33406

Dear Sir/Madam:

NOTICE TO PROCEED WITHHELD
PERMIT NUMBER: DBS9A0330 PB
PERMITTEE NAME: Palm Beach County

Your request for a permit pursuant to Section 161.041, Florida Statutes, and Chapter 62B-41, Florida Administrative Code, for activities below the mean high water line on sovereign lands of The State of Florida has been approved by the Department of Environmental Protection. However, construction may not commence until after the permittee has received a notice to proceed in accordance with Special Permit Condition 1 and 2, and the permittee complies with any preconstruction requirements described in Special Permit Condition 6.

Please read the permit and permit conditions closely before starting construction. Particularly note that General Permit Conditions 1(h), and 1(i) pertain to written reports which must be submitted to the Department of Environmental Protection under the signature and seal of a professional engineer at specified times. Forms for use in preparation of the final certification of completeness and periodic progress report are enclosed. You will need to make sufficient copies of the periodic report form to provide the required reports. The periodic reports are due in the office of the Bureau of Beaches and Coastal Systems on a monthly basis on the last working day of each month beginning at the start of construction.

Special Permit Condition 2.1 requires the permittee to publish a public notice in the newspaper pursuant to Rule 62B-41.012(4)(c), Florida Administrative Code. The public notice must be published within 10 days of the date of your receipt of this final order. A draft of the required notice is enclosed.

The permit will expire December 18, 2000. Upon receipt of a written request signed by the permittee or authorized agent, the Department will consider extending the permit for up to but no more than one additional year. In order to be considered, the time extension request must meet all requirements of Section 62B-41.017, Florida Administrative Code.

A party to this proceeding has the right to request review of this order by the Governor and Cabinet, sitting as the Land and Water Adjudicatory Commission, in accordance with Chapter 42-2, Florida Administrative Code, and specifically Rule 42-2.0131, Florida Administrative Code. To initiate such a review, your request must be filed within twenty (20) days of the date of this order with the Secretary of the Commission at

Florida Land and Water Adjudicatory Commission, The Capitol, Room 2105, Tallahassee, Florida 32399-0001. A copy of the request must also be served on both the Department of Environmental Protection, Agency Clerk, 2600 Blair Stone Road, Mail Station 35, Tallahassee, Florida 32399, and on any person named in this order, within 20 days from the date of this order if the request for review is to be effective.

Additionally, any person substantially affected by this determination has the right to request an administrative hearing to be conducted in accordance with the provisions of Section 120.57, Florida Statutes. Should you desire an administrative hearing, your request must comply with the provisions of Rule 28-5.201, Florida Administrative Code, for a formal administrative hearing, or Rule 28-5.501, Florida Administrative Code, if requesting an informal hearing. Requests for such hearings must be sent to the Department of Environmental Protection, Bureau of Beaches and Coastal Systems, Mail Station 310, 3900 Commonwealth Boulevard, Tallahassee, Florida 32399-3000, and must be received by the Department within twenty-one (21) days after your receipt of this notice. Failure to respond within this allotted time frame shall be deemed a waiver of all rights to an administrative hearing.

In the event that a legally-sufficient petition for hearing is not timely received, you have the right to seek judicial review of this final order, pursuant to Section 120.68, Florida Statutes, and Rule 9.030(b)(1)(c) and 9.110, Florida Rules of Appellate Procedure. To initiate an appeal, a Notice of Appeal must be filed with the Department of Environmental Protection, Office of General Counsel, and with the appropriate District Court of Appeal within thirty (30) days of the date this final order is filed with the Agency Clerk. The Notice filed with the District Court must be accompanied by the filing fee specified in Subsection 35.22(3), Florida Statutes.

You are advised that notice of this agency's final action on this permit shall be given to other interested parties. They have twenty-one (21) days from receipt of a notice or newspaper publication of a public notice to exercise any rights they may have under Chapter 120, Florida Statutes. Actions undertaken by you under this permit, during this period may be subject to modification, removal or restoration.

The authorized work is strictly limited to that described on the enclosed final order. Please direct any questions pertaining to this permit to me by letter at the above address, or by telephone at 904/487-4475.

Sincerely,

Robert M. Brantly

Robert M. Brantly, P.E.
Bureau of Beaches and Coastal Systems

RMB/dw
Enclosures
cc: Permit Information Center
Red Taylor, Field Engineer
Palm Beach County, Permittee

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Environmental Resource Permitting
Bureau of Beaches and Coastal Systems
3900 Commonwealth Blvd. - Mail Station 300
Tallahassee, Florida 32399-3000
(904) 488-3180

PERMIT NUMBER: DBS9A0330 PB

PERMITTEE

Palm Beach County
Department of Environmental Resources Management
3323 Belvedere Road, Bldg. 502
West Palm Beach, Florida 33406

PERMIT FOR CONSTRUCTION OR OTHER ACTIVITIES
PURSUANT TO SECTION 161.041, FLORIDA STATUTES

FINAL ORDER

FINDINGS OF FACT: An application for authorization to conduct the activities below mean high water line on sovereignty lands of Florida which are indicated in the project description was filed by the applicant/permittee named herein on August 2, 1993, and was determined to be complete pursuant to rule on November 6, 1995. The application was considered by the Secretary of the Department of Environmental Protection.

CONCLUSIONS OF LAW: After considering the merits of the proposal and any written objections from affected persons, the Department finds that on compliance with the permit conditions, the activities indicated in the project description are of such a nature that they will result in no significant adverse impacts to the sandy beaches of the state; are not expected to adversely impact nesting sea turtles, their hatchlings, or their habitat; will not interfere, except during construction, with the use by the public of any area of the beach seaward of mean high water; are appropriately designed in accordance with Rule 62B-41, Florida Administrative Code. Based on the foregoing considerations, the Secretary approves the application; authorizes construction and/or activities at the location indicated below in strict accordance with the project description; the approved plans (if any) which by this reference are incorporated herein; the conditions provided in Rule 62B-41.015, Florida Administrative Code; and any additional conditions shown below, pursuant to Rule 62B-41.015(2), Florida Administrative Code.

EXPIRATION DATE: December 18, 2000

LOCATION: Between 200 feet north of Department of Environmental Resources' DNR reference monument R-152 and 100 feet south of DNR reference monument R-159, in Ocean Ridge, Palm Beach County.

PROJECT DESCRIPTION:

Beach Restoration

1. Location of beach fill: Between 200 feet north of DNR reference monument R-152 and 100 feet south of DNR reference monument R-159.
2. Design fill volume: Approximately 784,300 cubic yards.
3. Length of fill: 1.42 miles (7,520 feet).
4. Berm elevation: +9.0 feet NGVD.
5. Design berm width: 50 feet (seaward limits contiguous with ECL).
6. Construction berm width: 180 feet to 230 feet (50 feet to 100 feet within groin field).

Borrow Area

1. Location of dredging: 2100 feet offshore between DNR reference monument R-152 and DNR reference monument R-156.
2. Water depth: Average -33.0 feet NGVD.
3. Volume of dredging: Approximately 784,300 cubic yards with an additional 25 percent overdredge allowance to fill the construction template.
4. Dimensions: 750 feet wide in the shore-normal direction by 3,875 feet long in the shore-parallel direction.
5. Depth of dredge cut: 15 feet.

Groin Field

1. Location: Between 200 feet north of DNR reference monument R-152 and 100 feet south of DNR reference monument R-153.
2. Length of groin field: 1,800 feet.
3. Number of T-head groins: eight (8).
4. Spacing of groins: Average 240 feet.
5. Length of groins: 110 feet to 180 feet in the shore-normal direction with T-head lengths of 50 feet or 90 feet in the shore-parallel direction.
6. Crest elevation: +4.0 feet to +5.0 feet NGVD.
7. Side Slopes: 1 vertical to 2 horizontal.
8. Toe elevation: 0.0 feet to -4.0 feet NGVD.

Derelict Structures Removal

Existing derelict structures located between DNR reference monument R-152 and 600 feet south of DNR reference monument R-155 (between 400 feet and 4400 feet south of the south jetty of South Lake Worth Inlet) are to be removed or modified.

SPECIAL PERMIT CONDITIONS:

1. No work shall be conducted under this permit until the permittee has received a written notice to proceed from the Department.

2. Prior to the issuance of the notice to proceed, the permittee shall submit the following:

2.1 Written evidence that a public notice of the Department's action, advising the public of their rights pursuant to Chapter 120, Florida Statutes, has been published for one day in the largest newspaper of general circulation in Palm Beach County. A certification from the newspaper showing compliance shall be provided to the staff. Prior to publishing the required public notice, the permittee shall contact the staff and obtain the specific language that must appear in the advertisement. The notice must be published within 14 days of the permittee's receipt of the final order.

2.2 Two copies of final construction plans and specifications for the project, including a separate work plan describing procedures, equipment and staging areas for construction of the groins.

2.3 Two copies of a derelict structures removal plan. At a minimum all portions of the derelict structures above the pre-construction beach profile or an elevation 3 feet below the design beach grade, whichever is lower, shall be removed.

2.4 A hydrographic plan to monitor the performance of the project, to identify potential erosion and accretion patterns within the project limits and along the adjacent shorelines, to verify the analyses that were conducted in the development of the design of the project, and to identify any adverse impacts, which would be attributable to the project authorized by this permit. The monitoring plan shall specify the data that is to be collected, the time period for data collection, the proposed analyses to be conducted and the format in which the results are to be presented. The plan shall include an executive summary, a table of contents, a list of tables and figures, and a plan view map.

3. The permittee shall perform beach renourishment of the 1000-foot segment of shoreline south of the groin field sufficient to maintain the design berm width. Failure to perform beach renourishment shall require modification or removal of the groin field as directed by the Department. Should sufficient volume of material not be available from the mechanical bypassing of the fixed sand transfer plant to maintain the shoreline, then the permittee shall find an alternate source.

4. Subsequent beach renourishment activities or modifications to the groin field shall comply with all conditions of this permit and require prior approval from the Bureau staff. Prior to receiving approval for additional activities, the permittee shall submit the required processing fee, construction plans, and any other information the staff deems necessary for a review of the activity.

5. A hydrographic monitoring program shall be conducted in accordance with the monitoring plan approved as a part of Special Permit Condition 2. The monitoring program is subject to modification at the direction of the department should shoreline conditions change. The monitoring program shall consist of the following:

5.1 Topographic profile surveys from the Department of Environmental Protection's DNR reference monument R-152 through DNR reference monument R-163 measured along the same azimuths previously surveyed by the Department and extending seaward to a depth of -30.0 feet NGVD. Additional profile surveys shall be conducted between the south jetty of South Lake Worth Inlet and a point 1000 feet south of the groin field to provide a survey map depicting topographic contours on one-foot intervals from the vegetation line to the -10.0 feet NGVD contour. All profiles shall be surveyed immediately (within 30 days) prior to construction, immediately (within 30 days) following completion of construction, and annually thereafter during each month of August. Additional surveys may be required following a major storm as determined by the Department.

5.2 Bathymetric profile surveys of the borrow area. The surveys shall be conducted immediately following completion of construction and annually thereafter for a period of two years, unless otherwise determined by the Department following the second annual survey.

5.3 Targeted aerial photography shall be taken immediately following completion of construction and annually thereafter for a period of at least two (2) years as close to the date of the topographic surveys as possible. The photography shall be at a scale of 1 inch=500 feet or larger and a 60 percent overlap. The limits of the targeted aerial photography shall be from DNR reference monument R-152 to DNR reference monument R-163 and shall be centered on the local shoreline. The permittee shall submit 9x9-inch contact prints of the aerial photography and copies of any enlargements used by the permittee in their analysis of the project.

5.4 Sand samples shall be obtained concurrently with the post-construction and second annual beach profile surveys on at least three (3) stations along at least three (3) beach profiles within the fill project area. The stations shall include a sample from the dry beach area, the foreshore, and the equilibrium toe of fill. Each sample shall be tested

for grain size distribution and shell content. Testing and reporting shall be in accordance with applicable Army Corps of Engineers and ASTM standards.

5.5 Within 90 days of completion of each annual survey the permittee shall submit to the Bureau an engineering report summarizing the monitoring data and project performance in accordance with the approved monitoring plan. All survey data and survey control information shall be submitted on 3.5-inch or 5.25-inch double sided high density disk in ASCII format. The data shall be arranged according to the DEP/DBS specifications and include all information required by the DEP/DBS specifications.

6. Prior to commencement of construction activity authorized by this permit, a preconstruction conference shall be held among the contractor, the owner or authorized agent, the marine turtle permit holder, and a staff representative of the Bureau of Beaches and Coastal Systems to establish an understanding among the parties as to the items specified in the special and standard conditions of the permit. At least 7 days advance notice shall be provided prior to conducting this meeting.

7. If work associated with the removal and modification of existing groins and the construction of eight (8) T-head groins, pursuant to this permit, is performed during the marine turtle nesting season (March 1 through October 31) the following conditions shall apply.

7.1 Daily early morning surveys of the nesting beach shall be conducted. Surveys shall be initiated at least 65 days prior to the commencement of construction activities or on March 1, whichever date is later. Surveys shall be continued through September 30.

7.2 Nests that are deposited in areas where construction activities have not yet been completed shall be relocated if such construction would threaten the successful incubation and hatching of the eggs. Nests deposited within the project boundaries in areas where construction has been completed or where construction will not occur, or will not occur for 70 days, shall be marked and the actual location of the clutch determined. A circle with a radius of ten (10) feet, centered at the clutch, shall be marked by stake and survey tape or string. No construction activities shall enter this circle and no adjacent construction shall be allowed which might directly or indirectly disturb the area within the staked circle. Nests that require relocation shall be relocated prior to 9:00am each day to nearby self-release beach location where artificial lighting and/or other disturbances will not interfere with successful incubation, hatching nor hatching orientation. At least two of these locations shall be selected prior to commencement of relocations and the sites approved by the Department prior to usage.

7.3 No overnight storage of equipment or materials are authorized seaward of the dune crest, existing seawalls or bulkheads during the marine turtle nesting season (1 March through 31 October), unless authorized in accordance with a work plan approved by the Department.

7.4 No temporary lighting of the construction area is authorized at any time during the marine turtle nesting season (1 March through 31 October). No permanent lighting is authorized.

8. Beach restoration activities are not authorized during the main portion of the marine turtle nesting season (May 1 through October 31). This condition is consistent with the conditions of the U.S. Fish and Wildlife Service's Biological Opinion dated May 26, 1994. If subsequent to issuance of this permit the Service authorities activities during the main portion of the marine turtle nesting season, then the permittee may proceed during this time period but shall contact the Department for additional permit conditions required for the protection marine turtles.

9. If work associated with the beach restoration activities occurs during the early portion of the marine turtle nesting season (March 1 through April 30), the following conditions shall apply.

9.1 Construction pipes which are placed parallel to the shoreline shall be located as far landward as possible without compromising the integrity of the dune system. Temporary storage of pipes and equipment shall be off the beach to the maximum extent possible or as far landward as possible without compromising the integrity of the dune system if temporary storage on the beach is necessary.

9.2 All on-beach lighting associated with the project shall be limited to the immediate area of active construction only. Such lighting shall be shielded low pressure sodium vapor lights to minimize illumination of the nesting beach and nearshore waters. Lighting on offshore equipment shall be minimized through reduction, shielding, lowering, and appropriate placement of lights to avoid excessive illumination of the water, while meeting all Coast Guard and OSHA requirements. Shielded low pressure sodium vapor lights are highly recommended for lights on offshore equipment that cannot be eliminated.

9.3 Daily early morning surveys of the nesting beach shall be conducted. Surveys shall be initiated on March 1. Surveys shall be continued until September 30 in order to assess the performance of the restored beach. Survey work shall be performed in such a manner so as to ensure that construction activity does not occur in any location prior to completion of the necessary marine turtle protection measures. Nests which will be affected by construction activities shall be relocated between sunrise and 9:00 am each

day unless nighttime monitoring is being conducted. If nighttime monitoring is being conducted in association with this permit nests may be relocated immediately after the nesting process has been completed and the nesting turtle has left the beach. Nests shall be relocated to a nearby self-release beach site, in a secure setting where artificial lighting will not interfere with hatchling orientation. Relocation site(s) shall be approved by the Department prior to usage. Nest relocations in association with construction activities shall cease when construction activities no longer threaten nests. Nests deposited within areas where construction activities have ceased or will not occur for 70 days shall be marked and left in place unless other factors threaten the success of the nest. Any nests left in the active construction zone shall be clearly marked and the actual location of the clutch determined. A circle with a radius of ten (10) feet, centered at the clutch, shall be marked by stake and survey tape or string. No construction activities shall enter this circle and no adjacent construction shall be allowed which might directly or indirectly disturb the area within the staked circle.

10. All nesting surveys, nest relocations screening or caging activities etc. shall be conducted only by persons with prior experience and training in these activities and is duly authorized to conduct such activities through a valid permit issued by the Department, Division of Marine Resources, pursuant to Florida Administrative Code 62R-1.

11. The permittee shall ensure that sand compaction and escarpments do not adversely impact marine turtle nesting by implementing the following:

11.1 Immediately after completion of the construction project, sand compaction shall be measured by use of a cone penetrometer. Measurements shall be taken from at least two locations spaced equidistant along shore normal transects established every 500 feet within the project limits with values recorded at 6, 12, and 18 inches depth. If values exceeding 500 psi's are encountered at any two adjacent stations at any depth, tilling shall be required. If tilling is required, the beaches shall be plowed (tilled) to a depth of 36 inches. All tilling must be completed prior to March 1 unless project construction has not been completed. If project construction continues into the early portion of the nesting season, then all tilling shall be completed prior to May 1.

11.2 Visual surveys for escarpments along the project area shall be made before March 1 following completion of the project. Any escarpments which interfere with marine turtle nesting or which exceed 18 inches in height for a distance of 100 feet shall be mechanically leveled to the natural beach contour to ensure that no escarpments are present prior to March 1 unless project construction has not been completed. If project construction continues into the early portion of the nesting season, then all escarpments shall be leveled prior to May 1. If escarpments form during the main portion of the nesting season (May 1 through October 31) so that marine turtle nesting is adversely

impacted, the applicant shall contact the Department for a determination of whether removal of escarpments is required.

11.3 A written report containing the compaction measurements and results of the visual survey for escarpments shall be submitted to the Department as soon as possible after data collection and prior to commencement of the nesting season (March 1 or May 1 depending upon construction completion date).

12. Reports on all nesting activity, marine turtle protection measures taken during construction, and nest success shall be provided for the initial construction year's nesting season and for a minimum of three additional nesting seasons. Monitoring of nesting activity shall include but not be limited to daily surveys enumerating nesting activity and evaluating hatching success in a statistically valid sample of in situ nests. All reports shall include daily report sheets noting all activities, nesting success of a representative sampling of nests left in place, dates of construction and names of all personnel involved in marine turtle activities. All marine turtle monitoring reports shall be submitted no later than 90 days after completion of all monitoring activities to the DEP-Division of Marine Resources, 3900 Commonwealth Boulevard, MS-245, Tallahassee, Florida 32399-3900.

Approved plans are incorporated into this permit by reference.

Done and ordered this 18th day of December 1995, in Tallahassee, Florida.

State of Florida
Department of Environmental Protection

Keith B. Ormsee
E.O. Virginia B. Wetherell
Secretary

DBS

GENERAL PERMIT CONDITIONS

Pursuant to Section 161.041, Florida Statutes and Chapter 16B 41, Florida Administrative Code

16B-41.015 Coastal Construction Permit Conditions.

(1) The following permit conditions shall apply to all permits issued pursuant to this Chapter unless waived or modified in accordance with Subsection (3) below:

(a) The permittee shall carry out the coastal construction for which the permit was granted in accordance with the plans and specifications which were approved by the Department as part of the permit. Any deviation therefrom, without written approval from the Bureau, shall be grounds for suspension of the work and revocation of the permit pursuant to Section 120.60(7), Florida Statutes, and may result in assessment of civil fines or issuance of an order to alter or remove the unauthorized structure, or both. No other coastal construction shall be conducted. No modifications to project size, location, or structural design are authorized without prior written approval from the Department. A copy of the permit, notice to proceed, any modifications, time extensions, or permit transfers shall be conspicuously displayed at the project site.

(b) The permittee shall conduct the coastal construction authorized under the permit using extreme care to prevent any adverse impacts to the coastal system, marine turtles, nests and their habitat or adjacent property and structures.

(c) The permittee shall allow any duly authorized member of the staff to enter upon the premises associated with the project authorized by the permit for the purpose of ascertaining compliance with the terms of the permit and with the rules of the Department, until all coastal construction authorized or required in the permit has been completed, and all reports, certifications, or other documentation of project performance are received and accepted by the Department.

(d) The permittee shall hold and save the State of Florida, the Department, its officers and employees, harmless from any damage, no matter how occasioned and no matter what the amount, to persons or property which might result from the coastal construction authorized under the permit and from any and all claims and judgments resulting from such damage.

(e) The permittee shall allow the Department to use all records, notes, monitoring data and other information relating to construction or operation under the permit which are submitted for any purpose it may deem necessary or convenient, except where such use is otherwise specifically forbidden by law.

(f) The permittee shall not disturb existing beach and dune or inlet topography and vegetation except as expressly authorized in the permit. Before the project is considered complete, any disturbed topography or vegetation shall be restored as prescribed in the permit, with suitable fill material or revegetated with appropriate beach and dune vegetation.

(g) The permittee shall immediately inform the Bureau of any change of mailing address of the permittee and authorized agent until all requirements of the permit are met.

(h) The permittee shall provide periodic progress reports certified by an engineer registered in the State of Florida. The reports shall be submitted on a monthly basis beginning at the start of construction and continuing until all work has been completed. The engineer shall certify

that all construction as of the date of each report has been performed in compliance with the plans and the project description approved as a part of the permit, and with all conditions of the permit, or shall specify any deviation from the plans, project description or conditions of the permit. The report shall also state the percent of completion of the project and each major individual component.

(i) The permittee shall provide the Department with a final report certified by an engineer registered in the State of Florida within thirty (30) days following completion of the work. This certification shall state that: all locations and elevations specified by the permit have been verified; the coastal construction authorized by the permit has been performed in compliance with the plans and project description approved as a part of the permit and all conditions of the permit; or shall describe any deviations from the approved plans, project description or permit conditions and any work not performed. Such certification shall not relieve the permittee of the provisions of 1(a) above. If none of the permitted work is performed, the permittee shall inform the Department in writing no later than 30 days following expiration of the permit. The final certification shall be on the form Final Certification (DNR Form 73-206 effective 8-23-92), hereby incorporated by reference. Copies of the form may be obtained by writing the Department of Environmental Protection, Division of Beaches and Shores, Bureau of Coastal Engineering and Regulation, 3900 Commonwealth Boulevard, Mail Station 310, Tallahassee, Florida 32399; or by telephoning (904)487-4475.

(j) The permittee shall obtain any applicable licenses or permits which may be required by federal, state, county or municipal law.

(k) The permittee shall not commence any coastal construction on, or encroaching on, the sovereignty land of Florida seaward of the mean high-water line, or, if established, the erosion control line, until the permittee has received from the Board of Trustees of the Internal Improvement Trust Fund the required lease, license, easement, or other form of consent authorizing the proposed use.

(l) The permittee shall adjust, alter or remove any permitted structure or other physical evidence of the work or activity permitted, upon written notice from the Department that the coastal construction in question results in a significant adverse impact or is inconsistent with Section 370.12, Florida Statutes, or otherwise proves to be undesirable or becomes unnecessary. The permittee shall also be required to restore the impacted coastal system. Adjustment, alteration, or removal required under this provision, shall be accomplished by the permittee at no cost to the State of Florida.

(m) The permittee shall conduct and report all required project monitoring and data collection in conformance with this Chapter.

(n) The permittee shall cease work if shoreline conditions change such that continued construction under the permit would result in an adverse impact to the coastal system. The permit is subject to suspension, revocation or modification by the Department in order to eliminate any adverse impact.

(2) The Department shall require additional permit conditions to insure compliance with the provisions of this Chapter.

(3) The Department is authorized to waive or modify any of the permit conditions set forth in Rule 16B-41.015(1), if, in the opinion of the Department, such conditions are found to be not applicable, inappropriate, or unnecessary to carry out the intent of Chapters 161 or 370, Florida Statutes.

Specific Authority 161.041, 370.021, Florida Statutes. Law Implemented 161.041, 161.042, 161.051, 161.054, 161.061, 370.021(1), Florida Statutes. History - New 8-23-92.

PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
(FROM MARTIN COUNTY LINE TO LAKE WORTH INLET AND FROM SOUTH LAKE WORTH INLET TO BROWARD COUNTY LINE)

GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE OCEAN RIDGE SEGMENT

APPENDIX 1

ENGINEERING DESIGN AND COST ESTIMATES

APPENDIX 1
ENGINEERING DESIGN AND COST ESTIMATES
PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE
OCEAN RIDGE SEGMENT

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APPENDIX 1
ENGINEERING DESIGN AND COST ESTIMATES
PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM
OCEAN RIDGE SEGMENT

PROBLEM IDENTIFICATION

1-1. Whether a shoreline erodes, accretes, or remains stable, depends upon various interrelated phenomena. Since the construction of South Lake Worth Inlet in 1927, the shoreline along the Town of Ocean Ridge, downdrift of the inlet, has historically experienced severe beach erosion. Since 1937, a fixed sand transfer plant has intermittently bypassed sand across the inlet to mitigate the downdrift erosion; however, erosion continues. The erosion can be attributed to the combination of the downdrift inlet effects and storm induced winds, waves and tides. This chronic erosion has resulted in extensive loss of land and has made oceanfront property and infrastructure vulnerable to storm-induced damage. Efforts to protect the land and upland development have included the construction of extensive shore-parallel (coastal armor) and shore-perpendicular (groin) structures. Where constructed, these structures have reduced the chronic loss of land and to some degree provided storm protection to the upland development; but in doing so, they have exacerbated local beach erosion and therefore contribute to the long-term vulnerability of the area to storm winds and waves. This study addresses the effect of continued chronic erosion along the Ocean Ridge shoreline and the increasing probability of storm damage to upland property. Additionally, the study quantifies the shore protection needs of the Ocean Ridge shoreline and presents the engineering development of the proposed shore protection project. Figure 1-1 presents a vicinity and location map of the Ocean Ridge shoreline.

GEOLOGY

1-2. The State of Florida is situated on the Floridian Plateau geologic structure. The Floridian Plateau is a partially submerged platform that separates the deep water of the Gulf of Mexico and the deep water of the Atlantic Ocean. The Plateau is nearly 500 miles long and about 250 to 450 miles wide.

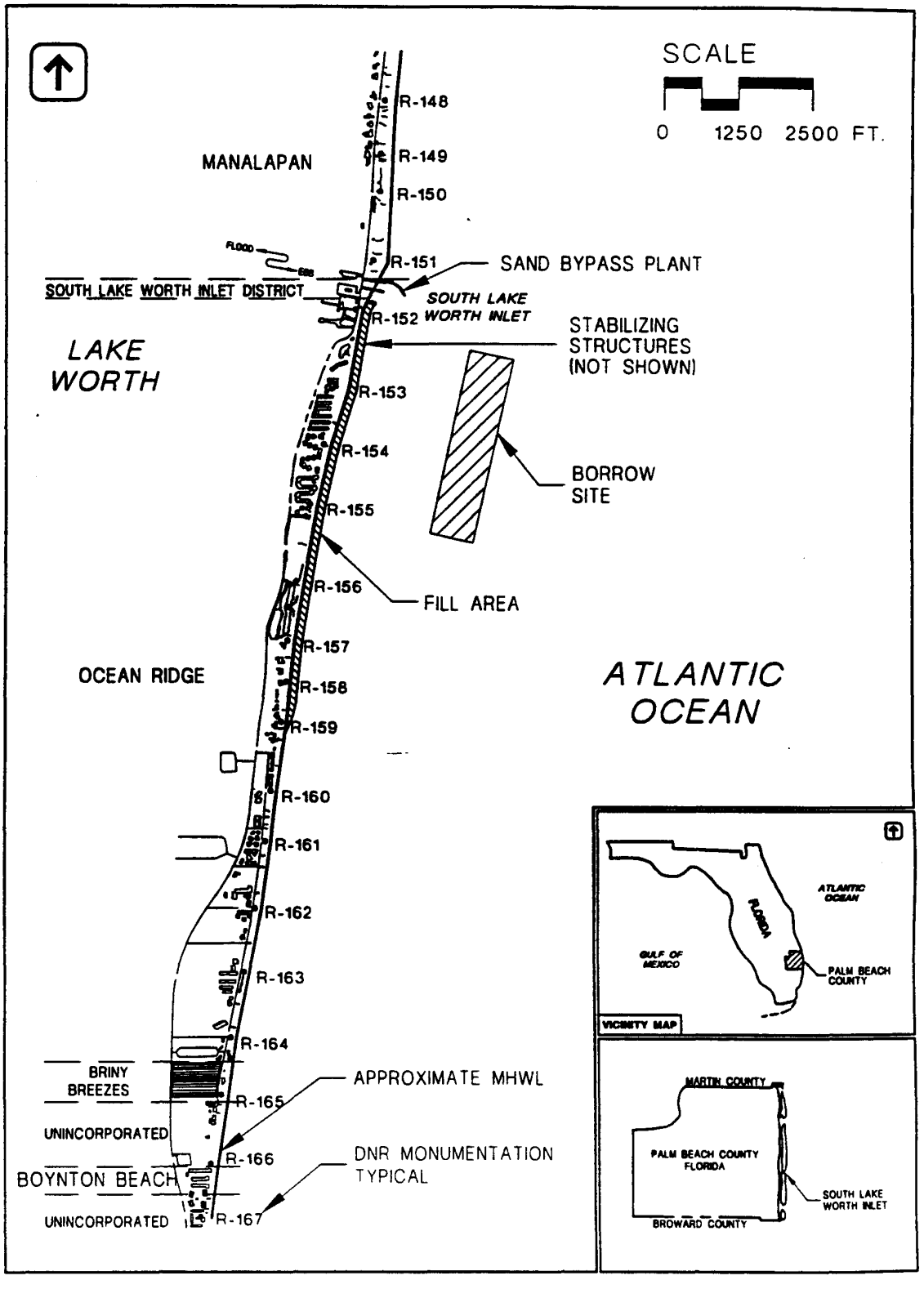


Figure 1-1: LOCATION MAP

1-3. Since the Mesozoic Era roughly 200 million years B.P. (before present), the plateau has been alternately dry land or covered by shallow seas. About 4,000 to greater than 20,000 feet (north central and southernmost Florida, respectively) of carbonate and marine sediments were deposited during this time.

1-4. Either following or concurrent with the later periods of emergence, there appears to have been a tilting of the plateau about its longitudinal axis. The west coast of Florida was partially submerged, as indicated by the wide estuaries and offshore channels of its streams, while the east coast was correspondingly elevated. As a result of that movement, the east coast manifests the characteristics of an emergent coastline. It is probable that the barrier strip forming the present Atlantic shoreline of Florida was started, at least in some sections, as an offshore bar which was elevated above the water surface by the tilting of the plateau and built up to its present condition by wave and wind action. This hypothesis permits an explanation of the presence of successive parallel ridges consisting principally of silica sand.

1-5. Silica sand on the Florida east coast is that which has been carried down to the sea by the Savannah, Altamaha, and other rivers of Georgia and the Carolinas, and gradually shifted southward by shore currents and wave action. For the most part, all east coast beaches in Florida are composed largely of unconsolidated limestone, coquina and sandstone deposits.

1-6. Most of the barrier islands in Palm Beach County are founded on the Anastasia formation. The Anastasia formation varies in composition and texture from coarse sandstone composed of consolidated shell sand to a compact mass of only slightly worn shells. This rock formation appears at several places along the county's shoreline as a submerged reef that is generally parallel to the shoreline.

1-7. Along the Ocean Ridge shoreline, the beaches are composed of mostly silica sand mixed with portions of whole and broken shell. Along this shoreline, two significant nearshore rock outcroppings are also present. These are located between Florida Department of Environmental Protection (FDEP) monuments T-152 and R-153 and R-160 and R-165. The outcroppings varying in width from approximately 5 to 60 feet with the landwardmost areas being exposed during an average low tide.

NATURAL FORCES

WIND CLIMATE

1-8. The yearly average offshore winds at nearby Palm Beach, as reported by ships at sea from 1897 to 1933, are listed in Table 1-1. Wind direction, duration, and velocity, observed every six hours by the U.S. Weather Bureau at West Palm Beach from July 1, 1938 to July 31, 1946 are summarized in Figure 1-2 and in Table 1-2. Both data sets describe winds as being onshore at least 56% to 58% of the time. The shipboard and weather station data respectively predict that the frequency of southeast winds is 1.25 to 2.1 times greater than northeast winds; but the wind velocities are greater from the northeast than from the southeast.

TABLE 1-1

Average offshore winds near Palm Beach from ship reports; 1879-1933.

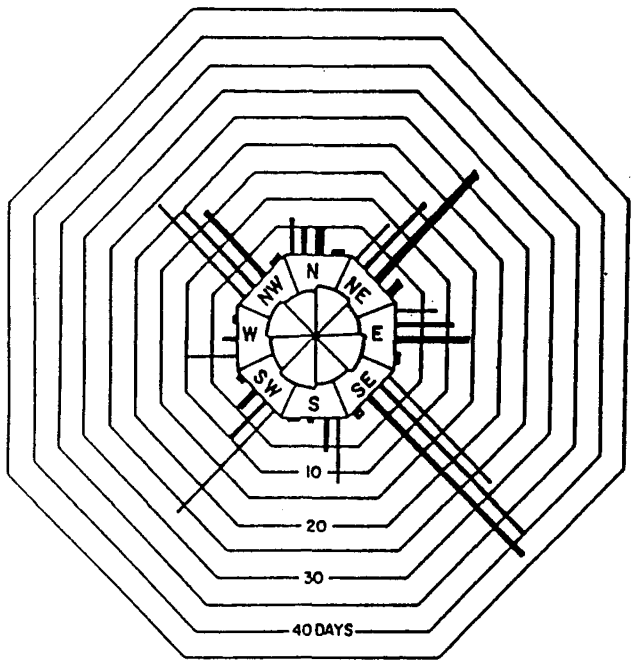
Yearly Average Offshore Winds

Direction	Percentage of time	Direction	Percentage of time
North	10	Southwest	6
Northeast	16	West	5
East	22	Northwest	8
Southeast	20	Calm	3
South	10		

WAVE CLIMATE

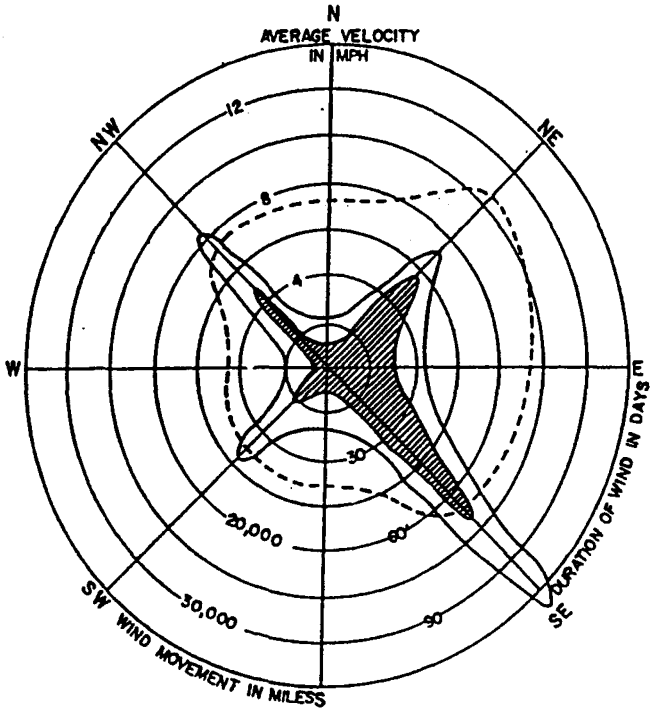
1-9. Wind generated waves impinging upon a shoreline are a principal component in long-term shoreline change. The wind generated wave field in the vicinity of Ocean Ridge is most frequently directed from the northeast, east, and southeast directions. The most energetic wave fields originate from the northeast. East and southeast wave fields are typically less energetic due to the fetch limiting effects of the Bahama Banks. The local wave climate has been characterized by hindcast, observed and measured wave data.

WIND DIAGRAMS



AVERAGE DIRECTION, DURATION AND VELOCITY OF WINDS FOR ONE YEAR AT WEST PALM BEACH, FLORIDA

VELOCITIES	MPH
———	0 TO 5
———	6 TO 10
———	11 TO 20
———	21 TO 30
———	31 AND OVER



AVERAGE VELOCITY, DURATION AND MOVEMENT OF WINDS FOR ONE YEAR AT WEST PALM BEACH, FLORIDA

- - - - - -	AVERAGE VELOCITY IN MPH
———	DURATION OF WIND IN DAYS
▨	WIND MOVEMENT IN MILES

Figure 1-2: Wind data at West Palm Beach, Florida (from Johnson, 1957).

TABLE 1-2

Wind data at West Palm Beach; July 1,1938 to July 31, 1946.

Wind Duration and Direction -- West Palm Beach

Direction	Percentage of time	Direction	Percentage of time
North	5	South	6
Northeast	15	Southwest	5
East	9	West	8
Southeast	32	Northwest	3

1-10. WIS Hindcast Data. In 1992, the wave information study (WIS) 20 year hindcast wave data were revised for Phase II locations in southeast Florida (Hubertz and Brandon, 1992). The hindcast, which excluded tropical storm events, was conducted for the 20 year period between 1956 and 1975. Unlike previous hindcasts in southeast Florida, the study incorporated the sheltering effects of the Bahama Banks. The hindcast produced a times series, with time increments of 3 hours, of spectral wave height, mean and peak wave period, and mean and peak wave direction.

1-11. As a part of the 1992 Coast of Florida Study, the Coastal Engineering Research Center compared the revised hindcast wave data to nearshore wave data collected in 1990 at Lake Worth and Hallandale. The results of the study demonstrated that hindcast values of spectral wave height, peak period and peak direction provided the best agreement with the measured wave data (Hubertz and Brandon, 1992).

1-12. The revised data from the Phase II hindcast station closest to the study area were analyzed for application to the project area. Station RAL2-011 is located at latitude 26.50 north, longitude 80.00 west, approximately 4.3 miles southeast of South Lake Worth Inlet in 90 meters of water.

1-13. The hindcast provides a general description of simple wave characteristics such as height, period and direction. The wave hindcast did not include waves generated from tropical storms. The significant wave height

(H_s) represents the combination of sea and swell. The wave period (T) and direction are of the dominant wave. Wave direction is measured clockwise in degrees from true north. Tables 1-3 through 1-5 summarize Phase II wave statistics for deepwater waves at station RAL2-011. Table 1-3 is a summary of the percent occurrence of significant wave height and peak period in increments of peak direction. Table 1-4 summarizes the percent occurrence of significant wave height and peak period for all directions. Table 1-5 is a summary of the mean significant wave height by month and year for all directions. The average significant wave height and peak period for the entire 20-year time span was 3.0 ft and 6.4 seconds, respectively.

1-14. Observed Nearshore Wave Data. Visual estimates of nearshore wave conditions were collected at Hillsboro Inlet between 1955 and 1970 (Strock and Associates, 1983). Hillsboro Inlet is located 23 miles south of South Lake Worth Inlet. Table 1-6 presents a summary of direction and percent occurrence of average wave heights observed over the 16 year period of record. During this period, the average reported occurrence of northeast waves (7.0%) was 1.23 times greater than that of southeast waves (5.7%), and 1.73 times greater on a year-by-year basis. The observed wave height averaged over all incident directions was about 3.5 ft.

1-15. Measured Nearshore Wave Data. As a part of the 1992 Coast of Florida Study, nearshore directional wave data were collected at Lake Worth and Hallandale, Florida. Tables 1-7 and 1-8 present a summary of the measured wave data at the Lake Worth and Hallandale wave gages, respectively. A mean significant wave height of 1.6 ft and mean peak wave period of 7.2 seconds was computed from the Lake Worth wave gage data. From the Hallandale gage data, a mean significant wave height of 2.0 ft and mean peak period of 6.1 seconds were computed. The most frequent wave directions measured at the two gage locations were from the east (90°) at the Lake Worth gage and from the northeast (45°) at the Hallandale gage.

1-16. Hurricane Hindcast Data. The hindcast data presented in Tables 1-3 through 1-5 do not include waves generated from tropical and extra-tropical storm systems. To complement the hindcast data, the Corps of Engineers conducted a hurricane hindcast for the period 1956-1975 (Abel, Tracy, Vincent, and Jensen, 1989). Table 1-9 presents the hurricane wave statistics for WIS hindcast station 70. Hindcast Station 70 is located at latitude 26.60 north, longitude 79.67 west, approximately 23 miles east-northeast of South Lake Worth Inlet in approximately 580 meters of water. In Table 1-9, the 0.25 and 0.75

TABLE 1-3
PERCENT OCCURRENCE OF WAVE HEIGHT AND PERIOD

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 0.0

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00 0.49	.	334	356	.	.	.	.	.	690
0.50-0.99	.	700	1665	3	.	.	.	.	2368
1.00-1.49	.	92	1071	10	.	.	.	.	1174
1.50 1.99	.	.	418	84	.	.	.	.	501
2.00-2.49	.	.	121	154	.	.	.	.	275
2.50-2.99	.	.	2	166	.	.	.	.	168
3.00-3.49	.	.	.	44	7	.	.	.	51
3.50-3.99	.	.	.	3	5	.	.	.	9
4.00-4.49	.	.	.	.	12	.	.	.	12
4.50-4.99	.	.	.	.	2	.	.	.	2
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	1126	3633	465	26	0	0	0	

MEAN HS(M) = 1.0 LARGEST HS(M) = 4.6 MEAN TP(SEC) = 5.4 NO. OF CASES = 3067

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 22.5

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	317	967	703	351	80	.	.	2418
0.50-0.99	.	811	2382	2923	1545	341	2	.	8003
1.00-1.49	.	62	1247	1504	965	387	7	.	4172
1.50-1.99	.	.	424	585	604	173	.	.	1786
2.00-2.49	.	.	86	281	115	53	3	.	537
2.50-2.99	.	.	3	205	15	5	.	.	229
3.00-3.49	.	.	.	44	46	.	.	.	91
3.50-3.99	.	.	.	9	33	.	.	.	41
4.00-4.49	.	.	.	.	21	.	.	.	21
4.50-4.99	.	.	.	.	5	2	.	.	7
5.0 +	.	.	.	.	.	.	.	19	19
TOTAL	0	1189	5109	6254	3699	1040	12	19	

MEAN HS(M) = 1.0 LARGEST HS(M) = 7.0 MEAN TP(SEC) = 7.3 NO. OF CASES = 10112

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 45.0

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	630	1013	1843	1588	938	370	51	6432
0.50-0.99	.	1367	1916	3046	2224	1894	756	133	11338
1.00-1.49	.	101	1088	1324	1035	756	387	63	4755
1.50-1.99	.	.	575	503	433	258	240	10	2019
2.00-2.49	.	.	80	607	115	68	44	7	922
2.50-2.99	.	.	.	371	31	15	39	15	472
3.00-3.49	.	.	.	60	163	9	2	.	233
3.50-3.99	.	.	.	7	87	3	.	.	98
4.00-4.49	.	.	.	.	48	.	.	.	48
4.50-4.99	.	.	.	.	14	9	.	.	22
5.0 +	.	.	.	.	.	.	.	17	17
TOTAL	0	2098	4673	7762	5737	3951	1838	298	

MEAN HS(M) = 0.9 LARGEST HS(M) = 6.0 MEAN TP(SEC) = 8.3 NO. OF CASES = 15392

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 67.5

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	878	234	1812	927	252	15	29	4148
0.50-0.99	.	2998	662	62	198	291	106	91	4408
1.00-1.49	.	72	1901	24	9	39	33	7	2084
1.50-1.99	.	.	1011	245	.	7	.	.	1263
2.00-2.49	.	.	106	695	.	.	.	.	801
2.50-2.99	.	.	3	356	12	.	.	.	371
3.00-3.49	.	.	.	56	79	.	.	.	135
3.50-3.99	.	.	.	7	87	.	.	.	94
4.00-4.49	.	.	.	.	27	2	.	.	29
4.50-4.99	.	.	.	.	5	2	.	.	7
5.0 +	.	.	.	.	.	.	.	5	5
TOTAL	0	3948	3918	3256	1345	592	154	132	

MEAN HS(M) = 0.9 LARGEST HS(M) = 5.0 MEAN TP(SEC) = 6.3 NO. OF CASES = 7795

TABLE 1-3
PERCENT OCCURRENCE OF WAVE HEIGHT AND PERIOD
(continued)

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 90.0

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	1691	.	72	29	7	.	.	1798
0.50-0.99	.	4416	801	.	.	.	.	.	5217
1.00-1.49	.	75	2014	5	.	.	.	.	2094
1.50-1.99	.	.	811	53	.	.	.	.	864
2.00-2.49	.	.	128	185	.	.	.	.	313
2.50-2.99	.	.	2	101	.	.	.	.	103
3.00-3.49	.	.	.	74	.	.	.	.	74
3.50-3.99	.	.	.	.	.	.	.	.	0
4.00-4.49	.	.	.	.	.	.	.	.	0
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	6182	3756	489	29	7	0	0	

MEAN HS(M) = 0.9 LARGEST HS(M) = 3.4 MEAN TP(SEC) = 4.4 NO. OF CASES = 6114

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 112.5

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	2004	.	.	.	.	.	.	2004
0.50-0.99	.	3660	864	2	.	.	.	.	4526
1.00-1.49	.	60	1441	2	.	.	.	.	1502
1.50-1.99	.	.	382	29	.	.	.	.	411
2.00-2.49	.	.	41	70	.	.	.	.	111
2.50-2.99	.	.	.	29	.	.	.	.	29
3.00-3.49	.	.	.	22	.	.	.	.	22
3.50-3.99	.	.	.	9	.	.	.	.	9
4.00-4.49	.	.	.	.	3	.	.	.	3
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	5724	2728	163	3	0	0	0	

MEAN HS(M) = 0.8 LARGEST HS(M) = 4.0 MEAN TP(SEC) = 4.2 NO. OF CASES = 5035

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 135.0

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	1836	.	.	.	.	.	.	1836
0.50-0.99	.	1966	460	.	.	.	.	.	2426
1.00-1.49	.	12	655	.	.	.	.	.	667
1.50-1.99	.	.	156	15	.	.	.	.	171
2.00-2.49	.	.	53	22	.	.	.	.	75
2.50-2.99	.	.	2	19	.	.	.	.	21
3.00-3.49	.	.	.	15	2	.	.	.	17
3.50-3.99	.	.	.	7	5	.	.	.	12
4.00-4.49	.	.	.	2	2	.	.	.	3
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	3814	1326	80	9	0	0	0	

MEAN HS(M) = 0.7 LARGEST HS(M) = 4.1 MEAN TP(SEC) = 4.0 NO. OF CASES = 3055

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 157.5

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	1318	3	.	.	.	.	.	1321
0.50-0.99	.	1018	335	2	.	.	.	.	1355
1.00-1.49	.	21	380	12	.	.	.	.	412
1.50-1.99	.	.	151	46	.	.	.	.	197
2.00-2.49	.	.	33	60	.	.	.	.	92
2.50-2.99	.	.	2	24	2	.	.	.	27
3.00-3.49	.	.	.	9	3	.	.	.	12
3.50-3.99	.	.	.	.	3	.	.	.	3
4.00-4.49	.	.	.	.	.	.	.	.	0
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	2356	903	152	9	0	0	0	

MEAN HS(M) = 0.7 LARGEST HS(M) = 3.7 MEAN TP(SEC) = 4.1 NO. OF CASES = 1998

TABLE 1-3
PERCENT OCCURRENCE OF WAVE HEIGHT AND PERIOD
(continued)

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 180.0

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	796	50	.	.	.	.	.	845
0.50-0.99	.	760	378	12	.	.	.	.	1150
1.00-1.49	.	19	445	63	.	.	.	.	527
1.50-1.99	.	.	163	116	5	.	.	.	284
2.00-2.49	.	.	22	113	7	.	.	.	142
2.50-2.99	.	.	.	53	10	.	.	.	63
3.00-3.49	.	.	.	10	7	.	.	.	17
3.50-3.99	.	.	.	5	2	.	.	.	7
4.00-4.49	.	.	.	.	2	.	.	.	2
4.50-4.99	.	.	.	.	2	.	.	.	2
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	1574	1057	373	34	0	0	0	

MEAN HS(M) = 0.9 LARGEST HS(M) = 4.6 MEAN TP(SEC) = 4.7 NO. OF CASES = 1775

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 202.5

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	301	.	.	.	.	.	.	301
0.50-0.99	.	453	.	.	.	.	.	.	453
1.00-1.49	.	116	48	.	.	.	.	.	164
1.50-1.99	.	.	36	.	.	.	.	.	36
2.00-2.49	.	.	2	3	.	.	.	.	5
2.50-2.99	.	.	.	2	.	.	.	.	2
3.00-3.49	.	.	.	.	.	.	.	.	0
3.50-3.99	.	.	.	2	.	.	.	.	2
4.00-4.49	.	.	.	.	.	.	.	.	0
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	871	86	7	0	0	0	0	

MEAN HS(M) = 0.7 LARGEST HS(M) = 3.5 MEAN TP(SEC) = 3.7 NO. OF CASES = 562

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 225.5

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	209	2	.	.	.	.	.	210
0.50-0.99	.	320	.	.	.	.	.	.	320
1.00-1.49	.	175	15	.	.	.	.	.	190
1.50-1.99	.	.	15	.	.	.	.	.	15
2.00-2.49	.	.	2	.	.	.	.	.	2
2.50-2.99	.	.	.	.	.	.	.	.	0
3.00-3.49	.	.	.	.	.	.	.	.	0
3.50-3.99	.	.	.	.	.	.	.	.	0
4.00-4.49	.	.	.	.	.	.	.	.	0
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	703	34	0	0	0	0	0	

MEAN HS(M) = 0.7 LARGEST HS(M) = 2.1 MEAN TP(SEC) = 3.6 NO. OF CASES = 430

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 247.5

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	224	.	.	.	.	.	.	224
0.50-0.99	.	359	.	.	.	.	.	.	359
1.00-1.49	.	113	7	.	.	.	.	.	120
1.50-1.99	.	2	2	.	.	.	.	.	3
2.00-2.49	.	.	.	.	.	.	.	.	0
2.50-2.99	.	.	.	.	.	.	.	.	0
3.00-3.49	.	.	.	.	.	.	.	.	0
3.50-3.99	.	.	.	.	.	.	.	.	0
4.00-4.49	.	.	.	.	.	.	.	.	0
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	698	9	0	0	0	0	0	

MEAN HS(M) = 0.6 LARGEST HS(M) = 1.7 MEAN TP(SEC) = 3.3 NO. OF CASES = 412

TABLE 1-3
PERCENT OCCURRENCE OF WAVE HEIGHT AND PERIOD
(continued)

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 270.0

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	250	.	.	.	.	.	.	250
0.50-0.99	.	732	.	.	.	.	.	.	732
1.00-1.49	.	175	9	.	.	.	.	.	183
1.50-1.99	.	.	19	.	.	.	.	.	19
2.00-2.49	.	.	2	.	.	.	.	.	2
2.50-2.99	.	.	.	.	.	.	.	.	0
3.00-3.49	.	.	.	.	.	.	.	.	0
3.50-3.99	.	.	.	.	.	.	.	.	0
4.00-4.49	.	.	.	.	.	.	.	.	0
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	1157	29	0	0	0	0	0	

MEAN HS(M) = 0.7 LARGEST HS(M) = 2.0 MEAN TP(SEC) = 3.3 NO. OF CASES = 692

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 292.5

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	144	.	.	.	.	.	.	144
0.50-0.99	.	431	.	.	.	.	.	.	431
1.00-1.49	.	222	26	.	.	.	.	.	248
1.50-1.99	.	.	96	.	.	.	.	.	96
2.00-2.49	.	.	12	.	.	.	.	.	12
2.50-2.99	.	.	.	.	.	.	.	.	0
3.00-3.49	.	.	.	.	.	.	.	.	0
3.50-3.99	.	.	.	.	.	.	.	.	0
4.00-4.49	.	.	.	.	.	.	.	.	0
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	797	133	0	0	0	0	0	

MEAN HS(M) = 0.9 LARGEST HS(M) = 2.3 MEAN TP(SEC) = 3.7 NO. OF CASES = 543

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 315.0

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	70	.	.	.	.	.	.	70
0.50-0.99	.	375	.	.	.	.	.	.	375
1.00-1.49	.	269	115	.	.	.	.	.	383
1.50-1.99	.	.	209	.	.	.	.	.	209
2.00-2.49	.	.	58	.	.	.	.	.	58
2.50-2.99	.	.	.	.	.	.	.	.	0
3.00-3.49	.	.	.	.	.	.	.	.	0
3.50-3.99	.	.	.	.	.	.	.	.	0
4.00-4.49	.	.	.	.	.	.	.	.	0
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	714	382	0	0	0	0	0	

MEAN HS(M) = 1.1 LARGEST HS(M) = 2.3 MEAN TP(SEC) = 4.2 NO. OF CASES = 639

RAL2-011 26.50N 80.00W AZIMUTH(DEGREES) = 337.5

PRECENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	89	2	10	.	.	.	.	101
0.50-0.99	.	476	.	2	.	.	.	.	477
1.00-1.49	.	332	151	.	.	.	.	.	483
1.50-1.99	.	.	234	.	.	.	.	.	234
2.00-2.49	.	.	38	.	.	.	.	.	38
2.50-2.99	.	.	2	.	.	.	.	.	2
3.00-3.49	.	.	.	.	.	.	.	.	0
3.50-3.99	.	.	.	.	.	.	.	.	0
4.00-4.49	.	.	.	.	.	.	.	.	0
4.50-4.99	.	.	.	.	.	.	.	.	0
5.0 +	.	.	.	.	.	.	.	.	0
TOTAL	0	897	426	12	0	0	0	0	

MEAN HS(M) = 1.1 LARGEST HS(M) = 2.7 MEAN TP(SEC) = 4.2 NO. OF CASES = 779

TABLE 1-4

SUMMARY - PERCENT OCCURRENCE OF WAVE HEIGHT AND PERIOD

RAL2-011 26.50N 80.00W ALL DIRECTIONS

PERCENT OCCURRENCE (X1000) OF HEIGHT AND PERIOD FOR ALL DIRECTIONS

HEIGHT(METERS)	PERIOD(SECONDS) 0.0 - 2.9	3.0 - 4.9	5.0 - 6.9	7.0 - 8.9	9.0 - 10.9	11.0 - 12.9	13.0 - 14.9	15.0 - LARGER	TOTAL
0.00-0.49	.	11088	2627	4440	2895	1277	385	80	22792
0.50-0.99	.	20843	9464	6051	3968	2526	864	224	43940
1.00-1.49	.	1915	10612	2945	2009	1182	426	70	19159
1.50-1.99	.	2	4700	1677	1042	438	240	10	8109
2.00-2.49	.	.	784	2190	236	121	48	7	3386
2.50-2.99	.	.	15	1326	70	21	39	15	1487
3.00-3.49	.	.	.	335	306	9	2	.	652
3.50-3.99	.	.	.	48	222	3	.	.	274
4.00-4.49	.	.	.	2	115	2	.	.	118
4.50-4.99	.	.	.	.	27	12	.	.	39
5.0 +	.	.	.	.	.	.	.	41	41
TOTAL	.	33848	28203	19014	10891	5590	2004	448	

MEAN HS(M) = 0.9 LARGEST HS(M) = 7.0 MEAN TP(SEC) = 6.2 NO. OF CASES = 58440

TABLE 1-5

MEAN SIGNIFICANT WAVE HEIGHT BY MONTH AND YEAR

STATION: 11

SUMMARY OF MEAN Hmo(m) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1956	1.07	0.86	0.92	0.82	0.89	0.57	0.44	0.39	0.89	1.29	1.63	0.84	0.88
1957	1.05	1.07	0.76	0.99	0.61	0.60	0.36	0.52	0.74	1.19	1.10	1.46	0.87
1958	1.53	1.18	0.84	0.89	0.86	0.63	0.65	0.42	0.74	1.25	0.88	1.23	0.92
1959	1.25	0.94	1.06	0.93	0.78	0.46	0.49	0.59	0.94	0.68	1.35	1.41	0.91
1960	0.89	1.15	0.98	0.97	0.66	0.62	0.42	0.65	0.98	0.62	1.10	1.48	0.87
1961	1.07	0.95	0.75	0.83	0.64	0.56	0.44	0.47	0.82	1.57	0.96	0.95	0.83
1962	1.11	0.91	1.23	0.85	0.68	0.44	0.35	0.47	0.61	1.01	1.36	1.01	0.84
1963	1.12	1.05	0.87	0.86	0.76	0.53	0.47	0.37	0.82	1.64	1.42	1.03	0.91
1964	1.00	0.99	0.93	0.98	0.80	0.44	0.61	0.59	0.99	1.39	1.01	1.33	0.92
1965	1.02	1.15	0.86	0.68	0.70	0.74	0.42	0.43	1.19	0.97	1.17	1.26	0.88
1966	1.26	1.23	1.01	0.95	0.67	1.00	0.44	0.54	0.47	1.06	1.72	1.05	0.95
1967	0.99	1.11	1.01	1.02	0.68	0.56	0.47	0.45	0.85	1.16	1.34	1.09	0.89
1968	1.18	0.97	1.05	0.75	0.57	0.61	0.48	0.40	0.65	0.98	1.00	1.05	0.81
1969	1.29	1.37	1.16	0.94	0.85	0.48	0.43	0.54	0.77	1.41	1.45	0.95	0.97
1970	1.15	1.56	1.07	0.73	0.98	0.50	0.50	0.54	0.73	1.26	1.13	0.83	0.91
1971	0.98	1.17	0.91	0.73	0.56	0.37	0.44	0.50	0.79	0.61	1.35	1.29	0.81
1972	1.00	1.10	0.98	0.82	0.80	0.89	0.60	0.45	0.78	1.09	0.81	1.31	0.89
1973	1.13	1.29	1.10	1.14	0.55	0.56	0.37	0.54	0.61	1.30	0.97	1.06	0.88
1974	0.68	0.97	0.70	0.91	0.60	0.50	0.37	0.52	0.68	1.74	1.10	0.83	0.80
1975	1.18	0.72	1.05	0.92	0.48	0.38	0.60	0.54	0.79	0.83	1.53	1.54	0.88
MEAN	1.10	1.09	0.96	0.89	0.71	0.57	0.47	0.50	0.79	1.15	1.22	1.15	

TABLE 1-6

SUMMARY OF VISUAL WAVE DATA AT HILLSBORO INLET (1955-1970)

	EASTERLY		NORTHEARSTERLY		SOUTHEASTERLY		TOTAL		NE/SE
YEAR	%OCC.	Avg Ht	%OCC.	Avg Ht	%OCC.	Avg Ht	%OCC.	Avg Ht	OCC.
1955	9.9%	3.04	7.1%	3.35	2.9%	3.00	19.9%	3.15	2.45
1956	35.6%	3.54	19.7%	3.84	8.8%	3.67	64.1%	3.65	2.24
1957	11.2%	3.22	2.4%	3.21	1.6%	4.00	15.2%	3.30	1.50
1958	5.9%	3.27	3.2%	3.25	1.7%	4.12	10.8%	3.40	1.89
1959	5.5%	3.25	2.4%	3.29	1.8%	4.67	9.7%	3.53	0.51
1960	7.5%	3.84	2.4%	3.00	2.1%	3.00	12.0%	3.52	1.14
1961	21.4%	3.84	2.0%	3.00	1.8%	3.33	25.2%	3.73	1.11
1962	30.6%	4.14	14.2%	4.50	3.5%	3.69	48.3%	4.22	4.06
1963	21.9%	3.84	16.7%	3.76	5.6%	3.30	44.2%	3.74	2.98
1964	31.8%	3.64	5.4%	3.81	3.8%	3.21	41.0%	3.62	1.42
1965	28.4%	3.46	9.2%	3.64	3.9%	3.44	41.5%	3.50	2.36
1966	14.2%	3.39	5.9%	3.64	4.7%	3.30	24.8%	3.43	1.26
1967	6.6%	3.36	6.0%	3.48	2.9%	3.41	15.5%	3.42	2.07
1968	5.6%	3.21	3.5%	3.23	4.7%	3.77	13.8%	3.41	0.74
1969	7.8%	3.51	5.0%	4.86	5.7%	3.14	18.5%	3.76	0.88
1970	23.6%	3.94	7.0%	3.64	36.7%	4.02	67.3%	3.96	0.19
AVG.	16.7%	3.53	7.0%	3.59	5.8%	3.57	29.5%	3.58	1.68

TABLE 1-7

SUMMARY OF MEASURED WAVE DATA, LAKE WORTH, FLORIDA

MEAN HmO (METRES) BY MONTH AND YEAR
LAKE WORTH, FL (26.61N 80.03W)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1989	.	.	.	.	.	.	.	.	.	.	.	.	0.0
1990	0.7	0.8	0.7	0.6	0.5	0.3	.	0.2	.	0.7	0.7	0.7	0.6
1991	0.6	0.6	0.6	.	.	.	.	.	.	.	.	.	0.6
MEAN	0.6	0.7	0.6	0.6	0.5	0.3	.	0.2	.	0.7	0.7	0.7	

LARGEST HmO (METRES) BY MONTH AND YEAR
LAKE WORTH, FL (26.61N 80.03W)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1989	.	.	.	.	.	.	.	.	.	.	.	.
1990	1.8	2.2	1.5	1.9	1.4	0.8	.	0.6	.	2.3	1.7	1.9
1991	1.6	1.9	1.6	.	.	.	.	.	.	.	.	.

THE MEAN SIGNIFICANT WAVE HEIGHT (METRES)=	0.6
THE MEAN PEAK WAVE PERIOD (SECONDS)=	7.2
THE MOST FREQUENT 22.5 (CENTER) DIRECTION BAND (DEGREES)=	90.0
THE STANDARD DEVIATION OF HmO (METRES)=	0.4
THE STANDARD DEVIATION OF TP (SECONDS)=	3.0
THE LARGEST HmO (METRES)=	2.3
THE TP (SECONDS) ASSOC. WITH THE LARGEST HmO=	7.8
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST HmO=	58.0
THE DATE OF LARGEST HmO OCCURRENCE IS	90100916

NUMBER OF RECORDS BY MONTH AND YEAR
LAKE WORTH, FL (26.61N 80.03W)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1989	.	.	.	.	.	.	.	.	.	.	.	.	.
1990	109	160	166	151	120	139	.	169	.	184	117	183	1498
1991	182	163	181	.	.	.	.	.	.	.	.	.	526
TOTAL	291	323	347	151	120	139	.	169	.	184	117	183	2024

TABLE 1-8

SUMMARY OF MEASURED WAVE DATA, HALLANDALE, FLORIDA

MEAN Hm0(METRES) BY MONTH AND YEAR
HALLANDALE, FL (25.97N 80.10W)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1989	.	.	.	.	.	.	.	.	.	.	0.4	0.4	0.4
1990	0.6	0.7	0.6	0.6	0.5	0.3	.	0.2	.	0.7	0.6	0.7	0.6
1991	0.5	0.5	.	.	.	.	.	.	.	.	.	.	0.5
MEAN	0.5	0.6	0.6	0.6	0.5	0.3	.	0.2	.	0.7	0.6	0.5	

LARGEST Hm0(METRES) BY MONTH AND YEAR
HALLANDALE, FL (25.97N 80.10W)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1989	.	.	.	.	.	.	.	.	.	.	0.8	1.2
1990	1.5	1.9	1.3	1.9	1.6	0.8	.	0.6	.	2.0	1.5	1.8
1991	1.1	1.5	.	.	.	.	.	.	.	.	.	.

THE MEAN SIGNIFICANT WAVE HEIGHT(METRES)=	0.5
THE MEAN PEAK WAVE PERIOD (SECONDS)=	6.1
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	45.0
THE STANDARD DEVIATION OF Hm0(METRES)=	0.3
THE STANDARD DEVIATION OF TP(SECONDS)=	2.1
THE LARGEST Hm0(METRES)=	2.0
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	7.8
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	67.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	90100920

NUMBER OF RECORDS BY MONTH AND YEAR
HALLANDALE, FL (25.97N 80.10W)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1989	.	.	.	.	.	.	.	.	.	.	20	178	198
1990	150	132	87	97	136	65	.	86	.	125	132	119	1129
1991	157	100	.	.	.	.	.	.	.	.	.	.	257
TOTAL	307	232	87	97	136	65	.	86	.	125	152	297	1584

fractiles give a range of wave heights around the median. Fifty percent of all the extreme waves for each return period should fall within this range.

TABLE 1-9

EXTREME WAVE STATISTICS HINDCAST AT WIS PHASE II STATION 70

RETURN PERIOD (YRS)	MEDIAN SIG. WAVE HGT. H_s(FT)	UPPER LIMIT H_s(FT) ASSOCIATED WITH .75 FRACTILE	LOWER LIMIT H_s(FT) ASSOCIATED WITH .25 FRACTILE
50	43.6	58.1	35.1
20	31.8	43.3	25.9
10	25.3	34.4	20.7
5	19.7	27.6	16.7

TIDES AND CURRENTS

1-17. Tides in the study area are semi-diurnal with a daily inequality. The mean tidal range is 2.76 ft. Mean high water is +1.84 ft NGVD and mean low water is -0.92 ft NGVD. The mean tide level is +0.44 ft NGVD.

1-18. The influential currents in the vicinity of the Ocean Ridge shoreline are (1) the Florida Current, (2) wave generated longshore currents, (3) cross-shore currents, (4) inlet currents generated by flood and ebb tides, and (5) a secondary current which develops just south of South Lake Worth Inlet during ebb tide. The Florida Current is located approximately 1 mile offshore from Palm Beach County and flows from the south to the north. The average speed of the current is approximately 1 ft per second. The wave-generated longshore currents are the primary beach shaping currents along the Ocean Ridge shoreline. The magnitude and direction of the longshore currents vary throughout the year with the incident wave climate. The average annual net longshore current is directed from the north to the south. Cross-shore currents are the primary water motion resulting in the onshore/offshore transport of beach material and seasonal profile change. During a storm event, cross-shore currents transport beach material from the upper to lower areas of the profile.

1-19. The ebb and flood currents through South Lake Worth Inlet affect the downdrift shoreline. These currents indirectly change the configuration of the Ocean Ridge shoreline through interruption of the natural transport of

material across the inlet. A percentage of the longshore transport that would naturally bypass the inlet is displaced to the ebb and flood shoals by these currents. These currents, therefore, indirectly impact the Ocean Ridge shoreline by increasing the sediment deficit downdrift of the inlet. Because of the configuration of the inlet jetties at South Lake Worth Inlet, the flood and ebb currents are not a dominant mechanism for sand transport along the project area shoreline. The length of the inlet jetties is such that flood currents do not directly affect sand transport along the adjacent shoreline.

1-20. A secondary current, or circular gyre, develops immediately south of the inlet during ebb tide. This clockwise current is generated by strong ebb tidal currents which are deflected to the south by the inlet's curved north jetty (UF/COE, 1969).

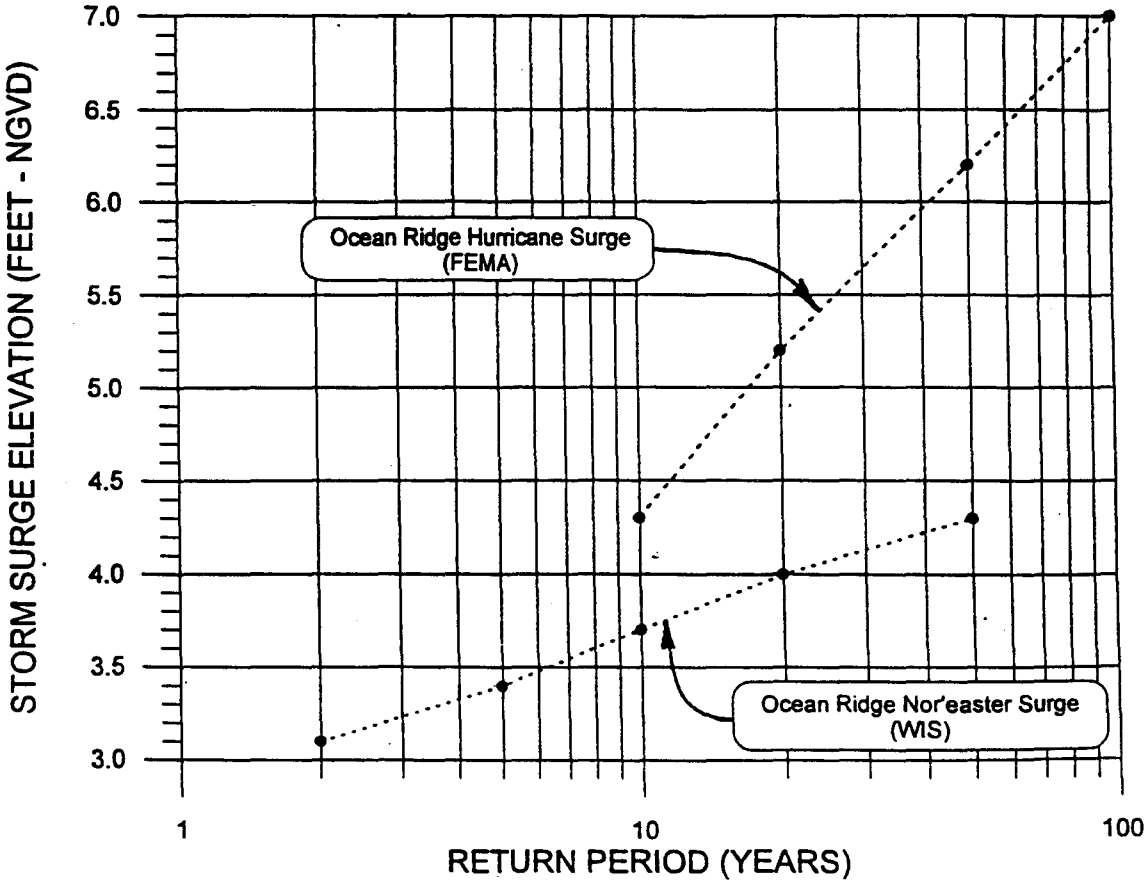
STORM SURGE

1-21. Storm surge is a fundamental component contributing to shoreline recession during a storm event. Storm surge is an increase in the water surface elevation above the normal astronomical tide caused by wave setup, wind stress on the water surface, and a reduction in atmospheric pressure over the water column. The shoreline recedes as a result of the combination of the storm surge and the onshore, wind-generated wave fields. Superimposed upon the storm surge, the wave field propagates to the higher areas of the beach profile and thereby erodes the backshore and bluffline. Additionally, the increased water depth during a storm event allows larger waves to propagate closer to shore contributing to accelerated erosion. An estimate of the surge level is central to the design of the crest elevation of a shore protection structure.

1-22. The major threats to the shoreline of Ocean Ridge are storm surge and waves caused by nor'easters, subtropical and tropical storms, and hurricanes. It is possible to classify and estimate storm surge elevations for various storms through the use of historical information and theoretical models.

1-23. Figure 1-3 presents storm surge estimates for the Ocean Ridge shoreline. The Federal Emergency Management Agency (FEMA) surge estimates were for hurricane storm events for Palm Beach County (FEMA, 1978). The estimates were developed for return frequencies of 10, 20, 50 and 100 years. Assumptions made in the analysis include; 1) breaking wave heights are limited to 0.78 of the local still water depth, 2) the wave crest constitutes 70% of the wave height, and 3) waves are dissipated by features such as sand dunes, dikes and seawalls, buildings, and vegetation.

Figure 1-3
STORM SURGE FREQUENCY CURVE
OCEAN RIDGE, PALM BEACH COUNTY, FLORIDA



1-24. More frequently occurring storm surge elevations for other meteorological induced water-level anomalies (i.e., northeaster type storms) were obtained from WIS Report 7 (Ebersole, 1982). Hindcasting of the nor'easter storm surges was performed utilizing historical wind and pressure fields. The data for northeaster events for Palm Beach County are based on interpolation between the storm surge data for Mayport and Miami Beach, Florida.

RECENT STORM HISTORY

1-25. Recent storms which have affected the Ocean Ridge shoreline have been mostly extratropical storms or nor'easters. The latter storms are generally characterized by moderately strong winds of long duration directed from the northeast direction. Waves generated by these storms contribute to significant southerly directed sand transport and shoreline change in southeast Florida. In November 1984, a nor'easter, named the "Thanksgiving Day Storm", caused minor beach and dune erosion along the Ocean Ridge shoreline. No significant structural damage was reported.

In March 1989, a large nor'easter caused significant beach and dune erosion and resulted in the destruction of several beach accesses and dune walkovers. In October 1991, unusually large, long swell associated with the so-called "Halloween Storm," a large-scale disturbance in the north Atlantic, caused substantial beach and dune erosion and some structural damage along the Ocean Ridge shoreline. A wooden bulkhead, protecting State Road A1A, was destroyed.

1-26. The most recent hurricane to affect the Ocean Ridge shoreline was Hurricane David in 1979. This alongshore traveling storm caused minor beach and dune erosion.

YEARLY DEPTH LIMIT

1-27. The yearly depth limit defines the seaward boundary of active wave and nearshore current-induced sediment transport. Hallermeir (1978) proposed that the depth of limited sediment motion be estimated from the site's approximate, extreme wave condition; i.e, that wave condition which is exceeded for 12 hours per year. The depth of limiting motion (d_s), as defined by Hallermeir, is

$$d_s = 2.28\, H_e - 68.5\, \left(\frac{H_e}{g\, T_e^2}\right), \text{ where}$$

H_e = extreme wave height
T_e = extreme wave period
g = gravitational constant (32.2 ft/sec^2)

1-28. Based on hindcast data from WIS Station RAL2-011, waves greater than 13.1 ft (3.99 meters) in height with wave periods between 9 and 11 seconds occur an average 18.8 hours per year from between the north-northeast and south-southeast direction. For a wave height, H_e, of 13.1 ft and a wave period, T_e, of 10 seconds, the limiting depth of sediment motion in the vicinity of Ocean Ridge was computed to be 29.6 ft. This analysis does not take into account hardbottom (non-mobile) seabed features which may ultimately limit the seaward boundary of wave and current-induced sediment transport.

SEA LEVEL RISE

1-29. Throughout geologic history, global sea level variations, both rise and fall, have occurred. Some

authorities have found evidence to indicate that a new ice age with a resultant sea level drop may be occurring. Others argue that increasing atmospheric concentrations of carbon dioxide and other gases are causing the earth to warm, thus contributing to a sea level rise.

1-30. It is Corps of Engineers policy that, until substantial evidence indicates otherwise, only local regional history of sea level changes be used to project a rise or fall for a site specific project will be considered (USACE, 1987). The National Ocean Service (NOS) has published sea level trends for regions along the United States coasts based on measured yearly mean sea level records (Hicks and Hickman, 1988). Tide gage data collected at Miami Beach, Florida between 1932 and 1986 were used to estimate the mean rate of sea level rise in southeast Florida. For the Miami Beach gage, the mean rate of sea level rise was estimated to be 0.0076 ft per year.

SHORELINE RESPONSE TO SEA LEVEL RISE

1-31. Bruun (1962) proposed a method for computing the rate of shoreline recession resulting from an increase in sea level. His contention was that with a rise in sea level, the beach profile attempts to reestablish the same bottom depths across the profile relative to the sea surface level which existed before the sea level rose. The method assumes no longshore gains or losses to the profile over the time period of sea level rise. The relationship

$$x = \frac{ab}{(h+d_s)}$$

where

- x = shoreline recession (ft)
- h = shoreline berm elevation (ft above mean sea level, MSL)
- d_s = limiting depth of yearly sediment motion (ft below MSL)
- b = horizontal distance from shoreline berm elevation to location of limiting depth
- a = estimated relative rate of sea level rise

which has been termed the Bruun Rule, relates shoreline recession to sea level rise and the local beach profile. From profile data measured along the project area, the

average shoreline berm elevation is approximately 9 ft. The horizontal distance from the shoreline berm elevation to the location of limiting depth is 1,850 ft. For the computed yearly depth limit of 29.6 ft, and a mean rate of sea level rise of 0.0076 ft/yr, the predicted rate of shoreline recession due to sea level rise in the vicinity the Ocean Ridge shoreline is 0.36 ft/yr. This is equivalent to 18.0 ft of recession over the 50 year life of the shore protection project. This estimate may be conservative (large) because it is based upon a seaward limit of sediment motion, d_*, which does not take into account the hardbottom nature of the seabed.

1-32. Over the project's six year renourishment interval, the predicted shoreline recession attributable to sea level rise is 2.2 ft. Because of the order of magnitude and the level of uncertainty of this prediction, shoreline recession due to sea level rise was not included in project volumetric requirements. During future project evaluations, measured changes in project volumes will include the effects of sea level change. Accommodations for project volume losses attributed to sea level change will be made at that time, if needed.

HISTORICAL SHORELINE CHANGE

1-33. Comparative data which describe historical locations of the Ocean Ridge Atlantic mean high water shoreline are available for the years 1883/84, 1927/28, 1942/45, 1966 through 1969, 1970/73, 1975, 1981, 1986, 1990, and 1993. The data collected since 1967 (when the most recent modifications to the inlet and fixed sand bypass plant were complete) are considered representative of the present littoral system. The 1967 inlet modifications included construction of a 410 ft curved extension to the north jetty, a 65 ft extension to the south jetty, the addition of a training wall on the south side of the inlet into Lake Worth, shifting the fixed sand transfer plant 118 ft seaward, and increasing the size and capacity of the plant's pump system.

1-34. The mean high water shoreline survey data suggest both shoreward and seaward movement of the Ocean Ridge shoreline over the period of record. Since the 1930's the project area shoreline has been subject to extraordinary levels of artificial manipulation such as sand bypassing, beach fills, and shoreline stabilization. The temporal and spatial inconsistencies of these projects imply that the meaningfulness of the survey data collected along the Ocean Ridge shoreline is strongly dependent upon the time and

location at which the data were collected. In particular, revetments, seawalls, and groins reduce the apparent magnitude of shoreline erosion by limiting profile recession to, or near, fixed locations across the beach. There are two reaches along the Ocean Ridge shoreline where this effect is notable. The first reach comprises the shoreline within 4,000 ft south of the inlet's south jetty. It includes continuous seawalls, revetments, and numerous groins. This area is also affected by mechanical bypassing discharge that is placed along the first 1,200 ft of shoreline south of the inlet. The second reach comprises the shoreline between about 6,500 ft and 8,500 ft south of the inlet. This area features several large groins. In assessing the rate at which the post project shoreline is expected to erode, the effects of the structures and mechanical bypassing must be considered.

1-35. In this study, shoreline recession rates were estimated with shoreline data collected after the 1967 inlet modifications. Assuming the current mechanical sand bypassing operation will not be significantly changed during the life of the project, shoreline change data collected since 1967 are assumed to be most representative of future shoreline change trends. Shoreline data collected in 1975, 1981, 1986, 1990, and 1993 were used in this study. Table 1-10 presents (1) the shoreline locations measured during these surveys with respect to current Florida DEP monument locations, and (2) the shoreline change rate between each consecutive survey.

1-36. Figure 1-4 presents the computed mean high water shoreline change rate between 1975 and 1993. Shoreline changes over this 18 year period depict a general trend of erosion along the shoreline; however, two reaches of apparent diminished erosion exist between approximately (1) 400 and 2,500 feet, and (2) 6,900 and 8,500 feet south of the inlet. These two areas correspond to those along which the shoreline change data are affected by groins and mechanical sand bypassing discharge. The shoreline change data for those transects adjacent to groins are inconsistent and not considered reliable because they lie within the groins' local field of influence. The data measured along transects which lie within the reach of shoreline that is frequently nourished with mechanically bypassed sand are distorted by the nourishment events.

1-37. Because of the uncertainties associated with the shoreline change data for those sections of shoreline where groins and mechanical sand bypassing influence measured data, it is appropriate to define a project wide trend of shoreline change based upon reliable data. As such, only those data outside the immediate influence of groins and mechanical sand bypassing discharge areas were used to compute the best fit data. The results of this fit are shown by the dashed line in Figure 1-4 and in the last column of Table 1-10. These rates were used for storm damage and land loss estimates in Appendix 2.

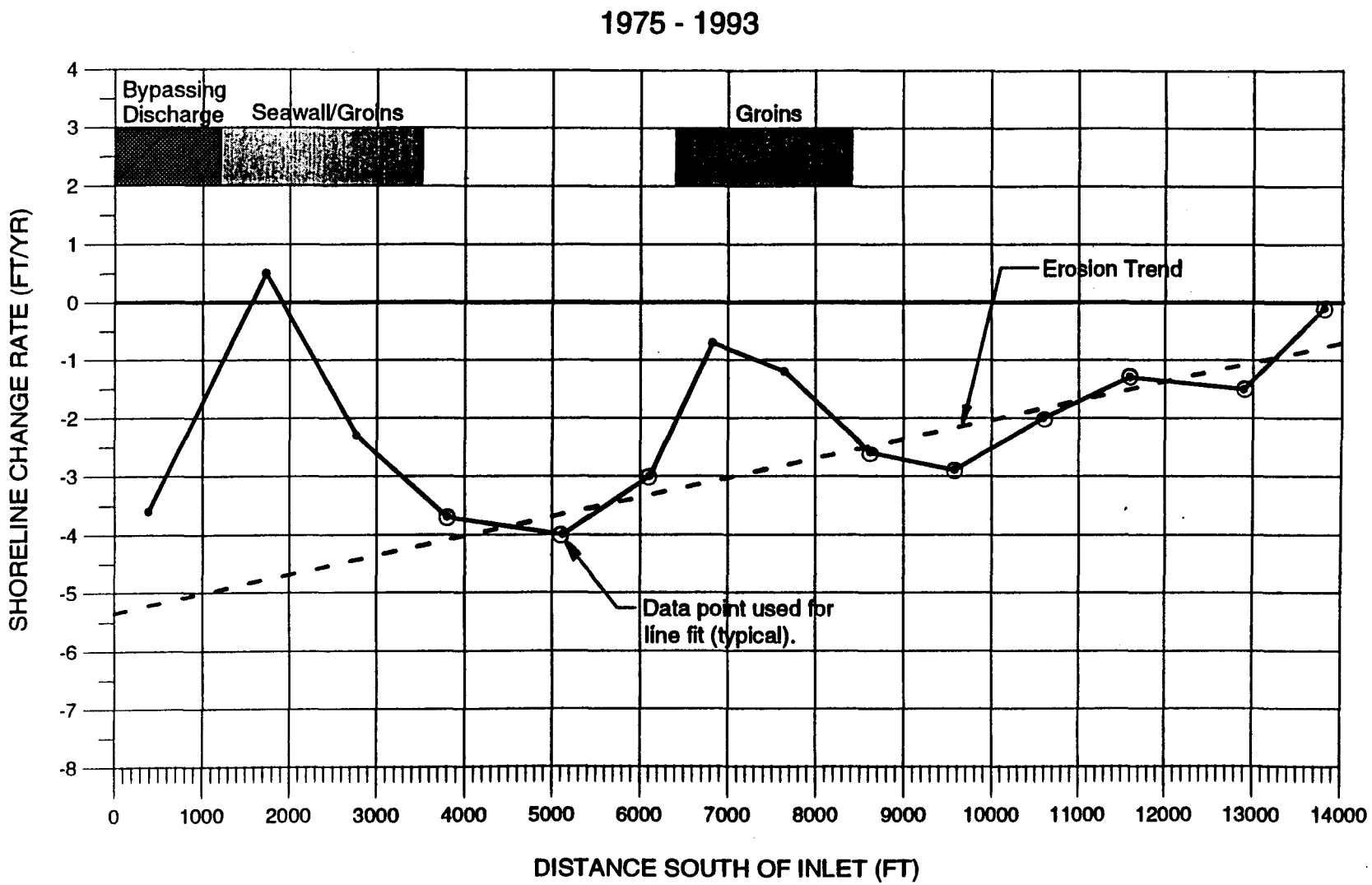


Figure 1-4: Historical mean high water shoreline change rates downdrift of South Lake Worth Inlet from 1975 to 1993. The dashed line represents the shoreline response if shoreline change data along the stabilized areas are neglected.

Table 1-10

SUMMARY - HISTORICAL MEAN HIGH WATER SHORELINE ANALYSIS

R-MON	Dist. So. of So. Jetty (ft)	Shoreline Location (ft from monument) Survey Date					Shoreline Change Rate (ft/yr)						Erosion Trend
		Jan-75	Nov-81	Feb-86	Jul-90	Feb-93	75-81	81-86	86-90	81-90	90-93	**75-93**	
T-152	390	175	105	89	121	110	-10.2	-3.8	7.2	-	0.4	**-3.6**	-5.3
R-153	1730	163	191	157	230	173	4.1	-8.0	16.5	-	-1.6	**0.5**	-4.8
R-154	2770	140	112	138	128	99	-4.1	6.1	-2.4	-	-1.2	**-2.3**	-4.5
R-155	3800	162	106	122	133	94	-8.2	3.8	2.5	-	-1.0	**-3.7**	-4.1
R-156	5120	200	150	141	145	128	-7.3	-2.1	0.9	-	-2.0	**-4.0**	-3.7
R-157	6120	183	156	142	122	128	-4.0	-3.3	-4.6	-	-2.5	**-3.0**	-3.4
R-158	6830	108	90	-	64	96	-2.6	-	-	-3.0	0.5	**-0.7**	-3.1
R-159	7650	117	139	-	95	95	3.2	-	-	-5.1	-3.9	**-1.2**	-2.9
R-160	8620	142	141	-	98	96	-0.1	-	-	-5.0	-4.0	**-2.6**	-2.5
R-161	9580	125	121	-	97	73	-0.6	-	-	-2.7	-4.2	**-2.9**	-2.2
R-162	10600	110	143	-	111	74	4.8	-	-	-3.7	-6.1	**-2.0**	-1.9
R-163	11600	97	134	-	97	74	5.4	-	-	-4.3	-5.3	**-1.3**	-1.6
R-164	12900	126	144	-	146	99	2.6	-	-	0.3	-4.0	**-1.5**	-1.1
R-165	13800	130	160	-	128	128	4.4	-	-	-3.7	-2.8	**-0.1**	-0.8

HISTORICAL VOLUME CHANGE

1-38. Determination of the historical volume change along a section of shoreline provides information as to the material rate at which the beach is eroding or accreting. Along areas where a beach restoration project is to be constructed, identification of the rate at which sand is eroded from the shoreline allows for the placement of a sufficient volume of sacrificial material to protect the project shoreline.

1-39. As with the historical shoreline change analysis, only data collected since the 1967 modifications to South Lake Worth Inlet are considered to represent the current littoral conditions along the Ocean Ridge shoreline. These data include the 1975, 1981, 1990, and 1993 profile datasets. Profile data collected in 1986 extend only to wading depth and do not represent the total active profile. As evidenced in Figures 1-5A through 1-5H, active sediment transport generally occurs to at least the -15 ft NGVD contour and in some cases beyond.

1-40. Table 1-11 presents volume change data for the intervals 1975 to 1981, 1981 to 1990, 1990 to 1993, and 1981 to 1993. These data suggest alternate periods of accretion and erosion along the Ocean Ridge shoreline. Similar to the shoreline change data, the volume change data indicate two areas of moderate stability along the Ocean Ridge shoreline. The volume change data suggest that the stable areas are between 390 and 2,770 feet and between 6,830 and 7,650 feet south of the inlet. These two areas correspond to the two reaches of shoreline which were directly influenced by the effects of extensive coastal armor, groins fields, discharge from bypassing operations at South Worth Lake Inlet, and the attachment of the natural bypassing bar. Additionally, the temporal and spatial inconsistencies of bypassing events, dredging from the interior shoals and construction and maintenance of coastal structures imply that the meaningfulness of the survey data is strongly dependent upon the time and location at which the data were collected. Therefore, the volume change rates computed with the historical profile data do not completely represent the potential volume loss rates along the Ocean Ridge shoreline.

1-41. Volume change data indicate that the 7,770 ft of shoreline immediately south of the inlet lost approximately 107,830 cy of material between 1981 and 1993, or 9,580 cy/yr on average. These data do not include the volume of mechanically bypassed material transported away from the south shoreline, nor do they represent the effects of the coastal structures described above. That is, the volumetric erosion rates most representative of a beach fill project

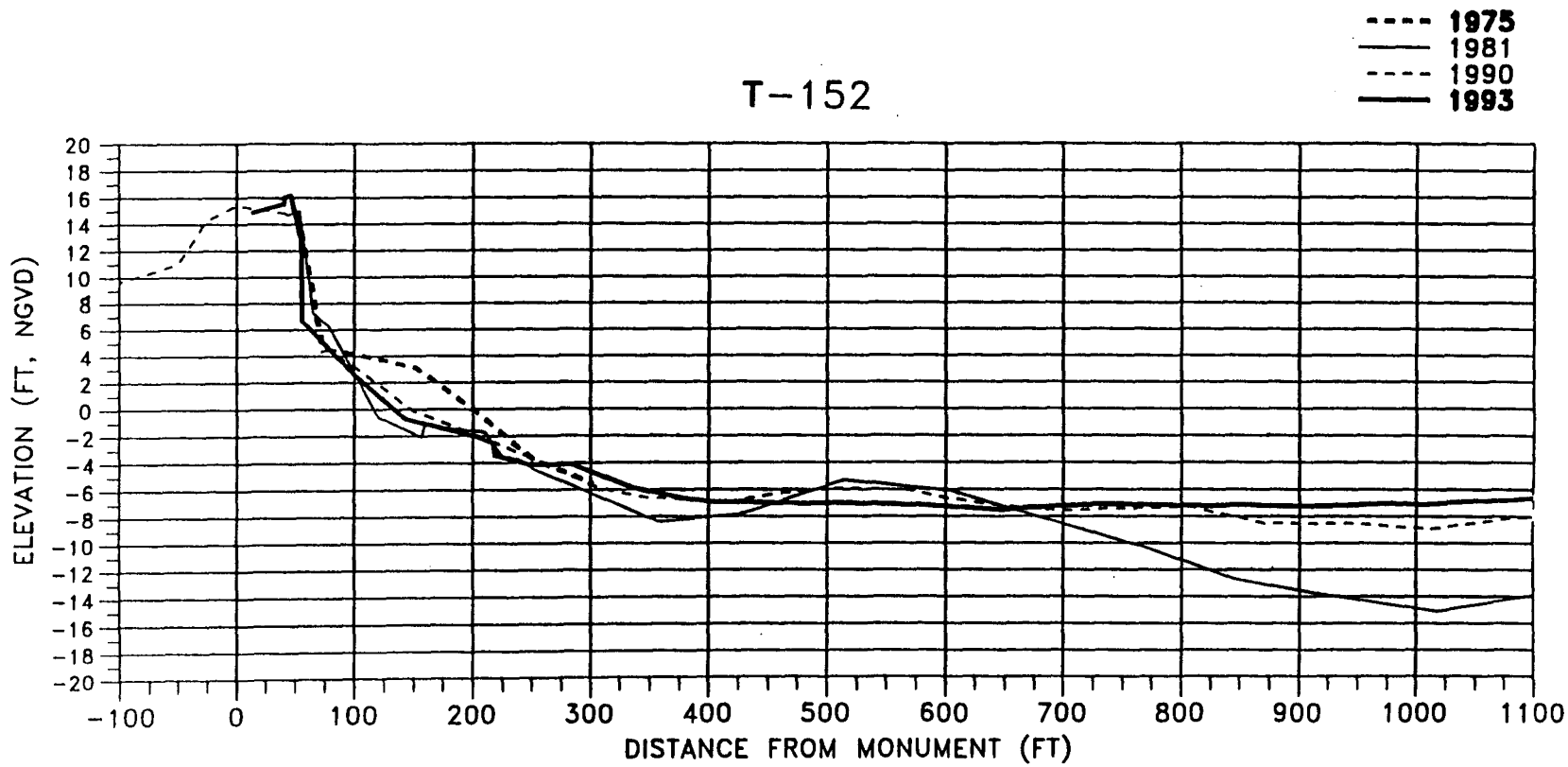


FIGURE 1-5A: Profile Data (1975, 1981, 1990, and 1993).

Note: The 1981 profile data beyond 700 feet from the monument were collected across the inlet channel. These data were not used in volume change calculations.

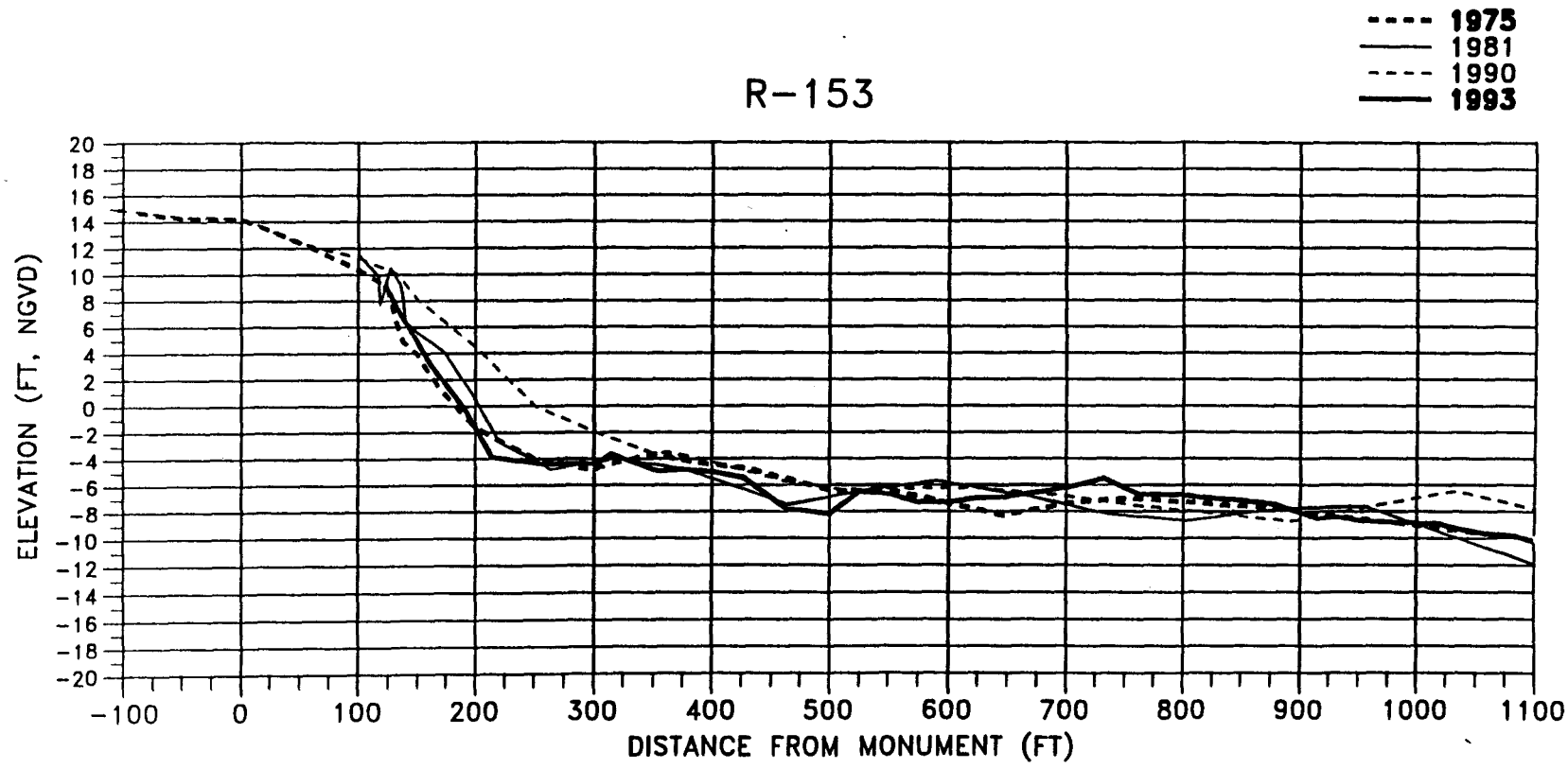


FIGURE 1-5B: Profile Data (1975, 1981, 1990, and 1993).

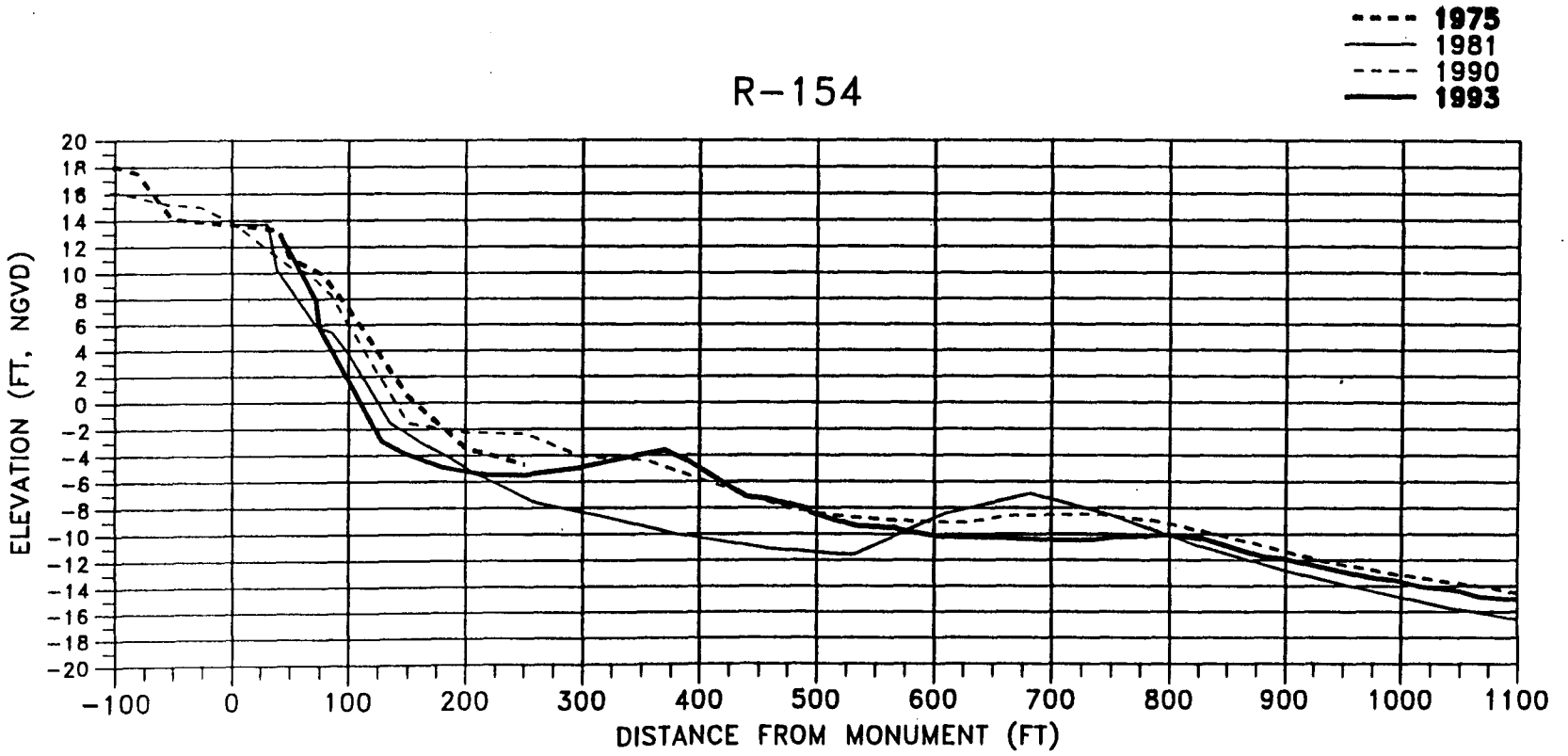


FIGURE 1-5C: Profile Data (1975, 1981, 1990, and 1993).

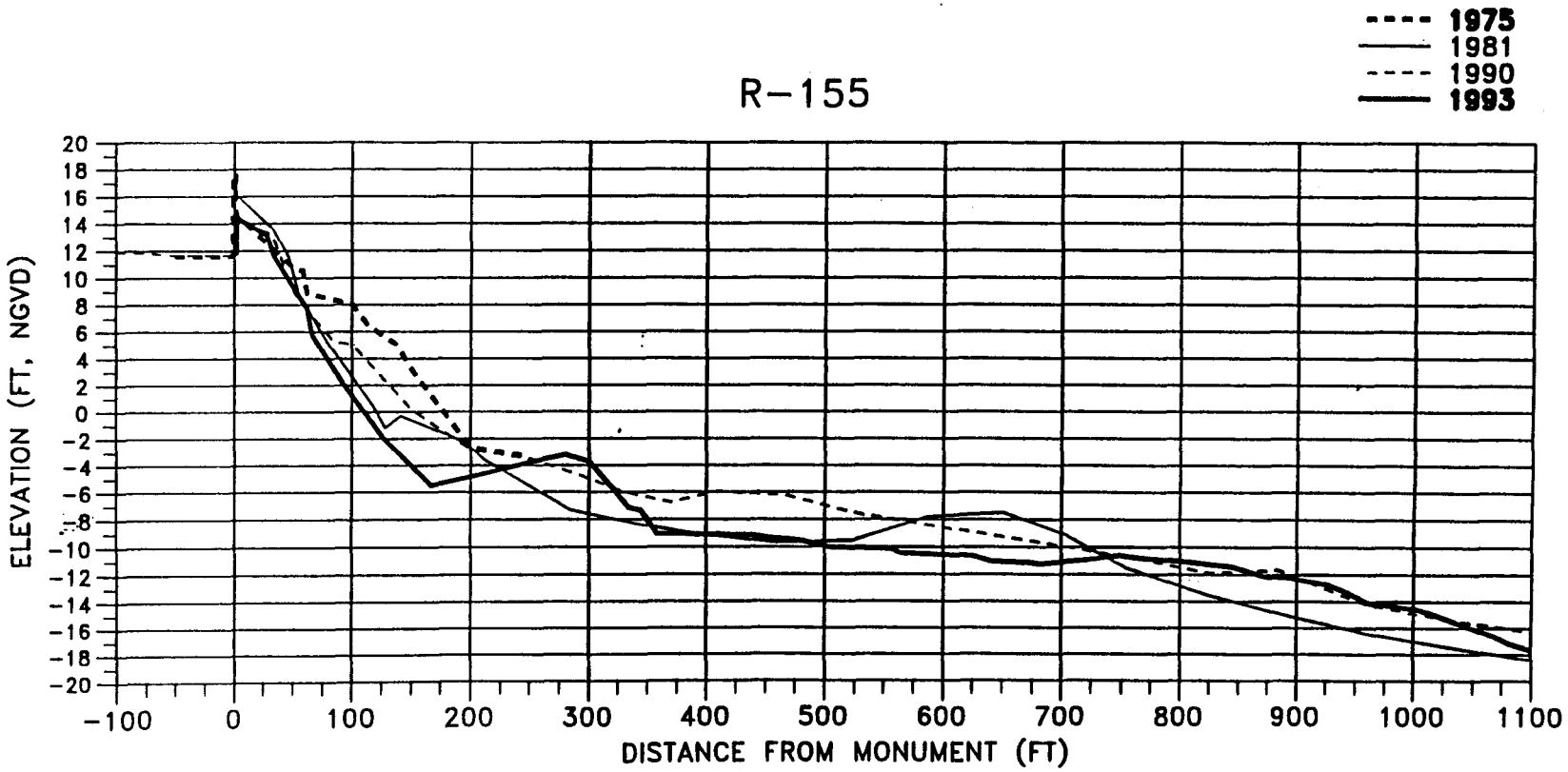


FIGURE 1-5D: Profile Data (1975, 1981, 1990, and 1993).

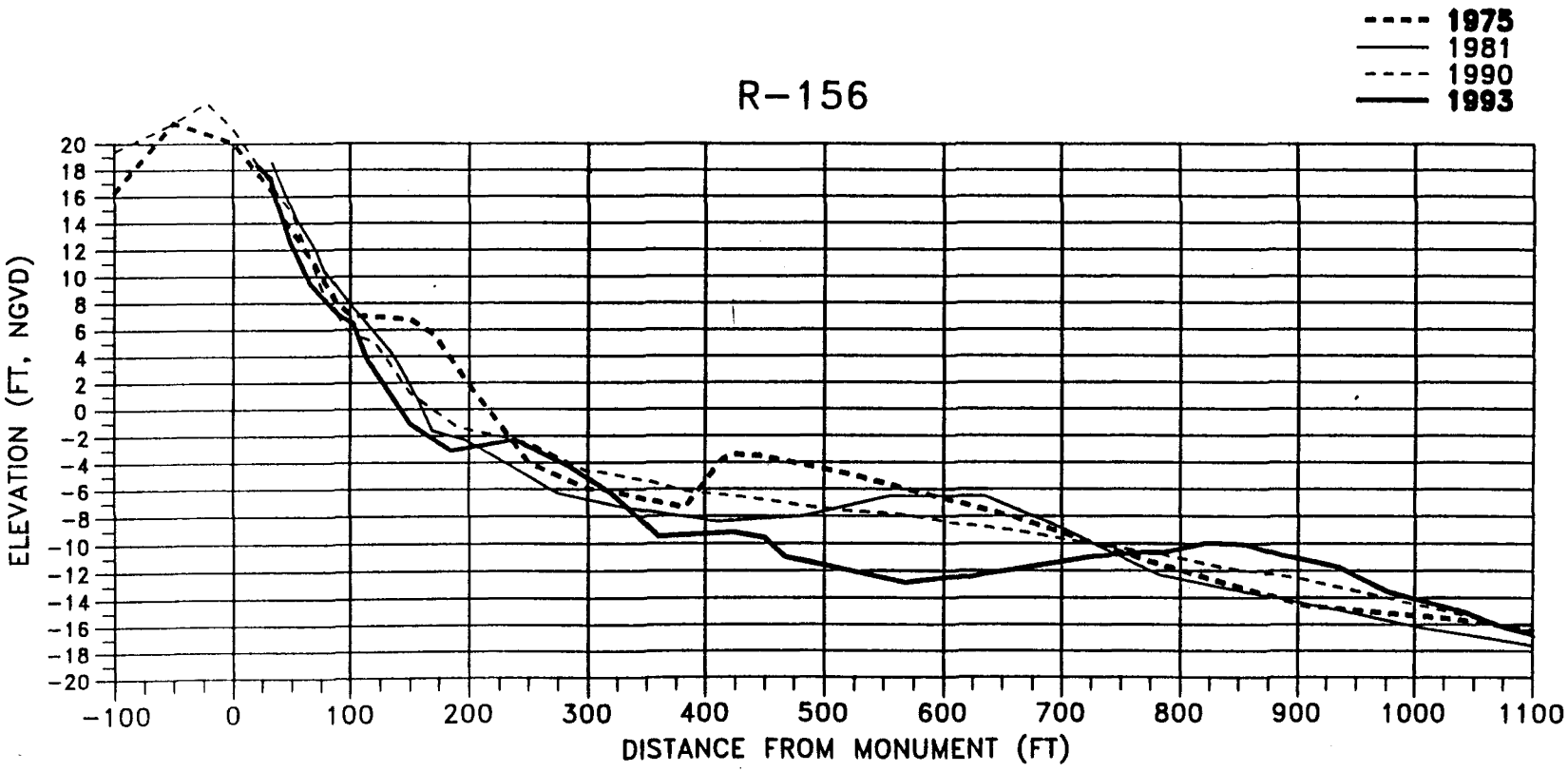


FIGURE 1-5E: Profile Data (1975, 1981, 1990, and 1993).

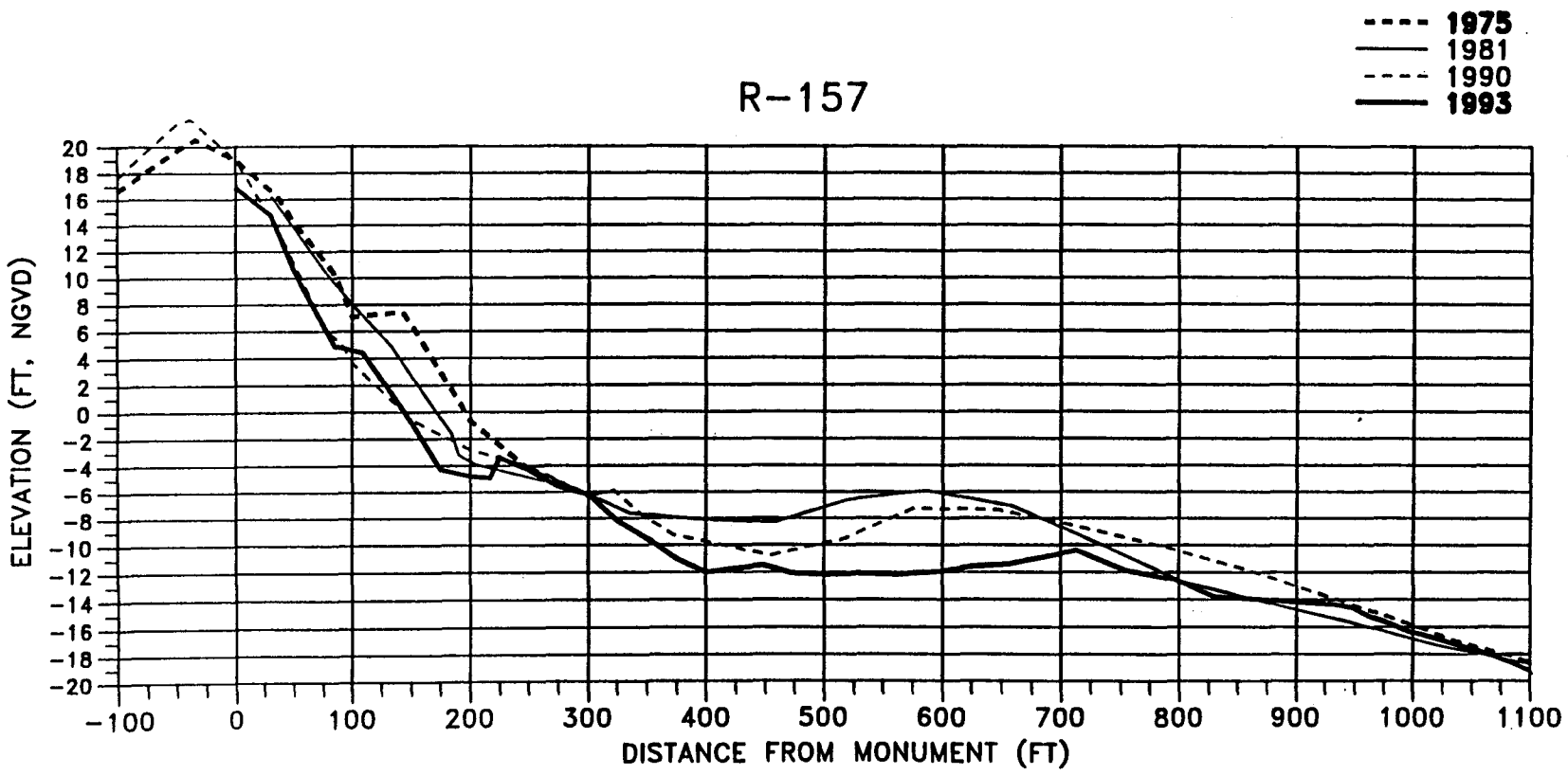


FIGURE 1-5F: Profile Data (1975, 1981, 1990, and 1993).

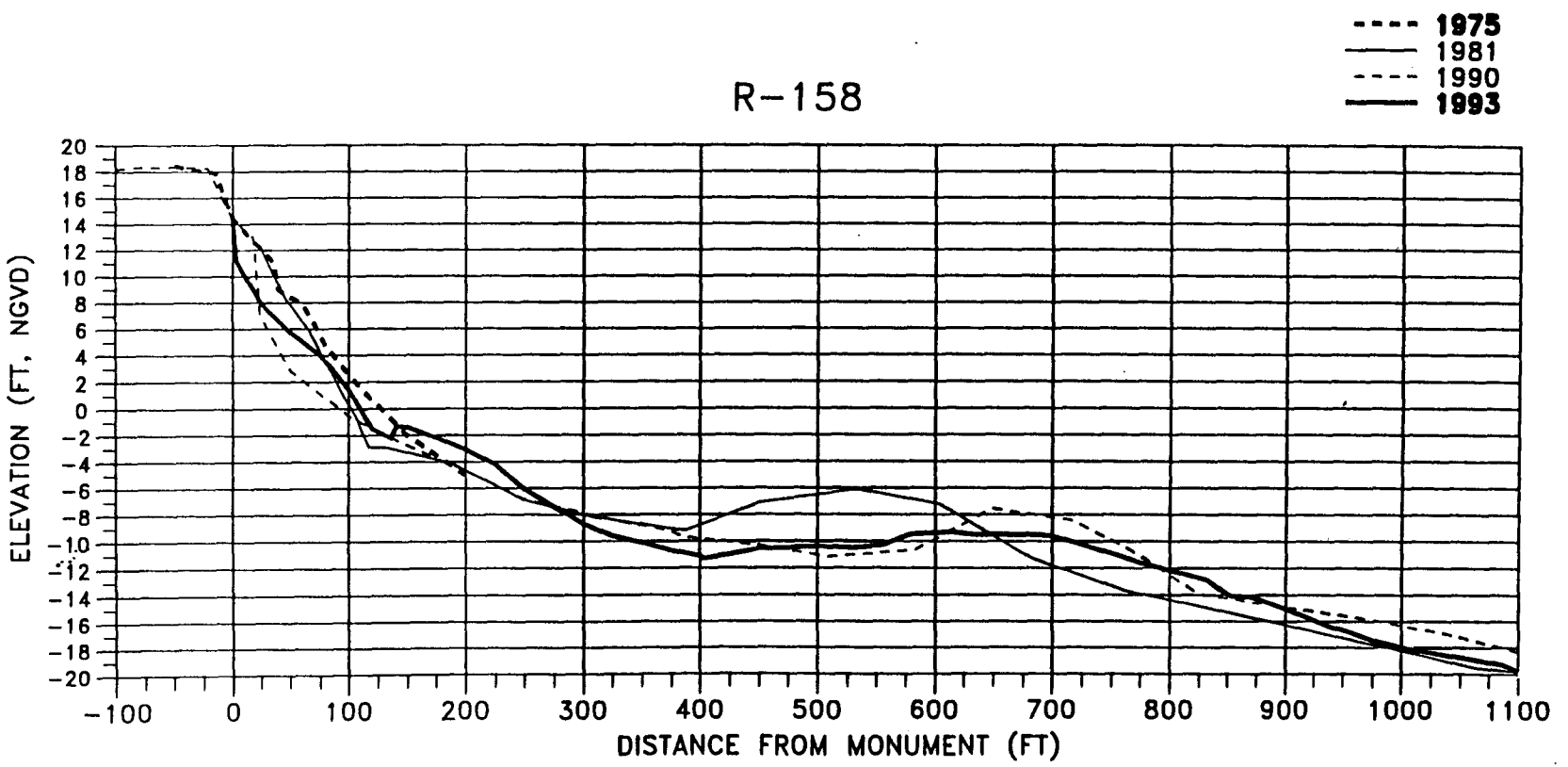


FIGURE 1-5G: Profile Data (1975, 1981, 1990, and 1993).

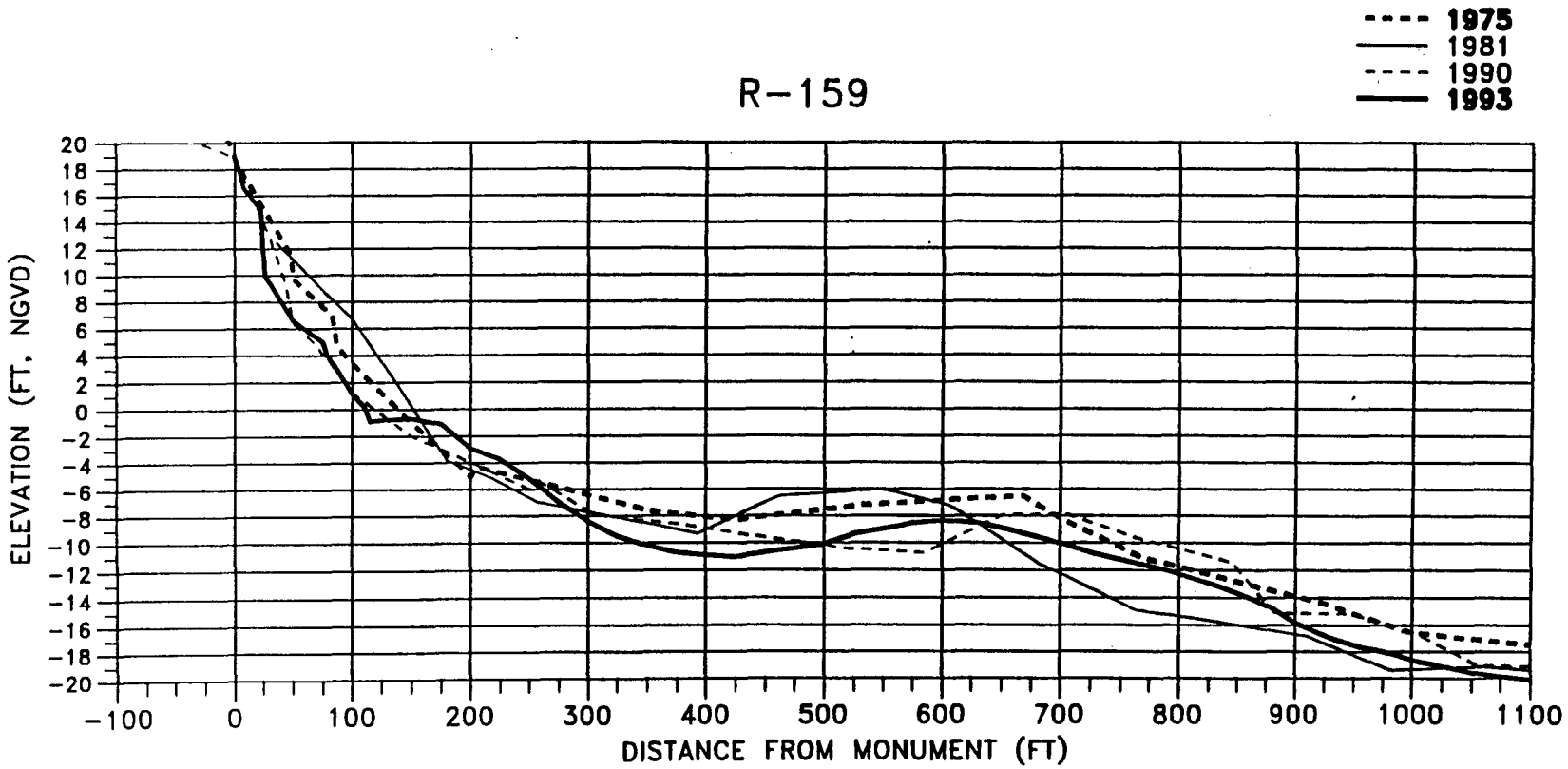


FIGURE 1-5H: Profile Data (1975, 1981, 1990, and 1993).

Table 1-11
Summary of Historical Volumetric Changes

DNR MONUMENT	DIST. SO. OF SO. JETTY (ft)	DISTANCE BETWEEN MONUMENTS (ft)	Volume Change Jan-75 to Nov-81 (cy/ft/yr)	Nov-81 to Jul-90 (cy/ft/yr)	Jul-90 to Feb-93 (cy/ft/yr)	Nov-81 to Feb-93 (cy/ft/yr)
T-152	390	975	-1.38	0.26	-0.46	-0.20
R-153	1730	1305	0.57	3.17	-13.09	-9.92
R-154	2770	1045	-9.25	8.75	-17.61	-8.86
R-155	3800	1190	-10.17	5.27	-19.09	-13.82
R-156	5120	1155	-6.33	2.39	-20.07	-17.68
R-157	6120	840	-6.95	-2.31	-24.12	-26.43
R-158	6830	750	-4.06	-1.94	0.62	-1.32
R-159	7650	440	-4.17	-0.79	-6.31	-7.10
Average Volume Change (cy/ft/yr)			-5.25	2.45	-13.59	-1.24
Total Volume Change (cy/yr)			-40,400	18,830	-104,620	-9,580
Total Volume Change (cy)			-276,070	163,140	-270,970	-107,830

are those at locations which are outside the immediate influence of the bypassing activity and the coastal structures.

1-42. Table 1-12 presents estimates of annual bypassing quantities from the fixed sand transfer plant for the intervals 1975 to 1981, 1981 to 1990, 1990 to 1993, 1981 to 1993, and 1975 to 1993. Also presented in the table are volume change data for profiles T-152 through R-159 and for profiles R-155, R-156, and R-157 during the same intervals. The latter set of profiles are situated away from the influence of coastal armor.

1-43. Between 1975 and 1993, the fixed sand transfer plant bypassed approximately 573,510 cy of material, or the equivalent of 69,970 cy/yr. Despite this, the computed volume change along 7,700 ft of shoreline south of the inlet (T-152 through R-159) indicates a net loss of 21,230 cy/yr during this period. Removing the effect of bypassed material, the volume change data suggest that this section of shoreline lost 91,200 cy/yr. It is necessary to note that the volume change data for monuments T-152 to R-154 and R-158 to R-159 is influenced by the shore stabilizing effects of the coastal armor. Therefore, using these data, the computed volume change rates are most likely underestimates of the potential volume change.

1-44. In order to estimate the effects of the coastal armor upon volume change, the volume change data at monuments situated away from the influence of coastal armor (R-155, R-156, and R-157) were considered. The computed average sectional volume change at these monuments between 1975 and 1993 is -4.90 cy/ft/yr. Applying this to the 7,700 ft of shoreline south of the inlet, the computed volume change rate is -37,770 cy/yr. Removing the effect of bypassed material, the computed volume change rate is 107,740 cy/yr during this interval. This change rate is representative of the expected volume change rate uninfluenced by coastal armor and fixed plant bypassing operations.

1-45. Volume Change Experiment. In an attempt to better determine the rate of volumetric change south of the inlet, a volume change experiment was conducted by the Palm Beach County Department of Environmental Resources Management (DERM). Between June, 1989 and January, 1990, about 48,000 cy of sand were placed within 1,200 ft south of the inlet from the fixed sand transfer plant and dredging of the interior sand trap. Surveys indicated that this 1,200 ft reach of shoreline experienced a net loss of about 36,000 cy of sand above -5.0 ft NGVD during this same interval. During the same period, the shoreline between 1,200 and 2,400 feet south of the inlet lost an additional 6,000 cy of material while the shoreline between 2,400 and 5,100 feet

Table 1-12
Summary of Historical Volumetric Changes With and Without Bypassing

		Jan-75 to Nov-81	Nov-81 to Jul-90	Jul-90 to Feb-93	Nov-81 to Feb-93	Weighted Average (1/75 -2/93)
	SAND BYPASSING					
(1)	Total Volume Bypassed (cy)	513,525	774,375	57,330	831,705	573,510
(2)	Average Bypass Rate (cy/yr)	75,150	80,100	22,220	73,930	69,970
	T-152 to R-159					
(3)	Average Volume Change (cy/ft/yr)	-5.25	2.45	-13.59	-1.24	-2.76
(4)	Total Volume Change					
(4a)	Neglecting Bypassing (cy/yr)	-40,400	18,830	-104,620	-9,580	-21,230
(4b)	Including Bypassing (cy/yr)	-115,550	-61,270	-126,840	-83,510	-91,200
	R-155 to R-157					
(5)	Average Volume Change (cy/ft/yr)	-7.93	2.22	-20.77	-18.54	-4.90
(6)	Total Volume Change (Over Project Length)					
(6a)	Neglecting Bypassing (cy/yr)	-61,050	17,120	-159,920	-58,480	-37,770
(6b)	Including Bypassing (cy/yr)	-136,200	-62,980	-182,140	-132,410	-107,740

south the inlet gained approximately 12,000 cy of sand above -5.0 ft NGVD.

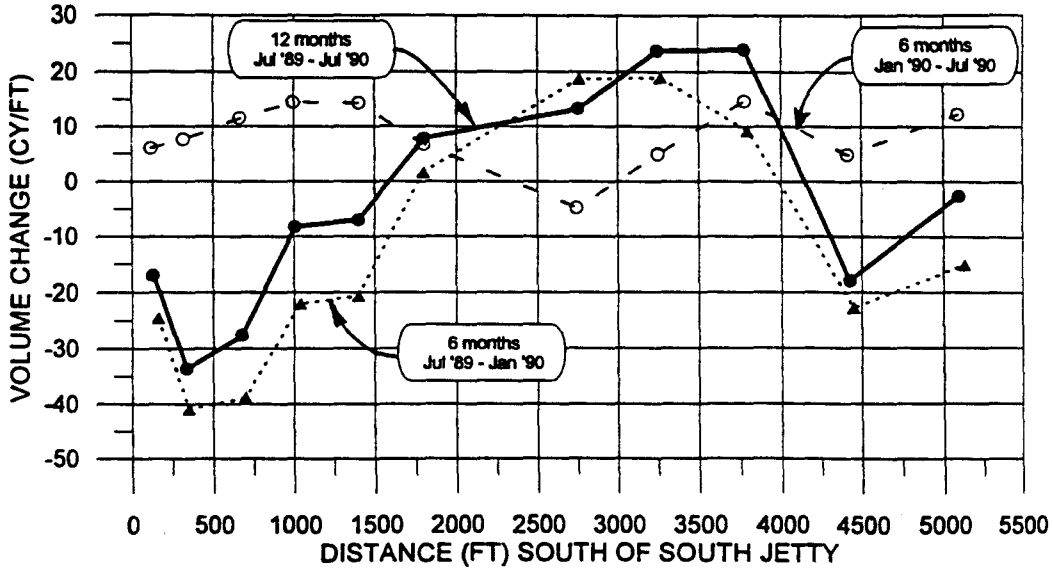
1-46. During the following six months, from January, 1990 to July, 1990, another 15,000 cy of sand were placed south of the inlet via the fixed sand transfer plant. At the end of this interval, the beach within 1,200 ft south of the inlet experienced a net gain of 13,000 cy above -5.0 ft NGVD. The shoreline between 1,200 ft and 2,400 feet gained 10,500 cy and the shoreline between 2,400 and 5,100 feet south of the inlet gained 14,500 cy above -5.0 ft NGVD.

1-47. Over the entire one year period, about 63,000 cy of sand were placed within 1,200 ft south of the inlet. Despite this, this 1,200 ft reach of shoreline demonstrated a net loss of at least 23,000 cy. Simplistically, the potential erosion rate within the first 1,200 ft south of the inlet therefore equates to at least 86,000 cy/yr for the year of study.

1-48. During the same one year period, the shoreline within 5,100 ft south of the inlet exhibited a net volumetric increase of only 8,000 cy (above -5.0 ft NGVD) despite the 63,000 cy placement of sand. The net erosion potential within the first 5,100 ft of shoreline south of the inlet therefore equates to at least 55,000 cy/yr for the year of study.

1-49. Computed volume changes for the one year period are presented in Figure 1-6. These volume change data indicate that net erosion over the twelve month period occurred along 1,600 feet of shoreline south of the inlet despite the placement of mechanically bypassed sand. This is consistent with the historical average annual shoreline and volume change data which indicate that the shoreline within the first 500 to 1,700 feet south of the inlet experiences net average annual erosion. South thereof, between 1,600 to 4,000 feet south of the inlet historical shoreline and volume change data suggest that the shoreline is mildly erosional to stable over the period of record. The decrease in erosion potential beginning approximately 1,600 feet south of the inlet, and the variable erosive/stable behavior of the shoreline between 1,600 and 4,000 feet south of the inlet are attributed to the influence of existing seawalls and groins and the location of the natural bypassing bar. These data also suggest that during the six month period between July, 1989 and January, 1990, the erosional stress extended as far as 1,800 feet south of the inlet. This indicates that the extent of the erosional stress along this shoreline varies throughout the year.

Figure 1-6
Computed Volume Change (cy/ft) Above -5.0 ft NGVD
July '89 to Jul '90



1-50. The rates of potential erosion cited above describe the volume of sand expected to erode from the beach (above -5.0 ft NGVD) in the absence of mechanical sand bypassing for the year of study. The rates underestimate the total potential erosion because they do not include losses below the -5.0 ft NGVD depth contour.

1-51. The volumetric erosion rates utilized in the design of the shore protection project were developed through a global sediment budget prepared for South Lake Worth Inlet, described below.

SOUTH LAKE WORTH INLET

1-52. The processes which affect the existing shoreline and the potential performance of a shore protection project along the Town of Ocean Ridge are in large part a function of South Lake Worth Inlet, immediately to the north. The inlet's structures and the operation of a sand transfer plant at the inlet influence the project area's hydraulics, bathymetry, and sediment supply.

1-53. History. South Lake Worth Inlet is the northern corporate boundary of the Town of Ocean Ridge and the northern terminus of the proposed shore protection project. The inlet was constructed in 1927 as a flushing channel to improve the water quality of the southern end of Lake Worth.

It is one of two inlets which connect Lake Worth to the Atlantic Ocean. The inlet is also used for small craft (recreational) navigation, but is not a Federally maintained navigation project.

1-54. During initial construction, the inlet was excavated to a width of 130 ft and a depth of -8 ft MLW and north and south jetties were constructed with a crest elevation of +5 ft MLW (Strock, 1983). In 1936, the crest elevation of the inlet jetties was raised to +12 ft MLW in an attempt to prevent sand from entering the channel. In 1937, a fixed sand transfer plant was installed at the north jetty to bypass sand impounding updrift of the inlet in order to reduce downdrift erosion along the Ocean Ridge shoreline. Operation of the plant was interrupted from 1942 to 1945 due to wartime fuel shortages.

1-55. In 1967, the north and south jetties were extended seaward 410 ft and 69 ft, respectively. Additionally, the fixed sand transfer plant was relocated 118 ft seaward of its original location and the engine and pump size were increased. The modifications were primarily intended to reduce interior shoaling. The 1967 modifications represent the current configuration of the inlet and the bypassing operations.

1-56. Currently, there are no plans to modify the inlet jetties or the fixed sand transfer plant. A history of the inlet and its influence upon the adjacent shorelines and nearshore bathymetry is presented in the South Lake Worth Inlet Sand Management Plan (Olsen Associates, Inc., 1990).

1-57. Effect. South Lake Worth Inlet acts as a partial littoral barrier to the net southerly transport of material in southern Palm Beach County. This is evidenced by accretion of the updrift (north) shoreline, recession of the downdrift (south) shoreline, and the historical growth of tidal inlet shoals.

1-58. The inlet is not a complete littoral barrier in that material is bypassed across the inlet by both mechanical and natural means. Sand is mechanically transferred across the inlet by a fixed sand transfer plant as well as periodic dredging of the interior shoals. The fixed sand transfer plant operates throughout the year, although about 85% of bypassing operations occur from September through April. Since 1967, Palm Beach County records indicate that the plant has bypassed approximately 66,000 cy/yr, on average. Table 1-13 presents estimated annual bypassing volumes since 1967.

TABLE 1-13
Mechanical Bypassing at South Lake Worth Inlet (1967-1992)

Year	Interior Shoal Dredging (cy)	Fixed Sand Transfer Plant Bypass Volume (cy)[1]
1967		17,025
1968	46,000	34,875
1969	44,000	73,800
1970		44,250
1971		42,000
1972		31,425
1973	32,500	92,250
1974		34,875
1975		73,125
1976		79,950
1977		94,800
1978		74,250
1979		42,300
1980		52,500
1981		122,400
1982		154,250
1983		100,050
1984		115,350
1985		80,475
1986		69,900
1987		73,575
1988		59,925
1989	37,500	39,720
1990		41,175
1991		24,465
1992		39,100
TOTAL	159,500	1,707,810
AVG. RATE (cy/yr)	6,100	65,690

[1] Estimates based upon 150 cy/hr times the hours of plant operation each year.

1-59. Dredging of the interior shoal has contributed less than 160,000 cy of material to the Ocean Ridge shoreline since 1967. This is equivalent to approximately 6,100 cy/yr. Interior shoaling decreased significantly since the 1967 inlet modifications. These modifications, which included extensions to the interior training walls and jetties, were intended to decrease interior shoaling.

1-60. A portion of the local net southerly drift is naturally bypassed across the ebb tidal shoal. It has been estimated that approximately 80,000 to 90,000 cy of material are bypassed across the ebb tidal shoal each year, on average (Olsen Associates, Inc., 1990).

1-61. Construction of the inlet also resulted in the development of flood and ebb tidal shoals. It has been estimated that the ebb tidal shoal contains between 1.6 MCY and 3.1 MCY of sand (Olsen Associates, Inc., 1990). The flood tidal shoal volume has been estimated as approximately 1.0 MCY, but the accuracy of this estimate is uncertain due to limitations of available data. From the 1930's to the 1950's, significant, but unknown, quantities of sand were dredged from the interior shoals and used for upland fill projects. Because the ebb and flood tidal shoals did not exist before the inlet was constructed it is assumed that the material contained therein has been diverted from the adjacent shorelines.

1-62. Although some littoral material is bypassed across the inlet, losses from the littoral system to the north shoreline, the ebb and flood tidal shoals and areas offshore of the inlet create a net downdrift sediment deficit along the Ocean Ridge shoreline. The downdrift sediment deficit created by the inlet is central to the erosional stress experienced along the Ocean Ridge shoreline. In the following section, a sediment budget for the inlet is developed to quantify the erosion potential along the Ocean Ridge shoreline.

1-63. Sediment Budget. The sediment budget developed for the South Lake Worth Inlet Sand Management Plan (Olsen Associates, Inc., 1990) was utilized to estimate the sediment deficit downdrift of the inlet. The budget describes a control volume which includes the inlet's tidal

shoals, natural and mechanical sand bypassing, and the shorelines within about 5,300 ft north and 7,700 ft south of the inlet. These shoreline boundaries respectively reflect the approximate limit of the inlet's updrift impoundment and the downdrift limit of the project area. The sediment budget includes nine (9) major sediment transport components. These components, depicted in Figure 1-7, are described as the net longshore transport rate incident to the north shoreline (Q_1); the net volumetric change rate immediately north of the inlet (Q_2, accretion being positive); the net rate of accretion to the ebb shoal (Q_3); the gross rate of accretion to interior shoals (Q_4); the rate at which sand is bypassed naturally (Q_5) and via the fixed transfer plant (Q_6); the rate at which sand is placed upon the south beach via interior dredging (Q_7); the net volumetric change rate immediately south of the inlet (Q_8, accretion being positive); and the net rate at which sand is transported southward from the south beach (Q_9). The transport components are related by the following two expressions:

$$Q_1 = Q_2 + Q_3 + Q_4 + Q_5 + Q_6$$

$$Q_9 = Q_5 + Q_6 + Q_7 - Q_8$$

1-64. In order to evaluate these relationships, values for six of the nine transport components were estimated with historical data. These data include historical shoreline and volume changes and records of sand bypassing activity. Only data collected since the 1967 inlet modifications were utilized in order to develop results which characterize current littoral conditions. Unless otherwise noted, data from the South Lake Worth Inlet Sand Management Plan (Olsen Associates, Inc., 1990) were used in the analysis.

1-65. The values of Q_2 and Q_8 were estimated from volumetric changes developed from comparative beach profiles between January, 1975 and July, 1990. During this period, the 5,300 ft reach of shoreline north of the inlet gained

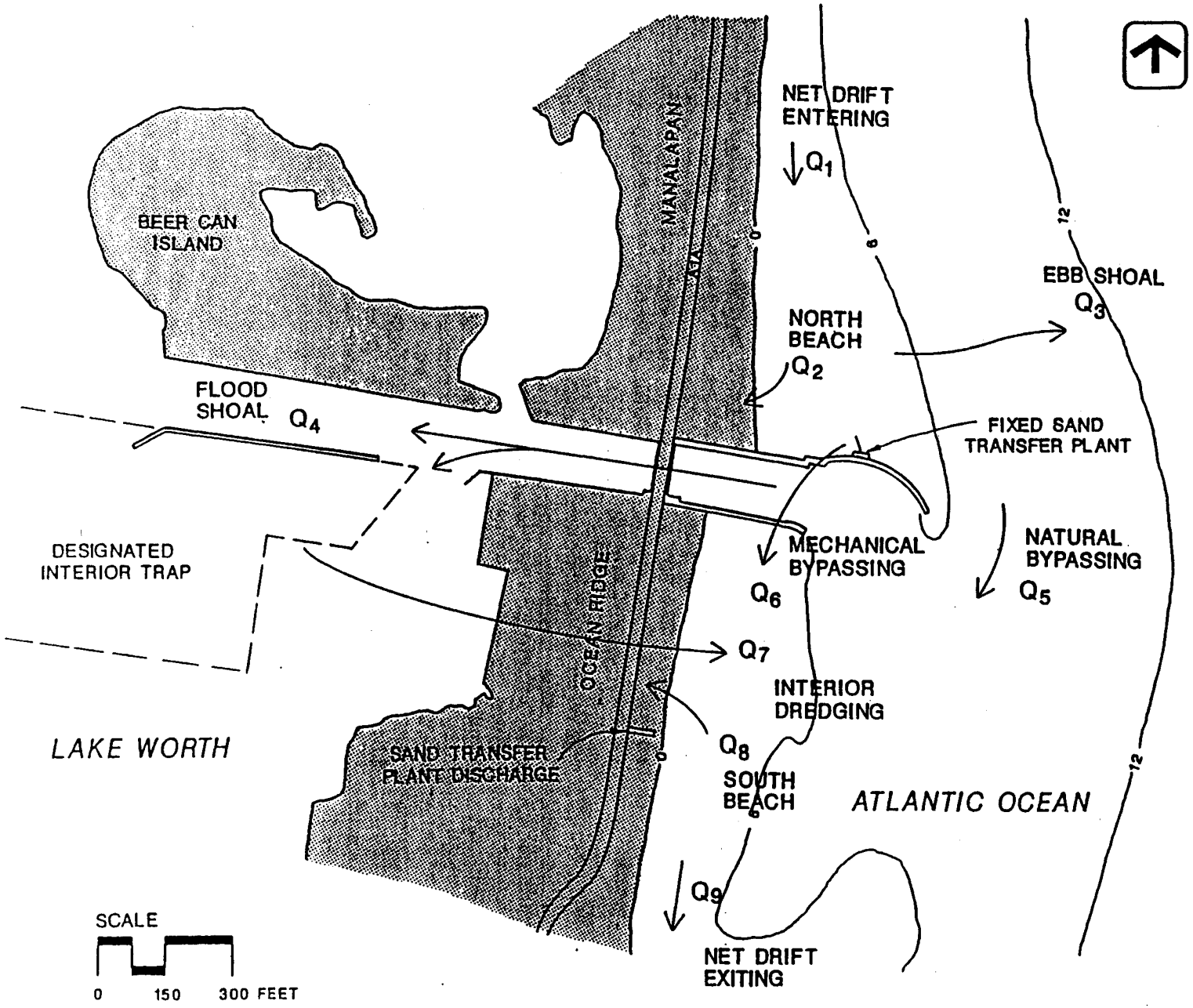


Figure 1-7: Component sediment flow paths of sediment budget analysis.

approximately 151,720 cy of material above the -6 ft NGVD contour. Comparison of two 1975 and 1990 beach profiles which extend beyond wading depth (R-147 and R-150; 4,190 ft and 1,420 ft north of the inlet, respectively) suggest that the total net volume change across the active profile is about 1.65 times greater than the change above -6 ft NGVD. The total increase in beach volume north of the inlet between 1975 and 1990 is therefore estimated as 1.65 times 151,720 cy, or 250,340 cy. This equates to 16,150 cy/yr on average; hence Q_2 = 16,150 cy/yr. During this same period, the shoreline south of the inlet lost approximately 112,930 cy across the active beach profile (see Table 1-11). This equates to -7,290 cy/yr, on average; hence Q_8 = -7,290 cy/yr.

1-66. The average rate of ebb shoal accretion and offshore losses (Q_3) was estimated from comparison of February 1979 and January 1990 bathymetric data. The net volume change of the ebb shoal totalled 50,000 cy (accretion) over the 10.9 year interval between surveys. This equates to about 4,600 cy/yr on average. Additional offshore losses (i.e., losses from the control volume not otherwise accounted for by surveys of the ebb tidal shoal) are estimated as 15,000 cy/yr (UF/COEL, 1965). Combining these two values, Q_3 = 19,600 cy/yr.

1-67. The rate of interior shoaling (Q_4) was assumed to be equal to the average rate of dredging of the interior shoals and the Atlantic Intracoastal Waterway (AIWW) immediately west of the inlet (approximately Mile 294), plus additional internal shoaling not otherwise accounted for by surveys. From Table 1-13, for the 26-year period since the 1967 inlet modifications, the average rate of dredging of the inlet's interior trap area is 6,100 cy/yr. Records for the AIWW indicate that about 30,000 cy of sandy material were dredged from a shoal within the channel, due west of the inlet, only once during this same period; hence, the AIWW shoaling rate is estimated as 1,150 cy/yr. Additional shoaling was assumed to be 20% of the interior and AIWW dredging rates, or 1,450 cy/yr. Combining these values, Q_4 = 8,700 cy/yr.

1-68. Bypassing rates from the fixed sand transfer plant (Q_6) and interior shoal (Q_7) were estimated from Palm Beach County records. From Table 1-13, the average rate of sand bypassing via the fixed plant is 65,690 cy/yr. Likewise, from Table 1-13, the average rate at which sand dredged from the interior shoals is placed upon the south beach equates to 6,100 cy/yr. Hence, Q_6 = 65,690 cy/yr, and Q_7 = 6,100 cy/yr.

1-69. Estimates of the net southerly drift rate incident to the north shoreline (Q_1) average about 200,000 cy/yr (Watts, 1953; USACE, 1971, Dewall and Richter, 1977; and A.V. Strock, 1983). This estimate for Q_1, together with the values estimated for the transport components described above (Q_2, Q_3, Q_4, Q_6, Q_7, and Q_8) were substituted into the two sediment budget equations in order to solve for Q_5 and Q_9. The average rate of natural sand bypassing, Q_5, is computed as 89,860 cy/yr; or, about 45% of the net drift directed toward the inlet from the north. The average rate of net southerly drift directed away from the inlet, Q_9, is 168,940 cy/yr. The values of the sediment budget's transport components are summarized in Table 1-14.

1-70. The downdrift sediment deficit associated with the inlet is represented by (1) the rate of erosion along the shoreline south of the inlet, $-Q_8$, and (2) the difference between the net rate of longshore transport incident to the control volume, Q_1, and the net rate of longshore transport directed away from the control volume, Q_9. From Table 1-14,

$$\text{Downdrift Sediment Deficit} = (Q_1 - Q_9) - Q_8$$

$$= (200{,}000-168{,}940) + 7{,}290$$

$$= 38{,}350 \text{ cy/yr}$$

This value, 38,350 cy/yr, represents the potential rate of erosion along the 7700-ft reach of shoreline south of the inlet. It does not include erosion specific to a shore protection project such as end losses and losses related to textural differences between the borrow and native beach sand.

EXISTING SHOREFRONT PROTECTIVE STRUCTURES

1-71. Since the construction of South Lake Worth Inlet in 1927, segments of the Ocean Ridge shoreline have been heavily armored with revetments, seawalls, and groins. As early as 1934, seven years after the completion of the inlet, a 2,000 ft seawall was constructed immediately south of the inlet. As erosion continued along this section of shoreline seven groins were constructed in an attempt to retain sand and provide protection to the seawall and upland development. Because of the sediment deficit along the Ocean Ridge shoreline, however, the groins never filled to capacity.

1-72. Since the initial attempts to stabilize the shoreline, local interests, including the County, have constructed numerous shore protection structures. Specifically, approximately 4,000 ft of seawalls and 16 groins have been

TABLE 1-14

Components of Sediment Transport at South Lake Worth Inlet, Palm Beach County, Florida.

Sediment Transport	Estimate
Incident Southerly Drift Rate (Q_1)	200,000
Volume Change, North Shoreline (Q_2)	16,150
Ebb Shoal & Offshore Losses (Q_3)	19,600
Interior Shoaling (Q_4)	8,700
Natural Bypassing (Q_5)	89,860
Mechanical Bypassing (Q_6)	65,690
Bypassing from Interior	6,100
Volume Change, South Shoreline (Q_8)	-7,290
Exiting Southerly Drift Rate (Q_9)	168,940

constructed along approximately 8,000 ft of shoreline immediately south of the inlet. Tables 1-15 and 1-16 provide inventories of existing seawalls and groins and their locations south of the inlet's south jetty. The size, construction, and condition of each structure were determined from aerial photography and an April, 1993 field survey of the structures. Replacement costs for these structures were developed from Palm Beach County records.

1-73. The effect of these structures has been to stabilize the upland while sacrificing the protective natural beach and dune system. The structures, in conjunction with the sediment deficit along this shoreline, have contributed to a lowering of the beach causing portions of the shoreline to be completely inundated during daily high water.

TABLE 1-15

Inventory of Shore-Parallel Coastal Armor.

Shore Parallel Length of Structure (ft)	Structure Type	Distance South of South Jetty (ft)
660	Steel Sheetpile Wall w/ Conc. Cap	180 to 810
120	Concrete Rubble	810 to 930
2350	Concrete Wall w/ Toe Protection	930 to 3280
510	Concrete Wall w/ Toe Protection	3280 to 3790
200	Concrete Wall	3790 to 3990

TABLE 1-16

Inventory of Existing Groins.

Structure Number	Approximate Distance South of South Jetty (ft)	Structure Type
1	180	Sheetpile & Sandbag Groin
2	400	Sandbag Groin
3	530	Sandbag Groin/Sill
4	980	Sheetpile & Concrete Groin
5	1580	Sheetpile Groin
6	2730	Sheetpile Groin
7	2840	Concrete Block Groin
8	3160	Concrete Block Groin
9	3475	Sheetpile & Concrete Groin
10	3800	Sheetpile & Concrete Groin
11	4400	Sheetpile & Concrete Groin
12	5640	Concrete Block Groin
13	6710	Sheetpile & Concrete Groin
14	7150	Concrete Block Groin
15	7610	Concrete Block Groin
16	7980	Concrete Block Groin

SHORE PROCESSES

1-74. Estimates of the net southerly drift rate incident to the north shoreline average about 200,000 cy/yr (Watts, 1953; USACE, 1971, Dewall and Richter, 1977; and A.V. Strock, 1983). There is, however, considerable year-to-year variability in this rate. To estimate this variability, the Phase II hindcast wave data were refracted and shoaled to incipient wave breaking under the assumption of regular (straight and parallel) depth contours and a uniform shoreline angle of 11.31 degrees east of true north. The gross and net rates of longshore sediment transport were computed from the breaking wave estimates for each year of the hindcast wave data using the relationship

$$Q_L = K_L H_b^{5/2} \sin(2\alpha_b)$$

where H_b and a_b are the wave height and angle to shore at breaking, respectively. The coefficient K_L was calibrated such that the average value of the net longshore transport rate was 200,000 cy/yr over the twenty year period of the hindcast. Wave events which did not significantly contribute to the sediment transport rate (i.e., those falling below critical threshold values) were neglected in the manner of Kraus, Hanson, and Larson (1988). The results of the analysis are shown in Table 1-17. The net longshore transport rate varies from about 115,000 to 310,000 cy/yr over the 20 year hindcast. The standard deviation about the mean of the annual net transport rates is about ±50,800 cy/yr.

1-75. These sand transport rates are based upon the assumption of straight and parallel contours and are assumed to be uniform along the study shoreline. However, the bathymetry in the vicinity of the South Lake Worth Inlet ebb tidal shoal is not straight and parallel which causes extreme variability in the breaking wave climate and sand transport rates along the Ocean Ridge shoreline. To accurately represent the influence of the ebb tidal shoal upon the wave climate and the sand transport rates, a grid-based wave refraction analysis was conducted as part of the GENESIS modeling study presented in this report.

Table 1-17

	LONGSHORE TRANSPORT (CY)			
CALIBRATED TO 200,000 CY/YR NET SOUTHERLY				
YEAR	SOUTH	NORTH	GROSS	NET
1956	244,729	10,573	255,302	234,156
1957	259,033	15,472	274,505	243,561
1958	259,994	30,657	290,651	229,337
1959	238,798	15,031	253,829	223,767
1960	179,889	35,056	214,946	144,833
1961	190,476	22,136	212,611	168,340
1962	212,884	12,479	225,362	200,405
1963	328,451	18,412	346,863	310,038
1964	207,065	40,506	247,571	166,558
1965	240,715	38,569	279,284	202,147
1966	248,543	45,959	294,502	202,584
1967	279,866	14,798	294,664	265,068
1968	186,952	36,935	223,887	150,017
1969	292,202	32,672	324,874	259,531
1970	208,330	43,615	251,944	164,715
1971	182,529	21,170	203,699	161,360
1972	226,046	41,322	267,368	184,724
1973	176,268	45,661	221,929	130,606
1974	263,169	19,436	282,604	243,733
1975	170,688	56,166	226,854	114,522
TOTAL	4,596,625	596,625	5,193,250	4,000,000
AVERAGE	229,831	29,831	259,662	200,000
(CY/YR)				
STANDARD	43,245	13,570	39,073	50,812
DEVIATION				
(CY/YR)				

SHORELINE RESPONSE MODELS

STORM-INDUCED BEACH CHANGE MODEL (SBEACH)

1-76. Larson and Kraus (1989) developed the numerical model SBEACH (Storm-induced BEAch CHange) for simulating beach profile response to storm conditions. The model is empirically-based and was developed to simulate morphologic, storm-induced, beach profile changes such as berm erosion and bar growth. The model was developed and calibrated using net cross-shore sand transport rates and beach profile change data measured in large scale wave tank tests. Calibration and verification of the model for field applications were conducted with high-quality water level, wave and profile change data collected at the Corps of Engineers Field Research Facility (FRF) in Duck, North Carolina. A discussion of the calibration and verification of the model is presented in Larson and Kraus (1989) and Larson, Kraus, and Byrnes (1990). For this study, SBEACH Version 2.0 was used.

1-77. SBEACH is a two-dimensional cross-shore model. The model assumes that four primary zones of cross-shore transport exist along the beach profile. These zones include (1) the pre-breaking zone, (2) the breaker transition zone, (3) the broken wave zone, and (4) the swash zone. Within each zone, the magnitude and direction of transport can vary. Thus, the model can simulate both onshore and offshore directed transport. Its ability to simulate offshore transport and subsequent dune recession is central to this study. Other assumptions made in the model include conservation of mass (amount of material eroded must equal amount of material accreted), uniform cross-shore grain size distribution, and validity of linear wave theory along the beach profile.

1-78. Calibration/Verification. SBEACH requires calibration of three empirical parameters: (1) the transport rate coefficient, K, (2) the transport rate slope dependence, ϵ, and (3) the transport rate decay coefficient multiplier, λ. Calibration of these parameters requires measurement of pre-storm and post-storm profiles at the site where the model is to be used.

1-79. Pre- and post-storm profile data are not available for the study shoreline nor the adjacent shorelines in Palm Beach County. Therefore, the SBEACH model could not be formally calibrated for the study shoreline. The default calibration coefficients were developed with water level, wave and beach change data

collected at Duck, North Carolina. In this study, it is not assumed that storm-induced beach change at Duck, North Carolina is representative of that in south Florida. Instead of relying solely upon the default values for this study, however, a sensitivity analysis of several calibration coefficient sets was conducted.

1-80. The calibration coefficient sets used for the sensitivity analysis include (1) the default values, (2) values developed for Martin County (the county bordering Palm Beach County to the north), (3) values developed for Broward County (the county bordering Palm Beach County to the south), and (4) estimated values for Palm Beach County based upon SBEACH calibration studies in Broward and Dade counties. The Martin County values were developed for the Martin County shore protection project (USACE, 1994). Water level, wave and beach change data for the 1984 Thanksgiving Day nor'easter were used for the Martin County calibration. The calibration coefficients for Broward County and the estimated coefficients for Palm Beach County were developed as part of the Coast of Florida Erosion and Storm Effects Study for Dade, Broward, and Palm Beach Counties (USACE, 1995). The Broward County calibration was conducted with water level, wave and beach change data from Hurricane David (1978). The estimated calibration coefficients for Palm Beach County were based upon profile similarities between Broward and Palm Beach counties.

1-81. During the sensitivity analysis, only the coefficients, K, e, and l were varied. These coefficients were varied as indicated in Table 1-18. Input water level, wave and beach conditions were held constant for all simulations. The input water level and wave data included a 100-year maximum storm surge and a 20-year maximum wave height. The 100-year storm surge elevation was taken from the FEMA storm surge estimates for Palm Beach County. The 20-year maximum wave event was determined by ranking all maximum wave conditions in the WIS station 11 hindcast data according to return period. The time dependent wave conditions for the 20-year wave event were extracted directly from the WIS hindcast time series. The storm duration was chosen from the WIS hindcast data to be 24 hours. This duration was based on the time in which the significant wave height was greater than 10 feet, centered around the peak significant wave height of 23 feet, over the storm event. The beach profile used as the initial profile for the sensitivity test was a composite developed from typical unarmored beach profiles measured along the project reach. The profile data were collected in 1993 by Morgan and Eklund, Inc. as part of this investigation.

1-82. The results of the sensitivity analysis are presented in Figure 1-8. Recession distances from these results are presented in Table 1-18. The location at which the recession distances were measured is the +9.0 ft NGVD elevation. This elevation is considered the natural berm, or bluffline, along the study area shoreline. This is also the elevation used al the baseline for the storm damage model presented in Appendix 2. The landward limit of the erosion envelope is defined as the landwardmost occurrence of an erosional scarp of 0.1, 0.5, or 1.0 vertical feet.

1-83. Inspection of Table 1-18 indicates little sensitivity of bluffline recession to the various calibration coefficients used in this analysis. Recession estimates computed with the Martin County, Broward County and Palm Beach County coefficients vary by about ±7 percent, on average. The default calibration coefficients produced the greatest amount of bluffline recession, while the estimated calibration coefficients for Palm Beach County produced the least. For purposes of project justification, the estimated calibration coefficients for Palm Beach County were used in this study (see Appendix 2).

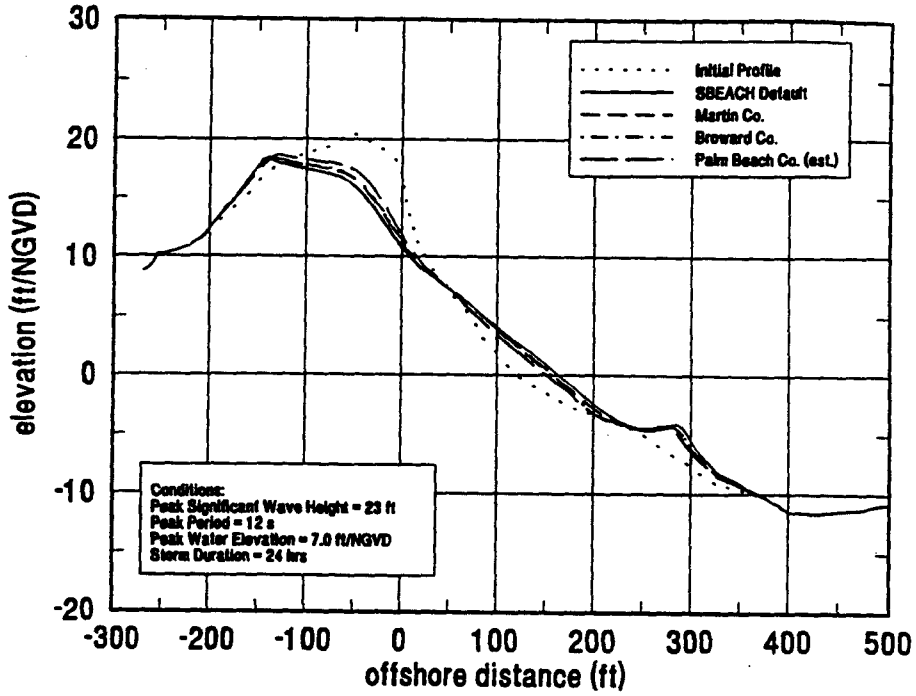
Table 1-18: Sensitivity Test for SBEACH Transport Coefficients.

Data Set	Coefficients			Horizontal Recession**		
	K	ϵ	λ	1.0′ scarp	0.5′ scarp	0.1′ scarp
SBEACH Defaults	1.75e-06	0.002	0.2	138	148	153
Martin Co.	1.50e-06	0.0015	0.4	128	143	148
Broward Co.	1.50e-06	0.001	0.1	128	143	148
Palm Beach Co.	1.35e-06	0.001	0.4	118	133	143

Note: **These values represent the maximum landward horizontal recession from +9.0 foot/NGVD initial elevation to the erosion scarp.

1-84. To verify the selected calibration coefficients, simulations were conducted with the calibration coefficients presented in Table 1-18 and a different typical beach profile. This verification was intended to determine if the model's sensitivity to the calibration coefficients varies

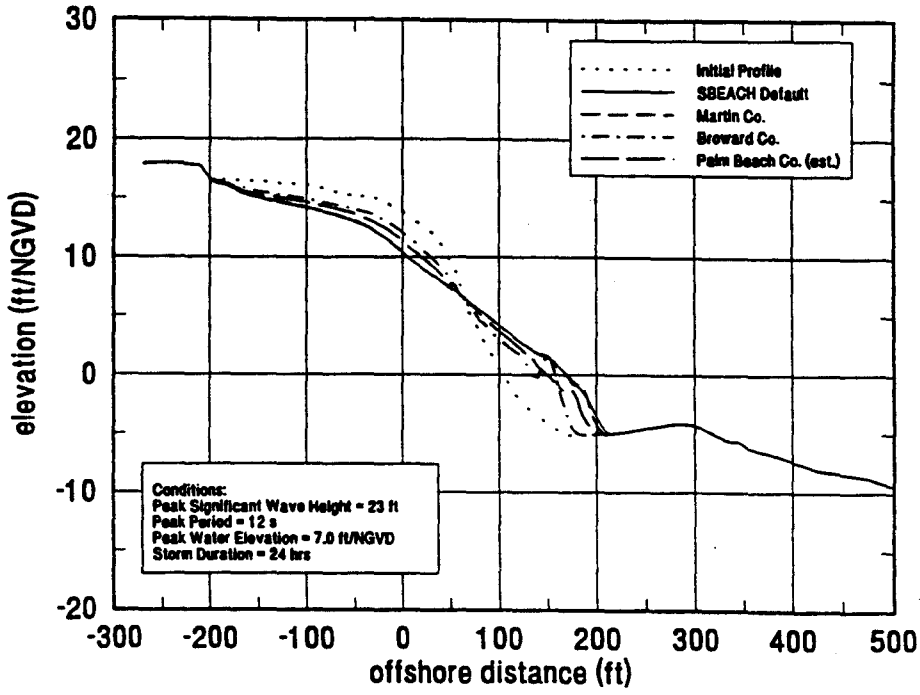
Figure 1-8
Sensitivity Analysis of SBEACH Calibration Coefficients
100 year surge, 20 year wave event



for different profile conditions. The profile used in this verification analysis is a composite profile of armored stretches of the project shoreline. Like the composite profile used in the calibration simulations, this composite profile was developed from beach profile data collected in 1993 by Morgan and Eklund, Inc. The storm surge and wave conditions used in this analysis were the same as those used for the calibration. Figure 1-9 presents the results of the verification simulations. As indicated in the figure, the sensitivity of the model to the calibration coefficients for the verification profile is similar to that for the calibration profile.

1-85. Simulations. The SBEACH model was applied, using the estimated calibration coefficients for Palm Beach County, to determine the probability of storm-induced bluffline recession for existing beach conditions. Again, recession is defined as the distance from the +9 ft NGVD contour on the pre-storm profile to the landward limit of the storm-induced erosion envelope. The +9 ft NGVD contour is the baseline for the storm damage model used in this report (see Appendix 2). The landward limit of the erosion envelope is defined as the landwardmost occurrence of a 0.5 ft erosion scarp.

Figure 1-9
Verification of SBEACH Calibration Coefficients
100 year surge, 20 year wave event



1-86. The required input for SBEACH includes an initial (pre-storm) beach profile, a storm surge hydrograph, a time series of offshore wave height and period, the median (d_{50}) grain size of the beach sediment, the avalanching angle of beach sediment, and the sea surface temperature. Primary output is a final (post-storm) beach profile.

1-87. Input data for SBEACH were obtained from a variety of sources. Pre-storm beach profile data were obtained from a 1993 field survey conducted by Morgan and Eklund, Inc. These data were used to develop three typical profiles which represent the study area shoreline. Three profiles were developed in order to account for variations in beach profile shape and coastal armor along the study area.

1-88. Storm surge data were taken from a FEMA Flood Insurance Study Report (FEMA, 1978) and WIS Report 7 (Ebersole, 1982). The WIS storm surge estimates were adjusted to include the effects of astronomical tides and all storm surge estimates were adjusted to the National Geodetic Vertical Datum (NGVD). A symmetric cosine-squared shape was used to create the surge hydrographs.

1-89. WIS wave data was used as input wave conditions for all simulations. To determine which wave event would represent the desired storm conditions, the maximum wave conditions in the hindcast were ranked based on wave height

and return period. A time series of wave conditions for the 20, 10, 5, 2, 1, 6 month and 3 month return period wave conditions were extracted from the WIS time series.

1-90. Storm surge return periods from one year to 100 years were considered in the study. Storm surge durations were estimated from the storm events extracted from the WIS time series. The duration for each return period event was determined by defining storm conditions as those where wave heights exceed 8 feet. For example, the 1 year storm event duration was determined to be 42 hours and the 20-year storm duration was determined to be 30 hours. Table 1-19 summarizes the storm surge durations for all storm events considered in this investigation. All durations were centered around the peak significant wave height for the given storm and limited to a minimum wave height.

Table 1-19 Surge Levels and Durations.

Surge Period (yrs)	Surge Level (ft)	Surge Duration (hrs)
1	2.7	42
2	3.1	39
5	3.4	36
10	4.4	33
20	5.2	30
50	6.2	27
100	7.0	24

1-91. The median (d_{50}) sediment grain size of the beach material, including shell content, is 0.36 millimeters. An avalanching angle of 28° from horizontal was used for all simulations. This avalanching angle was estimated from typical maximum beach slopes above the mean high water line along the project shoreline. The avalanching angle is used to adjust sections of the profile, which steepen during model simulations, to a more natural slope. However, if areas of the initial profile are steeper than the avalanching angle, the model will make adjustments to the profile which are not related to the storm conditions. To ensure that the simulation results represent adjustments caused only be storm conditions, all input profiles were pre-adjusted using the defined avalanching angle. The

adjustment was accomplished by running the initial profiles for two time steps with no wave or surge conditions, allowing the SBEACH program to "smooth" the profile. The output profile from the smoothing was then used as input for all storm simulations. A sea surface water temperature of 77.0° Fahrenheit was used.

1-92. Coastal storms are generally categorized in terms of frequency of occurrence of storm surge, not frequency of occurrence of wave heights. At this time, no known source correlates wave height frequency and surge level frequency within storms. In this study, storm surge return frequencies of 1, 2, 5, 10, 20, 50, and 100 years were considered. To cover the range of possible wave conditions for a given storm surge, three different wave conditions (moderate, high, and extremely high) were considered. Therefore, a total of 54 simulations (18 for each of three representative profile) were conducted. For example, three SBEACH simulations were performed for a storm with a surge level frequency of 20 years for each beach profile. All three simulations, however, had different wave conditions associated with the same surge level. One simulation had extremely high wave conditions (20 year frequency waves), another simulation had high wave conditions (10 year frequency waves) and a third had moderate wave conditions (5 year frequency waves). Table 1-20 summarizes the combination of storm surge return periods and wave conditions used for the SBEACH simulations.

1-93. An envelope of cumulative frequency curves of storm-induced bluffline recession was developed for each representative profile. Figures 1-10a, 1-10b, and 1-10c depict the recession curves for profiles 1, 2 and 3, respectively.

Table 1-20: Surge and Wave Conditions for SBEACH Simulations.

	Extremely High Waves		High Waves		Moderate Waves	
Surge Period (yrs)	Return Period (yrs)	Max. Wave Hgt. (ft)	Return Period (yrs)	Max. Wave Hgt (ft)	Return Period (yrs)	Max. Wave Hgt. (ft)
1	1	12.1	0.5	11.2	0.25	9.5
2	2	14.7	1	12.1	0.5	11.2
5	5	17.4	2	14.7	1	12.1
10	10	19.7	5	17.4	2	14.7
20	20	23.0	10	19.7	5	17.4
50	**	**	20	23.0	10	19.7
100	**	**	**	**	20	23.0

* Test Plan for each profile - 3 profiles - 54 simulations
** The WIS hindcast is for a twenty year period only. Recession distances for these cases will be extrapolated.

1-94. Profile 1 represents a natural profile with no seawall, typical of the shoreline reach represented by monuments R-156 through R-160. Figure 1-11 presents the SBEACH results for the moderate wave simulations. Recession estimates using the moderate wave conditions range from 11 feet for the 2 year storm to 125 feet for the 100 year storm. One-hundred year bluffline recession estimates for the extremely high wave condition was estimated to be 163 feet and for the high wave condition the bluffline recession was estimated to be approximately 142 feet. Therefore, the recession distance computed with the moderate wave conditions is considered to be a conservative estimate (in the economic justification sense) of bluffline recession.

1-95. Profile 2 represents the stretch of shoreline in the vicinity of R-154 and R-155. This section of shoreline is characterized by a rubble mound revetment and a low dune crest elevation. Simulations using the moderate wave conditions produced reasonable estimates of bluffline recession compared to profile #1. Because of the low dune crest elevation, however, simulations using the high and extremely high wave cases resulted in dune overwash and

Figure 1-10a

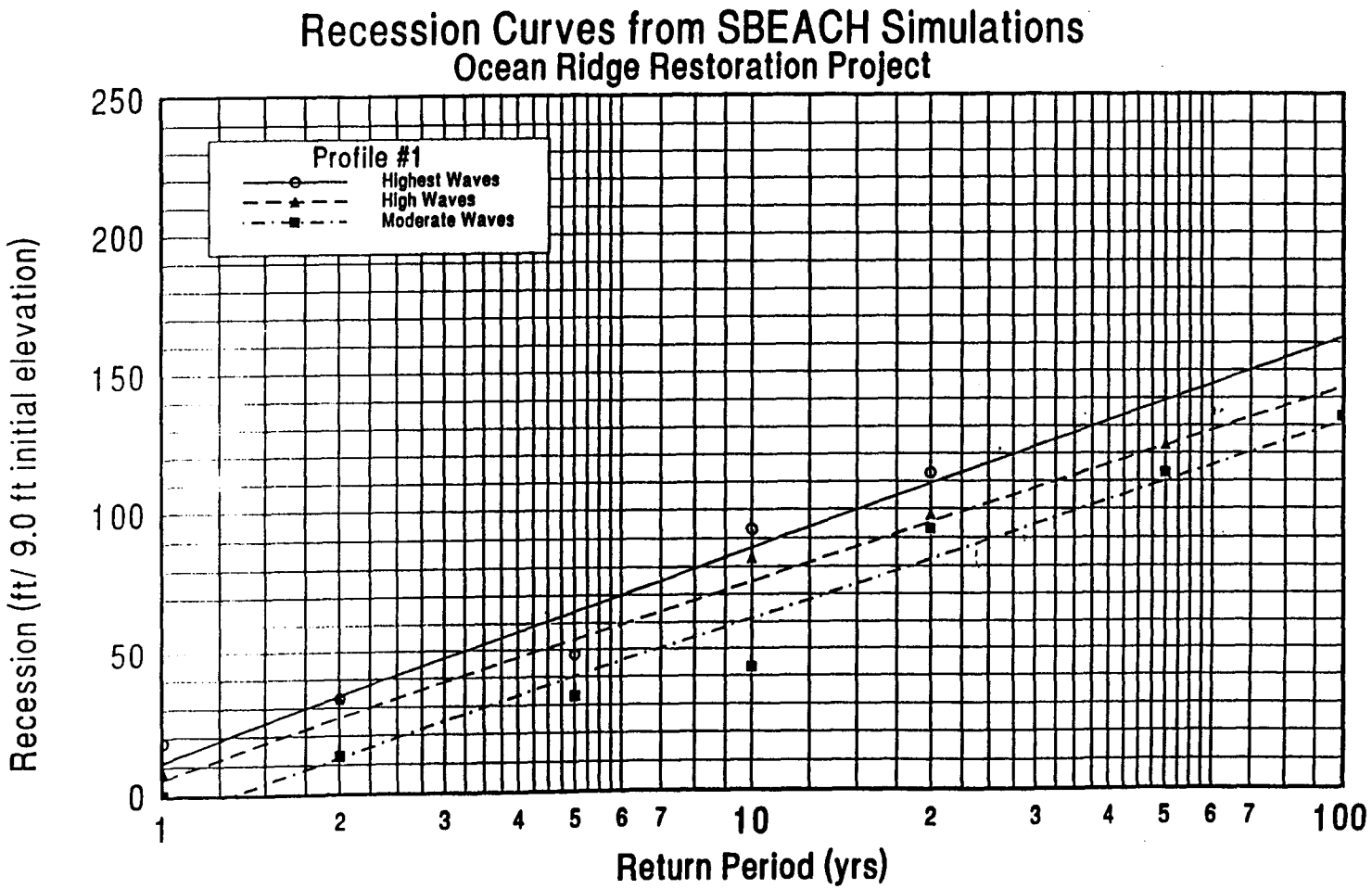

Recession Curves from SBEACH Simulations
Ocean Ridge Restoration Project
Profile #1
Highest Waves
High Waves
Moderate Waves
Recession (ft/ 9.0 ft initial elevation)
250
200
150
100
50
0
1
2
3
4
5
6
7
10
2
3
4
5
6
7
100
Return Period (yrs)

Figure 1-10b

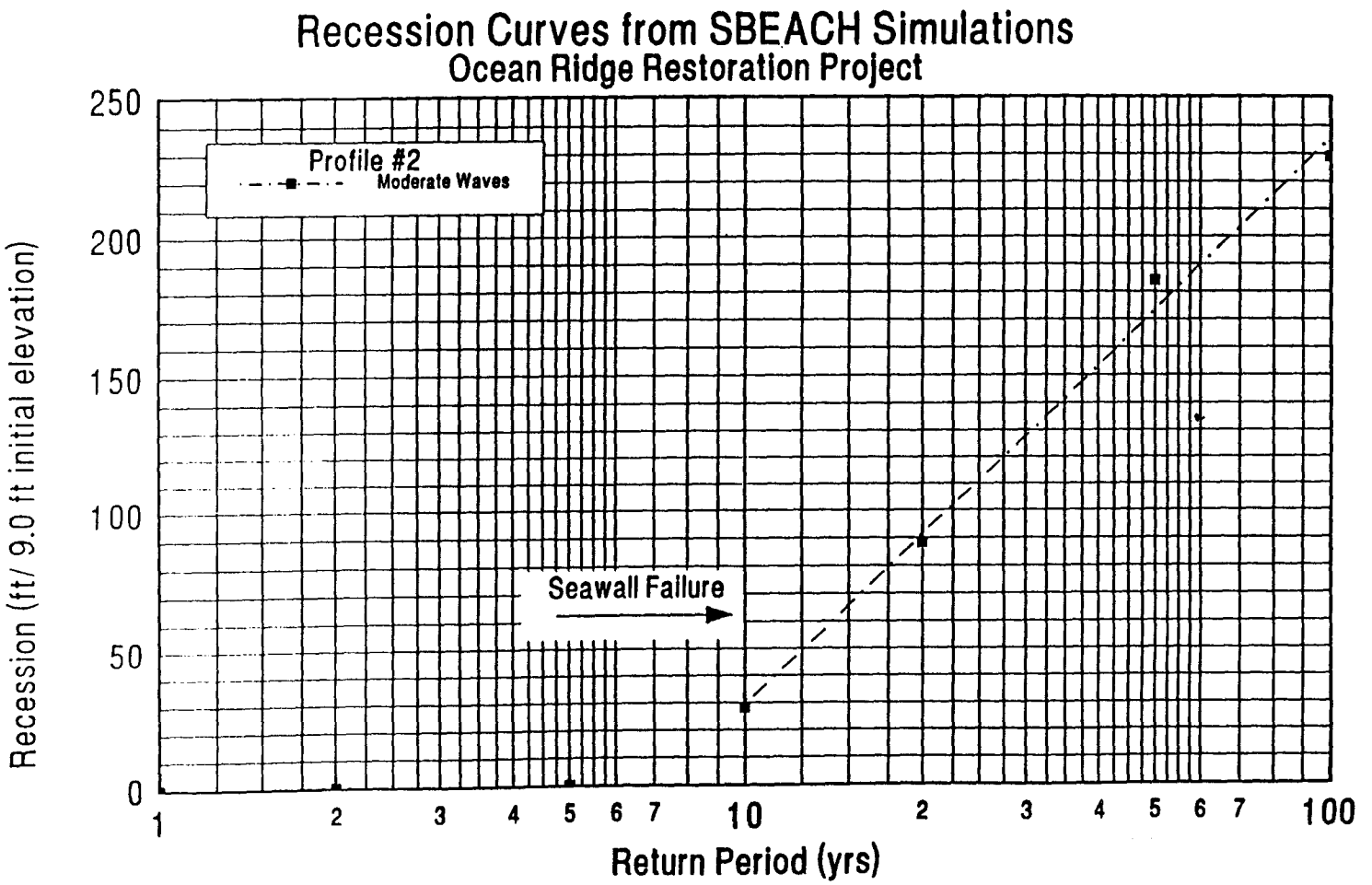

Recession Curves from SBEACH Simulations
Ocean Ridge Restoration Project
Profile #2
Moderate Waves
Seawall Failure
Recession (ft/ 9.0 ft initial elevation)
250
200
150
100
50
0
1
2
3
4
5
6
7
10
2
3
4
5
6
7
100
Return Period (yrs)

Figure 1-10c

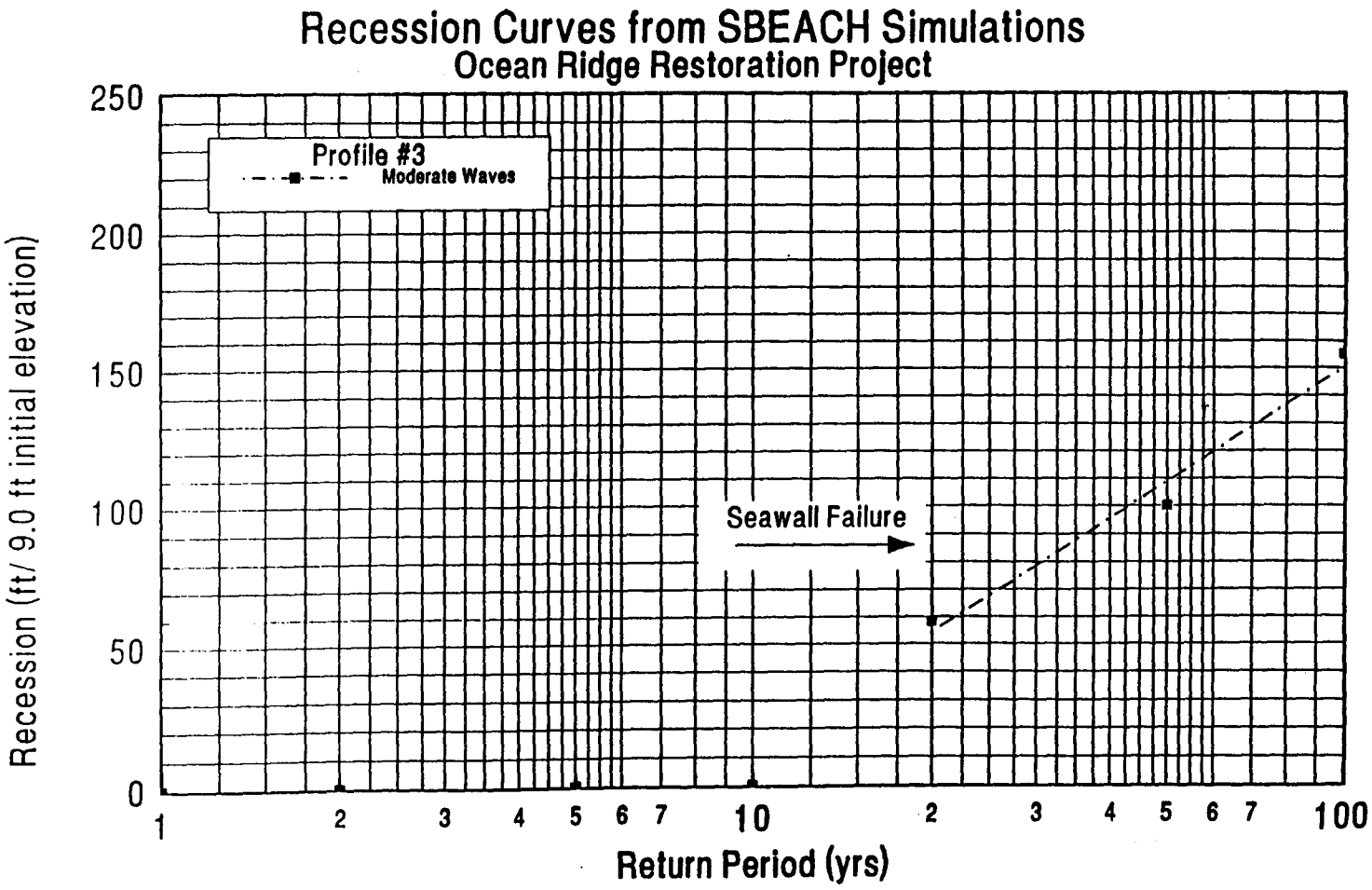
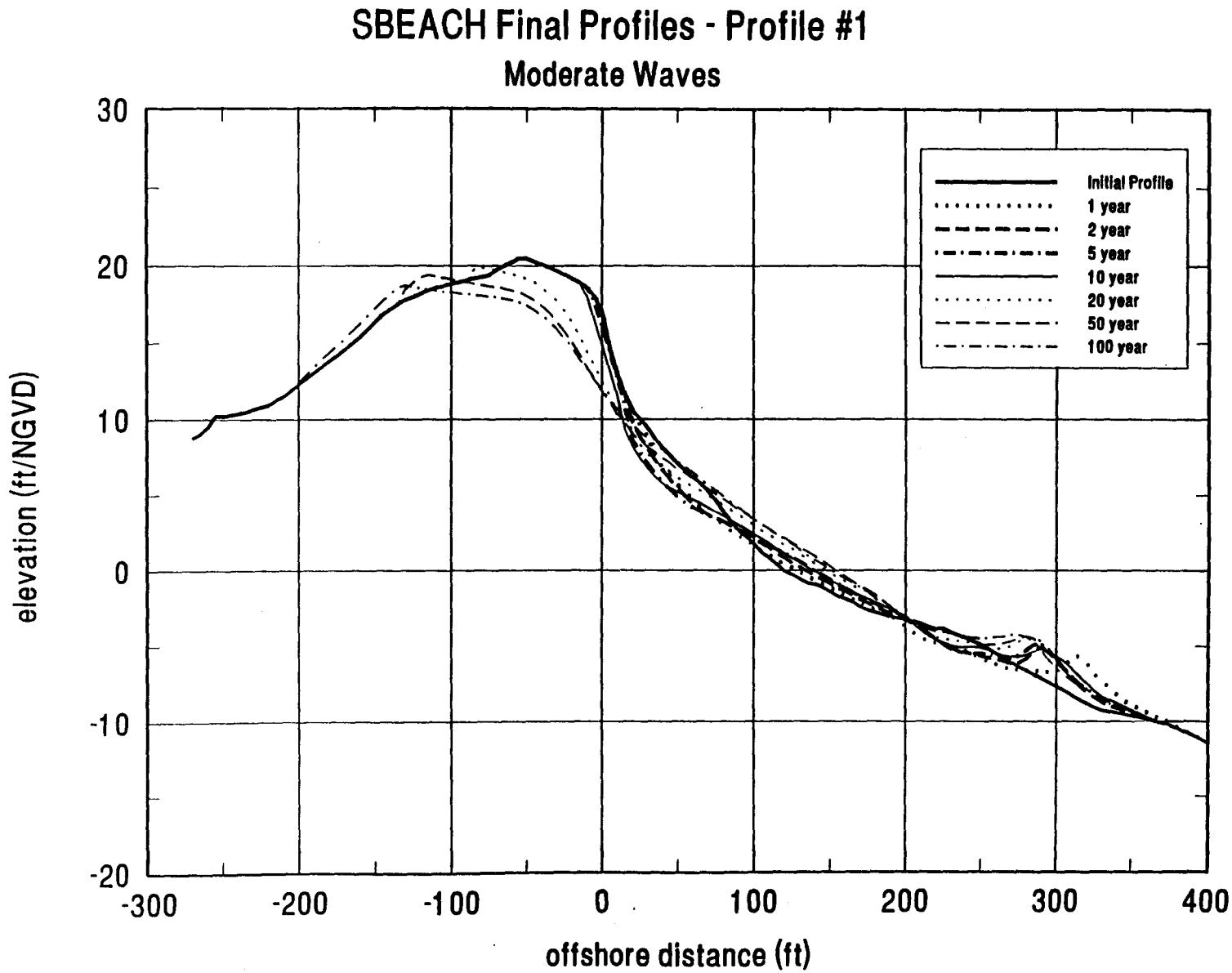

Recession Curves from SBEACH Simulations
Ocean Ridge Restoration Project
Profile #3
Moderate Waves
Seawall Failure
Recession (ft/ 9.0 ft initial elevation)
250
200
150
100
50
0
1
2
3
4
5
6
7
10
2
3
4
5
6
7
100
Return Period (yrs)

Figure 1-11


SBEACH Final Profiles - Profile #1
Moderate Waves
Initial Profile
1 year
2 year
5 year
10 year
20 year
50 year
100 year
elevation (ft/NGVD)
30
20
10
0
-10
-20
-300
-200
-100
0
100
200
300
400
offshore distance (ft)

profile inundation. For these cases, the model does not accurately simulate the behavior of the storm-induced bluffline recession. Because of this, only the recession estimates using the moderate wave conditions were considered acceptable. Figure 1-12 presents the results for each storm return frequency computed with the moderate conditions. Recession estimates using the moderate wave conditions range from 0 feet for the 1 year storm to 225 feet for the 100 year storm.

1-96. Profile 3 is typical of the section of shoreline represented by monuments R-152 and R-153. This section of shoreline is armored with a concrete seawall and has a low dune crest elevation. Because of the same problems experienced with profile 2, only the results computed with the moderate wave conditions are presented. Figure 1-13 presents the results for each storm return frequency computed with the moderate conditions. Recession estimates using the moderate wave conditions range from 0 feet for the 1 year storm to 160 feet for the 100 year storm.

1-97. Modeling Summary. Because no pre-and post-storm beach profile data are available from the study area or Palm Beach County, the SBEACH model was calibrated using a sensitivity analysis of calibration coefficients developed for surrounding counties. Using calibration coefficients estimated for Palm Beach County and a matrix of storm surge and wave condition combinations, SBEACH was used to develop estimates of bluffline recession for three profiles. These three profiles are representative of the southern (non-armored), central (revetted), and northern (seawalled) reaches of the project shoreline. For each return period surge event, three levels of wave condition severity were considered: extremely high, high, and modest. This resulted in a range of storm recession estimates for each return period. The lower limit of the range of estimates was used for the project economic justification.

SHORELINE CHANGE MODEL (GENESIS)

1-98. The shoreline change model GENESIS was used to simulate long-term shoreline change associated with the Ocean Ridge shore protection project. The objective of the study was to quantify longshore sand transport rates and shoreline change and response to various project alternatives. The study employs two numerical modeling tasks comprised of (1) transformation of waves from offshore conditions to the project shoreline and (2) shoreline change simulations of existing shoreline conditions and project alternatives.

Figure 1-12

SBEACH Final Profiles - Profile #2

Moderate Waves

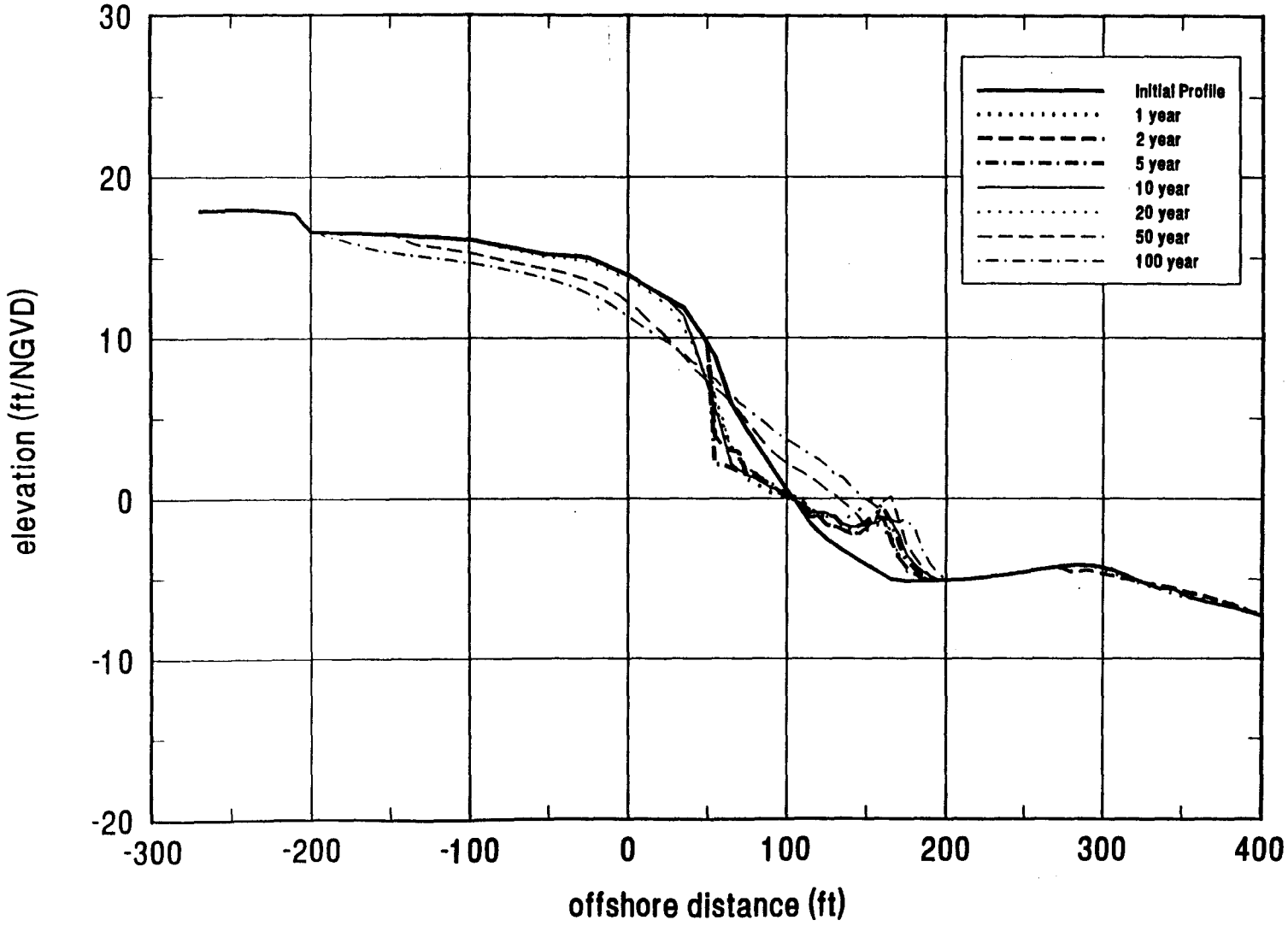
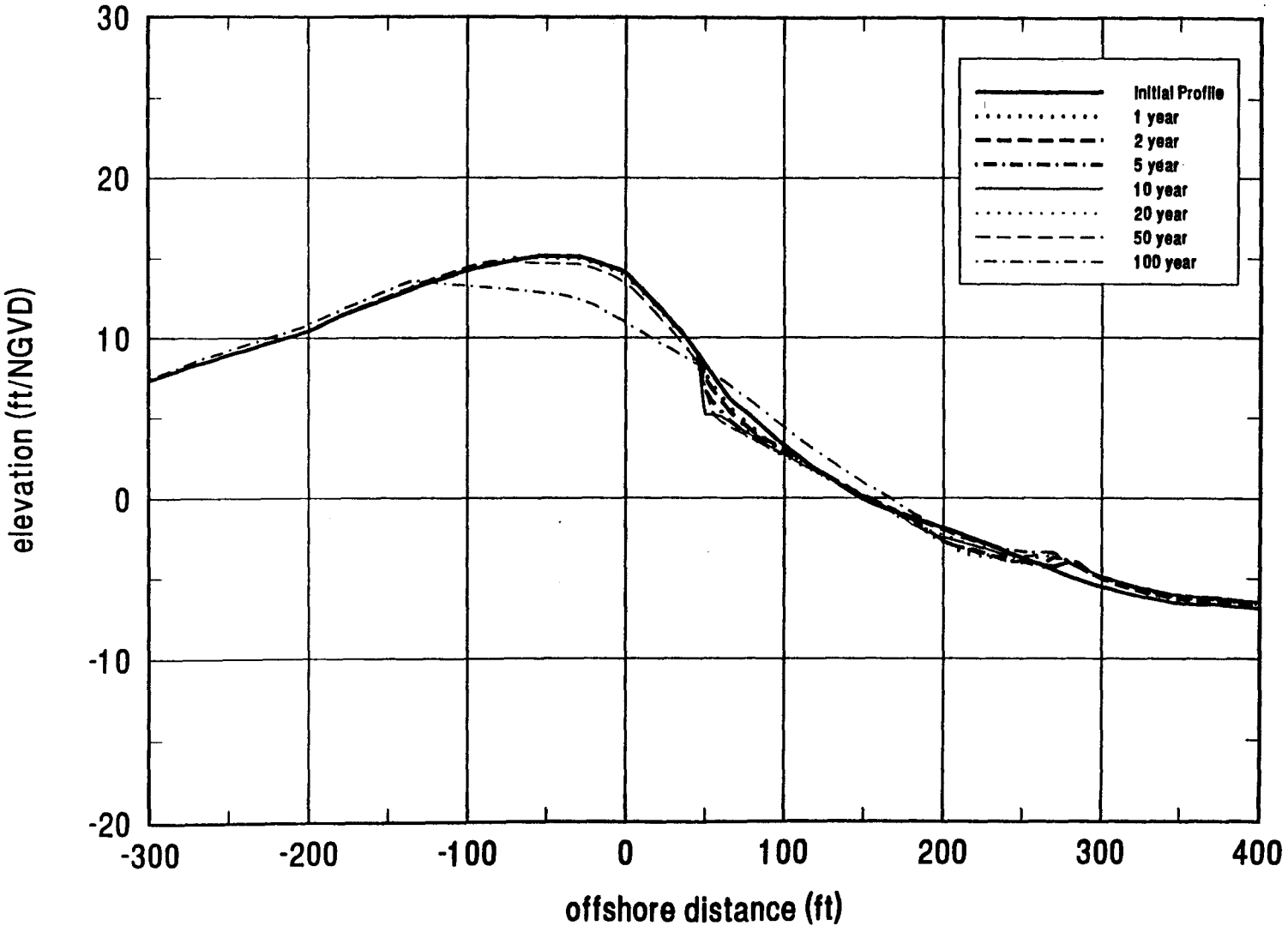


Figure 1-13

SBEACH Final Profiles - Profile #3

Moderate Waves



WAVE TRANSFORMATION

1-99. In order to compute longshore sand transport and shoreline change, GENESIS requires wave input in the form of an offshore time series and representative nearshore wave conditions defined at a nearshore reference line. The offshore time series was developed from hindcast wave data and the nearshore wave conditions were developed through grid-based transformation of representative offshore waves, as described below.

1-100. Wave Data. Offshore wave data used in this study consists of a hindcast wave data set obtained from the Wave Information Study (WIS). The hindcast data set represents offshore wave conditions at 3-hr intervals over the 20-year period from 1956 to 1975. Hindcast wave data from WIS Phase II station RAL2-011 were used to represent the offshore wave conditions in the vicinity of the project area.

1-101. The transformation of offshore wave conditions to the project shoreline were conducted in two steps. First, the 20-year time series was transformed from the Phase II location at 295 ft depth to a Phase III location at 49 ft depth, assuming straight and parallel bottom contours. This transformation was conducted with the linear spectral wave transformation routine WAVETRAN, which is part of the Coastal Engineering Research Center's (CERC) Shoreline Modeling System (SMS). The result of this transformation is a 20-year time series of significant wave height, peak period, and peak direction for primary and secondary wave components. Wave angles at the Phase III location are with respect to the study area shoreline orientation, which is 11.31 degrees east of grid north.

1-102. Before further transformation, a filter was applied to the Phase III time series to identify those waves which are travelling away from the project shoreline and those which do not produce significant longshore sand transport. The wave events identified by the filter were removed from the time series, in order to decrease computational time.

1-103. The second part of the wave transformation task requires that the waves be transformed from the Phase III (49 ft) location to the breaking location. Because the nearshore bathymetry in the vicinity of South Lake Worth Inlet is irregular, a straight and parallel bottom contour assumption is inappropriate. Therefore, a grid-based, finite-difference refraction/diffraction wave model was employed to perform this transformation. The linear refraction/diffraction wave model of Bodge (1990), which

employs finite difference algorithms similar to those of RCPWAVE (Ebersole, 1985), was used in this study.

1-104. The Phase III 20-year time series contains approximately 38,000 unique wave events. It is impractical to transform each individual wave event from the Phase III location to the project shoreline with the refraction/diffraction model. To reduce the number of requisite refraction/diffraction simulations, the wave data were bin-sorted into nine wave period bins and nine wave angle bins (Table 1-21). Each angle bin represents a 22.5 degree sector. The average significant wave height, wave period and shore normal wave angle were computed for each bin and assumed to be the representative wave condition of each respective bin. The representative wave conditions of each bin are presented in Table 1-22. Because some bins do not contain wave events, twenty-five unique wave conditions represent the Phase III time series. Each of these twenty-five wave conditions was used as input to the refraction/diffraction model.

Table 1-21

DEFINITION OF ANGLE BANDS

ANGLE BAND NUMBER	WAVE ANGLE WITH RESPECT TO NORTH	WAVE ANGLE WITH RESPECT TO SHORE-NORMAL
1	11.31 : 33.75	90.00 : 67.56
2	33.75 : 56.25	67.56 : 45.06
3	56.25 : 78.75	45.06 : 22.56
4	78.75 : 101.25	22.56 : 0.06
5	101.25 : 123.75	0.06 : -22.44
6	123.75 : 146.25	-22.44 : -44.94
7	146.25 : 168.75	-44.94 : -67.44
8	168.75 : 191.25	-67.44 : -89.94
9	191.25 : 191.31	-89.94 : -90.00

DEFINITION OF PERIOD BANDS

PERIOD BAND NO.	WAVE PERIODS, T (sec)
1	0.0< T < 5.0
2	5.0< T < 7.0
3	7.0< T < 9.0
4	9.0< T <11.0
5	11.0< T <13.0
6	13.0< T <15.0
7	15.0< T <17.0
8	17.0< T <23.0
9	23.0< T

Note: Shoreline orientation is assumed to be 11.31 degrees.

Table 1-22: Representative Offshore Wave Conditions Used as Input to the Refraction/Diffraction Model.

wave condition number	angle band	period band	number of events	average wave height (ft)	average wave period (sec)	average wave direction (deg)	max wave height (ft)	max wave period (sec)	max wave direction (deg)
1	2	1	1313	1.9	3.9	55.0	3.6	4.0	49.1
2	2	2	4357	2.3	5.6	57.2	6.2	6.0	45.2
3	2	3	4316	2.1	7.4	50.0	7.2	7.0	46.2
4	2	4	292	2.3	9.0	45.7	6.2	9.0	45.2
5	3	1	2115	1.8	3.9	32.9	3.6	4.0	42.2
6	3	2	2707	3.6	5.5	33.1	7.2	6.0	35.2
7	3	3	3647	3.1	7.6	38.1	9.2	7.0	24.4
8	3	4	3734	2.2	9.4	38.5	9.8	10.0	23.8
9	3	5	1838	1.8	11.3	31.3	11.2	12.0	25.4
10	3	6	562	1.8	13.4	24.7	4.6	14.0	25.1
11	4	1	1773	2.0	3.9	16.4	3.9	4.0	22.3
12	4	2	2146	3.5	5.4	13.6	7.2	6.0	10.3
13	4	3	335	6.3	7.1	15.4	9.2	7.0	3.7
14	4	5	60	1.3	12.0	21.8	3.0	12.0	22.0
15	4	6	136	1.3	13.4	20.1	2.6	13.0	19.7
16	4	7	125	1.7	15.4	19.2	4.9	16.0	21.2
17	5	1	1436	1.9	4.0	-14.7	3.9	4.0	-17.7
18	5	2	1826	3.3	5.3	-11.5	6.9	6.0	-18.7
19	5	3	123	6.4	7.2	-10.4	10.2	8.0	-18.6
20	6	1	1582	1.7	3.9	-32.0	3.3	4.0	-24.6
21	6	2	1035	3.1	5.2	-33.1	7.2	6.0	-36.9
22	6	3	136	4.8	7.6	-37.4	9.5	8.9	-24.5
23	7	1	1064	1.7	3.9	-54.0	3.3	4.0	-58.9
24	7	2	1055	2.6	5.4	-56.3	5.6	6.0	-57.0
25	7	3	268	3.4	7.3	-51.2	6.9	7.0	-49.6
		total	37981						

1-105. Model Grid. Grid-based refraction/diffraction modeling of the incident wave climate requires a two dimensional digitized grid of the bottom bathymetry. For this study, two computational grids -- an offshore and an onshore grid -- were required because of computational limitations. The layout of the grids is presented in Figure 1-14. Each grid is orientated 11.31 degrees east of grid north which is the approximate average orientation of the study shoreline. The grid encompasses an area 1,800 feet in the onshore/ offshore direction and 15,480 feet in the alongshore direction. The northern grid boundaries are located approximately 2,400 feet north of the South Lake Worth Inlet south jetty. The grid cell dimensions are 60 feet in the onshore/offshore direction and 120 feet in the alongshore direction. Each grid consists of 30 onshore/offshore grid cells (rows) and 129 alongshore grid cells (columns). The grids are positioned to encompass the ebb tidal shoal of South Lake Worth Inlet. This size and orientation of the grids ensured that the effects of the inlet's ebb tidal shoal upon the incident wave climate are included in the shoreline change modeling.

1-106. Bathymetric Data. The input bathymetric data were digitized from 1990 and 1992 nearshore bathymetric surveys. Figure 1-14 presents the input bathymetric data for the refraction/diffraction model.

1-107. Nearshore Wave Conditions. GENESIS includes an internal wave transformation model which refracts and shoals the waves from the nearshore reference line to breaking. This internal wave model is based upon the assumption of straight and parallel bottom contours. In areas where the bottom contours are not straight and parallel between the nearshore reference line and the shoreline, such as in the vicinity of an inlet ebb tidal shoal, the assumption of straight and parallel contours may produce unrealistic results. Typically, the nearshore reference line is located at a water depth where the largest wave in the offshore time series will not break. In this study, that water depth is about 16 feet. In the vicinity of the South Lake Worth Inlet ebb tidal shoal and natural bypassing bar, the bottom irregularities are most pronounced above the -16 ft, NGVD contour (see Figure 1-14). If the nearshore wave conditions were represented by the wave conditions at the -16 ft contour, the effects of the ebb tidal shoal and bypassing bar would not be represented in the breaking wave climate and in turn the longshore sand transport rate.

1-108. Instead of simply representing the nearshore wave conditions with the wave conditions computed along the nearshore reference line, the incipient breaking wave height, H_b, and wave angle, a_b, are computed at each

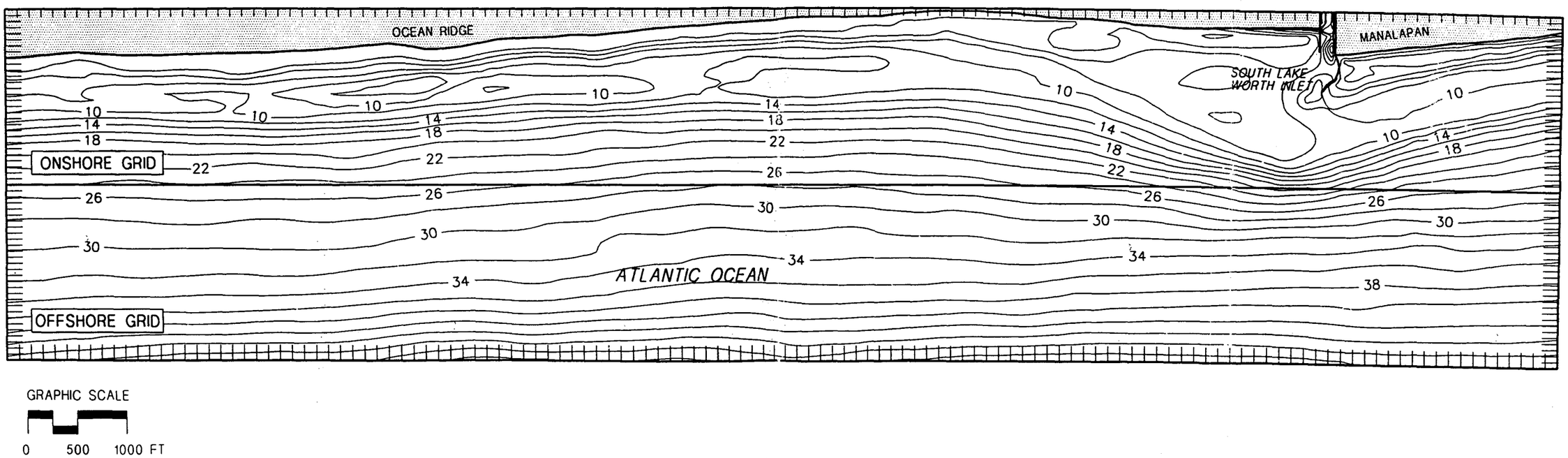


Figure 1-14

Representative Depth Contours of Onshore and Offshore Grids used in the Refraction/Diffraction Analysis (ft, NGVD).

alongshore column of the refraction grid for all twenty-five wave conditions. These breaking conditions were then "unrefracted", assuming straight and parallel contours, to a reference depth, d_R. In this report the reference depth is assumed to be the -20 ft NGVD contour. The -20 ft contour is used to ensure that all wave conditions are unbroken when input into GENESIS.

1-109. The wave height H_R and angle α_R at the nearshore reference depth d_R are computed through traditional applications of Green's Law and Snell's Law; i.e.,

$$\alpha_R = \sin^{-1} \left[\frac{C_R \sin \alpha_b}{\sqrt{g\, H_b/\kappa}}\right] \quad (6)$$

$$H_R = H_b^{5/4} \left[\frac{\sqrt{g/\kappa} \cos \alpha_b}{C_{g_R} \cos \alpha_R}\right]^{1/2} \quad (7)$$

where C_R and C_{gR} are the wave's celerity and group celerity, respectively, at the reference water depth d_R. The "backwards refracted" wave data are used to create the nearshore waves file NSWAV.ext required by GENESIS.

1-110. A more detailed discussion of this technique is presented in Bodge, *et al.* (1994, in review). Essentially, this method takes advantage of the reciprocal nature of the linear refraction theory in order to provide "artificial" nearshore wave input condition to GENESIS that will produce breaking conditions which more accurately portray those developed by the area's irregular bathymetry.

1-111. <u>Representative Offshore Time Series.</u> In this study, the verification simulation is performed for the years 1975 to 1993. The WIS hindcast time series ends in 1975. Therefore, a time series of wave conditions does not exist for the verification and shoreline extrapolation simulations. For this reason, a time series was created from the 20 year WIS hindcast data set which produces average net and gross sand transport rates approximately equivalent to the 20-year averages. To accomplish this, annual net and gross transport rates were computed for each year of the 20-year time series. The average net and gross transport rates computed for 1958, 1961, 1965, and 1972 best represent the average annual conditions for the 20-year time series. Accordingly, a composite time series of wave data was developed from these four years and used for model verification and shoreline extrapolation simulations.

GENESIS

1-112. Model Grid. The GENESIS model requires a one-dimensional grid. If an external wave model is used, the orientation of the GENESIS grid must be identical to the orientation of the wave modeling grid. Consistent with the refraction/ diffraction computational grid used in this study, the GENESIS grid is orientated 11.31 degrees east of grid north (see Figure 1-15). The GENESIS modeling reach includes 12,000 feet of shoreline immediately south of South Lake Worth Inlet. Two hundred, 60-ft wide GENESIS grid cells were used to model this reach. The model's northern boundary corresponds to the south jetty of South Lake Worth Inlet. The model's southern boundary is located on unrestrained (open) shoreline and is treated as a gated boundary. The historical erosion rate at this point has been less than 1 ft per year since 1975. The grid origin is 812,375.91 feet east and 804,947.29 feet north in 1983 NAD Florida State Plane coordinates.

1-113. Historical Shoreline Data. Two of the three historical shoreline surveys used in this study were obtained from the Florida Department of Environmental Protection (FDEP). The third survey is the 1993 Erosion Control Line (ECL) survey. Shoreline data obtained from the FDEP include the 1 May 1973 and 1 January 1975 surveys. The ECL survey was conducted on 30 November, 1993. The shoreline data for each survey were rotated and translated from Florida State Plane coordinates to the GENESIS coordinate system. Each shoreline was then interpolated to the 60 foot spacing of the model.

1-114. Bypassing. Littoral material is bypassed around South Lake Worth Inlet both mechanically and naturally. Material is mechanically bypassed from north to south by the inlet's mechanical sand transfer plant. Material is naturally bypassed around the inlet by way of the ebb tidal shoal and bypassing bar. The version of GENESIS used in this study allows for the representation of sand bypassing. In the model, sand bypassing can be specified as multiple operations at arbitrary locations, durations, and discharge rates. Although the bypassing feature of GENESIS was originally intended to emulate mechanical bypassing operations, in this study it was used to emulate both mechanical and natural bypassing.

1-115. Bypassing is specified in the model as a time series of bypassing rates. Mechanical bypassing rates used in the model were developed from historical mechanical bypassing rate data for South Lake Worth Inlet. Historical mechanical sand bypassing rate records for the South Lake Worth Inlet sand transfer plant, as currently configured, are available from 1967 to the present. These records,

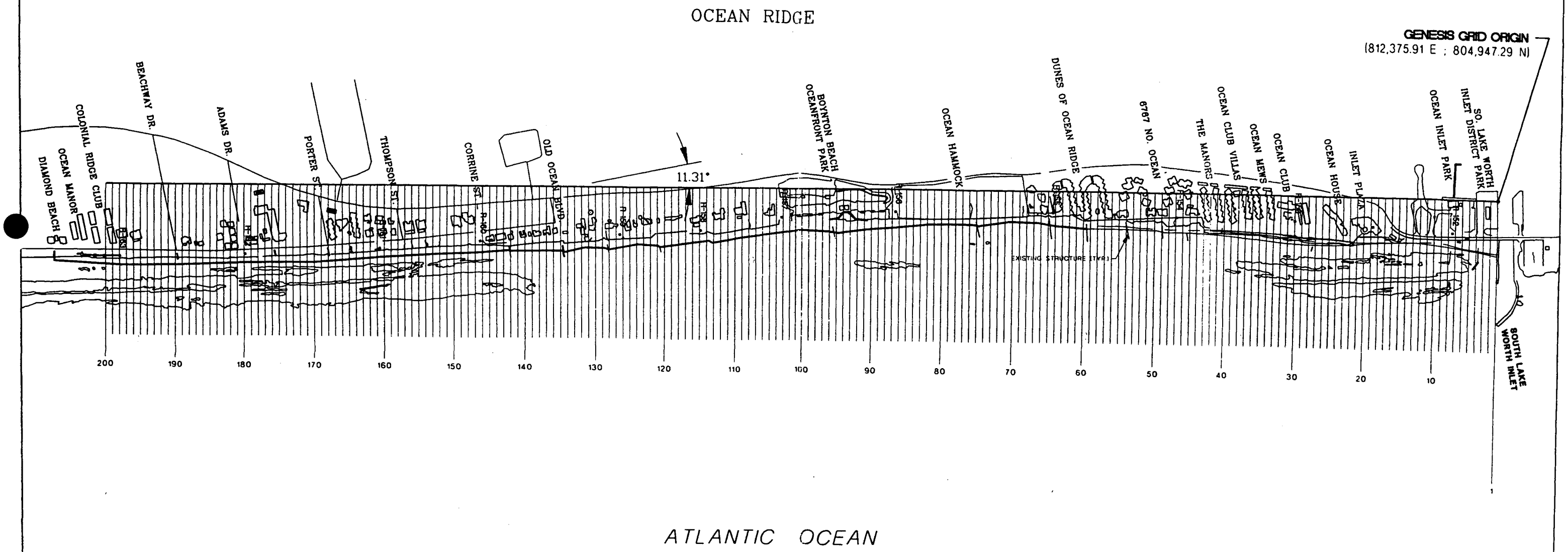


Figure 1-15

Shoreline Model Reach and GENESIS Grid.

along with longshore transport rates computed from the WIS hindcast data, were used to determine a correlation between the longshore sand transport rate and the recorded bypassing rates. To determine this correlation, the following assumptions were employed:

1_ The average annual net transport at South Lake Worth Inlet is 200,000 cy/yr.

2_ Mechanical bypassing occurs only during periods of southerly transport.

1-116. Computed southerly transport rates and recorded bypassing quantities for the six-year period January 1970 to December 1975 were used for the correlation. The southerly transport rates were computed with the CERC longshore sand transport formula (USACE, 1984) and the WIS hindcast wave data. Breaking wave conditions required by the CERC formula were computed using linear theory and assuming straight and parallel bottom contours. The correlation between the mechanical bypassing rates (developed from the plant's monthly records) and the corresponding transport potential (developed from the wave data) is presented in Figure 1-16.

1-117. The correlation between these data was applied to a 20-year time series of southerly transport (developed from the hindcast wave data) to create an artificial 20-year time series of mechanical bypassing. The correlation expression used to create this time series is

$$Y = 29.0\ X^{0.54}$$

where X is the computed southerly transport rate and Y is the reported mechanical bypassing rate, each in units of cubic yards per month. The coefficient in the relationship was determined such that the average annual bypassing rate of the 20-yr time series is equivalent to 65,690 cy/yr -- which is the recorded historical average annual rate.

1-118. Figure 1-17 presents the recorded and computed monthly bypassing rates between 1967 and 1975, where the latter were developed from correlation relationship. This figure demonstrates good agreement between the magnitude and occurrence of the computed and recorded mechanical bypassing.

1-119. To model shoreline change along the study reach accurately, a time series of natural bypassing rates was also developed. Although direct data for natural bypassing do not exist, estimates can be developed based upon results

Figure 1-16

CORRELATION OF RECORDED BYPASSING AND
COMPUTED SOUTHERLY LONGSHORE SAND TRANSPORT (1970-1975)

SOUTH LAKE WORTH INLET, PALM BEACH COUNTY, FLORIDA

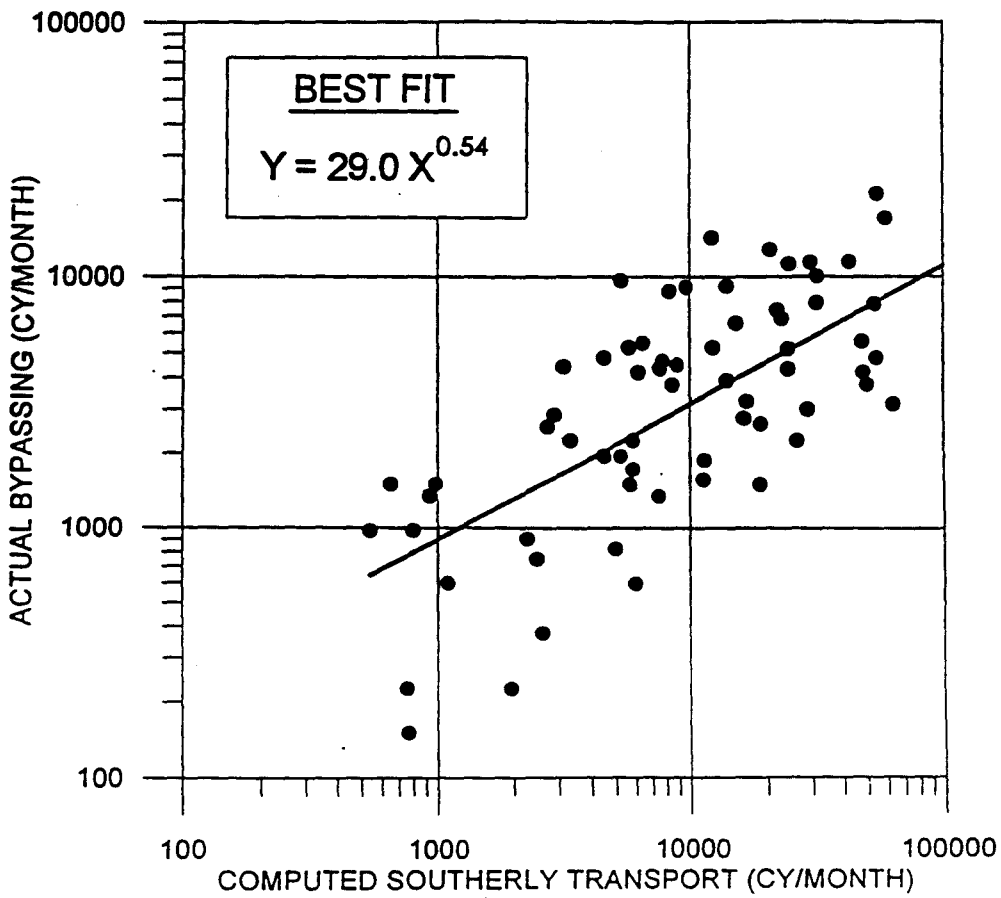
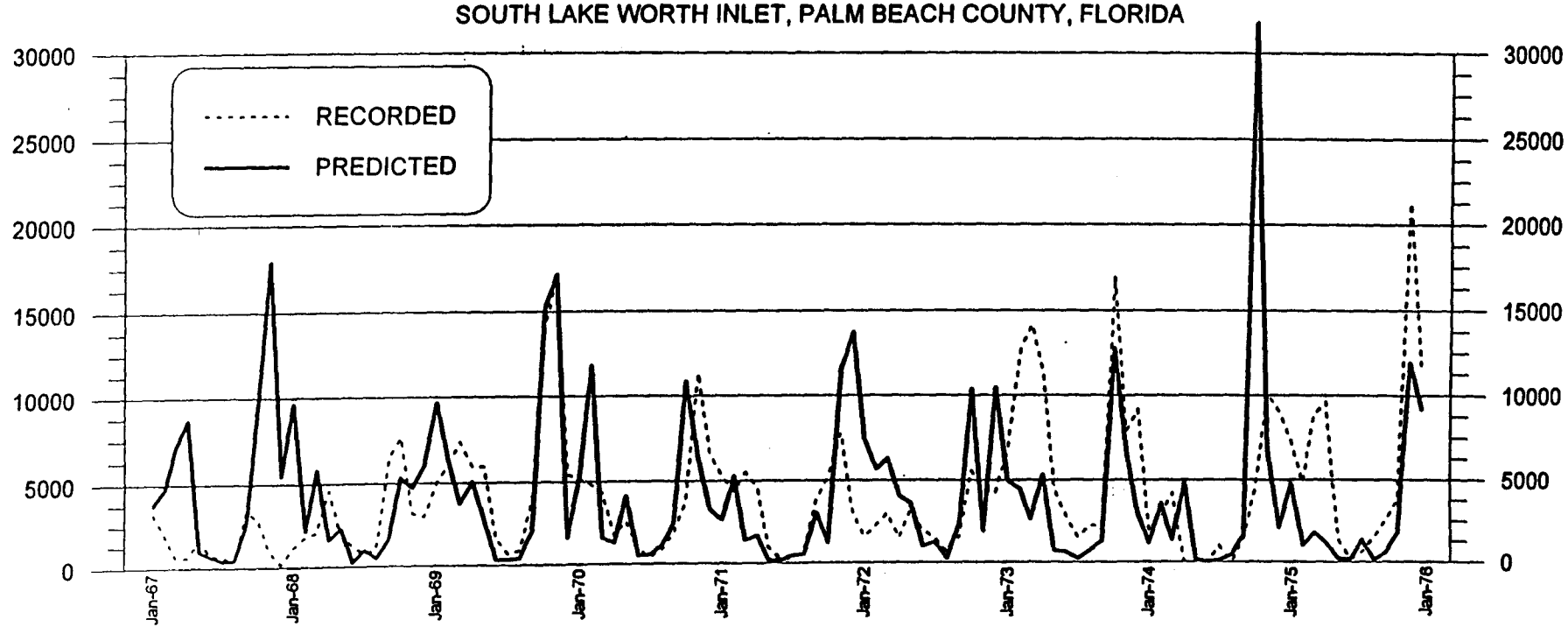


Figure 1-17

RECORDED vs. PREDICTED BYPASSING

SOUTH LAKE WORTH INLET, PALM BEACH COUNTY, FLORIDA



PREDICTED BYPASSING IS A FUNCTION OF COMPUTED NET TRANSPORT POTENTIAL.

of the inlet's sediment budget. Several assumptions were employed to develop a time series of natural bypassing rates

1_ The average annual net longshore sand transport rate at South Lake Worth Inlet is 200,000 cy/yr.
2_ The net natural bypassing rate around the inlet is approximately 45% of the average annual net sand transport.
3_ Net natural bypassing occurs only during periods of southerly directed sand transport.

Applying these assumptions, a time series of natural bypassing was computed to correspond to the wave time series. Specifically, the southerly transport rate potential was developed from the hindcast wave data, multiplied by 0.45, and then adjusted such that the average annual value was equivalent to 90,000 cy/yr (i.e., 0.45 times 200,000 cy/yr).

1-120. For the calibration simulations, recorded mechanical bypassing rates were used. The natural bypassing rates used for calibration simulations were taken from the computed 20-year time series of the natural bypassing rate. For verification and extrapolation simulations, both mechanical and natural bypassing times series were created for the years 1958, 1961, 1965, and 1972. These data correspond to the 4-years of wave data which best represent average annual net and gross transport rates, and which were used as the input wave data for the model.

1-121. Physical Properties of the Study Shoreline. GENESIS requires specification of an effective sand grain size, taken to be the median grain size (d_{50}). The geotechnical investigation (conducted as part of this project) reveals that the median grain size of the study area native beach is 0.36 mm. GENESIS does not allow the sediment grain size to be adjusted after a beach fill project. Therefore, it is assumed that the post-project grain size will be the same size as the native beach after project construction.

1-122. The active berm elevation along the study area shoreline is approximately +6 feet NGVD. The depth of closure, as determined from historical profile and bathymetric data is approximately -15 feet NGVD. These values were input to GENESIS to describe the active beach profile.

1-123. Manmade and Natural Coastal Armor. Manmade coastal structures within the study area include the South Lake Worth Inlet jetties, numerous seawalls and revetments, and 15 groins. The inlet jetties act as a partial littoral barrier to material transported from the north. Material is bypassed around the inlet mechanically by the sand bypassing

plant and naturally by way of the inlet's ebb tidal shoal and bypassing bar. Both mechanical and natural bypassing around South Lake Worth Inlet are simulated in the model.

1-124. The area's seawalls and revetments limit the extent of erosion upon the upland properties. These structures are included in the model as permanent features of the study reach. During model simulations, the shoreline is precluded from eroding landward of these structures.

1-125. The area's existing groins have been constructed in an effort to trap sand transported along the shoreline. All existing groins have been included in the model setup for calibration and verification simulations. The ability of a groin to impound sand within the model is a function of its active length and porosity. Length and porosity values used as input to the model were estimated from site inspections, surveys and photography.

1-126. Naturally occurring structures within the study area include nearshore rock hardbottom. Two areas of extensive hardbottom are located within the study reach. One is located between the south jetty of South Lake Worth Inlet and a point approximately 2,300 feet south thereof. The other lies between 8,500 and 13,500 feet south of the south jetty. These structure affect both the local breaking wave climate and the cross-shore shape of the beach. The irregular nature of the hardbottom features tends to affect the height and angle of the breaking wave climate. The wave model internal to GENESIS cannot model the effects of these irregularities. However, utilization of the backward-refraction technique discussed earlier provides for representation of the effect of these bottom irregularities.

1-127. An assumption within GENESIS is that the cross-shore shape of the beach takes the form of

$$h = A\,x^{2/3}$$

where h is the water depth, x is the offshore distance from the shoreline and A is a empirical constant. As GENESIS computes erosion or accretion, this representative beach profile is assumed to translate landward or seaward, respectively. Because the hardbottom is a permanent, immovable feature of the profile, GENESIS is unable to accurately calculate shoreline change in areas where the hardbottom is located. Additionally, the cross-shore shape of the profile along areas of nearshore hardbottom does not take the shape described above.

1-128 Calibration/Verification. Calibration and verification of the model include adjustment of the transport rate coefficients K_1 and K_2, and bypassing and groin characteristics, to achieve measured shoreline change

and longshore sand transport rates. Numerous calibration/verification runs were executed to determine the appropriate values of these parameters to yield the best agreement between measured and predicted shoreline changes. Calibration of GENESIS for this study was conducted for the period 1 May 1973 to 1 January 1975. The model was verified for the period 1 January 1975 to 30 November 1993.

1-129. The longshore sand transport coefficients K_1 and K_2 are 0.245 and 0.30, respectively. The injection point for the mechanical bypassing is approximately equivalent to the existing field locations. These locations were determined from site inspection and aerial photography. The distribution of the mechanical bypassing discharge is assumed to be triangular with maxima at cell 9 and minima at cell 12. The general location of the injection point for the natural bypassing was identified from historical aerial photography and hydrographic surveys. The final location and distribution of the natural bypassing discharge was identified from comparison of computed and measured shorelines. The distribution of natural bypassing discharge is assumed to be Gaussian, 14 cells wide and centered about cell 58.

1-130. A local transport phenomenon which has been observed along the north section of the project area was also considered during calibration and verification of GENESIS. A clockwise circular gyre current which forms immediately south of South Lake Worth Inlet during ebb tide causes the nearshore currents immediately south of the inlet to be directed from south to north (UF/COE, 1969). Sand entrained by this current is transported from the project area shoreline towards the inlet and into the ebb tidal jet. Once entrained in this jet, the sand is transported offshore to the ebb tidal bypassing bar and eventually the downdrift shoreline. This process suggests that a portion of the mechanically bypassed material placed along the shoreline immediately south of the inlet is transported to the downdrift shoreline via the bypassing bar and not the shoreline. To simulate this phenomenon, a sensitivity test was conducted during the calibration and verification simulations by redistributing the mechanical and natural bypassing volumes input to GENESIS. That is, a fraction of the mechanically bypassed material was removed from the mechanical bypassing discharge and added to the natural bypassing discharge. Reductions in the mechanical bypassing volume of 10, 15, 20 and 30 percent were analyzed. The best agreement between computed and measured shorelines was achieved by reducing the mechanical bypassing approximately 15% and adding that volume to the natural bypassing.

1-131. Over the calibration period, the computed average annual volumetric loss from the study reach was approximately 37,500 cy/yr. Within the project area, the

average annual volumetric loss was approximately 21,000 cy/yr. The average annual net longshore sand transport rate was to the south and varied from under 1,000 cy/yr, just south of the inlet, to approximately 190,000 cy/yr, 6,000 feet south of the inlet. Measured shoreline positions were modeled within an average of about 28 feet along the entire study reach. Computed and measured shorelines from the calibration simulation are presented in Figure 1-18.

1-132. Over the verification period, the computed average annual volumetric loss from the study reach was approximately 19,200 cy/yr. Within the project area, the computed average annual volumetric loss was approximately 15,000 cy/yr. The average annual net longshore sand transport rate was to the south and varied from under 1,000 cy/yr just south of the south jetty to approximately 180,000 cy/yr about 12,000 feet south of the inlet. Measured shoreline positions were modeled within an average of about 16 feet along the entire study reach. Computed and measured shorelines from the verification simulation are presented in Figure 1-19.

1-133. Observations. The verification run provided the best agreement between computed and measured shorelines. This is due, in part, to the detail of the 1993 shoreline data. These data were collected along the study reach shoreline at 50 ft survey intervals. The 1973 and 1974 shoreline data were available at 1,000 ft survey intervals along the study reach. The resolution of the 1973 and 1974 shoreline location data was improved with aerial photography.

1-134. The quality of the verification results was achieved by modestly adjusting the length of the existing groins within the model. Initial values for groin length and porosity were determined from field inspection and photography. Because GENESIS does not model the interaction between groins and the shoreline accurately, these adjustments resulted in better agreement between measured and computed shorelines.

1-135. From 1973 to 1993, most of the study reach experienced erosion. From inspection of Figure 1-19, the most significant erosion, both measured and computed, occurred along two reaches. The first erosional reach is located between cells 1 and 30, which represents the 1,800 feet of shoreline immediately south of the inlet. The second erosional reach is located between cells 45 and 110. A quasi-stable to mildly erosional section of shoreline appears to exist between cells 31 and 44. This apparent stability may be the result of a nodal point in the longshore sand transport due to the refractive effects of the ebb tidal shoal and natural bypassing bar. The GENESIS

Figure 1-18

Ocean Ridge Calibration Simulation
1 May 1973 to 1 January 1975

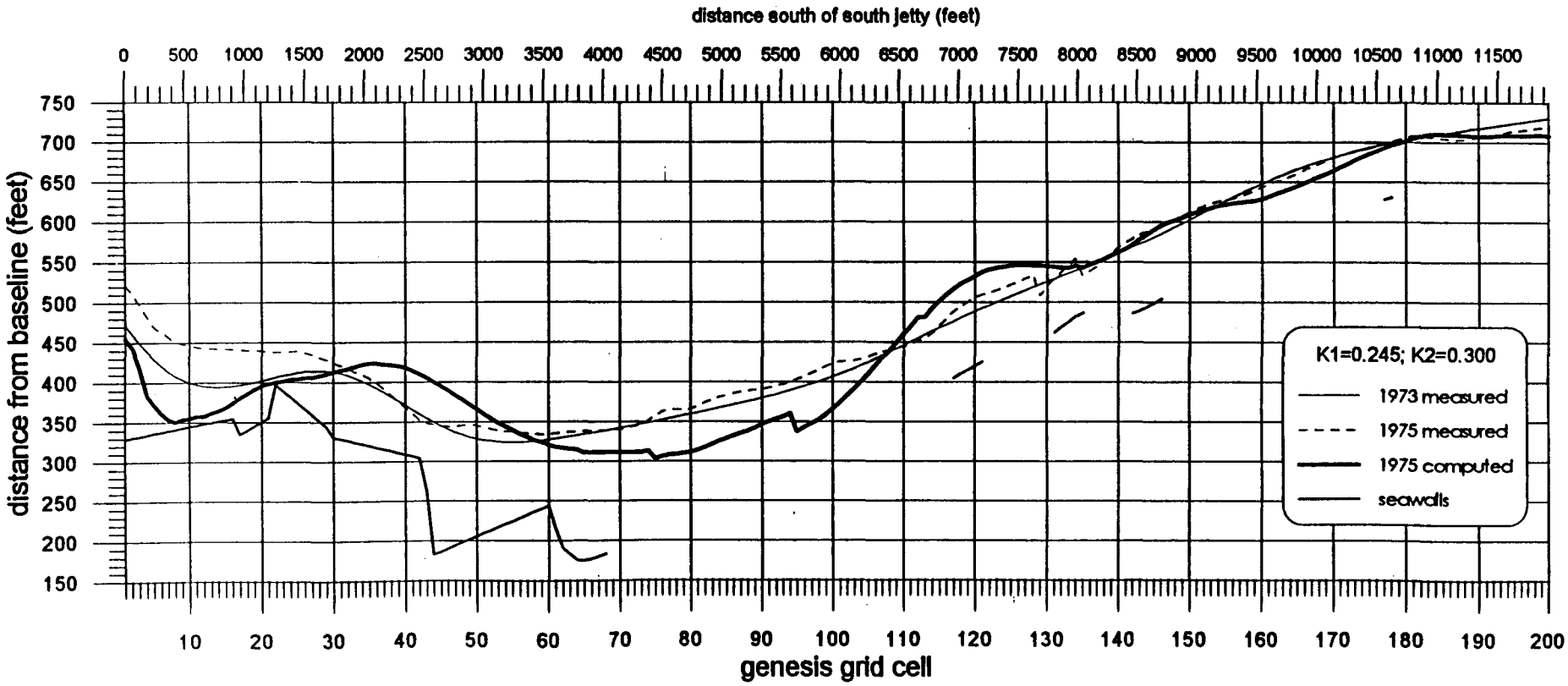
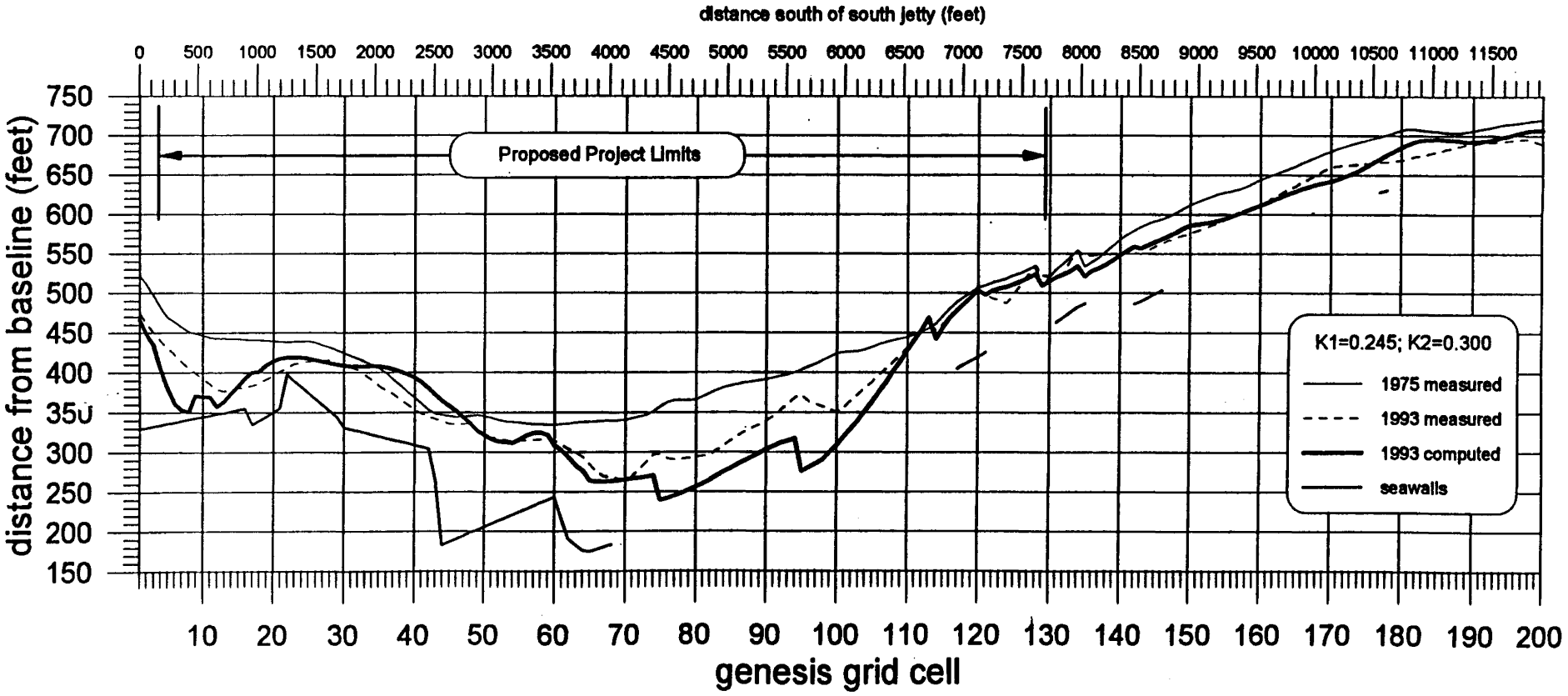


Figure 1-19

Ocean Ridge Verification Simulation
1 January 1975 to 30 November 1993



model successfully predicted these variations in historical shoreline change along the study shoreline.

1-136. Simulations. The calibrated and verified model was used to predict shoreline change for a no-project "do nothing" alternative and various project alternatives. The results from simulations of various project alternatives are presented in the following section.

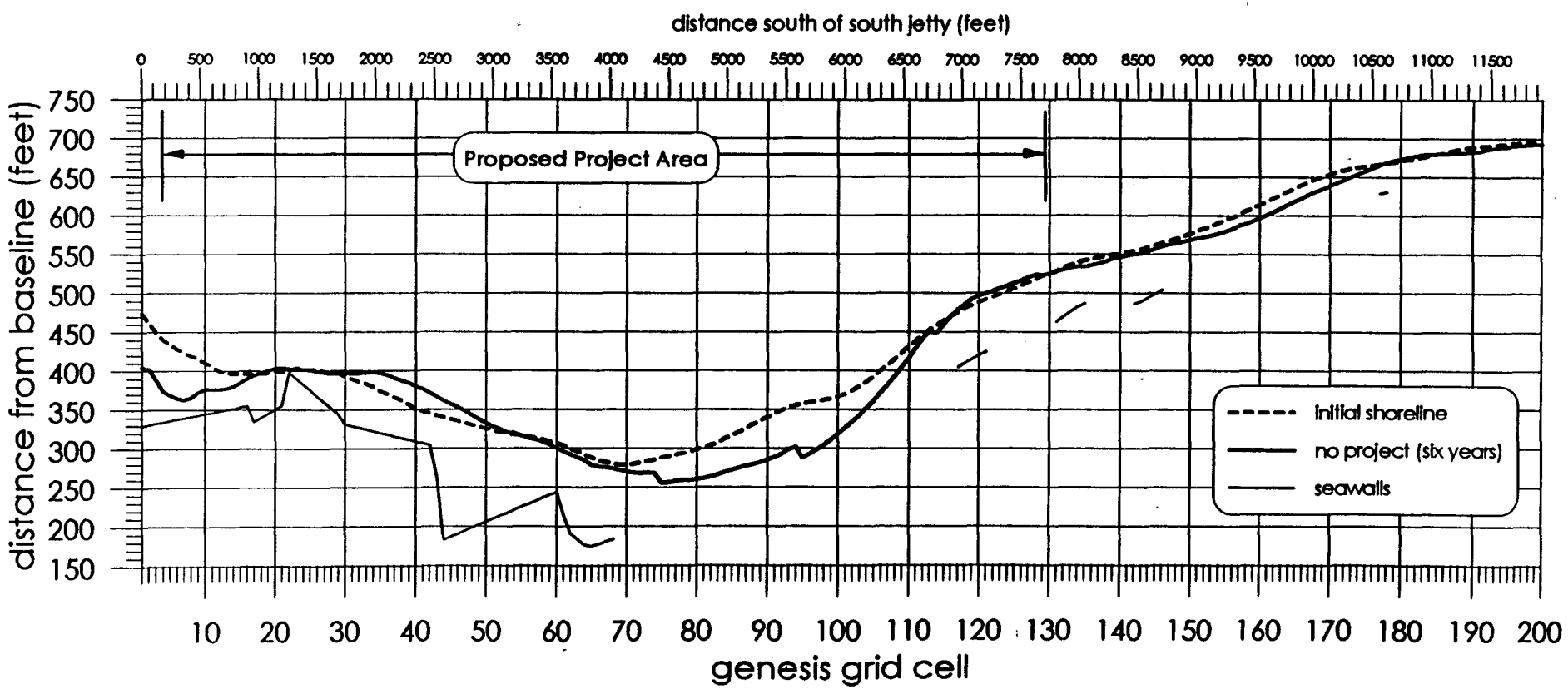
1-137. The no-project alternative was run for six years to determine the expected shoreline change if the project is not constructed. Six years is the proposed renourishment interval for this project. The initial shoreline and computed no-project shoreline are presented in Figure 1-20. As shown in the figure, shoreline recession is expected to continue along the study reach if no project is constructed. The modeled no-project alternative assumed that mechanical sand bypassing activities would continue as usual.

PROBLEM SUMMARY

1-138. Based upon field inspections, examination of aerial photography, historical hydrographic and topographic survey data, a sediment budget analysis of South Lake Worth Inlet, and the calibrated and verified GENESIS model, a 1.46 mile long shoreline erosion problem area has been identified at Ocean Ridge, Florida. This area is bounded by South Lake Worth Inlet to the north and extends 7,700 ft south to approximately R-159. The problem is directly related to downdrift effects of South Lake Worth Inlet. Despite both natural and mechanical sand bypassing, the inlet induces an average net sediment deficit of 38,350 cy/yr along the downdrift shoreline within 7,700 ft of the inlet. Results for the GENESIS modeling also indicate that the erosion along this section of shoreline is expected to continue if a shore protection project in not implemented. This erosion threatens seawalls, development, and State Road A1A. The latter is the region's only hurricane evacuation route. Over $57 million in structural improvements, not including infrastructure and/or land, are threatened by storms. With the current shoreline position and continued long term erosion, damages from hurricanes, tropical storms, and higher frequency storms will continue to increase.

1-139. Two expansive areas of nearshore hardbottom are located along the problem shoreline. The State of Florida and the Project Sponsor have indicated that significant coverage of these areas with beach fill is unacceptable. Project alternatives must be formulated to minimize impacts to these hardbottom areas.

Figure 1-20
Ocean Ridge GENESIS Simulation - Six Years of No Project Conditions



PROJECT DESIGN

1-140. Storm damage protection and minimization of nearshore hardbottom impacts are central to the project design. To determine the project configuration which will meet these criteria, several alternatives were considered. The alternatives included beach fill only and combinations of beach fill and groins.

1-141. The calibrated shoreline change model GENESIS, historical shoreline and volume change data and the sediment budget developed for South Lake Worth Inlet were the primary tools used to evaluate the physical performance of the alternatives. Results from the model were also used to estimate downdrift impacts to nearshore hardbottom areas south of the project. The physical performance of each alternative and the corresponding level of impact to nearshore hardbottom were considered in the selection of a preferred alternative.

1-142. The objective of the alternatives analysis was to develop a plan which would provide sufficient shoreline stability to maintain the minimum design beach over the six year renourishment interval while minimizing nearshore hardbottom impacts.

1-143. Beach fill Only Alternatives. Two beach fill only alternatives were considered. The conceptual layout of these alternatives (Alternatives 1 and 2) are illustrated in Figure 1-21. The first alternative represents the project described in the 1987 GDM. This alternative provides for a 50-ft extension of the mean high water line and 8 years of advance nourishment. The design beach and advance nourishment would result in a 125 ft extension of the pre-project mean high water line. The GENESIS results (Figure 1-22) indicate that this alternative would not maintain the design beach along the northernmost 1,000 feet of the project area. Additionally, this alternative would impact approximately 12.5 acres of nearshore hardbottom along the northern section of the project. An additional 10 acres (M.O.L) of nearshore hardbottom would be impacted south of the project area due to spreading losses.

1-144. The second beach fill only alternative (Alternative 2 in Figure 1-21) provides for a 50 ft extension of the mean high water line and 6 years of advance nourishment. The former would establish the +9 ft NGVD design berm at the erosion control line. The entire project would extend the shoreline approximately 110 feet. The southern limit of Alternative 2 is approximately 1,000 feet north of the southern limit of Alternative 1, the 1987 GDM project. The project was truncated in order to reduce downdrift impacts to the southern area of nearshore

Figure 1-21
Alternatives Considered to Evaluate Physical Performance and Hardbottom Impacts

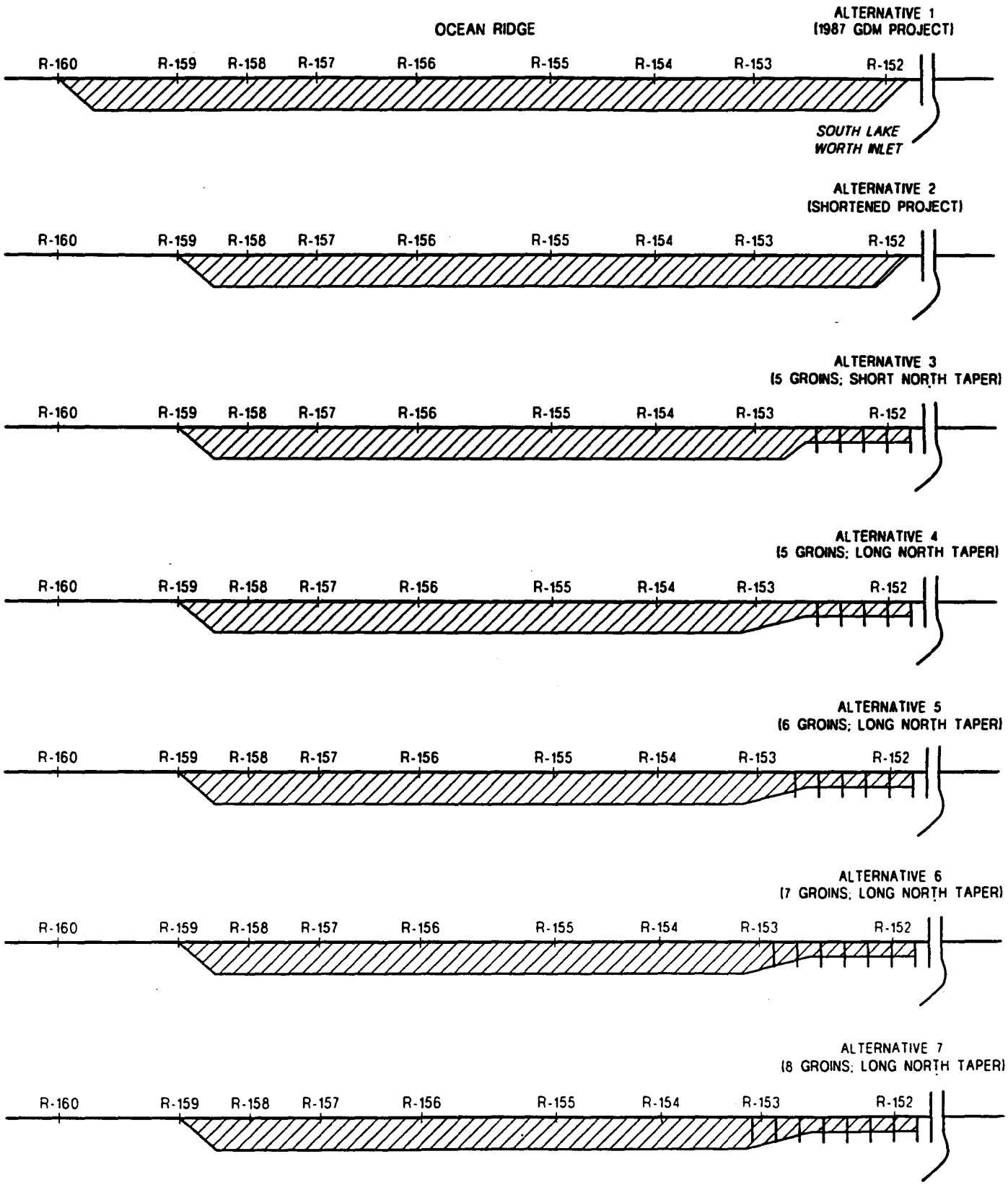
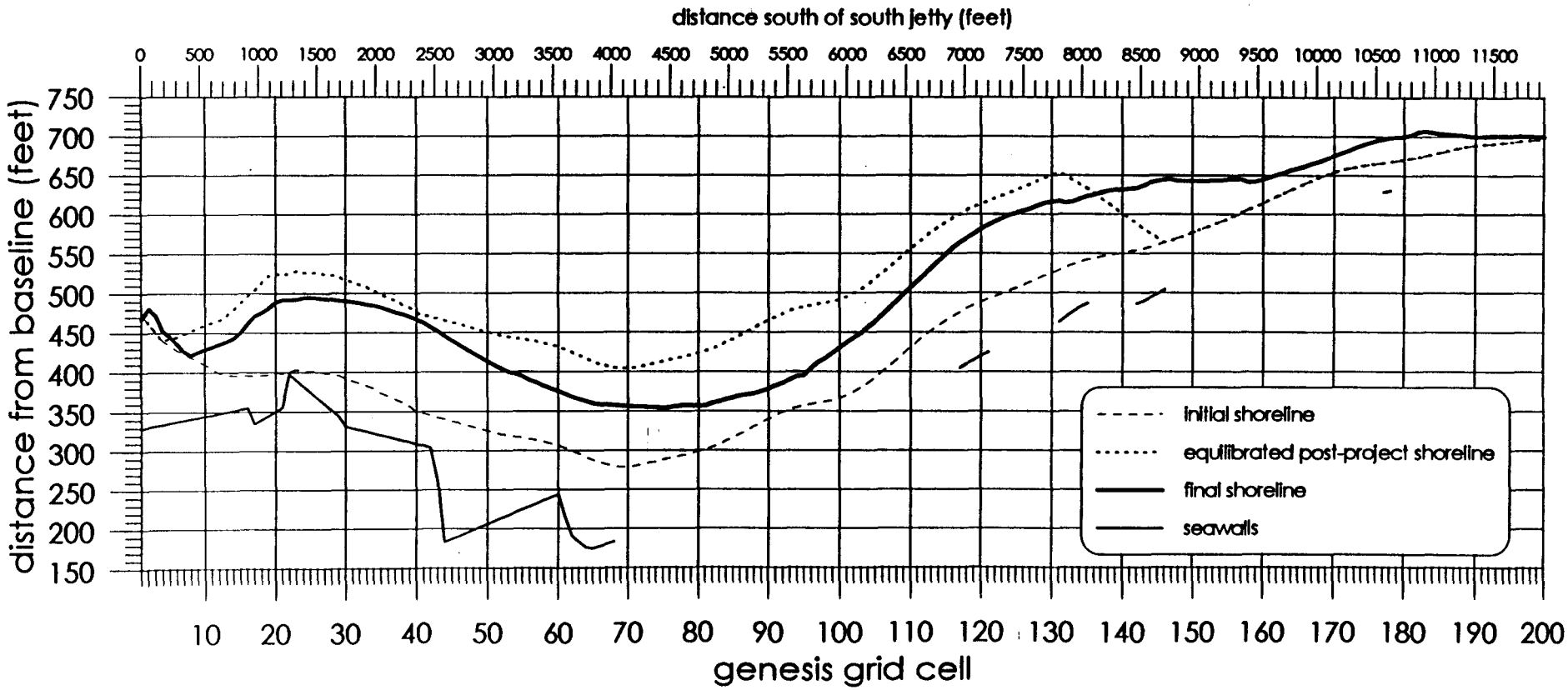


Figure 1-22
Ocean Ridge Simulation - 1987 GDM Project (Alternative 1)



hardbottom; however, this alternative would still impact the 12.5 acres of hardbottom along the northern section. Like the 1987 GDM project, the GENESIS results (Figure 1-23) indicate that this alternative would not maintain the design beach along the northernmost 1,000 feet of the project.

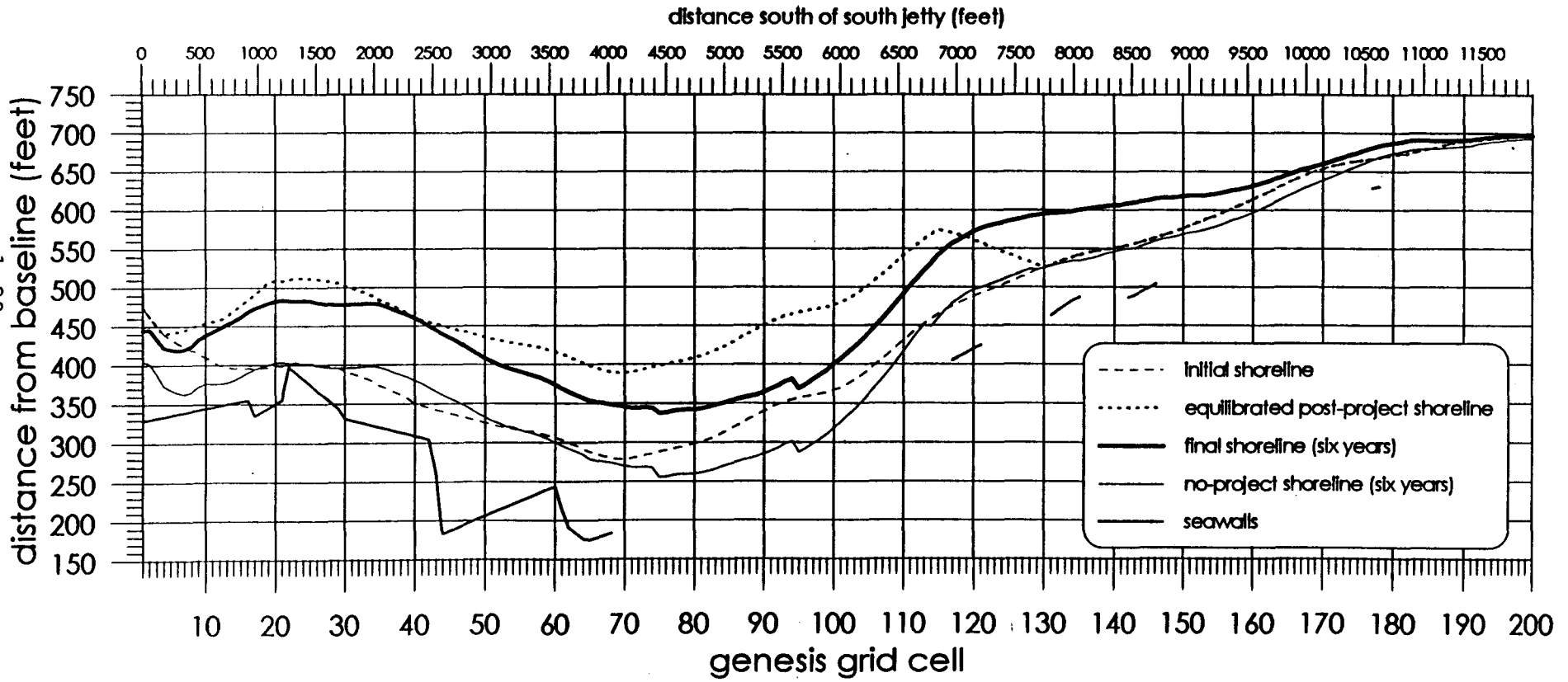
1-145. Beach Fill and Groin Alternatives. The GENESIS results indicate that the northernmost section of the project shoreline must be stabilized by means other than conventional advance nourishment. Historical shoreline and volume change data, and a global sediment budget for South Lake Worth Inlet suggest that significant erosional stress may extend as far south as 1,700 to 1,800 feet from the inlet. The placement of advance nourishment along this section of shoreline would cause unacceptable levels of hardbottom impact and possibly increased shoaling in the inlet. To protect the design beach and reduce nearshore hardbottom impacts along this section of shoreline, combinations of beach fill and groins were considered.

1-146. The first beach fill/groin alternative includes five groins located along 1,200 feet of shoreline with no advance nourishment (Alternative 3 in Figure 1-21). The northernmost groin is located 180 feet south of the South Lake Worth Inlet south jetty. The spacing between structures is 240 feet and the length of each structure, measured seaward of the +6 ft NGVD post-project contour is approximately 80 feet. The +6 ft contour is considered the upper limit of active sediment transport. The permeability of each structure is assumed to be zero percent. The alternative includes a 550 ft taper between the groins and the fully developed beach fill.

1-147. The results from the GENESIS model indicated that this 5 groin configuration would maintain the design beach cross-section, on average, along this section of shoreline. However, the impacts to nearshore hardbottom along the northern section of the project would exceed 7.0 acres. This magnitude of hardbottom impact is considered unacceptable by the State of Florida and the Project Sponsor.

1-148. To reduce hardbottom impacts, a milder transition between the groins and the fully developed beach fill was considered. The taper length was increased to 1100 feet, based upon the location of the landward limit of the hardbottom (Alternative 4 in Figure 1-21.). This configuration would impact approximately 3.0 acres of hardbottom. Although this alternative would reduce hardbottom impacts, GENESIS simulations indicate that it would not provide acceptable protection for the design beach cross-section.

Figure 1-23
Ocean Ridge GENESIS Simulation - Beach Fill Only (Alternative 2)



1-149. To provide protection to the design beach cross-section south of the fifth groin and simultaneously maintain a comparable, reduced level of hardbottom impact, alternate configurations of 6, 7, 8, 9 and 10 groins were considered. For each configuration, the groin field was extended into the transitional area to increase its stability. Configurations consisting of 6, 7 and 8 groins correspond to Alternatives, 5, 6, and 7 in Figure 1-21. The spacing, length and porosity of the additional groins are identical to those employed for the first 5 groins. Figure 1-24 illustrates the results of the 5, 6, 7, and 8 groin simulations. For clarity, results from simulations with 9 and 10 groins are not shown. The results of the simulations suggest that increasing the number of groins would increase shoreline stability south of the fifth groin with no substantial increase to hardbottom impacts.

1-150. Considering average annual wave and bypassing conditions, the results of the GENESIS simulations indicate that the seven-groin alternative provides the most stable shoreline response and minimum hardbottom impacts. The 7 groin alternative includes groins located along approximately 1,600 feet of shoreline. Relying solely upon the GENESIS simulations, it appears that the addition of an eighth groin would not provide additional shoreline stability. This result is somewhat inconsistent with the historical shoreline and volume change data which suggest that the reach of most severe erosion extends as far as 1,800 feet south of the inlet. Based upon the GENESIS results and the historical shoreline and volume change data, beach fill with 8 groins is considered the most effective alternative. No substantial increase in shoreline stability would be provided by the 9 and 10 groin project configurations. The GENESIS results for the proposed project are presented in Figure 1-25.

1-151. Summary. The proposed project consists of a design beach which will establish the +9 ft berm at the erosion control line. This is equivalent to extending the mean high water shoreline approximately 50 feet from 1993 conditions. The design beach will be protected by six years of advance nourishment and eight rubble mound groins, which will be located along the northernmost 1,800 feet of the project shoreline.

Figure 1-25
Ocean Ridge GENESIS Simulation - Beach Fill/8 Groins (Alternative 7)

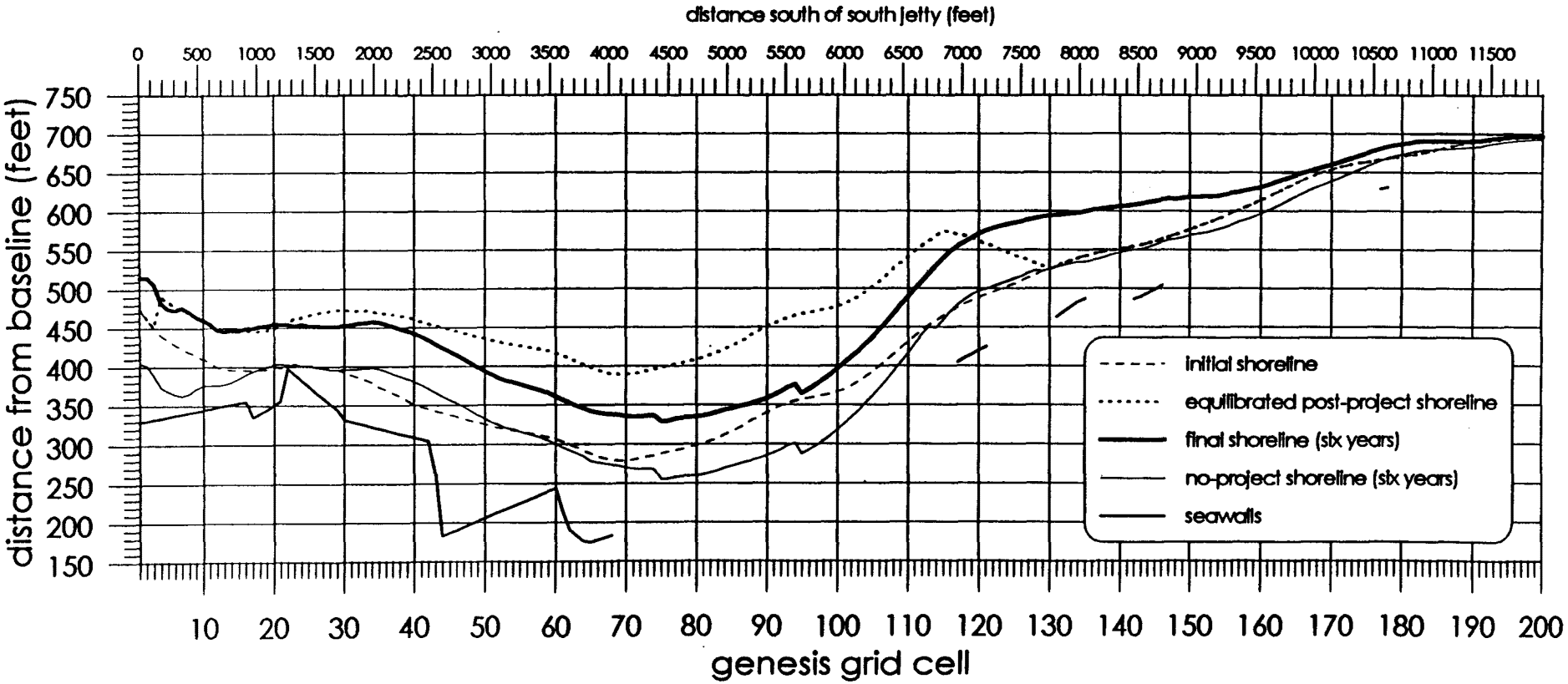
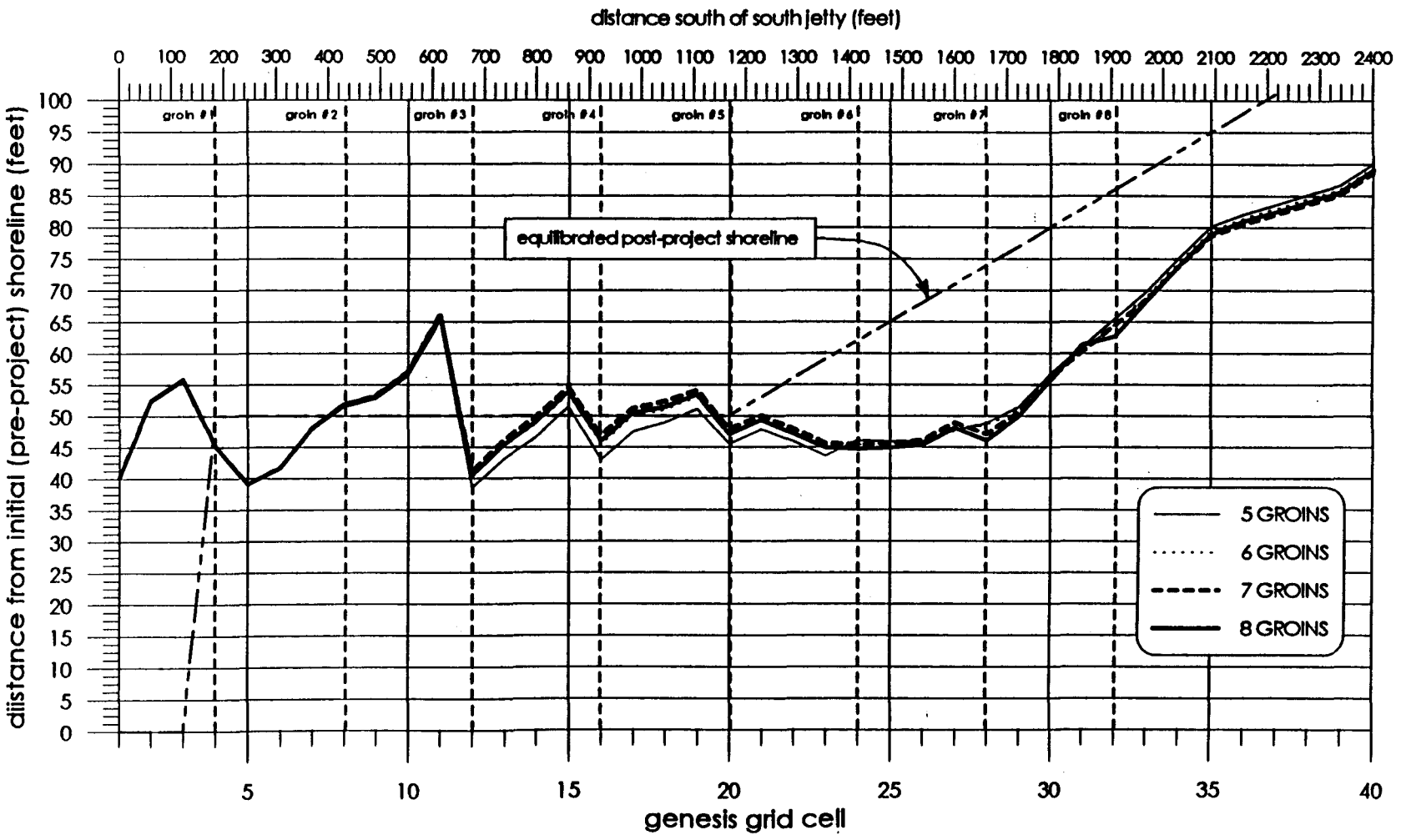


Figure 1-24
Comparison of GENESIS Results for Beach Fill/Groin Alternatives



GEOTECHNICAL INVESTIGATIONS

INTRODUCTION

1-152. A detailed geotechnical investigation was conducted for the Ocean Ridge, Florida, shore protection project to identify a beach compatible sand source for purposes of beach restoration. From the investigation, a shore-parallel, offshore borrow area containing a sufficient quantity of beach compatible material for the shore protection project was identified.

PREVIOUS INVESTIGATIONS

1-153. Reconnaissance-level sand source investigations intended to identify a beach compatible sand source for Palm Beach County were initially conducted in 1965 by the Coastal Engineering Research Center (CERC). The results of the investigation, published in bulletin CERC-TM-29, November 1969, indicate that a beach compatible sand source is located offshore of Palm Beach County.

1-154. Efforts to identify a beach compatible sand source continued in 1979 when Arthur V. Strock and Associates performed detailed seismic, bathymetric, and sampling investigations offshore of Palm Beach County. The study encompassed an area between 500 and 6,000 feet offshore of Palm Beach County, excluding Palm Beach Island.

1-155. The detailed sub-bottom seismic survey identified the upper surface bedrock and reef structures within the study area. The offshore sand source is defined as a sand wedge extending from the shoreline and thickening in the offshore direction. The maximum thickness of the sand deposit is generally 40 to 50 feet where the sand body terminates against a rock or reef structure. The reef is approximately 5,000 to 6,000 feet offshore running generally parallel to the shoreline in 60 to 65 feet of water. In the southernmost portion of the survey area, another reef, approximately 2,000 feet offshore, is found in 30 to 35 feet of water.

1-156. In 1979, the Corps of Engineers conducted additional sampling to further develop the findings of Arthur V. Strock and Associates. This included five core borings collected between 350 and 13,000 feet south of South Lake Worth Inlet, offshore of Ocean Ridge. The results of

these investigations were used to identify the limits of a potential offshore borrow site.

1-157. In 1990, eighteen core borings were collected by vibracore across the ebb tidal shoal of South Lake Worth Inlet as part of the South Lake Worth Inlet Sand Management Plan (Olsen Associates, Inc, 1990). The borings were collected within an area 2,300 feet from shore and within 1,000 feet north and 2,200 feet south of the inlet. The sand material from the ebb tidal shoal was identified as a source of beach compatible material. The ebb tidal shoal was not recommended as a primary borrow site, however, because of the potential detrimental effects dredging may have on the natural bypassing features of the shoal, and because another potentially suitable sand source had been identified offshore of the Ocean Ridge shoreline.

RECENT INVESTIGATIONS (1992-1993)

1-158. Native Beach Sampling. In 1992, beach sand samples were collected along three transects to the north and six transects to the south of South Lake Worth Inlet. Along each transect, sand samples were collected at the toe of the dune, across the berm and at approximately 3 ft vertical intervals from the 0 to -12 ft NGVD contours. All sampling transects south of the inlet were located at non-armored sections of the shoreline. The locations of the sampling transects are shown on Plate 5.

1-159. Offshore Borrow Site Investigation. In 1992, twenty vibracore borings were collected by Olsen Associates, Inc. in order to re-evaluate the offshore borrow area identified in 1979 by Arthur V. Strock and Associates. The borings were spaced approximately 1,000 feet apart and staggered throughout the study area. The average boring penetration depth was 15 feet below the seabed. Results from sediment sieve analyses of the material recovered from the borings were used to refine the limits of a suitable borrow area. The offshore borrow area and core-boring locations are presented on Plate 5.

1-160. In 1993, an additional ten core borings were collected by vibracore within the refined limits of the proposed offshore borrow area. The intent of this collection effort was to increase the resolution of sediment data throughout the borrow area and better characterize the borrow material.

MATERIAL ENCOUNTERED

1-161. Native Beach. The native beach material within the project limits was sampled at transects, R-154, R-155, R-155.5, R-156, R-157, and R-159. Additionally, physical composites were constructed by manually combining sand from all samples along a transect. The composites are considered to represent the general characteristics of all beach sediments along each transect.

1-162. The composites were sieved with and without shell material. The shell material was removed using an acid treatment technique. The shell content was determined by calculating the difference in sample weight from before and after the acid treatment.

1-163. The native beach material is fine grained quartz sand with varying amounts of shell material. The mean grain size of the native beach material with the shell material included is 1.64 phi (0.32 mm) with a sorting value of 0.72 phi (moderately sorted). The shell content is approximately 42 percent by visual estimate.

1-164. With the shell material removed, the physical composite mean grain size is 1.76 phi (0.30 mm) with a sorting value of 0.56 (moderately well sorted). The shell content of the native beach is 51 percent by weight.

1-165. Offshore Borrow Site. Inspection of the 1992 core boring data revealed that the eleven landwardmost borings (Plate 5) contain the most suitable beach fill material within the study area. The ten borings collected in 1993 confirmed these conclusions. The borrow area is located approximately 1,700 feet offshore and averages 750 feet in width. It extends approximately 12,400 feet southward from South Lake Worth Inlet. The average water depth throughout the borrow area is 33 ft NGVD. The cumulative grain size distribution curves and core boring logs are included as Appendix 5 and Appendix 6, respectively. A geologic cross-section of the borrow area is presented on Plate 6.

1-166. Physical composites were constructed of the material recovered from each boring. The composites are considered to be representative of all material within each boring. The composites were analyzed with and without shell material. The shell material was removed by an acid treatment technique. The shell content was determined by

calculating the difference in sample weight from before and after the acid treatment.

1-167. The borrow area material is fine grained sand with varying amounts of whole and broken shell. The mean grain size of the borrow area material with the shell material included is 1.94 phi (0.26 mm) with a sorting value of 0.79 phi (moderately sorted). The shell content is approximately 33 percent by visual estimate.

1-168. With the shell material removed, the borrow area material has a mean grain size of 2.27 phi (0.21 mm) with a sorting value of 0.62 phi (moderately well sorted). The shell content is 55 percent by weight.

1-169. The percent fines by weight (i.e, that fraction passing a U.S. Standard No. 200 sieve) for the borrow area material was measured using three techniques: (1) dry sieving of individual samples taken from each boring, (2) dry sieving of the physical composites of each boring and (3) wet sieving of physical composites of representative borings. The amount of fines by weight ranges from less than 1 to 4 percent with an average of 1.5 percent.

1-170. Figure 1-26 presents the cumulative grain size distributions with and without the shell material for both the native beach and the borrow area material. Analysis of the distributions suggests that the highest level of compatibility is achieved when the shell material is retained. Therefore, the stability of the borrow area material, once placed upon the beach, is dependent upon the shell material.

SUITABILITY ANALYSIS

1-171. A borrow area is, in part, selected based upon the similarity of the textural characteristics between the borrow area and native beach material. Typically, the borrow area material is finer than that found along the native beach. Therefore, the borrow area material, once placed as beach fill, will be susceptible to higher loss rates than the coarser native beach material. Additionally, the borrow material will undergo sorting by the action of nearshore waves and currents which contribute to more rapid displacement of the beach fill material.

1-172. The difference between the textural characteristics of the borrow and native beach materials can be represented by an overfill ratio. The overfill ratio is a measure by which an extra volume of material, or overfill

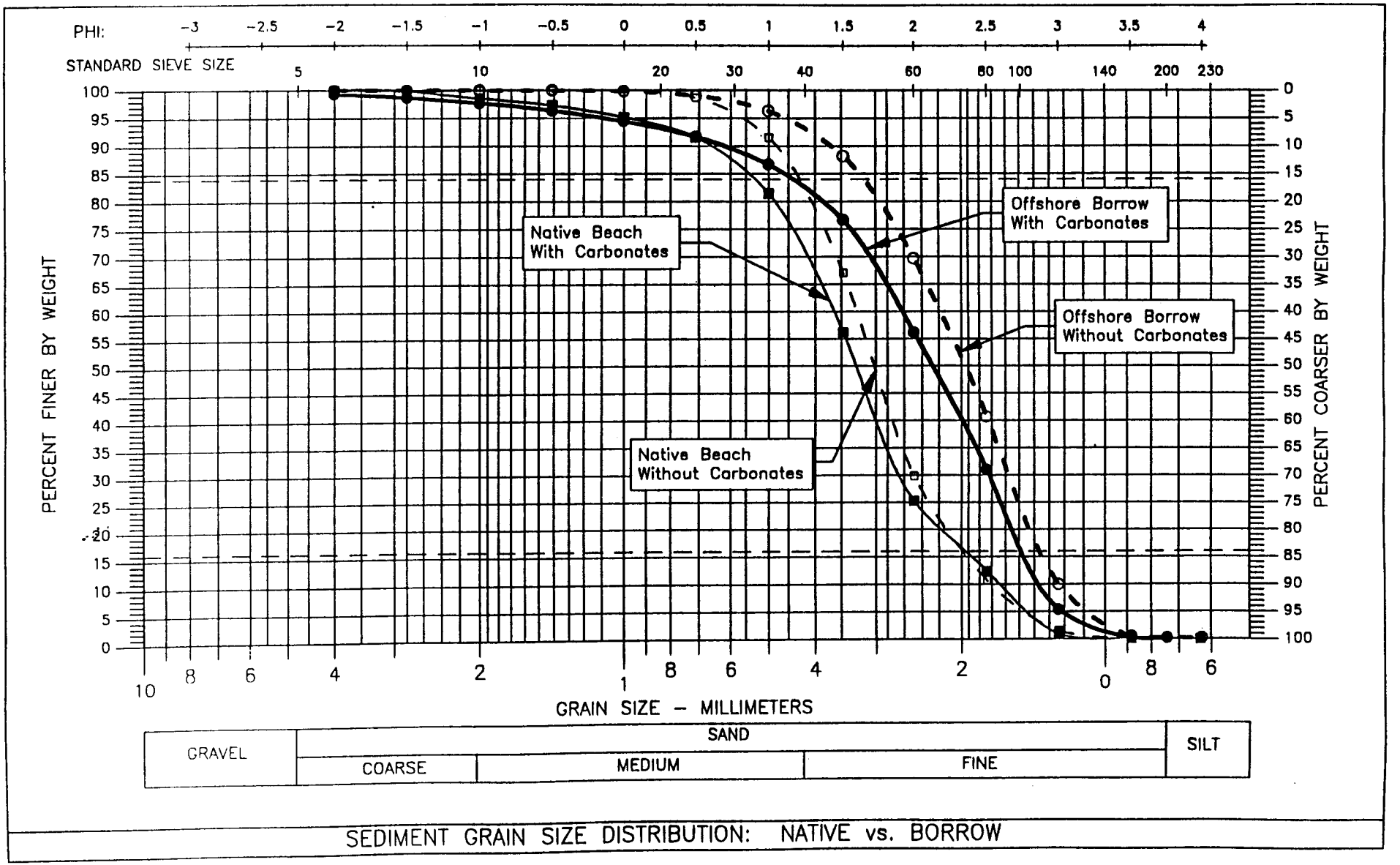


Figure 1-26: Native Beach and Borrow Area Composite Grain Size Distribution Curves

volume, can be specified to account for losses resulting from textural differences between the borrow and native material. The modified SPM method was used to calculate the overfill ratio (USACE, 1984).

1-173. The overfill ratio for the offshore borrow area is 1.50. Tables 1-23 and 1-24 present a summary of the grain size distribution data for the native beach and the offshore borrow area material. Table 1-25 includes a summary of the textural parameters used to calculate the overfill ratio as well as the results of the overfill analysis.

1-174. Applying the overfill ratio, the project's advance and future nourishment volumes will require a 50 percent increase to accommodate the increased transport and sorting losses of the borrow material. The overfill ratio is applied to the advance nourishment volume and future nourishment volume, and not to the design beach volume, because only these two volumes will be exposed to the sorting action of the nearshore wave and current climate. By design, the design beach volume will be protected from the sorting action by the nourishment volumes. Once the advance nourishment has eroded to the design beach, the subsequent renourishment will be constructed.

QUANTITY OF MATERIAL

1-175. The computed volume of material within the alongshore borrow area is approximately 5.2 million cubic yards. This estimate is based upon an average dredging depth of 15 ft below the ambient seabed. The volume of the borrow area is likewise based upon the assumption that the entire borrow area can be dredged. Minor dredging restrictions may be necessary, however, because of the presence of ferrous materials (magnetic anomalies) detected by the magnetometer survey. If necessary, it is anticipated that these materials can be removed prior to construction.

MAGNETOMETER SURVEY

1-176. In April, 1993, a magnetometer survey was conducted across two potential borrow areas offshore of the Ocean Ridge project shoreline. These areas included a portion of the ebb tidal shoal of South Lake Worth Inlet and an alongshore area located approximately 1,000 feet offshore and extending approximately 14,000 feet south from South

Table 1-23

Grain Size Distribution Data (Phi).

		NATIVE BEACH		OFFSHORE BORROW AREA	
		WITH CARBO-NATES	WITHOUT CARBO-NATES	WITH CARBO-NATES	WITHOUT CARBO-NATES
PHI GRAIN SIZE	5%	0.29	0.81	-0.45	1.12
	16%	0.92	1.22	1.15	1.64
	50%	1.47	1.74	2.25	2.32
	84%	2.32	2.32	2.74	2.84
	95%	2.74	2.74	3.06	3.18

Table 1-24

Grain Size Distribution Data (mm).

		NATIVE BEACH		OFFSHORE BORROW AREA	
		WITH CARBO-NATES	WITHOUT CARBO-NATES	WITH CARBO-NATES	WITHOUT CARBO-NATES
MILLI-METER GRAIN SIZE	5%	0.82	0.57	1.37	0.46
	16%	0.53	0.43	0.45	0.32
	50%	0.36	0.30	0.21	0.20
	84%	0.20	0.20	0.15	0.14
	95%	0.15	0.15	0.12	0.11

Table 1-25

Textural Characteristics of Native Beach and Borrow Area Materials.

	PHI MEAN GRAIN SIZE	MEAN GRAIN SIZE (mm)	SORTING	PERCENT SHELL BY WGT.	OVERFILL RATIO Ra
NATIVE BEACH					
with carbonate	1.64	0.32	0.72	51%	
without carbonate	1.76	0.30	0.56	-	
OFFSHORE BORROW AREA					
with carbonate	1.94	0.26	0.79	55%	1.50
without carbonate	2.27	0.21	0.62	-	

Lake Worth Inlet. The study was conducted to determine the location of ferrous materials that may pose hazards to dredging operations or may have historical and/or archeological significance. The survey was conducted by a professional underwater archeologist and was performed to comply with the National Historic Preservation Act of 1966 asamended, National Environmental Policy Act of 1969, and the Advisory Council on Historical Preservation Regulations (36 CFR 800).

1-177. A total of nineteen magnetic anomalies were identified within the limits of the study area. Plate 5 depicts the limits of the magnetometer survey study area and the locations of the magnetic anomalies. Thirteen are situated in isolated locations and appear to represent small ferrous objects. Due to their small size and distribution, these anomalies are assumed to pose no hazard to dredging operations and are not likely to have sufficient historical or archeological significance to merit identification as a cultural resource.

1-178. A large anomaly cluster was identified within the limits of the proposed borrow area. This cluster is represented by anomalies 1 and 2 on Plate 5 and represents a

substantial mass of magnetic material. Diver inspections concluded that the magnetic material was not historically significant and dredging the borrow area will have no effect on cultural resources. However, unless the objects are removed, dredging operations should avoid these areas to prevent damage to equipment.

1-179. The findings of the magnetometer survey and diver investigation found no evidence that submerged cultural resources of archeological or historical interest are located in the survey area. No further archeological investigation of the study area is required prior to construction of the proposed project.

GEOTECHNICAL INVESTIGATION SUMMARY

1-180. Results of the geotechnical investigation indicate that approximately 5.2 million cubic yards of beach compatible material exists within the limits of an offshore borrow area. This quantity of material will support the renourishment requirements of the 50-yr shore protection project. The overfill factor of the offshore borrow area material is 1.50. Therefore, the advance nourishment and future nourishment volumes will be increased by 50 percent to account for the textural differences between the native beach and the offshore borrow area material. Magnetometer and diver surveys revealed no evidence that submerged resources of archeological or historical interest are located in or adjacent to the borrow area. A cluster of ferrous objects of non-cultural significance are present within the borrow area.

PROTECTIVE BEACH DESIGN

PROJECT DIMENSIONS

1-181. Project Length. The Ocean Ridge project segment length described in the 1987 GDM is 1.6 miles, or 8,450 feet. The northern limit of the 1987 project is 300 feet south of South Lake Worth Inlet. The southern limit of the 1987 project is located at Corrine Street, or at approximately Florida Department of Environmental Protection (FDEP) monument R-160. This southern limit is immediately adjacent to an expansive nearshore hardbottom area. Allowing for mitigation, the cost to construct the project to R-160 exceeds the incremental increase in storm damage and loss of land benefits. To reduce nearshore hardbottom impacts and mitigation costs, the southern limit of the project was moved 1,050 feet northward to approximately R-159. Additionally, the northern end of the project was moved 120 feet northward to the property boundary of Palm Beach County and the South Lake Worth Inlet District. The latter was done as part of the design of the project's structures. The relocated northern limit of the project, along with the attendant structures, will simultaneously provide for reduced hardbottom impacts and project stability along the project's north end. With these modifications the project length is 1.42 miles, or 7,520 feet.

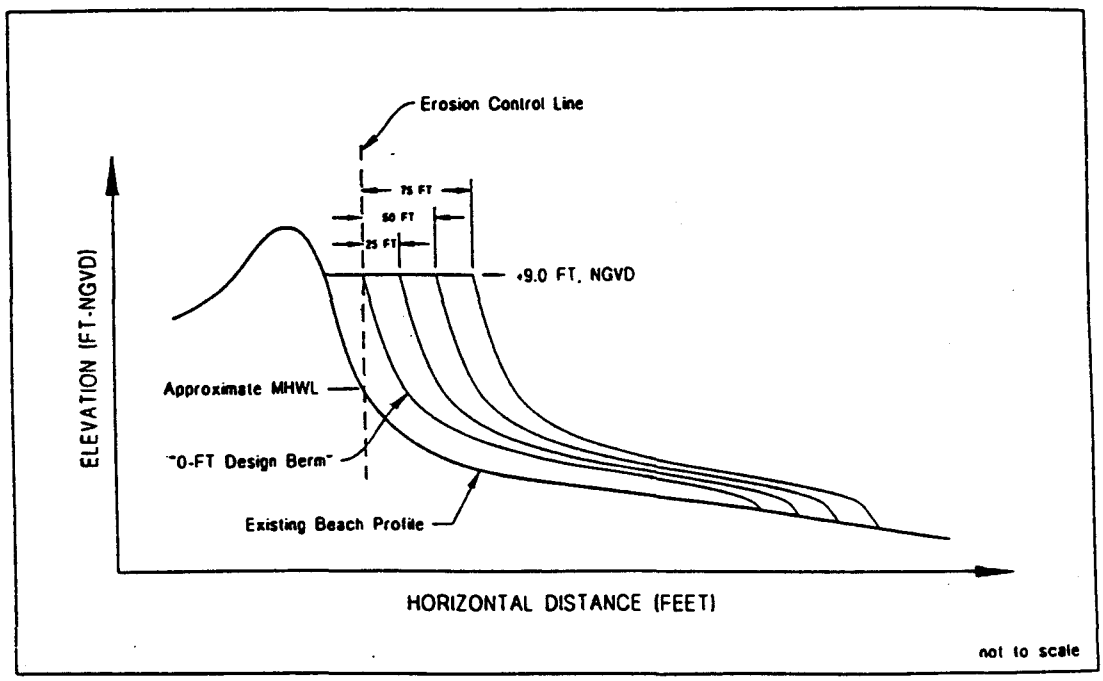
1-182. Design Berm Elevation. The berm elevation for the considered beach fill is +9.0 ft NGVD (+10.0 ft MLW). This approximately coincides with the natural berm elevation of the existing beach.

1-183. Construction Berm Elevation. The construction berm is also designed to be +9.0 ft NGVD. As a result of the hydraulic filling technique used to construct the beach fill, the construction berm elevation may vary ±0.5 ft from the specified design elevation. This level of tolerance is commonly accepted for hydraulically constructed beach fill projects.

1-184. Design Berm Width. The design berm width is the minimum width of the beach, seaward of the Erosion Control Line (ECL), which shall be maintained for the life of the project. Design berm widths considered in the report include a 0, 25, 50 and 75 extension of the +9 ft NGVD contour from the ECL (see Figure 1-27). These berm widths are equivalent to extending the Ocean Ridge mean high water shoreline approximately 50, 75, 100 and 125 feet. The optimum berm width is that which maximizes the net project primary benefits. The optimum design berm width was determined to be the 0-ft alternative.

Figure 1-27

Conceptual Schematic of Design Berm Alternatives.



1-185. Construction Berm Width. In order to maintain the design berm width, advance nourishment and overfill volumes are placed in conjunction with the design beach fill. This results in an initial project fill volume that is larger than the design fill volume. During construction, the fill volume is not placed along the entire active profile, but is instead placed along the upper portions of the profile and allowed to "equilibrate" to the natural profile shape. The construction profile consists of a horizontal berm and a uniformly sloping seaward face.

1-186. The width of the construction berm is a function of (1) the seaward slope of the construction berm, and (2) the sectional volume of material to be placed along a profile (i.e., the fill volume per unit length of shoreline). Because the borrow material is finer than the native beach material, the seaward slope of the construction berm is expected to be milder than the natural beach slope. For this project, it is assumed that the construction berm slope will be 1V:20H.

1-187. The sectional volume of fill material is determined as the local volume necessary to establish the design beach, advance nourishment, and overfill. The width of the construction berm is determined by superimposing the construction profile upon the existing profile, then adjusting the construction profile landward or seaward until

the requisite sectional fill volume is realized. Because of shoreline irregularities and variations in the advance nourishment requirement, the width of the construction berm will vary from 0 to 190 feet along the project.

1-188. If the seaward slope of the construction berm is 1V:20H, initial impacts to the northern area of nearshore hardbottom may exceed 7 acres. Although temporary, efforts to minimize this impact should be implemented. To do this, material from the fixed sand transfer plant will be used to construct portions of the northernmost section of the construction berm (within the groin field). Because the bypassed material has the same textural characteristics as the native beach material, it is assumed that the slope of the construction berm in this area will be similar to the slope of the native beach (1V:8H), thus reducing impacts to nearshore hardbottom. The volume of material from the offshore borrow area intended to be placed along the northern section of shoreline will be added to fully developed beach fill south of the nearshore hardbottom area. The final volume of bypassed material placed along the northernmost section of project shoreline will ultimately depend upon the timing of bypassing operations and the phasing of construction of both the groin field and the beach fill. For example, the groin field is scheduled to be constructed in the summer, before construction of the beach fill. The beach fill will be constructed in the winter, between November and April. During the period between the completion of the groin field and initial construction of the beach fill, sand will be discharged within the completed groin field by the fixed sand transfer plant. This bypassed material will be used to meet a portion of the sectional beach fill volume requirements within the groin field.

1-189. Beach Slopes. After placement, the construction berm will "equilibrate" to the natural profile shape under the influence of natural forces. Along areas of non-erosive (or "healthy"), natural shoreline, it may be assumed that the beach profile will maintain roughly the same shape after the beach fill is placed and equilibrated. Along areas where the shoreline is over-eroded, the pre- and post-project profiles may not have the same shape. The post-project profile is more likely to take the shape of profiles along healthy sections of shoreline.

1-190. The general shape of the natural profile can be approximated by one or more equivalent slopes, or described more accurately by a composite beach profile. The composite beach profile is developed by averaging together several healthy profiles measured outside the problem area. The equivalent slopes of the composite profile, which is an average of many natural profiles, are 1V:8H above mean low water and 1V:30H below.

1-191. The equivalent slopes or the composite profile can be superimposed upon existing (pre-project) profiles to determine the requisite fill volumes necessary to establish the design berm widths. Use of the composite profile has proven more effective in accurately predicting post-project profile shapes and volume requirements of beach restoration projects (Jarrett, 1981; Olsen, 1992).

1-192. The difference in computed fill volume requirements between the equivalent slopes and the composite profile can be significant. Table 1-26 presents the 0-ft design berm volume computed using both the equivalent slopes and the composite profile. The composite profile predicted the design beach volume to be about 18 percent greater than that computed with the equivalent slopes. The fill volume required landward of the Erosion Control Line (ECL) does not depend upon the design beach slopes.

Table 1-26

Design Beach Volume Computed with Equivalent Slopes and Composite Profile.

		PROFILE SECTIONAL VOLUME			TOTAL VOLUME		
PROFILE NON.	REACH	LANDWARD OF ECL	EQUIVALENT SLOPES	COMPOSITE PROFILE	LANDWARD OF ECL	EQUIVALENT SLOPES	COMPOSITE PROFILE
	(FT)	(CY/FT)	(CY/FT)	(CY/FT)	(CY)	(CY)	(CY)
T-152	520	16.6	24.2	26.5	8632	12593	13795
152.5	510	5.5	13.3	13.3	2788	6765	6800
R-153	780	6.5	25.4	27.4	5032	19790	21410
153.5	540	11.6	40.9	43.4	6248	22097	23441
R-154	520	15.3	35.0	36.1	7958	18190	18791
154.5	510	22.6	36.5	37.3	11501	18636	19007
R-155	630	12.6	32.1	38.4	7938	20237	24192
155.5	620	3.9	21.7	32.8	2395	13432	20359
R-156	590	5.4	25.3	32.8	3214	14903	19324
156.5	520	7.2	47.3	55.3	3742	24618	28753
R-157	410	9.6	55.7	62.9	3916	22831	25801
157.5	340	7.4	37.7	42.4	2508	12826	14403
R-158	400	9.9	40.1	43.9	3976	16035	17548
158.5	370	8.5	12.8	24.9	3142	4743	9223
R-159	260	11.6	17.2	44.6	3008	4476	11595
TOTAL	7520				76000	232172	274441

VOLUME OF MATERIAL

1-193. Fill Behind Erosion Control Line (ECL). The State of Florida requires that the local sponsor establish an Erosion Control Line (ECL) at the existing mean high water line prior to implementation of a shore protection project. The purpose of the line is to delineate the upland boundary of State-owned bottom lands. The volume of material required landward of the ECL to construct a +9.0 ft NGVD berm along the 7,520 ft project area is 76,000 cy.

1-194. Design Beach Volume. The design beach volume is that portion of the beach fill placed seaward of the ECL which provides the permanent storm damage and recreation benefits to the project area. The design volume for each alternative was determined using the design berm width, elevation and composite profile. The optimum design beach volume is that which maximizes the primary net benefit-to-cost ratio for variations in berm width. The optimum design beach volume is 274,500 cy. Typical cross-sections of the design beach are shown on Plates 1 through 4.

1-195. Advance Nourishment Volume and Renourishment Interval. A sacrificial volume of fill material, termed "advance nourishment" will be placed in addition to the design beach volume to offset erosion anticipated after the project's construction. The volumetric requirement for the advance nourishment is determined by historical ("background") volume loss rates along the project area, end losses associated with the project itself, and the renourishment interval.

1-196. The historical volume loss rate is based on beach profile changes measured between 1975 and 1993 and the results of the sediment budget developed for South Lake Worth Inlet. The average erosion rate along the 7,700 feet of shoreline south of the inlet is 38,350 cy/yr. The total project length will be 7,520 feet, with the northern limit being located 180 feet south of the south jetty and the southern limit being located 7,700 feet south of the inlet. Considering only the total project length, the project area average annual volume loss rate is expected to be 37,500 cy/yr. This rate does not include the project-related losses such as end effects and textural differences.

1-197. The project's anticipated end losses result from the perturbation to the shoreline which the beach fill represents. Dean (1988) proposed a method to compute end losses for beach fill projects. The method assumes end losses to be a function of the project length and renourishment interval. For a given project length and various renourishment intervals, an expected end loss rate can be computed. Table 1-27 and Figure 1-28 present the end loss rates for the 7,520 ft project for renourishment intervals of 1 to 10 years. The values represent half of the total computed end losses because end losses are not expected from the northern end of the proposed project. A line best-fit to the computed values indicates the end losses to be approximately 18,500 cy/yr. Combined with the historical volume loss rate of 37,500 cy/yr, the expected volumetric loss rate from the project (not including losses due to material textural differences) is 54,000 cy/yr.

Table 1-27

Summary of Volume Change Attributed to End Losses.

YEAR	FRACTION OF FILL REMAINING AFTER END-LOSS	HISTORIC VOLUME LOSS (CY)	REQUIRED ADVANCE FILL VOLUME (CY)	VOLUME ATTRIBUTED TO END LOSSES (CY/YR)
1	0.84	37,500	44,570	7,070
2	0.78	75,000	95,754	20,754
3	0.75	112,500	150,632	38,132
4	0.72	150,000	207,905	57,905
5	0.70	187,500	266,882	79,382
6	0.69	225,000	327,154	102,154
7	0.68	262,500	388,449	125,949
8	0.67	300,000	450,580	150,580
9	0.66	337,500	513,407	175,907
10	0.65	375,000	576,833	201,833

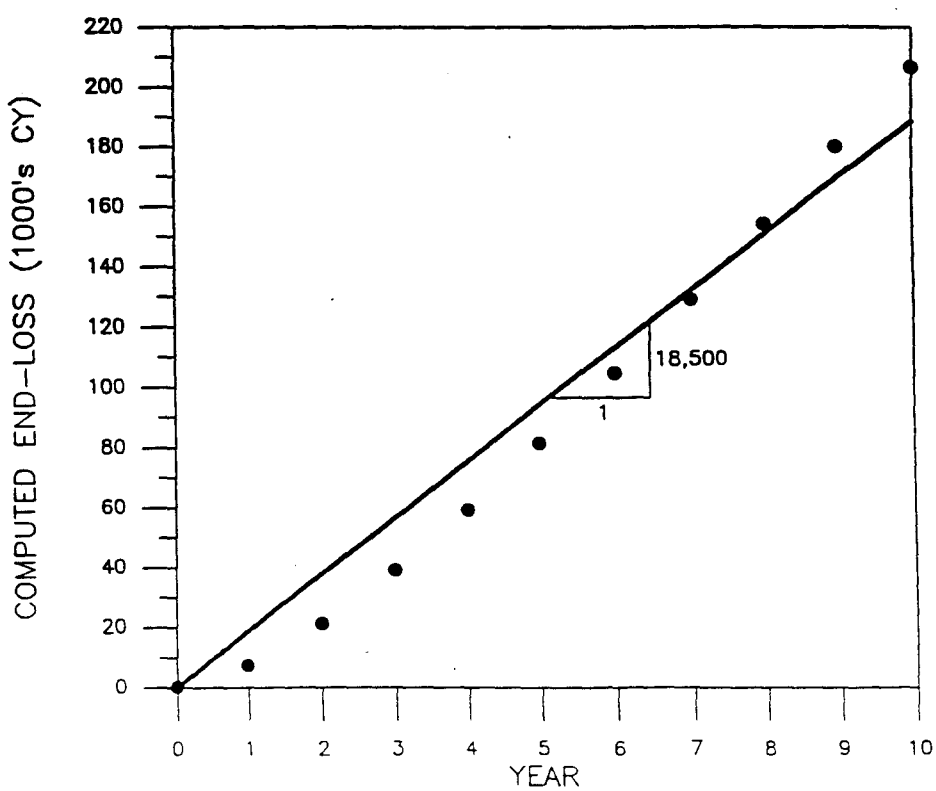


Figure 1-28: Computed End-Loss for 7,520 ft Long Project.

1-198. Nearshore hardbottom impacts along approximately the northern 2,300 ft of project shoreline require that beach fill width be minimized in that area. To minimize the beach fill width in this area and ensure that the beach cross-section will be maintained, the protective volume of advance nourishment will be replaced by a field of groins. The groin field will be configured to provide a level of protection to the design beach equivalent to the advance nourishment. Some advance nourishment will be placed within the groin field to provide a transition from no advance nourishment to fully developed advance nourishment. The advance nourishment will be placed over an effective shoreline length of 5,950 ft. With the groins, six years of advance nourishment will require 289,200 cy of material.

1-199. The project renourishment interval is the number of elapsed years between programmed replacements of the advance nourishment and overfill volumes. The optimum renourishment interval is defined as that which minimizes the average annual equivalent cost of project implementation. Table 1-28 presents the average annual equivalent project costs for renourishment intervals from 1 to 12 years. The average annual equivalent costs were computed using a 7 and 3/4 percent interest rate and a 50-year project life. Considering the placement of advance nourishment along the entire project shoreline, the most cost effective renourishment interval is six years.

1-200. Future Renourishment Volume. After construction of the initial project, performance monitoring of the placed material will be conducted to determine with greater accuracy the future periodic renourishment requirements. For the purposes of this report, it is considered that the future periodic renourishment volume is the same as the advance nourishment volume, and the offshore borrow area would be used for all future renourishments.

1-201. Overfill Volume. The overfill volume is the additional quantity of material necessary to allow for the textural differences between the native beach and borrow area material. The overfill volume is determined by multiplying the overfill ratio by the required advance and future nourishment volumes. The overfill ratio is only applied to the nourishment volumes because the design beach will theoretically never be exposed to the sorting action of nearshore waves and currents. The overfill ratio for the offshore borrow area, determined by the modified SPM method (USACE, 1984), is 1.50. Applying this overfill ratio to the required advance and future nourishment volume of 289,200 cy, an additional 144,600 cy of material will be added to the total project volume.

Table 1-28

Ocean Ridge Shore Protection Project Cost Optimization.

ECONOMIC ANALYSIS PERIOD	50	years	
INTEREST RATE	7.75%		
EROSION RATE	48,200	cy/yr	
FILL BEHIND ECL	76,000	cy	
DESIGN FILL QUANTITY	274,500	cy	
OVERFILL FACTOR	1.50		
MONTHLY PRODUCTION RATE	289,741	cy/mo	
CAPITAL RECOVERY	0.0794009		

MOBILIZATION COST	$699,040	/job
PRICE PER CUBIC YARD	$3.21	/cy
TURBIDITY MONITORING	$16,667	/month
LANDS & DAMAGES	$103,261	/job
ENVIRONMENTAL MONITORING	$239,400	/job
POST PROJECT MONITORING	$170,600	/job
PHYSICAL MONITORING	$68,800	/job
MITIGATION	$74,659	/acre
CONSTRUCT NEW GROINS	$956,776	/job
MAINTAIN NEW GROINS (1%/yr)	$15,600	/yr (ann. equiv.)
REMOVE/MODIFY EXISTING GROINS	$400,000	/job
E&D, S&A	13	%
CONTINGENCY	15	%

nourishment interval (years)	total design fill+ecl (cy)	advance nourishment (cy) (w/overfill	total initial fill (cy) (w/overfill)	strx work (ls)	miti-gation area (acres)	estimated const. time (months)	initial volume costs ($)	interest amort ($)	renourish volume (cy) (w/overfill)	nourishment cost ($)	average annual ($)	total average annual ($)
1	350,500	72,300	422,800	1,356,776	0.5	1.5	5320620	422462	72,300	1928528	1924862	2362924
2	350,500	144,600	495,100	1,356,776	1.0	1.7	5675056	450605	144,600	2240958	1074420	1540625
3	350,500	216,900	567,400	1,356,776	1.5	2.0	6029493	478747	216,900	2553388	785332	1279680
4	350,500	289,200	639,700	1,356,776	2.0	2.2	6383929	506890	289,200	2865818	635818	1158308
5	350,500	361,500	712,000	1,356,776	2.5	2.5	6738365	535032	361,500	3178248	538419	1089051
6	**350,500**	**433,800**	**784,300**	**1,356,776**	**3.5**	**2.7**	**7141166**	**567015**	**433,800**	**3490678**	**476951**	**1059566**
7	350,500	506,100	856,600	1,356,776	7.0	3.0	7785784	618198	506,100	3803108	428681	1062479
8	350,500	578,400	928,900	1,356,776	10.0	3.2	8382040	665542	578,400	4115538	388888	1070030
9	350,500	650,700	1,001,200	1,356,776	13.0	3.5	8978295	712885	650,700	4427968	354333	1082818
10	350,500	723,000	1,073,500	1,356,776	15.0	3.7	9477822	752548	723,000	4740398	322122	1090269
11	350,500	795,300	1,145,800	1,356,776	16.0	4.0	9880622	784530	795,300	5052828	303364	1103495
12	350,500	867,600	1,218,100	1,356,776	17.0	4.2	10283423	816513	867,600	5365258	285808	1117921

1-202. Table 1-29 summarizes the total project volume requirements for all project alternatives considered in this report.

TABLE 1-29

Beach Fill Volumes for Project Alternatives.

PROJECT ALTERNATIVE	FILL LANDWARD OF THE ECL (CY)	DESIGN FILL VOLUME (CY)	ADVANCE NOURISH-MENT (CY)	OVERFILL (CY)	TOTAL VOLUME (CY)
1.6 MILE*	85,400	321,530	364,200	182,100	953,230
1.11 MILE	59,200	234,950	286,200	143,100	723,450
0-FT**	76,000	274,500	336,000	168,000	854,500
25-FT**	76,000	403,100	336,000	168,000	983,100
50-FT**	76,000	529,200	336,000	168,000	1,109,200
75-FT**	76,000	657,100	336,000	168,000	1,237,100
0-FT W/ GROINS**	76,000	274,500	289,200	144,600	784,300

Notes: * - Project length described in the 1987 GDM.
** - Volumes based on a 1.42 mile project length.

GROINS

1-203. Configuration. To reduce nearshore hardbottom impacts and increase shoreline stability along the northernmost 1,800 feet of the project shoreline, a system of eight groins will be constructed thereby precluding the requirement for advance nourishment at that location (see Figure 1-29). Replacing the advance nourishment volume with groins will maintain the minimum design beach cross-section while reducing the amount of required nearshore hardbottom mitigation from about 12.5 to 3.5 acres.

1-204. Dimensions. The location, spacing, and physical dimensions of the groins were determined using procedures outlined in the Shore Protection Manual (USACE, 1984). The spacing and physical dimensions of the groin field were designed to (1) maintain the minimum design beach cross-section, (2) minimize nearshore hardbottom impacts, and (3) allow bypass material from the fixed sand transfer plant to be transported over and around the seaward ends of the groins. A groin spacing to active groin length ratio of 3:1 was used to configure the groin field. The active groin length is measured from the crest of the active beach berm (which is approximately the +6 ft NGVD elevation along the project area) to the seaward end of the groin. The Shore Protection Manual suggests that the groin spacing to active length ratio be between 2:1 and 3:1 (USACE, 1984). A ratio of 3:1 was used for this project to minimize the required number of groins.

1-205. Design of the active groin lengths considered (1) the minimum width of the design beach cross-section (2) the expected equilibrated slope of the beach cross-section and (3) the seawardmost location the equilibrated toe-of-fill (i.e., nearshore hardbottom impacts). The minimum design beach cross-section requires that the seawardmost portion of the +9 ft NGVD berm be maintained at the Erosion Control Line (ECL). The expected post-project equilibrated slope of the beach fill is approximately 1 vertical to 8 horizontal above the mean water level. A design active groin length of approximately 80 feet meets the above design criteria.

1-206. The total length of each groin will be longer than the active groin length. The added section of each groin will be extended landward of the active portion of the groin to protect against flanking during storm events. The landward end of each groin will be completely covered by the beach fill. Total groin lengths will vary from approximately 110 to 180 feet. The longer groins will be located at the northern end of the groin field where erosional stress is higher.

1-207. The groin spacing to active groin length ratio of 3:1 requires an average distance between groins of approximately 240 feet. The northernmost groin (groin no. 1) will be located at the northern project limit which is approximately 180 feet south of the inlet. It is noted that the northern project limit is the property boundary between Palm Beach County and the South Lake Worth Inlet District. The Inlet District has elected not to participate in the Federal Shore Protection Project and has requested that no portion of the project be constructed upon or seaward of their property.

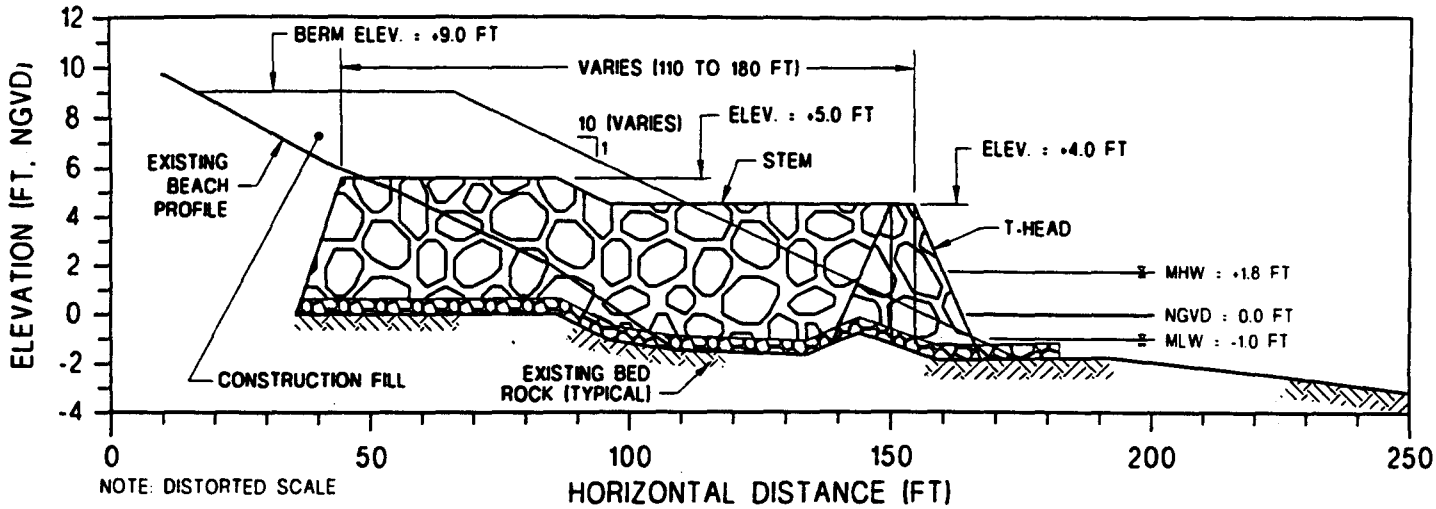
1-208. A T-head will be constructed at the seaward end of each groin. The T-heads will serve to reduce the potential for the generation of rip currents along the groin stems and protect the seaward terminus of the groins. Because the erosional stress is higher along the northern portion of the groin field than along the southern end, the dimensions of the T-heads will vary. The northernmost four groins will have 90 ft T-heads and the southernmost four groins will have 50 ft T-heads. The curved configuration of the northernmost T-heads is necessary to accommodate the curvature of that portion of shoreline and to optimize sediment transport within each cell. It is noted that specific design guidance regarding the size and shape of T-heads is not available. The dimensions of the T-heads is based upon the performance similar structures constructed in the southeastern United States.

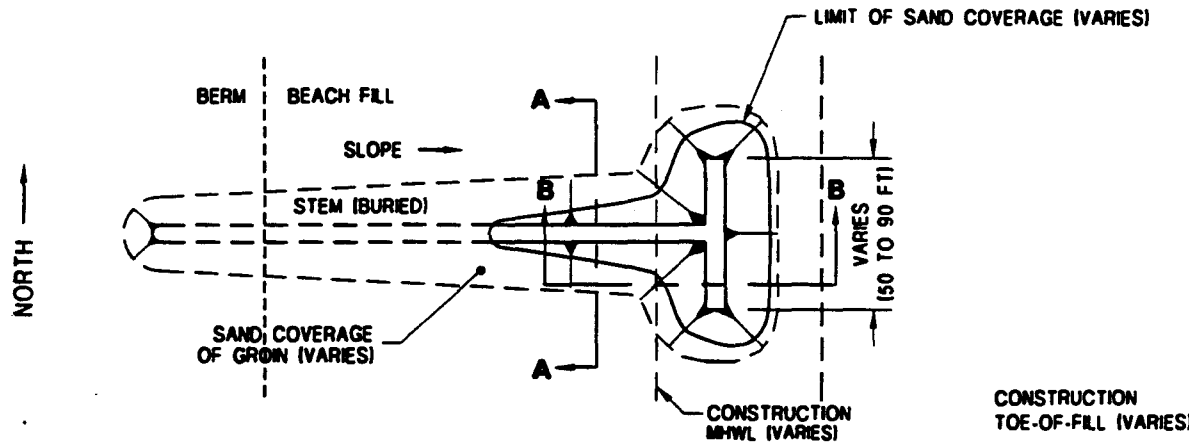
1-209. The crest elevation of the T-heads and seaward end of the groin stems will be +4 ft NGVD. The crest elevation of the landward end of each groin stem will be +5 ft NGVD. Plan and profile sections of a typical groin are shown in Figure 1-30.

1-210. The groins will be of rubble mound construction to minimize wave reflection and the generation of rip currents. The side slopes of the groins will be 1V:2H. The groins will be primarily comprised of two layers of armor stone with a central section of core and chinking stone. The core and chinking stone will be placed, where possible, to partially sand tighten portions of the structures. The cross-section of the landward portions of the groins is not large enough to allow for placement of sufficient core and chinking material to provided for a sand-tight core. However, this portion of the groins will be buried by sand from the design beach and mechanical bypassing discharge. Because the cross-sectional area of the seaward ends of the groins is larger, sufficient core and chinking material will be placed to provide reasonable sand tightness.

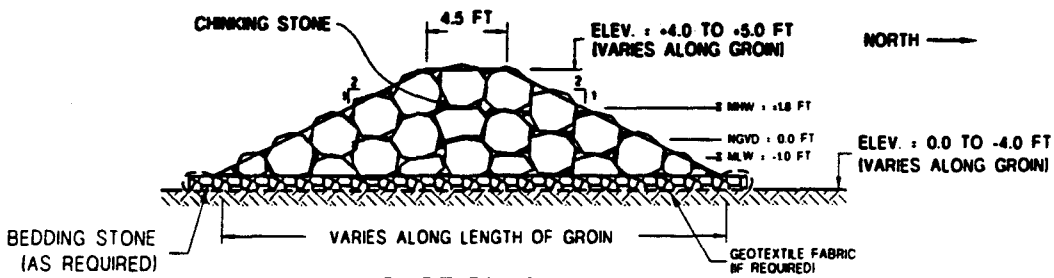
1-208. Stone Sizes. Armor stone sizes were determined using Hudson's stability equation and the design, depth limited breaking wave height. A 10-year design storm condition was used to estimate the required armor stone size. In southern Palm Beach County, the 10-yr storm surge has been estimated to be approximately 4.0 ft NGVD (FEMA, 1978: WIS, 1982).

1-209. The seabed elevation at the seaward end of the groins varies from -2.0 to -4.0 ft NGVD. During a 10-year storm event, the water depth at the seaward ends of the groins may range from 6.0 to 8.0 feet. Assuming a breaking

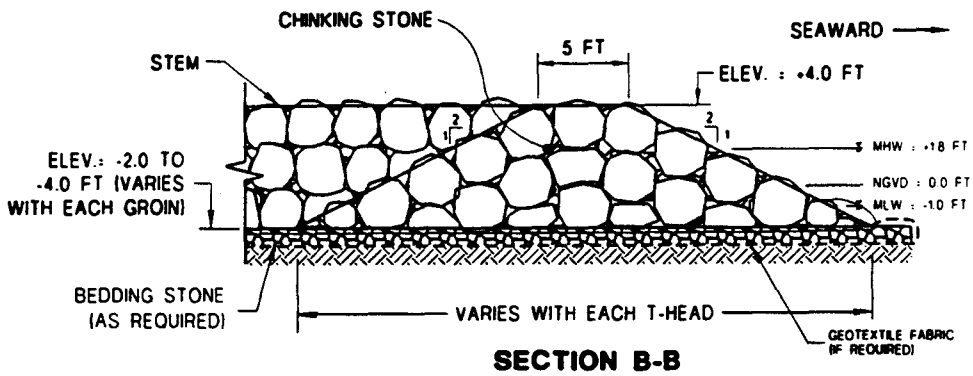




TYPICAL PLAN VIEW T-HEAD GROIN



SECTION A-A



SECTION B-B

FIGURE 1-30

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

PALM BEACH COUNTY
SHORE PROTECTION PROJECT
OCEAN RIDGE SEGMENT
TYPICAL T-HEAD GROIN

DIV NO. DATED:		DWG NO.
SCALE:	DATED: APRIL, 95	SHEET OF

wave height to water depth ratio of 0.78, the design, depth limited breaking wave height is 4.7 ft to 6.3 ft.

1-210. Rough, angular quarried granite with a unit weight of 165 lb/ft^3 will be used for the armor stone. The stability coefficient (K_D) for this material, two layers of armor stone, and breaking wave conditions is 1.6 (Table 7-8, SPM).

1-211. The minimum armor stone weight for the T-heads and the seaward end of the groin stems will range from 0.4 to 0.8 tons with 50 percent of the individual stones weighing 0.6 tons or more. These armor stone sizes will be used for groins where the seawardmost seabed elevation along the groin is approximately -2.0 ft NGVD.

1-212. The maximum armor stone weight for the T-heads and the seaward end of the groin stems will range from 1.3 to 1.9 tons with 50 percent of the individual stones weighing 1.5 tons or more. These armor stone sizes will be used for groins where the seawardmost seabed elevation along the groin is approximately -4.0 ft NGVD.

1-213. The armor stone weight for the landward end of the groin stems will range from 0.4 to 0.8 tons with 50 percent of the individual stones weighing 0.6 tons or more.

1-214. The core and chinking stone used in selected structures will consist of well-graded stone with a minimum unit weight of 165 lb/ft^3. The size of the core and chinking stone will vary with respect to the size of the armor stone of each structure.

1-215. Foundation Conditions. The structures will be underlain by sand and exposed bedrock. The elevation of the bedrock formation throughout the structure field varies from approximately -2 to -7 ft NGVD. Most of the structures will be constructed directly upon bedrock. A geotextile fabric and bedding stone layer will be placed to stabilize the foundations, as required.

1-216. Groin Construction. The groin field will be constructed in the summer preceding winter construction of the beach fill. All groin field construction activity will be land based.

1-217. Fixed Sand Transfer Plant Discharge Locations. Material bypassed by the fixed sand transfer plant is currently discharged within the limits of the proposed structure field. As part of the proposed project, material will continue to be discharged within the limits of the

structure field. It is intended that a portion of the groin field will be filled with bypass discharge material before beach fill construction commences.

1-218. Continued placement of material from bypassing operations is central to the performance of the project and the structure field. Modifications to the existing discharge locations are not proposed at this time. However, results from project monitoring will be reviewed to determine if the locations of the bypass discharge points are appropriate. Any modifications would include extension of the bypass discharge line. Modifications to the sand bypass plant itself would not be part of the Ocean Ridge Shore Protection Project.

1-219. Future Maintenance of Groins. The groin field was designed for a 10-year storm surge event with no damage. Because the 10-year event is expected to be exceeded during the 50-year project life, future maintenance of the groin field will be required.

1-220. The future maintenance requirements and costs were calculated using a probabilistic approach. The approach involves the development of a relationship between expected structure damage and storm events which exceed the design storm event. Using Table 7-9, page 7-211 of the Shore Protection Manual (SPM, 1984), the expected structure damage for a storm event exceeding the design storm can be estimated. A probabilistic relationship between structure damage and the occurrence of a storm which exceeds the design storm is determined by tabulating damage estimates for various storm frequencies greater than the design storm. Total damages are computed by integrating the annual probability of damage over the life of the project. The cost to repair annual is assumed to be a percentage of the initial construction cost of the groin field.

1-221. Table 1-30 summarizes the various storms considered in this analysis and the level of damage expected from each storm event. The annual expected maintenance cost for the groin field is 1 percent of the initial groin field construction cost.

TABLE 1-30

Expected Damage to the Groin Field for Various Storms Exceeding the Design Storm.

Storm Return Period (yrs.)	Prob. of Occur.	Surge (ft)	Breaking Wave Hgt. (H) (ft)	H/H_D	Damage (%) (from Table 7-9, SPM)	Assumed Damage (%)
10	0.1000	4.0	6.3	1.00	0 to 5	0
15	0.0667	4.5	6.6	1.05	5 to 10	7.5
20	0.0500	5.0	7.0	1.10	5 to 10	10
35	0.0286	5.5	7.4	1.15	10 to 15	12.5
50	0.0200	6.0	7.8	1.21	10 to 15	15
75	0.0133	6.5	8.2	1.29	15 to 20	20
100	0.0100	7.0	8.6	1.35	20 to 30	30

REMOVAL/MODIFICATION OF EXISTING GROINS

1-222. There are fifteen existing groins along the proposed project shoreline (see Table 1-16). Of these, ten will be removed or modified as part of the proposed project. As a minimum, all derelict groins and derelict section of the groins will be lowered to an elevation not less than 3 feet below the design beach grade. Within the proposed groin field existing derelict groins will be used as core for the new structures.

ENVIRONMENTAL CONSIDERATIONS - NEARSHORE HARDBOTTOM IMPACTS

1-223. Three areas of nearshore hardbottom exist along the Ocean Ridge shoreline. Approximately 12.5 acres of low to medium relief hardbottom are located continuously along 2,300 feet of shoreline between South Lake Worth Inlet and R-154 (see Figure 1-29). A smaller area of low relief hardbottom, estimated to be approximately 1.5 acres, is located at R-156. An estimated 20 acres of low to medium relief hardbottom with areas of high relief hardbottom are located between R-160 and R-165. The areal extent of the hardbottom areas was estimated from 1994 controlled aerial photography.

1-224. The State of Florida Department of Environmental Protection and U.S. Fish and Wildlife Service require that unavoidable impacts to fish and wildlife

habitat be mitigated. Habitat that will be impacted by the proposed shore protection project are the nearshore hardbottom areas adjacent to the project shoreline. The area of hardbottom impacts was estimated to formulate the mitigation plan for the project.

1-225. Hardbottom impacts were estimated as direct and indirect. Direct impacts are those caused by the initial construction and subsequent cross-shore equilibration of the project profile. The direct impacts were computed by superimposing the project's toe-of-fill over a map of nearshore hardbottom surveyed in 1994. The project's toe-of-fill was estimated assuming equilibrium conditions of the design beach, advance nourishment, and overfill volumes. Indirect impacts are those caused by the long-term spreading losses from the beach fill. The indirect impacts were estimated using the shoreline locations computed with GENESIS.

1-226. The amount of required mitigation for direct and indirect impacts to nearshore hardbottom was estimated for each project alternative considered in this report. Table 1-31 presents the impacts for each of the project alternatives considered.

COSTS

1-227. From conception to completion of the project, the project cost estimate is a paramount management document. It is a guide to further refinement of uncertain features and leads to high confidence in the Federal Government's ability to award and execute contract construction within prescribed cost and time limits. Uncertainty exists in all estimates. The goal is to identify the uncertainty associated with a cost element, to forecast the risk of cost or time growth associated with an uncertainty and to assign a contingency to the cost element that will not be exceeded when further detailed information become available. During preconstruction engineering and design, the focus is on detailed investigations and design which result in a significant increase in the detail of the estimate and decrease in the contingencies.

TABLE 1-31

Estimates of Required Mitigation for Direct and Indirect Hardbottom Impacts for Project Alternatives.

Alternative	Direct Impact (acres)	Indirect Impacts (acres)	Total Impacts (acres)
1.60 miles 1987 GDM	14.00	10.50	24.00
1.11 miles w/o structures	1.50	4.20	5.70
1.42 miles w/o structures	14.00	0.00	14.00
1.42 miles w/ structures	3.50	0.00	3.50

1-228. In this report, cost estimates were developed using October, 1993 price levels. Dimensions and volumetric requirements of the beach fill and structures were developed from February, 1993 beach profile and shoreline surveys. The cost estimates included 15 percent for contingencies.

1-229. The project costs are divided into three contracts: (1) design, construction and monitoring of beach nourishment, (2) design, construction and monitoring of habitat mitigation, and (3) design and construction of new structures and removal of existing structures. The beach nourishment costs include $700,000 for mobilization and demobilization and $3.21 per cy for material dredging. These costs were developed assuming a 30-inch hydraulic dredge pumping from an offshore borrow area through a combined floating and submerged pipeline. Results of the pipeline dredge estimate are presented at the end of this appendix. Cost estimates for monitoring were provided by the Palm Beach County Department of Environmental Resources Management. Engineering, design, supervision and administration were based upon contract amounts agreed upon by Palm Beach County and the engineer.

1-230. Costs for construction of the nearshore structures and removal of existing, derelict structures were estimated using accepted Corps of Engineers methods. Estimates from local marine contractors in Palm Beach County were used as guidance in development of these estimates. Costs for mitigation of nearshore hardbottom impact were developed from similar projects in south Florida.

1-231. Present worth and annual equivalent costs were computed for an 7 and 3/4 percent interest rate and a 50-year project life. Results of the cost estimates are presented at the end of this appendix.

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Ocean Ridge Shore Protection

October 1993 Price Levels

Designed By: **Olsen Associates, Inc.**
Estimated By: **Olsen Associates, Inc.**

Prepared By: **Olsen Associates, Inc.**
Jacksonville, Florida

Date: **01/15/95**

M C A C E S G O L D E D I T I O N
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Release 5.20J

This cost estimate is for the planning, construction and monitoring of the Ocean Ridge Shore Protection Project. The project will include the placement of approximately 785,000 cy of beach compatible sand along approximately 7,500 feet of shoreline immediately south of South Lake Worth Inlet in southern Palm Beach County, Florida. The project will also include the construction of eight (8) rock groins and approximately 3.5 acres of nearshore hardbottom mitigation.

Estiamted costs to construct the beach fill are based upon the use of a 30 inch hydraulic dredge and an offshore borrow area. Estimated costs to construct the rock groins are based upon the transport and placement of granite rock material from a quarry in Georgia, South Carolina or North Carolina. Estimated costs to construct nearshore hardbottom are based upon recent construction costs incurred by Palm Beach County as part to their ongoing nearshore habitat mitigation program. A fifteen precent contengency was applied to all estimates to allow for uncertainties related to estimated material requirements and estimated costs.

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03. Contract 3.....5

No Backup Reports...

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		QUANTITY UOM	CONTRACT	CONTING	TOTAL COST	UNIT
01 Contract 1						
01-01 Construction Cost						
01-01/17 Beach Replenishment						
01-01/17.00 Beach Replenishment						
01-01/17.00.01 Mob, Demob & Preparatory Work						
	Mob, Demob & Preparatory Work	1.00 JOB	699,040	104,856	803,896	803896
01-01/17.00.70 Pipeline Dredging						
01-01/17.00.70/ 1	Fill Behind ECL - Private	29340.00 CY	94,192	14,129	108,320	3.69
01-01/17.00.70/ 2	Fill Behind ECL - Public	46660.00 CY	149,795	22,469	172,264	3.69
01-01/17.00.70/ 3	Design Fill	274500.00 CY	881,240	132,186	1,013,426	3.69
01-01/17.00.70/ 4	Advance Nourishment	289200.00 CY	928,432	139,265	1,067,697	3.6[illegible]
01-01/17.00.70/ 5	Design Overfill	144600.00 CY	464,216	69,632	533,848	3.[illegible]
	Pipeline Dredging		2,517,874	377,681	2,895,555	
01-01/17.00.99 Associated General Items						
01-01/17.00.99/01	Environmental Monitoring	1.00 JOB	239,400	35,910	275,310	275310
01-01/17.00.99/02	Post-Project Monitoring	1.00 JOB	170,600	25,590	196,190	196190
01-01/17.00.99/03	Turbidity Monitoring	1.00 JOB	45,000	6,750	51,750	51750.00
01-01/17.00.99/04	Physical Monitoring	1.00 JOB	68,800	10,320	79,120	79120.00
	Associated General Items		523,800	78,570	602,370	
	Beach Replenishment		3,740,714	561,107	4,301,822	
	Beach Replenishment		3,740,714	561,107	4,301,822	
	Construction Cost	1.00 EA	3,740,714	561,107	4,301,822	4301822
01-02 Non-construction Cost						
01-02/01 Lands and Damages						
	Lands and Damages		103,261	15,489	118,750	
01-02/30 Planning, Engineering and Design						

		QUANTITY UOM	CONTRACT	CONTING	TOTAL COST	UNIT
	Planning, Engineering and Design		427,200	64,080	491,280	
01-02/31	Construction Management (S&I)					
	Construction Management (S&I)		106,800	16,020	122,820	
	Non-construction Cost	1.00 EA	637,261	95,589	732,850	732850
	Contract 1	1.00 EA	4,377,975	656,696	5,034,672	5034672
02	Contract 2					
02-01	Construction Cost					
02-01/06	Fish and Wildlife Facilities					
02-01/06.03	Wildlife Facilities & Sanctuary					
02-01/06.03.73	Habitat and Feeding Facilities					
02-01/06.03.73/01	Mob/Demob		41,501	6,225	47,726	
02-01/06.03.73/02	Construct Offshore Habitat	3.50 ACR	261,307	39,196	300,503	85858.08
	Habitat and Feeding Facilities		302,808	45,421	348,229	
	Wildlife Facilities & Sanctuary		302,808	45,421	348,229	
	Fish and Wildlife Facilities		302,808	45,421	348,229	
	Construction Cost	1.00 EA	302,808	45,421	348,229	348229
02-02	Non-construction Costs					
02-02/01	Lands and Damages					
02-02/30	Planning, Engineering and Design					
	Planning, Engineering and Design		17,400	2,610	20,010	
02-02/31	Construction Management (S&I)					
	Construction Management (S&I)		14,900	2,235	17,135	
	Non-construction Costs	1.00 EA	32,300	4,845	37,145	37145.00
	Contract 2	1.00 EA	335,108	50,266	385,374	385374

		QUANTITY UOM	CONTRACT	CONTING	TOTAL COST	UNIT
03 Contract 3						
03-01 Construction Costs						
03-01/10 Breakwaters and Seawalls						
03-01/10.00 Breakwaters & Seawalls						
03-01/10.00.01 Mob, Demob & Preparatory Work						
	Mob, Demob & Preparatory Work		50,000	7,500	57,500	
03-01/10.00.46 Breakwaters						
03-01/10.00.46/01	Armor Stone Placed From Shore	11500.00 TON	747,984	112,198	860,181	74.80
03-01/10.00.46/02	Core Stone Placed From Shore	1350.00 TON	83,068	12,460	95,528	70.76
03-01/10.00.46/03	Filter Cloth	63600.00 SF	66,477	9,971	76,448	1.20
03-01/10.00.46/04	Excavation	400.00 CY	9,248	1,387	10,635	26.59
	Breakwaters		906,775	136,016	1,042,792	
03-01/10.00.99 Associated General Items						
03-01/10.00.99/01	Remove Existing Structures		400,000	60,000	460,000	
	Associated General Items		400,000	60,000	460,000	
	Breakwaters & Seawalls		1,356,775	203,516	1,560,292	
	Breakwaters and Seawalls		1,356,775	203,516	1,560,292	
	Construction Costs	1.00 EA	1,356,775	203,516	1,560,292	1560292
03-02 Non-construction Costs						
03-02/01 Lands and Damages						
03-02/30 Planning, Engineering and Design						
	Planning, Engineering and Design		75,500	11,325	86,825	
03-02/31 Construction Management (S&I)						
	Construction Management (S&I)		64,700	9,705	74,405	

** PROJECT OWNER SUMMARY - LEVEL 6 **

	QUANTITY	UOM	CONTRACT	CONTING	TOTAL COST	UNIT
Non-construction Costs	1.00	EA	140,200	21,030	161,230	161230
Contract 3	1.00	EA	1,496,975	224,546	1,721,522	1721522
Ocean Ridge Shore Protection	1.00	EA	6,210,059	931,509	7,141,567	7141567

PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
(FROM MARTIN COUNTY LINE TO LAKE WORTH INLET AND FROM SOUTH LAKE WORTH INLET TO BROWARD COUNTY LINE)

GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE OCEAN RIDGE SEGMENT

APPENDIX 2

ECONOMIC ANALYSIS

APPENDIX 2
ECONOMIC ANALYSIS
PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE
OCEAN RIDGE SEGMENT

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APPENDIX 2
ECONOMIC ANALYSIS
PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE OCEAN RIDGE SEGMENT

DESCRIPTION OF STUDY AREA

2-1. The study area is located along the Atlantic shoreline of the Town of Ocean Ridge in Palm Beach County, Florida (see Figure 2-1). The study area extends 13,040 feet (2.5 miles) from 180 feet south of South Lake Worth Inlet to the corporate limit of Ocean Ridge and Briny Breezes. The project area is situated along the northernmost 7,520 feet of the study area.

PROJECT BENEFITS

2-2. The shore protection project provides both primary and incidental benefits. The primary benefits include storm damage benefits generated by a reduction in storm damage to upland structural improvements, infrastructure, coastal armor and backfill. The primary benefits also include loss of land benefits. Loss of land benefits accrue from a reduction in annual land area lost to historical (background) erosion. Incidental benefits include increased recreational capacity of the project shoreline as a result of increased beach width and improved shoreline stability. Increased recreational capacity serves to meet an existing and expected surplus demand of beach users on the project shoreline.

2-3. Both primary and incidental benefits may be used to justify a shore protection project; however, the economically optimum (NED) plan must be based solely on the primary benefits produced by the project. The economically optimum (NED) plan represents the project dimensions which maximize the primary net benefits (the primary benefits minus project costs). Guidelines provided in Engineering Regulation (ER) 1105-2-100 were used to determine the NED plan. Those guidelines were used to develop the economically optimum plan presented in this report. The Federal mandated project evaluation interest rate of 7 and 3/4 percent, a 50-year economic analysis period, and January, 1995 price levels were used to evaluate the economic feasibility of the plan.

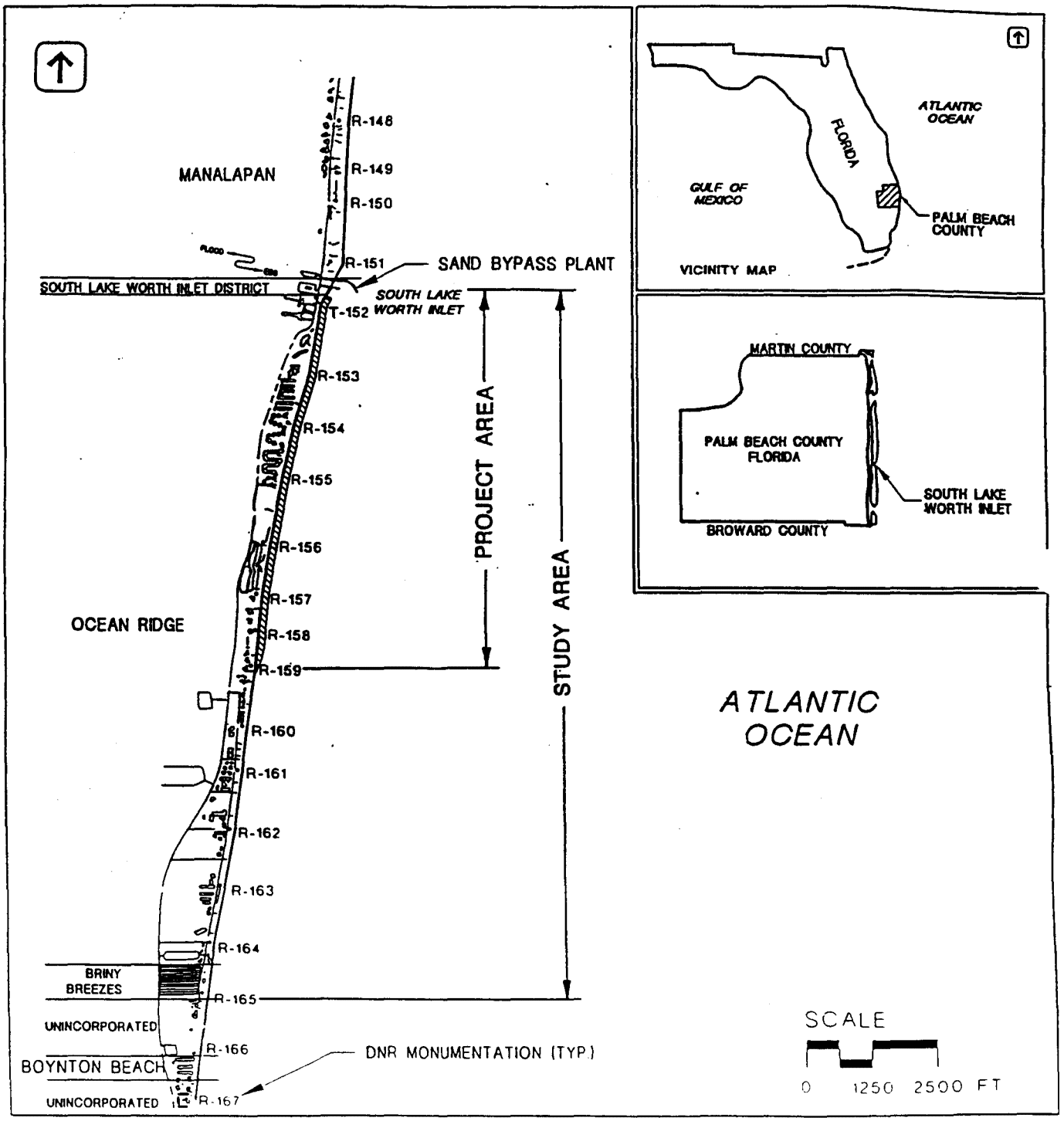

Figure 2-1: Location Map

PRIMARY BENEFITS

STORM DAMAGE BENEFITS

2-4. Storm damage benefits accrue from a reduction in storm damage to upland structures as a result of a shore protection project. Storm damage benefits are estimated by computing storm-induced damage to upland structures, infrastructure, and coastal armor with and without project conditions. The reduction in computed storm damage is equivalent to the storm damage benefit provided by the shore protection project.

2-5. Storm damage to upland structures, infrastructure, and coastal armor results from storm-induced shoreline recession. Shoreline recession causes structural damage by undermining structures and their foundations. Shoreline recession is principally related to the storm surge elevation of a storm event. Storm surge is an increase in the mean water level resulting from the superposition of the astronomical tides, wave-induced setup and a reduction in atmospheric pressure above the water column. However, storm surge alone does not directly cause profile recession. The wind-generated wave field superimposed upon the storm surge is the eroding mechanism that causes profile recession. The magnitude of profile recession for a given storm surge elevation is a function of the wave steepness (the ratio of wave height to wave length), the mean grain size of the beach material and the cross-shore configuration of the beach profile. Storm-induced shoreline recession as presented in this report is defined as the horizontal distance from the pre-storm bluffline to the furthest landward location of the erosion envelope. In this report, the bluffline is defined as the +9 ft National Geodetic Vertical Datum (NGVD) contour.

CALCULATION OF STORM DAMAGE

2-6. Storm damage to upland development, coastal armor, and upland property can be calculated using a probabilistic approach. Storm damage calculations involves the development of a relationship between bluffline recession estimates and storm events. From bluffline recession estimates for various storm events, a relationship is developed between bluffline recession and storm frequency. Using structure and property setback and footprint distances relative to bluffline recession estimates, a relationship is developed between bluffline recession and upland structure and property damage. Setback and footprint distances are determined from aerial photography and field inspection of the study area

oceanfront properties. The relationship between probability and damages is determined by tabulating damage estimates for various storm frequencies. Total damages are computed by integrating the annual probability of damage over the life of the project.

2-7. In this report, the storm-induced cross-shore profile change model SBEACH is used to compute storm-induced bluffline recession for various probabilistic storm surge and wave conditions (see Appendix 1). The annual equivalent damage to upland development is estimated using the storm damage model of Bodge (1990).

STORM DAMAGE MODEL

2-8. The storm damage model used in this study was developed by Bodge (1990). The model calculates the annual equivalent damages to upland land and structures along a reach of shoreline due to storm induced and historical (background) bluffline recession. The algorithm used in the development of the model complies with U.S. Federal guidelines regarding prediction of storm damage benefits of coastal works (U.S. Army, 1989).

2-9. The method requires that shorefront properties be grouped into contiguous, self-similar parcels. Self-similarity is based upon (1) beach profile characteristics, (2) property depth, (3) character of upland construction, (4) structural set-back, (5) structural footprint, (6) the type of shoreline armoring (if any), and (7) the historical erosion rate of adjacent properties. When cost sharing is an issue, self-similarity is also based on property ownership. In this study, publicly and privately owned properties were not grouped together. Figure 2-2 presents a typical layout of parcels and self-similar properties.

2-10. Storm damage is calculated for each parcel by "tracking" changes of the bluffline position of each parcel with respect to its initial location at year zero. The damage to structures due to either historical (background) or storm-induced erosion is expressed as a function of the bluffline's location relative to the structure's setback, footprint, and construction type. Herein, the "damage function" was developed so that (1) an entire slab on grade structure and the first two-floors of a multi-story embedded pile foundation structure are 100 percent damaged if the bluffline or storm recession extended through 50 percent of the structures's footprint and (2) structure damage is proportionally determined by calculating the ratio of the

horizontal distance eroded through the structure divided by the midpoint of the distance through the structure.

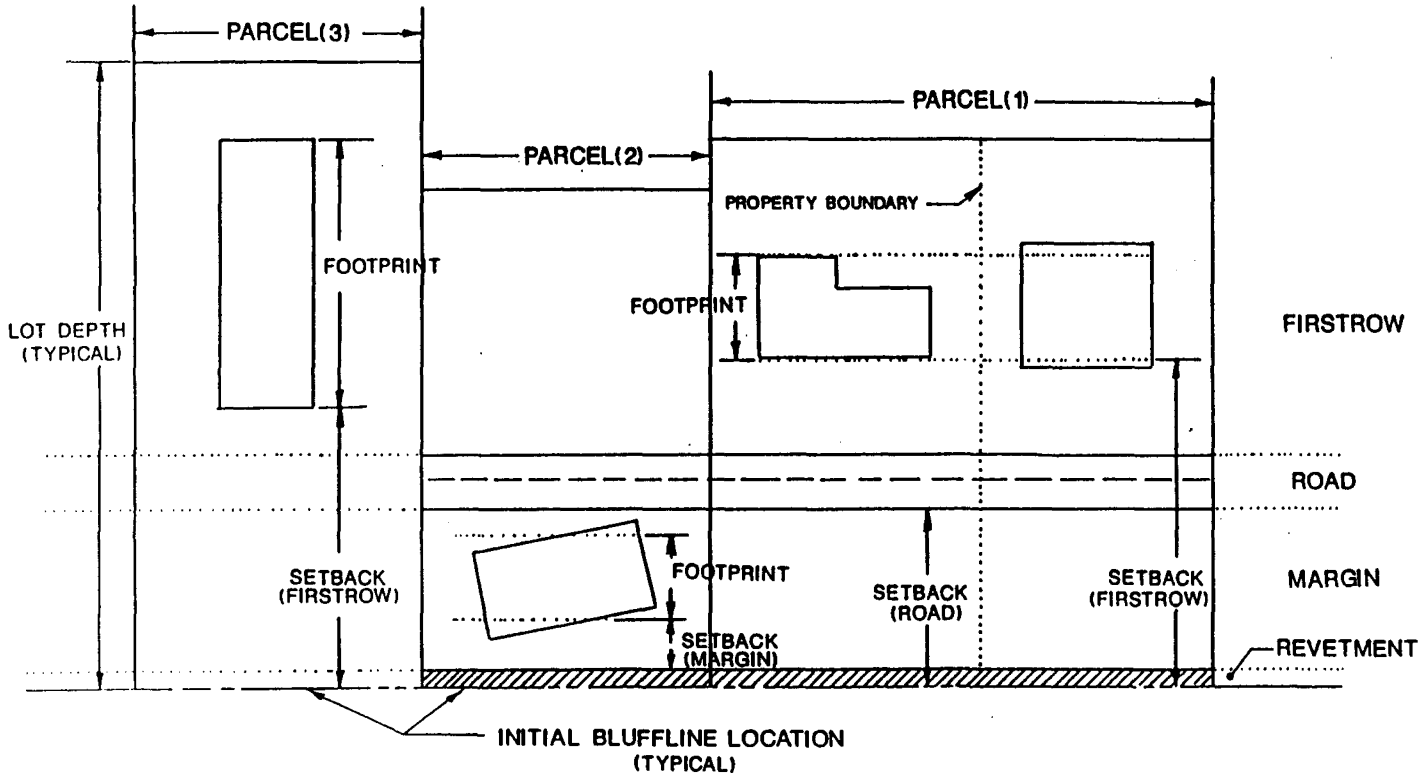

Figure 2-2: Conceptual Layout of Parcel Divisions

2-11. The expected annual damage caused by historical (background) erosion was determine directly in accordance with the above described relationship. The expected annual damage caused by storm-induced erosion was determine as the probabilistically-weighted sum of the damage associated with discrete storm events.

2-12. The potential for structure damage increases as the bluffline erodes toward the structure and decreases the setback distance. Likewise, the potential for damage decreases in the presence of a shore protection project which increases (or stabilizes) the setback distance. The damage model accounted for these changes for each parcel and for each year of the analysis. The computed damage for each parcel was then integrated over the economic life of the project to determine cumulative damages for each parcel and the entire project. Present worth and annual equivalent estimates of storm damage were computed using an 7 and 3/4 percent interest rate and a 50-year economic project life.

2-13. The primary assumptions considered in developing storm damage estimates are as follows:

1 _ The relationship of probability to bluffline recession is constant throughout the economic life of the project.

2 _ Damage to upland improvements will not occur until the bluffline location exceeds the seaward edge of the improvement.

3 _ Upland structures in a given parcel are assumed to totally fail (i.e., 100 percent damaged) in the year that:

a _ the combined damage from background erosion and storms exceeds 50 percent in a single year, and/or
b _ the bluffline eroded through over 50 percent of the structure, and/or

In the event that any of these conditions are met during the economic life of the project, the damaged structure is removed from the analysis.

4 _ When the shoreline recedes halfway through a structure which has a slab on grade foundation (i.e., one or two story structures), the structure is considered a total loss.

5 _ When the shoreline recedes halfway through a structure which has an embedded pile foundation (i.e., three or more story structures), only the value of the first two floors is considered a total loss.

6 _ Structural improvements are repaired at a cost equal to the percent damage times the initial value of the improvement. The initial value of the improvements is based upon the replacement cost new less depreciation method.

7 _ The cost to repair storm damaged pavement such as roads and parking areas is the same as the cost of new construction.

8 _ Repair of storm damaged structures, infrastructure, and coastal armor will result in full restoration of pre-storm conditions.

9 _ Only those structures currently existing along the study area are considered in storm damage calculations. Future development is not included.

10_ Repair cost to coastal armor is based upon the percent damage times the initial value of the structure. Backfill cost is implicitly included in the cost of armor replacement.

11_ It is assumed that mechanical bypassing around South Lake Worth Inlet will continue at current levels such that coastal armor will not fail due to increased background erosion. This implicitly assumes that enough material will be in-place along the shoreline in without project conditions to prevent armor toe instability.

12_ Along unarmored sections of the project shoreline, historical (background) shoreline recession may threaten upland structures. In that case the land owner may qualify for permits to protect that structure with small scale shore-hardening. This scenario is taken into account in this analysis in accordance with The Coastal Armoring Policy for the Florida Department of Natural Resources, Division of Beaches and Shores. It is assumed that all structures along the study area will be endangered by a 5 year event when the stable bluffline is within 20 feet of the seaward boundary of a structure. In accordance with State policy, all new coastal armor is 20 feet seaward of the endangered structure. To simulate a 10 year failure, a damage function is created that allows the structure to withstand the 9 year storm, but fail during the 10

year. Only land with structures that qualify for shore-hardening are used in the analysis.

13_ Storm damage benefits are provided by the design beach only. Benefits from the advance beach fill are not considered.

14_ Structure contents damage was not evaluated in this report.

MODEL SETUP AND PARCEL PHYSICAL DATA

2-14. Aerial photography, land use, and beach profile data were used to determine the self-similarity of properties along the study shoreline. The shorefront properties were grouped into forty-six self-similar parcels. Parcels 1 through 20 lie within the limits of the project area. Although storm damage to upland structures were computed for the entire study area, only storm damage benefits within the project area were used for plan optimization. Land use description and location of parcel boundaries along the study shoreline are presented in Table 2-1. Parcels and properties within the project area are presented in Table 2-2.

2-15. In addition to shore-perpendicular parcel divisions, the study shoreline was divided into four shore-parallel regions (see Figure 2-2). These divisions accommodate the shore-perpendicular non-uniformity of development along the study shoreline. For example, within a parcel there may be two to three structures located one behind the other from the bluffline. However, the storm damage model can only simulate damage to one structure per parcel. Therefore, if more than one structure is located on the property, in the shore-perpendicular direction, a separate simulation is required to simulate damage to structures beyond the first. In this study, the shore-parallel regions are defined as: 1) Revetment Region, 2) Margin Region, 3) Roadway Region, and 4) First Row Region. Each shore-parallel region was modeled as a separate shorefront. The damages computed in each region were combined to determine the total damage.

TABLE 2-1

OCEAN RIDGE STUDY AREA
LAND USE IDENTIFICATION BY PARCEL NUMBER

PARCEL	DISTANCE S. OF INLET (100's of FEET)	R-MONUMENT	LAND USE
1	1.80 - 4.15	(T-152)	Park,Parking,Restrooms
2	4.15 - 7.90		Vacant Land
3	7.90 - 9.40		Single Family
4	9.40 - 12.60		Condominium
5	12.60 - 15.00		Condominium
6	15.00 - 18.85	(R-153)	Condominium
7	18.85 - 25.50		Condominium
8	25.50 - 32.90	(R-154)	Condominium
9	32.90 - 35.70		Condominium
10	35.70 - 38.05		Condominium
11	38.05 - 40.00	(R-155)	Condominium
12	40.00 - 51.30		Vacant Land
13	51.30 - 62.00	(R-156;R-157)	Park,Parking,Restrooms
14	62.00 - 69.50	(R-158)	Single Family
15	69.50 - 72.50		Single Family
16	72.50 - 74.30		Single Family
17	74.30 - 74.40		Street End
18	74.40 - 75.00		Single Family
19	75.00 - 75.50	(R-159)	Single Family
20	75.50 - 77.00		Single Family
21	77.00 - 78.40		Single Family
22	78.35 - 80.80		Single Family
23	80.80 - 83.10		Single Family
24	83.10 - 83.70		Single Family
25	83.70 - 85.30		Single Family
26	85.30 - 87.60	(R-160)	Single Family
27	87.60 - 89.90		Single Family
28	89.90 - 91.80		Vacant Land
29	91.80 - 94.00		Single Family
30	94.00 - 97.50	(R-161)	Single Family
31	97.50 - 100.70		Condominium
32	100.70 - 102.40		Restaurant/Parking
33	102.40 - 103.80		Vacant Lot/Parking
34	103.80 - 106.30		Condominium
35	106.30 - 106.95		Single Family
36	106.95 - 108.45	(R-162)	Townhouse
37	108.45 - 109.60		Apartment
38	109.60 - 119.00	(R-163)	Single Family
39	119.00 - 125.15		Condominium
40	125.15 - 127.15		Vacant Land
41	127.15 - 129.00		Condominium
42	129.00 - 130.20		Vacant Land
43	130.20 - 131.15	(R-164)	Duplex
44	131.15 - 132.40		Single Family
45	132.40 - 133.10		Single Family
46	133.10 - 134.30		Duplex

Table 2-2: Project Area Property Data.

Parcel Number	Property Identification	Width of Shorefront	Setback from Initial Bluffline	Number of Floors	Structure Value
1	Park, Parking, Restrooms	235	230	1	523,300
2	Vacant Land	50	0	0	0
	Vacant Land	60	0	0	0
	Vacant Land	110	0	0	0
	Vacant Land	70	0	0	0
	Vacant Land	85	0	0	0
3	Single Family	150	20	1	348,255
4	Condominium	320	40	6	5,290,800
5	Condominium	240	70	5	9,682,100
6	Condominium	385	105	2	3,125,248
7	Condominium	210	70	2	1,676,856
	Condominium	255	70	2	8,532,302
	Condominium	200	70	2	5,204,532
8*	Condominium	740	40	2	6,651,289
9	Condominium	280	40	2	6,164,669
10	Condominium	235	40	2	5,409,605
11**	Condominium	195	40	4	1,355,300
12	Vacant Land	250	0	0	0
	Vacant Land	210	0	0	0
	Vacant Land	210	0	0	0
	Vacant Land	290	0	0	0
	Vacant Land	170	0	0	0
13	Park, Parking, Restrooms	660	55	1	414,200
	Park, Parking, Restrooms	200	55	1	14,443
	Park, Parking, Restrooms	165	55	1	14,443
	Park, Parking, Restrooms	45	55	1	14,443
14	Single Family	120	95	1	243,070
	Single Family	120	95	1	381,500
	Single Family	130	95	1	1,274,864
	Single Family	260	95	1	426,517
	Single Family	120	95	1	516,660
15	Single Family	300	130	1	915,491
16	Single Family	120	110	1	505,542
	Single Family	60	110	1	179,087
17	Street End	10	0	0	0
18	Single Family	60	100	1	247,975
19	Single Family	50	170	1	228,355
20	Single Family	150	100	1	1,012,719

* - The structure value for this parcel represents fourteen individual slab grade buildings. Only eight of these are located within the potential erosion envelop. The value of these eight buildings is divided between the margin and first row storm damage model input files (see Tables 2-3b and 2-3d).

**- There are three individual 4 story buildings on this lot - one behind the other. The structural value presented for this parcel is for only one building.

2-16. The revetment input file contains coastal armor data. The margin input file contains structure and land data located within the first 50 feet landward of the bluffline. The roadway input file contains roadway structure and land data for the parcels where A1A and Ocean Boulevard are located. The first row input file contains structure and land data for oceanfront properties not included in the first three regions.

2-17. Each region requires a separate input file for the storm damage simulation (see Tables 2-3a through 2-3d). Input includes:

(1)	Parcel No.	Parcel Number.
(2)	Range (Begin)	Distance from south jetty of South Lake Worth Inlet to *north boundary* of parcel.
(3)	Range (End)	Distance from south jetty of South Lake Worth Inlet to *south boundary* of parcel.
	(3)-(2) =	*Shorefront distance of parcel.*
(4)	Struct. Value	Value of structural improvement.
(5)	Rec. Ix.	Recession Index: Relates parcel to storm-recession curve.
(6)	dX/dT	Historical (background) erosion rate.
(7)	Bldg. Setback	Structure's setback from bluffline.
(8)	Bldg. Depth	Shore perpendicular horizontal dimension of structure.
(9)	Prop. Depth	Shore perpendicular horizontal dimension of parcel region. (Value for all four regions is equal to the total horizontal dimension of the parcels. Where the region depth equals -99 the land value is zero.)
(10)	Margin	Region's setback from bluffline.
(11)	Foot Type	Foundation index (1 = Slab-on-grade).

The bluffline for each parcel was identified using aerial photography and beach profile data. Aerial photography was also used to measure setback distances from the bluffline, structural footprints, and lot depths.

Table 2-3a: Revetment Input File.

Parcel No.	Range Begin (1000's ft)	Range End (1000's ft)	Struct. Value ($/1000)	Rec. Ix.	dX/dT (ft)	Bldg. SetBack (ft)	Bldg. Depth (ft)	Prop. Depth (ft)	Margin (ft)	Foot Type
1	0.180	0.415	157.6	1	-5.3	0.5	10	-99	0	1
2	0.415	0.790	251.4	1	-5.2	0.5	10	-99	0	1
3	0.790	0.940	40.6	1	-5.1	0.5	10	-99	0	1
4	0.940	1.260	214.5	1	-5.0	0.5	10	-99	0	1
5	1.260	1.500	220.9	1	-4.9	0.5	10	-99	0	1
6	1.500	1.885	104.1	2	-4.8	0.5	10	-99	0	1
7	1.885	2.550	179.8	2	-4.6	0.5	10	-99	0	1
8	2.550	3.290	200.1	1	-4.4	35	10	-99	0	1
9	3.290	3.570	187.7	1	-4.2	0.5	10	-99	0	1
10	3.570	3.805	157.6	1	-4.1	0.5	10	-99	0	1
11	3.805	4.000	130.7	1	-4.1	35	10	-99	0	1
12	4.000	5.130	0.0	3	-3.8	0.5	0	-99	0	1
13	5.130	6.200	0.0	3	-3.5	0.5	0	-99	0	1
14	6.200	6.950	0.0	3	-3.2	0.5	0	-99	0	1
15	6.950	7.250	81.1	1	-3.0	0.5	10	-99	0	1
16	7.250	7.430	0.0	3	-2.9	0.5	0	-99	0	1
17	7.430	7.440	0.0	3	-2.9	0.5	0	-99	0	1
18	7.440	7.500	0.0	3	-2.9	0.5	0	-99	0	1
19	7.500	7.550	0.0	3	-2.9	0.5	0	-99	0	1
20	7.550	7.700	0.0	3	-2.8	0.5	0	-99	0	1
21	7.700	7.835	0.0	3	-2.8	0.5	0	-99	0	1
22	7.835	8.080	164.3	1	-2.7	0.5	10	-99	0	1
23	8.080	8.310	0.0	3	-2.6	0.5	0	-99	0	1
24	8.310	8.370	0.0	3	-2.6	0.5	0	-99	0	1
25	8.370	8.530	0.0	3	-2.6	0.5	0	-99	0	1
26	8.530	8.760	154.2	1	-2.5	0.5	10	-99	0	1
27	8.760	8.990	0.0	3	-2.4	0.5	0	-99	0	1
28	8.990	9.180	0.0	3	-2.3	0.5	0	-99	0	1
29	9.180	9.400	0.0	3	-2.3	0.5	0	-99	0	1
30	9.400	9.750	0.0	3	-2.2	0.5	0	-99	0	1
31	9.750	10.070	0.0	3	-2.1	0.5	0	-99	0	1
32	10.070	10.240	0.0	3	-2.0	0.5	0	-99	0	1
33	10.240	10.380	0.0	3	-1.9	0.5	0	-99	0	1
34	10.380	10.630	0.0	3	-1.9	0.5	0	-99	0	1
35	10.630	10.695	17.6	1	-1.8	0.5	10	-99	0	1
36	10.695	10.845	0.0	3	-1.8	0.5	0	-99	0	1
37	10.845	10.960	0.0	3	-1.7	0.5	0	-99	0	1
38	10.960	11.900	0.0	3	-1.6	0.5	0	-99	0	1
39	11.900	12.515	0.0	3	-1.3	0.5	0	-99	0	1
40	12.515	12.715	0.0	3	-1.2	0.5	0	-99	0	1
41	12.715	12.900	0.0	3	-1.1	0.5	0	-99	0	1
42	12.900	13.020	0.0	3	-1.1	0.5	0	-99	0	1
43	13.020	13.115	0.0	3	-1.0	0.5	0	-99	0	1
44	13.115	13.240	0.0	3	-1.0	0.5	0	-99	0	1
45	13.240	13.310	46.9	1	-1.0	0.5	10	-99	0	1
46	13.310	13.430	80.5	1	-0.9	0.5	10	-99	0	1

Table 2-3b: Margin Input File.

Parcel No.	Range Begin (1000's ft)	Range End (1000's ft)	Struct. Value ($/1000)	Rec. Ix.	dX/dT (ft)	Bldg. SetBack (ft)	Bldg. Depth (ft)	Prop. Depth (ft)	Margin (ft)	Foot Type
1	0.180	0.415	0.0	1	-5.3	0	0	10	0	1
2	0.415	0.790	0.0	1	-5.2	0	0	13	0	1
3	0.790	0.940	348.3	1	-5.1	20	40	100	0	1
4	0.940	1.260	0.0	1	-5.0	0	0	40	0	1
5	1.260	1.500	0.0	1	-4.9	0	0	70	0	1
6	1.500	1.885	0.0	2	-4.8	0	0	80	0	1
7	1.885	2.550	0.0	2	-4.6	0	0	80	0	1
8	2.550	3.290	1900.4	1	-4.4	0	0	35	0	1
9	3.290	3.570	0.0	1	-4.2	0	0	30	0	1
10	3.570	3.805	0.0	1	-4.1	0	0	40	0	1
11	3.805	4.000	0.0	1	-4.1	0	0	35	0	1
12	4.000	5.130	0.0	3	-3.8	0	0	60	0	1
13	5.130	6.200	0.0	3	-3.5	0	0	60	0	1
14	6.200	6.950	0.0	3	-3.2	0	0	85	0	1
15	6.950	7.250	0.0	1	-3.0	0	0	75	0	1
16	7.250	7.430	0.0	3	-2.9	0	0	75	0	1
17	7.430	7.440	0.0	3	-2.9	0	0	75	0	1
18	7.440	7.500	0.0	3	-2.9	0	0	75	0	1
19	7.500	7.550	0.0	3	-2.9	0	0	75	0	1
20	7.550	7.700	0.0	3	-2.8	0	0	75	0	1
21	7.700	7.835	0.0	3	-2.8	0	0	75	0	1
22	7.835	8.080	0.0	1	-2.7	0	0	75	0	1
23	8.080	8.310	254.3	3	-2.6	60	55	130	0	1
24	8.310	8.370	176.8	3	-2.6	60	50	120	0	1
25	8.370	8.530	428.2	3	-2.6	60	45	120	0	1
26	8.530	8.760	428.7	1	-2.5	60	50	85	0	1
27	8.760	8.990	0.0	3	-2.4	0	0	70	0	1
28	8.990	9.180	0.0	3	-2.3	0	0	60	0	1
29	9.180	9.400	0.0	3	-2.3	0	0	60	0	1
30	9.400	9.750	0.0	3	-2.2	0	0	50	0	1
31	9.750	10.070	0.0	3	-2.1	0	0	50	0	1
32	10.070	10.240	0.0	3	-2.0	0	0	40	0	1
33	10.240	10.380	0.0	3	-1.9	0	0	40	0	1
34	10.380	10.630	0.0	3	-1.9	0	0	40	0	1
35	10.630	10.695	251.8	1	-1.8	10	35	60	0	1
36	10.695	10.845	0.0	3	-1.8	0	0	40	0	1
37	10.845	10.960	0.0	3	-1.7	0	0	45	0	1
38	10.960	11.900	0.0	3	-1.6	0	0	50	0	1
39	11.900	12.515	0.0	3	-1.3	0	0	60	0	1
40	12.515	12.715	0.0	3	-1.2	0	0	60	0	1
41	12.715	12.900	0.0	3	-1.1	0	0	70	0	1
42	12.900	13.020	0.0	3	-1.1	0	0	75	0	1
43	13.020	13.115	0.0	3	-1.0	0	0	75	0	1
44	13.115	13.240	0.0	3	-1.0	0	0	70	0	1
45	13.240	13.310	207.2	1	-1.0	15	40	70	0	1
46	13.310	13.430	467.2	1	-0.9	5	65	100	0	1

Table 2-3c: Road Input File.

Parcel No.	Range Begin (1000's ft)	Range End (1000's ft)	Struct. Value ($/1000)	Rec. Ix.	dX/dT (ft)	Bldg. SetBack (ft)	Bldg. Depth (ft)	Prop. Depth (ft)	Margin (ft)	Foot Type
1	0.180	0.415	11.8	1	-5.3	18	25	40	10	1
2	0.415	0.790	18.8	1	-5.2	21	25	40	13	1
3	0.790	0.940	7.5	1	-5.1	108	25	40	100	1
4	0.940	1.260	0.0	1	-5.0	0	0	-99	0	1
5	1.260	1.500	0.0	1	-4.9	0	0	-99	0	1
6	1.500	1.885	0.0	2	-4.8	0	0	-99	0	1
7	1.885	2.550	0.0	2	-4.6	0	0	-99	0	1
8	2.550	3.290	0.0	1	-4.4	0	0	-99	0	1
9	3.290	3.570	0.0	1	-4.2	0	0	-99	0	1
10	3.570	3.805	0.0	1	-4.1	0	0	-99	0	1
11	3.805	4.000	0.0	1	-4.1	0	0	-99	0	1
12	4.000	5.130	0.0	3	-3.8	0	0	-99	0	1
13	5.130	6.200	0.0	3	-3.5	0	0	-99	0	1
14	6.200	6.950	0.0	3	-3.2	0	0	-99	0	1
15	6.950	7.250	0.0	1	-3.0	0	0	-99	0	1
16	7.250	7.430	0.0	3	-2.9	0	0	-99	0	1
17	7.430	7.440	0.0	3	-2.9	0	0	-99	0	1
18	7.440	7.500	0.0	3	-2.9	0	0	-99	0	1
19	7.500	7.550	0.0	3	-2.9	0	0	-99	0	1
20	7.550	7.700	0.0	3	-2.8	0	0	-99	0	1
21	7.700	7.835	0.0	3	-2.8	0	0	-99	0	1
22	7.835	8.080	0.0	1	-2.7	0	0	-99	0	1
23	8.080	8.310	11.5	3	-2.6	138	25	40	130	1
24	8.310	8.370	3.0	3	-2.6	128	25	40	120	1
25	8.370	8.530	8.0	3	-2.6	128	25	40	120	1
26	8.530	8.760	11.5	1	-2.5	93	25	40	85	1
27	8.760	8.990	11.5	3	-2.4	78	25	40	70	1
28	8.990	9.180	9.5	3	-2.3	68	25	40	60	1
29	9.180	9.400	11.0	3	-2.3	68	25	40	60	1
30	9.400	9.750	17.5	3	-2.2	58	25	40	50	1
31	9.750	10.070	16.0	3	-2.1	58	25	40	50	1
32	10.070	10.240	8.5	3	-2.0	48	25	40	40	1
33	10.240	10.380	7.0	3	-1.9	48	25	40	40	1
34	10.380	10.630	12.5	3	-1.9	48	25	40	40	1
35	10.630	10.695	3.3	1	-1.8	68	25	40	60	1
36	10.695	10.845	7.5	3	-1.8	48	25	40	40	1
37	10.845	10.960	5.8	3	-1.7	53	25	40	45	1
38	10.960	11.900	47.0	3	-1.6	58	25	40	50	1
39	11.900	12.515	30.8	3	-1.3	68	25	40	60	1
40	12.515	12.715	10.0	3	-1.2	68	25	40	60	1
41	12.715	12.900	9.3	3	-1.1	78	25	40	70	1
42	12.900	13.020	6.0	3	-1.1	83	25	40	75	1
43	13.020	13.115	4.8	3	-1.0	83	25	40	75	1
44	13.115	13.240	6.3	3	-1.0	78	25	40	70	1
45	13.240	13.310	3.5	1	-1.0	78	25	40	70	1
46	13.310	13.430	6.0	1	-0.9	108	25	40	100	1

Table 2-3d: First Row Input File.

Parcel No.	Range Begin (1000's ft)	Range End (1000's ft)	Struct. Value ($/1000)	Rec. Ix.	dX/dT (ft)	Bldg. SetBack (ft)	Bldg. Depth (ft)	Prop. Depth (ft)	Margin (ft)	Foot Type
1	0.180	0.415	523.3	1	-5.3	230	85	290	50	1
2	0.415	0.790	0.0	1	-5.2	0	0	347	53	1
3	0.790	0.940	0.0	1	-5.1	0	0	190	140	1
4	0.940	1.260	1922.3	1	-5.0	41	155	230	40	1
5	1.260	1.500	4221.4	1	-4.9	71	250	320	70	1
6	1.500	1.885	3125.2	2	-4.8	130	175	320	80	1
7	1.885	2.550	15413.7	2	-4.6	91	290	370	80	1
8	2.550	3.290	1900.4	1	-4.4	40	100	105	35	1
9	3.290	3.570	6164.7	1	-4.2	40	350	390	30	1
10	3.570	3.805	5409.6	1	-4.1	40	290	320	40	1
11	3.805	4.000	677.7	1	-4.1	40	90	105	35	1
12	4.000	5.130	0.0	3	-3.8	0	0	280	60	1
13	5.130	6.200	457.5	3	-3.5	61	110	290	60	1
14	6.200	6.950	2842.6	3	-3.2	101	80	295	85	1
15	6.950	7.250	839.9	1	-3.0	155	30	275	75	1
16	7.250	7.430	628.1	3	-2.9	125	55	295	75	1
17	7.430	7.440	0.0	3	-2.9	0	0	295	75	1
18	7.440	7.500	227.5	3	-2.9	100	70	295	75	1
19	7.500	7.550	209.5	3	-2.9	170	70	295	75	1
20	7.550	7.700	929.1	3	-2.8	100	70	295	75	1
21	7.700	7.835	1501.0	3	-2.8	100	70	235	75	1
22	7.835	8.080	1578.9	1	-2.7	125	50	205	75	1
23	8.080	8.310	0.0	3	-2.6	0	0	190	170	1
24	8.310	8.370	280.0	3	-2.6	190	60	200	160	1
25	8.370	8.530	0.0	3	-2.6	0	0	200	160	1
26	8.530	8.760	680.0	1	-2.5	150	70	200	125	1
27	8.760	8.990	1390.1	3	-2.4	135	120	190	110	1
28	8.990	9.180	0.0	3	-2.3	0	0	200	100	1
29	9.180	9.400	1649.6	3	-2.3	155	80	200	100	1
30	9.400	9.750	631.6	3	-2.2	120	55	120	90	1
31	9.750	10.070	5391.0	3	-2.1	125	200	280	90	1
32	10.070	10.240	239.5	3	-2.0	360	55	345	80	1
33	10.240	10.380	0.0	3	-1.9	0	0	345	80	1
34	10.380	10.630	3708.9	3	-1.9	130	240	290	80	1
35	10.630	10.695	157.9	1	-1.8	120	40	160	100	1
36	10.695	10.845	473.7	3	-1.8	100	40	160	80	1
37	10.845	10.960	526.3	3	-1.7	90	50	50	85	1
38	10.960	11.900	906.4	3	-1.6	135	115	170	90	1
39	11.900	12.515	6004.4	3	-1.3	140	135	190	100	1
40	12.515	12.715	0.0	3	-1.2	0	0	260	100	1
41	12.715	12.900	2344.7	3	-1.1	150	200	290	110	1
42	12.900	13.020	0.0	3	-1.1	0	0	110	115	1
43	13.020	13.115	189.5	3	-1.0	145	40	85	115	1
44	13.115	13.240	477.6	3	-1.0	150	60	125	110	1
45	13.240	13.310	0.0	1	-1.0	0	0	120	110	1
46	13.310	13.430	368.4	1	-0.9	180	70	150	140	1

Note: The structure values for multi-story buldings -- parcels 4, 5 and 11 -- have been adjusted to reflect the value of only the first two floors.

STRUCTURAL IMPROVEMENT AND INFRASTRUCTURE VALUES

2-18. Structures. For this study, a real estate appraisal of oceanfront structures and both oceanfront and nearshore (non-oceanfront) lands was performed by a certified real estate appraiser. The appraisal was developed from a gross valuation of properties based on percentage adjustments to property tax assessments by the Palm Beach County Property Appraiser's Office. The appraisal included single and multi-family residences and commercial buildings. Property appraisal data and estimates of structural improvement values provided by the Jacksonville District Corps of Engineers Planning Branch were also examined. Using the available appraisal data, structure values were estimated using the Replacement Cost New Less Depreciation method. The aged-life depreciation method was then used to estimate accrued depreciation.

2-19. In this report, it was assumed that all multi-story structures (3 stories or greater) along the study area have deeply embedded pile foundations. Because this type of foundation may limit damage to the entire structure, it is assumed that only the first two floors of multi-story structures would be damaged. During failure of the first two floors, it is expected the higher floors would remain anchored to the columns. Structures of two stories of less are assumed to be on slabs or short post foundations which would incur damage up to the full structural value.

2-20. Roadway. The roadway was valued based upon a gross estimate of construction time and materials for asphalt surface. The roadway is valued as $\$2.00/ft^2$.

2-21. Coastal Armor. The value of seawalls and revetments along the project were estimated based upon construction type and material. Field inspections were conducted to estimate the size, type and condition of all coastal armor along the project area. Additionally, cost information for the coastal armor along the project area was provided by the Palm Beach County Department of Environmental Resources Management (DERM). The value per lineal foot of coastal armor is presented in Table 2-4.

2-22. When coastal armor fails, beach compatible sand material must be placed as backfill behind the reconstructed armor. The cost of backfill and vegetation is also added to the model input. The value of $1.43 is the dollar price per cubic foot times the depth of backfill replacement (assuming a uniform depth of 2 feet).

Table 2-4

COASTAL ARMOR DATA

DESCRIPTION OF STRUCTURE	UNIT COST ($/FT)
STONE RUBBLE	200
CONCRETE WALL SHEETPILE WALL W/CONCRETE CAP	600
CONCRETE WALL WITH TOE PROTECTION	850

CALCULATION OF STORM DAMAGE BENEFITS

2-23. Storm damage prevention benefits accrue from a reduction in storm damage to upland structural improvements with- and without-project conditions. With-project damages represent the value of structural damage that would occur if the shore protection project is implemented, where as, without-project damages represent the value of structural damage that would occur if a shore protection project is not implemented. The storm damage prevention benefits are the difference between the value of damage with and without the project. Project area and downdrift damages were computed for without- and with-project conditions. Only computed damages within the project area were used to compute primary project benefits. Downdrift benefits are considered incidental. The average annual value of parcel-by-parcel damage for without- and with-project conditions are presented in Tables 2-5 and 2-6, respectively. The year-by-year stream of average annual damages without and with the project are presented in Tables 2-7 and 2-8. The average annual damages were appropriately amortized and discounted using an 7 and 3/4 percent interest rate and a 50-year project life.

Table 2-5

Damage by Parcel (Without Project)
(Average Annual - 1000's of Dollars)

Interest Rate = 7.75% **Damages Through Yr 50**

Parcel	Margin	First	Revt	Road	Total
1	0.0	0.0	11.1	0.8	11.9
2	0.0	0.0	17.6	1.3	18.9
3	24.4	0.0	2.9	0.1	27.4
4	0.0	68.3	15.1	0.0	83.4
5	0.0	42.7	15.5	0.0	58.2
6	0.0	24.8	15.7	0.0	40.5
7	0.0	204.0	27.2	0.0	231.2
8	115.9	5.9	14.0	0.0	135.8
9	0.0	126.9	13.2	0.0	140.1
10	0.0	126.6	11.1	0.0	137.7
11	0.0	42.8	9.2	0.0	52.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	53.4	0.0	0.0	53.4
14	0.0	204.6	0.0	0.0	204.6
15	0.0	0.2	5.7	0.0	5.9
16	0.0	26.6	0.0	0.0	26.6
17	0.0	0.0	0.0	0.0	0.0
18	0.0	17.0	0.0	0.0	17.0
19	0.0	1.8	0.0	0.0	1.8
20	0.0	67.0	0.0	0.0	67.0
project	**140.3**	**1012.6**	**158.3**	**2.2**	**1313.4**
21	0.0	28.2	0.0	0.0	28.2
22	0.0	3.2	11.5	0.0	14.7
23	24.1	0.0	0.0	0.1	24.2
24	17.1	0.0	0.0	0.0	17.1
25	42.0	0.0	0.0	0.1	42.1
26	11.6	0.3	10.8	0.2	22.9
27	0.0	24.7	0.0	1.3	26.0
28	0.0	0.0	0.0	1.2	1.2
29	0.0	14.8	0.0	1.3	16.1
30	0.0	25.0	0.0	2.6	27.6
31	0.0	79.7	0.0	2.3	82.0
32	0.0	0.0	0.0	1.6	1.6
33	0.0	0.0	0.0	1.2	1.2
34	0.0	33.6	0.0	2.3	35.9
35	17.7	3.6	0.9	0.2	22.4
36	0.0	30.1	0.0	1.4	31.5
37	0.0	39.8	0.0	0.9	40.7
38	0.0	8.4	0.0	6.4	14.8
39	0.0	26.1	0.0	3.2	29.3
40	0.0	0.0	0.0	1.0	1.0
41	0.0	2.6	0.0	0.7	3.3
42	0.0	0.0	0.0	0.4	0.4
43	0.0	0.7	0.0	0.4	1.1
44	0.0	0.9	0.0	0.4	1.3
45	14.5	0.0	2.9	0.3	17.7
46	32.7	0.0	5.0	0.2	37.9
downdrift	**159.7**	**321.7**	**31.1**	**29.7**	**542.2**

Table 2-6

Damage by Parcel (With Project)
(Average Annual - 1000's of Dollars)

Interest Rate = 7.75% **Damages Through Yr 50**

Parcel	Margin	First	Revt	Road	Total	Benefit
1	0.0	0.0	4.3	0.3	4.6	7.3
2	0.0	0.0	6.8	0.5	7.3	11.6
3	8.8	0.0	1.1	0.0	9.9	17.5
4	0.0	6.5	5.8	0.0	12.3	71.1
5	0.0	2.0	6.0	0.0	8.0	50.2
6	0.0	1.8	7.3	0.0	9.1	31.4
7	0.0	25.6	12.6	0.0	38.2	193.0
8	9.3	0.0	4.0	0.0	13.3	122.5
9	0.0	11.9	5.1	0.0	17.0	123.1
10	0.0	11.7	4.3	0.0	16.0	121.7
11	0.0	3.5	2.6	0.0	6.1	45.9
12	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.8	0.0	0.0	0.8	52.6
14	0.0	0.0	0.0	0.0	0.0	204.6
15	0.0	0.0	2.2	0.0	2.2	3.7
16	0.0	0.0	0.0	0.0	0.0	26.6
17	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	17.0
19	0.0	0.0	0.0	0.0	0.0	1.8
20	0.0	0.0	0.0	0.0	0.0	67.0
project	**18.1**	**63.8**	**62.1**	**0.8**	**144.8**	**1168.6**
21	0.0	0.0	0.0	0.0	0.0	28.2
22	0.0	0.3	11.5	0.0	11.8	2.9
23	8.1	0.0	0.0	0.0	8.1	16.1
24	7.5	0.0	0.0	0.0	7.5	9.6
25	21.3	0.0	0.0	0.0	21.3	20.8
26	10.4	0.2	10.8	0.2	21.6	1.3
27	0.0	1.3	0.0	0.8	2.1	23.9
28	0.0	0.0	0.0	0.7	0.7	0.5
29	0.0	0.0	0.0	0.8	0.8	15.3
30	0.0	5.4	0.0	1.3	6.7	20.9
31	0.0	8.1	0.0	1.1	9.2	72.8
32	0.0	0.0	0.0	0.6	0.6	1.0
33	0.0	0.0	0.0	0.5	0.5	0.7
34	0.0	4.0	0.0	0.9	4.9	31.0
35	17.7	3.6	0.9	0.2	22.4	0.0
36	0.0	12.8	0.0	0.6	13.4	18.1
37	0.0	23.0	0.0	0.4	23.4	17.3
38	0.0	0.9	0.0	3.3	4.2	10.6
39	0.0	1.5	0.0	2.2	3.7	25.6
40	0.0	0.0	0.0	0.7	0.7	0.3
41	0.0	0.0	0.0	0.6	0.6	2.7
42	0.0	0.0	0.0	0.4	0.4	0.0
43	0.0	0.0	0.0	0.3	0.3	0.8
44	0.0	0.0	0.0	0.4	0.4	0.9
45	14.5	0.0	2.9	0.3	17.7	0.0
46	32.7	0.0	5.0	0.2	37.9	0.0
downdrift	**112.2**	**61.1**	**31.1**	**16.5**	**220.9**	**321.3**

Table 2-7

Damage by Year (Without Project)
(Average Annual - 1000's of Dollars)

Interest Rate = 7.75% **Damages Through Yr 50**

Year	Margin	First	Revt	Road	Total
1995	8.1	51.8	11.8	0.3	72.0
1996	8.0	50.1	10.9	0.2	69.2
1997	7.8	46.5	10.1	0.2	64.6
1998	7.7	45.5	9.4	0.2	62.8
1999	7.4	43.9	8.6	0.2	60.1
2000	7.2	42.2	8.0	0.1	57.5
2001	6.9	40.2	7.4	0.1	54.6
2002	6.5	38.1	6.9	0.1	51.6
2003	6.1	37.1	6.4	0.1	49.7
2004	5.6	35.1	5.9	0.1	46.7
2005	5.2	33.1	5.5	0.1	43.9
2006	4.8	31.6	5.1	0.1	41.6
2007	4.5	30.2	4.8	0.1	39.6
2008	4.2	28.7	4.4	0.1	37.4
2009	3.9	28.7	4.1	0.1	36.8
2010	3.6	27.5	3.8	0.1	35.0
2011	3.3	27.4	3.5	0.0	34.2
2012	3.1	26.0	3.3	0.0	32.4
2013	2.9	27.0	3.1	0.0	33.0
2014	2.7	20.2	2.8	0.0	25.7
2015	2.5	18.9	2.6	0.0	24.0
2016	2.3	18.0	2.4	0.0	22.7
2017	2.1	18.2	2.3	0.0	22.6
2018	2.0	18.2	2.1	0.0	22.3
2019	1.8	18.0	1.9	0.0	21.7
2020	1.7	17.7	1.8	0.0	21.2
2021	1.6	17.4	1.7	0.0	20.7
2022	1.5	16.9	1.6	0.0	20.0
2023	1.4	17.8	1.5	0.0	20.7
2024	1.3	17.8	1.3	0.0	20.4
2025	1.2	17.9	1.2	0.0	20.3
2026	1.1	17.8	1.2	0.0	20.1
2027	1.0	23.0	1.1	0.0	25.1
2028	0.9	8.0	1.0	0.0	9.9
2029	0.9	7.8	0.9	0.0	9.6
2030	0.8	7.9	0.9	0.0	9.6
2031	0.7	7.8	0.8	0.0	9.3
2032	0.7	3.9	0.7	0.0	5.3
2033	0.6	3.6	0.7	0.0	4.9
2034	0.6	3.6	0.6	0.0	4.8
2035	0.6	3.5	0.6	0.0	4.7
2036	0.5	3.4	0.5	0.0	4.4
2037	0.5	3.2	0.5	0.0	4.2
2038	0.4	2.0	0.5	0.0	2.9
2039	0.4	1.9	0.4	0.0	2.7
2040	0.4	1.7	0.4	0.0	2.5
2041	0.4	1.6	0.4	0.0	2.4
2042	0.3	1.5	0.3	0.0	2.1
2043	0.3	1.4	0.3	0.0	2.0
2044	0.3	1.3	0.3	0.0	1.9
project	**140.3**	**1012.6**	**158.3**	**2.2**	**1313.4**

Table 2-8

Damage by Year (With Project)

(Average Annual - 1000's of Dollars)

Interest Rate = 7.75% **Damages Through Yr 50**

Year	Margin	First	Revt	Road	Total	*Benefit*
1995	1.4	5.2	4.5	0.2	11.3	*60.7*
1996	1.2	4.0	4.2	0.2	9.6	*59.6*
1997	1.2	4.0	3.9	0.1	9.2	*55.4*
1998	1.0	3.4	3.7	0.1	8.2	*54.6*
1999	1.0	4.0	3.5	0.1	8.6	*51.5*
2000	0.9	3.2	3.1	0.1	7.3	*50.2*
2001	0.9	3.0	2.9	0.0	6.8	*47.8*
2002	0.8	2.1	2.7	0.0	5.6	*46.0*
2003	0.8	3.1	2.5	0.0	6.4	*43.3*
2004	0.6	2.0	2.3	0.0	4.9	*41.8*
2005	0.7	2.6	2.2	0.0	5.5	*38.4*
2006	0.5	1.5	2.1	0.0	4.1	*37.5*
2007	0.6	2.3	1.9	0.0	4.8	*34.8*
2008	0.5	2.0	1.7	0.0	4.2	*33.2*
2009	0.5	1.4	1.6	0.0	3.5	*33.3*
2010	0.4	1.8	1.5	0.0	3.7	*31.3*
2011	0.4	1.1	1.4	0.0	2.9	*31.3*
2012	0.3	1.6	1.3	0.0	3.2	*29.2*
2013	0.4	1.1	1.2	0.0	2.7	*30.3*
2014	0.3	1.3	1.1	0.0	2.7	*23.0*
2015	0.3	0.9	1.0	0.0	2.2	*21.8*
2016	0.3	1.0	1.0	0.0	2.3	*20.4*
2017	0.3	0.9	0.9	0.0	2.1	*20.5*
2018	0.2	0.9	0.8	0.0	1.9	*20.4*
2019	0.2	0.7	0.8	0.0	1.7	*20.0*
2020	0.2	0.8	0.7	0.0	1.7	*19.5*
2021	0.2	0.7	0.7	0.0	1.6	*19.1*
2022	0.2	0.5	0.6	0.0	1.3	*18.7*
2023	0.2	0.7	0.6	0.0	1.5	*19.2*
2024	0.1	0.5	0.5	0.0	1.1	*19.3*
2025	0.1	0.5	0.5	0.0	1.1	*19.2*
2026	0.1	0.4	0.5	0.0	1.0	*19.1*
2027	0.1	0.5	0.4	0.0	1.0	*24.1*
2028	0.1	0.4	0.4	0.0	0.9	*9.0*
2029	0.1	0.4	0.4	0.0	0.9	*8.7*
2030	0.1	0.3	0.3	0.0	0.7	*8.9*
2031	0.1	0.4	0.3	0.0	0.8	*8.5*
2032	0.1	0.3	0.3	0.0	0.7	*4.6*
2033	0.1	0.3	0.3	0.0	0.7	*4.2*
2034	0.1	0.3	0.2	0.0	0.6	*4.2*
2035	0.1	0.2	0.2	0.0	0.5	*4.2*
2036	0.1	0.2	0.2	0.0	0.5	*3.9*
2037	0.1	0.2	0.2	0.0	0.5	*3.7*
2038	0.1	0.2	0.2	0.0	0.5	*2.4*
2039	0.1	0.2	0.2	0.0	0.5	*2.2*
2040	0.0	0.2	0.2	0.0	0.4	*2.1*
2041	0.0	0.1	0.1	0.0	0.2	*2.2*
2042	0.0	0.2	0.1	0.0	0.3	*1.8*
2043	0.0	0.1	0.1	0.0	0.2	*1.8*
2044	0.0	0.1	0.1	0.0	0.2	*1.7*
project	**18.1**	**63.8**	**62.1**	**0.8**	**144.8**	***1168.6***

COMPARISON OF STORM DAMAGE MODELS

2-24. The storm damage model used in this report was developed by Bodge (1990). This model differs from the storm damage model typically used by the Jacksonville District Corps of Engineers (SDM) only in the method by which the storm-induced beach profile recession is represented the model. The Bodge model requires that a unique beach profile be used for various beach and coastal armor conditions along the project shoreline, unlike the SDM which requires only one typical profile to represent the entire project shoreline. A comparison was conducted to determine if the two methods produce similar estimates of storm-induced damage along the project shoreline.

2-25. In addition to the three profiles used to represent the project shoreline in the Bodge model, one typical profile was developed for the Ocean Ridge shoreline. These typical profiles were developed using the February, 1993 beach profile data collected along the project shoreline. These profiles, along with the surge and water level conditions presented above, were used as input to SBEACH (see Appendix 1). The SBEACH results for the single profile were used as input to the Jacksonville District's SDM. The SBEACH results for the three typical profiles were used as input to the Bodge model. Storm damage estimates computed with the SDM and the Bodge model are presented in the Table 2-9. From inspection of the table, it is evident that the two methods produce similar storm damage estimates.

Table 2-9: Comparison of Storm Damage Estimates.

		Average Annual Storm Damage Estimate (1000's of $)	
Storm Damage Model	Number of Profiles	Using 0.1 ft Erosion Scarp	Using 0.5 ft Erosion Scarp
SDM	1	$1,980.7	$1,351.1
Bodge	3	$2,040.8	$1,313.4

LOSS OF LAND BENEFITS

2-26. Loss of land benefits accrue from a reduction in the amount of land damaged by historical (background) shoreline erosion with and without project conditions. Land damages are estimated using historical shoreline change rates characteristic of the project shoreline, the areal dimensions of oceanfront properties and parcels, and an estimate of the current market value of land along the project shoreline. Historical shoreline change rates for each parcel were developed in Appendix 1. Property and parcel dimensions were determined from aerial photography. Land values were estimated by a certified real estate appraiser. All land damage input data are included in Table 2-10.

2-27. Engineering Circular 1165-2-149 requires that the market value of oceanfront project area land be determined based upon the value of nearshore (non-oceanfront) land. Nearshore land is defined in the Circular as

> "land that is sufficiently removed from shore to lose it's significant increment of value because of its proximity to the shore, when compared to adjacent parcels that are more distant from the shore."

The current market value of nearshore land along the project shoreline was determined from sales data of non-oceanfront vacant properties in the vicinity of Ocean Ridge.

2-28. Ocean Ridge is situated on a coastal barrier island and is bordered by the Atlantic Ocean to the east and Lake Worth and the Intracoastal Water Way (ICWW) to the west. Because Ocean Ridge is bordered by waterfront property to the east and west, the value of typical non-oceanfront properties is higher than that for properties west of Lake Worth. It is assumed that the non-oceanfront property values included in the appraisal represent nearshore land values typical of the Ocean Ridge area. In this study, a nearshore value of land of $\$20.00/ft^2$ was used.

2-29. Land damages are based upon the annual area of land that may be lost to historical (background) erosion. Land damages are computed on a parcel-by-parcel basis where each parcel is damaged by the recession rate characteristic of the adjacent shoreline. Land damages accrue from the mean high water line (MHWL) to the landwardmost extent of shoreline recession during the 50-year study period. Unarmored parcels with structural improvements are assumed to erode until coastal armor is constructed to protect the

Table 2-10: Input Data for Loss of Land Benefit Analysis.

Parcel No.	Ownership	Shorefront (ft)	Recess. Rate (ft)	Prop. Depth (ft)	Armor Setback (ft)	Bldg. Setback (ft)
project area						
1	Public	235	-5.3	420	80	310
2	Public	375	-5.2	440	40	0
3	Private	150	-5.1	390	60	0
4	Private	320	-5.0	330	60	101
5	Private	240	-4.9	420	30	101
6	Private	385	-4.8	420	20	150
7	Private	665	-4.6	455	5	96
8	Private	740	-4.4	190	50	90
9	Private	280	-4.2	475	55	95
10	Private	235	-4.1	430	70	110
11	Private	195	-4.1	220	80	120
12	Public	1130	-3.8	340	-99	0
13	Public	1070	-3.5	421	-99	61
14	Private	750	-3.2	480	-99	101
15	Private	300	-3.0	435	25	180
16	Private	190	-2.9	420	-99	125
17	Public	10	-2.9	420	-99	0
18	Private	60	-2.9	410	-99	140
19	Private	50	-2.9	400	-99	210
20	Private	150	-2.8	380	-99	140
downdrift						
21	Private	395	-2.8	360	-99	140
22	Private	245	-2.7	320	40	165
23	Private	230	-2.6	400	-99	0
24	Private	60	-2.6	400	-99	190
25	Private	160	-2.6	400	-99	0
26	Private	230	-2.5	360	35	185
27	Private	230	-2.4	360	-99	135
28	Private	190	-2.3	360	-99	0
29	Private	220	-2.3	360	-99	155
30	Private	350	-2.2	270	-99	120
31	Private	320	-2.1	430	-99	125
32	Private	170	-2.0	485	-99	360
33	Private	140	-1.9	485	-99	0
34	Private	250	-1.9	430	-99	130
35	Private	65	-1.8	270	10	130
36	Private	150	-1.8	295	-99	100
37	Private	115	-1.7	190	-99	90
38	Private	940	-1.6	315	-99	135
39	Private	615	-1.3	345	-99	140
40	Private	200	-1.2	405	-99	0
41	Private	185	-1.1	445	-99	150
42	Private	120	-1.1	270	-99	0
43	Private	95	-1.0	245	-99	145
44	Private	125	-1.0	280	-99	150
45	Private	70	-1.0	265	35	35
46	Private	120	-0.9	295	5	185

improvements. Armored parcels are assumed to erode until the shoreline recedes to the coastal armor. Assuming mechanical and natural bypassing around South Lake Worth Inlet will continue, it is assumed that existing and future coastal armor will not fail due to historical (background) erosion. Therefore, once the shoreline recedes to the coastal armor, the annual shoreline change rate is set to zero. The value of land damage was computed by multiplying the land area lost to historical erosion by the nearshore land value.

2-30. The loss of land benefit is the difference between the value of land damaged with- and without-project conditions. Table 2-11 presents with- and without-project land loss damages. Present worth and average annual damages and benefits were computed using a 7 and 3/4 percent interest rate and a 50-year project life.

2-31. Evaluation of land loss benefits at non-Federal public and private shores must reflect the special use for which the shoreline is dedicated. The relationship between benefits and shoreline ownership is shown in Figure 2-3. Typically, non-Federal public shorelines are dedicated to parks and recreation areas. The loss of land benefits along non-Federal public shorelines are principally derived from the reduction of expected loss of recreational beach. Therefore, land loss benefits along non-Federal public shorelines are considered incidental benefits.

2-32. Land lost to historical erosion along areas of privately owned shores primarily results in the devaluation of the property. The reduction in the loss of private land is considered a primary benefit. The annual loss of land benefit for the project area is $241,400.

assumed that existing and future coastal armor will not fail due to historical (background) erosion. Therefore, once the shoreline recedes to the coastal armor, the annual shoreline change rate is set to zero. The value of land damage was computed by multiplying the land area lost to historical erosion by the nearshore land value.

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Table 2-11

PROJECT AREA LOSS OF LAND
(1000's of Dollars)

INTEREST RATE = 7.75

YEAR	WITHOUT PROJECT LOSS OF LAND	WITHOUT PROJECT PRESENT WORTH LAND LOSS	WITH PROJECT LOSS OF LAND	WITH PROJECT PRESENT WORTH LAND LOSS
1	383.6	383.6	0.0	0.0
2	383.6	356.0	0.0	0.0
3	322.4	277.7	0.0	0.0
4	322.4	257.7	0.0	0.0
5	322.4	239.2	0.0	0.0
6	285.5	196.5	0.0	0.0
7	285.5	182.4	0.0	0.0
8	261.9	155.3	0.0	0.0
9	261.9	144.2	0.0	0.0
10	243.9	124.6	0.0	0.0
11	243.9	115.6	0.0	0.0
12	243.9	107.3	0.0	0.0
13	163.5	66.8	0.0	0.0
14	131.5	49.8	0.0	0.0
15	108.0	38.0	0.0	0.0
16	108.0	35.3	0.0	0.0
17	108.0	32.7	0.0	0.0
18	108.0	30.4	0.0	0.0
19	88.7	23.2	0.0	0.0
20	88.7	21.5	0.0	0.0
21	72.7	16.3	0.0	0.0
22	72.7	15.2	0.0	0.0
23	72.7	14.1	0.0	0.0
24	72.7	13.1	0.0	0.0
25	72.7	12.1	0.0	0.0
26	72.7	11.3	0.0	0.0
27	72.7	10.4	0.0	0.0
28	72.7	9.7	0.0	0.0
29	72.7	9.0	0.0	0.0
30	72.7	8.3	0.0	0.0
31	72.7	7.7	0.0	0.0
32	72.7	7.2	0.0	0.0
33	72.7	6.7	0.0	0.0
34	72.7	6.2	0.0	0.0
35	72.7	5.7	0.0	0.0
36	72.7	5.3	0.0	0.0
37	72.7	5.0	0.0	0.0
38	72.7	4.6	0.0	0.0
39	72.7	4.3	0.0	0.0
40	72.7	4.0	0.0	0.0
41	72.7	3.7	0.0	0.0
42	72.7	3.4	0.0	0.0
43	72.7	3.2	0.0	0.0
44	72.7	2.9	0.0	0.0
45	72.7	2.7	0.0	0.0
46	72.7	2.5	0.0	0.0
47	72.7	2.3	0.0	0.0
48	72.7	2.2	0.0	0.0
49	72.7	2.0	0.0	0.0
50	72.7	1.9	0.0	0.0
Cumulative Present Worth:		3040.9		0.0
Annual Equivalent:		241.4		
Annual Equivalent Loss of Land Benefit:		241.4		

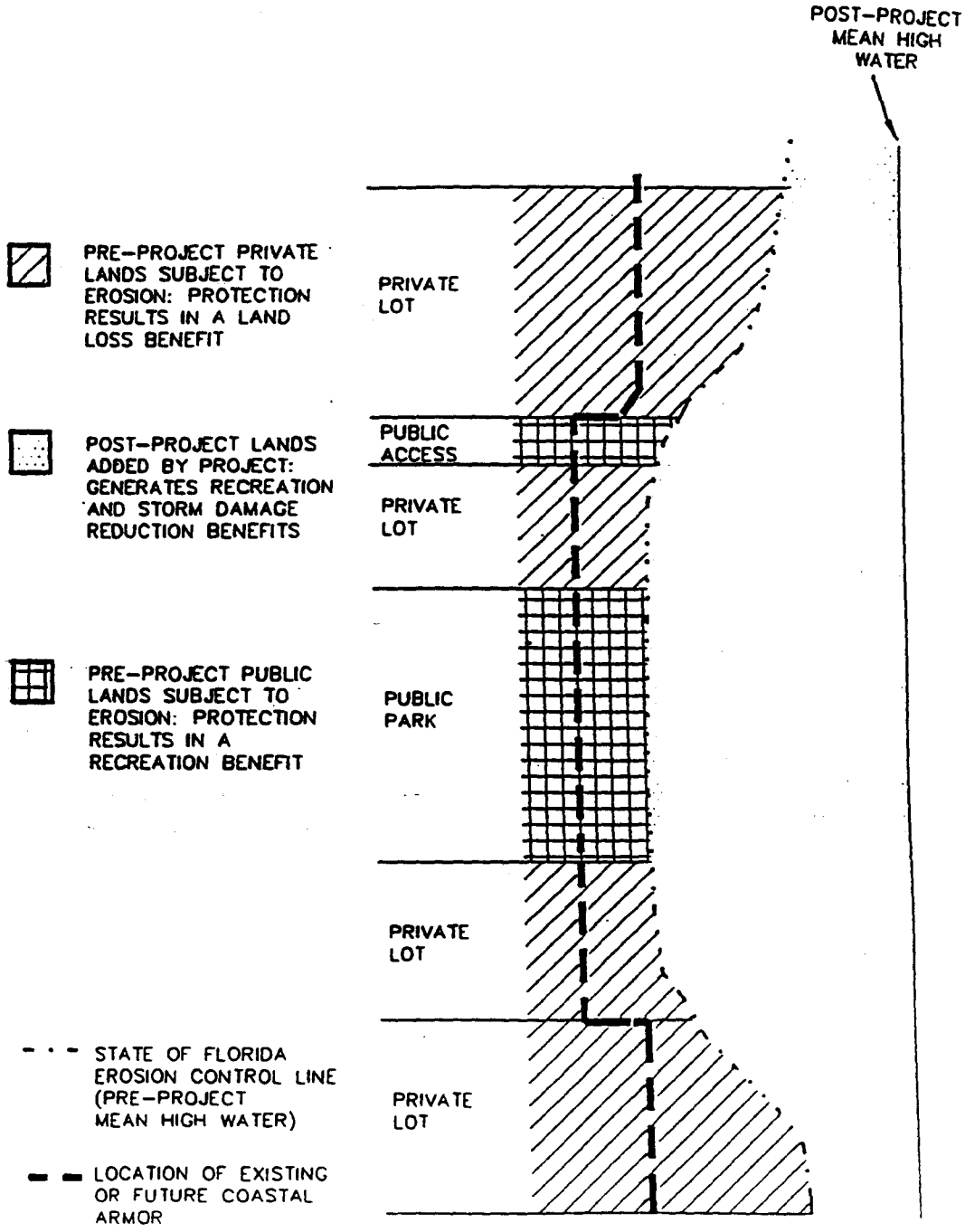


Figure 2-3: Shore Ownership and Lands Subject to Recession.

MAXIMUM NET PRIMARY BENEFITS
(Project Optimization)

2-33. It is required in the "Economic and Environmental Principle and Guidelines for Water and Related Land Resources Implementation Studies" March 1983, a comprehensive part of ER-1105-2-100, that various alternative plans be formulated in a systematic manner to ensure that all reasonable alternatives are evaluated. Another requirement is that a plan that reasonably maximizes net national economic development benefits should be formulated. The formulation of this alternative requires an optimization analysis to determine the amount of shore protection required to maximize net storm damage prevention and loss of land benefits. Not only should the analysis consider the storm damage and loss of land benefits, but also the potential environmental impacts of the project. The net benefits are computed by evaluating the annual equivalent primary benefits minus the annual equivalent costs of each alternative.

2-34. The optimization method used in this report involved (1) varying the project length, (2) varying the project width and (3) replacing a portion of the advance nourishment along the northern 1,800 feet of the project with a groin field. The latter was done to reduce nearshore hardbottom impacts and maintain the minimum design beach cross-section.

2-35. Optimization of the project length included comparison of the 1987 GDM project length, which is 1.6 miles (T-152 to R-160), a 1.42 mile project (T-152 to R-159), and a 1.11 mile project (R-154 to R-159). The 1.42 and 1.11 mile project lengths were chosen based on the location of two nearshore hardbottom areas along the Ocean Ridge shoreline. One of the hardbottom areas is located at the northern end of the 1987 project between South Lake Worth Inlet and R-154 and the other is located south of the 1987 project between R-160 and R-165. The 1.42 mile project would avoid direct impact to the nearshore hardbottom located south of the 1987 project. The 1.11 mile project would avoid initial impact to both the northern and southern nearshore hardbottom areas. This analysis was performed to determine which project length would minimize nearshore hardbottom impacts and maximize net storm damage reduction and loss of land benefits.

2-36. The storm damage reduction and loss of land benefits and total costs of each project length alternative are presented in Table 2-12. The costs include nearshore

hardbottom mitigation costs. The results of the benefit to cost analysis demonstrate that the relocation of the southern end of the project resulted in an increase in the net storm damage and loss of land benefits. This is directly related to a decrease in nearshore hardbottom impacts and associated mitigation costs. Relocation of the northern end of the 1987 project would not provide additional net storm damage and loss of land benefits. Therefore, the 1.42 project would generate the maximum storm damage and loss of land benefits.

TABLE 2-12
ECONOMIC OPTIMIZATION OF PROJECT LENGTH
(1000's of Dollars)

	PROJECT LENGTH (miles)		
	1.6*	1.42	1.11
STORM DAMAGE REDUCTION	1247	1169	772
LOSS OF LAND REDUCTION	274	241	205
PRIMARY BENEFITS	1521	1410	977
PROJECT COSTS	1228	1111	986
NET PRIMARY BENEFITS	293	299	-9

Notes:

1_ Annual Equivalent Expected Values

2_ 50 Year Economic Life: 1995-2044

3_ 7.75% Interest Rate

4_ * - 1987 GDM Project

2-37. The project design berm width was varied to determine the optimum width which minimized nearshore hardbottom impacts and maximized storm damage benefits. The design berm width is measured from the Erosion Control Line (ECL). The berm width was varied between zero (0) and seventy-five (75) feet in increments of twenty-five (25) feet. The berm widths were measured from the ECL. The zero (0) ft berm is that which establishes the +9 ft NGVD elevation at the ECL. This is equivalent to extending the mean high water line approximately 50 feet, on average. The results of the project berm width optimization are presented in Table 2-13.

TABLE 2-13
ECONOMIC OPTIMIZATION OF PROJECT BERM WIDTH
(1000's of Dollars)

	PROJECT BERM WIDTH (feet)			
	0	25	50	75
STORM DAMAGE REDUCTION	1169	1242	1291	1303
LOSS OF LAND REDUCTION	241	241	241	241
PRIMARY BENEFITS	1410	1483	1532	1544
PROJECT COSTS	1111	1194	1252	1324
NET PRIMARY BENEFITS	299	289	280	220

Notes:

1_ Project Berm Width is Measured from the ECL

2_ Annual Equivalent Expected Values

3_ 50 Year Economic Life: 1995-2044

4_ 7.75% Interest Rate

5_ Fill Length is 1.42 Miles.

2-38. In order to minimize nearshore hardbottom impacts and maintain the +9 ft berm at the ECL, eight (8) groins will be constructed in place of advance nourishment. This alternative was developed considering both nearshore hardbottom impacts and the physical performance of the beach fill, bypassing operations and the structures themselves (see pp. 1-85 through 1-92, Appendix 1). The economics of the 1.42 mile, zero ft project both with and without structures are presented in Table 2-14.

2-39. In Tables 2-12 through 2-14 the annual equivalent net benefits and costs were computed using a 7 and 3/4 percent interest rate and a 50-year project life.

2-40. The optimization analysis demonstrates that the plan which maximizes net storm damage and loss of land benefits is 1.42 miles long and will establish the +9 ft NGVD berm at the Erosion Control Line (i.e., a 0 ft berm). The design beach will be protected by advance nourishment, periodic nourishment and eight groins. The groins will be constructed along the northernmost 1,800 feet of the project.

TABLE 2-14
ECONOMICS OF PROJECT WITH GROINS
(1000's of Dollars)

	1.42 MILES W/O GROINS	1.42 MILES W/ GROINS
STORM DAMAGE REDUCTION	1169	1169
LOSS OF LAND REDUCTION	241	241
PRIMARY BENEITS	1410	1410
PROJECT COSTS	1111	1060
NET PRIMARY BENEFITS	299	350

Notes:
1_ Annual Equivalent Expected Values
2_ 50 Year Economic Life: 1995-2044
3_ 7.75% Interest Rate

INCIDENTAL BENEFITS

RECREATIONAL BENEFITS

2-41. Recreational benefits of a shore protection project accrue from an increase in the recreational capacity of the usable dry beach to meet the surplus demand of beach users along the project shoreline. The recreation capacity of the project shoreline is increased by the shore protection project through shoreline stabilization and added beach width. Recreational demand on a shore protection project is based on current populations and projections of potential user groups and the rates at which individuals from each group participate in saltwater beach activities. In this study, the recreational benefits were formulated following the procedures and guidelines presented in Engineering Regulation 1105-2-100.

2-42. Recreational benefits were computed as the difference between the number of beach users the project area can support with and without the shore protection project multiplied by the amount a beach user is willing to pay to recreate on the project beach. The number of beach users was based on empirical estimates of user demand. Estimates of demand reflected the socio-economic characteristics of market populations, recreation resources under study, and existing alternative recreation opportunities. The willingness-to-pay value was calculated using the Travel Cost Method.

ANNUAL BEACH ACTIVITY DEMAND

2-43. Annual beach activity demand was estimated by comparing current population estimates with observed beach use populations within the study area. The Florida Department of Environmental Protection (FDEP) conducts studies to identify the beach activity demand of various user groups. The users are divided into three groups: (1) regional resident, (2) state residents outside the region, and (3) out-of-state tourist. From data collected in these studies, beach use participation rates were developed which relate beach use population to user group population. The participation rate of a user group represents the number of times in a given year a member of a user group will participate in a recreation activity. For example, if the project-wide saltwater beach participation rate is 2 for a user group, then each member of that user group will recreate on the project shoreline twice a year. Participation rates for most recreation activities in the State of Florida are published in the "State Comprehensive

Outdoor Recreation Plan" (SCORP). SCORP reports used in this report include 1981, 1987 and 1989 editions.

2-44. Palm Beach County Demand. SCORP data are organized to represent eleven regions within the state. Regional data are indicative of the socio-economic and recreational activities of all counties included in each region. Palm Beach County is included in Region Ten (10) of the SCORP format. Because regional beach use was assumed to be too general for a site specific study in Palm Beach County, participation rate data for Palm Beach County were obtained directly from the FDEP, Division of Recreation and Parks. Although not published, these data are part of the database used to prepare SCORP regional data sets.

2-45. Annual per-capita participation rates for salt-water beach activity in Palm Beach County were obtained from the FDEP Division of Recreation and Parks. The rates for Palm Beach County are 4.6898 for county residents, 2.39548 for out-of-state tourist. A ratio of annual beach activity demand for Palm Beach County by other State of Florida residents to Palm Beach County residents was calculated to be 0.0328. The per capita participation rates and beach activity demand ratio are assumed to remain constant throughout the economic period of analysis.

2-46. The participation rates multiplied by the annual population estimate or projection of each user group represents the number of annual beach users along Palm Beach County shorelines. More specifically, annual beach activity demand for Palm Beach County residents is determined by multiplying the county population by the county resident participation rate, the tourist population by the tourist participation rate and the State of Florida population less the population of Palm Beach County by the ratio of annual beach activity demand for Palm Beach County by other State of Florida residents to Palm Beach County residents. The total beach activity demand on Palm Beach County shorelines is the combination of demand from each of these user groups.

2-47. Population estimates and population projections were obtained from the "1992 Florida Statistical Abstract." The state resident population data was presented for years 1992 through 2020. Estimated and projected tourists populations were obtained from the FDEP for the years 1990 through 2010. Linear extrapolation was used for population projections through the year 2040. These estimates and projections are presented in Table 2-15.

2-48. Recreational benefits can only be computed on areas of public shoreline. Therefore, annual county-wide

beach activity demand must be determined for both public and private shorelines throughout the county.

Table 2-15

EXPECTED ANNUAL BEACH ACTIVITY DEMAND
(1000'S USER VISITS)

	YEAR					
	1995	2000	2010	2020	2030	2040
Resident Population	972.0	1091.1	1299.9	1400.1	1691.1*	1896.6*
Resident Demand	4558.3	5117.0	6096.3	6566.2	7931.0	8894.6
Other Florida Demand	149.5	167.8	200.0	215.4	260.1	291.7
Tourist Population	2119.5	3106.1	4148.0*	5187.0*	6226.1*	7265.1*
Tourist Demand	5077.2	7440.6	9936.5	12425.4	14914.5	17403.4
Total Demand	9785.1	12725.5	16232.7	19206.9	23105.6	26589.7
Private Shore Demand	3279.0	3279.0	3279.0	3279.0	3279.0	3279.0
Public Shore Demand	6506.1	9446.5	12953.7	15927.9	19826.6	23310.7
Study Area Demand	334.1	485.1	665.2	817.9	1018.1	1197.0

Resident Participation Rate	4.6898	visits/person/year
Tourist Participation Rate	2.39548	visits/person/year
Other Florida Resident Demand	0.0328	visits/person/year

Source: 1992 Florida Statistical Abstract and the Florida Department of Natural Resources Division of Recreation and Parks.

* = extrapolated projection

2-49. Demand Along County Private Shorelines. The Palm Beach County Department of Environmental Resources Management conducted a county-wide beach count using aerial video collected on September 1, 1984 (Labor Day). The video documented the number of people and their location relative to public and private shoreline along the Palm Beach County shorelines that day. Analysis of the video tape revealed that 5,682 persons were using the county shorelines at that time. Of these 1,534, or 27 percent, were recreating on private shorelines.

2-50. The demand for recreational beaches along the private shorelines is assumed to be proportional to the level of coastal development and local population. Public use of private shorelines is limited by the number of public access points and the amount of public parking adjacent to private shorelines. Although access points do exist, the parking is limited or non-existent along most private shorelines. Therefore, the demand for private shorelines is directly related to the level of development along the shoreline and the local population near each access point.

2-51. The maximum demand attributable to private shorelines was estimated assuming the annual demand for private and public shorelines in 1984 was distributed the same as observed during the aerial survey. The estimated number of beach visits to Palm Beach County's private shorelines in 1984 was 10,930,000. Therefore, 2,951,100, or 27 percent, of all beach visits in 1984 were along the private shorelines. Since the private shorelines of Palm Beach County were approximately 90 percent developed and the coastal neighborhoods fully populated at the time of the aerial survey, the maximum annual demand attributable to private shorelines is assumed to be 30 percent (27x100/90) of 10,930,000 or 3,279,000 beach visits.

2-52. Demand Along Public Shorelines - County. The demand for public shorelines is determined by subtracting the demand for private shorelines from the total demand of all shorelines in Palm Beach County. The demand for public shorelines is assumed to be uniformly distributed over all accessible public shorelines in Palm Beach County (USACE, 1987).

2-53. Demand Along Public Shorelines - Study Area. The study area includes the 1.42 miles (7,520 feet) of shoreline immediately south of South Lake Worth Inlet. Access to public shoreline within the study area is available at four public parks and one street end access. Figure 2-4 shows the public parks and points of public access and available public parking along the project shoreline.

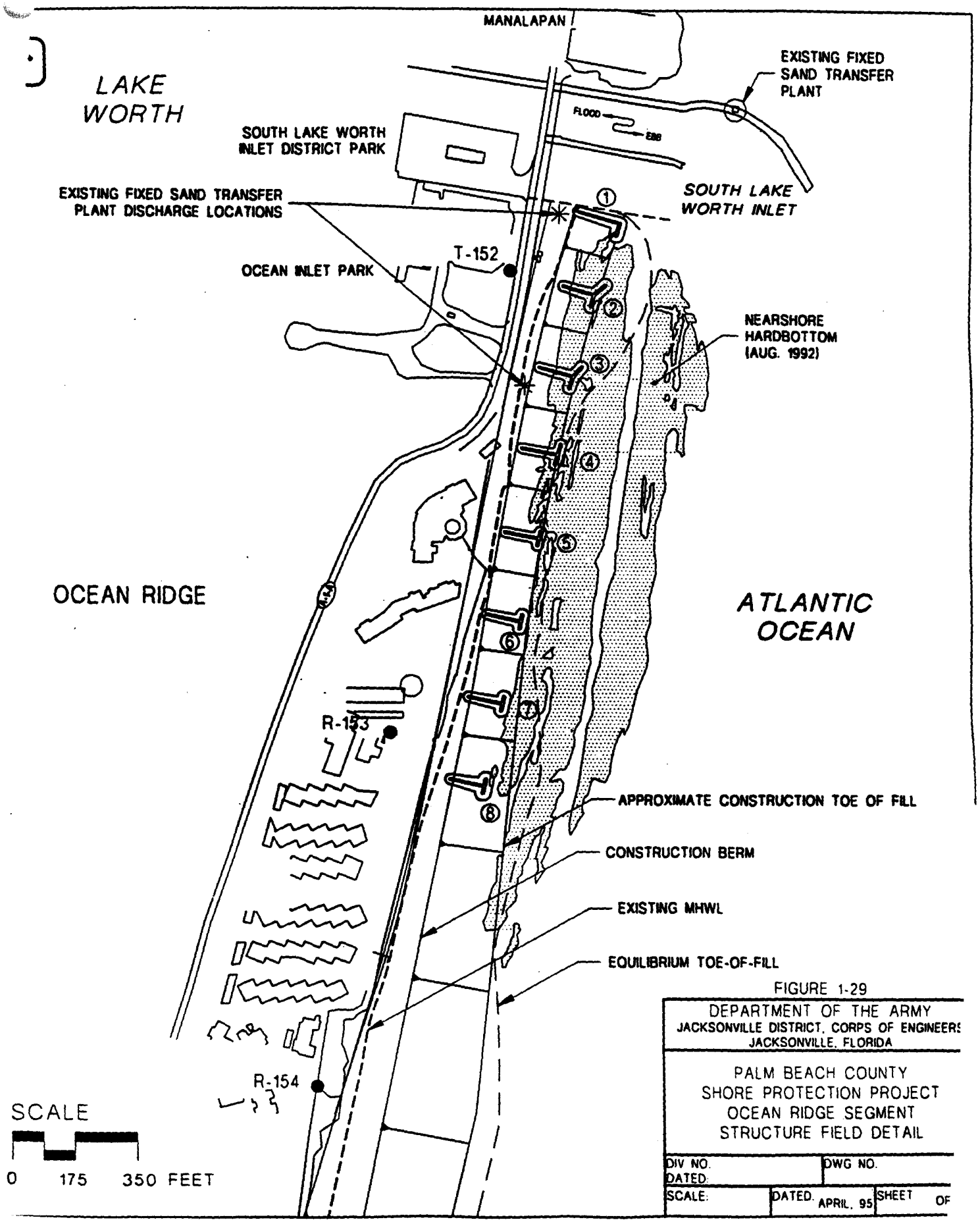


FIGURE 1-29

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

PALM BEACH COUNTY
SHORE PROTECTION PROJECT
OCEAN RIDGE SEGMENT
STRUCTURE FIELD DETAIL

DIV NO. DATED:		DWG NO.
SCALE:	DATED. APRIL, 95	SHEET OF

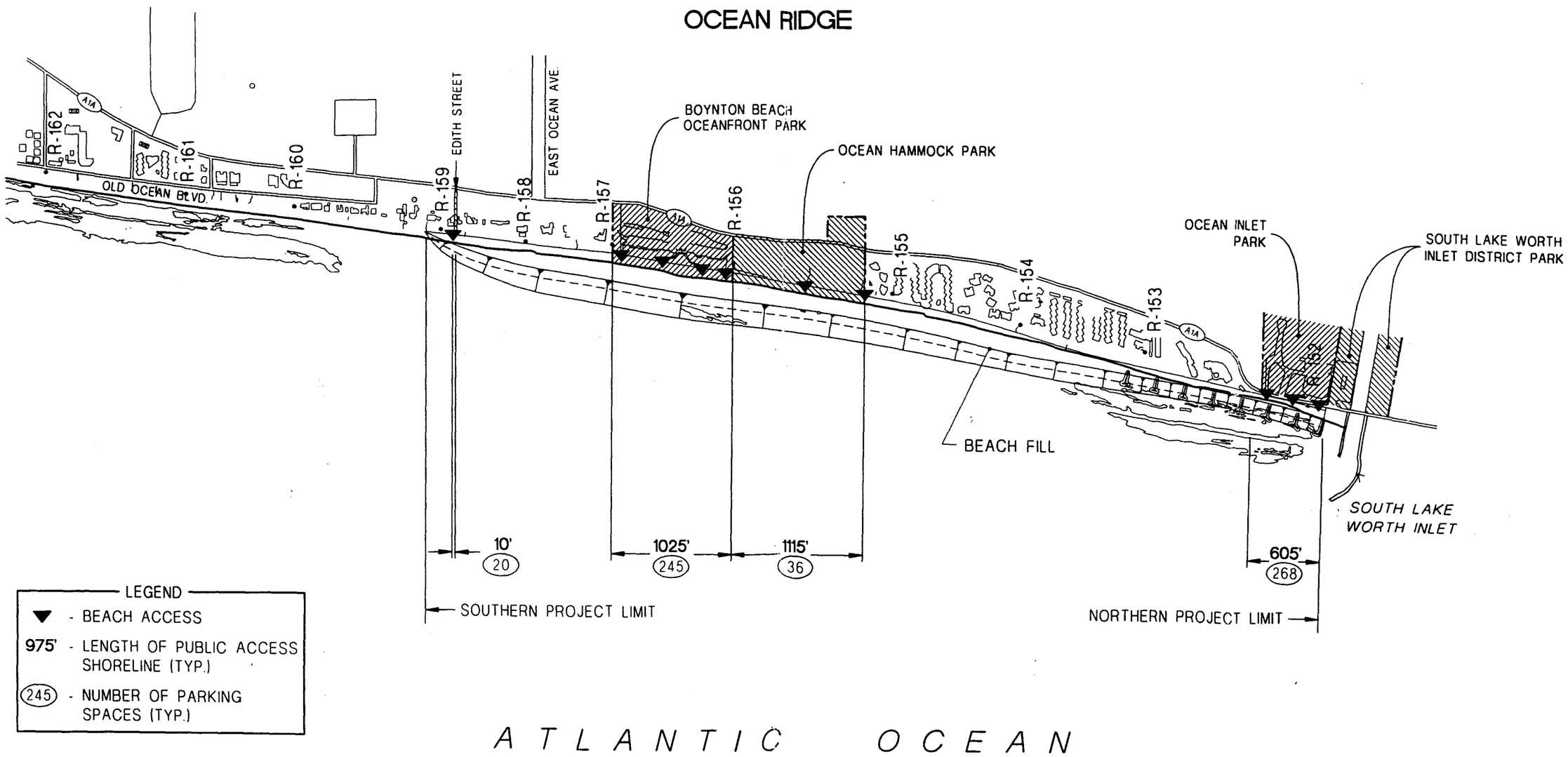


FIGURE 2-4
OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA

PARKING AND BEACH ACCESS

2-54. The demand for public shorefront along the Ocean Ridge shoreline is represented as a fraction of the user demand for all public shorefront within Palm Beach County. The project area includes 2,790 feet of public shorefront. The length of shorefront available for salt water beach use in Palm Beach County is 57,840 feet. Therefore, the project area public shorefront represents 4.8 percent of that for the entire county. This percentage is assumed to remain constant throughout the economic life of the project. Assuming public demand is uniformly distributed along all public accessible salt water beaches within the county, the fraction of project area shoreline was directly applied to user demand to estimate the project area user demand.

DAILY BEACH ACTIVITY DEMAND

2-55. Daily beach activity demand varies considerably from day-to-day with the greatest demand occurring on weekends, holidays, and other special events. Daily demand also varies with the climatic seasons throughout the year. The distribution of daily beach activity demand is determined is determined by performing a frequency analysis on actual beach activity data collected within the study area where possible. Once this distribution is determined, annual beach activity demand can be distributed confidently into daily demand.

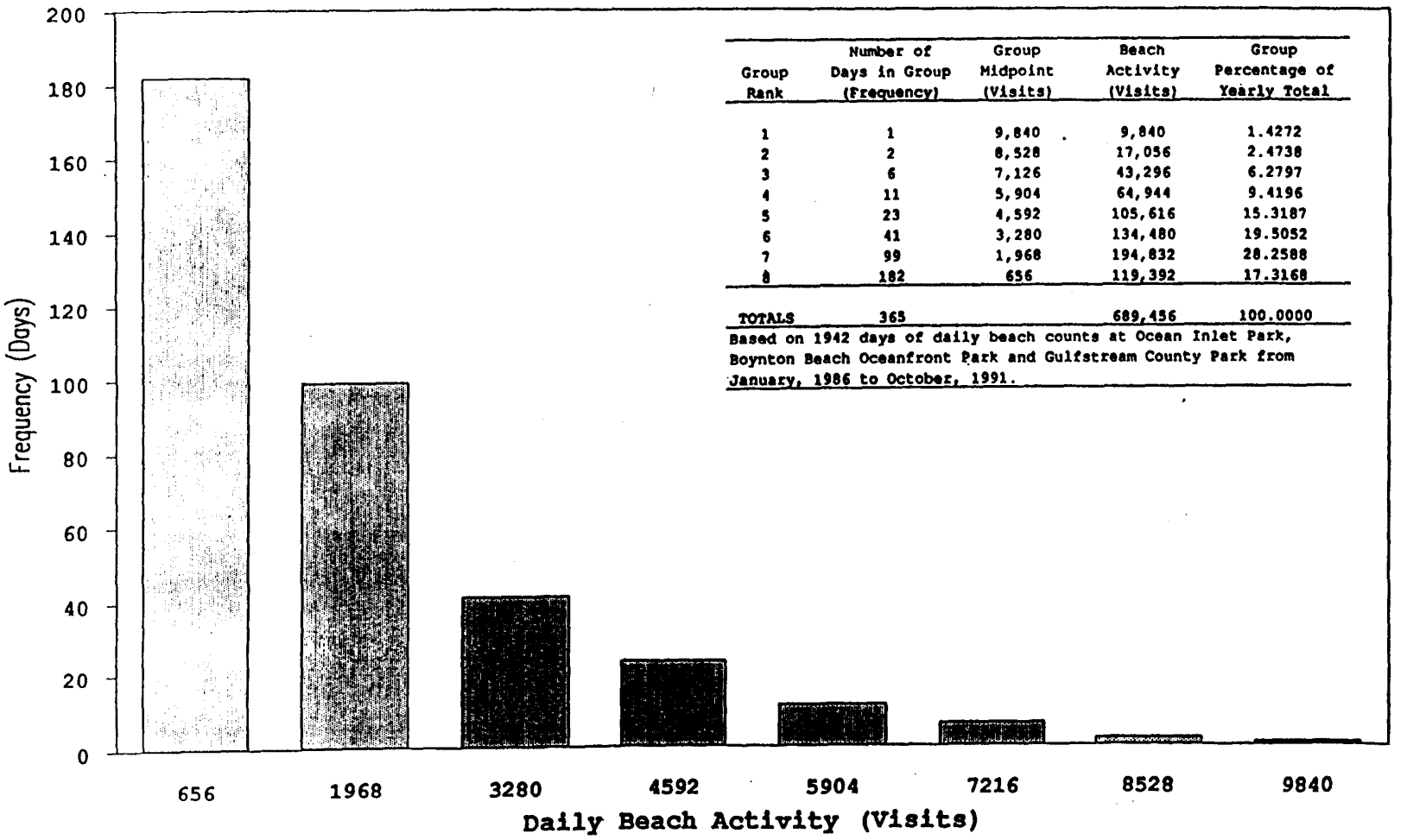
2-56. Daily beach counts are conducted at Ocean Inlet Park, Boynton Beach Park and Gulfstream Park. Data collected between 1986 and 1991 at these parks were combined to develop a composite representation of daily beach activity demand within the study area. A frequency analysis was used to determine the distribution of daily beach activity demand represented by the data. Several iterations were performed to determine an appropriate number of class intervals that accurately represented observed daily beach activity trends. The frequency distribution representing daily beach activity demand groups is shown in Figure 2-5.

2-57. The daily beach activity demand distribution was applied to annual population estimates and projections to determine daily beach activity demand for the study period. For each year during the analysis period, daily beach activity demand was compared to daily beach capacity to quantify the annual beach activity demand surplus.

2-58. By using site specific beach activity data, the estimates of beach activity demand and future beach activity demand have been determined in a manner that reflects the socio-economic characteristics of the actual population and also accounts for the fact that alternate existing recreation resources exist.

Figure 2-5

Daily Beach Activity Distribution



Group Rank	Number of Days in Group (Frequency)	Group Midpoint (Visits)	Beach Activity (Visits)	Group Percentage of Yearly Total
1	1	9,840	9,840	1.4272
2	2	8,528	17,056	2.4738
3	6	7,126	43,296	6.2797
4	11	5,904	64,944	9.4196
5	23	4,592	105,616	15.3187
6	41	3,280	134,480	19.5052
7	99	1,968	194,832	28.2588
8	182	656	119,392	17.3168
TOTALS	365		689,456	100.0000

Based on 1942 days of daily beach counts at Ocean Inlet Park, Boynton Beach Oceanfront Park and Gulfstream County Park from January, 1986 to October, 1991.

DAILY BEACH ACTIVITY CAPACITY

2-59. Daily beach activity capacity is a measure of the maximum number of beach users that can recreate on a beach in a single day. Beach activity capacity is limited by the area of dry beach (that above the mean high water line MHWL) and/or the amount of public parking and access available in the vicinity of the project shoreline. That is, enough square footage of dry beach may be available to meet beach user demand, but parking and beach access may limit the total number of beach users that can recreate along a section of public shoreline. Table 2-16 presents the daily beach activity capacity of project area with- and without-project conditions.

2-60. Dry Beach Capacity. Dry beach capacity was determined by estimating the area of dry beach along the project shoreline with and without project conditions. The without-project dry beach area was estimated from aerial photography and a 1993 mean high water line survey of the project area shoreline. The area of dry beach with-project conditions was computed using post-equilibrium design beach widths superimposed upon existing conditions. Variations in beach width over a renourishment interval were not considered. The maximum number of beach users (assuming no restrictions from parking or beach access) was estimated assuming a beach user requires 100 square feet of dry beach to recreate. Additionally, a turnover rate of two beach users per day per 100 square feet of dry beach was used to develop the estimate.

2-61. Parking Capacity. Although the project shoreline may have the available dry beach area to accommodate recreational beach use demand, beach access and the number of parking spaces available to beach users may limit the number of visits. Parking capacity was computed assuming that a parking space can accommodate eight (8) visitors per day. Therefore, the number of visitors that have access to the project area's public shorefront is the number of parking spaces multiplied by eight plus the number of "notional" visitors that use the beach. A "notional" visitor is one which accesses the public shorefront via walking, bicycle, public transportation, or means other than that requiring a parking facility. Assuming that the notional visitation observed in the 1984 aerial survey represents a maximum value and that value is linearly distributed along the county's shorefront, then one notional visitor is present along every 13 feet of project area shoreline.

Table 2-16

WITHOUT PROJECT DAILY BEACH CAPACITY

	PUBLIC PARKING SPACES	PARKING & NOTIONAL CAPACITY (VISITS)	PUBLIC SHORE-FRONT (FEET)	1995		2005		2015		2025		2035		2045	
				WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)
OCEAN INLET PARK	268	2191	605	35	424	0	0	0	0	0	0	0	0	0	0
OCEAN HAMMOCK	40	406	1115	70	406	70	406	70	406	70	406	70	406	70	406
BOYNTON BCH PARK	245	2035	975	105	2035	67	1307	29	566	0	0	0	0	0	0
EDITH STREET	20	164	50	70	70	38	38	6	6	0	0	0	0	0	0
TOTALS	573	4795	2745		2934		1750		977		406		406		406

WITH PROJECT DAILY BEACH CAPACITY

	PUBLIC PARKING SPACES	PARKING & NOTIONAL CAPACITY (VISITS)	PUBLIC SHORE-FRONT (FEET)	1995		2005		2015		2025		2035		2045	
				WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)	WIDTH (FEET)	CAPACITY (VISITS)
OCEAN INLET PARK	268	2191	605	95	1150	95	1150	95	1150	95	1150	95	1150	95	1150
OCEAN HAMMOCK	40	406	1115	145	406	145	406	145	406	145	406	145	406	145	406
BOYNTON BCH PARK	245	2035	975	180	2035	180	2035	180	2035	180	2035	180	2035	180	2035
EDITH STREET	20	164	50	140	140	140	140	140	140	140	140	140	140	140	140
TOTALS	573	4795	2745		3730		3730		3730		3730		3730		3730

2-62. Public parking and access for Federal shore protection projects must be reasonable and available to all persons on an equal basis. To meet these restrictions, only public parking spaces located within one-quarter mile of a public access were considered for the purpose of computing beach activity capacity. The number of parking spaces and public access areas were determine using Palm Beach County records and field verification (see Figure 2-4).

TRAVEL COST METHOD

2-63. In this study, the Travel Cost Method is used to estimate the value of a beach visit in Palm Beach County, Florida. The Travel Cost Method is based upon the premise that the per capita use of a recreation site will decrease as the out-of-pocket expenses and travel time from place of origin to recreational site increase. The Travel Cost Method consists of deriving a demand curve by using the variable costs of travel and the value of time as proxies for price. From this, a cost of travel versus beach activity demand curve can be developed. The value of a beach visit is computed by dividing the area under beach activity demand curve by the total annual demand.

2-64. Estimating Use. The preferred method for estimating use is to relate recreational use of the project area to travel distance, socio-economic factors, characteristics of the project area, and alternative recreation opportunities. In this study, county beach-use data collected by FDEP for the 1980 SCORP were used to develop beach use estimates. These data meet all of the aforementioned criteria. Using these data, the Florida State University Computing Center, under contract (DACW17-81-M-0854) to the U.S. Army Corps of Engineers Jacksonville District, developed per capita participation rates by zip code for beach activity in each of the coastal counties of the state. The analysis provided tables of per capita participation data for zip code areas in each coastal county in the State of Florida. Using the zip code areas as population zones, a relationship can be developed between recreational beach usage and travel distance.

2-65. A least squares regression analysis was performed on the Palm Beach County zip code population data to develop a functional relationship between per capita beach activity participation and travel distance. The results were compared with participation functions developed for other Federal studies in Palm Beach County. The analysis resulted in the per capita participation function

$$Participation = 7.87\ e^{(-.10\ x\ distance)}$$

2-66. This relationship is assumed to be constant throughout the economic life of the project. The acceptable range of the relationship is assumed to be from 0 to 50 miles. That is, participation for distances greater than 50 miles is considered to be zero. The relationship is presented graphically in Figure 2-6.

2-67. Deriving Demand. The Travel Cost Method is based upon the correlation between travel distance to the project area and cost of travel to, or price of recreation at, the project area. Total beach use from each area of incremental distance must also be estimated. The number of recreational visits to the project area for different incremental distances away from the project area was determined by using the per capita relationship developed in the previous section. These data were used to develop the resource demand curve.

2-68. The estimate of recreational use for a project, derived from application of the per capita participation curve, yields an initial point on the resource demand curve. This point is equivalent to a beach user being located at the project shoreline. The remainder of the points on the resource demand curve are computed by adding small incremental increases in travel distance. This, in turn, increases the cost of travel to the project shoreline and decrease the demand of potential beach users. This procedure is equivalent to moving the project farther and farther away from the users, requiring them to pay more and more for the cost of travel.

2-69. In this study, the distance to the project area from each population zone is the incremental distance plus the original distance the population zone was from the project area. As the simulated distance increases, beach use of the population in each zone decreases, and for each increment in distance, a new estimate of beach use is computed using the per capita participation curve. For this study, 10-mile increments of total driving distance were used to define the remaining points on the resource demand curve. Points were generated until the anticipated visitation was approximately zero. The resulting resource demand curve is shown graphically in Figure 2-7.

2-70. Cost of Travel. The price associated with various quantities of use is determined by calculating the cost of travel associated with the incremental increases in distance. These are the costs that would be incurred by

Figure 2-6: Participation Rate vs. Distance

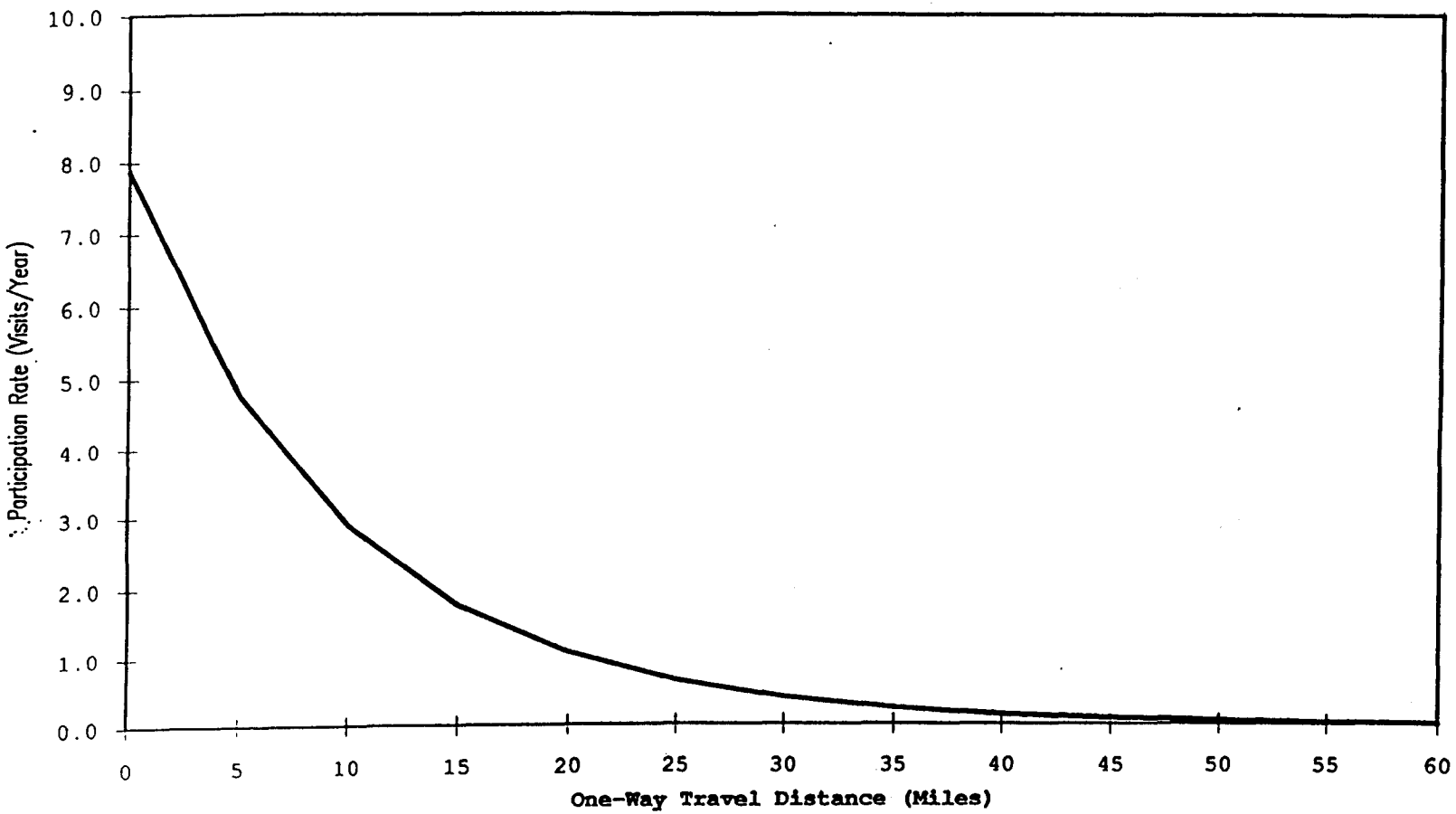
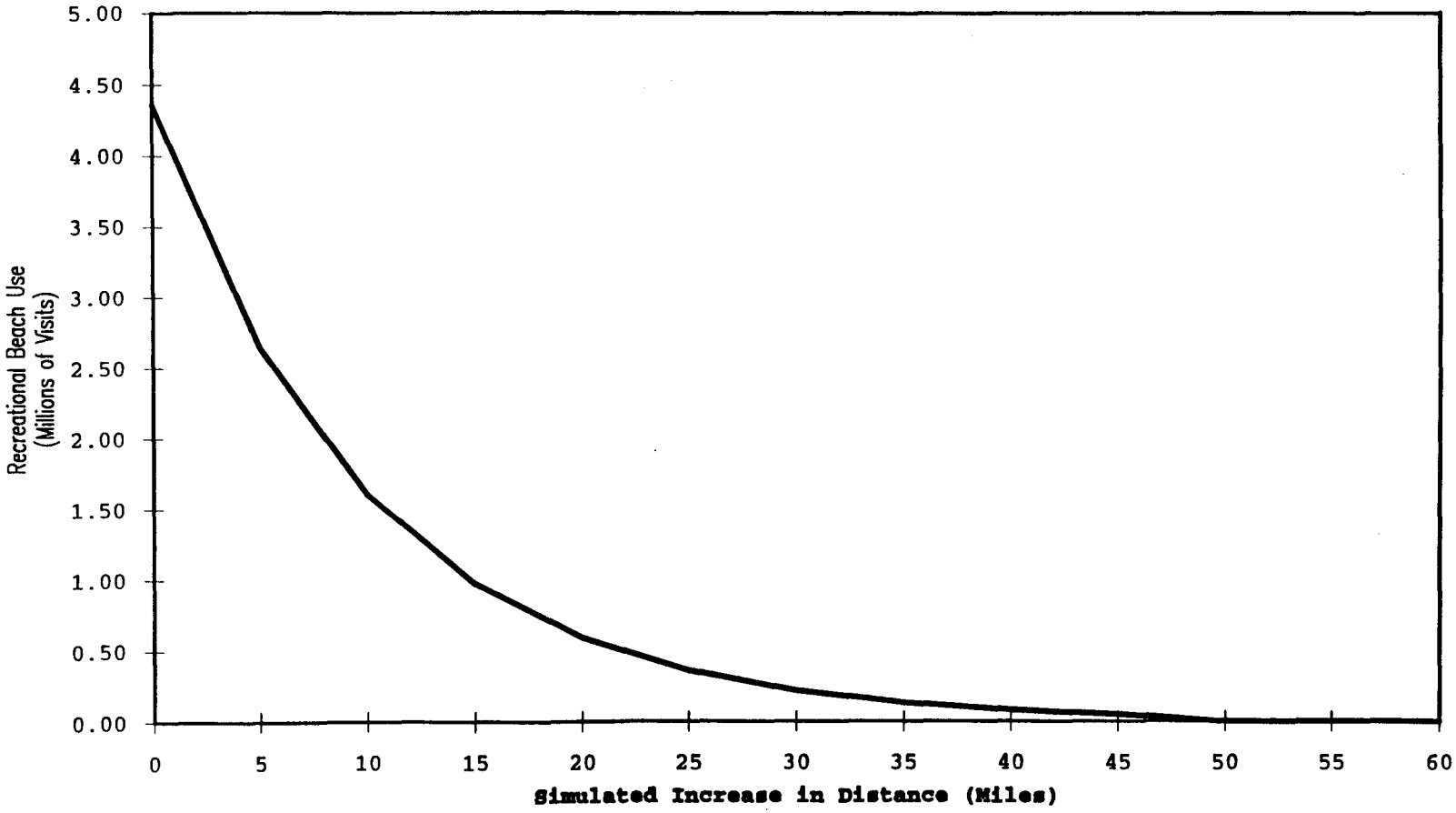


Figure 2-7: Resource Demand Curve



the recreation users if they were required to travel the additional mileage. The variable or out-of pocket travel costs are used as a proxy for price, since these are the costs that potential users would be most aware of when making a decision about whether to visit a particular recreation area.

2-71. The cost of travel consists of out-of-pocket travel costs and the opportunity cost of time. Out-of-pocket travel costs are determined as a average variable cost per mile. Based on data published by the U.S. Department of Transportation (USDOT), the variable cost to operate a car in 1984 was computed to be 11.47 cents per mile (USDOT, 1985). No data on the cost of travel has been computed or published by the USDOT since 1985. However, the American Automobile Association prepares a pamphlet each year on the costs of owning and operating automobiles. Out-of-pocket travel (variable) costs to operate an automobile are summarized in Table 2-17. For an average of 3.5 passengers per vehicle, the variable cost is 2.62 cents per mile per person.

2-72. The opportunity cost of time was determined using the guidance provided by EC-1105-2-XXX dated 31 March 1993. Based on a median family income of $32,191, the opportunity cost of time $9.29 per car per hour. Based on the 1990 U.S. Census, the average family income in Palm Beach County is $32,524. Therefore, the opportunity cost of time is computed as:

$$\$9.29 \times \$32,5243 / \$32,191 = \$9.39$$

For an average of 3.5 people per vehicle, this results in an opportunity cost of time of $2.68 per hour per visitor.

2-73. <u>Cost per Visit.</u> The total cost of travel per beach visitor for incremental distances away from the project area is presented in Table 2-18. These data represent the resource demand curve. The total area under the resource demand curve divided by the total number of actual visits is equal to average amount users are willing to pay, but do not have to pay, for the opportunity to recreate along the project shoreline.

Table 2-17

COST TO OPERATE AN AUTOMOBILE

(CENTS PER MILE)

1993 Variable Costs				
Variable Vehicle Class	Maintenance	Gasoline and Oil	Tires	Total Cost
Intermediate	2.50	7.00	1.00	10.50
Compact	2.40	6.00	0.90	9.30
Subcompact	2.20	4.80	0.70	7.70
			Average:	9.17

Source: American Automobile Association, "Your Driving Costs, 1993 Edition."

Table 2-18

TRAVEL-COST RESULTS

Simulated Increase in Distance (Miles)	Total Travel Distance (Miles)	Travel Time (Hours)	Variable Travel Costs ($)	Opportunity Cost of Time ($)	Total Cost ($)	Beach Use (Visits)	Incremental Resource Demand Areas
0	0	0.00	0.00	0.00	0.00	4,357,434	
5	10	0.37	0.26	0.98	1.24	2,642,917	4,340,218
10	20	0.65	0.52	1.74	2.26	1,603,010	2,165,423
15	30	0.90	0.79	2.41	3.20	972,275	1,210,384
20	40	1.15	1.05	3.08	4.13	589,715	726,325
25	50	1.40	1.31	3.75	5.06	357,680	440,538
30	60	1.65	1.57	4.42	5.99	216,944	267,200
35	70	1.90	1.83	5.09	6.92	131,583	162,065
40	80	2.15	2.10	5.76	7.86	79,809	99,354
45	90	2.40	2.36	6.43	8.79	48,407	59,620
50	100	2.65	2.62	7.10	9.72	0	22,509
						Area:	9,493,638
Total number of visits:			4,357,434			Cost per visit:	$2.18

2-74. The total amount users are willing to pay includes all costs incurred on a beach visit. Costs beyond the cost of travel and the opportunity costs are entrances fees, parking fees, or user charges. Such additional fees are not required at the public beach locations along the project area. Therefore, the average cost per visit in Palm Beach County as calculated from the resource demand curve is $2.18.

RECREATIONAL BENEFIT SUMMARY

2-75. Recreational benefits accrue from an increase in beach capacity to accommodate an over-supply of beach users. The difference in visitation between with and without project conditions is the recreational benefit. The value of the benefit is determined by multiplying the number of beach visits attributed to the project by the value os a beach visit. This analysis was performed on a year-by-year basis for each year throughout the economic life of the project.

2-76. The distribution of daily demand for the study area was used to determine the expected amount of visitation in each year. Applying the frequency distribution presented in Figure 2-5 to the annual beach activity demand (Table 2-16), the distribution of daily beach activity demand was determined for every tenth year during the life of the project (see Table 2-19). The visits attributable to the project were estimated by comparing daily demand to with- and without-project daily capacity. Tables 2-20a through 2-20f present the results of this analysis.

2-77. The recreational benefits computed over the 50-year economic life of the project are presented in Table 2-21. The annual equivalent recreational benefits produced by the project were computed using an 7 and 3/4 percent and a 50-year project life. The annual equivalent recreational benefit of the project is $393,000.

DOWNDRIFT BENEFITS

2-78. As discussed in the Appendix 1, the net average annual transport along the project shoreline is from north to south. It is expected that the advance nourishment material will be transported to the shoreline south of the project area. Reduction in damage to development benefits will accrue along the downdrift shoreline as a result of this north to south transport of the beach fill material.

2-79. The storm damage model was used to compute damages due to shoreline recession and storm-induced

Table 2-19

BEACH ACTIVITY DEMAND DISTRIBUTION
(USERS PER GROUP PER DAY)

Group	Number of Days	YEAR 1995	2005	2015	2025	2035	2045
1	1	4768	6936	9504	11687	14543	28535
2	2	4132	6011	8237	10129	12604	24730
3	6	3497	5086	6970	8571	10665	20925
4	11	2861	4161	5702	7012	8726	17121
5	23	2225	3237	4435	5454	6787	13316
6	41	1589	2312	3168	3896	4848	9512
7	99	954	1387	1901	2337	2909	5707
8	182	318	462	634	779	970	1902
	365	334,076	485,963	665,916	818,876	1,018,962	1,999,320

BEACH ACTIVITY DEMAND DISTRIBUTION
(USERS PER GROUP PER YEAR)

Group	Number of Days	YEAR 1995	2005	2015	2025	2035	2045
1	1	4768	6936	9504	11687	14543	28535
2	2	8264	12022	16474	20258	25207	49460
3	6	20979	30517	41818	51423	63988	125552
4	11	31469	45776	62727	77135	95982	188328
5	23	51176	74444	102010	125442	156092	306271
6	41	65162	94788	129889	159724	198751	389972
7	99	94406	137327	188180	231405	287947	564984
8	182	57851	84154	115316	141803	176452	346219
	365	334,076	485,963	665,916	818,876	1,018,962	1,999,320

Table 2-20

a)

YEAR 1995

Daily Capacity With Project 3730
Daily Capacity Without Project 2934

Number of Days	Daily Demand	Yearly Demand (1000's)	Capacity With Project (1000's)	Visits With Project (1000's)	Capacity Without Project (1000's)	Visits Without Project (1000's)	Visits Attributable To Project (1000's)
1	4768	4.8	3.7	3.7	2.9	2.9	0.8
2	4132	8.3	7.5	7.5	5.9	5.9	1.6
6	3497	21.0	22.4	21.0	17.6	17.6	3.4
11	2861	31.5	41.0	31.5	32.3	31.5	0.0
23	2225	51.2	85.8	51.2	67.5	51.2	0.0
41	1589	65.2	152.9	65.2	120.3	65.2	0.0
99	954	94.4	369.3	94.4	290.5	94.4	0.0
182	318	57.9	678.9	57.9	534.0	57.9	0.0
365		334.1		332.2		326.5	5.8

b)

YEAR 2005

Daily Capacity With Project 3730
Daily Capacity Without Project 1750

Number of Days	Daily Demand	Yearly Demand (1000's)	Capacity With Project (1000's)	Visits With Project (1000's)	Capacity Without Project (1000's)	Visits Without Project (1000's)	Visits Attributable To Project (1000's)
1	6936	6.9	3.7	3.7	1.8	1.8	2.0
2	6011	12.0	7.5	7.5	3.5	3.5	4.0
6	5086	30.5	22.4	22.4	10.5	10.5	11.9
11	4161	45.8	41.0	41.0	19.3	19.3	21.8
23	3237	74.4	85.8	74.4	40.3	40.3	34.2
41	2312	94.8	152.9	94.8	71.8	71.8	23.0
99	1387	137.3	369.3	137.3	173.3	137.3	0.0
182	462	84.2	678.9	84.2	318.5	84.2	0.0
365		486.0		465.3		368.5	96.8

Table 2-20 (cont.)

c)

YEAR 2015

Daily Capacity With Project 3730
Daily Capacity Without Project 977

Number of Days	Daily Demand	Yearly Demand (1000's)	Capacity With Project (1000's)	Visits With Project (1000's)	Capacity Without Project (1000's)	Visits Without Project (1000's)	Visits Attributable To Project (1000's)
1	9504	9.5	3.7	3.7	1.0	1.0	2.8
2	8237	16.5	7.5	7.5	2.0	2.0	5.5
6	6970	41.8	22.4	22.4	5.9	5.9	16.5
11	5702	62.7	41.0	41.0	10.7	10.7	30.3
23	4435	102.0	85.8	85.8	22.5	22.5	63.3
41	3168	129.9	152.9	129.9	40.1	40.1	89.8
99	1901	188.2	369.3	188.2	96.7	96.7	91.4
182	634	115.3	678.9	115.3	177.9	115.3	0.0
365		665.9		593.8		294.2	299.6

d)

YEAR 2025

Daily Capacity With Project 3730
Daily Capacity Without Project 406

Number of Days	Daily Demand	Yearly Demand (1000's)	Capacity With Project (1000's)	Visits With Project (1000's)	Capacity Without Project (1000's)	Visits Without Project (1000's)	Visits Attributable To Project (1000's)
1	11687	11.7	3.7	3.7	0.4	0.4	3.3
2	10129	20.3	7.5	7.5	0.8	0.8	6.6
6	8571	51.4	22.4	22.4	2.4	2.4	19.9
11	7012	77.1	41.0	41.0	4.5	4.5	36.6
23	5454	125.4	85.8	85.8	9.3	9.3	76.5
41	3896	159.7	152.9	152.9	16.6	16.6	136.3
99	2337	231.4	369.3	231.4	40.2	40.2	191.2
182	779	141.8	678.9	141.8	73.9	73.9	68.0
365		818.9		686.6		148.1	538.4

Table 2-20 (cont.)

e)

YEAR 2035

Daily Capacity With Project 3730
Daily Capacity Without Project 406

Number of Days	Daily Demand	Yearly Demand (1000's)	Capacity With Project (1000's)	Visits With Project (1000's)	Capacity Without Project (1000's)	Visits Without Project (1000's)	Visits Attributable To Project (1000's)
1	14543	14.5	3.7	3.7	0.4	0.4	3.3
2	12604	25.2	7.5	7.5	0.8	0.8	6.6
6	10665	64.0	22.4	22.4	2.4	2.4	19.9
11	8726	96.0	41.0	41.0	4.5	4.5	36.6
23	6787	156.1	85.8	85.8	9.3	9.3	76.5
41	4848	198.8	152.9	152.9	16.6	16.6	136.3
99	2909	287.9	369.3	287.9	40.2	40.2	247.8
182	970	176.5	678.9	176.5	73.9	73.9	102.6
365		1019.0		777.7		148.1	629.6

f)

YEAR 2045

Daily Capacity With Project 3730
Daily Capacity Without Project 406

Number of Days	Daily Demand	Yearly Demand (1000's)	Capacity With Project (1000's)	Visits With Project (1000's)	Capacity Without Project (1000's)	Visits Without Project (1000's)	Visits Attributable To Project (1000's)
1	28535	28.5	3.7	3.7	0.4	0.4	3.3
2	24730	49.5	7.5	7.5	0.8	0.8	6.6
6	20925	125.6	22.4	22.4	2.4	2.4	19.9
11	17121	188.3	41.0	41.0	4.5	4.5	36.6
23	13316	306.3	85.8	85.8	9.3	9.3	76.5
41	9512	390.0	152.9	152.9	16.6	16.6	136.3
99	5707	565.0	369.3	369.3	40.2	40.2	329.1
182	1902	346.2	678.9	346.2	73.9	73.9	272.4
365		1999.3		1028.9		148.1	880.8

Table 2-21

RECREATION BENEFIT ANALYSIS

YEAR	YEARLY DEMAND (1000'S)	DAILY CAPACITY WITH PROJECT	DAILY CAPACITY WITHOUT (1000'S)	VISITS WITH PROJECT (1000'S)	VISITS WITHOUT PROJECT (1000'S)	VISITS ATTRIBUTED TO PROJECT (1000'S)	RECREATION BENEFIT (1000'S)	PRESENT WORTH OF BENEFIT (1000'S)
1995	378	3730	2934	332	326	6	13.1	13.1
1996	396	3730	2816	346	331	15	32.7	30.3
1997	414	3730	2697	359	335	24	52.3	45.1
1998	432	3730	2579	372	339	33	71.9	57.5
1999	450	3730	2461	385	343	42	91.6	67.9
2000	469	3730	2342	399	347	52	113.4	78.1
2001	487	3730	2224	412	352	60	130.8	83.6
2002	505	3730	2105	425	356	69	150.4	89.2
2003	523	3730	1987	439	360	79	172.2	94.8
2004	542	3730	1869	452	364	88	191.8	98.0
2005	560	3730	1750	465	369	96	209.3	99.2
2006	578	3730	1673	478	361	117	255.1	112.2
2007	596	3730	1596	491	354	137	298.7	121.9
2008	615	3730	1518	504	346	158	344.4	130.5
2009	633	3730	1441	517	339	178	388.0	136.5
2010	651	3730	1364	530	331	199	433.8	141.6
2011	669	3730	1286	542	324	218	475.2	144.0
2012	687	3730	1209	555	316	239	521.0	146.5
2013	706	3730	1132	568	309	259	564.6	147.3
2014	724	3730	1055	581	302	279	608.2	147.3
2015	742	3730	977	594	294	300	654.0	147.0
2016	760	3730	920	603	280	323	704.1	146.9
2017	779	3730	863	612	265	347	756.5	146.4
2018	797	3730	806	622	250	372	811.0	145.7
2019	815	3730	749	631	236	395	861.1	143.6
2020	833	3730	692	640	221	419	913.4	141.3
2021	852	3730	634	649	207	442	963.6	138.4
2022	870	3730	577	659	192	467	1018.1	135.7
2023	888	3730	520	668	177	491	1070.4	132.4
2024	906	3730	463	677	163	514	1120.5	128.6
2025	924	3730	406	687	148	539	1175.0	125.2
2026	943	3730	406	696	148	548	1194.6	118.1
2027	961	3730	406	705	148	557	1214.3	111.4
2028	979	3730	406	714	148	566	1233.9	105.1
2029	997	3730	406	723	148	575	1253.5	99.1
2030	1016	3730	406	732	148	584	1273.1	93.4
2031	1034	3730	406	741	148	593	1292.7	88.0
2032	1052	3730	406	750	148	602	1312.4	82.9
2033	1070	3730	406	760	148	612	1334.2	78.2
2034	1089	3730	406	769	148	621	1353.8	73.7
2035	1107	3730	406	778	148	630	1373.4	69.4
2036	1125	3730	406	803	148	655	1427.9	66.9
2037	1143	3730	406	828	148	680	1482.4	64.5
2038	1161	3730	406	853	148	705	1536.9	62.0
2039	1180	3730	406	878	148	730	1591.4	59.6
2040	1198	3730	406	903	148	755	1645.9	57.2
2041	1216	3730	406	928	148	780	1700.4	54.9
2042	1234	3730	406	954	148	806	1757.1	52.6
2043	1253	3730	406	979	148	831	1811.6	50.4
2044	1271	3730	406	1004	148	856	1866.1	48.1

Costs per visit	$2.18		TOTAL	$4,951
Interest Rate	7.75%			
Capital Recovery Factor	0.0794	ANNUAL EQUIVALENT BENEFIT		$393

bluffline recession along the 5,730 feet of shoreline immediately south of the 7,520 ft project for without- and with-project conditions. To account for the effects of beach fill material being transported south, it was assumed that historical erosion immediately downdrift of the project shoreline will cease, once the project is in place. The without- and with project storm-induced damages along the downdrift shoreline are presented in Tables 1-5 and 1-6. The results of this analysis indicate that the average annual downdrift benefits of the proposed project are $321,300 using a 7 and 3/4 percent interest rate for the 50-year economic project life.

SUMMARY OF TOTAL PROJECT BENEFITS AND COSTS
(Project Justification)

2-80. The Ocean Ridge shore protection project will provide storm damage reduction, loss of land reduction, and recreational benefits. All benefits have been evaluated on an annual equivalent basis assuming a 7 and 3/4 percent interest rate and a 50-year project life. Comparison of total project benefits with annual equivalent cost of the project provides an indication of the economic feasibility of the project and an estimate of its net contribution to the objective of national economic development (NED). Table 2-22 summarizes total project costs and benefits, benefit-to-cost ratios, and net annual equivalent benefits. As shown in the table, the project that maximizes primary net benefits is economically justified with a benefit-to-cost ratio of 2:1 and would provide net annual equivalent benefits estimated at $1,064,400.

Table 2-22

SUMMARY OF AVERAGE ANNUAL PROJECT BENEFITS AND COSTS

Storm Damage Reduction	1,168,600
Loss of Land Reduction	241,100
Primary Benefits	**1,409,700**
Recreational Benefits	393,000
Downdrift Benefits	321,300
Total Benefits	**2,124,000**
Project Costs	**1,059,600**
Net Benefits	**1,064,400**
Benefit-to-Cost Ratio	**2.0:1**

Notes:

1_ Annual Equivalent Expected Values.
2_ 50-Year Economic Life: 1995-2044
3_ 7.75% Interest Rate
4_ Fill Length is 1.42 Miles

REFERENCES

American Automobile Association, "Your Driving Costs," American Automobile Association, Heathrow, FL, 1993.

Bodge, K.R., "Damage Benefits and Costs Sharing for Shore Protection Projects", Journal of the American Shore and Beach Preservation Association, University of California, Berkeley, CA, April 1990.

Bureau of Economic and Business Research, "1992 Florida Statistical Abstract," University Press of Florida, University of Florida, Gainesville, FL, 1992.

Florida Department of Natural Resources, "Outdoor Recreation in Florida 1989," State of Florida, Tallahassee, FL, 1990.

U.S. Army, "Water Resources and Authorities; Federal Participation in Shore Protection," Department of the Army, Office of the Chief of Engineers, E.R. 1165-2-130, Washington, DC, 1989.

U.S. Army Corps of Engineers, "Beach Erosion Control Projects for Palm Beach County, Florida General Design Memorandum," U.S. Army Corps of Engineers, Jacksonville, FL, May, 1987.

U.S. Army Corps of Engineers, "Palm Beach County, Florida Shore Protection Project (From Martin County Line to Lake Worth Inlet and from South Lake Worth Inlet to Broward County Line: General Design Memorandum Addendum for Jupiter/Carlin Segment," U.S. Army Corps of Engineers, Jacksonville, FL, January, 1995.

U.S. Water Resources Council, "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies," U.S. Government Printing Office, March, 1983.

PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
(FROM MARTIN COUNTY LINE TO LAKE WORTH INLET
AND FROM SOUTH LAKE WORTH INLET TO BROWARD COUNTY LINE)

GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE
OCEAN RIDGE SEGMENT

APPENDIX 3

REAL ESTATE PLAN

APPENDIX 3
REAL ESTATE PLAN
PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE
OCEAN RIDGE SEGMENT

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1. STATEMENT OF PURPOSE

This Real Estate Appendix is for planning purposes only. Both the real property requirements and the estimates of value are subject to change even after approval of this report.

2. PROJECT AUTHORIZATION

This project was authorized 23 October 1962 by Public Law 87-874. The project described by House Document (HD) 164/87/1, provided for Federal participation in the costs of beach erosion control along two segments of the Palm Beach County, Florida Atlantic shoreline. The project segments were (1) from the Martin County line to Lake Worth Inlet and (2) from South Lake Worth Inlet to the Broward County line. Ocean Ridge is located within the South Lake Worth Inlet to Broward County line segment.

3. PROJECT LOCATION AND DESCRIPTION

a. Project Location. The project is located along the Atlantic shoreline of the Town of Ocean Ridge in Palm Beach County, Florida. The Town of Ocean Ridge is approximately 30 miles south of the Palm Beach/Martin County line and approximately 15 miles north of the Palm Beach/Broward County line. Vicinity and location maps are provided in Figure 1.

b. Project Description. The proposed modification to the authorized project provides for the initial restoration of 7,520 ft of shoreline immediately south of South Lake Worth Inlet. The restored beach will consist of a 0 ft +9 ft NGVD berm measured from the erosion control line. This is equivalent to approximately a 50-ft extension of the mean high water line. The project will extend from 180 feet south of the south jetty of South Lake Worth Inlet (approximately R-152) to R-159 (Palm Beach County). The restored beach will be protected by advance nourishment, groins and periodic renourishment.

4. REAL ESTATE REQUIREMENTS

The Project Sponsor will be required to provide and certify the availability of lands for the project life. Temporary construction access and temporary stockpile and storage requirements are intended to be provided at existing areas of

public ownership. Construction access to the beach will be at Ocean Inlet Park and Boynton Beach Oceanfront Park. Stockpile and storage areas will be provided at both construction access locations.

Temporary easements for beach nourishment and work areas will be obtained by the Project Sponsor to provide temporary construction access landward of the Erosion Control Line to support the placement of material upon private lands (see paragraph 22.a). Twenty-six temporary easements will be required for beach nourishment and work area access. These easements will not receive Federal cost sharing since the lands are not open to the public. All costs associated with these lands are 100% non-Federal responsibility. Easements for these lands will not be required for the future operation and maintenance of the project, but may be required for subsequent renourishment. Temporary construction easements will be obtained as necessary for future renourishments.

Temporary construction easements will be obtained by the Project Sponsor to support the removal or modification of derelict groins upon private lands landward of the Erosion Control Line (see paragraph 22.b). Nine temporary construction easements will be required to remove or modify existing groins. These easements will not receive Federal cost sharing since the lands are not open to the public. All costs associated with these lands are 100% non-Federal responsibility.

Permanent shore protection structure easements will be provided by the Project Sponsor to support the construction of the rock groins upon private lands (see paragraph 22.c). Five permanent easements will be required for the rock groins.

The Project Sponsor will obtain a Consent of Use from the State of Florida for the rights needed seaward of the Erosion Control Line (ECL) to place the initial beach fill, portions of the groins, and periodic renourishment upon state owned bottom lands. The Consent of Use will also include the rights needed for the borrow area and any pipeline access. Refer to paragraph 22.d for a description of the Consent of Use.

5. GOVERNMENT-OWNED LAND

There exists no Federal Government land within the proposed project area.

6. SPONSORED-OWNED LAND

Approximately 10 acres of the proposed project is owned by Palm Beach County. These areas include recreational parks, beaches, public parking facilities, and vacant land open to the public.

7. APPRAISAL INFORMATION

Pursuant to ER 1165-2-130 (15 June 1989), the value of the publicly-owned beaches are excluded from the value of the total project costs and non-Federal credit. These publicly-owned beach areas will be those seaward of the Erosion Control Line and the public beaches. The temporary construction areas are currently in public ownership and will not be valued nor credited for cost-sharing due to the present public use being identical to the needed construction. Also pursuant to ER 1165-2-130 (15 June 1989), the borrow area is deemed to have the identical value before and after use.

Placement of material along areas not open to public use will be a 100 percent non-Federal responsibility. The Project Sponsor will be required to certify these lands for construction purposes so the Corps' contractor can perform the work.

8. RELOCATION ASSISTANCE (PUBLIC LAW 91-646)

There are neither persons nor businesses to be relocated as a result of this project.

9. RELOCATIONS

There are no known utilities, roads, highways, or railroads that will require relocation.

10. ACQUISITION/ADMINISTRATIVE COST ESTIMATES

a. Federal:

Project Planning	$ 10,000
Review of Acquisitions (5 @ $250 ea)	1,250
Review of Appraisals (5 @ $300 ea)	1,500
Real Estate Review of PCA	2,000
Review of Consent of Use	1,000
Total Federal Acquisition/Administrative Cost:	$ 15,750

b. Non-Federal:

Acquisitions (40 @ $1,000 ea)	$ 40,000

Appraisals (40 @ $600 ea)	24,000
Consent of Use	10,000
Damage Claims	5,000
Total Non-Federal Acquisition/Administrative Cost:	$79,000

11. NON-FEDERAL OPERATION/MAINTENANCE RESPONSIBILITIES

The Project Sponsor will operate and maintain the project for the economic life. Future periodic nourishments are considered construction and will be constructed as part of the Federal project. Maintenance of the shore protection structures will be 100 percent non-Federal cost.

12. NON-FEDERAL AUTHORITY TO PARTICIPATE IN THE PROJECT

Palm Beach County is a municipality which under Florida Law enjoys home rule as provided for in Chapter 166 F.S. Section 166.021 F.A.C. provides that municipalities have governmental, corporate and proprietary powers for municipal purposes. Municipal purposes is defined in this section as and activity or power which may be exercised by the State or its political subdivisions. Pursuant to Section 166.401, Palm Beach County enjoys eminent domain power for the exercise of municipal purposes under Section 166.411.

13. HAZARDOUS, TOXIC AND RADIOACTIVE WASTES (HTRW)

No hazardous, toxic, or radioactive waste sites have been identified in the proposed project area.

14. RECREATION LANDS

There are no separable recreational lands identified for the project.

15. STRUCTURES AND FACILITIES

There are no structures or facilities to be affected as part of the Project.

16. MINERAL RIGHTS

There exist no known minerals in the project area which require valuation or extraction precaution.

17. STANDING TIMBER AND VEGETATIVE COVER

No timber nor vegetative cover exist in the area of project construction.

18. CULTURAL RESOURCES

Other than fish and marine life habitat being mitigated for, there are no other cultural resources that have been identified for the Project.

19. MAPS

Real Estate Project maps are shown on the plates located at the end of this appendix. The maps identify publicly owned lands, the Erosion Control Line, the upland limit of construction, and the location of proposed temporary and permanent easements.

20. ESTIMATED COSTS OF LANDS, EASEMENTS, RIGHTS-OF-WAY AND RELOCATIONS (LERR) FOR THE PROJECT

The estimated cost of lands, easements, rights-of-way and relocations is summarized as follows:

a. Lands and Damages	
Land (acres)	$ 0
Improvement	$ 0
Minerals	$ 0
Severance	$ 0
Total land and damages	$ 0
b. Acquisition/Administration Costs (Including Corps Real Estate Planning and Monitoring Costs)	
Federal	$ 15,750
Non-Federal	$ 79,000
c. Public Law 91-646	$ 0
d. Contingencies (25%) (nearest thousand)	$ 24,000
e. Total Estimated Real Estate Cost	$118,750

21. ATTITUDE OF LANDOWNERS

Landowners affected by the proposed project are very supportive of the shore protection project due to the severe erosion along the shoreline. The State of Florida, Palm Beach County and the Town of Ocean Ridge are also supportive of the project.

22. REAL ESTATE ACQUISITION SCHEDULE

All easements will be available for construction of the project within 12 months.

23. ESTATES TO BE ACQUIRED

a. Standard estate for beach nourishment and work areas:

Temporary Work Area Easement. A temporary easement and right-of-way in, on, over and across (the land described in Schedule A), (Tract Nos. __ and __), for a period not to exceed _____, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a work area, including the right to borrow and/or deposit fill, spoil and waste material thereon and to perform any other work necessary and incident to the construction of the Ocean Ridge Shore Protection Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

b. Standard estate for removal or modification of derelict groins:

Temporary Work Area Easement. A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract Nos. __ and __), for a period not to exceed _____, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a work area, including the right to borrow and/or deposit fill, spoil and waste material thereon, move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Ocean Ridge Shore Protection Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

c. Non-standard estate for shore protection structures on private lands:

Perpetual Shore Protection Structure Easement. A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract Nos. ___ and ___) for the location, construction, operation, maintenance, alteration and replacement of (a) groin(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

d. Consent of Use. The project sponsor acquires a Consent of Use from the State of Florida in lieu of an easement which allows placement of beach fill and shore protection structure material seaward of the Erosion Control Line (ECL). The Consent of Use is issued when the initial Water Quality Certificate is approved by the Florida Department of Environmental Regulation and the Erosion Control Line is approved by the Governor and Cabinet of the State of Florida.

The Consent Of Use basically grants the rights to place sand and shore protection structure material (e.g., rock) upon State-owned bottom land in accordance with the beach nourishment and shore protection plans submitted with the application for an Erosion Control Line. Also included in this document is use of submerged borrow areas and/or pipeline corridors. This document must be renewed with the Water Quality Certificate, as needed.

24. CHART OF ACCOUNTS

01 LANDS AND DAMAGES

01A00	PROJECT PLANNING	$10,000
01B--	ACQUISITIONS	
01B20	BY LOCAL SPONSOR (LS)	40,000
01B40	REVIEW OF LS	1,250
01C--	CONDEMNATIONS	
01C20	BY LS	0
01C40	REVIEW OF LS	0
01E--	APPRAISALS	
01E30	BY LS	24,000
01E50	REVIEW BY LS	1,500
01G--	TEMPORARY PERMITS/LICENSES/RIGHT-OF-ENTRY	
01G20	BY LS	10,000
01G60	DAMAGE CLAIMS	5,000
01M00	PROJECT RELATED ADMINISTRATION	
	REAL ESTATE REVIEW OF PCA	2,000
	REAL ESTATE REVIEW OF CONSENT OF USE	1,000
01R--	REAL ESTATE PAYMENTS	
01R10	LAND PAYMENTS	
01R1B	BY LS	0
01R1D	REVIEW OF LS	0
01RX CONTINGENCIES		$24,000
TOTAL REAL ESTATE COSTS EXCLUDING CONTINGENCIES		$ 94,750
TOTAL REAL ESTATE CONTINGENCIES COST		$ 24,000
TOTAL PROJECT REAL ESTATE COST		$118,750

PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
(FROM MARTIN COUNTY LINE TO LAKE WORTH INLET
AND FROM SOUTH LAKE WORTH INLET TO BROWARD COUNTY LINE)

GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE
OCEAN RIDGE SEGMENT

APPENDIX 4

PERTINENT CORRESPONDENCE

United States Department of the Interior
NATIONAL PARK SERVICE
SOUTHEAST REGIONAL OFFICE
75 Spring Street, S.W.
Atlanta, Georgia 30303

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

Mr. A.J. Salem, Chief
Planning Division
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

We have reviewed the copy of the report "Underwater Archeological Background Study, Remote Sensing Survey, and Anomaly Identification for the Ocean Ridge Shore Protection Project, Palm Beach County, Florida." The report is well written and the author presents the data and documentation in an acceptable manner. We believe the recommendations are appropriate but in view of this office's lack of information and data pertinent to the area we defer to the Florida State Historic Preservation Officer concerning the acceptability of the report's conclusions and recommendations.

If sufficient copies are available, we would appreciate a copy of the final report for our library.

Sincerely,

John E. Ehrenhard 11/17/93

John E. Ehrenhard, Chief
Interagency Archeological Services Division

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director's Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

December 10, 1993

Mr. A. J. Salem, Chief
Planning Division, Environmental
Resources Branch
Jacksonville District Corps of
Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

In Reply Refer To:
Denise M. Breit
Historic Sites
Specialist
(904) 487-2333
Project File No. 933605

RE: Cultural Resource Assessment Review Request
Underwater Archeological Background Study, Remote Sensing Survey, and Anomaly Identification for the Ocean Ridge Shore Protection Project, Palm Beach County, Florida. By Daniel Koski-Karell, October 1993.

Dear Mr. Salem:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the results of the magnetometer survey and diver verification for the referenced project and find them to be complete and sufficient. We note that nineteen magnetic anomalies were located during the course of the survey, some of which formed two clusters. The latter were diver verified and found to be representative of modern materials. Those magnetic anomalies which did not cluster appeared to be isolated objects of no significance. We concur with these results. It is the determination of this office, therefore, that sand borrowing activities in the two areas will have no effect on any significant resources.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

Laura A. Kammerer

for George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Bdb

November 5, 1993

Planning Division
Environmental Branch

Mr. George Percy
Division of Historic Resources
Compliance Review Section
500 South Bronough
Tallahassee, Florida 32399

Dear Mr. Percy:

Enclosed is a copy of the report "Underwater Archeological Background Study, Remote Sensing Survey, and Anomaly Identification for the Ocean Ridge Shore Protection Project, Palm Beach County, Florida." This report was prepared by Karell Archeological Services for Morgan and Ekland, Inc. and Palm Beach County. The U.S. Army Corps of Engineers, Jacksonville District, is coordinating this report with your office to obtain compliance with the National Historic Preservation Act of 1966, as amended.

The study area for the enclosed report is comprised of two offshore borrow areas which are located in the Atlantic Ocean, east of Ocean Ridge. During the course of the fieldwork, the Contractor identified two potentially significant magnetic anomalies. The sources of these two anomalies were inspected by the Contractor. It was determined that the signals were produced by modern debris dating from the latter half of the 20th century. Ms. Janice Adams, archeologist with the Jacksonville District has reviewed the report and accepts the Contractor's recommendation that these anomalies are not significant cultural resources and that additional field investigations are not required for the two borrow areas.

In compliance with 36 CFR 800, the Jacksonville District requests written concurrence from your office that use of the two borrow areas discussed in the above referenced report will not affect cultural resources included in or eligible for inclusion in the National Register of Historic Places. If you have any questions or require additional information, please contact me.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosure

November 5, 1993

Planning Division
Environmental Branch

Mr. John E. Ehrenhard
National Park Service
Interagency Archeological Service Division
75 Spring Street, SW
Atlanta, Georgia 30303

Dear Mr. Ehrenhard:

Enclosed is a copy of the report "Underwater Archeological Background Study, Remote Sensing Survey, and Anomaly Identification for the Ocean Ridge Shore Protection Project, Palm Beach County, Florida." This report was prepared by Karell Archeological Services for Morgan and Ekland, Inc. and Palm Beach County. The U.S. Army Corps of Engineers, Jacksonville District, is coordinating this report with your office to obtain compliance with the National Historic Preservation Act of 1966, as amended.

The study area for the enclosed report is comprised of two offshore borrow areas which are located in the Atlantic Ocean, east of Ocean Ridge. During the course of the fieldwork, the Contractor identified two potentially significant magnetic anomalies. The sources of these two anomalies were inspected by the Contractor. It was determined that the signals were produced by modern debris dating from the latter half of the 20th century. Ms. Janice Adams, archeologist with the Jacksonville District has reviewed the report and accepts the Contractor's recommendation that these anomalies are not significant cultural resources and that additional field investigations are not required for the two borrow areas.

In compliance with 36 CFR 800, the Jacksonville District requests written concurrence from your office that use of the two borrow areas discussed in the above referenced report will not affect cultural resources included in or eligible for inclusion in the National Register of Historic Places. If you have any questions or require additional information, please contact me.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosure

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P.O. BOX 2676
VERO BEACH, FLORIDA 32961-2676

February 14, 1994

Colonel Terrence Salt
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Attn: Planning Division

RE: Ocean Ridge Beach Nourishment

Dear Colonel Salt:

This responds to your letter dated January 21, 1994 and attached environmental assessment in accordance with the Fish and Wildlife Coordination Act and Section 7 of the Endangered Species Act of 1973, as amended.

The Corps of Engineers determined that this action "may affect" threatened or endangered sea turtles. Based upon our preliminary review, we concur with this determination. We are, therefore, initiating consultation under Section 7 of the Endangered Species Act on this date and will complete the consultation process within 90 days. A Biological Opinion will be issued shortly after the conclusion of the consultation period. Please be advised these are our regulatory time frames, and the vast majority of consultations are completed in a much shorter period.

The Corps has also determined that the project will not adversely affect the West Indian manatee. The Service concurs with this determination. Although this does not constitute a Biological Opinion described under Section 7 of the Endangered Species Act, it does fulfill the requirements of the Act, and no further action is required with regard to the West Indian manatee.

If modifications are made in the project or if additional information involving potential impacts on listed species becomes available, please notify Chuck Sultzman or Patricia Richards of my staff at (407-562-3909).

Sincerely yours,

David L. Ferrell
Field Supervisor

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

February 8, 1994 F/SE013:EH

Mr. A.J. Salem
Chief, Planning Division
Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

This responds to your letter and supplemental information dated February 3, 1994, regarding the Ocean Ridge segment of the Palm Beach County Shore Protection Program. We have reviewed the information and the previously submitted Biological Assessment (BA). We concur with your determination that populations of endangered or threatened species under our purview would not be adversely affected by the proposed action.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity.

If you have any questions please contact LCDR Eric Hawk, Fishery Scientist, at 813/893-3366.

Sincerely yours,

Charles A. Oravetz

for Andrew J. Kemmerer
Regional Director

cc:
F/SE02
F/PR2

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

January 21, 1994 F/SE013:EH

Mr. A.J. Salem
Chief, Planning Division
Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

This responds to your letter dated January 7, 1994, regarding the Ocean Ridge segment of the Palm Beach County Shore Protection Program. A Biological Assessment (BA) was submitted pursuant to the requirements for interagency consultation outlined in Section 7 of the Endangered Species Act (ESA).

We have reviewed the BA. Unfortunately, the information provided is insufficient for us to concur with your determination that populations of endangered or threatened species under our purview would not be adversely affected the proposed action.

Please provide us with details on the type of bottom to be dredged at the borrow site. Are any sea grasses or worm reefs present that might attract turtles? Also provide specifications on the hydraulic dredge type to be used. Does it have a cutting head or a suction head, what is the size of head, is it equipped with any type of turtle deflector, and what is the rate of advance over the bottom? For what months is the dredging planned, and how may that impact sea turtle nesting? Have provisions been made to ensure that minimal safe lighting, or shielded lighting, is used on the dredge and pipeline during nesting/hatching season, et cetera?

If you have any questions please contact LCDR Eric Hawk, Fishery Scientist, at 813/893-3366.

Sincerely yours,

Charles A. Oravetz

for Andrew J. Kemmerer
Regional Director

cc:
F/SE02
F/PR2

January 21, 1994

Planning Division
Environmental Branch

Mr. David L. Ferrell
Field Supervisor
U.S. Fish and Wildlife Service
P.O. Box 2676
Vero Beach, Florida 32961-2676

Dear Mr. Ferrell:

This is in reference to the Palm Beach County Shore Protection Project and the planned nourishment of the Ocean Ridge segment.

Enclosed is the Biological Assessment pursuant to Section 7(a) of the Endangered Species Act concerning potential impacts to sea turtles. The U.S. Army Corps of Engineers has determined that the planned renourishment may affect sea turtle nesting. Therefore, we are requesting that formal consultation with the Service be initiated to address potential impacts the project may have on sea turtles.

Please provide your Biological Opinion within 90 days as specified in Section 7(b)(1) of the Endangered Species Act. If you have any questions or need any further information, please do not hesitate to contact me.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosure

bcc: w/encl
CESAJ-EN-HC
CESAJ-DP-I

January 7, 1994

Planning Division
Environmental Branch

Mr. Charles A. Oravetz
Chief, Protected Species Management Branch
National Marine Fisheries Service
9450 Koger Boulevard
St. Petersburg, Florida 33702-2496

Dear Mr. Oravetz:

This is in reference to the Ocean Ridge segment of the Palm Beach County Shore Protection Project.

Enclosed is the Biological Assessment pursuant to Section 7(a) of the Endangered Species Act. The U.S. Army Corps of Engineers has determined that the proposed action will not adversely affect any listed species under the jurisdiction of the National Marine Fisheries Service.

Your concurrence on this determination is requested. If you have any questions or need any additional information, please feel free to contact me.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosure

bcc:
CESAJ-EN-HC
CESAJ-DP-I

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

December 7, 1993

Planning Division
Environmental Branch

TO ADDRESSEES ON THE ATTACHED LIST:

The Jacksonville District U.S. Army Corps of Engineers, is beginning to gather information to help define issues and concerns that will be addressed in a Supplement to the Environmental Impact Statement for the Ocean Ridge segment of the Palm Beach County Shore Protection Project.

The project was authorized on October 23, 1962 by Public Law 87-874. The project has been coordinated with interested Federal, State and local agencies and the public. The Final Environmental Impact Statement and General Design Memorandum (GDM) for Palm Beach County was published in April 1987. The recommended plan in the 1987 GDM called for the restoration and periodic nourishment of 1.6 miles of shoreline using a 50 foot berm width. Approximately 770,000 cubic yards of fill would be placed and would include advanced nourishment for the initial eight year nourishment interval.

An alternative design is being considered that would reduce the width of the fill in the northern end of the project by using approximately 10 low profile rock structures. The use of structures is being considered to reduce the annual expected cost of the project and to protect nearshore rock habitat that exists in the northern end of the project. The project is proposed to begin at the south jetty of South Lake Worth Inlet and extend south about 7,700 feet (1.4 miles). The borrow area for the project is located between 1,750 and 2,800 feet offshore of the fill area in about 30 to 35 feet of water. The sand will be removed from the borrow area with hydraulic dredge and pumped onto the shoreline where it will be shaped by heavy equipment. Refer to the enclosed map for the project location.

We welcome your views, comments and information about resources, study objectives and important features within the described area, as well as any suggested improvements. Letters of comment or inquiry should be sent within 45 days to the letterhead address, attention Planning Division, Environmental Branch.

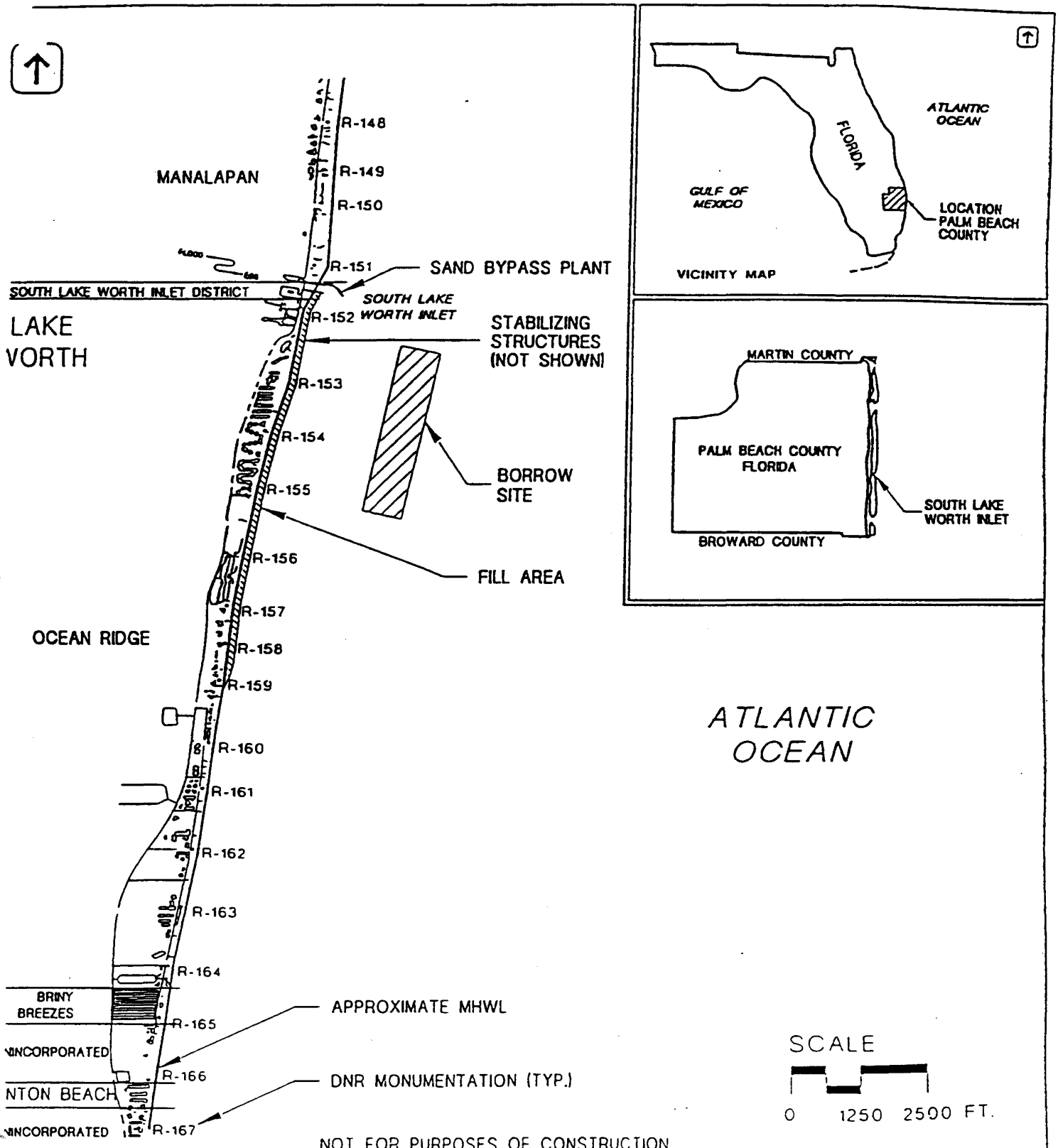
Sincerely,

A. J. Salem

A. J. Salem
Chief, Planning Division

Enclosure

Fig. 1



NOT FOR PURPOSES OF CONSTRUCTION

olsen associates, inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114
(Fax) 384-7368

OCEAN RIDGE
SHORE PROTECTION PROJECT
PALM BEACH COUNTY, FLORIDA
LOCATION MAP

DATE	APPROVED	REVISION

DATE: 6/23/93
DRAWN BY: M.R.L.
SHEET 1 OF 13

LIST OF ADDRESSEES

PALM BEACH COUNTY SHORE PROTECTION PROJECT
OCEAN RIDGE SEGMENT

FLORIDA AUDUBON SOCIETY
460 HIGHWAY 436
SUITE 200
CASSELBERRY, FLORIDA 32707

MR JOHN RAINS JR
ISAAK WALTON LEAGUE OF
5314 BAY STATE ROAD
PALMETTO, FLORIDA 33561-9712

STATE CLEARINGHOUSE
OFFICE OF PLANNING & BUDGETING
EXEC OFC OF THE GOVERNOR
THE CAPITOL
TALLAHASSEE, FLORIDA 32301-8074
(16 cys)

FLORIDA WILDLIFE FEDERATION
PO BOX 6870
TALLAHASSEE, FLORIDA 32314-6870

US DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
401 SE FIRST AVENUE
GAINESVILLE, FLORIDA 32602-6489

REGIONAL ENVIRONMENTAL OFFICER
HOUSING & URBAN DEVELOPMENT
ROOM 600-C
75 SPRING STREET SW
ATLANTA, GEORGIA 30303-3309
(2 CYS)

COMMANDER (OAN)
SEVENTH COAST GUARD DISTRICT
909 SE 1ST AVENUE
BRICKNELL PLAZA FEDERAL BLDG
MIAMI, FLORIDA 33131-3050

REGIONAL DIRECTOR
INSURANCE & MITIGATION DIVISION
FEMA
1371 PEACHTREE STREET NE
ATLANTA, GEORGIA 30303-3309

WILDERNESS SOCIETY
4203 PONCE DE LEON BOULEVARD
CORAL GABLES, FLORIDA 33416

PROFESSOR JOHN GIFFORD
ROSENSTIEL SCHOOL OF MARINE
AND ATMOSPHERIC SCIENCE
4600 RICKENBACKER CAUSWAY
MIAMI, FLORIDA 33149-1098

DR ELAINE HARRINGTON
FLORIDA CHAPTER
SIERRA CLUB
927 DELORES DRIVE
TALLAHASSEE, FLORIDA 32301-2929

ENVIRONMENTAL SERVICES INC
8711 PERIMETER PARK BLVD
SUITE 11
JACKSONVILLE, FLORIDA 32216

SOUTHERN REGION FORESTER
US FOREST SERVICE
DEPARTMENT OF AGRICULTURE
1720 PEACHTREE ROAD NW
ATLANTA, GEORGIA 30309-2405

NATIONAL MARINE FISHERIES SVC
CHIEF PROTECTED SPECIES BR
9450 KOGER BOULEVARD
ST PETERSBURG, FLORIDA 33702-2496

REGIONAL DIRECTOR
US FISH AND WILDLIFE SERVICE
75 SPRING STREET SW
ATLANTA, GEORGIA 30303-3309

FIELD SUPERVISOR
US FISH AND WILDLIFE SERVICE
PO BOX 2676
VERO BEACH, FLORIDA 32961-2676

MR HEINZ MUELLER
ENVIRONMENTAL POLICY SECTION
EPA REGION IV
345 COURTLAND STREET NE
ATLANTA, GEORGIA 30365-2401
(5 CYS)

MR GEORGE W PERCY DIRECTOR
DIV OF HISTORICAL RESOURCES
STATE HISTORIC PRESERVATION OFF
R A GRAY BUILDING
TALLAHASSEE, FLORIDA 32399

NATIONAL MARINE FISHERIES
SERVICE
ENVIRONMENTAL ASSESSMENT BR
3500 DELWOOD BEACH ROAD
PANAMA CITY, FLORIDA 32407-7499

NATIONAL MARINE FISHERIES SVC
OFFICE OF THE REGIONAL DIRECTOR
9450 KOGER BOULEVARD
ST PETERSBURG, FLORIDA 33702-24906

MS SUSAN MARYNOWSKI
CARIBBEAN CONSERVATION CORP
PO BOX 2866
GAINESVILLE, FLORIDA 32602

PALM BEACH COUNTY
DEPARTMENT OF ENVIRONMENTAL
RESOURCES PROTECTION
3111 S. DIXIE HIGHWAY, SUITE 146
WEST PALM BEACH, FLORIDA 33405
(3 CYS)

MR KIRBY GREEN DIRECTOR
DIVISION OF BEACHES AND SHORES
DEPARTMENT OF ENV. PROTECTION
MAIL STATION 300
3900 COMMONWEALTH BOULEVARD
TALLAHASSEE, FLORIDA 32399

SOUTH FLORIDA WATER MGMT DISTRICT
PO BOX 24680
WEST PALM BEACH, FL 33416-4680

REGIONAL COASTAL ZONE MGMT. COORD.
TREASURE COAST REG. PLNG. COUNCIL
P.O. BOX 1529
PALM CITY, FLORIDA 33490-1529

FLORIDA DEPT. OF ENV. PROTECTION
OFFICE OF AQUATIC PRESERVES
4842 U.S. HIGHWAY #1
FT. PIERCE, FLORIDA 34982

FLORIDA DEPT. OF ENV. PROTECTION
BUREAU OF STATE LANDS
7400 H. SOUTH GEORGIA AVENUE
WEST PALM BEACH, FLORIDA 33405

FLORIDA DEPT. OF ENV. PROTECTION
MARINE RESEARCH INSTITUTE
19100 S.E. FEDERAL HIGHWAY
TEQUESTA, FLORIDA 33469

FLORIDA DEPT. OF ENV. PROTECTION
1900 SOUTH CONGRESS AVENUE
WEST PALM BEACH, FLORIDA 33406

TOWN MANAGER
TOWN OF OCEAN RIDGE
6450 NORTH OCEAN BOULEVARD
OCEAN RIDGE, FLORIDA 33435

TOWN MANAGER
TOWN OF MANALAPAN
6000 SOUTH OCEAN BOULEVARD
MANALAPAN, FLORIDA 33462

CITY MANAGER
CITY OF BOYNTON BEACH
100 E. BOYNTON BEACH BOULEVARD
BOYNTON BEACH, FLORIDA 33435

TOWN MANAGER
TOWN OF BRINEY BREEZES
5000 NORTH OCEAN BOULEVARD
BOYNTON BEACH, FLORIDA 33435

CHAIRMAN
SOUTH LAKE WORTH INLET DISTRICT
P.O. BOX 3465
LANTANA, FLORIDA 33465

STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS

2740 CENTERVIEW DRIVE • TALLAHASSEE, FLORIDA 32399-2100

LAWTON CHILES
Governor

LINDA LOOMIS SHELLEY
[redacted]
Secretary

January 28, 1994

Mr. A. J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

RE: Beach Erosion Control Projects - Supplement to Environmental Impact Statement - Ocean Ridge Segment, Palm Beach County Shore Protection Project - Palm Beach County, Florida
SAI: FL9312091502C

Dear Mr. Salem:

The Florida State Clearinghouse, pursuant to Presidential Executive Order 12372, Gubernatorial Executive Order 93-194, the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended, and the National Environmental Policy Act, 42 U.S.C. §§ 4321, 4331-4335, 4341-4347, as amended, has coordinated a review of the above-referenced project.

The Department of Environmental Protection (DEP) notes that Palm Beach County has already requested a DEP permit for the referenced project. DEP has recommended that the county consider alternatives to the proposed project, including but not limited to the placement of fill above mean high water only along the segment where the rock structures are proposed. Furthermore, DEP indicates that the county has not adequately demonstrated a need for the permit. Therefore, the county has been asked to provide additional information. Please refer to the enclosed DEP comments.

The Department of Transportation (DOT) indicates that there are two DOT projects, WPI No. 4118743 and WPI No. 4118503, located at the Boynton (Lake Worth) Inlet. Therefore, the

applicant is required to coordinate project related activities with the referenced DOT personnel. Please refer to the enclosed DOT comments.

The State of Florida has completed a review of the referenced project, and based on the information available at this time, the state has determined that at this stage, the project is consistent with the Florida Coastal Management Program. However, our reviewing agencies have identified certain issues, as enclosed, which should be addressed by the applicant prior to any subsequent review of this project. Pursuant to 15 CFR 930.34 and 930.37, the applicant is required to prepare a consistency determination at each major decision point in the project for the state's review. The state's continued agreement with the project will be based, in part, on the adequate resolution of the concerns identified in all previous reviews of the project.

Very truly yours,

Linda Loomis Shelley
Secretary

LLS/jr

Enclosures

cc: Susan Goggin, Department of Environmental Protection
Neal Rogers, Department of Environmental Protection
Gustavo Schmidt, Department of Transportation
George Percy, Department of State

Florida Department of
Environmental Protection

Lawton Chiles
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Virginia B. Wetherell
Secretary

28 January 1994

Janice L. Hatter
Director, State Clearinghouse
Office of Planning and Budgeting
Executive Office of the Governor
The Capitol
Tallahassee, Florida 32399-0001

RE: COE/Scoping Request, Supplement to the Environmental Impact Statement, Ocean Ridge Segment of Palm Beach County Shore Protection Project
SAI: FL931091502C

Dear Ms. Hatter:

The U.S. Army Corps of Engineers has requested our comments on issues to be included in a Supplement to the Environmental Impact Statement (SEIS) for the above-referenced Pam Beach County Shore Protection project.

An alternative design has been presented for this project whereby ten low profile rock structures would be placed just south of the South Lake Worth Inlet in order to reduce beach fill requirements. Permits will be required for this project pursuant to Chapters 161 and 403, Florida Statutes. Palm Beach County has filed an application for a project permit with the Division of Beach and Shores, but has not adequately demonstrated that the proposed rock structures are justified, nor that approval of the permit is consistent with Section 161.041, Florida Statutes. The Bureau of Wetland Resource Management has received a complete permit application which is now under review.

Division of Beaches & Shores staff have requested that the county consider other alternatives to the proposed project including but not limited to fill above mean high water only along the segment where the rock structures are proposed. Excluding the rock structures, the Division of Beaches & Shores would recommend favorably for the beach nourishment project for this segment. Final design approval, however, must also be coordinated with the Bureau of Wetland Resource Management.

According to staff in the Division of Beaches & Shores, the County has also not adequately demonstrated that the proposed impacts to nearshore rock outcrops are the maximum allowable impacts and that the proposed reduction in potential

impacts to nearshore rock outcrops justifies the proposed rock structures and the potential impacts to longshore transport.

Department staff have also requested that the County demonstrate the methodology which was applied in evaluating the performance of the beach fill with respect to the proposed rock structures. It has also been requested that the County conduct a numerical model study of the project to evaluate the performance of the project and the potential impacts to the areas downdrift of the project.

Attached is a copy of the request for additional information sent to the County regarding their application. This requested information must be provided so that a complete application is on file with both the Division of Beaches & Shores and Bureau of Wetland Resource Management.

Questions regarding the permitting status of the proposed project should be referred to Neal Rogers, Beaches & Shores, at (904)487-4475, and John Abendroth, Wetland Resource Management, at (904)488-0130. If you have any questions regarding this letter, please call me at 488-0784.

Sincerely,

Susan Goggin

Susan Goggin
Environmental Specialist
Office of Intergovernmental Programs

NR/seg:

cc: Neal Rogers
John Abendroth

RECEIVED
JAN 7 1994
Florida Coastal Management Program

Date: 12/13/93
Comment Due Date: 12/27/93
SAI# FL9312091502C

STATE AGENCIES		Florida Coastal Management Program	OPB POLICY UNITS	
	Agriculture	RPC #1		Criminal Justice
	Board of Regents	RPC #2		Education
	Commerce	RPC #3		Environment/C & ED
X	Community Affairs	RPC #4		General Government
	Education	RPC #5		Health & Human Srv
X	Environmental Reg	RPC #6		Revenue & Eco. Ana
X	Game & Fish Comm	RPC #7		SCH
	Health & Rehab Srv	RPC #8	X	SCH/CON
	Highway Safety	RPC #9		
	Labor & Employmnt	RPC #10		
	Law Enforcement	RPC #11		
X	Marine Fish Comm	NWFWMD		
	Natural Resources	X SFWMD		
X	State	SWFWMD		
X	Transportation	SJRWMD		
	Trans Disad. Comm	SRWMD		
	DER District			

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DEC 1 5 1993
CENTRAL OFFICE FDOT
ICAR COORDINATOR

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evaluation and is categorized as one of the following:

___ Federal Assistance to State or Local Government(15 CFR 930, Subpart F). Agencies are required to evaluate the consistency of the activity.

_X_ Direct Federal Activity (15 CFR 930, Subpart C). Federal agencies are required to furnish a consistency determination for the State's concurrence or objection.

___ Outer Continental Shelf Exploration, Development or Production Activities (15 CFR 930, Subpart E). Operators are required to provide a consistency certification for state concurrence/objection.

___ Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.

SEE REVERSE SIDE FOR INSTRUCTIONS AND ADDRESSES FOR RETURN MAILING.

To: State Clearinghouse
Executive Office of the Governor-OPB

Florida Coastal Management Director
Department of Community Affairs

EO. 12372	Federal Consistency
[ ] No Comment	[ ] No Comment/Consistent
[X] Comments Attached	[X] Consistent/Comments Attached
[ ] Not Applicable	[ ] Inconsistent/Comments Attached
	[ ] Not Applicable

rom:
Division/Bureau: FDOT - DIST. 4
Reviewer: Ann Anderson
Date: 1/3/94

FLORIDA DEPARTMENT OF TRANSPORTATION

LAWTON CHILES
GOVERNOR

TRANSPORTATION PLANNING OFFICE - DISTRICT 4

3400 West Commercial Blvd., 3rd Floor, Ft. Lauderdale, FL 33309-3421
Telephone: (305) 777-4601; Fax: (305) 777-4671

BEN G. WATTS
SECRETARY

January 3, 1994

The State Clearinghouse
Executive Office of the Governor
Room 1603, The Capitol
Tallahassee, Florida 32399-0001

Dear Sirs:

Subject: FL9312091502C - Beach Nourishment Project
Palm Beach County
State Road AIA
WPI No. 4118743 and WPI No. 4118503

The Department has two projects, indicated above, which are located at the Boynton (Lake Worth) Inlet. Both are in conjunction with the bridge and its approaches and adjoining seawall. The first, (WPI No. 4118743), is nearly complete and involves construction of approximately 776 feet of seawall, curb and gutter and resurfacing of SR-AIA. The second, (WPI No. 4118503), is a larger project involving the reconstruction of the bridge over the inlet at a cost of over $2 million. This project is scheduled for construction in FY 1994/95. The project manager for the seawall project is Mr. Rene Aoun who can be reached at (305) 777-4641. The bridge reconstruction project is managed by Mr. Al Khah who can be reached at (305) 777-4636.

We do not envision any other impingement of the proposed U.S. Corps of Engineers Project on State Road AIA; however, we strongly urge that the Corps of Engineers project manager contact the above named staff in order to effect coordination between the Department's and the Corp's projects.

Sincerely,

For Gustavo Schmidt, P.E.
District Planning Manager
District 4

cc: Bill Keating
John Anderson

ICARPBC.AIA
FILE: 4280.05

RECYCLED PAPER

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director's Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

RECEIVED
JAN 5 1994
Florida Coastal Management Program

December 22, 1993

Ms. Janice L. Hatter, Director
State Clearinghouse
Executive Office of the Governor
Room 1603, The Capitol
Tallahassee, Florida 32399-0001

In Reply Refer To:
Denise M. Breit
Historic Sites Specialist
(904) 487-2333
Project File No. 933958

RE: Cultural Resource Assessment Request
SAI# FL9312091502C
Supplement to the Environmental Impact Statement for the Ocean Ridge Segment of the Palm Beach County Shore Protection Project
Palm Beach County, Florida

Dear Ms. Hatter:

In accordance with the provisions of Florida's Coastal Zone Management Act and Chapter 267, Florida Statutes, as well as the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the referenced project(s) for possible impact to historic properties listed, or eligible for listing, in the National Register of Historic Places, or otherwise of historical or architectural value.

A review of the Florida Site File indicates that no significant archaeological or historical sites are recorded for or likely to be present within the project area. Furthermore, because of the project location and/or nature it is unlikely that any such sites will be affected. Therefore, it is the opinion of this office that the proposed project will have no effect on historic properties listed, or eligible for listing, in the National Register of Historic Places, or otherwise of historical or architectural value. The project is also consistent with the historic preservation laws of Florida's Coastal Management Program.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

for Laura A. Kammerer

George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Bdb
xc: Jasmine Raffington, FCMP-DCA

Date: 12/13/93
Comment Due Date: 12/27/93
SAI# FL9312091502C

RECEIVED
DEC 14 1993
Marine Fisheries Commission

STATE AGENCIES	LOCAL/OTHER	OPB POLICY UNITS
Agriculture	RPC #1	Criminal Justice
Board of Regents	RPC #2	Education
Commerce	RPC #3	Environment/C & ED
X Community Affairs	RPC #4	General Government
Education	RPC #5	Health & Human Srv
X Environmental Reg	RPC #6	Revenue & Eco. Ana
X Game & Fish Comm	RPC #7	SCH
Health & Rehab Srv	RPC #8	X SCH/CON
Highway Safety	RPC #9	
Labor & Employmnt	RPC #10	
Law Enforcement	RPC #11	
X Marine Fish Comm	NWFWMD	
Natural Resources	X SFWMD	
X State	SWFWMD	
X Transportation	SJRWMD	
Trans Disad. Comm	SRWMD	
DER District		

RECEIVED
DEC 20 1993
Florida Coastal Management Program

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evaluation and is categorized as one of the following:

___ Federal Assistance to State or Local Government (15 CFR 930, Subpart F). Agencies are required to evaluate the consistency of the activity.

_X_ Direct Federal Activity (15 CFR 930, Subpart C). Federal agencies are required to furnish a consistency determination for the State's concurrence or objection.

___ Outer Continental Shelf Exploration, Development or Production Activities (15 CFR 930, Subpart E). Operators are required to provide a consistency certification for state concurrence/objection.

___ Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.

SEE REVERSE SIDE FOR INSTRUCTIONS AND ADDRESSES FOR RETURN MAILING.

To: State Clearinghouse
Executive Office of the Governor-OPB

Florida Coastal Management Director
Department of Community Affairs

From:
Division/Bureau:
Reviewer:
Date: 12/16/93

EO. 12372	Federal Consistency
[X] No Comment	[X] No Comment/Consistent
[ ] Comments Attached	[ ] Consistent/Comments Attached
[ ] Not Applicable	[ ] Inconsistent/Comments Attached
	[ ] Not Applicable

The City of
Boynton Beach

100 E. Boynton Beach Boulevard
P.O. Box 310
Boynton Beach, Florida 33425-0310
City Hall: (407) 375-6000
FAX: (407) 375-6090

December 21, 1993

Mr. A.J. Salem, Chief
Planning Division
Jacksonville Corps of Engineers
PO Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

The City of Boynton Beach is in receipt of your letter concerning the Ocean Ridge Shore Protection Project. Attached is a copy of a letter sent to the Florida Department of Environmental Protection which documents the City's support for the project.

Should you require additional information, please do not hesitate to contact us.

Sincerely,

CITY OF BOYNTON BEACH

John Wildner
Superintendent of Parks

JW:cm
xc: J. Scott Miller, City Manager
Charles C. Frederick, Director of Recreation & Parks
Jim White, City Engineer
George Evans, Beach Supervisor

The City of
Boynton Beach

100 E. Boynton Beach Boulevard
P.O. Box 310
Boynton Beach, Florida 33425-0310
City Hall: (407) 734-8111
FAX: (407) 738-7459

September 27, 1993

Florida Department of Environmental Protection
Bureau of Coastal Engineering and Regulation
ATTN: Neal Rogers
3900 Commonwealth Blvd.
Tallahassee, FL 32399

Dear Mr. Rogers:

Subject: File #DBS9A0330

This letter is in response to your agency's request for public comment regarding the Ocean Ridge Shore Protection Project as advertised in the Palm Beach Post on September 18, 19 and 20, 1993.

Please be advised that the Boynton Beach City Commission is in favor of and supports the Ocean Ridge Protection Project.

This City owns and operates a public park and beach in the Town of Ocean Ridge known as Oceanfront Park. Over the last several years, our beach has suffered dune and boardwalk damage due to storms and erosion. The Ocean Ridge Shore Protection Project will provide much needed renourishment to our beach front which will enhance the recreational enjoyment of our patrons and assist in protecting our dune and boardwalk from severe erosion damage. Our public beach experiences in excess of 500,000 visitations annually.

The Mayor and City Commission recently agreed to provide public parking spaces for this shoreline area as a part of the County's financing plan with the State for the Ocean Ridge Shore Protection Project.

Please accept this letter on behalf of the Boynton Beach Mayor and City Commission as this city's official position supporting the Ocean Ridge Shore Protection Project.

Sincerely,

CITY OF BOYNTON BEACH

J. Scott Miller
City Manager

JSM/CCF:cm

xc: Robert Clinger, D.E.R.M.
John Abendroth. D.E.P.
Mayor and City Commission
Charles Frederick, Director of Recreation & Parks

RESOLUTION R93-23

A RESOLUTION OF THE CITY COMMISSION OF THE CITY OF BOYNTON BEACH, FLORIDA, SUPPORTING A GRANT APPLICATION OF PALM BEACH COUNTY FOR A SHORE PROTECTION PROJECT IN OCEAN RIDGE AND REQUESTING THE STATE LEGISLATURE TO PROVIDE GRANT FUNDING FOR THE PROJECT.

WHEREAS, The Ocean Ridge Shore Protection Project has been submitted to the State Legislature for funding; and

WHEREAS, the Beach Re-Nourishment Project includes our public beach, Oceanfront Park.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COMMISSION OF THE CITY OF BOYNTON BEACH, FLORIDA, THAT:

Section 1. The City Commission of the City of Boynton Beach, Florida does hereby support the grant application of Palm Beach County for a Shore Protection Project in Ocean Ridge, and urges the State Legislature to provide grant funding of $1,875,000 for the project.

Section 2. The City Commission of the City of Boynton Beach, Florida hereby directs the City Clerk to provide a copy of this Resolution, upon passage, to the Governor of the State of Florida and the Palm Beach County Legislative Delegation.

PASSED AND ADOPTED this 16 day of February, 1993.

CITY OF BOYNTON BEACH, FLORIDA

Mayor

Vice Mayor

Commissioner

Commissioner

Commissioner

ATTEST:

City Clerk

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, Florida 33702

January 18, 1994

Mr. A. J. Salem
Chief, Planning Division
Department of the Army, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

This responds to your December 7, 1993, request for information regarding issues and concerns that will be addressed in a Supplement to the Environmental Impact Statement for the Ocean Ridge segment of the Palm Beach County Shore Protection Project.

Your letter states that an alternative design is being considered that would reduce the width of the fill in the northern end of the project in order to reduce costs and avoid existing nearshore rock bottom habitat in that area. In general, we support any effort to reduce or eliminate impacts to such areas which play an important role in fisheries productivity. At this time however, we have no site specific information to offer regarding the exact location or condition of the existing hard bottom areas.

We appreciate the opportunity to provide information regarding this shore protection project. Please continue to apprise us as project plans develop. If you have questions regarding these comments, please contact Ms. Shelley Du Puy of our Miami Field Office at 305/595-8352.

Sincerely,

Edwin J. Higgins

for Andreas Mager, Jr.
Assistant Regional Director
Habitat Conservation Division

cc:
F/SEO2
F/SEO23-MIAMI

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director's Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

January 10, 1994

Mr. A. J. Salem, Chief
Planning Division, Environmental
Resources Branch
Jacksonville District Corps of
Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

In Reply Refer To:
Denise M. Breit
Historic Sites
Specialist
(904) 487-2333
Project File No. 933877

RE: Supplement to the Environmental Impact Statement for the Ocean Ridge Segment of the Palm Beach County Shore Protection Project
Palm Beach County, Florida

Dear Mr. Salem:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the referenced project(s) for possible impact to historic properties listed, or eligible for listing, in the National Register of Historic Places. The authority for this procedure is the National Historic Preservation Act of 1966 (Public Law 89-665), as amended.

A review of the Florida Site File indicates that no significant archaeological or historical sites are recorded for or likely to be present within the project area. Furthermore, because of the project location and/or nature it is unlikely that any such sites will be affected. Therefore, it is the opinion of this office that the proposed project will have no effect on historic properties listed, or eligible for listing, in the National Register of Historic Places. The project is also consistent with the historic preservation laws of Florida's Coastal Management Program.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

for Laura A. Kammerer

George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Bdb

SOUTH LAKE WORTH INLET DISTRICT
PALM BEACH COUNTY, FLORIDA

Post Office Box 3465, Lantana, Florida 33465
Tel. (407) 969-9824

Board of Commissioners:
David W. Geller, Chairman, Lantana
George R. Frost, Vice-Chairman, West Palm Beach
Thelma E. Moore, Secretary/Treasurer, West Palm Beach
Kenneth Hall, Boynton Beach
Edwin H. Shepherd, Lake Worth
James R. Warnke, Boynton Beach

Dorothy A. Lindros, Executive Secretary
James McCartney Wearn, P.A. Attorney
Gee & Jenson, E-A-P, Inc., Engineers

January 3, 1994

CERTIFIED MAIL RETURN RECEIPT REQUESTED
and
REGULAR MAIL

Regulatory Division
South Permits Branch
Jacksonville District
Corps of Engineers
Department of the Army
Post Office Box 4970
Jacksonville, FL 32232-0019

Att: Ralph W. Pasquale

Planning Division
Environmental Branch
Jacksonville District
Corps of Engineers
Department of the Army
Post Office Box 4970
Jacksonville, FL 32232-0019

Att: A.J. Salem, Chief
Planning Division

Re: Ocean Ridge segment
Palm Beach County Shore Protection Project
Permit Application No. 199301676(IP-RP)
Applicant: Palm Beach County
Public Notice

Gentlemen:

As Chairman of the South Lake Worth Inlet District, I am submitting herewith comments on the referenced Project and Application, as requested in your Public Notice dated December 2, 1993, and request for comments dated December 10, 1993 (partial copies of each attached for your reference. These comments represent those from the Board of Commissioners sitting in regular session on December 20, 1993.

We understand that the project is to dredge approximately 700,000 cubic yards of beach quality sand from an offshore borrow site seaward of the 30 ft. depth contour and to place that material along approximately 1.46 miles of Ocean Ridge's beach, beginning at the south jetty of the South Lake Worth Inlet. Additionally, the project includes the construction of five rock T-head groins and five rock breakwaters. The project has been depicted on 7 pages of permit sketches and we have the following comments, questions, or concerns:

1. With the exception of page 1 of the permit sketches, the remaining six pages are the result of reducing 13 pages of sketches submitted by the applicant. The reduction process

has rendered some of the sketches and data illegible and incomprehensible. The COE should re-issue the Public Notice with sketches at a scale appropriate to allow proper review of the project.

2. Because the proposed project seems to involve matters of ongoing litigation, it would make sense that resolution of the litigation should precede permitting and construction of the project.

3. Construction of a major nourishment project immediately south of the South Lake Worth Inlet, prior to the south jetty being completed or prior to other containment, may result in partial or total closure of the Inlet during the seasonal southeast tradewinds. This proposed action is contradictory to the Department's prior position. The Department should clarify its position before acting on the proposed application, as presented.

4. In accordance with Chapter 161.141, FAC, an erosion control line needs to be established prior to the nourishment of a beach such as the one proposed. According to the sketches, the erosion control line will follow the 1992 Mean High Water Line. We feel that processing the proposed permit should follow the establishment of the erosion control line.

5. The proposed project appears to include construction on District property. Specifically, that portion of the fill on District property, beginning at the south jetty at the north end of the project and what appears to be a proposed spur groin extending south from the south jetty, but not otherwise identified in the permits. It would be appropriate to seek District's approval, authority, and permit for those works on District property.

6. The borrow area identified in the sketches contains more than twice the amount of sand necessary to construct the project. A more specific and detailed borrow site, therefore smaller, would minimize possible adverse impacts to the natural environment.

7. The northern portion of the borrow area appears to be the foot of or contiguous to the waterward side of the Inlet ebb

tidal shoal. Disruption or interference with the ebb tidal shoal will, most likely, interrupt the natural transfer of sand around the Inlet, interrupt the shoal's shore protection, and cause erosion on the beach. Assurance should be made that such disruption or interference will not occur.

8. Plate 5 of the Sketches depicts an existing seawall incorrectly. The majority of the project is adjacent to the "McCormick Seawall" and, as an example, Monument R-153 is located on top of the seawall, clearly showing the discrepancy. Additionally, this sheet does not appear to show the beach stabilization groin field located in the surf zone of the first 1,000 ft. south of the south jetty. Also, the substantial sheet pile groins extending out from the McCormick Seawall are not shown on the sketch.

9. Nowhere in the sketches does it identify the proposed T-head groins or breakwaters as proposed structures.

10. The profile through the borrow area, depicted on page 7 of 7, should exhibit evidence of the ebb tidal shoal. We find it puzzling that the profiles lack such evidence.

11. Page 2 of 7 shows public access location points at ten locations. Understanding the importance of public access to a beach constructed utilizing public funds, we question whether showing the ten access locations as depicted, is being totally open and honest. For example, the four locations shown between Monuments R-156 and R-157 are at one Municipal Beach Park owned by the City of Boynton Beach, which charges a fee for access. What appears to be shown as four separate access locations is simply four separate beach access ramps from the same parking lot. It should also be pointed out that additional access points have no public parking within a reasonable distance and are, therefore, limited to use by adjacent local residents in this very private community.

12. The Supplement to the Environmental Impact Statement is of great importance to the Inlet District. As such, we would appreciate receiving copies of any proposed revisions to the Final EIS/GDM and would like to be advised of any meetings or hearings related to these issues.

The District appreciates the opportunity to comment on this Project and Application.

We would appreciate your respective Planning Division and Regulatory Division keeping us advised of the progress of this Project and Application. Formally, we request notice and copying on all further action and communication concerning this Project and Application.

Thank you for your consideration.

Very truly yours,

David W. Geller

David W. Geller, Chairman
South Lake Worth Inlet District

DWG/JMcCW:jz

cc: Dorothy Lindros, Executive Secretary
James McC. Wearn, Esquire, District Attorney
John S. Yeend, P.E., District Engineer

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

02 DEC 1993

Regulatory Division
South Permits Branch

PUBLIC NOTICE
Permit Application No. 199301676(IP-RP)

TO WHOM IT MAY CONCERN: This District has received an application for a Department of the Army permit pursuant to Section 10 of the Rivers and Harbors Act of 1899(33U.S.C. 403) and Section 404 of the Clean Water Act as described below:

APPLICANT: Palm Beach County
3111 S. Dixie Highway, Suite 146
West Palm Beach, Florida 33405

WATERWAY & LOCATION: The proposed project is located along 1.46 miles of shoreline adjacent to the Atlantic Ocean, immediately south of South Lake Worth Inlet, beginning approximately 400 feet north of FDEP survey monument T-152 and ending approximately 120 feet south of monument R-159, in Sections 15, 22, and 27, Township 45S, Range 43E, Ocean Ridge, Palm Beach County, Florida.

LATITUDE & LONGITUDE: Lat. 26°32'03.3"N, Long. 80°02'44.78"W. (Center of fill area)

WORK & PURPOSE: The applicant proposes to place approximately 700,000 cubic yards of beach compatible sand for beach renourishment along the specified area. The sand would be obtained from a borrow area ranging from 1,840 to 2,750 offshore of Ocean Ridge in about 27 to 38 feet of water, and about 1,800 feet from the nearest offshore reef which is in 50 feet of water. A construction berm, 5 T-head groins, 5 detached nearshore breakwaters, and a field of low-relief rubble mound structures in the northern 2,500 feet are included in the proposed project. Each stone of the structures would be individually placed to avoid impacts to the existing nearshore hardbottom. Sand would be hydraulically dredged and deposited by pipeline behind a containment dike parallel to the shoreline. Sand would then be moved and shaped by bulldozers or other earth moving equipment. Turbidity would be controlled through the use of dikes and a water quality control monitoring program which would include shutting down dredging operations if necessary until an unacceptable condition is cleared.

NOTE: This public notice is being issued based on information furnished by the applicant. However, a General Design Memorandum (USACE 1987) for Beach Erosion Control Projects for Palm Beach County Florida, which includes a county-wide Environmental Impact

Statement (EIS), is currently on file at the U.S. Army Corps of Engineers Jacksonville District Office. Also, a supplemental EIS for this proposed project is being developed.

ENDANGERED AND THREATENED SPECIES: Coordination and Consultation, as defined under Section 7 of the Endangered Species Act, is being conducted with the U.S. Fish and Wildlife Service land the National Marine Fisheries Service by the U.S. Army Corps of Engineers, Jacksonville district, Planning Division, Environmental Resources Branch.

AUTHORIZATION FROM OTHER AGENCIES: The Florida Department of Environmental Protection (DEP): The DEP permit application number is 502355609.

Supplemental information has been forwarded to the resource agencies.

Comments regarding the application should be submitted in writing to the District Engineer at the above address within 30 days of this notice. If you have any questions concerning this application, you may contact Ralph W. Pasquale of this office, telephone 904-232-3358.

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO ATTENTION OF

December 7, 1993

RECEIVED
DEC 10 1993

Planning Division
Environmental Branch

TO ADDRESSEES ON THE ATTACHED LIST:

The Jacksonville District U.S. Army Corps of Engineers, is beginning to gather information to help define issues and concerns that will be addressed in a Supplement to the Environmental Impact Statement for the Ocean Ridge segment of the Palm Beach County Shore Protection Project.

The project was authorized on October 23, 1962 by Public Law 87-874. The project has been coordinated with interested Federal, State and local agencies and the public. The Final Environmental Impact Statement and General Design Memorandum (GDM) for Palm Beach County was published in April 1987. The recommended plan in the 1987 GDM called for the restoration and periodic nourishment of 1.6 miles of shoreline using a 50 foot berm width. Approximately 770,000 cubic yards of fill would be placed and would include advanced nourishment for the initial eight year nourishment interval.

An alternative design is being considered that would reduce the width of the fill in the northern end of the project by using approximately 10 low profile rock structures. The use of structures is being considered to reduce the annual expected cost of the project and to protect nearshore rock habitat that exists in the northern end of the project. The project is proposed to begin at the south jetty of South Lake Worth Inlet and extend south about 7,700 feet (1.4 miles). The borrow area for the project is located between 1,750 and 2,800 feet offshore of the fill area in about 30 to 35 feet of water. The sand will be removed from the borrow area with hydraulic dredge and pumped onto the shoreline where it will be shaped by heavy equipment. Refer to the enclosed map for the project location.

We welcome your views, comments and information about resources, study objectives and important features within the described area, as well as any suggested improvements. Letters of comment or inquiry should be sent within 45 days to the letterhead address, attention Planning Division, Environmental Branch.

Sincerely,

A. J. Salem

A. J. Salem
Chief, Planning Division

TOWN OF MANALAPAN
PALM BEACH COUNTY
600 SOUTH OCEAN BOULEVARD
MANALAPAN, FLORIDA 33462-3321
Telephone (407) 585-9477
Fax 407-585-9498

December 30, 1993

Department of the Army
Jacksonville District Corps of Engineers
Planning Division
Environmental Branch
P.O. Box 4970
Jacksonville, Florida 32232-0019

To Whom It May Concern:

Subject: Your letter dated December 7, 1993, Ocean Ridge segment of the Palm Beach County Shore Protection Project.

For your consideration and review, the Town of Manalapan is submitting our comments, objections and recommendations to the Ocean Ridge Project.

The Town of Manalapan lies to the north of the South Lake Worth Inlet and extends north for approximately three (3) mile along the Atlantic Ocean. The beaches in Manalapan are extensively eroded due to the interruption of the southerly flow of sand by the Lake Worth Inlet to the north, interruption of the northerly flow of sand by the South Lake Worth Inlet to the south, and the sand transfer pump located on the north side of the South Lake Worth Inlet. Therefore, the Town's beaches are greatly affected by any changes or adjustments to the coastline either by natural events or manmade alterations.

The Town has attached a memorandum that contains objections to the project as planned, historical information that must be considered and recommendations for modifications to the project, that if incorporated, would relieve the objections by the Town.

Should the Corps determine not to implement the Town of Manalapan's revisions to the project, we may desire that the Corps hold public hearings on the project.

Should you need additional information please contact Charles H. Helm, Town Manager, at 407-585-9477.

Sincerely,

G. Kent Shortz, M.D.
Mayor

enclosures

cc: Mr. Richard Walesky, P.B.C.D.E.R.M.
Honorable Daniel O'Connell, Mayor, Town of Ocean Ridge

December 28,1993

MEMORANDUM TO: File
FROM: C. H. Helm, Town Manager
SUBJECT: Staff Report - Ocean Ridge Beach Renourishment Project

Town of Manalapan strongly objects to the work, as proposed in Ocean Ridge, as described in US Corps of Engineers Permit Application No. 199301676(IP-RP) and the State of Florida Department of Environmental Protection File Number DBS9A0330 for the following reasons.

1. A court order, now on appeal, could increase the demands for additional sand to be pumped from Manalapan's beaches until the sand lost north of the inlet equals that lost south of the inlet. Which simply means, the beaches to the north will be penalized for all inlet and excessive beach fill losses south of the inlet.

2. Past over pumping has severely eroded a large section of the Manalapan's shore line and is continuing to do so because of the inshore pump location and removal of sand below the normal bottom profile, leaving the north beach severely pumped out. Much of the north shoreline has little beach sand left east of the sea wall and the seaward bottom is largely bare rock for about 400 feet out. This leaves little to be lost except the small remaining bit of sand at the sea wall.

3. The requested Permit application work involves adding 700,000 cu yds of sand to the north section of the beach south of the inlet, greatly increasing the width of an artificially filled and bulkheaded beach already well east of the historical shore line (Fig. 1), which coupled with the shadow of the inlet, will substantially increase the already severe erosion rate in spite of the groins and other works contemplated. This will cause large losses in Ocean Ridge and an unwarranted call for sand from the north (Manalapan).

4. An extension to the south jetty which was designed and approved, but never funded or constructed, is essential to control the present strong flood current that now enters the inlet in a northerly direction around the end of the short south jetty after scouring the beach to the south and carrying large quantities of sand into the inlet where substantial loss occurs. This loss increases demand for sand from the north (Manalapan).

5. No means is provided to prevent the <u>total</u> of the naturally by-passed and the pumped sand from exceeding the sand arriving by normal drift into Manalapan.

6. No provision is made to frequently pump the small, shallow sand trap inside the Inlet on a regular basis to prevent over filling and the run over loss of sand that is difficult if not impossible to recover.

BASIS FOR POSITION TAKEN

The South Lake Worth Inlet was completed in 1927. Erosion south of the inlet started and in 1929/30 the McCormack sea wall with 8 groins was constructed along the MHW line from approximately 900 feet south of the inlet to a point 3195 feet south of the inlet. In April 1937, a 6" pump and 65 hp engine was installed on the north jetty which pumped 252,000 cu yds of sand through 1941; covering the groins and filling the beach nearly to the top of the sea wall (14' MSL); clearly heavy overpumping did occur. The pumping commenced again in 1945 and transferred an estimated 70,000 cu yds/yr; it was rebuilt in 1947 with an 8" pump and 250 hp engine promoting increased sand transfer. Again in 1952 a system upgrade included a 300 hp engine.

The plant was rebuilt again in 1967 with a 10" pump, a 400 hp engine and the suction boom length was doubled.

Pumping reached a peak in 1963 when 206,822 cu yds were transferred. 3000 feet of shoreline north of the inlet steadily eroded, and by 1963, the 14 year old CBS Tupper ocean front home had gradually fallen into the ocean along with a frame cottage next door, as well as several smaller structures near by. In 1964 & 1966 a crash sea wall program had to be undertaken to prevent the loss of expensive ocean front homes that had been built well back from the dune crest. This seawall program had to be extended to the north Town limits in 1981/83 and represented a cost of over $5,000,000 in 1987 dollars. The effect of the sand pump is quite obvious from Fig. 2, which was constructed from the DNR digitized data.

The bulk of the littoral drifts occur where the combination of wave turbulence and current flow are maximum. In this coastal area, this occurs from 150 to 300 feet offshore. Since the current flow cannot go through the jetty it goes around the end carrying the littoral drift with it not 300 feet landward where the pump is now located. The beach drift reaching the pump has been determined to be in the order of only 25,000 cu yds per year, the balance is mined mostly off the beaches to the north (Manalapan).

The drift passes around the end of the north jetty and does not return to the shore line via the transfer bar for a distance of some 4000 to 5000 feet south of the inlet. During flood tide a substantial portion of the drift goes in the inlet, especially with a north drift: a part of which settles in the inside sand trap; a part enters and shoals the intercoastal canal and surrounding area; and the rest is swept out during ebb tide but joins that sand carried south by the transfer bar so that the first 4000 feet of shoreline south of the inlet will be naturally deficient in littoral drift. Sand movement in the area of the channel is significantly influenced by the heavy high powered boat traffic.

The area 900 feet south of the inlet for a distance of 3500 feet has been built out with fill over 100' east of the normal shore line of 1926 and protected by a new seawall (Fig.3). An extra ordinarily large fill of 655,000 cu yds in 1962/64, included 478,024 cu yds pumped from Manalapan. The erosion rate is enormous as would be expected with this large intrusion into the ocean. Prior to this intrusion the sand pump built and maintained a growing shore line. After this fill, little or no beach could be maintained in front of the new, more seaward, seawall in spite of continued pumping.

Repeated renourishment of this area (from the inside shoal sand trap) has occurred many times in the recent past, 1961, 62, 63, 65, 67, 68, 69, 73. Most recently in 1989, about a thousand feet of beach was renourished with 34,000 cu ft. of sand only to be lost in 6 months despite sand pump operation. Over the years renourishment from the flood shoal has amounted to 510,000 cu yds, while pumping sand from the Manalapan beach has added 3,870,300 cu yds. Clearly, a beach, in the inlet shadow and built out into the ocean can not be maintained without offshore devices to correct the extreme losses. The present sand pump is some 300 feet west of the principal path of the major natural sand transfer around the end of the north jetty. If a sand transfer pump is used, it should be located as near to the end of the north jetty as possible where heavy seas carry sand from the normal drift path and around the end of the jetty. Frequently in heavy weather, sand is carried to this location through and over the jetty to lay down a sand bar inside the jetty approximately 100

feet long and 25 feet wide up to MLW, often staying for days until a shift in wind and seas carries it into the Inlet.

While the long North jetty at the inlet has backed up sand some 4000 feet to the north in the past 65 years, heavy recession has occurred from that point north mandating use of sea walls to protect the dune from being pumped away. This loss attributed to the sand pump operation was confirmed by an in-depth computer model study by the US Corps of Army Engineers in a similar proposed sand pump installation, in which it was determined that a sand pump would unacceptably damage the beach to the north (Fig. 4). Another serious loss in Manalapan occurs during the approximately 30% of the time during northerly drift when the north curved jetty and short south jetty causes the drift to be directed into the inlet during flood tide.

While we are of the opinion that the problem in Ocean Ridge was caused largely by the decision to bulkhead an unusually large transfer of sand together with a surprisingly large dredging operation in the channel and surrounding lake, many large buildings are now on that fill and it could be impractical to remove them and restore the normal shore line that could be easily maintained. For this reason we endorse the beach renourishment and the use of proper offshore devices to reduce the erosion only if the following steps are taken to develop a situation that eliminates the damage to the beaches north of the Inlet (Manalapan).

A. Move the pump suction to a sand containment pit as depicted in Fig. 5. This is similar to an arrangement at Boca Raton Inlet where a weir at MLW, near the end of the jetty, allows drifting sand to spill into the inlet channel where it is pumped by a floating dredge to the near south shore. While the north shore line has receded to the weir location, erosion has been greatly reduced in the shadow zone just south of the inlet and updrift damage is minimal.

Also at the Hillsboro Inlet a rock formation forms a north jetty quite similar to the SLWI and a natural weir near the end allows sand to spill into pockets near the channel where a small floating dredge transfers the sand accumulation to the immediate south shore. This arrangement also has worked well over the years to reduce the south shore erosion.

Both of these systems have the advantage of picking up the small beach drift, and a portion of the natural drift, which occurs just seaward of the end of the north jetty, some of which is carried behind the end of the jetty in heavy seas - a condition that can't occur at SLWI because the pump is located so far landward from the end of the jetty.

B. Complete the south jetty, this will reduce the strong currents that run along the south shoreline and scour the beach area, and it may improve the flood currents somewhat to reduce the loss of northerly drift to Manalapan as well as the loss of sand into the inlet.

C. Construct a breakwater and groins such as in the permit application, or alternatively, a continuous perched beach breakwater from the south jetty extension to a point about 3000 feet south to contain a beach in water too deep to otherwise support the sand. Renourish the beach.

D. Provide a small floating dredge with semi-permanent discharge lines to keep the inside sand trap always pumped out to avoid overflow losses.

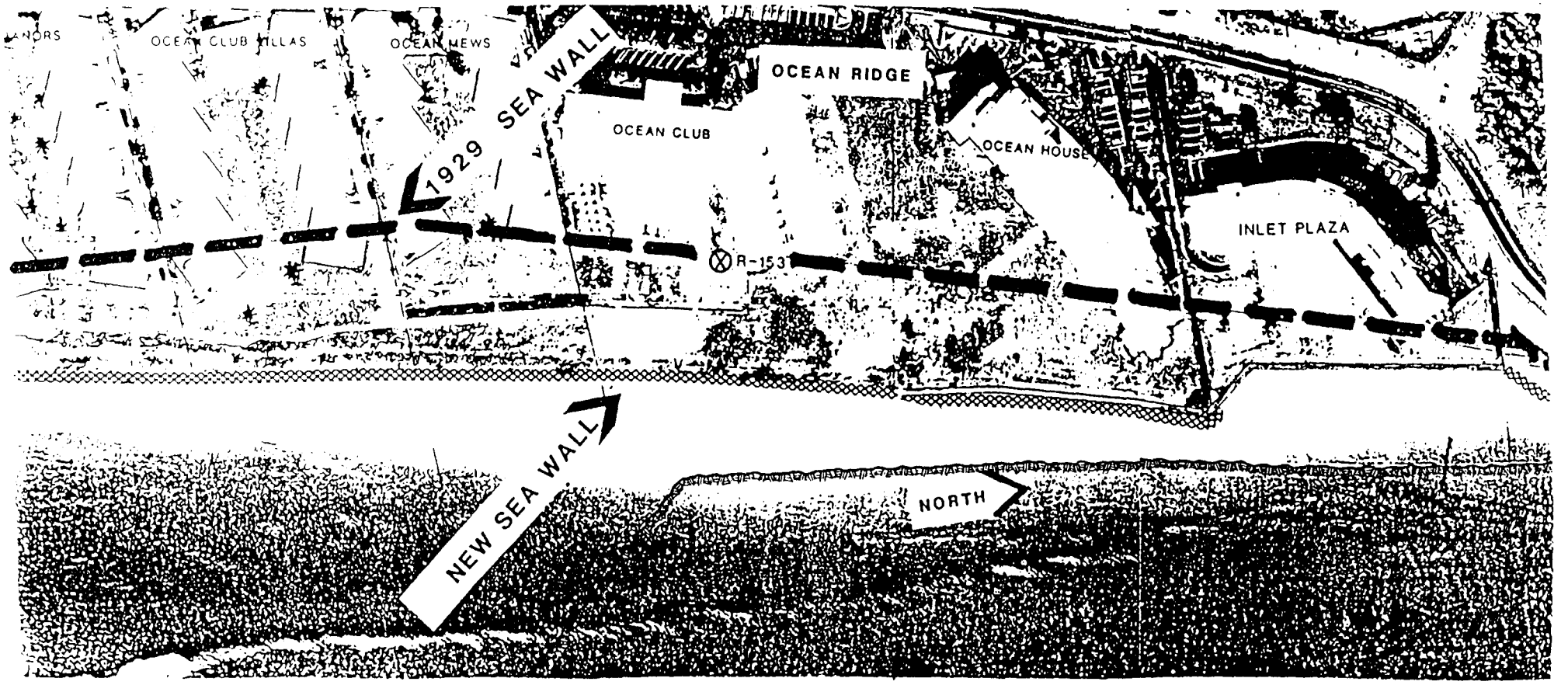

OCEAN CLUB
OCEAN MEWS
1929 SEA WALL
OCEAN RIDGE
OCEAN CLUB
OCEAN HOUSE
INLET PLAZA
R-153
NEW SEA WALL
NORTH

Fig. 1

SAND VOLUME CHANGES 1883-1986
Based on 1 sq. ft. beach area = 1 Cu. Yrd.
All data taken from "DNR HISTORICAL SHORE LINE DATA FOR PALM BEACH COUNTY" 2-13-90

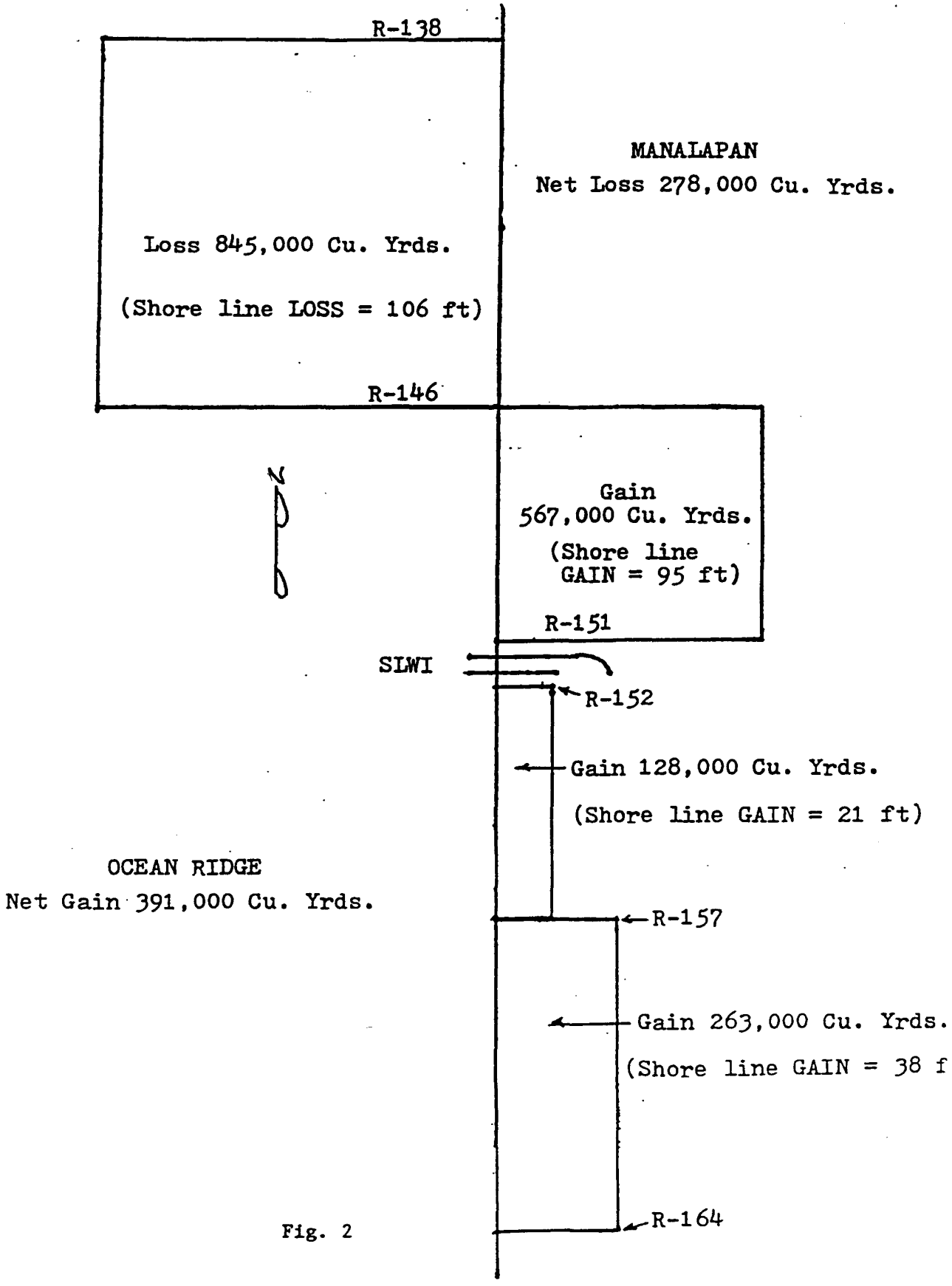


Fig. 2

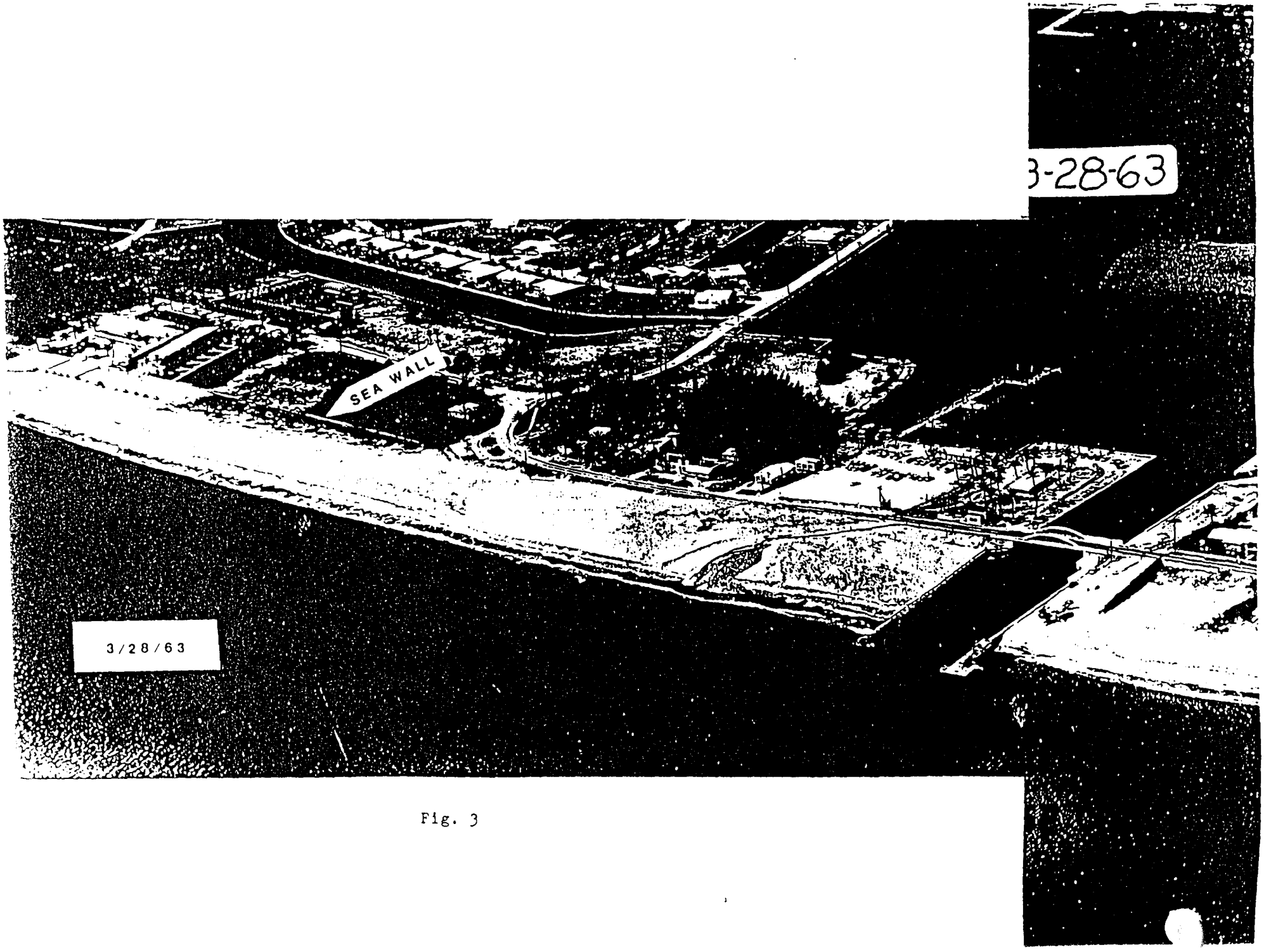


Fig. 3

ENGINEERING APPLICATION
GENERALIZED MODEL FOR SIMULATING SHORELINE CHANGE
CANAVERAL HARBOR, FLORIDA

Ed Hodgens, P.E.
U.S. Army Corps of Engineers
Jacksonville District

ABSTRACT

This paper focuses on the use of the computer model GENESIS (Generalized model for Simulating Shoreline change) for evaluation of coastal processes in a highly active area of shoreline where little hard physical field data is available.

Coastal inlets have historically contributed to shoreline erosion and the navigation channel at Canaveral Harbor, Florida, may be responsible for a significant portion of the erosion of the beaches south of the inlet. In 1962, Congress authorized the construction of a sand bypass system to transfer littoral material around the harbor to mitigate erosion losses and reduce navigation maintenance.

A General Design Memorandum (GDM) was prepared in 1989 to address the mitigation of the effects of the port on down-drift erosion. The recommended plan included the construction of a fixed shore-based sand bypass system located north of the north jetty with the capability to bypass 106,000 cubic yards to the south beaches annually. Detailed design was subsequently initiated to determine the most effective location for the bypass system. However, there is extremely limited data upon which to base a detailed coastal engineering analysis of the anticipated sediment budgets by location. Also, the cape and offshore shoals create complex wave patterns along the immediate coast which makes simplified long, sandy coast evaluations inaccurate. It was decided to model the shoreline response to bypassing by using the GENESIS numerical model.

Initial modeling indicated that the recommended GDM plan would have adverse impacts on the beaches north of the inlet. The model was then used to evaluate two alternative methods of bypassing which included a movable shore-based jet pump system and conventional dredging of a nearshore borrow area.

Presented 2-11-93 at the Florida Shore and Beach Convention at St. Petersburg, Florida.

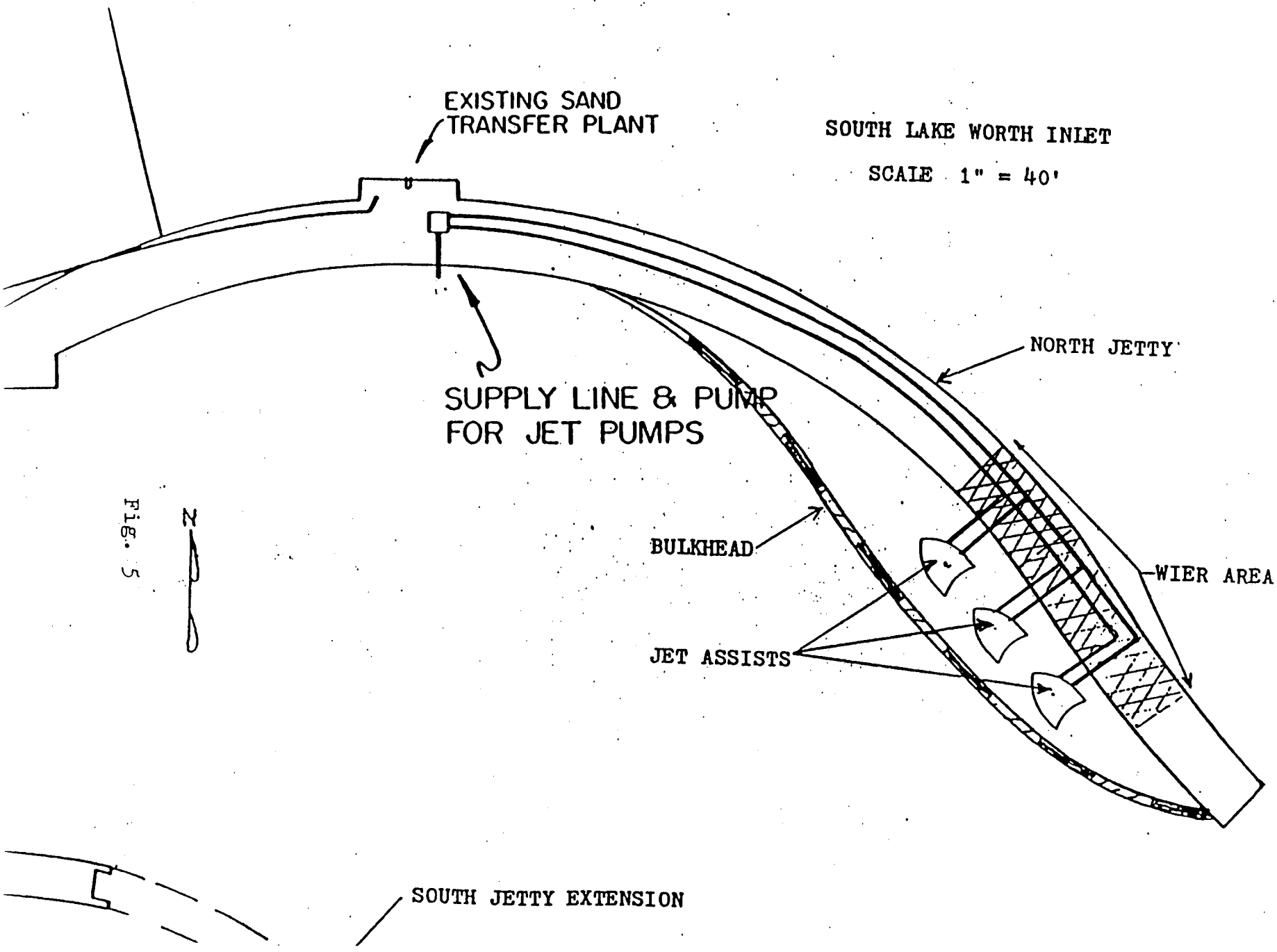

EXISTING SAND
TRANSFER PLANT
SOUTH LAKE WORTH INLET
SCALE 1" = 40'
NORTH JETTY
SUPPLY LINE & PUMP
FOR JET PUMPS
BULKHEAD
WIER AREA
JET ASSISTS
N
SOUTH JETTY EXTENSION

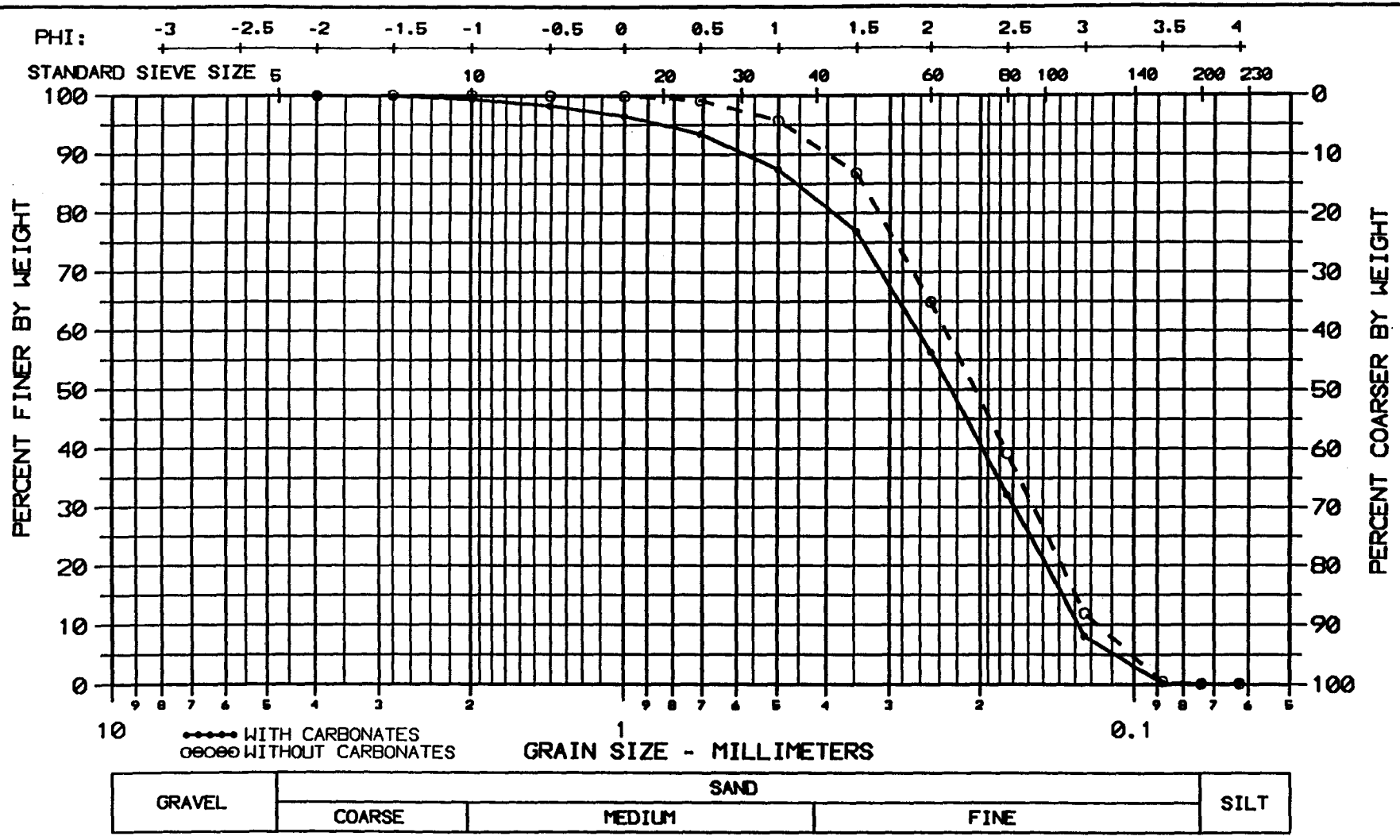
Fig. 5

PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
(FROM MARTIN COUNTY LINE TO LAKE WORTH INLET AND FROM SOUTH LAKE WORTH INLET TO BROWARD COUNTY LINE)

GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE OCEAN RIDGE SEGMENT

SUB-APPENDIX 1

GRAIN SIZE DISTRIBUTION CURVES



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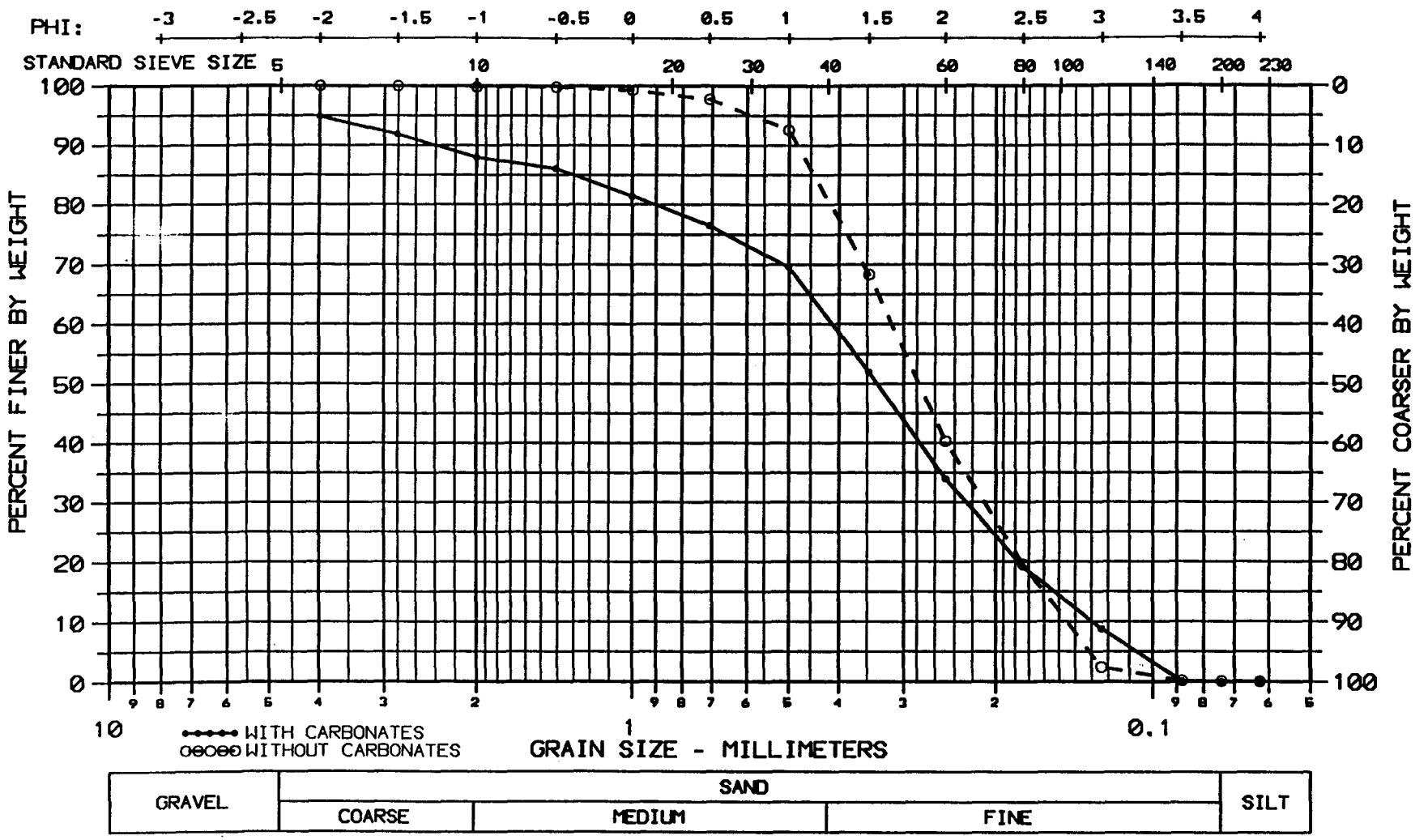

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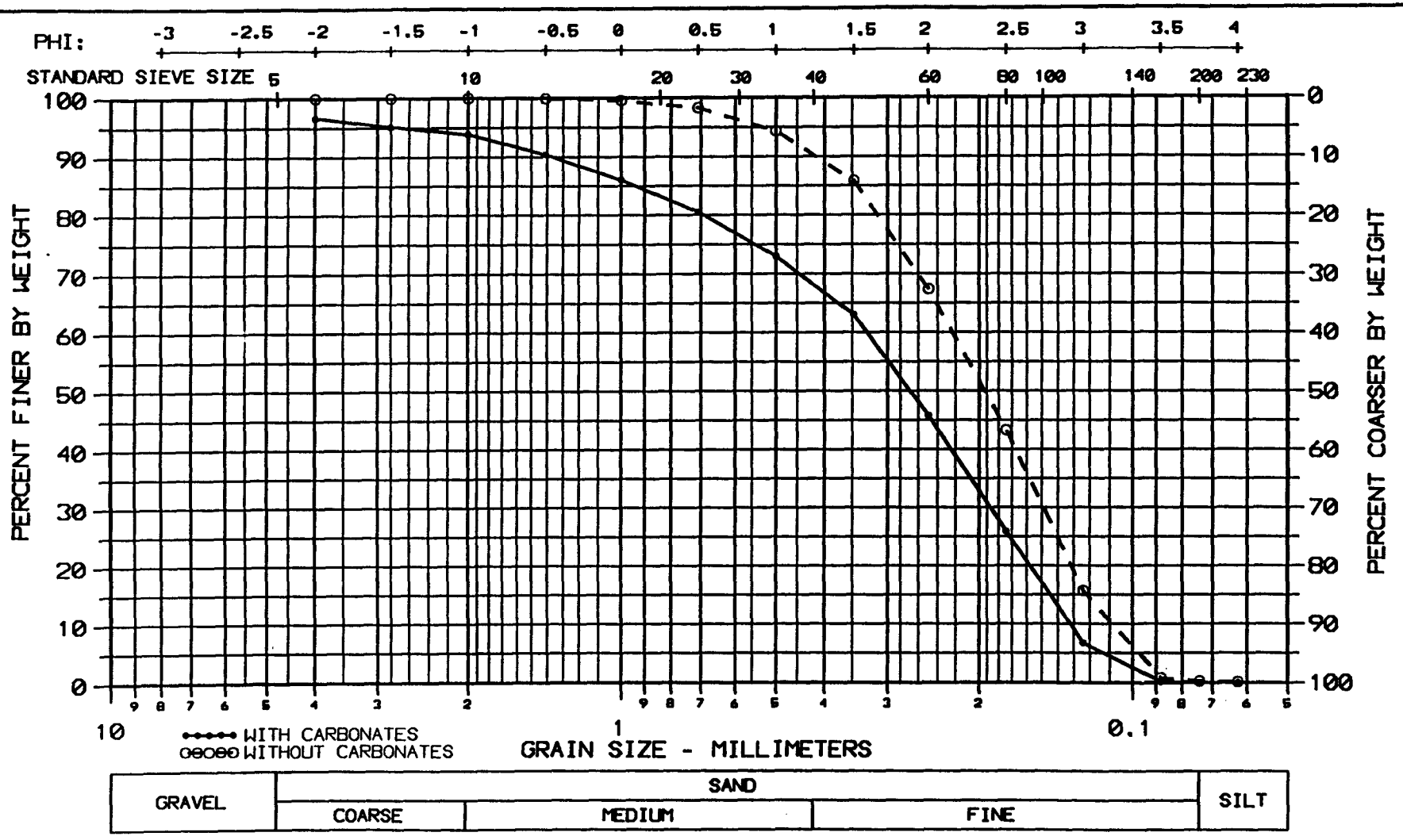

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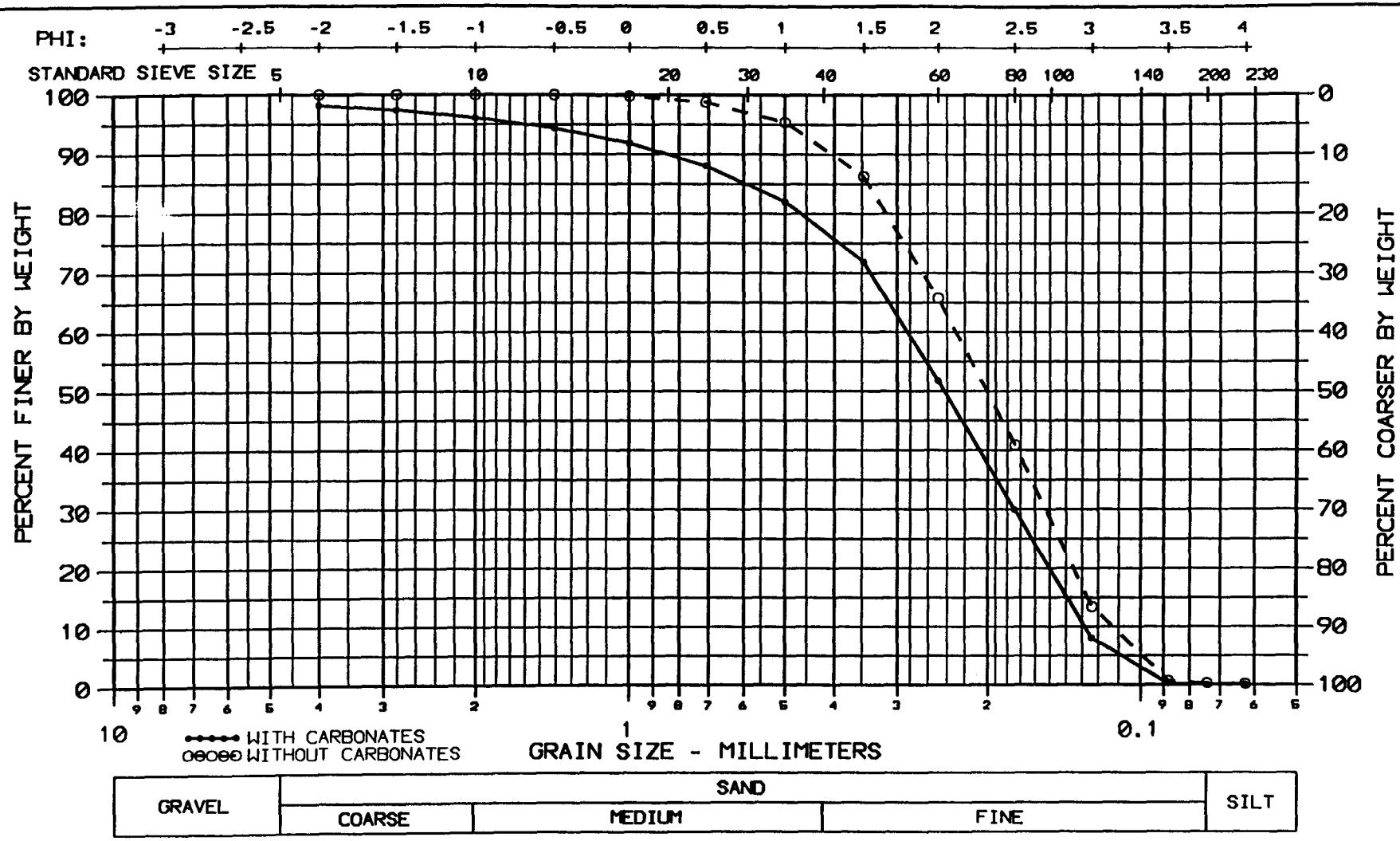

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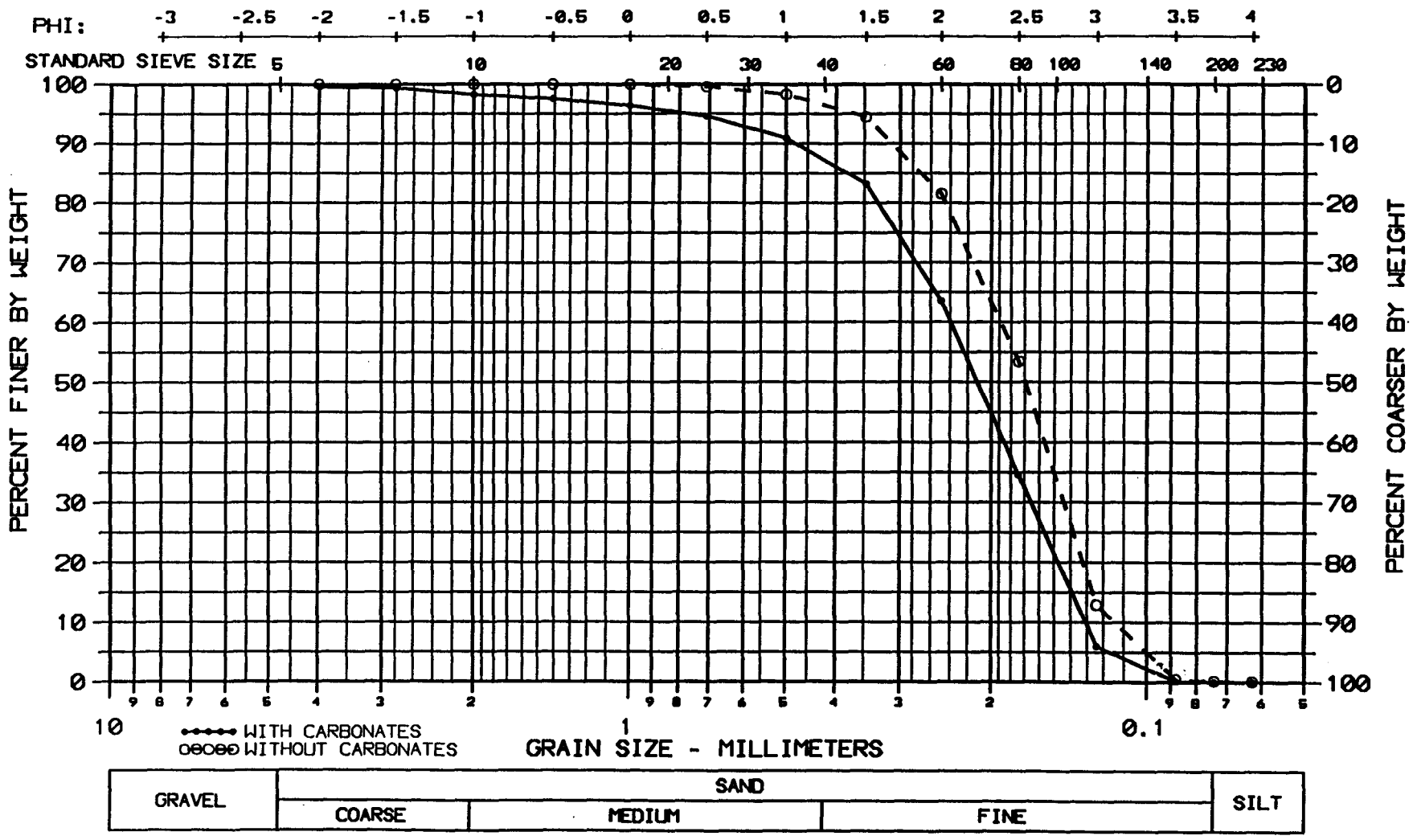

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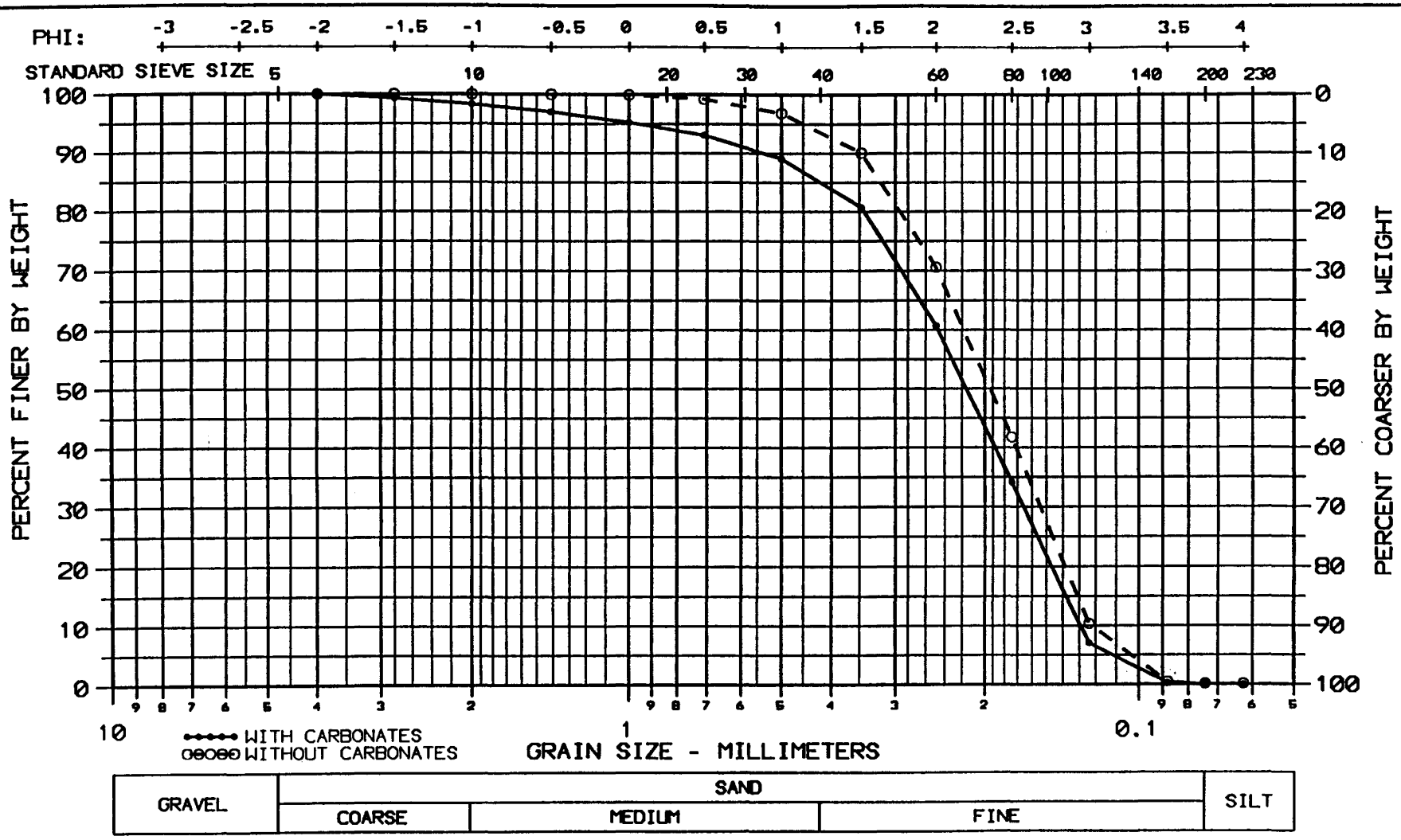

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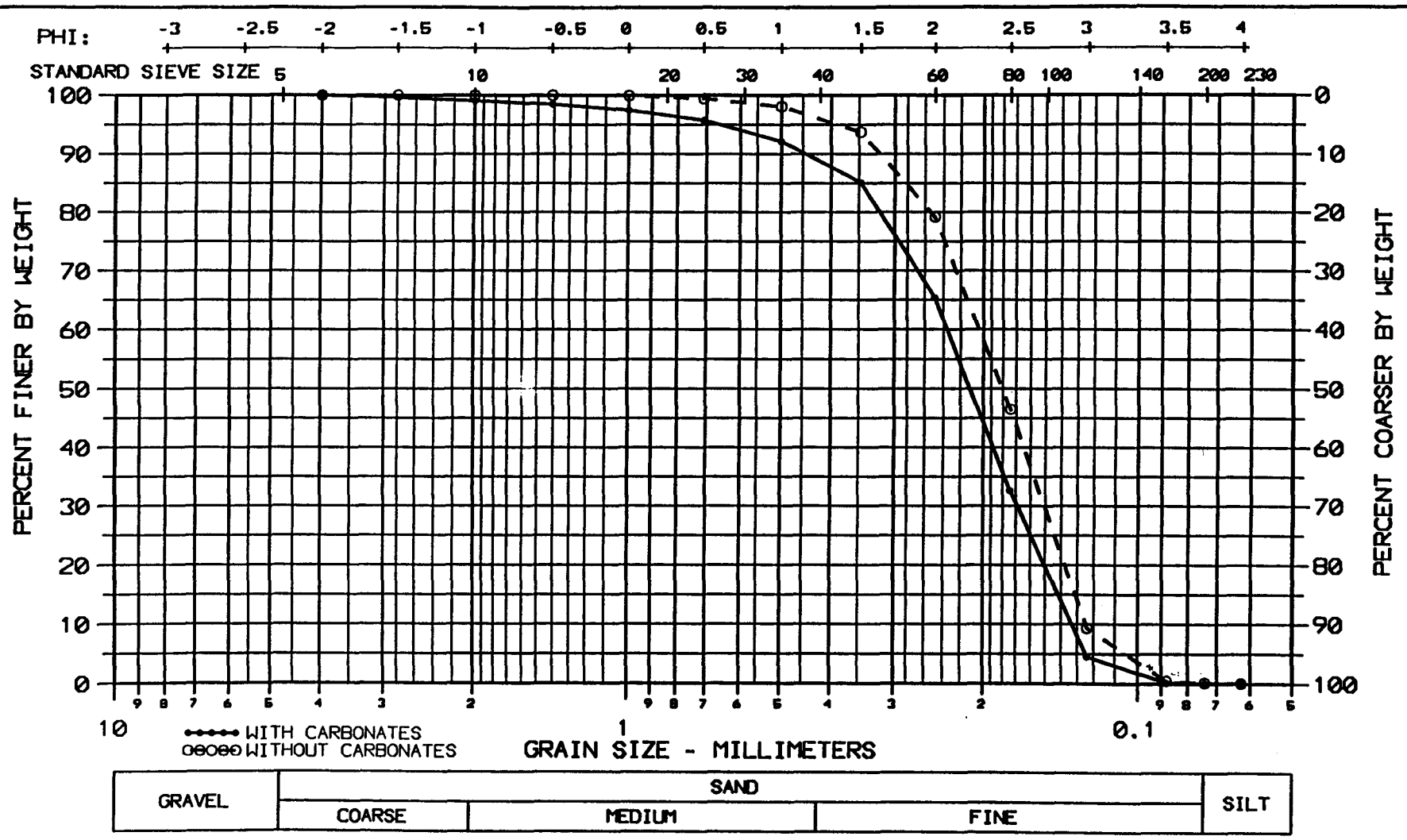

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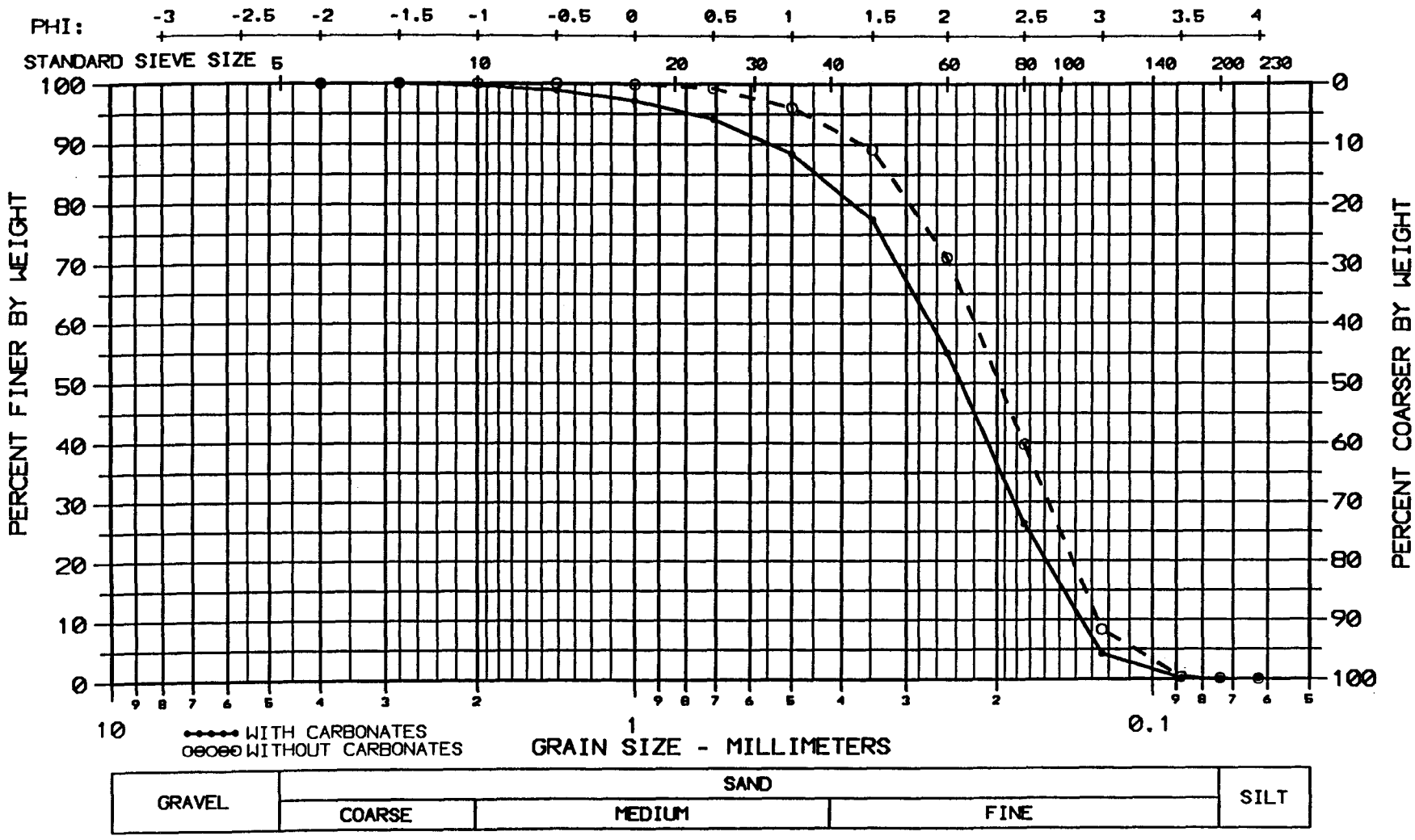

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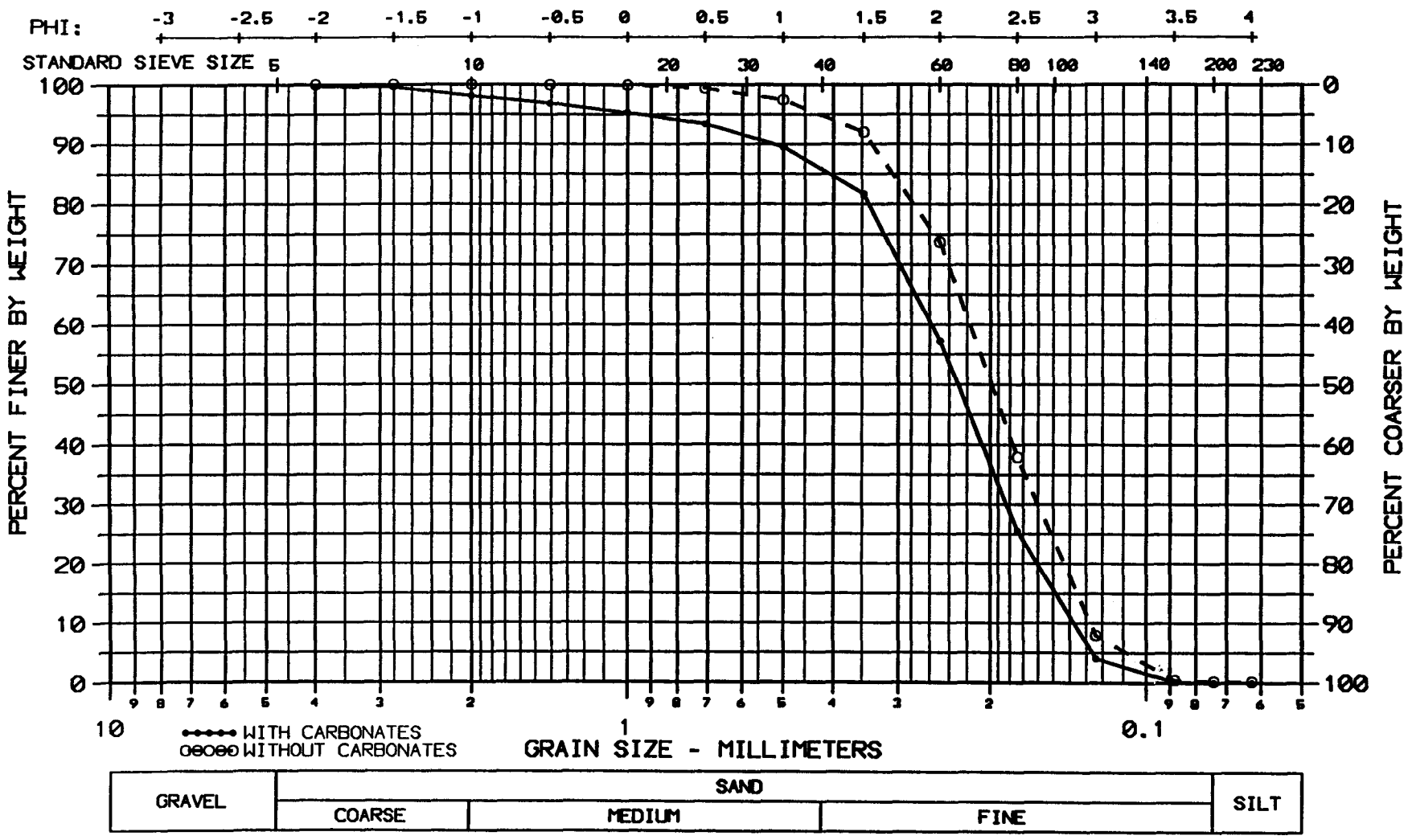

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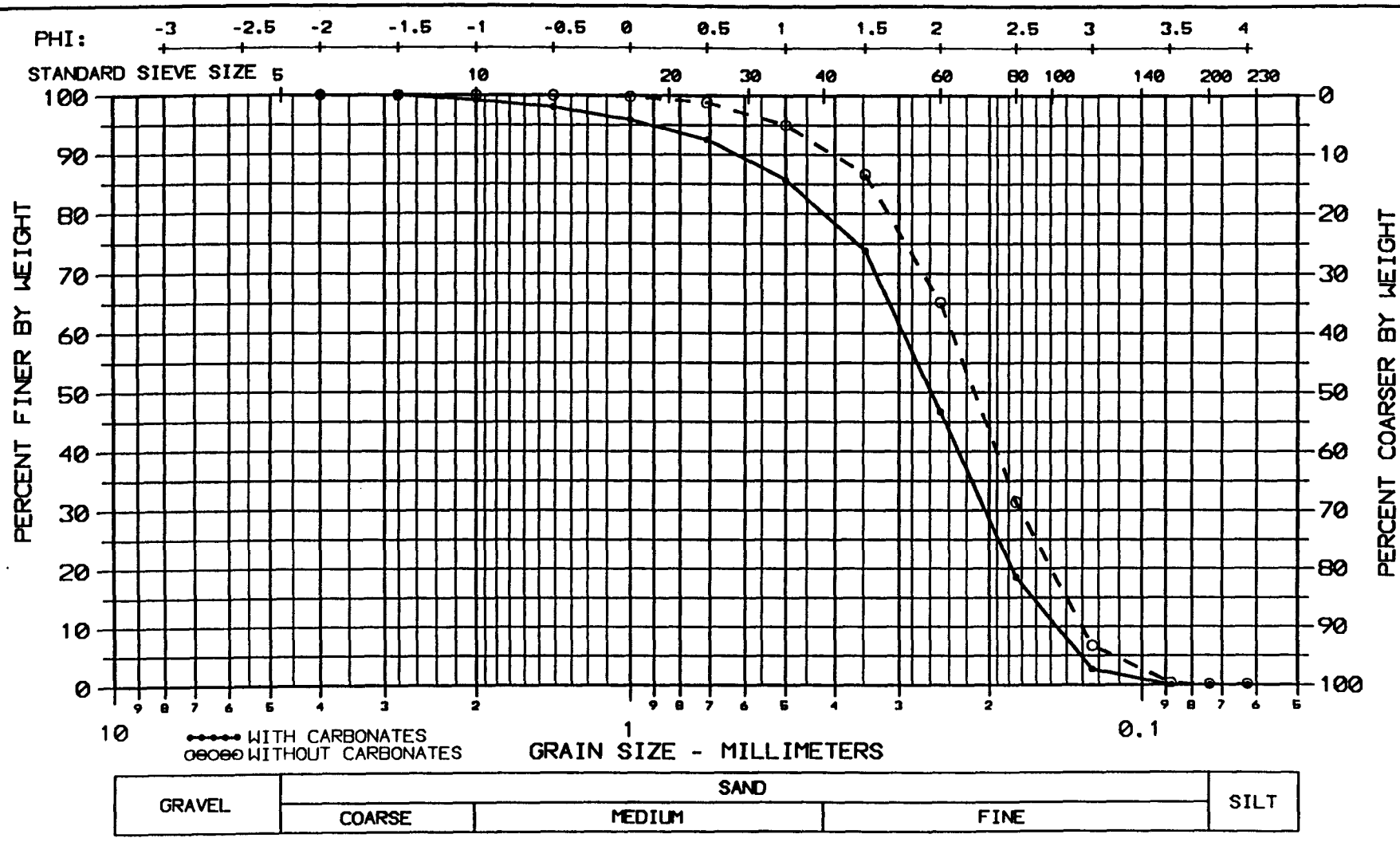

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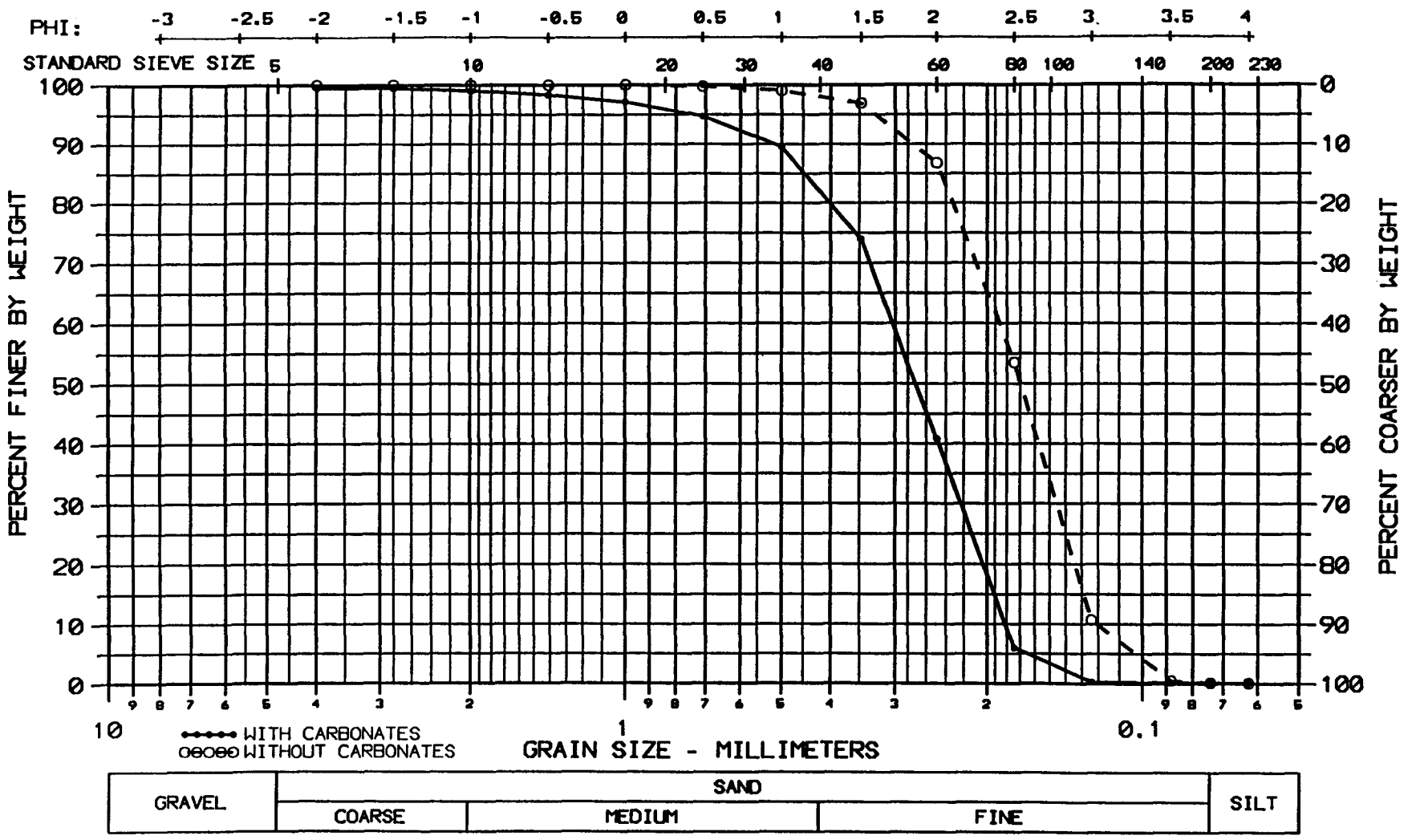

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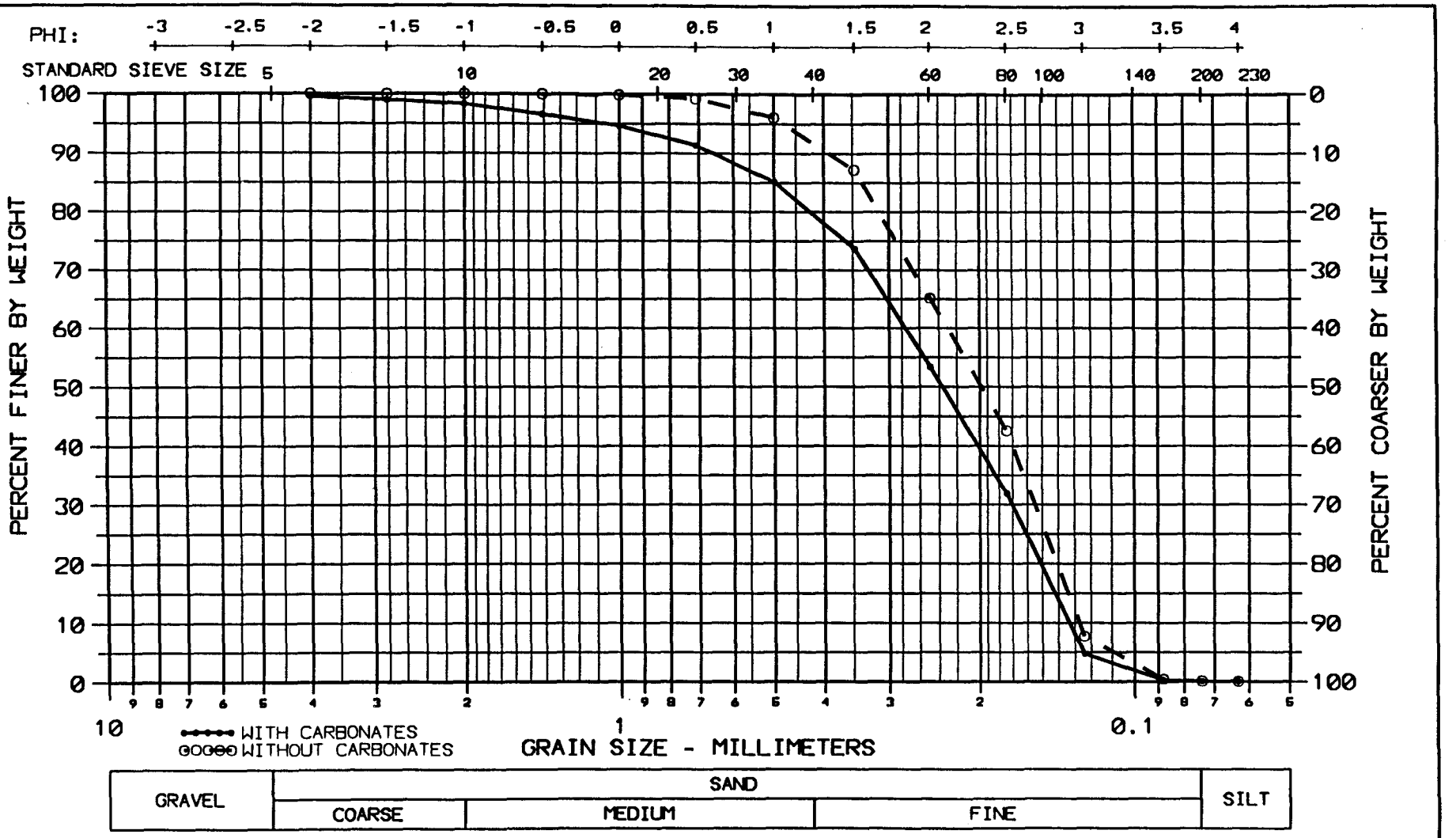

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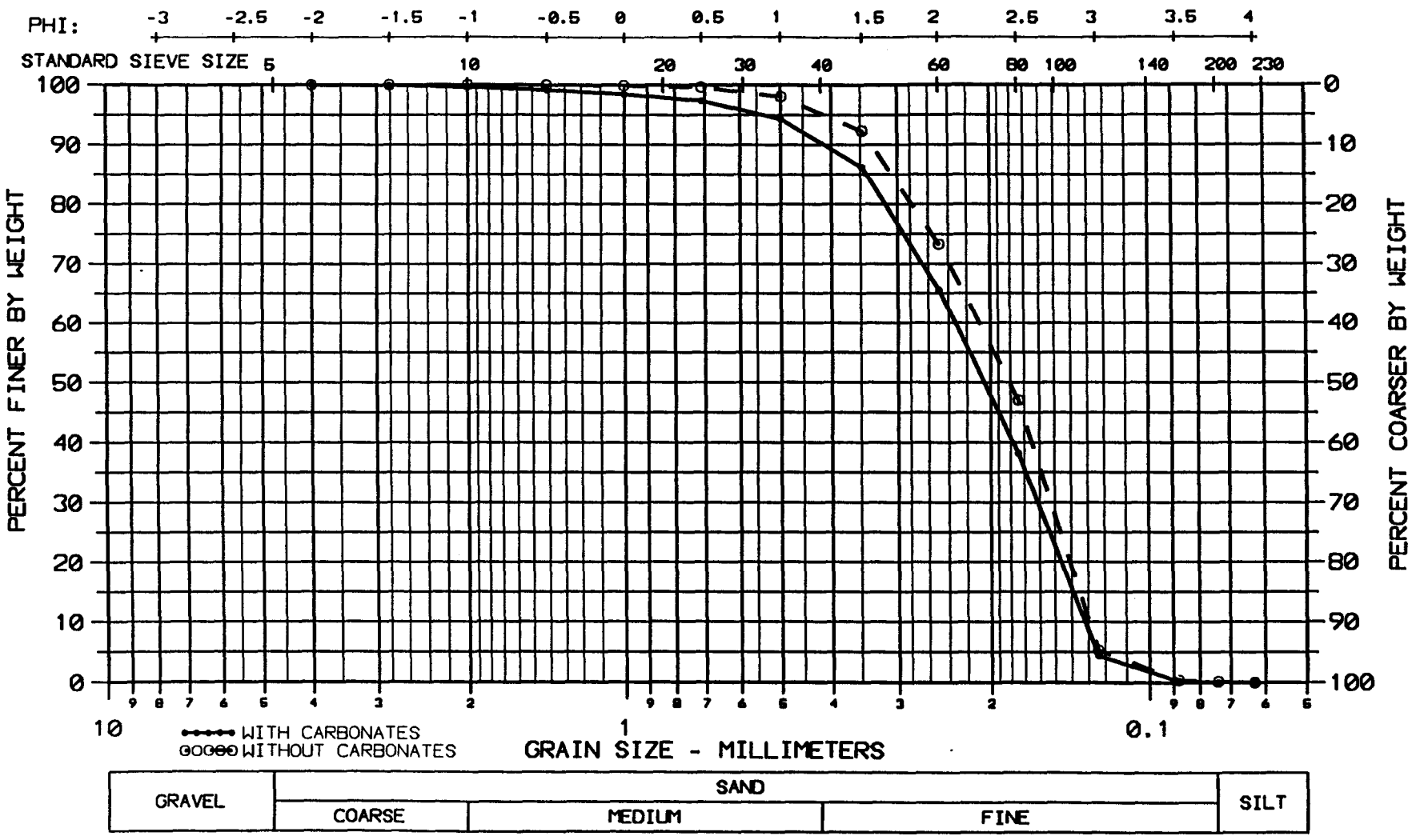

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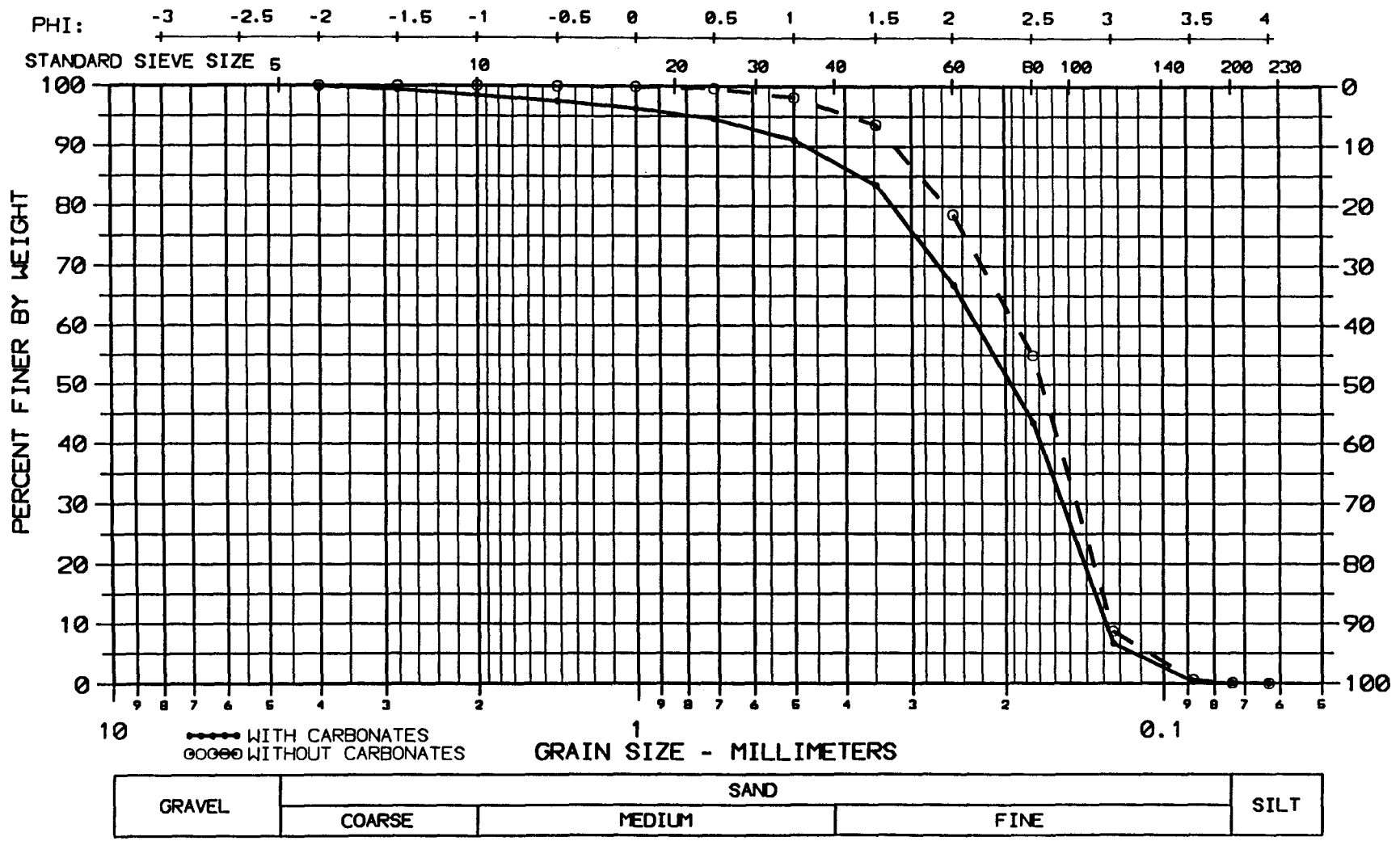

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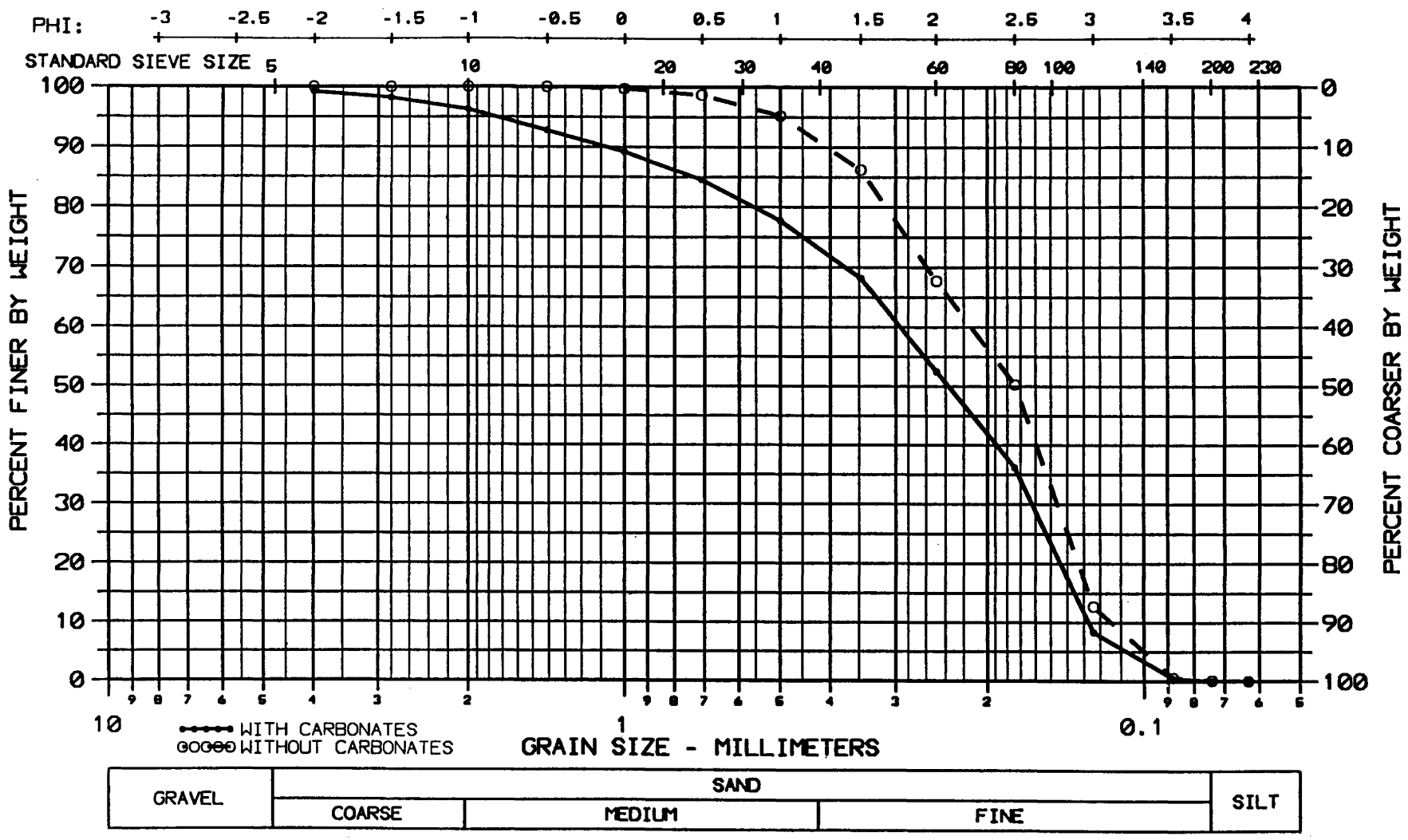

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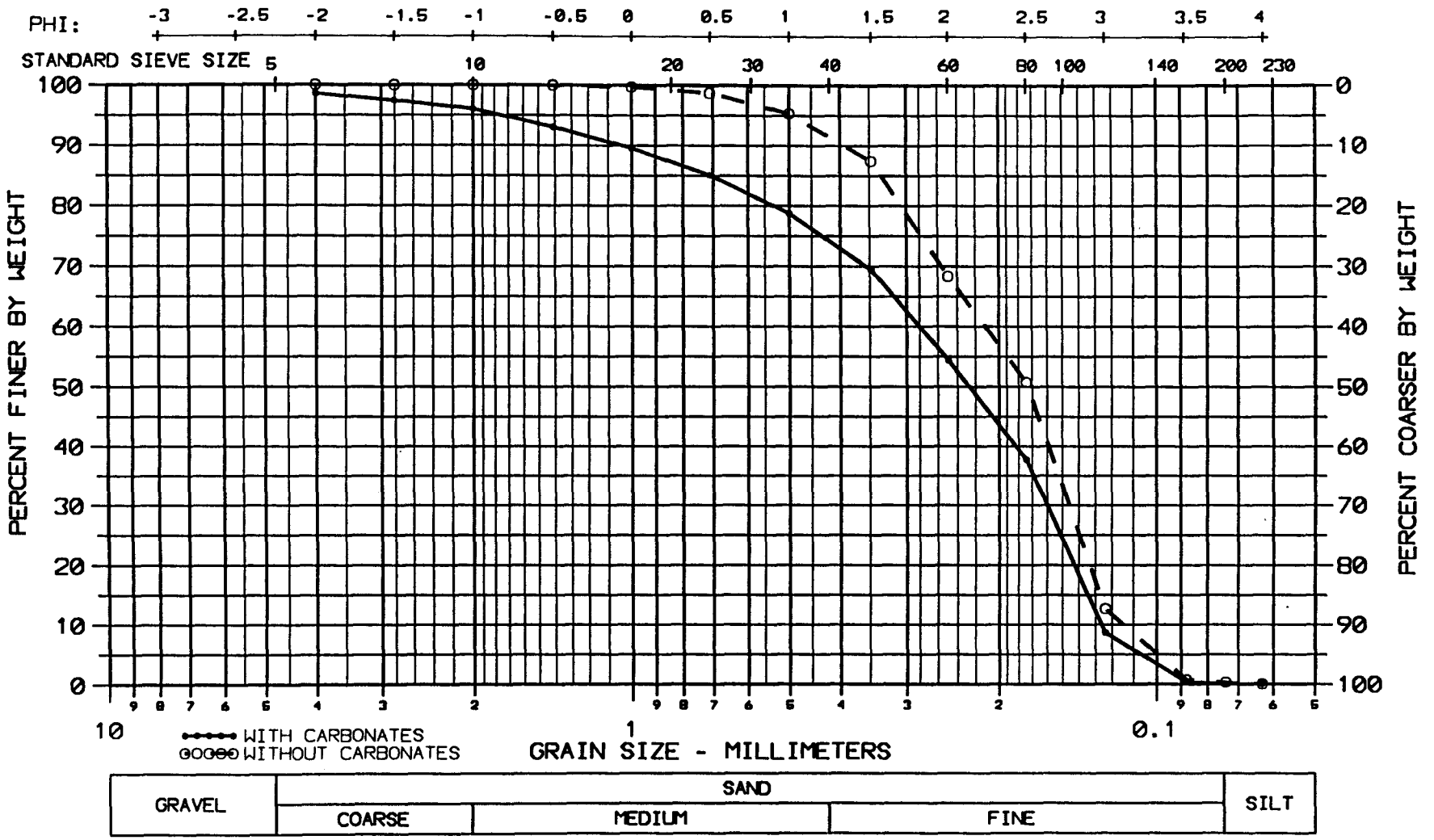

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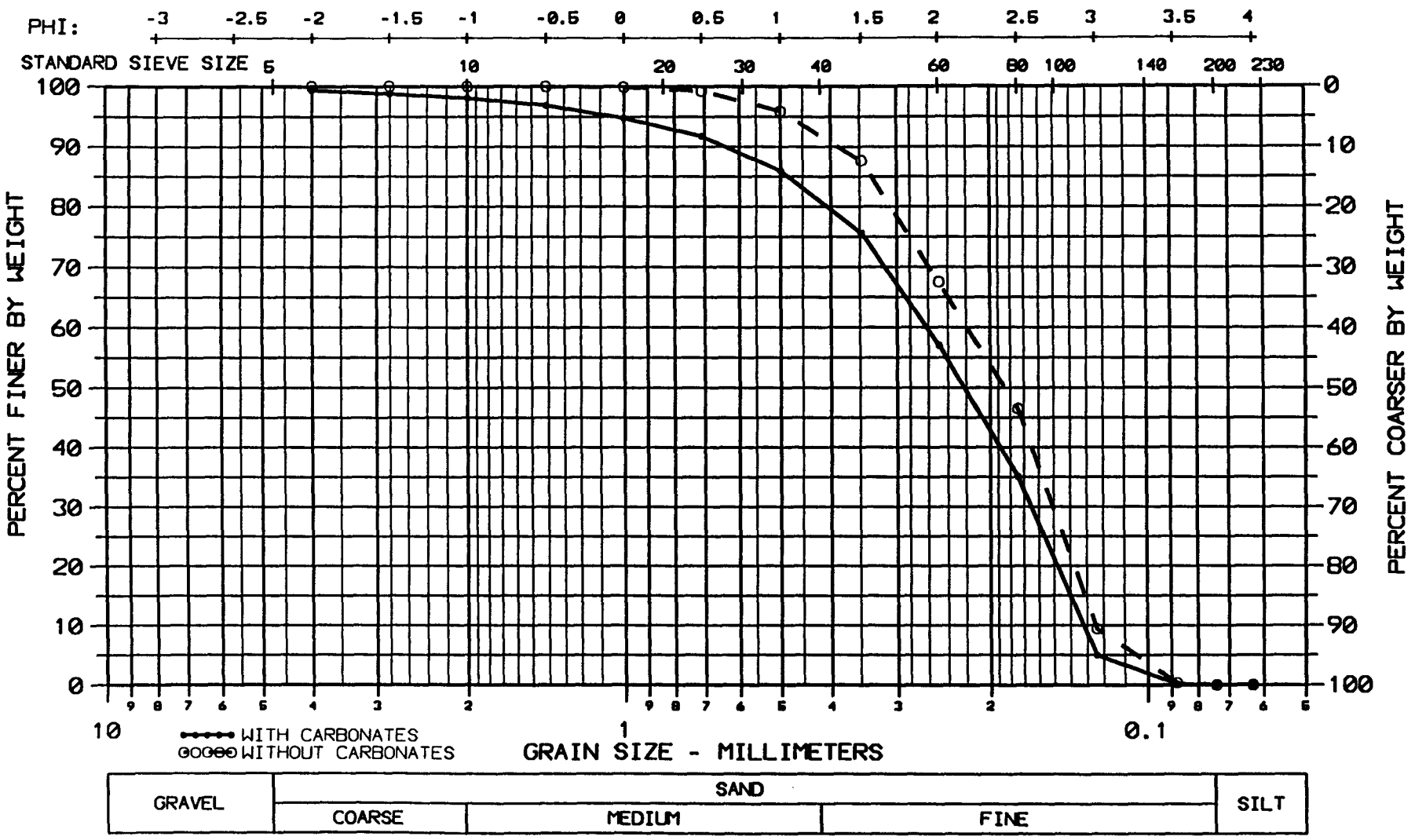

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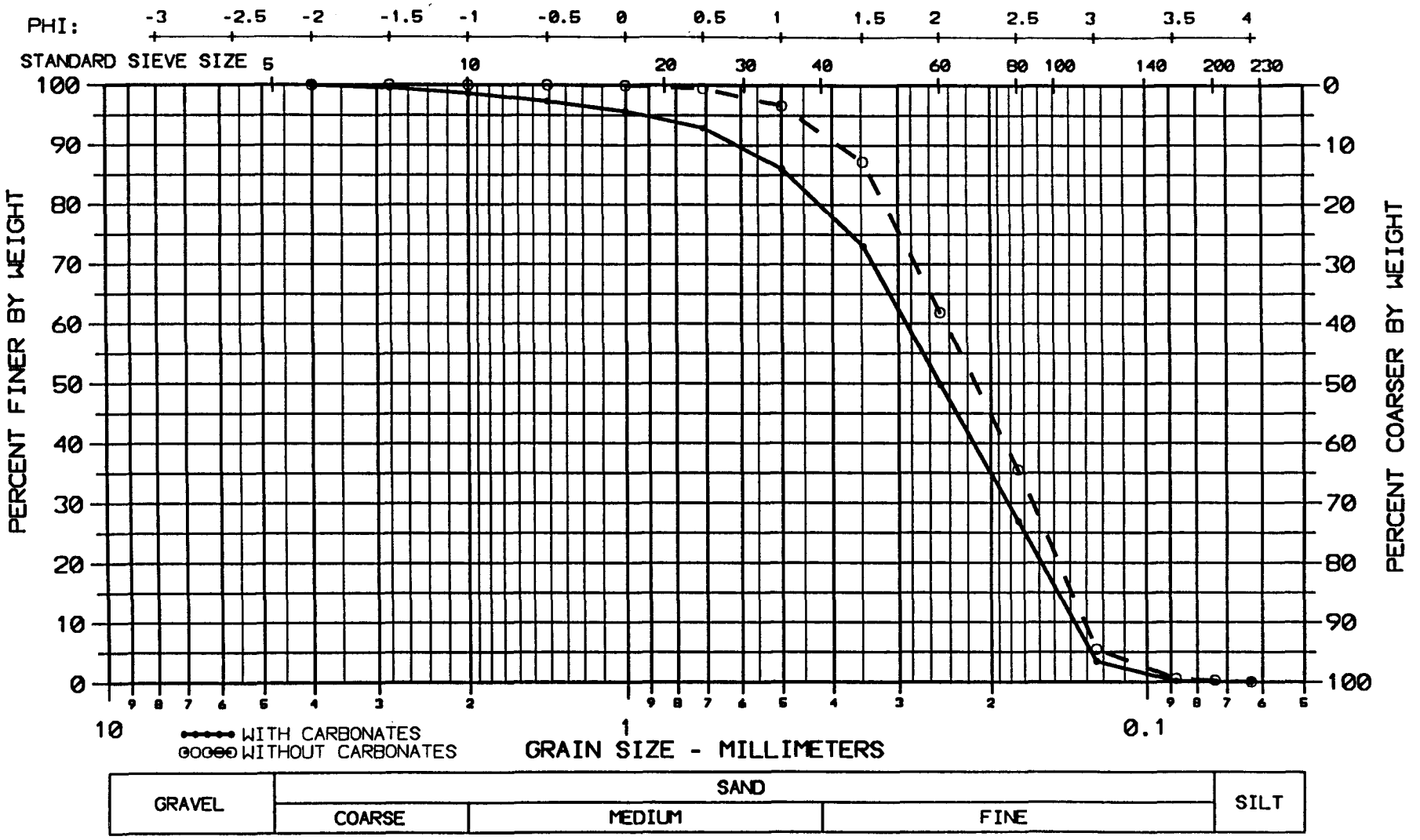

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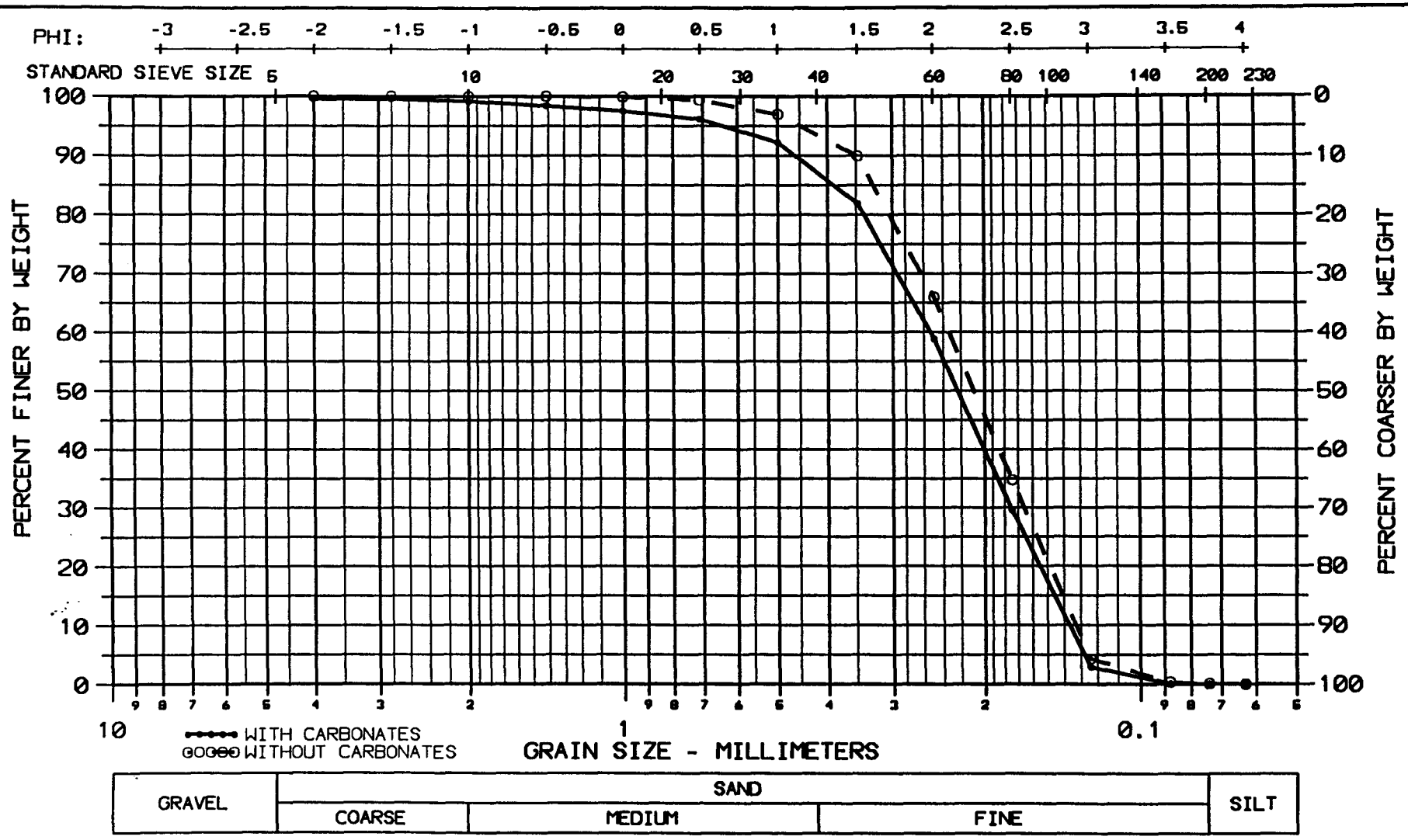

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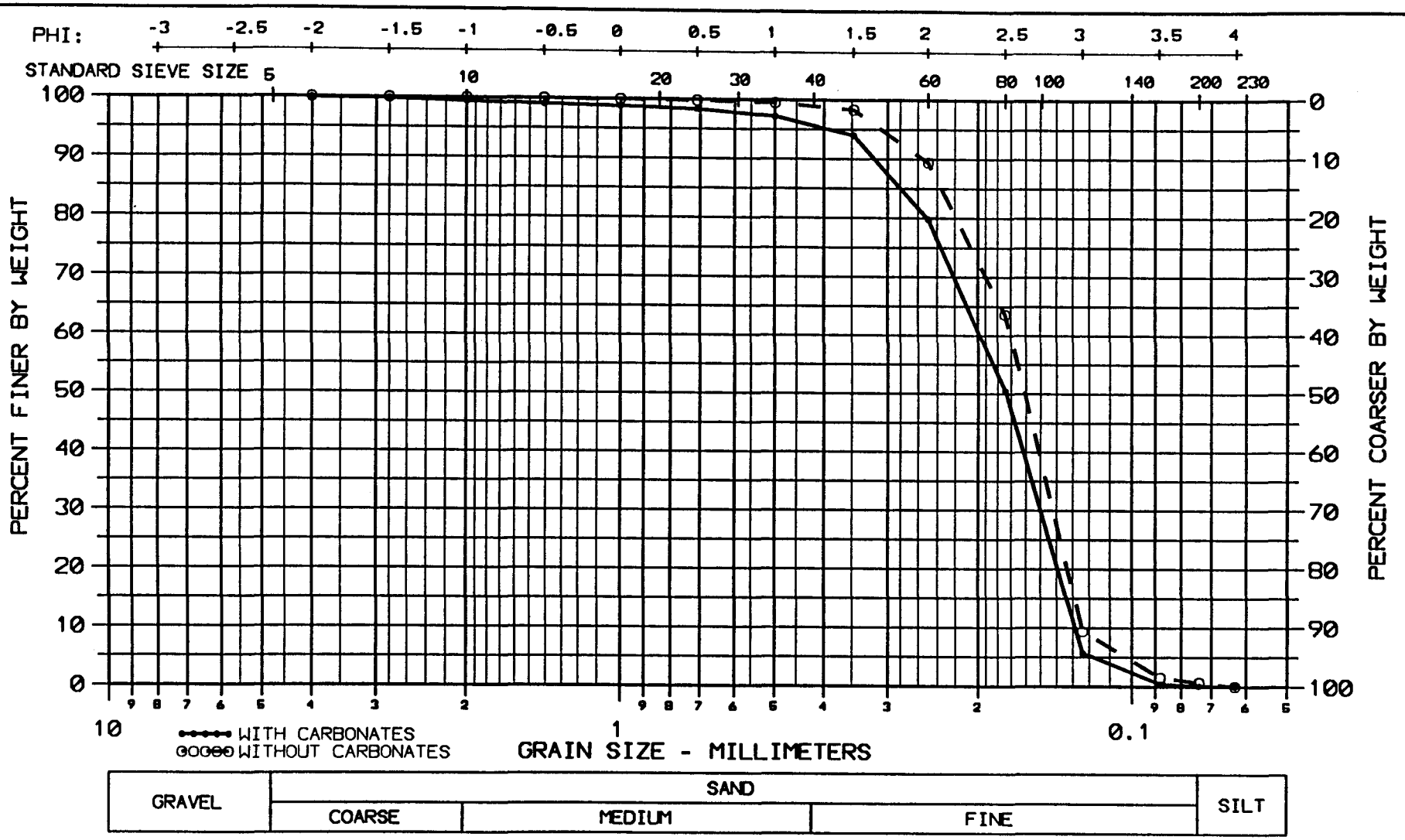

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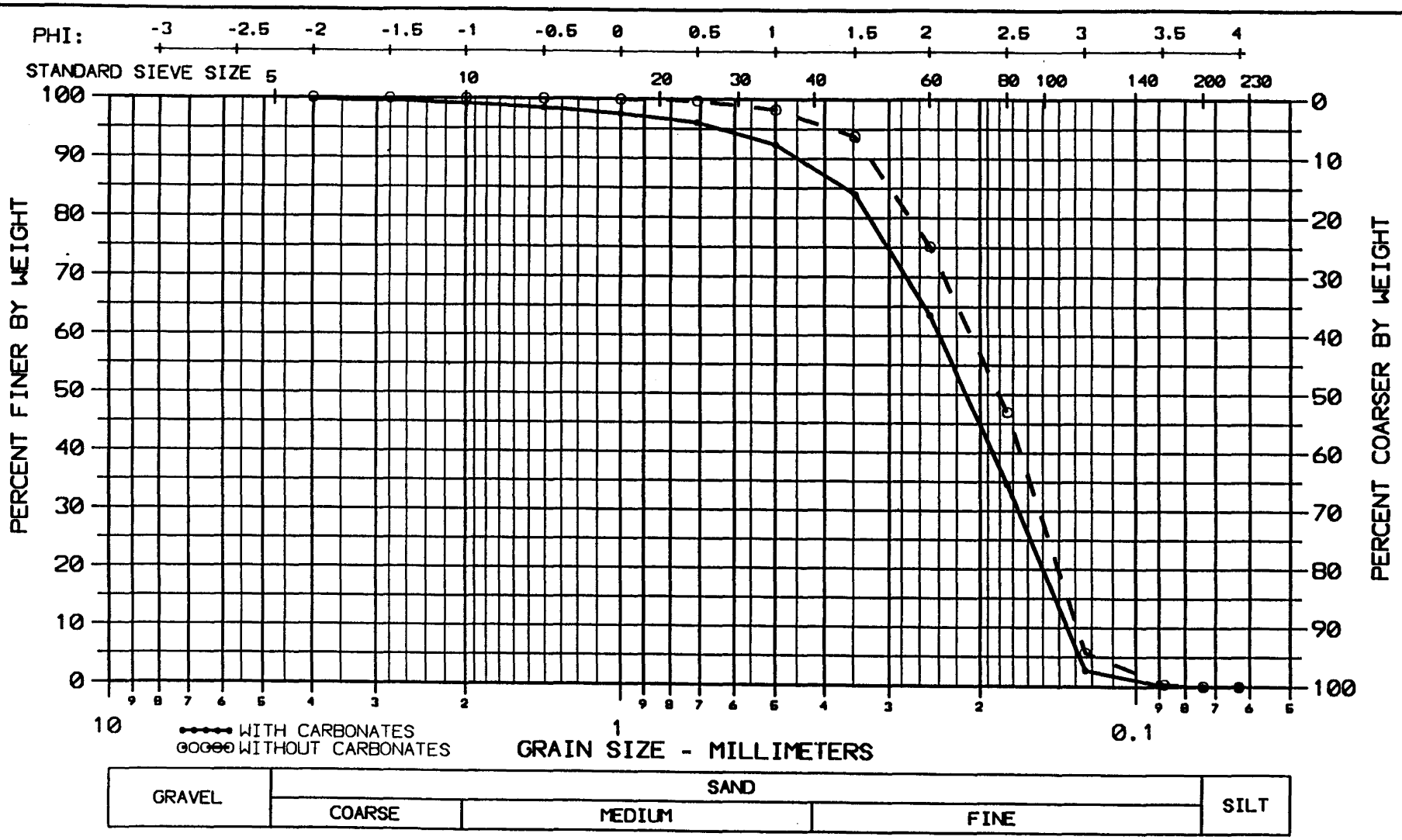

SEDIMENT GRAIN SIZE DISTRIBUTION: ORCB-30

PALM BEACH COUNTY, FLORIDA
SHORE PROTECTION PROJECT
(FROM MARTIN COUNTY LINE TO LAKE WORTH INLET AND FROM SOUTH LAKE WORTH INLET TO BROWARD COUNTY LINE)

GENERAL DESIGN MEMORANDUM ADDENDUM FOR THE OCEAN RIDGE SEGMENT

SUB-APPENDIX 2

CORE-BORING LOGS

PROJECT: Ocean Ridge LOCATION: N 802346 E 814453

CORE ORCB-3 LOG BY : FIT DATE: 2/29/92

Feet	Leg	Core Description	Rec	Samp	Remarks
0		Gray Medium to Fine Qtz Sand Trace Shell Frags SP - SM	100%	--#1	
2					
4				--#2	
		More Shell Fragments & Slightly Coarser Sand from 4.79-5.25ft			Cut A=4.99ft
6					
		Same as Above			
8				--#3	
10		Gray Medium to Coarse Qtz & ate Sand, Shell Fragments 5% SP-SW	100%	--#4	Cut B=5.12ft
12					
14		Same			
16				--#5	
		Total Length - 16.9 ft			Cut C=6.8 ft
18					
20					

ORCB-3

olsen associates, inc. Coastal Engineering

PROJECT: SOUTH LAKE WORTH INLET EBB TIDAL SHOAL	CORE NO.: CB-3A
DRILLER: EXMAR	DATE OF HOLE: 11/29/89 16:20
LOGGED BY: F.I.T. Venanzi/Zarillo	CLIENT REP.: Phil Venanzi
DEPTH OF WATER: XX.X DEPTH OF HOLE: 15.0'	N= 803635 E= 814899

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% CORE RECOVERY	SAMPLE NO.	REMARKS
	1		grey med sand (SP)			
	2				1 (2.0)	
	3					
	4				2 (4.0)	
			grey coarse sand (SW) shell frags(15%			
	5		grey med - coarse sand (SP-SW)			
	6		trace shell frags		3 (6.0)	
	7					cut 7'5"
	8		dark grey coarse sand (SW) trace shell frags		4 (8.0)	
	9		grey med-coarse sand (SP-SW)			
			dark grey med sand (SP)			
	10		rey med-coarse sand (SP-SW)		5 (10.0)	
			grey coarse sand (SW) shell frags (10%)			
	11		grey med sand (SP) trace shell frags few whole shells			
	12				6 (12.0)	
	13		grey coarse-med (SW-SP) sand trace shell frags			
	14				7 (14.0)	
						bottom 14'9"
	15					
	16					
	17					
	18					
	19					
	20					

PROJECT: Ocean Ridge LOCATION: N 801482 E 814076

CORE ORCB-5 LOG BY : FIT DATE: 2/29/92

Feet	Leg	Core Description	Rec	Samp	Remarks
0		Grey, Medium Sand, Few Shell	100%		
				--#1	
2		SM			
					Cut A=5 ft
4					
		Increased Shell Fragments -			
6		Material, Poorly Sorted			
		Material becomes Brownish Gray			
		Large shell fragments & 1/2 "			
		Shells Between 7.1-7.8 ft			
8		SP			
				--#2	
10					Cut B=5 ft
12		SP			
14				--#3	
		TTL Length = 15.4 ft			Cut C=5.4 ft
16					
18					
20					

ORCB-5

PROJECT: Ocean Ridge LOCATION: N 799910 E 815157

CORE ORCB-7 LOG BY : FIT DATE: 2/29/92

Feet	Leg	Core Description	Rec	Samp	Remarks
0		Gray Medium Sand Abundance of shell fragments at .92-1.12 ft SP		--#1	
2		Trace shell fragments		--#2	
4		Gray medium to coarse qtz & sand, poorly sorted. Small shell fragments at 5.18- SW		--#3	Cut A=5.02 ft
6					
8				--#4	Cut B=5.05 ft
10		Shell fragment 10-20%, horizons at & 11.15 ft			
12		Gray medium qtz sand, no shells SP		--#5	
14		Gray medium to coarse qtz & Sand, sm shell fragments-5%, SW			
		Gray medium qtz sand, trace shell SP		--#6	
16		Total length = 15.3 ft			Cut C=5.25 ft
18					
20					

ORCB-7

PROJECT: Ocean Ridge LOCATION: N 799294 E 814141

CORE ORCB-8 LOG BY : FIT DATE: 2/29/92

Feet	Leg	Core Description	Rec	Samp	Remarks
0		Gray, medium sand, trace shell SP	100%	--#1	
2		Gray medium to coarse sand & SW			
4		Gray, medium sand, trace shells & fragments SP		--#2	Cut A=5.08 ft
6				--#3	
8		SP			
10					Cut B=5.08 ft
12				--#4	
14					
16					
		SW Gray med. sand & fine sand, shell	100%	--#5	
		Total length = 17.55 ft			Cut C=7.4 ft
18					
20					

ORCB-8

PROJECT: Ocean Ridge LOCATION: N 798125 E 713619

CORE ORCB-10 LOG BY : FIT DATE: 2/29/92

Feet	Leg	Core Description	Rec	Samp	Remarks
0		Gray medium qtz sand w/shell 5%, horizons @ .92-1.12 ft	100%	--#1	
		SP			
2		Shell fragments 5% at 1.9-1.97 ft Shell fragments 10% @ 2.95-3.15 ft		--#2	
4					
		SP		--#3	Cut A=5.02 ft
6					
8		B & C sections, predominantly		--#4	
		SP			
10					Cut B=5.02 ft
				--#5	
12					
14				--#6	
		SP			
		Total length = 14.6 ft			Cut C=4.53 ft
16					
18					
20					

ORCB-10

PROJECT: Ocean Ridge LOCATION: N 797791 E 814496

CORE ORCB 12 LOG BY : FIT DATE: 2/29/9[illegible]

Feet	Leg	Core Description	Rec	Samp	Remarks
0		Gray Medium Qtz Sand			
		Trace of Shell Fragments	100%		
				--#1	
		SP			
2					
		Gray and White Speckled Coarse			
		SW			
4					
		Gray Medium Qtz Sand			
		Shell Fragment Horizon at 4.2 ft -			
6		SP		--#2	
		length A section = 7.0 ft.			
		Gray Medium Well Sorted Qtz Sand	100%		
8		Trace Shell Fragments			
		SP			
				--#3	
10					
12					Cut A=5 ft
		Same SP			
14					
16					
				--#4	
18					
		Length Section B = 11.7 ft			Cut B=6.7 ft
		TTL Length = 18.7 ft			ORCB-12
20					

PROJECT: Ocean Ridge LOCATION: N 795775 813444

CORE ORCB-14 LOG BY : FIT DATE: 2/29/92

Feet	Leg	Core Description	Rec	Samp	Remarks
0		Tan Medium To Coarse Sand, Shell Fragments 3 % SW	100%		
		Gray Medium Sand Trace Shell SP		--#1	
2		Gray Medium Sand, Trace Shell SW			
4		Gray Medium Sand, Trace Shell SP			Cut A =5 ft
6					
8		SP		--#2	
10					Cut B=5 ft
12		SP			
14				--#3	
16		TTL Length = 16.5 ft			Cut C=6.5 ft
18					
20					

ORCB-14

PROJECT: Ocean Ridge LOCATION: N 794356 E 813182

CORE ORCB16 LOG BY : FIT DATE: 3/1/92

Feet	Leg	Core Description	Rec	Samp	Remarks
0		Grey-Brown, Medium Sand, Trace Fragments SM	100%	--#1	
2					
		Grey Brown Coarse Sand, More Shell Fragments SW			
4		SP			
		SW			
				--#2	Cut A = 5 ft
6					
		Fewer Shell Fragments, Medium Sand			
8		SM			
10					Cut B = 5 ft
				--#3	
12					
		same SM			
14					
16					
				--#4	
		TTL Length = 17.2 ft			Cut C = 7.2
18					
20					

ORCB-16

PROJECT: Ocean Ridge LOCATION: N 793047 E 812958

CORE ORCB-18 LOG BY : FIT DATE: 3/1/92

Feet	Leg	Core Description	Rec	Samp	Remarks
0 -		Tan Coarse Medium Sand	100%		
-		5% Small Shell Fragments		--#1	
-		SW - SP			
-		Gray Medium Qtz Sand			
2 -		SP			
-		Gray and White Coarse Sand			
-		Small Sand Fragments - 25% Whole			
-		Up to 3cm SW			
4 -					
-		Gray Coarse - Medium Sand - Trace		--#2	
-		Shells SW -SP			
-		Length A Section = 5.4 ft			
6 -			0%		
-					
-		Gray Medium Well Sorted Qtz Sand			
-		Trace of Shell Fragment	100%		
8 -					
-					
-		SP			
-					
10-				--#3	
-					
-					
-					
12-		Length B section = 5 ft			
-		TTL Length = 12 ft			
-					
-					
14-					
-					
-					
-					
16-					
-					
-					
-					
18-					
-					
-					
-					
20-					
-					
-					
-					
-					

ORCB-18

PROJECT: Ocean Ridge LOCATION: N 791506 E 813156

CORE ORCB-20 LOG BY : FIT DATE: 3/1/92

Feet	Leg	Core Description	Rec	Samp	Remarks
0		Gray Medium Qtz Sand Well Sorted	100%		
		SP		--#1	
		Trace Shell Fragments			
2					
		SP			
4					
					Cut A = 5 ft
6					
		Speckled Whitish Gray Coarse Sand,			
8					
		Gray Medium Sand			
		SP			
		Trace Shell Fragments		--#2	
10					Cut B = 5 ft
12					
		same -- SP		--#3	
14					
		TTL Length = 14.8 ft			Cut C = 4.8
16					
18					
20					

ORCB-20

Drilling Log

1. Project	Ocean Ridge
2. Location	N803392 E814472
3. Drilling Agency	Florida Institute of Technology
4. Hole No. (As shown on drawing title)	ORCB-21
5. Name of Driller	
6. Direction of Hole	[X] Vertical [ ] Inclined _____ Degree from Vertical
7. Water Depth	29 ft
8. Depth Drilled into Rock	
9. Total Depth of Hole	14.4 ft
10. Size and Type of Bit	
11. Datum for Elevation Shown (TDM or MSL)	
12. Manufacturer's Designation of Drill	
13. Total No. of Overburden Samples Taken	Disturbed / Undisturbed
14. Total No. of Core Boxes	
15. Elevation Ground Water	
16. Date Hole	Started 6/28/93 / Completed 6/28/93
17. Elevation Top of Hole	
18. Total Core Recovery for Boring	%
19. Signature of Inspector	JV MC

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, if signficant) g
	0	SP	Gray, medium sand; damp; trace shells Small lenses of tan, coarse sand at about 2.5'		S	OR21-1.5
	1					
	2					
	3				S	OR21-3.0
	4	SW	Gray, medium to coarse sand and crushed shells; a few coccoliths		S	OR21-4.5
	5	SP	Gray, medium sand; trace shells			
	6	SW	Gray, medium to coarse sand; crushed shells; few coccoliths		S	OR21-5.9
	7	SP	Gray, medium sand; few shells			
	8	SW	Gray, fine to coarse sand and crushed shells; moist			
	9				S	OR21-8.9
	10					

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-21
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if significant) g
	10	SW	Gray, fine to coarse sand; crushed shells		S	OR21-10.4
	11				S	OR21-11.2
	12				S	OR21-11.7
	13	SW	Gray, fine to coarse sand; crushed shells			
	14					
			Total Recovery 14.4 ft			
	15					
	16					
	17					
	18					
	19					
	20					
	21					

Drilling Log

1. Project	Ocean Ridge
2. Location	N802802 E815014
3. Drilling Agency	Florida Institute of Technology
4. Hole No. (As shown on drawing title)	ORCB-22
5. Name of Driller	
6. Direction of Hole	[X] Vertical [ ] Inclined _____ Degree from Vertical
7. Water Depth	35 ft
8. Depth Drilled into Rock	
9. Total Depth of Hole	15.4 ft
10. Size and Type of Bit	
11. Datum for Elevation Shown (TDM or MSL)	
12. Manufacturer's Designation of Drill	
13. Total No. of Overburden Samples Taken	Disturbed / Undisturbed
14. Total No. of Core Boxes	
15. Elevation Ground Water	
16. Date Hole	Started 6/28/93 / Completed 6/28/93
17. Elevation Top of Hole	
18. Total Core Recovery for Boring	%
19. Signature of Inspector	JV MC

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, if signficant) g
	0	SP	Gray, medium sand; shell and coral pieces	100		
	1				S	OR22-1.2
	2		Zone of coccoliths		S	OR22-2.4
	3				S	OR22-3.0
	4	SP	Gray, medium sand; shell fragments	100		
	5				S	OR22-4.8
					S	OR22-5.6
	6					
	7				S	OR22-6.8
	8	SP	Gray, medium sand; shell fragments		S	OR22-8.0
	9		9.0'–9.7' Coccoliths		S	OR22-9.4
	10					

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-22
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if significant) g
	10	SP	Gray, medium sand; extremely moist		S	OR22-10.6
	11				S	OR22-11.2
	12					
	13				S	OR22-13.0
	14	SP	Gray, medium sand			
	15					
			Total Recovery 15.4 ft			
	16					
	17					
	18					
	19					
	20					
	21					

Drilling Log

1. Project	Ocean Ridge
2. Location	N801540 EE801733
3. Drilling Agency	Florida Institute of Technology
4. Hole No. (As shown on drawing title)	ORCB-23
5. Name of Driller	
6. Direction of Hole	[x] Vertical [ ] Inclined _____ Degree from Vertical
7. Water Depth	36 ft
8. Depth Drilled into Rock	
9. Total Depth of Hole	15.0 ft
10. Size and Type of Bit	
11. Datum for Elevation Shown (TDM or MSL)	
12. Manufacturer's Designation of Drill	
13. Total No. of Overburden Samples Taken	Disturbed / Undisturbed
14. Total No. of Core Boxes	
15. Elevation Ground Water	
16. Date Hole	Started 6/28/93 / Completed 6/28/93
17. Elevation Top of Hole	
18. Total Core Recovery for Boring	%
19. Signature of Inspector	JV MC

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, if significant) g
	0	SP	Gray, fine to medium sand	100		
	1				S	OR23-1.2
	2				S	OR23-2.4
	3	SP	Gray, fine to medium sand	100		
					S	OR23-3.6
	4		3.8'–4.3' Many crushed shells and coccoliths 4.3'–4.7' Dark mineral or peat present			
	5				S	OR23-4.8
	6	SP	Gray, fine to medium sand	100		
	7				S	OR23-6.9
	8				S	OR23-8.1
	9		8.7'–9.3' Zone of crushed shells and coccoliths		S	OR23-9.3
		SP	Gray, fine to medium sand	100		
	10				S	OR23-9.9

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-23
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if signficant) g
	10	SP	Gray, medium sand; some crushed shells and coccoliths; moist			
	11				S	OR23-11.6
	12		At 12.7' Zone of intact, well-preserved shells and coral			
	13				S	OR23-13.2
	14	SP	Gray, medium sand; shell fragments			
	15				S	OR23-14.8
			Total Recovery 15.0 ft			
	16					
	17					
	18					
	19					
	20					
	21					

Drilling Log		1 of 2 Sheets
1. Project	Ocean Ridge	10. Size and Type of Bit
2. Location	N800743 E813914	11. Datum for Elevation Shown (TDM or MSL)
3. Drilling Agency	Florida Institute of Technology	12. Manufacturer's Designation of Drill
4. Hole No. (As shown on drawing title)	ORCB-24	13. Total No. of Overburden Samples Taken: Disturbed / Undisturbed
5. Name of Driller		14. Total No. of Core Boxes
		15. Elevation Ground Water
6. Direction of Hole	[X] Vertical [ ] Inclined ____ Degree from Vertical	16. Date Hole: Started 6/28/93; Completed 6/28/93
7. Water Depth	31 ft	17. Elevation Top of Hole
8. Depth Drilled Into Rock		18. Total Core Recovery for Boring %
9. Total Depth of Hole	15.6 ft	19. Signature of Inspector JV MC

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, if significant) g
	0	SP	Area of loosely compacted gray, fine to medium sand	100		
	1				S	OR24-1.0
	2	SP	Gray, fine to medium sand; very moist		S	OR24-2.0
	3					
	4		4.2'–4.4 Lens of silt with sand		S	OR24-4.5
	5	SP	Gray, medium sand; some coccoliths; shell fragments; 1-in. lens of coarse sand and shell fragments at 6.1'	100	S	OR24-5.5
	6				S	OR24-6.0
	7		Increasing shell fragments and coarse sand at 7.1'			
	8	SW	Light brown, medium to coarse sand and crushed shells at 8.7'	100	S	OR24-7.5
	9		Some small (5 mm) intact, delicate shells (bivalves) and coccoliths		S	OR24-9.0
	10	SP	Gray, medium sand; some crushed shell fragments		S	OR24-9.5

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-24
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if significant) g
	10	SP	10.0'–12.3' Gray, medium to coarse sand; some crushed shells; moist			
	11				S	OR24-11.0
	12				S	OR24-12.0
		SP	Gray, coarse sand; many crushed shells		S	OR24-12.5
	13				S	OR24-13.5
	14	SP	Gray, medium to coarse sand			
	15					
	16		Total Recovery 15.6 ft			
	17					
	18					
	19					
	20					
	21					

Drilling Log

1. Project: Ocean Ridge	10. Size and Type of Bit
2. Location: N798925 E813914	11. Datum for Elevation Shown (TDM or MSL)
3. Drilling Agency: Florida Institute of Technology	12. Manufacturer's Designation of Drill
4. Hole No. (As shown on drawing title): ORCB-25	13. Total No. of Overburden Samples Taken — Disturbed: — Undisturbed:
5. Name of Driller	14. Total No. of Core Boxes
	15. Elevation Ground Water
6. Direction of Hole: [X] Vertical [ ] Inclined _____ Degree from Vertical	16. Date Hole — Started: 6/28/93 — Completed: 6/28/93
7. Water Depth: 33 ft	17. Elevation Top of Hole
8. Depth Drilled into Rock	18. Total Core Recovery for Boring: %
9. Total Depth of Hole: 15.5 ft	19. Signature of Inspector: JV MC

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, if significant) (g)
	0	SP	0.0'–6.2' Gray, fine to medium sand; dry	100		
	1				S	OR25-1.2
	2				S	OR25-2.4
	3	SW	Layer of brown, medium to coarse sand and crushed shells and coccoliths		S	OR25-3.0
	4	SW	Layer of brown, medium to coarse sand and crushed shells	100	S	OR25-4.2
	5	SW	4.8'–6.2' Moisture Layer of gray, medium to coarse sand and crushed shells		S	OR25-4.8
	6				S	OR25-6.0
	7	SP	Gray, fine to medium sand; few crushed shells	100		
	8	SP	Gray, fine to medium sand			
	9				S	OR25-9.2
	10					

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-25
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if significant) g
	10					
	11	SP	Gray, fine to medium sand	100	S	OR25-11.0
	12				S	OR25-12.2
	13	SW	Gray, medium to coarse sand; many crushed shells; moist		S	OR25-15.2
	14					
		SP	Gray, medium sand; damp	100		
	15					
			Total Recovery 15.5 ft			
	16					
	17					
	18					
	19					
	20					
	21					

Drilling Log		1 of 2 Sheets
1. Project	Ocean Ridge	10. Size and Type of Bit
2. Location	N796456 E813100	11. Datum for Elevation Shown (TDM or MSL)
3. Drilling Agency	Florida Institute of Technology	12. Manufacturer's Designation of Drill
4. Hole No. (As shown on drawing title)	ORCB-26	13. Total No. of Overburden Samples Taken — Disturbed: — Undisturbed:
5. Name of Driller		14. Total No. of Core Boxes
		15. Elevation Ground Water
6. Direction of Hole	[X] Vertical [ ] Inclined ____ Degree from Vertical	16. Date Hole — Started: 6/28/93 — Completed: 6/28/93
		17. Elevation Top of Hole
7. Water Depth	33 ft	18. Total Core Recovery for Boring %
8. Depth Drilled into Rock		19. Signature of Inspector JV MC
9. Total Depth of Hole	15.5 ft	

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, if significant) g
	0	SP	0.0'–3.2' Gray, medium sand; few coccoliths	100		
	1		0.0'–1.0' Very loose; dry		S	OR26-1.2
	2					
	3	SP	Medium to coarse sand; crushed shells and coccoliths		S	OR26-3.0
	4				S	OR26-4.2
	5	SP	Medium sand; few whole shells	100		
	6					
	7	SP	Zones of brown, coarse sand; largely crushed shell; damp			
	8				S	OR26-8.0
	9	SW	Gray–brown, coarse to medium, shelly sand; moist	100	S	OR26-9.2
	10				S	OR26-9.8

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-26
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if significant) g
	10	SW	Gray–brown, medium sand; some lenses of tan, coarse sand and a thick lens of shell hash; interspersed with crushed and well-preserved whole shells throughout; moist	100		
	11					
	12				S	OR26-11.8
		SW				
	13				S	OR26-13.0
	14	SW	Medium gray to brown, fine to coarse sand	100	S	OR26-14.2
	15					
			Total Recovery 15.5 ft			
	16					
	17					
	18					
	19					
	20					
	21					

Drilling Log

1. Project	Ocean Ridge
2. Location	N795128 E812975
3. Drilling Agency	Florida Institute of Technology
4. Hole No. (As shown on drawing title)	ORCB-27
5. Name of Driller	
6. Direction of Hole	[X] Vertical [ ] Inclined _____ Degrees from Vertical
7. Water Depth	34 ft
8. Depth Drilled into Rock	
9. Total Depth of Hole	15.4 ft
10. Size and Type of Bit	
11. Datum for Elevation Shown (TDM or MSL)	
12. Manufacturer's Designation of Drill	
13. Total No. of Overburden Samples Taken	Disturbed: Undisturbed:
14. Total No. of Core Boxes	
15. Elevation Ground Water	
16. Date Hole	Started 6/28/93 Completed 6/28/93
17. Elevation Top of Hole	
18. Total Core Recovery for Boring	%
19. Signature of Inspector	JV MC

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, if signficant) g
	0	SP	Gray, medium sand; occasional shell fragments; moist			
	1				S	OR27-1.2
	2	SP	1/2-in. lens green clay at 1.7'			
	3				S	OR27-3.0
	4	SW	Coarse to medium sand; coccoliths			
	5	SP	Gray, medium sand			
	6		Occasional zone of abundant crushed shells and coccoliths		S	OR27-6.2
	7					
	8	SP	Gray medium, sandy shell fragments			
	9					
	10				S	OR27-9.8

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-27
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if significant) g
	10	SP	Gray, medium sand	100		
	11					
	12					
	13				S	OR27-13.6
	14	SP	Gray medium sand	100		
	15				S	OR27-15.4
			Total Recovery 15.4 ft			
	16					
	17					
	18					
	19					
	20					
	21					

Drilling Log

1. Project	Ocean Ridge
2. Location	N793689 E812843
3. Drilling Agency	Florida Institute of Technology
4. Hole No. (As shown on drawing title)	ORCB-28
5. Name of Driller	
6. Direction of Hole	[x] Vertical [ ] Inclined _____ Degree from Vertical
7. Water Depth	32 ft
8. Depth Drilled into Rock	
9. Total Depth of Hole	15.7 ft
10. Size and Type of Bit	
11. Datum for Elevation Shown (TDM or MSL)	
12. Manufacturer's Designation of Drill	
13. Total No. of Overburden Samples Taken	Disturbed / Undisturbed
14. Total No. of Core Boxes	
15. Elevation Ground Water	
16. Date Hole	Started 6/28/93 / Completed 6/28/93
17. Elevation Top of Hole	
18. Total Core Recovery for Boring	%
19. Signature of Inspector	JV MC

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, if significant) g
	0	SP	Gray, medium to coarse sand; moist; some coccoliths and crushed shells	100		
	1				S	OR28-1.2
	2					
	3	SP	Gray, medium to coarse sand	100	S	OR28-3.0
	4					
	5				S	OR28-5.0
	6	SP	Gray, medium to coarse sand	100		
	7				S	OR28-7.0
	8	SP	Gray, medium to coarse sand	100		
	9				S	OR28-9.0
	10					

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-28
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if significant) g
	10					
	11	SP	Gray, medium to coarse sand	100		
					S	OR28-11.5
	12					
	13					
					S	OR28-13.5
	14	SP	Gray, medium to coarse sand	100		
	15				S	OR28-15.0
	16		Total Recovery 15.7 ft			
	17					
	18					
	19					
	20					
	21					

Drilling Log

1. Project: Ocean Ridge	10. Size and Type of Bit
2. Location: N792201 E813361	11. Datum for Elevation Shown (TDM or MSL)
3. Drilling Agency: Florida Institute of Technology	12. Manufacturer's Designation of Drill
4. Hole No. (As shown on drawing title): ORCB-29	13. Total No. of Overburden Samples Taken — Disturbed: — Undisturbed:
5. Name of Driller	14. Total No. of Core Boxes
	15. Elevation Ground Water
6. Direction of Hole: [x] Vertical [ ] Inclined _____ Degree from Vertical	16. Date Hole — Started: 6/28/93 — Completed: 6/28/93
7. Water Depth: 37 ft	17. Elevation Top of Hole
8. Depth Drilled into Rock	18. Total Core Recovery for Boring: %
9. Total Depth of Hole: 14.6 ft	19. Signature of Inspector: JV MC

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, if significant) (g)
	0	SP	Gray, fine to medium sand; moist	100		
	1				S	OR29-1.2
	2					
	3	SP	Gray, medium sand; crushed and intact shells; coccoliths		S	OR29-3.0
	4				S	OR29-4.2
	5	SP	Gray, fine to medium sand; some shell fragments; few coccoliths	100	S	OR29-5.7
	6		6.0'–6.7' Zone of coccoliths			
	7				S	OR29-6.9
	8	SP	Gray, fine to medium sand; shell fragments	100	S	OR29-8.1
	9					
	10				S	OR29-9.9

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-29
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if signficant) g
	10					
	11					
		SP	Gray, medium sand; some coccoliths		S	OR29-11.5
	12					
					S	OR29-12.7
	13					
	14					
					S	OR29-14.5
	15		Total Recovery 14.6 ft			
	16					
	17					
	18					
	19					
	20					
	21					

Drilling Log

1. Project	Ocean Ridge
2. Location	N791268 E812655
3. Drilling Agency	Florida Institute of Technology
4. Hole No. (As shown on drawing title)	ORCB-30
5. Name of Driller	
6. Direction of Hole	[x] Vertical [ ] Inclined _____ Degree from Vertical
7. Water Depth	33 ft
8. Depth Drilled Into Rock	
9. Total Depth of Hole	13.4 ft
10. Size and Type of Bit	
11. Datum for Elevation Shown (TDM or MSL)	
12. Manufacturer's Designation of Drill	
13. Total No. of Overburden Samples Taken	Disturbed / Undisturbed
14. Total No. of Core Boxes	
15. Elevation Ground Water	
16. Date Hole	Started 6/28/93 / Completed 6/28/93
17. Elevation Top of Hole	
18. Total Core Recovery for Boring	%
19. Signature of Inspector	JV MC

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, if signficant) g
	0	SP	Gray, medium sand; very moist			
	1				S	OR30-1.5
	2					
	3	SW	Layer of medium to coarse sand with abundant crushed shells and coccoliths; moist		S	OR30-3.0
	4	SP	Gray, medium sand		S	OR30-4.5
	5					
	6				S	OR30-6.5
	7					
	8				S	OR30-8.0
	9	SP	Gray, medium sand			
	10					

Drilling Log (Cont Sheet)	Elevation Top of Hole	Hole No. ORCB-30
Project Ocean Ridge	Installation	Sheet 2 of 2 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, if signficant) g
	10					
	11	SP	Gray, medium sand		S	OR30-11.0
	12					
	13				S	OR30-13.0
			Total Recovery 13.4 ft			
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					