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FLAGLER COUNTY, FLORIDA: HURRICANE AND STORM DAMAGE REDUCTION FINAL INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT

COMMUNICATION

FROM

THE ASSISTANT SECRETARY OF THE ARMY, CIVIL WORKS, THE DEPARTMENT OF DEFENSE

TRANSMITTING

THE DEPARTMENT'S FLAGLER COUNTY HURRICANE AND STORM DAMAGE REDUCTION FINAL INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT FOR SEPTEMBER 2014 (REV. OCTOBER 2014) (REV. APRIL 2015)



MARCH 2, 2016.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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HOUSE DOCUMENT NUMBER 114-11

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

FEB - 8 2016

Honorable Paul Ryan
Speaker of the House of Representatives
U.S. Capitol Building, Room H-232
Washington, DC 20515-0001

Dear Mr. Speaker:

In response to a Senate Committee on Environment and Public Works Resolution adopted April 22, 1988, the Secretary of the Army supports the authorization and construction of a coastal storm damage reduction project for Flagler County, Florida. The proposal is described in the report of the Chief of Engineers, dated December 23, 2014, which includes other pertinent documents. The Secretary of the Army plans to implement the project at the appropriate time, considering National priorities and the availability of funds.

The project study was conducted to analyze and formulate plans for reducing coastal storm damages along the shoreline of Flagler County, Florida. The recommended plan is the National Economic Development plan and includes the following elements:

a) Construction of a 2.6 mile long, 10-foot wide dune extension to an elevation 19 feet North American Vertical Datum 88 (NAVD88), matching the elevation of the existing dune. From the seaward end of the dune extension, a 1 vertical on 3 horizontal dune slope would extend to the design berm elevation of 11 feet NAVD88 to match the existing berm elevation. The constructed berm would extend 35 feet seaward from the toe of the dune with a 1 vertical on 100 horizontal berm slope. The foreshore fill would extend from the seaward edge of the berm to approximately -2 feet NAVD88 with a slope of 1 vertical on 5 horizontal. This template, dimensioned for constructability, will then equilibrate into the project (10-foot dune and profile extension) template. The berm taper, or transition from the constructed berm to the existing adjacent berm, would extend 200 feet at the north and south ends of the project.

b) Periodic nourishment of the project is planned at 11-year intervals.

Based on October 2015 (FY 2016) price levels, the total nourishment cost is estimated at $45,719,000, which includes the project first cost of initial construction of $14,513,000 and a total of four periodic nourishments at a total cost of $31,206,000. The Federal share of the initial construction would be $9,433,000 and the non-Federal share would be $5,080,000 which equates to 65 percent Federal and 35 percent non-Federal. The Federal share of the future periodic nourishments would be $15,603,000 and the non-Federal share would be $15,603,000 which equates to 50 percent Federal and 50 percent non-Federal. The costs of lands, easements, rights-of-way, relocations and dredged or excavated material disposal areas are estimated at $3,405,000. The non-Federal sponsor would be responsible for operation, maintenance, repair, replacement and rehabilitation (OMRR&R)

of the project after construction, at an estimated average annual cost of $10,000. The OMRR&R activities will include beach fill monitoring, semiannual beach profile surveys through the depth of closure, aerial photography, and an annual monitoring report.

Based on FY 2016 price levels, a 3.125 percent discount rate, and a 50-year period of economic analysis, the total equivalent average annual costs of the project are estimated to be $1,219,000, including OMRR&R. The selected plan would reduce average annual coastal storm damages by about $2,202,000. The equivalent average annual benefits, which include incidental recreation and traffic re-routing benefits, are estimated to be $2,402,000 with net average annual benefits of $1,183,000. The benefit-to-cost ratio is 2.1 to 1.

An Environmental Assessment and a Finding of No Significant Impact was prepared in accordance with the National Environmental Policy Act. All practicable means to avoid and minimize adverse environmental effects have been incorporated into the recommended plan. The Corps will take additional measures to minimize effects to threatened and endangered sea turtles in accordance with the U.S. Fish and Wildlife Service Statewide Programmatic Biological Opinion. The recommended plan has been identified as the environmentally preferred plan, will not adversely modify designated critical habitat, and will have beneficial effects to protected species habitat within the project area. Therefore, no compensatory mitigation is required.

The Office of Management and Budget (OMB) advises that there is no objection to the submission of the report to Congress. However, OMB also noted that the Administration will be requesting the Corps, after it completes all pre-construction design and engineering work on this project, to update the estimates of the benefits and costs of this project before determining whether to recommend funding to construct it and that the project would need to compete with other proposed investments for funding in future budgets. A copy of OMB's letter, dated January 21, 2016, is enclosed. I am providing a copy of this transmittal and the OMB letter to the Subcommittee on Water Resources and Environment of the House Committee on Transportation and Infrastructure, and the Subcommittee on Energy and Water Development of the House Committee on Appropriations. I am also providing an identical letter to the President of the Senate.

Very truly yours,

Jo-Ellen Darcy

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

Enclosures

4 Enclosures

1. OMB Clearance letter, dated January 21, 2016
2. Finding of No Significant Impact, signed January 22, 2016
3. Chief's Report, dated January 23, 2015
4. Flagler County, Florida Final Integrated Feasibility Study and Environmental Assessment, April 2015 (CD)

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

January 21, 2016

The Honorable Jo-Ellen Darcy
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Washington, DC 20310-0108

Dear Ms. Darcy:

As required by Executive Order 12322, the Office of Management and Budget has reviewed a September 2014 (revised in October 2014 and April 2015) Army Corps of Engineers feasibility study of the Flagler County, Florida hurricane and storm damage reduction project with a total cost of $44,387,052 (FY 2014 price level).

Based on an analysis of costs and benefits, the Corps estimated that the benefit-to-cost ratio for the project is 1.9 to 1 at a discount rate of 3.5 percent, which is the discount rate that the Corps is required to use for FY 2014 under section 80 of the Water Resources Development Act of 1974 to evaluate and formulate its proposed water resources projects. According to the Corps, the equivalent benefit-to-cost ratio is 1.09 to 1.0 at a seven percent discount rate. This is the discount rate that the Administration uses in the Budget to measure the performance of Corps construction projects whose primary purpose is to provide an economic return to the Nation. We would like to work with you to ensure that in the development of future Corps reports, non-Federal sponsors are made fully aware of the basis upon which the Executive Branch evaluates projects.

The Office of Management and Budget does not object to your submitting this report to Congress. However, when you do so, please advise the Congress that the Administration will be requesting the Corps, after it completes all pre-construction design and engineering work on this project, to update the estimates of the benefits and costs of this project before determining whether to recommend funding to construct it. In addition, should the Congress authorize this project for construction, the project would need to compete with other proposed investments for funding in future budgets. We anticipate future Budgets will continue to be limited to investments that demonstrate a high return to the Nation.

Sincerely,

John Pasquantino
Deputy Associate Director
Energy, Science, and Water

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

REPLY TO
ATTENTION OF

FLAGLER COUNTY HURRICANE AND STORM DAMAGE REDUCTION INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT

FLAGLER COUNTY, FLORIDA

FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the Feasibility Study and Environmental Assessment (EA) of the Recommended Plan and the Future Without Project (No Action Alternative) for the Flagler County Hurricane and Storm Damage Reduction Study, Flagler County. The Recommended Plan was identified as the National Economic Development (NED) plan and also the environmentally-preferred alternative as it includes reduction of damage from extreme storms and hurricanes through the shoreline protection measure of rebuilding a natural dune system and planting native dune vegetation. This Finding incorporates by reference all discussions and conclusions contained in the integrated EA (enclosed hereto) in which the U.S. Army Corps of Engineers, Jacksonville District (Corps) and Bureau of Ocean Energy Management (BOEM) conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. Technical and economic criteria used in the formulation of alternative plans were those specified in the Water Resource Council's 1983 Economic and Environmental Principles for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were considered in the evaluation of the alternatives. Based on information analyzed in the EA, reflecting pertinent information obtained from other agencies and special interest groups having jurisdiction by law and/or special expertise, I conclude that the proposed action will have no significant impact on the quality of the human environment. Reasons for this conclusion are in summary:

a. All practicable means to avoid and minimize adverse environmental effects have been incorporated into the recommended plan. The Corps will take additional measures to minimize effects to threatened and endangered sea turtles per the U.S. Fish and Wildlife Service Statewide Programmatic Biological Opinion. The recommended plan will not adversely modify designated critical habitat and will have beneficial effects to protected species habitat within the project area. Therefore, no compensatory mitigation is required.

b. I have determined that Recommended Plan, as proposed, will pose no adverse effect on significant historic properties. Coordination with the Florida State Historic Preservation Officer and appropriate federally recognized tribes has been initiated. As stated in the EA, use of the shoreline will have no effect on historic properties as none are located within the immediate footprint of the project area, and that the preferred alternative (Recommended Plan) will have beneficial effects to those historic properties located immediately west of the project area. Furthermore, no historic properties would be affected by any of the project alternatives in the

nearshore. It is anticipated that no historic properties would be affected by use of any of the proposed borrow areas. In a 2005 consultation with the SHPO, it was recommended that an underwater survey of the proposed borrow area be conducted. This survey will be conducted prior to project construction. If any resources are identified they will be properly buffered to avoid any impacts to ensure required protection of the resource.

c. State water quality standards will be met. A Water Quality Certification (WQC) permit application will be submitted for issuance by the Florida Department of Environmental Protection (FDEP).

d. The Corps has determined that the proposed project is consistent with the Coastal Zone Management Act (CZMA). The final concurrence from the State will be issued with the FDEP permit.

e. Measures to eliminate, reduce below the level of significance, or avoid potential impacts to fish and wildlife resources will be implemented during project construction.

f. The proposed project has been evaluated pursuant to the Migratory Bird Treaty Act. The Jacksonville District's Migratory Bird Protection procedures will be implemented for this project and for future projects. These procedures have been coordinated with the U.S. Fish and Wildlife Service (USFWS) and the State of Florida.

g. Benefits to the public will include restored and improved natural habitat for protected species, fish and wildlife, restored aquatic ecosystem, and engagement by the local community.

h. Measures will be in place during construction to eliminate, reduce, or avoid adverse impacts below the threshold of significance to fish and wildlife resources include the following:

1. All dredge and placement activities will occur within the template of authorized and permitted areas;
2. All water based activities would follow standard sea turtle protection measures and the conditions of the National Marine Fisheries Service (NMFS) South Atlantic Regional Biological Opinion (SARBO), and
3. Dredged material placement would comply with the shoreline protection measures conditions of the USFWS Statewide Programmatic Biological Opinion (SPBO).

In consideration of the information summarized, I find that the proposed action will not significantly affect the human environment and does not require an Environmental Impact Statement. This document will be available to the public on the U.S. Army Corps of Engineers Jacksonville District website at:

http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx#Flagler

Jason A. Kirk
Colonel, Corps of Engineers
Commanding

22 JAN 2016
Date

DEPARTMENT OF THE ARMY
CHIEF OF ENGINEERS
2800 ARMY PENTAGON
WASHINGTON, DC 20310-2600

REPLY TO
ATTENTION OF

DAEN

23 DEC 2014

THE SECRETARY OF THE ARMY

SUBJECT: Flagler County, Florida, Hurricane and Storm Damage Reduction Project

1. I submit for transmission to Congress my report on hurricane and storm damage reduction at Flagler County, Florida. It is accompanied by the report of the district and division engineers. This report is in partial response to Resolution 2676 adopted 22 May 2002 by the Committee on Transportation and Infrastructure of the United States House of Representatives. The resolution requested the Secretary of the Army to review the feasibility of providing shoreline erosion protection, hurricane and storm damage reduction, and related purposes to the shores of Flagler County, Florida. Pre-construction engineering and design activities for the project will continue under the authority cited above.

2. The reporting officers recommend a project for coastal storm damage reduction. Based on an evaluation of alternative plan costs and economic benefits, the national economic development (NED) plan consists of a 10-foot dune and beach profile extension along 2.6 miles of shoreline in Flagler Beach and mainly prevents damage to State Road A1A (SR A1A). SR A1A is considered critical infrastructure and serves as the only viable hurricane evacuation route for over 2,300 residents of Flagler Beach, as well as a necessary component of post storm emergency response and recovery. This segment of SR A1A in the project area is located on the highest elevation in the Flagler Beach barrier island and is a vital link within a 14 mile segment that connects two bridges that are the primary routes off and onto the island during evacuation and recovery efforts. The non-federal sponsor, Flagler County, supports the NED plan. The recommended plan is the NED plan and consists of the following improvements:

a. The project would extend the dune and beach profile 10 feet seaward from a construction baseline 20 feet east of, and parallel to, SR A1A along 2.6 miles of shoreline from survey monuments R80 to R94, with subsequent periodic nourishments;

b. The plan would include construction of the dune to an elevation 19 feet North American Vertical Datum 88 (NAVD88) to match the elevation of the existing dune. From the seaward end of the dune extension, a 1 vertical on 3 horizontal dune slope would extend to the design berm elevation of 11 feet NAVD88 to match the existing berm elevation. The constructed berm would extend 35 feet seaward from the toe of the dune with a 1 vertical on 100 horizontal berm slope. The foreshore fill would extend from the seaward edge of the berm to approximately -2 feet NAVD88 with a slope of 1 vertical on 5

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horizontal. This template, dimensioned for constructability, will then equilibrate into the project (10-foot dune and profile extension) template;

c. The berm taper, or transition from the constructed berm to the existing adjacent berm, would extend 200 feet at the north and south ends of the project;

d. Initial construction will require approximately 330,000 cubic yards of sand, and each periodic nourishment event will require approximately 320,000 cubic yards. The renourishment interval is expected to be approximately 11 years, equaling 4 renourishment events in addition to initial construction over the 50-year period of federal participation;

e. The borrow areas identified for the project, areas 2A and 2B, are located approximately 7 miles offshore from the placement area. There is approximately 3 million cubic yards (mcy) of beach quality sand in these two areas. The estimated volume to be dredged from areas 2A and 2B over the 50-year recommended plan is 2,028,600 mcy, assuming 26% dredging losses; and

f. Native vegetation will be planted on areas of the existing dune disturbed by construction, as well as the newly constructed dune and dune slope to stabilize the fill. It is assumed that dune planting will only be necessary for initial construction and that vegetation will spread and naturally grow and spread to any areas that are renourished in the future.

3. Flagler County is the non-federal cost sharing sponsor for all features. Based on Fiscal Year 2015 price levels, the estimated total project cost of the NED Plan is $44,962,000, which includes the project first cost of initial construction of $14,182,000 and a total of four periodic renourishments at a total cost of $30,780,000. Periodic renourishments are planned at 11-year intervals. Cost sharing is applied in accordance with the provisions of Section 103 of the Water Resources Development Act (WRDA) of 1986, as amended (33 U.S.C. 2213), as follows:

a. The federal share of the total first cost would be about $9,218,300 and the non-federal share would be about $4,963,700, which equates to 65 percent federal and 35 percent non-federal. The non-federal costs include the value of lands, easements, rights-of-way, relocations and dredged or excavated material disposal areas (LERRD) estimated to be $3,336,000.

b. The federal share of future periodic renourishment is estimated to be $15,390,000 and the non-federal share is estimated to be $15,390,000 which equates to 50 percent federal and 50 percent non-federal.

4. Based on a 3.375 percent discount rate and a 50-year period of analysis, the total equivalent average annual costs of the project are estimated to be $1,235,000. All project costs are allocated to the authorized purpose of hurricane and storm damage reduction.

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The selected plan would reduce average annual coastal storm damages by about $2,172,000. The equivalent average annual benefits, which include recreation and traffic re-routing benefits, are estimated to be $2,372,000 with net average annual benefits of $1,137,000. The benefit to cost ratio is approximately 1.9 to 1. The project would reduce damages to a hurricane evacuation route. The project would also establish at least 3.15 acres of beach habitat that could provide suitable nesting habitat for threatened and endangered species such as loggerhead, green, and leatherback sea turtles and piping plover and rufa red knot shorebirds along 2.6 miles of shoreline.

5. Risk and uncertainty has been explicitly factored into the economic analysis of this project. Chapter 6 of Corps Engineering Regulation 1105-2-100, entitled "Risk-Based Analysis for Evaluation of Hydrology/Hydraulics and Economics in Shore Protection Studies" specifies the analysis requirements for shore protection projects, the fundamental requirement being that all shore protection analyses adopt a life cycle approach. A statistical risk based model, Beach-fx, was used in this study to formulate and evaluate the project in a life-cycle approach. Beach-fx integrates the engineering and economic analyses and incorporates uncertainty in both physical parameters and environmental forcing, which enables quantification of risk with respect to project evolution and economic costs and benefits of project implementation. The application of Beach-fx in this study is to estimate future without project damages and quantify the damages prevented by various storm damage reduction alternatives for Flagler County over the 50 year project life.

6. The project is intended to address erosion and prevent damages to structures and infrastructure; it is not intended to, nor will it, reduce the risk to loss of life during major storm events. Loss of life can only be prevented by residents and visitors following the local evacuation plans that are already in place. The proposed project would greatly reduce, but not completely eliminate future storm damages. Coastal storm damages are reduced by approximately 96% in the location of the recommended plan, and by approximately 65% across the entire study area. These residual risks have been communicated to the residents of Flagler County.

7. In accordance with the ER 1100-2-8162 on sea level change, the study performed a sensitivity analysis to evaluate the effects that different rates of sea level change could have on the recommended plan. The NED plan was formulated using the historical or low rate of sea level change. Beach-fx was used to model the performance of the NED plan for what the ER defines as intermediate and high rates of sea level rise. The benefits of the project increase significantly in the intermediate and high sea level rise scenarios, but the costs also increase. Thus, the project performance (in terms of the benefit-cost ratio) is relatively constant throughout the three scenarios. As both costs and benefits are increasing, the net benefits actually increase with increasing rates of sea-level rise. Overall, these results suggest that the NED plan is both effective and robust in all three simulated sea level rise scenarios. Adaptive management will be used including adjusting the timing of periodic renourishments and project volume requirements based on monitoring reports to

compensate for any significant accelerated sea level rise beyond the historical or low rate should it become necessary.

8. In accordance with the Corps Engineering Circular (EC 1165-2-214) on review of decision documents, all technical, engineering and scientific work underwent an open, dynamic and rigorous review process to ensure technical quality. This included District Quality Control review, Agency Technical Review (ATR), Major Subordinate Command (MSC) review and a Corps Headquarters (HQUSACE) policy and legal review. All concerns of the ATR have been addressed and incorporated into the final report. The requirement to perform Independent External Peer Review (IEPR) was waived by HQUSACE since there was no Environmental Impact Statement (EIS) for the study, it had negligible adverse impacts to the environment and is not controversial. All comments from the above referenced reviews have been addressed and incorporated into the final documents. Overall, the reviews resulted in improvements to the technical quality of the report.

9. Washington level review indicates that the project recommended by the reporting officers is technically sound, environmentally and socially acceptable, and economically justified. The plan complies with all essential elements of the 1983 U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Land Related Resources Implementation studies and complies with other administrative and legislative policies and guidelines. Also the views of interested parties, including federal, state and local agencies have been considered.

10. I concur in the findings, conclusions and recommendations of the reporting officers. Accordingly, I recommend that the plan to reduce hurricane and storm damages for Flagler County, Florida is authorized in accordance with the reporting officers' recommended plan at an estimated total project cost of $44,962,000, which includes the project first cost of initial construction of $14,182,000 and a total of four periodic renourishments at a total cost of $30,780,000, with such modifications as in the discretion of the Chief of Engineers may be advisable. My recommendation is subject to cost sharing, financing and other applicable requirements of federal and state laws and policies, including Section 103 of the WRDA of 1986, as amended (33 U.S.C. 2213). The non-federal sponsor would provide the non-federal cost share and all LERRD. Further, the non-federal sponsor would be responsible for all operations, maintenance, repair, rehabilitation, and replacement (OMRR&R) costs. This recommendation is subject to the non-federal sponsor agreeing to comply with all applicable federal laws and policies including that the non-federal sponsor must agree with the following requirements prior to project implementation.

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits and as further specified below:

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SUBJECT: Flagler County, Florida, Hurricane and Storm Damage Reduction Project

(1) Enter into an agreement that provides, prior to construction, 35 percent of design costs;

(2) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of any relocations determined by the federal government to be necessary for the initial construction, periodic nourishment, and operation and maintenance of the project; in particular, the federal government and the project sponsor shall coordinate with the Bureau of Ocean Energy Management for use of offshore borrow areas and provide a copy of the lease agreement to the federal government; and

(3) Provide, during construction, any additional amounts as are necessary to make their total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits.

b. For so long as the project remains authorized, operate, maintain, and repair the completed project, or functional portion of the project, at no cost to the federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable federal and state laws and regulations, and any specific directions prescribed by the federal government;

c. Give the federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the federal government shall relieve the non-federal sponsor of responsibility to meet the non-federal sponsor's obligations, or to preclude the federal government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, mitigation, operation, maintenance, repair, replacement, and rehabilitation of the project and any project related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended (42 U.S.C. 9601 9675), that may exist in, on, or under lands, easements, or rights-of-way that the federal government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the federal government determines to be subject to the navigation servitude, only the federal government shall perform such investigations unless the federal government provides the non-federal sponsor with prior specific written direction, in which case the non-federal sponsor shall perform such investigations in accordance with such written direction;

g. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the federal government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

h. Agree that the non-federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. If applicable, 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 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, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable federal and state laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; the Age Discrimination Act of 1975 (42 U.S.C. 6102); the Rehabilitation Act of 1973, as amended (29 U.S.C. 794) and Army Regulation 600 7 issued pursuant thereto; and 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (labor standards originally enacted as the Davis-Bacon Act, the Contract Work Hours and Safety Standards Act, and the Copeland Anti-Kickback Act);

k. Provide the non-federal share of that portion of the costs of data recovery activities associated with historic preservation, that are in excess of 1% of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

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SUBJECT: Flagler County, Florida, Hurricane and Storm Damage Reduction Project

l. Participate in and comply with applicable federal floodplain management and flood insurance programs;

m. Do not use federal funds to meet the non-federal sponsor's share of total project costs unless the federal granting agency verifies in writing that the expenditure of such funds is authorized;

n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the project;

o. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

q. For so long as the project remains authorized, the non-federal sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of federal participation is based;

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

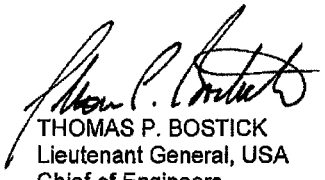
s. Comply with Section 221 of the Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the WRDA of 1986, as amended (33 U.S.C. 2213(j)), which provide that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the federal government; and

u. Comply with Section 402 of the WRDA of 1986, as amended (33 U.S.C. 701b-12), which requires the non-federal sponsor to participate in and comply with applicable federal floodplain management and flood insurance programs, prepare a floodplain management plan within one year after the date of signing the project partnership agreement (PPA), and implement the plan no later than one year after project construction is complete.

DAEN
SUBJECT: Flagler County, Florida, Hurricane and Storm Damage Reduction Project

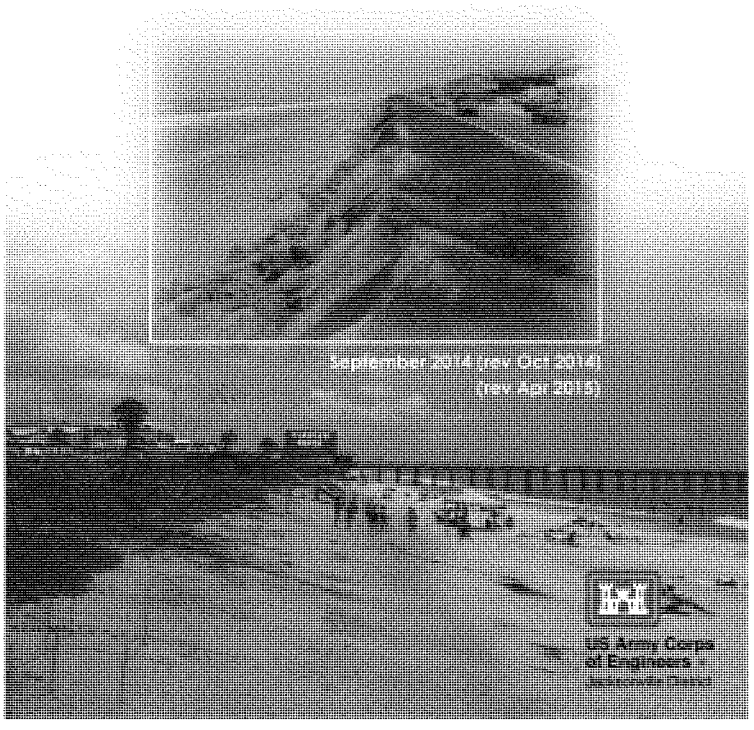
11. The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. These recommendations do not reflect program and budgeting priorities inherent in the formulation of national civil works construction program nor the perspective of higher review levels within the executive branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the non-federal sponsor, the state, interested federal agencies and other parties will be advised of any modifications and will be afforded an opportunity to comment further.



THOMAS P. BOSTICK
Lieutenant General, USA
Chief of Engineers

FLAGLER COUNTY, FLORIDA

HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FINAL INTEGRATED FEASIBILITY STUDY AND
ENVIRONMENTAL ASSESSMENT



ERRATA SHEET

Following the final State and Agency review period from September 9, 2014 through October 8, 2014, several minor revisions were made to the Flagler County, Florida, Hurricane and Storm Damage Reduction Project, Final Integrated Feasibility Study and Environmental Assessment. This errata sheet includes a list summarizing the revisions that have been made. Revised pages in the report are indicated by "(rev Oct 2014)" next to the page number.

Main Report

Page 2-35: At the bottom of this page "Currently, the NMFS has proposed designation of critical habitat for loggerhead turtles along the Florida coastline. The outcome of this designation is pending." has been replaced with "Effective as of August 11, 2014, NMFS has designated critical habitat for loggerhead turtles along several stretches of the Florida coastline."

Appendix F – Environmental

Page F-38: The labels indicating the location of the boat wreckage (outside of the project area) identified by the side scan sonar survey has been removed from Figure 3.

Page F-40: The labels indicating the location of the boat wreckage (outside of the project area) identified by the side scan sonar survey has been removed from Figure 4A.

Page F-47: The coordinates of the boat wreckage (outside of the project area) identified by the side scan sonar survey have been blacked out.

Following the signing of the Chief of Engineers Report on December 23, 2014, minor revisions were made for editorial and for report clarity purposes only. Revised pages in the report are indicated by "(rev Apr 2015)" next to the page number.

Main Report

Page 6-13: A typo in the second paragraph was corrected to clarify that the foreshore slope of the construction template is 1 on 5.

Appendix C – Economics

Page 4-49: Additional textual description added to clarify the recreational capacity and available public parking within the area of the recommended plan.

Page 4-50: Figure added to show the location and amount of public parking spaces in the vicinity of the recommended plan.

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HOW TO USE THIS DOCUMENT: The format of an Environmental Assessment (EA) has been integrated into this Feasibility Report. The basic table of contents below outlines how the EA format has been integrated into the planning process to develop a recommended plan that meets the requirements of both U.S. Army Corps of Engineers Plan Formulation Policy and the National Environmental Policy Act (NEPA). More detailed tables of contents are provided by chapter.

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EXECUTIVE SUMMARY

INTRODUCTION

Flagler County is located on the northeast coast of Florida approximately midway between the Florida/Georgia state line and Cape Canaveral. The county is bounded to the north by St. Johns County and to the south by Volusia County. Flagler County has approximately 18 miles of sandy shoreline, all of which are authorized for Federal study. See **Figure 1**.

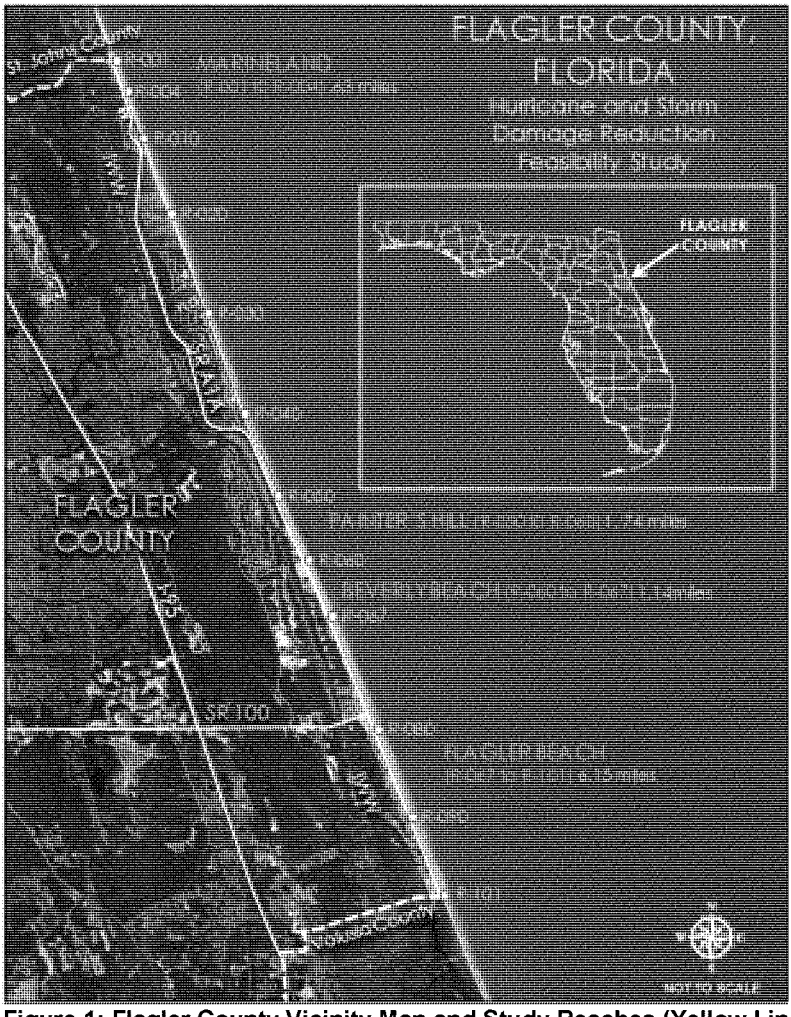


Figure 1: Flagler County Vicinity Map and Study Reaches (Yellow Lines)

The authority for conducting this Feasibility Study is contained in House Resolution 2676 adopted May 22, 2002:

> "Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, that in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing shoreline erosion protection, hurricane and storm damage reduction, and related purposes to the shores of Flagler County, Florida."

In response to this authority, the reconnaissance phase of the study was initiated upon receipt of Federal funds in 2003. The reconnaissance study for Flagler County, Florida, completed in March 2004, recommended that this study continue into the feasibility phase based on the likelihood that a Federal project may be justified and implementable given available information.

PURPOSE AND NEED

The Flagler County shoreline is subject to erosion caused by storms and natural shoreline processes. The purpose of this study is to assess the feasibility of providing Federal Hurricane and Storm Damage Reduction (HSDR) measures to portions of the Flagler County shoreline. Shoreline erosion in the Flagler County study reaches threatens oceanfront infrastructure, including National Scenic Highway, State Road (SR) A1A, and over 1,476 structures having a combined estimated structural and content value of approximately $340 million. SR A1A, the only north-south hurricane evacuation route for communities along this portion of the coastline, is an integral part of the county's infrastructure and is essential for public safety during evacuation events. Opportunities to reduce the risk of coastal damages and improve conditions were examined in this study. The local sponsor for this project, Flagler County, has indicated strong support for feasibility phase studies for HSDR purposes along their shoreline and has declared willingness and the capability to share applicable costs in the current study and the Recommended Plan.

The four study reaches shown in **Figure 1** encompass approximately 9.7 miles of coastline investigated in the Flagler County Feasibility Study. Other areas of the county did not have excessive erosion such that infrastructure was threatened, or potential benefits likely to outweigh the costs of implementing a solution.

ALTERNATIVE PLANS AND THE RECOMMENDED PLAN

This study evaluated the feasibility of providing hurricane and storm damage reduction within the Marineland, Painters Hill, Beverly Beach, and Flagler Beach reaches of the Flagler County coastline. Alternatives considered included: no action, non-structural measures (flood proofing, relocation, land acquisition, etc.), shore protection with hard structures (seawalls, revetments, groins, etc.), shore protection with soft structures (beach nourishment, geotubes, etc.), combinations of the above, and others.

After a preliminary screening of measures based on the potential for meeting the study objectives, followed by a detailed evaluation of a final array of alternatives, the project delivery team identified a Recommended Plan for reducing coastal storm and erosion damage to structures and infrastructure.

The Recommended Plan is the National Economic Development (NED) plan, consisting of a 10-foot dune and beach profile extension in Reach C, between Florida Department of Environmental Protection (FDEP) monuments R80 and R94 in central Flagler Beach. The Recommended Plan shown in **Figures 2 & 3** covers 2.6 miles of shoreline in length and mainly prevents damage to SR-A1A. **Table 1** provides a summary of the Recommended Plan cost.

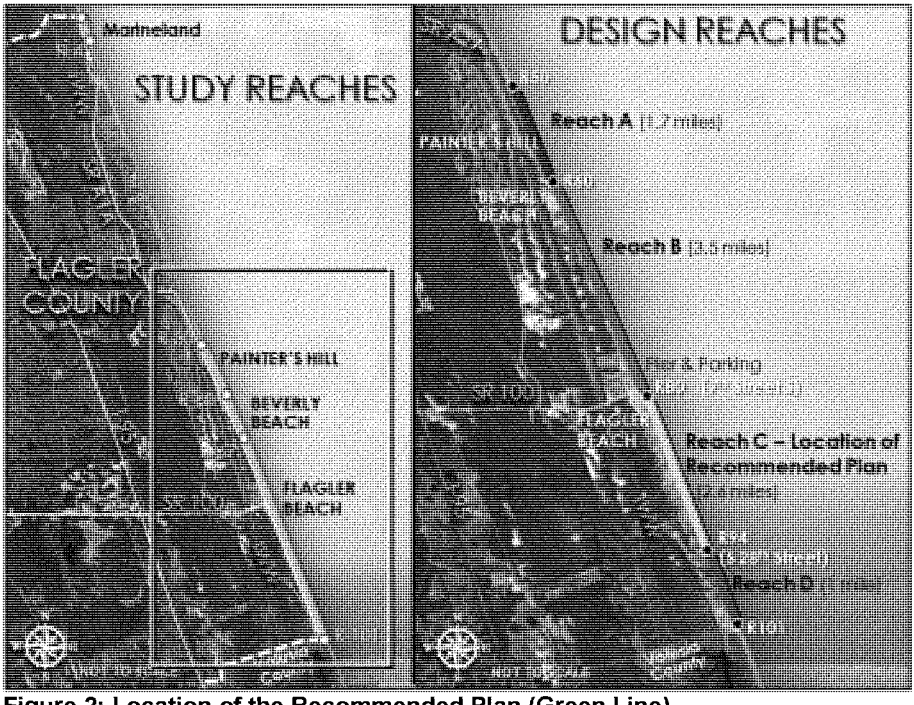


Figure 2: Location of the Recommended Plan (Green Line)

Construction of the Recommended Plan involves a sand borrow source located seven miles offshore of the project site in Federal waters. The Bureau of Ocean Energy Management (BOEM) has sole jurisdiction over the identified sand resources for this project under the Outer Continental Shelf Lands Act, and is a cooperating agency on this project. The plan will most likely be constructed with a dredge and land-based equipment typically used for beach nourishment projects. Initial construction will require approximately 415,800 cubic yards of sand from the borrow

area (330,000 cubic yards for placement), and each periodic nourishment event will require approximately 403,000 cubic yards from the borrow area (320,000 cubic yards for placement). The renourishment interval is expected to be approximately 11 years, equaling 4 renourishment events in addition to initial construction over the 50-year period of Federal participation.

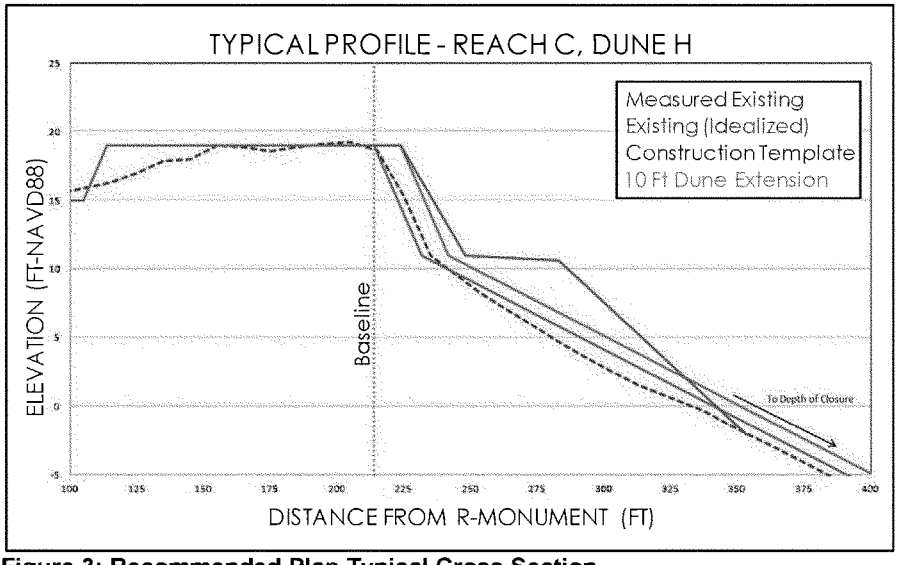


Figure 3: Recommended Plan Typical Cross Section

ENVIRONMENTAL CONSIDERATIONS

Although hardbottom exists along the coast of northern Flagler County in the form of exposed coquina outcroppings, no hardbottom exists in the planned sand placement area or offshore borrow area as verified by environmental resource surveys conducted in 2012. Based on the beach and nearshore hardbottom surveys neither direct burial of coquina outcroppings, nor indirect burial of nearshore hard bottom features through along shore and cross shore transport processes, will occur. No mitigation is required. The appropriate cultural resource studies have been conducted for feasibility stage of this project. There are no recorded cultural resources in the placement or borrow area. Existing dune vegetation will be impacted during construction; however, the Recommended Plan includes planting of dune vegetation on newly constructed areas, as well as revegetation of areas disturbed during construction.

COST ESTIMATE AND IMPLEMENTATION

Total project first costs and cost share breakdown in FY15 price levels are tabulated in **Table 1**. The Project First Costs are $44,962,000 over 50 years. Initial construction will be cost shared at 65% Federal and 35% non-federal. Periodic nourishments will be cost shared at 50% Federal and 50% non-Federal. The cost of the final periodic renourishment is slightly less than the first 3 periodic renourishments only because less post-construction monitoring is required for the final event. The Federal share of the total project cost is $24,608,300 and the non-federal share is $20,353,700.

Table 1: Cost Summary and Cost Sharing (Project First Costs)

Flagler County, Florida Hurricane and Storm Damage Reduction Project					
Summary of Project Cost Sharing (Constant Dollar Basis, FY15 (1 Oct 14) price levels)					
Initial Construction					
Cost Share Description	**Federal Cost Share %**	**Federal Cost**	**Non-Federal Cost Share %**	**Non-Federal Cost**	**Project First Cost**
Storm Damage Reduction Costs	65%	$9,218,300	35%	$4,963,700	$14,182,000
Real Estate Costs (LERRD Credit)	0%	$0	100%	$3,336,000	$3,336,000
Cash Portion		$9,218,300		$1,627,700	$10,846,000
Periodic Nourishment					
Periodic Nourishment	50%	$15,390,000	50%	$15,390,000	$30,780,000
Initial Construction + Periodic Nourishment					
Final Project Cost Share and Cost (50 years)	55%	$24,608,300	45%	$20,353,700	$44,962,000

LERRD – Lands, Easements, Rights-of-Way, Relocations, Disposal

The average annual costs and benefits, shown in **Table 2**, of the recommend plan in FY14 price levels and 3.50% discount rate are $1,239,000 and $2,362,000 respectively. The average annual net benefits for the recommended plan are $1,123,000 and benefit cost ratio (BCR) is 1.9 to 1.

Table 2: Economic Summary

Economic Summary (FY 14 Price Level, 50 -Year Period of Analysis, 3.5% Discount Rate)	
Initial Construction	$14,114,220
1st Renourishment	$7,589,733
2nd Renourishment	$7,589,733
3rd Renourishment	$7,589,733
4th Renourishment	$7,503,633
Total First Cost	$44,387,052
Interest During Construction (IDC)	$163,000
Total Investment Cost	$44,550,052
Average Annual Investment Cost	$1,229,000
Annual OMRR&R (100% Non-Federal)	$10,000
Total Average Annual Cost	**$1,239,000**
Average Annual Storm Damage Reduction	$2,159,000
Average Annual Recreation Benefits	$72,000
Average Annual Traffic Reroute Benefits	$131,000
Average Annual Total Benefits	**$2,362,000**
Average Annual Net Benefits	**$1,123,000**
Benefit Cost Ratio (3.5 % discount rate)	**1.9**

COORDINATION WITH AGENCIES AND THE PUBLIC

To ensure that the public and Federal, tribal, state, and local agencies were kept informed about progress on technical analyses and policy issues, public meetings were held throughout the study period. A scoping letter was mailed to all Federal, state, and local agencies; local libraries; and all abutting property owners on 26 August 2008. A public scoping meeting was held in Bunnell, Flagler County, Florida on 25 October 2011 in fulfillment of NEPA requirements at which a diversity of views were presented including those for and against a coastal storm damage reduction project. Notification of the Draft Integrated Feasibility Study and Environmental Assessment for public review and comment was issued on 17 January 2014. A public workshop on the Draft Integrated Feasibility Study and Environmental Assessment was held in Bunnell, Florida on 5 February 2014. Comments and questions on the Draft Integrated Feasibility Study and Environmental Assessment from resource agencies were received from 17 January 2014 through 15 March 2014. The Bureau of Ocean Energy Management (BOEM) was the only Federal agency to submit comments. Comments were received from state agencies including the Florida Fish and Wildlife Conservation Commission (FWC), the Florida Department of Environmental Protection (FDEP), and the Florida Department of Transportation (FDOT).

There is support for the project goals and objectives. There are no major controversial issues associated with this project. In addition to being economically justified based on National Economic Development (NED) benefits, the recommended plan will also yield incidental benefits under the Environmental Quality (EQ) and Other Social Effects (OSE) accounts. EQ benefits include the establishment of vegetated dune system that will promote biodiversity and establish at least 3.15 acres of suitable nesting habitat. OSE benefits include reduced damages and closures of the hurricane evacuation route which will improve the community's resilience following storms.

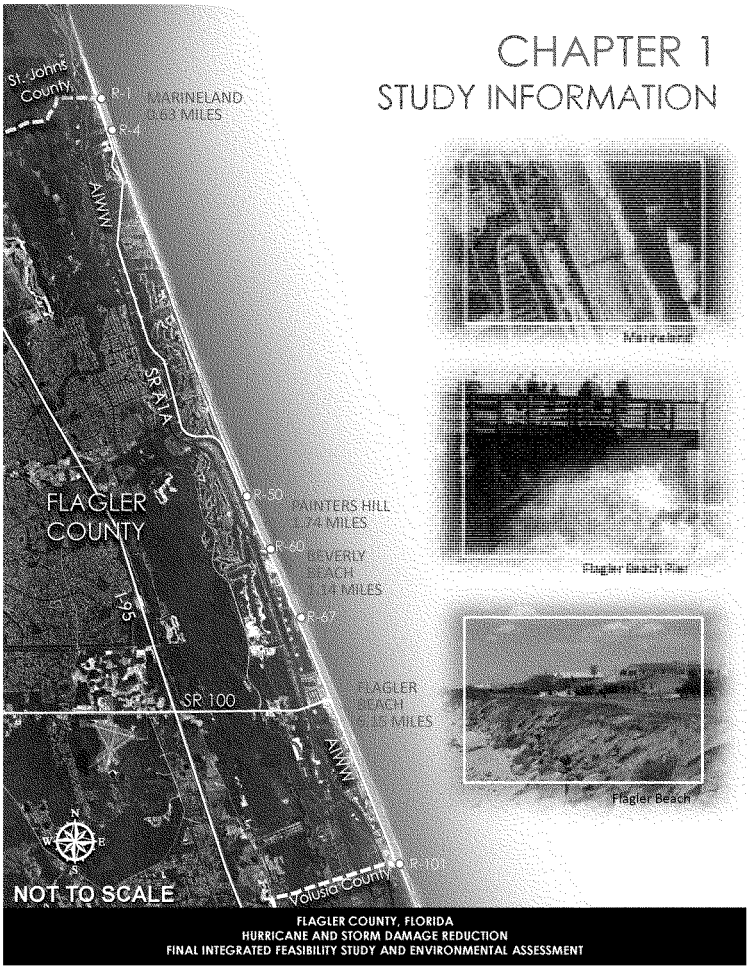
RESIDUAL RISK

The proposed project would greatly reduce, but not completely eliminate future storm damages. Coastal storm damages are reduced by approximately 96% in the location of the recommended plan (design reach C) over the 50 year period of analysis; therefore, the residual damages would be 4% in this area. Across all four design reaches evaluated (design reaches A, B, C, and D), the recommended plan reduces approximately 65% of coastal storm damages over the 50 year period of analysis; therefore the residual damages across the four design reaches is 35%. The greatest residual risk remains in design reach A, where justifiable improvements could be made if public access was made available. The majority of these damages are associated with the economic cost of older houses (built prior to 1988) constructing vinyl sheet pile walls to protect residences. The FWOP damages in design reach A do not include damages to SR A1A which is located landward of the residences in this reach. The residual risk that remains in design reaches B and D consists of minor armor costs and road damage to SR A1A which is not great enough to justify a project.

The proposed dune and beach profile extension would reduce damages but does not have a specific design level. In other words, the project is not designed to fully withstand a certain category of hurricane or a certain frequency storm event. The project is not claiming any benefits beyond 400 feet inland from the Mean High Water (MHW) line, damages to structures past this extent were not calculated. Structures would also continue to be subject to damage from hurricane winds and windblown debris. Even new construction is not immune to damage, especially from these processes. The project purpose is storm damage reduction, and the dune and profile extension is not designed to prevent loss of life. Public safety risks can be reduced by actions taken at the local, state, and Federal levels. **Table 3** describes the actions that can be taken by the entities associated with this project to improve public safety, as well as the limitations of their actions. The greatest level of public safety is achieved when action is taken at the local, state, and Federal Level to reduce public safety risks in a comprehensive manner.

Table 3: Roles for Public Safety

	Can Do	Can't Do
Flagler County	Can implement non-structural risk reduction efforts including building and zoning regulations. Can implement emergency management plans and strategies. Can sponsor and cost share in a Federal dune and beach project.	Can't afford a dune and beach nourishment project on their own.
State of Florida	Can implement non-structural risk reduction efforts including building and zoning regulations. Can implement emergency management plans and strategies Can perform maintenance of SR A1A and repair on an emergency basis by dumping rocks.	Can't construct seaward of the FDOT right of way. Can't abandon or relocate SR A1A.
US Army Corps of Engineers	Can implement a cost shared dune and beach nourishment project that reduces damages SR A1A and provides additional protection of the evacuation route beyond what the county and state are capable of providing.	Can't enforce building and zoning regulations. Can't implement local emergency management plans and strategies.


CHAPTER 1
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St. Johns County
R-1
MARINELAND
0.63 MILES
R-4
AIWW
SR A1A
FLAGLER
COUNTY
R-30
PAINTERS HILL
1.74 MILES
R-40
BEVERLY
BEACH
1.14 MILES
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HURRICANE AND STORM DAMAGE REDUCTION
FINAL INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT

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1 STUDY INFORMATION

1.1 Introduction *

Flagler County is located on the northeast coast of Florida approximately midway between the Florida/Georgia state line and Cape Canaveral to the south (refer to **Figure 1-1**). The county is bounded to the north by St. Johns County and to the south by Volusia County. Flagler County has approximately 18 miles of sandy shoreline, all of which are authorized for Federal study. The coast has no inlets or embayments and the beaches are typically fronted by steep dune faces or rock revetment. Sections of coquina rock outcroppings and nearshore hardbottom are present along the coast. The Flagler County shoreline is subject to erosion caused by both storms and natural shoreline processes. The purpose of this study is to assess the feasibility of providing Federal Hurricane and Storm Damage Reduction (HSDR) measures to portions of the Flagler County shoreline. The local sponsor for this project is Flagler County.

In 2009, the Florida Department of Environmental Protection (FDEP) had designated six coastal reaches as critically eroded. Both qualitative assessments and quantitative data and analyses are used to recommend a segment of shoreline as critically eroded. For an erosion problem area to be designated as critical, there must be a threat to, or loss of, one of four specific interests – upland development, recreation, wildlife habitat, or important cultural resources (FDEP, 2008). The reaches listed in **Table 1-1** received the critical designation as a result of erosion threatening development and State Road A1A (SR A1A). FDEP reference (R) monuments are located approximately every 1,000 feet along the shoreline and serve as geographic reference points for survey profile lines.

Table 1- 1: FDEP designated critically eroded reaches (June 2009), Flagler County

LOCATION	LOCATION (FDEP R monument)	EXTENT (miles)
Marineland	1 - 4	0.6
Painters Hill*	52.3 - 53.4	0.1
Painters Hill*	55.2 - 57	0.3
Beverly Beach	65.2 - 70	0.9
Flagler Beach	76 - 94.8	3.3
Flagler Beach*	98 -101	0.5
Total		5.7

Through coordination with the project sponsor and FDEP, the Flagler County feasibility study reaches have been developed based on these critically eroded areas, which were recommended for further investigation in the 2004 Reconnaissance Report. At the north end of the county, the Marineland study reach consists of the critically eroded area from the St. Johns County border at R-1 south

to R-4. The Painters Hill, Beverly Beach, and Flagler Beach study reaches span the southern half of the county from R-50 to R-101. The Painters Hill study reach is located in the middle of the county and extends from R-50 to R-60. Directly to the south from R-60 to R67 is the Beverly Beach study reach. The Flagler Beach study reach extends from the Beverly Beach study reach at R-67 all the way down to the Volusia County border at R-101. Study reach areas not designated as critically eroded by the FDEP were also included in the feasibility study area; though erosion in these areas is not currently causing a critical threat to public or private interests, it is possible that as erosion continues these areas will become critically threatened. From 2000 to 2009 the critically eroded areas in the southern 3 study reaches expanded from 2.9 miles to 5.1 miles. By including the entire southern half of the county, economic and real estate data will be available to determine the benefits of reducing the risk of storm damage in the critical areas along with non-critical areas that could likely become critical in the future if no action is taken. Additionally, shore protection alternatives may need to be implemented on a scale that includes the shoreline adjacent to and in between critical areas in order to be functional. The established study reaches will allow for the formulation of a plan that will best address the shoreline erosion problems in Flagler County.

The most recent update to FDEP critically eroded reaches was made in June 2012. As of this update, areas in Painter's Hill (R52.3 to 57) and Flagler Beach (R98 to 101) were no longer considered critically eroded by FDEP (see **Table 1- 2**) due to shoreline accretion (sand buildup and seaward advance of the shoreline).

Table 1-2: Changes to FDEP designated critically eroded reaches from June 2009 – June 2012, Flagler County

LOCATION	LOCATION (FDEP R monument)	EXTENT (miles)
Marineland	1 - 4	0.6
~~Painters Hill~~	~~52.3 - 53.4~~	~~0.1~~
~~Painters Hill~~	~~55.2 - 57~~	~~0.3~~
Beverly Beach	65.2 - 70	0.9
Flagler Beach	76 - 94.8	3.3
~~Flagler Beach~~	~~98 - 101~~	~~0.5~~
Total		4.8

The four study reaches listed in Table 1-3 encompass approximately 9.7 miles of coastline to be investigated in the Flagler County Feasibility Study with 4.8 miles of that shoreline currently designated as critically eroded by FDEP. **Figure 1-1** provides a plan view of the project area and study reaches.

Shoreline erosion in the Flagler County study reaches threatens oceanfront infrastructure, including National Scenic Highway SR A1A, and over 1,476 structures having a combined estimated structural and content value of approximately $340 million. SR A1A, the only north-south hurricane evacuation route for communities along the coastline, is an integral part of the county's infrastructure and is essential for public safety during evacuation events. Opportunities to reduce the risk of coastal damages and improve conditions will be examined in this study.

Table 1-3: Designated feasibility study reaches for Flagler County, Florida

NAME	LOCATION (FDEP R monument)	APPROXIMATE EXTENT (miles)
Marineland	1 - 4	0.63
Painters Hill	50-60	1.74
Beverly Beach	60-67	1.14
Flagler Beach	67-101	6.15
Total		9.66

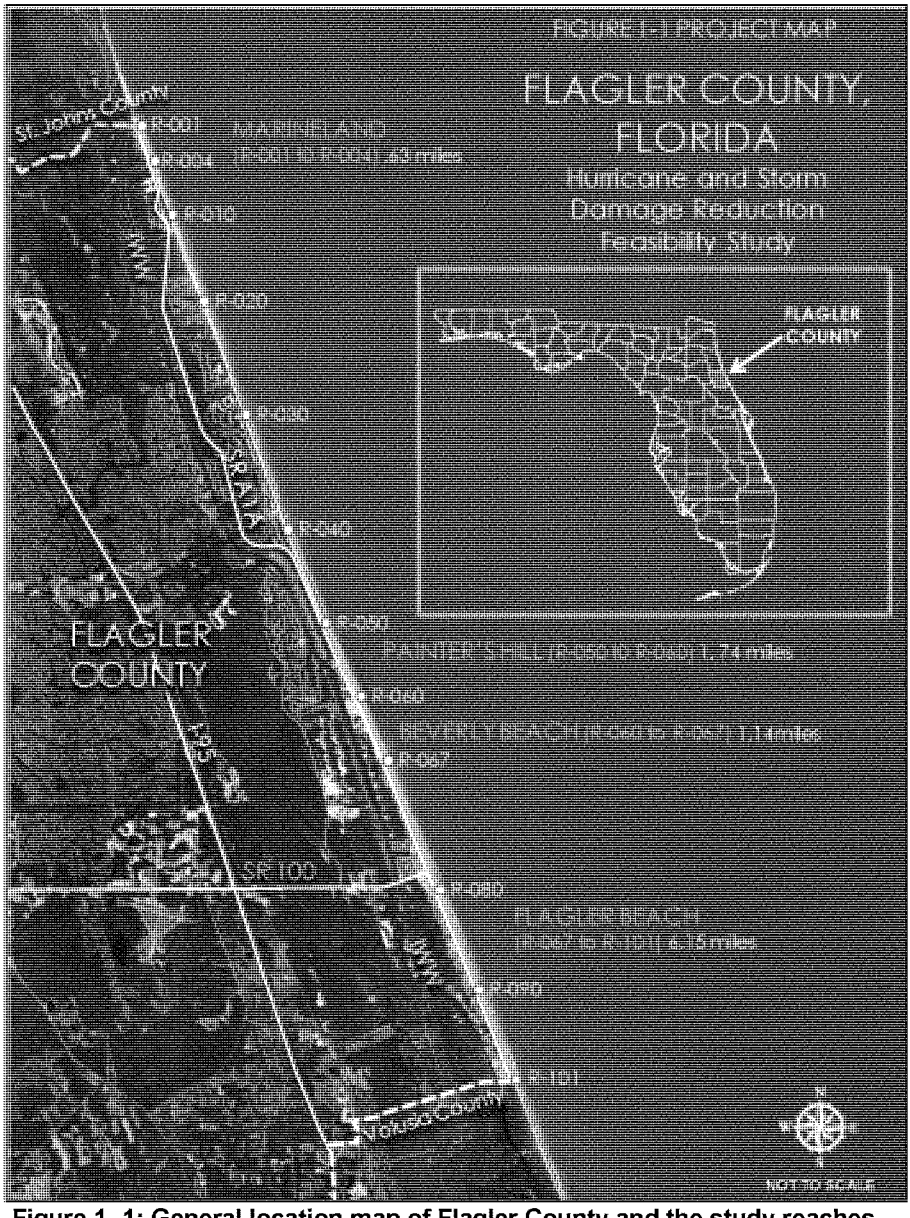


Figure 1- 1: General location map of Flagler County and the study reaches (yellow lines).

1.2 Study Authority *

The authority for conducting this Feasibility Study is contained in House Resolution 2676 adopted May 22, 2002:

> "Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, that in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing shoreline erosion protection, hurricane and storm damage reduction, and related purposes to the shores of Flagler County, Florida."

In response to this authority, the reconnaissance phase of the study was initiated upon receipt of Federal funds in 2003. The reconnaissance study for Flagler County, Florida, completed in March 2004, recommended that this study continue into the feasibility phase based on the likelihood that a Federal project may be justified and implementable given available information.

1.3 Purpose and Scope *

This study will determine the feasibility of providing hurricane and storm damage reduction within the Marineland, Painters Hill, Beverly Beach, and Flagler Beach reaches of the Flagler County coastline. Alternatives considered will include: no action, non-structural measures (flood proofing, relocation, land acquisition, etc.), shore protection with hard structures (seawalls, revetments, groins, etc.), shore protection with soft structures (beach nourishment, geotubes, etc.), combinations of the above, and others.

This report will recommend a plan that is technically sound, environmentally acceptable, and economically justified. **Appendix A**, Engineering Analysis and Design, will include suitable data to proceed into the preconstruction, engineering, and design (PED) phase of the project, contingent upon funding. Following the PED phase, construction of the recommended plan will be contingent upon congressional authorization, available Federal and non-federal sponsor funds, and will be subject to Department of the Army policy, guidance, and regulations.

1.4 Location of the Study Area *

The Flagler County study area extends from R1 to R4 in Marineland and from R50 to R101 from Painters Hill through Flagler Beach and approximately 400 feet inland from the Mean High Water (MHW) line in each of the study reaches described in **Table 1-2**. The inland extent of the Flagler County study is based on detailed engineering analysis recently completed for St. Johns County, the adjacent county to the north. The St. Johns County, Florida, General Reevaluation Report (USACE, 1998), which recommended beach nourishment along St. Augustine Beach,

determined 300 feet to be the approximate extent of shoreline recession expected from a 100-year storm. A 100-year storm is defined as storm that statistically has a 1-percent chance of occurring in any given year. The extent of shoreline recession in the current study area can be expected to be similar to that immediately to the north since geographic characteristics and wave climate closely resemble those of St. Johns County. The additional 100 feet was added to the probable 100-year storm recession to ensure adequate data collection for probable areas of impact. Figure 1-1 provides a location map of Flagler County.

The study area includes the areas investigated for potential sand sources that could be used to implement storm damage reduction measures. These include upland sand mines and offshore borrow areas. Several of the offshore borrow areas investigated are partially or fully located in Outer Continental Shelf (OCS) waters, which is under the sole jurisdiction of the Bureau of Ocean Energy Management (BOEM) under the Department of Interior.

1.5 History of the Investigation *

1.5.1 Erosion Problems

Since its earliest development in the 1920s, the Flagler County coastline has experienced sporadic accelerated beach erosion rates due to hurricanes and northeaster storms. The resultant damages to coastal infrastructure spurred local and state shore protection measures in various areas, particularly along A1A in Flagler Beach. State assistance, in response to catastrophic erosion events, has resulted in the construction of revetments, seawalls and temporary structures, structure condemnation, and various shore protection measures by private property owners. During the months of June through November, Flagler County is particularly at risk of damages from high winds and storm inundation caused by hurricanes and tropical storms. However, winter storms, or northeasters, are thought to have a greater impact on shoreline change than hurricanes in Flagler County because these winter storms occur more frequently and with longer duration of damaging waves and storm surge.

Several notable hurricanes that have affected Flagler County include: Dora (1964); David (1979); Bob (1985); Dennis, Floyd, and Irene (1999); and Frances and Jeanne (2004). During the fall of 2001 Tropical Storm Gabrielle caused significant erosion, prompting FDEP to include some areas of Flagler County, for the first time, as critically eroded beaches (FDEP, 2008). Due to its extended duration, Tropical Storm Fay caused significant erosion along the Flagler County shoreline in August 2008.

Due to their higher frequency and typically longer duration, northeasters most likely have a higher impact on Flagler County beaches than hurricanes and tropical

storms. Severe northeaster storm events impact Flagler County beaches annually. Florida experienced intense northeaster storm events during the years 1984, 1993, and 1994, all of which drastically altered beach profiles statewide. In 2007, Florida's entire Atlantic coast experienced the cumulative effects of several intense northeaster storms which intensified erosion in some areas of Flagler County, prompting FDEP to add a shoreline segment at Painters Hill to the 2008 critically eroded beaches listing. Historically, the threat of storm damage to coastal infrastructure has resulted in coastal armoring throughout several sections of Flagler County.

1.5.2 Coastal Armoring

The first coastal armoring effort in Flagler County was constructed along the shorelines of the Town of Marineland at the northern end of Flagler County. Between what are now FDEP monuments R1 and R3, a 1,350-foot long coquina rock revetment and a series of five coquina rock groins extending approximately 250 feet seaward were constructed in 1938. These structures protected the world famous Marineland Oceanarium and Aquatic Park, which was the first of its kind, and is still in operation today. In 2001, the Town of Marineland removed the original coquina revetment and replaced it with a 1,350-foot long revetment constructed of large granite stones, capped with a sheet pile anchored seawall, to protect the town and oceanarium from storm damage. Approximately 1,500 feet of additional seawall extends south of the revetment, covered by reconstructed dunes and a boardwalk. As part of the 2001 rejuvenation, a 1,000-foot long boardwalk and 1,000 linear feet of beach and dunes were constructed above a portion of the seawall cap. Additional public access was also constructed at the southern end of the revetted area.

Another major coastal armoring in Flagler County exists along SR A1A in Flagler Beach. SR A1A has historically experienced, and continues to experience, severe erosion from natural causes. Initial hardening actions along SR A1A, which included sand and coquina rock placement, were constructed as a result of Hurricane Dora impacts in 1964. A revetment permit was issued in 1981 for the placement of additional segments of sand and coquina rock revetment in areas north and south of the Flagler pier. In 1999, granite rock was placed between South 7th Street and South 23rd Street. The revetment in Flagler Beach has been repaired and restored many times since its initial construction. In 2007 alone, the Florida Department of Transportation (FDOT) performed 15 emergency or temporary repairs to the Flagler Beach segment of SR A1A (USFWS, 2009) at a cost of $847,000. Between 2000 and 2007, FDOT maintenance costs for SR A1A in Flagler Beach averaged $1.25 million per year (FDOT, 2010). Currently, the granite revetment protecting SR A1A in Flagler Beach extends from FDEP range monument R80 to R90 with aging and dilapidated segments of coquina rock protection extending north to approximately R76 and south of R90 approximately 150 feet.

1.6 Prior Reports and Existing Projects *

Several previous investigations and reports have been completed for the area by both Federal and non-federal parties. The most recent studies pertinent to Flagler County's coastal erosion are summarized in the following subsections.

1.6.1 Prior Federal Studies

Summaries of prior Federal studies relevant to this project are as follows:

Flagler County, Florida. Beach Erosion Control and Hurricane Protection Reconnaissance Report, U.S. Army Corps of Engineers, Jacksonville District, August 1980. The report emphasizes continuous erosion and substantial expenditures by both private citizens and local governments for restoration of private and public lands following erosion and storm damage. Economic justification considered future development of the county and a plan of study for developing non-structural alternatives for erosion control and storm protection was recommended. Further Federal study was never approved.

Section 14 Study, Flagler Beach, Flagler County, Florida, U.S. Army Corps of Engineers, Jacksonville District, November 1982. Section 14 is a continuing authority for emergency streambank and shore protection. In response to a request for emergency Federal assistance from Flagler County, a Section 14 Study was undertaken to investigate the feasibility of building a stone revetment along state road A1A in Flagler Beach to protect a 2,200 foot long section of the road from being undermined by storm induced erosion. Based on lack of financial support from the non-federal sponsor, no Federal project was adopted.

Flagler County, Florida Shore Protection Study Reconnaissance Report, U.S. Army Corps of Engineers, Jacksonville District, May, 1988. This report investigates the practicality of initiating a Federal feasibility study on shoreline protection for Flagler County, Florida. The report looks at the County's entire 18 miles of shoreline, but focuses on the Flagler Beach area. The report concluded that there was no Federal interest in further study for those beaches at that time. The report, which compares the average annual costs and benefits of a storm damage reduction project, found that such a project at the time was not economically justified.

Reconnaissance Report, Section 905(b) Analysis, Flagler County, Florida, Shore Protection, U.S. Army Corps of Engineers, Jacksonville District March, 2004. This report represents the most recent effort to assess the needs for hurricane and storm damage protection along the coastline of Flagler County. Following the previous reconnaissance report in 1988, as erosion along the shoreline continued, the population in Flagler County greatly increased as well as the amount of development along the coast. The study concluded that there is strong Federal interest in

initiating a feasibility phase study based on the likelihood that a Federal project may be justified and implementable.
Project Inspection Report: Flagler County, Florida Federal Shore Protection Project, U.S. Army Corps of Engineers, Jacksonville District, August 23, 2008. The brief Project Inspection Report summarizes the general conditions of the beaches along the Marineland, Painters Hill, Beverly Beach, and Flagler Beach study reaches. This inspection report documented beach erosion along the Flagler County shoreline which was caused by Tropical Storm Fay. Tropical Storm Fay affected Florida's mid and north Atlantic coasts from August 20-22, 2008.

Biological Opinion, United States Fish and Wildlife Service, July 2009. The document provides the USFWS biological opinion of SR A1A Shoreline Stabilization measures proposed by FDOT for Flagler Beach. The report identifies 11 areas along the roadway where erosion problems are recurring or have recently become problematic. Also, an extensive summary of the effects of the proposed shoreline stabilization project on endangered sea turtles that exist in the study area is provided. The report concludes that the erosion control systems proposed for use to stabilize SR A1A are not likely to jeopardize the continued existence of the loggerhead, green, or leatherback sea turtles.

1.6.2 Prior Non-federal Studies

Summaries of prior non-federal studies relevant to the project are as follows:

Shoreline Change Rate Estimates, Flagler County, Florida Department of Environmental Protection (FDEP), July, 1999. The report prepared by FDEP provides shoreline change rate estimates to assist in regulatory programs and beach management planning efforts. The report estimated a shoreline change rate of approximately -1 foot per year for the county.

Strategic Beach Management Plan for Northeast Atlantic Coast Region, Florida Department of Environmental Protection, October, 2001. The report presents data, analysis, and recommendations for managing the northeast Florida coastline, specifically the Sea Islands, and the beaches and inlets of St. Johns, Flagler, and Volusia counties. Special attention is placed on determining strategies for inlets and critically eroded beaches.

Revetment at Marineland, In 2001 the Town of Marineland completed rejuvenation of a seawall and revetment to protect the town and oceanarium from storm damage. The seawall and revetment were a cooperative effort between the Town of Marineland, Federal Emergency Management Agency (FEMA), and the Florida Division of Emergency Management for restoration of damage from Hurricanes Floyd and Irene and mitigation against future storm damage. In addition, the project protects a public park, the River to the Sea Preserve (which includes beach access and parking), and reestablished the beach and dune.

State Road A1A Shore Protection Evaluation Flagler Beach, Flagler County, Florida, Taylor Engineering, Inc., June 2002. The purpose of this study was to determine the most technically feasible and financially acceptable alternatives for protecting "critically eroding" shoreline from R-78 to R-92 in Flagler Beach, which is bordered by the National Scenic Highway, SR A1A. The report concludes with a two-part recommendation for a seawall and/or some form of beach nourishment plan in order to protect Highway A1A. The study was funded in part by the Florida Department of Transportation and Flagler County.

State Road A1A Shoreline Stabilization Project, Flagler Beach, Florida, Florida Department of Transportation (FDOT) – District 5, April 2006. The report was completed as a technical memorandum in support of FDOT's continuous efforts to protect SR A1A from being undermined by erosion. The report provides a review of current and historical conditions, a coastal engineering literature review pertinent to seawall impacts, comments on alternative erosion protection measures for SR A1A, and a discussion of potential environmental and shoreline impacts and optional mitigation measures for several shoreline protection alternatives.

Flagler County, State Road A1A PD&E Study, FDOT, January 2010. The Project Development and Environmental (PD&E) Study covers an approximately 5-mile stretch of SR A1A through Flagler and Beverly Beach. The study includes considerations for the possible construction of segments of seawall, revetment, or dune nourishment and impacts, costs, etc. of those options. FDOT does not currently have any dune stabilization plans for SR A1A in their 5-year work program. The main purpose of this PD&E Study was to comply with the National Environmental Policy Act (NEPA) so that work can be done in the future with Federal funds, and to inform the local officials and citizens of Flagler Beach of the various options available to FDOT regarding shoreline protection.

Critically Eroded Beaches in Florida, Florida Department of Environmental Protection June, 2008. This report was prepared by FDEP to provide an inventory of Florida's critically and non-critically eroded shoreline areas. The report designates six critically eroded beach segments (5.7 miles) in Flagler County.

City of Flagler Beach, Coastal Avulsion Mitigation and Resurection [sic] Analysis, Holmberg, 2013. This analysis was prepared by Mr. Holmberg, president of Holmberg Technologies, Inc. for the City of Flagler Beach. The analysis includes Mr. Holmberg's evaluation of erosion issues in the study area and recommends installation of the "Holmberg System" (undercurrent stabilizers).

1.6.3 Adjacent Projects

Florida Intracoastal Waterway, The Florida Intracoastal Waterway (IWW) is part of the intracoastal waterway system that provides an inland navigation channel from New York to Miami. By 1965 the United States had completed the project from Jacksonville to Fort Pierce, Florida, to the authorized depth of 12 feet and the project

width of 125 feet. The IWW in Flagler County extends from River Mile 55.71 through 73.85. The Florida Inland Navigation District (FIND) provides the items of local cooperation for the waterway and performs maintenance in the absence of Federal funding. The principal items of local cooperation are lands, easements, rights-of-way, and dredged material disposal areas. No dredged material disposal areas exist in Flagler County.

The Intracoastal Waterway near Matanzas Inlet, The section of the Intracoastal Waterway, to the north of Flagler County, is subject to shoaling and must regularly be dredged to maintain inland navigation. Maintenance dredging of the IWW channel in the vicinity of Matanzas Inlet removes between 150,000 and 200,000 cubic yards per year of dredged material (personal communication FIND, 2003). The material is pumped into dredged material management site MSA SJ-1 until its 800,000 cubic yard capacity is reached. In 1999 approximately 765,000 cubic yards were pumped from MSA SJ-1 and the IWW onto the beach at Summer Haven, directly adjacent to the northern border of Flagler County. This fine grained sand placed at Summer Haven beach, approximately 2.5 miles north of Marineland, tends to migrate rapidly after placement (FDEP, 2000), possibly reaching the beaches of the Marineland study reach. Table 1- 4 summarizes the IWW maintenance dredging beach placement activities in St. Johns County from 1992 to present.

Table 1- 4: Intracoastal Waterway Maintenance Dredging Beach Placement in St. Johns County 1992-present

Location	Year	Placement Area	Volume (cy)
Summer Haven Beach	1992	R 200-203	191,502
Summer Haven Beach	1999	R 200-208	222,000
Summer Haven Beach	2004	R200-208	214,475
Summer Haven Beach	2007	R200-208	187,862

St. Johns County, Florida Shore Protection Project, The General Reevaluation Report with Final Environmental Assessment for the St. Johns County, Florida Shore Protection Project, March 1998, serves as a post-authorization change report authorizing the HSDR project at St. Augustine Beach, approximately 10 miles north of the northern Flagler County border. The project includes the construction of a 60-foot berm along St. Augustine Beach from FDEP monuments R137 to R150, approximately 2.5 miles. Initial construction of the project in 2003 required placement of approximately 2,100,000 cubic yards of design fill and 1,600,000 cubic yards of advance material. Subsequent renourishments have taken place in 2005 and 2012.

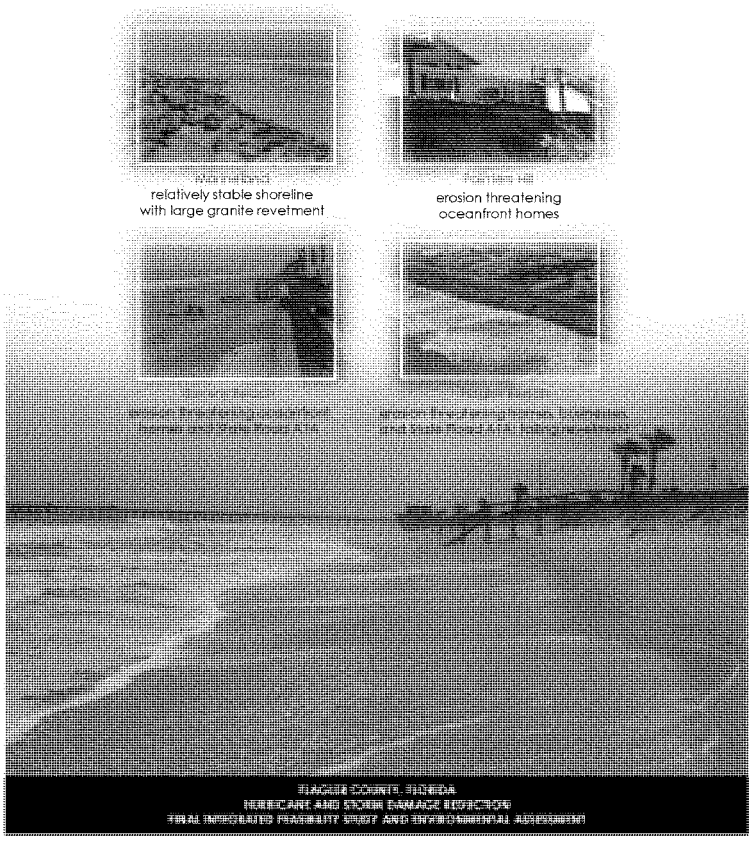
1.7 Planning Process and Report Organization

Plan formulation detailed in this report follows an iterative planning process. The planning process consists of six major steps: (1) specification of problems and opportunities; (2) inventory, forecast and analysis of existing conditions within the study area; (3) formulation of alternative plans; (4) evaluation of the effects of the alternative plans; (5) comparison of the alternative plans; and (6) selection of the recommended plan based upon the comparison of the alternative plans. Being iterative, steps can be repeated as problems become better understood and new information becomes available.

Organization of this report generally follows Exhibit G-7 (Feasibility Report Content) provided in Appendix G of ER 1105-2-100 (30 June 2004). Planning step 2 is covered in chapters 1-3 which lay out the study background and existing conditions of the specific study area as well as future conditions without Federal participation. This gives the reader the background necessary to more fully understand the problems and opportunities (step 1). The problems and opportunities are detailed in chapter 4. The formulation, evaluation, and comparison of alternative plans covered in steps 4 and 5 will be discussed in chapter 5. The recommended plan selected in step 6 will be detailed in chapter 6.

This report documents the Flagler County, HSDR Feasibility study process, which includes the Marineland, Painters Hill, Beverly Beach, and Flagler Beach reaches from study initiation through formulation, alternative evaluation, and plan recommendation. It also serves as the environmental document for compliance with NEPA. The U.S. Army Corps of Engineers (USACE) planning process ensures adherence to applicable state and Federal laws, regulations and policy. The chapter headings and order in this report generally follow the outline of an Environmental Assessment (EA), thereby integrating the EA into the Feasibility Study report.

CHAPTER 2
EXISTING CONDITIONS



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2 EXISTING CONDITIONS

2.1 General *

This chapter describes conditions as they currently exist within the Marineland, Painters Hill, Beverly Beach, and Flagler Beach study reaches. Information gathered in this step helps to describe the existing problems and opportunities and forecast future conditions. The following paragraphs summarize research into studies and data collection efforts conducted for this project.

2.2 Physical Conditions *

The Flagler County study area encompasses approximately 18 miles of sandy shoreline, located on a coastal barrier island that varies in width from approximately 800 to 5,000 feet. Refer to **Figure 2-1**. The Flagler County coastline is devoid of inlets or embayments and is part of a barrier island and mainland complex that extends uninterrupted for a length of 50 miles from Matanzas Inlet in the north to Ponce de Leon Inlet in the south. It is the longest barrier island in Florida (Bush et al, 2004). The Matanzas Inlet is located approximately 2.4 miles north of Flagler County in St. Johns County, and the Ponce de Leon Inlet is located about 27 miles south of Flagler County in Volusia County. Flagler County's coastal area is bound by the Matanzas River to the north, Smith Creek and the Intracoastal Waterway (IWW) to the west, and Volusia County beaches to the south.

Flagler County beaches are typically fronted by a line of dunes which range in height from 10 to 23 feet Mean Sea Level (MSL). The dunes are characterized by relatively steep faces composed primarily of coquina shell hash and fine quartz sand. Periodic natural coquina rock outcroppings are present, especially along the northern beaches in the Marineland reach. The coquina rock is exposed in the supratidal area and in the intertidal zone at low tide along sections of the northern beaches between Florida Department of Environmental Protection (FDEP) Monuments R3 and R16. Another section of exposed outcrop is located between R-20 and R- 43. Other sections of rock are suspected to exist in the subtidal zone along the shoreline but are likely covered with sand (DEP, 1999). The rock is semi-erodible providing a source of beach shell hash that is present along the Flagler County shoreline.

While Flagler County has significantly armored sections of its shoreline to provide some level of erosion and storm damage protection to threatened areas, the county remains one of the least armored shores along Florida's east coast (Bush et al, 2004). U.S. Army Corps of Engineers (USACE) shoreline surveys in February 2009 revealed prominent sections of shoreline armor in Flagler County. **Table 2- 1** summarizes the findings of the shoreline armor survey. **Figure 2- 1** displays several of these areas.

Table 2- 1: Summary of shoreline armoring in Flagler County, Florida

Reach	R-Monument	Length (ft)	Description
Marineland	R1 – R2	1350	Granite revetment at Marineland.
Marineland	R1 – R3	na	Five partially removed coquina groins.
Marineland	R2 – R3	1500	Steel seawall currently covered by dune and boardwalk.
Varn Park	R49.3 – R49.5	260	10' tall stand-alone seawall with no structures behind the wall.
Beverly Beach	R60.5 – R62.4	1560	Concrete seawall at Camptown RV park, starting at Windward Drive, continuing south.
Flagler Beach	R78.6 – R79.4	565	South 2nd Street to South 4th Street. Small section of aging seawall at the Flagler Pier.
Flagler Beach	R80 – R90	9240 (1.75 miles)	Flagler Beach Revetment constructed in sections of coquina and granite. Mostly failing.
Flagler Beach	R82	153	Concrete capped steel sheet pile seawall at South 13th Street.
Flagler Beach	R94.6 – R94.8	152	Small concrete seawall fronting a restaurant and a dilapidated wooden seawall fronting the residence to the north.

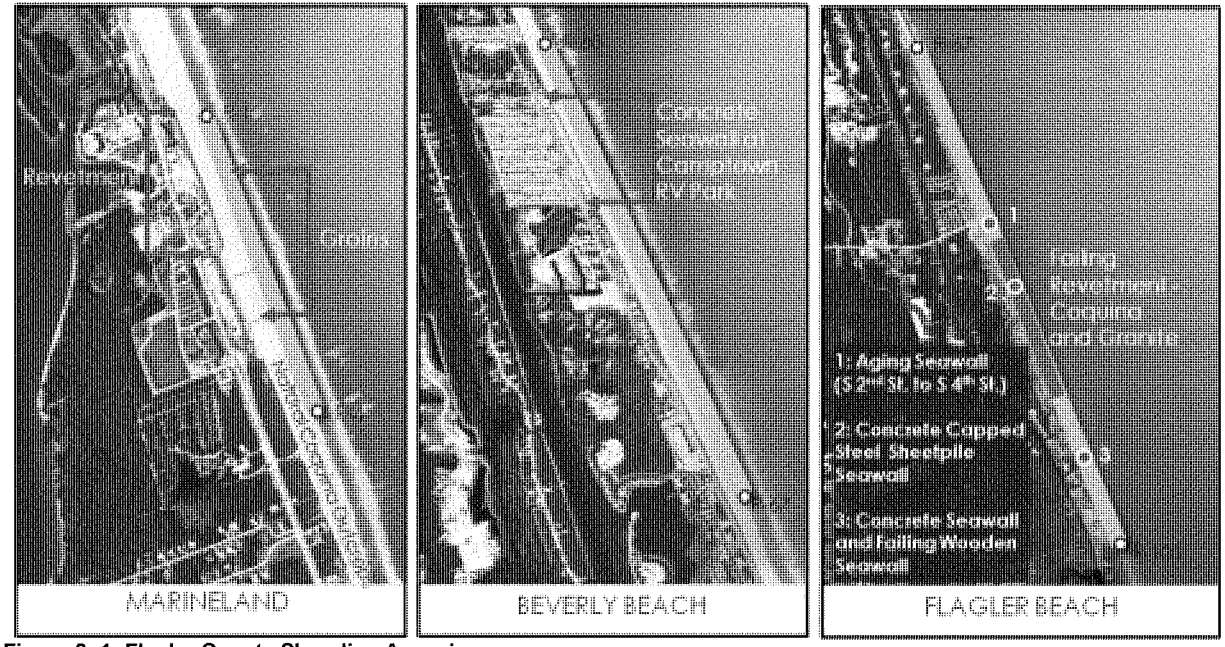


Figure 2- 1: Flagler County Shoreline Armoring

As shown in **Figure 2- 1**, the most significant sections of shoreline armor exist in the Marineland and Flagler Beach study reaches. At Marineland, a 1,350-foot long section of granite revetment protects the aquatic park between FDEP monuments R-1 and R-3. In Flagler Beach, an approximately 1.75 mile long rock revetment, built by the Florida Department of Transportation (FDOT), is meant to protect State Road A1A (SR A1A). The revetment along Flagler Beach has been constructed in sections beginning in 1984 following a season of severe northeaster storms. The revetment was improved and extended in 1999 following Hurricane Floyd and again in the spring of 2002. Currently, most of this revetment is in very poor condition and not functioning to its specifications. FDOT completed a Project Development and Environmental (PD&E) study in January 2010 to assess the feasibility of providing shoreline protection along Flagler Beach to protect SR A1A. The PD&E recommends that efforts to protect a 5.2-mile stretch (R-64 to R-94) of SR A1A in Flagler Beach be constructed on an as needed emergency basis. Construction would consist of using sand, rock, or seawall, within the FDOT right of way, to protect the road depending on available funding and the severity of road conditions. FDOT efforts to protect SR A1A are limited by available funding and limited to methods that can be constructed and maintained within FDOT's jurisdictional right-of-way which extends only 50 feet from the centerline of the roadway. The U.S. Fish and Wildlife Service (FWS) issued a Biological Opinion (BO) to FDOT to implement the above construction methods within the FDOT right of way. These limitations, along with continued dune erosion, make the roadway difficult to protect. **Appendix C** describes specifications of existing armor.

2.2.1 Study Reaches

The approximately 9.6-mile long study area is separated for analysis into 4 study reaches based on the areas' status as critically eroded by the FDEP (2008). The extent of each of the 3 southern reaches has been expanded beyond the FDEP designated areas in order to incorporate data collection and study of the relatively small areas of shoreline between the FDEP designated sections. Analysis of the entire southern half of the county, to include the small areas between the FDEP designated sections, will account for potential future expansion of the critically eroded areas.

The Marineland reach is located at the northernmost extent of Flagler County, between FDEP R monuments R-1 and R-4. The area between R-4 and R-50, locally referred to as "The Hammocks," is not included in this study. This area is not significantly threatened by shoreline erosion because most of the coastal structures are set back considerably from the shoreline and are protected by an undisturbed and well vegetated dune system. Along the southern half of the county between FDEP R monuments R-50 and R-101 are the Painters Hill, Beverly Beach, and Flagler Beach study reaches of this study. This feasibility study concentrates on 9.6 of the approximately 18 total miles of Flagler County coastline.

Marineland

The Marineland reach extends south from Summer Haven in St. Johns County through the northern 0.63 miles of Flagler County. The Marineland Oceanarium is protected by a 1,350-foot granite revetment (**Figure 2-2**), and the remnants of 5 small coquina groins located south of the revetment. Shoreline change rate estimates (FDEP, 1999) indicate that this reach has remained relatively stable since at least 1952, likely due to the presence and functioning of the revetment and groins.



Figure 2-2: The 1,350-foot long granite revetment and one partially buried coquina groin in the Marineland study reach. Three more coquina groins exist to the south of the revetment.

The Hammocks (provided for informational purposes, not a study reach)

The Hammocks and area to the south (**Figure 2-3**) extends from R-4 through R-50, with none of the shoreline in this reach designated as critically eroded by FDEP. There are no reports of significant damages caused by erosion in this area in recent history. In this area, SR A1A is located further inland in comparison to the rest of the county where the road runs directly along the coast. The shorefront in this area consists of Washington Oaks Gardens State Park, single family residences, Hammock Park, condominiums, resorts, golf courses, Varn Park, and undeveloped parcels. The shorefront structures are buffered by a dune system that is wider than in other areas of Flagler County. Coquina rock outcroppings, an important natural resource located on the beach in this area also provides a natural defense against erosion. Coquina rock outcroppings are described in more detail in **Section 2.4.4**. Many of the structures in this area are relatively newer than the rest of the coastal development in the county, and have been built landward of the Coastal Construction Control Line (CCCL) for Flagler County (established in 1988 by FDEP to protect beaches and dunes from imprudent construction).

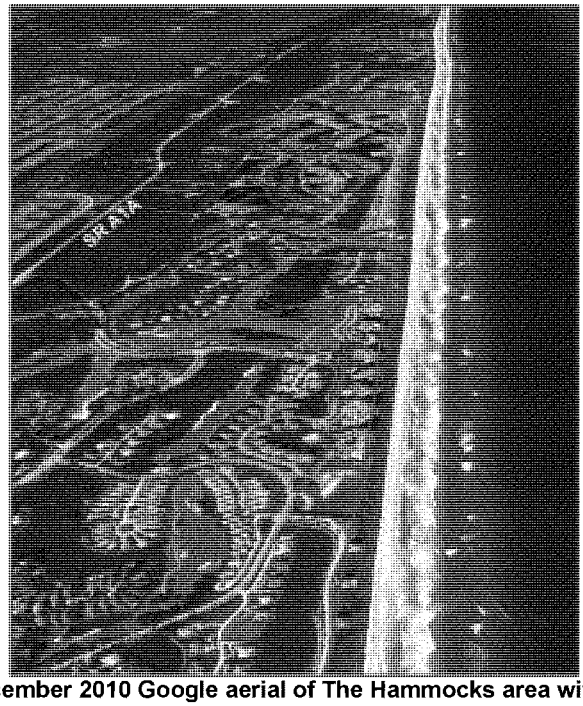


Figure 2-3: December 2010 Google aerial of The Hammocks area with the Coastal Construction Control Line (CCCL) overlaid in red showing the set back of newer development.

Painters Hill

The Painters Hill study reach (**Figure 2-4**) extends from R-50 through R-60. A single row of homes sits atop the dune east of SR A1A through much of Painters Hill. Continuous erosion in this vicinity has caused the dune adjacent to these homes to become degraded or nonexistent. Undeveloped lots east of SR A1A consist of a vegetated dune with a steep face. In December 2007, surf swells generated by Tropical Storm Olga in combination with high astronomical tides and a full moon, eroded away a patio, a hot tub, and a septic tank and put at least three homes in imminent danger of being undermined and destroyed. The beach erosion which threatened several of the homes in the Painters Hill community during this 2007 event resulted in Flagler County declaring a State of Local Emergency. Following this event, up to 25 homeowners attempted to obtain permits from the Flagler County Building Department and FDEP to construct temporary protective measures for their oceanfront homes.

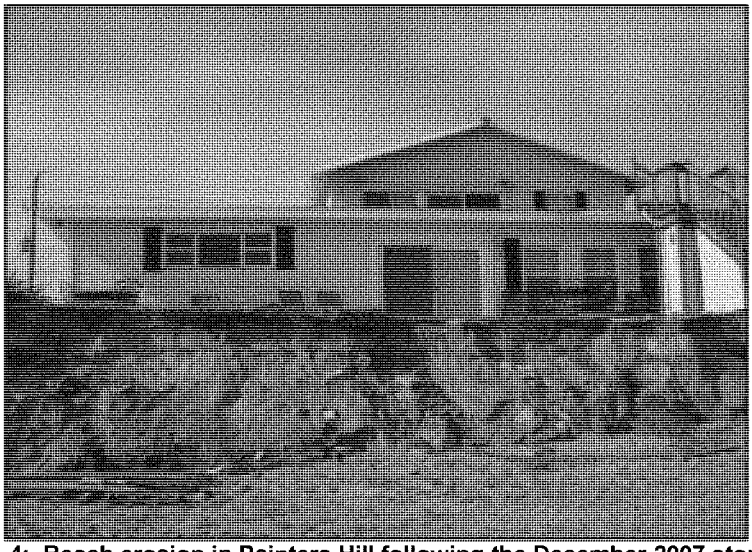


Figure 2-4: Beach erosion in Painters Hill following the December 2007 storm event.

Beverly Beach

The Beverly Beach study reach (**Figure 2-5**) extends from R-60 through R-66, with the area from R-65.2 to R-70.0 designated as critically eroded by FDEP (2008). Like Painters Hill, a single row of homes sits atop the dune east of SR A1A through much of Beverly Beach. Continuous erosion in the vicinity of these homes has caused the dune adjacent to these homes to become degraded or lost. Undeveloped lots east of SR A1A consist of a vegetated dune with a steep face. A 1,560-foot long concrete seawall fronts

the Camptown RV Park from R-61 to R-62 where the dune is nonexistent. In the southern portion of the Beverly Beach reach, between R-65.2 through R-70, SR A1A lies within 50 to 100 feet of the mean high water line, putting the road in danger of being undermined by a severe erosion event and prompting the FDEP to designate this section as critically eroded in 2008. Loss of a section of A1A in Beverly Beach would affect local residents' only hurricane evacuation route.

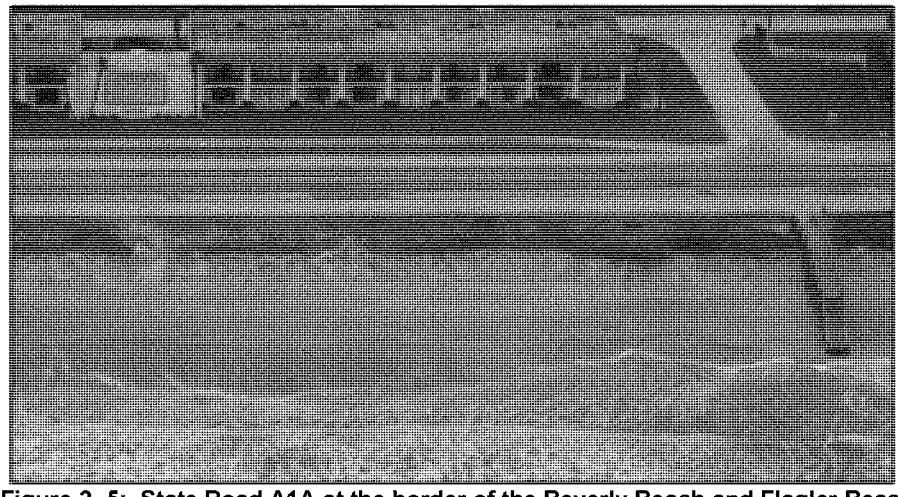


Figure 2- 5: State Road A1A at the border of the Beverly Beach and Flagler Beach reaches immediately after Tropical Storm Fay in August 2008. Sand has been washed over the dune and deposited on the road.

Flagler Beach

The largest reach in the study area is Flagler Beach which stretches 6.15 miles from R-67 to R-101. A portion of the reach from R-76.0 through R-94.8 is designated as critically eroded by FDEP (2012). In Flagler Beach, large portions of SR A1A are in imminent danger of being destroyed and many sections are damaged annually by the eroding shoreline (**Figure 2-6**). The development in Flagler Beach east of SR A1A consists of dune walkovers throughout the reach, the Flagler Beach Pier, and a parking lot at the southern end of the reach. There is a water main, wastewater line, electric, and fiber optic lines along the landward side of the SR A1A right of way. Since 1984, measures have been taken by Flagler County and the FDOT to protect SR A1A, including construction of a rock revetment (reconstructed and repaired several times since its initial construction due to storm damage) and a 153-foot long concrete seawall (**Figure 2-7**). During a post-storm inspection in 2009, sections of SR A1A in southern Flagler Beach were documented as within 75 feet of the water line during low tide (USACE, 2009), **Figure 2-8**. Erosion in this reach also poses a threat to commercial

and residential structures including homes, a pier, restaurants and shops. The dune is mostly degraded or nonexistent throughout most of Flagler Beach.



Figure 2-6: Looking west along SR A1A near R-68 on 23 August 2008, after Tropical Storm Fay. The rocks on the right side of the image were placed by FDOT as an emergency measure to protect SR A1A from being undermined by waves. Also, the sand on the road is a result of a complete wash over during the storm.

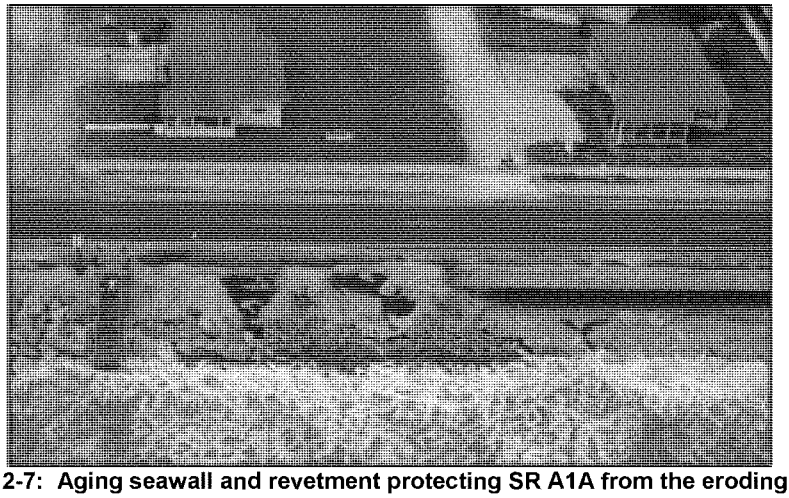


Figure 2-7: Aging seawall and revetment protecting SR A1A from the eroding shoreline in Flagler Beach.



Figure 2-8: Looking south from 19th Street South in Flagler Beach on 24 May 2009. This image was taken during low tide and the distance between A1A and the waterline was measured as approximately 75 feet. Notice the failing revetment and visible geotextile fabric which is meant to line the underside of the revetment.

2.2.2 Hurricane Evacuation Routes and Zones

Hurricane evacuation zones in Florida are defined by the county emergency management agencies, based on the expected inundation areas and definable boundaries. The entire study area is located in an "A" evacuation zone, meaning that this area would potentially be inundated by storm surge associated with a Category 1 Hurricane. Zone A in Flagler County had a 2010 population-at-risk of 14,258 persons. SR A1A is the only north-south evacuation route for the area. The evacuation zones and routes for coastal Flagler County are shown in **Figure 2-9** (FDEM 2010). The most recent evacuation events have taken place in 1985, 1998,and 2004.

Throughout most of the study area, SR A1A is located on the highest elevation on the barrier island. Other roads that exist at lower elevations are more vulnerable to inundation, and during a flood event these other roads will be flooded before SR A1A. **Figure 2-10** shows a typical cross section of the barrier island with SR A1A located at the highest elevation. SR A1A also serves as an important route for emergency vehicles and recovery efforts following natural disasters.

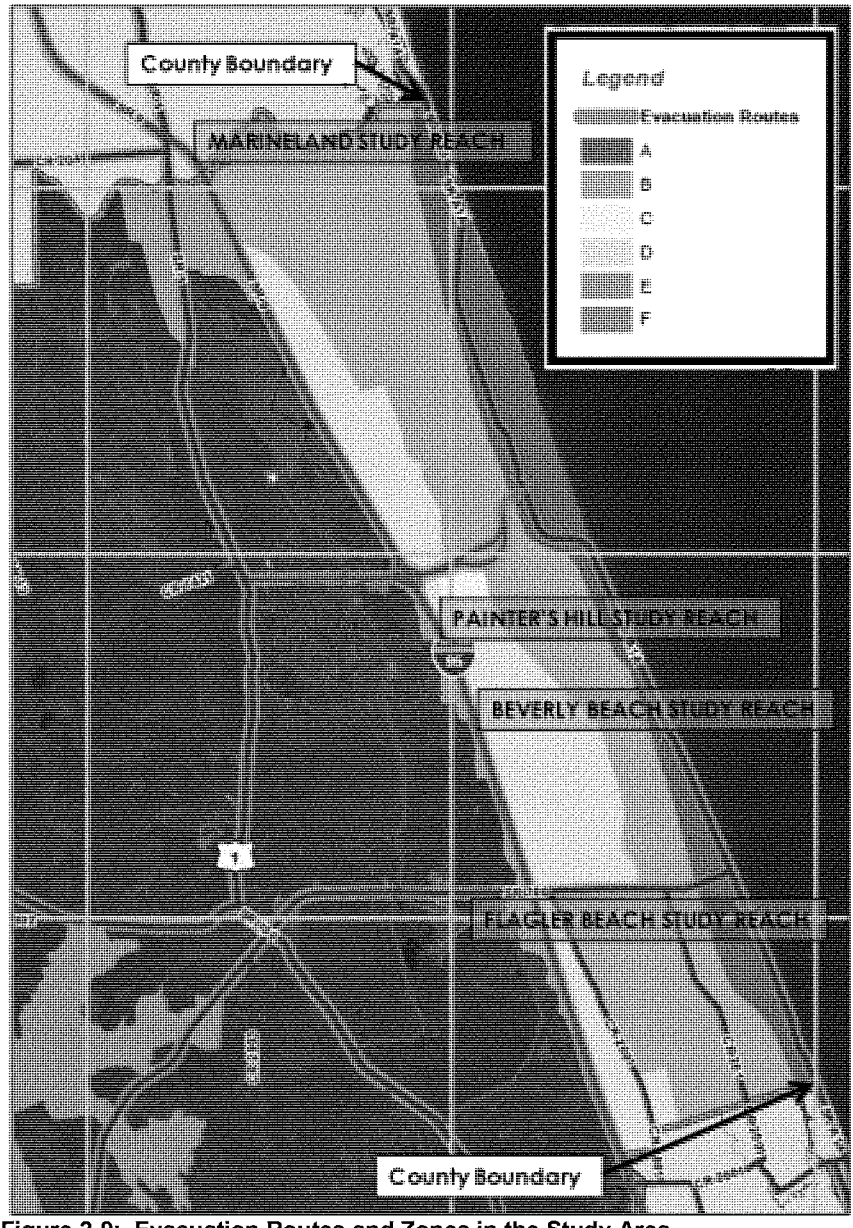


Figure 2-9: Evacuation Routes and Zones in the Study Area.

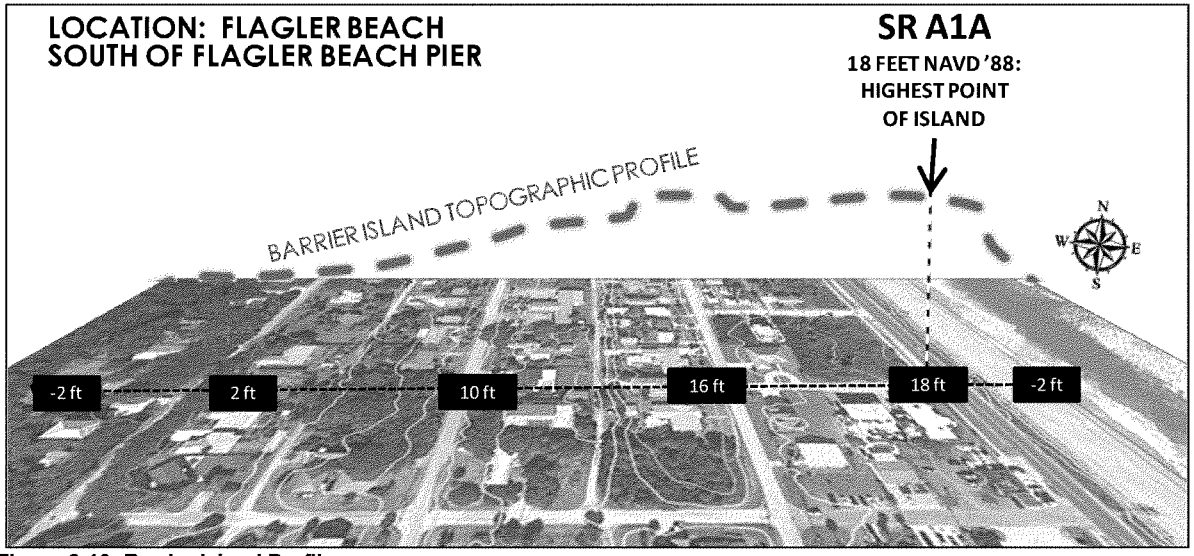


Figure 2-10: Barrier Island Profile.

2.2.3 Undeveloped Parcels (Lots)

Based on 2008 aerials the southern 685 feet of the Marineland study reach is undeveloped constituting approximately 25% of the reach. There are 33 undeveloped parcels in the Painters Hill and Beverly Beach study reaches comprising approximately 4,070 linear feet of shoreline (**Figure 2-11**), and about 27% of these two study reaches. The Flagler Beach study reach is considered fully developed with SR A1A being the most seaward damage element other than the Flagler Beach Pier, dune walkovers, and facilities at Gamble Rogers State Park.

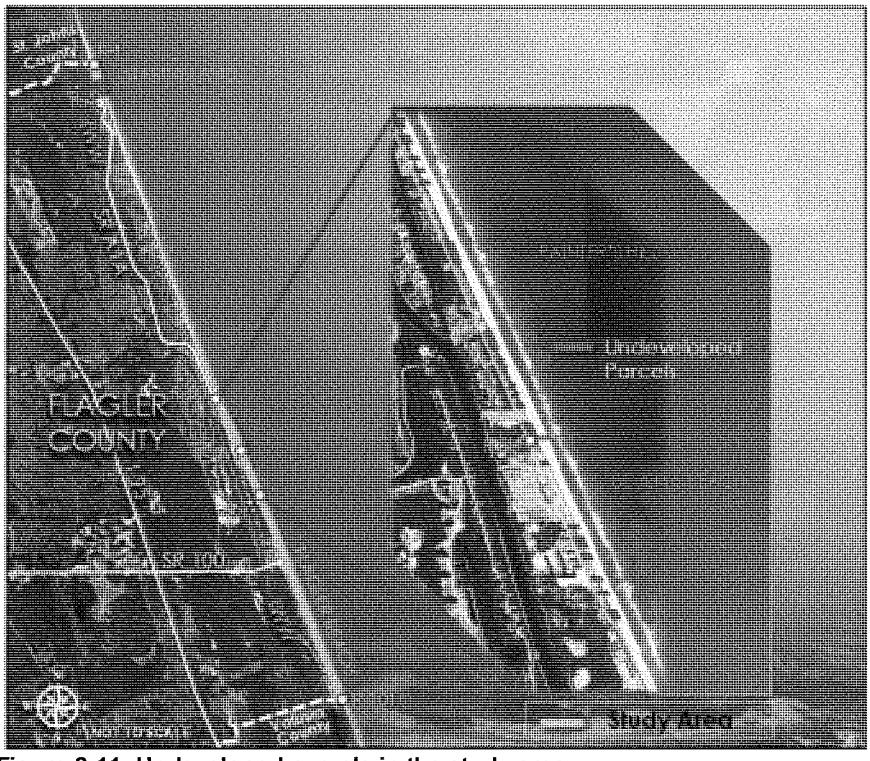


Figure 2-11: Undeveloped parcels in the study area.

2.2.4 Native Beach

Beach sediment sampling was performed by USACE in August 2012 along representative beach profile lines. Beach sediment samples were collected along the profile lines at the following locations as shown in **Figure 2-12**: toe of dune, berm, mid-tide, and -3, -5, -10, -15, and -20 feet below Mean Sea Level.

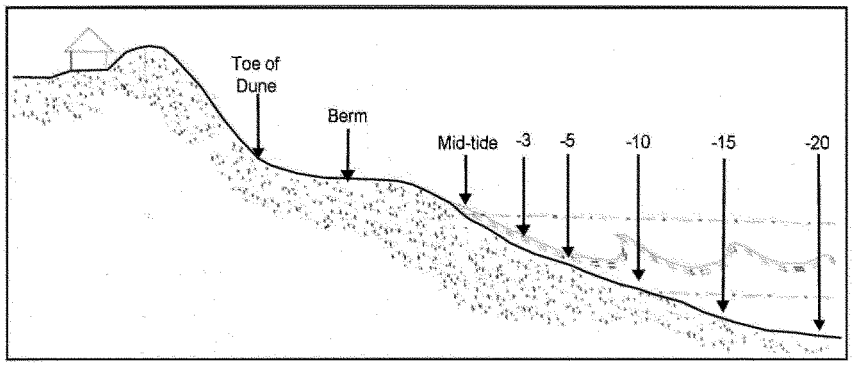


Figure 2-12: Beach Transect with Beach Sampling Locations

Due to severe erosion, only some of the beaches reflect this typical profile. At some locations, the dune is replaced by revetment, and therefore no sample was collected.

All samples were analyzed for grain size, visual shell, and color. Carbonate analysis was performed on representative samples. The associated gradation curves and granularmetric reports are presented in the **Geotechnical Appendix**. An arithmetic composite sample was created from all samples.

Results characterize the sediments at Flagler Beach as poorly-graded, fine-grained quartz sands. The mean grain size ranges between 0.14 mm (2.84 phi) and 0.67 mm (0.58 phi) averaging at 0.28 mm (1.85 phi). The carbonate content ranges from 8% to 64% averaging at 25%. The visual shell averages 23%, and the color of the sand is generally light gray to pinkish gray. Samples collected at the berm and at mid-tide locations have especially high shell contents caused by the deposits from the Anastasia formation, which also causes the unique color of the Flagler County beaches.

2.2.5 Offshore Sand Borrow Sources

Three offshore borrow areas were investigated for potential nourishment of Flagler County beaches (**Figure 2-13**). Of these three areas, Area 1, located approximately 2 miles off-shore and partially within Outer Continental Shelf (OCS) waters, did not reveal

sufficient quantities of beach compatible material for the entire life-cycle of the project during a 2009 geotechnical survey conducted by Flagler County.
Another source, Area 4, is in the Matanzas Inlet and the adjacent Intracoastal Waterway (IWW). USACE periodically dredges this area and typically places the material on Summer Haven Beach, directly south of the inlet or in an upland disposal area (SJ-1) which is periodically offloaded to Summer Haven Beach. Since it is much more economical to place the material on Summer Haven due to its close proximity, it is highly unlikely that it would be cost effective to transport the relatively small amount of dredged material (approximately 200,000 cubic yards every 5 years) to a potential project in Flagler County with the exception of a project located in Marineland.

Two other areas -- Area 2 and Area 3 -- are located approximately 6-7 miles and 12-14 miles offshore in OCS waters, respectively. These two areas, under sole Federal jurisdiction of BOEM, were investigated in 2011 by USACE.

The purple line in **Figure 2-13** marks the boundary between state waters within 3 miles of the shore and the Outer Continental Shelf (OCS) waters outside of 3 miles from the shore on the Atlantic Coast. The Bureau of Ocean Energy Management (BOEM) has sole jurisdiction of sand sources in OCS waters.

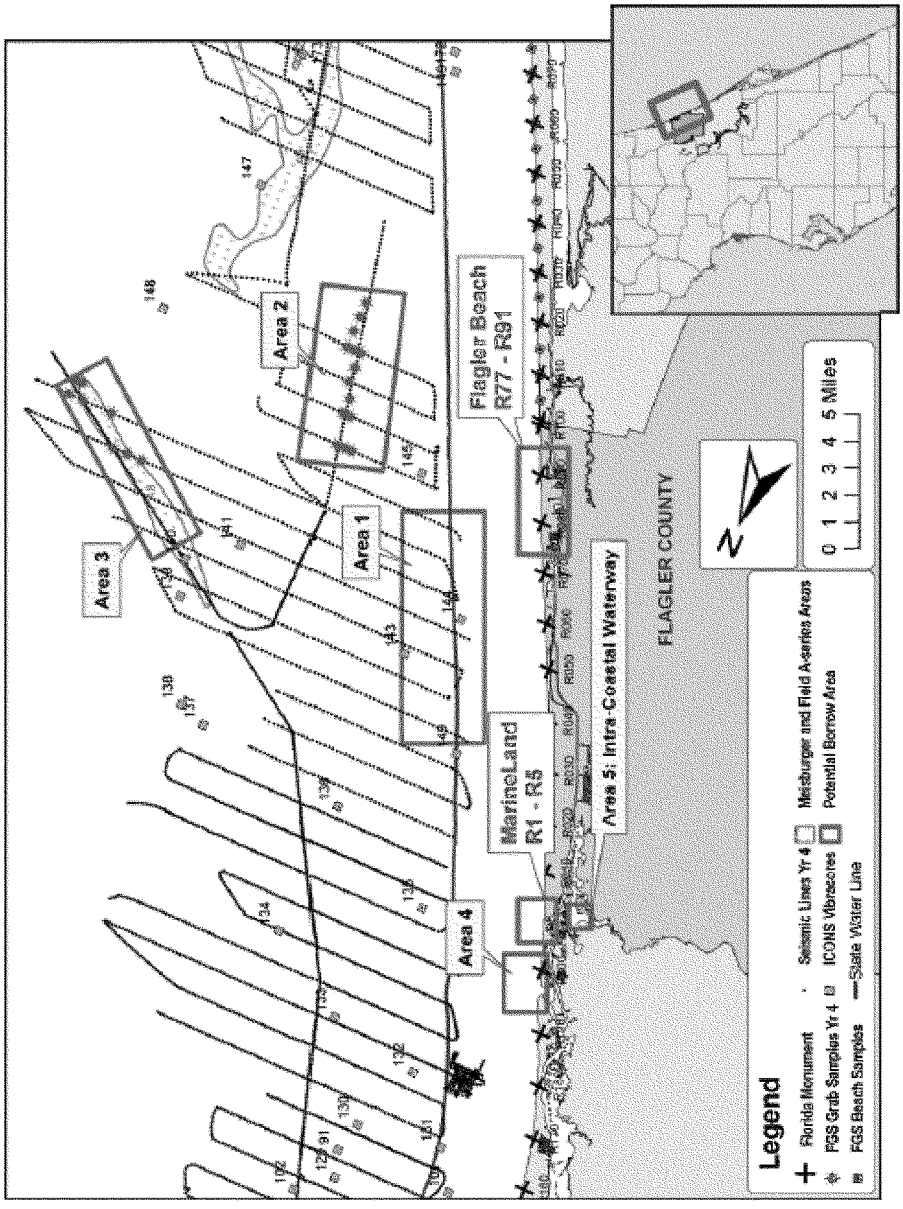


Figure 2-13: Locations of potential borrow areas (Halcrow 2010).

Both Area 2 and Area 3 borrow sources contain beach compatible sand, however considering the lower transportation costs, Area 2 is proposed as the primary sand source for Flagler County shoreline protection measures.

Borrow Area 2 is part of the Korona Ridge Field geomorphologic unit and was investigated by the USACE in 2011. Sand ridges are elongated shoals of mostly sandy sediments that have been heaped up by currents to form linear mounds. In general, sand ridges tend to be semi-permanent features that migrate with the current slowly over time. Area 2 revealed beach compatible sand at three distinct locations: Sub-areas 2A, 2B, and 2C. Borrow Sub-areas 2A and 2B have a combined volume of beach compatible sand of approximately 3 million cubic yards, and borrow Sub-area 2C contains about 2.6 million cubic yards of material. The three borrow sub-areas are depicted in **Figure 2-14,** and details are summarized in **Table 2-2** below.

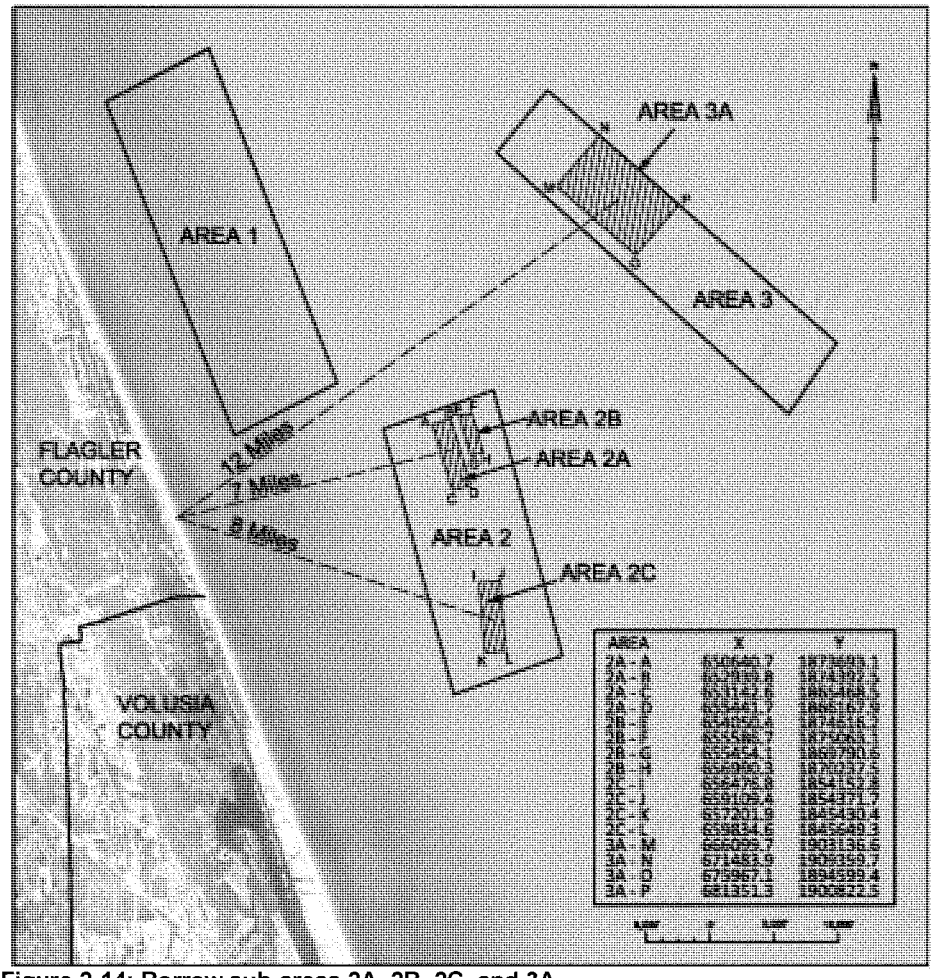


Figure 2-14: Borrow sub-areas 2A, 2B, 2C, and 3A

Table 2-2: Details for Proposed Borrow Area 2A, 2B, and 2C

Sub-area	Approximate Size (feet)	Approximate Volume (cubic yards)	Borings	Boring Elevation (ft. NAVD)
2A	5,000 1,700	1.7 mil	VC-FSP11-14,	-58
			VC-FSP11-16	-53
2B	3,300 x 1,500	1.3 mil	VC-FSP11-15	-62
2C	7,000 x 2,000	2.6 mil	VC-FSP11-22	-52

Four 20-foot vibracores (VC-FSP11-14 through VC-FSP11-16, and VC-FSP11-22) were collected in February 2011 at proposed Borrow Sub-areas 2A, 2B, and 2C, as depicted on **Table 2-2**. Thicknesses of the beach compatible sand layers vary from 5 to 18 feet. Conservative values between 5 and 7 feet below seafloor surface were used as dredging depths for the calculation of the volume estimates. However, the indicated dredging depths may change with the availability of additional testing results. Results characterize the sediments in all the samples as poorly-graded, fine-grained sands with an average of 19% visual shell and 15% carbonate content. The mean grain size ranges between 0.17 mm and 0.65 mm, averaging 0.26 mm. The average standard deviation is 1.01 phi. The amount of fines passing the #230 sieve averages around 2.89 %. The Munsell color of the wet sand is 5Y 5/1; the dry sand color is N 7/1.

Results from samples taken on Flagler Beach characterize the existing beach sediments as poorly-graded, fine-grained quartz sands. The mean grain size ranges between 0.14 mm (2.84 phi) and 0.67 mm (0.58 phi) averaging at 0.28 mm (1.85 phi). The carbonate content ranges from 8% to 64% averaging at 25%. The visual shell averages 23% and the color of the sand is generally light gray to pinkish gray. Samples collected at the berm and at mid-tide locations have especially high shell contents caused by the deposits from the Anastasia formation, which also causes the unique color of the Flagler County beaches.

Based on the findings of the geotechnical survey along with consideration of transportation costs, Area 2, with Sub-areas 2A, 2B, and 2C, is proposed as the primary source for Flagler County shoreline protection measures requiring a sand source. The source meets Florida Administrative Code 62B-41.007(2) (the "Sand Rule") which requires that sand for beach nourishment meet the following requirements:

- Carbonate or quartz with a particle size between 0.062 and 4.76mm
- <5% silt passing the #230 sieve
- <5% gravel sized shell retained on the #4 sieve
- Fill material must be free of foreign matter, debris, toxic material
- Fill material shall be similar in color and grainsize distribution

A topic of local concern is maintaining the existing sand color of the beaches. The Flagler County beaches have a surface layer containing especially high shell content caused by deposits from the Anastasia formation. This "shell hash" lies on top of quartz sand and causes the unique orangish color of the beaches. A beach nourishment project using the proposed borrow area would cover the existing beach with sand containing a mixture of quartz and shell hash, likely to initially result in a beach with a less dramatic orange shell hash lens. However, over time coastal processes should naturally sort the nourishment sand, sifting the smaller diameter quartz grains below any shell hash resulting in beach sand of a color similar to existing beaches. This process would repeat after each renourishment.

Detailed information regarding the geotechnical characteristics of the borrow areas as well as recipient beach placement areas is presented in the **Geotechnical Appendix D.**

A submerged resource survey of the proposed borrow sources was conducted in February of 2013, by the USACE Jacksonville District Hydrographics Survey Section, Operations Division. The survey consisted of sidescan sonar and encompassed the Sub-borrow areas 2A, 2B, and 2C. The results of the survey determined that no hardbottom or other anomalies are present within the three sub-areas; the data show a featureless homogenous blanket of sand in the borrow area limits. Please see the **Environmental Appendix F** for details of these surveys.

2.2.6 Compatibility of Potential Borrow Areas with the Beaches

Grain size distribution, overfill, and renourishment factor computations were used to determine if the proposed borrow areas 2A, 2B, 2C and 3A are compatible with the native beach. The grain size analysis revealed that the sediments of the borrow areas are composed of fine-grained quartz sand with visual shell values between 12% and 23%. The beach is also composed of fine-grained quartz sand with a visual shell value of 23%. Overfill and renourishment factors were calculated for each of the borrow areas using a USACE software program. Borrow areas 2A, 2B, and 3A showed overfill factors well below 1.3 and renourishment factors below 1.1 and are therefore suitable for Flagler County beaches. The material from borrow area 2C is too fine and too poorly sorted to be compatible with Flagler County's beaches. However it could still be used if mixed with sediments from the other proposed borrow areas. Also, additional investigation could reveal coarser material in borrow area 2C.

2.2.7 Shoreline Change

Flagler County is unique compared to the counties to the north and south in that the shoreline sediment contains a higher percentage of coarse shell hash which produces a larger median grain size and steeper beach profiles. The shoreline has mild concave curvature from north to south, transitioning to a headland at Flagler Beach. Shoreline irregularities along the generally curved shoreline are attributed to nearshore hard bottom exposed rock outcrops which influence shoreline erosion and accretion. A FDEP shoreline change rate study conducted in July of 1999 concluded that the beaches of Flagler County are subject to cyclic erosion and accretion but are relatively stable based on data from 1952 to 1993.

Refer to the **Engineering Appendix A** for additional detail on historical changes of the Mean High Water (MHW) line and volume change in the study area.

The position of the MHW line varies along the Flagler County project shoreline, with relatively small rates of change over the time period between 1972 and 2007. Shoreline change rates for this period range from +1.06 to -2.40 feet per year with isolated areas of moderate erosion and accretion. Factors which contribute to this variation include the distribution of exposed rock in the surf zone and foreshore slope, as well as structures in the area. One structure of particular influence on longshore transport and beach erosion and accretion is the Flagler Pier at R-79. The pier tends to trap sand from longshore transport causing accretion north of the pier, as well as downdrift erosion about 2,000 feet south of the pier due to the interruption of longshore transported sand. From 1972 to 2007 the MHW rate of change was generally erosional along the study limits with annual erosion rates of -0.58 feet per year in the north project segment (R1 to R-4) and -0.59 feet per year in the south project segment (R-50 to R-100). **Table 2-3** provides a further breakdown of annual shoreline rates of change by study reach.

Each of the study reaches, with the exception of Beverly Beach, have relatively consistent average shoreline rates of change, ranging from -0.58 feet per year to -0.67

feet per year. Due primarily to the stabilizing presence of a concrete and steel seawall over a significant portion of the reach, Beverly Beach experiences a lower shoreline rate of change, approximately -0.11 feet per year.

Table 2-3: Annual Shoreline Rate of Change by Study Reach

Project Segment	Study Reach	Location (DNR Monument)	MHW Rate of Change (1972 – 2007) (Feet/Year)
North	Marineland	R-1 to R-4	-0.58
TOTAL (North)		R-1 to R-4	-0.58
South	Painters Hill	R-50 to R-60	-0.64
	Beverly Beach	R-60 to R-67	-0.11
	Flagler Beach	R-67 to R-101	-0.67
TOTAL (South)		R-50 to R-101	-0.59
TOTAL (Project)		R-1 to R-4, R-50 to R-101	-0.59

2.2.8 Winds

Local winds are the primary means of generating the small-amplitude, short-period waves that are an important mechanism of sand transport along the Florida shoreline. Flagler County lies at about 29° degrees latitude, slightly north of the tropical trade wind zone. Winds in this region vary seasonally with prevailing winds ranging from the northeast though the southeast. The greatest velocities originate from the north-northeast quadrant in winter months and from the east-southeast quadrant in the spring, summer, and early fall.

Wind data offshore of the project area is available from the USACE Wave Information Study (WIS) Program. There are 523 WIS stations along the Atlantic Coast. WIS Station 63422 is representative of offshore deep water wind and wave conditions for the project area. **Table 2-4** provides a summary of wind data from WIS Station 63422, located at latitude 29.58, longitude -81.0 (about 3 miles northeast of Flagler Beach, **Figure 2-15**). This table contains a summary of average wind speeds and frequency of occurrence broken down into eight 45 degree angle-bands. This table indicates that winds are fairly evenly distributed between the northeast and south directions. Due to its orientation, winds from the north-northeast to south-southeast have the most significant impact on the Flagler shoreline.

Table 2-4: Average Wind Conditions

Wind Direction (from)	WIS Station #63442 (1980 – 1999)	
	Percentage Occurrence (%)	Average Wind Speed (mph)
North	10.3	14.0
Northeast	15.3	13.4
East	14.6	11.1
Southeast	12.6	10.0
South	14.5	10.4
Southwest	13.4	10.9
West	9.5	13.3
Northwest	10.0	15.1

Wind conditions in coastal Florida are seasonal. Between December and March, frontal weather patterns driven by cold Arctic air masses can extend as far as South Florida. These fronts typically generate northwest winds before the frontal passage, and northeast winds behind the front. This post-frontal "nor'easter" behavior is responsible for the increased intensity of wind speed seen in the northeast sector winds during the winter months. Northeasters may result in wave conditions that can cause extensive beach erosion and shorefront damage.

The summer months (June through September) are characterized by southeast trade winds and tropical weather systems traveling west to southwest in the lower latitudes. Additionally, daily breezes onshore and offshore result from differential heating of land and water masses. These diurnal winds typically blow perpendicular to the shoreline and have less magnitude than trade winds and nor'easters. Daily breezes account for the general shift to east/southeast winds during the summer months when nor'easters no longer dominate.

During the summer and fall months, tropical waves may develop into tropical storms and hurricanes, which can generate devastating winds, waves, and storm surge when they impact the project area. These storms contribute greatly to the overall longshore and cross-shore sediment transport at the site.

2.2.9 Waves

The energy dissipation that occurs as waves enter the nearshore zone and break is the principal method of sediment transport. Wave height and period, in combination with tides and storm surge, are the most important factors influencing the behavior of the shoreline. The Flagler County study area is exposed to both short period wind-waves and longer period open-ocean swells originating predominantly from north-northeast to south-southeast directions.

Damage to the Flagler County shoreline and upland development is attributable to large storm waves produced primarily by tropical disturbances, including hurricanes, during the summer months and by nor'easters during the late fall and winter months.

Because the study area is fully exposed to the open ocean in all seaward directions, the coastline is vulnerable to wave attack from distant storms, as well as local storms. Most hurricanes and tropical storms traversing northward through the Atlantic within several hundred miles of the east coast are capable of producing large swells. These swells can propagate long distances, causing erosion along the Flagler County shoreline.

Wave data for this report was obtained from the long-term USACE WIS hindcast database for the Atlantic coast of the U.S. This 20-year record extends from 1980 through 1999, and consists of a time-series of wave events at 3-hour intervals for stations located along the east and west coasts of the United States, as well as the Gulf of Mexico and the Great Lakes. The WIS station closest to the project area is #63422, located 3 miles offshore of the study area in 66 feet of water. The location of WIS station #63422 relative to the study area is shown in **Figure 2-15**.

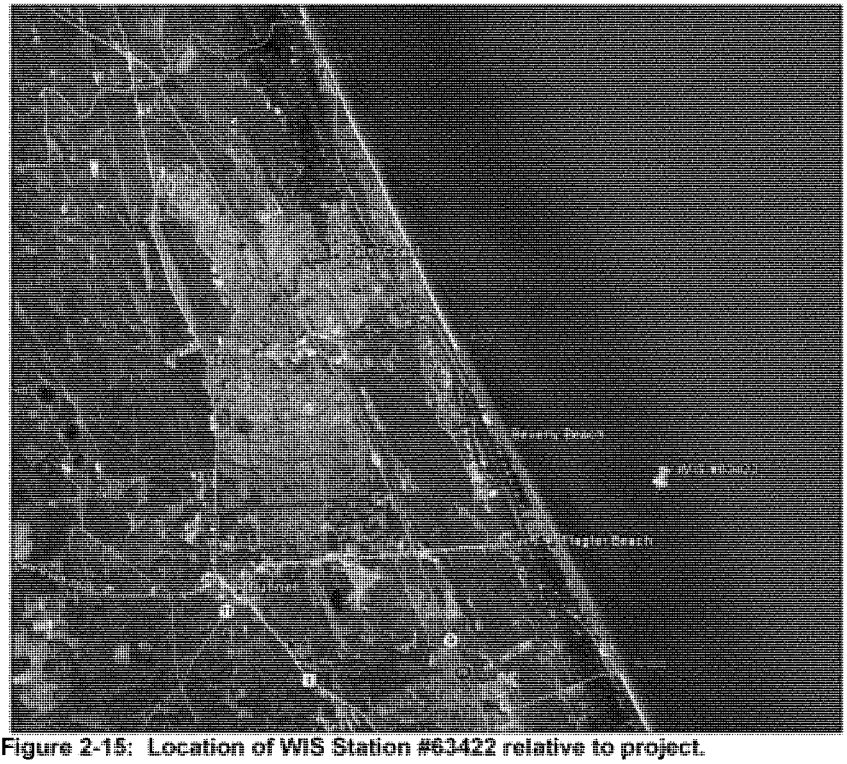


Figure 2-15: Location of WIS Station #63422 relative to project.

Table 2-5 summarizes the percentage of occurrence and average wave height of the WIS waves by direction. It can be seen that the dominant wave directions range from northeast to southeast. This reflects both the open ocean swell and more locally generated wind-waves.

Similar to wind conditions, wave conditions in coastal Florida experience seasonal variability. The seasonal breakdown of wave heights provided in **Table 2-6** shows that late fall and winter months have an increase in wave height due to nor'easter activity. The intensity and direction of these fall/winter wave conditions are reflected in the dominant southward sediment transport and seasonal erosional patterns in the project area. In contrast, summer months experience milder conditions, with smaller wave heights. Overall, waves originating from the east to northeast quadrant dominate.

Table 2-5: Average Wave Heights (1980 to 1999)

Wind Direction (from)	WIS Station #63422 (1980-1999)	
	Percentage Occurrence (%)	Average Wave Height (ft)
North	9	4.5
Northeast	24	4.5
East	51	3.3
Southeast	12	2.7
South	2	3.1
Southwest	1	2.9
West	0	3.0
Northwest	2	3.6

Table 2-6: Seasonal Wave Conditions

Month	WIS Station #63422 (1980-1999)	
	Average Wave Height (ft)	Predominant Direction (from)
January	4.09	E-NE
February	4.07	E-NE
March	3.83	E-NE
April	3.33	E-NE
May	3.04	E-NE
June	2.61	E
July	2.24	E-SE
August	2.79	E
September	3.81	E-NE
October	4.58	E-NE
November	4.53	E-NE
December	4.15	E-NE

Wave periods have the same seasonality as wave heights. Wave period is the time between two waves passing through a stationary point, typically measured in seconds. **Table 2-7** provides a seasonal breakdown of percent occurrence by wave period. From this table, it can be seen that short period, locally-generated wind waves are common throughout the year. The yellow highlighted values show the dominant wave period for each month. None of these dominant periods are less than 5.0 seconds or greater than 6.0 seconds. It can also be seen that in the summer months the shortest period waves occur more frequently. During the fall and winter months more frequent higher-energy, longer-period storm swells occur. Note that the percentage of waves with periods greater than 12.0 seconds increases from a low of 0.3% in June to a high of 13.4% in September (the height of hurricane season).

Table 2-7: Wave Period – Percent Occurrence

Wave Period (Sec)	Percent Occurrence by Wave Period Band											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
< 4.0	6.0	5.2	6.2	6.7	5.0	8.3	10.0	5.3	3.1	1.3	3.2	4.4
4.0 - 4.9	10.1	10.8	10.5	9.6	8.0	4.2	3.8	4.4	6.2	4.0	7.0	8.3
5.0 - 5.9	18.3	22.1	20.0	22.0	25.2	36.2	37.3	40.3	26.9	24.9	20.5	21.5
6.0 - 6.9	12.5	13.5	14.3	15.0	19.2	24.7	28.7	25.3	17.9	21.6	17.3	15.5
7.0 - 7.9	13.5	14.4	14.5	13.6	19.1	14.8	13.4	12.2	12.0	16.3	14.9	11.9
8.0 - 8.9	7.9	6.8	6.5	7.3	5.4	3.9	2.4	1.8	4.9	5.8	8.5	5.6
9.0 - 9.9	8.4	8.0	6.6	7.0	5.1	3.3	1.8	1.3	4.6	6.8	7.0	5.7
10.0 - 10.9	8.0	6.3	6.2	5.9	4.4	3.0	1.3	1.6	5.0	6.1	6.8	8.1
11.0 - 11.9	6.2	5.8	6.1	6.3	5.0	1.4	1.0	2.0	6.0	6.2	6.9	7.1
> 12.0	9.1	7.4	9.3	6.7	3.6	0.3	0.4	5.8	13.4	7.1	7.9	11.9

2.2.10 Tides and Currents

Astronomical tides are created by the gravitational pull of the moon and sun and are entirely predictable in magnitude and timing. The National Oceanic and Atmospheric Administration (NOAA) regularly publishes tide tables for select locations along the coastlines of the Unites States and select locations around the world. These tables provide times of high and low tides, as well as predicted tidal amplitudes.

Tides in the Flagler County area are semidiurnal: two high tides and two low tides per tidal day (24 hours 50 minutes). Two measures of tidal range are commonly used: the mean tide range is defined as the difference between Mean High Water (MHW) and Mean Low Water (MLW), and represents an average range during the entire lunar cycle (27.3 days); and, the spring tide range is the average semidiurnal range which occurs semimonthly when the moon is new or full, which causes greater tidal amplitudes. The semidiurnal tides around Flagler Beach exhibit a mean tidal range of 3.64 feet.

Presently, the nearest tide station to the project on the ocean side of the island is NOS Station 8720692 (State Road A1A Bridge), located at Matanzas Inlet approximately 17 miles north of Flagler Beach. The nearest tide station on the back-bay side of the barrier island is NOS Station 8720833 (Smith Creek, Flagler Beach), located directly west of Flagler Beach. **Table 2-8** summarizes tidal data from both stations.

Table 2-8: Tidal Datums

Tidal Datum	Elevation Relative to MLLW (feet)	
	State Road A1A	Smith Creek
Mean High Water (MHW)	3.80	0.94
North Americal Vertical Datum (NAVD88)	2.28	0.78
Mean Tide Level (MSL)	1.95	0.52
Mean Low Water (MLW)	0.16	0.07
Mean Lower Low Water (MLLW)	0.00	0.00

The primary ocean current in the project area is the Florida Gulf Stream. With the exception of intermittent local reversals, it flows northward. The average annual current velocity is approximately 28 miles per day, varying from an average monthly low of 17 miles per day in November to an average monthly high of approximately 37 miles per day in July. The Gulf Streams lies approximately 60 miles offshore of the project area.

The nearshore currents in the project vicinity are not directly influenced by the Gulf Stream, but may be influenced indirectly via interaction with incident waves. Littoral currents affect the supply and distribution of sediment on the sandy beaches of Flagler County. Longshore currents, induced by oblique wave energy, generally determine the long-term direction and magnitude of littoral transport. Cross-shore currents may have a more short-term impact, but can result in both temporary and permanent erosion. The magnitude of these currents is determined by the wave characteristics, angle of waves from offshore, configuration of the beach, and the nearshore profile. For Flagler County

beaches, the net sediment transport is from north to south. This is due to the dominant wave activity from the northeast during the fall and winter months, particularly northeaster storms.

The influence of the Matanzas Inlet (2.4 miles to the north) and Ponce de Leon Inlet (27 miles to the south) ebb and flood currents on local currents is negligible. In both cases the distance between the inlet and the project area places the project outside the influence of inlet tidal fluctuations.

2.2.11 Storm Effects

The shoreline of Flagler County is influenced by tropical systems during the summer and fall and by northeasters during the late fall, winter, and spring. Although hurricanes typically generate larger waves and storm surge, northeasters often have a greater impact on the shoreline because of their longer duration and greater frequency.

During intense storm activity, the shoreline is expected to naturally modify its beach profile. Storms erode and transport sediment from the beach into the active zone of storm waves. Once caught in the waves, this sediment is carried along the shore and re-deposited farther down the beach, or is carried offshore and stored temporarily in submerged sand bars. Periodic and unpredictable hurricanes and coastal storms, with their fierce breaking waves and elevated water levels, can change the width and elevation of beaches and accelerate erosion. After storms pass, gentle waves usually return sediment from the sand bars to the beach, which is restored gradually to its natural shape. While the beach profile typically recovers from storm energy as described, extreme storm events may cause sediment to leave the beach system entirely, sweeping it into inlets or far offshore into deep water where waves cannot return it to the beach. This may cause a permanent increase in the rate of shoreline recession.

Flagler County is located in an area of significant hurricane activity. **Figure 2-16** shows historic tracks of hurricanes and tropical storms from 1858 to 2008, as recorded by the National Hurricane Center (NHC) and available from the National Oceanic and Atmospheric Administration (http://csc.noaa.gov/hurricanes/#). The shaded circle in the center of this figure indicates a 50-nautical mile radius (encompassing the entire Flagler county shoreline) from the center of the study area. Based on NHC records, 62 hurricanes and tropical storms have passed within this 50-nautical mile radius over the 151-year period of record. Based on this chart, hurricanes and tropical storms pass within 50-nautical miles of the study area approximately every 2.4 years.

The 50-nautical mile radius was chosen for display purposes in **Figure 2-16** because any tropical disturbance passing within this distance, even a weak tropical storm, would be likely to produce some damage along the shoreline. Stronger storms are capable of producing significant damage to the coastline from far greater distances.

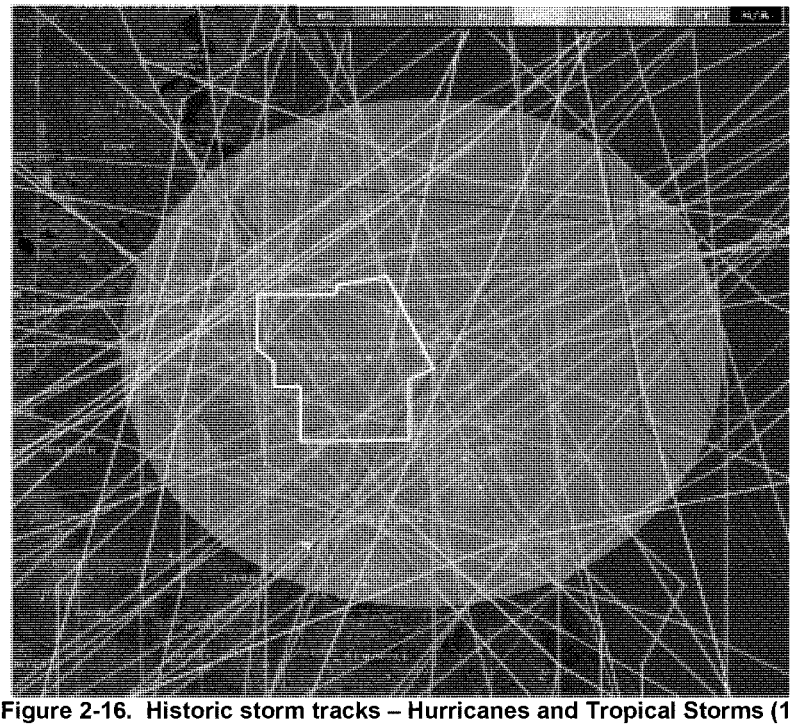


Figure 2-16. Historic storm tracks – Hurricanes and Tropical Storms (1858 – 2008, 50 mile radius).

In recent years, a number of named storms passing within the 50-nautical mile radius have significantly impacted the project area, including tropical storms Leslie (2000), Eduard (2002), Henri (2003), Charley (2004), Tammy (2005), and Fay (2008). Damages from these storms, as well as from more distant storms causing indirect impacts (Dennis, Floyd, and Irene in 1999; Gabrielle in 2001; Frances and Jeanne in 2004), included substantial erosion and damage from wind, wave, and water action.

Since the study area is exposed to the open ocean from northeast to southeast, as discussed previously, the coastline is vulnerable to wave attack from distant storms as well. Most hurricanes and tropical storms traversing northward through the Atlantic within several hundred miles of the east coast are capable of producing large swells which are capable of causing erosion along the Flagler County shoreline.

2.3 Storm Surge

Storm surge is defined as the rise of the ocean surface above its astronomical tide level due to storm forces. Surges occur primarily as a result of atmospheric pressure gradients and surface stresses created by wind blowing over a water surface. Strong onshore winds pile up water near the shoreline, resulting in super-elevated water levels along the coastal region and inland waterways. In addition, the lower atmospheric pressure that accompanies storms also contributes to a rise in water surface elevation. Extremely high wind velocities coupled with low barometric pressures (such as those experienced in tropical storms, hurricanes, and very strong northeasters) can produce very high, damaging water levels. In addition to wind speed, direction and duration, storm surge is also influenced by water depth, length of fetch (distance over water), and frictional characteristics of the nearshore sea bottom. An estimate of storm surge is required for the design of beach fill crest elevations. An increase in water depth may increase the potential for coastal flooding and allow larger storm waves to attack the shore.

The Flagler County study area is susceptible to overtopping from extreme storm surges. Topographic surveys show that much of the island is less than 15 feet in elevation. Elevations of 15 to 20 plus feet occur, but are almost exclusively along the oceanfront dune line. Flagler County Emergency Services (FlaglerEmergency.com) provides hurricane storm-surge and evacuation information to the public. Through this service, estimates indicated that virtually the entire study area would be inundated during a Category 1 hurricane should the storm make direct landfall in the Flagler County vicinity. In the event of a hurricane, only two evacuation routes outside of the barrier island in Flagler County exist: Palm Coast Parkway near the center of the county and the State Road 100 bridge about four miles north of the county line. The only continuous road extending along the length of the barrier island is SR A1A.

Storm surge levels versus frequency of occurrence were obtained from data compiled by the University of Florida for the Florida Department of Transportation (FDOT, 2003). **Table 2- 9** provides peak storm surge heights by return period for three locations in Flagler County: FDEP R-monuments R-0, R-55, and R-99. The storm tide elevations presented in this table include the effects of astronomical high tide and wave setup. Wave setup is the increase in mean water level due to the presence of waves.

Table 2- 9: Storm Tide Elevations

Return Period (Years)	Total Storm Tide Level (feet, NAVD88)		
	R-0	R-55	R-99
500	17.2	15.6	14.1
200	14.0	12.8	11.6
100	11.5	10.7	9.6
50	8.7	8.3	7.6
20	5.6	5.3	4.2
10	3.9	3.8	3.6

2.3.1 Sea-Level Rise

Throughout geologic history, global sea level variations, both rises and falls, have occurred. Changes in sea level cause the shoreline to be out of equilibrium and set into motion processes that restore equilibrium; which, in turn, cause the shoreline to erode or accrete. Two processes are predominantly responsible for relative changes in sea level: change in the absolute water level of the oceans and the subsidence or submergence of the land by geologic processes. Based on USACE sea-level rise engineering guidance (Engineering Regulation (ER) 1100-2-8162), the historic rate of sea- level rise for Flagler County is estimated to be 0.0075 feet/year.

2.3.2 Effects of Other Shore Protection/Navigation Projects

There are no navigation projects in the vicinity of Flagler County that will affect the study area. Material dredged from the Intracoastal Waterway (IWW) near the Matanzas inlet has been placed on Summer Haven beach in the past. Although it is possible that sand from these activities migrates south to the Marineland reach, a review of the shoreline change data indicates that effects of this migration are negligible.

Potential opportunities exist to implement projects on a regional basis, within the framework of Regional Sediment Management, including sand source investigations, planning, design, coordination, and construction contracts in cooperation with the governmental entities of Flagler County, Volusia County, St. Johns County, Flagler Beach, Ormond Beach, Daytona Beach, and the Florida Inland Navigation District. In particular, beach placement of IWW maintenance dredge material provides an opportunity for an additional sand source, although the channels dredged are quite distant from all but the Marineland reach.

2.3.3 Inlet Effects

There are no inlets within Flagler County. The nearest inlets are Matanzas Inlet, 2.4 miles to the north of Flagler County in St. Johns County, and Ponce de Leon Inlet, 27 miles to the south of Flagler County in Volusia County. Matanzas Inlet is a relatively small inlet and is not maintained for navigation. The inlet has a history of migrating to the south, but is now stabilized with the south bridge abutment of the Highway A1A Bridge. Effects of Matanzas Inlet on the Flagler County shorelines to the south have not been quantified, but are expected to be negligible. Ponce de Leon inlet is distant enough and down drift of Flagler County and is therefore not expected to have an impact on the county's beaches.

2.4 Environmental and Historic Resources *

2.4.1 General Environment

Present day Florida occupies a portion of the geological unit known as the Floridian Plateau. This partly submerged platform is nearly 500 miles long, up to 400 miles wide and represents the seaward extension of the coastal plain of Georgia and Florida (Shrober and Obreza, 2008). The submerged portions of the plateau comprise the continental shelf that extends into the ocean to a depth of approximately 300 feet (FDEP SCORP, 2008). Although the plateau has existed for millions of years as alternately dry land or shallow sea, it consists of a core of metamorphic rocks buried beneath a thick layer of sedimentary rock composed mostly of limestone (FDEP SCORP, 2008). Portions of the plateau have been exposed over time as dry land due to periods of relative drops in sea level. Each exposure has left behind a wide variety of hard mineral deposits. The movement of these deposits has formed present day sandy beaches, offshore bars, and barrier islands (Randazzo and Jones, 1997).

As previously discussed, wind and water are the primary environmental forces that shape the morphology of beach dunes present at Flagler County. Likewise, these processes also directly influence the ecology of this land form (Myers and Ewel, 1990). Vegetation on the dune face is regularly exposed to salt spray and sand burial from onshore winds blowing across the saltwater and open sandy beach (FNAI, 2010). Plants on the upper beach are subject to these stresses plus occasional inundation by high seasonal or storm tides and periodic destruction by waves. The vegetation of this community is adapted to either withstand these stresses or to rapidly re-colonize following destruction (Myers and Ewel, 1990). Storm waves may erode the seaward face of the dune, moving sand offshore to form underwater bars and barrier islands, or break through the dune moving sand inland as overwash (FNAI, 2010). New colonization by pioneer species is initially haphazard, but gradually becomes organized into a sorted dune face with an upper beach zone as waves build the beach back up. Likewise, wind moves the sand inland to form a new dune ridge (FNAI, 2010). Upon this level of maturity, the ridge blocks salt spray and plant cover inhibits sand movement. Inland herbaceous species become replaced by woody species indicative of an intermediate succession (Myers and Ewel, 1990). The investigated borrow areas include part of the Korona Ridge Field geomorphologic unit (Area 2) and part of the Flagler Sand Wave geomorphologic unit (Area 3).

2.4.2 Vegetation

Beach dune along the Flagler County coast is a predominantly herbaceous plant community consisting of wide-ranging coastal species on the upper beach and foredune (first dune above the beach). This community is primarily built by sea oats *(Uniola paniculata)*, whose rhizomes and stems trap sand grains blown from the beach. This process builds the dune by growing upward to keep pace with sand burial (Taylor, 1998). Other grasses that can tolerate sand burial include bitter panic grass (*Panicum amarum*), and saltmeadow cordgrass (*Spartina patens*) (Myers and Ewel, 1990).

Camphorweed *(Hetrotheca subaxillaris)* often grows with sea oats where sand burial is absent or moderate within a disturbed community. Seacoast marshelder *(Iva imbricata),* is a succulent shrub that is found at the seaward base of the foredune. These dominant species may also occupy the face left from dune disturbance due to storm erosion where sand is not yet stabilized by vegetation (Myers and Ewel, 1990). The upper beach area seaward of the foredune is a less stable habitat, frequently disturbed by high spring or storm tides, and is continually re-colonized by annual species such as sea rocket *(Cakile lanceolata.),* crested saltbush (*Atriplex cristata)*, and Dixie sandmat (*Chamaesyce bombensis),* or by trailing species like railroad vine *(Ipomoea pes-caprae),* beach morning glory *(Ipomoea imperati)*, the salt-tolerant grasses seashore paspalum (*Paspalum vaginatum*), and seashore dropseed (*Sporobolus virginicus)* (Taylor, 1998). Non-dominant species found in the beach dune community include dune sunflower *(Helianthus debilis),* sand spur *(Cenchrus spp.),* and shoreline seapurslane *(Sesuvium portulacastrum);* see **Figure 2-17** (FNAI, 2010).



Figure 2-17: Typical foredune vegetation of beach morning glory and shoreline seapurslane.

2.4.3 Threatened and Endangered Species

Several listed protected species under the Endangered Species Act of 1973 (ESA) are found along the coastal area of Flagler County. These include the federally-threatened West Indian manatees (*Trichechus manatus latirostris*) that primarily use the Atlantic Ocean and associated inlet estuaries to migrate and forage for food. As there are no inlets in the study area, manatee would not be likely found in the study area. This habitat type is outside of the study area and is excluded from this discussion. Marine turtles, including loggerhead *(Caretta caretta),* green *(Chelonia mydas),* leatherback

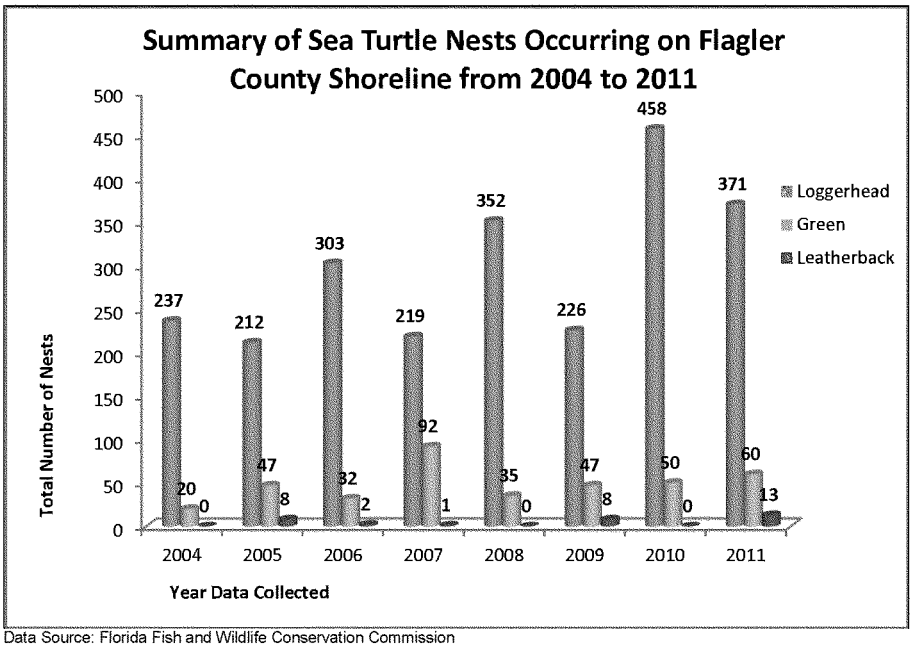
(Dermochelys coriacea), hawksbill (*Eretmochelys imbricata*), and Kemp's ridley (*Lepidochelys kempii*), are known to occur within the study area. All of these species are federally endangered except the loggerhead, which is classified as threatened. The loggerhead, green, and leatherback are the only sea turtles known to regularly nest on beaches within the project area (FWC FWRI website, 2012). To date, no critical habitat has been designated for the loggerhead sea turtle; however, FWS recently published a proposal to designate critical habitat throughout the southeast U.S. for loggerhead sea turtles that was published on March 25, 2013 (FR Vol.78 No. 57 18000 - 18082). One of the proposed "recovery units" (LOGG-T-FL-04) includes the entire coastline of Flagler County, starting at Matanzas Inlet and ending at the south boundary of Peninsula State Park in Volusia County. Sea turtles may also utilize the proposed borrow area offshore, although no survey data has been collected to assess this usage. The proposed loggerhead turtle critical habitat includes offshore Florida as potential breeding habitat, which could include the borrow area located 7 miles offshore (NMFS Website press release, July, 2013).

Five whale species listed as federally endangered may occur in the Atlantic Ocean along the Flagler County coastline during certain times of the year (National Marine Fisheries Service [NMFS] website, 2012). These species include the North Atlantic right whale *(Eubalaena glacialis)*, sei whale *(Balaenoptera borealis)*, fin whale *(B. physalus)*, humpback whale *(Megaptera novaeangliae)*, and sperm whale *(Physeter macrocephalus)*. Only the North Atlantic right whale and the humpback whale have been sighted along coastal Flagler County. Smalltooth sawfish are unlikely to be present in the nearshore along the Flagler County shoreline based on recent abundance and distribution data, although historically, they have been known to occur in the Atlantic in the Everglades region of south Florida and the Gulf of Mexico (NMFS website August, 2013). Areas of the Flagler County coast are also supportive of piping plover, (*Charadrius alexandrinus).* Although no FWS-designated critical habitat is located within Flagler County, several piping plover were observed on the beach associated with the Gamble Rodgers Memorial State Recreation Area, around FDEP monument R-95.

Sea Turtle

Sea Turtle Nesting Habitat

Sea turtle statistical data were acquired from the Florida Fish and Wildlife Conservation Commission (FWC) for three sea turtle species known to occur within the study area, including the critically eroded area that encompasses a total of 5.1 miles of potential sea turtle habitat. Sea turtle nests and false crawl trails were observed within the entire study area, and were evaluated from data collected between 2004 and 2011. Of the three species utilizing the study area, nests of loggerhead turtle (*Caretta caretta)* have the highest presence, followed by those of green turtle (*Chelonia mydas)*. Leatherback turtle (*Dermochelys coriacea)* nests were the least observed, see **Figure 2-18**. Effective as of August 11, 2014, NMFS has designated critical habitat for loggerhead turtles along several stretches of the Florida coastline.



Data Source: Florida Fish and Wildlife Conservation Commission

Figure 2-18: Flagler County Nesting Sea Turtle History

The Florida Fish and Wildlife Conservation Commission (FWC) data-set covers the period from 2004 to 2011, including the years of significant hurricanes and extreme storms from 2004 to 2006. Also, Tropical Storm Fay struck the coast along mid Flagler Beach in 2008, which extensively damaged sea turtle nests at that time. Similarly, several unnamed storms caused considerable impact to sea turtle nests during this period.

The species of sea turtles that occur in the Flagler County study area are intermittently migratory throughout their life cycles (NMFS factsheet, 2010). The nearshore and inshore waters may be used by juveniles as post-hatchling developmental or foraging habitat, but adults migrate seasonally between summer and winter habitats (Lohmann et al, 1999). Often, loggerhead and green turtles return to specific widely dispersed feeding grounds that are sometimes located hundreds or thousands of kilometers from their nesting sites (Limpus et al, 1992). Little information is available regarding how adult turtles navigate over long distances or how they relocate in the natal region for mating and nesting (Lohmann et al, 1999). Although some individuals may be present at their natal areas at any given time, abundance is likely to be greater in summer than winter within the Flagler County coastal reaches.

A 2008 FWS report determined that several beaches within the study area contain mostly unsuitable habitat for nesting sea turtles in the presence of various revetments and armor structures. These structures have the potential to modify behavior of nesting females resulting in false crawls, nesting in sub-optimal habitat, a decrease in nesting activity, and increased entrapment or mortality of nesting turtles and hatchlings, in addition to washout or inundation of eggs laid seaward of armor structures (FWS/NMFS, 2008). A 2002 report by FDOT also found that existing beaches along much of Flagler County's coast is unsuitable for sea turtle usage, concluding that the beaches may be too narrow for successful nesting. The FDOT report further determined it was highly probable that construction of SR A1A and development of residential and commercial structures have contributed to the loss of beach substrate and dune habitat.

Nesting data provided by FWC could not be correlated with exact spatial locations as GPS data are not collected during the nest monitoring event. Therefore, we were not able to determine any established trends, such as how many nests occur within a specific critically eroded area, or which of the three species may dominate a particular reach. Although no nest-specific location data is available, density of nests per particular reach within the study area was determined using the FWC data. High density is described as nests occurring in close proximity to others; conversely, low density is when nests occur with greater distance between them.

Of the three identified sea turtle species nesting within Flagler County, loggerhead turtles were found to have the highest density of nests throughout all reaches, see **Table 2-10**. Similar nesting data is presented in **Table 2-11** for green turtles, and **Table 2-12** for leatherback turtles. For all tables, reach length is provided for each area in both miles and feet. The density is stated in terms of the distance between each nest within the reach for a given year. For example, a reach that has several nests occurring within its limits will have lower footage or mileage; in contrast, the greater the footage (or mileage), the lesser the number of nests that occur within the reach for a given year.

The NMFS and FWS convened a biological review team (BRT) in February 2008 which determined that a distinct population segment (DPS) exists for loggerhead sea turtles within the Northwest Atlantic region based on genetic evidence, demographic data, and other criteria (Conant et al, 2009). Research indicates that the majority of nesting aggregations for the Northwest Atlantic loggerhead DPS is in South Florida (FWS website, 2012). The northern beaches of Flagler County, including Marineland and Washington Oaks State Park, are found to have a healthy density of loggerhead turtle nests, whereas the mid sections of the county's coastline are less utilized for nesting habitat. The extreme southern end of the county, including the Gamble Rodgers Memorial State Recreational Area, was found to have the highest density of loggerhead nests along the beach. The years 2004 to 2006 experienced reduced nesting due to extreme weather events from hurricanes and other storms. The year 2010 appears to have been the peak season for nesting loggerhead turtles in Flagler County.

Table 2-10: Flagler County Loggerhead Sea Turtle Nesting Density Data Summary

Year	Marineland R-1 to R-12		Washington Oaks State Park R-12 to R-16		North Flagler County Beaches R-16 to R-35		South Flagler County Beaches R-35 to R-67		Flagler Beach R-67 to R-95		Gamble Rodgers Memorial SRA R-95 to R-101	
Reach Length	Miles	Feet	Mile	Feet	Mile	Feet	Miles	Feet	Miles	Feet	Miles	Feet
	2.05	10824.00	0.90	4752.00	3.31	17476.80	5.70	30096.00	5.01	26452.81	1.25	6600.00
	1 Nest		1 Nest		1 Nest		1 Nest		1 Nest		1 Nest	
	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet
2004	0.44	2534.40	0.10	528.00	0.17	897.60	0.07	381.00	0.06	331.00	0.04	220.00
2005	0.26	1353.00	0.45	2376.00	0.08	426.30	0.06	338.20	0.08	426.70	0.13	660.00
2006	0.22	1202.70	0.30	1584.00	0.07	388.40	0.06	327.10	0.08	426.70	0.14	733.30
2007	1.03	5412.00	0.02	1188.00	0.06	317.80	0.06	327.10	0.09	456.10	0.16	825.00
2008	0.14	721.60	0.30	1584.00	0.05	286.50	0.04	212.00	0.06	334.42	0.06	161.00
2009	0.26	1353.00	0.08	396.00	0.07	388.40	0.06	344.40	0.12	630.00	0.04	227.60
2010	0.26	135.30	0.11	594.00	0.02	129.40	0.03	163.60	0.05	278.50	0.04	235.70
2011	0.19	984.00	0.08	396.00	0.04	201.00	0.04	185.80	0.07	367.40	0.05	244.40

Table 2-11: Flagler County Green Sea Turtle Nesting Density Data Summary

Year	Marineland R-1 to R-12		Washington Oaks State Park R-12 to R-16		North Flagler County Beaches R-16 to R-35		South Flagler County Beaches R-35 to R-67		Flagler Beach R-67 to R-95		Gamble Rodgers Memorial SRA R-95 to R-101	
Reach Length	Miles	Feet	Mile	Feet	Mile	Feet	Miles	Feet	Miles	Feet	Miles	Feet
	2.05	10824.00	0.90	4752.00	3.31	17476.80	5.70	30096.00	5.01	26452.81	1.25	6600.00
	1 Nest		1 Nest		1 Nest		1 Nest		1 Nest		1 Nest	
	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet
2004	0.68	3608.00	0.00	0.00	0.41	2184.60	0.63	3344.00	0.00	0.00	0.00	0.00
2005	0.41	2164.80	0.45	2376.00	0.25	1344.37	0.30	1584.00	0.63	3306.60	0.00	0.00
2006	0.00	0.00	0.30	1584.00	0.30	1588.80	0.71	3762.00	2.505	13226.40	0.16	825.00
2007	2.05	10824.00	0.23	1188.00	0.17	873.84	0.11	578.77	0.36	1889.49	1.25	6600.00
2008	0.34	1804.00	0.15	792.00	0.30	1588.80	0.63	3344.00	5.01	26452.80	0.63	3300.00
2009	2.05	10824.00	0.30	1584.00	0.28	1456.40	0.22	1157.54	1.67	8817.60	0.63	3300.00
2010	2.05	10824.00	0.30	1584.00	0.25	1344.37	0.23	1203.84	1.00	5290.56	0.42	2200.00
2011	0.41	2164.80	0.18	950.40	0.33	1747.68	0.20	1037.79	0.56	2939.20	0.63	3300.00

Table 2-12: Flagler County Leatherback Sea Turtle Nesting Density Data Summary

Year	Marineland R-1 to R-12		Washington Oaks State Park R-12 to R-16		North Flagler County Beaches R-16 to R-35		South Flagler County Beaches R-35 to R-67		Flagler Beach R-67 to R-95		Gamble Rodgers Memorial SRA R-95 to R-101	
Reach Length	Miles	Feet	Mile	Feet	Mile	Feet	Miles	Feet	Miles	Feet	Miles	Feet
	2.05	10824.00	0.90	4752.00	3.31	17476.80	5.70	30096.00	5.01	26452.81	1.25	6600.00
	1 Nest		1 Nest		1 Nest		1 Nest		1 Nest		1 Nest	
	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet	Per Mile	Per Feet
2004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	0.00	1.66	8738.40	1.90	10032.00	1.67	8817.60	0.00	0.00
2006	0.00	0.00	0.00	0.00	0.00	0.00	5.70	30096.00	0	0.00	1.25	6600.00
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.25	6600.00
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	3.31	17476.80	1.14	6019.20	2.51	13226.40	0.00	0.00
2010	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2011	2.05	10824.00	0.00	0.00	0.66	3495.36	1.43	7524.00	1.67	8817.60	0.00	0.00

Data Source: Florida Fish and Wildlife Conservation Commission Florida Wildlife Research Institute

Regionally, green sea turtles have the highest nesting densities located along the southeast Florida coast from Brevard to Palm Beach counties (FWC website, 2012). Locally, nesting green sea turtles were found more often on the beaches along the southern end of the Flagler County coast. The density of green sea turtle nests per reach distance was considerably lower overall than that of loggerhead turtles.

According to the FWC, Florida is the only state in the continental U.S. where leatherback turtles regularly nest (FWC website, 2012). Most of this nesting on the Atlantic coast occurs in Palm Beach County, or around 50% (FWC website, 2012). Locally, leatherback turtle nests were least frequently sighted, occurring along the Flagler County coast in the southern reaches from FDEP monument R-67 to R-95. The peak year for nesting by both green and leatherback sea turtles was 2007.

Anecdotal observations of sea turtle nests along various reaches of the study area were recorded during a site visit by a USACE biologist on 2 August 2011. Informal data collected from representative sites within each reach of the study area show a similar trend of nests present along the shoreline having the least amount of erosional damage or armoring. At the north end along Marineland Beach, 12 sea turtles nests were observed between FDEP monuments R-2 to R-4. Another 13 nests were present at Washington Oaks State Park, R-14 to R-15. However, no nests were observed near the Flagler Beach Pier, R-79, where dune erosion, revetment, and armor structure are present. At the southern reach of Flagler Beach from R-90 to R-100, 29 nests were observed where a wider, undeveloped beach is located. All of the nests were located in the upper beach area at the toe of the dune slope containing a backdrop of natural sand and vegetation, see **Figure 2-19**. No nests were observed along the sections of shoreline containing armoring or revetment.



Figure 2-19: Typical section along Flagler Beach where sea turtle nesting occurs within a vegetated natural area of upper dune. The species of sea turtle using this nest most likely was a loggerhead, based on the tracks.

Sea Turtle Mortality

The Florida Wildlife Research Institute (FWRI) is an arm of the FWC that conducts research and evaluation of sea turtle mortality throughout the state using the Florida Sea Turtle Stranding and Salvage Network (FLSTSSN).

FWC reports of Flagler County for the years 2010 and 2011 indicated 21 loggerhead, 19 green, 3 Kemps ridley, and 3 unknown species of sea turtles were found stranded. The primary threat to sea turtles in Flagler County is beachfront lighting. Ocean front artificial lighting that is visible from the beach can attract hatchling turtles away from the ocean to their deaths.

North Atlantic Right Whale

The North Atlantic right whale (*Eubalaena glacialis)* is a federally endangered species protected under the ESA with jurisdiction by NMFS, and also the Marine Mammal Protection Act of 1972 (NMFS website, 2012). They are among the most imperiled whale species in the world (NMFS website, 2012). Right whales are a marine mammal weighing up to 70 tons. They can grow up to 55 feet long with a stocky, black body and no dorsal fin, but have callosities (raised patches of rough skin) on the head region (NMFS website, 2012). They can live up to 50 years or possibly longer, although more research is needed to determine their true life span (NMFS website, 2012). Their mouths contain baleen (long strips of dangling hardened protein material) which they use to skim prey consisting of zooplankton and small invertebrates, such as krill, pteropods and copepods (NMFS website, 2012). Right whales initially give birth at the

age of nine or ten years after a year-long gestation. The interval between births averages three to six years. When born, calves are typically 13 to 15 feet long and weigh approximately 3,000 pounds (NMFS website, 2012).

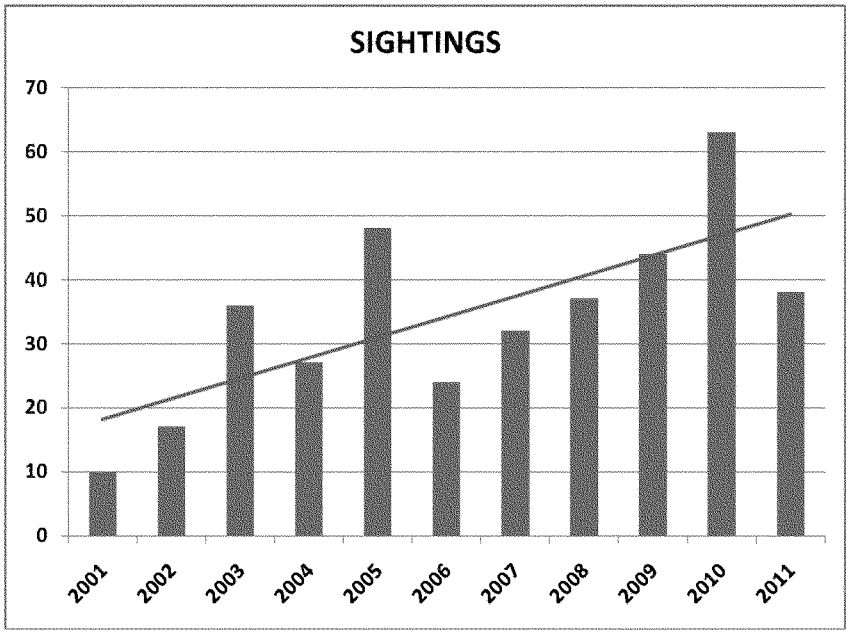
A population of right whales in the western North Atlantic range during wintering and calving season in warmer coastal waters off the southeastern United States. They return north in early spring to their summer feeding and nursery grounds in New England oceanic waters and the Bay of Fundy (NMFS website, 2012). An identified high use area is adjacent to Florida and Georgia, which includes the entire Flagler County coastal zone from the shoreline to five miles offshore. This usage is based upon key habitat criteria for wintering and calving, which led to a "Critical Habitat" designation by NMFS, designated pursuant to the ESA. The wintering and calving period of right whale activity in the southeastern United States, particularly the Florida coast, starts around early to mid December, and ends in late March, weather condition dependent.

Two main threats to right whales are ship strikes and fishing gear entanglement. Vessel collision has caused a clear trend of declining population that was first noticed in the late 1990s (NMFS website, 2012). This trend indicated a high probability that right whales could go extinct within 200 years if the mortality rate from ship strike was not curtailed (NMFS website, 2012). Their slow movement and time spent at the water surface in nearshore conditions make them highly vulnerable to human activities, especially collision with vessels (NMFS website, 2012). This finding resulted in policy adoption, such as the NMFS speed restriction zones, as well as technological advancement of the Mandatory Ship Reporting System (MSRS) (NMFS Recovery Plan, 2004).

The other leading source of human-induced mortality is entanglement in fixed fishing gear which can accidentally capture right whales in long lines used for crab traps and other sea life. To illustrate this problem, on December 19, 2012 a dead right whale carcass was found washed up on Flagler Beach just south of Varn Park (within the study area but outside of the project area). The whale was a juvenile male that was reported to have a large rope wrapped around its tail, although the cause of death is still pending from a necropsy being conducted by NMFS. In response to this growing concern, NMFS recently revised its recovery plan for the North Atlantic right whale in 2013. While research efforts are underway to address efficient and humane methods for detanglement of whales from fishing gear, NMFS is proactively pursuing regulatory requirements for commercial fishing gear to prevent entanglement (NMFS Recovery Plan, 2004).

The Marineland Right Whale Project, a volunteer-based citizen group in association with the Associated Scientists at Woods Hole, Inc (ASWH), has conducted annual data collection based on sightings from stationary sites, mobile sites, and most recently, a small aircraft-mounted camera known as "air cam". The group enlists local citizens to report and record daily sightings of whales that occur along the coast from St. Augustine in St. Johns County to the Ponce Inlet in Volusia County. Based on the data collected

through this research effort, a trend of right whale sightings is presented in **Figure 2-20.** After five years of an upward trend, there was a decrease in 2011.



Source: Associated Scientist at Woods Hole, Inc Marineland Right Whale Project

Figure 2-20: Marineland Right Whale Project Data. The number of total whale sightings per year, including a simple linear trend line.

Humpback Whale

Humpback whales (*Megaptera novaeangliae)*, whose name means "big-winged New Englander," typically reach lengths of 14.6 to 15.2 m and weights of 31 to 41 metric tons. Females are usually slightly larger than males and an exceptional individual may be up to 18.9 m in length and weigh 48 metric tons. For their length, they tend to be greater in girth than the other baleen type whales. Other differences of the humpback whale include lack of a median head ridge, enormous flippers, and the presence of numerous knobby structures, or "dermal tubercles," about the dorsal surface of the snout, chin, and mandible (NMFS website, 2012). The number and location of these head tubercles vary between individuals; each containing a sensory hair. The throat pleats are fewer and spaced wider apart than is typical for baleen whales. Coloration is black overall with irregular white markings on the throat, sides, and abdomen. Some individuals may have white undersides or white patterns dorsally. The flippers are long (up to 4.6 m) and narrow; they are typically white below but range from black to patterns

of black and white dorsally, or occasionally fully white (NMFS website, 2012). The tail flukes are broad, serrated on the free edge, and black above with black and white coloration ventrally. Distinctive tail flukes may serve to identify individual humpback whales. The humpback gestation period is approximately 11 months. A 10 to 15-foot baby humpback may nurse as long as a year, adding up to 15 feet in length each month. Sexual maturity is reached at 2 to 5 years, when the young whales measure about 12 meters in length. Physical maturity is reached at 12 to 15 years of age. Females breed only every other year which adds speculation to why they may be reaching extinction (NMFS website, 2012).

Humpbacks typically submerge for several minutes at a time with occasional dives up to 30 minutes. The blow may be up to 10 feet high and is rather bushy. When diving, humpbacks arch the back steeply, thus the common name, and routinely raise their flukes when they dive. The flukes rarely show in shallow dives but when a deep dive is accomplished the flukes may be lifted well above the water's surface. They are known for spectacular leaps and long, white side flippers and often congregate in groups of 20 to 30 up to 100 to 200 individuals.

Humpback whales migrate along the Gulf Stream in January off the east coast of Florida. Humpbacks are capable of travelling at 5 mph averaging only 1 mph on long journeys to rest and socialize along the way (NMFS website, 2012). They migrate through the same waters, though earlier and later than North American right whales, on their way to and from their Dominican Republic birthing grounds. After breeding season, they return to a newly-designated marine sanctuary off Massachusetts in the spring to feed on slender, five-inch-long fish called sand launce. They feed only in summer. During the winter and breeding, they live off their accumulated fat stores (NMFS website, 2012).

Through 2013, there are on average about two dozen reports of humpback whales from Sapelo Island, Georgia, to Fort Lauderdale, Florida. Researchers at FWC believe that this number of reports is not unusual for this time and location (Marineland Right Whale Project, 2013).

Piping Plover

Piping plover (*Charadrius melodus)* are buff colored, small shorebirds with short black bills and yellow legs (in wintering plumage) (FWS website, 2012). They became a protected species under the ESA in 1986 and are classified as threatened in their southern migration and wintering range, and as endangered in their northern nesting and breeding range, (FWS Recovery Plan, 2009). They migrate from their nesting grounds in northern climates (Great Lakes, southern Canada, and upper Midwest), to winter along the southeastern coastal areas including Florida's Atlantic and Gulf coasts. In Florida, the number of piping plover recorded during the 2006 International Piping Plover Breeding Census (USGS, 2009) totaled 454, with 133 occurring on the Atlantic coast and 321 found on the Gulf coast. A total of 69 sites along 239 miles (384

kilometers) on the Atlantic coast were surveyed, whereas 117 sites along 522 miles (840 kilometers) were surveyed on the Gulf coast.

The wintering habitat desired by piping plover consists of open sandy beach with access to the swash zone or intertidal pools at low tide that provide foraging of invertebrate food sources such as worms and tiny crustaceans. They also utilize the upper beach with short dunes and wrack-line debris to hunker down during wind or storm events (FWS website, 2012). Significant threats to piping plover include habitat loss from coastal development; disturbance by human foot and vehicular traffic; harassment by domesticated pets, feral cats, and predators such as raccoons, skunks and foxes; and finally, storm events.

In Flagler County, two sites have been identified in previous years for infrequent sightings of piping plover. These include the beach from Marineland to Washington Oaks State Park (FDEP Monument R-12 to R16), and Gamble Rodgers Memorial State Recreation Area, (R-95 – R-98) (USGS, 2009); see **Figure 2-30** for their locations along the Flagler County coastline. Although none of the Flagler County coastline is within a FWS-designated Piping Plover Critical Habitat Unit, they were sighted by a USACE biologist in the Gamble Rodgers Memorial State Recreation Area as recently as August, 2011, see **Figure 2-21**. Typical migration of piping plover to wintering habitat occurs during mid-July to late October, and they may remain until late March or April per year until returning to their northern breeding habitat (FWS website, 2012).

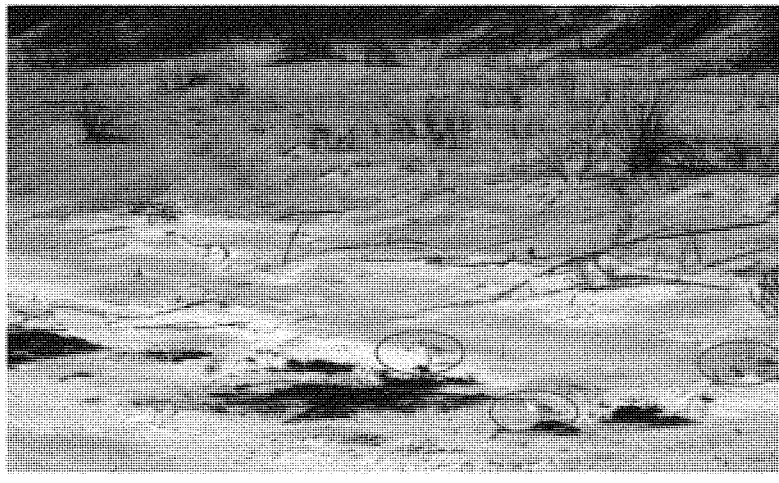


Figure 2-21: Wintering piping plover at Gamble Rodgers Memorial State Recreation Area. Three observed individuals (circled in red) by USACE biologist in August, 2011. Note the wrack line, a desirable habitat component, on the upper beach.

Red Knot

Red knot (*Caladris canutus* spp *rufus)* is proposed under the ESA as a candidate bird species by the northeast FWS Region 5 (FWS 2011). The current FWS species assessment and listing priority assignment (May 2011) states that the species wintering habitat range includes the eastern coastline of Florida where wintering red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks, as well as mangrove and brackish lagoons. Of these habitat types, only sandy beaches are found in Flagler County, which are moderately degraded. Although the most recent report of a red knot sighting was in 2007 at Gamble Rodgers Memorial State Recreation Area (eBirds database website 2013), the likelihood of red knot occurring on the beaches throughout Flagler County is very low.

Smalltooth Sawfish

The smalltooth sawfish (*Pristis pectinata*) is currently listed as endangered under the ESA by NMFS (50 CFR 224). In 2003, it was the first marine fish species in U.S. waters added to the ESA listing. Although smalltooth sawfish once ranged throughout U.S. coastal waters along the southeastern Atlantic and northern Gulf of Mexico, its known primary range is now reduced to the coastal waters near Everglades National Park and the Charlotte Harbor Estuary in extreme southern Florida (NMFS website August, 2013). Sightings are very rare. No designated critical habitat occurs along the Flagler County shoreline within the study area. Smalltooth sawfish typically inhabit shallow waters (depths up to 20 feet) near the mouths of rivers in estuarine lagoons over sandy or muddy substrates; likewise, they may also be found in deeper waters (greater than 50 feet) along the continental shelf (NMFS Website August 2013). The current 1997 South Atlantic Regional Biological Opinion (SARBO) does not include smalltooth sawfish. Sawtooth sawfish are unlikely to be present in the nearshore along Flagler County shoreline.

2.4.4 Hardbottoms *

There are extensive nearshore outcroppings of coquina rock (Anastasia formation) in the sub- and intertidal zones of many beaches in Flagler County (FWCC, 2008). Surveys completed by USACE in 2012 indicate that most nearshore outcorppings exist north of R-50 in the study area. These areas are ephemeral, meaning that they are periodically covered and uncovered by natural sediment movement, and require mapping to determine the exact locations of the rock. Nearshore hardbottom features affect wave refraction and provide a major factor in maintaining the overall shoreline curvature (FDOT, 2002). These exposed rock surfaces also provide important habitat in the nearshore environment. Nearshore hardbottom reefs serve as settlement habitats for immigrating sub-adults of fish and invertebrates, or as intermediate nursery habitats for juveniles emigrating out of nearby inlets (Vare 1991). **Table 2-13** provides the locations of known outcropping/hardbottoms.

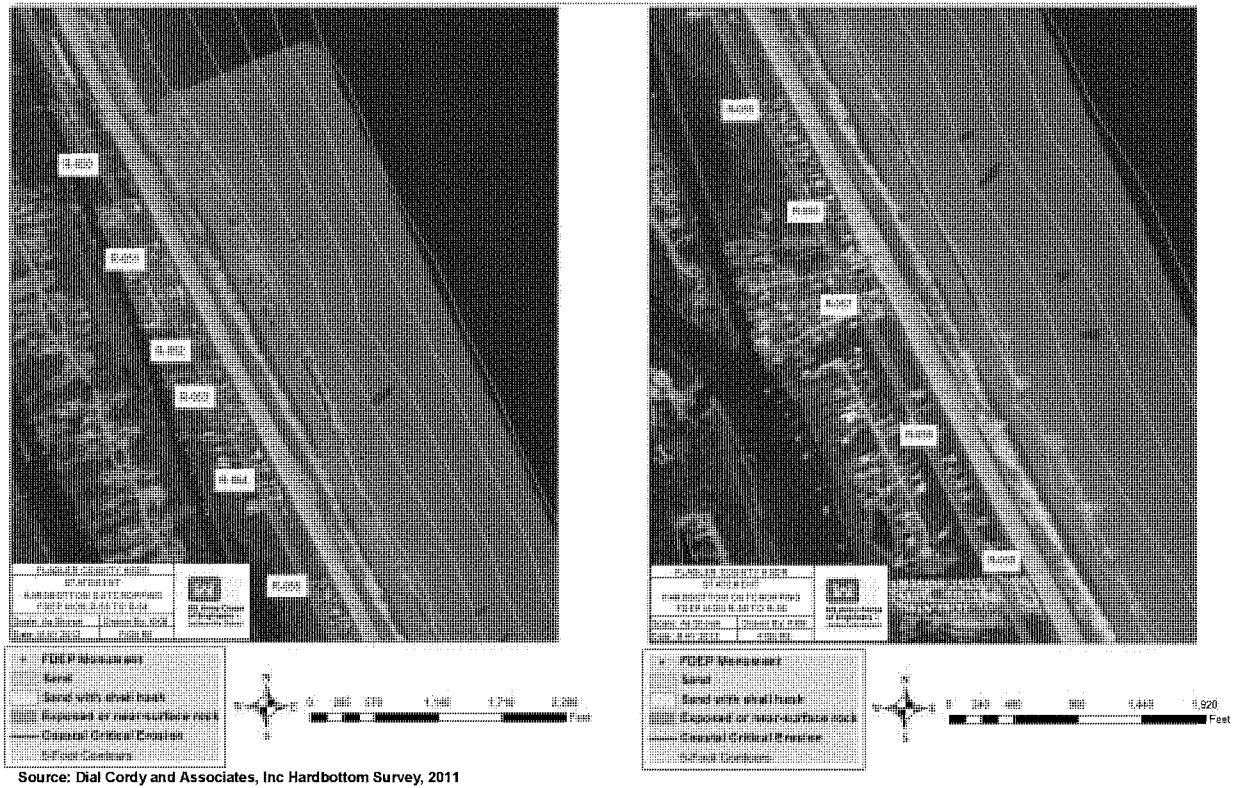
Table 2-13: Flagler County Nearshore Location of Rock Outcropping/Hardbottoms

Location/ Study Reach	Range Location	Major Feature(s)
Within the southern portion of Marineland study reach	R-3 to R-16	Pronounced outcrops of beach rock
Outside of study area (The Hammocks)	R-20 to R-43.	Patchy beach rock outcrops
Southern portion of the Beverly Beach study reach, and the north end of the Flagler Beach study reach	R-65 to R-71	Significant rock outcrops
Flagler Beach study reach	R-79 to R-92	Significant rock outcrops
Mainly north of R-50 in Marineland and The Hammocks.	R-1 to R-50	Nearshore hard-bottom outcrops

Source: DEP (1999), Flagler County, Shoreline Change Rate Estimates. Information updated as a result of 2012 Corps nearshore hard-bottom surveys.

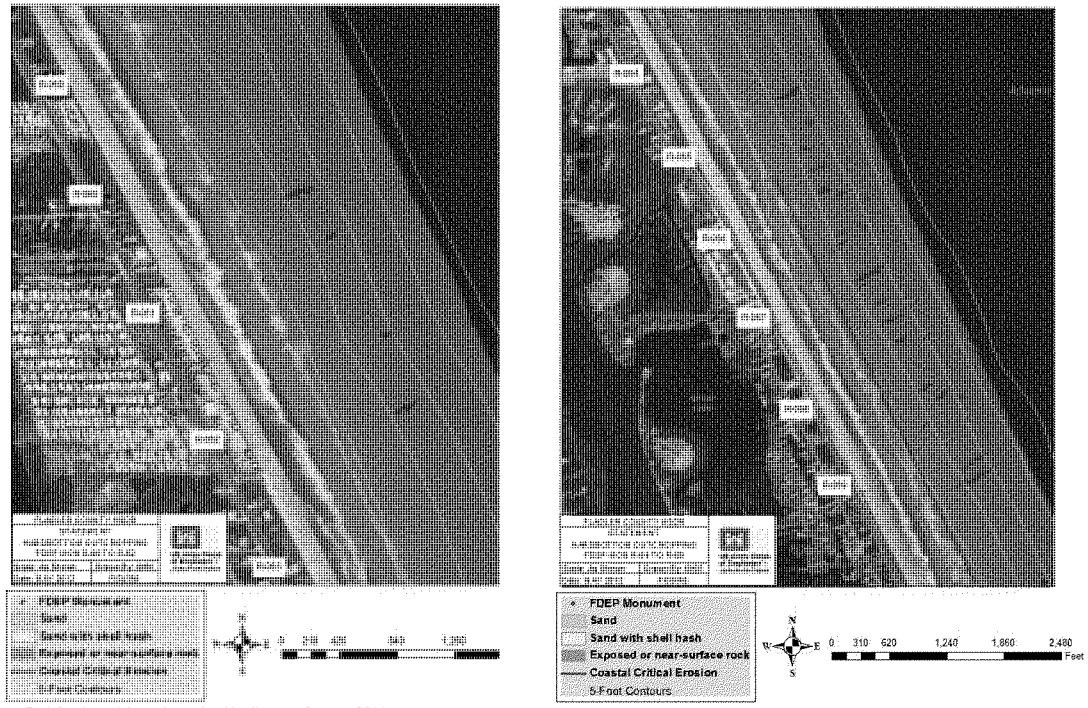
As the feasibility study progressed, the shoreline from R-50 to R-100 became the focus for a potential project. In 2011, a sub-surface survey consisting of sidescan sonar was conducted by Dial Cordy and Associates, Inc. (DCA), to map the locations of hardbottom within the nearshore adjacent to Flagler County. The specific survey area included the southern half of the county, from FDEP monument R-50 to R-100. As shown in **Figure 2-22** through **Figure 2-25**, the hardbottom features are predominantly linear, laying perpendicular to the shoreline. Their locations in the nearshore average between 800 to 1000 feet from the MHW, and they occur most often in clusters, or occasionally alone. The distance of the gaps between the clusters averages between 1000 to 2000 feet. A majority of the known locations are within sand substrate, although a considerable number occur in sand-shell hash that is present in the immediate submerged shoreline between 5 to 10 feet of depth. The hardbottom features range in size from small (mean length of 35 to 45 feet), medium (mean length of 80 to 100 feet), and large (mean length of 200 to 400 feet). The hardbottom reefs were typically found in water depths between 15 to 25 feet. Additional survey of the same area was conducted by the USACE Jacksonville District Hydrographic Survey Section, Operations Division during the summer of 2012. This survey found no hardbottoms in the area. A copy of both the Dial Cordy and Associates, Inc. survey report and the USACE survey report including methodologies and results is in **Appendix F**. The difference in findings is discussed in this section.

A side scan survey was also performed the USACE Jacksonville District Hydrographic Survey Section for Borrow Areas 2A, 2B, and 2C. No targets of interest or hardbottom were found in any of the areas. There were sand waves and sand ridges apparent in all three areas. The report from this survey can be found in **Appendix F**.



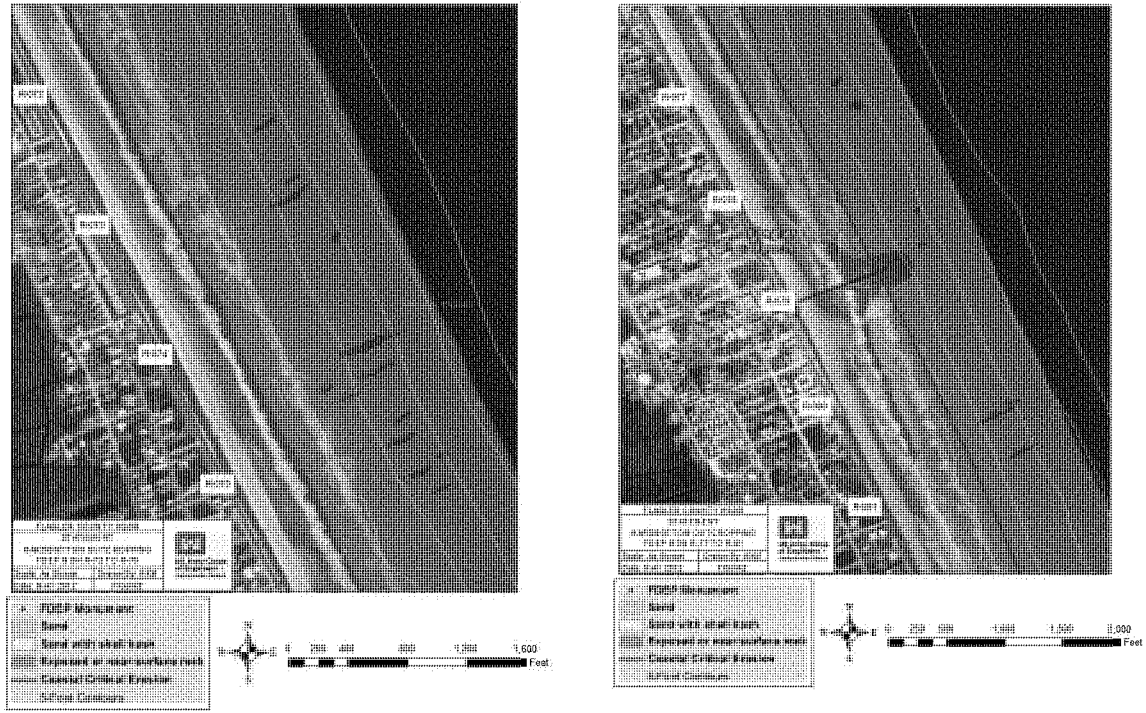
Source: Dial Cordy and Associates, Inc Hardbottom Survey, 2011

Figure 2-22: Presumed Hardbottom in Nearshore from FDEP monument R-50 to R-59



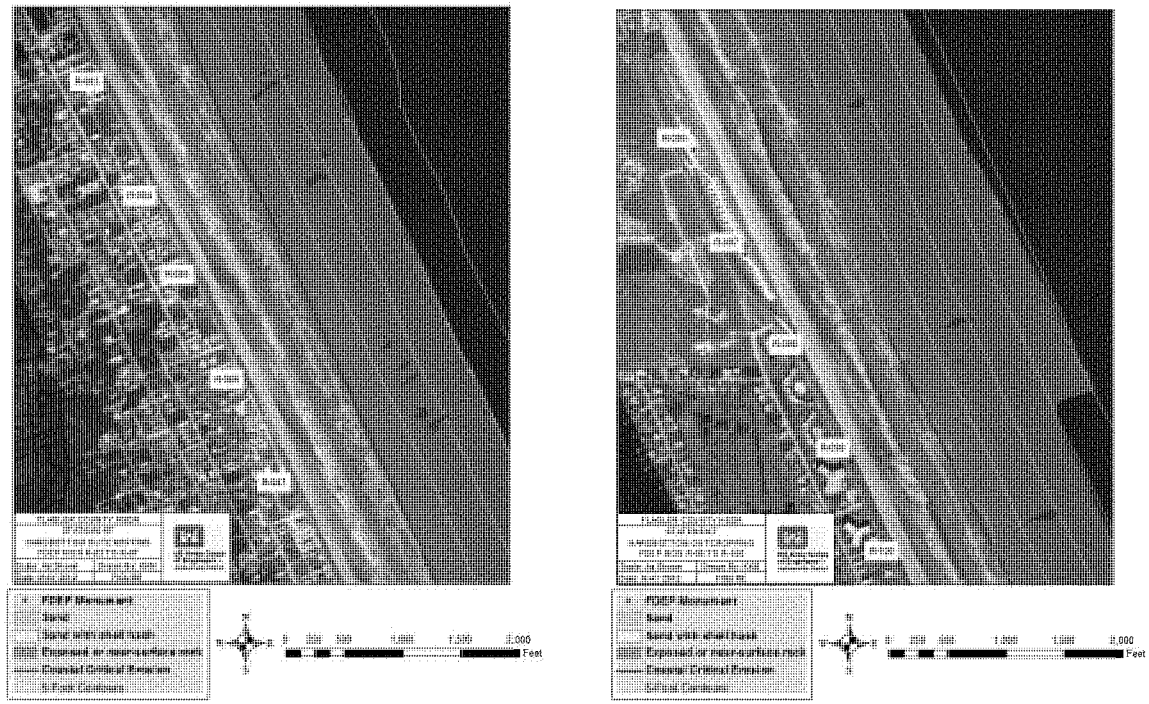
Source: Dial Cordy and Associates, Inc Hardbottom Survey, 2011

Figure 2-23: Presumed Hardbottom in Nearshore from FDEP monument R-59 to R-69



Source: Dial Cordy and Associates, Inc Hardbottom Survey, 2011

Figure 2-24: Presumed Hardbottom in Nearshore from FDEP monument R-72 to R-81



Source: Dial Cordy and Associates, Inc Hardbottom Survey, 2011

Figure 2-25: Presumed Hardbottom in Nearshore from FDEP monument R-83 to R-100

Additional survey of the same area was conducted by the USACE Jacksonville District Hydrographics Survey Section, Operations Division during the summer of 2012 in order to characterize the presumed hardbottom features in the nearshore environment. In addition to sidescan sonar, a multi-beam refractor and towed video were proposed to acquire further detail of the hardbottom such as relief off of the substrate and the presence of macro-algae growing on its surface. However, due to weather conditions at the time of survey, towed video data was unable to be collected. No manned scuba diving was conducted during this specialized survey. The geo-rectified areas indentified from the DCA survey were revisited in August, 2012 and sidescan sonar data was collected again to verify the original findings. No hardbottom features were found during this survey event. The USACE 2012 survey data collection method included use of EdgeTech 4125 Side-scan sonar operating at 400 and 900 kHz. Comparatively, the Dial Cordy and Associates 2011 data was operated at 600 kHz.

Figure 2-27 show the two sets of survey data overlaying the sidescan sonar mosaic representation of the substrate. The debris shown in **Figure 2-26** was found in both surveys and was used to geo-rectify the locations of the polygons, as shown with the red line (DCA data) overlain by the green line (USACE data). The red polygons are the DCA 2011 survey data of supposed locations of hardbottom features. However, no hardbottom features are present at these sites; the substrate in and adjacent to the features consists of a mostly homogeneous, unconsolidated sand substrate. The USACE 2012 survey data (green polygons) depict the compressed sand ripples adjacent to some of the DCA polygons as well as debris.

One could speculate that the hardbottom features thought to be present at the time of the DCA 2011 survey could have become covered by sand. However, this is an unlikely scenario since some of those features should still be exposed due to differing elevations. It is the Technical Surveyor's opinion (USACE Hydro-survey Division), based on the available survey data, that there is no hardbottom reef in the surveyed area. The current survey data shows no elevated outcroppings or scoured hardbottom areas associated with hardbottom reef. The areas of supposed hardbottom reef were not found in the current survey data as compared to the previous data set. The areas of interest found in the current survey data appear to be compacted sand waves due to their shape, texture, and intensity of signal return. Similar compacted sand waves appear in the previous survey data, but are in different locations and with far less frequency and coverage. Please see the **Environmental Appendix F** for details of these surveys, including the survey methodologies and findings.

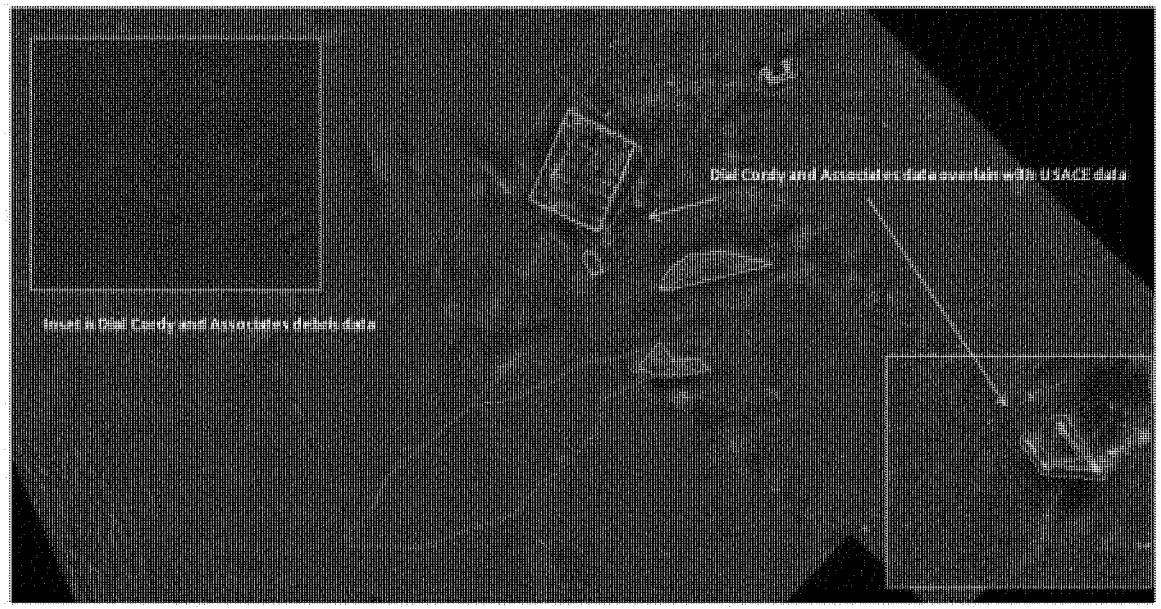


Figure 2-26: Hardbottom data from USACE survey geo-rectified with Dial Cordy Associates (DCA) data (August 2011). DCA data (red-lined polygons) are overlain by USACE Hydro-graphic Division data (green-lined polygons) on USACE collected sidescan data mosaic (August 2012). Note the absence of hardbottom features and presence of compressed sand and ripples.

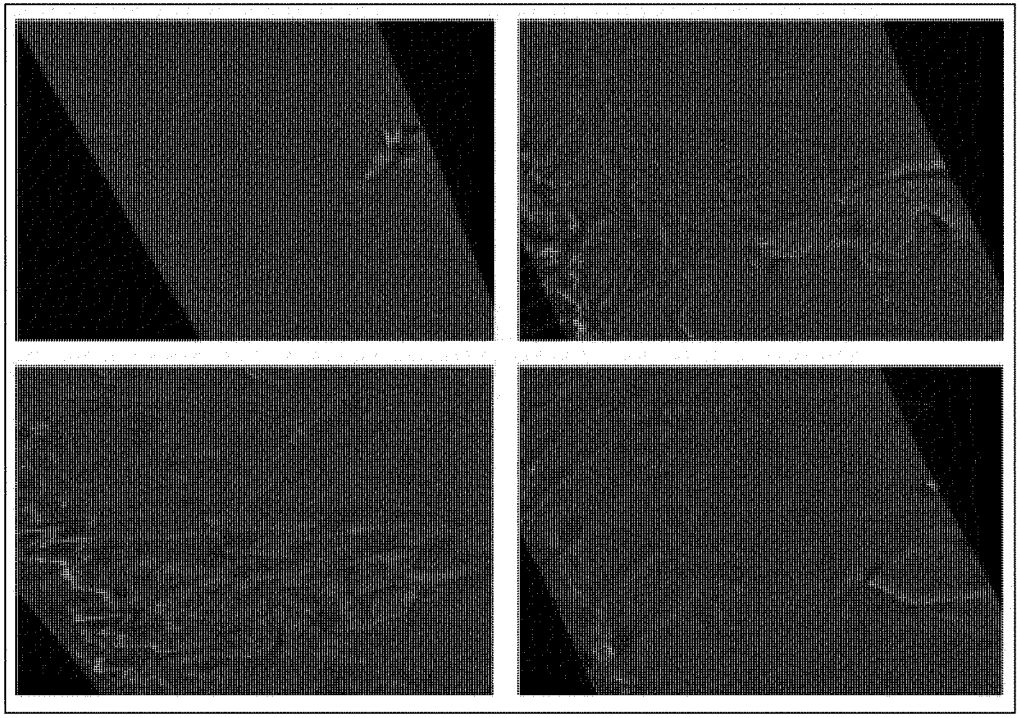


Figure 2-27: Comparison of the DCA 2011 and USACE 2012 substrate surveys. Green polygons (USACE) depict sand ripples whereas red polygons (DCA) delineate supposed hardbottom features. Polygons are overlain on USACE sidescan data.

2.4.5 Fish and Wildlife Resources

Biological communities found in the study area are well adapted to the particular physiochemical and hydrodynamic conditions associated with the supralittoral beach and the intertidal swash zone (Day 2008). The supralittoral beach, or splash zone, is the fringe that is regularly splashed but not submerged by ocean water (Day 2008). The intertidal (littoral) zone, or swash zone, is the part of the shore that is intermittently covered or exposed by rising and falling tides (Day 2008). Two major physical factors – exposure to both the air and wave action — shape the lives of inhabitants (Day, 2008). The biological communities in the highly dynamic intertidal swash zone must cope with being aerially exposed during normal tidal cycles as well as being subjected to high energy of ocean waves.

Wildlife species generally utilize the supralittoral zone as well as exposed beach and dune within the study area (Day 2008). These consist of small mammals, reptiles, raptors, wading birds, and shorebirds. Forage and game fish, invertebrates and other infauna are found below MLLW in the sublittoral and nearshore of the study area. The presence of fish and infauna attract wildlife to this area. Specifically, these inhabitants may include various terns (*Sterna* spp), gulls (*Laris* spp), and shorebirds like the ruddy turnstone (*Arenaria interpres*), along with medium sized mammals such as raccoon (*Procyon lotor)*. Shorebird nesting habitat occurs along the ecotone between the dune and unvegetated beach, although this habitat is marginal in several of the study reaches. Finally, larger pelagic fish and marine mammals, such as tarpon (*Megalops atlanticus)* and bottlenose dolphins (*Tursiops truncates)* are prevalent in the coastal and offshore waters of the study area.

Infauna

The intertidal zone is shaped constantly as animals and plants are swept away or holdfast species are disrupted, creating opportunities for colonizers to invade any newly opened spaces (Day, 2008). Receding waves tend to wash amphipods (shrimp-like crustaceans) and isopods (small crustaceans such as woodlice) out of their burrows and suspend these organisms in the water column where they serve as an important food source for a variety of nearshore forage and game fish. Following storms, some organisms are found at greater depths in the water column than before the storms occurred, whereas others may be found in concentration along the benthic surface (Dobbs, 1983). A variety of polychaete worms that are also adapted to this highly dynamic and stressful environment can be found within the intertidal zone of the Flagler County coast. These benthic organisms provide an important food source for foraging wading and shore birds. For example, Atlantic coquina (*Donax variabilis*) clams are important in both marine and terrestrial food chains, and are used as indicator species to monitor the ecological health of beaches following shoreline protection projects (Donoghue, 1999). Highly visible decapod crustaceans of the Flagler County upper intertidal zone include the ghost crab (*Ocypode quadrata*), mole crab (*Emerita talpoida*), and Atlantic fiddler crab (*Uca pugilator*). These organisms are highly mobile and burrow

into the moist sand for refuge to retard water evaporation from their bodies during aerial exposure (Barnes 1974).

Marine Mammals

The Flagler County coast, including the project area, is within the range of the Florida sub-species of the West Indian manatee (*Trichechus manatus latirostris*) and up to 28 cetacean species, with bottlenose dolphin (*Tursiops truncates)* being most common.

The West Indian manatee has been listed as a protected mammal in Florida since 1893 and is also federally protected under the Marine Mammal Protection Act of 1972 (MMPA) as a depleted species. The manatee was listed as an endangered species throughout its range in 1967 (32 FR 4061) and received Federal protection with the passage of the ESA in 1973. Although critical habitat was designated in 1976 for the Florida subspecies (50 CFR 19.95(a)), there is no federally designated critical habitat in the project's impact area. Florida provided further protection in 1978 by passing the Florida Marine Sanctuary Act designating the state as a manatee sanctuary and providing signage and speed zones in Florida's waterways. It is unlikely that manatees would utilize habitat along the study area as no inlets or access to freshwater exists in the beach coastal area.

Bottlenose dolphins have robust bodies that typically reach 6 to 12 feet as adults. They feed on fish such as mullet and sheepshead, along with marine invertebrates. The live up to 50 or more years, and have weights between 140 kilograms and 650 kilograms. Bottlenose dolphins frequent both inshore and offshore marine waters along temperate and tropical coasts. Inshore dolphins live in small social groups, or pods, of up to 10 individuals, and are frequently sighted along the Flagler County coast. They are highly intelligent and have complex socialization and communication skills. Dolphins along the coast of Florida are protected by Federal law against harassment under the Marine Mammal Protection Act (MMPA) of 1972. (FWC, NMFS, website factsheets).

2.4.6 Essential Fish Habitat

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act of 1996, waters and substrate within the project area have been identified as Essential Fish Habitat (EFH) by the South Atlantic Fishery Management Council (1998). EFH is defined as "those waters and substrate necessary for fish to spawn, breed, feed, or grow to maturity." Important habitats of the South Atlantic region are broadly divided into estuarine/inshore and marine/offshore with many subcategories under each heading. Marine/offshore habitats include coastal, open shelf, live/hardbottom, shelf edge, and lower shelf (SAFMC, 1998). Each of these habitats harbors a distinct assemblage of demersal (close to the ocean floor) fishes and invertebrates. The Flagler County HSDR study area encompasses only marine/offshore habitats and, of these, the reaches of the study area include other major habitats of nearshore hardbottom, soft bottom (open shelf), and the water column with an unconsolidated substrate and high salinity ocean surf zones. Hardbottom discussion is included in **Section 2.4.4**.

Fishes and Essential Fish Habitat

The fish community of eastern Florida is one of the most diverse in the western Atlantic region. This high diversity is the consequence of biogeographical (geographical distribution of organisms) and environmental factors operating on various spatial and temporal scales (Gilmore, 2001). Overlap of tropical, subtropical, and warm-temperature faunas underlies the transitional nature of the region's biogeography (Gilmore, 2001). Consequently, the resulting composition of species with differing ecological and evolutionary histories can be subdivided into several assemblages and habitats. The primary environmental factor influencing fish distribution in the region is water temperature. Seasonal drops in temperature affect inshore and coastal waters and limit the distribution of subtropical species in inshore waters along the central coastal region including Flagler County. The average water temperature during winter ranges from 15° to 18° C (59° to 64° F) in the study area. Although Flagler County is north of the tropical zone, many fish species still occur in the study area on a seasonal basis. The Gulf Stream brings warm water to the outer shelf of the region, but water temperatures on the outer shelf can decline rapidly as a result of periodic upwelling that originate along the shelf break (Smith, 1983). These features can influence nearshore waters if prevailing conditions promote inshore movement of water masses. In addition to water temperature, other environmental factors important to the distribution and abundance of fish include salinity, dissolved oxygen, turbidity, and hydrodynamics. Three habitats describe fish assemblages occurring in waters of the Flagler County coastal region: demersal soft bottom, coastal pelagic, and demersal hardbottom.

Demersal Soft Bottom

The demersal soft bottom fish assemblage that inhabits the open shelf off eastern Florida consists of 213 species in 53 families (Gilmore et al, 1981; Gilmore 2001). Only those species that are managed by the South Atlantic Fishery Management Council (SAFMC) are included in this discussion. These include skates (*Rajidae),* stingrays *(Dasyatidae),* torpedo rays (*Torpedindae),* cusk-eels (*Ophidiidae),* searobins (*Triiglidae),* flounders (*Bothidae),* sand flounders (*Paealichthyidae),* and soles (*Soleidae)* (SAFMC, 1998). The coastal or nearshore segment of the open shelf (or surf zone), represents the landward extent of this assemblage. Although movements of demersal soft bottom species are not well known, some species, such as flounders, may move along the coast or across the shelf in response to changes in temperature, salinity, dissolved oxygen, or high wave energy, and may occur during a variety of temporal scales ranging from daily to annual (Ross, 1983). Some species may use the surf zone only as juvenile habitat, while others spend most of their life cycle there (Peters and Nelson, 1987). Most demersal soft bottom species feed on infaunal or epifaunal invertebrates, while others like flounder feed in the water column on fishes and decapods (Modde and Ross, 1983).

Penaeid shrimp managed by the SAFMC and potentially occuring in the study area include brown shrimp (*Farfantepenaeus aztecus),* pink shrimp *(F. duorarum*), and white shrimp *(Litopenaeus setiferus)* (SAFMC Website, 2012). For penaeid shrimp, EFH encompasses a series of habitats used throughout their life history with two basic

phases: adult and juvenile benthic phase, and planktonic larval and post-larval phase (SAFMC, 1998). Benthic adults aggregate to spawn in shelf waters over coarse calcareous sediments and feed on zooplankton in the water column as they make their way into inshore waters.

Coastal Pelagic

The major coastal pelagic families occurring in nearshore waters of eastern Florida are requiem sharks (*Carcharhinidae),* eagle and cownose rays (*Myliobatidae)*, ladyfish (*Elopodae),* tarpon (*Magelapodae),* anchovies (*Engraulidae),* herrings (*Clupeidae),* mackerels (*Scombridae),* jacks and pompanos (*Carangidae),* mullets (*Mugilidae),* bluefish (*Pomatomidae),* and cobia *(Rachycentridae*) (SAFMC, 1998). Gilmore et al (1981) reported 91 species from the surf zone habitat of the South Atlantic region; 62 of these species were coastal pelagic. Species associated with the coastal pelagic environment migrate over shelf waters of the nearshore and surf zone throughout the year, although fall and winter are generally the times of peak activity. Some species form large schools, such as cownose rays, anchovies, herrings, and mullets. Other species travel singularly or in small groups, like tarpon, and cobia (SAFMC, 1998). Larger predatory species particularly sharks, tarpon, bluefish, and jack crevalle may be attracted to aggregations of anchovies, herrings, and mullets that typically occur in nearshore areas in late summer or fall. The local distribution of most species depends on water temperature and quality, especially turbidity that fluctuates seasonally (Gilmore, 2001). Rapid drops in air temperature and atmospheric pressure associated with passing cold fronts often initiate southerly migrations of coastal pelagic species including Spanish mackerel and bluefish along the Florida coast.

Coastal sharks commonly occur in inshore or nearshore waters. Several SAFMC managed species that may occur in the study area include blacknose (*Carcharhinus acronotus)*, spinner (*C. brevipinna),* bull (*C. leucas),* dusky (*C. obscurus),* sandbar (*C. plumbeus),* tiger (*Gaelocerdo cuvier),* sand tiger (*Carcharias Taurus),* bonnethead (*Spyrna tiburo)*, and lemon (*Negaprion brevirostris).* Sharks and rays reproduce through internal fertilization and bear live young or eggs in shelf or inshore waters, species dependent. Females often seek shallow water before releasing live pups or depositing eggs (NMFS, 1999). Sharks are opportunistic scavengers for much of their lives, feeding in both the water column and on the bottom. Ideal EFH identified by NMFS (1999) for shark species include coastal waters within the study area of less than 82-foot (25 meter) depths (SAFMC, 1998).

Coastal pelagic fishes, excluding rays and sharks typically spawn in open shelf waters that result in planktonic eggs and larvae. As larvae transform into juveniles, some may enter inshore estuarine habitats while others, like the Florida pompano, migrate into shallow nearshore where they will remain until obtaining a certain size or age (SAFMC, 1998). Most coastal pelagic fishes feed in the water column on nekton (drifting organisms) or plankton. Diets of individual species diversify with size and age based

upon the corresponding forage morphology of body shape and jaw mechanism. For example, mackerels and jacks change from an early diet of zooplankton-feeding larvae to an opportunistic adult diet consisting of pelagic and benthic organisms. Some species like juvenile and adult pompano, feed mostly on benthic organisms including clams, mole crabs, and other crustaceans. Coastal pelagic species managed by SAFMC include the cobia (*Rachycentron canadum)*, king mackerel (*Scomberomorus cavalla)*, Spanish mackerel (*S. maculates)*, and little tunny (*Euthynnus alletteratus)* (SAFMC, 1998). For the coastal pelagic species, EFH includes sandy shoals of capes and offshore bars, high profile rocky bottom, and barrier island ocean-side waters from the surf zone to the shelf break zone, as well as all coastal inlets and state designated nursery habitats of particular importance to coastal migratory pelagic (SAFMC, 1998).

Demersal Hardbottom

Hardbottom habitats support the most diverse assemblages of fishes off eastern Florida. Gilmore et al (1981) reported 255 species for offshore reefs and 109 species associated with nearshore hardbottom habitat. Groupers, *Serranidae),* snappers (*Lutjanidae),* grunts (*Haemulidae),* porgies (*Sparidae),* spadefishes (*Ephippidae),* damselfishes (*Pomacentridae),* and wrasses (*Labridae)* are the most common fish families occupying hardbottom. These groups are tropical and subtropical in origin. The most abundant species reported by Gilmore et al (1981) for the southeastern U.S. coastal region include black margate (*Anisotremus suninamensis),* porkfish (*Anisotemus virginicus)*, spottail pinfish (*Diplodus holbrooki),* and hairy blenny (*Labrisomus nuchinipinnis).*

Many reef fishes experience developmental migrations by using a continuum of cross-shelf habitats that are an integral part of their life cycle. Often, species migrate across the shelf from shallow nursery areas before returning to offshore spawning grounds (SAFMC, 1998). Hardbottom, including nearshore hardbottom, provides the connection for young stages of species making developmental migrations from inshore areas to offshore spawning grounds (Lindeman et al, 2000).

Generally, reef fish spawn off shore by releasing eggs and larvae into the water column. Some species of snapper have larvae that are transported into the inshore areas where they settle on the bottom, occupying seagrass meadows. As they mature, the juveniles will move to more structured artificial and natural nearshore hardbottom. Other species of reef fish have similar life cycles as their early stages may inhabit nearshore hardbottom (Lindeman and Snyder, 1999). Nearshore hardbottom provides an important connection among habitats for the cross-shelf developmental pathways undertaken by many reef species (Lindeman et al, 2000). Disruption of habitat connections can alter growth and ultimately reproduction of individuals that contribute to local demographic patterns. Other reef fishes such as damselfishes, blennies, and gobies settle onto reefs for the plankton and remain for their entire lives within a very small area of the habitat. Most reef fishes begin life feeding on zooplankton but change diet with size and age. Some species, such as snappers and groupers, are carnivorous from early stages, changing only the size of the food items as they grow, while others

feed on zooplankton as juveniles and then switch to benthic prey as they mature (Sweatman, 1993). Consequently, some reef fishes depend on the hardbottom for food, whereas many other depend on plankton and nekton across the reef or surrounding soft bottom areas.

The SAFMC reef fish management group (consisting of snapper and grouper) encompasses 73 species from 10 families. The fisheries and adult habitat of most of these species exist well offshore of the study area; however, the young stages of several reef fishes utilize nearshore hardbottom (SAFMC, 1998). Habitats associated with the study area that have been named by SAFMC as EFH for early life stages of reef fishes include macro-algae, soft sediments, artificial reefs, and live hardbottom. No known presence of hardbottom has been found in the nearshore of Flagler County at this time; subsequent hardbottom resources survey (including presence of macroalgae) for the Borrow Area 2 is underway. Reef fish of importance that are not included in the management by SAFMC include tarpon and common snook (*Centropomus undecimalis),* striped croaker (*Bairdiella sanctaeluciae)*, Florida pompano, summer flounder (*Paralichthys dentatus),* and southern flounder (*P. lethostigma).* Furthermore, Florida pompano, flounder, and tarpon are considered to be Aquatic Resources of National Importance (ARNI) by the U.S. Environmental Protection Agency (EPA) under jurisdiction of the Clean Water Act Section 404 (q) 1992 Memorandum of Agreement with USACE (EPA ARNI Website Factsheet, 2012). A summary table of fish species that may spend part of their life cycle in the study area is presented in **Table 2-14**.

Table 2- 14: Fish Species by Family. Data from the Reef Fish Management Unit for Essential Fish Habitat with anticipated occurrence along coastal Flagler County, Florida

Family	Common Name	Species	Spawning	Eggs	Larvae	Juveniles	Adults
Serrandiae— Sea Basses Groupers	Red grouper	*Epinephelus morio*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; inshore and shelf waters	Demersal; hardbottoms, shelf waters
	Goliath grouper	*Epinephelus itajara*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; inshore and shelf waters	Demersal; hardbottoms, shelf waters
	Gag	*Mycteroperca microlepsis*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; inshore and shelf waters	Demersal; hardbottoms, shelf waters
	Scamp	*Mycteroperca phenax*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; shelf waters	Demersal; hardbottoms, shelf waters
	Black sea bass	*Centriopristis striata*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; inshore and shelf waters	Demersal; hardbottoms, shelf waters
Carangidae-- Jacks	Blue runner	*Caranx crysos*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore; shelf waters
	Crevalle jack	*Caranx hippos*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore; shelf waters
Lutjanidae-- Snappers	Gray snapper	*Lutjanus griseus*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore; shelf waters
	Lane Snapper	*Lutjanus synagris*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; hardbottom; shelf waters	Demersal; hardbottom; inshore; shelf waters
	Vermillion snapper	*Rhomboplites aurorubans*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; shelf waters	Demersal; hardbottom; inshore; shelf

							waters
Haemulidae--	White grunt	*Haemulon plumieri*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore; shelf waters
Haemulidae--	Porkfish	*Anisotermus virginicus*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore; shelf waters
Grunts	Black margate	*Anisotermus surinamensis*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore; shelf waters
	Sailors choice	*Haemulon parra*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore; shelf waters
Sparidae-- Porgies	Sheepshead	*Archosargus probatocephalus*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore waters	Demersal; hardbottom; inshore; shelf waters
Ephippidae-- Spadefishes	Atlantic spadefish	*Craetodipterus faber*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; inshore and shelf waters	Demersal; hardbottom; inshore; shelf waters
Balistidae— *triggerfishes*	Gray triggerfish	*Balistes capriscus*	Shelf waters	Pelagic; shelf waters	Pelagic; shelf waters	Demersal; shelf waters	Demersal; hardbottom; inshore; shelf waters

Source: South Atlantic Fishery Management Council, 1998

2.4.7 Birds

Birds occurring in the study area include mostly wading bird, shorebird and seabird species that use the outer beach and primary dune habitats for roosting, feeding, and/or nesting activities. Species federally protected under the Migratory Bird Act and known to occur as residents or seasonal visitors within Flagler County are summarized in **Table 2-15**, along with abundance and locations where they have been observed. Data acquired from the Flagler Audubon Society in conjunction with the Cornell Lab of Ornithology from 2004 to 2011 show a trend of heavy usage within three reaches of the Flagler County coastline (eBirds website database, 2012). Areas considered as "hotspots" for bird usage by the Flagler Audubon Society include Marineland and Washington Oaks Garden State Park, south Flagler Beach, and Gamble Rodgers Memorial State Recreation Area. No reaches within the Flagler County study area are identified as Important Bird Areas (IBAs). Bird usage of inland areas and the Atlantic

Intracoastal Waterway are not included in this discussion. Additionally, incidental sightings of seabirds and shorebirds was conducted by a USACE Biologist in August, 2011. A summary of study-specific observations is presented in **Table 2-16**.

Data from the Flagler Audubon Society and Cornell Ornithology Lab (eBirds database website, 2012) include a few other shelf and pelagic seabird species that may seasonally range into near coastal waters of the study area but are not expected to be affected by proposed project activities. These species are as follows:

- Cory's Shearwater (*Caleonectris dioedea)*: occasionally comes close to shore from June to November: sighted off Flagler Beach
- Greater Shearwater (*Puffinus gravis)*: occasionally comes close to shore from June to November; rare sighting on coastal Flagler County
- Audubon's Shearwater (*Puffinus iherminieri)*: rarely comes close to shore in summer
- Northern Gannet (*Morus bassanus):* commonly sighted in winter along the shoreline at Washington Oaks Garden State Park and Gamble Rodgers Memorial State Recreation Area
- Great Scaup *(Aytha marila)*: occasional sightings off of Washington Oaks Garden State Park and Flagler Beach; November

Table 2-15: Shorebirds and near coastal seabirds in Flagler County, Florida

Common Name	Genus/Species	Sighting Abundance	Location within Flagler County
SHOREBIRDS			
Black-bellied Plover	*Pluvalis squatarola*	Common	Flagler Beach[1]
Semipalmated Plover	*Charadrius semipalmatus*	Occasional	Gamble Rodgers Memorial SRA
Wilson's Plover	*Charadrius wilsonia*	Rare	Gamble Rodgers Memorial SRA
Killdeer	*Charadrius vociferous*	Occasional	Flagler Beach
Piping Plover*	*Charadrius melodus*	Rare	Gamble Rodgers Memorial SRA
American Oystercatcher	*Haematopus palliates*	Occasional	Flagler Beach
Black-necked Stilt	*Himantopus mexicanus*	Occasional	Flagler Beach
American Avocet	*Recurvirostra Americana*	Occasional	Flagler Beach
Wilson's Snipe	*Gallinago gallinago*	Uncommon	Gamble Rodgers Memorial SRA
Short-billed Dowitcher	*Limnodromus griseus*	Rare	South Flagler Beach
Long-billed Dowitcher	*Limnodromus scolopaceus*	Rare	South Flagler Beach
Marbled Godwit	*Limosa fedoa*	Occasional	Washington Oaks, Gamble Rodgers Memorial SRA
Whimbrel	*Numenius phaeopus*	Accidental	Washington Oaks, Gamble Rodgers Memorial SRA
Greater Yellowlegs	*Tringa malenoleuca*	Occasional	Washington Oaks, Gamble Rodgers Memorial SRA
Lesser Yellowlegs	*Tringa flavipes*	Common	Flagler Beach
Willet	*Catoptrophorus semipalmatus*	Occasional	Flagler Beach
Ruddy Turnstone	*Arenaria interpres*	Occasional	Flagler Beach Pier
Red Knot	*Calidris canutus*	Occasional	Flagler Beach
Sanderling	*Calidris alba*	Common	Flagler Beach
Semipalmated Sandpiper	*Calidris pusilla*	Occasional	Washington Oaks, Gamble Rodgers Memorial SRA
Western Sandpiper	*Calidris mauri*	Occasional	South Flagler Beach
Least Sandpiper	*Calidris minutilla*	Common	Flagler Beach
White-rumped Sandpiper	*Calidris fuscicollis*	Rare	Flagler Beach
Baird's Sandpiper	*Calidris bairdii*	Accidental	Flagler Beach
Pectoral Sandpiper	*Calidris melanotos*	Accidental	Flagler Beach
Dunlin	*Calidris alpina*	Common	Gamble Rodgers Memorial SRA
Buff-breasted Sandpiper	*Tryngites subrufucollis*	Accidental	Flagler Beach
Red Phalarope	*Phalaropus fulicaria*	Rare	Gamble Rodgers Memorial SRA
SEABIRDS			

Brown Pelican	*Pelicanus occidentalis*	Common	Washington Oaks, Gamble Rodgers Memorial SRA
Double-crested Cormorant	*Phalacrocorax auritus*	Common	Gamble Rodgers Memorial SRA
Ring-billed Gull	*Larus delawarensis*	Common	Flagler Beach
Great Black-backed Gull	*Larus marinus*	Uncommon	Flagler Beach Pier
Herring Gull	*Larus argentatus*	Occasional	Gamble Rodgers Memorial SRA
Bonaparte's Gull	*Larus Philadelphia*	Common	Flagler Beach
Laughing Gull	*Larus atricilla*	Common	Flagler Beach
Gull-bill Tern	*Sterna nilotica*	Accidental	South Flagler Beach
Caspian Tern	*Sterna caspia*	Uncommon	Flagler Beach
Sandwich Tern	*Sterna sandvicensis*	Occasional	Beverly Beach
Royal Tern	*Sterna maxima*	Common	Flagler Beach
Common Tern	*Sterna hirundo*	Rare	Gamble Rodgers Memorial SRA
Forster's Tern	*Sterna fosteri*	Common	Flagler Beach Pier
Sooty Tern	*Sterna fuscata*	Rare	Washington Oaks SP
Black Tern	*Chlidonias niger*	Common	Flagler Beach
Black Skimmer	*Rhynchops niger*	Common	Flagler Beach
WADING BIRDS			
Great Blue Heron	*Ardea Herodias*	Common	Marineland, Washington Oaks SP
Great Egret	*Ardea alba*	Common	Gamble Rodgers Memorial SRA
Tricolored Heron	*Egretta tricolor*	Common	Flagler Beach
Little Blue Heron	*Egretta caerulea*	Common	Flagler Beach
Snowy Egret	*Egretta thula*	Common	Flagler Beach
Green Egret	*Butorides virescens*	Uncommon	Flagler Beach
Black-crowned Night Heron	*Nycticorax nycticorax*	Occasional	Marineland, Washington Oaks SP
Yellow-crowned Night Heron	*Nycticorax violacea*	Uncommon	Marineland, Washington Oaks SP

Source: Flagler Audubon Society and Cornell Ornithology Lab, 2012
* = Listed as Endangered under the Endangered Species Act of 1973; see Section 2.3.3.3 for full discussion
C = Common – Present in large numbers and widespread; certain to be seen in the right habitat.
U = Uncommon - Present in lower numbers or local in distribution; should be seen with reasonable effort in the correct habitat.
O = Occasional – Present in small numbers or local in distribution. Not expected to be seen without special effort.
R = Rare – in range but not expected to be seen every year. When present, usually in very low numbers or are secretive or very hard to find.
A = Accidental – Either very rare or out of their normal range.
Flagler Beach[1] = Sightings found throughout all Flagler County beaches; not expected to be restricted to any particular location.

Table 2-16: Bird Sightings within Flagler County HSDR Study Area by USACE Biologist

Common Name	Scientific Name	Abundance, Location of Sighting
Dunlin	*Calidris alpina*	Few, Throughout all beaches
Sanderling	*Calidris alba*	Many, Throughout all beaches
Willet	*Catoptrophorus semipalmatus*	Few, South Flagler Beach
Osprey	*Pandion haliaetus*	Two, Gamble Rodgers Memorial SRA
Herring Gull	*Larus argentatus*	Many, Throughout all beaches
Ring-billed Gull	*Larus delawarensis*	Many, South Flagler Beach
Bonaparte's Gull	*Larus Philadelphia*	Few, South Flagler Beach, Gamble Rodgers Memorial SRA
Laughing Gull	*Larus atricilla*	Many, South Flagler Beach
Snowy Egret	*Egretta thula*	Few, South Flagler Beach, Gamble Rodgers Memorial SRA
Piping Plover*	*Charadrius melodus*	Five, Gamble Rodgers Memorial SRA
Royal Tern	*Sterna maxima*	Many, South Flagler Beach
Forster's Tern	*Sterna fosteri*	Few, South Flagler Beach
Ruddy Turnstone	*Arenaria interpres*	Few, Gamble Rodgers Memorial SRA and Flagler Beach Pier

All observations occurred during one-day event (August 2, 2011) by USACE Biologist
* = Listed as Endangered under the Endangered Species Act of 1973; see Section 2.3.3.3 for full discussion

2.4.8 Cultural, Historical, and Archaeological Resources

Prior to this study, archival research and cultural resource surveys have been conducted along the Flagler County shoreline. Currently, no previously recorded resources are situated within the borrow areas or proposed beach placement areas. No cultural resource surveys have yet to be conducted within the borrow areas and along the nearshore. However, between the shoreline placement areas and the adjacent highway there are resources that are in peril due to continued shoreline erosion. A comprehensive Cultural Resources report entitled *Phase I Cultural Resource Survey as Part of the Flagler County Shoreline Protection Feasibility Study*, for the entire study area between the highway and shoreline, was conducted by Brockington and Associates, Inc. in December 2010. Each potential reach was examined for the presence of resources located either directly on the beach or east of the highway paralleling the beach or contained within the borrow area. The resulting data has led to the documentation of multiple cultural resources of which only a few are significant or potentially significant. There are three known resources located along the Marineland reach. One is an archaeological site and the other two are historic structures. Marineland is listed on the National Register of Historic Places while the Marineland Midden, a known site of past human activity, is reported to contain human remains. The Painters Hill reach does not contain known resources at this time. This determination is based on not having any previous cultural resource surveys in this area. The Beverly

Beach reach contains only a single known historic structure. The Flagler Beach reach contains five known resources. All five are historic structures.

Within the three identified potential borrow areas and shown in **Figure 2-14**, there are no yet-identified resources as cultural resource surveys have not been conducted in these areas. A Cultural Resource survey of Borrow Area 2, Sub-areas 2A, 2B, and 2C is currently pending.

Marineland opened in June of 1938 as Marine Studios. The innovative oceanarium created an opportunity for the general public to see marine life close-up. Throughout the years, Marineland has pioneered studies in marine science, animal training, water chemistry and more. Since 1938, Marineland has been the first to successfully breed and train dolphins and it was its early scientists who discovered dolphin echolocation, social behavior and communication. The effects of the salt air and hurricanes led to a decline in the structural integrity of many of the pools and artificial habitats that made up Marineland. The Dolphin Café (8FL270), once a component of the Marineland Historic District, was demolished in 2005 because the building had suffered too many alterations to be considered a contributing element to the district. In 2004, older structures were retired, and in early 2006, the Marineland Dolphin Conservation Center opened. The Marineland facility was purchased in 2010 by the Georgia Aquarium, and still provides research, educational and entertainment opportunity to the general public. The conservation center is a modern 1.3 million gallon facility designed with the behavioral needs of the animal, the viewing capabilities of the scientist, the logistical needs of the trainer, and the educational and entertainment needs of the public in mind.

Other previously recorded historically significant architectural properties within the study area include the High Tides at Snack Jack Restaurant (8FL305), and the Flagler Beach Pier (8FL885). The Pier was originally constructed in 1928, but has been reconstructed or significantly repaired numerous times due to continual storm damage and wave action (**Figure 2-28**). The original entrance pavilion was replaced in 1964 with the current A-framed design. Additionally, the SR A1A Oceanshore Boulevard (8FL286) is a historic landscape feature that extends along the entire length of the survey corridor and is a designated National Scenic Byway eligible for inclusion in the National Register of Historic Places (NRHP).



Source: Brockington and Associates, Inc.

Figure 2-28: Flagler Beach Fishing Pier Building, circa 1950's

In addition to identified, previously recorded and newly identified resources is a shipwreck report listed on the National Oceanic and Atmospheric Administration (NOAA) nautical charts for the area. This shipwreck/obstruction is indicated to be offshore of Flagler County but recently during biological hardbottom investigations, a potential wreck was identified in the nearshore area. A USACE survey vessel took a closer look at the reported NOAA shipwreck and confirmed that the map location is in error and the shipwreck is located in the immediate nearshore. The vessel, based on the remains of its shape and construction, may be the "Northwestern", a steam freighter built in 1881 and sunk in 1920. However, further investigation is needed to confirm this identification.

Because of the rich history of over 500 years of historic use and over thousands of years of prehistoric use, there continues to be high potential for the discovery of significant resources within the coastal environment of Flagler Beach. Prior to potential dredging and project implementation, areas of proposed work will be subjected to additional resource investigations to identify and evaluate resources. A comprehensive Cultural Resources report for the entire study area conducted by Brockington and Associates, Inc. is included in the **Environmental Appendix**.

2.4.9 Aesthetics

Consideration of aesthetic resources is required by NEPA, as amended and USACE Engineering Regulation (ER) 1105-2-100. Aesthetic resources are defined as "those natural and cultural features of the environment that elicit a pleasurable response" from the observer, most notably from the predominantly visual sense. The uniquely colored orange sand of Flagler County beaches, as well as the ability to see the beach, dunes, and ocean from SR A1A, is an example of additional aesthetic qualities valued by members of the community as shown in **Figure 2-29**. These values are subjective, and as such, the erosional features of the beach and its adverse impact to the area's aesthetic quality cannot be effectively quantified.

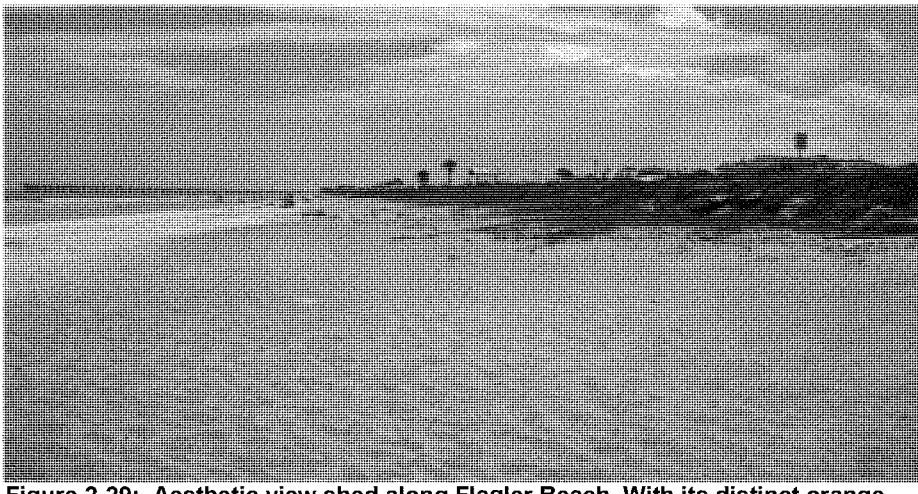


Figure 2-29: Aesthetic view shed along Flagler Beach. With its distinct orange color, coquina-derived shell hash composes the upper beach material making Flagler County beaches unique throughout Florida. Low dunes and beaches along SR A1A provide an aesthetically pleasing view shed from this historic roadway.

2.4.10 Recreation

The project area is a favorite for county residents to spend their leisure time sunbathing, swimming, surfing, walking, and fishing, in addition to a variety of other active and passive activities. However, the recreational capacity and potential of the beach within the limits of the project are being threatened with ongoing erosion. The spring, summer, and fall months of the year are the most active times with the summer months comprising the peak use period. During the winter months, the Flagler County beaches are generally used by relatively few people due primarily to low temperatures (40°F to 60°F) and the frequency of northeast winds which produce strong waves and high tides.

In 2010, the total number of beach visits in Flagler County was estimated to be 626,467 (for the entire year). This estimate is based on projections provided by the State of Florida "Trends and Conditions Report - 2008" for northeast Florida, the 2007 Florida Statewide Recreation Plan (SCORP), and county tourism allocation projections developed for the Nassau County Florida General Reevaluation Report (USACE 2008). The number of visits is projected to increase to 791,295 by 2020 and 1,265,250 by 2050.

Incidental recreation benefits will be measured using the Unit Day Value (UDV) method, in accordance with Appendix E of ER 1105-2-100 and USACE Economic Guidance Memo #12-03, *Unit Day Values for Recreation*, FY 2013. More information about the recreation analysis is provided in Section 6 of this report and in **Appendix C**.

2.4.11 Coastal Barrier Resources

The Coastal Barrier Resources Act (CBRA) of 1982 (FWS PL 97-348) discourages development on largely undeveloped coastal barriers along the Atlantic, Gulf, and Great Lakes coasts by prohibiting use of Federal expenditures. The purpose of the Act is to remove the Federal incentive to develop these areas by making them ineligible for Federal expenditure and financial assistance. This encourages conservation of hurricane prone, bio-rich coastal barriers by restricting Federal expenditure in the sensitive habitats (http://www.fws.gov/CBRA/index.html). CBRA Unit P05A Matanzas River lies immediately north of the Marineland study reach outside of the study area. CBRA Unit P06P, an Otherwise Protected Area (OPA) is located at the Washington Oaks Garden State park from FDEP monument R-12 to R-16 and is within the study area. OPAs are generally comprised of lands that are intended for natural resource conservation or recreational usage. CBRA Unit P07P is another OPA that lies immediately south of the Flagler Beach reach at the Gamble Rodgers Memorial State Recreation Area from R-95 to R-101. It is within the study area, as depicted on **Figure 2-30**.

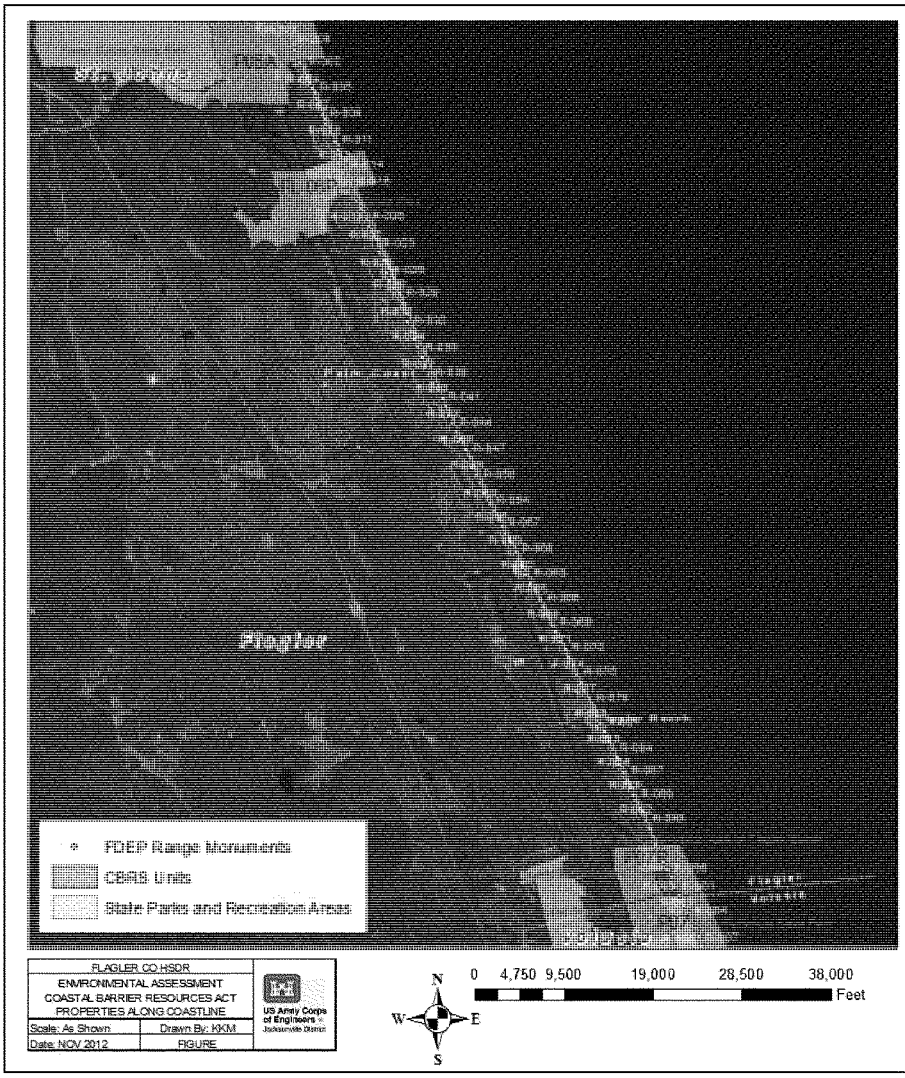


Figure 2-30: Coastal Barrier Resources Act (CBRA) units within Study Area. Note no units are located within the proposed Recommended Plan limits from FDEP monument R-65 to R95.

2.4.12 Water Quality

The waters off coastal Flagler County within the study area are listed as Class III waters under the criterion as "suitable for fish consumption, recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife" (Ch 62-302.400 (1) F.A.C.). Classifications are arranged in order of the degree of protection required, with Class I water having generally the most stringent water quality criteria, and Class V the least. However, Class I, II and III surface waters share water quality criteria established to protect fish consumption, recreation, and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife (Ch. 62-302.400 (4) F.A.C.).

Turbidity is a major limiting factor for coastal water quality in South Florida. Turbidity, expressed in Nephelometric Turbidity Units (NTU), quantitatively measures the light-scattering properties of the water. However, the properties of the material suspended in the water column that create turbid conditions are not reflected in turbidity measurements. The two reported major sources of turbidity in coastal areas are very fine organic particulate matter, and sand-sized sediments that are re-suspended around the seabed by local waves and currents (Dompe and Haynes, 1993). Turbidity values are generally lowest in the summer months and highest in the winter months, corresponding with winter storm events and the rainy season (Dompe and Haynes, 1993). Specific turbidity levels within the reaches of the study area are not currently available.

Threats from water-borne pathogens can cause diseases such as Hepatitis A, viral and bacterial gastroenteritis, typhoid fever, and dysentery. Through the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, the EPA has authority to keep the coastal recreation areas healthy and safe for public usage by adoption of marine surface water quality standards (EPA BEACH website). This allows the EPA to award eligible states the grants needed to develop and implement standards consistent with the Act requirements. The health and safety of public beaches are determined by water sampling and analysis for contamination from fecal matter (L. Leiendecker, 2007). In Florida, the Act is administered by the Department of Health (DOH) through the Florida Healthy Beaches Program (DOH website, 2004). In 1986, the EPA established the *Ambient Water Quality Criteria for Bacteria* (EPA 440/5-84-002) as the guidance to meet the requirement standards set forth by the BEACH Act of 2000. The EPA criteria identified *E. coli* and *Enterococci* as two recommended indicators to assess the microbiological safety of water (L. Leiendecker, 2007). Fecal coliform is a general term that encompasses all coliform bacteria, including *E.Coli,* found in human intestines. *Enterococci* are the bacteria that thrive in the intestinal tract of mammals and birds. Common sources for these bacteria are wastewater, failing septic systems, dog feces, and sewer water (EPA website, 2012). These bacterial indicators do not necessarily harm humans, but high levels suggest a high probability of dangerous pathogen contamination from feces (L. Leiendecker, 2007). In addition to adopting fecal coliform as an indicator organism for bacterial contamination, DOH used

the 1986 EPA guidance to implement *Enterococci* monitoring along with fecal coliform to fulfill both state and Federal requirements (DOH website, 2012).

Since the enactment of BEACH Act in 2000, sample analytical data has been submitted to the EPA by the Florida DOH, who is responsible for the reporting. Data collected from Flagler County include the following beaches:

- Gamble Rodgers Memorial State Recreation Area
- North Flagler Pier
- Beverly Beach (including Varn Park)
- South Flagler Pier
- Washington Oaks State Park

The beaches are monitored year round, starting in the year 2000, and continue through the present (June, 2012). The standards set forth by the EPA are as follows:

- Good: 0 to 35 *Enterococcus* per 100 ml of marine water, or the Geometric standard of 0 to 35 Colony Forming Units (CFU) per 100 ml of marine water; 0 to 199 fecal coliform organisms per 100 ml of marine water

- Advisory : >36 *Enterococcus* per 100 ml of marine water, or the Geometric standard of >36 CFU/100 ml of marine water; >200 fecal coliform organisms per 100 ml of marine water

- Warning: Geometric standard of >400 CFU/100 ml of marine water

BEACH Act data collected from Flagler County beaches listed above from January 2004 to June 2012 determined that of all samples collected, none were found to exceed the state or Federal standards. Furthermore, there have been no advisories issued, nor have any beaches been forced to close due to threat of unsafe conditions for public recreational usage (DOH website, 2012).

Beaches not included in the monitoring include Hammock Beach, Marineland, and South Flagler Beach.

2.4.13 Hazardous, Toxic, and Radioactive Waste

There are currently no identified hazardous, toxic, and radioactive waste producers within or adjacent to the study area that could discharge effluent near the Flagler County shoreline.

2.4.14 Air Quality

The urbanization of the beaches within Flagler County, along with their popularity, contributes to a large number of motorized vehicles in the vicinity of the study area at

any given time. However, because of the sea breezes that are usually present along the shore, air quality is generally regarded as good as airborne pollutants are readily dispersed by the ocean generated winds. "Florida is one of only three states east of the Mississippi River to meet all national ambient air quality standards established by the EPA to protect public health, including air quality standards for ground-level ozone." (www.dep.state.fl.us/secretary/)

2.4.15 Noise

Ambient noise levels in Flagler County are low to moderate and are typical of recreational environments. The major noise producers include the breaking surf, adjacent commercial and residential areas, and traffic (boat, vehicular, and airplane).

2.4.16 Native Americans

Numerous antiquities and cultural resources are recorded within the proposed project area. Amongst the previous recorded sites are resources that can be identified with Native American use. The Marineland Midden, a mound reported to contain human remains, is within the Marineland reach. The National Register of Historic Places eligibility has yet to be determined for this midden. No portion of this project will affect tribal lands located in the State of Florida.

2.5 Economic Conditions

Information on the existing economic conditions along the Flagler County coastline was collected for economic modeling purposes using Beach-*fx*. Beach-*fx* is a USACE Monte Carlo life-cycle simulation model for estimating shore protection project evolution and cost benefit analyses. The information on the coastal assets detailed in this section was collected from Flagler County mapping resources, site visits, and contractors. Each parcel along the beach was identified as developed or undeveloped, with streets and parks noted. USACE real estate specialists provided depreciated replacement value of existing structures within the study area. Coastal armor was inventoried, categorized, and valued based on its composition and level of protection afforded.

The Flagler County study area was disaggregated into 4 study reaches, consisting of 13 profiles, 50 model reaches, 1,372 lots, and 1,476 damage elements for economic modeling and reporting purposes. This hierarchical structure is depicted as follows:

- Study Reaches: Consists of the political/administrative boundaries of the following cities, townships, municipalities: Marineland, Painters Hill, Beverly Beach, and Flagler Beach.
    - Profiles: Coastal surveys of the shoreline modified by USACE Jacksonville District (SAJ) coastal engineering personnel to apply coastal morphology changes to the model reach level. Profiles are strictly used for modeling purposes, and only referred to in this section for informational purposes.
        - Beach-*Fx* Model Reaches: Quadrilaterals parallel with the shoreline used to incorporate coastal morphology changes for transfer to the lot level. Model reaches are also useful for dividing study reaches into more manageable segments for analysis.
            - Lots: Quadrilaterals encapsulated within model reaches used to transfer coastal morphology changes to the damage element. Lots are also repositories for coastal armor costs, specifications, and failure threshold information; referred to in this section for information purposes only.
                - Damage Elements: Represents a unit of the existing condition coastal inventory and a store of economic value subject to losses from wave attack, inundation, and erosion damages. Damage elements are a primary model input and the topic of focus in this discussion. The 24 damage element types have been grouped into 5 categories for reporting purposes. Examples of damage elements are residential structures, patios, dune walkovers, and paved roads.

The distribution of study reaches, profiles, model reaches, lots, and damage elements for Flagler County are depicted further in **Table 2-17**.

Table 2-17: Flagler County Study Area

Flagler County Study Area Composition					Total #
Study Reaches:	Marineland	Painters Hill	Beverly Beach	Flagler Beach	
Profiles:	$ 2	$ 2	$ 1	$ 2	6
Model Reaches:	$ 4	$ 10	$ 5	$ 31	50
Lots:	$ 5	$ 106	$ 36	$ 168	315
Damage Elements:	$ 25	$ 368	$ 154	$ 1,027	1574
Note: One Profile extends through both Painter's Hill and Beverly Beach. This is why there are only six total profiles even though the sum of columns equals seven.					

2.5.1 Data Collection

Economists have collected and compiled detailed information for 9.6 miles of Flager County's 18 mile coastline, from the Mean High Water (MHW) line to 400 feet inland. This area includes: over 600 single family homes; 102 different multi-family structures; 124 commercial buildings; 9.6 miles of road; and over 477 other structures that are vulnerable to future hurricane and storm damages. In addition, data was collected on coastal armor within Flagler County. In total, over 1,500 damageable structures were collected for economic modeling using Beach-*fx*.

Real Estate professionals from the USACE SAJ district using geospatial parcel data from Flagler County provided detailed data on each structure including: geographic location, structure type, foundation type, construction type, width, length, number of floors, depreciated replacement value, and year built. Elevation data for enclosed structures was collected by a survey contractor and FEMA elevation certificates were provided by Flagler County. The elevations of paved surfaces such as roads and parking lots were acquired from USACE SAJ LIDAR data.

Data on all coastal armor was collected from a variety of sources including Florida Department of Transportation (FDOT) contractors, site visits, aerial orthophotography, and USACE SAJ Coastal Engineering personnel. Coastal armor value was determined by USACE SAJ Cost Engineering personnel.

2.5.2 Value of Existing Inventory

The economic value of the existing Flagler County structure inventory represents the depreciated replacement costs of damageable structures and their associated contents along the coastline. Real Estate professionals from the USACE SAJ district worked together with economists and planners to provide economic valuations for all of the damageable structures.

Figure 2-31 shows the existing inventory value by reach. The Flagler Beach reach has the majority of inventory value.

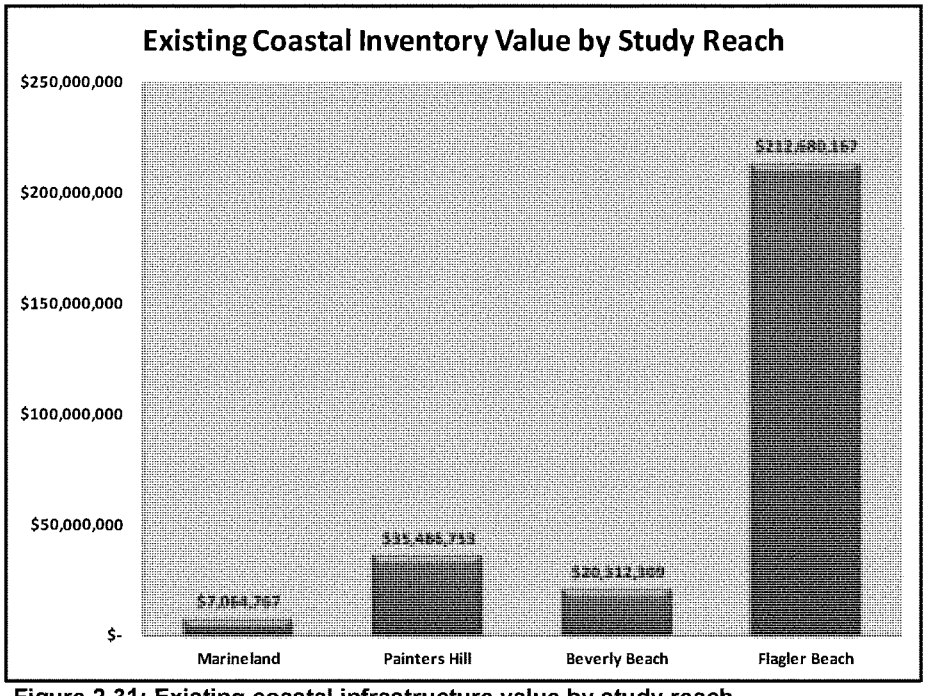


Figure 2-31: Existing coastal infrastructure value by study reach.

A graphical representation of inventory value by category is provided in **Figure 2-32**.

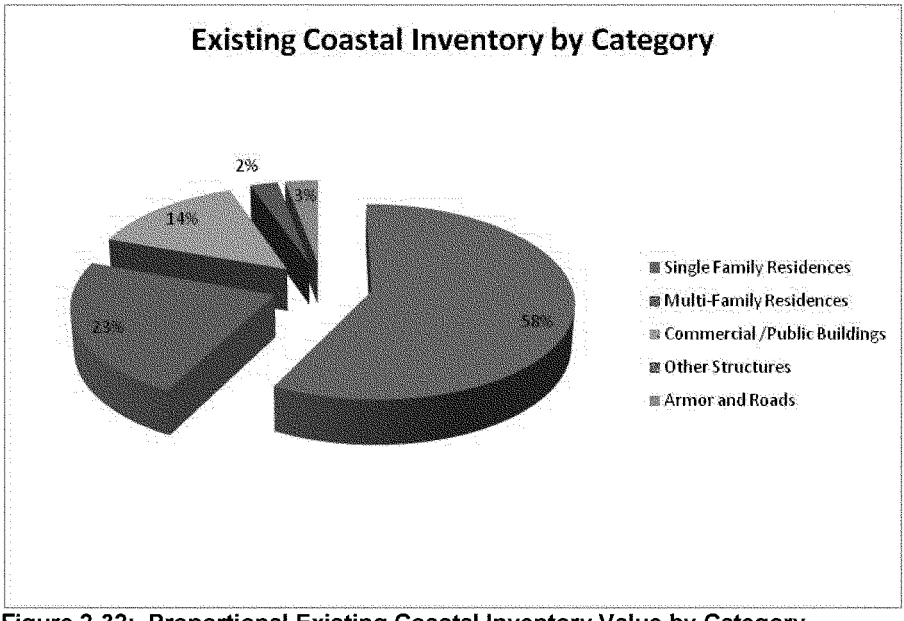


Figure 2-32: Proportional Existing Coastal Inventory Value by Category

A content to structure value ratio (CSVR) of 50% was used per guidance contained in ER 1105-2-100. Total structure and content valuations equal $190 M and $85.4 M respectively. **Table 2- 18** provides detail on the existing coastal inventory by category and type.

Table 2- 18: Existing Coastal Inventory by Damage Element Category & Type

Flagler County Study Area Inventory				
Structure Category and Type	Structure #	Structure Value	Contents Value	Total Value
Single Family Residences	**607**	**$ 90,442,033**	**$ 45,221,016**	**$ 135,663,049**
Single Family Residence 1 Story	263	$ 19,231,488	$ 9,615,744	**$ 28,847,233**
Single Family Residence 2 Story	118	$ 42,278,535	$ 21,139,266	**$ 63,417,801**
Single Family Residence 3 Story	198	$ 28,217,700	$ 14,108,850	**$ 42,326,550**
Manufactured Single Family Residence	28	$ 714,310	$ 357,155	**$ 1,071,465**
Multi-Family Residences	**102**	**$ 49,586,300**	**$ 24,793,150**	**$ 74,379,450**
Multi-Family Residences 1 Story	33	$ 4,478,350	$ 2,239,175	**$ 6,717,525**
Multi-Family Residences 2 Story	60	$ 25,509,950	$ 12,754,975	**$ 38,264,925**
Multi-Family Residences 3 Story	2	$ 5,194,000	$ 2,597,000	**$ 7,791,000**
Multi-Family Residences 4 Story	6	$ 9,504,000	$ 4,752,000	**$ 14,256,000**
Large Multi-Story High Rise	1	$ 4,900,000	$ 2,450,000	**$ 7,350,000**
Commercial /Public Buildings	**124**	**$ 32,663,532**	**$ 15,114,742**	**$ 47,778,273**
Commercial Structure 1 Story	70	$ 12,949,750	$ 6,614,475	**$ 19,564,224**
Commercial Structure 2 Story	42	$ 10,043,382	$ 5,021,691	**$ 15,065,073**
Commercial Structure 3 Story	4	$ 5,580,000	$ 2,790,000	**$ 8,370,000**
Public Structure 1	7	$ 2,375,400	$ 448,476	**$ 2,823,876**
Public Structure 2	1	$ 1,715,000	$ 240,100	**$ 1,955,100**
Other Structures	**453**	**$ 9,179,298**	**$ 859,560**	**$ 10,038,858**
Parking Lots	44	$ 1,471,815	$ -	**$ 1,471,815**
Other paved surfaces (shuffleboard court)	1	$ 11,280	$ -	**$ 11,280**
Dunewalks	186	$ 2,322,347	$ -	**$ 2,322,347**
Wood decks	66	$ 982,936	$ -	**$ 982,936**
Swimming Pools	79	$ 2,416,200	$ -	**$ 2,416,200**
Storage Buildings	22	$ 464,220	$ 232,110	**$ 696,330**
Tennis Courts	5	$ 225,600	$ -	**$ 225,600**
Large tent in Marineland	1	$ 30,000	$ -	**$ 30,000**
Residential Garages	49	$ 1,254,900	$ 627,450	**$ 1,882,350**
				$ -
Subtotal - Structures and Contents	**1,286**	**$ 181,871,163**	**$ 85,988,467**	**$ 267,859,630**
				$ -
Armor and Roads		$ 9,566,716	$ -	**$ 9,566,716**
Armor and Roads	288	$ 9,566,716		**$ 9,566,716**
				$ -
Grand Total	**1,574**	**191,437,879**	**85,988,467**	**$ 277,426,346**

Single-Family Residences

Single-family residences comprise 58% of the existing value within the study area (Figure 2-31). Even though single-family residences constitute the greatest overall value within the study area, they are of less value per structure relative to multi-family and commercial structures. The majority of the structure inventory of the Painters Hill and Beverly Beach study reaches consists of single-family residential structures and their associated amenities (decks, pools, dune walks, etc.).

Multi-Family Residences

Multi-family residences constitute 23% of the existing value. Damage elements within this category tend to be more substantial in terms of construction, and contain the greatest amount of economic value per structure within the study area. This is particularly true of Beverly Beach. Thus, the distribution of value within Beverly Beach is concentrated in its southernmost section.

Commercial / Public Structures

Commercial and public buildings represent 14% of the overall study area value. Similar to multi-family structures, commercial/public buildings tend to be more robust in terms of construction, and have greater value per structure. Commercial/public structures are more prevalent in Flagler Beach. The Marineland study reach inventory consists primarily of a small number of high value commercial/public facilities.

Armor and Roads and Critical Infrastructure

The armor and roads category contains 3% of the damageable value. SR A1A is the primary transportation infrastructure of concern within the study area. According to 2008 FDOT figures, average annual daily traffic along the segments of SR A1A within the four study reaches is as follows:

- Marineland: 4,950 vehicles
- Painters Hill: 4,400 vehicles
- Beverly Beach: 4,650 vehicles
- Flagler Beach: 7,040 vehicles

Coastal armor within the study area was categorized into a number of different types based on construction type, material and elevation. The types of coastal armor were granite revetments, precast concrete panel seawalls, steel sheet pile sea walls, and vinyl bulkheads.

Coastal armor in Marineland consists of a 1,550-foot granite revetment and a 1,000-foot steel sheet pile sea wall covered by a dune. This shoreline protection effort was improved and expanded after Hurricane Floyd caused significant damage to the area in 1999.

The only coastal armor found in Painters Hill were two lots with vinyl bulkhead armor units with crest elevations at grade level. In Beverly Beach there is a large 1,560 foot precast concrete panel seawall providing protection for an RV park.

Flagler Beach has the most armor in the study area, much of which is in varying stages of disrepair. There is a 420-foot precast concrete panel seawall starting 285 feet north of the pier. Starting at 7th Street South and ending at 23rd Street South, there is approximately 9,000 feet of granite revetment maintained by FDOT. This revetment was originally built in the 1960s and 1970s, with additional newer stone placed during maintenance and repairs. Between 2000 and 2007, FDOT maintenance costs for SR A1A in Flagler Beach averaged $1.25 million per year (FDOT, 2010). FDOT funds repairs from the state budget as available. If damage is caused by a storm event that has been declared an emergency by the Governor of Florida, FDOT seeks reimbursement from the Federal government. Within this revetted area is a 150-foot steel sheet pile sea wall with a concrete cap between 12th Street South and 13th Street South. This armor unit was constructed in December 2005 by FDOT to protect SR A1A from being undermined by erosion. Approximately 410 feet south of 28th Street are small precast concrete panel seawalls protecting several commercial properties toward the southern end of the county.

Other Structures

The remaining 2% of Flagler County's structure value consists of relatively lower value damageable elements such as garages, storage buildings, dune walks, decks, swimming pools, wood shelters, and parking lots. However, these structures constitute $8,200,000 of the study area's existing inventory. Many of these structures serve as amenities for the aforementioned single and multi-family residential structures.

SR A1A is by far the most vulnerable critical infrastructure within the study area. Police, emergency rescue, hospitals, and other critical facilities are not constructed within the study area.

2.6 Public Access and Parking

USACE SAJ district personnel have conducted several parking and access windshield surveys since 2008. Information from these surveys shows that approximately 5.98 miles of the 9.62 mile study area are publicly accessible with adequate parking.

The Marineland study reach contains 4 public access points along a public boardwalk to the south of the oceanarium. Approximately 160 parking spaces are available for beach goers within this study reach.

Public access and parking is limited in the Painters Hill and Beverly Beach study reaches. Approximately 50 parking spaces and public access is located about 1,000 feet north of the Painters Hill study reach at Varn Park. At the south end of Beverly

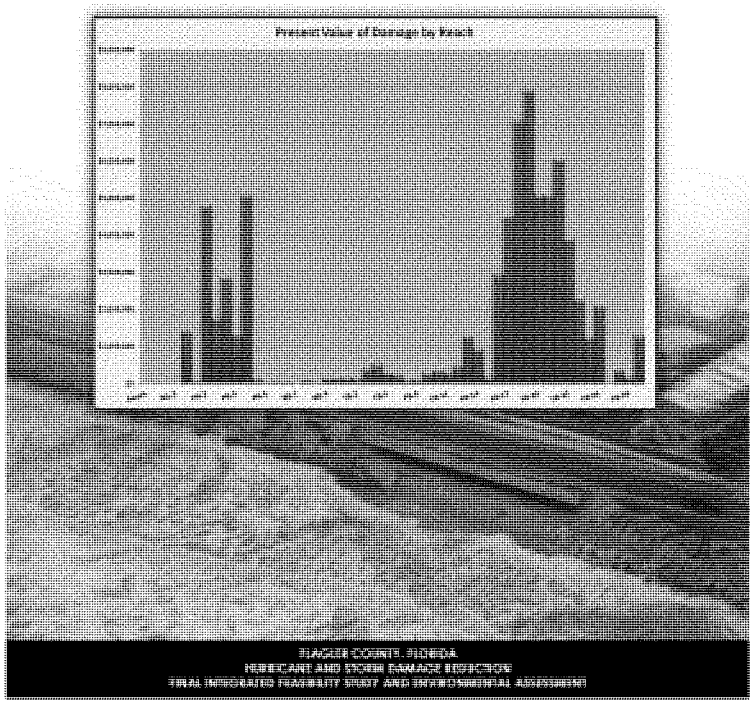
Beach, public access is available from R-64 to R-67 with approximately 30 parking spaces along the shoulder of SR A1A.

Public access is provided at most street ends in the Flagler Beach study reach with approximately 410 public parking spaces located throughout the study reach.

Federal participation in shore protection projects is limited to shorelines open to public use. Guidance is provided in Engineering Regulation (ER) 1105-2-100 and ER 1165-2-130. Cost sharing for the Recommended Plan is based on shoreline ownership and the availability of public access. Parking and access related to the Recommended Plan is detailed in **Section 5.3.5**.

CHAPTER 3
FUTURE WITHOUT PROJECT CONDITIONS

BEACH-FX OUTPUT ILLUSTRATING WITHOUT PROJECT DAMAGES



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3 FUTURE WITHOUT-PROJECT CONDITION

3.1 General

The future without-project condition is the most likely condition of the study area, over the next 50 years, without construction of a Federal Hurricane and Storm Damage Reduction (HSDR) project. The period of analysis starts at the base year (when construction would be complete) of 2018 and ends at 2068. Recent climate research by the Intergovernmental Panel on Climate Change (IPCC, 2007) has predicted continued or accelerated global warming for the 21st century and possibly beyond. One impact of continued global warming is the rise of global mean sea level (USACE, 2009). Due to the combination of rising sea level and continued storm activity, it is projected that erosion in the study area will continue in the future and infrastructure damage will occur due to storms. It is assumed that any project recommended by this study will not increase development in the project area. Sections 3.2 through 3.4 summarize some of the physical, social, and economic conditions, and related assumptions, which were input into the U.S. Army Corps of Engineers (USACE) Beach-*fx* model in order to develop the most probable future without-project condition for the study area.

3.2 Physical Conditions

Historical rates of shoreline erosion were projected to future years in order to locate the shoreline position 50 years from now. As the beach erodes, less beach will be available to protect against other storm damages such as waves and inundation.

Each of the study reaches, with the exception of Beverly Beach, have relatively consistent average shoreline rates of change, ranging from -0.58 feet/year to -0.67 feet/year (**Table 3-1**). Due primarily to the stabilizing presence of a concrete and steel seawall over a significant portion of the reach, Beverly Beach experiences a lower shoreline rate of change, approximately -0.11 feet/year.

Table 3-1: Annual Shoreline Rate of Change by Study Reach

Project Segment	Study Reach	Location (DNR Monument)	MHW Rate of Change (1972 – 2007) (feet/year)
North	Marineland	R-1 to R-4	-0.58
TOTAL (North)		R-1 to R-4	-0.58
South	Painters Hill	R-50 to R-60	-0.64
	Beverly Beach	R-60 to R-67	-0.11
	Flagler Beach	R-67 to R-101	-0.67
TOTAL (South)		R-50 to R-101	-0.59
TOTAL (Project)		R-1 to R-4, R-50 to R-101	-0.59

Relative sea level (RSL) refers to the local elevation of the sea with respect to land, including the lowering or rising of land through geologic processes such as subsidence and glacial rebound. It is anticipated that sea level will rise within the next 100 years. To incorporate the direct and indirect physical effects of projected future sea-level change on design, construction, operation, and maintenance of coastal projects, USACE has provided guidance in the form of an Engineering Regulation, ER 1100-2-8162 (USACE, 2013).

ER 1100-2-8162 provides both a methodology and a procedure for determining a range of sea-level rise estimates based on the local historic sea-level rise rate, the construction (base) year of the project, and the design life of the project. Three estimates are required by the guidance, a Baseline (low) estimate which is based on historic sea-level rise and represents the minimum expected sea-level change; an intermediate estimate; and a high estimate representing the maximum expected sea-level change. Using equations in ER 1100-2-8162, the baseline, intermediate, and high sea-level rise values were estimated over the life of the project.

The Flagler project area is located approximately 60 miles from National Ocean Service (NOS) gage #8720218 at Mayport, Florida. The historical sea-level rise rate taken from this gage was determined to be 2.4 mm/year (0.0079 feet/year) (http://tidesandcurrents.noaa.gov/sltrends/index.shtml).

In order to provide a more accurate estimate of local vertical land motion, the historical sea-level rise rate is adjusted to account for regional trends. The local, adjusted sea-level rise (*e*+M) at this location becomes 2.29 mm/year (0.0075 feet/year) (http://www.corpsclimate.us/ccaceslcurves.cfm).

Given a project base year of 2016 and a project life of 50 years, a table of sea-level change rates was produced for each of the three required scenarios. **Table 3-2**

shows the sea-level change rates in five-year increments, starting from the base year of 2016.

Table 3-2: Relative Sea Level vs Year – Flagler County

	Baseline (Historic)			Intermediate (NRC Curve I)			High (NRC Curve III)		
	Year	mm	ft	Year	mm	ft	Year	mm	ft
Base Year	2016	9.16	0.03	2016	13.93	0.05	2016	29.05	0.10
	2021	20.61	0.07	2021	32.56	0.11	2021	70.44	0.23
	2026	32.06	0.11	2026	52.55	0.17	2026	117.49	0.39
	2031	43.51	0.14	2031	73.89	0.24	2031	170.18	0.56
	2036	54.96	0.18	2036	96.59	0.32	2036	228.53	0.75
25 Year	2041	66.41	0.22	2041	120.64	0.40	2041	292.52	0.96
	2046	77.86	0.26	2046	146.04	0.48	2046	362.17	1.19
	2051	89.31	0.29	2051	172.81	0.57	2051	437.46	1.44
	2056	100.76	0.33	2056	200.92	0.66	2056	518.41	1.70
	2061	112.21	0.37	2061	230.39	0.76	2061	605.00	1.98
50 Year	2066	123.66	0.41	2066	261.22	0.86	2066	697.25	2.29

Figure 3-1 shows the three levels of projected future sea-level rise for the life of the project. From these curves, the average baseline, intermediate, and high sea-level rise rates were found to be 0.0075 feet/year, 0.0159 feet/year, and 0.0424 feet/year, respectively. **Engineering Appendix A** provides additional information regarding shoreline response in the project area as a result of SLC.

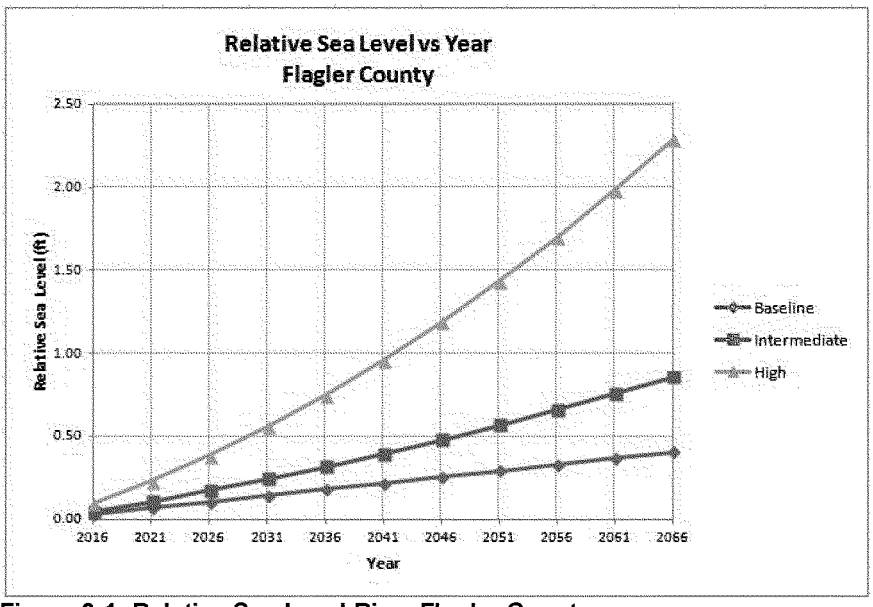

Figure 3-1: Relative Sea Level Rise, Flagler County

The local rate of vertical land movement is found by subtracting the regional MSL trend from local MSL trend. The regional mean sea-level trend is assumed equal to the eustatic mean sea level trend (a uniform worldwide change in sea level rate) of 1.7 mm/year. Therefore in Flagler County, there is 0.59 mm/year of subsidence.

In compliance with ER 1100-2-8162, Beach-fx was configured and run for each sea-level rise scenario in order to estimate the future without-project condition damages. The results are included in Section 3.4.

3.3 Incorporation of ER 1100-2-8162: Guidance for Sea Level Change

The draft Sea-Level Change (SLC) Civil Works Technical Letter (CWTL) supporting ER 1100-2-8162 suggests a tiered analysis to determine the risk of potential SLC and resulting incorporation into the plan formulation process. Incorporation of potential SLC into the USACE Planning process will require active focus on risk-based scoping to define pertinent needs, opportunities, and the appropriate level of detail for conducting investigations. In particular, close attention is needed at the beginning of each study in order to screen planning/scoping decisions. The tiered analysis for SLC is incorporated into the 6-step planning process used in this report.

In order to evaluate SLC impacts to infrastructure, critical resources, and the population residing in the study area, a qualitative matrix was developed in **Table 3-2**. Resources evaluated in the matrix were based on those identified by the USACE Coastal Systems Portfolio Initiative (CSPI). CSPI describes the resource risk in a project area relative to the density of the resource, the population density that the resource serves, or in the case of environment/habitat and recreation, the value placed on the resource. See http://projects.rsm.usace.army.mil/CSPI for more information.

The qualitative matrix shown in **Table 3-3** evaluates the resources on which the study area depends. In addition to the CSPI evaluation criteria, **Table 3-3** evaluates the vulnerability to resources from potential SLC, or Sea-Level Rise (SLR) in the case of the study area. Averaging the "Vulnerability from SLR" to resources gives an average of 1.2, equating to a relatively low vulnerability of resources. This indicates that SLR is not a major contributor to overall resource vulnerability within the 50-year period of analysis.

Table 3-3: Qualitative Matrix describing vulnerability of resources from potential accelerations in SLC

Resource	Risk Rating from CSPI - Value or density of resource or dependent population (3=high, 2=med., 1=low, X=none present)	Description	Vulnerability from SLR (3=high, 2=med., 1=low, X=none present)	Description
Residential/commercial structures	2	Mostly residential (single-family homes) and commercial structures. Approximately 50% of the project area is currently protected by revetment or seawall of varying quality. Most ground floor elevations of structures are 14 feet above existing Mean Sea Level (MSL).	1	Projected high scenario SLC would not place Mean Sea Level (MSL) near infrastructure within the 50 year planning horizon and would increase the flood frequency very minimally. Typical surge experienced in the project area from large coastal storms is between 2 and 4 feet. This indicates that SLR is not a major contributor to future damages over the 50 year planning horizon.
Environment and Habitat	3	Beach/dune habitat. Fairly narrow, steep beach backed by average 18.5 feet high dunes. Where no dune exists, revetments or seawalls of varying quality have been constructed.	2	Beach berm and dune system is located between 10.5 and 18.5 feet above MSL. Sub aerial habitat is located throughout this system.
Infrastructure (roads, water/sewer lines, boardwalks, navigation structures)	2	Water/sewer lines, septic tanks, revetment and dune walkovers exist. State Road A1A is located approximately 14 feet above MSL. Most other infrastructure would not be impacted until water level, including storm surge, reached above this point. The 10-year return period storm tide level is equal to 4 feet.	1	By the end of the 50 year planning horizon, State Road A1A remains adequately elevated above MSL under any SLC scenario. Even under the high SLC scenario, a 12-foot difference would remain between MSL and A1A.
Critical Facilities (police, fire, schools, hospitals, and nursing homes)	1	low density of critical facilities	1	Elevation of most critical facilities remains above MSL under any SLC scenario by the end of the 50-year planning horizon.
Evacuation Routes	3	State Road A1A is main north/south evacuation route, located approximately 14 feet above MSL.	1	By the end of the 50 year planning horizon, State Road A1A remains adequately elevated above MSL under any SLC scenario. Even under the high SLC scenario, a 12-foot difference would remain between MSL and A1A.
Recreation	3	significant recreational use of beaches and fishing pier	1	Beach berm is approximately 10.5 feet above current MSL. Recreational use of beach is high. Fishing pier deck is approximately 25 feet above current MSL. Projected high SLC scenario would not impact the pier within the 50-year planning horizon.
		average =	**1.2**	**Low Vulnerability**

Overall, the initial analysis above indicates that the project area vulnerability to SLC is relatively low. However, elevations within the project area (Atlantic Ocean side of the island) are some of the highest on the barrier island, about 15 to 20 feet above Mean Sea Level (MSL). The profile of the island slopes downward from these elevations to the landward side (marsh side) of the island where the lowest elevations of infrastructure are around 2 to 10 feet above current MSL. The island profile is shown in **Figure 3-3**. Marsh side areas of the island will likely be impacted by inundation more frequently than the ocean side as sea level rises, especially during extreme high tide events. A relatively low risk from SLC to the project area combined with high uncertainty over potential accelerations in the rate of SLC lead to an adaptive management strategy as shown in **Figure 3-2**.

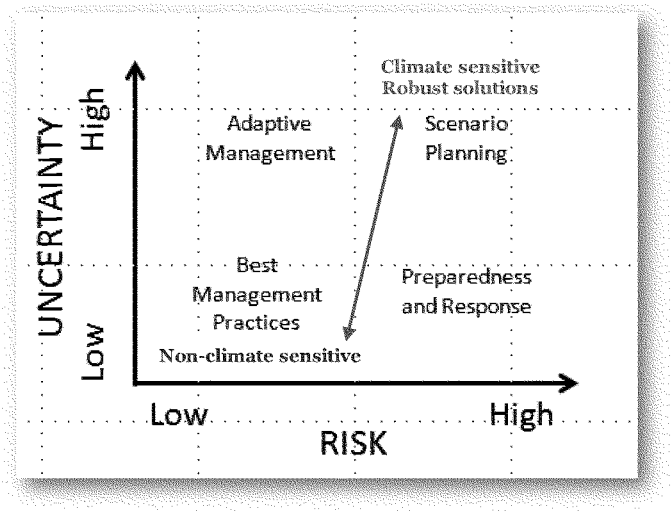

Figure 3-2: Consideration of risk and uncertainty in climate change related decision-making

In the project area, the oceanfront area covered from MHW to 400 feet inland adequately covers the area impacted by erosion, inundation, and wave attack through a 50-year period of analysis under the high SLC scenario. The majority of the oceanfront area is fronted by 18-foot high dunes relative to NAVD88 according to surveys carried out by the Florida Department of Environmental Protection (FDEP) at coastal range monuments (R-monuments) and 2004 LIDAR data. These surveys typically extend from the dune crest toward the ocean and do not cover the back-bay side of the barrier islands. However, LIDAR data from 2009 was available for the back side of the island and, in combination with the 2004 data, was used to create **Figure 3-3**.

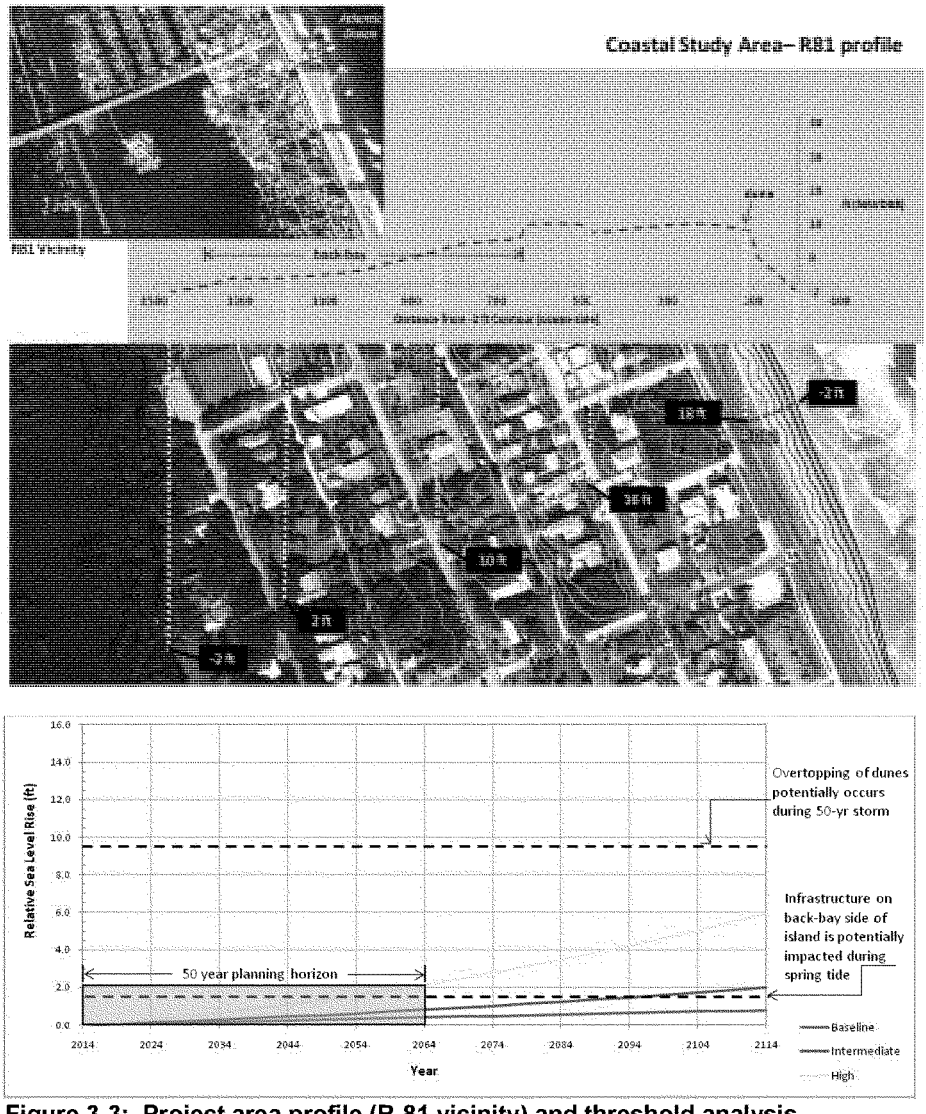

Figure 3-3: Project area profile (R-81 vicinity) and threshold analysis

A key question when assessing the vulnerability of the project area to SLC is when critical thresholds will be crossed, if at all, by potential SLC. **Figure 3-3** has two thresholds depicted, one on the seaward side of the barrier island on which the project area is located and one on the back-bay side of the island, outside of the project area.

Throughout the project area, the dune crest height represents a critical threshold. State Road A1A is located at roughly this elevation and most infrastructure (including single family homes, businesses, etc.) are located at, or above, this elevation.

Mean Sea Level (MSL) is 0.33 feet lower than 0 feet NAVD88 on the ocean side of the island as shown in **Table 3-4**, and 0.27 feet lower than 0 feet NAVD88 on the back-bay side of the island as shown in **Table 3-5**.

Table 3-4: Tidal datums for Flagler County Study Area (Atlantic Ocean)

State Road A1A Bridge over Matanzas Inlet (NOS bench mark #8720692)		
	meters (m)	feet (ft)
Mean Higher High Water (MHHW)	1.26	4.12
Mean High Water (MHW)	1.16	3.80
North American Vertical Datum of 1988 (NAVD88)	0.70	2.28
Mean Tide Level (MTL)	0.61	1.98
Mean Sea Leve (MSL)	0.59	1.95
Mean Low Water (MLW)	0.05	0.16
Mean Lower Low Water (MLLW)	0.00	0.00

Table 3-5: Tidal datums for Flagler County back-bay side of barrier island, outside of study area (Intracoastal Waterway)

Smith Creek, Flagler Beach (NOS bench mark #8720833)		
	meters (m)	feet (ft)
Mean Higher High Water (MHHW)	0.33	1.08
Mean High Water (MHW)	0.29	0.94
North American Vertical Datum of 1988 (NAVD88)	0.24	0.78
Mean Tide Level (MTL)	0.16	0.52
Mean Sea Leve (MSL)	0.15	0.51
Mean Low Water (MLW)	0.02	0.07
Mean Lower Low Water (MLLW)	0.00	0.00

The maximum 50-year storm tide elevation in the study area is given as 8.37 feet NAVD88 in Chapter 2. To be conservative, the maximum was used. Combined total storm tide includes contributions of wind stress, barometric pressure, dynamic wave set-up and astronomical tide. Water elevations during such storm events could reach the top of the dunes (18 feet NAVD88 in **Figure 3-3**) once sea level increases by about 9.5 feet (8.37 feet storm tide + 9.5 feet sea level increase ≈ 18 feet). This estimate does not take erosion of the dune height into consideration which could occur over time. However, based on past local practice, it can be reasonably assumed that efforts will be made to maintain the dune at its current elevation to protect Highway A1A. At the end of 50 years, sea level may increase by 2 feet under the high SLC scenario, 7.5 feet below the threshold.

The draft CWTL recommends that systems related to, but existing outside, the project area should also be evaluated for vulnerability to SLC. Vulnerability of the back-bay of the island was evaluated to inform the sponsor and to determine if there would be incidental effects on the project area. SR A1A is the main hurricane evacuation route running north and south along the island. In an evacuation event, the vulnerable population would need to exit the island via a bridge to reach the mainland. The bridge (Highway 100) is located on the backside of the island. However, it is sufficiently elevated. MSL on the back-bay (inland) side of the island is approximately 0.27 feet lower than NAVD88. Infrastructure on the back-bay is generally built at or above 2 feet NAVD88 as seen in **Figure 3-3**. This side of the island is mainly affected by tides, not surge, due to its distance from coastal inlets and subsequent sheltering from most factors contributing to combined total storm tide. Tidal range on the back-bay side of the island is smaller than the ocean side. **Table 3-5** shows that MHHW is recorded as 0.3 feet relative to NAVD88.

Infrastructure could be periodically impacted once sea level increases by about 1.7 feet (0.3 feet + 1.7 feet sea level increase = 2 feet). The low and medium scenarios are not expected to increase by this much within the 50-year planning horizon as seen in **Figure 3-3**. However, the high scenario is predicted to surpass this threshold in approximately 40 years after the base year. If the sea level rise rate increases to the high scenario, infrastructure on the back side of the island could be impacted during higher high tide events (spring tide events), dependent on current and future construction to protect against elevated water levels such as seawalls and bulkheads. SLC should be monitored in order to provide adequate lead time to plan for impacts in the case of accelerated SLC.

The existing Coastal Vulnerability Index (CVI) developed by the United States Geological Survey (USGS) is a useful indicator of the project area's natural vulnerability to SLC. Population and infrastructure type, or density, are not parameters used in the assessment. The USGS used six input parameters to assess the CVI for geographic areas along the nation's shoreline. Parameters used include geomorphology, coastal slope, relative SLC, shoreline erosion/accretion, mean tide range, and mean wave height (USGS 2000). **Figure 3-4** shows the CVI for the study area is rated as moderate to high based on the area being part of an erosional barrier island surrounded by sandy beaches and salt marsh.

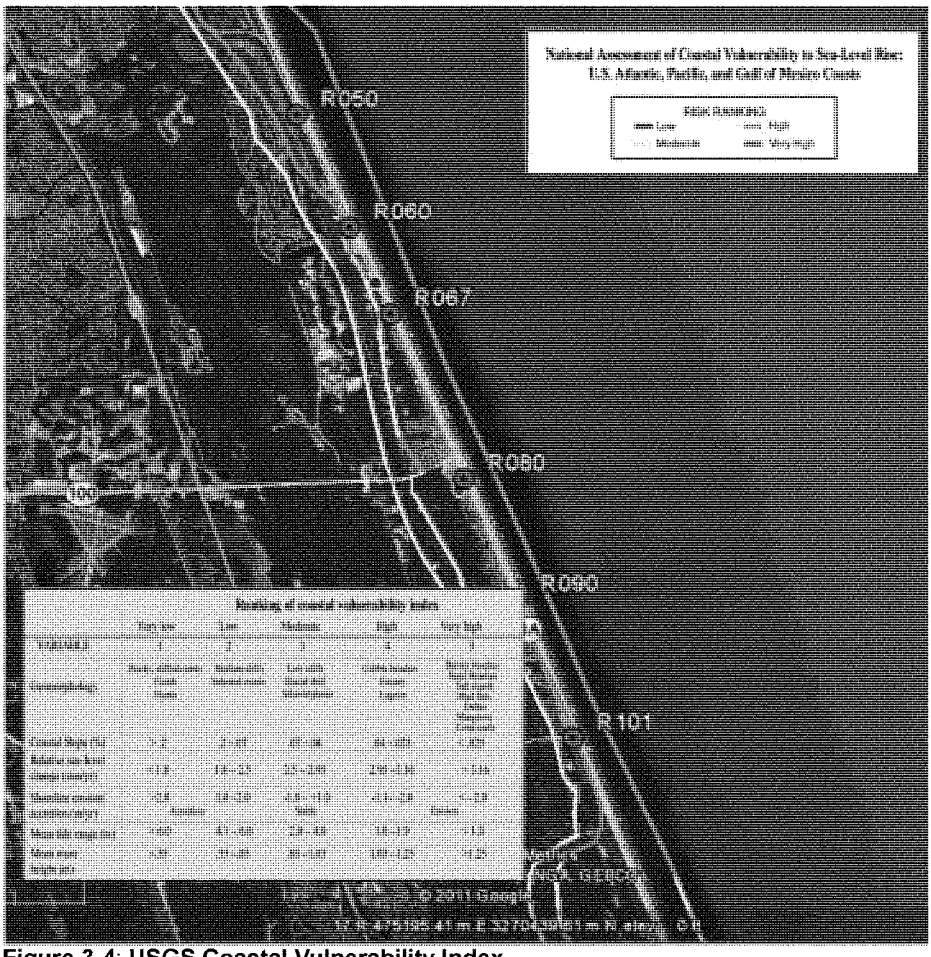

Figure 3-4: **USGS Coastal Vulnerability Index.**

3.4 Property Owner Response

At present, approximately 10% of the project area is protected by some form of constructed shore protection (seawall or revetment). It is projected that additional shore protection measures will be constructed in the future, as allowed by state law, absent a Federal HSDR project in place. With respect to armor, the following assumptions were made:

- Homeowners east of SR A1A whose property is threatened by erosion to within 20 feet of the structure will erect a vinyl sheet pile armoring structure in order to defend their property against damage. This assumption is supported by current practices where homeowners in the Painters Hill reach have been approved by the Florida Department of Environmental Protection (FDEP) to construct vinyl sheet pile armor to ward off erosion.

- The Florida Department of Transportation (FDOT) will continue with measures as necessary to protect SR A1A as described in their 2010 PD&E Study, which states, "FDOT is committed to protecting SR A1A in its existing location, as this road is a hurricane evacuation route, a designated State Scenic Highway (A1A Ocean Shore Scenic Highway), a National Historic Byway, and provides an economic base for the region." The Flagler Beach reach of the study area contains around 9,000 feet of granite revetment in varying condition that is maintained by FDOT. As SR A1A becomes damaged, FDOT makes repairs to the road and the revetment as required and as funding allows. In recent years, FDOT has most commonly placed rock and sand to protect the road. It is assumed that this type of repair will continue to happen into the future. The FDOT repairs must be within their jurisdictional right of way and in accordance with the Biological Opinion issued by U.S. Fish and Wildlife Service (FWS). The ability of future revetments to withstand coastal storms and erosion is assumed to be similar to that of the existing revetment.

- Homeowners/property owners will continue to add/rebuild armor until their lot is condemned due to erosion.

3.5 Economic Analysis

Data on historic storms, beach survey profiles, and private, commercial and public structures within the project area is used as input to the USACE Beach-*fx* model. The model is then used to estimate future project hurricane and storm damages. Beach-*fx* was developed by the Engineering Research and Development Center (ERDC) in Vicksburg, Mississippi. On 1 April 2009 the Model Certification Headquarters Panel certified the Beach-*fx* hurricane and storm damage reduction (HSDR) model based on recommendations from the HSDR - Planning Center of Expertise (PCX). The model was reviewed by the PCX and found to be appropriate for use in coastal storm damage reduction studies. The model links the predictive capability of coastal evolution modeling with project area infrastructure information, structure and content damage functions, and economic valuations to estimate the costs and total damages under various shore protection alternatives. This output is then used to determine the benefits of each alternative. Beach-*fx* fully incorporates risk and uncertainty, and is used to simulate future hurricane and storm damages at existing and future years and to compute accumulated present worth damages and costs. Storm damage is defined as the damage incurred by the temporary loss of a given amount of shoreline as a direct result of waves, erosion, and inundation caused by a storm of a given magnitude and probability. Beach-fx is an event-driven life-cycle model that estimates damages and associated costs over a 50-year period of analysis based on storm probabilities, tidal cycle, tidal phase, beach morphology and many other factors. Damages or losses to developed shorelines include buildings, pools, patios, parking lots, roads, utilities, seawalls, revetments, bulkheads, replacement of lost backfill, etc., all classified as "damage elements." Beach-*fx* also provides the capability to estimate the costs of certain future measures undertaken by state and local organizations to protect coastal assets. Preliminary Beach-fx reaches were designated within each study reach. **Figure 3-5** depicts how the reaches correspond to FDEP R-monuments along the coast.

Flagler County Reach Designations and Alignments		
FDEP R-monument	Study Reaches	Preliminary Beach-fx Reaches
R-1	Marineland	ML-1 to ML
R-2		
R-3		
R-4		
No reaches between R-4 and R-50		
R-50	Painter's Hill	PH-1 to PH-10
R-51		
R-52		
R-53		
R-54		
R-55		
R-56		
R-57		
R-58		
R-59		
R-60	Beverly Beach	BB-1 to BB-5
R-61		
R-62		
R-63		
R-64		
R-65		
R-66		
R-67	Flagler Beach	FB-1 to FB-31
R-68		
R-69		
R-70		
R-71		
R-72		
R-73		
R-74		
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R-100		
R-101		

Figure 3-5: Reach designations and alignment

For economic analysis purposes, the future structural inventory and values are the same as the existing condition. This conservative approach neglects any increase in value due to future development. Due to the uncertainty involved in projections of future development, using the existing inventory is preferable and considered conservative for Florida where coastal development has historically increased in density and value. Although newer construction may have a higher value, there may not be more value at risk due to updated construction standards and fewer damageable elements exposed to erosion, inundation, and wave attack.

Assumptions based on data and experience is used in Beach-fx in order to determine actions that effect damages in the future conditions. **Table 3-6** presents general assumptions used in Beach-fx for this study. Additional detail is presented in the **Economic Appendix C**.

Table 3-6: General Beach-fx Assumptions for Flagler County, Florida

Flagler County, FL Hurricane and Storm Damage Reduction Project	
Selected Beach-fx Assumptions	
Assumption	**Explanation**
Storms	
Storm Suite	The Plausible Storm Suite is based on actual historical tropical and extra-tropical storms that impacted the study area between 1887 and 1999.
Storm Probability	Storm Probability parameter was defined as the ratio between number of storms and total number of years in the storm record.
Nourishment	
Emergency Nourishment	Emergency Nourishment was not specified in the model because Flagler County has no historic record of emergency nourishment.
Beach Profile	Six (6) distinct profiles were created in accordance with the natural variations on the beach and dune system. Profile criteria (dune height, dune width, berm width, etc.) were all set according to an adaptation (simplification) of the most recent beach surveys taken in 2007.
Reaches	
Reach Specification	Fifty (50) different reaches were created in approximately 1,000 feet increments, centered on survey monuments (R-monuments) that were established by Florida Department of Environmental Protection. Each reach is assigned a beach profile, created as described in the "Nourishment" section.
Applied Erosion Rate	The Applied Erosion Rate for each Reach was determined by calibrating the model so that many iterations return an average erosion rate that is equivalent to the measured erosion rate of that segment of the project.
Berm Width	It is assumed, based on past shoreline monitoring, that 90% of the berm recovers post-storm.
Back Bay	Back Bay Flooding is not applicable to this study.
Armor	
Armor Type	Coastal armor within the study area was categorized into a number of different types based on construction type, material and elevation. The types of coastal armor were: granite revetments, precast concrete panel sea walls, steel sheet pile sea walls, and vinyl bulkheads. Within Beach-fx, the armor prevented erosion damage in protected lots. In order to accurately simulate damage to the armor itself, several new damage elements were created. The advantages to this approach include: modeling flexibility, the ability to account for gradual, incremental damage, and the ability to account for uncertainty in armor performance. More information about the modeling approach for armor is provided in the Economics Appendix.
Damage Elements	A total of 310 individual damage elements were created, of 17 different types.
Foundation Type	Data were collected from the Flagler County Property Appraiser's Office. Foundation types for structures in the study area were predominately of one of three types: 1) Concrete Perimeter Footing (i.e. slab), 2)Pilings (deep or shallow), 3)Piers and Posts.
Construction Type	Construction type data were also collected from the Flagler County Property Appraiser's Office. Construction types within the study area were one of two types: 1) Wood; or 2) Masonry
Number of Rebuild Times	The number of possible rebuild times varied depending on the structure.
Structure Values	Replacement cost minus depreciation values were calculated for each structure by Real Estate, Jacksonville District Corps office.
Content Values	Content values were based on Content-to-Structure value ratios (CSVRs). The CSVRs were assumed to be 0.5 for all residential and commercial structures.
Future Development	For modeling purposes, no future development was assumed in the structure inventory. Within Beach-fx, the structures and their values are the same in the FWOP as they are in the existing condition. This is a conservative assumption in the sense that development does not depend on speculative future development. It also means that the analysis is not implicitly inducing development in the FWOP.
Structure Elevation Data	SAJ contracted a surveyor to estimate the first floor elevations of all structures in the study area. The elevation of these structures was surveyed to an accuracy of +/- 0.5 feet.
Modeling	
Number of Iterations	100 iterations were used. This number provides stable simulation with negligible variability in output.
Discount Rate	3.500%
Sea Level Rise	Sea Level Rise estimates for Low, Mid, and High scenarios were developed in accordance with ER 1100-2-8162.

In order to model damages in Beach-fx, the team developed site specific damage functions for wave attack, inundation and erosion. The team was also required to develop armor failure thresholds in order to calculate armor damage. The most recently developed damage functions (which incorporated both roads and its protective revetment), were calibrated based on empirical data provided by the Florida Department of Transportation for the damages resulting from model runs versus the damage repair costs historically realized. These damage functions and this method of simulating armor damage were coordinated with the Coastal and Hydraulics Laboratory (CHL) and the Coastal Planning Center of Expertise (PCX).

The A1A armor maintenance damages modeled during the first 10 years of the simulation (2013-2023) are within the modeling tolerance of the actual costs incurred by FDOT for maintaining the road from 2000-2010. It is only after 2027 in the model that without-project damages start to increase dramatically. Only after the cumulative effects of storms, sea level rise, and erosion over time begin to take their toll does the model begin to show significant damage. Model results indicate that the future without-project damages are likely to increase significantly in the mid to late 2020s, decrease somewhat by around 2050, but remain relatively high for the remainder of the period of analysis. See the **Economics Appendix** for more details.

Table 3-7 provides a summary of the results from Beach-*fx* for the future without-project condition by reach for the low, intermediate, and high SLC scenarios.

Table 3-7: Future Without Project Present Value Damages for SLC scenarios.

Present Value Damages for baseline, intermediate, and high SLC scenario			
Study Reach	Baseline (low) SLC Scenario	Intermediate SLC Scenario	High SLC Scenario
Marineland	$1,396,178	3,941,899	$5,746,220
Painters Hill	$16,012,271	22,673,505	$26,630,026
Beverly Beach	$379,170	4,168,906	$10,118,431
Flagler Beach	$55,725,961	112,688,503	$182,917,865
Total	**$73,513,580**	**$143,472,813**	**$225,412,542**

* FY13 price level and discount rate

Figure 3-6 shows damages for the future without-project condition under the baseline SLC condition, breaking the data down to Beach-fx reaches. From this figure and **Table 3-7**, it can be seen that the majority of damages occur in the Flagler Beach reach.

The future without project damages will be used as a base condition against which potential alternatives for storm damage reduction will be measured. The difference between with and without-project damages will be used to determine the benefits of an alternative. Other sources of benefits include recreational benefits and benefits from avoiding land loss.

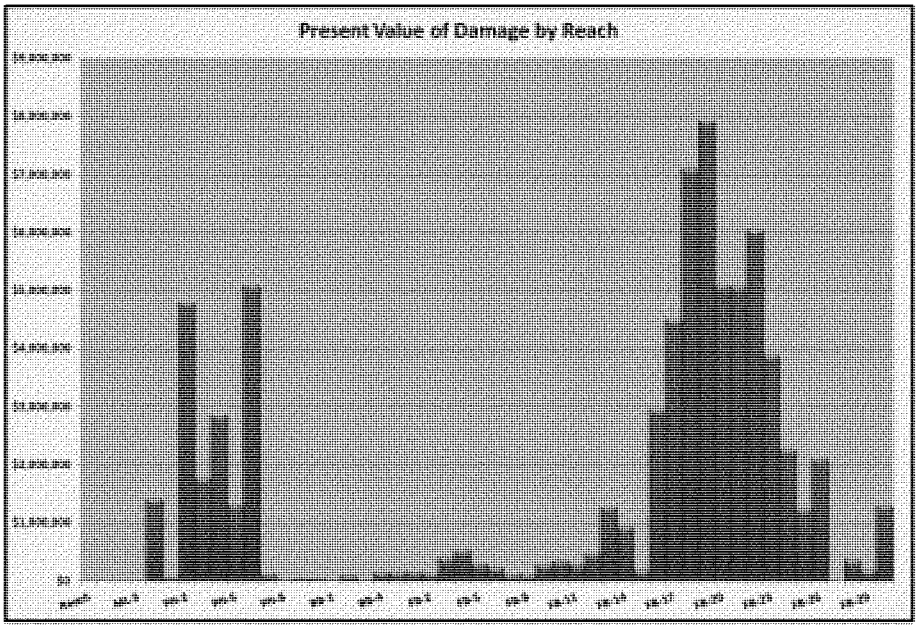


Figure 3-6: **Future without project present value total damages by preliminary Beach-fx reach (FY13 price level and discount rate).**

Once benefits for each of the alternatives are calculated, they will be compared to the costs of implementing the alternative. Dividing the benefits of an alternative by the costs of the alternative yields a Benefit-to-Cost Ratio (B/C Ratio). This ratio must be greater than 1.0 in order for the alternative to be justified and implementable (i.e., the benefits must be greater than the costs). The federally-preferred plan (NED – National Economic Development Plan) is the plan that maximizes net benefits while protecting the nation's environment and is socially acceptable. Net benefits are determined by simply subtracting the cost of any given alternative from the benefits of that alternative (Benefits – Costs = Net Benefits). Furthermore, each project area is evaluated on an incremental basis. That is, each portion of the project must be justified independently.

Pursuant to estimating future without-project condition damages and associated costs for the study area in Flagler County, Beach-*fx* was used to estimate damages and costs in the following categories:

- Structure Damage: Economic losses resulting from structures being exposed to wave attack, inundation, and erosion damages.

- Contents Damage: The material items within structures (usually air conditioned and enclosed) that are potentially subject to damage.

- Armor/Road Damage: Beach-*fx* provides the capability to estimate the costs incurred from measures likely to be taken to protect coastal assets and or prevent erosion in the study area. Based on the existence of coastal armor throughout the study area, Beach-*fx* was used to estimate the costs of erecting such measures throughout the period of analysis. It should be noted that road damages and armor damages are reported in a single damage category. This is due to the fact that State Road A1A (SR A1A) runs adjacent to the beach throughout the study area. SR A1A and the armor that protects it (typically revetment) are inextricably linked. The armor was built specifically to protect the road. And, if the armor is damaged beyond a defined threshold, the road itself can receive damage. Damages to the road and armor, and costs to repair or construct new armor, are reported by Beach-*fx* as a single category, defined in this report as "armor/road" damage. The damage functions and values that were developed are based on existing FDOT data. More information about these damage elements is provided in the economics appendix.

- Land Loss Value: The estimated land loss value associated with erosion is based on land loss estimates from Beach-fx and nearshore land values provided by USACE Jacksonville District (SAJ) real estate personnel.

Table 3-8 provides detail on the accumulated present value damages and cost calculated for the Flagler County study area by category.

Table 3-8: Future Without Project Damages by Category (Present Value),

Area	Structure Damage	Content Damage	Armor and Road Damage	Total Costs and Damages
Marineland	$ -	$ -	$ 1,396,178	$ 1,396,178
Painters Hill	$1,999,405	$343,693	$13,669,173	$16,012,271
Beverly Beach	$ 117,392	$ 16,927	$ 244,849	$ 379,169
Flagler Beach	$2,079,098	$182,763	$53,464,100	$55,725,961
Total	**$4,195,895**	**$543,384**	**$68,774,300**	**$73,513,579**
Percent of Total Costs and Damages	**6%**	**1%**	**94%**	

* FY13 price level and discount rate

There is a great deal of variability in the amount of damages among the project reaches. This is explained by the large number of variables, all of which the Beach-*fx* model takes into account. Examples of variation result from the following:

- Density and amount of development
- Typical size and value of structures
- Typical distance between structures and mean-high water
- Size, shape and location of the dunes and coastal morphology
- Rate of erosion for each reach
- Amount and type of coastal armoring present
- Eligibility of homeowners to construct coastal armoring

In **Table 3-8**, structure and content damages comprise nearly 7% of the total estimated future economic losses. **Figure 3-7** depicts structure and content damages throughout the study area.

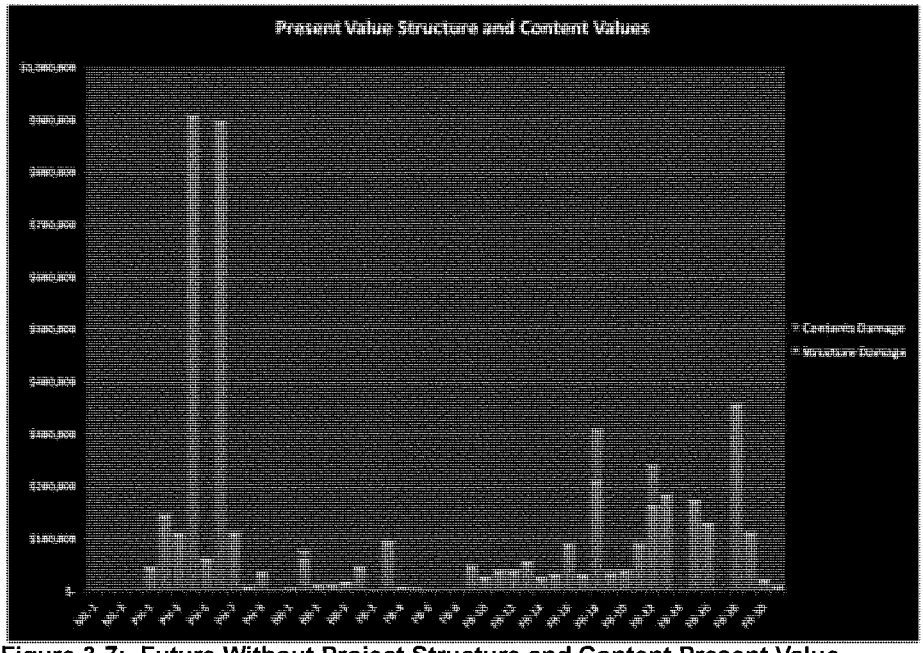


Figure 3-7: Future Without Project Structure and Content Present Value Damages by Preliminary Beach-fx Reach (FY13 price level and discount rate).

Painters Hill and Beverly Beach have a mix of newer and older residential structures and vacant lots seaward of SR A1A. Some of the structures are designated not "armorable" in the future due to their location relative to the coastal construction control line (CCCL) and the construction dates of structures according to parcel data. Structures built seaward of the CCCL after 1988 are designated not "armorable" in the future. Thus, residences seaward of A1A that may acquire armor are scattered among those that may not. Even though SR A1A is assumed to be "armorable" in the future based on recent and past occurrences of FDOT taking measures to rebuild and protect the road, the presence of armored and unarmored lots seaward of the road prolongs the damage elements' exposure to erosion damage driving parameters.

For purposes of economic analysis vacant lots were assumed "unarmorable" in the future since it is also assumed that vacant lots will remain undeveloped.

Armor damages and costs throughout the period of analysis are estimated to be 93% of total damages and costs for the study area in the future without project condition. The majority of the armor costs are incurred protecting SR A1A, particularly in Flagler Beach. **Figure 3-8** shows damages to existing armor and

costs to build future armor throughout the study area over the 50-year period of analysis. It is evident from this figure that the majority of existing and future armor impacts are located in the Flagler Beach reach. Any potential Federal project will most likely be justified by preventing these damages and future costs to repair/construct a new revetment protecting SR A1A.

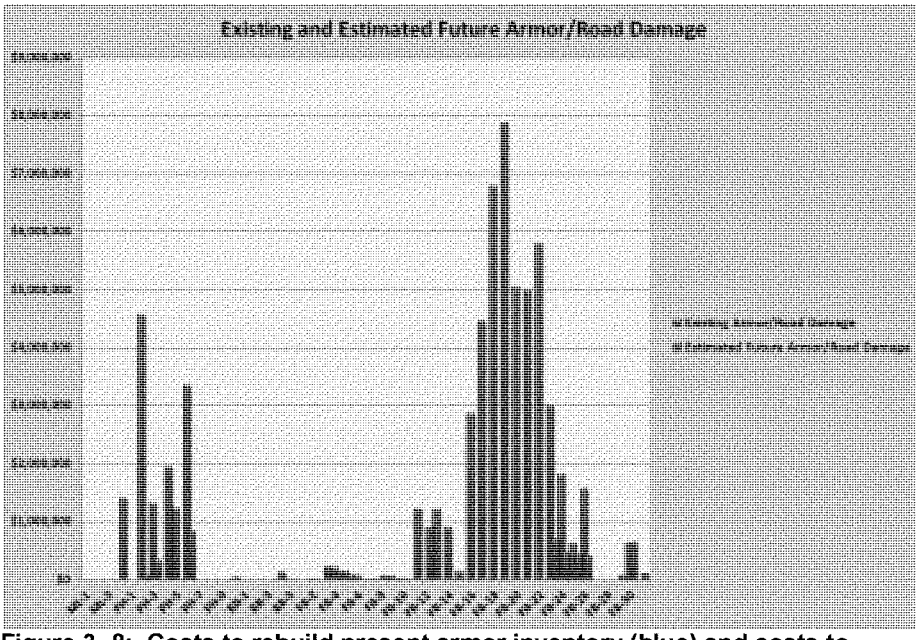


Figure 3- 8: Costs to rebuild present armor inventory (blue) and costs to construct new armor (red) by Preliminary Beach-fx Reach (FY13 price level and discount rate).

FDOT plans to maintain A1A in its current location. However, if the existing SR A1A revetment is not maintained, it will be impossible to maintain the road. Over time, the road would absorb significant erosion damage. Eventually the structures and property located on the landward side of the road would also receive damage. Within the Flagler Beach Study Area, where A1A is the most seaward damage element from R-60 through R-94, there are 490 single-family structures, 87 multi-family structures, and 104 commercial structures located landward of A1A. The road and road armor is not a protective feature that provides benefits for protecting landward structures. The road and road armor is modeled as a damage element. In the intermediate and high sea level rise scenarios (SLR1 and SLR2), the road would be destroyed earlier and the damage elements behind the road would receive significantly more damage if the road and armor were not maintained.

3.6 Environmental Resources *

3.6.1 General

The majority of the existing environmental and historic resources discussed in Chapter 2 are not predicted to significantly change during the 50-year period of analysis of the future without-project condition. A major stressor in the future without-project condition will be the continued erosion of the berm and dune system and projected responses from property owners. The beach berm and dune width will be reduced and there will be an increase in shore armoring as structures are threatened by coastal storms. The projected reduction in berm width is most likely to adversely affect sea turtles and shorebirds.

3.6.2 Specific

Table 3- 9 provides details of the environmental effects of the future without-project conditions.

Table 3- 9: Summary of Direct and Indirect Impacts.

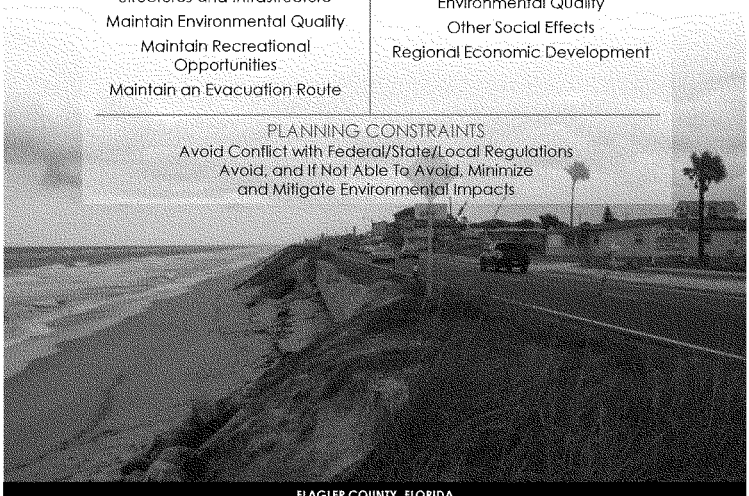
EXISTING ENVIRONMENTAL FACTOR	ALTERNATIVE No Action
VEGETATION	Continued erosion of the dune and upper beach will further stress dune vegetation causing die-back of species.
PROTECTED SPECIES	Continued loss of sea turtle nesting habitat on the beach.
HARDBOTTOM RESOURCES	No reasonably foreseen impacts would occur. Known hardbottom resources occur within the study area but do not occur within the proposed project limits.
FISH AND WILDLIFE RESOURCES	Continued loss of dune and beach habitat.
ESSENTIAL FISH HABITAT	No reasonably foreseen impacts would occur.

EXISTING ENVIRONMENTAL FACTOR	ALTERNATIVE No Action
COASTAL BARRIER RESOURCES	Continued loss of beach habitat associated with CBRA Units FL-P07P and P05A.
WATER QUALITY	No reasonably foreseen impacts to water quality would occur.
AIR QUALITY	No reasonably foreseen impacts would occur.
NOISE	No reasonably foreseen impacts would occur.
AESTHETIC RESOURCES	Long-term decline in appearance of the beach as it continues to erode.
RECREATION RESOURCES	Long-term decline in beach available for use by recreational interests.
NAVIGATION	No reasonably foreseen impacts would occur.
HISTORIC AND CULTURAL RESOURCES	Long term shoreline encroachment will impact historic properties immediately adjacent to the shoreline.
NATIVE AMERICANS	No adverse effects to Native American properties.

CHAPTER 4
PROBLEMS AND OPPORTUNITIES

PROBLEMS	OPPORTUNITIES
Storm waves, inundation and erosion threatens: Coastal Structures and Infrastructure including Highway A1A Natural Habitat Recreational Opportunities	Reduce Storm Damage to Structures and Infrastructure Restore Dunes Protect Habitat Protect Evacuation Route (Highway A1A) Maintain Recreation
PLANNING OBJECTIVES	**FEDERAL OBJECTIVES**
Reduce Storm Damages to Structures and Infrastructure Maintain Environmental Quality Maintain Recreational Opportunities Maintain an Evacuation Route	National Economic Development Environmental Quality Other Social Effects Regional Economic Development

PLANNING CONSTRAINTS
Avoid Conflict with Federal/State/Local Regulations
Avoid, and If Not Able To Avoid, Minimize and Mitigate Environmental Impacts



FLAGLER COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION
FINAL INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT

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* Items required for an Environmental Assessment by the National Environmental Policy Act

4 PROBLEMS AND OPPORTUNITIES

4.1 Agency and Public Concerns *

Scoping

During formulation and evaluation of the project, input from environmental agencies and the public was facilitated through numerous means, including the following:

- A scoping letter to all Federal and state agencies, local libraries and agencies, and all abutting property owners on August 26, 2008
- A Notice of Intent to prepare a Draft Environmental Impact Statement published in the Federal Register on August 26, 2008
- A public scoping meeting held in Bunnell, Flagler County, Florida on October 25, 2011 in fulfillment of NEPA requirements at which a rich diversity of views were expressed including those for and against a shore protection project

As a result of the August 26 scoping letter, the Florida Department of Environmental Protection (FDEP) indicated that state designated critically eroding areas had been extended in the Painters Hill, Beverly Beach, and Flagler Beach reaches. In response, USACE extended the study area to close the gaps between the three southern study reaches.

A feasibility scoping meeting (FSM) was held by Jacksonville District Planning Division staff to discuss the study on January 28, 2011. One purpose of the FSM was to collect input from affected resource agencies regarding:

- The Future Without-Project anticipated conditions in the study area
- The affect on resources due to expediting the study, with specific reference to the alternatives identified in the Draft Feasibility Study Report and integrated Environmental Impact Statement (now revised as an Environmental Assessment)
- The feasibility study and its key alternatives
- The required depth of analysis, as well as defined study constraints

A study overview was provided by the SAJ District via a web-meeting. Either physical or virtual (via phone conferencing and webinar) attendance at the FSM included representation from the following agencies:

- U.S. Army Corps of Engineers (USACE) Headquarters (HQ), South Atlantic Division (SAD), and Jacksonville District (SAJ)
- Flagler County (Project Sponsor)
- City of Flagler Beach
- Florida Department of Environmental Protection (FDEP)
- Florida Department of Transportation (FDOT)
- Bureau of Ocean Energy Management (BOEM)

- Florida Fish and Wildlife Conservation Commission (FWC)

In addition to those listed above, an invitation to the event included the following agencies:

- U.S. Fish and Wildlife Service (FWS)
- National Marine Fisheries Service (NMFS)
- U.S. Environmental Protection Agency (EPA)

The sponsor and agencies provided their comments and input regarding the study, and important issues identified by the USACE HQ Office of Water Project Review (OWPR) were discussed in detail.

Issues

The concerns voiced in response to the USACE scoping letter included:

- Potential opportunities to redirect heavy traffic from SR A1A
- Claims that erosion problems in Flagler County are overstated
- Suggestion that the apparent erosion problems are really caused by rainwater runoff and poorly maintained storm drains and there is no need for storm damage reduction
- Desire to maintain the uniquely colored sandy beaches

In addition, significant input was derived from the June 2006 Florida Department of Transportation (FDOT) public workshops soliciting community feedback on an ongoing Project Development and Environment (PD&E) study and related alternatives. The FDOT study focused on plans to protect SR A1A in Flagler Beach. Multiple representatives from various Federal, state, and local agencies and interest groups provided comments, illuminating a wide variety of concerns and recommendations to be considered by state and Federal agencies while planning projects with potential impacts to the coastline and SR A1A.

The ideas and comments offered included the following:

Safety Concerns

- Preserving SR A1A
- Limiting truck traffic
- Providing pedestrian access/crosswalks
- Protecting SR A1A from storm surges
- Maintaining SR A1A as an evacuation route

Environment

- Preserving the beach naturally
- Protecting the dunes from storm-induced erosion
- Protecting sea turtle habitat and activities

- Preserving the ecosystem

Community Issues

- Providing beach access
- Increasing public parking for beach and adjacent businesses
- Maintaining/preserving/enhancing scenic highway and aesthetics
- Creating better and uniform signage
- Preserving the pier located in the Flagler Beach reach
- Improving and preserving the "Old Florida" unique characteristics of downtown (e.g. through zoning, signage and access)
- Maintaining an unobstructed view of the ocean from the roadway

From the FDOT public workshops, a number of ideas for long-term solutions were suggested by attendees. Some of the ideas are listed below:

- Relocate SR A1A
- Designate SR A1A for local traffic only
- maintain the current north/south configuration of SR A1A through Flagler and Volusia counties
- Beach renourishment using a variety of techniques
- Build seawalls
- Construct undercurrent stabilizers, i.e., submerged groins

The following issues were identified to be relevant to the proposed action and appropriate for detailed evaluation:

- Vegetation
- Threatened and endangered species
- Fish and wildlife resources
- Essential fish habitat
- Coastal barrier resources
- Water quality
- Air quality
- Noise
- Aesthetic resources
- Recreation resources
- Navigation
- Historic and cultural resources
- Native Americans
- Socio-economics
- Public safety

Conflicts and Controversy *

No conflicts or controversy regarding this project have been identified.

4.2 Problems and Opportunities *

A problem is an existing undesirable condition to be changed. An opportunity is a chance to create a future condition that is desirable. The difference between problems and opportunities is often indistinct, but in both cases a changed future condition is preferred. The purpose of this feasibility study is to develop an implementable and acceptable plan to improve the future condition and address specific problems and opportunities in the study area. Problems and opportunities to be addressed were identified in several ways. The study team reviewed previous studies by USACE and the Florida Department of Transportation (FDOT), as well as scoping letter comments received from local residents and stakeholders to identify current hurricane and storm damage related problems affecting the study area. Also, USACE has taken into account the outcomes of the public workshops and brainstorming meetings which have been held by FDOT since 2006 to solicit public input regarding storm damage protection along the Flagler Beach shorelines paralleled by SR A1A.

4.2.1 Problems

Specific problems in the study area include the following:

- Effects from storms including erosion, storm surge (inundation), and wave attack are causing damage to coastal structures and infrastructure.
- Natural beach habitat of nesting sea turtles, benthic invertebrates, and shore birds is being lost to coastal erosion.
- Shoreline erosion is decreasing beach width, threatening recreational and tourism opportunities.

Beach erosion, both long term and storm induced, is the greatest problem in the study area. Due to the unique beach sediments and proximity of existing coastal development, Flagler County's beaches are experiencing a long-term erosional trend with little natural recovery. Throughout the study area, infrastructure has been developed directly on top of the primary dune system, often depriving the beach from sediment gained from natural dune erosion. Beach and dune width is reduced during storm events as sediments are transported away from the beach and are less likely to be fed back into the upper beach and dune system by aeolian (wind driven) processes due to the sediment grain size and associated relative weight. Therefore, periodic severe storm events are removing sediment from the dune and beach face and the natural processes to replace the sediment are restricted.

Some major concerns voiced by the public relate to the vulnerability of the historic Marineland Oceanarium, the National Scenic Highway SR A1A, and coastal residences. As a result of past coastal storms, homes have been in imminent danger of being undermined and destroyed in the Painters Hill reach. Painters Hill homeowners have applied for permits from FDEP to construct temporary seawalls signifying the severity of the situation. Such permits have been granted by FDEP in

the past, but only in response to severe erosion and on the conditions that structures are temporary and will be removed at some point in the future. In addition, FDOT has been addressing the problem of shoreline erosion threatening SR A1A in Flagler Beach for more than 30 years. FDOT has periodically applied sand fill and replaced lost dune sections with native coquina and granite rock. This method of protecting the roadway is a result of available funding and a construction footprint limited to 50 feet from the centerline of SR A1A. It is estimated that the annual expense to FDOT to maintain the revetment in Flagler Beach is approximately $600,000/year.

Sea-level rise and projected increases in the frequency and intensity of tropical and subtropical storms are expected to exacerbate the erosion pressures in the study area. Problems associated with the eroding shoreline include impacts to tourism, recreation, and habitat loss.

4.2.2 Opportunities

Opportunities focus on desirable future conditions and potential ways to address the specific problems within the study area. Opportunities that may result from management measures are to:

- Reduce storm damage to coastal structures and infrastructure, and residential and commercial property.
- Restore dunes to function naturally where possible in the study area.
- Protect habitat of nesting sea turtles, benthic invertebrates, and shore birds.
- Protect the current hurricane evacuation route capability in eastern Flagler County.
- Maintain existing recreation and tourism opportunities.

Protecting coastal structures and infrastructure, as well as residential and commercial property from storm damage may be realized by implementing a single management measure or a combination of management measures which may be structural and/or non-structural. Coincident with some management measures like beach nourishment and dune creation/remediation are opportunities to protect natural habitat for sea turtles, shore birds, etc. While some natural functions, such as sea turtle nesting, may be disrupted during construction activities, there is an opportunity for long-term benefits in preserving the beach habitat. Providing hurricane and storm damage reduction benefits in Flagler Beach will help to preserve the current hurricane evacuation route (SR A1A) capability and the economic base for eastern Flagler County. There is also the opportunity to preserve recreational opportunities that the current beach and dune systems provide such as beach access, surfing, fishing, and wildlife viewing. Preserving recreational opportunities provides many benefits to the local economy.

4.3 Objectives *

4.3.1 Federal Objectives

The Federal objective, as stated in The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, established by the U.S. Water Resources Council on March 10, 1983 (P&G), is to contribute to national economic development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net economic benefits that accrue in the study area and the rest of the nation.

4.3.1.1 Federal Environmental Objectives

The USACE considers carefully and seeks to balance the environmental and development needs of the nation in full compliance with the National Environmental Policy Act (NEPA) and other authorities provided by Congress and the Executive Branch. Public participation is encouraged early in the planning process to define environmental problems and elicit public expression of needs and expectations. Significant environmental resources and values that would likely be impacted, favorably as well as adversely, by an alternative under consideration are identified early in the planning process. All plans are formulated to avoid to the fullest extent practicable any adverse impact on significant resources. Significant adverse impacts that cannot be avoided are minimized and/or mitigated as required by Section 906(d) of the Water Resources Development Act (WRDA) of 1986. This feasibility study describes the environmental impacts of the recommended plan and summarizes compliance with Federal statutes and regulations.

4.3.1.2 Environmental Operating Principles

Consistent with the National Environmental Policy Act (NEPA), USACE has reaffirmed its commitment to the environment by formalizing a set of environmental operating principles applicable to all its decision making and programs. These principles foster unity of purpose on environmental issues and ensure that conservation, and environmental preservation and restoration are considered in all USACE activities.

Sustainability can only be achieved by the combined efforts of federal agencies, tribal, state and local governments, and the private sector, each doing its part, backed by the citizens of the world. These principles help USACE define its role in that endeavor. The USACE Environmental Operating Principles are:

- Foster sustainability as a way of life throughout the organization.
- Proactively consider environmental consequences of all Corps activities and act accordingly.
- Create mutually supporting economic and environmentally sustainable solutions.
- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps, which may impact human and natural environments.
- Consider the environment in employing a risk management and systems approach throughout life cycles of projects and programs.
- Leverage scientific, economic and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner.
- Employ an open, transparent process that respects views of individuals and groups interested in Corps activities.

4.3.1.3 Federal Project Purposes

Hurricane and storm damage reduction projects have been authorized for a variety of purposes: beach erosion control, shore/shoreline protection, hurricane/hurricane wave protection, and storm protection. The WRDA of 1986 assigns costs of Federal projects to appropriate project purposes. The costs for construction associated with this study area are assigned to either hurricane and storm damage reduction or recreation. Project reaches that provide hurricane and storm damage reduction are assigned a 65% Federal share for initial construction. Specifically for beach renourishment projects, WRDA 1999 assigned a 50% Federal share for future renourishments. Project reaches that provide for separable recreation are not federally cost shared. The Federal government does not participate in any work in separable recreation benefits realized such as constructing a beach only for recreational purposes (and not hurricane and storm damage reduction purposes) or constructing recreation facilities at hurricane and storm damage reduction project site. Recreation is not considered to be a high priority output or primary project output under current Department of Army policy. This policy precludes Federal funds to support construction of shore or hurricane protection projects which depend on separable recreation benefits for economic justification, or for which incidental recreation benefits are greater than 50% needed for justification (ER 1105-2-100 section 3-4.b(4)(a)).

4.3.1.4 Campaign Plan of the U.S. Army Corps of Engineers (USACE)

The USACE Campaign Plan goals and objectives are derived, in part, from the Commander's intent, the Army Campaign Plan, and the Office of Management and Budget. The four goals and their associated objectives also build on prior strategic planning efforts. Each goal and objective is led by a USACE senior leader who manages and oversees actions to reach the goal and objectives.

The successful achievement of the goals and objectives contained in the Campaign Plan are dependent on actions implemented by the entire USACE team. The implementing actions supporting each goal and objective are contained in the headquarters staff and Major Subordinate Command (MSC) implementation guidance for the Campaign Plan. The four goals of the Campaign Plan are:

Goal 1: Deliver innovative, resilient, and sustainable solutions to DoD and the nation.
Goal 2: Deliver enduring and essential water resource solutions, utilizing effective transformation strategies.
Goal 3: Deliver support that responds to, recovers from, and mitigates disaster impacts to the nation.
Goal 4: Build resilient People, Teams, Systems and Processes to sustain a diverse culture of collaboration, innovation and participation to shape and deliver strategic solutions.

These Campaign Plan goals and associated objectives will be addressed through the course of the feasibility study.

4.3.2 State and Local Objectives

The State of Florida is empowered by the Federal Coastal Zone Management Act (CZMA) and its implementing regulations in 15 CFR Part 930 to review Federal activities within, or adjacent to, the coastal zone in Florida to determine whether the activity complies with the requirements of the state's approved management program. Florida's Coastal Zone Management Program was established under the Coastal Management Act of 1978 (Chapter 380, Florida Statutes) and approved by the Federal Coastal Zone Management office in 1981. Florida does not regulate its coastal zone through one comprehensive law but rather through 24 state statutes. Through Florida's comprehensive planning act, local governments are also given the opportunity to determine whether these activities are consistent with their goals and policies. The Florida Department of Environmental Protection (FDEP) is the lead state agency for the implementation of the Coastal Zone Management Program.

The Beach and Shore Preservation Act (Chapter 161, Florida Statutes) is Florida's primary statute for developing and implementing the state's strategic beach management plan, regulating coastal construction seaward of the mean high water

line, and regulating activities seaward of the coastal construction control line, defined below. The act, administered by the FDEP, was first passed in 1965 and has since been significantly amended. The objective of the Beach and Shore Preservation Act is to preserve and protect Florida's sandy beaches and adjacent beach and dune systems which serve to protect upland properties from storm damage, provide recreation for Florida residents and visitors, and provide habitat for wildlife. The following paragraphs describe programs which may have a bearing on this study.

4.3.2.1 Coastal Construction Control Lines

In the State of Florida Beach and Shore Preservation Act, the legislature asserted that Florida beaches and coastal barrier dunes are among the state's most valuable natural resources and that these resources should be protected from "imprudent construction which can jeopardize the stability of the beach-dune system, accelerate erosion, provide inadequate protection to upland structures, endanger adjacent properties or interfere with public beach access" (Section 161.053, Florida Statutes). To ensure that such "imprudent construction" does not take place, the statute charged the FDEP to define and establish Coastal Construction Control Lines (CCCL's). The CCCL represents the area of the beach and dune system that is expected to be subject to severe fluctuation from a 100-year storm surge. The specific location of the line is a function of the predicted storm surge and erosion resulting from a 100-year storm. The FDEP has established control lines on a county-by-county basis for Florida's 25 sandy beach counties (Section 161.053, Florida Statutes), including Flagler County. The CCCL defines the FDEP jurisdictional area in which special planning and design criteria are applied to construction and related activities through the permit program. The primary purposes of this permitting program are to ensure that construction seaward of the control line is designed and cited to protect beaches and dunes from adverse impacts and to ensure that construction seaward of the line does not result in accelerated erosion on adjacent land. Coastal storm damage reduction alternatives such as beach restoration and nourishment, dune restoration and maintenance, seawalls, revetments, and groins would be included under the jurisdiction of this program. The FDEP has also implemented a coastal monitoring program for survey and documentation purposes. Control monitoring locations (R-monuments) have been established approximately every 1,000 feet along the coastal shoreline of all beach front areas to serve as monument reference stations during surveying. FDEP regularly conducts post-storm surveys that provide Florida with a comprehensive pre- and post-storm database.

4.3.2.2 Joint Coastal Permit Program

The Beach and Shore Preservation Act regulates construction activities on sovereign lands of Florida seaward of the mean high water line (Chapters 161.041, 373, 253 and 258, Florida Statutes) through the Joint Coastal Permit (JCP) program. This program is a combination of the CCCL regulatory program and the Environmental Regulatory Program, including the water quality certification, authorized under Chapters 373 and 403, Florida statutes. It also covers activities affecting inlets. The program is intended to protect the beach from further erosion, maintain water quality, protect threatened and endangered species habitat, and properly allocate public trust resources. The JCP program regulates activities that could have a material physical effect on coastal processes. Those activities primarily include beach restoration and nourishment projects, erosion control projects (including breakwaters and groins), and coastal inlet management projects (including navigational dredging, sand bypassing, and jetties). The JCP is the vehicle for the Corps' water quality certification under Section 401 of the Clean Water Act, 33 U.S.C. Section 1341, as well as for a finding of consistency with the Florida Coastal Zone Management Program pursuant to Section 307 of the Coastal Zone Management Act.

4.3.2.3 Erosion Setbacks

The 1985 State Comprehensive Growth Management Act (Chapter 85-55, Laws of Florida) amended the Beach and Shore Preservation Act to include a construction setback provision for all sandy beach counties. The amendment prohibits FDEP from granting most coastal construction permits on land that will be seaward of the seasonal high water line within 30 years (Section 161.053, Florida Statutes). The 30-year erosion projection cannot, however, extend landward of an established CCCL (Section 161.053, Florida Statutes). FDEP uses long-term erosion rates to delineate the location of the 30-year erosion projection, considering also the presence of shore protection structures and beach restoration projects (Section 161.053, Florida Statutes). FDEP can grant coastal construction and JCP permits for shore protection structures, piers, and minor structures seaward of the 30-year erosion projection. FDEP can permit construction of a single-family residence seaward of the line only if the parcel was platted before adoption of the amendment, the landowner does not own another parcel adjacent to and landward of the parcel proposed for development, and the structure is located landward of the frontal dune and as far landward as practicable (Section 161.053, Florida Statutes). In addition, repairs or reconstruction of a building cannot "expand the capacity of the original structure seaward of the 30-year erosion projection" (Section 161.053, Florida Statutes). The department can, however, issue a permit for landward relocation of a damaged or existing structure if the relocation will not damage the beach-dune system (Section 161.053, Florida Statutes).

4.3.2.4 Coastal Building Zone

The 1985 Growth Management Act further amended the Beach and Shore Preservation Act to establish a coastal building zone extending landward of coastal construction control lines. Standards for structures within the coastal building zone are contained in the Florida Building Code. For mainland beaches, barrier spits, and peninsulas lying within Florida's sandy beach counties, the coastal building zone extends from the seasonal high water line to 1,500 feet landward of the CCCL. On barrier islands, the entire island or the area from the seasonal high water line to a maximum of 5,000 feet inland from the CCCL is included in the building zone (Section 161.54, Florida Statutes). All land areas within the Florida Keys, regardless of island size, lie within the coastal building zone.

4.3.2.5 Erosion Control Program

In 1986, the Florida legislature amended the Beach and Shore Preservation Act to address the statewide problem of beach erosion through a "state-initiated program of beach restoration and beach nourishment" (Section 161.101, Florida Statutes). The legislature declared, "beach erosion is a serious menace to the economy and general welfare of the people of this state and has advanced to emergency proportions" (Section 161.088, Florida Statutes). The statute directs the FDEP to develop and maintain a comprehensive long-term management plan for restoration of Florida's critically eroding beaches (Section 161.091, Florida Statutes). The plan must provide for the following: 1) encourage the geographic coordination and sequencing of prioritized projects, 2) try to reduce equipment mobilization and demobilization costs, 3) maximize the quantity of beach-quality sand into the system, 4) extend the life of beach nourishment projects and reduce the frequency of nourishment, and 5) promote inlet sand bypassing to replicate the natural flow of sand interrupted by inlets and ports. The plan, known as the *Strategic Beach Management Plan*, is updated periodically to address changing conditions in the coastal system. Flagler County's beaches are addressed as a sub-region in the Strategic Beach Management Plan for the Northeast Atlantic Coast Region (FDEP, 2008). State funds for erosion control projects are available from Florida's Ecosystem Restoration and Management Trust Fund (Section 161.091, Florida Statutes). The fund provides money for erosion control projects consistent with the Strategic Beach Management Plan. The state can pay up to 50% of the actual non-Federal cost of restoring a critically eroding beach, while the local government in which the project occurs must provide the balance of the funds (Section 161.101, Florida Statutes). The level of state funding is directly related to the amount of public beach access and parking located within the project area.

4.3.2.6 Erosion Control Line

Property rights of state and private upland owners in beach restoration project areas are set forth in Chapter 161.141, Florida Statute. The statute proclaims that the

Legislature declares that it is the public policy of the state to cause to be fixed and determined, pursuant to beach restoration, beach nourishment, and erosion control projects, the boundary line between sovereignty lands of the state bordering on the Atlantic Ocean, the Gulf of Mexico, or the Straits of Florida, and the bays, lagoons, and other tidal reaches thereof, and the upland properties adjacent thereto; except that such boundary line shall not be fixed for beach restoration projects that result from inlet or navigation channel maintenance dredging projects unless such projects involve the construction of authorized beach restoration projects. Prior to construction of such a beach restoration project, the board of trustees shall establish the line of mean high water for the area to be restored; and any additions to the upland property landward of the established line of mean high water which result from the restoration project shall remain the property of the upland owner subject to all governmental regulations and shall not be used to justify increased density or the relocation of the coastal construction control line as may be in effect for such upland property. Such resulting additions to upland property shall also be subject to a public easement for traditional uses of the sandy beach consistent with uses, which would have been allowed prior to the need for such restoration project. It is further declared that there is no intention on the part of the state to extend its claims to lands not already held by it or to deprive any upland or submerged landowner of the legitimate and constitutional use and enjoyment of his property. If an authorized beach restoration, nourishment, and erosion control project cannot reasonably be accomplished without the taking of private property, then such taking shall be made by the requesting authority by eminent domain proceedings.

4.3.2.7 Local Comprehensive Planning

The Local Government Comprehensive Planning Act of 1985 (Chapter 163) requires that all local governments prepare, adopt, and implement comprehensive plans that address community growth and development needs. It requires that local, regional, and state comprehensive plans be consistent with each other and requires coastal counties and cities to include a coastal management "element" in their local plans. This section of the plan must be based on an inventory of the beach-dune system and existing coastal land uses and an analysis of the effects of future land uses on coastal resources. Local governments must also address disaster mitigation and redevelopment, designation of coastal high-hazard areas, beach protection, and shoreline use.

In response to the state's growth management mandate, Flagler County has developed a Comprehensive Plan which is premised on the County's individual unique characteristics, historical trends, current conditions and citizens' aspirations for the future of Flagler County with a desirable quality of life. Each element in Flagler County's Comprehensive Plan includes specific goals, objectives and policies that determine how the future growth of the county will be guided. The plan includes elements dealing with: Future Land Use, Transportation, Housing, Infrastructure, Coastal Management, Conservation, Recreation and Open Space,

Intergovernmental Coordination, and Capital Improvements.

The Coastal Management Element of the Flagler County Comprehensive Plan specifies goals, objectives, and policies: 1) Preserving, protecting, or enhancing the natural and historic resources of the coastal area, 2) Reducing vulnerability to hurricanes, 3) Increasing public access to coastal resources, 4) Providing public infrastructure, and 5) Pursuing intergovernmental coordination to protect coastal resources.

The Comprehensive plan addresses post-disaster and pre-hazard mitigation. Flagler County has a comprehensive and up-to-date Hurricane Evacuation and Management Plan which is available to the public through the website www.flagleremergency.com.

4.4 Constraints

4.4.1 Planning Constraints

A constraint is a restriction that limits the extent of the planning process; it is a statement of effects the alternative plans should avoid. Constraints are designed to avoid undesirable changes between the without and with-project future conditions. The planning constraints for this study area are:

1) Avoid conflict with Federal and state regulations, as stated in Federal law, USACE regulations, executive orders and State of Florida statutes. While local and state policy is considered for consistency, the emphasis is on legal requirements.

4.4.2 Local Constraints

Local constraints are those that the sponsor wishes to avoid and will be taken into consideration. However, they are not used to screen alternatives.

1) Avoid impacts to current recreation caused by the implementation of a management measure, in and adjacent to the study area, during and following construction and equilibration of any potentially chosen shore protection alternative.

2) Preserve the unique characteristics and quality of Flagler County's beach sediments.

4.5 Related Environmental Documents

This report presents the results of a feasibility-level investigation for the study area integrated with the Environmental Assessment for the recommended plan. The Appendices include the Section 404(b) Evaluation, Coastal Zone Management Consistency Determination, Pertinent Correspondence and Mailing List, Cumulative Effects Assessment, and Environmental Documentation. Section 1.6 lists pertinent previous studies. Additional environmental documents prepared in conjunction with this study are included in the references and the **Environmental Appendix F**.

4.6 Decisions to be Made

The report will serve as a decision document for Federal participation related to hurricane and storm damage reduction over a 50-year period.

4.7 Planning Objectives (EA Agency Objectives)

The planning objectives are statements of the study purpose. Planning objectives are more general than the Federal and non-federal objectives described in Section 4.3. Planning objectives reflect means of solving the study area's problems while taking advantage of the identified opportunities. An objective is developed to address each of the identified problems and opportunities; although a single objective may address multiple problems and opportunities simultaneously. Planning objectives represent desired positive changes in the without project future conditions.

The planning objectives for the Flagler County study area would be attained within the period of analysis for the study, a 50-year period of Federal participation. All of the objectives focus on activity within the study area.

The overarching goal of the project is to reduce the damages caused by erosion and coastal storms to shorefront structures and infrastructure within the study area. The following objectives are based on the project problems, opportunities, goals, and Federal and state objectives and regulations:

1) Reduce storm damages to structures and infrastructure within the Flagler County project area over the 50-year period of Federal participation.

2) Maintain environmental quality in the project area and adjacent areas, for human and natural use, including air and water quality, habitat, and aesthetics over the life of the project.

3) Maintain opportunities for recreational use of beach and nearshore areas in Flagler County including surfing, fishing, and wildlife viewing over the life of the project.

4) Maintain a safe hurricane evacuation route for the Flagler County project area over the life of the project.

The goal of this feasibility study is to develop a range of alternative plans that balance the objectives while avoiding conflicts or, where necessary, demonstrate the tradeoffs between conflicting objectives, enabling decisions to be made.

The Federal objective is to maximize net benefits. Because of this, it is not appropriate to identify specific targets within objectives; for example, to protect infrastructure from some effects of a pre-defined storm frequency (i.e. the 100-year storm). Rather, the planning process includes formulation and comparison of multiple alternative plans in order to recommend a plan that maximizes National Economic Development (NED) benefits relative to costs. The Federal objective to maximize net benefits supersedes any project-specific target output which does otherwise.

4.8 Scoping and Environmental Issues

4.8.1 Issues Evaluated in Detail

The following environmental issues were identified during scoping and by the preparers of this document to be relevant to any proposed action and appropriate for detailed evaluation: threatened and endangered species and essential fish habitat; preservation of the unique beach sediment characteristics, and protecting and preserving National Scenic Highway SR A1A.

4.8.2 Issues Eliminated from Detailed Analysis

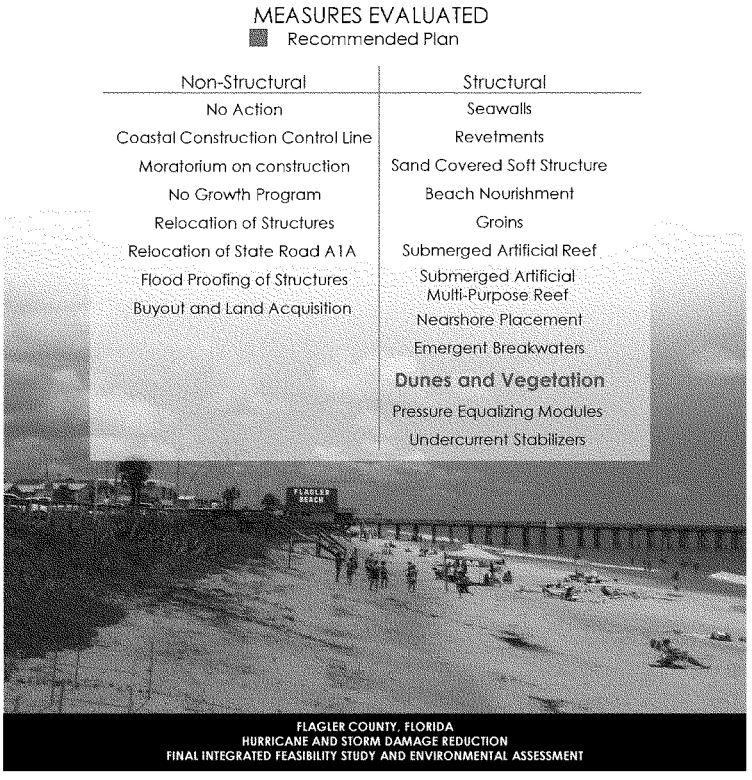
The following issues were not considered imperative or relevant to any proposed storm damage reduction action based on scoping and the professional judgment of the preparers of this document: air quality; urban quality; solid waste; and drinking water. These items are not likely to be affected by the potential alternatives under consideration.

4.9 Permits, Licenses, and Entitlements *

Water quality certification will be required prior to construction and will be obtained from the State of Florida. A Joint Coastal Permit (JCP) application for shore protection along the Flagler County HSDR project area will be prepared and submitted by USACE upon completion of the feasibility phase of the project for

purposes of obtaining water quality certification and coastal zone consistency concurrence. The physical scope and any anticipated direct or indirect impacts to coastal natural resources, along with proposed mitigation and monitoring plans of the project described in the permit application, will be equivalent to those of the selected project alternatives described herein.

CHAPTER 5
FORMULATION AND EVALUATION OF ALTERNATIVE PLANS



FLAGLER COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION
FINAL INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT

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5 FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

5.1 Plan Formulation Rationale *

Plan formulation is the process of developing alternative plans which meet the project-specific objectives while avoiding constraints.

The first step of plan formulation involves identifying all potential management measures for the given problems. A management measure is a structural or nonstructural action that can be implemented at a specific geographic site to address one or more planning objectives.

An alternative plan is a set of one or more management measures functioning to address one or more objectives. Sometimes a plan consists of only one measure, but more often it's a combination of measures. Different alternative plans consist of different measures, or they combine the same measures in different ways, such as different dimensions, quantities, materials, locations or implementation time frames. As the study evolves, favorable plans are reformulated to devise the most efficient, effective, complete, and acceptable plan.

Four accounts, making up the Federal objectives, are established in the *Principles and Guidelines* (P&G 1983) to facilitate the evaluation of management measures and display the effects of alternative plans. The national economic development (NED) account displays the plan with the greatest net economic benefit consistent with protecting the nation's environment; the environmental quality (EQ) account displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of alternative plans; the regional economic development (RED) account displays changes in the distribution of regional economic activity (e.g., income and employment); and the other social effects (OSE) account displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others. The Federal *Principles and Guidelines* require that for Hurricane and Storm Damage Reduction (HSDR) Projects the NED plan is to be the selected plan unless an exception is granted. As discussed above, the NED plan must also be evaluated in consideration of the Principles and Guidelines criteria of completeness, effectiveness, efficiency, and acceptability. Each alternative plan shall be formulated in consideration of these four criteria.

5.2 Management Measures

5.2.1 Identification of Management Measures

Management measures were selected to accomplish at least one of the planning objectives for the Flagler County study. Both nonstructural (NS) measures and structural (S) measures were identified. All possible measures were considered, including those beyond the authority of USACE to implement. The following is a summary of the management measures to be considered for Flagler County.

NS-1: No-Action.
The no-action plan represents future conditions without the implementation of a project. Although this measure does not address any specific problems, it provides a comparison for all other measures. Information to describe this measure was collected during the inventory of existing conditions. The rate of shoreline change will be assumed to continue over the 50-year period of analysis. Present structures and replacement costs will be used into the future.

NS-2 : Coastal Construction Control Line.
A coastal construction control line (CCCL) that does not prohibit construction, but provides stringent structural restrictions, was established in 1988 by the State of Florida. The CCCL affects the entire coastline of Flagler County. This management measure provides for potential changes to the CCCL or building regulations that could be implemented by the State of Florida. Such changes could include moving the CCCL landward, increasing the setback for construction, or increasing the standards for construction to reduce storm damages. The erosion of the shoreline would continue at the present rate, unabated by this measure.

NS-3: Moratorium on Construction.
This management measure would not permit new construction in the area vulnerable to storm damages adjacent to the study area. As properties are damaged, reconstruction would not be permitted. The erosion of the shoreline would continue at the present rate, unabated by this measure. Although not a congressionally-authorized activity, this measure could be implemented by state or local governments.

NS-4: Establish a No-Growth Program.
This management measure would allow for limited reconstruction of existing structures following storm damage, but would not allow for an increased number of new structures within the area vulnerable to storm damages adjacent to the study area. The erosion of the shoreline would continue at the present rate, unabated by this measure. Although not a congressionally-authorized activity, this measure could be implemented by state or local governments.

NS-5: Relocation of Structures.
This management measure would allow the area to continue to erode and the land in this area would be lost. Structures would be identified within the study areas which are vulnerable to storm damage. Where feasible, such structures would be moved further landward on their parcels to escape the vulnerable area.

NS-6: Relocation of State Road A1A.
The relocation of State Road A1A (SR A1A) would allow erosion to continue along with damages to the existing SR A1A. An existing street located further inland could be designated as SR A1A or the existing SR A1A could be rerouted to a new path where it would be less susceptible to storm damages.

NS-7: Floodproofing of Structures.
Floodproofing existing structures and regulating flood plain and shorefront development are management measures that state and local governments could implement. This measure would require changes to the building codes to prevent flood damages associated with coastal storms. New construction and substantial reconstruction would be improved by regulation of new building codes. Existing structures could be improved through incentives and aid programs.

NS-8: Buyout and Land Acquisition.
This measure would allow the shoreline to erode in the study area with a loss of land. Structures within the area vulnerable to storm damage would be identified for acquisition. Structures on the acquired parcels would be demolished and natural areas restored. Such parcels would become public property and would reduce the number of structures vulnerable to storm damages.

S-1: Seawalls.
The construction of additional concrete seawalls or improvements to and maintenance of the existing bulkheads/seawalls would provide a significant degree of protection. The seawalls would be constructed at the seaward edge of the existing bluff or vegetation line. Existing seawalls may be demolished in favor of a new seawall to provide a seamless wall over the entire study area or sub-reaches. This measure would stabilize the shoreline at the location of the bluff, allowing erosion to continue until the seawall becomes the water line. A concrete sheet pile wall is proposed due to its stability in the salt environment and ability to withstand wave action. Construction would entail excavation into the bluff to install tie-back features. The seawall must be of sufficient depth underground to withstand projected scour by wave action and will require rock toe protection. Construction would be from the beach, with intermittent access from roads. Impacts to any nearshore resources during construction would be avoided.

S-2: Revetments.
Revetments have been used extensively in portions of the study area to protect critically threatened, damaged and eroding areas. This measure could include the construction of revetments or improvements to existing revetments in the study area. This measure would involve placement of large rock, designed to withstand the wave environment, along the existing bluff line. The engineered structure would start at the elevation of the bluff, tie in to existing elevations, and have a sloped profile. The structure would be embedded under the beach elevation to a depth below expected scour and future erosion. In-place materials from the excavation would be used for backfill behind the structure. Along the shoreline, the revetment should be continuous to avoid erosional features at gaps and include tie-back features at the ends. Existing armor can either be incorporated into the structure, or demolished to provide a seamless structure. Construction would be from the beach, with intermittent access from roads. Impacts to the nearshore resources during construction would be avoided.

S-3: Sand Covered Soft Structures.
This management measure includes construction of a dune composed of geotextile sand-filled forms (typically tubes or bags) and covered with sand. This forms a sand dune with a structured core. When storm erosion causes the structured geotextile core to become exposed the soft structure acts as armoring to prevent erosion from reaching further inland. Sand depth over the geotextile core would be maintained to an adequate depth to allow the dune to function as habitat and not inhibit sea turtle nesting.

S-4: Beach Nourishment.
This management measure includes initial construction of a beach fill and future renourishments at periodic intervals. Renourishment of the beach would be undertaken periodically to maintain the recreational and storm damage reduction features within design dimensions. Dimensions of the beach fill would be based on the degree of protection desired or economically justified, storm damage protection of given widths of beach, and the environmental impact to the nearshore resources. Beach nourishment material (sand) would need to be available in adequate quantities. Geotechnical investigations would be conducted to identify potential offshore borrow sources. The potential for use of upland sources, as well as the beneficial use of beach quality dredged material from other sources in the region would also be investigated.

S-5: Groins.
A series of groins in the problem area would help hold a beach in front of existing development and prevent further losses of land. The construction of groins would have to be supplemented with beach nourishment so that adjacent beaches would not be starved of sand. For this reason, groins are considered a method to help hold the fill in place and to reduce periodic nourishment requirements. The groins would be constructed of large rocks, designed to interlock together, with a foundation designed to avoid subsidence. The groins would be placed perpendicular to the shoreline and would extend from above the mean high water line out into shallow water. The length, orientation, and head of the structure (T-head or not) would be designed based on wave conditions, storms, and sediment transport. The beach fill material would come from the sources discussed in the beach nourishment structural measure, S-4. Currently groins are in use in the Marineland reach of the study area.

S-6: Submerged Artificial Reefs.
This management measure would use the perched beach concept to limit the amount of underwater fill and retain the dry beach for a longer period. This would be accomplished by placement of a submerged artificial reef in shallow water with beach fill material placed "perched" landward of the reef structure. This measure may reduce initial fill quantities, reduce renourishment requirements and offer mitigation for the environmental impacts of potential nearshore hardbottom burial. The submerged artificial reef may be constructed using one of many various materials, and would sit on top of a foundation-type material to avoid subsidence. The beach fill material would come from the sources discussed in the beach nourishment structural measure, S-4.

S-7: Submerged Artificial Multi-Purpose Reefs.
Submerged artificial multi-purpose reefs are designed to prevent shoreline erosion through wave energy dissipation in a way that enhances wave breaking for surfing and provides additional nearshore habitat. These submerged reefs would be located in the nearshore area outside of the footprint of typical beach fill. They could be constructed as either a stand-alone measure or in conjunction with other measures including beach nourishment.

S-8: Nearshore Placement.
Dredged material would be placed in the nearshore to provide wave attenuation benefits, passive nourishment of the active profile, or a combination of both. This method allows placement in water depths 15 feet and deeper, avoiding direct placement covering any potential nearshore hardbottom. This management measure assumes that a portion of the sand placed in shallow water will move towards the beach under normal wave conditions. Over time following construction, the sand bar will migrate towards the beach through natural sediment transport processes, become transported onto the beach, and shaped into the natural equilibrium profile of the beach, thus adding material and enlarging the beach. The dredged material would come from the sources discussed in the beach nourishment structural measure, S-4.

S-9: Emergent Breakwaters.
The construction of breakwaters offshore along the Flagler County study area is considered as a management measure to stabilize the beach. Such structures reduce the amount of wave energy reaching the shoreline. As a result, the rate of annual erosion would decrease. The breakwaters would be constructed of large rock with foundation materials to prevent subsidence. The breakwaters would be trapezoidal in profile and would be placed parallel to the shoreline in shallow water. The breakwater would be constructed in segments, separated from each other, to prevent infilling between the beach and the breakwater. The elevation and length of each breakwater segment and the distance between segments would be designed considering the local wave and sediment transport characteristics.

S-10 - Dunes and Vegetation.
The presence of dunes is essential if a beach is to remain stable and able to accommodate the natural forces applied by unpredictable storms and extreme conditions of wind, wave, and elevated sea surface. Dunes maintain a sand repository that, during storms, provides sacrificial sand reserves to the eroding beach profile before upland structures would be damaged. Following large erosional events, dunes are generally replenished by natural forces provided by the calmer weather conditions following a storm. The dune system provides a measure of public safety and property protection. Proper vegetation on dunes increases sand erosion resistance by binding the sand together via extensive root masses penetrating deep into the sand. Further, such vegetation promotes dune growth through its sand trapping action when significant wind action transports substantial quantities of sand. Additionally, healthy dune systems are visually attractive to beach goers and contribute to the recreational beach experience and the all around appearance of the beach community. This measure

would include placement of beach compatible material, from either upland or offshore sources, in a dune feature adjacent to the existing bluff. The top elevation of the dune would tie into the bluff. The front slope of the dune would be a function of the material grain size and construction equipment. Vegetation would be planted after placement of the dune material.

S-11: Pressure Equalizing Modules (PEM)
Pressure Equalizing Modules are hollow permeable tubes inserted vertically into the beach, resulting in a well-drained beach. During falling tide, groundwater typically recedes slower than the sea, making the beach wet in the swash zone and prone to erosion. The PEM System is able to reduce water pressure in the beach which reduces erosion and prolongs the lives of nourished beaches. The PEM System works optimally where the water circulation in the swash zone is good, which favors areas with high tides and/or an active wave climate. The PEM System may be considered as a stand-alone measure or may be supplemented with beach nourishment.

S-12: Undercurrent Stabilizers
Undercurrent Stabilizers are modular geo-textile tubes filled with concrete composites, placed at right angles from the dune. The low-profile design makes the structures permeable to long shore sediment transport. The undercurrent stabilizers reduce incoming wave energy as waves approach shore, forcing suspended sand to drop out. As the stabilizers become covered with sand the beach grows in width and elevation.

5.3 Screening of Management Measures

The screening process was developed through several iterations of alternative development and evaluation. It was essential to screen out impractical or redundant alternatives prior to doing any detailed analysis given the number of possible alternative combinations. Screening measures was a three-step process: preliminary, intermediate, and final screening. The methodology used to screen and narrow the array of measures and alternatives to a Recommended Plan is described in the following sections.

5.3.1 Preliminary Screening

Figure 5-1 is an outline of the preliminary screening process. Descriptions of how the initial twenty structural and nonstructural management measures were screened to 5 intermediate measures (including "no-action") is outlined in the following sub-sections.

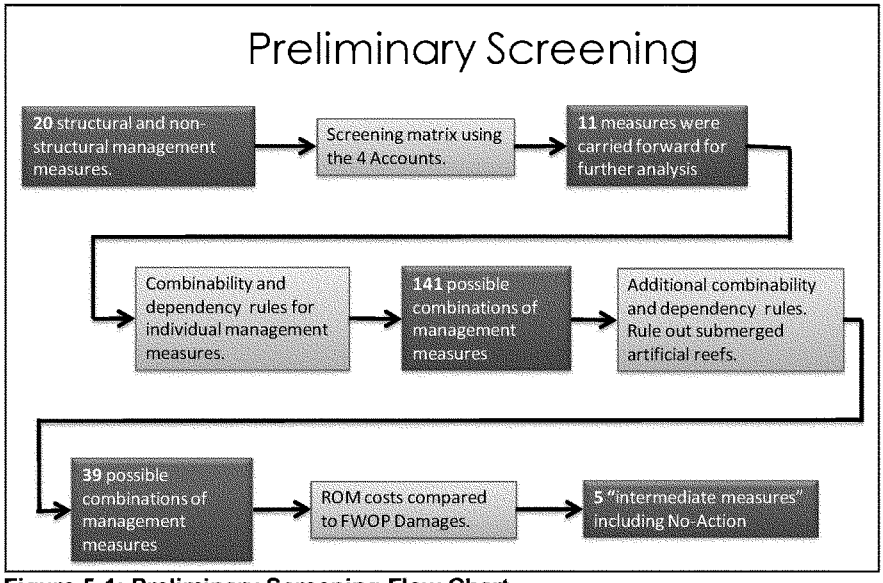

Figure 5-1: Preliminary Screening Flow Chart

5.3.1.1 Preliminary Screening: Step 1

The array of management measures that were identified to address the planning objectives were preliminarily evaluated for their potential to contribute to the Federal objectives. During this process, the interdependency, as well as the exclusivity of measures,is identified.. This process serves to eliminate some measures from further consideration. Costs and benefits are not calculated at this stage.

The Federal objectives (Four Accounts described in **Section 5.1**) were used to evaluate management measures for each of the study reaches in **Table 5-1** to **Table 5-6**. The National Economic Development (NED) account includes consideration of a measure's potential to meet the planning objective to reduce storm damages, as well as decrease costs of emergency services, lower flood insurance premiums, and consider project costs. Costs and benefits used to fully evaluate the NED objective are not calculated at this stage; however, estimates can be made to gage the overall cost-effectiveness of a measure for this initial screening. Effects of sea-level change and a measure's adaptability to such change were considered under the National Economic Development (NED) account. The Environmental Quality (EQ) account considers ecosystem restoration, water circulation, noise level changes, public facilities and services, aesthetic values, natural resources, air and water quality, cultural and historic preservation, and other factors covered by the National Environmental Policy Act (NEPA). The EQ account is a Federal objective, but as an evaluation criterion it is inclusive of the planning objective to maintain environmental quality and reflects the

planning constraint to avoid environmental impacts to natural resources. The Other Social Effects (OSE) account includes considerations for the preservation of life, health, and public safety; community cohesion and growth; tax and property values; and, the displacement of businesses and public facilities. For evaluation purposes, the OSE account is inclusive of the planning objectives to maintain recreation and maintain a safe evacuation route, and the planning constraint to avoid conflict with legal requirements. The Regional Economic Development (RED) account considers the potential impacts on the local economy including employment, income, and sales volume.

Each measure was subjectively given a score of 0 for not meeting an objective, 1 for partially meeting an objective, and 2 for fully meeting an objective. All four objectives were given equal weight for this preliminary screening to assess how a measure stacks up across all of the Federal objectives. For later screenings, more weight will be given to the NED account since this is a project for HSDR purposes and should maximize NED benefits. With all four accounts being equal, there is a maximum of 8 points that a measure can receive which would signify that a measure has potential to fully meet the Federal objectives. A total of 4 points signifies that a measure partially meets the Federal objectives. Measures receiving a total of 3 points or less will be screened out because they do not adequately meet the Federal objectives. Measures with 4 or greater total points were carried on for further evaluation. Measures screened out were allowed to be reincorporated further along in the planning process if warranted by new developments and information.

Table 5- 1: Marineland Non-Structural Measures

	Possible Measures	Evaluation and Effects of Possible Measures				Total Points	Carried Forward
		National Economic Development (NED)	Environmental Quality (EQ)	Other Social Effects (OSE)	Regional Economic Development (RED)		
NS-1	No-Action	No NED benefits are realized through this measure. No damages are prevented. No project costs. Makes no attempt to keep infrastructure from being damaged. No improvement.	Possible loss of dune habitat. Minimal change to other factors.	Small risk of evacuation route being damaged and a moderate risk of damages to public parking, boardwalk, and bathrooms. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. Does not conflict with any laws.	Future decline in tourism as the beach and dune system erode.		YES, BY DEFAULT
		0	1	0	0	1	
NS-2	Coastal Construction Control Line	Would only provide damage reduction benefits for potential future structures. NED benefits would be minimal. Makes no attempt to keep existing infrastructure from being damaged, but the enforcement of setbacks will reduce damages to new structures in the future, especially considering potential accelerated Sea Level Rise (SLR) rates.	Enforcing setbacks will improve safety and improve the quality of the dunes. Individual private shore protection measures may affect dune habitat.	Small risk of evacuation route being damaged and a moderate risk of damages to existing public parking, boardwalk, and bathrooms. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. Would require changes to state law.	Future decline in tourism as the beach and dune system erode.		NO
		1	1	0	0	2	
NS-3	Moratorium on Construction	Would only provide damage reduction benefits for potential future structures. NED benefits would likely be minimal. Makes no attempt to keep existing infrastructure from being damaged, but would reduce damages in the future, especially considering potential accelerated Sea Level Rise (SLR) rates.	Quality of the existing dune could be maintained, but still a possibility for loss of habitat from dune erosion.	Property and tax values will decrease. Will likely have an unfavorable perception. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. In the past attempts to implement a moratorium on construction have resulted in lawsuits. Changes to local laws may be needed.	Future decline in tourism as the beach and dune system erode.		NO
		1	1	0	0	2	
NS-4	Establish a No-Growth Program	Would only provide damage reduction benefits for potential future structures. NED benefits would likely be minimal. Makes no attempt to keep existing infrastructure from being damaged, but reduces potential damage in the future, especially considering potential accelerated Sea Level Rise (SLR) rates.	Quality of the existing dune could be maintained, but still a possibility for loss of habitat from dune erosion.	Property and tax values will decrease. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. May require changes to local laws.	Future decline in tourism as the beach and dune system erode.		NO
		1	1	0	0	2	
NS-5	Relocation of Structures	Benefits not likely to out weigh costs. The oceanarium is the main structure in this reach and is already protected by a seawall. Moving structure out of the way of danger will reduce damages to those structures, but as erosion continues other structures will continue to be at risk of being damaged. Additionally due to the current elevation of most infrastructure, SLR is not a significant contributing factor to storm damage over the period of analysis.	Moving buildings back from the dune would provide more area for dune habitat.	Minimal improvements to safety for parcels where this could be implemented, but overall would not have any social effects. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. Relocation of historical structures may cause conflict with section 106 of the National Historic Preservation Act.	Future decline in tourism as the beach and dune system erode.		NO
		0	1	0	0	1	
NS-6	Relocate State Highway A1A	Benefits not likely to out weigh costs as A1A is not critically threatened in this reach. This will reduce potential damages to A1A, but will not reduce damages to other infrastructure. Considering potential accelerated Sea Level Rise (SLR) rates, due to the current elevation of A1A, SLR is not a significant contributing factor to storm damage over the period of analysis.	No adverse effects would be created by this measure, nor would any positive benefits be realized.	A new hurricane evacuation route would need to be established. Moving A1A will take away from the scenic qualities of the highway. Beach berm may continue to erode leaving little or no beach for recreation. Near shore recreation will not be affected. Does not conflict with any laws. Considering potential accelerated Sea Level Rise (SLR) rates, this measure could benefit A1A's evacuation potential.	Future decline in tourism as the beach and dune system erode.		NO
		1	1	0	0	2	
NS-7	Flood Proofing of Structures	Benefits not likely to out weigh costs the oceanarium is the main structure in this reach and is already protected by a seawall. Flood proofing would reduce damages to buildings, but it would not do anything to reduce damages to other infrastructure. Additionally due to the current elevation of most infrastructure, SLR is not a significant contributing factor to storm damage over the period of analysis.	No adverse effects would be created by this measure, nor would any positive benefits be realized.	This will improve safety, but increased regulations may have an unfavorable perception. Beach berm may continue to erode leaving little or no beach for recreation. Near shore recreation will not be affected. Does not conflict with any laws.	Future decline in tourism as the beach and dune system erode.		NO
		0	1	1	0	2	
NS-8	Buyout and Land Acquisition	Benefits not likely to out weigh costs the oceanarium is the main structure in this reach and is already protected by a rock revetment. Acquired land and condemned structures will reduce the amount of infrastructure at risk of being damaged, especially considering potential accelerated Sea Level Rise (SLR) rates, but nothing is done to prevent further erosion and other damages. Additionally due to the current elevation of most infrastructure, SLR is not a significant contributing factor to storm damage over the period of analysis.	Condemning structures and acquiring land on or near the existing dune could provide more area for natural dune habitat.	Condemnation or acquisition of the oceanarium would eliminate Marineland's main attraction. Acquired land could be used to create recreational areas and parks, however the beach berm may continue to erode leaving little and less recreational beach. Nearshore recreation will not be affected. Does not conflict with any laws.	Condemnation or acquisition of the oceanarium would eliminate Marineland's main attraction.		NO
		0	2	0	0	2	

Carried Forward | Eliminated | 2 Fully Meets Objective | 1 Partially Meets Objective | 0 Does Not Meet Objective

Table 5- 2: Marineland Structural Measures

	Possible Measures	Evaluation and Effects of Possible Measures				Total Points	Carried Forward
		National Economic Development (NED)	Environmental Quality (EQ)	Other Social Effects (OSE)	Regional Economic Development (RED)		
S-1	Seawalls	Benefits not likely to out weigh cost if the oceanfront is the main structure in the reach and is already protected by a rock revetment. The unique private storm damage reduction to infrastructure landward of the seawall. However adjacent properties could be made more vulnerable due to erosive effects of structures. Seawalls would be moderately adaptable to potential accelerated Sea Level Rise (SLR) rates.	Likely to have negative impacts on sea turtle nesting. Not aesthetically appealing.	Could increase protection to the hurricane evacuation route and public facilities. Reflection of wave energy off the seawall will likely intensify erosion at the recreational beach berm. Near shore recreation will not be affected. Likely inconsistent with state CZMP.	Future decline in tourism as the beach erodes.		NO
		0	0	1	0	1	
S-2	Revetments	The scenarium system is needed. Additional revetment is not likely to be justified in Marineland. This would provide storm damage reduction to infrastructure landward of the revetment. However adjacent properties could be made more vulnerable due to erosive effects of structures. Revetment would be adaptable to potential accelerated Sea Level Rise (SLR) rates.	Likely to have negative impact on sea turtle nesting. Not aesthetically appealing.	Could increase protection to the hurricane evacuation route and public facilities. Reflection of wave energy off the revetment will likely intensify erosion of the recreational beach berm. Near shore recreation will not be affected. Likely inconsistent with state CZMP.	Future decline in tourism as the beach erodes.		NO
		0	0	1	0	1	
S-3	Sand Covered Soft Structure	Not likely that benefits would out weigh the costs in Marineland since the little infrastructure that is there is already protected. Would improve storm damage reduction. Would be acceptable to potential accelerated Sea Level Rise (SLR) rates.	Sand would need to be maintained on top of the soft structures to ensure environmental quality. Would protect dune habitat, but could be detrimental if it became uncovered and remained that way.	Could increase protection to the hurricane evacuation route and public facilities. Existing narrow beach may be maintained and nearshore recreation would not be affected. May not be permitable by the state.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	1	1	3	
S-4	Beach Nourishment	Not likely that benefits would out weigh the cost in Marineland since the little infrastructure that is there is already protected. This would reduce damages to infrastructure landward of the nourishment. Would be highly adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could result in temporary negative impacts to the nearshore environment during construction. Nearshore rock outcroppings would need to be avoided. Could enhance sea turtle nesting habitat.	Could increase protection to the hurricane evacuation route and public facilities. The recreational beach berm would be extended. Nearshore recreation such as surfing and fishing may be affected temporarily following nourishment. Does not conflict with any laws.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	1	1	3	
S-5	Grains	Several older groins, damaged but appear to be semi-functional exist in Marineland. Additional groins are not likely to be justified in Marineland. In combination with beach nourishment, groins could be used at hot spots to stabilize fill and maximize storm damage reduction. Would be moderately adaptable to potential accelerated Sea Level Rise (SLR) rates.	Periodic renourishment's could be reduced by stabilizing the beach. Possible entrapment hazard for hatching sea turtles.	Because only select areas would benefit, groins would not likely receive support from the entire community. In select areas the recreational beach berm would be extended. Nearshore recreation such as surfing and fishing may be affected following nourishments. New groins may not be permittable by the state. Prohibited by County Comp Plan.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	0	1	2	
S-6	Submerged Artificial Reefs	Not likely to be justified in Marineland, in combination with beach nourishment, and shore perpendicular structure, could maximize storm damage reduction. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could enhance nearshore fish habitat. Some considerations associated with beach fill. Could have temporary negative impact during construction.	May create a safety hazard for swimmers. Would provide protection for the evacuation route. The recreational beach berm would be maintained. Nearshore recreation such as surfing and fishing may be positively or negatively affected. May not be permittable by the state.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	1	1	3	
S-7	Submerged Artificial Multi-Purpose Reefs	Not likely that this measure would be justified in Marineland. Could provide storm damage reduction in combination with beach fill, for infrastructure landward of the reef. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could have temporary negative impact during construction, but would likely improve sea turtle nesting habitat by maintaining a beach berm and create habitat for nearshore marine life.	May create a safety hazard for swimmers. Would provide protection for the evacuation route. The recreational beach berm would be maintained. Nearshore recreation such as surfing and fishing should improve if correctly designed/constructed. May not be permittable by the state.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	1	1	3	
S-8	Nearshore Placement	Not likely to be justified in Marineland. Some reduction to erosional rate could be realized depending on the migration of the placed sand.	May have temporary impacts to the nearshore environment during and following construction. Depending on sand migration, volume of sand needed to provide significant benefits could have a negative impact to sea turtle nesting habitat dependent on migration of fill. However, sand could also have a positive, or no, impact on turtles depending on migration.	Depending on how the sand migrates, it could be viewed negatively by the community. Added protection would likely be minimal in this reach. Nearshore recreation may be positively or negatively affected following placement. Beach recreation would be maintained. May not be permittable by the state.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	0	1	2	
S-9	Emergent Breakwaters	Not likely to be justified in Marineland. Could provide storm damage reduction, in combination with beach fill, for infrastructure landward of the breakwaters. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could affect the nearshore environment during construction. May block sea turtle nesting lanes. Could possibly create nearshore habitat. May have a negative effect on adjacent shorelines.	May not be aesthetically pleasing. Could be a navigational hazard for boaters, and may pose a safety risk for swimmers. Nearshore recreation may be positively or negatively affected. Beach recreation would be maintained. May not be permittable by the state.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	0	1	2	
S-10	Dunes and Vegetation	Not likely to be justified in Marineland. Could provide a certain level of protection, as a stand alone measure or in combination with other measures. Could provide a certain level of protection as a stand alone measure. Would be adaptable to potential accelerated Sea Level Rise (SLR) rates.	Dune habitat would be enhanced and expanded. Not likely to have any negative impacts. Aesthetically appealing. Existing vegetation and beach rock outcrops may be impacted.	Likely to be supported by a majority of the community. This would likely maintain dunes but nearshore recreation could decline. Nearshore recreation would not be affected. Does not conflict with any laws. A locally constructed dune rehabilitation project was done successfully in the past.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	1	1	3	
S-11	Pressure Equalizing Modules (PEMs)	Not likely that this measure would be justified in Marineland. PEMs may provide storm damage reduction to infrastructure. Not likely that they would work as a stand alone measure. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Not likely to have any significant environmental effects other than those associated with beach fill.	Could have positive social impacts if they work in enhancing the beach. Beach recreation would be maintained and possibly enhanced. Nearshore recreation would most likely not be affected. Does not conflict with any laws.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	1	1	3	
S-12	Undercurrent Stabilizers	Not likely to be justified in Marineland. Could hold sand in place reducing damages for a specific area. May trap sand that would otherwise feed another area of the project depriving it of damage reduction benefits. Would be moderately adaptable to potential accelerated Sea Level Rise (SLR) rates.	Possible entrapment hazard for hatching sea turtles. Not proposed for use in conjunction with beach nourishment, therefore could have negative impacts on adjacent shorelines.	Because only select areas would benefit, undercurrent stabilizers may not receive support from the entire community. Would add some protection to the evacuation route. In select areas the recreational beach berm may be maintained or possibly extended. Nearshore recreation such as surfing and fishing may be positively or negatively affected. May not be permittable by the state. Prohibited by County Comp Plan.	Could possibly have a minor positive impact on the regional economy.		NO
		0	0	1	1	2	

Carried Forward | Eliminated | 2 Fully Meets Objective | 1 Partially Meets Objective | 0 Does Not Meet Objective

Table 5- 3: Painters Hill and Beverly Beach Non-Structural Measures

	Possible Measures	Evaluation and Effects of Possible Measures				Total Points	Carried Forward
		National Economic Development (NED)	Environmental Quality (EQ)	Other Social Effects (OSE)	Regional Economic Development (RED)		
NS-1	No-Action	No NED benefits are realized through this measure. No damages are prevented. No project costs. Makes no attempt to keep infrastructure from being damaged. No improvement.	Potential for continued dune and dune habitat loss. Minimal change to other factors. Individual private shore protection measures my affect dune habitat.	Small risk of damage to evacuation route. Moderate risk to oceanfront homes and the safety of homeowners. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. Does not conflict with any laws.	Potential for loss of property value and tax value.		YES, BY DEFAULT
		0	1	0	0	1	
NS-2	Coastal Construction Control Line	Would only provide damage reduction benefits for potential future structures. NED benefits would be minimal. Costs would be minimal. The enforcement of setbacks will reduce damages to new structures in the future, especially considering potential accelerated Sea Level Rise (SLR) rates.	Enforcing setbacks will improve safety and improve the quality of the dunes. Individual private shore protection measures may affect dune habitat.	Ocean front property owners may not like this. Small risk of damage to evacuation route. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. Would require changes to state law.	Potential for loss of property value and tax value.		NO
		1	1	0	0	2	
NS-3	Moratorium on Construction	Would only provide damage reduction benefits for potential future structures. NED benefits would be minimal. Makes no attempt to keep existing infrastructure from being damaged, but would reduce damages in the future, especially considering potential accelerated Sea Level Rise (SLR) rates.	Potential for continued dune and dune habitat loss. Minimal change to other factors. Individual private shore protection measures may affect dune habitat.	Property and tax values will decrease. Will likely have an unfavorable perception. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. In the past attempts to implement a moratorium on construction have resulted in law suits. Changes to local laws would be needed.	Potential for loss of property value and tax value.		NO
		1	1	0	0	2	
NS-4	Establish a No-Growth Program	Would only provide damage reduction benefits for potential future structures. NED benefits would be minimal. Makes no attempt to keep existing infrastructure from being damaged, but reduces potential damage in the future, especially considering potential accelerated Sea Level Rise (SLR) rates.	No adverse effects would be created by this measure, nor would and positive benefits be realized.	Property and tax values will decrease. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. May require changes to local law.	Potential for loss of property value and tax value.		NO
		1	0	0	0	1	
NS-5	Relocation of Structures	Benefits not likely to out weigh costs in this study reach. Moving structure out of the way of danger will reduce damages to those structures, but as erosion continues other structures will continue to be at risk of being damaged. Additionally due to the current elevation of most infrastructure, SLR is not a significant contributing factor to storm damage over the period of analysis.	Moving buildings back from the dune would provide more area for dune habitat. Dune would still face potential threat of continued erosion.	Minimal improvements to safety for parcels where this could be implemented, but overall would not have any social effects. Beach berm may continue to erode leaving little or no beach for recreation. Near shore recreation will not be affected. Does not conflict with any laws.	Potential for loss of property value and tax value.		NO
		0	1	0	0	1	
NS-6	Relocate State Highway A1A	Benefits not likely to out weigh costs as A1A is not critically threatened in this reach. This will reduce damages to A1A, but will not reduce damages to other infrastructure. Considering potential accelerated Sea Level Rise (SLR) rates, due to the current elevation of A1A, SLR is not a significant contributing factor to storm damage over the period of analysis.	No adverse effects would be created by this measure, nor would any positive benefits be realized.	A new hurricane evacuation route would need to be established. Moving A1A will take away from the scenic qualities of the highway. Beach berm may continue to erode leaving little or no beach for recreation. Near shore recreation will not be affected. Does not conflict with any laws.	Businesses along A1A will suffer if the highway is relocated. Potential for loss of property value and tax value.		NO
		1	1	0	0	2	
NS-7	Flood Proofing of Structures	Damage reduction benefits for structures would be realized, but other infrastructure would not see any benefits. Flood proofing would reduce damages to buildings, but it would not do anything to reduce damages to other infrastructure. Considering Sea Level Rise, due to the current elevation of most infrastructure, SLR is not a significant contributing factor to storm damage over the period of analysis.	No adverse effects would be created by this measure, nor would any positive benefits be realized.	This will improve safety, but increased regulations may have an unfavorable perception. Small risk to evacuation route remains. Beach berm may continue to erode leaving little or no beach for recreation. Near shore recreation will not be affected. May require changes to state law.	Potential for loss of property value and tax value.		NO
		1	1	0	0	2	
NS-8	Buyout and Land Acquisition	Benefits could possibly outweigh the costs. Condemnation of structures and conversion of land to a natural area will eliminate damages to infrastructure. Erosion could continue to threaten landward infrastructure in the future. Additionally due to the current elevation of most infrastructure, SLR is not a significant contributing factor to storm damage over the period of analysis.	Condemnation of structures and their removal would provide more area for dune habitat. Dune would still face potential threat of continued erosion.	Acquired land could be used in ways the could be beneficial to the overall community. Shorefront property owners would not like this. Small risk to evacuation route remains. Acquired land could be used to create recreational areas and parks, however the beach berm may continue to erode leaving less and less recreational beach. Nearshore recreation will not be affected. Does not conflict with any laws.	Acquired land used for public parks could contribute to regional recreational and tourism economic benefits.		YES
		1	1	1	1	4	

Carried Forward | Eliminated | 2 Fully Meets | 1 Partially Meets | 0 Does Not Meet

Table 5- 4: Painters Hill and Beverly Beach Structural Measures

Possible Measures		Evaluation and Effects of Possible Measures: National Economic Development (NED)	Environmental Quality (EQ)	Other Social Effects (OSE)	Regional Economic Development (RED)	Total Points	Carried Forward
S-1	Seawalls	Could possibly be justified. This would provide storm damage reduction to infrastructure landward of the seawall. However adjacent properties could be made more vulnerable due to erosive effects of structures. Damage reduction could be maximized in combination with beach/dune fill to offset impacts to adjacent shoreline. Seawalls would be moderately adaptable to potential accelerated Sea Level Rise (SLR) rates.	Much of these study reaches have no seawalls except for at the Camptown RV Park and no 2 private vinyl seawalls. Likely to have negative impacts on sea turtle nesting. Not aesthetically appealing.	Maybe supported by homeowners. May face objection by community. Could have negative effect on surrounding beaches. Reflection of wave energy off the seawall will likely intensify erosion of the recreational beach berm. Near shore recreation will not be affected. Likely inconsistent with state CZMP.	Could possibly have a minor positive impact on the regional economy.		YES
		2	0	1	1	4	
S-2	Revetments	Could possibly be justified. This would provide storm damage reduction to infrastructure landward of the revetment. However adjacent properties could be made more vulnerable due to erosive effects of structures. Damage reduction could be maximized in combination with beach/dune fill to offset impacts to adjacent shoreline. Revetments would be adaptable to potential accelerated Sea Level Rise (SLR) rates.	None of these study reaches currently have revetments. Likely to have negative impacts on sea turtle nesting. Not aesthetically appealing.	Maybe supported by homeowners. May face objection by community. Could have negative effect on surrounding beaches. Reflection of wave energy off the revetment will likely intensify erosion of the recreational beach berm. Near shore recreation will not be affected.	Could possibly have a minor positive impact on the regional economy.		YES
		2	0	1	1	4	
S-3	Sand Covered Soft Structure	Could possibly be justified, would improve storm damage reduction. Would be adaptable to potential accelerated Sea Level Rise (SLR) rates.	sand would need to be maintained on top of the soft structures to ensure environmental quality. Would protect dune habitat, but could be detrimental if it became uncovered and remained that way.	would protect evacuation route, shorefront property, and residents; existing narrow beach may be maintained and nearshore recreation would not be affected. May not be permittable by the state.	Could possibly have a minor positive impact on the regional economy.		YES
		1	1	2	1	5	
S-4	Beach Nourishment	Most likely a justifiable measure. This would reduce damages to infrastructure landward of the nourishment. Would be highly adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could result in temporary negative impacts to the nearshore environment. Could enhance sea turtle nesting habitat. Would need to avoid nearshore rock if present. If sand color is changed the beach may loose aesthetic quality.	Likely to be supported by homeowners and a majority of the community. Public parking and access would need to be increased in this reach for Fed. Participation. Improved protection of the evacuation route. The recreational beach berm would be extended. Nearshore recreation such as surfing and fishing may be affected temporarily following nourishments. Does not conflict with any laws.	Could possibly have a minor positive impact on the regional economy.		YES
		2	1	2	1	6	
S-5	Groins	Could possibly be justified. In combination with beach nourishment, groins could be used at hot spots to stabilize fill and maximize storm damage reduction. Would be moderately adaptable to potential accelerated Sea Level Rise (SLR) rates.	Periodic renourishments could be reduced by stabilizing the beach. Possible entrapment hazard for hatching sea turtles.	Because only select areas would benefit, groins may not receive support from the entire community. Would add some protection to the evacuation route. In select areas the recreational beach berm would be extended. Nearshore recreation such as surfing and fishing may be affected following nourishments. May not be permittable by the state. Prohibited by Counties Comp Plan.	Could possibly have a minor positive impact on the regional economy.		YES
		1	1	1	1	4	
S-6	Submerged Artificial Reefs	Could have temporary negative impact during construction, but would likely improve sea turtle nesting habitat by maintaining a beach berm and create habitat for nearshore marine life. Constructed in select locations, in combination with beach nourishment, and shore perpendicular structure, could maximize storm damage reduction. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could enhance nearshore fish habitat. Some considerations associated with beach fill.	May create a safety hazard for swimmers. Would provide protection for the evacuation route. The recreational beach berm would be maintained. Nearshore recreation such as surfing and fishing may be positively or negatively affected. May not be permittable by the state.	Could possibly have a minor positive impact on the regional economy.		YES
		1	1	1	1	4	
S-7	Submerged Artificial Multi-Purpose Reefs	Could possibly be justified. Could provide storm damage reduction, in combination with beach fill, for infrastructure landward of the reef. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could have temporary negative impact during construction, but would likely improve sea turtle nesting habitat by maintaining a beach berm and create habitat for nearshore marine life.	May create a safety hazard for swimmers. Would provide protection for the evacuation route. The recreational beach berm would be maintained. Nearshore recreation such as surfing and fishing should improve if correctly designed/constructed. May not be permittable by the state.	Likely to have a positive effect on local tourism industry.		YES
		1	1	1	2	5	
S-8	Nearshore Placement	Could possibly be justified. Some reduction to infrastructure could be realized depending on the migration of the placed sand. Would be highly adaptable to potential accelerated Sea Level Rise (SLR) rates.	May have temporary impacts to the nearshore environment during and following construction. Depending on sand migration, volume of sand needed to provide significant benefits could have a negative impact to sea turtle nesting habitat dependent on migration of fill. However, sand could also have a positive, or no, impact on turtles depending on migration.	Depending on how the sand migrates, this could be viewed negatively by the community. Nearshore recreation may be affected following placement. Beach recreation would be maintained. May not be permittable by the state.	Could possibly have a minor positive impact on the regional economy.		NO
		1	1	0	1	3	
S-9	Emergent Breakwaters	Could possibly be justified. Could provide storm damage reduction, in combination with beach fill, for infrastructure landward of the breakwaters. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could affect the nearshore environment during construction. May block turtle nesting lanes. Could possibly create nearshore habitat. May have a negative effect on adjacent shorelines.	May not be aesthetically pleasing. Could be a navigational hazard for boaters and may pose a safety risk for swimmers. Nearshore recreation may be positively or negatively affected. Beach recreation would be maintained. May not be permittable by the state.	Could possibly have a minor positive impact on the regional economy.		NO
		1	1	0	1	3	
S-10	Dunes and Vegetation	Could possibly be justified. Could provide a certain level of protection as a stand alone measure or in combination with other measures. Could provide a certain level of protection as a stand alone measure. Would be adaptable to potential accelerated Sea Level Rise (SLR) rates.	Dune habitat would be enhanced and expanded. Not likely to have any negative impacts. Aesthetically appealing.	Likely to be supported by a majority of the community. Would moderately increase protection of the evacuation route. This would likely maintain dunes but nearshore recreation could decline. Nearshore recreation would not be affected. Does not conflict with any laws.	Could possibly have a minor positive impact on the regional economy.		YES
		1	2	1	1	5	
S-11	Pressure Equalizing Modules (PEMs)	Not likely to be justified. Has not been shown to work in a costal environment similar to Flagler County. Not likely that they would work as a stand alone measure. PEMs may provide storm damage reduction to infrastructure in combination with nourishment, but additional benefits would not likely be justified. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Not likely to have any significant environmental effects other then those associated with a combined beach fill.	Could have positive social impacts if they work in enhancing the beach. Beach recreation would be maintained and possibly enhanced. Nearshore recreation would most likely not be affected. Does not conflict with any laws.	Could possibly have a minor positive impact on the regional economy.		NO
		0	1	1	1	3	
S-12	Undercurrent Stabilizers	Not likely to be justified. Has not been shown to work in a costal environment similar to Flagler County. Could hold sand in place reducing damages for a specific area. May trap sand that would otherwise feed another area of the project depriving it of damage reduction benefits. Would be moderately adaptable to potential accelerated Sea Level Rise (SLR) rates.	Possible entrapment hazard for hatching sea turtles. Not proposed for use in conjunction with beach nourishment, therefore could have negative impacts on adjacent shorelines.	Because only select areas would benefit, undercurrent stabilizers may not receive support from the entire community. Would add some protection to the evacuation route. In select areas the recreational beach berm may be maintained or possibly extended. Nearshore recreation such as surfing and fishing may be positively or negatively affected. May not be permittable by the state. Prohibited by Counties Comp Plan.	Could possibly have a minor positive impact on the regional economy.		NO
		0	0	1	1	2	

Carried Forward | Eliminated | 2 Fully Meets Objective | 1 Partially Meets Objective | 0 Does Not Meet Objective

Table 5- 5: Flagler Beach Non-Structural Measures

	Possible Measures	Evaluation and Effects of Possible Measures				Total Points	Carried Forward
		National Economic Development (NED)	Environmental Quality (EQ)	Other Social Effects (OSE)	Regional Economic Development (RED)		
NS-1	No-Action	No NED benefits are realized through the measure. No damages are prevented. No project costs. Makes no attempt to keep infrastructure from being damaged. No improvement.	Potential for continued loss of the already minimal dune and dune habitat. Minimal change to other factors. Individual private shore protection measures may affect dune habitat.	Moderate risk of damage to evacuation route. Small risk to homes, businesses and the safety of residents. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. Does not conflict with any laws.	Potential for loss of property value and tax value. Potential for decline in local business revenues.		YES, BY DEFAULT
		0	1	1	0	2	
NS-2	Coastal Construction Control Line	Would only provide damage reduction benefits for potential future structures. NED benefits would be minimal. Costs would be minimal. The enforcement of setbacks will reduce damages to new structures in the future, especially considering potential accelerated Sea Level Rise (SLR) rates.	Enforcing setbacks will improve safety and improve the quality of the dunes. Individual private shore protection measures may affect dune habitat.	Will likely have an unfavorable perception by home owners. Moderate risk of damage to evacuation route. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. Would require changes to state law.	Potential for loss of property value and tax value.		NO
		1	1	0	0	2	
NS-3	Moratorium on Construction	Would only provide damage reduction benefits for potential future structures. NED benefits would be minimal. Makes no attempt to keep existing infrastructure from being damaged, but would reduce damages in the future, especially considering potential accelerated Sea Level Rise (SLR) rates.	Potential for continued dune and dune habitat loss. Minimal change to other factors. Individual private shore protection measures may affect dune habitat.	Property and tax values will decrease. Will likely have an unfavorable perception. Risk of damage to the evacuation route remains. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. In the past attempts to implement a moratorium on construction have resulted in lawsuits. Changes to local laws would be needed.	Potential for loss of property value and tax value.		NO
		1	1	0	0	2	
NS-4	Establish a No-Growth Program	Would only provide damage reduction benefits for potential future structures. NED benefits would be minimal as there is little room for growth east of A1A. Makes no attempt to keep existing infrastructure from being damaged, but reduces potential damage in the future, especially considering potential accelerated Sea Level Rise (SLR) rates.	No adverse effects would be created by this measure, nor would any positive benefits be realized.	Property and tax values will decrease. Risk of damage to the evacuation route remains. Beach berm may continue to erode causing a gradual loss of beach recreation. Near shore recreation will not be affected. May require changes to local law.	Potential for loss of property value and tax value.		NO
		1	0	0	0	1	
NS-5	Relocation of Structures	Benefits not likely to outweigh costs in this study reach. Moving structure out of the way of danger will reduce damages to those structures, but as erosion continues other structures will continue to be at risk of being damaged. Additionally due to the current elevation of most infrastructure, SLR is not a significant contributing factor to storm damage over the period of analysis.	Moving buildings back from the dune would provide more area for dune habitat. Dune would still face potential threat of continued erosion.	Minimal improvements to safety for parcels where this could be implemented, but overall would not have any social effects. Risk of damage to the evacuation route remains. Beach berm may continue to erode leaving little or no beach for recreation. Near shore recreation will not be affected. Relocation of historical structures may cause conflict with section 106 of the National Historic Preservation Act.	Potential for loss of property value and tax value.		NO
		0	1	0	0	1	
NS-6	Relocate State Highway A1A	Measure may be justified as damages to the highway would be avoided. This will reduce damages to A1A, but will not reduce damages to other infrastructure. Considering potential accelerated Sea Level Rise (SLR) rates, due to the current elevation of A1A, SLR is not a significant contributing factor to storm damage over the period of analysis.	Moving A1A inland may create more area for dune habitat. Dune would still face potential threat of continued erosion.	A new hurricane evacuation route would need to be established. Moving A1A will take away from the scenic qualities of the highway. Likely to be opposed by much of the community. Beach berm may continue to erode leaving little or no beach for recreation. Near shore recreation will not be affected. Does not conflict with any laws.	Businesses along A1A will suffer if the highway is relocated. Potential for loss of property value and tax value.		NO
		1	1	0	0	2	
NS-7	Flood Proofing of Structures	Damage reduction benefits for structures would be realized, but other infrastructure would not see any benefits. Flood proofing would reduce damages to buildings, but it would not do anything to reduce damages to other infrastructure. Considering Sea Level Rise, due to the current elevation of most infrastructure, SLR is not a significant contributing factor to storm damage over the period of analysis.	No adverse effects would be created by this measure, nor would any positive benefits be realized.	This will improve safety, but increased regulations may have an unfavorable perception. Risk to evacuation route remains. Beach berm may continue to erode leaving little or no beach for recreation. Near shore recreation will not be affected. May require changes to state law.	Potential for loss of property value and tax value.		NO
		1	1	0	0	2	
NS-8	Buyout and Land Acquisition	Benefits not likely to outweigh costs. Condemnation of structures and conversion of land to a natural area will eliminate damages to infrastructure. However this measure will not protect A1A which is the most seaward damage element in this study reach. Additionally due to the current elevation of most infrastructure, SLR is not a significant contributing factor to storm damage over the period of analysis.	Condemnation of structures and their removal would provide more area for dune habitat. Dune would still face potential threat of continued erosion.	Acquired land could be used in ways the could be beneficial to the overall community. Property owners would not like this. Risk to evacuation route remains. Acquired land could be used to create recreational areas and parks. However the beach berm may continue to erode leaving less and less recreational beach. Nearshore recreation will not be affected. Does not conflict with any laws.	Acquired land used for public parks could contribute to regional recreational and tourism economic benefits.		NO
		0	1	0	1	2	

Carried Forward | Eliminated | 2 Fully Meets | 1 Partially Meets | 0 Does Not Meet

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Table 5- 6: Flagler Beach Structural Measures

	Possible Measures	Evaluation and Effects of Possible Measures				Total Points	Carried Forward
		National Economic Development (NED)	Environmental Quality (EQ)	Other Social Effects (OSE)	Regional Economic Development (RED)		
S-1	Seawalls	Could be justified in certain areas, but not likely to be justified over the entire project area. This would provide storm damage reduction to infrastructure landward of the seawall; however adjacent properties could be made more vulnerable due to erosive effects of structures. Damage reduction could be maximized in combination with beach/dune fill to offset impacts to adjacent shoreline. Seawalls would be moderately adaptable to potential accelerated Sea Level Rise (SLR) rates.	As seawall currently exist in this study reach, the environmental w/o project conditions would not be significantly altered should a new seawall be built in the location of an existing seawall. New seawall built where no seawall exists would likely have negative environmental impacts.	Likely to face objection by community and resource agencies. Could have negative effect on surrounding beaches. Reflection of wave energy off the seawall will likely intensify erosion of the recreational beach berm. Near shore recreation will not be affected. Likely inconsistent with state CZMP.	As seawall currently exist in this study reach, the regional economic w/o project conditions would not be significantly altered should a new seawall be built in the location of an existing seawall. New seawall built where no seawall exists could likely cause increased erosion of the berm which may negatively affect local tourism.	5	YES
		2	1	1	1		
S-2	Revetments	Portions of this study reach are currently revetted. Could be justified in certain areas, but not likely to be justified over the entire area of the project. This would provide storm damage reduction to infrastructure landward of the revetment. However adjacent properties could be made more vulnerable due to erosive effects of structures. Damage reduction could be maximized in combination with beach/dune fill to offset impacts to adjacent shoreline. Revetments would be adaptable to potential accelerated Sea Level Rise (SLR) rates.	As revetment currently exist in much of this study reach, the environmental w/o project conditions would not be significantly altered should a new revetment be built in the location of an existing revetment. New revetment built where no revetment exists would likely have negative environmental impacts.	Likely to face objection by community. Could have negative effect on surrounding beaches. Reflection of wave energy off the revetment will likely intensify erosion of the recreational beach berm. Near shore recreation will not be affected. Likely inconsistent with state CZMP.	As revetment currently exist in this study reach, the regional economic w/o project conditions would not be significantly altered should a new revetment be built in the location of an existing revetment. New revetment built where no revetment exists could likely cause increased erosion of the berm which may negatively affect local tourism.	5	YES
		2	1	1	1		
S-3	Sand Covered Soft Structure	Could possibly be justified, would improve storm damage reduction. Would be adaptable to potential accelerated Sea Level Rise (SLR) rates.	sand would need to be maintained on top of the soft structures to ensure environmental quality. Would protect dune habitat, but could be detrimental if it became uncovered and remained that way.	would protect evacuation route and improve the aesthetics along A1A compared to the existing revetment. existing narrow beach may be maintained and nearshore recreation would not be affected. May not be permitable by the state.	Could possibly have a minor positive impact on the regional economy.	5	YES
		1	1	2	1		
S-4	Beach Nourishment	Most likely a justifiable measure. This would reduce damages to infrastructure landward of the nourishment. Would be highly adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could result in temporary negative impacts to the nearshore environment. Could enhance sea turtle nesting habitat. Would need to avoid nearshore rock if present. If sand color is changed the beach may loose aesthetic quality.	Likely to be supported by a majority of the community. Improved protection of the evacuation route. The recreational beach berm would be extended. Nearshore recreation such as surfing and fishing may be affected temporarily following nourishments. Does not conflict with any laws.	Likely to have a positive effect on local tourism industry.	7	YES
		2	1	2	2		
S-5	Groins	Could possibly be justified and reduce periodic nourishment in select areas, however would not likely be feasible over the entire project area. In combination with beach nourishment, groins could be used at hot spots to stabilize fill and maximize storm damage reduction. Would be moderately adaptable to potential accelerated Sea Level Rise (SLR) rates.	Periodic renourishment's could be reduced by stabilizing the beach. Possible entrapment hazard for hatchling sea turtles. Not aesthetically appealing.	Because only select areas would benefit, groins may not receive support from the entire community. Would add some protection to the evacuation route. In select areas the recreational beach berm would be extended. Nearshore recreation such as surfing and fishing may be affected following nourishments. May not be permitable by the state. Prohibited by Counties Comp Plan.	Could possibly have a minor positive impact on the regional economy.	4	YES
		1	1	1	1		
S-6	Submerged Artificial Reefs	Could possibly be justified. Constructed in select locations, in combination with beach nourishment, and shore perpendicular structure, could maximize storm damage reduction. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could enhance nearshore fish habitat. Some considerations associated with beach fill.	May create a safety hazard for swimmers. Would provide protection for the evacuation route. The recreational beach berm would be maintained. Nearshore recreation such as surfing and fishing may be positively or negatively affected. May not be permitable by the state.	Could possibly have a minor positive impact on the regional economy.	4	YES
		1	1	1	1		
S-7	Submerged Artificial Multi-Purpose Reefs	Could possibly be justified in areas of this study reach. Could provide storm damage reduction, in combination with beach fill, for infrastructure landward of the reef.	Could have temporary negative impact during construction, but would likely improve sea turtle nesting habitat by maintaining a beach berm and create habitat for nearshore marine life.	May create a safety hazard for swimmers. Would provide protection for the evacuation route. The recreational beach berm would be maintained. Nearshore recreation such as surfing and fishing should improve if correctly designed/constructed. May not be permitable by the state.	Likely to have a positive effect on local tourism industry.	5	YES
		1	1	2	2		
S-8	Nearshore Placement	Could possibly be justified. Some reduction to infrastructure could be realized depending on the migration of the placed sand. Would be highly adaptable to potential accelerated Sea Level Rise (SLR) rates.	May have temporary impacts to the nearshore environment during and following construction. Depending on sand migration, volume of sand needed to provide significant benefits could have a negative impact to sea turtle nesting habitat dependent on migration of fill. However, sand could also have a positive, or no,	Depending on how the sand migrates, this could be viewed negatively by the community. Improved protection of the evacuation route may be minimal. Nearshore recreation may be affected following placement. Beach recreation would be maintained. May not be permitable by the state.	Could possibly have a minor positive impact on the regional economy.	3	NO
		1	1	0	1		
S-9	Emergent Breakwaters	Could possibly be justified. Could provide storm damage reduction, in combination with beach fill, for infrastructure landward of the breakwaters. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Could affect the nearshore environment during construction. May block turtle nesting lanes. Could possibly create nearshore hazitat. May have a negative effect on adjacent shorelines.	May not be aesthetically pleasing. Could be a navigational hazard for boaters and may pose a safety risk for swimmers. Nearshore recreation may be positively or negatively affected. Beach recreation could be maintained. May not be permitable by the state.	Could possibly have a minor positive impact on the regional economy.	3	NO
		1	1	1	1		
S-10	Dunes and Vegetation	Could possibly be justified. Could provide a certain level of protection as a stand alone measure or in combination with other measures. Would be adaptable to potential accelerated Sea Level Rise (SLR) rates.	Dune habitat would be enhanced and expanded. Not likely to have any negative impacts. Aesthetically appealing.	Likely to be supported by a majority of the community. Would moderately increase protection of the evacuation route. This would likely maintain dunes but nearshore recreation could decline. Nearshore recreation would not be affected. Does not conflict with any laws.	Could possibly have a minor positive impact on the regional economy.	5	YES
		1	2	1	1		
S-11	Pressure Equalizing Modules (PEMs)	Not likely to be justified. Has not been shown to work in a coastal environment similar to Flagler County. Not likely that they would work as a stand alone measure. PEMs may provide storm damage reduction to infrastructure in combination with nourishment, but additional benefits would not likely be justified. Would be minimally adaptable to potential accelerated Sea Level Rise (SLR) rates.	Not likely to have any significant environmental effects other then those associated with a combined beach fill.	Could have positive social impacts if they work in enhancing the beach. May add some protection to the evacuation route. Beach recreation would possibly be maintained or enhanced. Nearshore recreation would most likely not be affected. Does not conflict with any laws.	Could possibly have a minor positive impact on the regional economy.	3	NO
		0	1	1	1		
S-12	Undercurrent Stabilizers	Not likely to be justified. Has not been shown to work in a coastal environment similar to Flagler County. Could hold sand in place reducing damages for a specific area, may trap sand that would otherwise feed another area of the project depriving it of damage reduction benefits. Would be moderately adaptable to potential accelerated Sea Level Rise (SLR) rates.	Possible entrapment hazard for hatchling sea turtles. Not proposed for use in conjunction with beach nourishment therefore could have negative impacts on adjacent shorelines.	Because only select areas would benefit, undercurrent stabilizers may not receive support from the entire community. Would add some protection to the evacuation route, in select areas the recreational beach berm may be maintained or possibly extended. Nearshore recreation such as surfing and fishing may be positively or negatively affected. May not be permitable by the state. Prohibited by Counties Comp Plan.	Could possibly have a minor positive impact on the regional economy.	2	NO
		0	0	1	1		

Carried Forward | Eliminated | 2 Fully Meets Objective | 1 Partially Meets Objective | 0 Does Not Meet

Table 5- 1 to **Table 5- 6** present a preliminary evaluation of the possible management measures considered in the first step of plan formulation compared to the Federal objectives represented by the four accounts. Many of the measures did not fully address the screening criteria and were not carried forward to the next phase of analysis. Management measures with the greatest potential to contribute to planning objectives, Federal objectives, and consistency with planning constraints were carried forward for each study reach. The no-action measure was carried forward as an alternative plan throughout plan formulation as required by NEPA and as a basis for comparison with other alternatives. The option was maintained to reincorporate measures, if it was warranted by new developments and information.

Marineland is a completely separable reach with only one major damageable structure, and that structure is currently protected by a substantial revetment. Beach-*fx* modeling of the without-project condition indicates limited damages in this reach, and it is highly unlikely that implementation of any alternatives in this area would be economically justified. Therefore, Marineland was eliminated from further analysis in this study.

The only non-structural measures carried forward other than the no-action plan was buyout and land acquisition, and relocation of SR A1A. These measures could provide potential benefits in the Painters Hill and Beverly Beach reaches where a majority of the shorefront includes a single row of homes east of SR A1A. In Flagler Beach, this measure was screened out because much of the infrastructure is west of SR A1A, and the city has already begun to purchase several of the (few) lots east of SR A1A and designate them as not buildable. FDOT has looked at relocating A1A to an existing secondary street, but the other streets in the area do not have the capability to handle the amount of traffic required of A1A. The main reasons for elimination of the rest of the nonstructural measures were conflicts with state and local regulations and the inability of these measures to contribute to the Federal objectives.

Four structural measures were screened out in the preliminary screening. Nearshore placement could possibly reduce damages, however it is not likely to work as well as beach placement as there is a possibility that the sand may never migrate onto the beach. Emergent breakwaters would likely be less socially acceptable and not as effective for storm damage reduction as other measures, and have been screened out. It is uncertain that PEMs or any type of beach drainage system would be effective in preventing storm damages. The only use of PEMs on the east coast of Florida has been in Hillsboro Beach, Florida where they were placed in 2008. Monitoring reports indicate that the Hillsboro Beach project area functioned similarly to the adjacent control areas, but sand placement directly up-drift of the project was likely to have influenced the results. This technology was presented to Flagler County Commissioners in 2006 as a solution to erosion problems in Flagler Beach and was never pursued. A local grassroots organization called Save Flagler's Beaches supports undercurrent stabilizers as a solution to erosion. Undercurrent stabilizers may not be able to be permitted by the state, and they have not been shown to work in a coastal environment similar to that of Flagler County. Undercurrent stabilizers were presented to Flagler County

commissioners in 2006 as a solution to erosion problems in Flagler Beach. In 2013, the City of Flagler beach funded an analysis evaluating the potential use of undercurrent stabilizers, *City of Flagler Beach, Coastal Avulsion Mitigation and Resurection [sic] Analysis* (Holmberg, 2013). After receipt of the analysis, the City of Flagler Beach Board of Commissioners unanimously decided not to pursue the use of undercurrent stabilizers further.

The eight structural measures carried forward were seawalls, revetments, sand covered soft structures, beach nourishment, groins, submerged artificial reefs, submerged artificial multi-purpose reefs, and dunes and vegetation. These measures were deemed to have the greatest potential for addressing the planning and Federal objectives while avoiding constraints. Seawalls and revetments are discouraged by the State of Florida unless absolutely necessary and are inconsistent with the state's Coastal Zone Management Plan (CZMP). However, these measures were carried forward because portions of the study area are currently armored with revetments or seawalls, and it may be more acceptable if these measures are implemented in an area where this type of armor already exists and impacts are already occurring. The measures carried forward were further evaluated as the study progressed.

Measures carried forward (unless noted, measures could apply to any reach):
NS-1: No-Action
NS-6: Relocate SR A1A (Flagler Beach reach only)
NS-8: Buyout and Land Acquisition (Painters Hill and Beverly Beach reaches only)
S-1: Seawalls
S-2: Revetments
S-3: Sand Covered Soft Structures
S-4: Beach Nourishment
S-5: Groins
S-6: Submerged Artificial Reefs
S-7: Submerged Artificial Multi-Purpose Reefs
S-10: Dunes and Vegetation

5.3.2 Formulation Strategy

Measures, used singularly or in combination with others, create alternatives. Varying scales of each create additional alternatives. An alternative may be implementable for an entire reach or for only a portion of a reach. The combination of management measures results in alternatives that merit further analysis.

Non-Structural (Land Acquisition and Buyout): Basic Combinability
In the Painters Hill and Beverly Beach reaches the nonstructural measure of buyout and land acquisition (NS-8) would be implemented as a standalone alternative. It would not be feasible to construct structural measures to protect structures in the same area where structures have been condemned and removed. **Note:** throughout the study area nonstructural risk reduction measures including education efforts, maintenance of evacuation route signage, zoning codes, and setback requirements were carried forward as elements of any complete systematic package of risk reduction measures. Many of these additional nonstructural efforts are currently being pursued by Flagler County and the City of Flagler Beach and would be performed by local entities alone.

Structural Measures – Basic Combinability

- In the Painters Hill, Beverly Beach, and Flagler Beach reaches sand covered soft structures (S-3) would need to be combined with dunes and vegetation (S-10) as it is a state requirement that soft structures such as geo-tubes remain covered by sand at all times.

- Sand covered soft structures (S-3), seawalls (S-1), and revetments (S-2) are exclusive of each other as they would be constructed along the same footprint. Seawalls (S-1) and revetments (S-2) may be implemented as standalone measures or in combination with other structural measures.

- Groins (S-5) and submerged artificial reefs (S-6) would need to be combined with beach nourishment (S-4) as these two measures would be used to extend nourishment intervals and maximize damage reduction by holding beach sand in place longer without impacting adjacent beaches.

- Beach nourishment, submerged artificial multi-purpose reefs, and dunes and vegetation (S-4, S-7, and S-10) may be implemented either as standalone or in combination with any of the other structural measures.

Alternatives were further developed by scaling the management measures in length and size for specific locations. As the alternatives were developed, the evaluation criteria of completeness, effectiveness, efficiency and acceptability were considered. Completeness is satisfied by ensuring that the alternatives include all activities to implement the plan. Effectiveness is determined by how well the alternatives address the project problems. Efficiency is determined by the cost effectiveness of a plan, which is determined through the cost and benefit analysis. Acceptability is determined by evaluating the plan against local, state, and Federal law and policy, and environmental constraints.

Alternatives not meeting the criteria were eliminated. Alternatives which met the criteria were carried forward as alternative plans and underwent further analysis and modeling.

5.3.2.1 Preliminary Screening: Step 2

The initial screening of management measures (described in **Sections 5.2.1, 5.2.2, and 5.2.3**) evaluated 20 structural and nonstructural management measures against the Federal objectives. The individual management measures having the most potential to meet the study objectives were carried forward for further analysis.

Additional combinability and dependency rules were established for the 11 individual measures carried forward. These rules established which measures could or could not be combined with other measures and which measures would be dependent on other measures being implemented. The USACE Institute for Water Resources (IWR) Plan software was used to come up with a list of all combinations of measures based on the established combinability and dependency rules. This resulted in 141 possible combinations of management measures. More detailed combinability and dependency rules were added to reduce this number. Additionally, the Submerged Artificial Reef measure, which would be implemented as a perched beach, was screened out. Initially this measure was considered in order to provide shore protection and keep sand (from beach nourishment) from migrating offshore and covering nearshore hardbottom. It was determined that the perched beach concept would not work to provide shore protection on a long straight coastline like that in Flagler County. Similarly, there was no need to continue consideration of the Submerged Artificial Reef measure because it has minimal potential to meet any of the Federal objectives. This exercise resulted in 39 possible combinations of management measures as shown in **Figure 5-2.**

11 Individual Measures Carried Past Preliminary Screening		Code
NS-1	No-Action	
NS-6	Relocation of SR A1A	RR
NS-8	Buyout and Land Acquisition	BLA
S-1	Seawalls	SW
S-2	Revetments	RV
S-3	Sand Covered Soft Structures	SCSS
S-4	Beach Nourishment	BN
S-5	Groins	G
S-6	Submerged Artificial Reefs	SAR
S-7	Submerged Artificial Multi-Purpose Reefs	SAMPR
S-10	Dunes and Vegetation	DV

39 possible combinations

Possible and Realistic Combinability and Dependency	
NS-1	standalone,
NS-6	combinable with S-1, S-2, S-3, S-4, S-5, S-6, S-7, & S-10, *limited to FB reach*
NS-8	standalone, *limited to PH & BB reaches*
S-1	exclusive of S-2&S-3 combinable with S-4,S-5,S-6,S-7, & S-10
S-2	exclusive of S-1&S-3,&S-4, combinable with S-4,S-5, S-6,S-7, & S-10
S-3	dependent on S-10, exclusive of S-1&S-2, combinable with S-4,S-5, S-6, & S-7
S-4	dependent on S-10, exclusive of S-1,S-2,&S-3, combinable with S-5, S-6, & S-7
S-5	dependent on S-4, exclusive of S-6 & S-7, combinable with S-1, S-2, S-3, & S-10
S-7	dependent on S-4, exclusive of S-5 & S-6, combinable with S-1, S-2, S-3, & S-10
S-10	combinable with S-1, S-2, S-3, S-4, S-5, S-6, & S-7
NOTE: Standalone indicates that measure is exclusive of all other measures.	

Figure 5-2: Possible Combinations of Measures

Screening with ROM Costs Prior to Beach-*fx*

In order to screen the 39 combinations prior to Beach-*fx* modeling, rough order of magnitude (ROM) cost estimates were developed for each of the individual measures that make up the possible combinations. The ROM cost estimates were developed using information from historical projects. The estimates were based on implementing a measure along one mile of shoreline. It was assumed that it would not be feasible or practical to implement any alternatives along a stretch of shoreline less than 1 mile. These ROM costs were brought to present value (PV) based on maintenance assumptions over 50 years and broken down to a cost per linear foot (LF) of shoreline, shown in **Figure 5-3**.

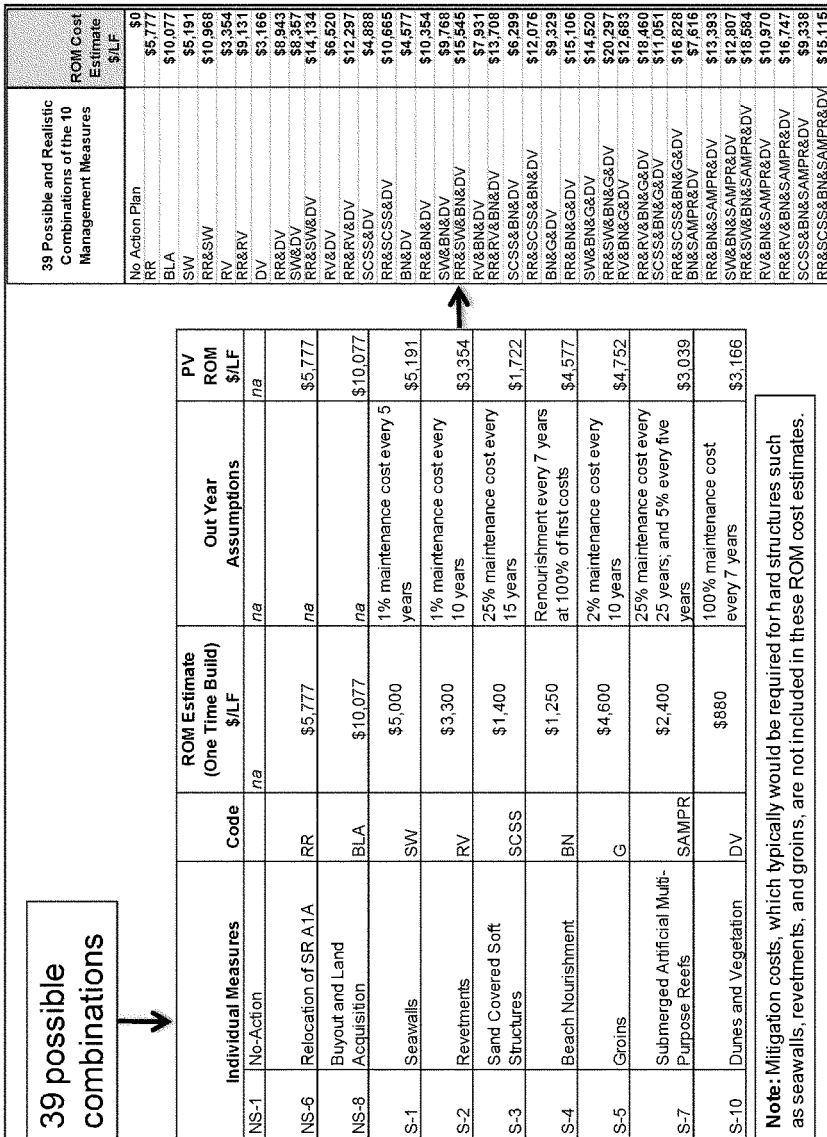
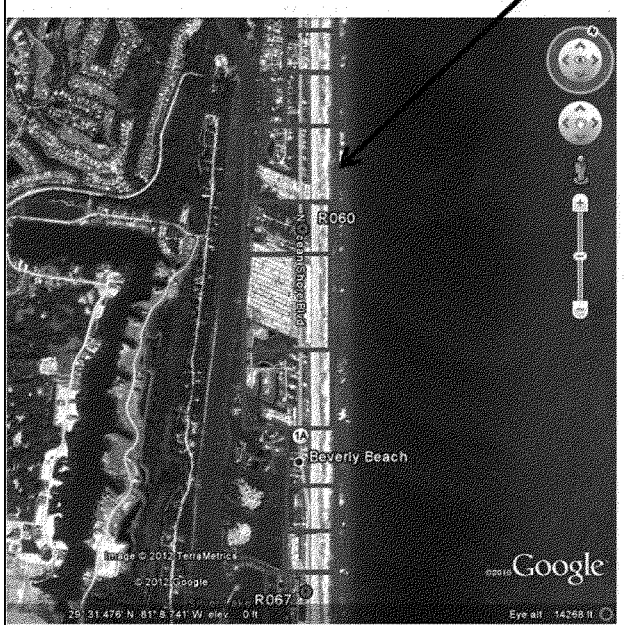


Figure 5-3: ROM Cost Estimates for Possible Combinations of Alternatives

The ROM cost for relocating SR A1A was derived using FDOT input on what it would take to make Central Avenue the new A1A. Central Avenue runs parallel to SR A1A and is located one block landward. The current A1A right-of-way (ROW) is 70 to 100 feet wide, while the Central Ave ROW is approximately 25 feet wide. The ROM cost includes buyout of properties on the east side of Central Avenue at a conservative $500,000 per developed property, in order to widen the Central Ave ROW. Construction of the new A1A on Central Avenue would require a 3-lane (1 lane in each direction plus a bi-directional lane due to the large number of driveways) urban section which would be comprised of a curb, gutter and 2 to 5-foot wide sidewalks. The estimated construction cost included in the ROM A1A relocation estimate is $5.5 million per mile. The cost for property buyout and road construction is approximately $5,777 per linear foot. FDOT noted that this is a very rough estimate that does not include associated design costs or contingency, and the estimate is in no way an acceptance of this concept. It is assumed that due to the scale of the construction, the right-of-way that would be impacted, and increased traffic on what is now designated a local road, gaining consensus on this type of project would pose a significant challenge. In summary, regardless of the cost, it is likely that relocating A1A would not be a practical alternative, and would not be acceptable to residents and local governments. FDOT has stated that they cannot legally abandon A1A to natural erosion and they cannot turn it over to local interests unless the local interests agree to take ownership. Alternatively, if no local interest would accept the road, it could be demolished at an additional expense which is not currently included in the ROM cost. According to the 2010 PD&E Study, "FDOT is committed to protecting SR A1A in its existing location, as this road is a hurricane evacuation route, a designated State Scenic Highway (A1A Ocean Shore Scenic Highway), a National Historic Byway, and provides an economic base for the region."

Beach-fx, Future Without-Project Condition, and Sea-Level Change (SLC)

Beach-fx was run for the Future Without-Project (FWOP) condition using each of the three Sea Level Change (SLC) scenarios prescribed by ER 1100-2-8162. The average present value (PV) damage output for each SLC scenario for each Beach-fx reach (blue boxes along the coast in **Figure 5-4**) was divided by the length of the reach to get the value of damages per linear foot (LF).



Study Reaches	Preliminary Beach-fx Reaches	R-monument vicinity	Reach Length (LF)	PV Damages and Costs $/LF SLC1	PV Damages and Costs $/LF SLC2	PV Damages and Costs $/LF SLC3
Painters Hill	PH-1	R050-R050	662.66	$71	$109	$470
	PH-2	R051-R052	934.64	$5,126	$6,247	$7,323
	PH-3	R052-R053	625.76	$2,815	$3,088	$3,391
	PH-4	R053-R054	1071.00	$2,655	$3,443	$4,372
	PH-5	R055-R055	1063.12	$1,219	$1,320	$1,250
	PH-6	R055-R056	706.77	$7,182	$12,139	$13,378
	PH-7	R056-R057	770.19	$147	$477	$629
	PH-8	R057-R058	984.70	$10	$26	$52
	PH-9	R058-R059	1396.21	$26	$96	$133
	PH-10	R060-R060	953.10	$40	$664	$1,221
Beverly Beach	BB-1	R061-R062	1759.06	$4	$20	$277
	BB-2	R062-R064	1435.70	$55	$157	$194
	BB-3	R064-R065	1055.07	$13	$74	$574
	BB-4	R065-R066	836.34	$166	$2,260	$5,295
	BB-5	R066-R067	755.17	$185	$2,570	$5,721
Flagler Beach	FB-1	R067-R068	1429.04	$105	$971	$3,435
	FB-2	R068-R069	811.02	$157	$2,165	$5,764
	FB-3	R069-R070	1177.50	$328	$2,311	$5,589
	FB-4	R070-R071	1035.78	$506	$4,590	$7,136
	FB-5	R071-R072	1032.76	$285	$3,130	$4,752
	FB-6	R072-R074	1231.49	$185	$2,206	$3,405
	FB-7	R074-R075	1324.08	$78	$1,298	$2,619
	FB-8	R075-R076	941.27	$104	$3,038	$5,117
	FB-9	R076-R077	888.27	$319	$3,375	$5,653
	FB-10	R077-R078	1255.43	$268	$1,756	$4,517
	FB-11	R078-R079	1039.51	$279	$1,301	$3,428
	FB-12	R079-R080	717.90	$650	$2,382	$7,825
	FB-13	R080-R081	1043.75	$1,213	$3,108	$4,693
	FB-14	R081-R082	907.38	$1,024	$4,910	$8,288
	FB-15	R082-R083	1290.12	$139	$1,595	$3,165
	FB-16	R083-R085	1292.29	$2,285	$4,049	$5,897
	FB-17	R085-R085	679.82	$6,610	$8,794	$11,199
	FB-18	R086-R086	861.36	$8,238	$11,134	$14,249
	FB-19	R086-R087	660.22	$11,989	$14,296	$16,508
	FB-20	R087-R088	658.31	$7,722	$9,144	$10,692
	FB-21	R088-R089	691.38	$7,336	$9,293	$11,412
	FB-22	R089-R090	1188.91	$5,081	$6,439	$8,365
	FB-23	R090-R091	1304.00	$2,976	$4,066	$6,272
	FB-24	R092-R092	919.66	$2,459	$3,449	$5,334
	FB-25	R092-R093	1030.97	$1,202	$3,249	$6,199
	FB-26	R094-R095	1352.89	$1,547	$2,317	$3,653
	FB-27	R095-R096	777.84	$0	$0	$41
	FB-28	R096-R097	1137.18	$315	$415	$799
	FB-29	R097-R098	839.42	$207	$580	$1,748
	FB-30	R098-R099	1299.01	$993	$3,829	$6,091
	FB-31	R099-R000	1643.13	$70	$1,393	$4,617

Figure 5-4: Present Value Damages divided by shoreline length ($/linear foot) for the three SLC scenarios (SLC1, SLC2, SLC3)

A project's benefit-to-cost ratio (B/C ratio) must be greater than 1.0 in order for an alternative to be justified and implementable (i.e., the benefits must be greater than the costs). Benefits equal damages prevented, or the difference between without-project damages and damages resulting after implementation of an alternative. At this point in the study, alternatives had not been formulated, so no "with project" Beach-fx scenarios were able to be run. Until management measures are scaled, or combined, to form alternatives, damages are used as a proxy for benefits. Using the value of without-project damages as a substitute for the benefits will overestimate the benefit provided by any measure since this assumes that 100 percent of damages have been averted. Therefore if the cost of implementing a measure is equal to, or less than, the without-project damages, the B/C ratio can be assumed to approximate 1 and the measure may be justified. **Figure 5-5** displays the costs per linear foot of measures in addition to damages along the shoreline for each of the three SLC scenarios. Wherever damages were far below a measure's implementation costs, it was assumed that the measure would not be justified along that shoreline length and the measure was screened out. Where damages are near or above ROM costs along a stretch of shoreline of sufficient length for an alternative to be realistically implemented, it was assumed that the measure was justified and was carried forward. This comparison not only helps in screening, but it also serves to scale measures that are carried forward, illustrating the shoreline lengths that may have enough FWOP damages to justify implementation of a project.

The cost of a measure's implementation may vary depending on the SLC scenario used for design. Because of this it is important to note that there is uncertainty around future costs, and measures with costs just above projected damages should not be screened out prematurely. Beach nourishment (S4), for example, will have a higher cost for higher SLC scenarios because more sand or shorter renourishment intervals would be required. Other measures may have the same implementation cost for any scenario.

In **Figure 5-5**, damages are shown for each preliminary Beach-fx reach from Painters Hill through Flagler Beach. On the horizontal axis "PH-1" is the northernmost reach in Painters Hill, "FB-1" is the northernmost reach in Flagler beach, "FB-31" is the furthest south reach at the Volusia County line. Straight horizontal lines are the ROM costs for combinations of management measures. The damages include both damages to infrastructure (roads and houses), as well as costs for replacing and constructing armor as it is damaged or triggered in the model.

Many combinations had ROM costs that far exceed the expected damages along lengths of shoreline of sufficient length to realistically implement an alternative and were screened out.

39 Possible and Realistic Combinations of the 10 Management Measures	ROM Cost Estimate $/LF
No Action Plan	$0
DV	$3,166
RV	$3,354
BN&DV	$4,577
SCSS&DV	$4,888
SW	$5,191
RR	$5,777
SCSS&BN&DV	$6,299
RV&DV	$6,520
BN&SAMPR&DV	$7,616
RV&BN&DV	$7,931
SW&DV	$8,357
RR&DV	$8,943
RR&RV	$9,131
BN&G&DV	$9,329
SCSS&BN&SAMPR&DV	$9,338
SW&BN&DV	$9,768
BLA	$10,077
RR&BN&DV	$10,354
RR&SCSS&DV	$10,665
RR&SW	$10,968
RV&BN&SAMPR&DV	$10,970
SCSS&BN&G&DV	$11,051
RR&SCSS&BN&DV	$12,076
RR&RV&DV	$12,297
RV&BN&G&DV	$12,683
SW&BN&SAMPR&DV	$12,807
RR&BN&SAMPR&DV	$13,393
RR&RV&BN&DV	$13,708
RR&SW&DV	$14,134
SW&BN&G&DV	$14,520
RR&BN&G&DV	$15,106
RR&SCSS&BN&SAMPR&DV	$15,115
RR&SW&BN&DV	$15,545
RR&RV&BN&SAMPR&DV	$16,747
RR&SCSS&BN&G&DV	$16,828
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RR&SW&BN&G&DV	$20,297

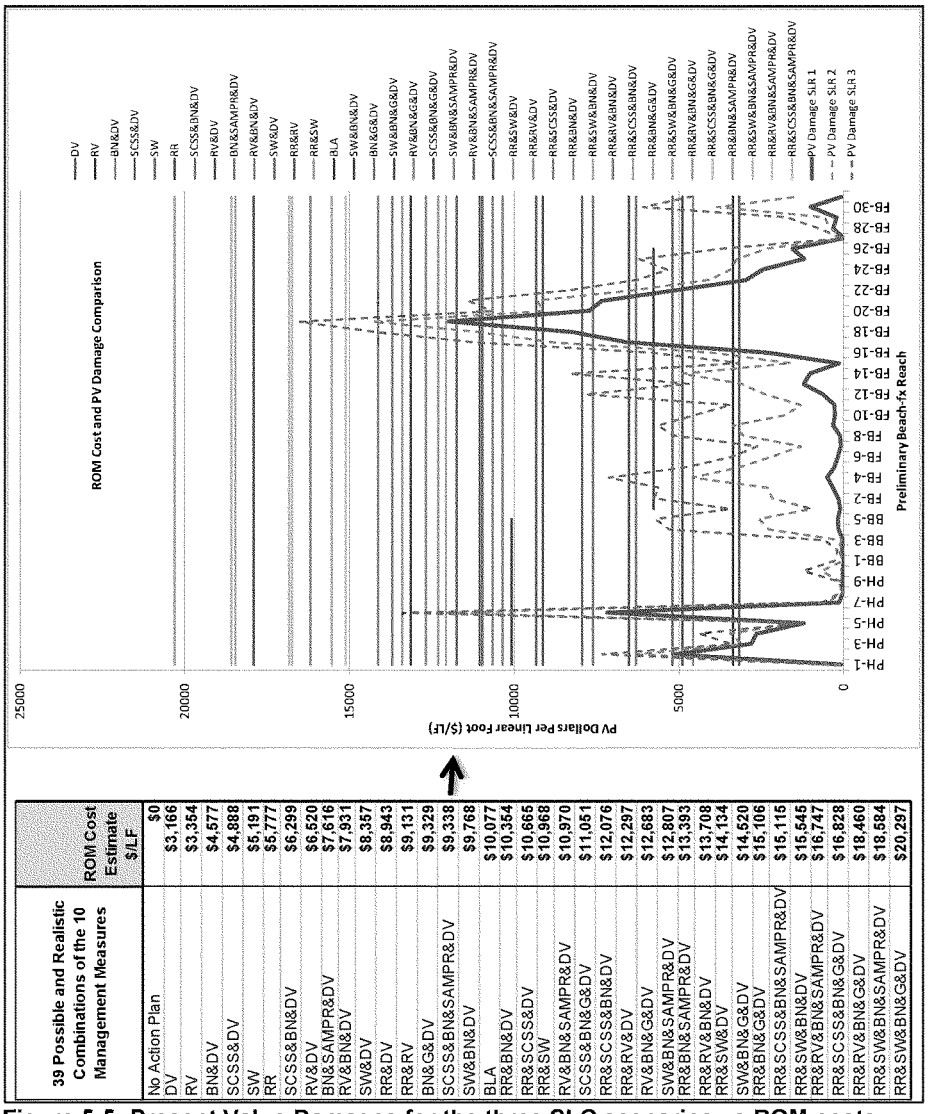


Figure 5-5: Present Value Damages for the three SLC scenarios vs ROM costs

This step resulted in five measures carried forward to intermediate screening as shown in **Figure 5-6**:

- No-action
- Geotube with Dune
- Revetment
- Dunes
- Beach Nourishment with Dune

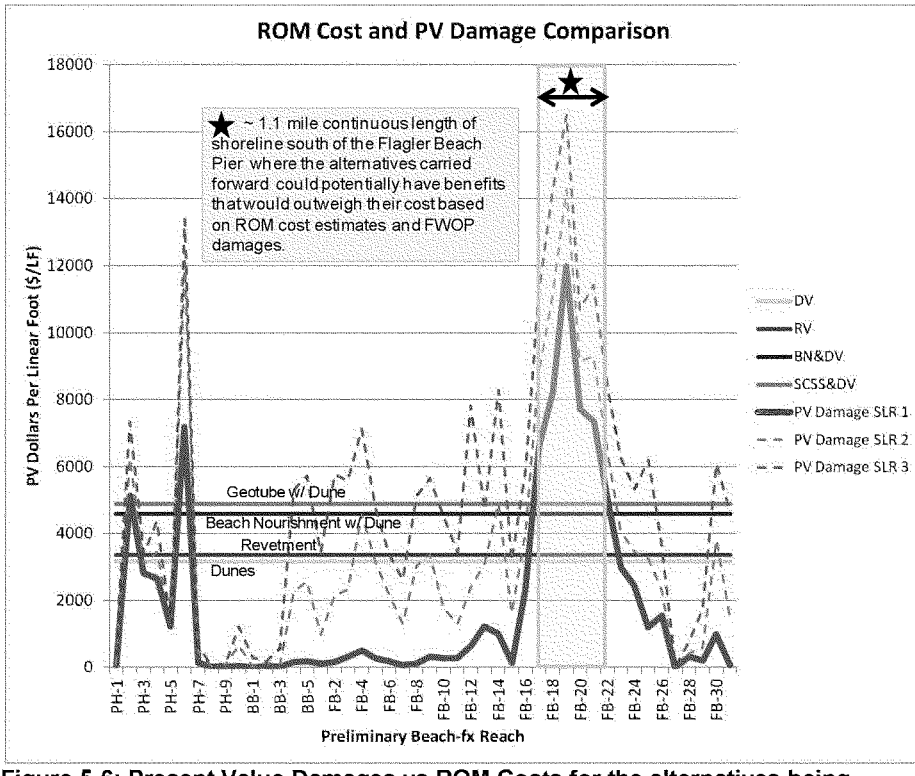


Figure 5-6: Present Value Damages vs ROM Costs for the alternatives being carried forward to intermediate screening

5.3.3 Intermediate Screening

Figure 5-7 shows the methodology for intermediate screening. The five remaining measures were evaluated in four design reaches. These remaining measures are referred to as "alternatives" from this point forward. Beach-fx was then used to evaluate

Future With-Project (FWP) damages. Comparing "future without" to "future with" project damages results in the damage prevention provided by the alternative. Damage prevention is equivalent to storm damage reduction benefits. From here, a final array of alternatives was established.

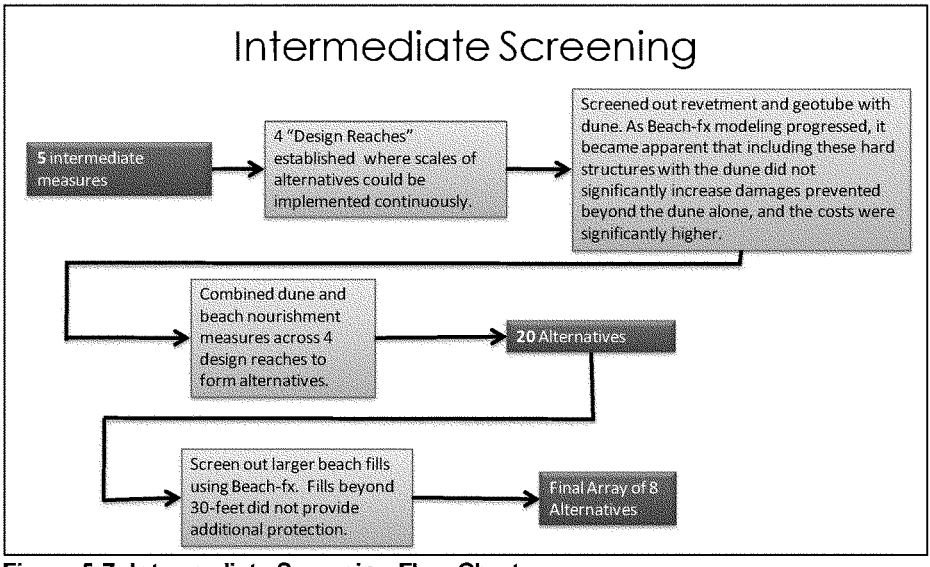


Figure 5-7: Intermediate Screening Flow Chart

The five alternatives carried forward into the intermediate screening phase showed the greatest potential to feasibly achieve planning objective #1 to reduce damages to structures and infrastructure in the study area based on ROM cost estimates. **Table 5-7** shows how these five alternatives either met or fail to met all four of the planning objectives described in **section 4.7**. As this is a single purpose project for hurricane and storm damage reduction, planning objectives # 2, # 3, and #4 are secondary to planning objective #1. However, all three objectives were considered throughout the formulation process, as were the Environmental Operating Principles, Executive Order 11988, and the criteria of completeness, effectiveness, efficiency, and acceptability.

The **no-action alternative** does not meet any of the planning objectives because it does not address any specific problems. It provides a comparison for all other alternatives.

The revetment only alternative would be constructed similarly to the revetment that exists in Marineland, and would provide much greater protection than the existing FDOT revetment along SR A1A. This alternative would meet objective # 4 by protecting the

evacuation route, but it does not meet objectives # 2 and # 3 because beach erosion would likely continue or intensify from wave reflection off the revetment during storms and down drift impacts, resulting in loss of habitat and recreational opportunities. Without any mitigation, this alternative may not be consistent with the Environmental Operating Principles because it would not foster unity of purpose on environmental issues. This alternative would not violate EO 11988 by encouraging new development in a floodplain, but rather would serve to protect existing development. As alternative development progressed, it became apparent that a **revetment with dune nourishment alternative** needs to be considered, rather than revetment only, in order to keep the structure covered and not impact sea turtle nesting and to offset down drift erosion impacts. This is due to the fact that the revetment alternative would have a much larger footprint than the existing FDOT revetment in order to provide a significant reduction in damages.

The **geotube with dune, dunes,** and **beach nourishment with dune** alternatives meet all four of the planning objectives. They all have outputs consistent with the Environmental Operating Principles because they foster unity of purpose on environmental issues. None of these alternatives would violate EO 11988 by encouraging new development in a floodplain, but rather would serve to protect existing development.

Table 5-7: Intermediate Alternatives and Planning Objectives

Alternatives	Planning Objective #1 *Reduce storm damages to structures and infrastructure*	Planning Objective #2 *Maintain environmental quality in the project area and adjacent areas*	Planning Objective #3 *Maintain opportunities for recreational use of beach and nearshore areas*	Planning Objective #4 *Maintain safe hurricane evacuation route*
No-Action	Does not meet. No improvement made to reduce damages.	Does not meet. Loss of the already minimal beach berm and dune habitat would continue.	Does not meet. Loss of the already minimal recreational beach berm would continue.	Does not meet. The existing evacuation route would continue to be damaged and emergency repairs would continue to be needed to keep the route open.
Geotube with Dune	Meets. Damages landward of the geotubes would be reduced.	Meets. Dune and beach habitat would be maintained as long as the geotube remains buried in the dune.	Meets. Recreational beach would be maintained as long as the geotube remains buried in the dune.	Meets. Damages to the road would be reduced allowing for a safe evacuation route.
Revetment Only	Meets. Damages landward of the revetment would be reduced.	Does not meet. Negative impacts on sea turtle nesting. Not aesthetically appealing.	Does not meet. Reflected wave energy off the revetment will likely intensify erosion of the recreational beach berm.	Meets. Damages to the road would be reduced allowing for a safe evacuation route.
Dunes	Meets. Damages landward of the dune would be reduced.	Meets. Dune and beach habitat would be maintained.	Meets. Recreational beach would be maintained.	Meets. Damages to the road would be reduced allowing for a safe evacuation route.
Beach Nourishment with Dune	Meets. Damages landward of the beach and dune would be reduced.	Meets. Dune and beach habitat would be maintained.	Meets. Recreational beach would be maintained.	Meets. Damages to the road would be reduced allowing for a safe evacuation route.

As the study progressed into intermediate screening, reaches along the shoreline were regrouped according to modeled damages and existing shoreline conditions rather than the political boundaries of Painter's Hill, Beverley Beach, and Flagler Beach. **Figure 5-8** shows how the new "design reaches" (described in the next section) relate to R-monuments, study reaches, and preliminary Beach-fx reaches. Beach-fx model reaches were designated to correspond to the design reaches as shown in **Figure 5-8**.

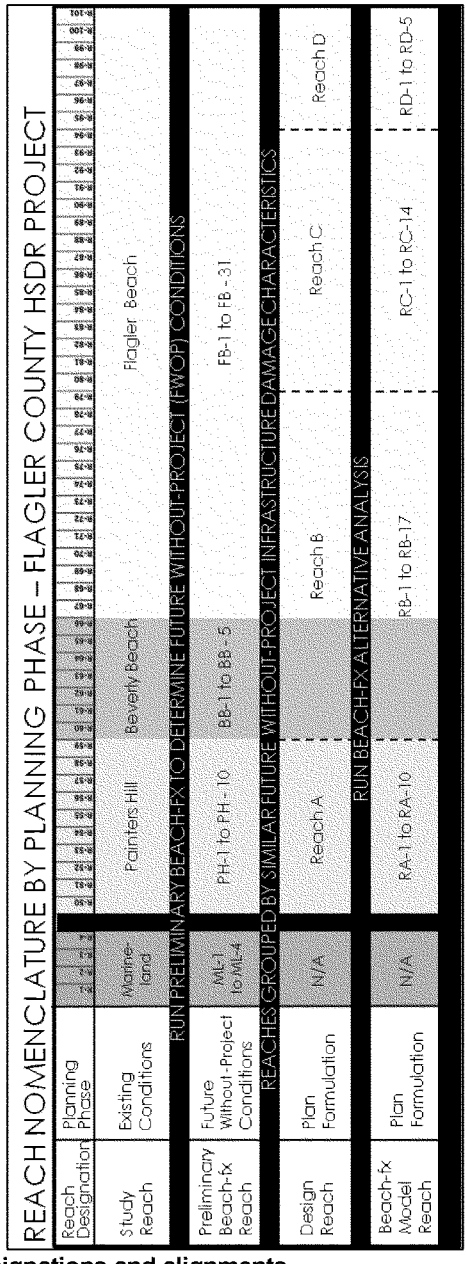


Figure 5-8: Reach designations and alignments

5.3.3.1 Intermediate Screening: Step 1

Four Beach-fx design reaches were created based on average present value (PV) damages of the FWOP condition (see **Figure 5-9**), as well as existing shoreline conditions such as existing beach width and profile. In **Figure 5-9**, the continuous horizontal segments of the solid lines indicate the PV damages per linear foot throughout the four design reaches for the 3 SLR scenarios prescribed by ER 1100-2-8162.

- Design Reach-A includes Painters Hill and is a 1.7-mile long segment (R50 to R60). Much of this reach is an unarmored bluff with one row of single family oceanfront homes east of SR A1A.

- Design Reach-B includes Beverly Beach and the northern portion of Flagler Beach and is a 3.5-mile long segment (R60 to R80). The shorefront consists of a steep, mostly unarmored bluff with varying amounts of vegetated dune between SR A1A and the beach berm. A salient (seaward extension of the beach) exists in the berm on both sides of the pier.

- Design Reach-C includes central Flagler Beach and is a 2.6-mile long segment (R80 to R94). The shorefront to the south of the pier consists of a steep bluff armored with mostly granite and some coquina rock revetment and a 150-foot section of steel seawall immediately east of SR A1A.

- Design Reach-D includes south Flagler Beach and is a 1-mile long segment (R94 to R101). The shorefront consists of a steep, unarmored bluff with varying amounts of vegetated dune between SR A1A and the beach berm. In the middle of this design reach there is a half mile stretch where SR A1A curves slightly inland and there are four structures east of SR A1A which are armored with old wooden and concrete seawalls. There are also several parking and bath facilities east of SR A1A in Gamble Rogers State Park fronted by a steep vegetated dune system.

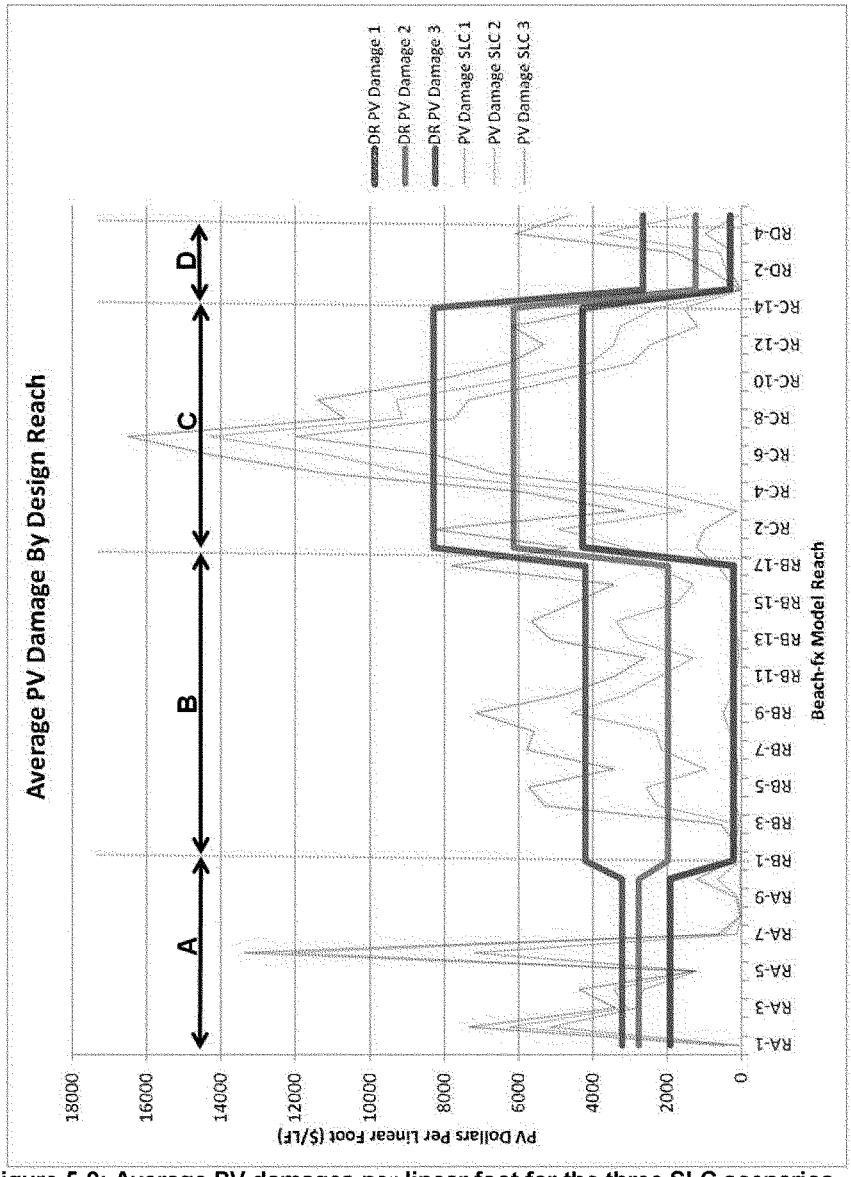


Figure 5-9: Average PV damages per linear foot for the three SLC scenarios throughout the four design reaches

As Beach-fx modeling progressed, it became apparent that including either a revetment or geotube with the dune would not significantly reduce damages beyond the dune alone, and the costs would be significantly higher. Therefore, the **revetment with dune** and **geotube with dune alternatives** were screened out, and the alternatives to be modeled further included combinations of the **dune and beach nourishment alternatives**.

Figure 5-10 depicts the average present value FWOP damages for the four design reaches compared to the ROM cost estimates of the alternatives carried forward. In **Figure 5-10**, "Beach X 4" means that four separate widths of beach nourishment were modeled in Beach-fx: 20-foot, 40-foot, 60-foot, and 80-foot widths. This resulted in 30 alternatives to be evaluated in Beach-fx throughout the project area.

Although the ROM costs exceed the damages for the low and intermediate SLC scenarios in all of the design reaches except C, all the design reaches were modeled to capture benefits for adjacent nourishments that could affect erosion rates.

These Beach-fx model runs result in Future With-Project (FWP) damages. Comparing "future without" to "future with" project damages results in the damage prevention provided by the alternative. Damage prevention is equivalent to storm damage reduction benefits.

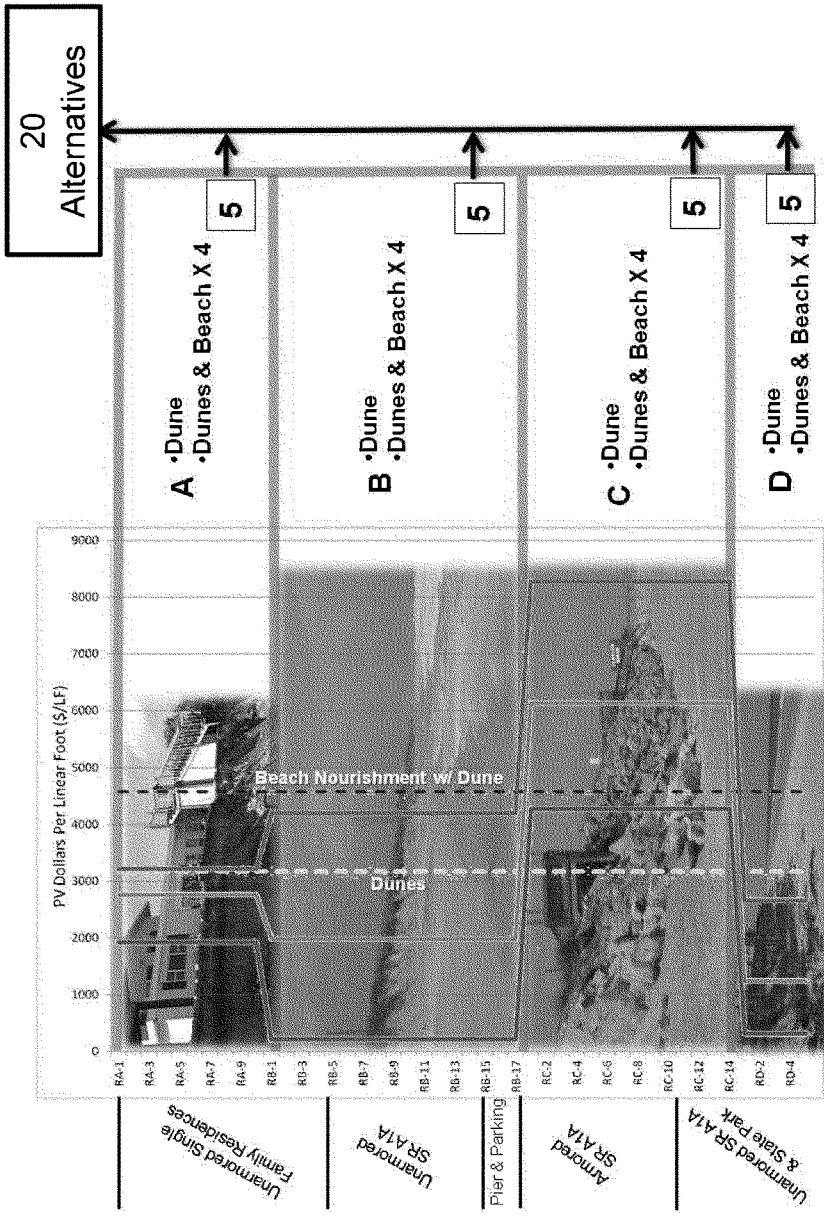


Figure 5-10: Design Reaches and Alternatives to be modeled.

5.3.3.2 Intermediate Screening: Step 2

ER 1100-2-8162 directs that alternatives should be adaptable to potential SLC scenarios across the planning horizon. In **Figure 5-11**, the alternatives are symbolized by colored bars spanning increments of Sea-Level Rise (SLR). The length of the colored bars indicates each alternative's robustness and adaptability as sea level increases. Each alternative has a beginning and ending threshold. The beginning threshold may not be immediate but at some time in the future when sea level reaches a point which makes the alternative acceptable for environmental, economic, social or other reasons. The ending threshold indicates a sea-level height where the alternative no longer functions or can no longer be adapted to provide storm damage reduction. In between these thresholds the alternative can be adapted as sea level increases. Adaptability is dependent on relative sea level and is independent of specific SLC scenarios. The different SLC scenarios only impact the future point in time when the sea level is reached that corresponds to an alternative's thresholds. Some alternatives that have start thresholds above RSL=0 will require lead times to coordinate with agencies and the public.

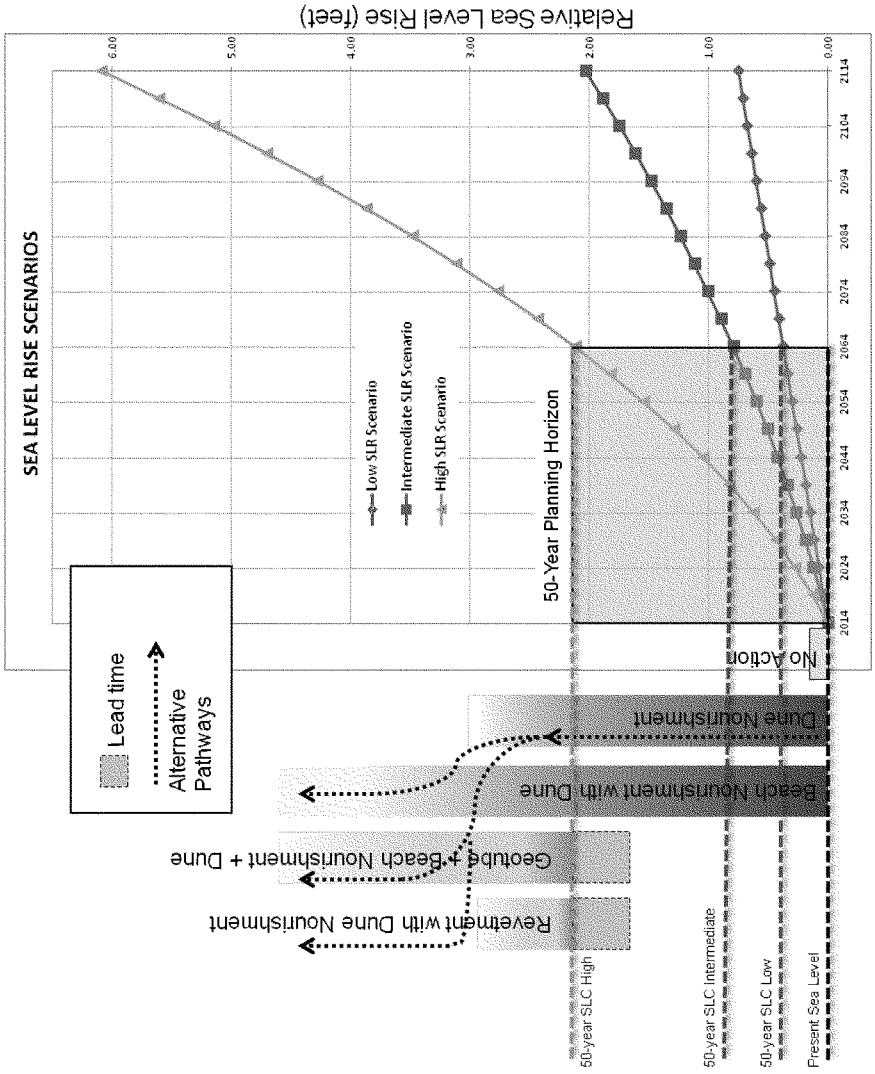


Figure 5-11: Alternative adaptability to SLC scenarios prescribed by ER 1100-2-8162.

No Action: Based on without-project Beach-fx simulations, damages increase dramatically between 2025 and 2030 under the low SLC curve (see the **Economic Appendix**). In **Figure 5-11**, this would correspond to an approximate 0.25 foot increase in the present sea level. Therefore 0.25 feet is shown as the ending threshold for No Action. This alternative is most sensitive to the background erosion rate. The intermediate and high SLC scenarios cause a proportional increase in background erosion and therefore would cause the No-action project damages to increase even sooner than the low SLC scenario. This alternative is not feasible under any SLC scenario.

Dune Nourishment: This alternative is implementable at current sea level. The dune nourishment alternative consists of a 10-foot seaward extension of the dune and beach profile out to the depth of closure. The depth of closure is the most landward depth seaward of which there is no significant change in bottom elevation and no significant net sediment transport between the nearshore and the offshore for a given or characteristic time interval. It can be applied over a single project reach or multiple project reaches. Over a 50-year project life, it is estimated that the total fill volume required for this alternative would fall between a minimum of 610,000 cubic yards (Reach A only, low SLC scenario) and a maximum of 9,900,000 cubic yards (Reaches A, B, C, and D high SLC scenario). Presently, three borrow sites, 2A, 2B, and 2C, have been identified as immediate sources of fill material. Combined, the three primary sites have an available volume of 5,600,000 cubic yards of beach quality material. A fourth borrow site, 3A, has been identified as a future borrow site. Site 3A has an estimated available volume of 20,000,000 cubic yards. Taking all four borrow sites into account, there is sufficient volume to support dune nourishment for all project reaches over the full 50-year life of the project. This alternative is adaptable across all SLC scenarios for at least the 50-year period of analysis.

Dune and Beach Nourishment: This alternative is implementable at current sea level. The dune and beach nourishment alternative consist of a 10-foot seaward extension of the dune and a 20-foot to 80-foot extension of the berm. Over a 50-year project life, it is expected that the total fill volume required for a dune and beach nourishment would fall between 1,330,000 cubic yards (Reach A, 10-foot dune and 20-foot berm extensions, low SLC scenario) and 42,190,000 cubic yards (Reach A, B, C, and D 10-foot dune and 80-foot berm extension, high SLC scenario). While the combined volume of beach quality material available from the identified borrow sites is sufficient to maintain a smaller (20-foot to 40-foot) berm extension in a single reach over a 50-year project life, combined reach cases and larger fill alternatives (60-foot to 80-foot berm extensions) would rapidly exhaust all of the identified borrow sites. Therefore, unless additional sand sources are identified, only a 20-foot to 40-foot berm extension (combined with a 10-foot dune extension) would be feasible throughout and beyond the 50-year project life. Depending on the size of the berm constructed, this alternative is not necessarily adaptable across all SLC scenarios for the 50-year period of analysis. In **Figure 5-11**, the ending threshold is beyond the 50-year planning horizon to reflect that smaller berms may be adaptable or additional sand sources may be found.

The Beach-fx model employed to determine damages for each design case can only consider climate change impacts through sea-level rise and corresponding changes to shoreline erosion rates. Storm frequency and intensity remain constant. It is possible in the future that climate change will result not only in accelerated sea-level change, but also change the frequency and intensity of the storm conditions that impact the project shoreline. Should there be an intensification or increase in storm activity, it is possible that a dune and beach nourishment alternative would become more practical than a dune nourishment alone. Therefore, it is possible that a dune nourishment could transition into a dune and beach nourishment at a time beyond the projected 50-year project life. The "alternative pathway" in **Figure 5-11** reflects this.

Revetment with Dune Nourishment: This alternative is not currently implementable. Presently a majority of the Flagler shoreline is protected by an existing revetment that is in relatively poor condition with rock that is not all sized appropriately. The previously discussed dune nourishment would cover the revetment to avoid sea turtle nesting concerns. The revetment with dune nourishment alternative differs from the dune nourishment alternative only in that a robust revetment would be installed where the more simple revetment presently exists. Being significantly more expensive than the dune alternative, this alternative would not be desirable until climate change altered sea level and incident storm conditions to a degree that reinforcement of the dune alternative with a robust revetment is necessary to maintain adequate protection to A1A and other infrastructure. Currently, predicted damages would not justify construction of this alternative unless the high SLC curve is realized. Therefore this alternative is not currently implementable given that the much less expensive dune only alternative prevents the majority of predicted damages. It is assumed that the implementation threshold for this alternative would be when the dune only alternative is no longer able to provide adequate protection. For planning purposes, the ending threshold is assumed to be at a time beyond the 50-year planning horizon when it becomes impractical to maintain sand cover over the revetment.

Dune with Geotube Core and Beach Nourishment: This alternative is not currently implementable. Like the revetment with dune nourishment alternative, this alternative also requires an extension of the dune sufficient to completely cover a sand filled geotube core. This alternative has the same beginning threshold as the revetment alternative. For planning purposes, the ending threshold would be approximately the same as the beach nourishment with dune alternative with the added problem of needing to maintain sand cover over the geotube core. Other such geotube projects in Florida indicate that it is difficult to maintain sand cover and as the geotubes are exposed they are highly susceptible to damage from both natural environmental conditions and through vandalism.

5.3.4 Final Screening

Figure 5-12 shows the methodology for final screening. Additional Beach-fx runs of the beach nourishment alternatives indicated that berm extensions greater than 30-feet did not prevent a significant amount of additional damages. Therefore, the **dune** and **beach nourishment** alternative was refined by eliminating the 50 and 70-foot widths but maintained for consideration of the 10 and 30-foot widths.

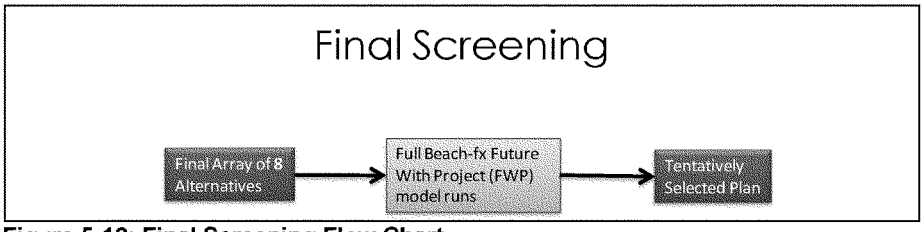


Figure 5-12: Final Screening Flow Chart

A key aspect of the Flagler County study is that each study reach (A,B,C,D) is treated as a separable element. Between the two remaining alternatives and the four study reaches, eight fully developed alternatives were carried forward to be modeled in Beach-fx, representing a reasonable number of project alternatives for evaluation. The naming convention for the alternatives is described below. In **Table 5- 8**, "dune width" is equivalent to the approximate dune crest width. All berm widths are measured from the seaward toe of the 10-foot dune extension. The letter "H" in the alternative names represents that the alternative would be constructed using hydraulic dredging methods from an offshore borrow area.

Table 5-8: Final Array of Design Alternatives

Design Alternative	Description	Dune Height Extension (ft)	Dune Width Extension (ft)	Berm Width Extension (ft)
Reach A duneH	10-foot extension of the existing ReachA dune and beach profile	0	10	0
Reach A 30	Extension of ReachA dune and berm	0	10	20
Reach B duneH	Extension of ReachB dune	0	10	0
Reach B 30	Extension of ReachB dune and berm	0	10	20
Reach C duneH	10-foot extension of the existing ReachC dune and beach profile	0	10	0
Reach C 30	Extension of ReachC dune and berm	0	10	20
Reach AC duneH	10-foot extension of the existing ReachA + ReachC dune and beach profile	0	10	0
Reach AC 30	Extension of ReachA + ReachC dune and berm	0	10	20

Other combinations were considered during the plan formulation process. However, preliminary modeling indicated that the other alternatives would not be economically justified. For example, an ABC-Dune-H alternative was screened out because Reach B, which is a separable element, is not economically justified. The same is true for ABCD, as both the B and D segments are not incrementally justified. Larger beach nourishment alternatives were also considered. In every reach, the construction and maintenance of a wider berm (50 feet, 70 feet, etc.) generates few, if any additional benefits, while incurring significant increases in total project cost. In fact, most of the larger beach nourishment alternatives had costs that were greater than all of the damages in the FWOP condition. Even if such a project eliminated 100% of the damages, it would still not be economically justified.

5.3.5 Alternative Comparison

All the alternatives described above were modeled in Beach-fx using full (100 iterations) life-cycle simulations. The results of these simulations were used to select the NED Plan. The results of the alternative comparison are presented in **Table 5-9**. Additional detail is provided in the **Economics Appendix.**

Table 5-9: AAEQ Benefits and Costs for Final Array of Alternatives

Alternatives	Brief Description	Benefits	Cost	Net Benefits	BCR
Reach A duneH	Dune extension and 10' sacrificial berm in Reach A only	$220,000	$170,000	$52,000	1.35
Reach A 30	Dune extension and 30' sacrificial berm in Reach A only	$690,000	$700,000	-$16,000	0.98
Reach B duneH	Dune extension and 10' sacrificial berm in Reach B only	$200,000	$250,000	-$57,000	0.78
Reach B 30	Dune extension and 30' sacrificial berm in Reach B only	$210,000	$1,030,000	-$809,000	0.21
Reach C duneH (NED)	Dune extension and 10' sacrificial berm in Reach C only	$2,190,000	$810,000	$1,387,000	2.72
Reach C 30	Dune extension and 30' sacrificial berm in Reach C only	$2,250,000	$1,180,000	$1,065,000	1.90
Reach AC duneH	Dune extension and 10' sacrificial berm in Reaches A and C (non-contiguous)	$2,940,000	$1,130,000	$1,814,000	2.61
Reach AC 30	Dune extension and 30' sacrificial berm in Reaches A and C (non-contiguous)	$2,960,000	$1,750,000	$1,206,000	1.69

[1] Costs were developed by SAJ District Cost Engineering personnel in FY2013 dollars, and deflated back to 2011 price levels. The original real estate assessment was completed in 2011, so the benefits are in 2011 price levels.

The criteria of completeness, effectiveness, efficiency, and acceptability were considered in order to determine if a plan is worthy of further consideration. The final array of alternatives consist of dune and beach nourishment at various scales. None of the alternatives require substantial activity by others that are not likely to be forthcoming, in order to meet the objectives. Therefore, all of the final alternatives equally meet the criteria of completeness. All of the final alternatives equally meet the criteria of effectiveness because they meet all the planning objectives. This is shown in **Table 5-7**. The criteria of efficiency is best met by alternatives **Reach AC duneH and Reach C duneH** which have the highest net benefits and BCR respectively. The rest of the alternatives in the final array are not efficient because they do not meet the objective to maximize net benefits relative to cost. In order to be considered acceptable, an alternative must be workable and viable with respect to acceptance by the state, local entities, the public, and compatibility with existing laws, regulations, and public policies. Alternatives that include reach A do not meet the acceptability criteria because for all intents and purposes reach A is a private beach, and not publicly accessible per current USACE policy. For this reason reach A is screened out.

With **Reach AC duneH** screened out, the NED Plan with the highest net benefits and BCR is **Reach C duneH**.

The benefits for alternatives with multiple reaches are not simply the additive benefits of the alternatives for the individual reaches combined. For example, the benefits for **Reach AC dune H** are not just the added benefits of the **Reach A dune H** and **Reach C dune H** alternatives. The construction of a berm and/or dune results in direct benefits to the segment receiving the nourishment; it also results in supplemental benefits to down-drift segments. A down-drift segment could be either north or south of a constructed fill. The net transport in the project area is north to south, but the instantaneous direction will vary depending on meteorological conditions. For example, the nourishment in Reach A actually improves the performance of the dune constructed in Reach C.

The assessment of the future-without project conditions identified additional planning opportunities that were integrated into the formulation as secondary planning objectives. Consequently the NED plan produces benefits that fall within the three other P&G accounts that the FDOT reactive maintenance does not address. These project specific objectives included the need to increase the reliability of A1A as a critical emergency evacuation route that produce other social effects account benefits; identify opportunities to provide additional critical beach habitat that has degraded in the study area due to coastal erosion that produces environmental quality account benefits; and maintain the local economy through recreational opportunities that produces regional economic development account benefits.

When the plans were evaluated against the four P&G accounts (the FDOT reactive plan to coastal storms by continuing rock revetment repairs and Corps proactive plan to

construct a beach dune system) the more complete plan is the beach dune system being proposed as the recommended plan. The plan provides a more complete solution and is in the federal interest to cost share at the historic rate.

ER 1165-2-130, paragraph 6.h. states, "Unless the protection of privately-owned beaches is incidental to protection of public beaches, they must be open to all visitors regardless of origin or home area, or provide protection to nearby public property to be eligible for Federal assistance." Reach A is considered a privately-owned beach since it does not have significant public access, and its protection is not incidental to protection of Reach C. **Figure 5-13** and **Figure 5-14** display parking and access currently provided in Reaches A and C. As shown in **Figure 5-13**, a large portion of Reach A does not have adequate parking and access.

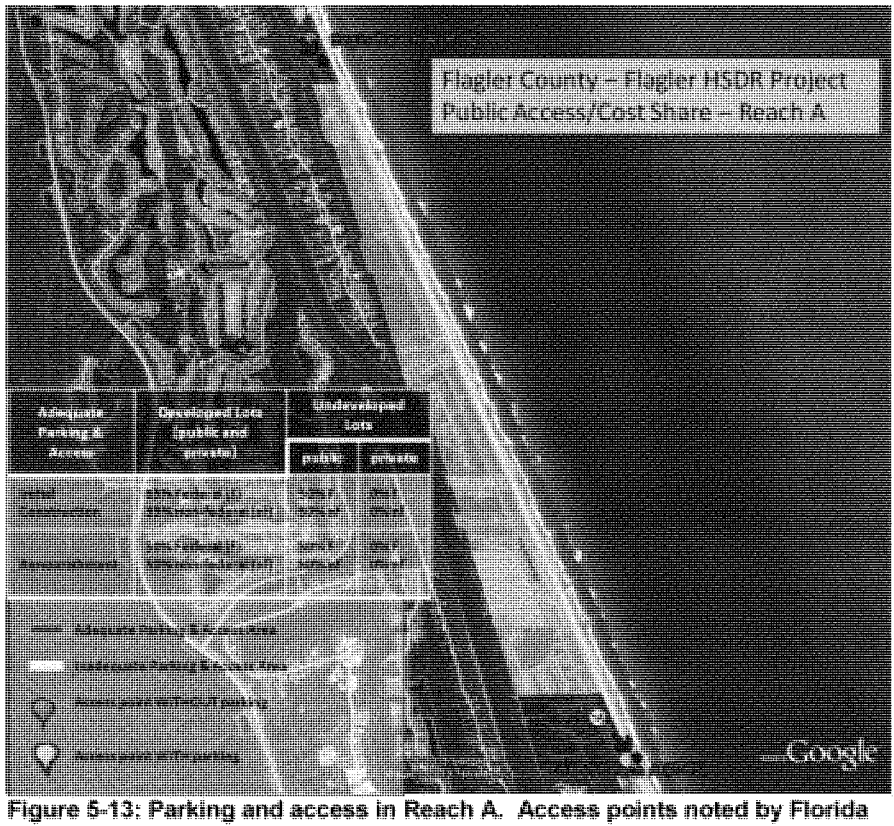


Figure 5-13: Parking and access in Reach A. Access points noted by Florida Department of Environmental Protection (FDEP) and verified by field visits.

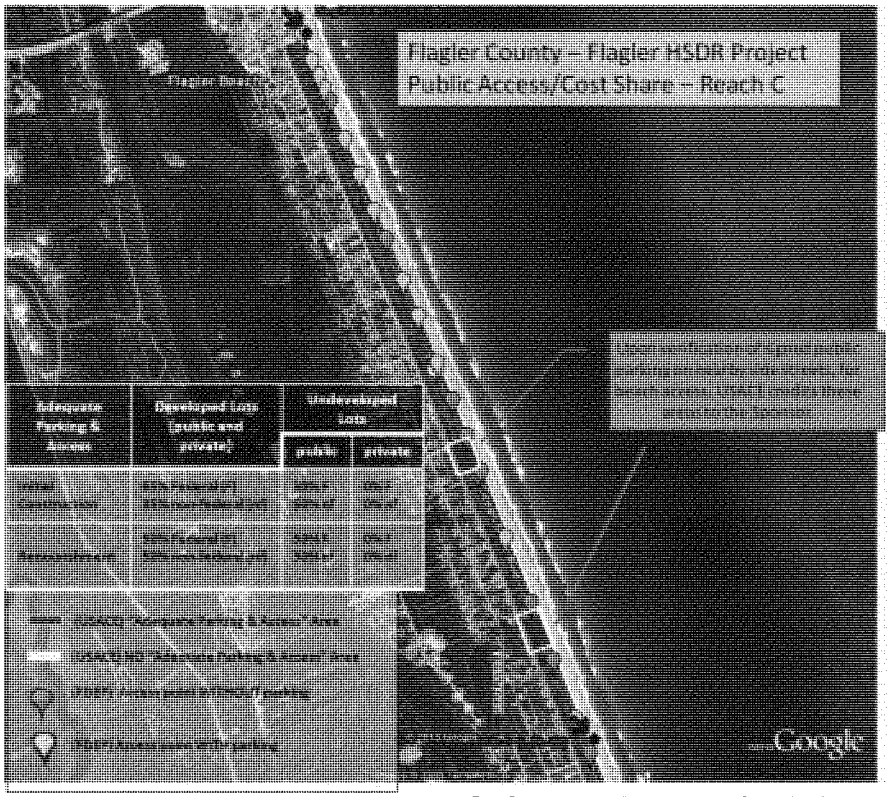


Figure 5-14: Parking and access in Reach C. Access points noted by Florida Department of Environmental Protection (FDEP) and verified by field visits.

Figure 5-14 shows that the majority of Reach C has adequate parking and access. Two areas have adequate street-side parking but lack a sign indicating that public parking is available. The sponsor has indicated that signage will be posted in order to claim 100% public access and parking coverage in Reach C. **Table 5-10** provides additional detail on public parking and access within the Recommended Plan area. There are at least 223 public parking spaces in the vicinity of Reach C. This amount of parking spaces is adequate to meet the beach use demand in the area and meets the policy requirements of ER 1165-2-130 which states "Generally, parking on free or reasonable terms should be available within a reasonable walking distance of the beach. The amount of parking should be consistent with the attendance used in benefit evaluation."

Table 5-10: Reach C Access and Parking

Reach C Access and Parking				
Access Point	**Within 1/2 Mile of Adjacent Access Point?**	**Public Parking Available?**	**Number of Parking Spaces**	**Notes**
FLAGLER BEACH PIER	Y	Y	40	
4th St. S	Y	Y	25	
5th St. S	Y	Y	25	
6th St. S	Y	Y	70*	
	Y	Y	20	
7th St. S	Y	Y	20	
9th St. S	Y	Y	10	
10th St. S	Y	Y	10	
11th St. S	Y	Y	5	
12th St. S	Y		0	Within 1/4 mile of public parking available at both 11th and 13th Streets
13th St. S	Y	Y	5	
14th St. S	Y	Y	5	
15th St. S	Y	Y	10	
16th St. S	Y		0	Within 1/4 mile of public parking available at both 15th and 17th Streets
17th St. S	Y	Y	5	
18th St. S	Y	Y	10	
19th St. S	Y	Y	5	
20th St. S	Y		0	Within 1/4 mile of public parking available at 19th St.
21st St. S	Y		8	Unsigned street-side parking exists on west side of SR A1A. Sponsor has indicated that signs will be posted indicating that public parking is available.
22nd St. S	Y		0	Within 1/4 mile of public parking available at 23rd St.
23rd St. S	Y	Y	2	
25th St. S	Y		3	Within 1/4 mile of public parking available at 23rd St. Unsigned street-side parking exists on west side of SR A1A. Sponsor has indicated that signs will be posted indicating that public parking is available.
26th St. S	Y		10	Within 1/4 mile of public parking available at 27th St. Unsigned street-side parking exists on west side of SR A1A. Sponsor has indicated that signs will be posted indicating that public parking is available.
27th St. S	Y	Y	5	
28th St. S	Y		0	
Total			223	
*6th St. S Parking Area West of A1A				

The access points in **Table 5-9** are sourced from the FDEP's Public Access Guide (available online), which also provides the number of parking spaces available at each of these points. However, the number of parking spaces shown in the table reflect the results of a USACE site visit in 2011. The number of spaces estimated by USACE personnel in the vicinity of the pier south to 7th Street South was greater than the number on the FDEP database, and as such the values shown in the table for these access points were increased accordingly. For example, FDEP appears to have omitted the parking area at 6th Street South, which is estimated by USACE to contain 70 spaces. The values shown for 9th Street South to 28th Street South are unchanged from the FDEP database. See **Figure 5-15**.

Discussions with the sponsor indicated that public access and parking could not be provided in Reach A, and therefore no Federal interest in this reach. Additionally, the sponsor was not interested in providing access and parking in Reach A or pursuing **Reach AC duneH** as a Locally Preferred Plan (LPP). **Due to these facts, Reach C duneH is selected as the NED and Recommended Plan.**

The sponsor is aware of the parking and access requirements, including those listed in ER 1165-2-130 and ER 1105-2-100, and has committed to those requirements being met prior to any execution of a project partnership agreement (PPA).

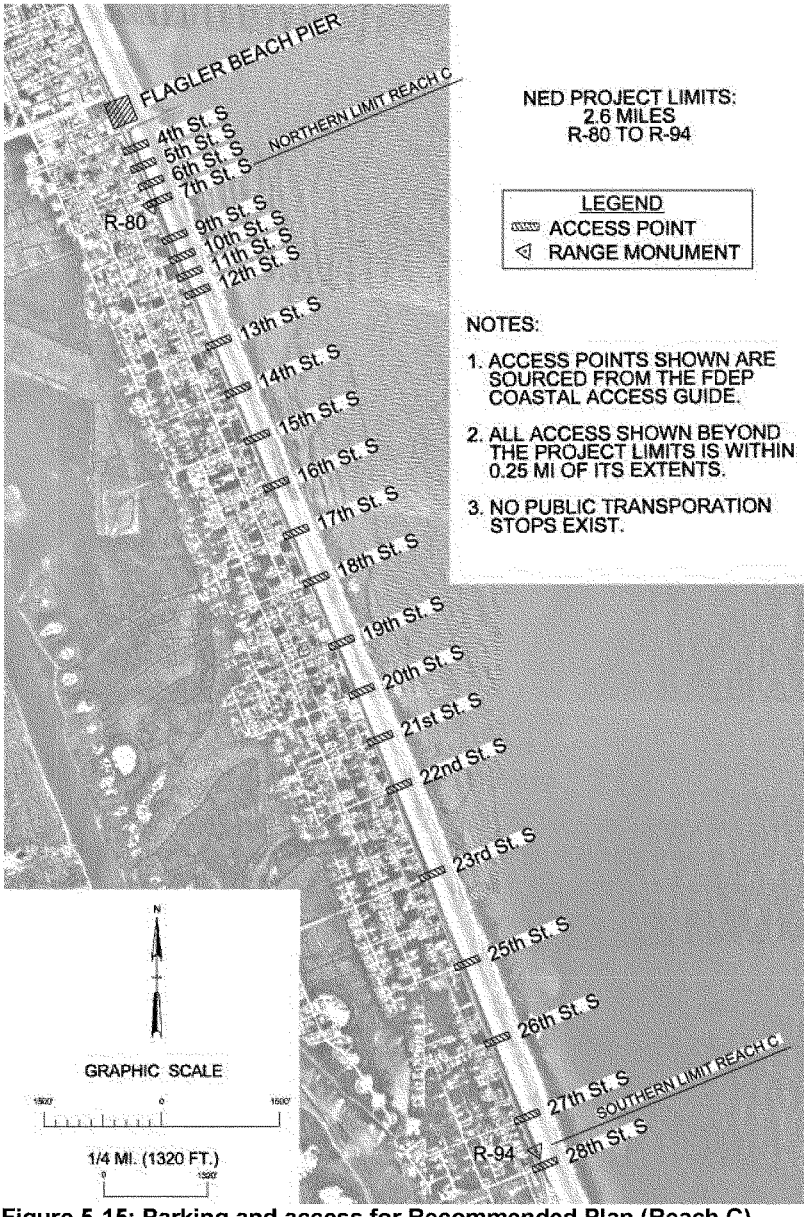


Figure 5-15: Parking and access for Recommended Plan (Reach C)

5.3.6 Description of the NED Plan

As described above, the NED plan consists of a 10-foot dune and beach profile extension in Reach C only. **Figure 5-16** shows the location of the NED plan in Reach C relative to the entire study area. **Table 5-11** provides a summary of the plan.

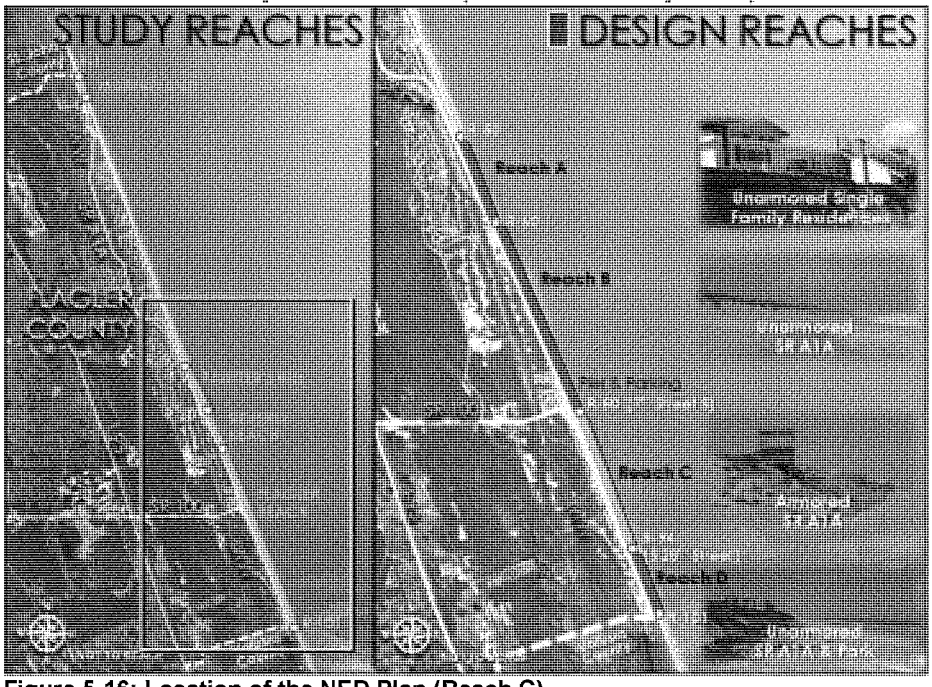


Figure 5-16: Location of the NED Plan (Reach C)

Table 5-11: Detailed Description of the NED Plan (FY11 price levels and discount rate).

Name	Reach C duneH
Description	10' dune extension (note: the construction template will include a 10' sacrificial berm) constructed with a hydraulic dredge in Reach C
Shoreline Length	2.6 miles
Average # of Nourishment Events	5
Average Renourishment Interval	11 years
FDEP Monuments	R80 – R94
Average Volume of each nourishment event (cubic yards)	320,000
Total Volume over life of project (cubic yards)	1,610,000
Average Annual Cost	$810,000
Average Annual Benefits	$2,190,000

It should be noted that Beach-*fx* is a life-cycle simulation model. These results are based on 100 iterations of 50-year simulations. Each iteration within the simulation is unique. The values presented in the table above are an average of all 100 iterations. More information regarding renourishment volume and interval is provided in **Section 6.2.5** and **Appendix A**.

5.3.6.1 Performance of the NED Plan in the Sea Level Rise (SLR) scenarios

An important question about the Recommended Plan is its performance under different Sea-Level Rise (SLR) scenarios. Each of the three SLR scenarios is considered equally likely to occur. Therefore, if the project does not perform under each scenario, then it cannot be considered a completely effective and adaptable plan. **Table 5-12** shows the BCRs and net benefits of the plan in the different SLR scenarios.

Table 5-12: AAEQ Benefits and Costs for NED Plan in different SLR scenarios

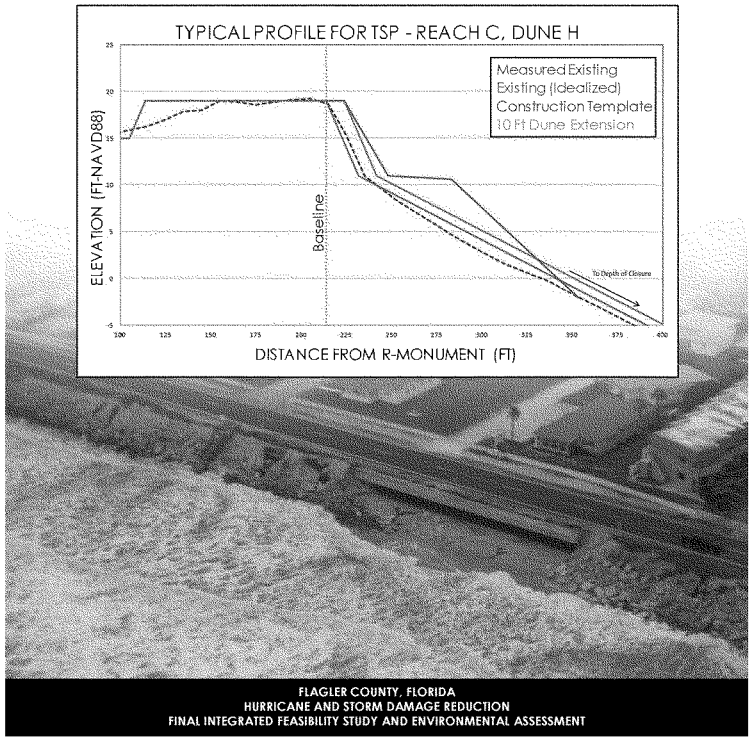
SLR Scenario	Benefits	Cost	Net Benefits	BCR
Baseline (SLR1)	$2,190,000	$810,000	$1,387,000	**2.72**
Intermediate (SLR2)	$3,475,000	$1,155,000	$2,320,000	**3.01**
High (SLR3)	$4,625,000	$1,581,000	$3,044,000	**2.93**

As shown in **Table 5-12**, though the benefits of the project increase significantly in the SLR scenarios, the costs also increase. Thus, the project performance (in terms of the benefit-cost ratio) is relatively constant throughout the SLR scenarios. As both costs

and benefits are increasing, the net benefits actually increase with increasing rates of sea-level rise. Overall, these results suggest that the NED Plan is both effective and robust in all three simulated SLR scenarios.

During the screening of the final array of alternatives, including berm alternatives, all three SLR scenarios were run and compared. In each scenario, no other alternative, including berm alternatives, gain enough benefits to become the NED plan.

CHAPTER 6
RECOMMENDED PLAN



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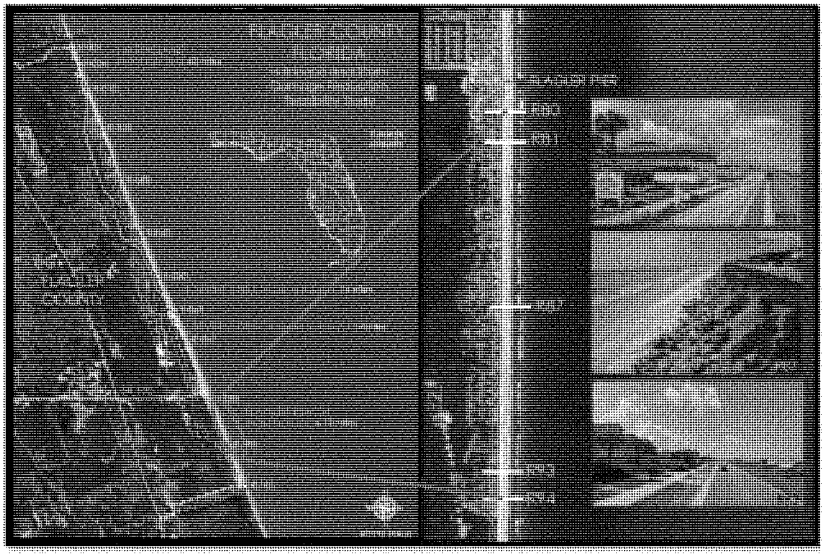
6 THE RECOMMENDED PLAN

6.1 Description of the Recommended Plan

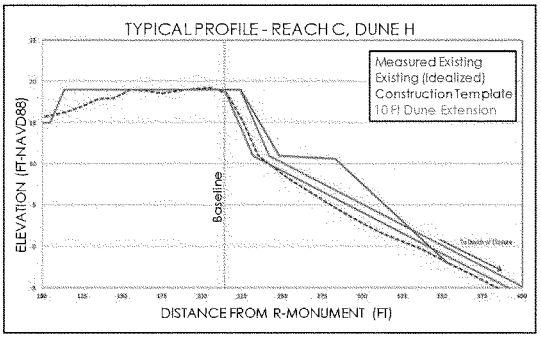
The NED plan consists of a 10-foot seaward extension of the existing dune. Construction of the dune extension will extend the existing berm and entire active beach profile seaward. **Table 6-1** provides a summary of the plan. There is no mitigation expected to be necessary for the Recommended Plan.

Table 6- 1: Detailed Description of the NED Plan



DESCRIPTION

- 10-foot seaward extension of the existing dune and beach profile in Reach C
- R-80 to R-94 plus tapers
- 2.6 miles of shoreline



NOURISHMENTS

Average # of Nourishment Events	5
Average Renourishment Interval	11 years
Average Volume (each event)	320,000 cu yards
Total Volume (over project life)	1,610,000 cu yards
Average Annual Cost*	$1,239,000
Average Annual Benefits*	$2,362,000

*FY14 price levels and discount rate

It should be noted that Beach-*fx* is a life-cycle simulation model. These results are based on 100 iterations of simulations. Each iteration within the simulation is unique. The values presented in the above table are an average of all 100 iterations. More information regarding renourishment volume and interval is provided in **Section 6.2.5** and the **Engineering Appendix A**.

6.1.1 Benefits of the NED Plan

With **Alternative AC-Dune-H** screened out, the plan with the highest net benefits is **C-Dune-H**. Therefore, it is both the NED Plan and the Recommended Plan. This is also the plan with the highest Benefit to Cost Ratio. For the results presented from this point forward, the structure inventory value was inflated from FY2011 to FY2014 price levels to match the current project cost, which has also been refined to a higher level of detail. Benefits and costs have been discounted using the FY2014 Federal Water Resources Discount Rate of 3.5%. Therefore the costs and benefits will not match those presented in previous chapters.

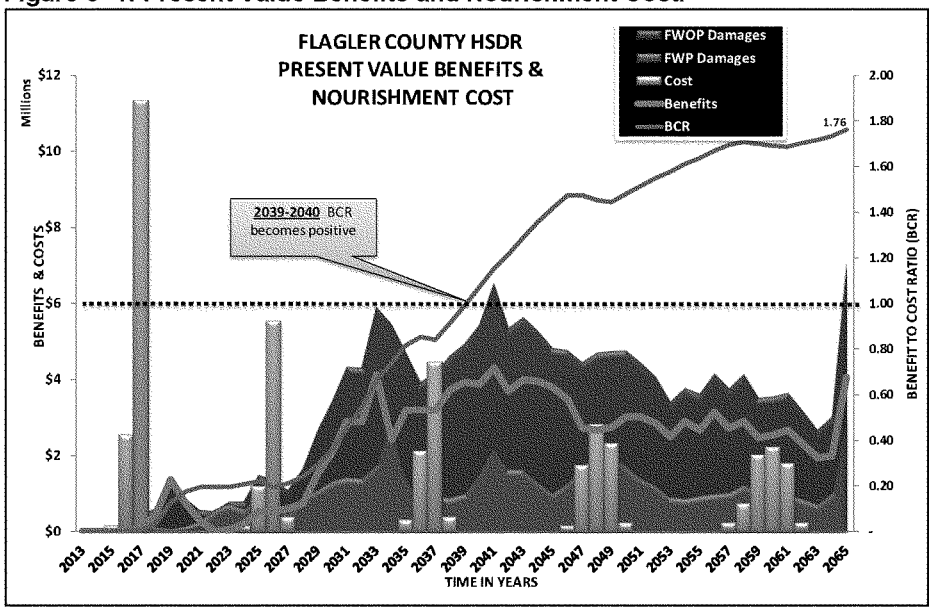
Table 6- 2: Present Value (PV) of Damages in Reach C

Number	Reach	FWOP DAMAGES	FWP DAMAGES	PV BENEFITS	% DAMAGE PREVENTED
32	RC-1	$1,892,833	$797	$1,892,036	99.96%
33	RC-2	$844,935	$1,696	$843,238	99.80%
34	RC-3	$279,511	$136	$279,375	99.95%
35	RC-4	$4,295,755	$21,396	$4,274,359	99.50%
36	RC-5	$3,325,934	$7,756	$3,318,178	99.77%
37	RC-6	$5,602,065	$17,524	$5,584,541	99.69%
38	RC-7	$4,300,370	$54,285	$4,246,085	98.74%
39	RC-8	$4,147,648	$18,267	$4,129,382	99.56%
40	RC-9	$4,352,709	$34,789	$4,317,920	99.20%
41	RC-10	$6,499,679	$265,187	$6,234,492	95.92%
42	RC-11	$6,153,999	$1,061,579	$5,092,420	82.75%
43	RC-12	$3,156,661	$547,802	$2,608,858	82.65%
44	RC-13	$1,301,232	$60,917	$1,240,315	95.32%
45	RC-14	$2,791,150	$124,614	$2,666,536	95.54%
	Total	**$48,944,481**	**$2,216,746**	**$46,727,735**	**95.47%**

Most of the benefits are associated with reductions to armor damage along the State Road A1A (SR A1A) revetment. In the with-project condition, the cost of maintaining and repairing the revetment is significantly less than it would be in the without-project (FWOP) condition. This reduction is the primary source of economic benefits. As seen in **Table 6- 2**, the alternative is highly effective; it prevents 95% of total damages in Reach C. Notably, the total cost of maintaining the SR A1A revetment decreases from $49 million in the FWOP condition to $2.2 million in the with project condition. This is a 95% decrease. Within Reach C there are 272 single family structures, 35 multi-family structures, and 39 commercial structures located landward of SR A1A. The structures would be vulnerable to damage if SR A1A was not armored.

The economic benefits of the plan are generated by reductions in erosion damages. Inundation and wave attack damages were extremely limited in the study area. Model results suggest that the NED plan is highly effective at reducing erosion damages. In the with-project condition the vast majority of damages in Reach C are prevented. It can be seen that the damages modeled in Reach C during the first 10 years of the simulation (2013-2023) are within the modeling tolerance of the actual costs incurred by FDOT for maintaining the road from 2000-2010. It is after 2027 (in the model) that without-project damages start to increase dramatically. Only after the cumulative effects of storms, sea-level rise (SLR), and erosion over time begin to take their toll does the model begin to show significant damage. **Figure 6-1** provides detail on the accumulation of damages, benefits, and costs over time.

Figure 6- 1: Present Value Benefits and Nourishment Cost.



After the NED Plan was selected, traffic rerouting benefits were calculated using vehicle operating costs and average daily traffic counts. These benefits account for the reduction in time that the road would need to be closed for emergency road repairs. The average annual benefits for traffic rerouting are estimated at $131,000. More information about the traffic rerouting analysis is available in **Addendum B of Economic Appendix C**.

Incidental recreation benefits were calculated using the Unit Day Value (UDV) method, as described in EGM 09-03 and in Appendix E of ER 1105-2-100. Using this method, the total present value of recreation benefits was estimated to be $1,696,452 or $72,326 in average annual terms. More information about the recreation analysis is available in the **Economic Appendix**.

It should be noted that the Recommended Plan is both highly effective and efficient. As the plan successfully reduces the vast majority of damages, a larger project is not necessary. Finally, the plan can be considered robust in the sense that it is economically justified in all 100 iterations simulated by Beach-*fx*. More detail on these results is available in the **Economic Appendix**.

The recommended plan reduces damages to the most vulnerable section of SR A1A which is critical for emergency evacuation events as well as recovery efforts following natural disasters. The population of the area served by the portion of the

A1A evacuation route that the project would protect is about 2,300 people. Reducing damages to this section provides a critical link in a 14 mile stretch between Highway 100 in Flagler Beach and West Granada Boulevard in Ormond Beach, shown in **Figure 6-2** where there are no other east-west evacuation routes off of the barrier island.

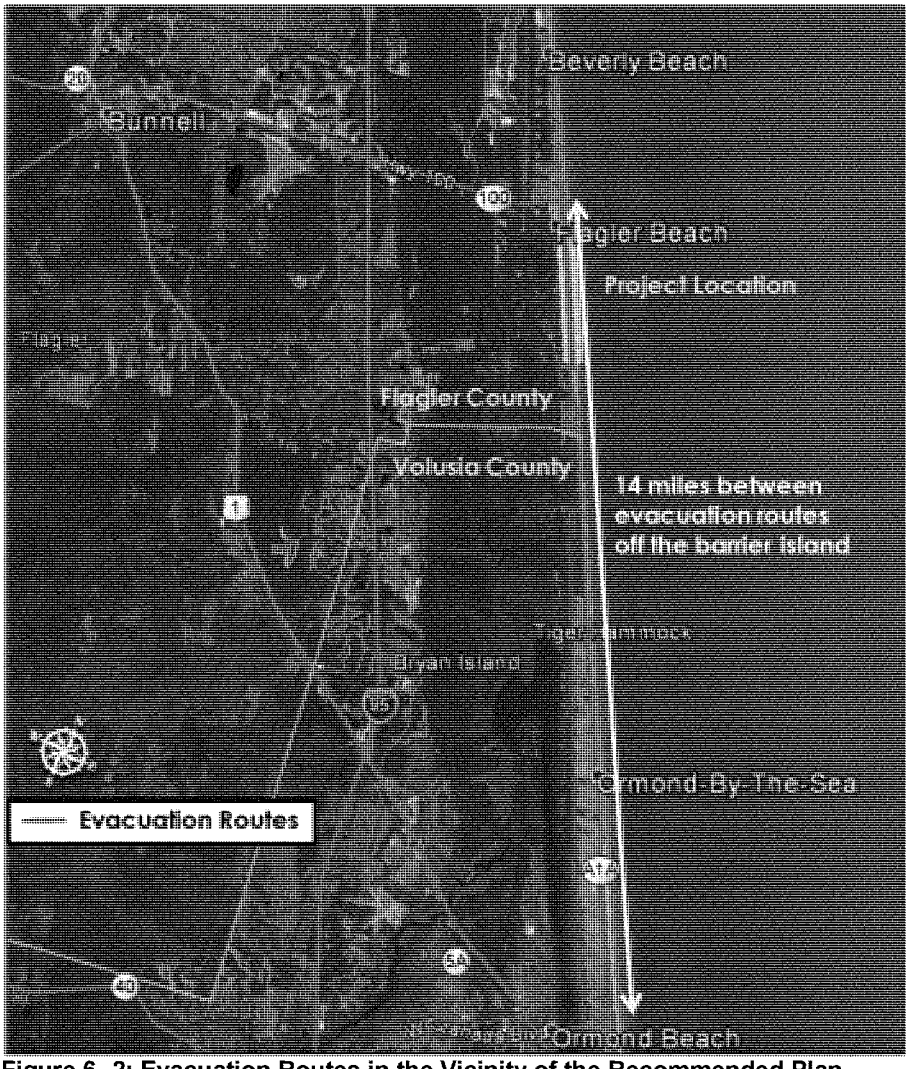


Figure 6- 2: Evacuation Routes in the Vicinity of the Recommended Plan.

Highway 100 is located about 0.25 miles from the northern terminus of the project location. There is a small section of aging seawall (about 150'long) under the pier structure located about mid way between the project and SR100. A row of diagonally oriented public parking spaced and a shore parallel boardwalk are located seaward of A1A along this 0.25 mile stretch between the project and SR100, but no other armoring is present other that under the pier. This stretch of shoreline has been historically stable. - The distance from the southern end of the project to the Volusia County line is slightly over 1 mile. A1A curves inland through the first half mile of this stretch. In the half mile north of the Volusia County line, where SR A1A runs along the top of the dune, there is no existing protection. SR A1A is designated as an evacuation route in both directions; however there is very little population at the north end of Volusia County that would be likely to use it.

In the future without-project conditions, the existing revetment along SR A1A will continue to be repaired by dumping rocks on an as needed basis as erosion continues to occur and additional rocks will be dumped within the FDOT right of way in areas that are currently unarmored as erosion encroaches on the road. These efforts will likely use rocks or other material brought in with a dump truck, and the road will need to temporarily be closed, with traffic routed to Central Avenue. The traffic rerouting analysis described in **Addendum B of Appendix C** was used to determine the reduction in the number of traffic impacts as a result of the recommended plan being implemented. Compared to the future without-project conditions, the extension of the dune and beach profile would reduce the number of traffic impact incidences from 281 to 151 incidences in the future with-project condition over 50 years. This is a 46% reduction in traffic re-routing incidences.

Within the 2.6 miles of shoreline covered by the recommended plan, 1.75 miles is currently armored by FDOT revetment or seawall and 0.85 miles does not have existing armor. In the future without-project conditions, existing FDOT armor will be maintained by dumping rocks on an as needed basis and additional rocks will be dumped within the FDOT right of way in unarmored areas so that the entire 2.6-mile stretch will be armored. With an armored shoreline it is expected that there would be minimal beach area for turtles and birds to use for nesting habitat. In the future with-project conditions, the extension of the dune and beach profile would establish at least a 10 foot width of suitable nesting habitat along the entire 2.6-mile length of shoreline, which is 3.15 acres over 50 years. Public recreation will not reduce the habitat value of the 3.15 acres established by the project. There is a local group that monitors the area beaches and marks nests with caution tape so that the general public recreating on the beach can avoid the nests.

6.2 Project Design

6.2.1 Project Length

The Recommended Plan design, **Reach C Dune H** covers approximately 2.6 miles of the study area extending from R-80 to R-94 with tapers extending approximately 100 feet north of R-80 and approximately 100 feet south of R-94.

6.2.2 Project Dune

Existing dune elevations in the project area are between 18 and 20 feet-NAVD88. Evaluation of the design alternatives has shown that the existing elevations, when combined with a berm and/or dune extension, provide sufficient protection. No additional elevation is included in the selected design plan. For Reach C, the dune elevation is 19 feet-NAVD88.

Existing dune widths in the project area are variable. Between R-80 and R-88, the dune has an average width of approximately 100 feet. Between R-88 and R-94 the average width is approximately 40 feet. SR A1A , which runs parallel to the project shoreline, is located within the dune. Based on the average dune widths, design widths are 110 feet in the northern portion of Reach C and 50 feet in the southern portion.

6.2.3 Project Berm

The design berm elevation in Reach C is 11 feet-NAVD88, which approximates the natural berm elevation. Restricting the design berm elevation to the natural berm elevation minimizes scarping of the beachfill as it undergoes readjustment. Vertical scarps can hinder beach access by nesting sea turtles, and may also pose safety problems related to recreational beach use. Other reasons for mimicking the natural berm elevation are related to storm damage protection. A berm constructed at a lower elevation would increase the probability of overtopping by relatively frequent storms, thereby offering less protection to upland development and/or existing dunes. A higher berm elevation could result in problems related to backshore flooding due to excessive rainfall or wave overtopping. A higher berm may also be more susceptible to wind-induced erosion.

Although the design berm for **Reach C Dune H** is described as a 0 foot extension, construction of the dune extension will increase the existing berm. **Figure 6- 2** shows a graphical representation of the Recommended Plan profile as modeled by Beach-*fx*.

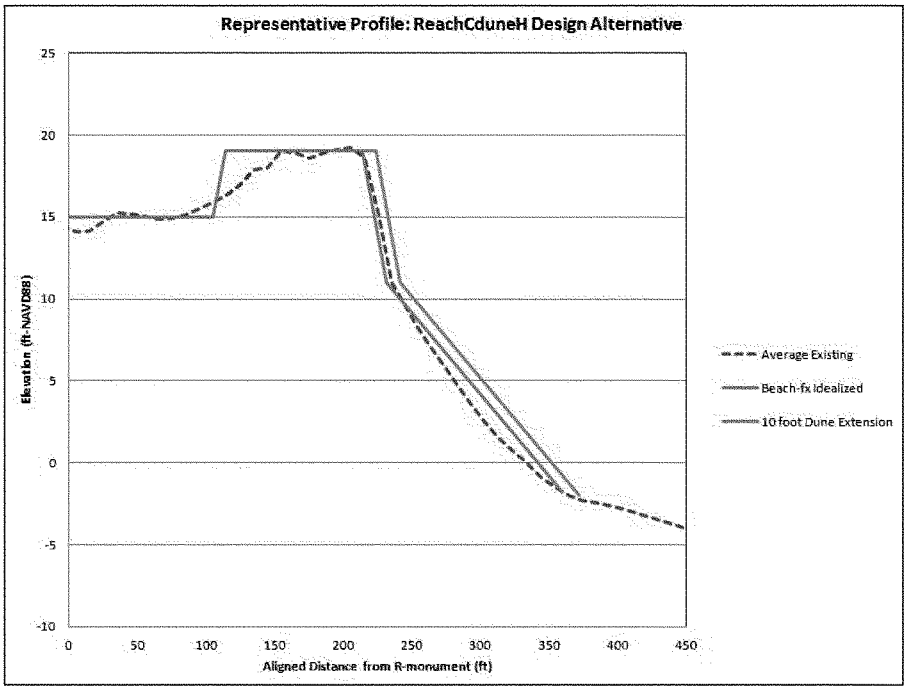


Figure 6- 3: Graphical Representation of Reach C Dune Extension Alternative Beach-*fx* Profile

6.2.4 Project Beach Slopes

After initial placement of the sand, wave action will adjust and sort the material into an equilibrium beach slope, similar to the native beach. In Flagler County, the native beach slopes in Reach C are estimated as a 1 (vertical) on 2.2 (horizontal) at the dune, 1 on 10 from the berm to MLW (-3.1 feet-NAVD88), and 1 on 40 to 1 on 70 below MLW. The estimate of the slope of the material after adjustment is based on averaging the beach profile slopes of the native beach from the mean low water datum to the approximate location of the 12-foot depth contour. Below the 12-foot depth contour, various bar type features appear in the profiles, making a representative slope difficult to determine.

It is unnecessary and impractical to artificially grade beach slopes below the mean low water elevation since they will be shaped by wave action. For this reason, the front slope of the beach fill placed at the time of construction or future renourishment may differ from that of the natural profile. The angle of repose of the hydraulically placed material depends on the characteristics of the fill material and the wave

climate in the project area. With steep initial slopes, the material will quickly adjust to the natural slopes.

6.2.5 Project Volumes and Renourishment Interval

Traditionally, beach fill designs are presented as a set of three cross-sectional templates, the design template, which is based on an equilibrium profile translated seaward by the desired width of the berm or mean high water (MHW) extension; the advanced nourishment template, which represents the volume of material that is expected to erode between successive renourishment intervals; and the construction template, which includes both the design and advanced fill quantities, but incorporates the wider berm and steeper slope that reflects the capabilities of the construction equipment. The design template is the minimum beach profile to be maintained, while the advance nourishment template contains the volume of material that will dissipate through erosion over the economically optimized renourishment interval while protecting the design template. This traditional approach, however, does not conform well to the probabilistic nature of the Beach-*fx* model or the methodology used for determining renourishment requirements.

Beach-*fx* begins with the desired design template (i.e., the 10-foot dune and profile extension, **Figure 6- 2**). Each life-cycle simulation then applies randomly generated storms, storm erosion, and natural background shoreline change rates. At one-year intervals, the model evaluates the resulting shoreline against two criteria (1) whether shoreline position at one or more reaches has exceeded one or more planned nourishment triggers and (2) whether the total volume presently required to fill the original design template exceeds the mobilization threshold. If both criteria are met then a renourishment event is initiated. There are three planned nourishment triggers in Beach-*fx*: berm width, dune width, and dune height. Each trigger indicates what percentage of the design template berm width, dune width, or dune height must be present to *prevent* a renourishment (For example, a 90% [0.90] dune width trigger means that 90% of the total design template dune width (existing dune plus fill extension) must remain intact. If 10% or more of the template dune width is eroded, the first criteria for initiating a planned renourishment event has been met. Should the allowable erosion be exceeded in one or more Beach-*fx* design reaches, then Beach-*fx* computes the volume required (over all of the *triggered* nourishment Beach-*fx* design reaches) to fill the original design template and compares that volume to the mobilization threshold. The mobilization threshold is the optimal volume for a project that is both economical and maintains adequate storm damage protection at all times over the life of the project. If the mobilization threshold is exceeded a renourishment over all planned nourishment Beach-*fx* design reaches occurs and the model continues through the remainder of the life-cycle.

For the Recommended Plan, the berm width, dune width, and dune height planned nourishment triggers were set at 0, 0.91, and 0.9, respectively. The mobilization threshold was set to 300,000 cubic yards. Together, the triggers and the mobilization

threshold allow for the optimization of the beach fill based on the physical dimensions of the project, as well as assumptions regarding tolerable erosion limits and reasonable fill volumes. Sensitivity analysis of the nourishment triggers and mobilization threshold indicated that threshold volume was the dominant parameter for optimizing project cost for an alternative in which the berm width has a zero value. A mobilization threshold of 300,000 cubic yards was found to be (when combined with the above nourishment triggers), the most optimal threshold value. Decreasing the threshold decreased the net NED benefits. Increasing the threshold above 300,000 cubic yards produced a small increase in the net NED benefits. However, it also allowed segments of the dune to erode to beyond the existing project condition. This was not considered to be an acceptable assumption. The net benefits associated with the 300,000 and 400,000 cubic yard thresholds are $26,803,584 and $26,810,596 respectively. The sensitivity analysis used to determine 300,000 cubic yards as the optimal nourishment threshold is contained in **Appendix C**. This analysis optimizes the triggers used to determine when the renourishment should occur and not the resulting renourishment interval. The renourishment interval is the most likely interval to occur based on the triggers, as described in the following paragraphs.

Each complete Beach-*fx* model run consists of 100 iterations, each iteration representing the life of the project. Based on the Recommended Plan (100 iteration runs), a range of volumes was determined for the initial fill event and each subsequent renourishment event. Model runs were made for each of the three SLR cases: Base, Intermediate, and High. **Table 6-3** provides the minimum, maximum, and average fill volumes for both initial and renourishment events over the life of the project. This table also provides the number of expected renourishment events.

Traditionally, in Hurricane and Storm Damage Reduction (HSDR) studies, a fixed renourishment interval is defined and optimized for the life of the project. This interval is based in part on a clear distinction between a design berm and advance fill. With Beach-*fx*, no such distinction is defined. Rather, renourishment events are triggered within the model when specific criteria are met. In this case, the triggers were set up to simulate a point at which the dune and beach profile extension had eroded away and were no longer capable of reducing damages. Based on these parameters, the expected renourishment interval is 11 years, defined by the average time between renourishments triggered over 100 iterations of a 50-year life cycle simulated by Beach-*fx*. In reality, this interval could vary depending on the timing of erosion and storm events.

Table 6-3: Project Volumes

Project Volumes (Averaged over 100 Beach-fx Life-cycle Iterations)				
Sea Level Rise Case	Volume Description	Initial Fill Volume (cy)	No. of Renourishment Events* (not including initial construction)	Average Volume per Interval (cy)
Base	Min - Max	300,000 – 370,000	4	300,000 – 350,000
	Average	330,000		320,000
Intermediate	Min - Max	300,000 – 370,000	5	300,000 – 350,000
	Average	330,000		320,000
High	Min - Max	350,000 – 410,000	8	310,000 – 370,000
	Average	370,000		330,000
*Due to its probabilistic nature, Beach-*fx* can result in a range of required renourishment events. However, for the Flagler County Recommended Plan (a relatively modest extension of the dune and profile), the minimum and maximum number of events was the same.				

6.3 Project Construction

The Recommended Plan for Flagler County results in a 10-foot seaward extension of the existing dune and beach profile. Due to erosion, armor damage, and intermittent repairs and maintenance, the project shoreline does not presently have a smooth, consistent dune feature. In order to ensure that the nourishment project provides the maximum benefit, it is necessary to first establish a smooth, relatively straight base construction line that will allow the project to perform as predicted during the Beach-*fx* shoreline analysis.

In order to establish the project construction line, SR A1A, which runs roughly parallel to the project shoreline, was identified as a reliable land-based reference for developing a smooth, consistent project dune. The seaward crest of the dune was then identified as the shoreline profile reference point. Based on historical surveys, it was determined that the average distance between the eastern edge of SR A1A and the seaward crest of the dune (as measured at each FDEP R-monument) in Reach C is 20 feet. Therefore, the base construction line (defined as the "existing" seaward crest of the dune) is designated to be 20 feet east of, and parallel to, SR A1A. The project shoreline would then add an additional 10 feet of width to the base construction line ("existing" dune). Existing armor, such as stone revetment or seawall, located within this 10-foot extension will be buried under the constructed dune rather than removed. If the constructed dune extension is severely eroded

during a storm event or several storms where intermediate repairs cannot be made, the armor will act as an additional layer of protection to SR A1A. **Figure 6-3** shows graphically the location of the measured (2011 survey), "existing," and project dunes relative to the eastern edge of SR A1A. Note that this approach will ultimately provide a consistent level of protection to the road, which is the primary damageable infrastructure.

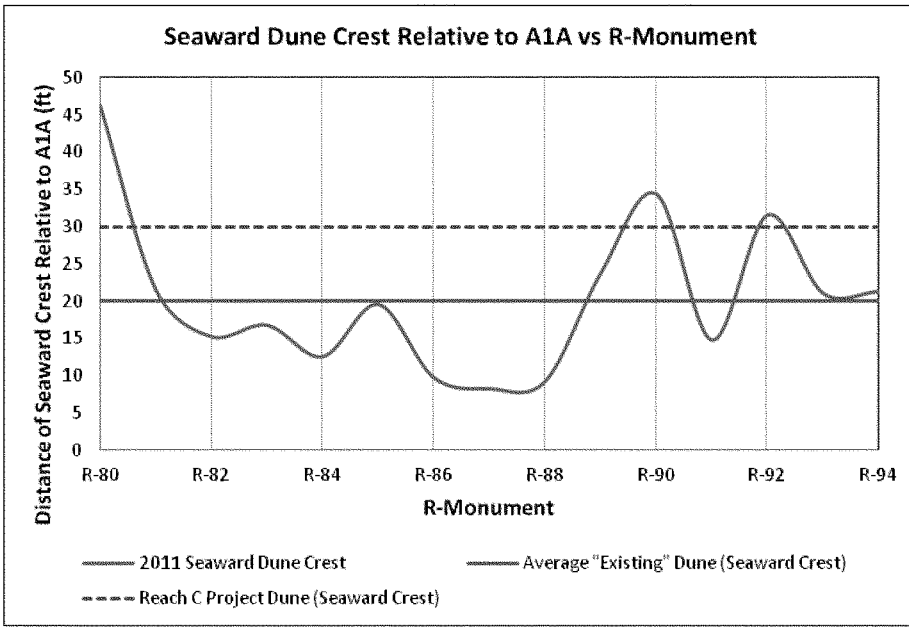
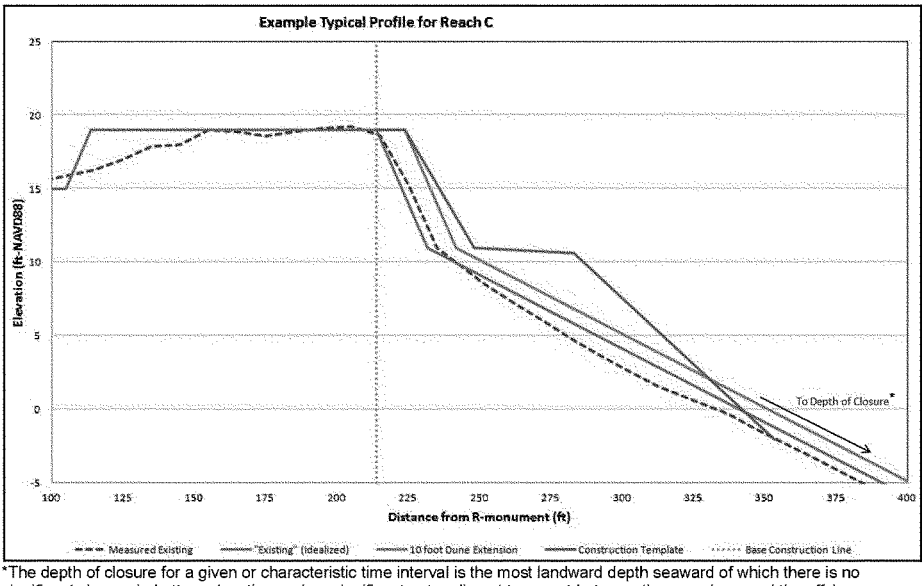


Figure 6-4: Measured and Design Dune Locations Relative to State Road A1A

Beach-*fx* estimates that initial construction of the Reach C 10-foot dune and beach profile extension will require between 300,000 and 370,000 cubic yards of material. Using the 2011 survey (the most recently available reference), the designated construction line, and the project (10-foot dune and beach profile extension) design template, it was determined that the volume required for initial construction would be approximately 360,000 cubic yards. While this is above the Beach-*fx* average initial volume of 330,000 cubic yards, it is within 10% of the modeled values and is considered reasonable. Therefore, this volume is considered to be appropriate verification of the location of the base construction line and the validity of the project template. Because this volume is based on a conceptual layout and survey information that will be updated prior to construction, it will be used only for verification of the design dimensions and will not be used for cost estimating. Costs will continue to be based on average Beach-*fx* volumes.

As previously discussed, the front slope of the beach fill placed at the time of construction or future renourishment may differ from that of the natural profile. This reflects the capabilities of the construction equipment that will be used to build the shore protection project. Within the first year or two after placement of the beach fill, the construction profile will be reshaped by waves into an equilibrium profile, causing the berm to retreat to a position more characteristic of the project design template.

Based on the estimated initial fill volume, constructability considerations, and existing (2011) shoreline dimensions, a construction template applicable to Reach C was determined. The construction template (shown in **Figure 6-4**) consists of a 10-foot wide dune extension with a 1 on 3 slope, a 35 foot berm with a 1 on 100 slope, and foreshore fill extending to approximately -2 feet-NAVD88 with a slope of 1 on 5. This template, dimensioned for constructability, will then equilibrate into the project (10-foot dune and beach profile extension) template. The volume of material in the equilibrated profile (between the template and the "existing" condition) represents the material that is expected to erode between successive nourishment events.



*The depth of closure for a given or characteristic time interval is the most landward depth seaward of which there is no significant change in bottom elevation and no significant net sediment transport between the nearshore and the offshore.

Figure 6-5: Typical Profile Sketch, Recommended Plan

6.4 Renourishment Events

While the basic principles of renourishment still apply, due to the probabilistic nature of Beach-*fx* and the way in which the model assesses renourishment requirements, a new means of assessing project performance must be employed. The former concepts of "design template" and "advance fill" are no longer applicable in the traditional sense. As shown in **Figure 6-4** the entire 10-foot dune and beach profile extension template acts as the "advance fill", while the existing beach profile is the minimum acceptable profile (making it akin to what was formerly the "design template").

Assessing the performance of the project fill now has two stages. First, a survey of the project area (such as a monitoring or post-storm survey) will be assessed to determine if the seaward crest of the dune at any of the R-monument locations within the project have receded past the Base Construction Line (**Figure 6-4**). If recession has occurred at one or more of the R-monuments, then a summation of the volume required to restore those profiles to the original construction template will be made. If the total volume required to restore the receded profiles exceeds the threshold volume, then a renourishment event is recommended. It is possible that the decision to renourish may be influenced by the timing of Federal appropriations and available funding for the project.

6.5 Borrow Area

Borrow areas 2A, 2B, 2C, and 3A shown in **Figure 6-5** all contain compatible sand that could be used for construction of the Recommended Plan. Areas 2A and 2B, which are estimated to contain a combined volume of 3 million cubic yards (mcy), will be used since they are located closest to the placement area. These borrow areas are part of the Korona Ridge Field geomorphological unit and are located approximately 7 miles off-shore of Flagler Beach. Thicknesses of the beach compatible sand layers vary from 5 to 18 feet in Area 2. Conservative values between 5 and 7 feet below seafloor surface were used as dredging depths for the volume estimates shown in **Table 6-4**.

A total of 1,610,000 cy will be need for placement over the 50 years of the Recommended Plan. It is assumed that dredging losses will be 26% of the placement volume based on information from the Duval County Shore Protection Project which used methods similar to those anticipated to be used for this project, and had a borrow area a similar distance offshore. Therefore the estimated volume to be dredged from Areas 2A and 2B over the 50-year Recommended Plan is 2,028,600 mcy. More details on borrow area compatibility and characteristics can be found in **Appendix D**.

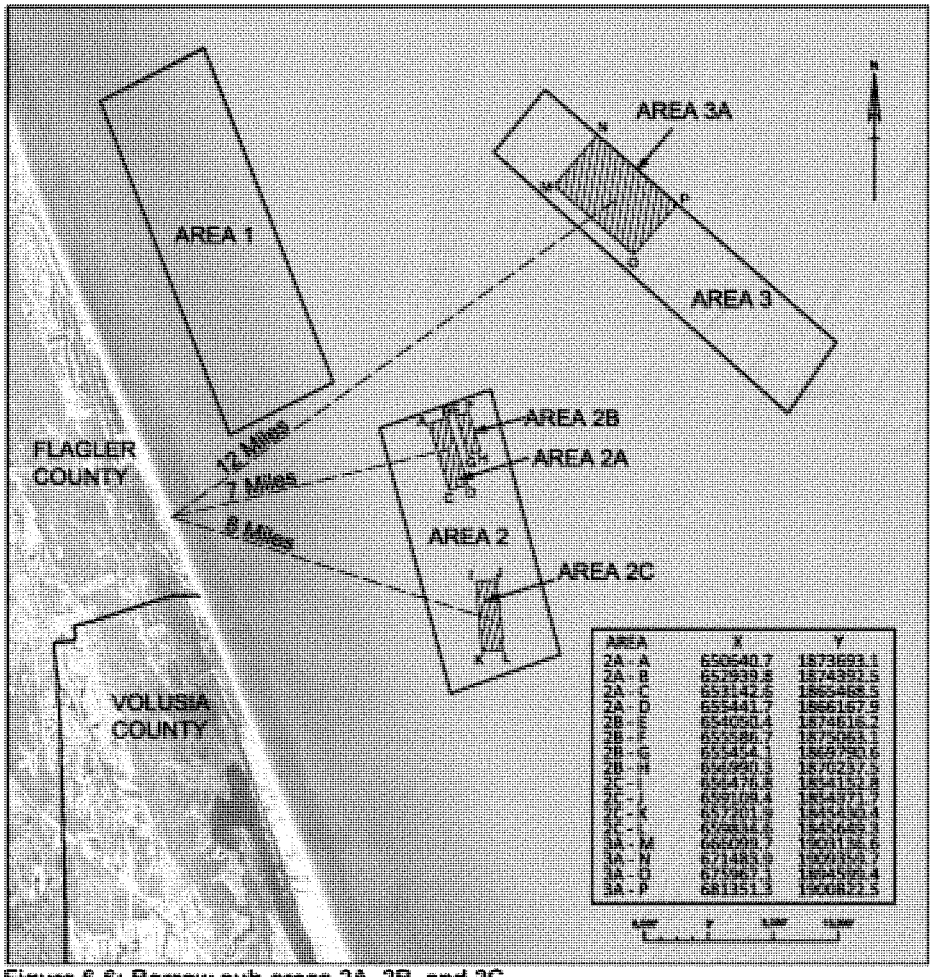


Figure 6-6: Borrow sub-areas 2A, 2B, and 2C

Table 6-4: Details for Proposed Borrow Area 2A, 2B, and 2C

Sub-area	Approximate Size	Approximate Volume	Borings
2A	5,000 ft x 1,700 ft	1.7 mcy	VC-FSP11-14, VC-FSP11-16
2B	3,300 ft x 1,500 ft	1.3 mcy	VC-FSP11-15
2C	7,000 ft x 2,000 ft	2.6 mcy	VC-FSP11-22

The borrow areas to be used are located within Outer Continental Shelf (OCS) waters. Under Section 8(k) of the Outer Continental Shelf Lands Act (OCSLA), dredging of sediment resources within the OCS requires authorization by the Bureau of Ocean Energy Management (BOEM) for use during initial or maintenance construction or both. The BOEM Leasing Division is charged with environmentally responsible management of Federal OCS sand and gravel resources. P.L. 102-426 [43 United States Code (U.S.C.) 1337(k)(2)], enacted October 31, 1994, gave BOEM the authority to negotiate, on a noncompetitive basis, the rights to OCS sand, gravel, and shell resources for Coastal Storm Damage Reduction (CSDR) projects; beach or wetlands restoration projects; or for use in construction projects funded in whole or part by or authorized by the Federal government. Recognizing that identified borrow areas are within the OCS, BOEM has agreed to serve as a cooperating Federal agency on this study and may undertake a connected action (i.e., authorize use of the OCS borrow area) that is related to, but unique from the USACE proposed action. BOEM's proposed action is to issue a negotiated agreement pursuant to its authority under the OCSLA.

A tri-party agreement for use of the borrow area in OCS waters between BOEM, USACE, and Flagler County will be executed during the PED phase, prior to construction. BOEM has been engaged throughout the study process as a cooperating agency on this project, and currently there are no issues that would prevent the use of the proposed borrow areas for this project.

6.6 Project Monitoring

Physical monitoring of the recommended project is necessary to assess project performance and to ensure that project functionality is maintained throughout the 50-year project life. The monitoring plan will be directed primarily toward accomplishing systematic measurements of the beach profile shape. Profile surveys should provide accurate assessments of dune and beach fill volumes and a basis for assessing post-construction dune and beach fill adjustments, as well as variation in the profile shape due to seasonal changes and storms. Monitoring will play a vital role in determining if project renourishment is necessary. Post-construction monitoring activities include topographic and bathymetric surveys of the placement area on an annual basis for 3 years following construction and then biannually until the next construction event. The cost for this post-construction monitoring is included in the cost-shared total project cost. This cost-shared post construction monitoring is separate from the monitoring described in **Section 6.10**.

Other monitoring efforts include bathymetric mapping of the borrow site, which will be done as part of the pre-construction engineering and design (PED) phase prior to each nourishment.

Measured wind, wave, and water-level information will be obtained from the best available existing data sources. This data will be applied in support of previously

discussed monitoring efforts. It will also be used to periodically assess the state of sea-level rise (SLR) and to determine if reassessment of the project volumes and/or renourishment intervals based on an intermediate high SLR case is required.

6.7 Detailed Cost Estimates (MCACES)

The (Micro-Computer Aided Cost Estimating System) MCACES for the NED plan reflects FY14 (1 Oct 13) price levels. A detailed cost estimate for the Recommended Plan is included in **Appendix B (Cost Engineering and Risk Analysis)**.

6.8 Design and Construction Considerations

During the PED phase, new surveys will be conducted and a determination made regarding the erosion or accretion of the shoreline, and a final initial fill volume will be determined prior to construction.

The major items of construction work, in sequence, include dredging material (sand) from the offshore borrow areas 2A and 2B, located approximately 7 miles offshore of the project site (**Figure 6-5** and **Table 6-5**), placement by hydraulic dredge in the project area, then planting of vegetation on the constructed dune. Vegetation will be planted on areas of the existing dune disturbed by construction, as well as newly constructed areas to stabilize the fill. It is assumed that dune planting will only be necessary for initial construction and that vegetation will spread and naturally grow and spread to any areas that are renourished in the future.

Currently, there are no calendar restrictions on dredging and or placement activities. The duration of initial construction is estimated to be 30 days for mob/demob and 123 days for construction. The duration of subsequent periodic nourishments is estimated to be 30 days for mob/demob and 41 days for construction.

6.9 Lands, Easements, Rights-of-Way, Relocations, Disposal (LERRD) Considerations

In accordance with the "Interagency Coordination Agreement for Civil Works Projects between Florida Department of Environmental Protection (FDEP) and the United States Army Corps of Engineers Jacksonville District (USACE SAJ)" dated February 2006, the non-federal sponsor will obtain all real estate permissions required from the State of Florida to place material on state-owned submerged lands in accordance with the beach nourishment plans submitted with the application for an erosion control line. This will include the use of any submerged borrow areas and/or pipeline corridors in state public trust waters.

Perpetual Storm Damage Reduction easements will be required over approximately 2.6 miles of Atlantic shoreline in Flagler County from FDEP monument R-80 to R-94 located landward of the proposed ECL. A perpetual beach storm damage reduction easement will be required over 184 parcels that exist between the FDOT right of way and the ocean. 172 of these parcels are privately owned and 12 parcels are public. The Flagler Beach pier, located at R-79, is approximately 800-feet beyond the northern limit of the R-80 taper and is therefore outside of the project limits.

The Reach C project length (R-80 to R-94) contains 42 dune walkovers. Walkovers include 21 privately-owned and 21 local government-owned structures. Walkovers on public properties are considered relocations, and one-time replacement costs of the 21 public structures is included in the total project cost, should these structures need to be removed in order to construct the project. Replacement of privately-owned structures will not be included in project costs.

The borrow area is located approximately 7 miles offshore northeast of the project area. As the borrow area is located within the territorial waters of the United States, the Corps of Engineers will enter into a Memorandum of Agreement (MOA) with the Bureau of Ocean Energy Management (BOEM) pursuant to 43 U.S.C. Section 1337(k)(2).

Staging areas have not been identified at this time, but will require a temporary work area easement if not located within the perpetual storm damage reduction easement area. Additional information can be found in the **Real Estate Appendix**.

6.10 Operations and Maintenance Considerations

6.10.1 Beach Nourishment

By Public Law 84-826 dated 1956 (beach nourishment), periodic nourishment is considered construction and not maintenance, and therefore is cost shared. The Recommended Plan involves initial construction and periodic nourishment of a dune and beach profile extension, and is technically "beach nourishment." The operations, maintenance, repair, rehabilitation, and replacement (OMRR&R) anticipated for this project includes semiannual beach profile surveys, aerial photography, and an annual monitoring report. Other OMRR&R items may include revegetating the dune and beach tilling although it is not anticipated that these actions will be needed for this project. The operations and maintenance will also include the draft items of local cooperation described in **Section 9.1**. These items entail publicizing floodplain information, ensuring continued conditions of public ownership and use of the shore, performing surveillance of the beach, and any specific directions prescribed by the government. Based on the size and scope of the recommended plan and the cost of similar activities for similar projects, the annual costs for OMRR&R, including beachfill monitoring over the 50 year project, are estimated to be $10,000 per year.

Operations and maintenance is borne 100% by the non-federal sponsor and is detailed in the Project Partnership Agreement (PPA). An Operations and Maintenance Manual will be completed by USACE and provided to the sponsor following completion of initial construction.

6.11 Summary of Accounts

The Recommended Plan was shown to have a net improvement over the future without- project condition and has positive net benefits. The Recommended Plan is the NED plan.

In addition to being the NED plan and meeting the Federal objective to contribute to national economic development, the Recommended Plan is also consistent with the Environmental Operating Principles because it is a sustainable plan that has taken environmental issues into consideration. The Recommended Plan is also consistent with the state and local objectives described in **section 4.3**. The Recommended Plan is consistent with the planning constraint described in **section 4.4.1**, to avoid conflict with Federal and state regulations.

The Recommended Plan meets all four of the planning objectives listed in **Section 4.7**. The Recommended Plan maximizes NED benefits by reducing storm damages, and provides incidental environmental and recreational benefits. The Recommended Plan will benefit the Environmental Quality (EQ) account by improving the environmental quality in the project area. **Table 7-1** shows that the Recommended Plan will have positive impacts on several environmental factors compared to the no-action alternative. These positive environmental impacts include improved dune habitat and increased sea turtle nesting area. The Recommended Plan would also benefit the Regional Economic Development (RED) and Other Social Effects (OSE) accounts by maintaining opportunities for recreational use of beach and nearshore areas. **Table 7-1** shows that the Recommended Plan would provide positive long-term benefits for improving the aesthetics of the beach and maintaining use of the beach for recreational interests, while the aesthetics and beach availability for recreation would likely decline in the long term with the no-action alternative. SR A1A is recognized as a national scenic byway. The Recommended Plan provides protection for SR A1A which is a hurricane evacuation route and will improve the communities' resiliency in post-storm recovery situations.

6.12 Risk and Uncertainty

6.12.1 Residual Risks

The proposed project would greatly reduce, but not completely eliminate future storm damages. Coastal storm damages are reduced by approximately 96 percent

in the location of the recommended plan (design reach C) over the 50 year period of analysis; therefore, the residual damages would be 4 percent in this area. Across all four design reaches evaluated (design reaches A, B, C, and D), the recommended plan reduces approximately 65% of coastal storm damages over the 50 year period of analysis; therefore the residual damages across the four design reaches is 35%. The greatest residual risk remains in design reach A, where justifiable improvements could be made if public access was made available. In Reach A the present value FWOP damages are $14,527,576 over 50 years. The majority of these damages are associated with the economic cost of older houses (built prior to 1988) constructing vinyl sheet pile walls to protect residences. Flagler County will continue to take steps to mitigate this residual risk through Florida's Coastal Construction Control Line (CCCL) program. Under this program any new development must be built back from the dune and on pilings. The FWOP damages in design reach A do not include damages to SR A1A which is located landward of the residences in this reach. The residual risk that remains in design reaches B and D consists of minor armor costs and road damage to SR A1A which is not great enough to justify a project.

The project is designed to reduce damages from storm waves, direct flooding, and erosion, but would not prevent any damage from back bay flooding; therefore, any ground-level floors of structures, ground-level floor contents, vehicles, landscaping, and property stored outdoors on the ground would still be subject to saltwater flooding that flows in from the Intracoastal Waterway on the west side of the barrier island. However, back-bay flooding is a relatively minor issue in the study area extending 400 feet inland from the Mean High Water (MHW) line. This is where the benefits of the project are being measured and any potential damages associated with back bay flooding were not claimed as a project benefit. The project is not claiming any benefits beyond 400 feet inland from the Mean High Water (MHW) line, damages to structures past this extent were not calculated. Structures would also continue to be subject to damage from hurricane winds and windblown debris. Even new construction is not immune to damage, especially from these processes.

The proposed dune and beach profile extension would reduce damages but does not have a specific design level. In other words, the project is not designed to fully withstand a certain category of hurricane or a certain frequency storm event. The project purpose is storm damage reduction, and the dune and profile extension is not designed to prevent loss of life. Loss of life is prevented by the existing procedures of evacuating the barrier island completely, well before expected hurricane landfall and removing the residents from harm's way. The erratic nature and unpredictability of hurricane path and intensity require early and safe evacuation. That policy should be continued either with or without the storm damage reduction project.

The Florida Hazard Mitigation Strategy is a statewide initiative, under the direction of the Department of Community Affairs, to foster the development of a Local Mitigation Strategy (LMS) in each of Florida's 67 counties. Flagler County was one of the first

counties in the state and among the first counties nationwide to adopt a working LMS. The Flagler County LMS was last updated and approved by the Federal Emergency Management Agency (FEMA) in 2011. The LMS is a long term effort that is updated as needed to reduce the County's vulnerability to disasters and minimize damage.

The Flagler County Emergency Management Division provides coordination of resources and decision making during disasters. Emergency Management assists with the coordination of preparedness programs for all citizens of Flagler County, County agencies, and support organizations. The Division develops and maintains emergency plans for all types of natural and man-made hazards, which include hurricane evacuation plans, and provides analysis and recommendations necessary to make decisions that will effectively save lives and protect property in such emergencies.

Public safety risks can be reduced by actions taken at the local, state, and Federal levels. **Table 6-5** describes the actions that can be taken by the entities associated with this project to improve public safety, as well as the limitations of their actions. The greatest level of public safety is achieved when action is taken at the local, state, and Federal Level to reduce public safety risks in a comprehensive manner.

Table 6-5: Roles for Public Safety

	Can Do	Can't Do
Flagler County	Can implement non-structural risk reduction efforts including building and zoning regulations. Can implement emergency management plans and strategies. Can sponsor and cost share in a Federal dune and beach project.	Can't afford a dune and beach nourishment project on their own.
State of Florida	Can implement non-structural risk reduction efforts including building and zoning regulations. Can implement emergency management plans and strategies Can perform maintenance of SR A1A and repair on an emergency basis by dumping rocks.	Can't construct seaward of the FDOT right of way. Can't abandon or relocate SR A1A.
US Army Corps of Engineers	Can implement a cost shared dune and beach nourishment project that reduces damages SR A1A and provides additional protection of the evacuation route beyond what the county and state are capable of providing.	Can't enforce building and zoning regulations. Can't implement local emergency management plans and strategies.

6.12.2 Risk and Uncertainty in Economics

Risk and uncertainty is incorporated into the economic evaluation through use of Beach-*fx*. The Beach-fx model accounts for uncertainty in the economic evaluations through the use of Monte-Carlo simulations to model future damages. The average annual damages reported in this study are based on the damages averaged across 100 life cycles, with each life cycle experiencing a different suite of storms during the period of analysis. Additionally, uncertainty is accounted for in the damage functions that are used to determine the amount of damage incurred to a structure and its contents from a given storm. Each structure type is assigned a minimum, maximum, and most likely damage function, meaning that the amount of damage experienced by a structure due to a specific amount of erosion or water depth can vary between life cycles. Further discussion is available in **Appendix C**.

6.12.3 Risk and Uncertainty in Project Costs

In order to account for uncertainties in the final project costs, which could result from a variety of factors, all costs include an appropriate contingency on top of the actual estimated cost. The contingencies are based on a Cost Schedule Risk Analysis (CSRA), which is included in **Appendix B**. The costs presented in **Table 6-8** include a 23% contingency based on the cost and schedule risk analysis (CSRA) conducted for this project using an 80% confidence level. The top three risk drivers which this contingency is based on are the risk associated with competition and market conditions, dredging quantities for the final design, and increasing fuel prices. These risks will be mitigated for in the PED phase by obtaining up to date surveys prior to construction to reassess project needs. Also, acquisition planning and early solicitation can help maximized bid competition.

Through the CSRA it was determined that 23% is an appropriate contingency to account for uncertainty in initial construction as well as all periodic nourishment over the 50 year period of Federal participation.

6.12.4 Risk and Uncertainty in Borrow Availability

An estimated 2 mcy of borrow material would be needed over the 50 year project. Borrow areas 2A, 2B, and 2C contain approximately 5.6 mcy of compatible material for beach placement. Therefore, the risk of running out of material over the 50 year project life is minimal, even if further investigations during PED reveal that less material than originally estimated is actually available at the borrow sites.

6.12.5 Risk and Uncertainty in Sea Level Rise Assumptions

The current guidance on sea level change in ER 1100-2-8162 and ETL 1100-2-1 was used throughout the formulation process and to assess the performance of the

final array of alternatives and the recommended plan for the three potential sea-level rise scenarios.

In general the risk of storm damages will increase under increased sea-level rise (SLR) scenarios. **Section 5.3.6.1** and **Appendix C** describes how the recommended plan remains justified in the intermediate and high SLR scenarios. Since beach nourishment projects are naturally adaptable, the renourishment interval can be reduced if SLR leads to increased erosion. For the recommended plan, the average nourishment interval becomes 9 years for the intermediate SLR scenario and 6 years for high SLR scenario. The renourishment interval and placement volume will be re-evaluated with new information in the future.

The residual risks described in **Section 6.12.1** are also sensitive to increased SLR. With rising sea-levels the risk of back-bay flooding in particular is likely to increase. Currently the County and State do not have specific plans for adapting to SLR. However, further into the future additional adaptive management plans may be warranted to address residual risks that are sensitive to SLR.

6.13 Implementation Requirements

A Design Agreement with the non-federal sponsor will be executed prior to starting the preconstruction engineering and design (PED) phase, which includes developing the plans and specifications for the project. Once the PED phase is nearing completion and upon approval of this document by headquarters, and authorization and funding, USACE and the non-federal sponsor execute a Project Partnership Agreement (PPA). The PPA is needed before the project can be advertised for construction.

6.13.1 Compliance with Executive Order (EO) 11988

EO 11988 requires Federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities."

The Water Resources Council Floodplain Management Guidelines for implementation of EO 11988, as referenced in USACE ER 1165-2-26, require an 8-step process that agencies should carry out as part of their decision-making on projects that have potential impacts to or within the floodplain. The 8 steps reflect the

decision-making process required in Section 2(a) of the EO. The 8 steps and responses to them are summarized below.

1. **Determine if a proposed action is in the base floodplain (that area which has a one percent or greater chance of flooding in any given year).**
   Yes, the study area, and the Recommended Plan project footprint, is within the base floodplain. However, this project reduces damages caused by erosion, and flooding (or inundation) does not cause significant future without-project damages.

2. **If the action is in the base floodplain, identify and evaluate practicable alternatives to the action or to location of the action in the base floodplain.**
   Chapter 5 of this document has an analysis of alternatives. Practicable measures and alternatives were formulated and evaluated, including non-structural measures such as buyout and land acquisition.

3. **If the action must be in the floodplain, advise the general public in the affected area and obtain their views and comments.**
   A scoping letter was sent to all Federal and state agencies, local libraries and agencies, and all abutting property owners on August 26, 2008. A public scoping meeting was held in Bunnell, Flagler County, Florida on October 25, 2011 in fulfillment of NEPA requirements at which a rich diversity of views were expressed including those for and against a storm damage reduction project.

4. **Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base floodplain will affect the base floodplain, impacts resulting from these actions should also be identified.**
   Potential impacts associated with the Recommended Plan are summarized in **Chapters 6 and 7** of this report. The project will not alter or impact the natural or beneficial floodplain values.

5. **If the action is likely to induce development in the base floodplain, determine if a practicable non-floodplain alternative for the development exists.**
   The project will not encourage development in the floodplain, as development is expected to continue the same as it would in both FWOP and FWP conditions. The project provides benefits for existing development. The project will not change the base flood plain. Practicable measures and

alternatives were formulated and evaluated in **Chapter 5** of this report, including non-structural measures such as buyout and land acquisition.

6. **As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial flood plain values. This should include reevaluation of the "no action" alternative.**
   There is no mitigation expected to be necessary for the Recommended Plan. The project will not induce development in the floodplain and the project will not impact the natural or beneficial flood plain values. Alternatives went through several evaluation screenings in **Chapter 5** of this report.

7. **If the final determination is made that no practicable alternative exists to locating the action in the floodplain, advise the general public in the affected area of the findings.**
   The Draft Feasibility Study and Environmental Assessment (EA) was released for public review and a public meeting was held on February 5, 2014. Comments received and responses to the comments have been incorporated into the report as discussed in **Chapter 8**.

8. **Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order.**
   The Recommended Plan is the most responsive to all of the study objectives described in **Chapter 4**, and it is consistent with the requirements of EO 11988. This project reduces damages caused by erosion, and flooding (or inundation) does not cause significant future without project damages.

6.13.2 Federal Implementation Responsibilities

USACE is responsible for budgeting for the Federal share of future Federal construction projects. Federal funding is subject to budgetary constraints inherent in the formation of the national civil works budget in a given fiscal year. USACE would perform the necessary preconstruction engineering and design (PED) needed prior to construction. USACE would meet requirements for the use of Federal lands at the borrow area, obtain water quality certification, coordinate with the state as required by the Coastal Zone Management Act, and construct the project. Cost sharing of PED, initial construction, and periodic nourishment will be in accordance with WRDA 1986, as amended, subject to the availability of appropriations.

6.13.3 Non-federal Implementation Responsibilities

The non-federal sponsor for the shore protection project will be Flagler County. The non-federal project sponsor would provide an up-front cash contribution for initial construction costs of the proposed project. The amount of the non-federal up-front cash contribution would be based on cost sharing principles reflecting shoreline use, ownership and public access in existence at the time of construction. The non-federal sponsor shall provide the entire cost of all material placed on or seaward of undeveloped lands and developed private lands (which are inaccessible to the public). The non-federal sponsor shall provide lands, easements, and rights-of-way and bear a portion of the administrative costs associated with land requirements. 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. The non-federal project sponsor will be responsible for all costs of operation, maintenance, repair, rehabilitation and replacement of project features. Section 402 of the 1986 Water Resources Development Act (33 USC 701b-12) as amended by Section 14 of the 1988 Water Resources Development Act states that "Before construction of any project for local flood protection or any project for hurricane or storm damage reduction, that involves Federal assistance from the Secretary, the non-federal interests shall agree to participate in and comply with applicable Federal floodplain management and flood insurance programs." The non-federal sponsor and communities must be enrolled in and in compliance with the National Flood Insurance Program (NFIP) to receive Federal funding for a recommended storm damage reduction project. Flagler County is enrolled in and in compliance with the NFIP.

6.13.4 Cost Sharing

Federal participation in HSDR projects is limited to shorelines open to public use. Guidance is provided in ER 1105-2-100 wherein user fees, parking, access, beach use by private organizations, and public shores with limitations are addressed (E-24.d). Federal participation is determined by project purpose, either hurricane and storm damage reduction or recreation, and by shoreline ownership. Shoreline ownership is separated into lands that are federally owned, publicly and privately owned, and privately owned with limited use, as shown in **Table 6-6**. More specific guidance is provided in ER 1165-2-130 on what constitutes sufficient parking.

Table 6-6: Shore Ownership and Levels of Federal Participation

Shore Ownership and Project Purpose (as defined in EC 1165-2-130)	Maximum Level of Federal Participation in Initial Construction Costs	Maximum Level of Federal Participation in Periodic Renourishment
I. Federally Owned	100%	100%
II. Publically and Privately Owned, Protection Results in Public Benefits		
A. Hurricane and Storm Damage Reduction	65%	50%
B. Loss of Land or Incidental Recreation	50%	50%
C. Separable Recreation	50%	50%
III. Privately Owned, Use Limited to Private Interests	0%	0%
IV. Privately Owned, Undeveloped	0%	0%

In order to evaluate the study area, available information was gathered from aerial photography, Flagler County sources and field reconnaissance. The public use of the shoreline was addressed first to determine the level of Federal participation, then secondly the shoreline ownership, and then the cost-sharing percentage was calculated for initial nourishment and future periodic renourishments (**Table 6-7** and **Table 6-8)**. The project area is accessible to the public with adequate parking. There are two small areas, discussed in Chapter 5, that have adequate access and parking, but no signage to inform the public that parking is available (see parking and access figures in **Chapter 5**). The sponsor has indicated that signage will be provided prior to initial construction.

Table 6-7: Recommended Plan Initial Construction Cost Sharing

Design Reach	Reference	Parcel Number	Lot Width (Feet)	Shoreline Description	Within Project Limits	Within 1/4 Mile of Access	Shore Ownership and Project Purpose	Level of Federal Participation	Federal Participation Times Lot Width	
C	7th Street	1212314500007500390	13970	Developed	Y	Y	II.A.	65%	9081	SR A1A Hurricane Evacuation Route
C										
C										
C										
C										
C										
C										
C										
C										
C										
C										
C										
C	28th Street	1912320150000500210								

Shore Ownership and Project Purpose (as defined in EC 1165-2-149)	Maximum Level of Federal Participation in Construction Costs	Shoreline Length (feet)	**Federal Participation (feet)**	**non-Federal Participation (feet)**
I. Federally Owned	100%	0	0	0
II. Publically and Privately Owned, Protection Results in Public Benefits				0
A. Hurricane and Storm Damage Reduction	65%	13,970	9,081	4,890
B. Loss of Land or Incidental Recreation	50%	0	0	0
C. Separable Recreation	50%	0	0	0
III. Privately Owned, Use Limited to Private Interests	0%	0	0	0
IV. Privately Owned, Undeveloped	0%	0	0	0
	Total Distance	13,970	9,081	4,890
			65.0%	**35.0%**

Table 6-8: Recommended Plan Periodic Renourishment Cost Sharing

Design Reach	Reference	Parcel Number	Lot Width (Feet)	Shoreline Description	Within Project Limits	Within 1/4 Mile of Access	Shore Ownership and Project Purpose	Level of Federal Participation	Federal Participation Times Lot Width	
C	7th Street	1212314500007500390	13970	Developed	Y	Y	II.A.	50%	6985	SR A1A Hurricane Evacuation Route
C										
C										
C										
C										
C										
C										
C										
C										
C										
C										
C	28th Street	1912320150000500210								

Shore Ownership and Project Purpose (as defined in EC 1165-2-149)	Maximum Level of Federal Participation in Construction Costs	Shoreline Length (feet)	**Federal Participation (feet)**	**non-Federal Participation (feet)**
I. Federally Owned	100%	0	0	0
II. Publically and Privately Owned, Protection Results in Public Benefits				0
A. Hurricane and Storm Damage Reduction	65%	13,970	6,985	6,985
B. Loss of Land or Incidental Recreation	50%	0	0	0
C. Separable Recreation	50%	0	0	0
III. Privately Owned, Use Limited to Private Interests	0%	0	0	0
IV. Privately Owned, Undeveloped	0%	0	0	0
	Total Distance	13,970	6,985	6,985
			50.0%	**50.0%**

6.13.5 Project Costs

Total project first costs and cost share breakdown in FY15 price levels are tabulated below in **Table 6-9**. The cost of the final periodic renourishment is slightly less than the first 3 periodic renourishments only because less post-construction monitoring is required for the final event. The Total Project Cost Summary and a more detailed cost break down for initial construction and each periodic renourishment is located in **Appendix B**.

Table 6-9: Cost Summary and Cost Sharing (Project First Costs)

Flagler County, Florida Hurricane and Storm Damage Reduction Project					
Summary of Project Cost Sharing (Constant Dollar Basis, FY15 (1 Oct 14) price levels)					
Initial Construction					
Cost Share Description	**Federal Cost Share %**	**Federal Cost**	**Non-Federal Cost Share %**	**Non-Federal Cost**	**Project First Cost**
Storm Damage Reduction Costs	65%	$9,218,300	35%	$4,963,700	$14,182,000
Real Estate Costs (LERRD Credit)	0%	$0	100%	$3,336,000	$3,336,000
Cash Portion		$9,218,300		$1,627,700	$10,846,000
Periodic Nourishment					
Periodic Nourishment	50%	$15,390,000	50%	$15,390,000	$30,780,000
Initial Construction + Periodic Nourishment					
Final Project Cost Share and Cost (50 years)	55%	$24,608,300	45%	$20,353,700	$44,962,000

A summary of the average annual costs and benefits for the Recommended Plan in FY14 (1 Oct 13) price levels is provided in **Table 6-10**. The benefit cost ratio was calculated for the current discount rate of 3.5%.

Table 6-10: Economic Summary of the Recommended Plan

Economic Summary (FY 14 Price Level, 50 -Year Period of Analysis, 3.5% Discount Rate)	
Initial Construction	$14,114,220
1st Renourishment	$7,589,733
2nd Renourishment	$7,589,733
3rd Renourishment	$7,589,733
4th Renourishment	$7,503,633
Total First Cost	$44,387,052
Interest During Construction (IDC)	$163,000
Total Investment Cost	$44,550,052
Average Annual Investment Cost	$1,229,000
Annual OMRR&R (100% Non-Federal)	$10,000
Total Average Annual Cost	**$1,239,000**
Average Annual Storm Damage Reduction	$2,159,000
Average Annual Recreation Benefits	$72,000
Average Annual Traffic Reroute Benefits	$131,000
Average Annual Total Benefits	**$2,362,000**
Average Annual Net Benefits	**$1,123,000**
Benefit Cost Ratio (3.5 % discount rate)	**1.9**

6.13.6 Financial Analysis of Non-federal Sponsor's Capabilities

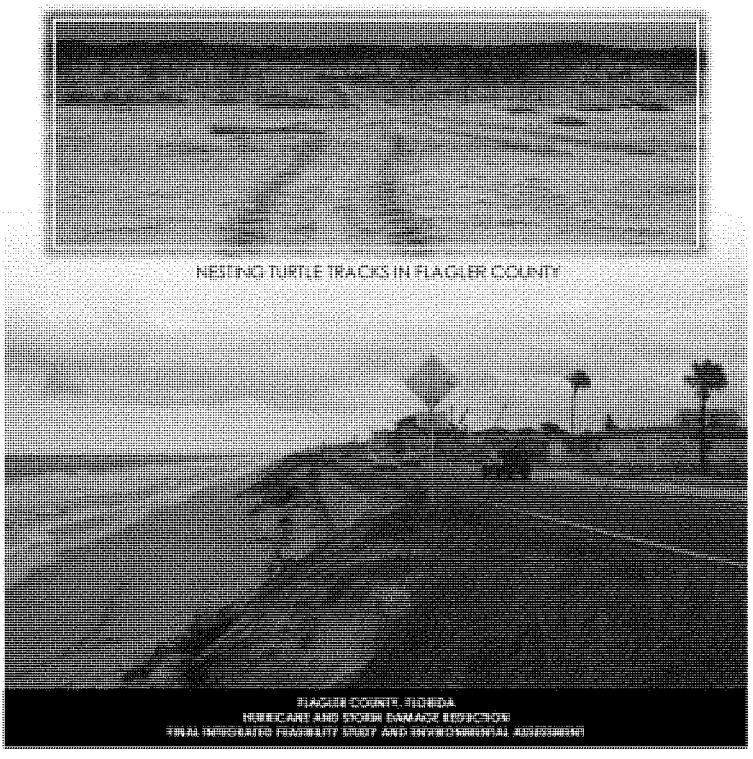
A financial analysis is required for any plan being considered for USACE implementation that involves non-federal cost sharing. The ultimate purpose of the financial analysis is to ensure that the non-federal sponsor understands the financial commitment involved and has reasonable plans for meeting that commitment. By memorandum dated April 24, 2007 the Assistant Secretary of the Army (Civil Works) granted approval of the self-certification of non-federal sponsors for their ability to pay the non-federal share of projects. The self-certification is required prior to submission of the Project Partnership Agreement, typically during the PED phase of the project. Included with the self-certification, the financial analysis shall include 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. The Flagler County Board of Commissioners provided a letter certifying Flagler County's willingness and ability to pay the non-federal share of this Federal Hurricane and Storm Damage Reduction Project.

6.13.7 Views of Non-Federal Sponsor

Flagler County is the non-federal sponsor for the Flagler County, Florida Hurricane and Storm Damage Reduction Project. They have been an integral part of the PDT from the conception of the project. At each step of the process, Flagler County has contributed to the available information, participated in the formulation, and reviewed the products. Flagler County supports the Recommended Plan, and is aware that a majority of the benefits for this plan come from reducing road and armor maintenance costs. The Board of County Commissioners selected this plan on April 17, 2013.

CHAPTER 7
ENVIRONMENTAL CONSEQUENCES



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7 ENVIRONMENTAL CONSEQUENCES *

This chapter is the scientific and analytic basis for the comparisons of the no action plan and the Recommended Plan which is the preferred alternative. See **Table 7-1** for a summary of impacts and anticipated changes to the existing environment including direct, indirect, and cumulative effects.

Formulation, evaluation, and comparison of alternatives, culminating in selection of the Recommended Plan, are presented in **Chapter 5** of this integrated document. Through the plan formulation process, the alternatives were screened until the final alternative became the Recommended Plan. Five measures were carried past the preliminary screening based on rough order of magnitude (ROM) costs as described in **Section 5.3.2.1**. The environmental consequences of these five intermediate measures are as follows.

- No action: The no-action plan represents future conditions without the implementation of a project. Environmental consequences associated with this measure are the continued deterioration of sea turtle nesting habitat due to shoreline erosion. No adverse effect would occur to North Atlantic right whale or its critical habitat. No adverse effect would occur to piping plover although continued erosion would further discourage this species from using this shoreline for wintering habitat. Migratory shorebirds would likewise be discouraged from using the shoreline as the habitat quality degrades.
- Geotube with Dune Alternative: This management measure includes construction of a dune composed of geotextile sand-filled tubes that would be covered with a constructed dune. Environmental consequences associated with this measure are outlined in **Sections 7.1.1 and 7.2 to 7.17** with respect to vegetation, federally-protected species, cultural resources, air and water quality, and other considerations. Although the section is specific to the Recommended Plan, the environmental consequences are the same for this alternative.
- Revetment Alternative: This measure would involve placement of large rock, designed to withstand the wave environment, along the existing bluff line. Environmental consequences associated with this measure are outlined in **sections 7.1.1 and 7.2 to 7.17** with respect to federally-protected species, cultural resources, air and water quality, and other considerations. The environmental consequences of the revetment alternative would be similar to the Recommended Plan, but would also include the loss of sandy habitat necessary for shorebird and sea turtle nesting.
- Dune Alternative: This measure would include placement of beach compatible material in a dune feature adjacent to the existing bluff. Vegetation would be planted after placement of the dune material. Environmental consequences associated with this measure are detailed in the sections below as this is the Preferred Alternative, or the designated Recommended Plan.
- Beach Nourishment with Dune Alternative: This measure would include placement of beach compatible material to extend the existing berm seaward in addition to dune construction. Environmental consequences associated with this measure are

outlined in **Sections 7.1.1 and 7.2 to 7.17** with respect to federally-protected species, cultural resources, air and water quality, and other considerations. Although the section is specific to the Recommended Plan, the environmental consequences are the same for this alternative.

It was determined through the intermediate screening described in **Section 5.3.3** that the geotube with dune and revetment measures could not be carried forward as implementable alternatives. Both of these alternatives would need to be combined with the dune alternative to be considered beneficial. Preliminary modeling showed that the dune alternative by itself prevented almost all of the future without-project (FWOP) damages. Therefore, the geotube and revetment alternatives would have additional costs without additional benefits, and they were not carried forward to the final screening described in **Section 5.3.4**. The final array of alternatives, shown in **Table 5-7**, consists of various combinations of dune and beach nourishment. Through this process, the Dune Alternative became the Recommended Plan; see **Chapter 6** regarding details for this recommended plan

The National Environmental Policy Act (NEPA) requires evaluation of alternatives, including the no-action alternative. The Environmental Consequences section describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. The Recommended Plan presented in this chapter represents the Preferred Alternative described in Section 6.2. This section, in conjunction with the description of the FWOP condition described in Chapter 3, forms the baseline conditions for determining the environmental impacts of the proposed action and reasonable alternatives. It is referred to as the No Action Alternative in this chapter. A summary of the direct and indirect environmental impacts for both the Preferred Alternative and the No Action Alternative is presented in **Table 7-1**.

Table 7-1: Summary of Direct and Indirect Impacts.

EXISTING ENVIRONMENTAL FACTOR	ALTERNATIVE **Dune construction from material mined from offshore borrow site (Preferred Alternative)**	ALTERNATIVE **No Action**
VEGETATION	Temporary impact to dune and upper beachface vegetation will occur from construction activities. Disturbed or removed vegetation will be replanted as a component of the project, which will benefit native species diversity and overall habitat stability	Continued erosion of the dune and upper beach will further stress dune vegetation causing die-back of species.
PROTECTED SPECIES	Direct adverse impacts include: • Alteration of the beach face resulting in potential adverse impact to sea turtle nesting and hatching success (including effects from grade changes, sediment material, over-compaction, escarpment formation, artificial lighting during construction) resulting in potential "incidental" take of sea turtles • Potential taking of sea turtles with hopper dredge (if utilized) • Possible encounters with North Atlantic Right Whales by dredge and support vessels during dredge and disposal operations. Unlikely to encounter manatees in the open ocean; no effects are expected to occur. Direct positive impacts: • Nesting area along project reach would increase with nourishment activities	Continued loss of sea turtle nesting habitat on the beach.
HARDBOTTOM RESOURCES	No hardbottom resources are known to be present within or adjacent to the project limits or borrow area based on project-specific surveys. Resources that may exist outside of the project or borrow area will be avoided. No effects are expected to occur.	No impacts would occur. Known hardbottom resources occur within the study area but do not occur within the borrow area or project limits.

EXISTING ENVIRONMENTAL FACTOR	ALTERNATIVE Dune construction from material mined from offshore borrow site (Preferred Alternative)	ALTERNATIVE No Action
FISH AND WILDLIFE RESOURCES	Short-term impact to dune and beach habitat due to burial/disturbance, but long term benefit through increase in these habitats for nesting shorebirds and benthic fauna. Temporary impact to fish in the water column and benthic resources during dredging activities.	Continued loss of dune and beach habitat.
ESSENTIAL FISH HABITAT	Short-term turbidity would be present at the borrow area. No hardbottom resources were identified to be present in the borrow area during the subsurface resource survey; therefore, no impact would occur to this resource. No placement of material will occur in the nearshore. No impact would occur to this resource.	No impacts would occur.
COASTAL BARRIER RESOURCES	Coastal barrier resources (Units FL-P07P and P05A) would be enhanced through restoration of natural habitat. No structural components are proposed with this project.	Continued loss of beach habitat associated with CBRA Units FL-P07P and P05A.
WATER QUALITY	Direct adverse impacts include a temporary increase in turbidity adjacent to the borrow site and beach fill area. Turbidity would be monitored during project construction and work would cease if turbidity is not in compliance with Florida water quality standards.	No impacts to water quality would occur.
AIR QUALITY	Direct adverse impacts include small, localized, temporary increases in concentrations of nitrogen dioxide (NO_2), sulfide (SO_2), carbon monoxide (CO), volatile organic compounds (VOCs), and particulate matter (PM) mostly associated with the dredge plant.	No impacts would occur.
NOISE	Temporary increase in noise at the borrow area and at the placement sites.	No impacts would occur.

EXISTING ENVIRONMENTAL FACTOR	ALTERNATIVE Dune construction from material mined from offshore borrow site (Preferred Alternative)	ALTERNATIVE No Action
AESTHETIC RESOURCES	Temporary decrease in the aesthetic appeal of the beach while placement activities occur; long-term increase in the appearance of the beach.	Long-term decline in appearance of the beach as it continues to erode.
RECREATION RESOURCES	Inability to utilize beach during construction; long-term benefit to recreational interests using the beach. Minor temporary impact to recreational boaters required to avoid the dredge and associated vessels during construction activities.	Long-term decline in beach available for use by recreational interests.
NAVIGATION	Temporary impacts to vessels utilizing the Atlantic Ocean near the Borrow Area 2 sub-areas and utilizing the nearshore areas during sand pump-out.	No impacts would occur.
HISTORIC AND CULTURAL RESOURCES	Adverse effects to potentially significant historic properties in the nearshore and borrow areas. Buffer of 200-ft around any identified significant historic properties if encountered. May require use of borrow area 2 B to meet sand volume needs.	No direct impact historic resources but does allow for continued shoreline erosional forces
NATIVE AMERICANS	No adverse effects on Native American properties.	No adverse effects on Native American properties.

7.1 General Environmental Effects

7.1.1 Environmental Effects

The beneficial effects from the placement of sand fill along the proposed project areas include the establishment of a dune and buffer area for protection against storms and erosion, and creation of additional dry beach for recreational activities. The placement of sand may increase sea turtle nesting habitat provided that the sand is highly compatible with naturally occurring beach sediments and that compaction and escarpment remediation measures are incorporated into the project.

Potential negative effects on sea turtles during construction include:

- Possible destruction of nests deposited within the boundaries of the proposed project
- Harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches
- Disorientation of hatchlings on beaches adjacent to the construction area as they emerge from the nest and crawl to the water as a result of project lighting, and
- Behavioral modification of nesting females due to escarpment formation within the project area during a nesting season, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs

Sea turtle nesting density within the project limits has decreased when compared to areas outside of the recommended plan but within the study area, as discussed in **Section 2.4.3** Extensive armoring and revetment has disrupted sea turtle nesting due to disturbance to the habitat quality. These areas are anticipated to become desirable nesting areas once the dune and beach are reconstructed as the quality of habitat will be increased significantly. However, minor effects on sea turtle nesting may occur as a result of the project. The quality and color of the sand could affect the ability of female turtles to nest, the suitability of the nest incubation environment, and the ability of hatchlings to emerge from the nest. Subsequently, geotechnical evaluation of the offshore sand sources identified for the proposed project found sediment quality compatible with the natural beach conditions. The elevation of the dune feature and modest, seaward-sloping berm widths associated with the proposed beach fill are not unreasonably anticipated to increase hatchling disorientation associated with beach lighting.

Protective measures can alleviate the potential for some of the negative impacts to nesting sea turtles:

- nest monitoring and relocation
- using minimum and/or shielding construction lighting
- compaction monitoring and tilling activities to reduce sand compaction
- leveling escarpments prior to nesting season
- conducting construction outside of the main nesting season, and
- conducting daily surveys and avoiding nests during construction activities for early or late nesting season

Adverse effects on shorebirds may occur by:

- Harassment during construction and physical impacts to nesting or fledgling animals
- Temporary loss of benthic macroinfaunal invertebrates along areas of beach-face fill, and
- Relocation (concentration) of waterbird feeding to non-affected areas of the shoreline

These impacts are typically temporary, and will be lessened by monitoring during construction and the fact that portions of the project area will include only dune fill placement (versus inter-tidal or sub-tidal placement).

The presence of construction equipment and personnel will temporarily detract from the aesthetics of the beach and temporarily limit recreational beach activity by the public within areas of construction activity. Best management practices will be implemented to ensure efficient construction and the minimization of extended presence of equipment and personnel in the project area and related habitats. Aesthetic impacts due to temporary discoloration of the beach sand after placement is not anticipated in the proposed project.

7.1.2 Environmental Surveys

The environmental evaluation included numerous investigations and activities undertaken by USACE and the local sponsor, Flagler County, to identify the environmental resources within the project area that would be affected by the proposed action. These efforts include the studies and tasks described below.

Two substrate surveys were conducted to identify the presence and nature of the exposed submerged nearshore hardbottom along the study area. A mapping survey of the nearshore rock resource using sidescan sonar technology was conducted for the Flagler County HSDR project in July and August, 2011 (DCA, 2011). The focus of this study was to determine the presence and location of hardbottom resources within the study area from FDEP monument R-50 to R-100. The result of this survey was the basis for an additional characterization survey of supposed hardbottom features which was conducted by the USACE Jacksonville District in July, 2012. This second survey focused on supposed rock outcroppings at locations identified in August 2011 using an additional, comparative sidescan sonar survey. Methods employed for the DCA survey differed from those employed by the USACE Hydrographic Survey Section as described in Section 2.4.4, and may account for the contrasting results. Preliminary results from the 2012 USACE survey found no presence of hardbottom at the previously identified locations. It is the surveyor's opinion (USACE Hydro-survey Section), based on the available survey data, that there is no hardbottom reef in the study area. Details of the two surveys, including details of methods and findings, are included in the **Environmental Appendix F**.

The sedimentary characteristics of the proposed beach fill material from the proposed offshore borrow areas were studied through sample vibracore collections within three separate candidate locations. The purpose of the study was to indentify sufficient beach compatible material for the entire life cycle of the project. Sediment samples were collected from the borings and laboratory testing was performed to create an arithmetic composite sample from all collected material. Of the three sites, one area, Borrow Area 2, was found to contain abundant beach quality material required for renourishment for the life of the project. The analytical results characterize the sediments in the borrow area as poorly-graded, fine grained sands with an average of 16% visual shell and 27% carbonate content.

Prior to construction, additional surveys may be required to assess the most current conditions to assure avoidance of hardbottom and cultural resources. Such surveys will be performed as needed to address any changes in conditions or to complete any work as previous identified in the study.

7.2 Vegetation

7.2.1 No-Action Alternative

The no-action alternative would result in increased or continued erosion of the beach and dune, consequently resulting in increased stress and continued loss of native desirable vegetation.

7.2.2 Preferred Alternative

Dune and beach fill placement activities will occur seaward of existing beach and dune vegetation, which is consistent with anticipated requirements by state and Federal resource protection agencies to limit, to the greatest extent practical, disturbance to existing beach and dune vegetation. No permanent impact on vegetation is expected from the proposed activity. Project construction will require planting of vegetation on newly constructed dune areas and replanting in equivalent density and type (limited to naturally occurring native coastal species) to replace existing vegetation that was disturbed during the construction activity. Furthermore, there are no seagrass communities present that would be subject to direct or secondary impacts from the project activities.

7.3 Threatened and Endangered Species

The following sections describe impacts on threatened and endangered species associated with the proposed action. This description includes the preferred alternative for which impacts are essentially identified. Impacts associated with the no-action alternative are described at the end of this section.

7.3.1 Preferred Alternative

7.3.1.1 Sea Turtles

As the preferred alternative proposes to place sand on the dune and beach, USACE has determined that it may affect nesting sea turtles. If a hopper dredge is utilized, the project may also affect sea turtles in the marine environment. The terms and conditions of the Southeastern Atlantic Regional Biological Opinion (SARBO) will be adhered to during construction activities; see **Section 7.27.2**.

(1) Nesting Habitat

Sea turtles that may occur within the project area are listed in **Chapter 2** of the main report. All sea turtle species are currently listed as endangered or threatened by the USFWS and FWC.

The construction of a stable dune and a wider beach will ensure that sufficient beach habitat is available for sea turtles to nest. There are a number of potential impacts to nesting sea turtles as a result of changes in beach characteristics following renourishment. Scarp development could hinder sea turtles from accessing suitable nesting habitat. Sand compaction could make excavating a proper nest difficult. Changes in sand color or sand chemistry could affect the viability of a clutch.

To minimize these potential effects, geotechnical surveys of the borrow areas were conducted to identify sand that is suitable for placement at this site. The sand grain size and color must meet specific criteria to prevent compaction and to help ensure its acceptability by sea turtles. Comparison of the geotechnical data of both the native material and the borrow area sampling indicates that the materials are similar from these two sources. Post-construction surveys will monitor the presence of scarps, and tilling will be conducted if scarps or compaction occur.

The terms and conditions of the Statewide Programmatic Biological Opinion (SPBO) will be adhered to during construction activities; see **Section 7.27.2**.

(2) Nearshore and Offshore Habitat

The preferred alternative plan would place beach fill along the dune as well as on the beach. The placement and subsequent cross-shore equilibration of this sand fill will result in sedimentation and/or partial burial of the portions of the existing unconsolidated substrate of the nearshore along the beach, anticipated to be mostly along the landward edge extending into the nearshore some 300 to 500 feet, or to a depth of -0.5 feet at MLLW. If a hopper dredge is used, dredging may impact sea turtles due to entrainment,

benthic foraging and resting habitat disturbance, noise disruption, and injury from vessel and dredges.

Sidescan sonar surveys did not identify any significant hardbottom areas in either the proposed borrow areas or along the immediate nearshore (within 1500 feet of the MLLW). If a hopper dredge is used for the dredging operations, potential impacts to sea turtles could occur. To minimize the risk to sea turtles, standard sea turtle protection conditions will be implemented such as deflector dragheads, inflow screens, and/or monitoring of the operation. At present, no hardbottom resources are present in the nearshore within the project reach limits, or in Borrow Area 2 (Sub-areas 2A, 2B, and 2C). If unknown hardbottom resources are encountered, a 400-foot buffer will be maintained around low-relief hardbottom areas that could serve as attractants to sea turtles for foraging. The project will adhere to all turtle safety precautions outlined in the NMFS SARBO (25 August, 1995; Revision 29 October, 1997), as well as implement the NMFS Sea Turtle Construction Conditions during project construction.

7.3.1.2 North Atlantic Right Whales

The shoreline along the Flagler County coast is within designated critical habitat for the North Atlantic Right Whale. Borrow Area 2, located some 6 to 7 miles offshore, is beyond the limits of the critical habitat. However, transporting beach material from the borrow area will entail crossing through the critical habitat. As described in Chapter 2 of the main report, the two main threats to this species are ship strikes and fishing gear entanglement. Collision with dredge vessels poses moderate risk to right whales if a hopper dredge is used for acquiring material from the borrow area. This risk is significantly reduced by use of a hydraulic suction cutter dredge and pipeline for transporting material to the beach in the project reach limits. To best ensure that adverse impacts to whales are avoided during construction activities, the requirements and recommendations in the NMFS South Atlantic Regional Biological Opinion (SARBO) will be followed. Furthermore, if an animal is encountered during construction, USACE has standard language in the contracting specifications to protect the animal.

7.3.1.3 Piping Plover

The Preferred Alternative may affect, but is not likely to adversely affect the wintering piping plover population in Flagler County. Piping plover have been observed occasionally on the beach at Gamble Rodgers Memorial State Recreation Area which has the most suitability for their habitat requirements. This area is beyond the proposed project southern limit (FDEP monument R-95) and, therefore, would not be impacted directly or indirectly from construction activities. Furthermore, the proposed action would not adversely modify critical habitat as it is not located within a designated area.

7.3.1.4 Red Knot

The Preferred Alternative may affect, but is not likely to adversely affect the wintering red knot population in Flagler County. The most recent sighting of a Red Knot on a Flagler County Beach was in 2007 at the Gamble Rodgers Memorial State Recreation Area. The degraded beach habitat quality within the project limits would prohibit use by Red Knot.

7.3.2 No-Action Alternative

No impacts would occur on the threatened and endangered species discussed in this section, except for the slow decline in the quality of available habitat for nesting sea turtles, red knot, and the wintering piping plover.

7.4 Marine Mammals

7.4.1 Preferred Alternative

Borrow area activities are not likely to affect marine mammal species. Any minor impact due to dredging activity at the borrow areas and vessels traversing from the borrow areas to the placement sites would be temporary in nature. Use of a hydraulic cutterhead dredge and pipeline would avoid potential contact with marine mammals. In the event that a hopper dredge is used, a Marine Mammal Observer (MMO) would be present during the dredge operation and material transport to the project area.

7.4.2 No-Action Alternative

No impacts on marine mammals would occur as a result of the no-action alternative.

7.5 Birds

7.5.1 Preferred Alternative

Bird species that may visit the project area during the beach nourishment period are likely to be displaced from the target shoreline by disturbance from ongoing activities. These disturbances may result in temporary displacement, or may result in the abandonment of the target beach area by individual birds. These impacts include:

- disturbance from ongoing dune and beach-face fill placement, pump-out, and grading activities
- the loss of benthic macroinfaunal invertebrates within the beach fill placement areas that are used as a food source for certain listed species, and
- alteration of water clarity resulting from suspended sediment during dredging operations that could negatively affect the foraging capabilities of some species

Migratory birds would be minimally affected by proposed activities. Dune and beach construction activities will include specific monitoring measures during construction with regard to migratory birds. For instance, activities at the beach will be monitored at dawn or dusk daily during the nesting season to protect nesting migratory birds. Should nesting activities occur within the construction area, appropriate buffers will be placed around nests to ensure their protection. The impact of increases in turbidity would be a temporary impact as water clarity is expected to recover soon after completion of all activities.

7.5.2 No-Action Alternative

The no-action alternative would result in a steadily eroding shoreline that would limit the availability of beach habitat available for nesting, roosting and foraging migratory birds.

7.6 Essential Fish Habitat Assessment

The project description is located in Chapter 6 of the main report. **Chapter 2** describes the existing conditions of the Essential Fish Habitat (EFH), federally managed fisheries, and associate species such as major prey species, including affected life history stages. The following subsections describe the individual and cumulative impacts of the proposed action(s) and alternatives on EFH, federally managed fisheries, and associate species such as major prey species, including affected life history stages.

7.6.1 Preferred Alternative

Marine habitats of coastal non-vegetated demersal soft bottoms, open shelf, shelf edge, and lower shelf water columns within the study area have been designated as EFH. Borrow areas that include part of the Korona Ridge Field geomorphologic unit (Area 2) and part of the Flagler Sand Wave geomorphologic unit (Area 3) would be affected by material excavation. These areas rely on currents to form mounds which are gradually deposited over time. Removal of the upper portion of the ridge would have minimal impact as the removal of material is conservatively estimated over the expanse of the shoal's upper portion, which is approximately 7,500 feet long by 2,500 feet wide.

Although no hardbottom habitat is known to be present in the vicinity of the borrow areas or immediately nearshore of the project area, pursuant to the NMFS South Atlantic Regional Biological Opinion, USACE will attempt to maintain 400-foot buffers where possible if this resource is encountered. With the establishment of the 400-foot buffer, less impact to reef fish would occur due to their ability to move from the dredging site.

The water column is a habitat used for foraging, spawning, and migration. Impacts on the water column may have localized effects on marine species. Injury or entrainment due to dredging would most likely affect demersal or less mobile species, such as shellfish. Dredging may temporarily affect feeding success of EFH species due to turbidity and loss of benthic organisms; however, adjacent similar habitat is available for feeding. Benthic organisms are expected to recover and inhabit the substrate within the borrow areas over time. Other potential adverse effects include: vessel strikes; behavioral alterations due to sound, light, and structures; increased turbidity and sedimentation; changes to soft bottom bathymetry in the borrow area during dredging; and temporary loss of prey items and foraging habitat.

Water quality concerns are of particular importance in the maintenance of this habitat. During dredging, suspended materials may interfere with the diversity and concentration of phytoplankton and zooplankton, and therefore could affect foraging success and patterns of schooling fishes and other grazers that comprise prey for managed species.

Foraging patterns would be expected to return to normal at the end of dredging activities.

7.6.2 No-Action Alternative

No impacts would occur to EFH as a result of the No Action Alternative.

7.7 Coastal Barrier Resources

The proposed project does not include the construction of structures that would require Federal Flood Insurance; therefore, Federal expenditures for the proposed project are not restricted in Unit FL-06P, Washington Oaks Garden State Park, or Unit FL-P07P, Gamble Rodgers Memorial State Recreation Area OPA. Although these areas fall within the feasibility study area, they are outside of the project limits for any proposed shoreline protection activities.

7.8 Water Quality

7.8.1 Preferred Alternative

Construction activities may cause temporary increases in turbidity in the immediate vicinity of construction. These conditions will cause short-term impacts to the area's water quality. The State of Florida water quality regulations require that water quality standards not be violated during constructions operations. The standards require that turbidity shall not exceed 29 NTU's above background. Should turbidity exceed state water quality standards as determined by monitoring, the contractors will be required to cease work until conditions return to normal. Increased turbidity at the borrow site during excavation should be minor and less than the turbidity increase along the shore during renourishment.

7.8.2 No-Action Alternative

The no-action alternative will not adversely affect water quality in the action area.

7.9 Air Quality

7.9.1 Preferred Alternative

The short-term impact of emissions by the dredge and other construction equipment associated with the project will not significantly impact air quality. Flagler County is an attainment area and the FDEP does not regulate marine or mobile emission sources (construction equipment) in attainment areas. No air quality permits will be required for this project.

7.9.2 No-Action Alternative

The no-action alternative would not affect air quality in the project area.

7.10 Noise

7.10.1 Preferred Alternative

Dredging noise can affect marine mammals, sea turtles, and fisheries. Possible effects of dredging noise can vary depending on a variety of internal and external factors, and can be divided into masking (obscuring of sounds of interest by interfering sounds, generally at similar frequencies), response, discomfort, hearing loss, and injury (MALSF, 2009). Deeper water operations may propagate sound over greater distances than those in confined nearshore areas (Hildebrandt, 2004).

Dredging to extract marine aggregates produces broadband and continuous sound, mainly at lower frequencies. The little available data indicates that dredging is not as noisy as seismic surveys, pile driving, and sonar; however, it is louder than most shipping, operating, offshore wind turbines, and drilling (MALSF, 2009). Noise associated with dredging activities can be placed into five categories:

- Collection noise – The noise generated from the collection of material from the sea-floor; for example, the scraping of the buckets on a bucket ladder dredge or the operation of the drag head. This noise is dependent on the structure of the sea floor and the type of dredge used.
- Pump noise – The noise from the pump driving the suction through the pipe.
- Transport noise – The noise of the material being lifted from the sea floor to the dredge. For trailing suction hopper and cutter suction dredges, this would be the noise of the material as it passes up the suction pipe. For clamshell dredges, it would be the sound of the crane dropping/lifting the bucket.
- Deposition noise – This noise is associated with the placement of the material within the barge or hopper.
- Ship/machinery noise – The noise associated with the dredging ship itself. For stationary dredges, the primary source will be the onboard machinery. Mobile dredges will also have propeller and thruster noise (MALSF, 2009).

Field investigations have been undertaken to characterize underwater sounds typical of bucket, hydraulic cutterhead, and hopper dredging operations (Dickerson *et al.,* 2001). Preliminary findings indicate that cutterhead dredging operations are relatively quiet as compared to other sound sources in aquatic environments. Hopper dredges produce somewhat more intense sounds similar to those generated by vessels of comparable size. Bucket dredges create a more complex spectrum of sounds, very different than either cutterhead or hopper dredges. Hopper dredge noises consist of a combination of sounds emitted from two relatively continuous sources: engine and propeller noise similar to that of large commercial vessels, and sounds of dragheads moving in contact with the substrate.

Reported source levels for dredging operations range from 160 to 180 dB re 1 uPa @ 1 m for 1/3 octave bands (equivalent to the sound wave energy of a killer whale whistle) with peak intensity between 50 and 500 Hz (JASCO, 2011) (Greene and Moore, 1995). The intensity, periodicity, and spectra of emitted sounds differ greatly among dredge types. Components of underwater sounds produced by each type are influenced by a

host of factors including substrate type, geomorphology of the waterway, site-specific hydrodynamic conditions, equipment maintenance status, and skill of the dredge plant operator (Dickerson *et al.,* 2001).

Noise generated by the dredge will be offshore and will not impact those living on the beaches. Noise generated on the beaches by equipment placing the dredged material will be relatively low level and will be of a short duration. Construction equipment such as booster pumps will be properly maintained to minimize effects of noise. Once dredging and material placement have concluded, noise levels will drop back to normal levels for the dune and beach area. Noise may temporarily impact some underwater organisms, but is not anticipated to adversely affect these organisms since the increases to the current level of noise as a result of this project will be localized and minor. There will only be a temporary reduction in aesthetics and no expectation of adverse effects to the environment as a result of construction-related noise.

7.10.2 No Action Alternative

Noise levels in the project area would not be affected by the No Action Alternative.

7.11 Aesthetic Resources

7.11.1 Preferred Alternative

Construction equipment on the beach will be aesthetically unappealing for the duration of construction. The duration of initial constructed is estimated to be 30 days for mob/demob and 123 days for construction. The duration of subsequent periodic nourishments is estimated to be 30 days for mob/demob and 41 days for construction. The project will result in a wider, more aesthetically pleasing beach. Also, reconstruction of the dune includes planting native upland dune species that will result in improved aesthetics.

7.11.2 No-Action Alternative

Beach ecosystems are generally considered to be aesthetically pleasing. The no-action alternative may ultimately result in a loss of this ecosystem and a less aesthetically appealing shoreline that may require additional hard stabilization methods (i.e., revetments or seawalls) to protect upland properties.

7.12 Socio-Economic Resources

7.12.1 Preferred Alternative

Construction equipment on the beach may have a minor effect on tourism interests at Flagler Beach for the duration of construction (less than six months). Post–project, the long-term result of dune restoration will have an overall increased value to properties abutting the beach. Construction of the dune will require removal or burial of existing publicly and privately-owned boardwalk crossovers from SR A1A to the beach. The loss of private access to the beach may pose an impact of hardship to affected property owners. The public crossovers will be replaced as part of the project.

7.12.2 No-Action Alternative

Continued loss of beach and degradation of the existing dune will have a negative effect on property values and the tourism industry. The existing public and privately-owned boardwalk crossovers will eventually become unstable and require maintenance or possible removal from future storm surge or high wind events.

7.13 Recreation Resources

7.13.1 Preferred Alternative

The current use of Flagler County beaches within the project limits (FDEP monument R80 to R94) is subject to erosion after significant storm events. The proposed action of dune rebuilding and beach nourishment would cause temporary impediment of recreational usage where placement and distribution of material occurs within the project limits. There would be a long-term benefit to recreation from the extended width of the beach and stabilization of the system.

The current use of the borrow areas (Sub-areas 2A, B and C) for recreation is limited. Recreational fishermen may be required to alter their fishing locations during dredging.

7.13.2 No-Action Alternative

The no-action alternative would result in a loss of recreation resources due to long-term erosion of usable beach.

7.14 Navigation

7.14.1 Preferred Alternative

Recreational boaters frequently use this area. Boating in the area of the dredge equipment will be restricted due to equipment and pipeline activities, but only temporarily while the beach is being renourished. Once the project has been completed, navigation will resume unhindered.

7.14.2 No-Action Alternative

There will be no affect on navigation with the no-action alternative.

7.15 Historic and Cultural Resources

7.15.1 Preferred Alternative

7.15.1.1 Shoreline Operations Area

The shore-based operations area will have no effect on historic resources. In 2005 USACE consulted with the State Historic Preservation Officer (SHPO) regarding the initial development of the project and upon the recommendation of the SHPO and the Miccosukee Tribe of Florida, the shoreline area was surveyed for cultural resources (DHR letter # 2005-3337, Miccosukee Tribe letter dated 19 April 2005); a copy is included in **Appendix F**. The survey conducted by USACE did not identify any historic

properties within the immediate project foot print. USACE determined that the use of the shoreline area will have no effect on historic properties (DHR letter #2010-03935-C, THPO#006745); a copy is included in **Appendix F**. The preferred alternative will beneficially affect historic properties located immediately west of the project area. Material placed along the shoreline will serve as a protective buffer for the historic resources in the immediate vicinity.

7.15.1.2 Nearshore Operations Area

Within the nearshore of the study area, a single target has been identified during a hardbottom survey. While additional archeological work will be needed to precisely map the location of the historic property, it is anticipated that no historic properties would be affected by any of the project alternatives in the nearshore. The identified resource will be properly buffered (minimum of 200 feet; see Table 7-1) to ensure required protection of the resource. Consultation with the SHPO and appropriate federally recognized tribes will occur prior to the project construction when additional work is completed.

7.15.1.3 Offshore Borrow Area

It is anticipated that no historic properties would be affected by use of any of the proposed borrow areas. As part of the investigations of the proposed design of the borrow areas, a background and literature search revealed that there are currently no known historic properties within the proposed borrow areas. In a 2005 consultation with the SHPO, it was recommended that an underwater survey of the proposed borrow area be conducted. This survey will be conducted prior to project construction. If any resources are identified they will be properly buffered to ensure required protection of the resource. Borrow areas are sufficiently designed to provide space for required buffering without altering their size. While currently borrow area 2A is the main source, if volume is removed because of the identification of resources within the proposed borrow area, then additional borrow sources can be considered at borrow area 2B. Consultation with the SHPO and appropriate federally-recognized tribes is ongoing and will continue occur prior to project construction.

7.15.2 No-Action Alternative

7.15.2.1 Shoreline Sand Operations Area

The no-action alternative does not directly impact historic resources but does allow for continued shoreline erosional forces. There are historic structures located between the highway and the shoreline. Subsequently, these structures will be vulnerable to both short-term effects from storm damage and long- term erosional forces that will eventually place these historic structures within reach of the ocean. If lost, the historic fabric of the coastal community will suffer.

7.15.2.2 Nearshore Operations Area

There would be no effects on historic properties.

7.15.2.3 Offshore Borrow Area

There would be no effects on historic properties.

7.16 Native Americans

No portion of this project affects Native American properties. Consultation with appropriate federally-recognized tribes has been ongoing since 2005 and will continue through project design. USACE has discussed this project with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida in regard to its Section 106 responsibilities under the National Historic Preservation Act (NHPA).

7.17 Natural or Depletable Resources

Sand is a natural and depleting resource. Using sand from the proposed borrow area, Borrow Area 2 (Sub-areas 2A, 2B, and 2C), will deplete the sand source at those sites. The sand will be depleted from the borrow areas, but will enter into the nearshore sand transport system. Although sand will eventually return to offshore areas and be redistributed over nearshore areas downdrift of the project, it is unlikely that the redistributed sand will be sufficient to refill the borrow area. This would result in depletion of mineral resources in the borrow areas.

7.18 Cumulative Impacts

Cumulative impacts are defined in 40 CFR 1508.7 as those effects that result from:

> *...the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

Table 7- 2 summarizes the impact of such cumulative actions by identifying the past, present, and reasonably foreseeable future condition (50 years) of the various resources which are directly or indirectly impacted by the proposed action and its alternatives. The table also illustrates the with-project and without-project condition (the difference being the incremental impact of the project). Also illustrated is the future condition with any reasonable alternatives (or range of alternatives).

As part of the evaluation of cumulative impacts pursuant to CEQ 1997 *Considering Cumulative Effects under the National Environmental Policy Act*, other actions affecting similar resources or ecosystem were considered. There are no other projects in the region that share a similar ecosystem that could have cumulative impacts on similar resources. In Northeast Florida, there are active beach nourishment projects in Nassau, Duval, and St. Johns Counties. All of these projects have separate sufficient sand resources identified, which will not be impacted by the proposed project. Beach nourishment projects located south of Cape Canaveral, in the southeast region of Florida, will not impact the borrow areas identified for the proposed project. The proposed project will not impact or be impacted by any inlet maintenance project within the region. The closest maintained inlets to the proposed project are the St. Augustine Inlet located approximately 33 miles north of the project area and Ponce inlet locate approximately 29 miles south of the project area.

Table 7- 2: Summary of Cumulative Effects

	Boundary (time and space)	Past (baseline condition)	Present (existing condition)	Future without project (No Action)	Future with Proposed Action
Sand Resources	Pre- development to 2062, Flagler County	Offshore sand resources identified for this project have never been used for beach nourishment or other purposes	Sufficient offshore sand resources exist for all the beach nourishment projects in Northeast Florida including the proposed project	Offshore sand resources identified for this project will not likely be utilized for other shore protection activities in other areas of Florida	Offshore sand resources identified for this project will be reduced, but not depleted over the life of this project
Protected Species	Pre- development to 2062, Flagler County	More abundant and widespread	Individuals becoming increasingly rare; habitat shrinking	individuals are not acutely affected by dredging; however, beach habitat continues to shrink	Individuals may be affected by dredging and placement activities; habitat is sustained for life of project. Loss of private access cross-overs may impact dune from foot traffic through vegetation, and nesting areas for sea turtles and shorebirds.
Dune Vegetation	Pre- development to 2062, Flagler County	Abundant vegetative cover of appropriate dune species with moderate diversity	Areas of the shoreline have lost dune and associated vegetation from armoring. Existing dunes are subject to erosion resulting in loss of vegetation.	Areas containing vegetated dunes will continue to erode causing stress to plant species and lessen diversity	Reconstruction of dunes will stabilize the coastal ecosystem. Replanting with appropriate native species will increase diversity and improve overall dune habitat.
Water quality	Pre- development to 2062, Flagler County	Pristine	Increasingly degraded due to anthropogenic actions	no change to present condition	Temporary increases in local turbidity; no long-term change to degraded state
Socio-Economic	Pre- development to 2062, Flagler County	More abundant tourism and property values, fluctuating with national economy	Increasingly degraded beach has negative impact on tourism industry and property values.	Loss of revenue from decreased tourism. Property values decline. Boardwalk structures will become undermined and unstable.	Privately owned boardwalk cross-overs will be removed or buried. Easements will compensate property owners for replacement cost for private access to the beach

7.18.1 Sand Resources

Because sand resources at offshore sites are not replenished very quickly by natural forces, it is anticipated that the use of the borrow areas for the life of this project would result in the depletion of this sand supply. Dredging of the proposed borrow areas to construct the beach fill project would have temporary impacts on the benthic infaunal communities. If the borrow areas identified in this environmental assessment are not used for this project, the growing demand for sand to use in protecting Florida shorelines suggests that they would be utilized in the future by other stakeholders.

Sediment transport in the nearshore region is natural and continuous. However, cumulative beach nourishment and other anthropogenic activities can increase rates of nearshore sediment transport, exacerbating background levels and causing stress to nearshore benthic communities (Jordan, Banks et al. 2010). The proposed action would likely have minimal, temporary adverse impacts to EFH during each nourishment event over the life of the project. With the renourishment interval expected every eleven years, and the recovery time of the affected benthic community after sand removal anticipated to be within one to two years, the potential for significant cumulative benthic biological impacts is remote. No significant cumulative impacts on the pelagic environment, including zooplankton, fishes, sea turtles, and marine mammals, are expected from the use of the borrow areas.

7.18.2 Protected Species

Dredge equipment activities could possibly have an impact on manatees, sea turtles, and whales, but measures will be taken to prevent these impacts and they are not likely to have a cumulative adverse impact on these species. Long-term changes in beach characteristics such as sand color, grain size, etc. could affect the use of the beach by nesting sea turtles. Since the proposed project is not likely to affect protected species, with the exception of sea turtles, should a hopper dredge be utilized, the project would not contribute to adverse cumulative impacts on protected species. Through the ESA Section 7 consultation process, NMFS has determined that utilization of a hopper dredge is not likely to lead to the extinction of sea turtles, provided the reasonable and prudent measures and implementing terms and conditions are followed. The project would restore beach use by nesting sea turtles and migratory birds, which may result in a positive effect on the long-term populations of these species. Protected species would be periodically affected in a manner similar to that described in **Section 7.3** for each nourishment event through the life of the project.

7.18.3 Water Quality

Water quality impacts from the proposed action would be temporary in nature. There is some concern that sand movement from nourished beaches can cause increased turbidity in nearshore waters during large storm events. However, barrier islands are dynamic systems with constantly shifting sands. Erosion and accretion

of sands occurs naturally in these systems, creating localized turbidity during storm events and in the winter months (Jones and Mangun 2001). An increase in fine sediments following a nourishment event can result in increased turbidity causing a localized, short duration disturbance that generally last only as long as the dredging operations are taking place (Nightingale and Simenstad, 2001).

7.18.4 Conclusion

Because sand resources appear to be replenished slowly, the proposed project provides an incremental effect on the depletion of offshore sand resources. The proposed project would not have significant adverse effects on protected species, EFH, or water quality due to protective conditions developed in coordination and consultation with the resource agencies. The proposed project would not provide any known incremental result that would contribute to adverse cumulative impacts of these biological resources.

7.19 Irreversible and Irretrievable Commitment of Resources

7.19.1 Irreversible

An irreversible commitment of resources is one in which the ability to use and/or enjoy the resource is lost forever. One example of an irreversible commitment might be the mining of a mineral resource. The use of sand from the proposed borrow areas would, for all practical purposes, irreversibly deplete the suitable sand reserves. The sands would not replenish fast enough to be of much value to future nourishment projects.

7.19.2 Irretrievable

An irretrievable commitment of resources is one in which, due to decisions to manage the resource for another purpose, opportunities to use or enjoy the resource as they presently exist are lost for a period of time. An example of an irretrievable loss might be where a type of vegetation is lost due to armoring. Environmental impacts caused by use of the borrow sites for placement on the dune and beach would be small since only a featureless, sandy bottom would be impacted.

7.20 Unavoidable Adverse Environmental Effects

Species of relatively non-motile infaunal invertebrates (aquatic animals that live in the substrate of a body of water, such as soft sea bottom) that inhabit the benthic zone of borrow areas and the immediate submerged beach placement site will unavoidably be lost during dredging. Those species that are not able to escape the construction area are expected to re-colonize after project completion.

7.21 Local Short-Term Uses and Maintenance/Enhancement of Long-Term Productivity

Species of motile epifaunal invertebrates (benthic animals that live on the substrate surface) may inhabit the borrow areas and placement site. Motile organisms such as fish, crabs, and sand dwelling organisms should be able to escape the area during construction. Many of those species that are not able to escape the construction area are expected to re-colonize after project completion.

7.22 Compatibility with Federal, State, and Local Objectives

The Preferred Alternative is compatible with Federal, state, and local objectives of protecting upland properties while maintaining a natural beach. It also provides the most cost-effective option for meeting these objectives. The no-action alternative does not meet the Federal, state, and local objectives.

7.23 Conflicts and Controversy

No conflicts or controversy regarding this project have been identified.

7.24 Uncertain, Unique, or Unknown Risks

The direct site-specific impacts of the Preferred Alternative and the no-action alternative can be predicted with a high degree of certainty; therefore, uncertainty in minimized. However, predictions of cumulative and indirect impacts are, to a degree, inherently uncertain. This project is based on the best available scientific and engineering information, and although no significant adverse impacts are expected, a low probability is always present. The project design is not unique; thus, it should not create unique risks.

7.25 Precedent and Principle for Future Actions

This project would not establish a precedent for future actions with significant effects or represent a decision in principle for future considerations.

7.26 Environmental Commitments

USACE and its contractors commit to avoiding, minimizing, or mitigating for adverse effects during construction activities. Adequate buffers were established during the borrow site design to ensure that no impacts on resources occur. Environmental commitments resulting from agency comments, public concern, laws and regulations, and permit requirements will be included in the contract specifications.

7.26.1 Protection of Fish and Wildlife Resources

The contractor shall keep construction activities under surveillance, management, and control to minimize interference with, disturbance to, and damage of fish and wildlife. Species that require specific attention along with measures for their protection shall be listed in the Contractor's Environmental Protection Plan prior to the beginning of construction operations.

Dredging will not occur within 400 feet of any known significant hardbottom areas. This project is not anticipated to result in hardbottom impacts.

7.26.2 Endangered species protection

USACE will comply with all requirements of any consultation documents associated with this project provided under the Endangered Species Act from either USFWS or NMFS. Buffers will be maintained for any known significant hardbottom areas or structures that serve as attractants to sea turtles for foraging or shelter. These buffers and any other turtle safety precautions would be maintained to comply with the NMFS SARBO. If a hopper dredge is used for the dredging operations, potential impacts to sea turtles could occur. To minimize the risk to sea turtles, standard sea turtle protection conditions will be implemented such as the use of a state-of-the-art rigid deflector draghead at all times, inflow screens, and/or monitoring of the operation.

7.26.3 Water Quality

The USACE contractor will prevent oil, fuel, or other hazardous substances from entering the air or water. This will be accomplished by design and procedural controls. All wastes and refuse generated by project construction would be removed and properly disposed. The USACE contractor will implement a spill contingency plan for hazardous, toxic, or petroleum material for the borrow area. Compliance with U.S. EPA Vessel General Permits would be ensured, as applicable. USACE will secure a Section 401 Water Quality Certification prior to construction.

7.27 Dredge and Borrow Area Monitoring Requirements

Electronic positioning information, production, and volume data would be collected. Pre- and post-dredging hydrographic surveys will be conducted to monitor physical changes in the borrow area. The dredge would be equipped with an on-board global positioning system capable of maintaining or recording the location of the dredge, drag arms, and/or cutterhead.

7.28 Compliance with Environmental Requirements

7.28.1 National Environmental Policy Act of 1969

Environmental information on the project has been compiled and this Environmental Assessment has been prepared. At this time, USACE is not proceeding with an Environmental Impact Statement. Final compliance with the National Environmental Policy Act will occur with the signing of a Finding of No Significant Impact (FONSI). The project is in compliance with this Act. For a feasibility study and certain other actions, a 30-day comment period is required.

7.28.2 Endangered Species Act of 1973

This project falls under the scope of the USFWS Statewide Programmatic Biological Opinion for Shore Protection Activities along the Coast of Florida (SPBO; issued 18 April, 2011, and modified 22 August, 2011). USACE will adhere to the terms and conditions outlined in that document for projects including sand placement from beach nourishment activities primarily for shore protection. USACE coordinated with USFWS pursuant to the SPBO on 1 November 2011. Although no piping plover wintering population critical habitat is present within the study area or the project limits, individuals have been observed on the shoreline south of the project limit (ending at FDEP monument R-95) at the Gamble Rodgers Memorial State Recreation Area (located at R-98). Additional coordination with the USFWS was conducted as part of the action. The required SPBO 30-day notification letter was submitted on 3 October 2013 to the USFWS and included a Piping Plover Programmatic Biological Opinion Survey; see the **Environmental Appendix** for copies of these documents. Correspondence from USFWS dated May 30, 2014 was received on June 5, 2014 which stated "This letter fulfills the requirements of the Act and no further action is required." A copy of the letter is included in **Appendix F**.

Critical habitat designation is proposed for loggerhead that would affect operations. Terms and Conditions with respect to loggerhead in the current SARBO will be employed at this time. New SARBO update consultation between USACE and NMFS is addressing the issue of critical habitat designation for loggerhead along with other issues in the proposed SARBO revision. SPBO will require updating once the proposed critical habitat is finalized. FWS has proposed areas of critical habitat for shoreline nesting. Future renourishment events may require updated consultation with respect to the FWS SPBO and NMFS SARBO once the critical habitat is finally established.

This project also falls under the scope of the NMFS South Atlantic Regional Biological Opinion (SARBO; issued 25 November, 1991, as amended in 1995 and 1997). The SARBO requires a 400-foot buffer surrounding significant hardbottom resources. For the purposes of the SARBO, a significant hardbottom is "one that, over a horizontal distance of 150 feet, has an average elevation above the sand of

1.5 feet or greater, and has algae growing on it." The study conducted by Dial Cordy and Associates, Inc., in 2011, and further explored with the USACE survey of 2012, did not identify any hardbottom habitats that met this definition within the project action limits. Additionally, no hardbottom resources were found in the proposed borrow areas. Therefore, the 400-foot buffer requirement is not applicable to the three borrow areas considered in this environmental assesssment. However, the borrow areas will include a 400-foot buffer around any hardbottoms identified during operations as a precautionary measure to avoid impacts to these habitats if they are encountered.

This project was fully coordinated under the Endangered Species Act of 1973, as amended, 16 U.S.C. 1531, *et seq.,* P.L. 93-205, and is in full compliance with this Act.

7.28.3 Fish and Wildlife Coordination Act of 1958

USACE has and will continue to maintain continuous coordination with the USFWS during all stages of the planning and construction process. USACE consulted with the USFWS pursuant to the FWCA, NEPA, and the ESA. This project is in full compliance with the Act. Correspondence from USFWS dated May 30, 2014 was received on June 5, 2014 which addressed compliance with the FWCA. A copy of the letter is included in **Appendix F**.

7.28.4 National Historic Preservation Act of 1966

Consultation with the Florida State Historic Preservation Officer (SHPO) is ongoing in accordance with the National Historic Preservation Act (NHPA) of 1966, as amended, and as part of the requirements and consultation processes contained within the NHPA implementing regulations of 36 CFR 800, this project is also in compliance with the Archeological Resources Protection Act (96-95), Native American Graves Protection Act (PL 101-601, American Indian Religious Freedom Act (PL 95-341), Executive Orders (E.O) 11593, 13007, & 13175 and the Presidential Memo of 1994 on Government to Government Relations. In a letter dated 28 February 2012, the SHPO concurred with the USACE finding of no historic properties use of the shoreline. Consultation related to nearshore and borrow areas are ongoing. The current project has been briefed to the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida as part of the district's annual face-to-face meetings on cultural resources that have been occurring since 2010. No comments have been received during these ongoing annual meetings. Additional cultural resource survey and consultation with the SHPO and appropriate federally-recognized tribes will be needed for areas within the nearshore and borrow areas. Consultation is ongoing.

7.28.5 Clean Water Act of 1972

A Joint Coastal Permit (JCP) application for shore protection along the Flagler County HSDR project area will be prepared and submitted by USACE upon completion of the feasibility phase of the project. Final compliance with the Clean Water Act will occur when this Water Quality Certification is received from the State of Florida. All State water quality standards would be met. A Section 404(b) evaluation is included in **Appendix F**. The project is in compliance with this Act.

7.28.6 Clean Air Act of 1972

No air quality permits would be required for this project. This environmental assessment will be coordinated with the U.S. Environmental Protection Agency (EPA) and is in compliance with Section 309 of the Act. Any correspondence received from the EPA will be included in **Appendix F** of the final environmental assessment, and a discussion of any issues they raise will be included in the Public and Agency Involvement section of the final environmental assessment.

7.28.7 Coastal Zone Management Act of 1972

A Federal consistency determination in accordance with 15 CFR 930 Subpart C is included in this report as **Appendix F**. State consistency review was performed during the coordination of the draft environmental assessment. The FDEP commented that they "concur the project is consistent with the state statutory authorities at this stage. The state's final coastal zone consistency finding will occur at the completion of the engineering and design phase when the items needed to complete the state's permitting of the project are available." A copy of the FDEP comment is included in **Appendix G – Pertinent Correspondence**.

7.28.8 Farmland Protection Policy Act of 1981

No prime or unique farmland would be impacted by implementation of this project. This act is not applicable.

7.28.9 Wild and Scenic River Act of 1968

No designated Wild and Scenic River reaches would be affected by project related activities. This act is not applicable.

7.28.10 Marine Mammal Protection Act of 1972

The project will not adversely affect marine mammal species. Incorporation of safeguards to protect threatened and endangered species during project construction would also protect marine mammals in the area. Therefore, this project is in compliance with this act.

7.28.11 Estuary Protection Act of 1968

No designated estuary would be affected by project activities. This act is not applicable.

7.28.12 Federal Water Project Recreation Act

The principles of the Federal Water Project Recreation Act, (Public Law 89-72) as amended, have been fulfilled by complying with the recreation cost-sharing criteria. Another area of compliance includes the public beach access requirement on which the renourishment project depends, as described in **Chapter 2** pursuant to USACE ER 1105-2-100 and ER 1105-2-130.

7.28.13 Submerged Lands Act of 1953

The project would occur on submerged lands of the State of Florida. The project will be coordinated with the state and is in compliance with the act.

7.28.14 Coastal Barrier Resources Act and Coastal Barrier Improvement Act of 1990

The Coastal Barrier Resources Act (CBRA) and the Coastal Barrier Improvement Act of 1990 (CBRA) limit federally-subsidized development within CBRA Units to limit the loss of human life by discouraging development in high-risk areas; to reduce wasteful expenditures of Federal resources; and to protect the natural resources associated with coastal barriers. CBRA provides development goals for undeveloped coastal property held in public ownership, including wildlife refuges, parks, and other lands set aside for conservation known as "otherwise protected areas" (OPAs). These public lands are excluded from most of the CBRA restrictions, although they are prohibited from receiving Federal Flood Insurance for new structures.

Federal monies can be spent within CBRA units for certain activities, including (1) projects for the study, management, protection, and enhancement of fish and wildlife resources and habitats; (2) establishment of navigation aids; (3) projects funded under the Land and Water Conservation Fund Act of 1965; (4) scientific research; (5) assistance for emergency actions essential to saving lives and the protection of property and the public health and safety, if preferred pursuant to the Disaster Relief Emergency Assistance Act and the National Flood Insurance Act and are necessary to alleviate the emergency; (6) maintenance, repair, or reconstruction, but not expansion, of publically-owned or publically-operated roads, structures, or facilities; (7) nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore a natural stabilization system; (8) any use or facility necessary for the exploration, extraction, or transportation of energy resources; (9) maintenance or construction of improvements of existing Federal navigation

channels, including the disposal of dredge materials related to such projects; and (10) military activities essential to national security.

There are two CBRA OPAs in the project vicinity Unit FL-06P, Washington Oaks Garden State Park, or Unit FL-P07P, Gamble Rodgers Memorial State Recreation Area (see Chapter 2). Although these areas fall within the study area, they are otherwise protected and are not subject to the same restrictions as a "coastal barrier resource unit." Furthermore, they occur outside of the project limits for any proposed shoreline protection activities. The proposed project does not include the construction of structures that would require Federal Flood Insurance in any areas designated as pursuant to the CBRA; therefore, Federal expenditures for the proposed project are not restricted in these OPA areas. The activities proposed in the remainder of the CBRA units in the project area are consistent with the intent of the Act. The project is in compliance with the Act.

7.28.15 Rivers and Harbors Act of 1899

The proposed work would not obstruct navigable waters of the United States. The proposed action will be subject to the public notice, public hearing, and other evaluations normally conducted for activities subject to the act. The project is in full compliance.

7.28.16 Anadromous Fish Conservation Act

Anadromous fish species would not be affected. This environmental assessment will be coordinated with NMFS. This project is in compliance with the act.

7.28.17 Migratory Bird Treaty Act and Migratory Bird Conservation Act

Migratory birds would be minimally affected by dredging in the borrow areas. USACE will include our standard migratory bird protection requirements in the project plans and specifications and will require the contractor to abide by those requirements. Dune and beach construction activities at the placement site will be monitored at dawn or dusk daily during the nesting season to protect nesting migratory birds. If nesting activities occur within the construction area, appropriate buffers will be placed around nests to ensure their protection. The project is in compliance with these acts.

7.28.18 Marine Protection, Research and Sanctuaries Act

The term "dumping" as defined in the Act (3[33 U.S.C. 1402](f)) does not apply to the disposal of material for dune and beach nourishment, or to the placement of material for a purpose other than disposal (i.e., placement of rock material as an artificial reef or the construction of artificial reefs as mitigation). Therefore, the Marine Protection, Research and Sanctuaries Act does not apply to this project. The

disposal activities addressed in this EA have been evaluated under Section 404 of the Clean Water Act (see **Appendix F**).

7.28.19 Magnuson-Stevens Fishery Conservation and Management Act

This act requires preparation of an EFH Assessment and coordination with NMFS. This document serves as this assessment, and includes these required elements: (1) a description of the proposed action (see **Section 5**); (2) analysis of individual and cumulative effects on EFH, federally managed fisheries, and associated species such as major prey species, including affected life history stages (see **Sections 2.4.6 and 7.6**); and (3) USACE Jacksonville District's view regarding effects (see **Section 7.6**). Correspondence from NMFS with regards to EFH dated June 11, 2014 addressed compliance with the Act. A copy of the letter is included in **Appendix F.** This project is in compliance with the Act.

7.28.20 Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970

The purpose of PL 91-646 is to ensure that owners of real property to be acquired for Federal and federally-assisted projects are treated fairly and consistently and that persons displaced as a direct result of such acquisition will not suffer disproportionate injuries as a result of projects designed for the benefit of the public as a whole.

This project does not involve displacement of property owners or tenants. The project involves real property acquisition in the form of easements. Acquisition will be in compliance with PL 91-646.

7.28.21 E.O. 11990, Protection of Wetlands

No wetlands would be affected by project activities. This project is in compliance with the goals of this Executive Order.

7.28.22 E.O. 11988, Flood Plain Management

Under Section 102(2) (C) of the NEPA, the project limits are within a mapped flood hazard zone as determined by the Department of Housing and Urban Development floodplain mapping. The proposed Federal action of implementing this project will not significantly, adversely affect the quality of the human environment, but may in fact, benefit the environment. Although the area is within a coastal flood-prone area, the purpose of the project is to provide better protection for human health and safety. Design of the proposed action will minimize potential harm from storm events that result in flood impacts. No other development will occur as a result of the project. Therefore, this project is in compliance with the goals of this Executive Order.

7.28.23 E.O. 12898, Environmental Justice

This action would not result in adverse human health or environmental effects that would be disproportionately higher towards minority or low-income populations. The activities will not affect subsistence consumption of fish and wildlife. This project is in compliance with the goals of this Executive Order.

7.28.24 E.O. 13089, Coral Reef Protection

This Executive Order refers to "those species, habitats, and other natural resources associated with coral reefs." This project will not affect U.S. coral reef ecosystems as defined by this Executive Order. Precautions would be implemented during construction to minimize impacts.

7.28.25 E.O. 13112, Invasive Species

The proposed action will require the mobilization of dredge equipment from other geographical regions. Dredge equipment has the potential to transport species from one region to another, introducing them to new habitats where they are able to out-compete native species. The benefits of the proposed project outweigh the risks associated with the very slight potential for introducing non-native species to this region. The action takes place solely in ocean waters, minimizing risk to more sheltered coastal habitats. This environmental assessment will be coordinated with the Invasive Species Council, and is consistent with the Florida Invasive Species Strategic Plan.

7.28.26 E.O. 13186, Migratory Birds

This Executive Order requires, among other things, a Memorandum of Understanding (MOU) between the Federal Agency and the USFWS concerning migratory birds. No final MOU exists between USACE and the USFWS pursuant to this Executive Order; however, there is an MOU between the Department of Defense and the USFWS, and there is a draft MOU between USACE and the USFWS. Neither the Department of Defense MOU nor the USACE Draft MOU clearly address migratory birds on lands not owned or controlled by USACE, as is the case with the project area. For many USACE civil works projects, the real estate interests are provided by the non-federal sponsor. Control and ownership of the project lands remain with a non-federal interest. USACE will include our standard migratory bird protection requirements in the project plans and specifications and will require the contractor to abide by those requirements. Measures to avoid the destruction of migratory birds and their eggs or hatchlings are described in the section above on the Migratory Bird Treaty Act.

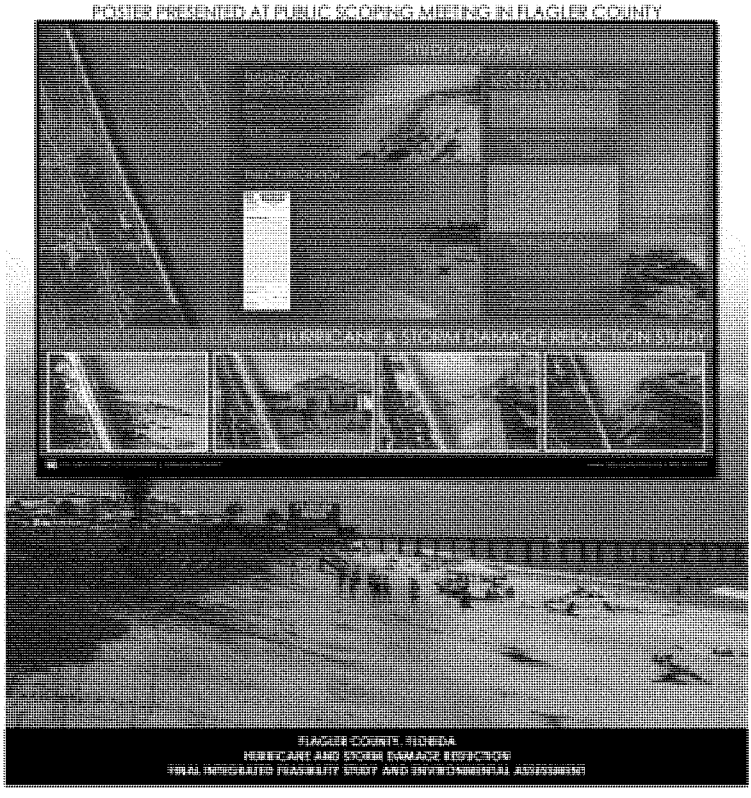
7.28.27 E.O. 13045, Protection of Children

A growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health risks and safety risks. These risks arise because children's neurological, immunological, digestive, and other bodily systems are still developing; children eat more food, drink more fluids, and breathe more air in proportion to their body weight than adults; children's size and weight may diminish their protection from standard safety features; and children's behavior patterns may make them more susceptible to accidents because they are less able to protect themselves. This Executive Order requires Federal agencies to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children.

This project will not negatively impact the food supplies, drinking water, or air quality to which children are exposed. The construction site will be hazardous to children, but the project specifications include a number of protocols intended to designate the project area as a work area and prevent non-authorized personnel from entering the site. These protocols include the installation of orange safety fencing and danger signs, functioning back-up warning signals on all construction equipment, and providing site security when on-site construction activities have temporarily ceased. The project specifications also require contractors to adhere to the provisions outlined in USACE EM 385-1-1 (15 September 2008).

CHAPTER 8
PUBLIC INVOLVEMENT, REVIEW, AND CONSULTATION

POSTER PRESENTED AT PUBLIC SCOPING MEETING IN FLAGLER COUNTY



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8 PUBLIC INVOLVEMENT, REVIEW AND CONSULTATION

8.1 Public Involvement Program

The public involvement program included the following items to contact or directly involve the public in the planning process by: sending a scoping letter to interested parties, conducting a public scoping meeting, sending a Notice of Availability on the draft report to interested parties, and holding a public workshop in order to obtain comment on the draft report.

8.2 Agency Involvement

A feasibility scoping meeting (FSM) was held by the Jacksonville District Planning Division staff to discuss the study on January 28, 2011. The purpose of the FSM was to collect input from affected resource agencies by discussion of:

- The "Future Without Project" anticipated conditions in the study area
- Related issues on the affect to resources for moving the study forward, with specific reference to the alternatives identified in the Draft Feasibility Study Report and integrated National Environmental Policy Act (NEPA) document
- Focus on the feasibility study tailored to the key alternatives
- Further definition of the required depth of analysis, as well as defined study constraints.

Either physical or virtual (via phone conferencing and webinar) attendance at the FSM included representation from the following agencies:

- U.S. Army Corps of Engineers (USACE) Headquarters (HQ), South Atlantic Division (SAD), and Jacksonville District (SAJ)
- Flagler County (Project Sponsor)
- City of Flagler Beach
- Florida Department of Environmental Protection (FDEP)
- Florida Department of Transportation (FDOT)
- Bureau of Ocean Energy Management, Regulation, and Enforcement (a.k.a. BOEM)
- Florida Fish and Wildlife Conservation Commission (FWC)

In addition to those listed above, an invitation to attend the event also included the following agencies:

- U.S. Fish and Wildlife Service (USFWS)
- National Marine Fisheries Service (NMFS)
- U.S. Environmental Protection Agency (EPA)

A study overview presentation was provided by the SAJ District via a web-meeting. The sponsor and agencies provided their comments and input on the study, and the important issues identified from the USACE HQ Office of Water Project Review (OWPR) comments were discussed in detail.

8.3 Required Coordination

8.3.1 Outer Continental Shelf Lands Act (OCSLA)

Under Section 8(k) of the Outer Continental Shelf Lands Act (OCSLA), dredging of sediment resources within the OCS requires authorization by the Bureau of Ocean Energy Management (BOEM) for use during initial or maintenance construction or both. The BOEM Leasing Division is charged with environmentally responsible management of Federal OCS sand and gravel resources. P.L. 102-426 [43 United States Code (U.S.C.) 1337(k)(2)], enacted October 31, 1994, gave BOEM the authority to negotiate, on a noncompetitive basis, the rights to OCS sand, gravel, and shell resources for CSDR projects; beach or wetlands restoration projects; or for use in construction projects funded in whole or part by or authorized by the Federal government. Recognizing that identified borrow areas are within the OCS, BOEM has agreed to serve as a cooperating Federal agency on this study and may undertake a connected action (i.e., authorize use of the OCS borrow area) that is related to, but unique from the USACE proposed action. BOEM's proposed action is to issue a negotiated agreement pursuant to its authority under the OCSLA.

8.3.2 USFWS and NMFS: Endangered Species Act (ESA) - Section 7 Consultation

This project falls under the scope of the USFWS Statewide Programmatic Biological Opinion for Shore Protection Activities along the Coast of Florida (SPBO; issued April 18, 2011, and modified August 22, 2011). USACE coordinated with USFWS pursuant to the SPBO on November 1, 2011 (see **Appendix F**). Continued coordination with the USFWS will be conducted as part of the action.

This project also falls under the scope of the NMFS South Atlantic Regional Biological Opinion (SARBO; issued November 25, 1991, as amended in 1995 and 1997). The SARBO covers the proposed action of BOEM to issue a negotiated

agreement pursuant to its authority under the Outer Continental Shelf Lands Act (OCSLA) for uses of the OCS borrow area.

8.3.3 USFWS: Fish and Wildlife Coordination Act (FWCA)

USACE has and will continue to maintain continuous coordination with the USFWS during all stages of the planning and construction process. USACE consulted with the USFWS pursuant to the FWCA, NEPA, and the ESA. USACE is coordinating with the USFWS concerning compliance with the Fish and Wildlife Coordination Act. Given the limited impacts of this project, USACE is seeking agreement from the USFWS that the requirements of the act would be met through the NEPA coordination and Section 7 ESA consultation process.

8.3.4 NMFS: Magnuson-Stevens Fishery Conservation and Management Act

The NEPA portion of this integrated document serves as the Essential Fish Habitat (EFH) assessment, and includes these required elements: (1) a description of the proposed action; (2) analysis of individual and cumulative effects on EFH, federally managed fisheries, and associated species such as major prey species, including affected life history stages; and (3) SAJ's view regarding effects. Comments received from the NMFS as a result of USACE coordination and incorporated EFH Assessment will be included in the final environmental assessment once they are received. As a cooperating agency, BOEM will have a participating role in the EFH consultation.

8.3.5 Florida Department of Environmental Protection: Clean Water Act

Final compliance with the Clean Water Act will occur when the FDEP Water Quality Certification (WQC) is issued by the State of Florida. All State water quality standards would be met pursuant to all conditions of the WQC. Section 404 (a) requires a public notice with opportunity to request a public hearing for the proposed discharge of dredged or fill material into wetlands or other waters of the U. S. (ER 1105-2-100, Appendix C, part C-6.f). A Section 404(b) evaluation is included in this report in **Appendix F**.

8.3.6 State Historic Preservation Officer: National Historic Preservation Act (NHPA)

Consultation with the Florida State Historic Preservation Officer (SHPO) is ongoing in accordance with the National Historic Preservation Act of 1966, as amended, and as part of the requirements and consultation processes contained within the NHPA implementing regulations of 36 CFR 800. In a letter dated February 28, 2012, SHPO concurred with the USACE finding of no historic properties for use of the shoreline. This project is also in consultation with respect to the Archeological Resources

Protection Act (96-95), Native American Graves Protection Act (PL 101-601, American Indian Religious Freedom Act (PL 95-341), Executive Orders (E.O) 11593, 13007, & 13175, and the Presidential Memo of 1994 on Government to Government Relations. The current project has been briefed to the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida as part of the district's annual face-to-face meetings on cultural resources that have been occurring since 2010. Additional cultural resource survey and consultation with the SHPO and appropriate federally-recognized tribes will be needed for areas within the borrow areas and nearshore. Consultation related to the borrow area is ongoing.

8.3.7 National Environmental Policy Act

Pursuant to part 11 of ER 200-2-2 and 40 CFR 1501.4(e), a Finding of no Significant Impact (FONSI) is subject to a Notice of Availability. For a feasibility study and certain other actions, a 30-day comment period is required.

The draft EA and FONSI was circulated for a minimum 30-day review on January 17, 2014 to concerned agencies, organizations, and interested parties. Comments and responses received in response to the 30-day review are noted in **Appendix G**.

8.4 Scoping

8.4.1 Scoping Letter

In formulation and evaluation of the project, specific input from environmental agencies and the public were solicited through numerous means, including the following:

- A scoping letter was mailed to all Federal, state, and local agencies; local libraries; and all abutting property owners on August 26, 2008.
- A Notice of Intent to prepare a Draft Environmental Impact Statement was published in the Federal Register on August 26, 2008.

8.4.2 Public Scoping Meeting

A public scoping meeting was held in Bunnell, Flagler County, Florida on October 25, 2011 in fulfillment of NEPA requirements at which several viewpoints were presented including those for and against a coastal storm damage reduction project.

The following issues were identified to be relevant to the proposed action and appropriate for detailed evaluation:

- Vegetation
- Threatened and endangered species
- Fish and wildlife resources
- Essential fish habitat
- Coastal barrier resources
- Water quality
- Air quality
- Noise
- Aesthetic resources
- Recreation resources;
- Navigation
- Historic and cultural resources
- Native Americans
- Socio-economics
- Public safety

As mentioned in Section 8.2, a Feasibility Scoping Meeting (FSM) was held by the SAJ District Planning Division staff to discuss the study on January 28, 2011. A study overview presentation was provided by the SAJ District via web-meeting. The sponsor and various resource agencies provided their comments and input on the study, and the important issues identified from the USACE HQ Office of Water Project Review (OWPR) comments were discussed in detail.

8.5 Notice of Availability (NOA) of Draft Environmental Assessment (EA)

Notification of the Draft Integrated Feasibility Study and Environmental Assessment for public review and comment was issued on January 17, 2014.

8.5.1 Public Workshop on Draft Environmental Assessment (EA)

A public workshop on the Draft Integrated Feasibility Study and Environmental Assessment was held in Bunnell, Florida on February 5, 2014 from 6pm to 8pm. The recorded transcripts from this meeting can be found in **Appendix G**.

8.5.2 Comments on the Draft Environmental Assessment (EA) from the General Public

The original 30-day comment period was extended at the request of several members of the public, and comments and questions were received from January 17, 2014 through March 15, 2014. All of the comments and questions along with a

summary table that includes responses can be found in **Appendix G**. Most of the comments were opposed to the project and to the study in general while only a couple of comments received were in support of the project.

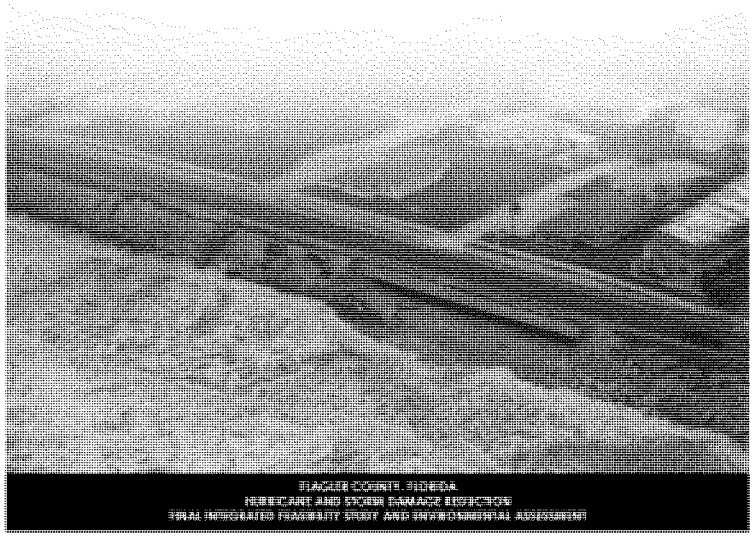
8.5.3 Comments on the Draft Environmental Assessment (EA) from Agencies

Comments and questions on the Draft Integrated Feasibility Study and Environmental Assessment from the invested resource agencies in response to the notice of availability (NOA) were received from January 17, 2014 through March 15, 2014. The Bureau of Ocean Energy Management (BOEM) was the only Federal agency to submit comments. Comments were received from state agencies including the Florida Fish and Wildlife Conservation Commission (FWC), the Florida Department of Environmental Protection (FDEP), and the Florida Department of Transportation (FDOT). All of the agency comments are included in **Appendix G**. None of the agencies that commented were in opposition to the project.

8.6 Mailing List of Recipients

A complete and specific mailing list of recipients is included in **Appendix F**.

CHAPTER 9
RECOMMENDATIONS



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9 RECOMMENDATIONS

I have given consideration to all significant aspects in the overall public interest including engineering feasibility, economic, social, cost and risk analysis, and environmental effects. The Recommended Plan described in this final report provides the optimum solution for shore protection benefits within the study area that can be developed with the framework of the formulation concepts. Implementation of the Hurricane and Storm Damage Reduction (HSDR) project for Flagler County, Florida is recommended at this time, with such modification as in the discretion of the Commander, Headquarters, U.S. Army Corps of Engineers (HQUSACE), may seem advisable.

The identified Recommended Plan is the National Economic Development (NED) plan, consisting of a ten-foot dune extension including a 10-foot sacrificial berm in Reach C, between FDEP R-monuments R80 and R94 in central Flagler Beach. The Recommended Plan covers 2.6 miles of shoreline length and mainly prevents damage to SR A1A. In addition to the NED benefits associated with reducing damages to infrastructure, the recommended plan will also have non-monetary benefits for environmental quality and other social effects.

Construction of the identified Recommended Plan will use a sand borrow source located seven miles offshore of the project site in territorial waters. The identified plan will most likely be constructed with a dredge and land based equipment typically used for beach nourishment projects. Initial construction will require approximately 415,800 cubic yards of sand from the borrow area (330,000 cubic yards for placement), and each periodic nourishment event will require approximately 403,000 cubic yards from the borrow area (320,000 cubic yards for placement). The renourishment interval is expected to be approximately 11 years, equaling 4 renourishment events in addition to initial construction over the 50-year period of Federal participation.

9.1 Draft Items of Local Cooperation

Recommendations for provision of Federal participation in the Recommended Plan described in this report would require the project sponsor to enter into a written Project Partnership Agreement (PPA), as required by Section 221 of Public Law 91-611, as amended, to provide local cooperation satisfactory to the Secretary of the Army. Such local cooperation shall provide the following non-federal responsibilities:

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs

assigned to protecting undeveloped private lands and other private shores which do not provide public benefits and as further specified below:

(1) Enter into an agreement that provides, prior to construction, 35 percent of design costs;

(2) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of any relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, and operation and maintenance of the project; in particular, the Federal Government and the project sponsor shall coordinate with the Bureau of Ocean Energy Management (BOEM) for use of offshore borrow areas and provide a copy of the lease agreement to the Federal Government;

(3) Provide, during construction, any additional amounts as are necessary to make their total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting public park lands, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;

b. For so long as the project remains authorized, operate, maintain, and repair the completed project, or functional portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and state laws and regulations, and any specific directions prescribed by the Federal Government;

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-federal sponsor of responsibility to meet the non-federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, mitigation, operation, maintenance, repair, replacement, and rehabilitation of the project and any project related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform

Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601 9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-federal sponsor with prior specific written direction, in which case the non-federal sponsor shall perform such investigations in accordance with such written direction;

g. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

h. Agree that the non-federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. If applicable, 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 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, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600 7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract

Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*);

k. Provide the non-federal share of that portion of the costs of data recovery activities associated with historic preservation, that are in excess of 1% of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

l. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

m. Do not use Federal funds to meet the non-federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized;

n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the project;

o. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

q. For so long as the project remains authorized, the non-federal sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based;

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

s. Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the Federal Government; and

u. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires the non-federal sponsor to participate in and comply with applicable Federal floodplain management and

flood insurance programs, prepare a floodplain management plan within one year after the date of signing the project partnership agreement (PPA), and implement the plan no later than one year after project construction is complete.

9.2 Disclaimer

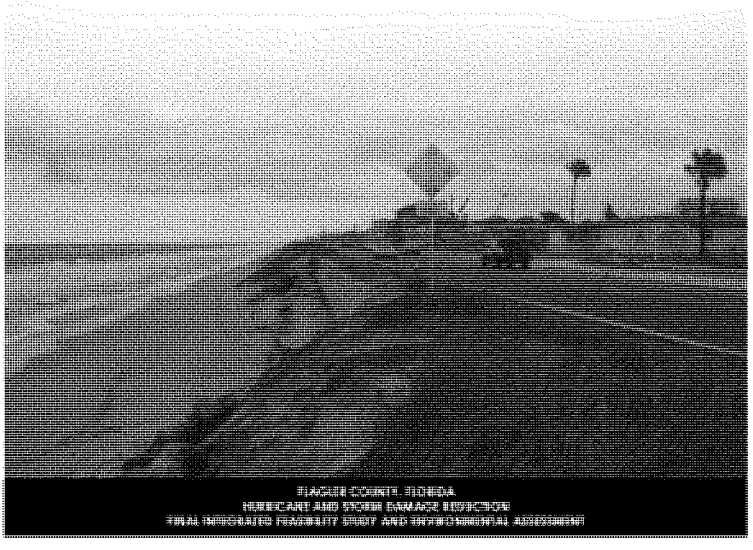
The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective 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. The recommendations herein for provision of a hurricane and storm damage reduction project for Flagler County, Florida, do not include any provisions for work which would result in any new Federal expenditures or financial assistance prohibited by the Coastal Barrier Resources Act (Public Law 97-348); nor were funds obligated in past years for this project for purposes prohibited by this Act.

9.3 Certification of Public Accessibility

As part of the obligations established in the project partnership agreement (PPA) for the Flagler County, Florida, Hurricane and Storm Damage Reduction (HSDR) Project, the non-federal sponsor shall assure continued conditions of public ownership and public use of the shore upon which Federal participation is based during the economic life of the project. The non-federal sponsor shall also provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms. In the determination of the Federal interest in cost sharing, Federal participation was limited to areas where adequate parking and access are available. For shoreline reaches farther than ¼ mile from public parking and/or beach access points, Federal participation was not provided. The maximum Federal participation allowable for each land use category is applied for cost sharing. I therefore conclude that there is reasonable public availability of the project beaches in all areas where Federal participation is provided.

Alan M. Dodd
Colonel, U.S. Army
District Engineer

CHAPTER 10
LIST OF PREPARERS



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10 LIST OF PREPARERS

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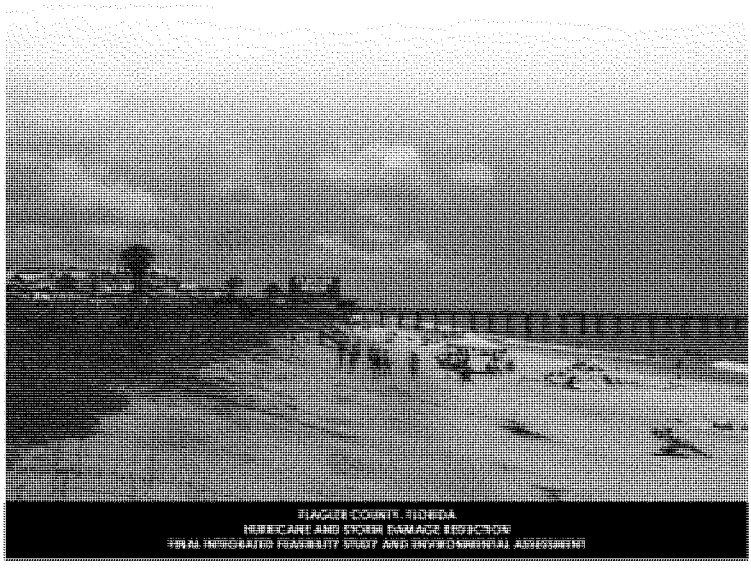
CHAPTER 11
REFERENCES AND INDEX



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Allen, Ginger M., Main M.B. 2005. *Florida's Geological History*. University of Florida IFAS Extension WEC 189, Gainesville, FL

Barnes, R.D. 1974. *Invertebrate Zoology*. Saunder's International Student Edition (second ed). Saunder's College Publishing, Philadelphia, PA.

Bush, D.M., W.J. Neal, N.J. Longo, K.C. Lindeman, D.F. Pilkey, L. Slomp Esteves, J.D. Congleton, and O.H. Pilkey. 2004. *Living with Florida's Atlantic Beaches: Coastal Hazards from Amelia Island to Key West*. Duke University Press. Durham, North Carolina

CH2MHill. 2010. *SR A1A Project Development and Environmental (PD&E) Study Final Summary Report.* Prepared for the U.S. Department of Transportation Federal Highway Administration and Florida Department of Transportation District 5. CH2MHill. Orlando, FL

Conant, T.A., P.T. Dutton, T. Eguchi, S. P. Epperly, C.C. Fahy, M.H. Godfrey, S. L. MacPherson, E.E. Possardt, B. A. Schroeder, J.A. Seminoff, M.L. Snover, C. M. Upite, B.E. Witherington. 2009. *Loggerhead Sea Turtle (Caretta caretta) 2009 Status Review Under the Endangered Species Act.* National Marine Fisheries and U.S. Fish and Wildlife Service Loggerhead Biological Review Team

Day, T. 2008. *Ecosystems: Oceans*. Revised edition. Facts on File of Infobase Publishing. New York, NY

Dean, C. 1999. *Against the tide: the battle for America's beaches.* Columbia University Press. New York, NY.

Dean, R.G, T.Y. Chiu, and S.Y. Wang. 1987. *Combined Total Storm Tide Frequency Analysis for Flagler County, Florida.* Institute of Science and Public Affairs, Florida State University, Tallahassee, FL and Division of Beaches and Shores, Department of Natural Resources (now known as Office of Beaches and Coastal Systems, FDEP), Tallahassee, FL

Dean, A.D. and J.T. Schaefer. 1987. *PDS Watches: How dangerous are these "Particularly Dangerous Situations?"* Cooperative Institute for Mesodcale Meterological Studies, University of Oklahoma, Norman, OK and NOAA/NWS Storm Prediction Center, Norman, OK

Dickerson, C., Reine, K.J., and Clarke, D.G. 2001. Characterization of underwater sounds produced by bucket dredging operations, DOER Technical Notes Collection (ERDC TN-DOER-E14), U.S. Army Engineer Research and Development Center, Vicksburg, MS. www.wes.army.mil/el/dots/doer.

Dial Cordy and Associates. 2011. *Flagler County (Florida) Nearshore Hardbottom Survey).* Dial Corsy and Associates, Jacksonville Beach, FL

Dobbs, F.C., and J.M. Vozarik. 1983. *Immediate effects of a storm of coastal infauna.* Marine Ecology Progress Series. Vol 11:273 – 279. Northeast Utilities Environmental Laboratory, Waterford, CT

Dompe, P. E. and D. M. Haynes. 1993. *Turbidity Data: Hollywood Beach, Florida, January 1990 to April 1992.* Coastal & Oceanographic Engineering Department, University of Florida: Gainsville, FL. UFL/COEL - 93/002.

Donoghue, C.T. 1999. *The Influence of Swash Processes on Donax variabilis and Emerita talpoida.* Graduate Dissertation, University of Virginia, Department of Environmental Sciences

Elliott-Smith, E., S.M. Haig, and B.M. Powers. 2009. *Data from the 2006 International Piping Plover Census.* U.S. Geological Survey Data (USGS) Series 426, 322 p. U.S. Department of Interior. Reston, VA

Florida Department of Environmental Protection (FDEP). 1999. *Shoreline Change Rate Estimates, Flagler County.* Florida Department of Environmental Protection Office of Beaches and Coastal Systems. Tallahassee FL Publication No. BCS-99-02

Florida Department of Environmental Protection (FDEP). 2001. *Strategic Beach Management Plan for Northeast Atlantic Coast Region.* Florida Department of Environmental Services, Office of Beaches and Coastal Systems, Tallahassee, FL

Florida Department of Environmental Protection (FDEP). 2008a. *Strategic Beach Management Plan for Northeast Atlantic Coast Region.* Florida Department of Environmental Services, Office of Beaches and Coastal Systems, Tallahassee, FL

Florida Department of Environmental Protection (FDEP). 2008b. *Critically Eroded Beaches in Florida.* Florida Department of Environmental Services, Office of Beaches and Coastal Systems, Tallahassee, FL

Florida Department of Environmental Protection (FDEP). 2010. *Chapter 62-302 Surface Water Quality Standards.* Florida Administrative Code. Effective Date: 5 August, 2010

Florida Department of Environmental Protection (FDEP). (2008c) *Outdoor Recreation in Florida – 2008.* Florida's Statewide Comprehensive Recreation Plan (SCORP). Division of Recreation and Parks Tallahassee, FL

Florida Division of Emergency Management (FDEM) and Northeast Florida Regional Council. *2010 Florida Statewide Regional Evacuation Study.* Regional Evacuation Study, Northeast Florida Region.

Florida Natural Areas Inventory (FNAI). 2010. *Guide to the natural communities of Florida: 2010 edition.* FNAI, Tallahassee, FL

Gilmore, R.G., Jr., C.J. Donohoe, D.W. Cooke, and D.J. Herrema. 1981. *Fishes of the Indian River Lagoon and adjacent waters.* Harbor Branch Tech. Rep. No. 41. 64 pp.

Gilmore, R.G., Jr. 2001. *The origin of Florida fish and fisheries.* Proc. Gulf Carib. Fish. Inst. 52:713-731.

Greene, C.R.J. and S.E. Moore. 1995. Man-made noise. Pp 101-158 in Marine Mammals and Noise. W.J. Richardson, C.R.J. Greene, C.I. Malme and D.H. Thomson (ed.), Academic Press, San Deigo.

Hains, J. 2005 – 2012. *Monitoring of Endangered Right Whales in Coastal Waters of Norteastern Florida by a Volunteer-Based Citizens Network: Southeastern U.S. Season.* Associated Scientists at Wood Hole and the Marineland Right Whale Project. Woods Hole, MA

Halcrow, Inc. 2010. *City of Flagler Beach, Flagler Beach Shore Protection Project, Feasibility Sand Search Report.* In association with: Coastal Technology Corporation and Dial Cordy & Associates.

Hildebrand, J. 2004. Sources of anthropogenic sound in the marine environment. In E. Vos and R.R. Reeves (eds.) Report of an International Workshop: Policy on Sound and Marine Mammals, 28–30 September 2004, London, England 23 December 2005. U.S. Marine Mammal Commission, London, England.

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* (Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller, eds.) Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. (http://ipcc-wg1.ucar.edu/wg1/wg1-report.html)

JASCO Applied Sciences (JASCO), 2011. *Underwater Acoustics: Noise and the Effects on Marine Mannals,* 3rd ed. compiled by C. Erbe. Victoria, British Columbia and Dartmouth, Nova Scotia, Canada.

Jordan, L. B. K., K. W. Banks, et al. 2010. "Elevated sedimentation on coral reefs adjacenet to a beach nourishment project." Marine Pollution Bulletin 60: 261-271.

Kolasa, K.V., and V. Craw. 2009. *Improving Seagrass Maps of Florida's Springs Coast Through Digital Imagery.* Southwest Florida Water Management District, Resource Projects Department. Brooksville, FL.

Leiendecker, L. 2007. *Evaluation of Current Indicators of Water Safety for Coastal Recreational Waters.* Master Thesis Submittal, Nicholas School of the Environment and Earth Sciences of Duke University

Limpus, C.J., J.D. Miller, J. Parmenter, D. Reimer, N McLachland, and R. Webb. *Migration of Green (Chelonia mydas) and Loggerhead (Caretta caretta) Turtles to and From Eastern Australian Rookeries.* Wildlife Research 19:347 - 358

Lindeman, K.C., R. Pugliese, G.T. Waugh, and J.S. Ault. 2000. *Developmental patterns within a multispecies reef fishery: Management applications for essential fish habitats and protected areas.* Bull. Mar. Sci. 66(3):929-956.

Lindeman, K.C. and D.B. Snyder. 1999. *Nearshore hardbottom fishes of southeast Florida and effects of habitat burial caused by dredging.* Fish. Bull. 97:508-525.

Lohmann, K.T., J.T. Hester, and C.M.F. Lohmann. 1999. *Long-distance navigation in sea turtles.* University of North Carolina. Ethology Ecology and Evolution 11:1-23

Marine Aggregate Levy Sustainability Fund (MALSF). 2009. *A generic investigation into noise profiles of marine dredging in relation to the acoustic sensitivity of the marine fauna in UK waters with particular emphasis on aggregate dredging: PHASE I Scoping and review of key issues.* MEPF Ref No: MEPF 08/P21. CEFAS contract report C3312 http://www.cefas.co.uk/media/462318/mepf-08-p21%20final%20report%20published.pdf.

Modde, T. and S.T. Ross. 1983. *Trophic relationships of fishes occurring within a surf zone habitat in the northern Gulf of Mexico.* NE Gulf Sci. 6:109-120.

Myers, R. L., J.J. Ewel. 1990. *Ecosystems of Florida.* University of Central Florida, Orlando, FL. 337 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1992a. *Recovery Plan for the Kemp's Ridley Sea Turtle (Lepidochelys kempii).* National Marine Fisheries Service, St. Petersburg, FL. 40 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1992b. *Recovery Plan for Leatherback Turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico.* National Marine Fisheries Service, Washington, DC. 65 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1993. *Recovery Plan for Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico.* National Marine Fisheries Service, St. Petersburg, FL, 47 pp.

National Marine Fisheries Service. 1999. *Fishery Management Plan for Atlantic tunas, swordfish, and sharks, Volume II .* National Marine Fisheries Service Division of Highly Migratory Species, Office of Sustainable Fisheries, Silver Spring, MD. 302 pp.

National Research Council (NRC). 1995. *Beach Nourishment and Protection.* National Academy Press. Washington, D.C.

National Marine Fisheries Service (NMFS). 2005. *Recovery Plan for the North Atlantic Right Whale (Eubalaena gracialis).* National Marine Fisheries Service Office of Protected Resources.

National Marine Fisheries Service (NMFS). 1991. *Recovery Plan for U.S. Population of Atlantic Green Turtle (Chelonia mydas).* Loggerhead/Green Turtle Recovery Team, National Marine Fisheries Service. Southeast Region Atlanta, GA, and Washington D.C.

Nelson, W.G. 1985. *Physical and biological guidelines for beach restoration projects. Part I, Biological guidelines.* Florida Sea Grant College, Report No. 76. 65 pp.

Peters, D.J. and W.G. Nelson. 1987. *The seasonality and spatial patterns of juvenile surf zone fishes of the Florida East coast.* Fla. Sci. 50(2):85-99.

Postal, M., K. Joiner, and T. Lilly. 2010. *The Likelikhood of Shore Protection along the Atlantic Coast of the United States; Vol 2: New England and the Southeast.* Included in *Northeast Florida.* James G. Titus, Daniel L Trescott, and Daniel E. Hudgens (eds). Report to the U.S. Environmental Protection Agency. Washington, D.C.

Randazzo, A.F., and D.S. Jones, eds. 1997. *The Geology of Florida*, University Press of Florida, Gainesville, FL

Ross, S.T. 1983. A review of surf zone ichthyofauna in the Gulf of Mexico, pp. 25-34. In: S.V. Shabicam, N.B. Cofer, and S.V. Cake, Jr. (eds.), Estuaries and Barrier Islands Conference. U.S. Department of the Interior, National Park Service, Southeast Regional Office, Atlanta, GA.

Smith, N.P. 1983. Temporal and spatial characteristics of summer upwelling along Florida's Atlantic shelf. J. Phys. Oceanogr. 13(9):1,709-1,715.

South Atlantic Fishery Management Council (SAFMC). 1998. *Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region.* South Atlantic Fishery Management Council, Charleston, SC.

Shrober, A.L. and T. Obreza. 2008. *Soils & Fertilizers for Master Gardeners: Soil Formation in Florida.* Revised January 2009. Reviewed February 2012. Document No. SL274, Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Available at website: http://edis.ifas.ufl.edu.

Sweatman, H.P.A. 1993. *Tropical snapper (Lutjanidae) that is piscivorous at settlement.* Copeia 1137-1139.

Taylor Engineering, Inc. 2002. *State Road A1A Shore Protection Evaluation Flagler Beach, Flagler County, Florida.*

Taylor, W.K. 1998.*Florida Wildflowers in their Natural Communities.* University Press of Florida. Gainesville, FL

U.S. Army Corps of Engineers (USACE). 1980. *Flagler County, Florida. Beach Erosion Control and Hurricane Protection Reconnaissance Report.* USACE Jacksonville District.

U.S. Army Corps of Engineers (USACE). 1982. *Section 14 Study, Flagler Beach, Flagler County, Florida.* USACE Jacksonville District.

U.S. Army Corps of Engineers (USACE). 1988. Flagler County, Florida Shore Protection Study Reconnaissance *Report.* USACE Jacksonville District.

U.S. Army Corps of Engineers (USACE). 2000. *Planning Guidance Notebook.* USACE CECW-P Washington, D.C. Publication No. ER 1105-2-100

U.S. Army Corps of Engineers (USACE). 2008. *Project Inspection Report: Flagler County, Florida Federal Shore Protection Project*. USACE Jacksonville District

U.S. Army Corps of Engineers (USACE). 2009. *Post Storm inspection Report, Flagler County, Florida, Federal Feasibility Study.* USACE Jacksonville District.

U.S. Army Corps of Engineers (USACE). 2013. *Incorporating Sea Level Change in Civil Works Programs* USACE CECW-CE Washington D.C. Engineering Regulation No. ER 1100-2-8162

U.S. Army Corps of Engineers (USACE). 2011. *Sea Level Change Considerations for Civil Works Programs* USACE CECW-CE Washington D.C. Publication No. EC 1165-2-212

U.S. Army Corps of Engineers (USACE). 2009. *Water resource policies and authorities: Incorporating sea-level change considerations in civil works programs.* USACE CECW-CE Washington D.C. Publication No. EC 1165-2-211

U.S. Army Corps of Engineers (USACE) Engineering Research and Development Center (ERDC) (Lott, C. A.) 2009. *Distribution and Abundance of Piping Plovers (Charadrius melodus) and Snowy Plovers (Charadrius alexanddrinus) on the West Coast of Florida Before and After the 2004/2005 Hurricane Seasons.* Publication No. ERDC/EL TR-09-13.

U.S. Environmental Protection Agency (EPA). 1986. *Ambient Water Quality Criteria for Bacteria.* Office of Water Regulations and Standards, Criteria and Standards Division, Washington D.C. Publication No. EPA 440/5-84-002

U.S. Fish and Wildlife Service (FWS). 2008. *Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (Caretta caretta).* Second Revision. National Marine Fisheries Service and U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service (FWS). 2009. *Biological opinion to FL Department of Transportation (FDOT), based on review of proposed SR A1A shoreline stabilization.* U.S. Fish and Wildlife Service, Department of the Interior, Washington D.C. and Northeast FL Field Office, Jacksonville, FL

U. S. Fish and Wildlife Service (FWS). 2009. *Piping Plover (Chardadrius melodus) 5-Year Review: Summary and Evaluation.* U.S. Fish and Wildlife Service Northeast Region, Hadley, MA and the Midwest Tegion's East Lansing Field Office, MI, contributions from North Dakota Field Office, Panama City, Florida Field Office, South Carolina Field Office, Corpus Christi, Texas Field Office

Vare, C.N., 1991. *A survey, analysis, and evaluation of the nearshore reefs situated off Palm Beach County, Florida*. Masters thesis, Florida Atlantic University.

Web-based References:

Flagler Audubon Society/Cornell Ornithology Lab: ebirds database (login/password required): http://ebird.org/ebird/MyEBird?cmd=lifeList&listType=US-FL-035&listCategory=allCounties&time=life

Federal Emergency Management Agency (FEMA). 2000. *Evaluation of Erosion Hazards*. Web address: http://www.heinzcenter.org

Florida Fish and Wildlife Conservation Commission (FWC) Florida Wildlife Research Institute (FWRI)
Marine turtle general Information:
http://myfwc.com/research/wildlife/sea-turtles/fl-sea-turtles/program/
Marine turtle mortality FWC FWRI Sea Turtle Stranding and Salvage Network (FLSTSSN):
http://myfwc.com/research/wildlife/sea-turtles/mortality/archived-stranding-data/
Marine turtle nesting data:
http://myfwc.com/research/wildlife/sea-turtles/nesting/

Florida Department of Health (DOH) 2004: Florida Healthy Beaches Program Website:
http://esetappsdoh.doh.state.fl.us/irm00beachwater/default.aspx

Holmberg Technologies, Inc. Copyright © 1999 – 2010, www.erosion.com.

K. W. Christensen. *Pressure Equalizing Modules (PEM), Environmentally friendly and cost-effective beach erosion control.* Website address: http://ecoshore.com

NOAA National Hurricane Center (NOAA NHC): Climatology
http://www.nhc.noaa.gov/climo/

NOAA National Marine Fisheries Service Protected Species Info/Factsheets:
Loggerhead Sea Turtle:
http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm
Green Sea Turtle: http://www.nmfs.noaa.gov/pr/species/turtles/green.htm
Kemp's ridley Sea Turtle:
http://www.nmfs.noaa.gov/pr/species/turtles/kempsridley.htm
Hawksbill Sea Turtle:
http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm
Leatherback Sea Turtle:
http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.htm
North Atlantic Right Whale:
http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/rightwhale_northatlantic.htm

Scenic A1A Pride Beach Management Committee, 2006
http://www.floridascenichighways.com/program/wp-content/uploads/2011/07/A1A_River_Sea_5YR_CMP_Update.pdf

Science Daily. 2009. *First Right Whale Sedation Enables Distanglement Effort* Web address:
http://www.sciencedaily.com/releases/2009/03/090311180335.htm

Science Daily. 2007. *Whales Entangled in Fishing Line: What can be done?* Web address: http://www.sciencedaily.com/releases/2007/04/070426143431.htm

U.S. Army Corps of Engineers Engineer (UASCE) Research & Development Center (ERDC) Coastal & Hydraulics Laboratory (CDL):
http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES;474
Wave Information Study (WIS) Hindcast Data download:
http://wis.usace.army.mil/wis.shtml

U.S. Environmental Protection Agency (EPA) Websites:
Aquatic Resources on National Importance (ARNI) Factsheet:
http://www.epa.gov/owow/wetlands/pdf/404g.pdf
Beaches Environmental Assessment and Coastal Heath (BEACH) Act 2000 (PUBLIC LAW 106–284 OCT. 10, 2000) Website access:
http://water.epa.gov/lawsregs/lawsguidance/beachrules/act.cfm
Beach Monitoring and Notification:
http://water.epa.gov/type/oceb/beaches/beaches_index.cfm/

U.S. Fish and Wildlife Service (FWS): Coastal Barrier Resources Act (CBRA) of 1982, access to Public Law (PL) 97-348:
http://www.fws.gov/laws/lawsdigest/COASBAR.HTML

University of Florida (UF): University of Florida Institute for Food and Agricultural Sciences (IFAS):

http://edis.ifas.ufl.edu/
ISB Florida Plant Atlas
http://florida.plantatlas.usf.edu/

U.S. Fish and Wildlife Service Endangered Species info/Factsheets
Piping Plover:
http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B079

Personal Communication with Bob Ridell (USACE). 18 March 2009. Maintenance dredging beach placement in St. Johns County 1992-Present.

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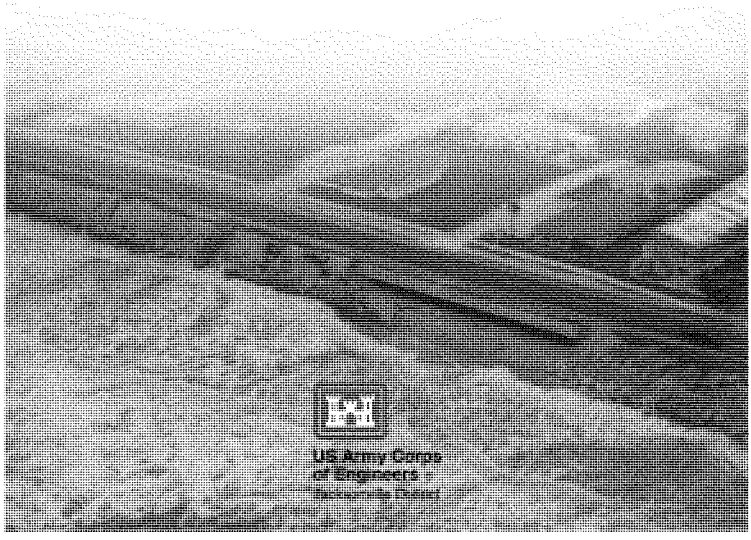
FLAGLER COUNTY, FLORIDA

HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FINAL INTEGRATED FEASIBILITY STUDY AND
ENVIRONMENTAL ASSESSMENT

Appendix A

Engineering



Flagler County Hurricane and Storm Damage Reduction Study

Final Integrated Feasibility Study and Environmental Assessment

Engineering Appendix

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Background

Flagler County is located on the northeast coast of Florida approximately midway between the Florida-Georgia state line and Cape Canaveral (Figure A- 1). The county is bounded to the north by St. Johns County and to the south by Volusia County. Flagler County has approximately 18 miles of sandy shoreline located on a coastal barrier island that varies in width from approximately 800 to 5,000 feet. The coast has no inlets or embayments and the beaches are typically fronted by steep dune faces or rock revetment. The Flagler County shoreline is subject to erosion caused by both and other natural shoreline processes. The purpose of this study is to assess the feasibility of providing Federal Hurricane and Storm Damage Reduction (HSDR) measures to portions of the Flagler County shoreline.

Four study reaches have been identified for Flagler County (Figure A- 1). One study reach (Marineland) is separate from the others, forming a north project segment. The Marineland reach extends from Florida Department of Environmental Protection (FDEP) DNR Monuments R-1 to R-4. The south project segment consists of the three remaining study reaches: Painters Hill (R-50 to R-60), Beverly Beach (R-60 to R-67), and Flagler Beach (R-67 to R-100). The purpose of this appendix is to document efforts related to the analysis of shoreline change and the design of remedial measures to alleviate beach erosion problems within the project area.

Problem Identification

In the past, beaches of Flagler County have generally experienced substantial erosion due to the combined effects of winds, waves, and tides. The severity of erosion in some areas is demonstrated by the presence of protective structures such as seawalls and revetments, and the absence of any beach seaward of those protective structures. The objectives of this appendix include quantification of existing beach erosion problems and the design of corrective measures. Quantification efforts involve analysis of historical shoreline positions, estimation of longshore transport rates, and prediction of cross-shore losses of beach material due to storms. The results of those efforts serve as the basis for the design and analysis of beach nourishment measures, which could be employed to reduce storm damage in the project area.

Natural Forces

Winds

Local winds are the primary means of generating the small-amplitude, short period waves that are an important mechanisms of sand transport along the Florida shoreline. Flagler County lies at about 29° degrees latitude, slightly north of the tropical trade wind zone. Winds in this region vary seasonally with prevailing winds ranging from the northeast though the southeast. The greatest velocities originate from the north-northeast quadrant in winter months and from the east-southeast quadrant in the spring, summer, and early fall.

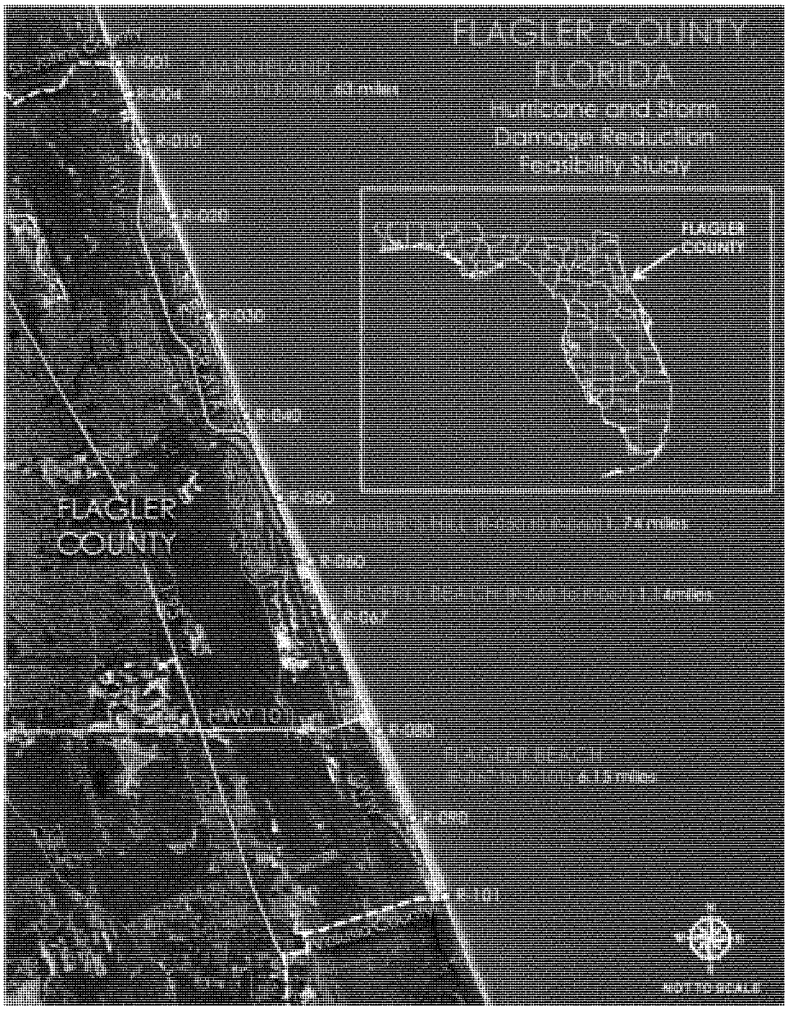

Figure A- 1. Flagler Project Location and Study Reaches

Wind data offshore of the project area is available from the USACE Wave Information Study (WIS) Program. WIS hindcast data are generated using the numerical hindcast model WISWAVE (Hubertz, 1992). WISWAVE is driven by wind fields overlaying a bathymetric grid. Model output includes significant wave height, peak and mean wave period, peak and mean wave direction, wind speed, and wind direction.

There are 523 WIS stations along the Atlantic Coast. WIS Station 63442 is representative of offshore deep water wind and wave conditions for the project area. Table A- 1 provides a summary of wind data from WIS Station 63422, located at latitude 29.58, longitude -81.0 (about 3 miles northeast of Flagler Beach - Figure A- 2). This table contains a summary of average wind speeds and frequency of occurrence broken down into eight 45 degree angle-bands. This table indicates that winds are fairly evenly distributed between the northeast and south directions. Due to its orientation, winds from the north-northeast to south-southeast have the most significant impact on the Flagler shoreline.

Table A- 1. Average Wind Conditions

Wind Direction (from)	WIS Station #63442 (1980 – 1999)	
	Percentage Occurrence (%)	Average Wind Speed (mph)
North	10.3	14.0
Northeast	15.3	13.4
East	14.6	11.1
Southeast	12.6	10.0
South	14.5	10.4
Southwest	13.4	10.9
West	9.5	13.3
Northwest	10.0	15.1

Wind conditions in Coastal Florida are seasonal. A further breakdown of the wind data provides a summary of the seasonal conditions (Table A- 2).

Between December and March, frontal weather patterns driven by cold Arctic air masses can extend as far as South Florida. These fronts typically generate northeast winds before the frontal passage, and northwest winds behind the front. This post-frontal "Northeaster" behavior is responsible for the increased intensity of wind speed seen in the northeast sector winds during the winter months. Northeasters may result in wave conditions that can cause extensive beach erosion and shorefront damage.

The summer months (June through September) are characterized by southeast trade winds and tropical weather systems traveling west to northwest in the lower latitudes. Additionally, daily breezes onshore and offshore result from differential heating of land and water masses. These diurnal winds typically blow perpendicular to the shoreline and have less magnitude than Trade winds and Northeasters. Daily breezes account for the general shift to east/southeast winds during the summer months when Northeasters no longer dominate.

During the summer and fall months, tropical waves may develop into tropical storms and hurricanes, which can generate devastating winds, waves, and storm surge when they impact the project area. These storms contribute greatly to the overall longshore and cross-shore sediment transport at the site. These intense seasonal events will be discussed in greater detail under **Storm Effects** (page A-8).

Table A- 2. Seasonal Wind Conditions

Month	WIS Station #63442 (1980 – 1999)	
	Average Wind Speed (mph)	Predominant Direction (from)
January	14.6	N-NE
February	14.6	N-NE
March	14.0	E
April	12.0	E
May	10.2	E-SE
June	9.5	S-SE
July	9.5	S-SE
August	9.3	S-SE
September	10.7	E-NE
October	13.2	E-NE
November	14.0	E-NE
December	13.8	N-NE

Waves

The energy dissipation that occurs as waves enter the nearshore zone and break is the principal method of sediment transport. Wave height and period, in combination with tides and storm surge, are the most important factors influencing the behavior of the shoreline. The Flagler County study area is exposed to both short period wind-waves and longer period open-ocean swells originating predominantly from north-northeast to south-southeast directions.

Damage to the Flagler County shoreline and upland development is attributable to large storm waves produced primarily by tropical disturbances, including hurricanes, during the summer months and by "northeasters" during the late fall and winter months.

Because the study area is fully exposed to the open ocean in all seaward directions, the coastline is vulnerable to wave attack from distant storms as well as local storms. Most hurricanes and tropical storms traversing northward through the Atlantic within several hundred miles of the east coast are capable of producing large swells. These swell can propagate long distances, causing erosion along the Flagler County shoreline.

Wave data for this report were obtained from the long-term USACE WIS hindcast database for the Atlantic coast of the U.S. This 20-year record extends from 1980 through 1999, and consists of a time-series of wave events at 3-hour intervals for stations located along the east and west coasts of the US, as well as the Gulf of Mexico and Great Lakes. The WIS station closest to the project area is #63442, located 3 miles offshore of the study area in 66 feet of water. The location of WIS station #63422 relative to the study area is shown in Figure A- 2.

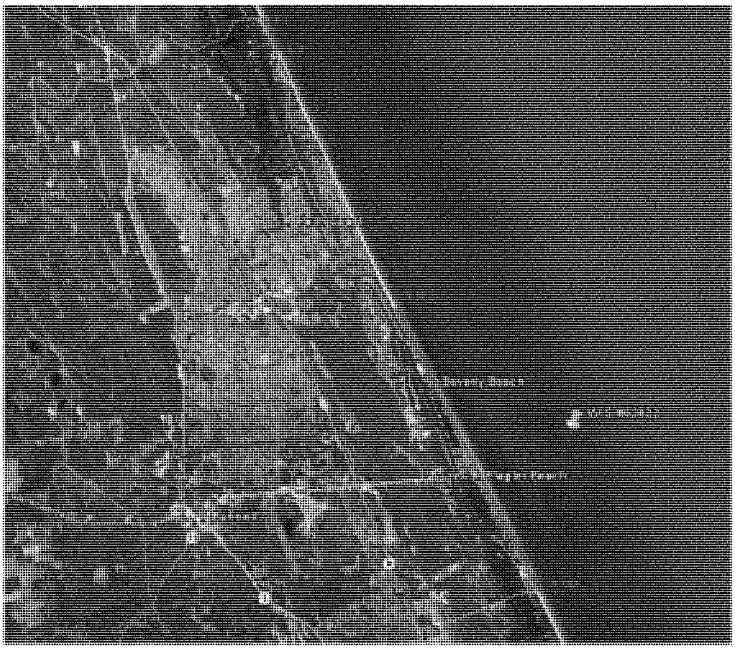

Figure A- 2. Location of WIS Station #63422 Relative to Project

Table A- 3 summarizes the percentage of occurrence and average wave height of the WIS waves by direction. It can be seen that the dominant wave directions range from northeast to southeast. This reflects both the open-ocean swell and more locally generated wind-waves.

Similar to wind conditions, wave conditions in Coastal Florida experience seasonal variability. The seasonal breakdown of wave heights provided in Table A- 4 shows that late fall and winter months have an increase in wave height due to Northeaster activity. The intensity and direction of these fall/winter wave conditions are reflected in the dominant southward sediment transport and seasonal erosional patterns in the project area. In contrast, summer months experience milder conditions, with smaller wave heights. Overall, waves originating from the east to northeast quadrant dominate.

Table A- 3. Average Wave Heights (1980 to 1999)

Wind Direction (from)	WIS Station #63422 (1980-1999)	
	Percentage Occurrence (%)	Average Wave Height (ft)
North	9	4.5
Northeast	24	4.5
East	51	3.3
Southeast	12	2.7
South	2	3.1
Southwest	1	2.9
West	0	3.0
Northwest	2	3.6

Table A- 4. Seasonal Wave Conditions

Month	WIS Station #63422 (1980-1999)	
	Average Wave Height (ft)	Predominant Direction (from)
January	4.09	E-NE
February	4.07	E-NE
March	3.83	E-NE
April	3.33	E-NE
May	3.04	E-NE
June	2.61	E
July	2.24	E-SE
August	2.79	E
September	3.81	E-NE
October	4.58	E-NE
November	4.53	E-NE
December	4.15	E-NE

Wave periods have the same seasonality as wave heights. Table A- 5 provides a seasonal breakdown of percent occurrence by wave period. From this table, it can be seen that short period, locally-generated wind waves are common throughout the year. The yellow highlighted values show the dominant wave period for each month. None of these dominant periods are less than 5.0 seconds or greater than 6.0 seconds. It can also be seen that in the summer months the shortest period waves occur more frequently. During the fall and winter months more frequent higher-energy, longer-period storm swells occur. Note that the percentage of waves with period greater than 12.0 seconds increases from a low of 0.3% in June to a high of 13.4% in September (the height of hurricane season).

Table A- 5. Wave Period – Percent Occurrence

Wave Period	Percent Occurrence by Wave Period Band											
(Sec)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
< 4.0	6.0	5.2	6.2	6.7	5.0	8.3	10.0	5.3	3.1	1.3	3.2	4.4
4.0 - 4.9	10.1	10.8	10.5	9.6	8.0	4.2	3.8	4.4	6.2	4.0	7.0	8.3
5.0 - 5.9	18.3	22.1	20.0	22.0	25.2	36.2	37.3	40.3	26.9	24.9	20.5	21.5
6.0 - 6.9	12.5	13.5	14.3	15.0	19.2	24.7	28.7	25.3	17.9	21.6	17.3	15.5
7.0 - 7.9	13.5	14.4	14.5	13.6	19.1	14.8	13.4	12.2	12.0	16.3	14.9	11.9
8.0 - 8.9	7.9	6.8	6.5	7.3	5.4	3.9	2.4	1.8	4.9	5.8	8.5	5.6
9.0 - 9.9	8.4	8.0	6.6	7.0	5.1	3.3	1.8	1.3	4.6	6.8	7.0	5.7
10.0 - 10.9	8.0	6.3	6.2	5.9	4.4	3.0	1.3	1.6	5.0	6.1	6.8	8.1
11.0 - 11.9	6.2	5.8	6.1	6.3	5.0	1.4	1.0	2.0	6.0	6.2	6.9	7.1
> 12.0	9.1	7.4	9.3	6.7	3.6	0.3	0.4	5.8	13.4	7.1	7.9	11.9

Tides and Currents

Astronomical tides are created by the gravitational pull of the moon and sun and are entirely predictable in magnitude and timing. The National Oceanic and Atmospheric Administration (NOAA) regularly publishes tide tables for selected locations along the coastlines of the Unites States and selected locations around the world. These tables provide times of high and low tides, as well as predicted tidal amplitudes.

Tides in the Flagler County area are semidiurnal: two high tides and two low tides per tidal day (24 hours 50 minutes). Two measures of tidal range are commonly used: the mean tide range is defined as the difference between Mean High Water (MHW) and Mean Low Water (MLW), and represents an average range during the entire lunar cycle (27.3 days); and, the spring tide range is the average semidiurnal range which occurs semimonthly when the moon is new or full. The semidiurnal tides around Flagler Beach exhibit a mean tidal range of 3.64ft..

Presently, the nearest tide station to the project on the ocean side of the island is NOS Station 8720692 (State Road A1A Bridge), located at Matanzas Inlet approximately 17 miles north of Flagler Beach. The nearest tide station on the intracoastal side of the island is NOS Station 8720833 (Smith Creek, Flagler Beach), located directly west of Flagler Beach. Table A- 6 summarizes tidal data from both stations.

Table A- 6. Tidal Datums

Tidal Datum	Elevation Relative to MLLW	
	State Road A1A	Smith Creek
Mean High Water (MHW)	3.80	0.94
North Americal Vertical Datum (NAVD88)	2.28	0.78
Mean Tide Level (MSL)	1.95	0.52
Mean Low Water (MLW)	0.16	0.07
Mean Lower Low Water (MLLW)	0.00	0.00

The primary ocean current in the project area is the Florida Gulf Stream. With the exception of intermittent local reversals, it flows northward. The average annual current velocity is approximately 28 miles per day, varying from an average monthly low of 17 miles per day in November to an average monthly high of approximately 37 miles per day in July. The Gulf Streams lies approximately 60 miles offshore of the project area.

The near-shore currents in the project vicinity are not directly influenced by the Gulf Stream, but may be influenced indirectly via interaction with incident waves. Littoral currents affect the supply and distribution of sediment on the sandy beaches of Flagler County. Longshore currents, induced by oblique wave energy, generally determine the long-term direction and magnitude of littoral transport. Cross-shore currents may have a more short term impact, but can result in both temporary and permanent erosion. The magnitude of these currents is determined by the wave characteristics, angle of waves from offshore, configuration of the beach, and the nearshore profile. For Flagler County beaches, the net sediment transport is from north to south. This is due to the dominant wave activity from the northeast during the fall and winter months, particularly northeaster storms.

Influence of Matanzas Inlet (2.4 miles to the north) and Ponce de Leon Inlet (27 miles to the south) ebb and flood currents on local currents is negligible. In both cases the distance between the inlet and the project area places the project outside the influence of inlet tidal fluctuations.

Storm Effects

The shoreline of Flagler County is influenced by tropical systems during the summer and fall and by northeasters during the late fall, winter, and spring. Although hurricanes typically generate larger waves and storm surge, northeasters often have a greater impact on the shoreline because of longer duration and greater frequency.

During intense storm activity, the shoreline is expected to naturally modify its beach profile. Storms erode and transport sediment from the beach into the active zone of storm waves. Once caught in the waves, this sediment is carried along the shore and re-deposited farther down the beach, or is carried offshore and stored temporarily in submerged sand bars. Periodic and unpredictable hurricanes and coastal storms, with their fierce breaking waves and elevated water levels, can change the width and elevation of beaches and accelerate erosion. After storms pass, gentle waves usually return sediment from the sand bars to the beach, which is restored gradually to its natural shape. While the beach profile typically recovers from storm energy as described, extreme storm events may cause sediment to leave the beach system entirely, sweeping it into inlets or far offshore into deep water where waves cannot return it to the beach. This may cause a permanent increase in the rate of shoreline recession.

Flagler County is located in an area of significant hurricane activity. Figure A- 3 shows historic tracks of hurricanes and tropical storms from 1858 to 2008, as recorded by the National Hurricane Center (NHC) and available from the National Oceanic and Atmospheric Administration (http://csc.noaa.gov/hurricanes/#). The shaded circle in the center of this figure indicates a 50-nautical

mile radius (encompassing the entire Flagler county shoreline) from the center of the study area. Based on NHC records, 62 hurricanes and tropical storms have passed within this 50-mile radius over the 151-year period of record. Based on this chart, it can be seen that hurricanes and tropical storms pass within 50 nautical miles of the study area approximately every 2.4 years.

The 50-mile radius was chosen for display purposes in Figure A- 3 because any tropical disturbance passing within this distance, even a weak tropical storm, would be likely to produce some damage along the shoreline. Stronger storms are capable of producing significant damage to the coastline from far greater distances.

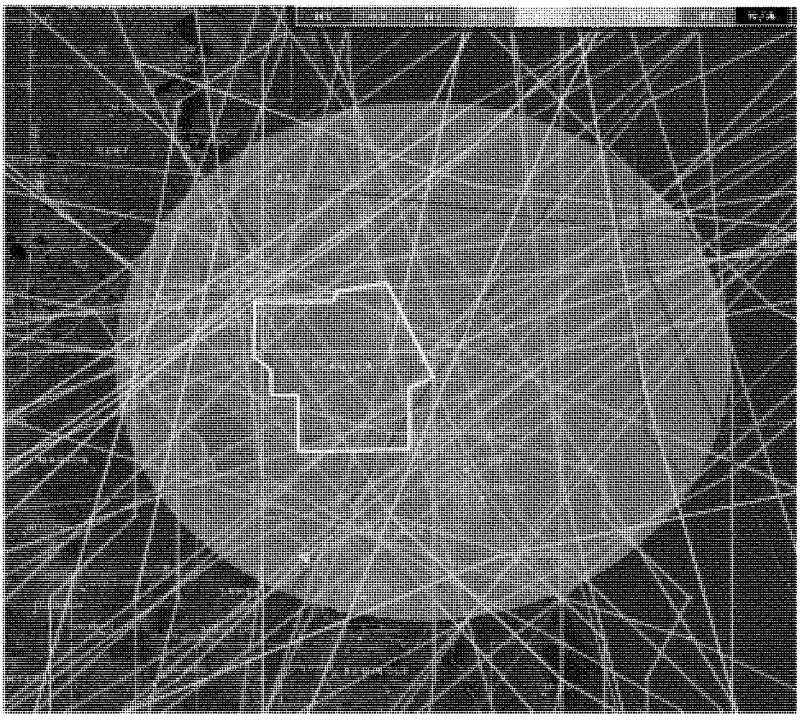

Figure A- 3. Historic storm tracks – Hurricanes and Tropical Storms (1858 – 2008, 50 mile radius)

In recent years, a number of named storms, passing within the 50 mile radius have significantly impacted the project area, including tropical storms Leslie (2000), Edouard (2002), Henri (2003), Charley (2004), Tammy (2005), and Fay (2008). Damages from these storms, as well as from more distant storms causing indirect impacts (Dennis, Floyd, and Irene in 1999; Gabrielle in 2001; Frances and Jeanne in 2004), included substantial erosion and damage from wind, wave, and water action.

Since the study area is exposed to the open ocean from northeast to southeast, the coastline is vulnerable to wave attack from distant storms as well. Most hurricanes and tropical storms traversing northward through the Atlantic passing within several hundred miles of the east coast are capable of producing large swells which are capable of causing erosion along the Flagler County shoreline.

Storm Surge

Storm surge is defined as the rise of the ocean surface above its astronomical tide level due to storm forces. Surges occur primarily as a result of atmospheric pressure gradients and surface stresses created by wind blowing over a water surface. Strong onshore winds pile up water near the shoreline, resulting in super-elevated water levels along the coastal region and inland waterways. In addition, the lower atmospheric pressure which accompanies storms also contributes to a rise in water surface elevation. Extremely high wind velocities coupled with low barometric pressures (such as those experienced in tropical storms, hurricanes, and very strong northeasters) can produce very high, damaging water levels. In addition to wind speed, direction and duration, storm surge is also influenced by water depth, length of fetch (distance over water), and frictional characteristics of the nearshore sea bottom. An estimate of storm surge is required for the design of beach fill crest elevations. An increase in water depth may increase the potential for coastal flooding and allow larger storm waves to attack the shore.

The Flagler County SPP study area is a relatively low, flat barrier island and is susceptible to overtopping from extreme storm surges. Topographic surveys show that much of the island is less than 15 feet in elevation. Elevations of 15-20+ feet occur, but are almost exclusively along the oceanfront dune line. Flagler County Emergency Services (FlaglerEmergency.com) provides a hurricane storm-surge and evacuation map for public information (Figure A- 4). An examination of this map shows that virtually the entire study area would be inundated during even a Category 1 hurricane, should the storm make direct landfall in the Flagler County vicinity. In the event of a hurricane, only two evacuation routes from the barrier island exist: Palm Coast Parkway near the center of the county and the State Road 100 bridge about four miles north of the county line. The only continuous road extending along the length of the barrier island is Hwy A1A.

Storm surge levels versus frequency of occurrence were obtained from data compiled by the University of Florida for the Florida Department of Transportation (FDOT, 2003). Table A- 7 provides peak storm surge heights by return period for three locations in Flagler County: FDEP R-monuments R-0, R-55, and R-99. The storm surge elevations presented in this graph include the effects of astronomical high tide and wave setup.

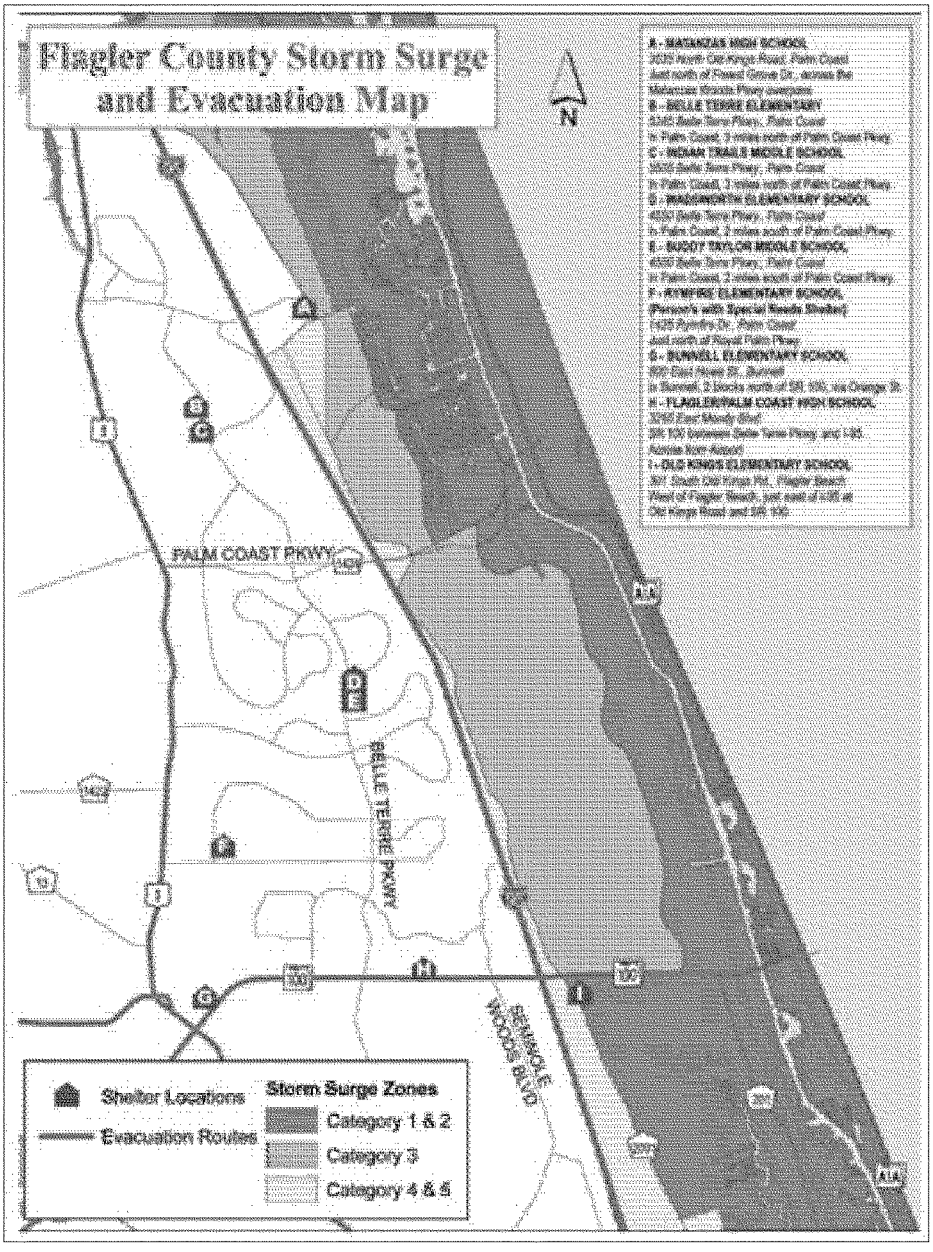

Figure A- 4. Storm Surge Zones, Flagler County, Florida.

Table A- 7. Storm Tide Elevations

Return Period (Years)	Total Storm Tide Level (Feet, NAVD88)		
	R-0	R-55	R-99
500	17.2	15.6	14.1
200	14.0	12.8	11.6
100	11.5	10.7	9.6
50	8.7	8.3	7.6
20	5.6	5.3	4.2
10	3.9	3.8	3.6

Sea Level Rise

Relative Sea Level Rise

Relative sea level (RSL) refers to local elevation of the sea with respect to land, including the lowering or rising of land through geologic processes such as subsidence and glacial rebound. It is anticipated that sea level will rise within the next 100 years. To incorporate the direct and indirect physical effects of projected future sea level change on design, construction, operation, and maintenance of coastal projects, the U.S. Army Corps of Engineers (USACE) has provided guidance in the form of an Engineering Regulation, ER 1100-2-8162.

ER 1100-2-8162 provides both a methodology and a procedure for determining a range of sea level change estimates based on global sea level change rates, the local historic sea level change rate, the construction (base) year of the project, and the design life of the project. Three estimates are required by the guidance, a Baseline (or "Low") estimate, which is based on historic sea level rise and represents the minimum expected sea level change, an Intermediate estimate (NRC Curve I), and a High estimate (NRC Curve III) representing the maximum expected sea level change. All three scenarios are based on the following eustatic sea level rise (sea level change due to glacial melting and thermal expansion of sea water) equation:

$$E(t) = 0.0017t + bt^2$$

Where E(t) is the eustatic sea level rise (in meters); t represents years, starting in 1992 (the midpoint of the current National Tidal Datum Epoch of 1983-2001), and b is a constant equal to 2.71E-5 (NRC Curve I), 7.00E-5 (NRC Curve II), and 1.13E-4 (NRC Curve III). This equation assumes a global mean sea level change rate of +1.7mm/year.

In order to estimate the eustatic sea level change over the life of the project, the eustatic sea level rise equation is modified as follows:

$$E(t_2) - E(t_1) = 0.0017(t_2 - t_1) + b({t_2}^2 - {t_1}^2)$$

Where t_1 is the time between the project's construction date and 1992 and t_2 is the time between the end of the project life and 1992. In order to estimate the required Baseline, Intermediate, and High

Relative Sea Level (RSL) changes over the life of the project, the eustatic sea level rise equation is further modified to include site specific sea level change as follows:

$$RSL(t_2) - RSL(t_1) = (e+M)(t_2 - t_1) + b(t_2^2 - t_1^2)$$

Where $RSL(t_1)$ and $RSL(t_2)$ are the total RSL at times t_1 and t_2, and the quantity $(e + M)$ is the local sea level rise in mm/year. Local sea level rise accounts for the eustatic change (0.0017mm/year) as well as uplift or subsidence and is generally available from the nearest tide gage with a tidal record of at least 40 years. The constant b is equal to 0.0 (Baseline), 2.71E-5 (Intermediate), and 1.13E-4 (High).

The Flagler project area is located approximately 60 miles from NOS gage #8720218 at Mayport, Florida. The historical sea level rise rate taken from this gage was determined to be 2.4 mm/year (0.0079 ft/year) (http://tidesandcurrents.noaa.gov/sltrends/index.shtml). In order to provide a more accurate estimate of local vertical land motion, the historical sea level rise rate is adjusted to account forregional trends. The local, adjustedsea level rise (e+M) at this location becomes 2.29 mm/yr (0.0075 ft/yr). Adjusted local sea level rise rates for NOS gages can be found at the USACE climate website: http://www.corpsclimate.us/ccaceslcurves.cfm. Given a project base year of 2016 and a project life of 50 years, a table of sea level change rates was produced for each of the three required scenarios. Table A- 8 shows the sea level change rates in five year increments, starting from the base year of 2014. Figure A- 5 provides a graphic representation of the three levels of projected future sea level change for the life of the project.

The local rate of vertical land movement is found by subtracting regional MSL trend from local MSL trend. The regional mean sea level trend is assumed equal to the eustatic mean sea level trend of 1.7 mm/year. Therefore in Flagler County, there is 0.59 mm/year of subsidence.

Table A- 8. Relative Sea Level vs Year - Flagler County

	Baseline (Historic)			Intermediate (NRC Curve I)			High (NRC Curve III)		
	Year	mm	ft	Year	mm	ft	Year	mm	ft
Base Year	2016	9.16	0.03	2016	13.93	0.05	2016	29.05	0.10
	2021	20.61	0.07	2021	32.56	0.11	2021	70.44	0.23
	2026	32.06	0.11	2026	52.55	0.17	2026	117.49	0.39
	2031	43.51	0.14	2031	73.89	0.24	2031	170.18	0.56
	2036	54.96	0.18	2036	96.59	0.32	2036	228.53	0.75
25 Year	2041	66.41	0.22	2041	120.64	0.40	2041	292.52	0.96
	2046	77.86	0.26	2046	146.04	0.48	2046	362.17	1.19
	2051	89.31	0.29	2051	172.81	0.57	2051	437.46	1.44
	2056	100.76	0.33	2056	200.92	0.66	2056	518.41	1.70
	2061	112.21	0.37	2061	230.39	0.76	2061	605.00	1.98
50 Year	2066	123.66	0.41	2066	261.22	0.86	2066	697.25	2.29

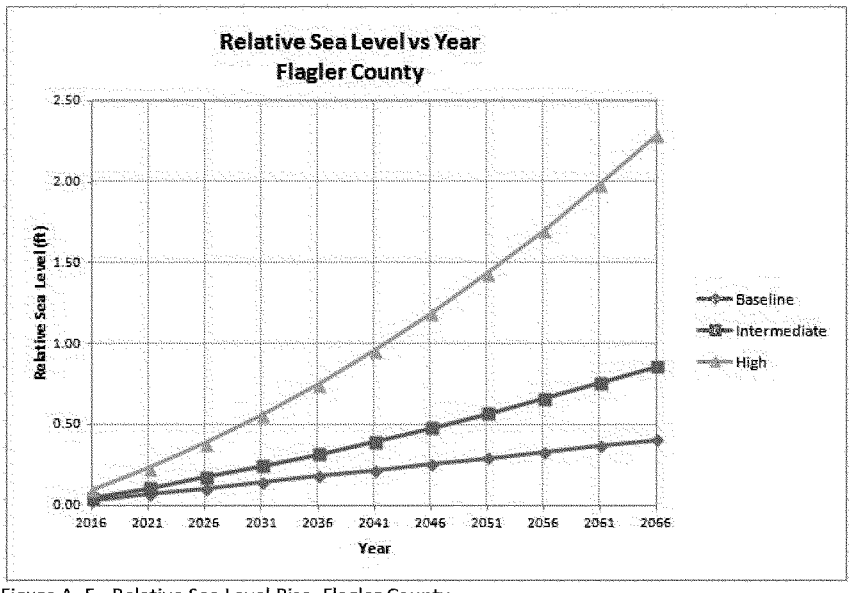

Figure A- 5. Relative Sea Level Rise, Flagler County

Beach Responses to Sea Level Change

This section evaluates how the above sea level change scenarios outlined in the preceding section could affect future beach and shoreline behavior in the project area. The principal means by which sea level change would manifest itself on an open coast, sandy beach would be through changes to shoreline position and to beach volume. The below analyses are based on the assumption that sea level change would cause a change in the horizontal and vertical position of the beach profile. This phenomenon was first outlined by Per Bruun (1962). The theory states that an increase in water level causes the beach profile to shift upward and landward in response, in order to maintain an equilibrium shape. This shift causes both a shoreline change and a volumetric change as described herein.

Shoreline Change

Per Bruun (1962) proposed a formula for estimating the rate of shoreline recession based on the local rate of sea level change. This methodology also includes consideration of the local topography and bathymetry. Bruun's approach assumes that with a change in sea level, the beach profile will attempt to reestablish the same bottom depths relative to the surface of the sea that existed prior to sea level change. That is, the natural profile will be translated upward and shoreward to maintain equilibrium. If the longshore littoral transport in and out of a given shoreline is equal, then the quantity of material required to re-establish the nearshore slope must be derived from erosion of the shore. Shoreline recession, X, resulting from sea level change can be estimated using Bruun's Rule, defined as:

$$X = \frac{-SW_*}{(h_* + B)}$$

Where S is the rate of sea level change; B is the berm height (approximately +10 feet NAVD88); h_* is depth of closure (the depth beyond which there is no significant change over time in the shoreline profile; estimated to be approximately -20 feet NAVD88); and W_* is the width of the active profile (approximately 1,800 feet). Figure A- 6 provides the resulting shoreline recession versus year for each of the three sea level rise scenarios.

The Bruun procedure is applicable to long straight sandy beaches with an uninterrupted supply of sand. Little is known about the rate at which profiles respond to changes in water level; therefore, this procedure should only be used for estimating long-term changes. The procedure is not a substitute for the analysis for historical shoreline and profile changes when determining historic (baseline) conditions. However, if little or no historical data is available, then historical analysis may be supplemented by this method to provide an estimate of the long-term erosion rates attributable to sea level rise. The offshore contours in the project area are not entirely straight and parallel; however, Bruun's Rule does provide an estimate of the potential shoreline changes within the project area attributable to a projected change in sea level.

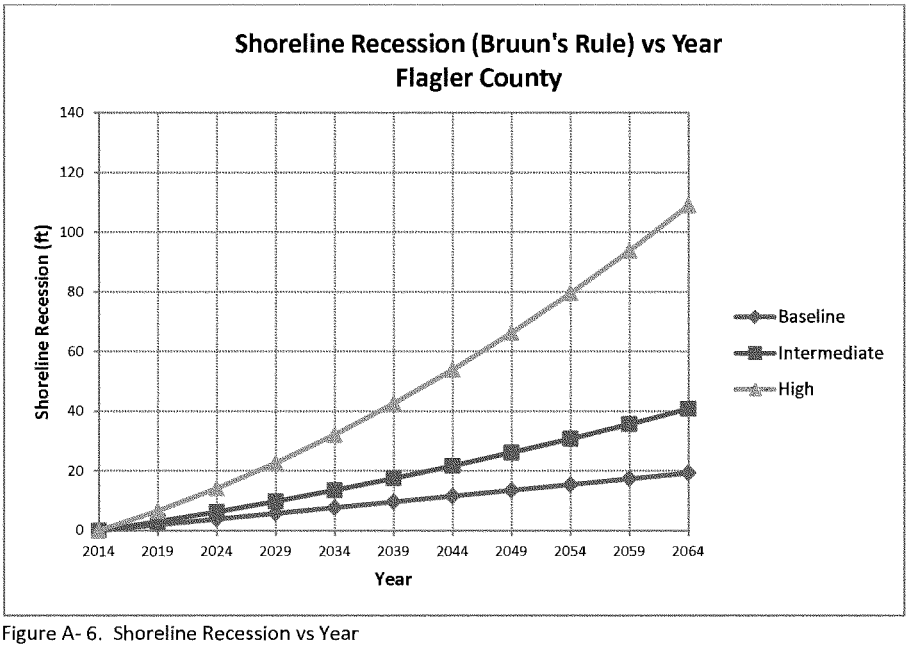

Figure A- 6. Shoreline Recession vs Year

Volumetric Change

Engineering Manual (EM) 1110-2-3301 (USACE, 1995) gives guidance on how to calculate beach volume based on berm height, depth of closure, and translation of the shoreline (in this case, shoreline recession). Assuming that as an unarmored beach erodes, it maintains approximately the same profile above the seaward limit of significant transport the volume can be determined as:

$$V = (B + h_*)X$$

Where B is the berm height, h_* is the depth of closure, and X is the horizontal translation of the profile. Figure A- 7 provides the resulting volume lost versus year for each of the three sea level rise scenarios.

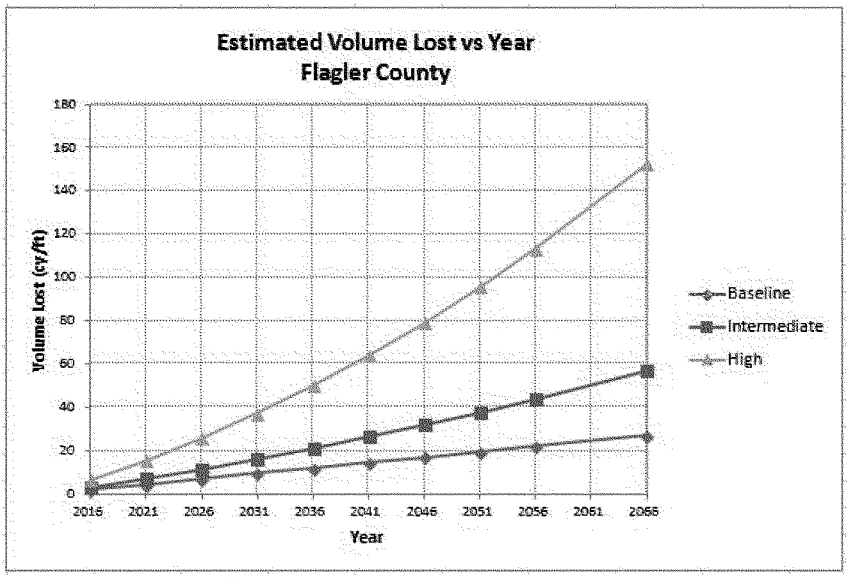

Figure A- 7. Estimated Volume Lost Versus Year

Historical Shoreline Change

Flagler County is unique compared to the counties to the north and south, in that the shoreline sediment contains a higher percentage of coarse shell hash which produces a larger median grain size and steeper beach profiles. The shoreline has mild concave curvature from north to south, transitioning to a headland at Flagler Beach. Shoreline irregularities along the generally curved shoreline are attributed to nearshore hard bottom exposed rock outcrops which influence shoreline erosion and accretion. A Florida Department of Environmental Protection shoreline change rate study conducted in

July of 1999 (FDEP, 1999) concluded that the beaches of Flagler County are subject to cyclic erosion and accretion but are relatively stable based on data from 1952 to 1993.

Changes in mean high water (MHW) position provide a historical view of the behavior of the shoreline. Beach profiles are traditionally gathered by the FDEP, local sponsors, and USACE. Available beach surveys for Flagler County go back as far as 1872. However, the reliability of such historical profiles may be questionable. Therefore, based on a review of all available surveys, it was determined that profiles dating from 1972 to present would be used for the MHW analysis.

MHW shoreline positions were measured at each DNR survey monument location, for each survey, along the proper azimuth (70 degrees, measured from north, clockwise). Resulting differences in MHW position in both the north (R-1 to R-4) and south (R-50 to R-100) project segments are tabulated in Table A- 9. This table also provides the overall MHW rate of change for the period between 1972 and 2007.

In order to better interpret the shoreline change, the MHW position data was put into a graphical format (Figure A- 8). Note that lines only connect data between adjacent R-monument locations. Gaps indicate where R-monument measurements are missing. As seen in the figures, shoreline changes fluctuate over time along the study areas. Figure A- 9 provides a summary of all measured shoreline changes (1972 to 2007). This figure shows the cumulative changes bases on the data presented in

Table A- 9. While areas of accretion exist throughout the project over time, the overall trend of the shoreline is erosional.

The position of the MHW line varies along Flagler County project shoreline, with relatively small rates of change over the time period between 1972 and 2007 (Figure A- 10). Shoreline change rates for this period range from +1.06 to -2.40 feet per year with isolated areas of moderate erosion and accretion. Factors which contribute to this variation include the distribution of exposed rock in the surf zone and foreshore slope, as well as structures in the area. One structure of particular influence on longshore transport and beach erosion and accretion is the Flagler Pier at R-79. The pier tends to trap sand from longshore transport causing accretion north of the pier, as well as downdrift erosion about 2,000 feet south of the pier due to the interruption of longshore transported sand. From 1972 to 2007 the MHW rate of change was generally erosional along the study limits with annual erosion rates of -0.58 feet per year in the north project segment (R1 to R-4) and -0.59 feet per year in the south project segment (R-50 to R-100). Table A- 10 provides a further breakdown of annual shoreline rates of change rates by study reach.

Each of the study reaches, with the exception of Beverly Beach, have relatively consistent average shoreline rates of change, ranging from -0.58 ft/yr to -0.67 ft/yr. Due primarily to the stabilizing presence of a concrete and steel seawall over a significant portion of the reach, Beverly Beach experiences a lower shoreline rate of change, approximately -0.11 ft/yr.

Table A- 9. Mean High Water Shoreline Position Change

DNR Monument	MHW Shoreline Position Change in Feet								MHW Rate of Change (1972-2007) (feet/year)
	1972-1980	1980-1984	1984-1986	1986-1993	1993-2000	2000-2003	2003-2007	1972-2007	
R-1	-68			14	0	78	-85	-58	-1.66
R-2	-44					73	-87	-54	-1.54
R-3	13	56	-59	13	-53	105	-39	36	1.03
R-4	-53					22	-30	-5	-0.14
Average	-38	56	-59	14	-27	70	-60	-20	-0.58
R-50	-49					16	-13	-4	-0.11
R-51	-73			43	-1	-7	-1	-38	-1.09
R-52	-68	43	-6			1	-26	-44	-1.24
R-53	-63					12	-16	-49	-1.40
R-54	-17	18	-5	17	-14	0	4	3	0.09
R-55	-42					-8	22	3	0.09
R-56	-79					-1	-41	-84	-2.40
R-57	-34	36	12	-9	5	-13	-2	-5	-0.14
R-58	-43					-6	-1	-14	-0.40
R-59	-39					-7	13	20	0.57
R-60	-69					0	-15	-36	-1.03
R-61	-47	71	4	1	-20	3	2	14	0.40
R-62	-26					-9	29	37	1.06
R-63	-59	52	21	-28	17	-11	-20	-28	-0.80
R-64	-65					-5	24	1	0.03
R-65	-48					-1	-3	-11	-0.31
R-66	-31	34	-1	1	-8	-1	7	1	0.03
R-67	-28					-5	26	-8	-0.21
R-68	-24					22	-51	-16	-0.46
R-69	-8	10	21			-10	6	31	0.89
R-70	-7			-13	7	-10	-8	-18	-0.51
R-71	-21					-18	13	-2	-0.06
R-72	-58			-3	-7	-5	-38	-43	-1.23
R-73	-14	40	16			-14	-7	5	0.14
R-74	-16					-15	19	28	0.80
R-75	-21	55	-7	0	-11	11	-48	-21	-0.60
R-76	-24					48	-29	11	0.31
R-77	-30					15	-1	19	0.54
R-78	-13	34	16	-6	-35	10	-28	-22	-0.63
R 79	69					39	51	27	0.77
R-80	-55					44	-53	-41	-1.17
R-81	-71	52	-26	40	-41	33	-26	-39	-1.11
R-82	-51					40	-28	-20	-0.57
R-83	-23					7	-6	-2	-0.06
R-84	-29	30	3	-14	7	-6	35	26	0.74
R-85	-54					6	-28	-54	-1.54
R-86	-53					18	-51	-73	-2.09
R-87	-45	64	2	-11	-23	19	-71	-65	-1.86
R-88	-29					18	-96	-51	-1.46
R-89	-31					39	-97	-31	-0.89
R-90	-45	61	-39	21	25	40	-111	-48	-1.37
R-91	-69					15	-54	-78	-2.23
R-92	-63					13	-4	-35	-1.00
R-93	-65	54	-8	-9	-22	20	-39	-69	-1.97
R-94	-59					38	-24	-17	-0.49
R-95	-74					46	-48	-39	-1.11
R-96	-60	83	-42	34	-30	30	-30	-15	-0.43
R-97	-58					23	-59	-55	-1.57
R-98	-39					40	-29	-3	-0.09
R-99	-50	55	-28	54	-39	6	-22	-24	-0.69
R-100	-37					23	-24	-5	-0.14
Average	-45	47	-4	7	-11	11	-22	-21	-0.59

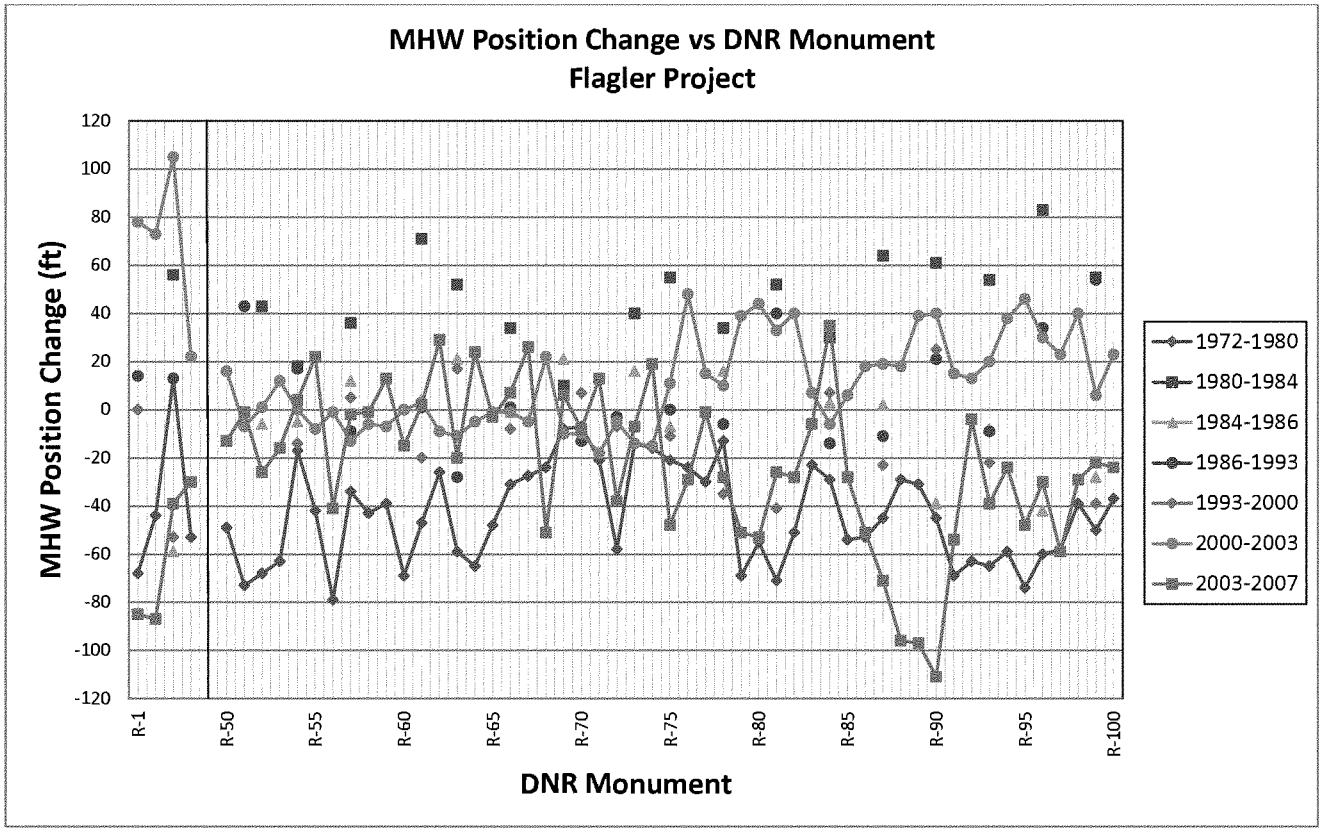

Figure A- 8. MHW Changes, Flagler County Study Area

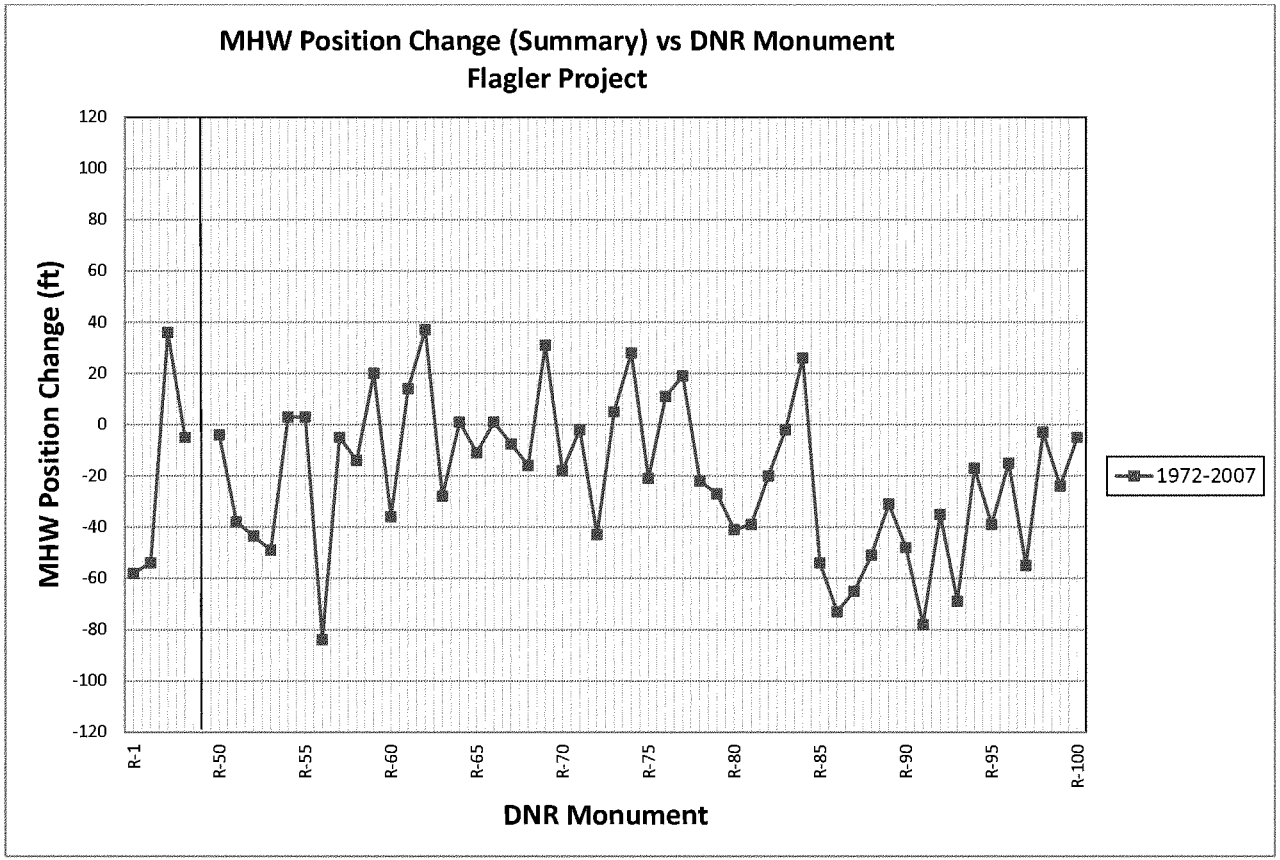

Figure A- 9. Summary of MHW Changes

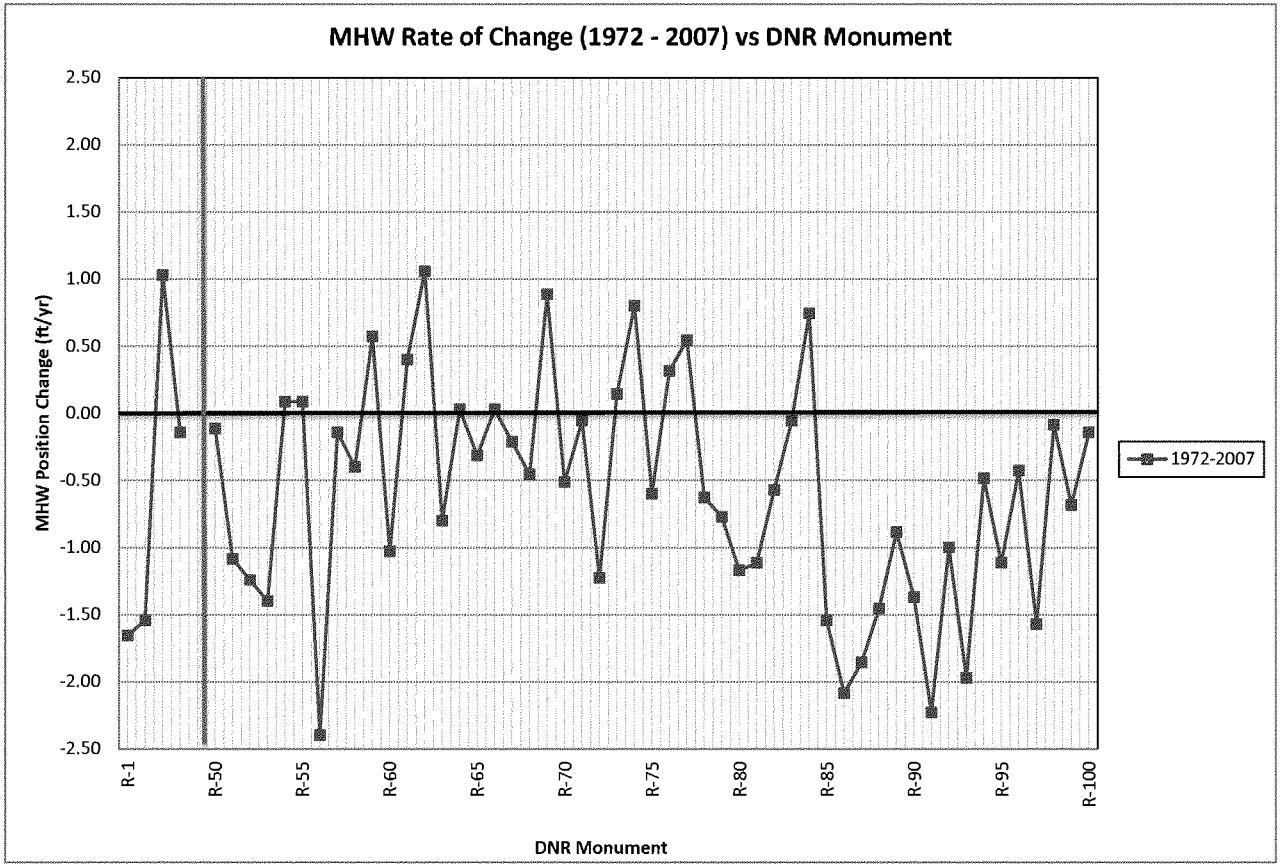

Figure A- 10. Shoreline Rate of Change (North and South Segments)

Table A- 10. Annual Shoreline Rate of Change by Study Reach

Project Segment	Study Reach	Location (DNR Monument)	MHW Rate of Change (1972 – 2007) (feet/year)
North	Marineland	R-1 to R-4	-0.58
Total (North)		R-1 to R-4	-0.58
South	Painters Hill	R-50 to R-60	-0.64
	Beverly Beach	R-60 to R-67	-0.11
	Flagler Beach	R-67 to R-101	-0.67
Total (South)		R-50 to R-101	-0.59
Total (Project)		R-1 to R-4, R-50 to R-101	-0.59

Existing Shoreline Armor

Historically, the threat that shoreline erosion has posed to both private and public infrastructure has resulted in coastal armoring throughout Flagler County. USACE shoreline surveys taken in February 2009 revealed that most of the existing shoreline armor could be found within the limits of the proposed project. Table A- 11 provides a summary of shoreline armor throughout Flagler County with armor outside of the study limits indicated. Further details of Flagler County coastal armoring can be found in the main report.

Table A- 11. Summary of Shoreline Armoring in Flagler County

Study Reach	R-Monument	Length (feet)	Description
Marineland	R-1 to R-2	1,350	Granite revetment at Marineland Aquatic Park
	R-1 to R-3	----	Five partially removed coquina groins
	R-2 to R-3	1,500	Steel seawall currently covered by dune and boardwalk
Varn Park*	R-49.3 to R-49.5	260	10' tall stand-alone seawall with no structures behind the wall
Beverly Beach	R-60.5 to R-62.4	1,560	Concrete steel seawall fronting Camptown RV park
Flagler Beach	R-78.6 to R-79.4	565	Small section of aging concrete seawall
	R-80 to R-90	9,240	Coquina and granite revetment with regions of damage
	R-82	153	Concrete capped steel sheetpile seawall
	R-94.6 to R-94.8	152	Small segment of concrete seawall and small segment of wooden seawall
* Varn Park armor does not fall within the limits of the study area			

Effects of Adjacent Features

Shore Protection/Navigation Projects

There are no navigation projects in the vicinity of Flagler County that will affect the study area. Material dredged from the Intracoastal Waterway (IWW) near the Matanzas inlet has been placed on Summer Haven beach in the past. Although it is possible that sand from these activities migrates south to the Marineland reach, a review of the shoreline change data indicates that effects of this migration are negligible.

Inlet Effects

There are no inlets within Flagler County. The nearest inlets are Matanzas Inlet 2.4 miles to the north of Flagler County in St Johns County and Ponce de Leon Inlet 27 miles to the south of Flagler County in Volusia County. Matanzas Inlet is a relatively small inlet and is not maintained for navigation. The inlet has a history of migrating to the south, but is now stabilized with the south bridge abutment of the Highway A1A Bridge. Effects of Matanzas Inlet on the Flagler County shorelines to the south have not been quantified, but are expected to be negligible. Ponce de Leon inlet is distant enough and down drift of Flagler County and is therefore not expected to have an impact on the county's beaches.

Beach-*fx* Life-Cycle Shore Protection Project Evolution Model

Federal participation in Hurricane and Storm Damage Reduction (HSDR) projects is based on a favorable economic justification in which the benefits of the project outweigh the costs. Determining the Benefit to Cost Ratio (BCR) requires both engineering analysis (project performance and evolution) and planning (alternative analysis and economic justification). The interdependence of these functions has lead to the development of the life-cycle simulation model Beach-*fx*. Beach-*fx* combines the evaluation of physical performance and economic benefits and costs of shore protection projects (Gravens et. al., 2007), particularly beach nourishment, to form the basis for determining the justification for Federal participation. This section describes the engineering aspects of the Beach-*fx* model.

Background & Theory

Beach-*fx* is an event-driven life-cycle model. USACE guidance (USACE, 2006) requires that flood damage reduction studies include risk and uncertainty. The Beach-*fx* model satisfies this requirement by fully incorporating risk and uncertainty throughout the modeling process (input, methodologies, and output). Over the project life-cycle, typically 50 years, the model estimates shoreline response to a series of historically based storm events. These plausible storms, the driving events, are randomly generated using a Monte Carlo simulation. The corresponding shoreline evolution includes not only erosion due to the storms, but also allows for storm recovery, post-storm emergency dune and/or shore construction,

and planned nourishment events throughout the life of the project. Risk based damages to structures are estimated based on the shoreline response in combination with pre-determined storm damage functions for all structure types within the project area. Uncertainty is incorporated not only within the input data (storm occurrence and intensity, structural parameters, structure and contents valuations, and damage functions), but also in the applied methodologies (probabilistic seasonal storm generation and multiple iteration, life cycle analysis). Results from the multiple iterations of the life cycle are averaged over a range of possible values.

The project site itself is represented by divisions of the shoreline referred to as "Reaches". Because this term may also be used to describe segments of the shoreline to which project alternatives are applied, Beach-*fx* reaches will be referred to in this appendix as "Model reaches". Model reaches are contiguous, morphologically homogenous areas that contain groupings of structures (residences, businesses, walkovers, roads, etc...), all of which are represented by Damage Elements (DEs). DEs are grouped within divisions referred to as Lots. Figure A- 11 shows a graphic depiction of the model setup. For further details about the specifics of Lot extents and DE grouping (see the Economics Appendix).

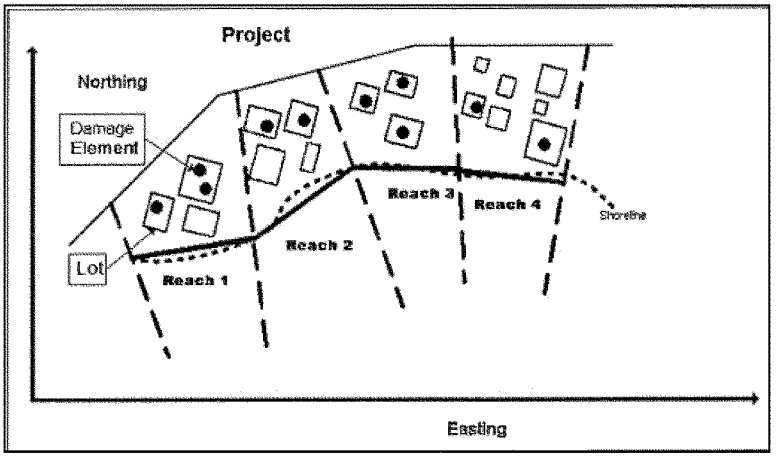

Figure A- 11. Beach-*fx* Model Setup Representation

Each model reach is associated with a representative beach profile that describes the cross-shore profile and beach composition of the reach. Multiple model reaches may share the same representative beach profile while groupings of model reaches may represent a single design reach. Five design reaches were identified in the course of this study, Marineland, Reach A, Reach B, Reach C, and Reach D. Due to the presence of a robust revetment that precluded damages, the Marineland design reach was eliminated from further consideration early in the study (see main report for more detail). Combined, the four design reaches are composed of 50 model reaches, 315 lots, and 1,908 DEs. Table A- 12 provides the extent of the project and model reaches relative to FDEP R-monument locations.

Table A- 12. Extent of Design and Model Reaches

Design Reach	Model Reaches	R-monuments
Marineland*	R1-1 to R1-4	R-1 to R-4
Reach A (Painters Hill)	RA-1 to RA-10	R-50 to R-60
Reach B (Beverly Beach & North Flagler Beach)	RB-1 to RB-17	R-61 to R-79
Reach C (Central Flagler Beach)	RC-1 to RC-14	R-80 to R-94
Reach D (South Flagler Beach)	RD-1 to RD-5	R-95 to R-100
*The Marineland design reach was eliminated from consideration following the Feasibility Scoping Meeting		

Implementation of the Beach-*fx* model relies on a combination of meteorology, coastal engineering, and economic analyses and is comprised of four basic elements:

- Meteorologic driving forces
- Coastal morphology
- Economic evaluation
- Management measures

The subsequent discussion in this section addresses the basic aspects of implementing the Beach-*fx* model. For a more detailed description of theory, assumptions, data input/output, and model implementation, refer to Gravens et al. 2007; Males et al., 2007, and USACE 2009.

Meteorologic Driving Forces

The predominant driving force for coastal morphology and associated damages within the Beach-*fx* model is the historically based set of storms that is applied to the life-cycle simulation. Because the eastern coast of Florida is subject to seasonal storms, tropical storms (hurricanes) in the summer months and extra-tropical storms (northeasters) in the winter and fall months, the "plausible storms" dataset for Flagler County is made up of both types. Derived from the historical record of the region, the Flagler plausible storm set is based on 46 tropical storms, occurring between 1887 and 1999 and 48 extra-tropical storms, occurring between 1980 and 1999.

Because tropical storm events tend to be of limited duration, passing over a given site within a single portion of the tide cycle, it is assumed that any of the historical storms could have occurred during any combination of tidal phase and tidal range. Therefore, each of the 46 tropical storms surge hydrographs was combined with possible variations in the astronomical tide. This was achieved by combining the peak of each storm surge hydrograph with the astronomical tide at high tide, mean tide falling, low tide, and mean tide rising for each of three tidal ranges corresponding to the lower quartile, mean, and upper quartile tidal ranges. The resulted in 12 distinct combinations for each historically based tropical storm and a total of 552 tropical storm conditions in the plausible storm dataset.

Due to their generally extended durations, extra-tropical storms in the historical record tend to occur over complete tide cycles. Therefore, it can be assumed that the storm hydrograph of each of the 48 historical extra-tropical storms is sufficient without combining with possible variations of the astronomical tide. The entire plausible storm suite therefore consists of a total of 600 tropical and extra-tropical storms.

In addition to the plausible storm dataset, the seasonality of the storms must also be specified. The desired storm seasons are based on the assumption that each plausible storm takes place within the season in which the original historical storm occurred. The probability of both tropical and extra-tropical storms is defined for each season through the Probability Parameter. The Probability Parameter is determined for each season and storm type by dividing the number of storms by the total number of years in the storm record (extra-tropical or tropical). Four storm seasons were specified for Flagler County (Table A- 13).

Table A- 13. Flagler County Beach-*fx* Storm Seasons

Storm Season	Start Date	End Date	Probability Parameter Extra-Tropical Storm	Probability Parameter Tropical Storm
Extratrop Winter/Spring	Dec 1	Apr 31	1.45	0.00
Tropical Early Summer	May 1	Jul 31	0.15	0.04
Tropical Peak	Aug 1	Sep 30	0.10	0.29
Extratrop/Tropical	Oct 1	Nov 30	0.70	0.07

The combination of the plausible storm dataset and the specified storm season allows the Beach-*fx* model to randomly select from storms of the type that fall within the season currently being processed. For each storm selected, a random time within the season is chosen and assigned as the storm date. The timing of the entire sequence of storms is governed by a pre-specified minimum storm arrival time. A minimum arrival time of 7 days was specified for Flagler County. Based on this interval the model attempts to place subsequent storm events outside of a 14 day window surrounding the date of the previous storm (i.e. a minimum of 7 days prior to the storm event and a minimum of 7 days following the storm event). The model does allow the user to set different minimum arrival times for extra-tropical and tropical storms. However, based on SBEACH model results, extra-tropical storms did not have a significant impact on profile change in the study area. Therefore, the 7 day interval was considered suitable for both storm types. Also, due to the probabilistic nature of the mondel the minimum arrival time may be overridden as warranted during the course of the life cycle analysis.

Coastal Morphology

The Beach-*fx* model estimates changes in coastal morphology through four primary mechanisms:

- Shoreline storm response
- Applied shoreline change

- Project-induced shoreline change
- Post-storm berm recovery

Combined, these mechanisms allow for the prediction of shoreline morphology for both with and without project conditions.

Shoreline Storm Response

Shoreline storm response is determined by applying the plausible storm set that drives the Beach-*fx* model to simplified beach profiles that represent the shoreline features of the project site. For the Flagler study, application of the storm set to the idealized profiles was accomplished with the SBEACH coastal processes response model (Larson and Kraus 1989). SBEACH is a numerical model which simulates storm-induced beach change based on storm conditions, initial profiles, and shoreline characteristics such as beach slope and grain size. Output consists of post-storm beach profiles, maximum wave height and wave period information, and total water elevation including wave setup. Pre- and post-storm profiles, wave data, and water levels can be extracted from SBEACH and imported into the Beach-*fx* Shore Response Database (SRD). The SRD is a relational database used by the Beach-*fx* model to pre-store results of SBEACH simulations of all plausible storms impacting a pre-defined range of anticipated beach profile configurations.

Pre-Storm Representative Profiles

In order to develop the idealized SBEACH profiles from which the SRD was derived, it was necessary to first develop representative profiles for the project shoreline. The number of representative profiles developed for any give project depends on the natural variability of shoreline itself. First historical profiles at each FDEP R-monument were compared over time. Using the USACE Regional Morphology Analysis Package (RMAP) (Morang et al., 2009) each profile was aligned and then averaged into a composite profile representative of the shoreline shape at that given R-monument location. Next, each of the composite profiles were compared and separated into groupings according to the similarity between the following seven dimensions:

- Upland elevation
- Dune slope
- Dune height
- Dune width
- Berm height
- Berm width
- Foreshore slope

For Flagler County six groupings of similarly dimensioned beach profiles were identified. Within each grouping, the composite profiles were then averaged into a single profile representative of a portion of

the project shoreline. Using these representative profiles, idealized profiles representing the major dimensions of the profile were defined (Figure A- 12 through Figure A- 17). Table A- 14 provides dimensions for each of the idealized pre-storm Beach-*fx* profiles.

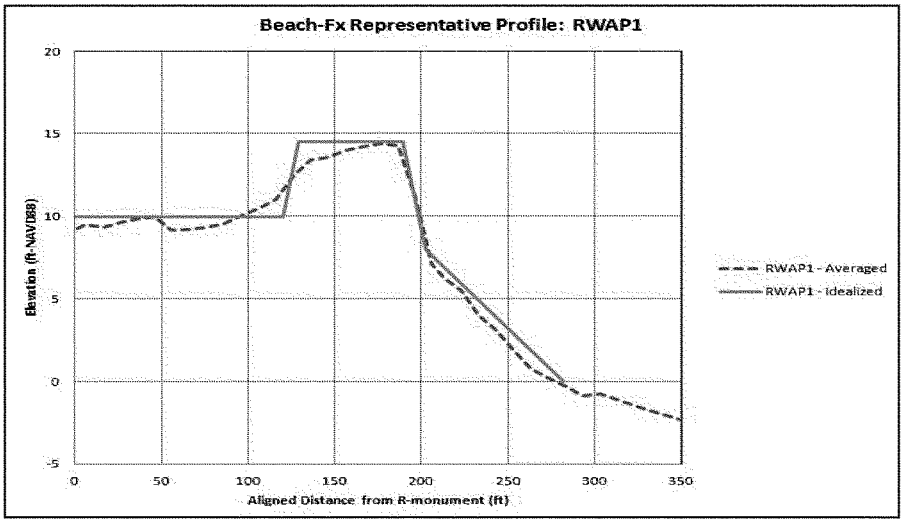

Figure A- 12. Averaged and Idealized Profiles: RWAP1 Grouping

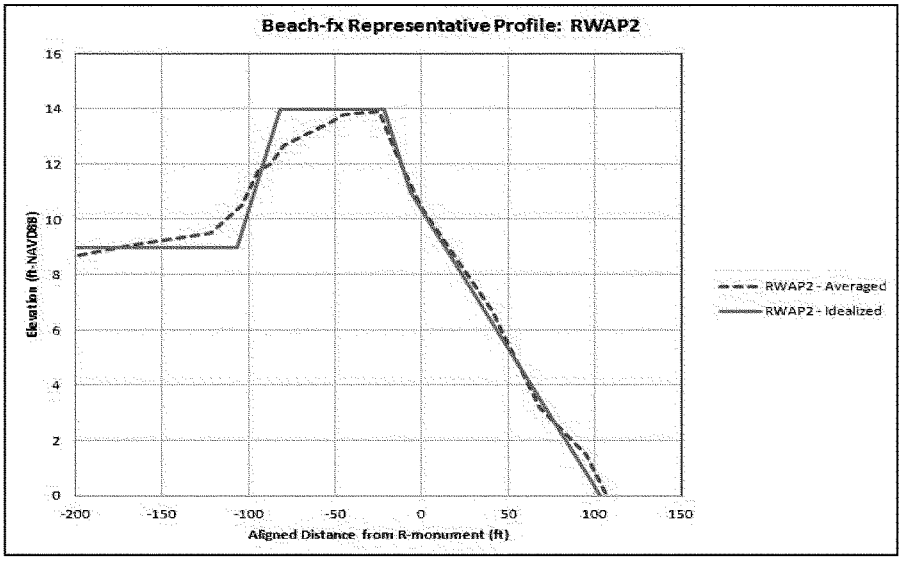

Figure A- 13. Averaged and Idealized Profiles: RWAP2 Grouping

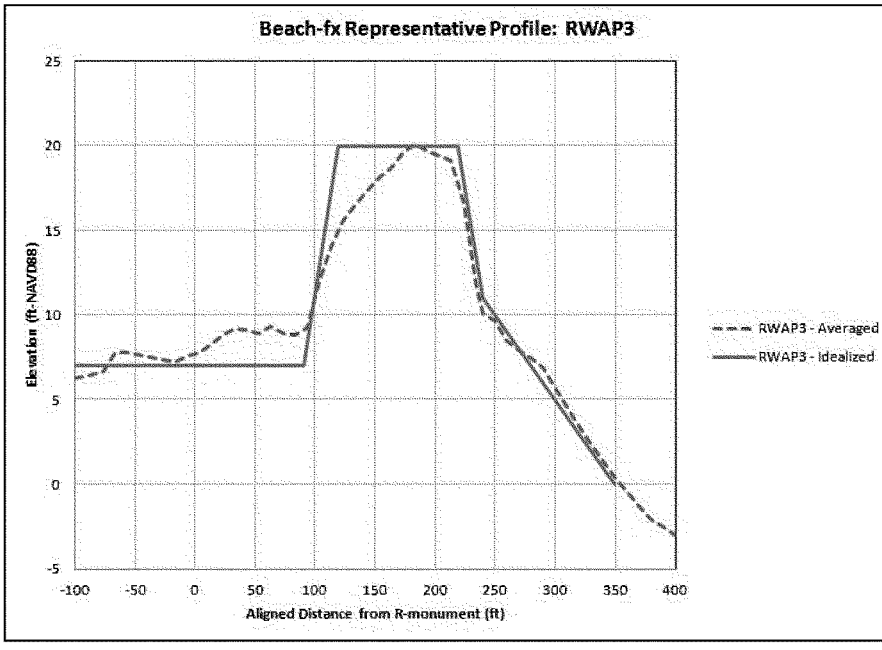

Figure A- 14. Averaged and Idealized Profiles: RWAP 3 Grouping

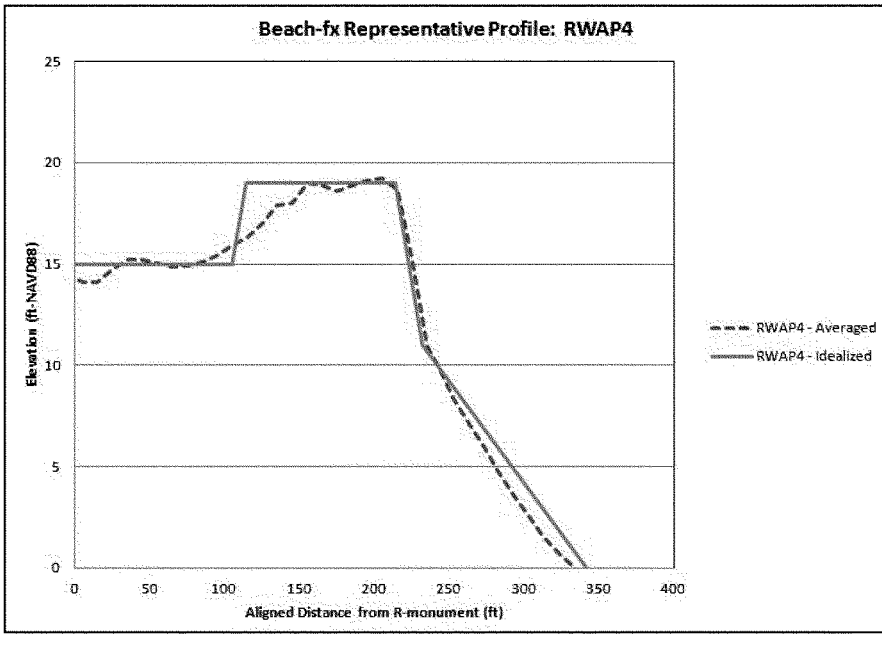

Figure A- 15. Averaged and Idealized Profiles: RWAP 4 Grouping

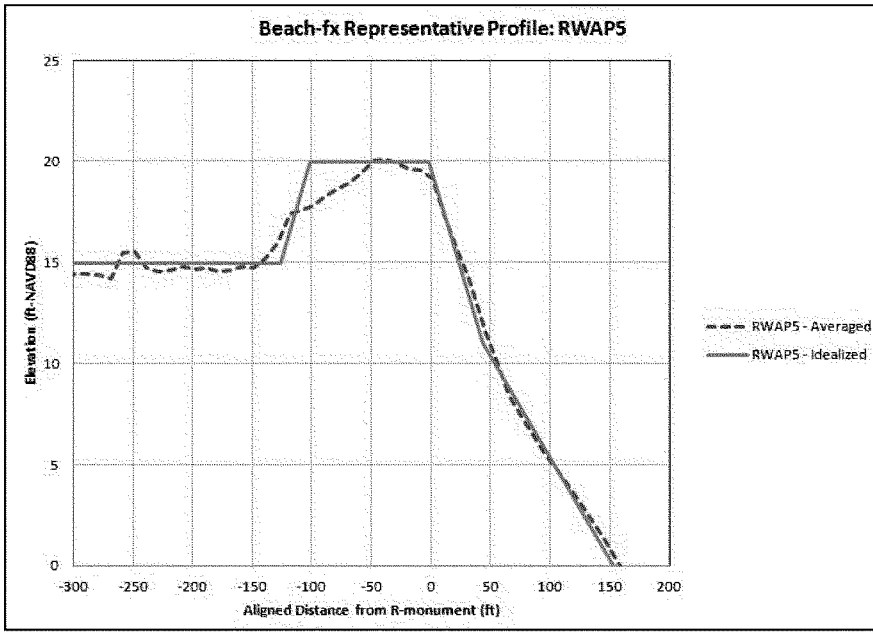

Figure A- 16. Averaged and Idealized Profiles: RWAP 5 Grouping

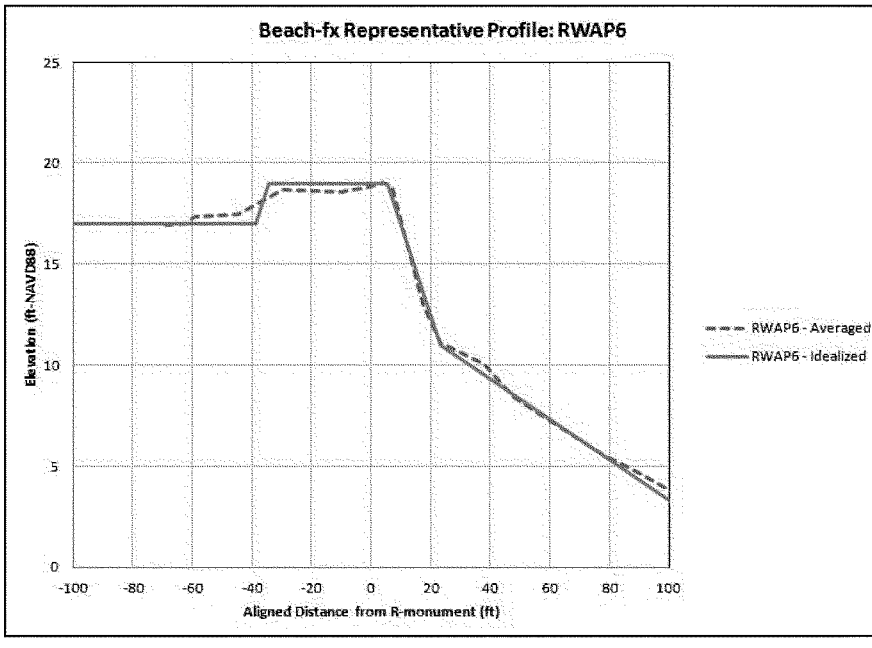

Figure A- 17. Averaged and Idealized Profiles: RWAP 6 Grouping

Table A- 14. Dimensions of Idealized Pre-Storm Representative Profiles (Existing)

Profile	R-monuments Represented	Upland Elevation (ft-NAVD88)	Dune Height (ft-NAVD88)	Dune Width (ft)	Dune Slope (V:H, ft)	Berm Elevation (ft-NAVD88)	Berm Width (ft)	Foreshore Slope (V:H,ft)
RWAP1	R-1	10	14.5	60	1:2	8	0	1:10
RWAP2	R-3 to R-4	9	14	60	1:5	8	0	1:10
RWAP3	R-50 to R-54	7	19	100	1:2.2	11	0	1:10
RWAP4	R-55 to R-70, R-80 to R-88, R-95 to R-97	15	19	100	1:2.2	11	0	1:10
RWAP5	R-71 to R-79	15	20	100	1:5	11	0	1:10
RWAP6	R-89 to R-94, R-98 to R-100	17	19	40	1:2.2	11	0	1:10

The idealized profiles described in Table A- 14 represent the existing shoreline condition. In order to provide Beach-*fx* SRD database entries representative of future shoreline conditions, with- and with-out the presence of a shore protection project, it was necessary to develop idealized profiles for a series of possible future conditions. Table A- 15 provides the array of future profile dimensions modeled for Flagler County. Note that elevations and slopes do not change between existing and future conditions.

Table A- 15. Dimensions of Idealized Pre-Storm Representative Profiles (Future)

Profile (s)	Without Project Conditions		With Project Conditions					
	Dune Width (ft)	Berm Width (ft)	Dune Width (ft)	Berm Width (ft)				
RWAP1, RWAP2	45	0	60	0	20	40	60	80
	50	0	65	0	20	40	60	80
	55	0	70	0	20	40	60	80
	60	0	75	0	20	40	60	80
RWAP3, RWAP4, RWAP5	60	0	100	0	20	40	60	80
	65	0	105	0	20	40	60	80
	70	0	110	0	20	40	60	80
	75	0	115	0	20	40	60	80
	80	0						
	85	0						
	90	0						
	95	0						
	100	0						
RWAP6	20	0	40	0	20	40	60	80
	25	0	45	0	20	40	60	80
	30	0	50	0	20	40	60	80
	35	0	55	0	20	40	60	80
	40	0	40	0	20	40	60	80

SBEACH Methodology

SBEACH simulates beach profile changes that result from varying storm waves and water levels. These beach profile changes include the formation and movement of major morphological features such as longshore bars, troughs, and berms. SBEACH is a two-dimensional model that considers only cross-shore sediment transport; that is, the model assumes that simulated profile changes are produced only by cross-shore processes. Longshore wave, current, and sediment transport processes are not included.

SBEACH is an empirically based numerical model, which was formulated using both field data and the results of large-scale physical model tests. Input data required by SBEACH describes the storm being simulated and the beach of interest. Basic requirements include time histories of wave height, wave period, water elevation, beach profile surveys, and median sediment grain size.

SBEACH simulations are based on six basic assumptions:

- Waves and water levels are the major causes of sand transport and profile change
- Cross-shore sand transport takes place primarily in the surf zone
- The amount of material eroded must equal the amount deposited (conservation of mass)
- Relatively uniform sediment grain size throughout the profile,
- The shoreline is straight and longshore effects are negligible
- Linear wave theory is applicable everywhere along the profile without shallow-water wave approximations

Once applied, SBEACH allows for variable cross shore grid spacing, wave refraction, randomization of input waves conditions, and water level setup due to wind. Output data consists of a final calculated profile at the end of the simulation, maximum wave heights, maximum total water elevations plus setup, maximum water depth, volume change, and a record of various coastal processes that may occur at any time-step during the simulation (accretion, erosion, over-wash, boundary-limited run-up, and/or inundation).

SBEACH Calibration

Calibration of the SBEACH model was performed using wave height, wave period, and water level information from Hurricane Dennis (August/September 1999) and Hurricane Floyd (September 1999) (Figure A- 18). Calibration of the model is required to ensure that the SBEACH model is tuned to provide realistic shore responses that are representative of the specific project location.

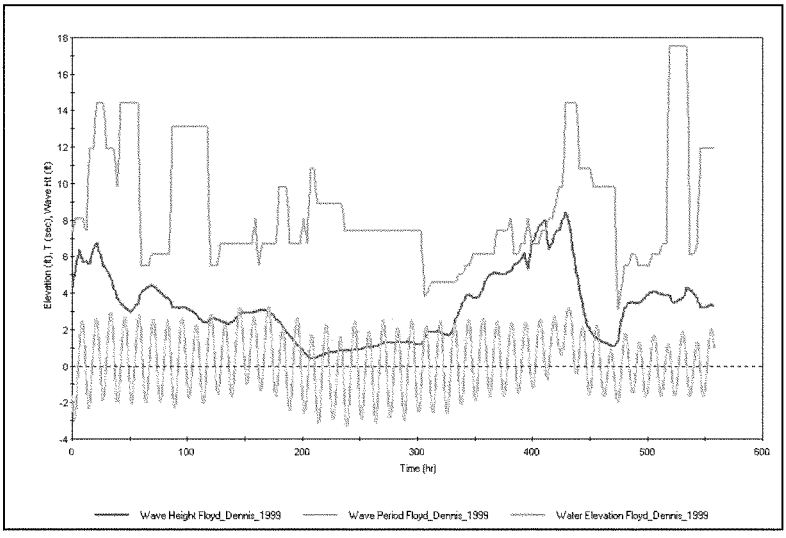

Figure A- 18. Hurricane Dennis and Floyd Wave and Water Level Data for SBEACH Calibration

Pre- and post-storm shoreline profiles were obtained from FDEP. Using the pre-storm profiles, SBEACH was then run with a range of values for an array of calibration parameters. Table A- 16 provides the relevant beach characteristic and sediment transport calibration parameters as well as their final calibrated values.

Table A- 16. SBEACH Calibrated Beach Characteristic and Sediment Transport Parameters

Beach Characteristic		**Sediment Transport**	
Parameter	**Calibrated Value**	**Parameter**	**Calibrated Value**
Landward Surf Zone Depth	0.5 ft	Transport Rate Coefficient	5e-007 (m4/N)
Effective Grain Size	0.44 mm	Overwash Transport Parameter	0.001
		Coefficient for Slope-Dependent Term	0.002
Maximum Slope Prior to Avalanching	45	Transport Rate Decay Coefficient Multiplier	0.1
		Water Temperature	20degC

SBEACH Simulations

Calibrated Flagler SBEACH simulations were run for each of the existing, future without project, and with project idealized profiles in combination with each of the tropical and extra-tropical storms in the plausible storm database. This resulted in 99,000 individual storm response profiles. From these profiles, changes in the key profile dimensions were extracted and stored in the Flagler Beach-*fx* SRD.

Applied Shoreline Change

The applied shoreline change rate (in feet per year) is a Beach-*fx* morphology parameter specified at each of the model reaches. It is a calibrated parameter that, combined with the storm-induced change generated internally by the Beach-*fx* model, returns the historical shoreline change rate for that location.

The target shoreline change rate is an erosion or accretion rate derived from the MHW rate of change determined at each R-monument location (see **Historical Shoreline Change**). Although the MHW rate of change represents the historical behavior of the project shoreline, when it is calculated at single point locations, such as R-monuments, there is a high degree of variability between consecutive locations. This variability results in a similar variability in the Beach-*fx* results, specifically in project costs and predicted damages. Because this does not reflect actual shoreline behavior and leads to inconsistencies between adjacent economic reaches, the target shoreline change rate is determined by averaging adjacent MHW change rates to allow for smoother transitions along the length of the project shoreline. Figure A- 19 shows the smoothed target shoreline change rates along with the original MHW shoreline change rates from which they were derived.

During Beach-*fx* calibration, applied erosion rates were adjusted for each model reach and the Beach-*fx* model was run for hundreds of iterations over the 50-year project life cycle. Calibration is achieved when the rate of shoreline change, averaged over hundreds of life cycle simulations, is equal to the target shoreline change rate.

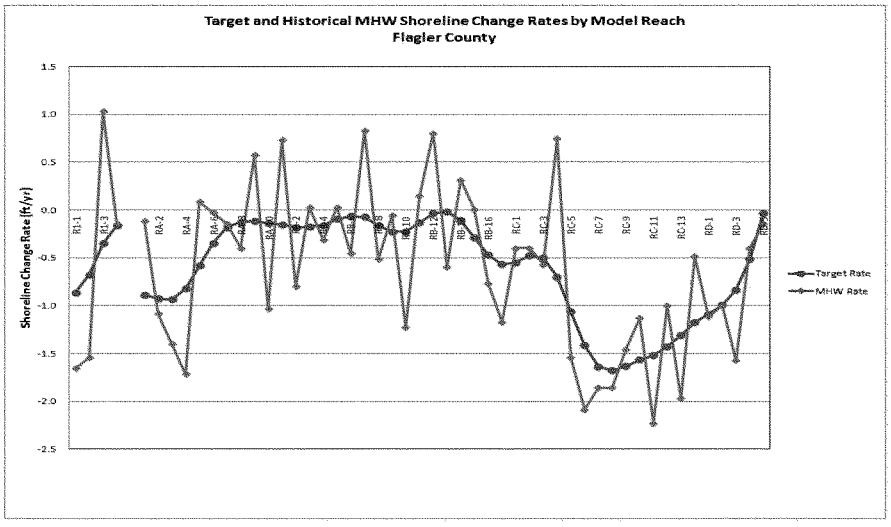

Figure A- 19. Target and Historical MHW Shoreline Change Rate

Project Induced Shoreline Change (GenCade)

The project induced shoreline change rate, also in feet per year, accounts for the alongshore dispersion of the placed beach nourishment material. Beach-*fx* requires the use of shoreline change rates in order to represent the planform diffusion of the beach fill alternatives after placement. The USACE one-dimensional shoreline change model GenCade was utilized to determine how the beaches at Flagler County, Florida would respond to shore protection alternatives, specifically beach nourishment. The results from each beach fill alternative model run, including the no-fill without project condition, provided the planform rate of change for each alternative. The difference in the rate of change for each alternative versus the without project condition was then used as input to the Beach-*fx* economic model to determine project benefits.

The GenCade model was developed by combining the USACE project-scale, engineering design-level shoreline change model GENESIS and the regional-scale, planning level model Cascade. The model can be set up and executed within the Surface-Water Modeling System (SMS) or executed as a stand-alone model through the MS-DOS interface and calculates the shoreline change and longshore sand transport due to waves. The original shoreline change model GENESIS was limited in its application to areas of sufficient distance from tidal inlets and to single littoral cells. By coupling the GENESIS and Cascade models, project areas represented in GenCade can span multiple littoral cells and include the features that separate the littoral cells such as inlets and structures (Frey et al., 2012).

Beach Profile Survey Data

All available survey data for Flagler County and neighboring St. Johns and Volusia Counties were obtained from the FDEP. The shoreline data were analyzed to determine shoreline and volume changes between surveys as well as cumulatively. The cumulative change was averaged through time to arrive at average annual shoreline and volume change rates.

Shoreline Change (Countywide)

Table A- 17 provides the Mean High Water (MHW) shoreline changes calculated for Flagler County. This table is an expansion of Table A- 9 (Historical Shoreline Change), which included only the project areas.

Overall, between 1972 and 2007 the shoreline receded on average -16 feet (-0.4 feet per year), with the greatest cumulative changes equal to -78 feet (-2.2 ft/yr) at monument R-91 and +37 feet (+1.1 ft/yr) at monument R-62. This indicates that although the shoreline was generally receding, some areas exhibited shoreline advance, most notably between R-59 and R-84, as seen in Figure A- 20. During the 1984 to 1986/87 period, the average shoreline change equaled -8 feet with all changes being greater than -59 feet (R-3) and less than +21 feet (R-63 and R-69) (Figure A- 21). During the 1986/87 to 1993 period, shoreline change averaged 6 feet, with the greatest changes equal to -28 feet at R-63 and +54 feet at R-99.

Table A- 17. Flagler County Mean High Water Change

R-Monument	Mean High Water Change (feet)							
	1972 to 1980	1980 to 1984	1984 to 1986/87	1986/87 to 1993	1993 to 2000	2000 to 2003	2003 to 2007	Cumulative
1	-68			14	0	78	-85	-58
2	-44					73	-87	-54
3	13	56	-59	13	-2	54	-39	36
4	-53					22	-30	-5
5	-48					7	-6	-13
6	-43	27	7	1	-7	-2	1	-16
7	-34					-17	3	-15
8	-61					-5	-15	-18
9	-27	9	3	4	9	-19	2	-19
10	-52					5	-23	-24
11	-54					-8	12	16
12	-39	33	0	5	-6	-5	6	-6
13	-33					19	-14	-7
14	-43					10	-2	-1
15	-66	45	9	-8	-5	-5	-2	-32
16	-39					-13	2	3
17	-54	50	2			20	-33	-23
18	-24			-4	15	-6	-17	-11
19	-6					-23	8	4
20	-34					-3	-3	-29
21	-15	12	-11	16	-23	16	-10	-15
22	-62					9	9	-14
23	-84					10	-24	-42
24	-74			7	7	36	-47	-37
25	-59	61	-8			-18	-3	-12
26	-92					-2	-10	-30
27	-72	56	5	-13	8	8	-15	-23
28	-71					11	-3	-21
29	-70					9	-12	5
30	-96	62	9	3	-11	1	16	-16
31	-76					20	-9	-6
32	-69					8	-4	-13
33	-92	68	2	-10	9	0	0	-23
34						17	-10	
35	-59	70	-9			11	-7	7
36	-66				1	-2	-1	-10
37	-68					3	0	4
38	-39					-11	-7	-1
39	-38	29	1	3	17	-3	-2	7
40	-71					-3	-6	-8
41	-39					-12	-3	0
42	-45	51	-16	0	0	4	-17	-23
43	-30					23	-36	-19
44	-38					-2	-26	-35

R-Monument	Mean High Water Change (feet)							
	1972 to 1980	1980 to 1984	1984 to 1986/87	1986/87 to 1993	1993 to 2000	2000 to 2003	2003 to 2007	Cumulative
45	-42	70	-55	9	16	6	-6	-2
46	-24					-13	-18	13
47	-56					14	-26	-3
48	-45	73	-51	25	6	-9	-15	-16
49	-57					2	-25	-17
50	-49					16	-13	-4
51	-73	40	-39	43	-1	-7	-1	-38
52						1	-26	
53	-63					12	-16	-49
54	-17	18	-5	17	-14	0	4	3
55	-42					-8	22	3
56	-79					-1		
57	-34	36	12	-9	5	-13	-2	-5
58	-43					-6	-1	-14
59	-39					-7	13	20
60	-69					0	-15	-36
61	-47	71	4	1	-20	3	2	14
62	-26					-9	29	37
63	-59	52	21	-28	17	-11	-20	-28
64	-65					-5	24	1
65	-48					-1	-3	-11
66	-31	34	-1	1	-8	-1	7	1
67						-5	26	
68	-24					22	-51	-16
69	-8	10	21			-13	7	29
70	-7			-13	7	-10	-8	-18
71	-21					-18	13	-2
72	-58			-3	-7	-5	-38	-43
73	-14	40	16			-14	-7	5
74	-16					-15	19	28
75	-21	55	-7	0	-11	11	-48	-21
76	-24					48	-29	11
77	-30					15	-1	19
78	-13	34	16	-6	-35	10	-28	-22
79	-69					39	-51	-27
80	-55					44	-53	-41
81	-71	52	-26	40	-41	33	-26	-39
82	-51					40	-28	-20
83	-23					7	-6	-2
84	-29	30	3	-14	7	-6	35	26
85	-54					7	-26	-54
86	-53					18	-51	-73
87	-45	64	2	-11	-23	19	-71	-65
88	-29					19	-43	-51
89	-31					39	-37	-31

R-Monument	Mean High Water Change (feet)							
	1972 to 1980	1980 to 1984	1984 to 1986/87	1986/87 to 1993	1993 to 2000	2000 to 2003	2003 to 2007	Cumulative
90	-45	61	-39	21	-46	40	-40	-48
91	-69					15	-54	-78
92	-63					13	-4	-35
93	-65	54	-8	-9	-22	20	-39	-69
94	-59					38	-24	-17
95	-74					46	-48	-39
96	-60	83	-42	34	-30	30	-30	-15
97	-58					23	-59	-55
98	-39					40	-29	-3
99	-50	55	-28	54	-48	6	-13	-24
100	-37					23	-24	-5
Average	-47.5	47.3	-8.2	5.5	-6.9	8.6	-15.2	-15.9
Min	-96.0	9.0	-59.0	-28.0	-48.0	-23.0	-87.0	-78.0
Max	13.0	83.0	21.0	54.0	17.0	78.0	35.0	37.0
Std Dev	21.1	19.4	22.1	18.1	18.0	19.6	23.3	23.6
Average (ft/yr)	-5.9	11.8	-2.7	0.9	-1.0	2.9	-3.8	-0.5

Figure A- 21 suggests that sand waves are moving along the shoreline, likely in the direction of the dominant sediment transport (north to south), since the 1984 to 1986/87 period shows areas of erosion in the same location as the areas of accretion during the following 1986/87 to 1993 period. The five point moving averages support this observation with nodes and antinodes observed in Figure A-21.

Historical Volume Change

The beach profile survey data that was collected in 1972, 1987, 2003, and 2007 extended far enough offshore to adequately describe the profile volume of the given year, and all except for 2007 covered virtually the entire county; 2007 only covered the northern third of the county. The shoreward and seaward limits used to calculate volume changes were set to coincide where beach profile surveys crossed on the seaward face of the dune and again where the survey data converged offshore (depth of closure). Volumes were calculated for each profile as unit volumes (cubic yards per linear foot of beach) (Table A- 18) and actual volume changes (Table A- 19). Volumes between profile lines were computed by the average end area method where two adjacent profile unit volumes are averaged then multiplied by the distance between the profile lines to arrive at the volume in cubic yards.

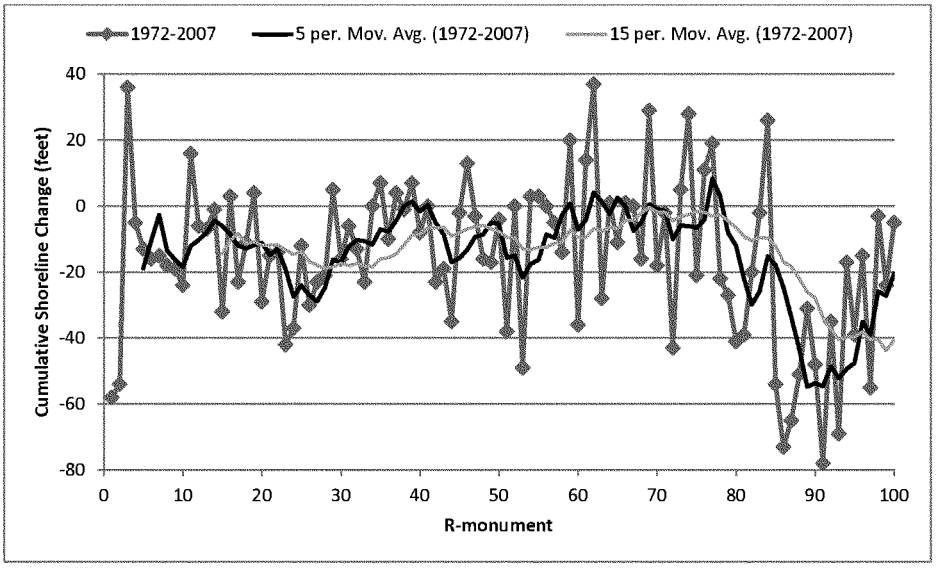

Figure A- 20. Flagler County Cumulative Shoreline Change (1972-2007)

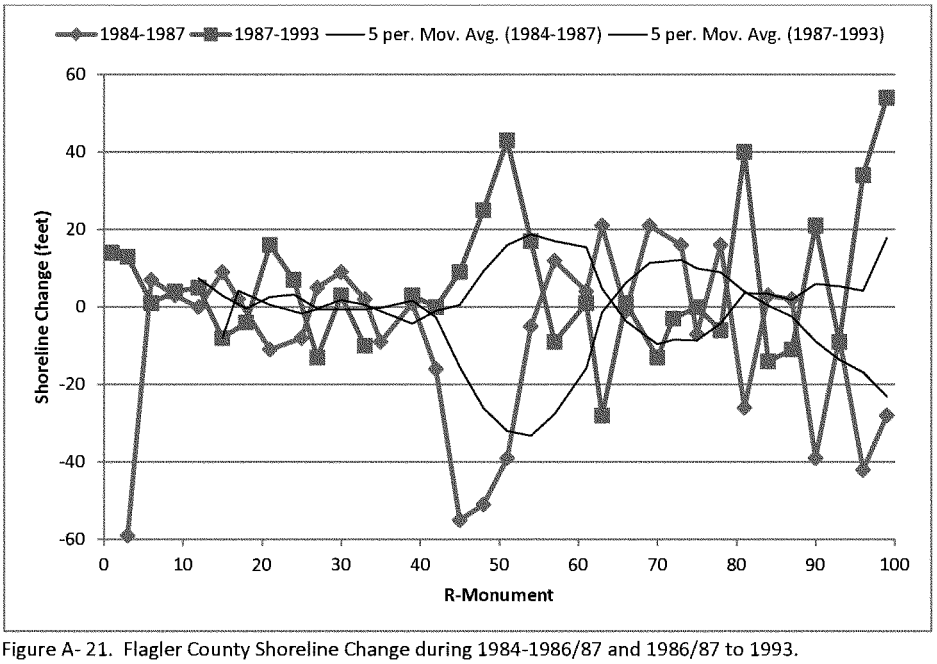

Figure A- 21. Flagler County Shoreline Change during 1984-1986/87 and 1986/87 to 1993.

The 1972, 1987, and 2003 surveys provided the most complete spatial and temporal coverage of Flagler County and were used to compute the volume change over each period. The average annual net volume change rate was also calculated. The great variability in the volume changes are noted as the beaches of Flagler County between the period between 1972 and 1987 *lost* 2.5 Mcy (-177,000 cy/year) and between 1987 and 2003 *gained* 1.6 Mcy (94,000 cy/year). The cumulative change between 1972 and 2003 was therefore equal to -931,000 cy (-30,000 cy/year) over the 31 year period.

Table A- 18. Flagler County Unit Volume Change

R-Monument	Distance Between Monuments (feet)	Unit Volume Change (cy/lf)		
		1972 to 1987	1987 to 2003	2003 to 2007
1		-74	81	-37
2	1001	-53	79	-36
3	1252	-33	119	-12
4	760	-26	88	-42
5	946	-26	56	-19
6	1005	-19	39	-27
7	965	-40	-1	16
8	920	-40	26	-10
9	1088	-61	0	11
10	991	-39	33	-20
11	930	-39	22	-7
12	976	-16	-1	-2
13	898	-28	5	-12
14	931	-28	33	-2
15	1078	-40	11	12
16	866	-22	30	-28
17	993	-22	26	-18
18	946	-3	16	-24
19	1006	-8	-24	6
20	950	-8	-3	-12
21	1096	-13	-19	-4
22	1137	-21	16	-18
23	817	-21	7	-13
24	986	-28	31	-34
25	1242	-18	-1	-18
26	874	-18	7	-48
27	836	-7	-2	-43
28	879	-23	4	-41
29	908	-23	-4	-33
30	1229	-38	44	-49
31	815	-26	53	-75
32	999	-26	57	-81
33	997	-13	25	-30
34	796	-11	2	-39
35	1249	-11	10	-44
36	937	-10	12	

R-Monument	Distance Between Monuments (feet)	Unit Volume Change (cy/lf)		
		1972 to 1987	1987 to 2003	2003 to 2007
37	966	-24	41	
38	947	-24	5	
39	976	-38	56	
40	1023	-20	14	
41	929	-20	18	
42	1009	-2	18	
43	918	-3	-14	
44	1050	-3	-23	
45	922	-4	-26	
46	1103	-6	10	
47	993	-6	-20	
48	965	-8	0	
49	946	-17	6	
50	1004	-17	20	
51	918	-26	12	
52	890	-16	27	
53	451	-16	23	
54	803	-6	7	
55	1027	-6	-18	
56	869	-6	-21	
57	725	-5	-48	
58	1104	-9	-9	
59	1102	1	-17	
60	784	-25	9	
61	926	-26	-6	
62	995	-39	6	
63	995	-38	-27	
64	882	-36	32	
65	1014	-34	-1	
66	936	-37	10	
67	917	-39	30	
68	1053	-46	36	
69	883	-37	12	
70	1064	-34	21	
71	969	-23	43	
72	940	-11	51	
73	952	-10	13	
74	948	0	26	
75	945	-24	23	
76	964	-22	58	
77	977	-47	29	
78	969	-69	32	
79	961	-73	64	
80	945	-97	30	
81	948	-72	0	
82	1006	-65	39	
83	903	-35	7	
84	1048	-31	-7	

R-Monument	Distance Between Monuments (feet)	Unit Volume Change (cy/lf)		
		1972 to 1987	1987 to 2003	2003 to 2007
85	732	-22	-27	
86	962	-26	-7	
87	946	-14	-40	
88	890	-22	23	
89	810	-19	40	
90	954	-37	30	
91	931	-33	33	
92	949	-44	31	
93	955	-51	10	
94	948	-46	35	
95	950	-58	23	
96	860	-52	46	
97	971	-57	16	
98	983	-56		
99	951			
100	951			
Average		-28	17	

Table A- 19. Flagler County Volume Changes

R-Monument	Distance Between Monuments (feet)	Volume Change (cy)		
		1972 to 1987	1987 to 2003	2003 to 2007
1				
2	1001	-63,688	79,900	-36,531
3	1252	-53,907	123,555	-30,099
4	760	-22,287	78,270	-20,550
5	946	-24,516	67,855	-28,550
6	1005	-22,599	47,492	-22,754
7	965	-28,476	18,290	-4,938
8	920	-36,779	11,699	2,785
9	1088	-54,877	13,990	116
10	991	-49,346	16,179	-4,781
11	930	-35,962	25,698	-12,831
12	976	-26,874	10,236	-4,700
13	898	-20,128	1,773	-6,604
14	931	-26,452	17,935	-6,637
15	1078	-37,114	23,680	5,241
16	866	-26,857	17,621	-7,263
17	993	-21,431	28,083	-23,050
18	946	-11,492	19,944	-20,051
19	1006	-5,283	-4,402	-8,971
20	950	-7,408	-12,877	-2,835
21	1096	-11,331	-11,771	-9,180
22	1137	-19,038	-1,818	-12,669
23	817	-16,820	9,329	-12,475
24	986	-24,099	18,964	-22,849
25	1242	-28,485	18,607	-31,910
26	874	-15,367	2,664	-28,804
27	836	-10,220	2,344	-37,959

R-Monument	Distance Between Monuments (feet)	Volume Change (cy)		
		1972 to 1987	1987 to 2003	2003 to 2007
28	879	-12,961	1,134	-36,735
29	908	-20,558	-19	-33,416
30	1229	-37,519	24,113	-49,942
31	815	-26,126	39,331	-50,551
32	999	-25,675	54,642	-77,834
33	997	-19,285	40,642	-55,002
34	796	-9,727	10,768	-27,522
35	1249	-14,301	7,817	-51,857
36	937	-10,002	10,434	
37	966	-16,328	25,499	
38	947	-22,611	21,817	
39	976	-30,135	29,779	
40	1023	-29,622	35,729	
41	929	-18,627	15,048	
42	1009	-11,241	18,180	
43	918	-2,444	1,654	
44	1050	-3,247	-19,598	
45	922	-3,249	-22,615	
46	1103	-5,614	-8,576	
47	993	-6,177	-4,888	
48	965	-7,099	-9,825	
49	946	-12,182	2,627	
50	1004	-17,323	12,893	
51	918	-19,874	14,732	
52	890	-18,783	17,409	
53	451	-7,304	11,348	
54	803	-9,040	12,054	
55	1027	-6,278	-6,087	
56	869	-5,124	-17,022	
57	725	-4,115	-24,846	
58	1104	-8,117	-31,369	
59	1102	-4,610	-14,545	
60	784	-9,498	-3,334	
61	926	-23,872	1,130	
62	995	-32,335	-97	
63	995	-38,262	-10,421	
64	882	-32,650	1,920	
65	1014	-35,415	15,671	
66	936	-33,555	4,260	
67	917	-35,307	18,049	
68	1053	-44,739	34,699	
69	883	-36,259	21,116	
70	1064	-37,734	17,269	
71	969	-27,927	31,193	
72	940	-16,059	44,334	
73	952	-9,938	30,224	
74	948	-4,707	18,510	
75	945	-11,268	23,432	

R-Monument	Distance Between Monuments (feet)	Volume Change (cy)		
		1972 to 1987	1987 to 2003	2003 to 2007
76	964	-22,043	39,170	
77	977	-33,331	42,607	
78	969	-55,789	29,629	
79	961	-68,016	45,964	
80	945	-80,540	44,192	
81	948	-80,325	14,164	
82	1006	-68,743	19,555	
83	903	-44,901	20,634	
84	1048	-34,488	6	
85	732	-19,579	-12,607	
86	962	-23,313	-16,627	
87	946	-19,179	-22,477	
88	890	-16,065	-7,863	
89	810	-16,289	25,471	
90	954	-26,570	33,630	
91	931	-32,427	29,227	
92	949	-36,303	30,081	
93	955	-45,324	19,682	
94	948	-46,019	21,484	
95	950	-49,304	27,418	
96	860	-47,146	29,673	
97	971	-52,740	30,416	
98	983	-55,250		
99	951			
100	951			
Total		-2,549,342	1,562,883	-771,709*
Number of Years		14.43	16.68	4.17*
Average Annual (cy/yr)		-176,701	93,717	-185,068*

*Note 2007 Survey only covered R-1 to R-35

Longshore Sediment Transport

The primary force that drives longshore sediment transport in Flagler County is the incident wave field. The net transport in Flagler County is generally north to south similar to other east coast Florida beaches as a result of the majority of annual wave energy originating from Northeaster conditions. However, during years of decreased Northeaster activity or in the calmer summer months dominated by smaller waves from southeast trade wind activity, the net annual transport can reverse to the north. The passage of tropical systems also promotes north-directed sediment transport.

The 1980 USACE Reconnaissance Report for Flagler County stated that the net annual southerly drift equaled 350,000 cy/yr (268,000 m^3/yr), based on Summaries of Synoptic Meteorological Observations (SSMO) data produced by the U.S. Navy (see Table 1). Further, the northward and southward transports equaled 263,000 cy/yr (201,000 m^3/yr) and 613,000 cy/yr (469,000 m^3/yr), respectively, resulting in a gross transport of 876,000 cy/yr (670,000 m^3/yr). Taylor (2002) reported that net transport in Flagler Beach ranged from 20,000-450,000 cy/yr (15,300-344,000 m^3/yr), using the CERC equation.

Table 1. Longshore Sediment Transport Estimates for Flagler County, FL.

Year	Report Title	Author	Sediment Transport Rates (cy/yr)
1980	Flagler County SPP Reconnaissance	USACE	+350,000 (Net) -263,000 (Northward) +613,000 (Southward) 876,000 (Gross)
2002	State Road A1A Shore Protection Evaluation Flagler Beach, Flagler County, FL	Taylor Engineering, Inc.	+20,000 to +450,000 (Net)
2007	Northeast Florida Atlantic Coast Regional Sediment Budget Nassau Through Volusia Counties	USACE	+177,000 at R-1 (Net); +154,000 at R-100 (Net)
2012	Regional Sediment Budget for St. Augustine Inlet and St. Johns County, FL, 1998/1999-2010	USACE	+100,000 (Net)

USACE (2007) studied the northeast Florida shoreline in order to develop a regional sediment budget using published volume change rates and transport rates as well as computing volume changes from surveys. The volume changes reported for Flagler County differed from those reported above and may be due to different calculation techniques; the 2007 study utilized digital terrain model surfaces to compare volume changes between surveys. The period from 1972 to 1987 was reported to change -208,000 cy/yr and by calculation the period from 1987 to 2003 was found to equal +240,000 cy/yr. So the total change over the 1972 – 2003 period equaled +32,000 cy/yr. The discrepancies were not further investigated, but more importantly and more relevant to the development of this study are the net transport rates that were calculated. The values equaled +177,000 cy/yr (with positive indicating southward transport) at the north end of the Flagler County cell, and +154,000 cy/yr at the south end using the calculated volume change within the cell equal to +23,000 cy/yr as previously indicated.

A recent report by USACE (2012-a) revised the regional sediment budget for St. Augustine Inlet and St. Johns County, FL. The analysis utilized a family of solutions scheme in order to converge on the final solution through the balancing of transport rates. At the southern end of the study area, at R-151- approximately 11.5 miles north of Flagler County, net transport was found to equal 100,000 cy/yr (76,000 m^3/yr) to the south. So with the more recent studies (2007 and 2012) in mind, net transport rates for Flagler should range from between 100,000 cy/yr (76,000 m^3/yr) to 177,000 cy/yr (135,000 m^3/yr). Further, if the volume change for Flagler calculated over the period from 1972 to 2003 were used in the 2007 USACE study, the upper range of net transport would thus be 207,000 cy/yr (158,000 m^3/yr). Given that these values of net transport are reduced from the original 1980 estimate by USACE, it is expected that the gross transport rate from that report (the only gross transport estimate available) over predicts the actual rate.

GenCade Model Setup

In order to fully capture the shoreline changes within Flagler County and to minimize any boundary effects to the study area, the GenCade model domain was extended to include about 2.5 miles of shoreline in St. Johns County to the north and a similar extension into Volusia County to the south. The northern boundary was therefore set to approximately coincide with FDEP monument R-198 in St. Johns County and the southern boundary extended to R-12 in Volusia County. The shoreline input data were limited however to the length of shoreline including R-201 in St. Johns County, R-1 through R-100 in Flagler County, and R-9 for Volusia County for the calibration and verification time periods. The model grid was located sufficiently landward so that the modeled shoreline would never intersect or recede landward of the grid. Additionally, the grid was oriented so that it was approximately parallel to the Flagler County shoreline, an azimuth of 158 degrees measured clockwise from due north (0°). Although Flagler County does have some shore protection structures in place, such as seawalls, revetments, and groins, the model setup ignored these structures since the seawalls and revetments are very rarely in contact with the ocean, and the groins are very porous with low crest heights, showing no signature of influence to the sediment transport that is typically observed with more prominent features.

The progression of the shoreline change modeling includes model calibration which tunes the model to better approximate the local conditions, the verification period which confirms that the model has been adequately adjusted during calibration, and finally the actual production runs which predict how engineering modifications to the system will react under typical conditions. Model guidance suggests that the GenCade model is most applicable to trending shorelines. Shoreline and volume changes were calculated and reviewed to select the best potential time periods where corresponding wave data were available. The wave data used for the analysis limited the number of surveys that could be used for direct comparison to the modeled results, specifically to the years between 1980 and 1999. The years selected for calibration and verification are bracketed by the surveys from 1984, 1987, and 1993.

The calibration start and end dates were set to a median date for each beach profile survey, or 8/1/1984 and 1/14/1987, respectively. The verification period immediately followed and covered the time period of 1/15/1987 to 07/31/1993. The calibration and verification periods were driven by wave data sets corresponding to the same dates of the beach profile surveys. For the production runs, engineering alternatives were introduced to the model space and shoreline changes were driven by using an average year of wave data repeated over ten years.

The computation time step was set at a three hour interval and modeled shoreline outputs were set to 168 hours (1 week). Grid cell sizes were set at 305 meters (~1,000 feet) which is approximately equal to the spacing of established monuments where profile line monitoring surveys originate. Beach profile surveys were analyzed through time to find the average berm height (11 feet; 3.35 meters) and depth of closure (20 feet; 6.1 meters) for the study area; these values are required model input and define the zone of sediment movement in the model. Geotechnical investigation of the beach sediments in Flagler County indicate that the median grain size (d50) was found to equal 0.44 mm. The calibration coefficients K1 and K2 were given the default values of 0.5 and 0.25, respectively. The lateral boundary

condition was set to "pinned" meaning the shoreline doesn't change position at either end. Further discussion of the lateral boundary condition is included in the Calibration section below. All other model parameter values were kept as default.

Wave Data

The GenCade model requires breaking wave heights to calculate potential sediment transport rates which are then used to calculate shoreline changes. Since breaking wave heights are rarely measured or readily available, GenCade includes an internal wave model that can transform waves from a given offshore depth to breaking depth using linear wave theory. If the offshore depth contours are believed to follow the shoreline as straight and parallel lines, using the internal wave model is recommended.

Although it is accepted that the contours off of Flagler County are generally rather straight and parallel, the offshore bathymetry as seen in Figure A- 22 suggests some features could influence the wave field. Since the degree of influence of the offshore features was unknown, the wave transformation model within the Coastal Modeling System (CMS-Wave) was used to shoal and refract the waves over the irregular bathymetry to a location seaward of the breaking depth. The transformed wave data output from the CMS-Wave model were then manipulated into the format required for input into GenCade.

The most complete wave data set available for Flagler County is a 20-year hindcast produced by USACE known as the Wave Information Studies. The wave hindcast is developed using computer models with observed wind fields as input. The wave model used for the Atlantic Coast, known as WISWAVE, is a discrete spectral wave model that solves the energy balance equation for the time and spatial variation of a 2-D wave spectrum from wind forcing (ERDC, 2012). The WIS database provides densely-spaced "virtual wave gages" between 15-20 meter (49-66 foot) water depths. The virtual wave gage closest to the study area is station 63422 located in 20 meters (66 feet) of water about 8.4 nautical miles from the shoreline at 29.58° latitude and -81.00° longitude.

Wave Transformation

To accomplish wave transformation from an offshore location to a nearshore location, CMS-Wave requires bathymetry data over the model domain and an offshore wave input. The National Geophysical Data Center (NGDC) of the National Oceanic and Atmospheric Administration (NOAA) maintains a database that integrates offshore bathymetry and land topography for the U.S. coastal zone known as the Coastal Relief Model (CRM). Through the internet interface, users can download data sets for one degree by one degree areas, or create custom grids to suit a project's needs (NOAA, 2012).

For the Flagler County Feasibility Study, a custom CRM grid was created that extended well beyond the study area and offshore of the WIS station. The last complete FDEP beach profile survey of Flagler County from 2003 was merged and smoothed with the custom CRM bathymetry grid to provide the best available nearshore bathymetry dataset. The CMS-Wave model grid extended 4.2 miles north into St.

Johns County, 3.2 miles south into Volusia County, and 10.8 miles offshore with an azimuth of 202°, measured counter-clockwise from due north (0°). The grid resolution was varied in the cross shore direction from about 6.5 meters (21 feet) in the nearshore zone to 120 meters (400 feet) offshore, using five refinement points that were spaced increasingly farther apart moving offshore. The cell widths in the alongshore direction were held constant at about 150 meters (500 feet). There were a total of 77964 cells with 267 cells in the alongshore direction and 292 cells in the cross-shore direction.

The WIS dataset is available as hourly two-dimensional directional spectra or in three-hour parameter form that includes wave height, period, and direction; each parameter corresponds to the parameter value at the peak energy location in each spectrum. Since the format of the WIS spectra files are not consistent with the spectral files used in CMS-Wave, the WIS parameter files were used for input waves. Once imported into CMS-Wave, the parameters were used by the internal spectral generator to create spectral files that follow a generalized distribution of energy with the peak energy centered at the parameter values for each time step.

Three wave observation stations were included in the model setup so the waves transformed with CMS-Wave could be easily obtained as a model output. The three stations were located near or just offshore of the 5 meter (16 foot) contour and at the north, center, and south ends of the modeled area. This contour location was tested by running CMS-Wave with the month containing the largest wave event of the 20-year record to ensure that it was sufficiently deep so that the largest wave event was not breaking at this location.

By linear wave theory, the largest wave this location could observe before the breaking condition was met equals 3.75 meters (12.30 feet). During the month of the maximum observed wave height, the offshore height at WIS station 63422 equaled 8 meters (26 feet) at a peak period of 14.3 seconds. The nearshore wave height for this event after transformation from the offshore virtual wave gage location equaled 4.1 meters (13.5 feet) at the southern observation station, the maximum of the three stations. The model also reported that wave breaking did not occur indicating that the 5 meter depth was a reliable location to obtain transformed wave data over the entire 20 year period for input into GenCade. The output from the three observation stations was bracketed by the times corresponding to the calibration and verification periods, and manipulated into the GenCade input file format.

Calibration

The calibration procedure optimizes site specific model parameters for a given study area by comparing model predictions with measured shoreline change and calculated or published transport rates. It was previously noted that model guidance suggests that the model works best on shorelines with an established trend in its position change. One way to calibrate to shorelines exhibiting minimal trends in behavior is to compare the calculated longshore transport rates with the modeled values (USACE, 2012-b). For Flagler County, calibration of model parameters was the result of statistical analysis of the modeled versus measured shoreline. In addition, parameter values that resulted in unreasonable longshore transport rates were excluded from the analysis.

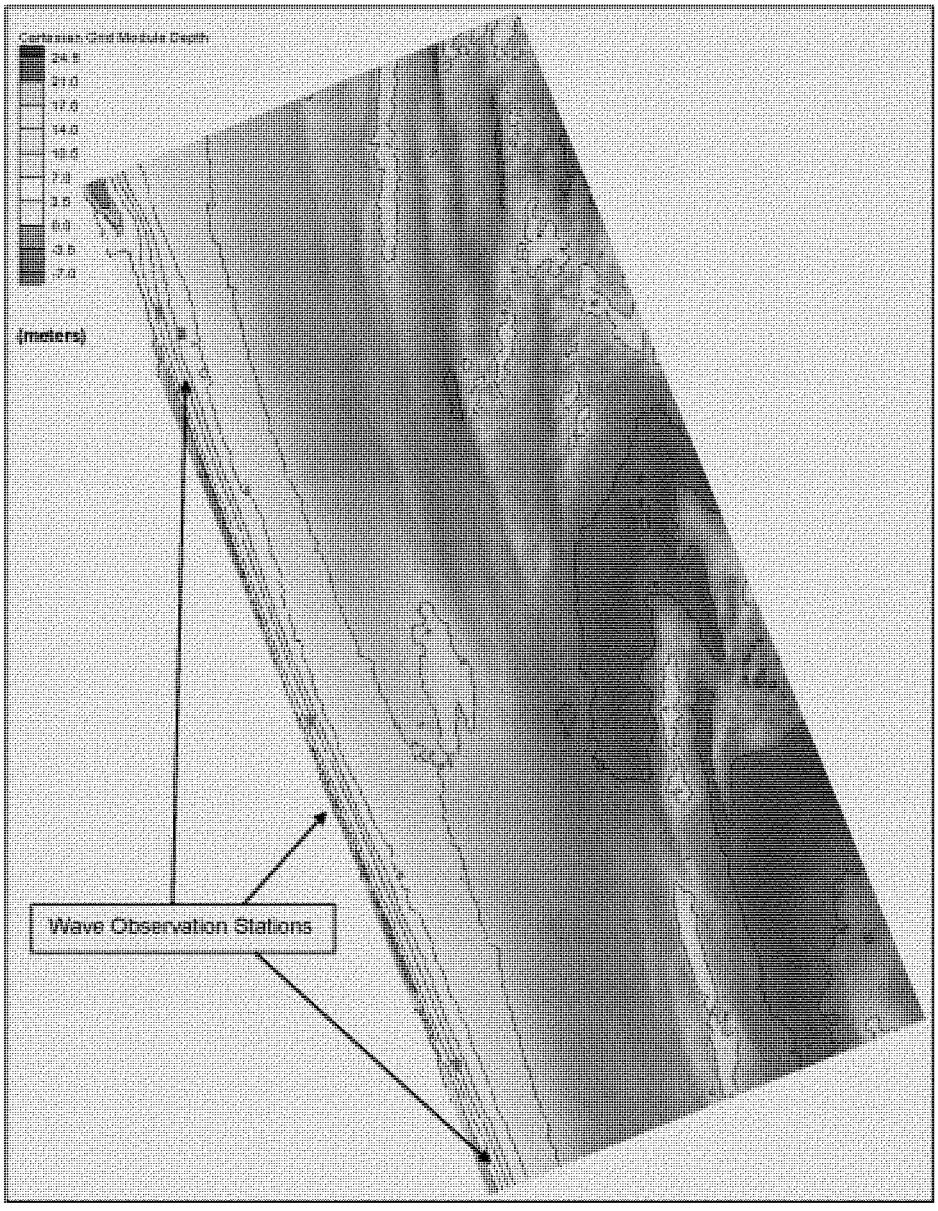

Figure A- 22. CMS-Wave Model Domain for Flagler County Feasibility Study

The calibration period was initially set up using all default parameter values with the 1984 measured shoreline as the initial shoreline and the three wave inputs that were output from the CMS-Wave model. Over the same model grid, the final surveyed shoreline for the calibration period from 1987 was added and saved. This allowed for comparison between the measured 1987 shoreline and the final shoreline calculated by the model, each referenced to grid-space. Additionally, the 1987 shoreline was ready for use following calibration in the model verification phase. The final shoreline for the verification period (1993) was similarly loaded into the model space and referenced to the model grid for later comparison with the 1987 initial shoreline condition for the verification phase.

The output from GenCade provided a calculated final 1987 shoreline plus sediment transport rates. Figure A- 23 shows the initial 1984 shoreline, modeled 1987 shoreline, and measured 1987 shoreline positions. The figure shows the model has heavily smoothed any undulation in the initial shoreline, including the embayment-like feature near the center of the study area. The measured versus modeled shoreline change reflects some of the discrepancies in shoreline positions, as seen in Figure A- 24. Some of the shoreline change magnitudes and directions match up well, but the majority of shoreline change does not and the worst areas between the modeled versus measured change are almost fully out of phase, resulting in a root mean square error (RMSE) of 11 meters (36 feet). Thus it was decided to incorporate a regional contour. Additionally, although the net annual transport rate calculated by the model seems to fall in the range provided by previous studies, the model is over predicting the gross rates (see Figure A- 25).

In order to preserve dominant regional shoreline characteristics in the absence of controlling structures, for example an embayment, GenCade provides the option to use a regional shoreline. If an open coast shoreline doesn't have specified sediment sources or sinks, or structures (such as the Flagler County shoreline), simulations over long time periods will result in a straight coastline. By providing a regional contour, the modeled shoreline will be guided in its evolution and eventually will assume a shape parallel to the regional contour if simulated over long enough time periods.

The regional contour was created using the mean high water location from the FDEP beach profile survey database by averaging the positions from the years of 1972, 1987, 1993, 2003, and 2007. Once the time-averaged shoreline was established, it was smoothed by applying a 3-point moving average. The regional contour was then formatted into the appropriate GenCade input file and loaded into the model. The results of the initial run using the regional contour with default parameter values can be seen in Figure A- 26 and Figure A- 27. Comparing the shoreline change figures (Figure A- 24 and Figure A- 27), one can see that the addition of the regional contour vastly improves the magnitudes and directions of shoreline change for the Flagler County study area, and the inflection points are more consistent with the measured data. The RMSE was reduced to 5.8 meters (18.9 feet) from 11.0 meters (36.0 feet) by adding the regional contour.

Following application of the regional contour, the first and most influential model parameter that was adjusted was the K1 transport coefficient. Changing the K1 value had direct noticeable effects to the longshore sediment transport rate. The magnitude of shoreline change also increased as K1 increased.

The K1 parameter was varied between 0.15 and 0.65, with the minimum achieved root mean square error result equal to 5.73 meters (18.8 feet) when K1 was set to 0.35. The average net annual transport predicted by GenCade with K1 equal to 0.35 ranged from -105,000 cy/yr (-80,000 m^3/yr) at the extreme north end of the county to around 146,000 cy/yr (112,000 m^3/yr) from the middle of the county southward; a negative transport rate indicates northbound sediment movement and a positive transport rate indicates southbound sediment movement. The gross transport for the same parameter model run was less varied across the model domain and equaled 719,000 cy/yr (550,000 m^3/yr) at the north end of the domain and 760,000 cy/yr (581,000 m^3/yr) at the south end, which is less than the USACE (1980) estimate of 876,000 cy/yr (670,000 m^3/yr).

The final K1 value of 0.35 resulted in an average annual shoreline change rate equal to -1.1 ft/yr. This is about two times as much as the historical average change rate of -0.5 ft/yr. Although this would indicate that the model is overpredicting shoreline recession, the longshore transport rates of the selected K1 value are at the bottom range of what was suggested in the literature. So reducing the K1 value in order to better align the modeled average shoreline change with the measured shoreline change over the calibration period would result in transport rates well below the lowest transport rate found in the literature. Further, when comparing the shoreline changes predicted by the model to the actual measured change, the calibration run with K1 set to 0.35 matched both the magnitude of shoreline change as well as the location of inflection points better than when K1 was set to 0.15.

The K2 longshore transport coefficient parameter is stated to only affect shoreline evolution in areas influenced by wave diffraction near structures (Frey et al. 2012). Nonetheless, K2 was varied during calibration following the selection of K1 equal to 0.35. Since the modeled Flagler County shoreline didn't include any structures, changes in the K2 value did not result in noticeable changes in modeled shoreline positions.

Other model parameters that had little effect on model solutions when varied were the median grain size (d_{50}) and the boundary type. The median grain size was varied between 0.10 mm and 0.65 mm with resulting RMSE values varying by less than 0.01 meters (0.03 feet). When the boundary type was set to a moving boundary that corresponded to the actual measured change at either end of the project during the calibration period, the result was not significantly improved. Due to the nature of the Flagler County shoreline, the values for the moving boundary applied during calibration would not be relevant during verification since the shoreline change direction and magnitude is rather ephemeral and not constant through time.

Therefore,
the lateral boundary condition was set to "pinned" meaning the shoreline doesn't change position at either end. The benefit of using a pinned boundary was to reduce any noise introduced by the oscillating nature of the shoreline which would be occur if using a moving boundary that reflects the actual measured change. For example during the calibration period the change at R-3 and R-99 equaled -59 and -28 feet, respectively. Those same monuments during the verification period equaled +13and +54 feet, respectively. The model was set up with the understanding that all parameters set during

calibration should be repeated during verification, and thus using a retreating shoreline during the verification period when measured data suggests an advancing shoreline didn't make sense. Tests were made during calibration using proxies for the long-term average shoreline change (0.5, 1.0, and 1.5 ft/yr), but the changes didn't improve the results. Further, the boundary was placed about 3.5 km north of the project area and 7.5 km south of the project area so problems with the boundary would be minimized in the area of interest.

The "Ismooth" model parameter, which represents the number of grid cells in the offshore contour smoothing window (a moving average applied to the shoreline to avoid instabilities caused by abrupt changes in shoreline orientation), was the only other parameter besides the K1 transport coefficient that exhibited some effect on the model solution. With the transport coefficient K1 set to 0.35, Ismooth was changed from the default value of 11 to a value of 1.0, 21, and 31. Changing the Ismooth parameter did not drastically change the fit between the modeled and measured shoreline, but the root mean square error was improved by 0.01 meters (0.03 feet) when using the value of 1.0. So the final Ismooth value used in verification and model runs on beach fill alternatives equaled 1.0 and resulted in an RMSE value of 5.72 meters (18.8 feet). The shoreline positions predicted from the final calibration run are seen in Figure A- 28, shoreline change for the same model run is found in Figure A- 29, and longshore transport is shown in Figure A- 30.

Verification

Using the parameters from the final calibration run, waves from the period between 15 January 1987 and 31 July 1993 were input along with the 1987 shoreline in order to model the verification period. As done with the calibration period, the final modeled shoreline position was compared with the final measured shoreline (1993) (Figure A- 31). For the majority of areas, the modeled shoreline followed the trend of the measured shoreline with some areas off in magnitude, typically predicting more erosion than measured, and other areas matching up very well in both trend and magnitude.

The shoreline changes predicted from the model are included with measured data in Figure A- 32, as well as the difference between the initial shoreline and the regional contour for reference. Between the 20km and 32km area of the grid space, the shoreline changes match extremely well. The areas where the model over-predicts erosion are more apparent in Figure A- 32 versus Figure A- 31. The influence of the regional contour on the final modeled shoreline is also apparent by the trend changes and minor perturbations in the two lines. The difference between the regional contour and the 1987 shoreline also largely follows the trends of the observed changes between 1987 and 1993, which suggests its validity. The RMSE for the validation run is included on Figure A- 32 and equaled 7.6 meters (24.9 feet). This value is greater than the calibration period, but deemed acceptable and validates that the model is properly calibrated. The longshore sediment transport rates during the verification period were reduced as compared to the final calibration run, but were determined acceptable (see Figure A- 33).

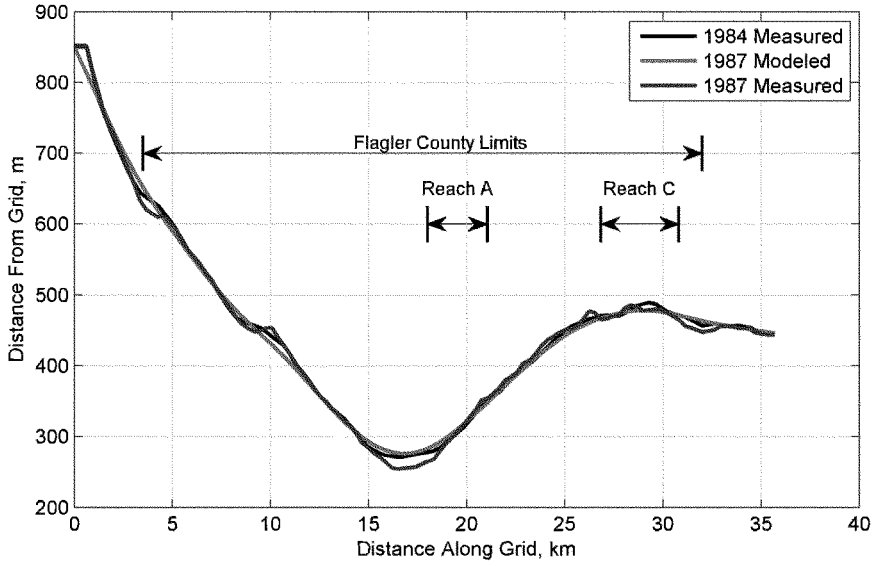

Figure A- 23. Modeled and Measured Shoreline Positions during Calibration Run #1

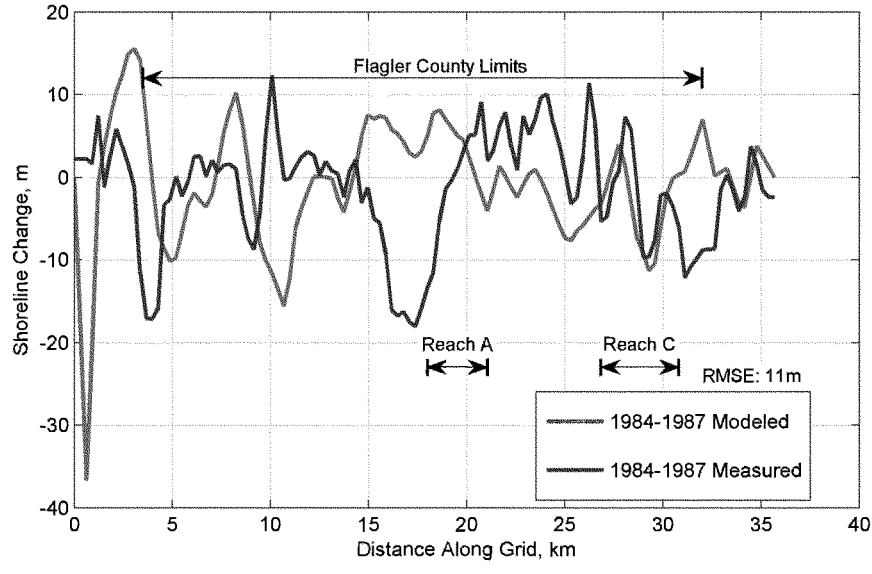

Figure A- 24. Modeled and Measured Shoreline Change during Calibration Run #1

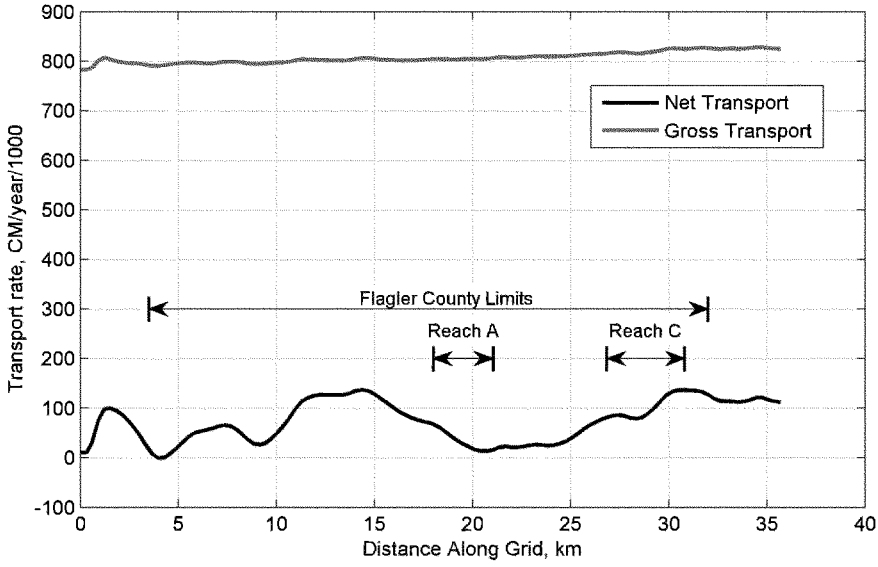

Figure A- 25. Longshore Sediment Transport for Calibration Run #1

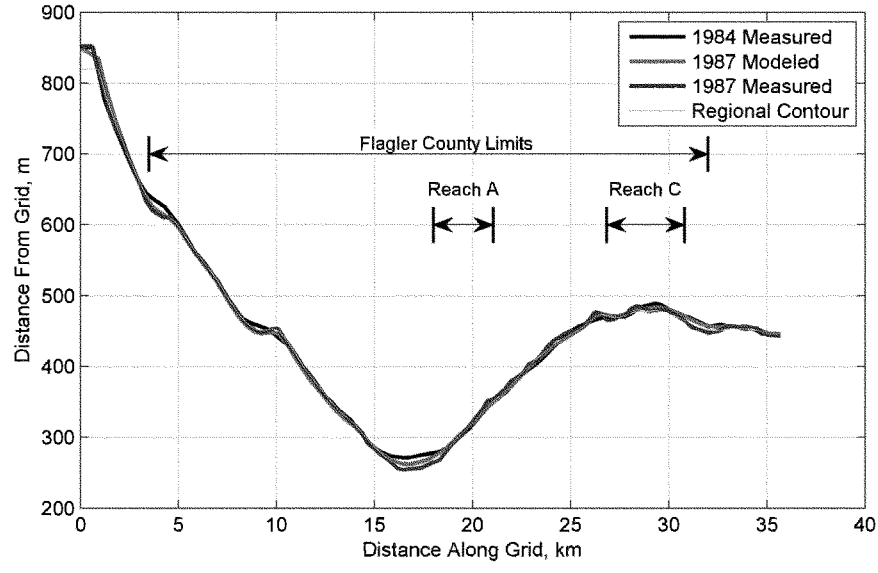

Figure A- 26. Modeled and Measured Shoreline Positions with Regional Contour

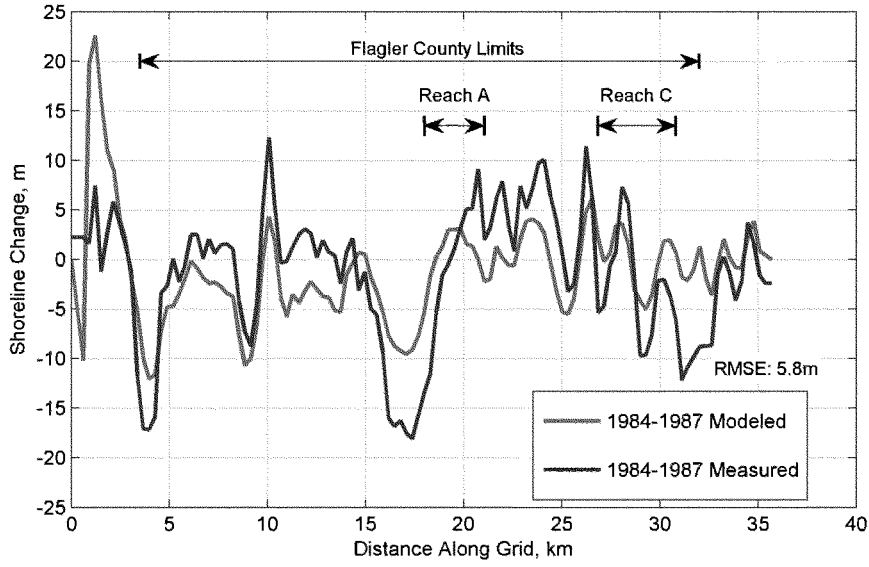

Figure A- 27. Modeled and Measured Shoreline Change with Regional Contour

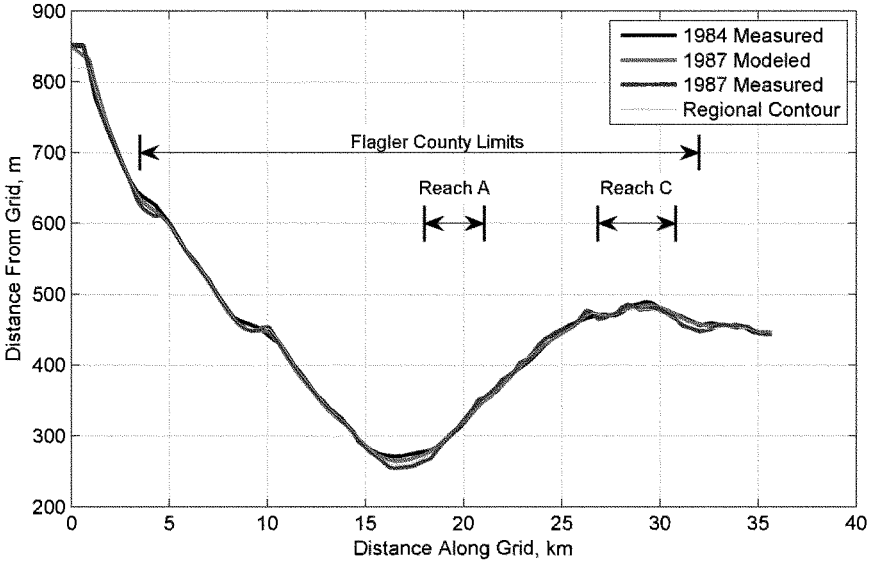

Figure A- 28. Final Calibration Modeled and Measured Shoreline Positions

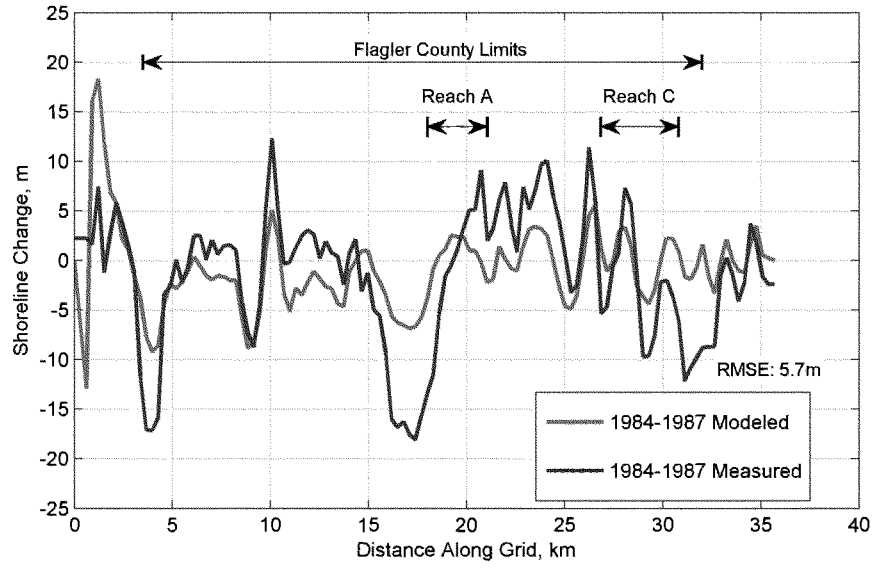

Figure A- 29. Final Calibration Modeled and Measured Shoreline Change

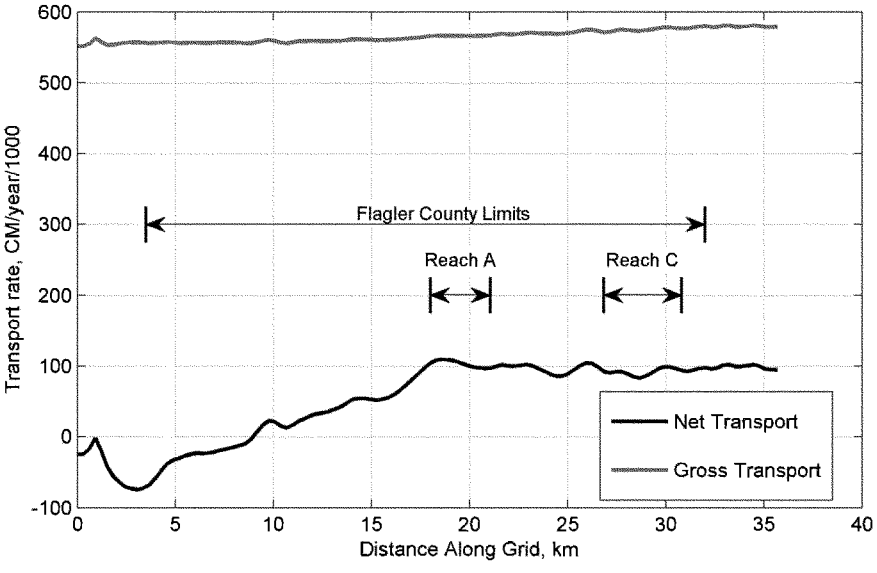

Figure A- 30. Final Calibration Longshore Sediment Transport

Model Results

The calibrated and verified GenCade model for Flagler County provides a means to test various proposed shoreline protection measures so that the most economically beneficial alternative can be determined. In order to compare proposed alternatives, an input shoreline condition with no modifications is first used to project the future background conditions. This model run is the future without-project condition. Then the various proposed alternatives are added to the initial input shoreline.

A beachfill is represented by extending the initial shoreline seaward by the amount specified for each alternative. For Flagler County, the input shoreline was extended seaward 10 feet to represent a dune only alternative, then 30 feet (10 foot dune + 20 foot berm), 50 feet (10 foot dune + 40 foot berm), 70 feet (10 foot dune + 60 foot berm) and 90 feet (10 foot dune + 80 foot berm) to represent a full beach nourishment template. The shoreline advances were applied to the areas that were determined to be favorable for a project to provide economic benefits (see Table A- 20, **Nourishment Design Templates**). The initial shoreline for all cases was based on the 1984 shoreline used during calibration. Figure A- 34 shows the initial model setup for both the with- and without-project conditions, focused on the areas where the nourishments are proposed and using the alternative with the maximum mean high water extension(70 feet).

The wave input for the production runs of project alternatives including the future without project condition was developed based on an average representative year. The entire 20 year wave dataset output by the CMS-Wave model was used as input into the GenCade model along with the 1984 shoreline. The average annual gross, net, northward, and southward transport outputs from the 20 years of the GenCade model period were amalgamated then averaged. The absolute relative difference of each year's different transport versus the 20-year mean was calculated and used to determine that 1991 best represented the average year. Ten year GenCade wave inputs were then developed by repeating the 1991 waves for each of the three stations used in the model simulations.

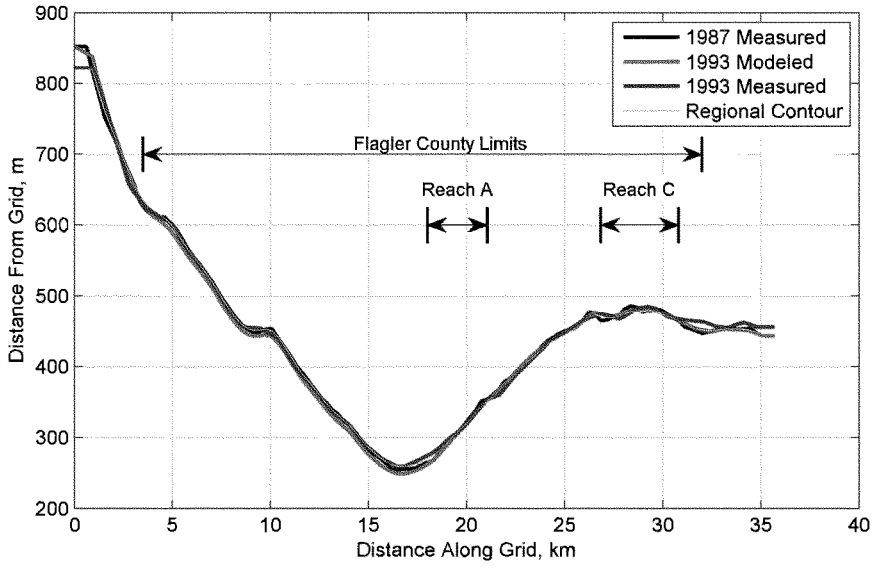

Figure A- 31. Verification Run Modeled and Measured Shoreline Positions

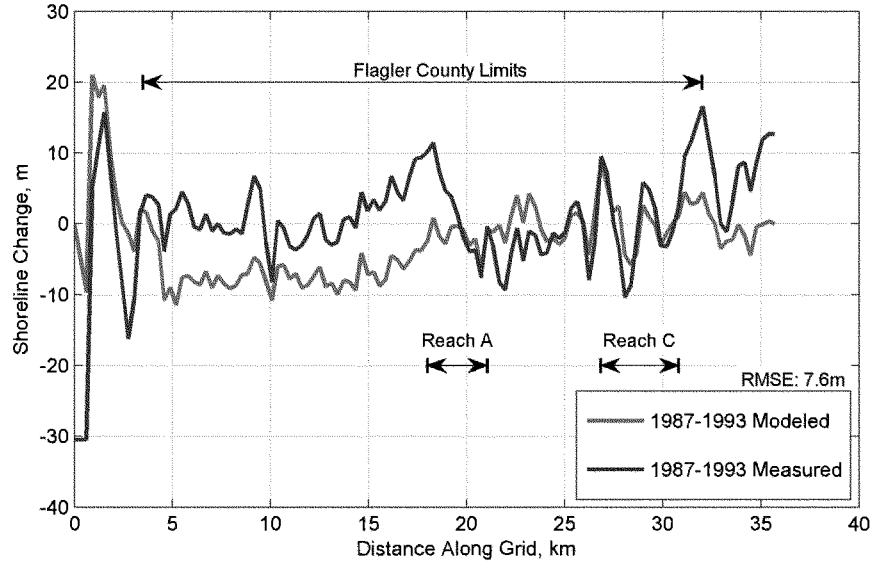

Figure A- 32. Verification Run Modeled and Measured Shoreline Change

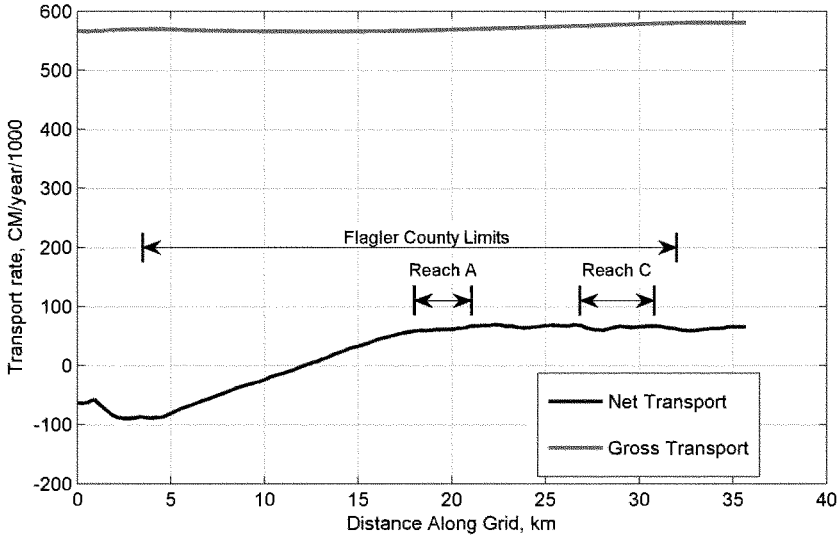

Figure A- 33. Verification Run Longshore Sediment Transport.

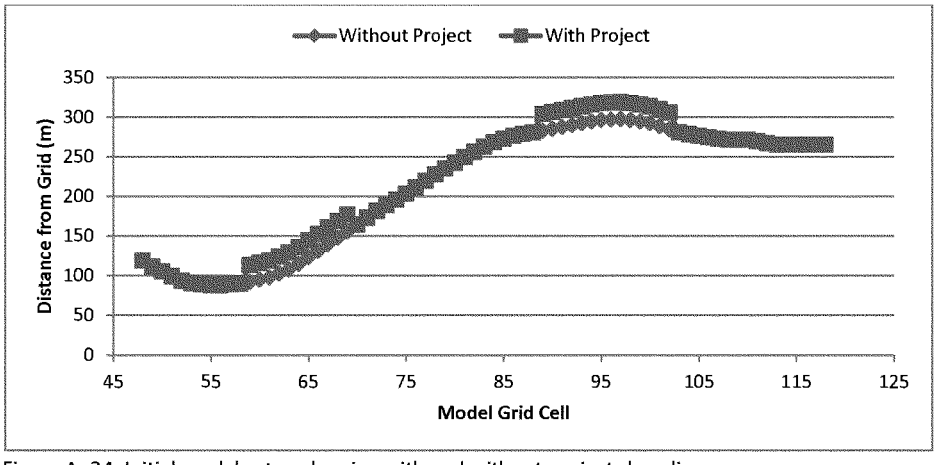

Figure A- 34. Initial model setup showing with and without project shorelines.

Future without Project Shoreline

The predicted shoreline changes without a nourishment project after a ten year simulation period is shown in Figure A- 35. Over the ten year period, the average change equaled -5.3 meters (-17.5 feet) or -0.5 m/yr (-1.75 ft/yr). The average values appear reasonable, but are greater than the historical average of -0.5 ft/yr. As previously discussed, the over-prediction of recession by the model was balanced with the amount of longshore sediment transport reported in the literature. The distribution as seen in Figure A- 35 is not uniform, giving rise to a standard deviation of 7.9 meters (25.9 feet). The area south of the embayment feature, from about 18 km south of the grid origin, shows mostly positive shoreline change over the 10 year simulation period, whereas the shoreline change for the area north of this point is largely negative.

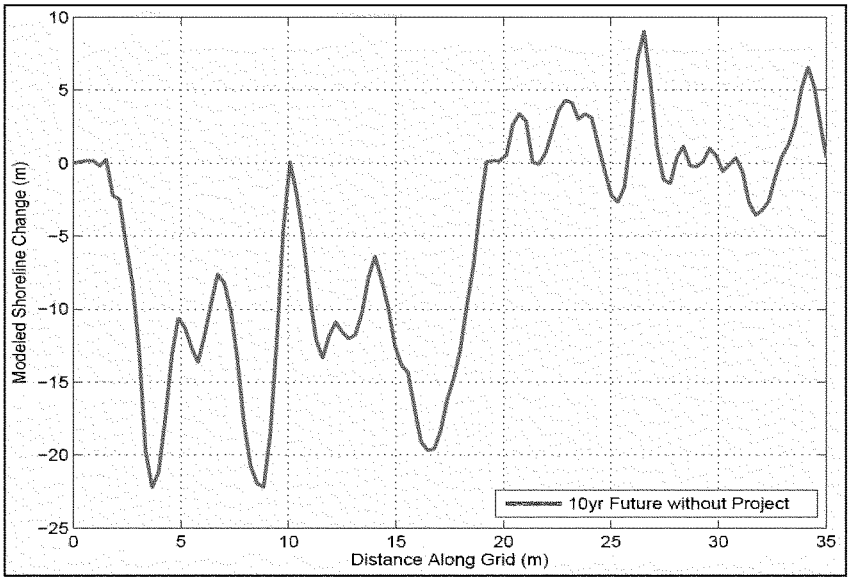

Figure A- 35. Future Without Project Predicted Shoreline Change

Future with Project Shoreline

The future with-project simulations featured a dune only option, represented by a 10 foot extension of the MHW shoreline, as well as dune+berm beachfill options of varying widths (30, 50, and 70 feet). The changes after 9 years of simulations were compared with the changes observed from the future without project run in order to determine the planform shoreline change rates that would be expected from a constructed project. Figure A- 36 and Figure A- 37 show two example model runs. Figure A- 36 shows shoreline change rates for fill alternatives in both Reaches A and C. Figure A- 37 provides the same

results, but only the option to fill Reach C was examined. Similar results were obtained for all of the design alternatives that were carried through the full economic analysis of this study.

The greatest rates of shoreline change for the future with-project versus the future without project are found at the lateral boundaries of the beach fills. The change within the fill areas are shown as losses as the project equilibrates with the surrounding beaches and the nourishment material spreads laterally through diffusion. The beaches immediately adjacent to the fill areas receive the lost nourishment material resulting in positive shoreline change. Of the two examples shown, the greatest losses were predicted for Reach A and equaled more than 4 ft/yr. Reach C losses were about 3.75 ft/yr, so given the accuracy of the model, the change rates are essentially equal.

The project induced shoreline change rates calculated by Gencade and shown graphically in Figure A- 36 and Figure A- 37, do not take into account the improved performance of beach nourishments projects that comes with project maturation. That is, theory and beach nourishment experience has shown that dispersion losses at a beach nourishment project tend to decrease with the number of project nourishments. Based on the behavior of previous storm damage reduction projects along the east coast of Florida, it is assumed for the sake of this study that there will be a 20% reduction in shoreline change rates following each consecutive renourishment cycle.

Given that the final selected project alternative is a dune only feature, the over-prediction of average shoreline change with the selected calibration parameters has much less influence on the project economics than that of the greatest beach fill alternative. Further, the average change predicted by the model for the dune only alternative is very near the historical change rate of -0.5 ft/yr as seen in Figure A- 36 and Figure A- 37.

Post Storm Berm Recovery

Post storm recovery of eroded berm width after passage of a major storm is a recognized process. Although present coastal engineering practice has not yet developed a predictive method for estimating this process, it is an important element of post-storm beach morphology. Within Beach-*fx*, post-storm recovery of the berm is represented in an ad hoc procedure in which the user specifies the percentage of the estimated berm width loss during the storm that will recovered over a given recovery interval. Based on review of available historical FDEP profiles that would qualify as pre- and post- storm, a recovery percentage of 90% over a recovery interval of 21 days was determined for Flagler County.

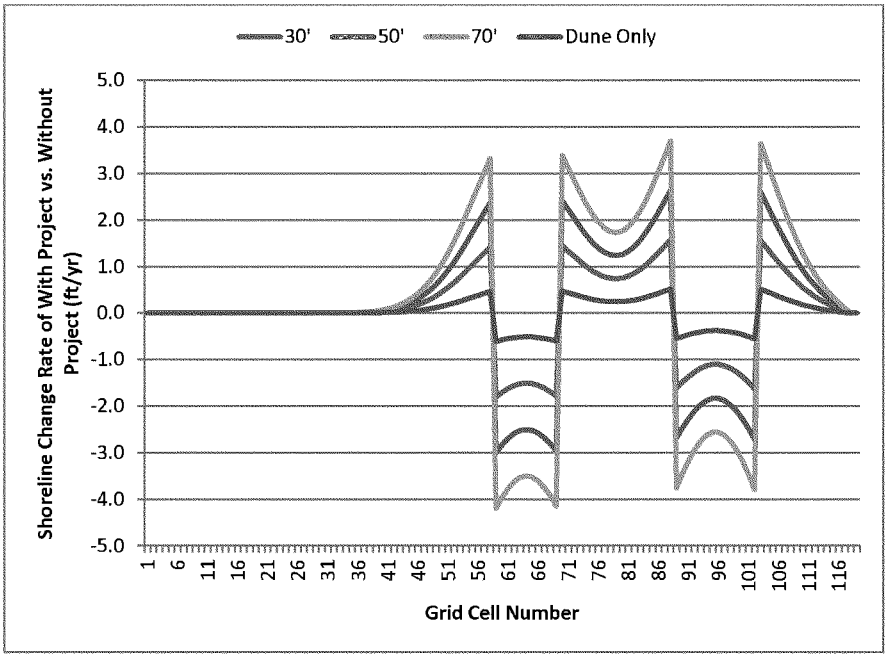

Figure A- 36. Modeled Shoreline Recession Rates for Reach A and C Nourishments

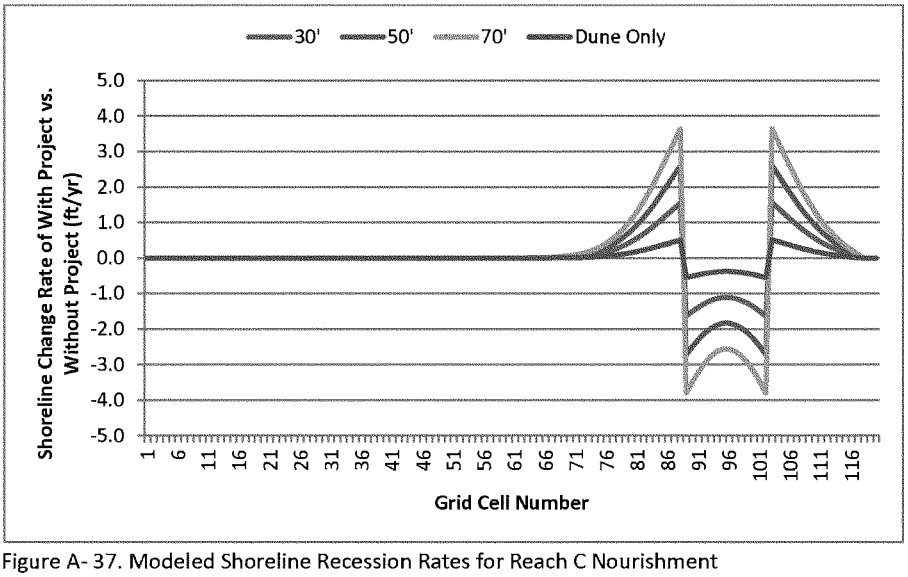

Figure A- 37. Modeled Shoreline Recession Rates for Reach C Nourishment

Economic Evaluation

The Beach-*fx* model analyzes the economics of shore protection projects based on the probabilistic nature of storm associated damages to structures in the project area. Damages are treated as a function of structure location and construction, the intensity and timing of the storms, and the degree of protection that is provided by the natural or constructed beach. Within the model, damages are attributed to three mechanisms:

- Erosion (through structural failure or undermining of the foundation)
- Flooding (through structure inundation levels)
- Waves (though the force of impact)

Although wind may also cause shoreline damage, shore protection projects are not designed to mitigate for impacts due to wind. Therefore, the Beach-*fx* model does not include this mechanism.

Damages are calculated for each model reach, lot, and damage element following each storm that occurs during the model run. Erosion, water level, and maximum wave height profiles are determined for each individual storm from the lookup values in the previously stored SRD. These values are then used to calculate the damage driving parameters (erosion depth, inundation level, and wave height) for each damage element.

The relationship between the value of the damage driving parameter and the percent damage incurred from it is defined in a user-specified "damage function". Two damage functions are specified for each damage element, one to address the structure and the other to address its contents. Damages due to erosion, inundation, and wave attack are determined from the damage functions and then used to calculate a combined damage impact that reduces the value of the damage element. The total of all damages is the economic loss that can be mitigated by the shore protection project.

A thorough discussion of the economic methodology and processes of Beach-*fx* can be found in the **Economics Appendix.**

Management Measures

Shoreline management measures that are provided for in the Beach-*fx* model are emergency nourishment and planned nourishment.

Emergency Nourishment

Emergency nourishments are generally limited beach fill projects conducted by local governments in response to storm damage. Flagler County does not have a history of emergency nourishment. The absence of past emergency nourishment events prevents the assumption that future emergency nourishment events will occur, either with or without an authorized shore protection project in place. Therefore, this management measure was not included in the Flagler Beach-*fx* analysis.

Planned Nourishment

Planned nourishments are handled by the Beach-*fx* model as periodic events based on design templates, triggers, and nourishment cycles. Nourishment templates are specified at the model reach level and include all relevant information such as order of fill, dimensions, placement rates, unit costs, and borrow-to-placement ratios. Planned nourishments occur when user defined nourishment triggers are exceeded and a mobilization threshold volume is met. At a pre-set interval, all model reaches which have been identified for planned nourishment are examined. In reaches where one of the nourishment threshold triggers is exceeded, the required volume to restore the design template is computed. If the summation of individual model reach level volumes exceeds the mobilization threshold volume established by the user, then nourishment is triggered and all model reaches identified for planned nourishment are restored to the design template.

Nourishment Design Templates

Beach-*fx* planned nourishment design templates are defined by three dimensions, the template dune height, template dune width, and template berm width. Berm elevations and dune and foreshore slopes remain constant based on the existing profiles. For Flagler County, each model reach level template was developed based on a 10-foot extension of the dune and beach profile (to depth of closure) and four berm widths: 20-foot, 40-foot, 60-foot, and 80-foot. Template dune heights in each case were set to the elevation of the existing Beach-*fx* profile. Design templates were developed for each profile within the four viable design reaches, Reach A, Reach B, Reach C, and Reach D. Note that the Marineland design reach was previously eliminated from further study. Table A- 20 provides dimensions for each of the design templates.

Table A- 20. Flagler County Beach-*fx* Nourishment Design Templates

Design Reach	Beach-fx model Reaches	Beach-fx Profiles	Template Dune Height (ft-NAVD88)	Template Dune Width (ft)	Template Berm Width (ft)				
Reach A	RA-1 to RA-10	RWAP3	20	110	0	20	40	60	80
		RWAP4	19	110	0	20	40	60	80
Reach B	RB-1 to RB-17	RWAP4	19	110	0	20	40	60	80
		RWAP5	20	110	0	20	40	60	80
Reach C	RC-1 to RC-14	RWAP4	19	110	0	20	40	60	80
		RWAP6	19	50	0	20	40	60	80
Reach D	RD-1 to RD-5	RWAP4	19	110	0	20	40	60	80
		RWAP6	19	50	0	20	40	60	80

Nourishment Triggers and Mobilization Threshold

Beach-*fx* planned nourishment design templates have three nourishment triggers (1) berm width, (2) dune width, and (3) dune height. Each trigger is a fractional amount of the corresponding template dimension that denotes the requirement for renourishment. During initial screening of project alternatives, the berm width, dune width, and dune height triggers were set at 0.5, 0.95, and 0.9, respectively, for alternatives which included a dune and profile extension (with berm). Triggers were set at 0.0, 0.91, and 0.9, respectively, for alternatives which included only an extension of the dune and beach profile. The mobilization threshold for all planned nourishment alternatives was specified as 300,000 cubic yards. Nourishment triggers and mobilization threshold are subjective parameters, based on local infrastructure and engineering judgement of when renourishment will become essential to the continued performance of the project. Application of these parameters for Flagler County is discussed in greater detail in Project Volumes.

Beach-*fx* Project Design Alternatives

In order to determine the most effective and cost efficient protective beach design for Flagler County, alternatives were developed by combining the design reaches and nourishment templates discussed previously (Table A- 20). Preliminary Beach-*fx* runs, along with assessment of potential benefits, allowed the initial array of alternatives to be screened down to those most likely to provide an effective and justified Federal project (see the **Main Text** for screening details). The final array of alternatives run with Beach-fx is presented in Table A- 21. These consist of two basic designs, a 10 foot hydraulic extension of the existing dune and beach profile (to depth of closure) and a 10 foot extension of the existing dune and beach profile combined with a 20 foot berm. No changes to the existing dune height were included.

Table A- 21. Final Array of Design Alternatives

Design Alternative	Description	Dune Height Extension (ft)	Dune Width Extension (ft)	Berm Width Extension (ft)
Reach A duneH	10' extension of ReachA existing dune and beach profile	0	10	0
Reach A 30	10' extension of ReachA existing dune and beach profile with a 20' berm	0	10	20
Reach B duneH	10' extension of ReachB existing dune and beach profile	0	10	0
Reach B 30	10' extension of ReachB existing dune and beach profile with a 20' berm	0	10	20
Reach C duneH	10' extension of ReachC existing dune and beach profile	0	10	0
Reach C 30	10' extension of ReachC existing dune and beach profile with a 20' berm	0	10	20
Reach AC duneH	10' extension of ReachA + ReachC existing dune and beach profile	0	10	0
Reach AC 30	10' extension of ReachA + ReachC existing dune and beach profile with a 20' berm	0	10	20

Protective Beach Design

Based on Beach-fx model results and economic evaluation, project alternative "ReachCduneH" (10' extension of ReachC existing dune and beach profile) was identified as the Recommended Plan for nourishment of Flagler County. A description of this shore protection plan is provided in the following sections.

Project Length

Nine miles of shoreline, extending from FDEP monument R-50 to R-100, within Flagler County was considered during project evaluation using Beach-*fx*. Note that this does not include the Marineland segment of the project (R-1 to R-4), which was removed early in the study. The selected design, ReachCduneH covers approximately 2.6 miles of the study area. The beach fill will be placed from R-80 to R-94 with tapers extending approximately 100 feet to the north of R-80 and approximately 100 feet to the south of R-94.

Project Design

The project design can be described by three factors, the dimensions of the dune, dimensions of the berm, and shoreline slopes.

Project Dune

Existing dune elevations in the project area are between 19 and 20 ft-NAVD88. Evaluation of the design alternatives has shown that the existing elevations, when combined with berm and/or dune extension, provide sufficient protection. No additional elevation is included in the selected design plan. For Reach C, the dune elevation is 19 ft-NAVD88.

Existing dune widths in the project area are variable. Between R-80 and R-88 the dune has an average width of approximately 100 feet. Between R-88 and R-94 the average width is approximately 40 feet. It should be noted that State Road A1A, which runs parallel to the project shoreline, is located within the dune. Based on the average dune widths, design widths for the 10 foot dune and profile extension alternative Reach C duneH are, therefore, 110 feet in the northern portion of Reach C and 50 feet in the southern portion.

Project Berm

The design berm elevation in Reach C is 11 ft-NAVD88, which approximates the natural berm elevation. Restricting the design berm elevation to the natural berm elevation minimizes scarping of the beachfill as it undergoes readjustment. Vertical scarps can hinder beach access by nesting sea turtles, and may also pose safety problems related to recreational beach use. Other reasons for mimicking the natural

berm elevation are related to storm damage protection. A berm constructed at a lower elevation would increase the probability of overtopping by relatively frequent storms, thereby offering less protection to upland development and/or existing dunes. A higher berm elevation could result in problems related to backshore flooding due to excessive rainfall or wave overtopping. A higher berm may also be more susceptible to wind-induced erosion.

Although the design berm for Reach C duneH is technically a 0 foot extension, construction of the dune and profile extension will result in an increase in the existing berm (see Project Construction). Figure A-38 shows a graphical representation of the Reach C duneH design alternative (110 foot dune template) as modeled by Beach-*fx*.

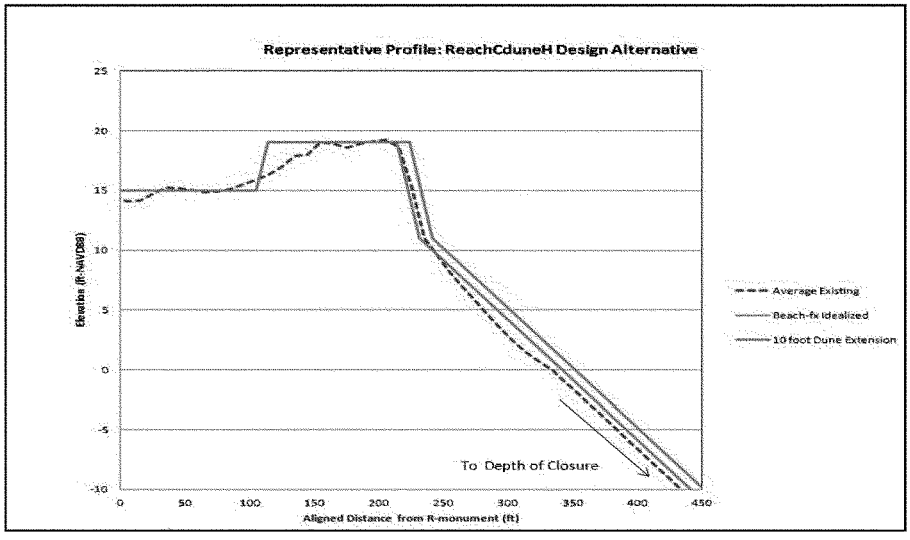

Figure A- 38. Graphical Representation of Reach C Dune Extension Alternative Beach-*fx* Profile

Project Beach Slopes

After adjustment and sorting of the placed material by wave action, the material is expected to adjust to an equilibrium beach slope, similar to the native beach. In Flagler County, the native beach slopes in Reach C are estimated as a 1 (vertical) on 2.2 (horizontal) at the dune, 1 on 10 from the berm to MLW (-3.1 ft-NAVD88), and 1 on 40 to 1 on 70 below MLW. The estimate of the slope of the material after adjustment is based on averaging the beach profile slopes of the native beach from the mean low water datum to the approximate location of the 12 foot depth contour. Sand from the project borrow site was determined to be a near match to the gradation and shell content of the existing beach. This will allow the beach fill to equilibrate to a shape similar to the existing profile. Below the 12 foot depth contour, various bar type features appear in the profiles, making a representative slope difficult to determine.

It is unnecessary and impractical to artificially grade beach slopes below the low water elevation since they will be shaped by wave action. For this reason, the front slope of the beach fill placed at the time of construction or future renourishment may differ from that of the natural profile. The angle of repose of the hydraulically placed material depends on the characteristics of the fill material and the wave climate in the project area. With steep initial slopes, the material will quickly adjust to the natural slopes.

Project Volumes

Traditionally, beachfill designs are presented as a set of three cross-sectional templates, the design template, which is based on an equilibrium profile translated seaward by the desired width of the berm or MHW extension; the advanced nourishment template, which represents the volume of material that is expected to erode between successive renourishment intervals; and the construction template, which includes both the design and advanced fill quantities, but incorporates the wider berm and steeper slope that reflects the capabilities of the construction equipment. The design template is the minimum beach profile to be maintained, while the advance nourishment template contains the volume of material that will dissipate through erosion over the economically optimized renourishment interval while protecting the design template. This traditional approach, however, does not conform well to the probabilistic nature of the Beach-fx model or the methodology used for determining renourishment requirements.

Beach-fx begins with the desired design template (i.e. the 10 foot dune and profile extension, Figure A-38). Each life-cycle simulation then applies randomly generated storms, storm erosion, and natural background shoreline change rates. At one year intervals the model evaluates the resulting shoreline against two criteria (1) whether shoreline position at one or more reaches has exceeded one or more planned nourishment triggers and (2) whether the total volume presently required to fill the original design template exceeds the mobilization threshold. If both criteria are met then a renourishment event is initiated. There are three planned nourishment triggers in Beach-fx: berm width, dune width, and dune height. Each trigger indicates what percentage of the design template berm width, dune width, or dune height must be present to *prevent* a renourishment (For example, a 90% (0.90) dune width trigger means that 90% of the total design template dune width – existing dune plus fill extension - must remain intact. If 10% or more of the template dune width is eroded, the first criteria for initiating a planned renourishment event has been met). Should the allowable erosion be exceeded in one or more reaches, then Beach-fx computes the volume required (over all of the *triggered* nourishment reaches) required to fill the original design template and compares that volume to the mobilization threshold. If the mobilization threshold is exceeded a renourishment over *all* planned nourishment reaches occurs and the model continues through the remainder of the life-cycle.

For Flagler County alternative Reach C duneH, the berm width, dune width, and dune height planned nourishment triggers were set at 0, 0.91, and 0.9, respectively. The mobilization threshold was set to 300,000 cubic yards. Together, the triggers and the mobilization threshold allow for the optimization of

the beach fill based on the physical dimensions of the project as well as assumptions regarding tolerable erosion limits and reasonable fill volumes. Sensitivity analysis of the nourishment triggers and mobilization threshold indicated that threshold volume was the dominant parameter for optimizing project cost for an alternative in which the berm width has a zero value. Employing 25,000 cubic yard increments, a mobilization threshold of 300,000 was found to be (when combined with the above nourishment triggers), the most optimal threshold value. Decreasing the threshold, decreased the benefit to cost ratio. Increasing the threshold to 325,000 cubic yards produced a small increase in the benefit to cost ratio. However, it also allowed segments of dune to erode to beyond the existing project condition. This was not considered to be an acceptable assumption.

Each complete Beach-fx model run consists of 100 iterations, each iteration representing the life of the project. Based on the Reach C dune H alternative (100 iteration runs), a range of volumes was determined for each initial fill event and each subsequent renourishment event. Model runs were made for each of the three sea level rise cases, Base, Intermediate, and High. Table A- 22 provides the minimum, maximum, and average fill volumes for both initial and renourishment events over the life of the project. This table also provides the number of expected renourishment events.

Table A- 22. Project Volumes

Project Volumes (Averaged over 100 Beach-fx Life-cycle Iterations)				
Sea Level Rise Case	Volume Description	Initial Fill Volume (cy)	No. of Renourish. Events*	Average Volume per Interval (cy)
Base	Min - Max	300,000 – 370,000	4	300,000 – 350,000
	Average	330,000		320,000
Intermediate	Min - Max	300,000 – 370,000	5	300,000 – 350,000
	Average	330,000		320,000
High	Min - Max	350,000 – 410,000	8	310,000 – 370,000
	Average	370,000		330,000
*Due to its probabilistic nature, Beach-*fx* can result in a range of required renourishment events. However, for the Flagler County Recommended Plan (a relatively modest extension of the dune and profile), the minimum and maximum number of events was the same.				

Project Construction

The Recommended Plan for Flagler County results in a 10 foot seaward extension of the existing dune and beach profile out to depth of closure. Due to erosion, armor damage, and intermittent repairs and maintenance, the project shoreline does not presently have a smooth, consistent dune feature. In order to ensure that the nourishment project provides the maximum benefit, it is necessary to first establish a smooth, relatively straight base construction line that will allow the project to perform as predicted during the Beach-*fx* shoreline analysis.

In order to establish the project construction line, State Road A1A, which runs roughly parallel to the project shoreline, was identified as a reliable land based reference for developing a smooth, consistent project dune. The seaward crest of the dune was then identified as the shoreline profile reference point. Based on historical surveys, it was determined that the average distance between the eastern edge of A1A and seaward crest of dune (as measure at each FDEP R-monument) in Reach C is 20 feet. Therefore, the base construction line (defined as the "existing" seaward crest of the dune) is designated to be 20 feet east of, and parallel to, State Road A1A. The project shoreline would then add an additional 10 feet of width to the base construction line ("existing" dune). Figure A- 39 shows graphically the location of the measured (2011 survey), "existing", and project dunes relative to the eastern edge of A1A. Note that this approach will ultimately provide a consistent level of protection to the road, which is the primary damageable infrastructure nearest the project.

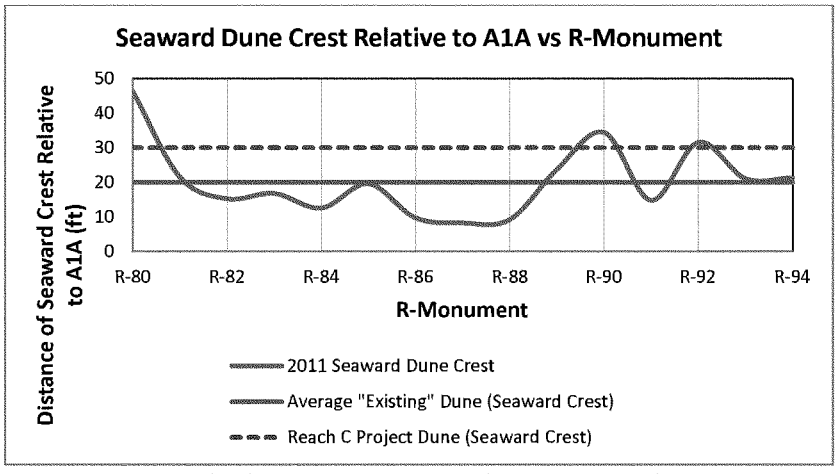

Figure A- 39. Measured and Design Dune Locations Relative to State Road A1A

Beach-*fx* estimates that initial construction of the Reach, C 10 foot dune and profile extension will require between 300,000 and 370,000 cubic yards of material. Using the 2011 survey (the most recently available reference), the designated construction line, and the project (10 foot dune and profile extension) design template, it was determined that the volume required for initial construction would be approximately 360,000 cubic yards. While this is above the Beach-*fx* average initial volume of 330,000 cubic yards, it is within 10% of the modeled values and is considered reasonable. Therefore, this volume is considered to be appropriate verification of the location of the base construction line and the validity of the project template. Because this volume is based on a conceptual layout and survey information that will be updated prior to construction, it will be used only for verification of the design dimensions and will not be used for cost estimating. Costs will continue to be based on average Beach-*fx* volumes.

As previously discussed, the front slope of the beach fill placed at the time of construction or future renourishment may differ from that of the natural profile. This reflects the capabilities of the construction equipment that will be used to build the shore protection project. Within the first year or two after placement of the beachfill, the construction profile will be reshaped by waves into an equilibrium profile, causing the berm to retreat to a position more characteristic of the project design template.

Based on the estimated initial fill volume, constructability considerations, and existing (2011) shoreline dimensions, a construction template applicable to Reach C was determined. The construction template (shown in Figure A- 40) consists of a 10 foot wide dune extension with a 1 on 3 slope, a 35.0 foot berm with a 1 on 100 slope, and foreshore fill extending to approximately -2 ft-NAVD88 with a slope of 1 on 5. This template, dimensioned for constructability, will then equilibrate into the project (10' dune and profile extension) template. The volume of material in the equilibrated profile (between the template and the "existing" condition) represents the material that is expected to erode between successive nourishment events.

Dune Walkovers

The Reach C project length (R-80 to R-94) contains forty-two dune walkovers. Walkovers are a mixture of twenty-one privately owned and twenty-one local government owned structures. On average, the structures are in good condition. Each crosses the dune within the project area and potentially will require replacement due to placement of the initial project fill. One time replacement costs of the twenty-one public structures is included in the total project cost. If needed, replacement of the remaining, privately owned structures will be a local responsibility to be covered in the perpetual storm damage reduction easement acquired by the Non-Federal Sponsor. Although the existing structures range from basic (Figure A- 40) to relatively elaborate (Figure A- 41), for feasibility level design and cost estimating purposes, a single dune walkover design (closely approximating the construction of existing public walkovers) is applied to all replacements (Figure A- 42). It should be noted that modification of this design may occur during the detailed design phase of the study.

Renourishment Events

Traditionally, renourishment events take place based on both an economically optimized renourishment interval and the physical performance of the project. Project performance, in the past, has been determined by assessing the condition of the design template. Should the design template be breached, the project is no longer providing the required level of protection and is considered for renourishment. Part of this consideration is how close the project may be to the designated renourishment interval.

While the basic principles of renourishment still apply, due to the probabilistic nature of Beach-*fx* and the way in which the model assesses renourishment requirements, a new means of assessing project performance must be employed. The former concepts of "design template" and "advance fill" are no

longer applicable in the traditional sense. As shown in Figure A- 43 the entire 10 foot dune and beach profile extension template acts as the "advance fill", while the existing beach profile is the minimum acceptable profile (making it akin to what was formerly the "design template").



Figure A- 40. Dune Walkover – Basic



Figure A- 41. Dune Walkover – Elaborate

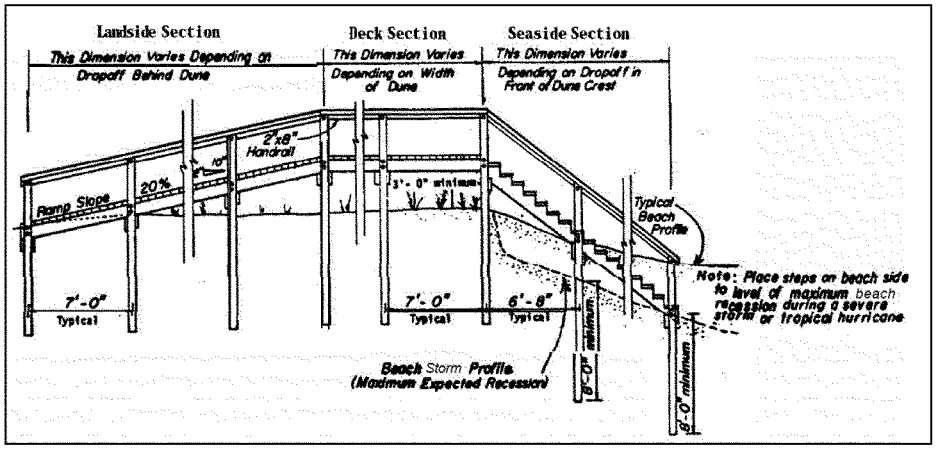

Figure A- 42. Dune Walkover – Feasibility Level Design Cross-section

Assessing the performance of the project fill now has two stages. First, a survey of the project area (such as a monitoring or post-storm survey) will be assessed to determine if the seaward crest of the dune at any of the R-monument locations within the project have receded past the Base Construction Line (Figure A- 43). If recession has occurred at one or more of the R-monuments, then a summation of the volume required to restore those profiles to the original construction template will be made. If the total volume required to restore the receded profiles exceeds the threshold volume, then a renourishment event is recommended. The decision to renourish may then be made based on traditional concerns, including such factors as budget cycle and available funding.

Project Monitoring

Physical monitoring of the recommended project is necessary to assess project performance and to ensure that project functionality is maintained throughout the 50-year project life. The monitoring plan will be directed primarily toward accomplishing systematic measurements of the beach profile shape. Profile surveys should provide accurate assessments of dune and beach fill volumes and a basis for assessing post-construction dune and beach fill adjustments, as well as variation in the profile shape due to seasonal changes and storms. Monitoring will play a vital role in determining if project renourishment is necessary. Post construction monitoring activities include topographic and bathymetric surveys of the placement area on an annual basis for 3 years following construction and then biannually until the next construction event. The cost for this post construction monitoring is included in the cost shared total project cost.

Other monitoring efforts include bathymetric mapping of the borrow site, which will be done as part of the pre-construction engineering and design (PED) phase prior to each nourishment.

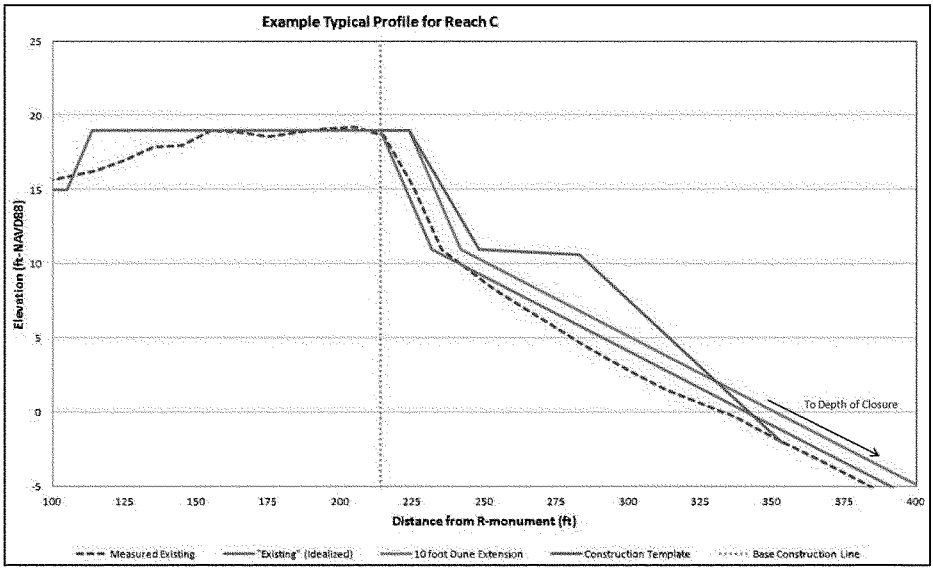

Figure A- 43. Typical Profile Sketch, Recommended Plan

Measured wind, wave, and water level information will be obtained from the best available existing data sources. This data will be applied in support of previously discussed monitoring efforts. It will also be used to periodically assess the state of sea level rise and to determine if reassessment of the project volumes and/or renourishment intervals based on an intermediate of high SLR case is required.

Summary

This appendix summarizes the engineering design of a shore protection project proposed for construction in Flagler County, Florida. The project consists of beach nourishment/renouishment along approximately 2.6 miles of shoreline between FDEP monuments R-80 to R-94. The design beachfill template is characterized by a 10-foot extension of the 2008 profile from dune to depth of closure. The total expected volume of beachfill material required under the Base SLR case ranges from 1,500,000 to 1,770,000 cubic yards (average of 1,600,000 cubic yards). This includes 300,000 to 370,000 cubic yards (average of 330,000 cubic yards) for construction of the design beach profile. Total cost of initial project construction is estimated at $14,182,000. Those costs would include the plans and specifications surveys of the project area and borrow site for construction, and the cost of a volumetric survey after initial construction for payment. Future renourishment costs are estimated at $7,717,000 per nourishment, with periodic nourishment expected at approximately 11 year intervals. Assuming that the Base SLR case applies, an estimate of the total cost incurred over the 50-year project life is $44,962,000.

References

Bruun, P., 1962. "Sea-level Rise as a Cause of Shore Erosion", American Society of Civil Proceedings, Vol 88, Paper 3065, Journal of Waterways and Harbors Division, No. WW1, pp117-130.

ERDC, 2012. http://wis.usace.army.mil/wis.shtml. Wave Information Studies website. U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS. October, 2012.

Frey, et al., 2012. Gencade Version 1 Model Theory and User's Guide, Technical Report, ERDC-CHL TR-12-XX, Coastal Inlets Research Program, U.S. Army Engineer Research and Development Center, Vicksburg, MS. September, 2012.

Florida Department of Transportation (FDOT), 1999. "Shoreline Change Rate Estimates: Flagler County" Report No. BCS-99-02.

Florida Department of Transportation (FDOT), 2003. "Design Storm Surge Hydrographs for the Florida Coast", Contract Number BC-354 RWPO 70. Submitted by Department of Civil Engineering, University of Florida.

Gravens, M.B., Males, R.M, and Moser, D.A, 2007. "Beach-*fx*: Monte Carlo Life-Cycle Simulation Model for Estimating Shore Protection Project Evolution and Cost Benefit Analyses", Shore and Beach, Vol. 75(1): 12-19.

Hubertz, J. A., 1992. "User's Guide to the Wave Information Studies (WIS) Wave Model, version 2.0," WIS Report 27, U.S. Army Engineer Waterways Experiment Station, Vicksburg , MS.

Larson, M., and Kraus, N.C., 1989. "SBEACH: Numerical Model for Simulating Storm-Induced Beach Change, Report 1. Empirical Foundation and Model Development." Techncial Report CERC-89-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg , MS.

Males, R.M., Gravens, M.B, Moser, D.A., and Rogers, C.M., 2007. "Beach-fx: Life-Cycle Risk Analysis of Shore Protection Projects", Proceedings 30th International Conference on Coastal Engineering, J.M. Smith (ed.). Singapore, Japan: World Scientific Publishing Company, Inc.

Morang, A., Batten, B.K., Connell, K.J., Tanner, W., Larson, M., Kraus, N.C., 2009. "Regional Morphology Analysis Package (RMAP), Version 3: User's Guide and Tutorial", ERDC/CHL CHETN-XIV-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg , MS.

NOAA, 2012. *NOAA National Geophysical Data Center, U.S. Coastal Relief Model, 01/19/2012,* http://www.ngdc.noaa.gov/mgg/coastal/crm.html.

Taylor Engineering, 2002. State Road A1A Shore Protection Evaluation Flagler Beach, Flagler County, FL, Taylor Engineering, Jacksonville, FL.

Taylor Engineering, Inc, 2006. "State Road A1A Shoreline Protection Evaluation, Flagler Beach, Flagler County, Florida". Prepared for CH2M Hill.

U. S. Army Corps of Engineers (USACE), 1980. Flagler County, FL Shore Protection Study. U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL.

U.S. Army Corps of Engineers (USACE), May 1995. EM 1110-2-3301: Design of Beach Fills. Washington, DC

U. S. Army Corps of Engineers (USACE), 2004. Reconnaissance report Section 905(b) Analaysis Flagler County, Florida, Shore Protection. U.S. Army Corps of Engineers, Jacksonville District. March, 2004.

U. S. Army Corps of Engineers (USACE), 2006. ER 1105-2-101: Risk Analysis for Flood Damage Reduction Studies. Washington DC.

U. S. Army Corps of Engineers (USACE), 2007. Northeast Florida Atlantic Coast Regional Sediment Budget Nassau Through Volusia Counties. U.S. Army Corps of Engineers, Jacksonville District. March, 2007.

U.S. Army Corps of Engineers (USACE), August 2009. ERDC/CHL SR-0906: "Beach-fx User's Manual: Version 1.0". Washington, DC.

U.S. Army Corps of Engineers (USACE), 2011. EC 1165-2-212: Sea-level Change Considerations in Civil Works Programs. Washington, DC.

U. S. Army Corps of Engineers (USACE), 2012-a. Regional Sediment Budget for St. Augustine Inlet and St. Johns County, FL, 1998/1999-2010. Letter Report. U.S. Army Corps of Engineers, Engineer Research and Development Center and Jacksonville District. March 2012.

U. S. Army Corps of Engineers (USACE), 2012-a. Walton County, Florida, Hurricane and Storm Damage Reduction, General Investigations Study. Draft Report, April 2012.

FLAGLER COUNTY, FLORIDA

HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FINAL INTEGRATED FEASIBILITY STUDY AND
ENVIRONMENTAL ASSESSMENT

Appendix B

Cost Engineering and Risk Analysis



HURRICANE AND STORM DAMAGE REDUCTION PROJECT FOR FLAGLER COUNTY, FLORIDA

INTEGRATED FEASIBILITY STUDY
AND
ENVIRONMENTAL ASSESSMENT

APPENDIX B
COST ENGINEERING AND RISK ANALYSIS

AUGUST 2014

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ATTACHMENT TO APPENDIX B
ATTACHMENT A: COST AND SCHEDULE RISK ANALYSIS

B. COST ESTIMATES

B1. GENERAL INFORMATION

Corps of Engineers cost estimates for planning purposes are prepared in accordance with the following guidance:

- Engineer Technical Letter (ETL) 1110-2-573, Construction Cost Estimating Guide for Civil Works, 30 September 2008
- Engineer Regulation (ER) 1110-1-1300, Cost Engineering Policy and General Requirements, 26 March 1993
- ER 1110-2-1302, Civil Works Cost Engineering, 15 September 2008
- ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 August 1999
- ER 1105-2-100, Planning Guidance Notebook, 22 April 2000, as amended
- Engineer Manual (EM) 1110-2-1304 (Tables Revised 31 March 2009), Civil Works Construction Cost Index System, 31 March 2000
- CECW-CP Memorandum for Distribution, Subject: Initiatives to Improve the Accuracy of Total Project Costs in Civil Works Feasibility Studies Requiring Congressional Authorization, 19 September 2007
- CECW-CE Memorandum for Distribution, Subject: Application of Cost Risk Analysis Methods to Develop Contingencies for Civil Works Total Project Costs, 3 July 2007
- Cost and Schedule Risk Analysis Process, March 2008

The goal of the cost estimates for the Flagler County Shore Protection Project Feasibility Study are to present a Total Project Cost (construction and non-construction costs) for the Recommended Plan(s) at the current price level to be used for project justification/authorization and to escalate costs for budgeting purposes. In addition, the costing efforts are intended to produce a final product (cost estimate) that is reliable and accurate, and that supports the definition of the Government's and the non-Federal sponsor's obligations.

The cost estimating effort for the study also yielded a series of alternative plan formulation cost estimates for decision making. The final set of plan formulation cost estimates used for plan selection rely on construction feature unit pricing and are prepared in Civil Works Work Breakdown Structure (CWWBS) format to the sub-feature level. The cost estimate supporting the National Economic Development (NED) plan (Recommended Plan/Locally Preferred Plan) is prepared in MCACES/MII (Microcomputer Aided Cost Estimating System) format to the CWWBS sub-feature level. This estimate is supported by the preferred labor, equipment, materials and crew/production breakdown. A fully funded (escalated for inflation through project completion) cost estimate, the Baseline Cost Estimate or Total Project Cost Summary, has also been developed.

An abbreviated risk analysis was prepared that addresses project uncertainties and sets contingencies for the plan formulation cost estimates. A full cost and schedule risk analysis was performed to establish the project contingency for the Recommended Plan's cost items.

B.1.1 Plan Formulation Cost Estimates

For the plan formulation cost estimates, unit prices for dredging related work were developed in CEDEP and then entered into MCACES/MII. Unit prices for the remaining major or variable construction elements were developed in MCACES/MII based on input from the PDT. Design details, information and assumptions were provided in the Engineering Appendix. Plan formulation alternatives were run through Beach-Fx for calculation of the Benefit-to-Cost Ratio (BCR). Cost Engineering provided estimates for the initial construction on all alternatives that were input into Beach-Fx. An abbreviated risk analysis was completed in order to establish the contingency for each of the alternatives. Non-construction costs were included as percentages of the total construction contract cost for this level of comparison and screening.

Refer to Economics Section in the main report for final plan formulation cost tables.

B.1.2 Recommended Plan(s)

The Recommended Plan or NED plan was chosen by the Project Delivery Team (PDT) according to the plan formulation described above. The Economics Appendix fully describes the plan selection. The scope of work for the Recommended Plan is found in Appendix A, Engineering. The MCACES/MII cost estimate for the Recommended Plan is based on that scope and is formatted in the CWWBS. The notes provided in the body of the estimate detail the estimate parameters and assumptions. These include pricing at the Fiscal Year 2014 price level (1 October 2013-30 September 2014). For project justification purposes, the estimate costs are categorized under the appropriate CWWBS code and include both construction and non-construction costs.

The construction costs fall under the following feature codes:

- 17 Beach Replenishment
- 02 Relocations

The non-construction costs fall under the following feature codes:

- 01 Lands and Damages
- 30 Planning, Engineering and Design
- 31 Construction Management

B.1.3 Construction Cost

For the construction costs, unit prices for dredging related work were developed in the Cost Engineeing Dredge Estimating Program (CEDEP) and then entered into MCACES/MII. These costs include all major project components categorized under the appropriate CWWBS to the sub-feature level. The Total Project Cost Summary (TPCS) on the Recommended Plan contains contingencies that were determined as a result of the cost and schedule risk analysis, which is covered under another paragraph.

B.1.4 Non-construction Cost

Non-construction costs typically include Lands and Damages (Real Estate), Planning Engineering & Design (PED) and Construction Management Costs (Supervision & Administration, S&A). These costs were provided by the PDT either as a lump sum cost or as

a percentage of the total Construction Contract Cost. Lands and Damages are provided by Real Estate and are best described in the Real Estate Appendix, Appendix D. PED costs are for the preparation of contract plans and specifications (P&S) and include itemized costs that were provided by the PDT, as well as costs for Post-Construction Monitoring costs and percentages for Engineering During Construction (EDC) that were provided by the project manager. Construction Management costs are for the supervision and administration of a contract and include Project Management and Contract Admin costs. These costs were provided by the project manager and are included as a percentage of the total construction contract cost.

The main report details both cost allocation and cost apportionment for the Federal Government and the non-Federal Sponsor. Also included in the main report are the non-Federal Sponsor's obligations (items of local cooperation).

B.1.5 Construction Schedule

A construction schedule was prepared utilizing input from the PDT and reflects all project construction components. The schedule considers not only durations of individual components of construction, but also the timing of construction contracts based on funding and construction windows. The construction schedule was combined with the project schedule to create an overall schedule that was used for the generation of the TPCS. The construction schedule will change as the project moves through the various project lifecycle phases.

B.1.6 Total Project Cost Summary

The cost estimate for the Recommended Plan is prepared with an identified price level date and inflation factors are used to adjust the pricing to the project schedule. This estimate is known as the Fully Funded Cost Estimate or Total Project Cost Summary. It includes all Federal and non-Federal costs: Lands, Easements, Rights of Way and Relocations; construction features; Planning Engineering and Design; Construction Management; Contingency; and Inflation.

B2. PLAN FORMULATION COST ESTIMATES

There were several alternatives the PDT evaluated during plan formulation in order to identify the Tentatively Selected Plan (TSP). All alternatives that were evaluated at various stages in the study can be found in the Economics Appendix and are also outlined in the Main Report.

The Final Array of Alternatives looked at the initial construction costs for three identified reaches, three separate conditions (varying beach widths) for each reach and several combinations of reaches and conditions; altogether there were fifteen beach replenishment alternatives estimated, evaluated and compared in the final array to determine the TSP.

All alternatives in the final array considered varying dune or beach widths constructed via dredging and hydraulic pumpout; costs for dune plantings were also included. All reach lengths, volumes and distances to borrow areas were provided in spreadsheet format by Engineering. The volumes were calculated by BeachFx. Average distances to borrow sites were estimated

using GoogleEarth. Quantities for dune plantings were calculated based on acreages and FDEP planting requirement information provided by Planning.

The various alternatives were as follows:

Reach A:

ReachAduneH

This alternative is a 10-foot extension of the existing ReachA dune and beach profile.

ReachA30

This alternative is a 10-foot extension of ReachA dune and a 20-foot berm extension.

ReachA50

This alternative is a 10-foot extension of ReachA dune and a 40-foot berm extension.

Reach B:

ReachBduneH

This alternative is a 10-foot extension of the existing ReachB dune and beach profile.

ReachB30

This alternative is a 10-foot extension of ReachB dune and a 20-foot berm extension.

ReachB50

This alternative is a 10-foot extension of ReachB dune and a 40-foot berm extension.

Reach C:

ReachCduneH

This alternative is a 10-foot extension of the existing ReachC dune and beach profile.

ReachC30

This alternative is a 10-foot extension of ReachC dune and a 20-foot berm extension.

ReachC50

This alternative is a 10-foot extension of ReachC dune and a 40-foot berm extension.

Reach A/C

ReachACduneH

This alternative is a 10-foot extension of the existing ReachA and ReachC dunes and beach profiles.

ReachAC30

This alternative is a 10-foot extension of ReachA and ReachC dunes and a 20-foot berm extension.

ReachAC50

This alternative is a 10-foot extension of ReachA and ReachC dunes and a 40-foot berm extension.

Reach A/B:

ReachABduneH

This alternative is a 10-foot extension of the existing ReachA and ReachB dunes and beach profiles.

Reach B/C:

ReachBCduneH

This alternative is a 10-foot extension of the existing ReachB and ReachC dunes and beach profiles.

Reach A/B/C:

ReachABCduneH

This alternative is a 10-foot extension of the existing ReachA, ReachB and ReachC dunes and beach profiles.

All dredging unit costs were calculated in CEDEP and transferred to MII to determine the total initial construction costs for each alternative. Real estate provided costs for the Lands and Damages by reach. The Planning, Engineering and Design (PED) costs, Engineering During Construction (EDC) costs and Supervision & Administration (S&A) costs were provided as a percentage of the total construction contract cost per the Project Manager.

A contingency was applied to each alternative. The contingency for the Real Estate costs was provided by RE Division. The contingencies for the construction and remaining non-construction costs were developed using an Abbreviated Risk Analysis. All major risk components were the same for each reach and alternative. Fluctuations in contingencies were mostly as a result of varying total initial construction costs. Site access, staging areas and dune crossovers were all identified as risk items that would require further consideration and refinement in the cost estimate.

Once the total initial construction costs for each alternative were developed in MII, the costs were broken down into a spreadsheet so that the PDT could input the cost information into BeachFx. The table listed the Mobilization & Demobilization costs separately and a Total Cost/Cubic Yard that consisted of the Dredging Cost, plus the non-Construction Costs (minus the Real Estate) since these were the two main cost inputs for BeachFx. The cost of the dune plantings and the Real Estate costs were listed separately and were added to the total project cost outside of BeachFx.

B3. RECOMMENDED PLAN (NED) COST ESTIMATE

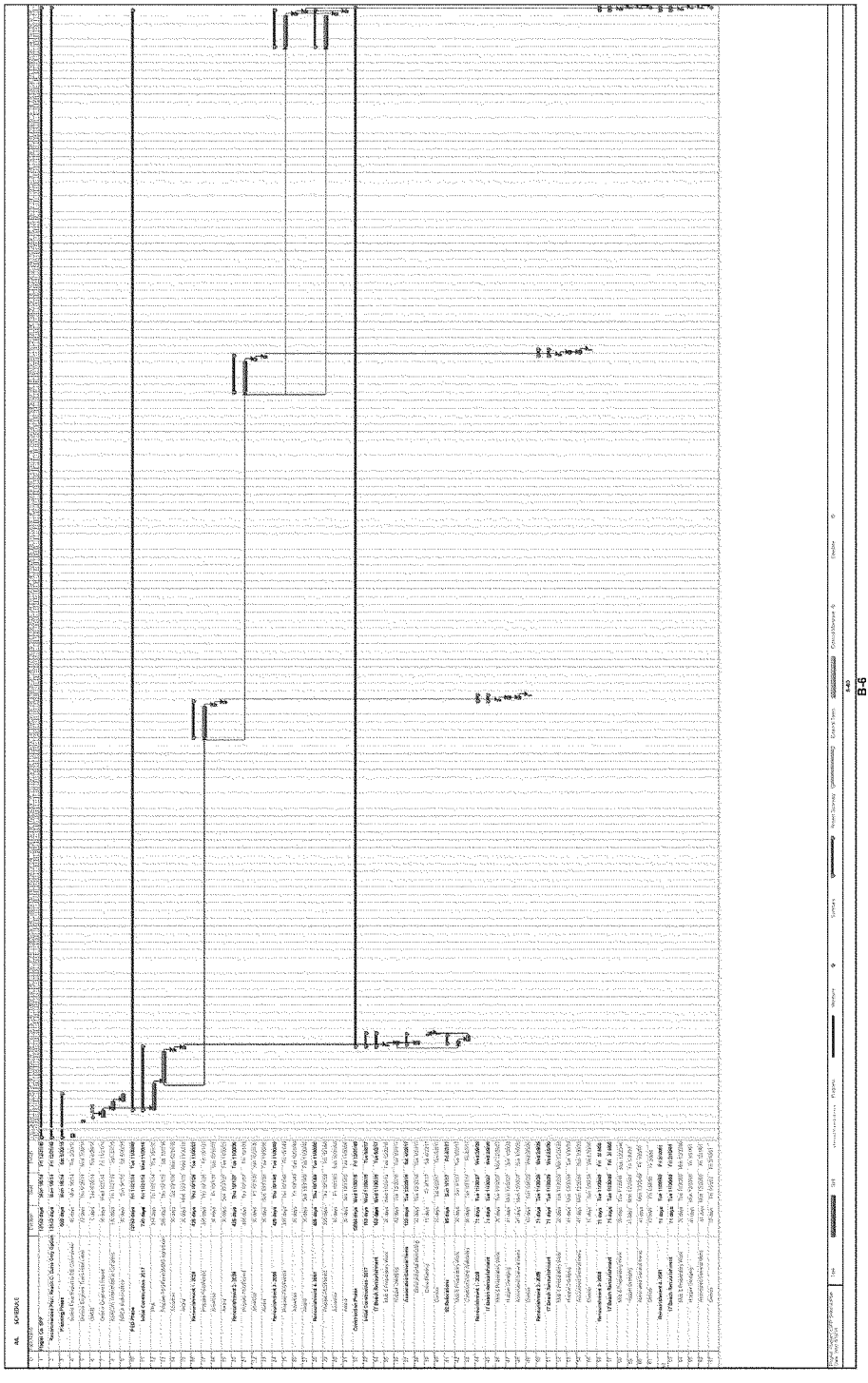
The recommended design, ReachCduneH covers approximately 2.6 miles of the study area extending from R-80 to R-94 with tapers extending approximately 100 ft north of R-80 and approximately 100ft south of R-94. The construction template consists of a 10 foot wide dune extension with a 1 on 3 slope, a 35.0 foot berm with a 1 on 100 slope, and foreshore fill extending to approximately -2 ft-NAVD88 with a slope of 1 on 5.

The Reach C project length (R-80 to R-94) contains twenty-one public dune walkovers. Each crosses the dune within the project area and will require replacement due to placement of the initial project fill. Although the existing structures range from basic to relatively elaborate, for feasibility level design and cost estimating purposes, a single dune walkover design is applied to all replacements. It should be noted that modification of this design may occur during the detailed design phase of the study.

The Recommended Plan estimate was prepared for the Total Project Cost, not just the initial construction costs.

B4. SCHEDULE

The project schedule covers the lifecycle phases of the recommended plan (Planning Phase, Preconstruction, Engineering and Design (PED) Phase and the Construction Phase). Refer to the Schedule on page B-6.



B-6

B5. RISK AND UNCERTAINTY ANALYSIS

A Cost and Schedule Risk Analysis was conducted according to the procedures outlined in the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.
- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.
- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

B.5.1 Risk Analysis Methods

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence.

The entire PDT participated in a risk analysis brainstorming session to identify risks associated with the Recommended Plan. The risks were listed in the risk register, which is a tool commonly used in project planning and risk analysis, and evaluated by the PDT. The actual Risk Register is provided in Attachment A. Assumptions were made as to the likelihood and impact of each risk item, as well as the probability of occurrence and magnitude of the impact if it were to occur. A risk model was then developed by Walla Walla in order to establish contingencies to apply to the project cost. Risks were evaluated for the following features of work:

- 01 Lands and Damages
- 02 Relocations
    - Dune Walkover Construction (Initial Construction Only)
- 17 Beach Replenishment
    - Mob, Demob & Preparatory Work
    - Hopper Dredging
    - Dune Planting (Initial Construction Only)
- 30 Planning, Engineering and Design
- 31 Construction Management

After the model was run, the results were reviewed and all parameters were re-evaluated by the PDT as a sanity check of assumptions and inputs. Adjustments were made to the analysis accordingly and the final contingency was established. The contingency was applied to the Recommended Plan estimate in the Total Project Cost Summary in order to obtain the Fully Funded Cost.

B.5.2 Risk Analysis Results

Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation.

Based on the risks that were assessed for the project, the resultant contingency was 23%. The complete breakdown of results can be viewed in the Cost and Schedule Risk Analysis

report prepared by Walla Walla Mandatory Cost Center of Expertise and provided in Attachment A.

B6. TOTAL PROJECT COST SUMMARY

The Total Project Cost Summary (TPCS) addresses inflation through project completion (accomplished by escalation to mid-point of construction per ER 1110-2-1302, Appendix C, Page C-2). It is based on the scope of the Recommended Plan and the official project schedule. The TPCS includes Federal and non-Federal costs for Lands and Damages, all construction features, PED, S&A, along with the appropriate contingencies and escalation associated with each of these activities. The TPCS is formatted according to the CWWBS and uses Civil Works Construction Cost Indexing System (CWCCIS) factors for escalation (EM 1110-2-1304) of construction costs and Office of Management and Budget (EC 11-2-18X, 20 Feb 2008) factors for escalation of PED and S&A costs.

The Total Project Cost Summary was prepared using the MCACES/MII cost estimate on the Recommended Plan, as well as the contingencies set by the risk analysis and the official project schedule.

B.6.1 Total Project Cost Summary Spreadsheet

Refer to the Total Project Cost Summary Spreadsheet on the next page.

****** TOTAL PROJECT COST SUMMARY ******

Printed:8/21/2014

PROJECT: **Flagler Co. Shore Protection Project**
PROJECT NO: **113166**
LOCATION: Flagler County, Florida

DISTRICT: SAJ- Jacksonville PREPARED: 6/4/2014
POC: ACTING CHIEF, COST ENGINEERING, Theresa Gneiting-James

This Estimate reflects the scope and schedule in report; Flagler Co. Shore Protection Project Integrated Feasibility Report

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Spent Thru: 10/1/2013 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J				M	N	O
17	BEACH REPLENISHMENT	$25,527	$5,871	23%	$31,398	1.6%	$25,924	$5,962	$31,886	$0	$31,886	66.9%	$43,270	$9,952	$53,223
02	RELOCATIONS	$941	$216	23%	$1,157	1.6%	$955	$220	$1,175	$0	$1,175	4.4%	$997	$229	$1,227
	CONSTRUCTION ESTIMATE TOTALS:	$26,468	$6,088		$32,555	1.6%	$26,879	$6,182	$33,061	$0	$33,061	64.7%	$44,268	$10,182	$54,449
01	LANDS AND DAMAGES	$2,768	$637	23%	$3,405	1.6%	$2,811	$647	$3,458	$0	$3,458	2.8%	$2,891	$665	$3,556
30	PLANNING, ENGINEERING & DESIGN	$4,732	$1,088	23%	$5,820	2.2%	$4,834	$1,112	$5,946	$0	$5,946	252.9%	$17,059	$3,924	$20,983
31	CONSTRUCTION MANAGEMENT	$1,987	$457	23%	$2,444	2.2%	$2,030	$467	$2,497	$0	$2,497	262.1%	$7,351	$1,691	$9,042
	PROJECT COST TOTALS:	$35,955	$8,270	23%	$44,224		$36,554	$8,407	**$44,962**	$0	**$44,962**	95.8%	$71,569	$16,461	$88,030

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PROJECT MANAGER, Jason Harrah

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CHIEF, PLANNING, Eric Bush

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CHIEF, ENGINEERING, Laureen Borochaner

CHIEF, OPERATIONS, Jim Jeffords

CHIEF, CONSTRUCTION, Stephen Duba

CHIEF, CONTRACTING, Carlos Clark

CHIEF, PM-PB, Daniel Haubner

CHIEF, DPM, David Hobbie

ESTIMATED INITIAL CONSTRUCTION FEDERAL COST:	**65.0%**	**$9,666**
ESTIMATED INITIAL CONSTRUCTION NON-FEDERAL COST:	**35.0%**	**$5,205**
ESTIMATED PERIODIC RENOURISHMENT FEDERAL COST:	**50.0%**	**$36,580**
ESTIMATED PERIODIC RENOURISHMENT NON-FEDERAL COST:	**50.0%**	**$36,580**
ESTIMATED TOTAL PROJECT COST:		**$88,030**

Filename: FlaglerCoSPP_RecommendedPlan_TPCS Mar 2014_Rev_01.xlsx
TPCS

****** TOTAL PROJECT COST SUMMARY ******

Printed:8/21/2014

****** CONTRACT COST SUMMARY ******

PROJECT: Flagler Co. Shore Protection Project
LOCATION: Flagler County, Florida
This Estimate reflects the scope and schedule in report; Flagler Co. Shore Protection Project Integrated Feasibility Report

DISTRICT: SAJ- Jacksonville
POC: ACTING CHIEF, COST ENGINEERING, Theresa Gneiting-James

PREPARED: 6/4/2014

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 3/15/2014 Effective Price Level: 10/1/2013				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14								
		RISK BASED												
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	CONTRACT 1- INITIAL CONSTRUCTION													
17	BEACH REPLENISHMENT	$5,811	$1,336	23%	$7,147	1.6%	$5,901	$1,357	$7,258	2017Q2	4.4%	$6,160	$1,417	$7,577
02	RELOCATIONS	$941	$216	23%	$1,157	1.6%	$955	$220	$1,175	2017Q2	4.4%	$997	$229	$1,227
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$6,751	$1,553	23%	**$8,304**		$6,856	$1,577	$8,433			$7,158	$1,646	$8,804
01	LANDS AND DAMAGES	$2,768	$637	23%	$3,405	1.6%	$2,811	$647	$3,458	2016Q3	2.8%	$2,891	$665	$3,556
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$80	$18	23%	$98	2.2%	$82	$19	$101	2016Q3	5.4%	$86	$20	$106
	Planning & Environmental Compliance	$249	$57	23%	$306	2.2%	$254	$59	$313	2016Q3	5.4%	$268	$62	$330
	Engineering & Design	$524	$121	23%	$645	2.2%	$535	$123	$658	2016Q3	5.4%	$564	$130	$694
	Reviews, ATRs, IEPRs, VE	$22	$5	23%	$27	2.2%	$22	$5	$28	2016Q3	5.4%	$24	$5	$29
	Life Cycle Updates (cost, schedule, risks)	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Contracting & Reprographics	$62	$14	23%	$76	2.2%	$63	$15	$78	2016Q3	5.4%	$67	$15	$82
	Engineering During Construction	$169	$39	23%	$208	2.2%	$173	$40	$212	2017Q2	8.5%	$187	$43	$230
	Planning During Construction	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Post Construction Monitoring	$210	$48	23%	$258	2.2%	$215	$49	$264	2022Q2	31.7%	$283	$65	$348
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$507	$117	23%	$624	2.2%	$518	$119	$637	2017Q2	8.5%	$562	$129	$691
	Project Operation:	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Project Management	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$11,342	$2,609		**$13,951**		$11,530	$2,652	$14,182			$12,090	$2,781	**$14,870**

Filename: FlaglerCoSPP_RecommendedPlan_TPCS Mar 2014_Rev_01.xlsx
TPCS

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Flagler Co. Shore Protection Project
LOCATION: Flagler County, Florida
This Estimate reflects the scope and schedule in report; Flagler Co. Shore Protection Project Integrated Feasibility Report

DISTRICT: SAJ- Jacksonville
PCC: ACTING CHIEF, COST ENGINEERING, Theresa Gneiting-James

PREPARED: 6/4/2014

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: / Effective Price Level:			3/15/2014 / 10/1/2013	Program Year (Budget EC): / Effective Price Level Date:			2015 / 1 OCT 14					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	CONTRACT 2- RENOURISHMENT 1													
17	BEACH REPLENISHMENT	$4,929	$1,134	23%	$6,063	1.6%	$5,006	$1,151	$6,157	2028Q2	29.8%	$6,497	$1,494	$7,992
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$4,929	$1,134	23%	**$6,063**		$5,006	$1,151	$6,157			$6,497	$1,494	$7,992
01	LANDS AND DAMAGES	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$80	$18	23%	$98	2.2%	$82	$19	$101	2027Q3	63.6%	$134	$31	$164
	Planning & Environmental Compliance	$74	$17	23%	$91	2.2%	$76	$17	$93	2027Q3	63.6%	$124	$28	$152
	Engineering & Design	$262	$60	23%	$322	2.2%	$267	$61	$329	2027Q3	63.6%	$437	$101	$538
	Reviews, ATRs, IEPRs, VE	$10	$2	23%	$12	2.2%	$10	$2	$13	2027Q3	63.6%	$17	$4	$21
	Life Cycle Updates (cost, schedule, risks)	$50	$12	23%	$62	2.2%	$51	$12	$63	2027Q3	63.6%	$84	$19	$103
	Contracting & Reprographics	$62	$14	23%	$76	2.2%	$63	$15	$78	2027Q3	63.6%	$104	$24	$127
	Engineering During Construction	$124	$29	23%	$153	2.2%	$127	$29	$156	2028Q2	68.9%	$214	$49	$263
	Planning During Construction	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Post Construction Monitoring	$210	$48	23%	$258	2.2%	$215	$49	$264	2033Q2	112.5%	$456	$105	$561
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$370	$85	23%	$455	2.2%	$378	$87	$465	2028Q2	68.9%	$639	$147	$785
	Project Operation:	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Project Management	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$6,171	$1,419		**$7,590**		$6,274	$1,443	$7,717			$8,704	$2,002	**$10,706**

Filename: FlaglerCoSPP_RecommendedPlan_TPCS Mar 2014_Rev_01.xlsx
TPCS

**** CONTRACT COST SUMMARY ****

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This Estimate reflects the scope and schedule in report; Flagler Co. Shore Protection Project Integrated Feasibility Report

DISTRICT: SAJ- Jacksonville
POC: ACTING CHIEF, COST ENGINEERING, Theresa Gneiting-James

PREPARED: 6/4/2014

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: / Effective Price Level:			3/15/2014 / 10/1/2013	Program Year (Budget EC): / Effective Price Level Date:			2015 / 1 OCT 14					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	CONTRACT 3- RENOURISHMENT 2													
17	BEACH REPLENISHMENT	$4,929	$1,134	23%	$6,063	1.6%	$5,006	$1,151	$6,157	2039Q2	61.4%	$8,079	$1,858	$9,937
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$4,929	$1,134	23%	**$6,063**		$5,006	$1,151	$6,157			$8,079	$1,858	$9,937
01	LANDS AND DAMAGES	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$80	$18	23%	$98	2.2%	$82	$19	$101	2038Q3	175.4%	$225	$52	$277
	Planning & Environmental Compliance	$74	$17	23%	$91	2.2%	$76	$17	$93	2038Q3	175.4%	$208	$48	$256
	Engineering & Design	$262	$60	23%	$322	2.2%	$267	$61	$329	2038Q3	175.4%	$736	$169	$905
	Reviews, ATRs, IEPRs, VE	$10	$2	23%	$12	2.2%	$10	$2	$13	2038Q3	175.4%	$28	$6	$35
	Life Cycle Updates (cost, schedule, risks)	$50	$12	23%	$62	2.2%	$51	$12	$63	2038Q3	175.4%	$141	$32	$173
	Contracting & Reprographics	$62	$14	23%	$76	2.2%	$63	$15	$78	2038Q3	175.4%	$174	$40	$215
	Engineering During Construction	$124	$29	23%	$153	2.2%	$127	$29	$156	2039Q2	175.4%	$349	$80	$429
	Planning During Construction	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Project Operations	$210	$48	23%	$258	2.2%	$215	$49	$264	2044Q2	175.4%	$591	$136	$727
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$370	$85	23%	$455	2.2%	$378	$87	$465	2039Q2	185.7%	$1,060	$248	$1,328
	Project Operation:	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Project Management	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$6,171	$1,419		**$7,590**		$6,274	$1,443	$7,717			$11,610	$2,670	**$14,280**

**** CONTRACT COST SUMMARY ****

PROJECT: Flagler Co. Shore Protection Project
LOCATION: Flagler County, Florida
This Estimate reflects the scope and schedule in report; Flagler Co. Shore Protection Project Integrated Feasibility Report

DISTRICT: SAJ- Jacksonville
POC: ACTING CHIEF, COST ENGINEERING, Theresa Gneiting-James

PREPARED: 6/4/2014

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 3/15/2014 Effective Price Level: 10/1/2013				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14				FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	CONTRACT 4- RENOURISHMENT 3													
17	BEACH REPLENISHMENT	$4,929	$1,134	23%	$6,063	1.6%	$5,006	$1,151	$6,157	2050Q2	100.7%	$10,045	$2,310	$12,355
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$4,929	$1,134	23%	**$6,063**		$5,006	$1,151	$6,157			$10,045	$2,310	$12,355
01	LANDS AND DAMAGES	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$80	$18	23%	$98	2.2%	$82	$19	$101	2049Q3	374.7%	$388	$89	$477
	Planning & Environmental Compliance	$74	$17	23%	$91	2.2%	$76	$17	$93	2049Q3	374.7%	$359	$83	$441
	Engineering & Design	$262	$60	23%	$322	2.2%	$267	$61	$329	2049Q3	374.7%	$1,268	$292	$1,560
	Reviews, ATRs, IEPRs, VE	$10	$2	23%	$12	2.2%	$10	$2	$13	2049Q3	374.7%	$48	$11	$60
	Life Cycle Updates (cost, schedule, risks)	$50	$12	23%	$62	2.2%	$51	$12	$63	2049Q3	374.7%	$242	$56	$298
	Contracting & Reprographics	$62	$14	23%	$76	2.2%	$63	$15	$78	2049Q3	374.7%	$301	$69	$370
	Engineering During Construction	$124	$29	23%	$153	2.2%	$127	$29	$156	2050Q2	392.5%	$624	$143	$767
	Planning During Construction	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Post Construction Monitoring	$210	$48	23%	$258	2.2%	$215	$49	$264	2055Q2	530.8%	$1,353	$311	$1,665
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$370	$85	23%	$455	2.2%	$378	$87	$465	2050Q2	392.5%	$1,862	$428	$2,290
	Project Operation:	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Project Management	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$6,171	$1,419		**$7,590**		$6,274	$1,443	$7,717			$16,490	$3,793	**$20,283**

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Flagler Co. Shore Protection Project
LOCATION: Flagler County, Florida
This Estimate reflects the scope and schedule in report; Flagler Co. Shore Protection Project Integrated Feasibility Report

DISTRICT: SAJ- Jacksonville PREPARED: 6/4/2014
POC: ACTING CHIEF, COST ENGINEERING, Theresa Gneiting-James

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 3/15/2014 Effective Price Level: 10/1/2013				Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14				FULLY FUNDED PROJECT ESTIMATE				
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	CNTG (%) *E*	TOTAL ($K) *F*	ESC (%) *G*	COST ($K) *H*	CNTG ($K) *I*	TOTAL ($K) *J*	Mid-Point Date *P*	ESC (%) *L*	COST ($K) *M*	CNTG ($K) *N*	FULL ($K) *O*
	CONTRACT 5- RENOURISHMENT 4													
17	BEACH REPLENISHMENT	$4,929	$1,134	23%	$6,063	1.6%	$5,006	$1,151	$6,157	2061Q2	149.5%	$12,489	$2,873	$15,362
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$4,929	$1,134	23%	**$6,063**		$5,006	$1,151	$6,157			$12,489	$2,873	$15,362
01	LANDS AND DAMAGES	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$80	$18	23%	$98	2.2%	$82	$19	$101	2060Q3	718.2%	$669	$154	$822
	Planning & Environmental Compliance	$74	$17	23%	$91	2.2%	$76	$17	$93	2060Q3	718.2%	$619	$142	$761
	Engineering & Design	$262	$60	23%	$322	2.2%	$267	$61	$329	2060Q3	718.2%	$2,186	$503	$2,689
	Reviews, ATRs, IEPRs, VE	$10	$2	23%	$12	2.2%	$10	$2	$13	2060Q3	718.2%	$84	$19	$103
	Life Cycle Updates (cost, schedule, risks)	$50	$12	23%	$62	2.2%	$51	$12	$63	2060Q3	718.2%	$418	$96	$514
	Contracting & Reprographics	$62	$14	23%	$76	2.2%	$63	$15	$78	2060Q3	718.2%	$518	$119	$637
	Engineering During Construction	$124	$29	23%	$153	2.2%	$127	$29	$156	2061Q2	748.9%	$1,075	$247	$1,323
	Planning During Construction	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Post Construction Monitoring	$140	$32	23%	$172	2.2%	$143	$33	$176	2064Q2	884.9%	$1,409	$324	$1,733
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$370	$85	23%	$455	2.2%	$378	$87	$465	2061Q2	748.9%	$3,209	$738	$3,947
	Project Operation:	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Project Management	$0	$0	23%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$6,101	$1,403		**$7,504**		$6,202	$1,427	$7,629			$22,675	$5,215	**$27,890**

B7. COST MCX TPCS CERTIFICATION

The recommended plan estimate, formal cost and schedule risk analysis and total project cost summary spreadsheet underwent cost review and certification by the Walla Walla Mandatory Center of Expertise in June 2014. The resulting cost certification that was issued for the Flagler County Hurricane and Storm Damage Reduction Project can be found on the next page.

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 113166

SAJ – Flagler County
Hurricane and Storm Damage Reduction

The Flagler County Hurricane and Storm Damage Reduction Study, as presented by Jacksonville District, has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of June 6, 2014, the Cost MCX certifies the estimated total project cost, including initial and 4 renourishments:

FY 2015 Price Level: $44,962,000
Fully Funded Amount: $88,030,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management throughout the life of the project.

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DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=NEUBAUER.JAMES.GERARD.1153289898
Date: 2014.06.06 09:38:50 -07'00'

For **Kim C. Callan, PE, CCE, PM**
Chief, Cost Engineering MCX
Walla Walla District

ATTACHMENT A
COST AND SCHEDULE RISK ANALYSIS

US Army Corps
of Engineers®

Flagler County Shore Protection Project

Flagler County, Florida

Cost and Schedule Risk Analysis Report

for the

Feasibility Report

Prepared for:
U.S. Army Corps of Engineers,
Jacksonville District

Prepared by:
U.S. Army Corps of Engineers
Walla Walla Cost MCX

Date: June 2014

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APPENDIX

APPENDIX A Detailed Risk Register

EXECUTIVE SUMMARY

Report Purpose

The Recommended Plan for Flagler County will:

a) Inform Congress' decision to authorize and fund. If authorized and funded, will consist of approximately 2.6 miles of construction from south 7th (R-80) Street to south 28th Street (R-94) (vicinity of Flagler Beach).

b) Provide a 10' dune extension seaward matching the existing dune elevation (15-20' NAVD 88).

c) Construct a berm that will allow equilibrium for the 10' shift seaward (elevation to match berm existing (11' NAVD 88).

d) Planting of vegetation to stabilize the new dune during initial construction.

e) Utilize an offshore borrow source in Federal waters (approximately 7 miles) placing approximately 320,000 CY each construction sequence.

f) Period of Federal Participation would be 50 years from initial construction. "Project Life" extends until de-authorized by Congress

Project Scope

The study area is the entire coast of Flagler County (Figure 1), which is subject to storm damage and shoreline erosion. The study area includes about 2.6 miles of critically eroding shoreline in Flagler Beach.

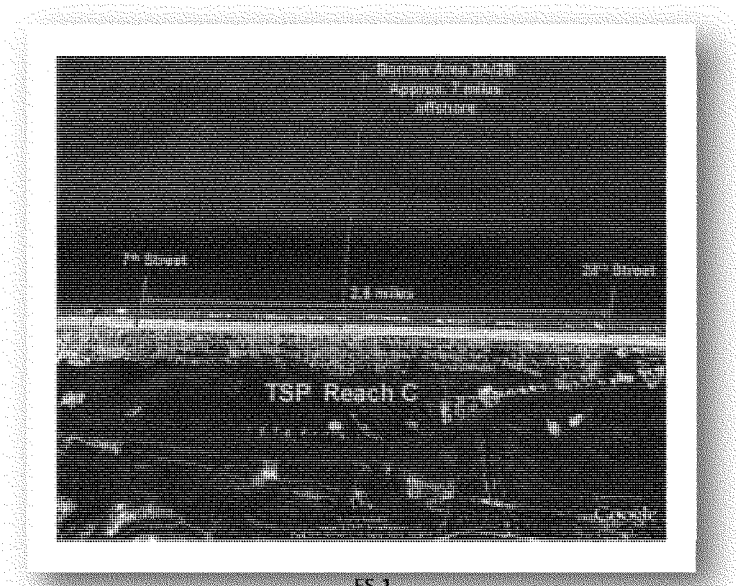


Figure 1 - Project Reach

Flagler County Shore Protection Project Risk Analysis

Risk Analysis Results

A Cost and Schedule Risk Analysis (CSRA) was performed on 3/13/13 - 4/12/13 on this project to identify the 80% confidence level contingencies for the remaining construction activities. The contingencies considered both cost and schedule; the schedule risks then being converted to an additional cost risk. The resulting 23% was then applied to the remaining project activities such as Lands and Damages, Planning, Engineering & Design and Construction Management. The following results were observed:

Table 1 - Risk Analysis Results

Construction Results	Contingency Amount	Contingency %
Remaining Construction	$8,270,000	23%
Project Schedule	50 years (5 dredge seasons)	0%

High Risk Items, Cost

The following were high risk items affecting cost. The complete risk register can be viewed in Appendix A.

- ES121 - Competition/Market Conditions:

Discussion: Current market conditions seem to indicate a high degree of interest in this type of project. Multiple competitive bids are anticipated, which should keep costs low. However, future market conditions are unknown and competition could affect the cost in a negative manner.

- TD17 & ES134 - Quantities/Finalize Designs:

Discussion: Quantities are estimated based on the best available information; storms and fluctuations in erosion rates could have an effect on actual quantities for construction. Some of the project scope has not been finalized for the project (staging and access areas, etc.), which could add to the project cost.

- ES151 - Current Fuel Price:

Discussion: Fuel cost continues to fluctuate. Dredging cost is highly dependent on fuel cost.

High Risk Items, Schedule

The following items were high risk items affecting the project schedule. The complete risk register can be viewed in Appendix A.

- None

Discussion – The PDT discussed scoping risk items. It was the consensus of the group, the project was flexible enough to complete within the current schedule. Three moderate risk items were identified which could impact windows on yearly seasons, but overall project schedule should show no impact.

Mitigation Recommendations

A positive outcome of the CSRA was a thorough discussion of the risks and their mitigation measures. PDT members worked through each risk item and how the risks would affect the overall project. Most

could not be mitigated such as fuel cost, adverse weather and availability of dredge fleet. However, risk for competition can be mitigated with open competition to the maximum dredge fleet and early solicitation methods.

Major recommendations are as follows for high risk items:

- ES-121 - Competition/Market Conditions – Acquisition planning and early solicitation can help maximize competition. Also, an industry day can give a good indication of interest and feedback on the project.

- TD17 & ES134 - Quantities/Finalize Designs – Obtain up to date surveys prior to construction to reassess project needs. Monitoring reports should be evaluated to verify the assumed erosion rates following initial construction. Complete PED phase which should identify any design issues and conflicts with assumptions made during the feasibility study. Once the design is complete the risk register can be updated to reflect risks that were mitigated.

Total Project Cost Summary

The following table portrays the full costs of the remaining project features based on the anticipated contracts. The costs are intended to address the congressional requests of estimates to complete the project. Costs are in thousands of dollars. The 23% contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table 2 - Cost Summary

ACCT	DESCRIPTION		COST ($K)	CONTG ($K)	TOTALS ($k)
01	Lands & Damages		2,768	637	3,405
02	Relocations		941	216	1,157
17	Beach Replenishment		25,527	5,871	31,398
Non-construction Costs					
30	Planning, Engineering & Design**	16.2%	4,732	1,088	5,820
31	Supervision & Administration**	6.8%	1,987	457	2,444
	Summary 30 & 31 Account		**6,719**	**1,545**	**8,264**
	Estimated Project Cost		**35,955**	**8,270**	**44,224**

Flagler County Shore Protection Project Risk Analysis

PURPOSE/BACKGROUND

The Recommended Plan for Flagler County will:

a) Inform Congress' decision to authorize and fund. If authorized and funded, will consist of approximately 2.6 miles of construction from south 7th (R-80) Street to south 28th Street (R-94) (vicinity of Flagler Beach).

b) Provide a 10' dune extension seaward matching the existing dune elevation (15-20' NAVD 88).

c) Construct a berm that will allow equilibrium for the 10' shift seaward (elevation to match berm existing (11' NAVD 88).

d) Planting of vegetation to stabilize the new dune during initial construction.

e) Utilize an offshore borrow source in Federal waters (approximately 7 miles) placing approximately 320,000 CY each construction sequence.

f) Period of Federal Participation would be 50 years from initial construction. "Project Life" extends until de-authorized by Congress

REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for both cost and schedule risks for all project features. The study and presentation can include or exclude consideration for operation and maintenance or life cycle costs, depending upon the program or decision document intended for funding.

Project Scope

Major Project Features studied from the civil works work breakdown structure (CWWBS) for this project includes:

01 – Lands & Damages

02 – Relocations

17 – Beach Replenishment

30 – Planning, Engineering & Design

31 – Construction Management

USACE Risk Analysis Process

The risk analysis process follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Directory of Expertise for Civil Works (Cost Engineering MCX). The risk analysis process reflected within the risk analysis report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. The risk analysis results are intended to serve several functions, one being the establishment of reasonable contingencies reflective of an 80 percent confidence level to successfully accomplish the project work within that established contingency amount. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analyses should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting, and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, the risk analysis is performed to meet the requirements and recommendations of the following documents and sources:

- ER 1110-2-1150, Engineering and Design for Civil Works Projects.
- ER 1110-2-1302, Civil Works Cost Engineering.
- ETL 1110-2-573, Construction Cost Estimating Guide for Civil Works.
- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.
- Memorandum from Major General Don T. Riley (U.S. Army Director of Civil Works), dated July 3, 2007.
- Engineering and Construction Bulletin issued by James C. Dalton, P.E. (Chief, Engineering and Construction, Directorate of Civil Works), dated September 10, 2007.

METHODOLOGY/PROCESS

A CSRA meeting was held in the CESAJ office on 9/4/12 – 9/7/12 with follow-up discussion help in April 2014. Participants include the following members. Note that the meetings included key sponsor participants:

Table 3 - PDT Risk Identification Team

Name	Office	Representing
Harrah, Jason S SAJ	CESAJ-PM-WN	Project Manager
Dobbs, Idris L SAJ;	CESAJ-PD-D	Economics

Flagler County Shore Protection Project Risk Analysis

Name	Office	Representing
Durkin, Martin T SAJ	CESAJ-PD-PN	Planning Lead
Hughes, Daniel B SAJ	CESAJ-PD-EP	Archaeologist
Jones, Russell G SAJ	CESAJ-PD-EQ	Water Quality Permit
McConnell, Kathleen K. SAJ;	CESAJ-PD-EC	NEPA
Nist, Barbara U SAJ	CESAJ-EN-GG	Geologist
Rivers, Katherine C SAJ	CESAJ-RE-A	Real Estate
Shuff, Sheldon G SAJ	CESAJ-OC	Office of Counsel
Tyler, Jennifer L SAJ	CESAJ-EN-TC	Cost Engineering
Jason Engle	CESAJ-EN-WC	Engineering Coastal
Rawls, Colin SAJ	CESAJ-PD-D	Planning Economics
Schrader, Matthew H SAJ	CESAJ-PD-PN	Planning Lead
Bilbao, Jose D SAJ	CESAJ-PM-WN	Project Management
Torres, Glisel SAJ	CESAJ-CD-M	Construction
Long, Wayne T SAJ	CESAJ-CD-NJ	Construction
Corbett, Beau J SAJ	CESAJ-CT-C	Contracting
Denson, Katrina L SAJ	CESAJ-CT-C	Contracting
Callan, Kim C NWW	CENWW-EC-X	Cost Engineering - Risk Analysis
Hughes, Daniel B SAJ	CESAJ-PD-EP	Archaeologist
Mayhew, Troy	CESAJ-EN-GG	Geologist
George, Gregory A SAJ	CESAJ-CD-M	

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence. A parallel process is also used to determine the probability of various project schedule duration outcomes and quantify the required schedule contingency (float) needed in the schedule to achieve any desired level of schedule confidence.

In simple terms, contingency is an amount added to an estimate (cost or schedule) to allow for items, conditions, or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Engineering MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as

a decision criteria is a risk adverse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. Because Crystal Ball is an Excel add-in, the schedules for each option are recreated in an Excel format from their native format. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results would be provided in section 6.

Identify and Assess Risk Factors

Identifying the risk factors via the PDT are considered a qualitative process that results in establishing a risk register that serves as the document for the further study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT is obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable and is considered.

A Formal PDT meeting was held in CESAJ on 3/14/2013 for the purposes of identifying and assessing risk factors. The initial formal meeting focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Discussions focused primarily on risk factor assessment and quantification.

Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are quantified using probability distributions (density functions), because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering, designers, and risk analysis team members with lesser inputs from other functions and disciplines.

The following is an example of the PDT quantifying risk factor impacts by using an iterative, consensus-building approach to estimate the elements of each risk factor:

- Maximum possible value for the risk factor.
- Minimum possible value for the risk factor.
- Most likely value (the statistical mode), if applicable.
- Nature of the probability density function used to approximate risk factor uncertainty.
- Mathematical correlations between risk factors.
- Affected cost estimate and schedule elements.

Risk discussions focused on the various project features as presented within the USACE Civil Works Work Breakdown Structure for cost accounting purposes. It was recognized that the various features carry differing degrees of risk as related to cost, schedule, design complexity, and design progress. It was also understood that features were in various phases of design and construction, varying risks further. The example features under study are presented in table 1:

Table 4 - Work Breakdown Structure by Feature

01	LANDS AND DAMAGES
02	RELOCATIONS
17	BEACH REPLENISHMENTS
30	PLANNING, ENGINEERING & DESIGN
31	CONSTRUCTION MANAGEMENT

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions are meant to support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the base cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes.

This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

For schedule contingency analysis, the option schedule contingency is calculated as the difference between the P80 option duration forecast and the base schedule duration. These contingencies are then used to calculate the time value of money impact of project delays that are included in the presentation of total cost contingency in section 6. The resulting time value of money, or added risk escalation, is then added into the contingency amount to reflect the USACE standard for presenting the "total project cost" for the fully funded project amount.

Schedule contingency is analyzed only on the basis of each option and not allocated to specific tasks. Based on Cost Engineering MCX guidance, only critical path and near critical path tasks are considered to be uncertain for the purposes of contingency analysis.

KEY CONSIDERATIONS AND ASSUMPTIONS

Key assumptions include the following:

- Remaining project features will be awarded as multiple projects.
- The project schedule is presented in the main report.
- Various project features are at different stages of design and construction. See 3.1 for details.
- The remaining components are at the feasibility level of design. The design PDT believes that they are conservative and will be reduced as H&H modeling is completed.
- Observed construction practices from work in progress have been included for future features. That is, estimates were based on current observed crews and productivity rates.
- Life Cycle costs have not been included in this cost estimate.
- Contract acquisition strategy will be full and open.

RISK ANALYSIS RESULTS

Risk Register

Risk is unforeseen or unknown factors that can affect a project's cost or schedule. Time and money have a direct relationship due to the time value of money. A risk register is a tool commonly used in project planning and risk analysis and serves as the basis for the risk studies and Crystal Ball risk models. The risk register describes risks in terms of cost and schedule. A summary risk register that includes typical risk events studied (high and moderate levels) is presented in this section. The risk register reflects the results of risk factor identification and assessment, risk factor quantification, and contingency analysis. A more detailed risk register is provided in Appendix A. The detailed risk registers of Appendix A include low level and unrated risks, as well as additional information regarding the specific nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing and communicating identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting risk analysis feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

A correlation is a dependency that exists between two risks and may be direct or indirect. An indirect correlation is one in which large values of one risk are associated with small values of the other. Indirect correlations have correlation coefficients between 0 and -1. A direct correlation is one in which large values of one risk are associated with large values of the other. Direct correlations have correlation coefficients between 0 and 1. Correlations were not identified in this analysis.

The risk register identifies thirty one different risks that are either moderate or high risks. An abridged version of the risk register is presented below.

Flagler County Shore Protection Project Risk Analysis

Table 5 - Risk Register

RT	Ref #	Risk/Opportunity Event	Description	PDT Discussions	Likelihood (C)	Impact (C)	Risk Level (C)	Likelihood (S)	Impact (S)	Risk Level (S)
CA	41	Possibility of Multiple Contracts	Added the removal and construction of the dune walkovers the PDT thinks that there will be a separate contract to handle the walkovers, possibly multiple contracts	The estimate currently assumes that the dredging contractor would sub-contract the work, but the PDT foresees the possibility of the dune walkovers being under a separate contract altogether	Likely	Significant	High	Likely	Marginal	Moderate
TD	73	Dredge Estimate scope, quantities, equipment	Varying qty	Significant design; recent surveys, however dredge cost is highly dependant on qty's.	Likely	Significant	High	Likely	Marginal	Moderate
CO	82	Access and Staging Area	Staging area has not been identified to date.	Staging and Access Areas: Due to the existence of a State Highway right along the beach area and the lack of space on the beach, access and room for staging areas may present a problem; Consultation with the County (email) revealed that there are accessible areas close to construction site (may need to get equipment under the pier) and there is room for staging.	Likely	Marginal	Moderate	Unlikely	Negligible	Low
CO	86	Weather Impacts	Storm Impacts	Coast of Florida is prone to storm events. Adverse weather could reduce dredging effective time for dredging	Likely	Marginal	Moderate	Likely	Significant	High
CO	87	Unknown Cultural Historic Preservation	Surveys have not been completed	Borrow areas has significant areas and qtys. Does have allowance for areas to be restrictive	Unlikely	Negligible	Low	Unlikely	Negligible	Low
ES	121	Competition	Matoc, and other acquisition strategy	Schedule is outside of busy window, therefore better competition, however, due to smaller qtys' potential risk for interested Hopper Dredge contractors.	Likely	Significant	High	Unlikely	Negligible	Low
ES	126	Mob, Demob & Prepwork	Higher mob costs due to construction timeframe	Currently project does not have an environmental window and should have a flexible construction schedule that would help to keep mob costs down; if project is completed during hopper season (environmental window from Nov to May), could see higher mob costs	Likely	Marginal	Moderate	Unlikely	Negligible	Low
ES	134	Estimate include waste / drop off quantities	Storm Impacts	Water surge may erode existing qtys	Unlikely	Significant	Moderate	Unlikely	Negligible	Low
ES	136	Estimate reasonableness of crews and productivities	Weather	Productivity changes due to weather; new area of dredging with no historical information, so production assumptions could vary; Environmental Restriction: NMFS may impose speed limit restriction due to whale habitat	Likely	Marginal	Moderate	Unlikely	Negligible	Low
ES	151	Fuel Prices Fluctuate Significantly	Fluctuation of Fuel pricing	Risk will be based on historical fluctuation of Marine fuel rates.	Likely	Significant	High	Unlikely	Negligible	Low
ES	154	Dredging (Plant Value)	Dredge Plant/Labor Cost	Due to Variance in dredge plant/labor cost for limited numbers of contractors and for lack of actual pricing data.	Very Likely	Significant	High	Unlikely	Negligible	Low
ES	159	Turbidity Requirements	Decant of disposal water	Basis of estimate currently allows for turbidity monitoring effects.	Unlikely	Marginal	Low	Unlikely	Negligible	Low
ES	160	Unsuitable Material	• Potential for construction modification and claims? • High risk or complex construction elements, site access, in-water?	Borrow Area: First time use of a borrow area- could encounter unsuitable material; Encountering rock or other unsuitable material in a "new and not established" borrow area happens quite frequently, but should be able to find enough suitable material within borrow area; if screening is required, could see cost increase	Unlikely	Significant	Moderate	Unlikely	Negligible	Low
ES	161	Dune Planting	• High risk or complex construction elements, site access, in-water?	Plant Survival: If plantings do not take root and thrive, may have to do additional plantings	Unlikely	Negligible	Low	Unlikely	Negligible	Low

Flagler County Shore Protection Project Risk Analysis

RT	Ref #	Risk/Opportunity Event	Description	PDT Discussions	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)
ES	162	Dune Walkovers	demolition of existing dune walkovers and the construction of new ones.	Low risk since we have now accounted for the construction cost in the initial construction of the dune. Estimate considers removal of all 42 existing public and private walkovers and reconstruction of 21 new public walkovers (based on decision by O.C. that the Federal government is only responsible for the public walkovers) with the same basic design considerations. The potential risks are 1) not all 42 walkovers are impacted 2) not all impacts result in complete removal and reconstruction 3) some of the walkovers have a more extravagant design and need to be rebuilt the same way thus being more expensive. This risk item can show a cost savings and a potential cost impact to the project.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
RE	189	Turtle Monitoring	May be environmental requirements within permit that are not covered within estimate	Yearly turtle monitoring will likely be required (typically annually for 3 years after initial construction);	Certain	Negligible	Low	Unlikely	Negligible	Low
RE	190	Physical Monitoring/ Beach Surveys	May be permit requirements that differ from estimate assumptions	Physical monitoring will be a permit requirement; assumptions were made in the estimate as to the frequency	Certain	Negligible	Low	Unlikely	Negligible	Low
RE	191	Turtle Nesting Impacts	Environmental Windows imposed	Environmental windows are not expected to be imposed on this project that would restrict beach placement outside of the turtle nesting season	Unlikely	Marginal	Low	Unlikely	Negligible	Low
RE	192	Hardbottoms	Hardbottom impacts that require mitigation	A hardbottom survey has been completed and nothing was found within the potential footprint of the project.	Unlikely	Marginal	Low	Unlikely	Negligible	Low
EX	213	Acts of God (seismic events: volcanic activity, earthquakes, tsunamis, or severe weather: freezing, flooding or hurricane)	Potential for Storm; may change qty or disrupt contractor	Accounted for on CO 61	Unlikely	Marginal	Low	Unlikely	Marginal	Low
EX	224	Local communities pose objections	Community is divided, could raise issues.	Small risk to project, due to project is common on coast	Unlikely	Negligible	Low	Unlikely	Negligible	Low
EX	226	Adequacy of project funding (incremental or full funding)	Annual incremental funding expected.	Project is small in scale and their are risk mitigation measures such as additional sponsor funding	Likely	Negligible	Low	Likely	Negligible	Low

Flagler County Shore Protection Project Risk Analysis

Cost Risk Analysis - Cost Contingency Results

The project Cost Contingency at the 80% confidence level is 23%. This level was established by analyzing the different cost risk factors that affect the project. Cost risks that were specific to individual project features were discussed in detail. The cost sensitivity chart communicates the high variance risk events.

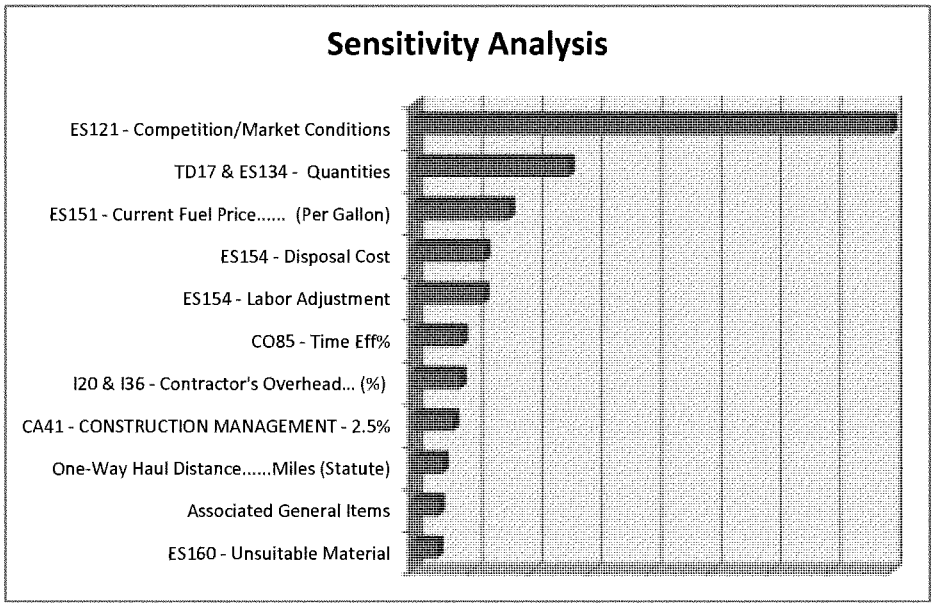


Figure 2 - Sensitivity Analysis

From this chart, we can see that the top three risks that affect cost are;

- ES121 - Competition/Market Conditions
- TD17 & ES134 - Quantities
- ES151 - Current Fuel Price

Flagler County Shore Protection Project Risk Analysis

The confidence table and curve showing the 80% confidence level is below.

Note that these results reflect only those contingencies established from the cost risk analysis.

Schedule Risk Analysis - Schedule Contingency Results

No Schedule risk was derived from team. Project is estimated at 5 seasons ranging over the next 50 years.

Table 6 - Contingency Analysis at Various Confidence Levels

Most Likely Cost Estimate			$35,955,000
Confidence Level	Value	Contingency	Contingency
0%	$37,586,000	$1,631,000	5%
5%	$39,956,000	$4,001,000	11%
10%	$40,473,000	$4,518,000	13%
15%	$40,868,000	$4,913,000	14%
20%	$41,225,000	$5,270,000	15%
25%	$41,512,000	$5,557,000	15%
30%	$41,778,000	$5,823,000	16%
35%	$42,036,000	$6,081,000	17%
40%	$42,260,000	$6,305,000	18%
45%	$42,531,000	$6,576,000	18%
50%	$42,766,000	$6,811,000	19%
55%	$42,993,000	$7,038,000	20%
60%	$43,200,000	$7,245,000	20%
65%	$43,462,000	$7,507,000	21%
70%	$43,732,000	$7,777,000	22%
75%	$44,041,000	$8,086,000	22%
80%	$44,302,000	$8,347,000	23.2%
85%	$44,814,000	$8,859,000	25%
90%	$45,339,000	$9,384,000	26%
95%	$46,047,000	$10,092,000	28%
100%	$50,200,000	$14,245,000	40%

Use 80% Confidence	$44,224,650	$8,269,650	23%

APPENDIX A

DETAILED RISK REGISTERS

Detailed Risk Register

RT	Ref #	Risk/Opportunity Event	Description	PDT Discussions	Likelihood (I)	Impact (I)	Risk Level (I)	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Correlation to Other(s)	Responsibility/ POC	Method for Risk Determination	Affected Project Component
CA	41	Possibility of Multiple Contracts	Added the removal and construction of the dune walkovers the PDT thinks that there will be a separate contract to handle the walkovers, possibly multiple contracts	The estimate currently assumes that the dredging contractor would sub-contract the work, but the PDT foresees the possibility of the dune walkovers being under a separate contract altogether	Likely	Significant	High	Likely	Marginal	Moderate	Triangular	N/A -Not Modeled	N/A	Cost Engineering	Modeled within CEDEP	Contract Cost
TD	73	Dredge Estimate scope, quantities, equipment	Varying qty	Significant design, recent surveys, however dredge cost is highly dependant on qtys.	Likely	Significant	High	Likely	Marginal	Moderate	Triangular	N/A -Not Modeled	N/A	Cost Engineering	Modeled within CEDEP	Contract Cost
CO	82	Access and Staging Area	Staging area has not been identified to date.	Staging and Access Areas: Due to the existence of a State Highway right along the beach area and the lack of space on the beach, access and room for staging areas may present a problem; Consultation with the County (email) revealed that there are accessible areas close to construction site (may need to get equipment under the pier) and there is room for staging.	Likely	Marginal	Moderate	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	N/A	Construction	Modeled as a separate cost item	Contract Cost
CO	85	Weather Impacts	Storm impacts	Coast of Florida is prone to storm events. Adverse weather could reduce dredging effective time for dredging	Likely	Marginal	Moderate	Likely	Significant	High	Triangular	N/A -Not Modeled	N/A	Cost Engineering	Included within risk element 03136	Project Cost
CO	87	Unknown Cultural Historic Preservation	Surveys have not been completed	Borrow areas has significant areas and qtys. Does have allowance for areas to be restrictive	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	N/A	Environmental Compliance	Not Modeled	N/A -Not Modeled
ES	121	Competition	Maloc, and other acquisition strategy	Schedule is outside of busy window, therefore better competition, however, due to smaller qtys' potential risk for interested Hopper Dredge contractors.	Likely	Significant	High	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	N/A	Contracting	Modeled as Market Condition Factor	Contract Cost
ES	126	Mob, Demob & Prepwork	Higher mob costs due to construction timeframe	Currently project does not have an environmental window and should have a flexible construction schedule that would help to keep mob costs down; if project is completed during hopper season (environmental window from Nov to May), could see higher mob costs	Likely	Marginal	Moderate	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	N/A	Cost Engineering	Modeled as seperate Cost Factor	Contract Cost
ES	134	Estimate include waste / drop off quantities	Storm impacts	Water surge may erode existing qtys	Unlikely	Significant	Moderate	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	N/A	Cost Engineering	Modeled as seperate Cost Factor, and within CEDEP	Contract Cost
ES	136	Estimate reasonableness of crews and productivities	Weather	Productivity changes due to weather; new area of dredging with no historical information, so production assumptions could vary; Environmental Restriction: NMFS may impose speed limit restriction due to whale habitat	Likely	Marginal	Moderate	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	N/A	Cost Engineering	Modeled within CEDEP	Contract Cost
ES	151	Fuel Prices Fluctuate Significantly	Fluctuation of Fuel pricing	Risk will be based on historical fluctuation of Marine fuel rates.	Likely	Significant	High	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	N/A	Cost Engineering	Modeled within CEDEP	Contract Cost
ES	154	Dredging (Plant Value)	Dredge Plant/Labor Cost	Due to Variance in dredge plant/labor cost for limited numbers of contractors and for lack of actual pricing data.	Very Likely	Significant	High	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	N/A	Cost Engineering	Modeled within CEDEP	Contract Cost
ES	159	Turbidity Requirements	Decant of disposal water	Basis of estimate currently allows for turbidity monitoring effects.	Unlikely	Marginal	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	N/A	Cost Engineering	Not Modeled	Contract Cost

Detailed Risk Register

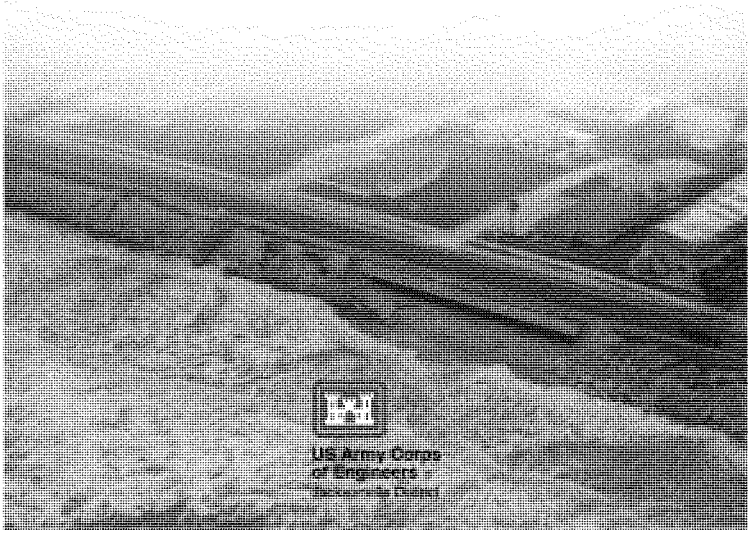
ES 160	Unsuitable Material	• Potential for construction modification and claims? • High risk or complex construction elements, site access, in-water?	Borrow Area: First time use of a borrow area- could encounter unsuitable material; Encountering rock or other unsuitable material in a "new and not established" borrow area happens quite frequently, but should be able to find enough suitable material within borrow area; if screening is required, could see cost increase	Unlikely	Significant	Moderate	Unlikely	Negligible	Low	Yes-No	Yes-No	N/A	Cost Engineering	Not Modeled	N/A -Not Modeled
ES 161	Dune Planting	• High risk or complex construction elements, site access, in-water?	Plant Survival. If plantings do not take root and thrive, may have to do additional plantings	Unlikely	Negligible	Low	Unlikely	Negligible	Low	Yes-No	Yes-No	N/A	Cost Engineering	Not Modeled	N/A -Not Modeled
ES 162	Dune Walkovers	demolition of existing dune walkovers and the construction of new ones	Low risk since we have now accounted for the construction cost in the initial construction of the dune. Estimate considers removal of all 42 existing public and private walkovers and reconstruction of 21 new public walkovers (based on decision by O.C. that the Federal government is only responsible for the public walkovers) with the same basic design considerations. The potential risks are 1) not all 42 walkovers are impacted 2) not all impacts result in complete removal and reconstruction 3) some of the walkovers have a more extravagant design and need to be rebuilt the same way thus being more expensive. This risk item can show a cost savings and a potential cost impact to the project.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	Yes-No	Yes-No	N/A	Cost Engineering	Not Modeled	N/A -Not Modeled
RE 189	Turtle Monitoring	May be environmental requirements within permit that are not covered within estimate	Yearly turtle monitoring will likely be required (typically annually for 3 years after initial construction);	Certain	Negligible	Low	Unlikely	Negligible	Low	Yes-No	Yes-No	N/A	N/A	Not Modeled	N/A -Not Modeled
RE 190	Physical Monitoring/ Beach Surveys	May be permit requirements that differ from estimate assumptions	Physical monitoring will be a permit requirement; assumptions were made in the estimate as to the frequency	Certain	Negligible	Low	Unlikely	Negligible	Low	Yes-No	Yes-No	N/A	N/A	Not Modeled	N/A -Not Modeled
RE 191	Turtle Nesting Impacts	Environmental Windows imposed	Environmental windows are not expected to be imposed on this project that would restrict beach placement outside of the turtle nesting season	Unlikely	Marginal	Low	Unlikely	Negligible	Low	Yes-No	Yes-No	N/A	N/A	Not Modeled	N/A -Not Modeled
RE 192	Hardbottoms	Hardbottom impacts that require mitigation	A hardbottom survey has been completed and nothing was found within the potential footprint of the project.	Unlikely	Marginal	Low	Unlikely	Negligible	Low	Yes-No	Yes-No	N/A	N/A	Not Modeled	N/A -Not Modeled
EX 213	Acts of God (seismic events; volcanic activity; earthquakes, tsunamis; or severe weather; freezing, flooding or hurricane)	Potential for Storm, may change qty or disrupt contractor	Accounted for on CO 81	Unlikely	Marginal	Low	Unlikely	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	N/A	Cost Engineering	Not Modeled	N/A -Not Modeled
EX 224	Local communities pose objections	Community is divided, could raise issues	Small risk to project, due to project is common on coast.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	N/A	Project Manager	Not Modeled	N/A -Not Modeled
EX 226	Adequacy of project funding (incremental or full funding)	Annual incremental funding expected	Project is small in scale and their are risk mitigation measures such as additional sponsor funding	Likely	Negligible	Low	Likely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	N/A	District Management	Not Modeled	N/A -Not Modeled

FLAGLER COUNTY, FLORIDA

HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FINAL INTEGRATED FEASIBILITY STUDY AND
ENVIRONMENTAL ASSESSMENT

Appendix C

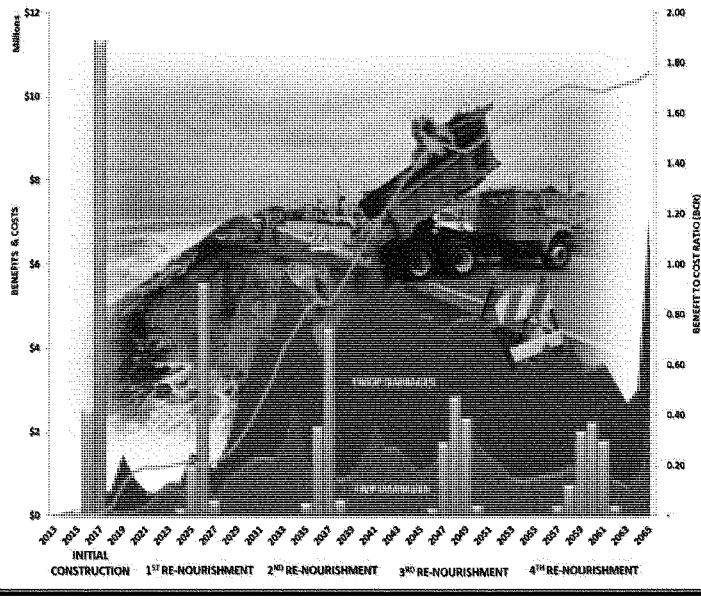
Economics



FLAGLER COUNTY, FL
HURRICANE AND STORM DAMAGE REDUCTION STUDY

APPENDIX – C: ECONOMICS

US Army Corps of Engineers, Jacksonville District
4/13/2015



1. EXECUTIVE SUMMARY

Flagler County is located on the northeast coast of Florida to the immediate south of St John's County, and the immediate north of Volusia County. Portions of Flagler County's 18 mile shoreline are subject to erosion caused by both storms and natural shoreline processes. A study was undertaken to assess the feasibility of providing Federal Hurricane and Storm Damage Reduction (HSDR) measures to portions of the Flagler County shoreline. The local sponsor for this project, Flagler County, has indicated strong support for feasibility phase studies for hurricane and storm damage reduction (HSDR) purposes along their shoreline, and has declared willingness and the capability to share applicable costs in the current study. In support of the study, an investigation was performed to estimate the economic benefits of alleviating erosion, storm surge, and wave attack damage to coastal infrastructure.

Alternative Evaluation

Upon conduct of a preliminary screening, followed by a detailed evaluation of a final array of alternatives, the project delivery team has determined a National Economic Development (NED), and a Tentatively Selected Plan (TSP) for reducing coastal storm and erosion damage to infrastructure. These plans were evaluated using FY 2011 price levels and the FY2013 federal water resources discount rate of 3.75%, and a 50 year period of analysis with a base year of 2016. See Table 1-1 for more detail on the evaluation of the final array of alternatives[1]

Table 1-1: Alternative Net Benefits & BCRs

Alternatives	Brief Description	Location[2]	Net Benefits	BCR
A-Dune-H	Dune extension and 10' sacrificial berm	Reach A	$52,000	1.35
A-30	Dune extension and 30' sacrificial berm	Reach A	-$16,000	0.98
B-Dune-H	Dune extension and 10' sacrificial berm	Reach B	-$57,000	0.78
B-30	Dune extension and 30' sacrificial berm	Reach B	-$809,000	0.21
C-Dune-H (NED)	Dune extension and 10' sacrificial berm	Reach C	$1,387,000	2.72
C-30	Dune extension and 30' sacrificial berm	Reach C	$1,065,000	1.9
AC-Dune-H	Dune extension and 10' sacrificial berm	Reach A, Reach C	$1,814,000	2.61
AC-30	Dune extension and 30' sacrificial berm	Reach A, Reach C	$1,206,000	1.69

The plan with the highest net benefits is **AC-Dune-H**. It consists of a 10' dune and beach profile extension in 2 non-contiguous segments, Reach-A (1.7 miles) and Reach-C (2.6 miles). Typically the plan with the highest net benefits is the NED Plan. However, subsequent plan formulation efforts determined that public access in Reach A is negligible. Because Reach A is a separable element that does not have public access, it was screened out after the final array of alternatives had been modeled. More

[1] Costs were developed by SAJ District Cost Engineering personnel in FY2013 dollars and deflated back to 2011 price levels. The original real estate assessment was completed in FY2009, and updated to FY2011 prices using a stratified random sample.

[2] Reach-A is the Painters Hill section of the study area. It is primarily residential and has little public access. Reach-B is the Beverly Beach section of the study area and is located between Painters Hill to the North, and Flagler Beach to the South. Reach-C is located in Flagler Beach between the municipal pier to the north, and Gamble Rogers State Park to the South.

information about the public access issue and the final screening is presented in Section 6 of the main feasibility report.

The NED Plan

With alternative **AC-Dune-H** screened out, the plan with the highest net benefits is **C-Dune-H**. Therefore, it is the NED Plan and the Tentatively Selected Plan (TSP). This is also the plan with the highest Benefit-Cost-ratio (BCR). This plan consists of a 10' dune and beach profile extension in Reach-C only, which is approximately 2.8 miles in length. The following table provides a summary of the NED Plan with and without incidental recreation benefits added at FY14 price levels discounted with the FY14 Water Resources Discount Rate (3.5%). See Table 1-2 for more detail on the NED Plan.

Table 1-2: Economic Summary of the NED Plan

ECONOMIC SUMMARY	STORM DAMAGE REDUCTION BENEFITS	STORM DAMAGE REDUCTION + RECREATION BENEFITS	STORM DAMAGE REDUCTION + RECREATION + TRAFFIC RE-ROUTING BENEFITS
Price Level	FY14	FY14	FY14
FY14 Water Resources Discount Rate	3.50%	3.50%	3.50%
Average Annual Storm Damage Reduction Benefits	$2,159,000	$2,159,000	$2,159,000
Average Annual Recreation Benefits	$0	$72,000	$72,000
Average Annual Traffic Reroute Benefits[3]	$0	$0	$131,000
Average Annual Total Benefits	$2,159,000	$2,231,000	$2,362,000
Average Annual Cost	$1,239,000	$1,239,000	$1,239,000
Average Annual Net Benefits	$920,000	$992,000	$1,123,000
Benefit Cost Ratio	**1.74**	**1.80**	**1.91**

[3] See Addendum B for more information on the estimation of traffic reroute benefits. Here, traffic reroute benefits are based on 2013 AAA Vehicle Operating Cost. Average Annual Benefits were reduced by 26% to only include the gas, oil, maintenance, and depreciation portion of the per mile vehicle operating cost.

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1. INTRODUCTION

The purpose of this economics appendix is to tell the story of the economics investigation, and provide greater detail on the results of the analysis. The sections that follow will cover the following topics:

- **Existing Conditions:** Items discussed include an assessment of socio-economic conditions, spatial organization of the study area, and an inventory of the coastal infrastructure within the study area.
- **Hurricane & Storm Damage Reduction Benefits:** This section will cover the methods used to estimate the future without, and future with project condition using Beach-fx, accounting for risk and uncertainty. The future without project condition will cover the distribution of the damages in the following dimensions:
  - Spatial (Where)
  - Categorization of structures (What)
  - Damage driving parameter (How)
  - Temporal (When)
  - The future with project condition discussion will address the alternatives evaluated, and the analysis results. In addition, an analysis of alternative performance under the intermediate and high sea level change scenarios is provided.
- **NED & TSP Plan Selection and Performance:** This section addresses the rationale for NED and TSP selection. A detailed description of the performance of the NED Plan is provided with the same 4 dimensions given in the Hurricane & Storm Damage Reduction section. A discussion on the project's incidental recreation benefits is also provided.

2. EXISTING CONDITIONS

All structure and content values presented in this section are in FY2011 price levels.

2.1 Socio-Economic Conditions

Flagler County is located on the northeast coast of Florida. It has more than seventeen miles of coastline along the Atlantic Ocean. The largest cities in Flagler County are Palm Coast, Flagler Beach, and Bunnell. Much of the study area in the Feasibility study is located within the City of Flagler Beach.

2.1.1 Demographic Characteristics

According to the US Census Bureau, the 2010 population of Flagler County was 95,696, making it the 25th most populous county in Florida (of 67 counties). In past several years, the county has seen rapid population growth. In fact, between 2000 and 2010, the county grew by approximately 92.0%.[1] According to a report by the University of Florida[2], Flagler County is expected to continue growing at a relatively fast pace. The population is estimated to be 136,900 by 2020 and 215,400 by 2040. These projections suggest that Flagler may be one of Florida's fastest growing counties over the next 30 years. The ethnic makeup of Flagler County is relatively homogeneous. Caucasians make up approximately 75.9% of the population[4]. The largest minority group is African Americans, which make up approximately 11.7%. Non-white Hispanics make up 9.0%. All other racial groups make less than 5% of the total population[4].

2.1.2 Economic Characteristics

Flagler County has a service based economy that has benefitted from a gradual influx of retirees since the late 1980s. Currently, the proportion of the population that is 62 years or older is 28.9%, which is well above the national (16.2%) and state average (20.9%).[4] The vibrant service sector includes banking/finance, real estate, insurance, healthcare, and related commercial businesses. The percentage of the workforce employed in social services (defined as educational services, healthcare, or social assistance) is 25.5%, which is above the national (22.8%) and state average (22.5%).[4] Other than services, the primary economic activities in Flagler County are building/construction, tourism, and agriculture.

With several notable attractions located within its borders, tourism is a critical component of the Flagler County economy. In addition to miles of beaches, the county posses numerous access points to the Intercostals Waterway, which is a popular destination for recreational fishing and boating as well as related activities (i.e. water skiing). The county is home to six state parks and "Marineland", one of Florida's original marine mammal parks. Flagler County also benefits from an appealing location between major tourist hubs St. Augustine (to the north) and Daytona (to the south).

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[1] Source: United States Census Bureau, American Fact Finder

[2] Martinovich, Milenko and Smith, Stan. *Florida population soars in century's first decade, but rate is slowing*. University of Florida News. June 13, 2011.

In addition to tourism, agriculture is an important economic activity in Flagler. According the United States Department of Agriculture, Flagler County has more than 8,000 acres of actively harvested crop land. The largest crops are citrus and potatoes[3]. Livestock farming is also an important activity. The county has several thousand acres of pasture land that support both beef and pork operations.

Income

On average, Flagler County's socioeconomic composition is comparable to the state of Florida. The median household income is $48,708, compared to $ $47,827 for the state of Florida (Census 2010). As of 2010, the percent of individuals living below the poverty line is 13.3%, compared to 14.7% for the state average (Census 2010). The per capita income is $24,455 compared to $26,733 for the state average. The unemployment rate is 10.3%, compared to 8.7% for the state average.

2.2 Data Collection

Economists and real estate specialists have collected and compiled detailed structure information for 9.6 miles of Flagler County's 18 mile coastline, which includes: over 600 single family homes; 102 different multi-family structures; 124 commercial buildings; 9.6 miles of road; and over 477 other structures that are vulnerable to future hurricane and storm damages. In addition, data was collected on nearly 3 miles of coastal armor within Flagler County. In total, over 1,908 damageable structures were collected for economic modeling using Beach-*fx*. The structure inventory includes all structures that are within 500 feet of the mean high water line.

Real Estate professionals from the USACE Jacksonville district (SAJ) using geo-spatial parcel data from Flagler County provided detailed data on each structure including: geographic location, structure type, foundation type, construction type, width, length, number of floors, depreciated replacement value, and year built. Elevation data for enclosed structures was collected by a survey contractor and FEMA elevation certificates were provided by Flagler County. The elevations of paved surfaces such as roads, and parking lots were acquired from U5ACE SAJ LIDAR data.

Data on all coastal armor was collected from a variety of sources including Florida Department of Transportation (FDOT) contractors, site visits, aerial ortho-photography, and USACE SAJ Coastal Engineering personnel. Coastal armor value was determined by USACE SAJ Cost Engineering personnel.

The Flagler County study area was disaggregated into 4 study reaches, consisting of 6 profiles, 46 model reaches, 315 and lots, for economic modeling and reporting purposes.[4] This hierarchical structure is depicted as follows:

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[3] United Stated Department of Agriculture. *Cropscape Agricultural data layer*. USDA National Agricultural Statistics Service. 2012

[4] Originally, the study area consisted of 50 model reaches. The Marineland segment was removed from the study area because the structures along the shoreline receive adequate protection from a large granite revetment.

- **Profiles:** Coastal surveys of the shoreline modified by USACE Jacksonville District (SAJ) Coastal Engineering personnel to apply coastal morphology changes to the model reach level. Profiles are strictly used for modeling purposes, and only referred to in this section for informational purposes.
- **Study Reaches:** Consists of the political/administrative boundaries of the following cities, townships, municipalities: Painters Hill, Beverly Beach, and Flagler Beach. The distribution of the study area is shown in Table 2-1.
- **Design Reaches:** Refined study reaches used in the economic analysis. The distribution of the study area is shown in Table 2-1.
- **Beach-*Fx* Model Reaches:** Quadrilaterals parallel with the shoreline used to incorporate coastal morphology changes for transfer to the lot level. Model reaches are also useful for dividing study reaches into more manageable segments for analysis.
- **Lots:** Quadrilaterals encapsulated within model reaches used to transfer the effect of coastal morphology changes to the damage element. Lots are also repositories for coastal armor costs, specifications, and failure threshold information. They are referred to in this section for information purposes only.
- **Damage Elements:** Represents a unit of the existing condition coastal inventory and a store of economic value subject to losses from wave attack, inundation, and erosion damages. Damage elements are a primary model input and the topic of focus in this discussion. The primary structure categories are coastal armor and coastal structures.

Table 2-1: Spatial Distribution of Study Area

Municipal	Design Reach	# Miles	Length (ft)	% of Municipality within Study Reach	% of Total
Painters Hill	Reach-A	1.74	9,168	100%	19%
Beverly Beach	Reach-B	1.11	5,841	100%	12%
Flagler Beach	Reach-B	2.16	11,407	35%	24%
	Reach-C	2.80	14,809	46%	31%
	Reach-D	1.18	6,246	19%	13%
Total		8.99	47,471		

The distribution of study reaches, model reaches, and lots for Flagler County are depicted further in Table 2-2.

Table 2-2: Distribution of Model Reaches, & Lots

Design Reach	# Model Reaches	Length (ft)	% of Total
Reach-A	10	9,168	19%
Reach-B	17	17,248	36%
Reach-C	14	14,809	31%
Reach-D	5	6,246	13%
Total	**46**	**47,471**	**100%**

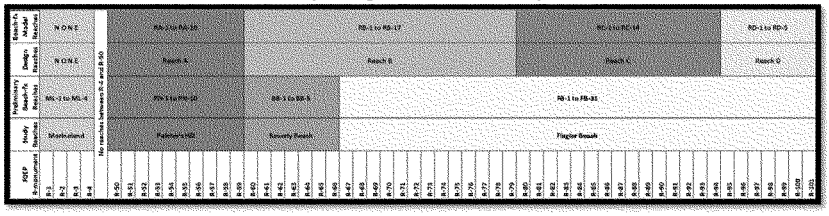
2.2.1 Refined Model Reaches

Early on in the feasibility study, the study area was broken into broad geographic areas (Marineland, Painter's Hill, Flagler Beach, etc) which were referred to as "study reaches". Later in the modeling

effort, the study reaches were refined based on engineering and socioeconomic characteristics. As a result, the study reaches used in the economic analysis differ slightly from the original study reaches. The new study reaches are referred to as "design reaches". Figure 3-3 provides a comparison between the design reaches in the economic analysis and the study reaches as they were originally defined. The main report still organizes results by study reach (i.e. geographic area). The appendixes organize results by design reach because all model runs used for alternative comparison analysis were based on the revised design reaches.

The most significant difference between the original areas and the current design reaches is Marineland, an area several miles north of all the other reaches. Preliminary model runs indicated that FWOP damages in Marineland were minimal (less than $2 million in present value damage). This is because the area is already protected by large revetment, and because there are few structures subject to damage. As a completely separable element with only minor damage, it was screened out. This is notable because, though Marineland results are excluded in this appendix, they are reported in the Main feasibility report.

Table 2-3: Summary of Original and Revised Study Reaches



The purpose of the feasibility report is to tell the entire story of plan formulation. The purpose of the economics appendix is to provide a technical guide to methods, assumptions, and results of the economic analysis. The economic analysis used for alternative comparison was completed using the current design reaches (A,B,C,D). Thus, Marineland is not included in the Engineering and Economic Appendix.

Another important note is that, for modeling purposes, the broad areas are broken up into smaller increments. Originally, these increments were called preliminary Beach-fx Reaches (PH-1, PH2 or FB-1, FB-2, etc.). And, they are still referred to as preliminary Beach-fx reaches in the main report. However, once the study reaches were refined for the alternative analysis, their names changed. Now they are referred to as Beach-fx model reaches. So, for example, the first study reach (i.e. small model increment) in Painter's Hill was previously referred to as PH-1. Now this same increment is a Beach-fx model reach; it is called "A-1". The economics appendix uses the later nomenclature (Design Reaches and Beach-fx Model Reaches) in all charts and figures.

2.3 Existing Condition Coastal Structure Inventory

Information on the existing economic conditions along the Flagler County coastline was collected for economic modeling purposes using Beach-*fx*. The information on the coastal assets detailed in this section was collected from Flagler County mapping resources, site visits, and contractors. Each parcel along the beach was identified as developed or undeveloped, with streets and parks noted. USACE real estate specialists provided depreciated replacement value of existing structures within the study area.

Coastal armor was inventoried, categorized, and valued based on its composition and level of protection afforded.

2.3.1 Coastal Armor

Coastal armor within the study area was categorized into a number of different types based on construction type, material and elevation. The types of coastal armor were granite revetments, precast concrete panel sea walls, steel sheet pile sea walls, and vinyl bulkheads.

- **ARMOR-A1A:** This type represents the economic costs associated with maintaining the existing revetment and SR-A1A.
- **NEW ARMOR-A1A**: Represents the initial economic cost incurred when erosion gets to within 10-15 ft of the road, which will require repair and/or replacement of the revetment along A1A.
- **BULKHEAD:** Vinyl sheet pile bulkheads erected to protect private residences from erosion
- **N-BULKHEAD:** Represents the economic cost of constructing vinyl sheet pile bulkheads in the future should erosion come within 20 ft of a residence.
- **ROAD1:** Road other than SR-A1A

Coastal armor in Marineland consists of a 1,350-foot granite revetment and a 1,500-foot steel sheet pile sea wall covered by a dune. This shoreline protection effort began after Hurricane Floyd caused significant damage to the area in 1999. Marineland's coastal armor is valued at nearly $10 M.
The only coastal armor found in Painters Hill were two lots with vinyl bulkhead armor units with crest elevations at grade level valued at nearly $232,500. In Beverly Beach there is a large 1,560 foot precast concrete panel sea wall providing protection for an RV park valued at $830,000.

Flagler Beach has the most armor in the study area, much of which is in varying stages of disrepair. There is a 420 foot precast concrete panel sea wall starting 285 feet north of the pier. Starting at 7th St. South and ending at 23rd St. South, there is approximately 15,000 feet of granite revetment maintained by the Florida Department of Transportation (FDOT). This revetment was originally built in the 1960s and 1970s, with additional newer stone being placed during maintenance and repairs. According to FDOT contractors, this revetment is maintained at an annual cost of approximately $1.5 million. Within this area is a steel sheet pile sea wall with concrete cap approximately 150ft in length between 12th St. South and 13th St. South. This armor unit was constructed in December 2005 by FDOT to protect SR A1A from being undermined by erosion. Approximately 410 feet south of 28th street are small precast concrete panel sea walls protecting several commercial concerns toward the southern end of the county. The damageable revetment and road value in Flagler Beach is estimated to be nearly $7.5 M (See Table 2-4).

Significant portions of the study area are protected by coastal armor. In one segment, called Design Reach-C by the study team, the primary structure subject to erosion damage in the baseline future-without project condition is a major road (SR-A1A), which is protected by a rock revetment (see Figure 2-1). This revetment is maintained by the Florida Department of Transportation (FDOT). Data from the FDOT suggest that in the ten year period between 2001 and 2010, an average of approximately $600,000 per year was spent maintaining the revetment. In one year (2001), total maintenance costs exceeded $3 million. Because of the nature of the structure inventory in Design Reach C, prevention of damages to armor represents the largest potential benefit category.

Table 2-4: Existing Damageable Road & Armor Value

Design Reach	Revetment & SR-A1A	Vinyl Bulkhead	Sea-walls
Reach-A		$232,500	
Reach-B			$1,141,250
Reach-C	$7,490,253		
Reach-D			



Figure 2-1: Revetment protecting SR-A1A in Flagler Beach

2.3.2 Structure & Contents Value

The economic value of the existing Flagler County structure inventory represents the depreciated replacement costs of damageable structures and their associated contents along the coastline. Real Estate professionals from the USACE SAJ district worked together with economists and planners to provide economic valuations for all of the 1,301 damageable structures and their contents. These

structures have an overall estimated value of $268 M, with structure and content valuations of $177 M and $91 M respectively. The overall distribution of value by study reach is as follows:

Table 2-5: Distribution of Structures & Structure Value by Study Reach

Design Reach	# of Structures	% Structures	Total	% of Value
Reach-A	221	17%	$38,998,933	15%
Reach-B	507	40%	$116,076,382	43%
Reach-C	472	37%	$83,792,131	31%
Reach-D	65	5%	$29,554,554	11%
Total	1265	100%	$268,422,000	100%

Values aggregated by study reach and model reach show significant variation due to differentiation between the type, magnitude, and density of development. Reaches with large commercial or multi-family structures tend to contain greater value than neighboring reaches. Table 2-5 and Table 2-6 provide summaries of inventory values by study reach. A graphical representation is provided in Figure 2-2.

Estimating content values is an important part of developing the structure inventory. Typically, content-to-structure value ratios (CSRVs) are used to define content value as a percentage of the depreciated structure value. In this case, a ratio of 0.50 has been applied to all structures in the study. Given the lack an appropriate empirical study about content values in south Florida, this is a conservative, reasonable assumption that is consistent with ER 1105-2-100. It should be noted that there were a few exceptions to the 0.50 ratio assumption, because there are a number of structures that typically do not have valuable contents. Gazebos, Dunewalks, and pools are examples of structures for which the CSVR was assumed to be zero.

Table 2-6: Economic Value of Structure Inventory by Design Reach

Structure Category	Reach-A	Reach-B	Reach-C	Reach-D	Total	% of Total
Residential	$36,009,849	$84,751,004	$66,578,902	$27,114,814	$214,454,568	80%
Public/ Commercial	$1,244,060	$27,185,162	$14,653,002	$766,580	$43,848,804	16%
Other Structures	$1,745,024	$4,140,217	$2,560,227	$1,673,160	$10,118,628	4%
Total	**$38,998,933**	**$116,076,382**	**$83,792,131**	**$29,554,554**	**$268,422,000**	100%

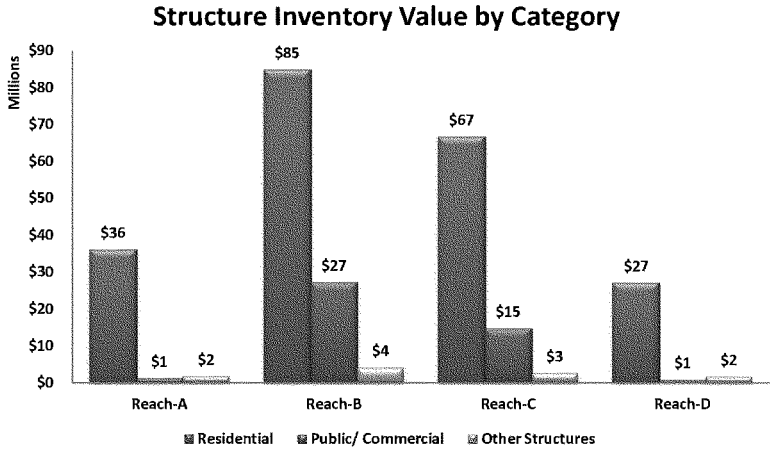


Figure 2-2: Economic Value of Structure Inventory by Design Reach

2.3.3 Residential (SFR)

Single- family residences consist of 1-3 story structures of varying construction type and value. They comprise 47% of the inventory and 56% of the inventory value within the study area. Reach-A, which is made up of Painters Hill, tends to have the greatest value per structure relative to the other three segments. It accounts for 18% of the inventory of single family residences, but 23% of the structure inventory single family residence value. Reach-B contains the second largest number of SFRs and SFR value within the structure inventory. Reach-C has the greatest number of older relatively less valuable residences with 45% of the inventory, and less than 39% of the SFR inventory value.

2.3.4 Multi-Family Residences

Multi-family residences constitute 8% of the structures, and 23% of the existing value. These structures range from 1-4 stories tall. Structures within this category tend to be more substantial in terms of construction, and contain the greatest amount of economic value per structure within the study area. Most of the multi-family residences are located in Reach-B (45%) and Reach-D (43%).

2.3.5 Commercial / Public Structures

Structures within this category include 1-2 story buildings used for public or commercial purposes. Commercial and public buildings represent nearly 9% of the existing structure inventory, and 16% of the overall study area value. Around 94% of these buildings are located in Reach-B (59%) and Reach-C (35%).

2.3.6 Other Structures

This category consists of relatively lower value damageable elements such as garages, storage buildings, dune walks, decks, swimming pools, wood shelters, and parking lots. These structures constitute nearly 36% of the inventory, but only 4% of the value. A detailed summary is provided in Table 2-7.

Table 2-7: Structure Inventory Distribution

Design Reach	Frequency	% of Single Family Structures	% of All Structures	Total	% of Single Family Structure Value	% of Total Value
Reach-A	112	18.6%	8.9%	$35,583,129	23.5%	13%
Reach-B	218	36.2%	17.2%	$56,713,214	37.4%	21%
Reach-C	272	45.1%	21.5%	$58,956,489	38.9%	22%
Reach-D	1	0.2%	0.1%	$227,136	0.1%	0%
Total	603	100%	47.7%	$151,479,967	100%	56%

Design Reach	Frequency	% Multi-Family Structures	% of All Structures	Total	% of Multi-Family Structure Value	% of Total Value
Reach-A	1	1%	0.1%	$426,720	1%	0%
Reach-B	52	51%	4.1%	$28,037,790	45%	10%
Reach-C	35	34%	2.8%	$7,622,413	12%	3%
Reach-D	14	14%	1.1%	$26,887,678	43%	10%
Total	102	100%	8.1%	$62,974,601	100%	23%

Design Reach	Frequency	% Public/Commercial Structures	% of All Structures	Total	% of Public & Commercial Structure Value	% of Total Value
Reach-A	3	3%	0.2%	$1,244,060	3%	0%
Reach-B	65	59%	5.1%	$27,185,162	62%	10%
Reach-C	39	35%	3.1%	$14,653,002	33%	5%
Reach-D	3	3%	0.2%	$766,580	2%	0%
Total	110	100%	8.7%	$43,848,804	100%	16%

Design Reach	Frequency	% Other Structures	% of All Structures	Total	% of Other Structure Value	% of Total Value
Reach-A	105	23%	8.3%	$1,745,024	17%	1%
Reach-B	172	38%	13.6%	$4,140,217	41%	2%
Reach-C	126	28%	10.0%	$2,560,227	25%	1%
Reach-D	47	10%	3.7%	$1,673,160	17%	1%
Total	450	100%	35.6%	$10,118,628	100%	4%

3. HURRICANE & STORM DAMAGE REDUCTION BENEFITS

This section of the appendix covers the approach used to estimate the economic benefits of reducing hurricane and storm related damages in Flagler County using Beach-*fx*. The topics covered include:

- Benefit estimation approach using Beach-*fx*
- The future without project condition
- The future with project condition

3.1 Benefit Estimation Approach using Beach-fx

Beach-*fx* was developed by the USACE Engineering Research and Development Center (ERDC) in Vicksburg, Mississippi. On April 1, 2009 the Model Certification Headquarters Panel certified the Beach-*fx* hurricane and storm damage reduction (HSDR) model based on recommendations from the HSDR - Planning Center of Expertise (PCX). The model was reviewed by the PCX for Coastal and Storm Damage and found to be appropriate for use in coastal storm damage reduction studies. The model links the predictive capability of coastal evolution modeling with project area infrastructure information, structure and content damage functions, and economic valuations to estimate the costs and total damages under various shore protection alternatives. This output is then used to determine the benefits of each alternative. Beach-*fx* fully incorporates risk and uncertainty, and is used to simulate future hurricane and storm damages at existing and future years and to compute accumulated present worth damages and costs. Storm damage is defined as the damage incurred by the temporary loss of a given amount of shoreline as a direct result of waves, erosion, and inundation caused by a storm of a given magnitude and probability. Beach-fx is an event-driven life-cycle model that estimates damages and associated costs over a 50 year period of analysis based on storm probabilities, tidal cycle, tidal phase, beach morphology and many other factors. Damages or losses to developed shorelines include buildings, pools, patios, parking lots, roads, utilities, seawalls, revetments, bulkheads, replacement of lost backfill, etc. Beach-*fx* also provides the capability to estimate the costs of certain future measures undertaken by state and local organizations to protect coastal assets.

Data on historic storms, beach survey profiles, and private, commercial & public structures within the project area is used as input to the USACE Beach-*fx* model. The model is then used to estimate future project hurricane and storm damages.

The future structure inventory and values are the same as the existing condition. This conservative approach neglects any increase in value due to future development. Due to the uncertainty involved in projections of future development, using the existing inventory is preferable and considered conservative for Florida where coastal development has historically increased in density and value. The Beach-fx model results for the future with project (FWOP) condition are summarized in later in this section.

The future without project damages will be used as the base condition. Potential alternatives are measured against this base condition. The difference between with and without project damages will be used to determine project benefits.

Once benefits for each of the alternatives are calculated, they will be compared to the costs of implementing the alternative. Dividing the benefits of an alternative by the costs of the alternative yields a Benefit-to-Cost Ratio (B/C Ratio). This ratio must be greater than 1.0 in order for the alternative

to be justified and implementable (i.e. the benefits must be greater than the costs). The federally preferred plan (NED – National Economic Development Plan) is the plan that maximizes net benefits. Net benefits are determined by simply subtracting the cost of any given alternative from the benefits of that alternative (Benefits – Costs = Net Benefits). Furthermore, each project area is evaluated on an incremental basis. That is, each portion of the project must be justified independently, or it cannot be constructed.

3.2 Assumptions

- **Start Year:** The year in which the simulation occurs is 2012
- **Base Year:** The year in which the benefits of a constructed federal project would be expected to begin accruing is 2018
- **Period of Analysis:** 50 years
- **Discount Rate:** 3.5% FY2013 Federal Water Resources Discount Rate
- **Coastal Armor Assumptions:**
  - As previously mentioned, the rubble revetment in Reach-C is maintained by the Florida Department of Transportation (FDOT). Data from the FDOT suggest that in the ten year period between 2001 and 2010, an average of approximately $600,000 per year was spent maintaining the revetment. Therefore, it is assumed that should erosion occur within 5-10 feet of the road, similar measures will be undertaken.
  - Armor costs were based on FDOT data collected between 2000 and 2011. The distribution of armor and road cost (respectively) per linear foot are as follows:
    - Minimum: $60.39 / $124.84
    - Most Likely: $348.01/ $461.16
    - Maximum: $650.48/ $555.31
  - If erosion occurs within 20-30 ft of a private residence on the seaward side of SR-A1A, it is assumed that homeowners will erect vinyl bulkhead armor units to protect their property.
- **Number of Times Rebuilding Allowed Assumptions**
  - Dunewalks: 4-10X
  - Armor / Road: 40X
  - Remaining: 5X

3.3 Future without Project Condition (FWOP)

Future without project condition damages range between $66.4 and $93.6M present value dollars. Descriptive statistics on the FWOP model results are as follows:

- Mean: PV $78,704,034 (AAEQ~ $3,355,156)
- Standard deviation: $5,769,298 (AAEQ~ $245,945)
- Median: $78,315,163 (AAEQ~ $3,338,575)
- # Iterations: 100

Figure 2-1 provides an illustration of FWOP results as a probability distribution. Approximately 85% of the distribution is between $68M and $79M. The distribution is also characterized by a relatively high peak and a slightly positive skew. This suggests that the uncertainty surrounding the damages is relatively small, and to the extent the damages deviate from the mean, they are more likely to be greater than the mean, rather than less.

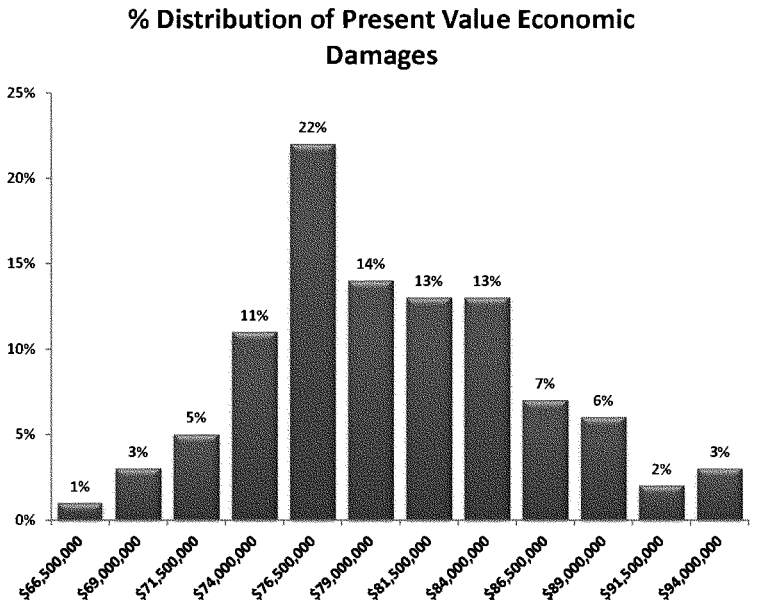


Figure 3-1: Probability Distribution of the Future without Project Condition Results

Pursuant to estimating future without project condition damages and associated costs for the study area in Flagler County, Beach-*fx* was used to estimate damages and costs in the following categories:

- Damages:
  - Structure Damage: Economic losses resulting from the structures situated along the coastline being exposed to wave attack, inundation, and erosion damages. Structure damages account for virtually all of the damages for the FWOP.
  - Contents Damage: The material items housed within the aforementioned structures (usually air conditioned and enclosed) that are potentially subject to damage. Content damages are extremely small, making up about 0.75% of the total.

Coastal Armor Cost: Beach-*fx* provides the capability to estimate the costs incurred from measures likely to be taken to protect coastal assets and or prevent erosion in the study area. Based on the existence of coastal armor units throughout the study area, Beach-*fx* was used to estimate the costs of erecting such measures throughout the period of analysis. The following sections will address the FWOP damages distributed by structure type and category, damage driving parameter, space, and time.

3.3.1 Damage Distribution by Structure Category and Type

This section addresses what is being damaged in the future without project condition by structure category and type.

Table 3-1: Distribution of Damages by Damage Category

Category	Type	Structure	Contents	Total	% of Total
Armor / Roads	BULKHEAD	$6,359,601	$0	$6,359,601	8%
	N-BULKHEAD	$5,266,378	$0	$5,266,378	7%
	NEW ARMOR	$10,746,608	$0	$10,746,608	14%
	ARMOR-A1A	$50,273,763	$0	$50,273,763	64%
	ROAD1	$76,169	$0	$76,169	0%
Armor / Roads Subtotal		$72,722,519	$0	$72,722,519	92%
Other Structures	POOL	$34,989	$0	$34,989	0%
	DUNEWALK	$2,725,959	$0	$2,725,959	3%
	SHELTER	$650,495	$0	$650,495	1%
	STORAGE	$65,987	$40,912	$106,900	0%
	PARKING	$36,312	$0	$36,312	0%
	DECK	$180,290	$0	$180,290	0%
Other Structures Subtotal		$3,694,033	$40,912	$3,734,945	5%
Public/ Commercial	COMM1	$272,360	$190,652	$463,012	1%
	COMM2	$119	$6	$124	0%
Public/ Commercial Subtotal		$272,479	$190,658	$463,137	1%
Residential	SFR1	$236,864	$163,436	$400,300	1%
	SFR2	$680,457	$455,906	$1,136,364	1%
	MFR2	$35	$0	$35	0%
	SFR3	$1,133	$759	$1,892	0%
	MFR1	$192,789	$52,053	$244,842	0%
Residential Subtotal		$1,111,278	$672,155	$1,783,433	2%
Grand Total		$77,800,309	$903,725	$78,704,034	100%

Table 3-1 provides greater detail on the composition of the FWOP damages by categorization. The coastal inventory was categorized as 'Armor / Roads', 'Public / Commercial', 'Residential', and 'Other Structures'. The percentage distribution of the damages by category is as follows:

- Armor / Roads: 92%
- Other Structures: 5%
- Residential: 2%
- Public / Commercial: 1%

3.3.1.1 *Armor / Roads:*

The overwhelming majority of damages in this category include the cost of maintaining the revetment protecting SR-A1A and the estimated cost of new measures taken to protect SR-A1A. As shown in Figure

3-4 and Figure 3-2, the overwhelming majority of these costs are incurred in Reach-C. The Reach-C damages consist of primarily of maintenance to the existing revetment, and extension of the revetment to the south. Within Reach-A, the damages consist primarily of building and repairing the sheet pile vinyl bulkheads for structures designated armorable in the future.
The purpose of coastal armor is to protect coastal infrastructure from hurricane and storm damage. For this reason these structures not only absorb the strongest forces, but do so with the greatest frequency.

3.3.1.2 *Other Structures*

Other structures include garages, dunewalks, decks, outdoor shelters, and other relatively less expensive non-conditioned structures. This was the second highest category of damages due to the frequency of exposure to the damage driving parameters and proximity to the shoreline. Dunewalks receive the most damage within this category. These structures are rarely protected by coastal armor units, are built for outdoor use, tend to be closer to the shoreline, and tend to be less costly to rebuild. As a result, these damage elements are hit by the damage driving parameters more often, and rebuilt with a greater frequency. With the exception of garages and storage buildings, these damage elements are not subject to contents damage.

3.3.1.3 *Residential & Public / Commercial*

The remaining two categories constitute virtually insignificant proportions of the FWOP damages (~2.14%), but represent the overwhelming majority of the structure inventory value. These structures tend to be of more robust construction, located further away from shoreline, and protected by coastal armor units. All of these damage elements are subject to content damage.

3.3.2 Spatial Distribution of Without Project Damages

Reaches-A&C account for around 86% of the damages, while Reaches-B & D comprise the remainder. Reach-C accounts for the lion's share of total damage; significantly more than all other study reaches combined. These results are summarized in Table 3-2.

Table 3-2: FWOP present value damages by Design Reach

Design Reach	Damages	%
Reach-A	$14,527,576	18%
Reach-B	$7,587,015	10%
Reach-C	$53,514,849	68%
Reach-D	$3,074,593	4%
Total	**$78,704,034**	**100%**

Figure 3-2 provides an illustration of FWOP damages by model reach and structure category. Figure 3-3 illustrates the spatial distribution of damages and erosion rates by range monument. Both figures show greater damages between range monument R050 and R056, followed by smaller, relatively stable damages until range monument R080-R095. The spatial distribution of damages shows the following pattern:

- **Reach-A:**
  - **R050-R056**: Reach-A has relatively larger erosion rates and damages between R051 and R057. The average erosion rate is about .98 ft/yr.
  - **R056-R060**: The erosion rate and the damages decrease through this spatial increment.

- **Reach-B:**
  - **R061-R067**: Erosion rates are relatively small, averaging around .21 ft/yr. FWOP damages begin to creep upward moving southward.
  - **R067-R080**: Reach-B has relatively smaller erosion rates and more stable damages. However, erosion rates rise considerably at R066, and fall considerably at R079. There is a small increase in damages as the erosion rates creep upward, but nothing significant.
- **Reach-C:**
  - **R080-R083**: The erosion rates begin to move upward, and spike between R082-R083. The damages are larger between R080 and R081, but fall for the remainder of this range. The existing revetment begins around R080, and continues until R090.
  - **R083-R090**: Average erosion rates are relatively lower, averaging around .41 ft/yr through this spatial increment. However, the damages are the greatest within this spatial increment, primarily because this area contains majority of the existing revetment.
  - **R090-R095**: Erosion rates begin an upward creep, but damages begin to move down.
- **Reach-D:**
  R095-R000: This is the southernmost spatial increment in the study area. The erosion rates are relatively higher, but damages are relatively lower.

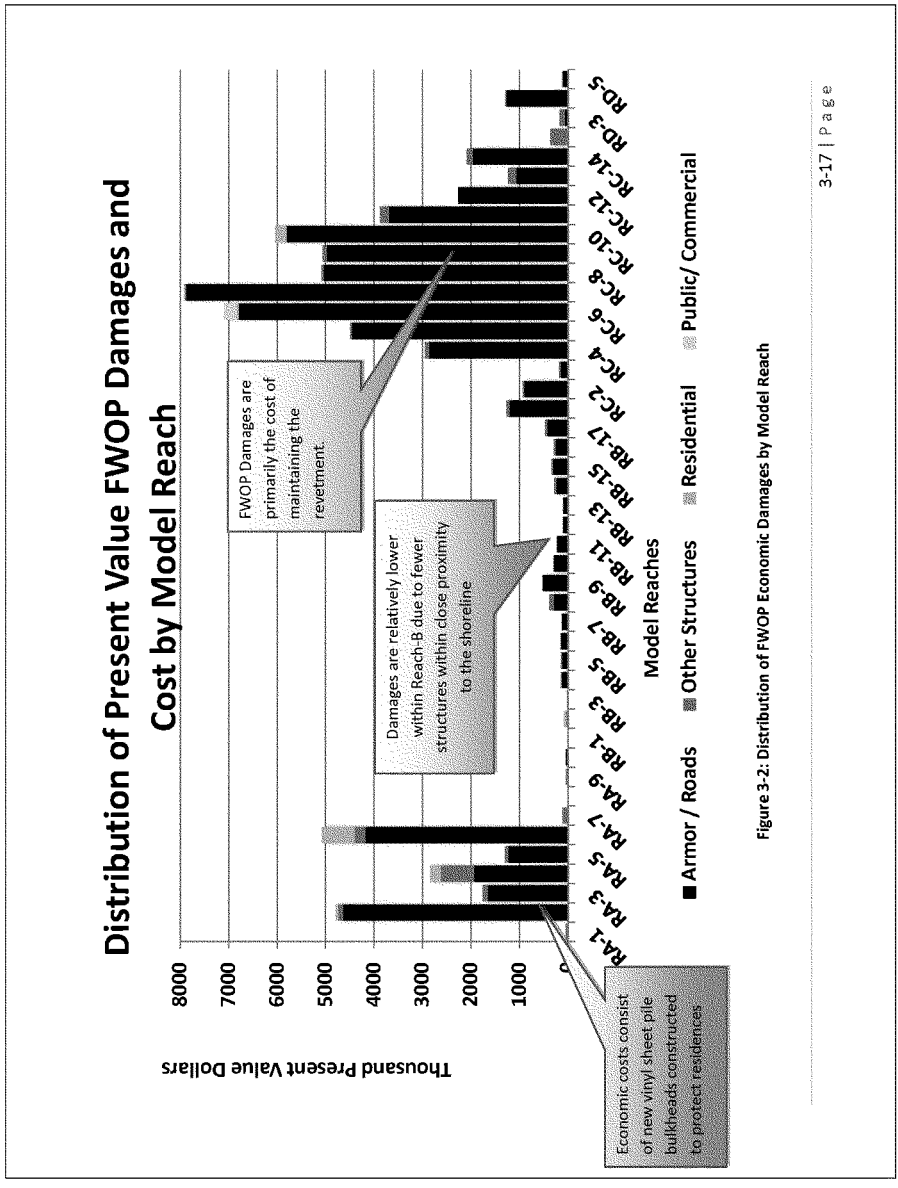


Figure 3-2: Distribution of FWOP Economic Damages by Model Reach

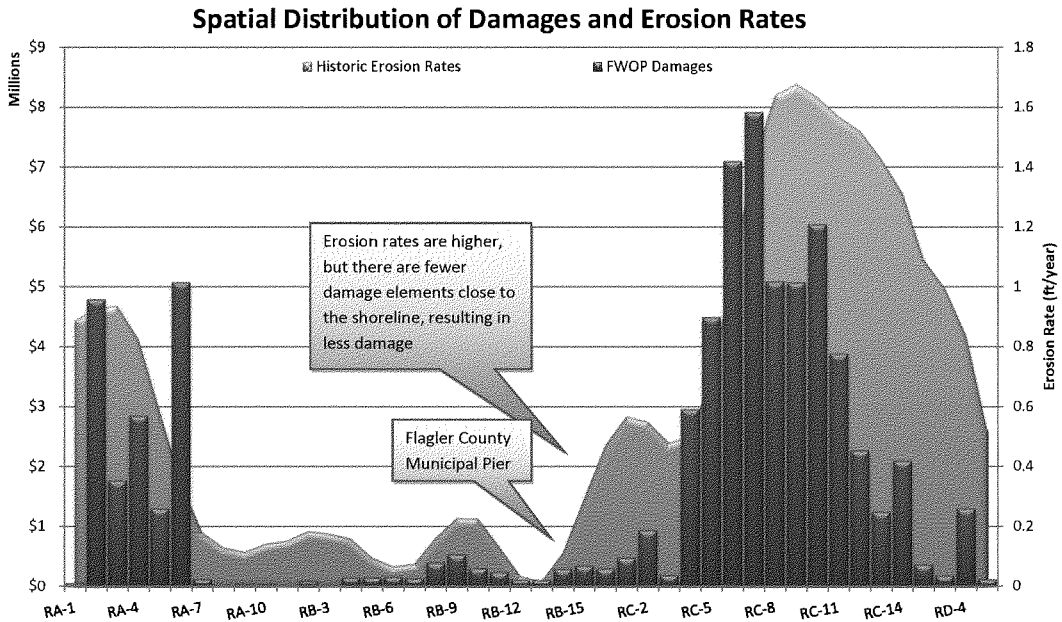


Figure 3-3: Spatial Distribution of Damages and Erosion Rates by Model Reach

Table 3-3: Spatial Distribution of Damages by Type

Number	Reach	Armor / Roads	Other Structures	Residential	Public/ Commercial	Total	% of Total
5	RA-1		$46,872	$3		**$46,875**	**0.1%**
6	RA-2	$4,643,295	$98,365	$49,205		**$4,790,866**	**6.6%**
7	RA-3	$1,648,593	$112,283	$439		**$1,761,315**	**2.4%**
8	RA-4	$1,933,873	$685,597	$223,765		**$2,843,235**	**3.9%**
9	RA-5	$1,229,364	$66,087			**$1,295,452**	**1.8%**
10	RA-6	$4,177,781	$225,759	$672,259		**$5,075,799**	**7.0%**
11	RA-7		$113,388			**$113,388**	**0.2%**
12	RA-8		$10,284			**$10,284**	**0.0%**
13	RA-9		$36,476			**$36,476**	**0.1%**
14	RA-10	$38,581				**$38,581**	**0.1%**
15	RB-1		$6,876			**$6,876**	**0.0%**
16	RB-2		$28,858	$50,541		**$79,400**	**0.1%**
17	RB-3		$13,612			**$13,612**	**0.0%**
18	RB-4	$124,214	$15,016			**$139,230**	**0.2%**
19	RB-5	$120,635	$19,417			**$140,052**	**0.2%**
20	RB-6	$137,318	$12,950			**$150,268**	**0.2%**
21	RB-7	$123,781	$3,849			**$127,630**	**0.2%**
22	RB-8	$290,807	$95,761			**$386,568**	**0.5%**
23	RB-9	$515,061	$9,355			**$524,416**	**0.7%**
24	RB-10	$287,943	$6,721			**$294,664**	**0.4%**
25	RB-11	$223,602	$4,081			**$227,682**	**0.3%**
26	RB-12	$101,140	$2,597			**$103,737**	**0.1%**
27	RB-13	$94,843	$2,805			**$97,648**	**0.1%**
28	RB-14	$233,163	$49,862			**$283,025**	**0.4%**
29	RB-15	$307,926	$29,055			**$336,981**	**0.5%**
30	RB-16	$248,613	$40,954			**$289,566**	**0.4%**
31	RB-17	$425,839	$40,527			**$466,366**	**0.6%**
32	RC-1	$1,207,150	$58,708			**$1,265,858**	**1.8%**
33	RC-2	$901,670	$27,090			**$928,760**	**1.3%**
34	RC-3	$148,373	$30,995			**$179,368**	**0.2%**
35	RC-4	$2,861,943	$90,978			**$2,952,921**	**4.1%**
36	RC-5	$4,460,612	$32,772			**$4,493,384**	**6.2%**
37	RC-6	$6,787,477	$15,373	$43,239	$250,034	**$7,096,124**	**9.8%**
38	RC-7	$7,877,107	$24,270	$13,730		**$7,915,108**	**11.0%**
39	RC-8	$5,042,495	$40,834			**$5,083,329**	**7.0%**
40	RC-9	$4,978,627	$82,877	$10,137		**$5,071,641**	**7.0%**
41	RC-10	$5,799,078	$10,264	$231,172		**$6,040,515**	**8.4%**
42	RC-11	$3,695,869	$185,092		$367	**$3,881,328**	**5.4%**
43	RC-12	$2,261,106				**$2,261,106**	**3.1%**
44	RC-13	$1,063,971	$174,826			**$1,238,797**	**1.7%**
45	RC-14	$1,962,829	$129,902	$264	$215	**$2,093,210**	**2.9%**
47	RD-2		$358,299			**$358,299**	**0.5%**
48	RD-3	$60,166	$113,340			**$173,506**	**0.2%**
49	RD-4	$1,265,624	$24,165			**$1,289,790**	**1.8%**
50	RD-5	$102,980	$11,386			**$114,366**	**0.2%**

As can be seen from the information in the tables, there is a great deal of variability in the amount of damages amongst the project reaches. This is explained by the large number of variables, all of which the Beach-*fx* model takes into account. Examples of variation between the project areas result from the following:

- Density and amount of development
- Typical size and value of structures
- Typical distance between structures and mean-high water
- Size, shape and location of the dunes and coastal morphology
- Rate of erosion for each reach
- Amount and type of coastal armoring present
- Eligibility of homeowners to construct coastal armoring.

3.3.3 Damage Distribution by Damage Driving Parameter

Virtually all of the FWOP damages and costs are attributable to erosion. The distribution of damages is as follows:

- Erosion: 99.49%
- Inundation: 0.05%
- Wave Attack: 0.47%

3.3.4 Temporal Distribution of Damages

Figure 3-4 provides an illustration of the FWOP condition armor and road economic costs over time. Figure 3-5 illustrates the damages over time by study reach, and Figure 3-6 displays the damages over time by structure category. It can be seen that the damages modeled in Reach-C during the first 10 years of the simulation (2013-2023) are actually less than the actual costs incurred by FDOT for maintaining the road from 2000-2010. It is only after 2027 in the model that without-project damages start to increase dramatically. Only after the cumulative effects of storms, sea level rise, and erosion over time begin to take their toll does the model begin to show significant damage. Model results indicate that the FWOP damages are likely to increase significantly in the mid to late 2020's, decrease somewhat by around 2050, but remain relatively high for the remainder of the period of analysis.

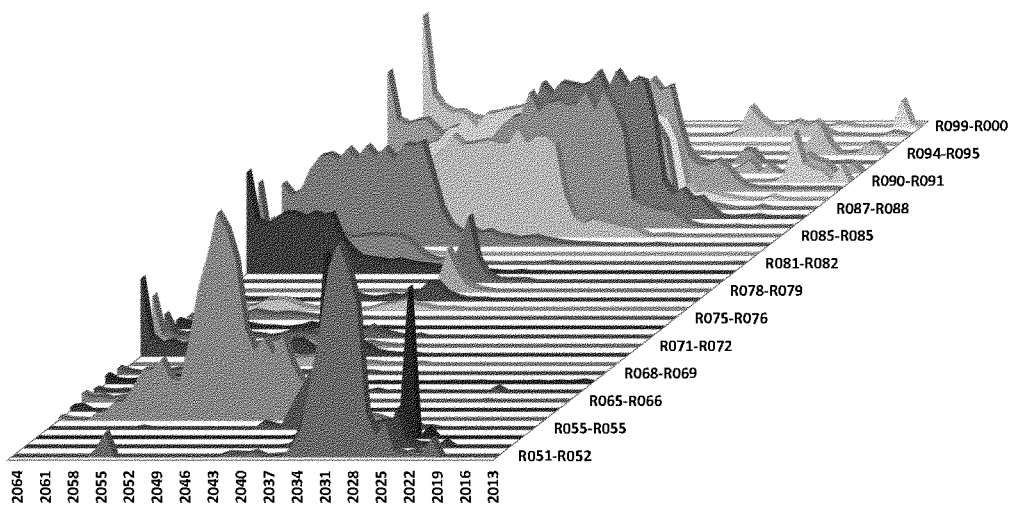


Figure 3-4: Distribution of Non-Present Value Armor/Road Cost over Space and Time

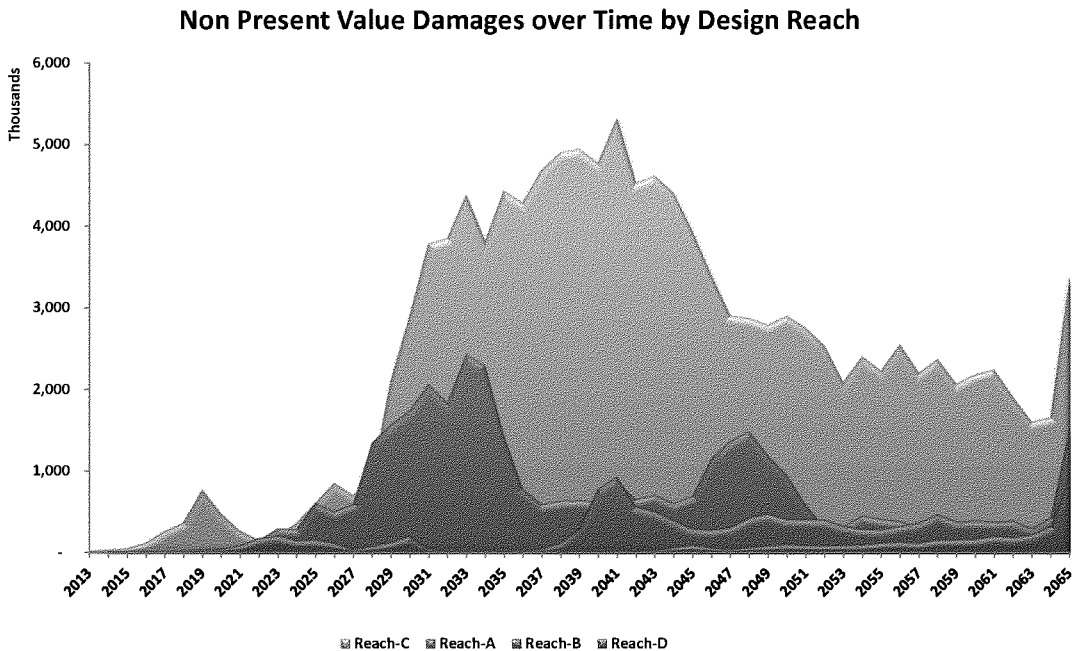


Figure 3-5: Damages over Time by Design Reach

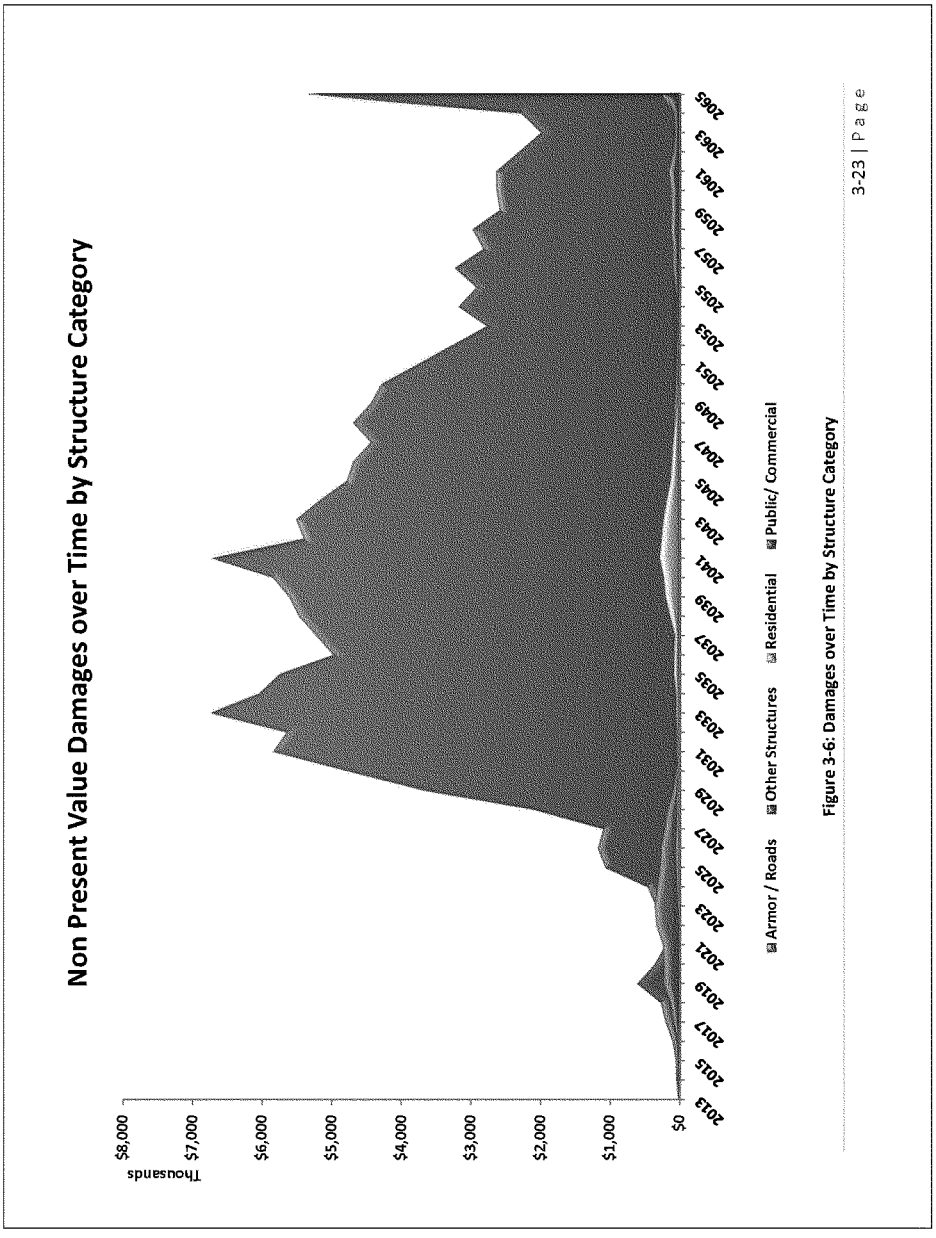


Figure 3-6: Damages over Time by Structure Category

3.3.5 FWOP Damages in alternative Sea Level Rise (SLR) scenarios

As noted in Section 3 of the Feasibility Report, the FWOP was modeled in three sea level rise (SLR) scenarios. EC 1165-2-211 provides both a methodology and a procedure for determining a range of sea level rise estimates based on the local historic sea level rise rate, the construction (base) year of the project, and the design life of the project. In Flagler County the average baseline (SLR1), intermediate (SLR2) and high (SLR3) sea level rise rates were found to be 0.0075 feet/year, 0.0159 feet/year, and 0.0424 feet/year, respectively. The Beach-*fx* results presented above refer to the baseline scenario (SLR1), which is based on the historic erosion rate. The results associated with the other two SLR scenarios are presented here. Figure 3-7 provides an overall summary of damages in each SLR scenario. Figure 3-8 provides a graphical illustration of the damages by reach. Figure 3-9 provides a graphical illustration of the damages over time. Figure 3-10 provides a graphical illustration of the cumulative damages over time. Table 3-4 shows the distribution of damages by category. Table 3-5, Table 3-6, Table 3-7, and Table 3-8 shows a detailed breakdown of the damages by model reach.

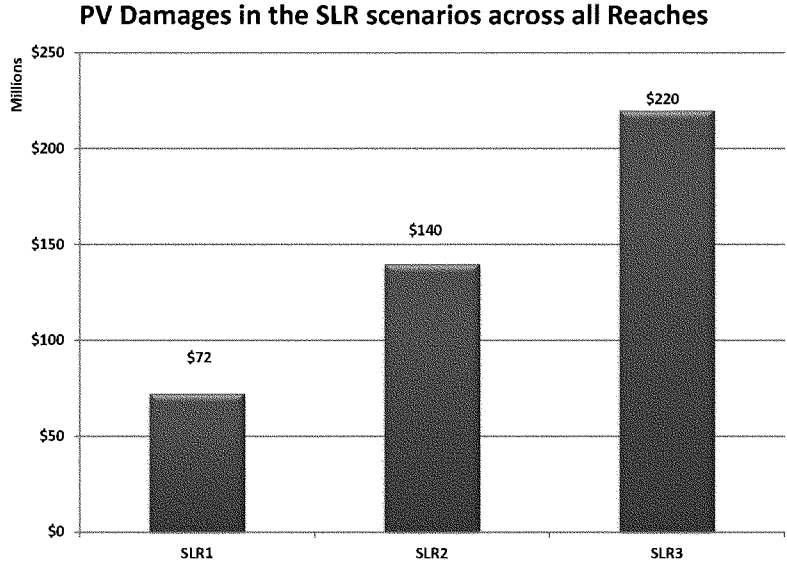


Figure 3-7: Damages by SLR Scenario

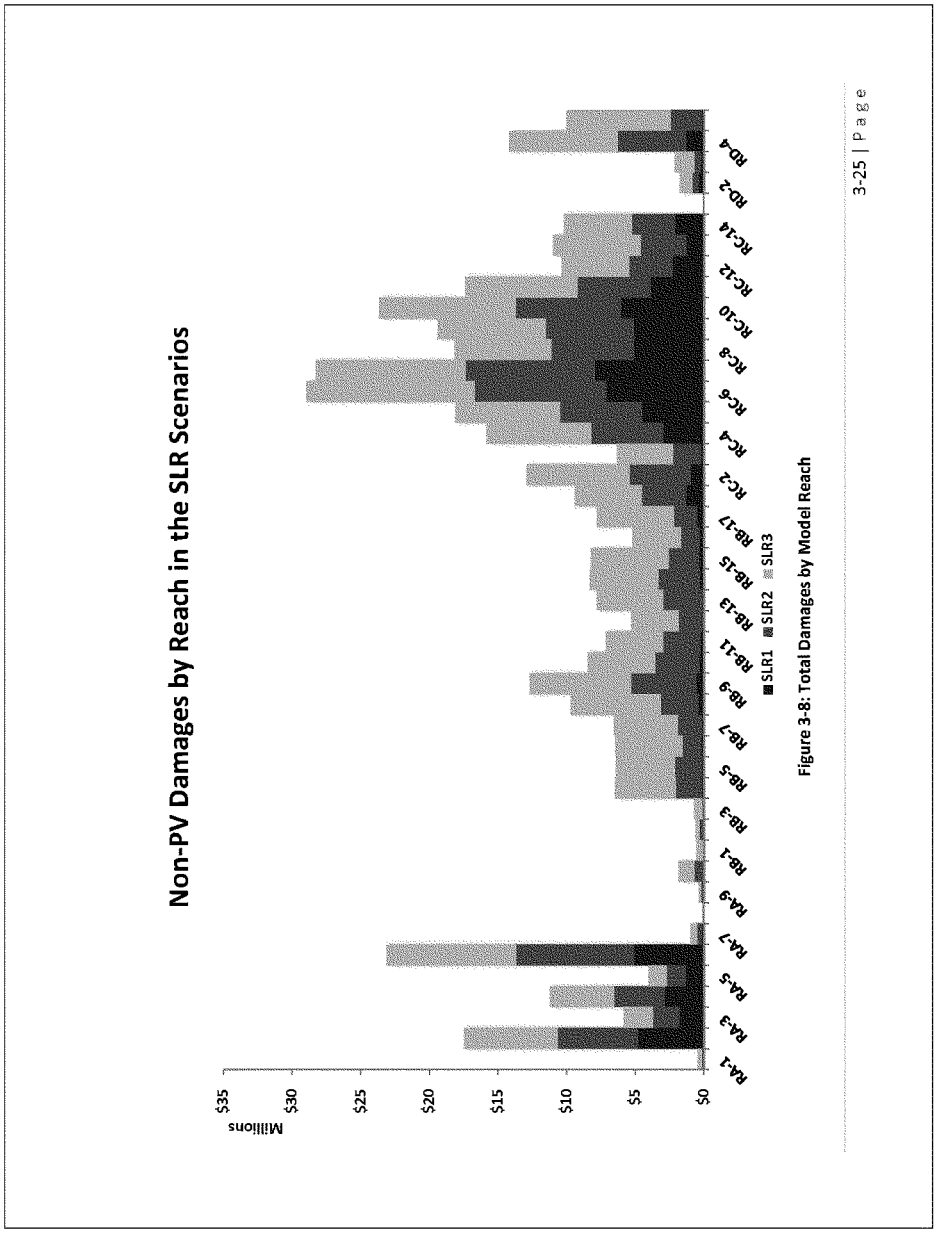


Figure 3-8: Total Damages by Model Reach

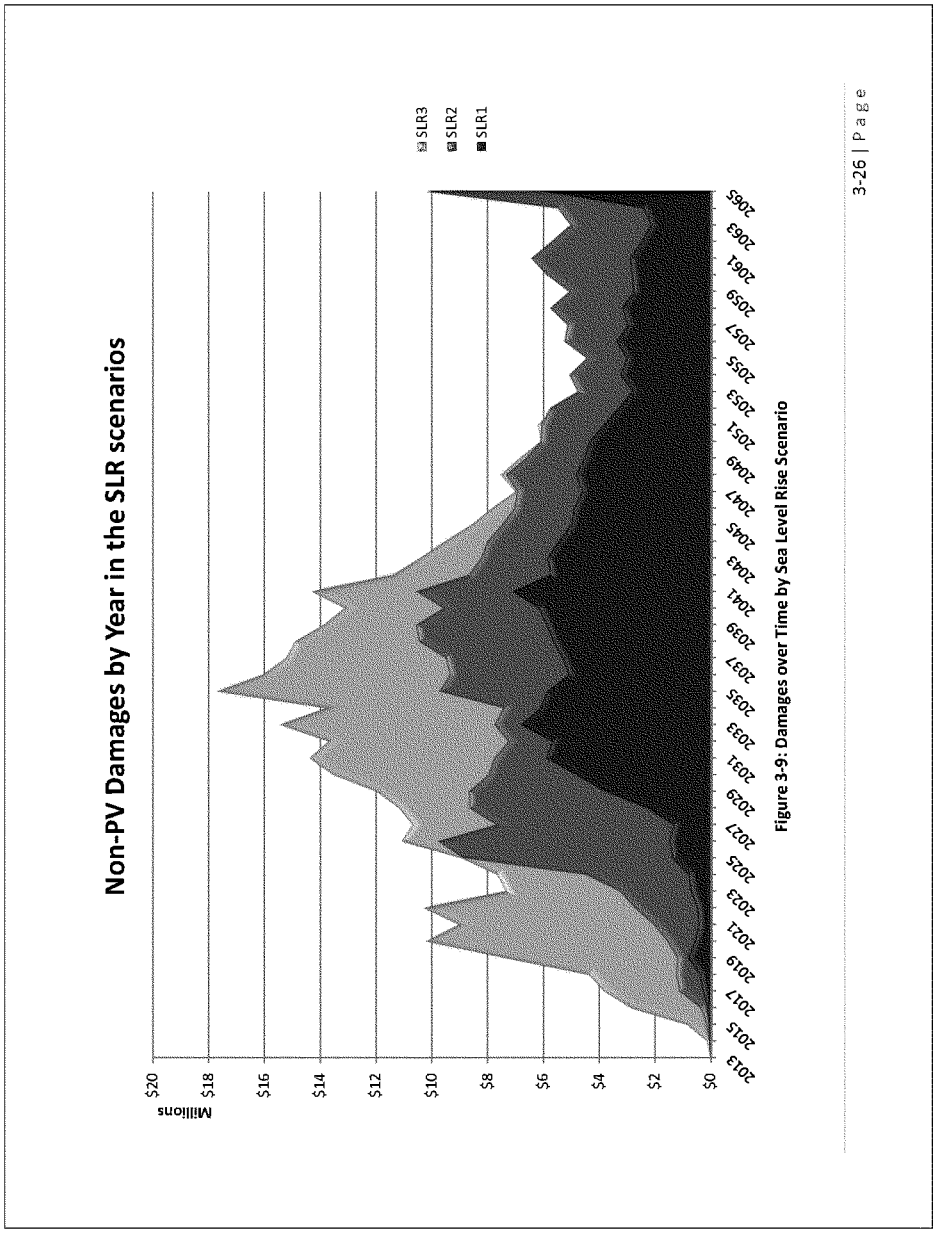


Figure 3-9: Damages over Time by Sea Level Rise Scenario

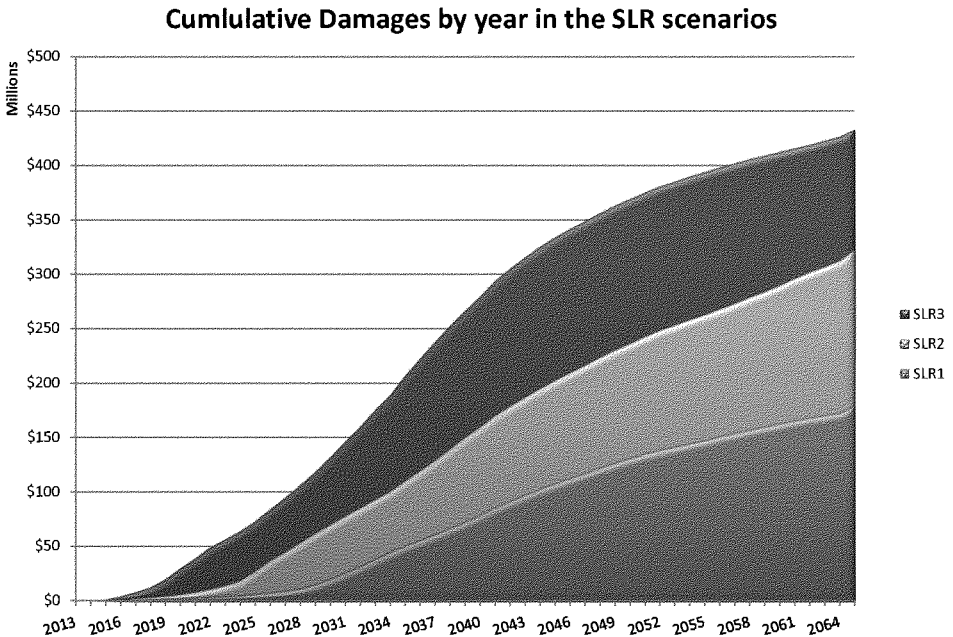


Figure 3-10: Damages over Time by Sea Level Rise Scenario

Table 3-4: Distribution of Damages by Category in the SLR scenarios

Category	Type	SLR1	SLR2	SLR3
Armor / Roads	ARMOR-A1A	$48,204,649	$99,854,604	$162,441,440
	BULKHEAD	$10,453,408	$13,950,103	$14,037,219
	N-BULKHEAD	$3,215,765	$5,211,348	$6,685,037
	SEAWALL	$0	$5,181	$100,386
	NEW ARMOR-A1A	$5,464,717	$10,548,905	$13,897,104
	ROAD1	$39,631	$499,823	$1,314,861
	ROAD3	0	0	$102,564
Armor / Roads Subtotal		$67,378,169	$130,069,964	$198,578,611
Other Structures	DECK	$146,340	$258,136	$398,800
	DUNEWALK	$2,356,115	$3,432,450	$4,554,684
	GARAGE	$0	$4,037	$66,138
	PARKING	$16,497	$178,198	$371,990
	POOL	$26,371	$77,882	$201,092
	SHELTER	$562,412	$789,485	$924,687
	STORAGE	$80,845	$248,864	$315,234
	TENNIS-CT	0	0	$22,834
Other Structures Subtotal		$3,188,580	$4,989,052	$6,855,459
Public/ Commercial	COMM1	$250,180	$1,351,986	$3,417,876
	COMM2	$195	$8,676	$101,758
	PUBLIC1	0	$23,400	$393,149
Public/ Commercial Subtotal		$250,376	$1,384,062	$3,912,783
Residential	MFR1	$230,997	$636,034	$1,529,002
	MFR2	$106	$1,376	$32,398
	SFR1	$275,201	$729,713	$2,509,395
	SFR2	$786,644	$1,660,904	$5,518,761
	SFR3	$428	$59,811	$729,913
Residential Subtotal		$1,293,374	$3,087,837	$10,319,469
Grand Total		$72,110,499	$139,530,914	$219,666,322

Table 3-5: Reach A SLR Scenario FWOP PV Damages

Number	Model Reach	SLR1	SLR2	SLR3
5	RA-1	$46,875	$72,372	$311,249
6	RA-2	$4,790,866	$5,838,331	$6,844,719
7	RA-3	$1,761,315	$1,932,332	$2,121,858
8	RA-4	$2,843,235	$3,687,295	$4,682,775
9	RA-5	$1,295,452	$1,403,428	$1,328,497
10	RA-6	$5,075,799	$8,579,488	$9,455,086
11	RA-7	$113,388	$367,184	$484,295
12	RA-8	$10,284	$25,519	$51,097
13	RA-9	$36,476	$134,656	$186,242
14	RA-10	$38,581	$632,900	$1,164,208
15	RB-1	$6,876	$35,540	$486,408
Subtotal		**$16,019,147**	**$22,709,046**	**$27,116,434**

Table 3-6: Reach B SLR Scenario FWOP PV Damages

Number	Model Reach	SLR1	SLR2	SLR3
16	RB-2	$79,400	$224,767	$277,862
17	RB-3	$13,612	$77,585	$605,109
18	RB-4	$139,230	$1,890,483	$4,428,443
19	RB-5	$140,052	$1,940,531	$4,320,609
20	RB-6	$150,268	$1,387,768	$4,908,105
21	RB-7	$127,630	$1,756,261	$4,674,481
22	RB-8	$386,568	$2,721,631	$6,580,553
23	RB-9	$524,416	$4,754,518	$7,391,292
24	RB-10	$294,664	$3,233,026	$4,907,770
25	RB-11	$227,682	$2,716,262	$4,193,314
26	RB-12	$103,737	$1,718,270	$3,467,167
27	RB-13	$97,648	$2,859,803	$4,816,607
28	RB-14	$283,025	$2,998,286	$5,021,710
29	RB-15	$336,981	$2,203,986	$5,670,627
30	RB-16	$289,566	$1,352,566	$3,563,276
31	RB-17	$466,366	$1,710,263	$5,617,501
Subtotal		**$3,660,845**	**$33,546,006**	**$70,444,426**

Table 3-7: Reach C SLR Scenario FWOP PV Damages

Number	Model Reach	SLR1	SLR2	SLR3
32	RC-1	$1,265,858	$3,243,569	$4,898,295
33	RC-2	$928,760	$4,455,684	$7,520,455
34	RC-3	$179,368	$2,058,203	$4,082,726
35	RC-4	$2,952,921	$5,232,964	$7,620,405
36	RC-5	$4,493,384	$5,978,513	$7,613,629
37	RC-6	$7,096,124	$9,590,704	$12,273,793
38	RC-7	$7,915,108	$9,438,487	$10,898,935
39	RC-8	$5,083,329	$6,019,301	$7,038,634
40	RC-9	$5,071,641	$6,424,807	$7,890,239
41	RC-10	$6,040,515	$7,654,979	$9,945,553
42	RC-11	$3,881,328	$5,301,515	$8,179,236
43	RC-12	$2,261,106	$3,171,822	$4,905,164
44	RC-13	$1,238,797	$3,349,259	$6,391,303
45	RC-14	$2,093,210	$3,134,792	$4,941,704
Subtotal		**$50,501,449**	**$75,054,599**	**$104,200,071**

Table 3-8: Reach D SLR Scenario FWOP PV Damages

Number	Model Reach	SLR1	SLR2	SLR3
45	RD-1	$0	$0	$31,783
47	RD-2	$358,299	$471,611	$908,426
48	RD-3	$173,506	$486,841	$1,467,312
49	RD-4	$1,289,790	$4,974,501	$7,912,278
50	RD-5	$114,366	$2,288,310	$7,585,590
Subtotal		**$1,935,961**	**$8,221,263**	**$17,905,390**
Grand Total		**$72,117,402**	**$139,530,914**	**$219,666,322**

The SLR results suggest that damages increase significantly as the erosion rate increases. With greater erosion, more structures are damaged more quickly. This increase in damage is observed across all model reaches. However, it is particularly notable in study Reach B. In the baseline FWOP condition, less than $4 million in present value damages are recorded in Reach B. In Intermediate condition (SLR2), this figure jumps to $33.5 million. In the high condition (SLR3), this figure reaches $70 million. Despite this dramatic increase, it continues to be the case that the greatest FWOP damages occur in Reach C. This is true in all SLR scenarios.

The reason Reach C continues to be receive more damage than any of the other reaches is because damage to the existing armor along A1A continues to be the largest damage category in all three scenarios. As seen in Table 3-4, damage to the existing revetment increases dramatically in the Intermediate and High scenarios. In all three scenarios, the cost of maintaining protection for SR-A1A is much larger than the damage that accrues to any of the other damage element categories. However, as seen in Table 3-4, damages increase in all categories as sea level rise increases. This increase in damages is particularly notable for bulkheads, single family residences, and commercial structures.

3.3.6 FWOP Condition Conclusion

- Most of the FWOP damages consists of the cost of maintaining protection for SR-A1A in Reach C and existing residences in Reach-A.
- The overwhelming majority of the damage is structural in nature, and is caused by erosion.
- Proximity to the shoreline and exposure to recurring damages are the most important factors for determining structure damage. Structures that receive the most damage are armor units and dunewalks.
- Damages in the future without project condition increase in the two sea level rise scenarios. This is particularly true in study Reach B. In all three SLR scenarios, Reach C has greater damages than any of the other reaches. This is because the cost of maintaining protection for SR-A1A increases dramatically in the SLR scenarios.

3.4 Future with Project Condition

This section of the appendix tells the story behind the evaluation and comparison of the Flagler County HSDR study alternatives. A description of the alternatives and their performance in terms of benefits and costs are provided in the sub-sections that follow.

3.4.1 Management Measures

Management measures were selected to accomplish at least one of the planning objectives for the Flagler County study. Both nonstructural (NS) measures and structural (S) measures were identified. All possible measures were considered, including those beyond the authority of USACE to implement. The following is a summary of the management measures considered for Flagler County.

- **Structural Measures:**
  - Seawalls
  - Revetments
  - Sand Covered Soft Structures
  - Beach Nourishment
  - Groins
  - Submerged Artificial Reefs
  - Near shore sand placement
  - Emergent Breakwaters
  - Dunes and Vegetation
  - Pressure Equalizing Modules
  - Undercurrent Stabilizers
- **Non-structural Measures:**
  - No Action

- Coastal Construction Control Line
- Moratorium on Construction
- No Growth Program
- Relocation of Structures
- Flood Proofing
- Condemnation and Land Acquisition

During the plan formulation process, management measures were screened against seven criteria. Benefits and costs were not calculated at this early stage of formulation, though a qualitative assessment of potential benefits was conducted. Ultimately, most of these measures were screened out. Two structural measures were carried forward to the modeling stage: Dunes and Vegetation and Beach Nourishment. More information about each measure is provided below. More information about the management measure screening process is provided in Section 5 of the main report.

Dunes and Vegetation: This measure would include placement of beach compatible material, from either upland or offshore sources, in a dune feature adjacent to the existing bluff. The top elevation of the dune would be such to tie into the bluff. The front slope of the dune would be a function of the material grain size and construction equipment. Vegetation would be planted after initial placement of the dune material. Preliminary engineering design work concluded that the most feasible plan for dunes and vegetation would have the following characteristics:

- Extension from the existing seaward face of the dune or existing armor (revetment/seawall) out to approximately 300 feet offshore or approximately to the -5 foot (NAVD 88) depth contour.
- Construction such that the dune will extend approximately 10 feet seaward from its existing location and the dune elevation will as closely as possible match the elevation of the existing dune elevation (15-20 feet NAVD 88).
- Construction such that the berm will extend approximately 10 feet seaward from its existing location. This berm extension is described as "sacrificial" in the sense it is designed to erode away throughout the life of the project.
- Periodic re-construction of the dune extension and sacrificial berm. The "trigger" for re-construction is complete erosion of the sacrificial berm.
- Construction using a hydraulic dredge to transport material from a borrow area located approximately 7 miles offshore.

Other construction methods were explored, including truck haul of fill material. But, the hydraulic dredge was determined to be the most cost effective by a wide margin.

Beach Nourishment: This measure includes initial construction of a beach fill and future re-nourishments at regular intervals. Re-nourishment of the beach would be undertaken periodically to maintain the erosion control features within design dimensions. Preliminary engineering design work and economic analysis suggested that the most feasible plan for beach nourishment would have the following characteristics:

- Extension from the existing seaward face of the dune or existing armor (revetment/seawall) out to approximately 300 feet offshore or approximately to the -5 foot (NAVD 88) depth contour.
- Construction such that the dune will extend approximately 10 feet seaward from its existing location and the dune elevation will as closely as possible match the elevation of the existing dune elevation (15-20 feet NAVD 88).
- Construction such that the berm will extend approximately 20 feet seaward from the extended dune face. This berm is described as "sacrificial" in the sense it is designed to erode away throughout the life of the project.

- Periodic re-construction of the dune extension. The "trigger" for re-construction is complete erosion of the berm extension.
- Construction using a hydraulic dredge to transport material from a borrow area located approximately 7 miles offshore.

The two remaining management measures are similar in that they both include an extension of the existing dune. The first measure, dunes and vegetation, is only a dune extension. The second measure also includes a 20 foot berm. In both cases, periodic nourishment would be required to continue accruing benefits throughout the project life.

3.4.2 Alternative Development

An alternative plan is a set of one or more management measures functioning to address one or more objectives. A key aspect of the Flagler County study is that each study reach (A,B,C,D) is treated as a separable element. Therefore, each project alternative is a combination of a selected measurement measure and the study reaches where it would be applied. Between the two remaining management measures and the four study reaches, eight fully developed alternatives were carried forward to be modeled in Beach-fx. This represents a reasonable number of project alternatives.1 The naming convention for the alternatives is described below.

- ADuneH: Reach-A; Dune extension, and 10' sacrificial berm constructed with a with a hydraulic dredge
- ADune30: Reach-A; Dune extension with a hydraulic dredge and a 30' berm
- BDuneH: Reach-B; Dune extension, and 10' sacrificial berm constructed with a with a hydraulic dredge
- BDune30: Reach-B; Dune extension with a hydraulic dredge and a 30' berm
- CDuneH: Reach-C; Dune extension, and 10' sacrificial berm constructed with a with a hydraulic dredge
- CDune30: Reach-C; Dune extension with a hydraulic dredge and a 30' berm
- ACDuneH: Combination of Reaches A and C; ; Dune extension, and 10' sacrificial berm constructed with a with a hydraulic dredge
- ACDune30: Combination of Reaches A and C; Dune extension with a hydraulic dredge and a 30' berm

It should be noted that many other combinations were considered during the plan formulation process. However, preliminary modeling indicated that the other alternatives would not be economically justified. For example, an ABC-Dune-H alternative was screened out because Reach B, which is a separable element, is not economically justified. The same is true for ABCD-Dune-H; both the B and D segments are not incrementally justified.

Larger beach nourishment alternatives were also considered. Preliminary Beach-*fx* modeling was used to simulate the performance of 10 foot dune extensions with wider berms (40 feet, 60 feet, etc.). However, these other potential designs were screened out due to unfavorable performance. In all test model runs, the wider berms generated comparable benefits to the 20 foot berm, but at a much higher

[1] Modeling alternatives in Beach-*fx* is a time consuming process; a single 100 iteration simulation takes at least six hours. Therefore, it was not practical to fully model a large number of alternatives.

cost. As a result, they were eliminated from consideration before the final array of alternatives was developed. In fact, most of the larger beach nourishment alternatives had costs that were greater than all of the damages in the FWOP condition. Even if such a project eliminated 100% of the damages, it would still not be economically justified.

3.4.3 Alternative Comparison

All the alternatives described above were modeled in Beach-fx using full (100 iteration) life cycle simulations. The results of these simulations were used to select the NED Plan. The results of the alternative comparison are presented in Table 3-9 and Table 3-10.

Table 3-9: AAEQ Damages for Final Array of Alternatives

Alternatives	PV Damages - without project	PV Damages - with project	PV Benefits
A-Dune-H	$72,117,402	$67,181,814	$4,935,588
A-30	$72,117,402	$56,637,602	$15,479,800
B-Dune-H	$72,117,402	$67,630,503	$4,486,899
B-30	$72,117,402	$67,406,158	$4,711,244
C-Dune-H	$72,117,402	$22,985,862	$49,131,540
C-30	$72,117,402	$21,639,792	$50,477,610
AC-Dune-H	$72,117,402	$6,159,992	$65,957,410
AC-30	$72,117,402	$5,711,302	$66,406,100

Table 3-10: AAEQ Benefits and Costs for Final Array of Alternatives

Alternatives	Benefits	Cost	Net Benefits	BCR
A-Dune-H	$220,000	$170,000	$52,000	1.35
A-30	$690,000	$700,000	-$16,000	0.98
B-Dune-H	$200,000	$250,000	-$57,000	0.78
B-30	$210,000	$1,030,000	-$809,000	0.21
C-Dune-H (NED)	$2,190,000	$810,000	$1,387,000	**2.72**
C-30	$2,250,000	$1,180,000	$1,065,000	1.90
AC-Dune-H	$2,940,000	$1,130,000	$1,814,000	2.61
AC-30	$2,960,000	$1,750,000	$1,206,000	1.69

The plan with the highest BCR is C-Dune-H. The plan with the highest net benefits is AC-Dune-H. Typically, the plan with the highest net benefits is the NED Plan. However, subsequent plan formulation efforts determined that public access in Reach A is negligible. Because Reach A is a separable element that does not have public access, it was screened out after the final array of alternatives had been modeled. More information about the public access issue and the final screening is presented in Section 6 of the main feasibility report.

Finally, the plan can be considered robust in the sense that it is economically justified in all 100 iterations simulated by Beach-*fx*. Table 3-11 shows the mean, minimum, and maximum net benefits for all project alternatives over all 100 iterations. Table 3-12 shows the minimum, mean, and maximum benefit-cost ratios. As seen in these tables, the TSP continues to be economically justified even in the simulations in which it is least effective. Therefore, the Beach-*fx* results suggest that the NED Plan can be considered robust.

Table 3-11: Range of potential net benefit outcomes for all alternatives

Alternatives	Minimum	Mean	Maximum
ADuneH	($4,200,000)	$1,200,000	$5,100,000
A30	($2,700,000)	($300,000)	$2,800,000
BDuneH	($4,800,000)	($1,300,000)	$3,400,000
B30	($20,100,000)	($18,200,000)	($13,800,000)
CDuneH (NED)	$24,100,000	$31,100,000	$38,800,000
C30	$16,800,000	$23,900,000	$31,200,000
ACDuneH	$32,300,000	$40,700,000	$48,900,000
AC30	$18,500,000	$27,100,000	$34,900,000

Table 3-12: Range of potential benefit-cost ratios for all alternatives over 100 iterations

Alternatives	Minimum	Mean	Maximum
ADuneH	0.07	1.35	2.57
A30	0.83	0.98	1.17
BDuneH	0.17	0.78	1.58
B30	0.13	0.21	0.40
CDuneH (NED)	2.31	2.72	3.10
C30	1.63	1.90	2.15
ACDuneH	2.27	2.61	2.91
AC30	1.48	1.69	1.88

3.4.4 Performance of NED Plan in the SLR scenarios

An important question about the TSP is its performance under different SLR scenarios. Each of the SLR scenarios described in the main report are considered equally likely to occur. Therefore, if the project does not perform, then it cannot be considered a completely effective plan. **Table 5-6** shows the BCRs and net benefits of the plan in the different SLR scenarios.

Table 3-13: AAEQ Benefits and Costs for NED Plan in different SLR scenarios

SLR Scenario	Benefits	Cost	Net Benefits	BCR
Baseline (SLR1)	$2,190,000	$810,000	$1,387,000	**2.72**
Intermediate (SLR2)	$3,475,000	$1,155,000	$2,320,000	**3.01**
High (SLR3)	$4,625,000	$1,581,000	$3,044,000	**2.93**

As shown in **Table 5-6**, though the benefits of the project increase significantly in the SLR scenarios, the costs also increase. The costs increase because re-nourishment is triggered more frequently. Thus, the project performance (in terms of the benefit-cost ratio) is relatively constant throughout the SLR scenarios. The damages and average re-nourishment intervals are summarized in **Table 5-7**.

Table 3-14: Damages and Re-nourishment Intervals in the SLR scenarios

SLR Scenario	Expected Re-nourishment Interval	Total PV Damages without project	Total PV Damages with project
Baseline (SLR1)	11 years	$72,117,402	$22,892,141
Intermediate (SLR2)	9 years	$139,530,914	$61,565,718
High (SLR3)	6 years	$219,530,914	$115,914,610

Because both costs and benefits are increasing, the net benefits actually increase with increasing rates of sea level rise. Overall, these SLR results suggest that the NED Plan is both effective and robust in all three simulated scenarios.

4. THE NED PLAN

With alternative AC-Dune-H screened out, the plan with the highest net benefits is C-Dune-H. Therefore, it is the NED Plan and the Tentatively Selected Plan (TSP). This is also the plan with the highest Benefit-Cost-ratio.

4.1 Structure Inventory Adjustments

In this section, the structure inventory was inflated from FY2011 to FY2014 price levels to match the project cost, which have also been refined to a higher level of detail. Benefits and costs have been discounted using the FY 2014 Federal Water Resources Discount Rate of 3.5%. The structure inventory was updated as follows:

- **Roads, Armor and Other Structures**
  - Source of Indices - CWCCIS
  - Inflation Factor - 1.05
- **Residential Structures**
  - Source of Indices – Housing price component of the CPI[1]
  - Inflation Factor – 1.04
- **Commercial and Public Buildings**
  - Source of Indices –Non-Residential Rents component of PPI[2]
  - Inflation Factor – 1.04

REFINEMENTS TO THE ARMOR AND ROAD COSTS

- **Revetment & Road Cost Per LF**
  - Minimum - $97.03
  - Most Likely - $423.87
  - Maximum - $631.63
- **New Revetment Cost Per LF**
  - Minimum - $365.41
  - Most Likely - $524.21
  - Maximum - $683.00

4.2 Project Cost Refinements

The costs were further refined by SAJ Cost Engineering to a higher level of detail. In addition, the current costs account for the demolition of approximately 42 dune walkovers, of which 21 will be reconstructed. Table 4-1 provides greater detail on the distribution of cost by nourishment.

Table 4-1: Project Cost Refinements[3]

	Initial Construction	1st Re-Nourishment	2nd Re-Nourishment	3rd Re-Nourishment	4th Re-Nourishment	Total Cost
Quantity (yd^3)	330,000	320,000	320,000	320,000	320,000	**1,610,000**
Mobilization	$1,184,043	$1,167,182	$1,167,182	$1,167,182	$1,167,182	**$5,852,773**
Prep Work[4]	$455,642	$352,516	$352,516	$352,516	$352,516	**$1,865,705**
Dredging	$3,244,858	$3,145,051	$3,145,051	$3,145,051	$3,145,051	**$15,825,062**
Associated General Items[5]	$1,758,552	$167,655	$167,655	$167,655	$167,655	**$2,429,172**
Lands & Damages	$2,768,000					**$2,768,000**
PED	$1,343,400	$685,000	$685,000	$685,000	$615,000	**$4,013,400**
Construction Management	$478,000	$362,000	$362,000	$362,000	$362,000	**$1,926,000**
Total Cost	**$11,232,495**	**$5,879,404**	**$5,879,404**	**$5,879,404**	**$5,809,404**	**$34,680,112**

[1] The index for the Fort Lauderdale MSA was used because it was the closest Floridian MSA for which FY2014 price indices were available.
[2] PPI is the Producer's Price Index. The national average was used for these structures.
[3] The costs in Table 4-1 do not include the contingency.
[4] Prep work includes the $103.343 dune walkover demolition costs.
[5] Associated General Items includes the $921,437 cost of reconstructing the 21 public dune-walkovers.

Table 4-1 provides greater detail on the distribution of cost by nourishment. Project costs were modified further for entry into the Beach-*fx* user interface. All onetime costs that only occur during the initial construction were not represented in the model (These costs were added back in for the life cycle cost calculations). Mobilization and prep work were entered as part of the mobilization costs, while the remainder was factored into the model as unit placement cost. The costs were averaged over all construction events in the life cycle to determine the values to be entered into Beach-fx (shown in Table 4-2).

Table 4-2: Representing the Project Costs in Beach-*fx*

Event	yd3	Mobilization	Placement Cost	Placement Cost/CY
Initial Construction	330,000	$1,901,743	$10,764,025	$32.62
1st Re-nourishment	320,000	$1,902,902	$5,686,831	$17.77
2nd Re-nourishment	320,000	$1,902,902	$5,686,831	$17.77
3rd Re-nourishment	320,000	$1,902,902	$5,686,831	$17.77
4th Re-nourishment	320,000	$1,902,902	$5,600,731	$17.50
Average	**322,000**	$1,902,670	$6,685,050	$20.69

A summary description of the Beach-fx cost inputs and outputs is as follows:

- **Beach-fx inputs for the NED Plan**
  - One-Time [6]cost of $1.2 M was excluded from representation in the model, but added back in to the life cycle cost calculations.
  - Mobilization Cost - $1,902,670
  - Unit Placement Cost - $20.69/yd^3
  - # Iterations – 100
- **Beach-fx outputs for the NED Plan**
  - Total Volume Placed - 1,584,654 yd^3
  - PV Mobilization Cost - $4,138,903
  - PV Placement Cost - $12, 071,722

Table 4-3 provides summary statistics on the volume of material per construction event. The 1st and 2nd re-nourishments tend to require less material relative to the initial construction and the 3rd and 4th re-nourishment events.

Table 4-3: Beach-fx Volume per Construction Event

Number	Frequency	Mean	SD	Min	Max
1	Initial Construction	325,825	6,221	322,674	354,025
2	1st Re-nourishment	312,987	10,907	301,619	353,216
3	2nd Re-nourishment	313,772	7,262	302,423	342,960
4	3rd Re-nourishment	317,318	11,334	301,442	345,503
5	4th Re-nourishment	318,072	6,671	302,154	352,623

[6] One time cost include lands & damages administration and acquisition costs, dune planting, and the demolition and reconstruction of dune walkovers.

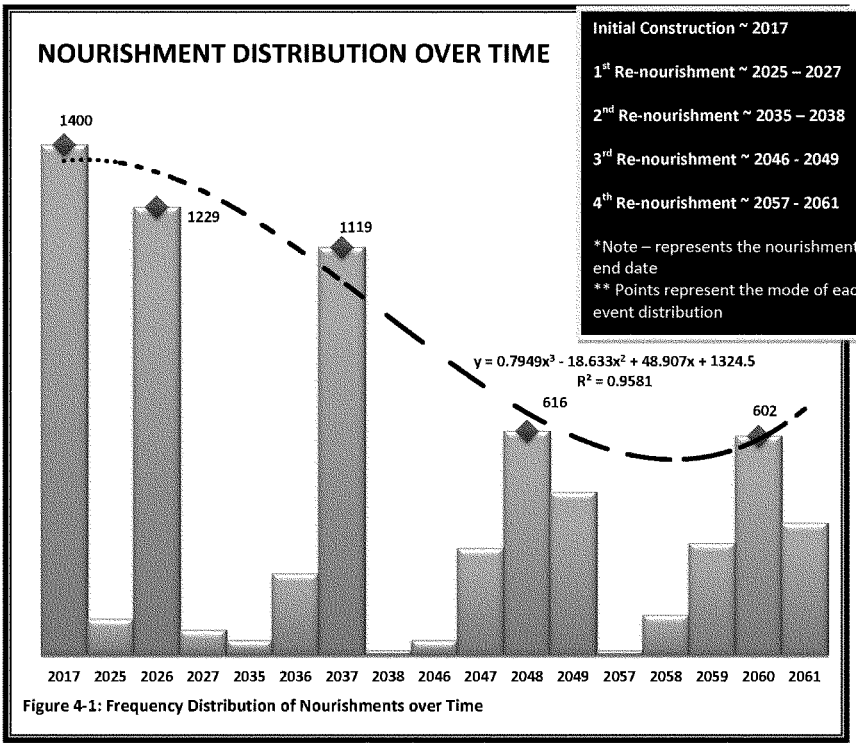


Figure 4-1: Frequency Distribution of Nourishments over Time

Figure 4-1 illustrates a frequency distribution of nourishments over time. Based on these results, the most likely nourishment years would be 2017, 2026, 2037, 2048, & 2060. However, the distribution of each construction event is noticeably flatter and less peaked than the prior event. Initial construction spreads just over 1 year. The 1st and 2nd re-nourishments are distributed over 3 & 4 year time spans respectively. The 3rd and 4th re-nourishments are distributed over 4 and 5 year time frames respectively. Model results indicate the amount of uncertainty surrounding the nourishment interval increases with each nourishment event at a nonlinear rate. This is because of the conditional nature of beach nourishment coupled with the interplay of all the variable factors in the model cause the number of possible nourishment years to grow relative to the median year for each construction event distribution over time.

It should be noted that Beach-fx is a life cycle simulation model. These results are based on 100 iterations generating over 7,000 observations of nourishment events. All iterations within the simulation are unique. The values presented in the figure above are essentially probabilistic nourishment events.

Traditionally, in HSDR studies, a fixed re-nourishment interval is defined and optimized for the life of the project. This interval is based in part on a clear distinction between a design berm and advance fill. With Beach-*fx*, no such distinction is defined. Rather, re-nourishment events are triggered within the model when specific criteria are met. In this case, the triggers were set up to simulate a point at which the dune extension and sacrificial berm had eroded away and were no longer capable or preventing or reducing damages. Based on these parameters, the expected re-nourishment interval is eleven years. In reality, this interval could vary depending erosion and storm events. More information about the re-nourishment triggers is provided in the engineering appendix. Ultimately, planning based on life-cycle modeling results in plans that are more resilient and adaptable. Life-cycle modeling allows planners to design projects while recognizing the inherent uncertainty that exists when future events are simulated.

The cost and nourishment volume distribution by event provided by SAJ cost engineering personnel was distributed over the period of analysis in the same proportions as the Beach-fx outputs. Table 4-4 provides detail on the life cycle cost distribution.

Table 4-4: Distribution of Nourishment Volume over Time[7]

Event	Year	Frequency	Percentage	Volume	Cost	Present Value Cost
Initial Construction	**2017**	1400	100%	325,825	$13,951,220	$14,439,512
1st Re-nourishment	**2025**	101	7%	22,417	$547,545	$430,365
	2026	1229	88%	273,689	$6,662,701	$5,059,732
	2027	70	5%	16,880	$379,487	$278,441
2nd Re-nourishment	**2035**	42	3%	9,255	$227,692	$126,871
	2036	225	16%	50,724	$1,219,778	$656,681
	2037	1119	80%	250,702	$6,066,365	$3,155,454
	2038	14	1%	3,090	$75,897	$38,143
3rd Re-nourishment	**2046**	42	3%	9,488	$227,692	$86,900
	2047	294	21%	65,733	$1,593,844	$587,727
	2048	616	44%	137,403	$3,339,482	$1,189,785
	2049	448	32%	104,694	$2,428,714	$836,037
4th Re-nourishment	**2057**	14	1%	3,026	$75,036	$19,615
	2058	112	8%	24,953	$600,291	$151,617
	2059	308	22%	70,889	$1,650,799	$402,847
	2060	602	43%	136,358	$3,226,562	$760,756
	2061	364	26%	82,846	$1,950,945	$444,437
	Total	**7000**		**1,587,974**	**$44,224,051**	**$28,664,922**

[7] The cost shown in Table 4-4 do include contingency and are used in all final BCR computations.

A description of the NED plan is as follows:

- **Name/Description:** CDuneH - 10' dune extension (note: the construction template will include a 10' sacrificial berm) constructed with a with a hydraulic dredge
- **Avg # Nourishment Events:** 1(ea)Initial Construction / 4(ea) Re-nourishments
- **# Nourished Reaches:** 14
- **Range of Nourished Reaches:** RC1 – RC14
- **Avg Volume of Each Nourishment:** 317,595 yd^3
- **Total Volume over project life cycle:** 1,587,974 yd^3
- **Initial Construction Duration** ~ 6 months
- **Interest During Initial Construction** ~ $163,106

4.3 Benefits of the NED Plan

The economic benefits of the plan are generated by reductions in erosion damages. As described in Table 4-5, the model results suggest that the alternative is highly effective at reducing erosion damages. In the with-project condition, the vast majority of damages in Reach C are prevented.

Table 4-5: PV of Damages in Reach C

Number	Reach	FWOP DAMAGES	FWP DAMAGES	PV BENEFITS	% DAMAGE PREVENTED
32	RC-1	$2,304,585	$467	$2,304,118	99.98%
33	RC-2	$1,109,732	$1,753	$1,107,979	99.84%
34	RC-3	$416,811	$19	$416,793	100.00%
35	RC-4	$4,655,106	$21,685	$4,633,421	99.53%
36	RC-5	$3,550,288	$8,516	$3,541,772	99.76%
37	RC-6	$6,139,952	$20,356	$6,119,596	99.67%
38	RC-7	$4,646,251	$61,194	$4,585,057	98.68%
39	RC-8	$4,429,101	$20,146	$4,408,954	99.55%
40	RC-9	$4,681,635	$37,916	$4,643,719	99.19%
41	RC-10	$6,988,182	$295,654	$6,692,528	95.77%
42	RC-11	$6,625,129	$1,148,376	$5,476,753	82.67%
43	RC-12	$3,410,176	$580,175	$2,830,001	82.99%
44	RC-13	$1,540,723	$57,723	$1,483,001	96.25%
45	RC-14	$3,017,180	$81,679	$2,935,501	97.29%
	Total	**$53,514,850**	**$2,335,657**	**$51,179,193**	**95.64%**

Most of the benefits are associated with reductions to armor damage along the A1A revetment. In the with-project condition, the cost of maintaining and repairing the revetment is significantly less than it would be in the without project condition. This reduction is the primary source of economic benefits. As seen in Table 4-5, the alternative is highly effective; it prevents 95% of total damages in Reach C. As seen in Table 4-6 the total cost of maintaining the A1A revetment decreases from $53.5 million in the FWOP condition to $2.3 million in the 'with project' condition.

It should be noted that CDuneH is not only highly effective, it is also efficient. Because the plan successfully reduces the vast majority of damages, a larger project is not necessary. A constructed berm, such as a project simulated with alternative C-30, would generate similar benefits at much higher cost. This is why the benefit-cost ratio is much lower for C-30 than it is for Reach CDuneH.

Table 4-6: PV Damages by Category

Category	Damage Element Type	FWOP	FWP	Benefits	% Change
Armor / Roads	BULKHEAD	$6,359,601	$6,360,599	$0	0.00%
	N-BULKHEAD	$5,266,378	$5,215,954	$50,424	0.96%
	NEW ARMOR	$10,746,608	$8,764,278	$1,982,330	18.45%
	ARMOR-A1A	$50,273,763	$2,623,382	$47,650,381	94.78%
	ROAD1	$76,169	$50,799	$25,371	33.31%
	Subtotal	$72,722,519	$23,015,012	$49,708,505	68.35%
Other Structures	POOL	$34,989	$31,332	$3,657	10.45%
	DUNEWALK	$2,725,959	$1,957,367	$768,593	28.20%
	SHELTER	$650,495	$649,183	$1,313	0.20%
	STORAGE	$106,900	$100,198	$6,702	6.27%
	PARKING	$36,312	$7,366	$28,946	79.71%
	DECK	$180,290	$174,192	$6,097	3.38%
	Subtotal	$3,734,945	$2,919,637	$815,308	21.83%
Public/ Commercial	COMM1	$463,012	$0	$463,012	100.00%
	COMM2	$124	$0	$124	100.00%
	PUBLIC1	$0	$0	$0	0.00%
	Subtotal	$463,137	$0	$463,137	100.00%
Residential	SFR1	$400,300	$307,094	$93,206	23.28%
	SFR2	$1,136,364	$982,900	$153,464	13.50%
	MFR2	$35	$0	$35	100.00%
	SFR3	$1,892	$1,509	$383	20.26%
	MFR1	$244,842	$0	$244,842	100.00%
	Subtotal	$1,783,433	$1,291,503	$491,930	27.58%
	GRAND TOTAL	**$78,704,034**	**$27,226,152**	**$51,478,880**	**65.41%**

Figure 4-2 provides detail on the accumulation of damages, benefits, and costs over time. Figure 4-3 graphically illustrates the accumulation of benefits over time and space.

For the Recommended Plan, the berm width, dune width, and dune height planned nourishment triggers were set at 0, 0.91, and 0.9, respectively. The mobilization threshold was set to 300,000 cubic yards. Together, the triggers and the mobilization threshold allow for the optimization of the beach fill based on the physical dimensions of the project, as well as assumptions regarding tolerable erosion limits and reasonable fill volumes. Sensitivity analysis of the nourishment triggers and mobilization threshold indicated that threshold volume was the dominant parameter for optimizing project cost for an alternative in which the berm width has a zero value. A mobilization threshold of 300,000 cubic yards was found to be (when combined with the above nourishment triggers), the most optimal threshold value. Decreasing the threshold decreased the net NED benefits. Increasing the threshold above 300,000 cubic yards produced a small increase in the net NED benefits. However, it also allowed segments of the dune to erode to beyond the existing project condition. This was not considered to be

an acceptable assumption. The net benefits associated with the 300,000 and 400,000 cubic yard thresholds are $26,803,584 and $26,810,596 respectively. Figure 4-4 provides added detail on model sensitivity to the volume of material placed during each construction event.

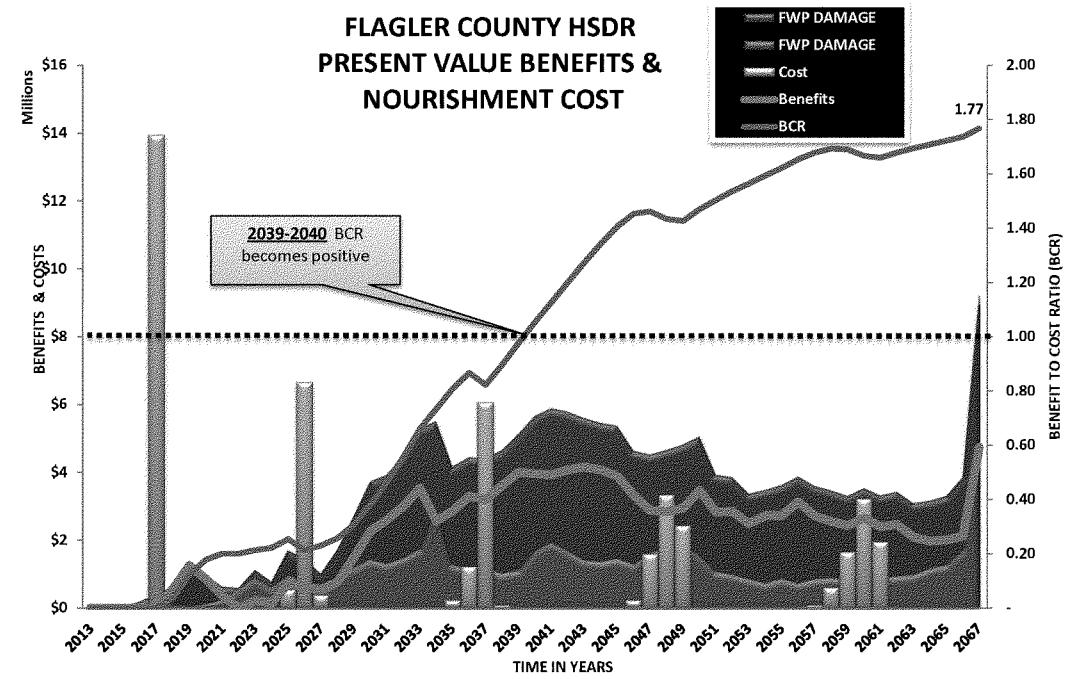


Figure 4-2: Present Value Damages, Benefits, and Costs over Time

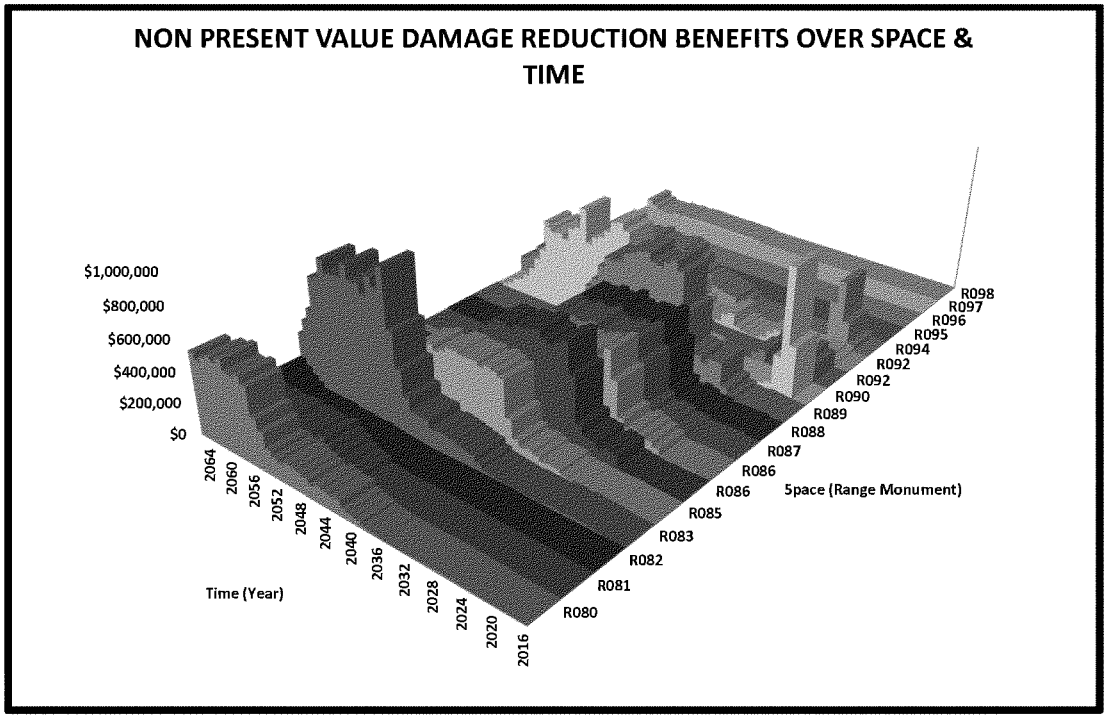


Figure 4-3: Non Present Value Benefits over Space & Time

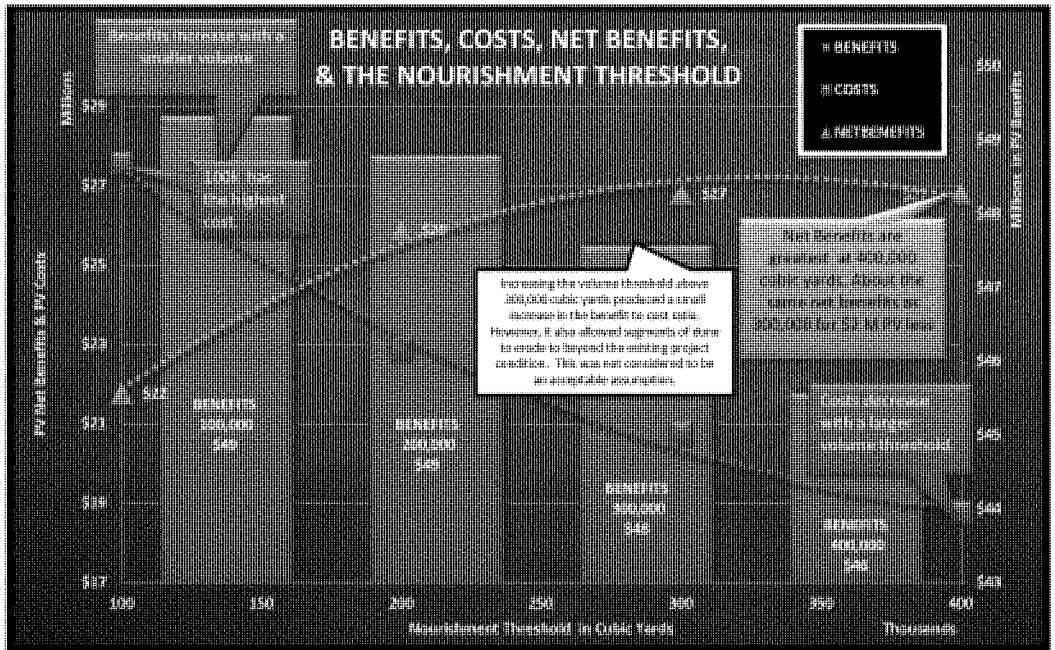


Figure 4-4: Volume Sensitivity[1]

[1] Benefits and costs in this chart extracted from Beach-fx outputs, and do not include the contingency.

4.4 Incidental Recreation Benefits

According to ER-1105-2-200, incidental recreation benefits can be calculated in HSDR studies. Recreation benefits are not to be used in plan formulation, but they can constitute up to 50% of total project benefits.

Typically in coastal studies, recreation benefits are calculated using the travel cost method (TCM). The basis for this method is the concept that by increasing the carrying capacity of a particular recreation resource, a project may reduce the travel time (and travel cost) associated with recreation visits. In this case, preliminary investigations concluded that there is no excess demand for recreation in Flagler County. Therefore, the travel cost method is not applicable.

However, even though a project in Flagler County would not increase the *availability* or *quantity* of recreation in the project area, there may be some benefits associated with increasing the *quality* of recreation that is already occurring. This is the basis for the Unit Day Value (UDV) method.
In the Flagler County Feasibility study, recreation benefits were calculated using the UDV method, as described in EGM 09-03 and in Appendix E of ER 1105-2-100. The Unit Day Value method estimates a user's willingness to pay for a given recreational opportunity, a dollar amount the recreational experience would be worth to them were they required to pay for it. This value is estimated via a series of criteria applied to the various recreational facilities and opportunities provided by the project; criteria gauging the overall quality of the experience, availability, carrying capacity, accessibility, and environmental factors. Each criterion can be assigned one of five possible scores, representing it's rating from low to high with a corresponding range of point values. These point values are summed together and applied a dollar day value based on the current UDV guidance. The current unit day values, provided by USACE Economic Guidance Memo #12-03, *Unit Day Values for Recreation*, FY 2014, are presented in Table 4-7. Linear interpolation was used to estimate the dollar value of point score between. So, for example, a point score of 2 corresponds with a dollar value of $3.94.

Table 4-7: Current Unit Day Values for Recreation

Point Values	General Recreation Values (FY14)	General Fishing and Hunting Values (FY14)
0	$3.84	$5.52
10	$4.56	$6.24
20	$5.04	$6.72
30	$5.76	$7.44
40	$7.20	$8.17
50	$8.17	$8.89
60	$8.89	$9.85
70	$9.37	$10.33
80	$10.33	$11.05
90	$11.05	$11.29
100	$11.53	$11.53

The recreation point values assigned to Flagler County vary by year. They are summarized in Table 4-8.

Table 4-8: Total Unit Day Point Scores applied to Flagler County

Year	Without Project	With Project
2010	50	50
2016	50	50
2020	48	50
2030	45	50
2040	42	50
2050	39	50
2060	36	50

The point assignments are based on qualitative criteria; they depend on best professional judgment (also referred to as "judgment criteria"). The differences in the assigned point scores vary for each category depending on the relevant recreation facilities. The following list briefly explains the logic behind some of the judgment criteria applied to Flagler County.

- **Recreation Experience:** Flagler Beach was assigned a point score of 15, which corresponds to "several general recreation activities and one high value activity". Beaches offer visitors the opportunity to experience several general activities, including swimming and walking. They also provide the opportunity for at least one high value activity at a time, such as wind-surfing. This point score does not change between the 'with' and 'without' project condition, because the proposed project would have no effect on the number of recreation opportunities.
- **Availability of Opportunity:** Flagler Beach was assigned a point score of 2, which corresponds to "several opportunities within one hour of travel time a few within 30 minutes". Flagler Beach is within easy driving distance of several other popular beaches, including Palm Coast, St. Augustine, and Daytona Beach. This point score does not change between with and without project condition, because the proposed project would have no effect on the availability of other recreation opportunities.
- **Carrying Capacity:** In the base year the without project condition (2016), Flagler Beach was assigned a score of 8, which corresponds to "adequate facilities". Over time, the carrying capacity of Flagler beach is expected to deteriorate somewhat, as damages are inflicted on the existing dune and its protective revetment. By 2050, the score assigned to Flagler County was reduced to 5, which corresponds to "basic facilities". While beach recreation will still be possible in 2050, the available facilities will be of lower quality than they are now. In the 'with project' condition, the point score was held constant at 8, because the project is expected to prevent most of the damage in the project area.
- **Accessibility:** In the base year the without project condition (2016), Flagler Beach was assigned a score of 15, which corresponds to "good access to and within site". Over time, the accessibility of Flagler beach is expected to deteriorate somewhat, as damages are inflicted on the revetment, the road, and the dune walks. By 2050, the score assigned to Flagler County was reduced to 10, which corresponds to "fair access to and within site". In the with project condition, the point score was held constant at 8, because the project is expected to prevent most of the damage in project area.
- **Environmental:** In the base year the without project condition (2016), Flagler Beach was assigned a score of 10, which corresponds to "above average aesthetic quality". Over time, the aesthetic quality of Flagler beach is expected to deteriorate somewhat, as damages are inflicted on the dune,

the revetment, and the dune walks. By 2060, the score assigned to Flagler County was reduced to 6, which corresponds to "average aesthetic quality". In the with project condition, the point score was held constant at 10, because the project is expected to prevent most of the damage in project area.

After assigning point scores and dollar values, these values must be assigned to expected recreation visits over the life the project. In 2010, the total number of beach visits in Flagler County was estimated to be 626,467 (for the entire year). This estimate is based on projections provided by the State of Florida "Trends and Conditions Report-2008" for northeast Florida, the 2007 Florida Statewide Recreation Plan (SCORP), and county tourism allocation projections developed for the Nassau County Florida General Reevaluation Report. The number of visits is projected to increase to 791,295 by 2050 and 1,265,250 by 2050.

Of course, these projections are for the entire county. The selected plan (**CDuneH)** only applies to small portion of the county's coastline. An assessment of public parking and access facilities in Flagler County concluded that only 12% of the available public parking spaces are located within the project area (Reach C). Therefore, 12% was used as a proxy value for the proportion of recreation visits that could benefit from the project. The unit day values developed above were only applied to 12% of the projected visits in Flagler County.

Using these methods, the total present value of recreation benefits was estimated to be **$1,696,452**, or **$72,326** in average annual terms.

In order to verify the reasonableness of the recreation benefits, total projected visitation must be compared to total recreation capacity. In 2064, the total projected visitation for the project area is 192,772 visits throughout the year. Based on 223 spaces and 4 people per vehicle at two vehicles per space throughout a 150 day season, that would allow for approximately 267,600 visitors, which is approximately 75,000 more than the expected visitation in 2064. The projection is less than 192,772 for all years before 2064. Therefore, it is reasonable to assume that parking capacity will not be a constraint on future recreation benefits.

Figure 4-5 shows how these 223 parking spaces are distributed over the length of the recommended plan. Many of the public parking spaces in Flagler Beach are gravel or dirt road bed and do not have clearly marked lines dividing individual parking spaces. Jacksonville District personnel performed a field survey to identify and count the actual number of public parking spaces available at public beach access points within the study area. Geographic information system (GIS) mapping and measurement tools were used to verify the number of parking spaces observed during the field survey. Development in the immediate vicinity of the recommended plan is primarily residential. Development in the area extending several blocks north of the recommended plan to Moody Boulevard is zoned primarily for commercial and recreational purposes and contains shops, restaurants, fishing pier, parks, and additional public parking. This is why a majority of the public parking spaces are located at the northern end of the project area.



Figure 4-5: Location of public parking spaces and beach access points in the vicinity of the recommended plan[1]

[1] This map shows the number of public parking spots within ¼ mile of each of the access points (Blue dots and numerical labels). Some parking spots are located within ¼ mile of more than one access. In these cases the parking spots are only counted for the closest access point, as to not double count parking spots.

5. CONCLUSION

Table 5-1 provides a summary of the NED Plan with recreation and traffic rerouting benefits added expressed in average annual equivalent terms. The alternative comparison was based on screening level costs, which were in FY11 price levels. This summary has been updated to FY14 price levels.

Table 5-1: Economic Summary

ECONOMIC SUMMARY	STORM DAMAGE REDUCTION BENEFITS	STORM DAMAGE REDUCTION + RECREATION BENEFITS	STORM DAMAGE REDUCTION + RECREATION + TRAFFIC RE-ROUTING BENEFITS
Price Level	FY14	FY14	FY14
FY14 Water Resources Discount Rate	3.50%	3.50%	3.50%
Average Annual Storm Damage Reduction Benefits	$2,159,000	$2,159,000	$2,159,000
Average Annual Recreation Benefits	$0	$72,000	$72,000
Average Annual Traffic Reroute Benefits[2]	$0	$0	$131,000
Average Annual Total Benefits	$2,159,000	$2,231,000	$2,362,000
Average Annual Cost[3]	$1,239,000	$1,239,000	$1,239,000
Average Annual Net Benefits	$920,000	$992,000	$1,123,000
Benefit Cost Ratio	**1.74**	**1.80**	**1.91**

Portions of Flagler County's shoreline are vulnerable to coastal erosion and storm damage. This is particularly true in southern portion of Flagler beach, designated Reach C in this study. Beach-*fx* modeling has demonstrated that significant economic damage from coastal forces can be expected to occur over the next 50 years in the future without project condition. The majority of this damage accrues to the existing revetment that was constructed to protect State Road A1A. In the two alternative Sea Level Rise scenarios, damages increase substantially.

In order to reduce future damages, a large number of management measures were considered. After a detailed investigation and extensive modeling effort, a plan was selected that maximizes expected

[2] Traffic reroute benefits are based on operating cost that include tires, maintenance, gas, oil, and depreciation.
[3] Includes additional monitoring cost incurred by the local sponsor.

future net benefits. This plan, **CDuneH**, consists of a 10' dune extension (including a 10' sacrificial berm as part of the construction template) constructed with a hydraulic dredge and periodically re-nourished in eleven year intervals. This alternative has been identified as the NED Plan and the Tentatively Selected Plan because it successfully prevents most of the future erosion damage that can be expected to accrue in Reach C. The net benefits of the NED plan range between $937,000 and $1,185,000.

The plan is effective and efficient. It is also robust, in the sense that it continues to be economically justified in all simulated model iterations and in all three sea level rise scenarios. Though the recommended plan is relatively small in scope and scale, it represents the most prudent investment of Federal dollars.

Economics Addendum A: The Specification of Armor as a Damage Element

Synopsis: The purpose of this document is to explain the Jacksonville District's approach for modeling coastal armor damage in the Corps certified storm damage reduction model, *Beach-fx*. It is part of an effort to engage the model developer and the Hurricane and Storm Damage Reduction (HSDR) PCX as the Feasibility Study is developed. This document only addresses the method for specifying coastal armor as a damageable element within Beach-fx.

Background: Flagler County is located on the northeast coast of Florida approximately midway between the Florida/Georgia state line and Cape Canaveral. The county has approximately 18 miles of sandy shoreline, all of which are authorized for Federal study. The coast has no inlets or embankments and the beaches are typically fronted by steep dune faces or rock revetment.
The Flagler County SPP economic analysis was initiated in FY2008. In mid-FY2012, the project schedule was accelerated in anticipation of rescoping due to implementation of SMART Planning guidelines. According to the accelerated schedule, the identification of the Tentatively Selected Plan (TSP) is to take place in December 2012. This will be followed by TSP optimization and the completion of the draft feasibility report in January 2013.

Modeling Challenges: Significant portions of the study area are protected by coastal armor. In one segment, called Design Reach C by the study team, the only structure subject to erosion damage in the baseline future-without project condition is a major road (SR-A1A), which is protected by a rock revetment (see **Figure 1**). This revetment is maintained by the Florida Department of Transportation (FDOT). Data from the FDOT suggest that in the ten year period between 2001 and 2010, an average of approximately $600,000 per year was spent maintaining the revetment. In one year (2001), total maintenance costs exceeded $3 million.

Figure 1: Rock Revetment Protecting SR A1A



Due to the nature of the structure inventory in Design Reach C, prevention of damages to armor represents the largest potential benefit category in this area. Therefore, accurate simulation of armor damage is critically important.

Throughout the study effort, estimating armor damage has been a consistent challenge. Initial *Beach-fx* model

results appeared to indicate that damage to the existing armor in Reach C was being significantly underestimated. Furthermore, the project alternatives did not appear to be generating realistic results. Some of the alternatives modeled were expected to reduce armor damage. However, the preliminary runs did not show this; armor damage was almost identical in the with and without project condition.

The issues with modeling armor damage in Flagler County are linked two inter-related facts:

1.) The accrual of damage to the revetment is gradual and incremental in nature. However, the armor damage function in *Beach-fx* is set up as binary calculation Either the armor fails, or it does not fail. There is no way so simulate gradual accrual of damage that does not lead to failure.

2.) The costs incurred to are really more akin to maintenance costs than to "armor damage". Therefore, the potential benefits of project in Reach C are reductions to maintenance costs. With dune construction or coastal nourishment, armor maintenance events will be less frequent and less costly. This results in economic benefits.

After extensive effort to calibrate the model to generate realistic armor maintenance costs, the study team concluded that a different modeling approach was warranted.

New Approach to Modeling Armor Maintenance Costs: To address this issue, a method was devised to represent the revetment and SR-A1A as a damageable element within the model. Conceptually, damage elements representing the cost of maintaining the armor and the road would be placed along the shoreline along the seaward edge of each lot. The damage element length would extend from the seaward toe of the revetment to the landward shoulder of the road. Rather than armor failure thresholds, damage functions would be used to estimate the damages.

Advantages of this Approach

- Allows the modeler to include greater flexibility in the representation of armor damage. Three damage functions allow the modeler to incorporate greater nuance into the armor damage calculations. Representing the armor as an auto-located linear damage element affords the ability to model the revetment as it conforms to the profile shape.
- Incorporates uncertainty into the armor damage calculations. The current armor feature allows only single discrete values, rebuild times, and failure thresholds to be used to represent armor. By using a damage element, uncertainty can be represented in the value, damage driving parameter, and the rebuild times.
- Easier to disaggregate spatial and temporal damages to armor. Using the approach as described makes it much easier to determine how, when, and where damages are estimated to occur.
- Responsive to the modeled alternative. The model is much more responsive in terms of representing alternative performance.

Challenges and Workarounds

- Representing the initial construction of armor. *Beach-fx* allows the user to simulate actions that would be taken in the future to protect property against storm damages. Using the prescribed approach makes simulating future behavior more challenging. Modeling future behavior was accomplished by creating a damage element type to represent initial armor construction, constructing a damage function that would spike to representing initial construction, and turning the number of times rebuilt attribute to 1. This "new armor" damage element was spatially located where initial construction would be anticipated to occur within the life cycle.
- Simulating armor as a damage element removes the protective attributes of the armor. The advantage of using the armor feature of *Beach-fx* is that while functioning, it simulates the prevention of erosion damages. The prescribed method does not incorporate this feature. To get around this limitation the following actions were taken:
  - The erosion protection feature of Beach-*fx* was left active while zeroing out the cost of armor protection as a lot level attribute.
  - active in the model road/armor maintenance cost was incorporated into the damage element.

Model Setup

1. Create the Damage Element Types: Five new damage element types were created to model the different kinds of armor in the study area, and the different conditions in which they would The following damage element types were created:
   a. *ARMOR-A1A & NEW ARMOR:* Existing and anticipated revetment built by FDOT to protect SR-A1A. This damage element type constitutes the overwhelming majority of the overall damages and is the primary focus of this write-up.
   b. *BULKHEAD & N-BULKHEAD:* Existing and anticipated vinyl pile bulkheads used to protect private residences in the Painters Hill (Reach-A) segment of the study area. These were used in concert with the armoring feature included in the model to achieve the spatial disaggregation of the damages, while protection for the residences in the study area.
   c. *SEAWALL:* Concrete panel and sheet pile metal seawalls, which receive little or no damage.
2. Create the Damage Functions: The damage functions are based on a collaborative effort by SAJ Economics and Coastal Engineering personnel. They were developed based on the armor failure thresholds pulled from the previously specified lot level attributes, where armor was initially specified.
   a. Damage Functions:
      The following section documents the damage functions. No damage accrues to the element until at least 50% of the footprint is compromised. As previously explained, these functions are based on the failure thresholds that were previously developed for the Flagler study. **Figure 2** shows the road damage function. As previously explained, the armor and the road itself are being modeled as a single integrated damage element. As seen in the table, the cost of a maintenance event is not incurred until at least 50% of the footprint in compromised. This is based on the assumption that the road must be

significantly damaged to warrant the cost of a maintenance event. **Figure 3** shows the damage function that was designed for the seawalls and bulkheads. In this case, the armor functions just as it would normally in *Beach-fx*. No damage occurs until 90-100% footprint is compromised, at which point the armor fails.

Figure 2: ARMOR-A1A Erosion Damage Function

% Footprint Compromised	Min	Most Likely	Max
0	0	0	0
10	0	0	0
20	0	0	0
30	0	0	0
40	0	0	0
49	0	0	0
50	0.5	0.5	0.5
60	0.51	0.6	0.75
70	0.52	0.7	1
80	0.53	0.8	1
90	0.54	0.9	1
100	0.55	1	1
	0	0	0

Figure 3:ARMOR-BULKHEAD Erosion Damage Function

% Footprint Compromised	Min	Most Likely	Max
0	0	0	0
90	0	0	0
100	1	1	1
	0	0	0

3. Spatially Locate the Damage Elements: Damage elements were dispersed throughout the study area on the seaward edge of the encompassing lot (ranging from 1 to 5 damage elements per lot). To model the initial construction of a revetment, the "NEW ARMOR" damage element type was spatially located were FDOT could be anticipated to take measures if SR-A1A were to be threatened by erosion. This damage element would accrue damages when hit, and then be deactivated. An "ARMOR-A1A" damage element was placed several feet behind the "NEW ARMOR", to capture recurring damages.

4. Determine the Damage Element Attributes: Armor value is based on actual maintenance cost provided by FDOT between 2000 and 2010. These figures were converted to a cost per LF, and are shown below.

Statistic	Cost/LF
Min	$60.39
Most Likely	$348.01
Max	$650.48

Cost/LF was multiplied by the along shore length of each damage element. Each ARMOR-A1A damage element was assigned a shore perpendicular width of ~70'. Previous rebuild times were also incorporated in the damage element.

Conclusion

The SAJ PDT feels confident in the results using this approach to model armor maintenance costs. The results we are getting with this method are reasonable and the method more accurately reflects what actually happens along the Flagler coast compared to other approaches to model armor.

Economics Appendix Addendum B: Future Without Project Condition Traffic Analysis Model Specification

1.1 Introduction

The purpose of this document is to describe the method used for estimating the cost of traffic rerouting due to erosion induced road/armor damage. Costs associated with traffic re-routing can be represented as damage elements and modeled to coincide with armor/road maintenance events. The purpose of this writing is to document the advantages theoretical considerations, methods, and results for estimating these costs using Beach-fx.

The advantages of this approach are analytical consistency, ease, and the ability to account for time sensitive conditions. Each traffic rerouting event can be tied to the occurrence of an armor/road structure damage event. Damage elements representing the revetment could be reconfigured to contain the overall present value traffic rerouting cost, and be easily extractible from model outputs. Knowing when and where traffic flow is most likely to be impacted in a study area could be of assistance in informing the plan formulation process. Model results could also provide support for sea level rise adaptation strategy considerations.

1.2 Theoretical Considerations

This section covers the theoretical underpinnings of representing the accrual of traffic re-routing costs as a damage element within Beach fx. The structure value of a particular damage element represents the depreciated replacement cost of the material and labor resources necessary for its existence. A damage elements content value can be envisioned conceptually as the opportunity cost of those resources typically deemed necessary to utilize the structure in a manner consistent with its intended purpose. For example, residential structures, content value is thought of as furniture, electronics, appliances, and other items not part of the structure, but commonly understood to be "necessary" to realize the benefits of housing. Commercial structure content values typically consist of the capital implements and/or inventory necessary to conduct the business associated with the structures intended business function. Therefore, the opportunity costs that must be incurred in order to use a road for its primary function (facilitating motorized transport) are the operating cost of the vehicles using the road.

However, the transportation value of a road consists of the difference between the cost of vehicle operation on the road in question and the cost of vehicle operation on the next best alternative route. This difference represents the 'benefit foregone' of no longer having the road in place. If the benefit that must be foregone due to road erosion damage can be: a)assessed a monetary value; b) applied coincident with the incursion of structure damage to the road providing the benefit; and c) cease to be applied when the road is repaired and serviceable, then that value can be stored as a data attribute within Beach-fx.

1.3 Method

This section of the appendix addresses the development of the triangular distribution of traffic costs and traffic reroute costs per damage element as well as the means by which these costs are stored and applied within Beach-fx. As alluded to in the previous section, these costs are stored as damage element level attributes in a triangular distribution of the structure value. Development of traffic costs within the study area encompasses the following components: 1) vehicle operating costs; 2) FDOT average annual daily traffic counts; and 3) typical and reroute travel distances within the study area.

1.3.1 Vehicle Operating Costs

The vehicle operating costs are based on the 2013 AAA per mile vehicle operating costs.[1] Vehicle operating cost per mile range from $0.52 for small sedans traveling 20,000 miles/year to $1.00 for 4WD sport utility vehicles traveling 10,000 miles/year.[2] The 2013 values were used to stay consistent with the price level for the rest of the structure inventory.

Vehicle operating costs were further refined by applying a percentage to each vehicle type category based on a 1999 US Department of Transportation study.[3] The percentage values derived in Table 1-1 were applied to estimate the composite cost in the last column in Table 1-2. The composite cost represents the range of operating costs per mile for vehicle travel.

Table 1-1: Distribution of Vehicle Types according to NPTS

VEHICLE TYPE	AVERAGE ANNUAL MILES DRIVEN	%
Automobile	11,318	22%
Van	14,389	28%
Sport Utility + Pickup	25,262	50%

Table 1-2: Development of Operating Costs per Mile

MILES/YEAR	COMPOSITE SEDAN	MINIVAN	SUV	COMPOSITE COST
10,000	$0.78	$0.84	$1.00	$0.91
15,000	$0.61	$0.65	$0.77	$0.70
20,000	$0.52	$0.56	$0.66	$0.60

[1] "Your Driving Cost, 2013 Edition", by AAA. Vehicle operating costs assume the vehicle travels 10,000, 15,000, and 20,000 miles per year.

[2] Decreased depreciation includes vehicles with an mileage accrual rate of less than less than 15,000 per year. Increased depreciation includes vehicles with mileage accrual rate of greater than 15,000 per year.

[3] "Growth in Motor Vehicle Ownership and Use: Evidence from the Nationwide Personal Transportation Survey" by Don Pickrell & Paul Schimek

1.3.2 Average Annual Daily Traffic Counts

Average Annual Daily Traffic Counts[4] (AADT): AADT spatial data is published by FDOT was geospatially associated with each traffic reroute damage element using GIS. Figure 1-1 illustrates the daily traffic count by range monument. Vehicle operating costs were applied to the AADT to convert the traffic count into value.

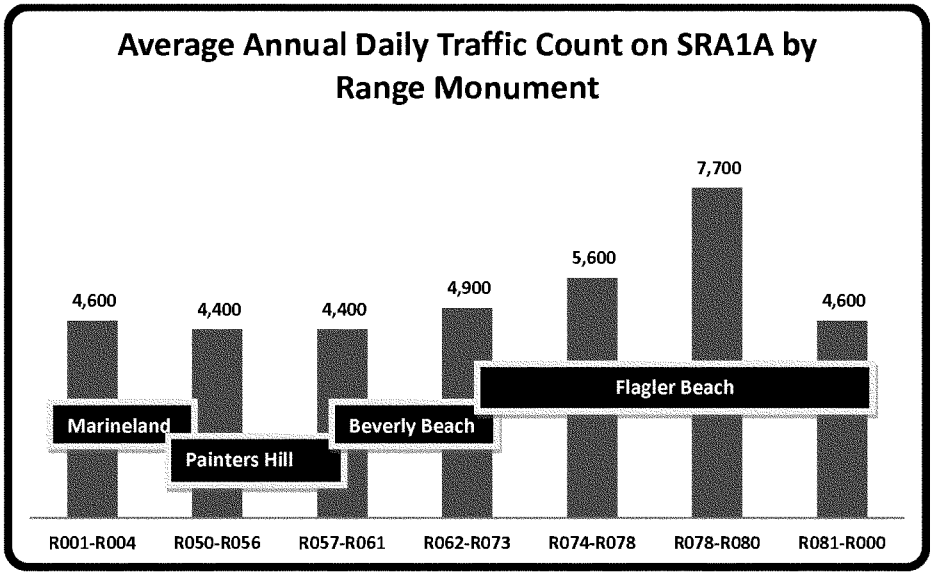


Figure 1-1: Average Annual Daily Traffic Counts

1.3.3 Typical and Re-routed Travel Distances

Table 1-3: Route Distances by Economic Reach

ECONOMIC REACH	TYPICAL LENGTH IN MILES	RE-ROUTED LENGTH IN MILES	TOTAL LENGTH IN MILES GIVEN A REROUTE EVENT
MARINELAND	0.63	8.00	8.63
PAINTERS HILL	1.74	20.00	21.74
BEVERLY BEACH	1.11	20.00	21.11
FLAGLER BEACH	6.15	0.25	6.40

The distance vehicles are likely to travel both with and without a reroute event is the next component of estimating the costs of rerouting traffic due to armor/road maintenance events. Applied re-routing distances are largely dependent on the location of the armor maintenance event.

[4] An annual average daily traffic count is the number of vehicles that travel a certain stretch of road divided by the # of days in the year.

1.3.4 Estimation of Traffic Cost

As mentioned previously, the damage element content value attributes were used to store the traffic value for each road/armor damage element. The value per lineal foot of road was estimated using the following equation:

$$TC_L = ((V_n * AADT)R_L)/5280\ ft$$

Where:

TC_L = traffic cost per lineal foot of road

V_N= vehicle operating cost per mile (V_1= minimum, V_2= most likely, V_3= maximum)

$AADT$ = average annual daily traffic count in vehicles per day

R_L = length of the road segment coincident with the FDOT traffic count in miles

The structure value triangular distribution for the damage element representing a particular segment of SRA1A was calculated using the following formulas[5]:

StructureMin: $TC_{DEMIN} = (TC_{V1} * DE_L)t_{DE}$

StructureML: $TC_{DEML} = (TC_{V2} * DE_L)t_{DE}$

StructureMax : $TC_{DEMAX} = (TC_{V3} * DE_L)t_{DE}$

Where:

$TC_{DEMIN, DEML, DEMAX}$= traffic cost of road segment represented by a damage element (triangular distribution)

$TC_{V1, V2, V3}$ = triangular distribution of traffic cost per lineal ft based on the min ($0.60), most likely ($0.70), and max ($0.91) vehicle operating cost per mile

DE_L = length of the damage element in ft (parallel to the coastline)

t_{DE} = most likely rebuild time of the damage element in days

Table 1-4 provides greater detail on the distribution of distances, traffic counts, and traffic value per lineal foot within the study area.

Table 1-4: Flagler County HSDR AADT Distribution

FLAGLER COUNTY DISTRIBUTION OF TRAFFIC & ESTIMATED COST/LF					
Location	Road Length Miles	AADT Counts	Min $/LF	Most Likely $/LF	Max $/LF
R001-R004	0.33	4,600	0.17	0.20	0.26
R050-R056	0.96	4,400	0.48	0.56	0.73
R057-R061	0.25	4,400	0.12	0.15	0.19
R062-R073	0.69	4,900	0.38	0.45	0.58
R074-R078	0.27	5,600	0.17	0.20	0.26
R078-R080	0.12	7,700	0.10	0.12	0.16
R081-R000	1.11	4,600	0.58	0.68	0.88

[5] Traffic costs per LF are based on vehicle operating cost per mile for a composite of sedan sizes, minivans, and SUV/trucks valued at .60, .70, & .91 cents per mile per year respectively.

1.3.5 Damage Function Application/Assumptions:

Road damage from erosion that undermines an area less than or equal to 70% of the road footprint is assumed to reduce the roads throughput by half. Road damage from erosion greater than 70% is assumed to produce a traffic rerouting event. This can be modeled using damage functions (discussed below). Approximate traffic rerouting distances were applied to SRA1A damage elements by study reach as follows: Marineland ~ 8 miles; Painters Hill ~ 20 miles; Beverly Beach ~ 20 miles; Flagler Beach ~ 0.25 miles.

Reroute cost were specified within Beach-fx by: estimating the cost of a traffic reroute event per damage element; determining the ratio of reroute cost to the traffic cost per damage element; and incorporating that ratio into an erosion structure damage function.

A triangular distribution of reroute cost per damage element was estimated as follows:

$$TC_{ALT} = (D_{ALT} * TC_L) t_{DE}$$

Where:

TC_{ALT} = traffic cost incurred due to a traffic reroute event

TC_{DE} = Traffic cost of the road segment represented by a damage element

D_{ALT} = reroute distance in ft

TC_L = traffic cost per lineal foot of road (TC_{L1}= minimum, TC_{L2}= most likely, TC_{L3}= maximum)

t_{DE} = most likely rebuild time of the damage element associated with the traffic reroute in days

Upon estimation of the traffic reroute costs, the ratio of traffic reroute cost per damage element to traffic cost per damage element was determined and specified within a number of damage functions. These functions were grouped according to each respective ratio of traffic reroute cost to damage element traffic cost. Table 1-5 and Figure 1-3 provides greater detail on the damage element types and functions used.

Table 1-5: Damage Element Types & Functions

DAMAGE ELEMENT TYPES & FUNCTIONS			
Damage Element Type	Damage Function Description	Fractional Damage to Structure 1% - 70%	> 70%
SRA1A-1	ERO-SRA1A-1	0.5	1.04
SRA1A-2	ERO-SRA1A-2	0.5	12.52
SRA1A-3	ERO-SRA1A-3	0.5	13.70
SRA1A-4	ERO-SRA1A-4	0.5	19.08

Table 1-5 shows detail on the factors that are applied to the traffic values to estimate the cost of constraining / rerouting traffic. Most of the traffic reroute events take place in Flagler Beach.

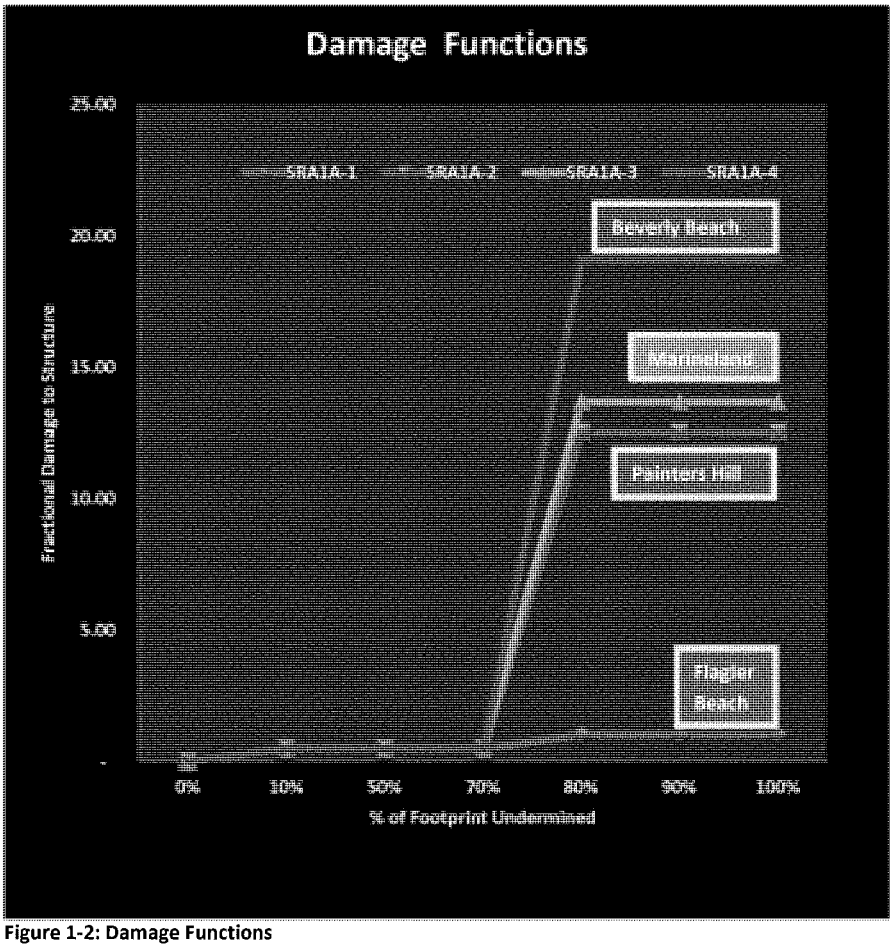


Figure 1-2: Damage Functions

Figure 1-3 provides an illustration of the new damage functions created to model the impact of road erosion on SRA1A's traffic within the study area. Percentages of the road's footprint undermined ranging between 1% - 70 % results in the loss of ½ of the traffic value. This essentially means that the roads average daily usage has been cut in half, by maintaining a single lane while repairs are made. When the percentage of footprint undermined exceeds 70%, the damage function generates a loss equivalent to the cost of a reroute event. Thus both lanes are closed and traffic must be rerouted. An explanation of the damage function examples depicted in the figure is as follows:

- ERO-SRA1A-1: $TC_{ALT}/TC_{DE} = 1$; describes the relationship between road/armor damage and maintenance events and traffic reroute costs in the Flagler Beach portion of the study area.
- ERO-SRA1A-2: $TC_{ALT}/TC_{DE} = 2$; describes the relationship between road/armor damage and maintenance events and traffic reroute costs in the Painters Hill portion of the study area.
- ERO-SRA1A-3: $TC_{ALT}/TC_{DE} = 3$; describes the relationship between road/armor damage and maintenance events and traffic reroute costs in the Marineland portion of the study area.
- ERO-SRA1A-4: $TC_{ALT}/TC_{DE} = 4$; describes the relationship between road/armor damage and maintenance events and traffic reroute costs in the Beverly Beach portion of the study area..

2 Traffic Cost Benefits

Traffic cost benefits are the difference in the cost for traffic between the future without and the future with project conditions. Both alternative scenarios were simulated in Beach-Fx using the following parameters:

- Base Year ~ 2018
- # of Observations/ Iterations~ 100
- Price Levels ~ FY 2014
- Discount Rate ~ 3.50%
- Foundation Critical Erosion Value = .8 ft
- Time to build roads triangular distribution
  - Minimum: 5 LF/day
  - Most likely: 7 LF/day
  - Maximum: 10 LF/day

Table 2-2 provides detail on the Beach-Fx result statistics, while Figure 2-1 illustrates the distribution of the benefits. The recommended plan produces $176,000 in average annual benefits. The benefits were reduced by about 26% to account only for the portion of the operating cost that varies with distance.

Table 2-1: % Distribution of Vehicle Operating Cost

Costs	% of Vehicle Operating Cost/Mile
Gas & Oil	23%
Maintenance	10%
Tires	2%
Insurance	10%
License & Registration	6%
Depreciation	40%
Financing	9%

Table 2-1 displays the distribution of vehicle operating cost on a percentage basis. Gas, oil, maintenance, tires, and depreciation are the portion of the cost that varies with distance. The combination of these cost components equal 74% of the cost to operate a vehicle. Based on these figures, the traffic benefits were reduced from $176,000 to $131,000.

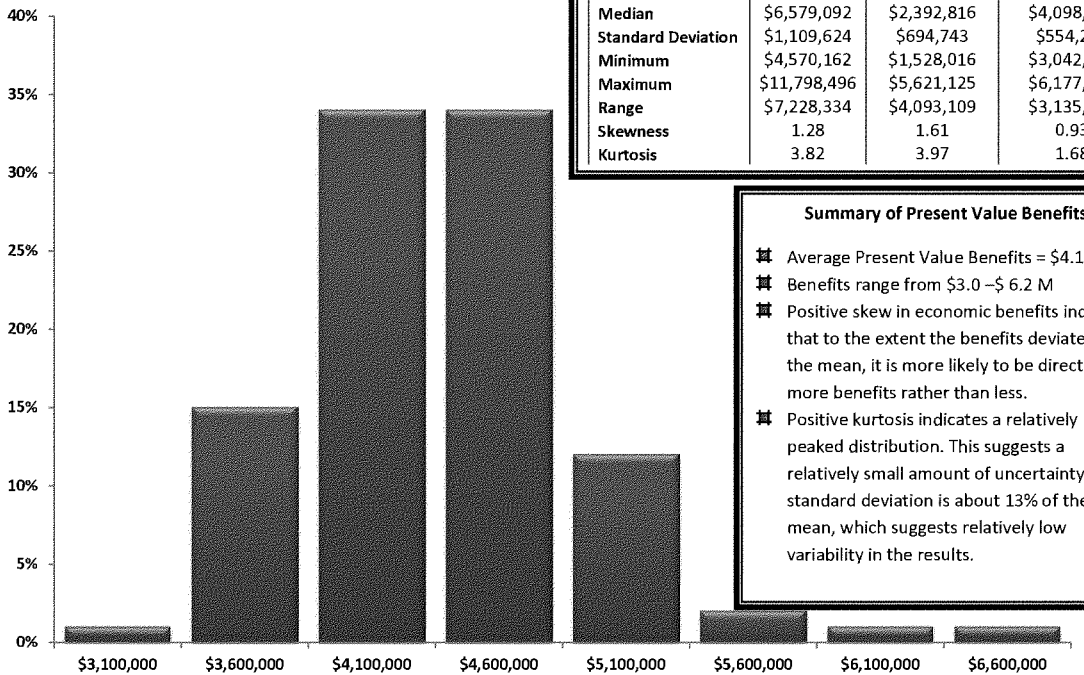


Table 2-2: Beach Fx Result Statistics

Statistic	Future w/o Project Condition	Future with Project Condition	Economic Benefits
Mean	$6,680,654	$2,548,321	$4,132,332
Median	$6,579,092	$2,392,816	$4,098,401
Standard Deviation	$1,109,624	$694,743	$554,279
Minimum	$4,570,162	$1,528,016	$3,042,146
Maximum	$11,798,496	$5,621,125	$6,177,371
Range	$7,228,334	$4,093,109	$3,135,225
Skewness	1.28	1.61	0.93
Kurtosis	3.82	3.97	1.68

Summary of Present Value Benefits

- Average Present Value Benefits = $4.1 M
- Benefits range from $3.0 –$ 6.2 M
- Positive skew in economic benefits indicates that to the extent the benefits deviate from the mean, it is more likely to be direction of more benefits rather than less.
- Positive kurtosis indicates a relatively peaked distribution. This suggests a relatively small amount of uncertainty. The standard deviation is about 13% of the mean, which suggests relatively low variability in the results.

Figure 2-1: Distribution of Traffic Benefits

FLAGLER COUNTY, FLORIDA

HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FINAL INTEGRATED FEASIBILITY STUDY AND
ENVIRONMENTAL ASSESSMENT

Appendix D

Geotechnical



USACE JACKSONVILLE DISTRICT

Appendix D
Geotechnical

FLAGLER COUNTY, FLORIDA

HURRICANE AND STORM DAMAGE REDUCTION PROJECT
INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT

March 2014

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1 BACKGROUND

This report includes a description of the regional and local geology of Flagler County, a sediment characterization of the native beach and a preliminary borrow area design. All boring logs and laboratory testing results are listed in **Table 2** through **Table 5** and depicted in **Plates 1 through Plate 5**. Boring logs and laboratory results are attached in the **Appendix**.

Additional borings in the borrow areas will be needed during the design phase of this project.

1.1 REGIONAL GEOLOGY

The Florida Peninsula occupies a portion of the much larger geologic unit called the Florida Plateau. Deep water in the Gulf of Mexico is separated from deep water of the Atlantic Ocean by this partially submerged platform nearly 500 miles long and 450 miles wide. In the last 200 million years, the plateau has been alternately dry land or covered by shallow seas. During that time up to 20,000 feet of carbonate and marine sediments were deposited. There has been a tilting of the Florida Plateau about its longitudinal axis. The west coast is partially submerged, as indicated by the wide estuaries and offshore channels, while the east coast is correspondingly elevated, showing the characteristics of an emergent coastline.

During the last million years, a series of four glacial periods, or ice ages, brought about significant changes in sea level. As a result of these sea level fluctuations, the Florida peninsula was again covered and uncovered by shallow seas. Following the first glacial period, sea level rose 270 ft. above its present level. Dry land on the Florida peninsula was then restricted to a few small islands along the central Florida ridge and in northeast Florida.

About 100,000 years ago, the last glacial period began. Sea level fell to 300 feet below its present level and the Florida Plateau emerged as dry land. Approximately 15,000 years ago, sea level began its most recent rise towards present sea level (Shinn, 1988). Sea level rose at an average rate of 30 feet per 1,000 years. About 7,000 years ago, the rate of sea level rise slowed when the sea level was about 30 feet below its present level. It was at this most recent slowing of sea level rise that the modern barrier islands of southeast peninsular Florida formed.

1.2 LOCAL GEOLOGY

Flagler County's approximately 19 Miles of open-ocean shoreline has no embayment or inlets. The barrier island extends over 50 Miles uninterrupted from Matanzas Inlet to the north to Ponce de Leon Inlet in the south. The barrier island is separated from the mainland by the Matanzas River, Smith Creek, and the Intracoastal Waterway.

Beaches along Flagler County are shelly and of a pinkish orange color. This is due the shell material derived from the Anastasia formation which outcrops off-shore of Flagler county and also at Hammock beach in northern Flagler county. The Pleistocene Anastasia Formation is comprised of clay, sand, and shell, and of coquina rock, which is composed of shells and quartz lithified in a calcite matrix. The Anastasia Formation reaches thickness of 20 to 140 feet.

Pliocene/Miocene sediments underlay the Anastasia formation and are comprised of interbedded layers of marine, fine to medium sand, shell and green, calcareous, silty clay. These sediments vary in thickness (20-100 feet) throughout the county.

Underneath the Pliocene/Miocene Sediments follow the deposits of the Hawthorn Group which is of middle Miocene age and consists mainly of dark gray and olive green sandy to silty clay, clay, clayey sand, and thin layers of sandy limestone, and contains moderate to large amounts of black phosphate sand, granules, and pebbles. The Hawthorn Group ranges in thickness from a few feet to 120 feet. The formation varies in thickness from place to place because of both an irregular upper and lower surface. The Hawthorn Group occurs at depths ranging from approximately 30 to 240 feet below land surface.

2 NATIVE BEACH

2.1 GENERAL

The original study area included the Flagler County shoreline at Marineland, Painters Hill, Beverly Beach and Flagler Beach. Locations are listed by FDEP Reference Monument (R-Monument) ranges in **Table 1** and are depicted on **Plate B-1.** Marineland, Painters Hill, Beverly Beach, and part of Flagler Beach were excluded in the course of the study due to the lack of infrastructure needing protection. Therefore the recommended plan for the project includes only the southern part of Flagler Beach from R-80 to R-94.

Table 1: Flagler Beaches

Beach	FDEP Reference Monument (R-monument)
Marineland	R-1 to R-4
Painters Hill	R-50 to R-60
Beverly Beach	R-60 to R-67
Flagler Beach	R-67 to R-101

2.2 NATIVE BEACH SAMPLING AND ANALYSIS

Beach sediment sampling was performed by the USACE in August 2012 along the following representative beach profile lines: R-81, R-85, R-89, and R-93. Sampling profile line locations are depicted on the attached **Plate B-2**.

Beach sediment samples were collected along the respective profile lines at the following locations as shown in **Figure 1**: Toe of Dune, Berm, Mid-tide, and -3, -5, -10, -15, and -20 below Mean Sea Level.

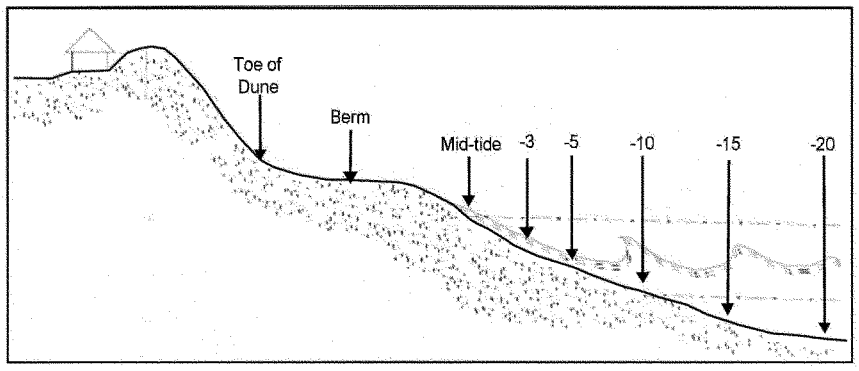


Figure 1. Beach Transect with Beach Sampling Locations

Due to the severe erosion, some of the beaches don't show this typical profile. At some locations, the dune is replaced by revetment, and therefore no sample was collected.

All samples were analyzed for grain size, visual shell and Munsell Color. Carbonate analysis was performed on representative samples. The associated gradation curves and granularmetric reports are presented in the Appendix.

An arithmetic composite sample was created from all samples. The granulometric results using the method of moments for each sample and for the composite sample are summarized in **Table 2.**

The test results characterize the sediments at Flagler Beach as poorly-graded, fine-grained quartz sands. The mean grain size ranges between 0.14 mm (2.84 phi) and 0.67 mm (0.58 phi) averaging at 0.28 mm (1.85 phi). The carbonate content ranges from 8% to 64% averaging at 25%. The visual shell averages 23%, and the color of the sand is generally light gray to pinkish gray. Samples collected at the berm and at mid-tide locations have especially high shell contents caused by the deposits from the Anastasia formation, which also causes the typical pinkish grey color of the Flagler County beaches.

Table 2: Flagler Beach, Beach Sediment Analysis

Point ID	Number	USCS	Mean (mm)	Mean (phi)	Gravel* (Shell)	Silt **	Std. Dev. (phi)	Visual Shell %	Carbo-nate %	Munsell Color (wet)
R-81	Toe of Dune	Dune not existent. No sample taken.								
	Berm	SP	0.43	1.22	0	0.07	0.9	42.9	40.3	7.5YR 7/2
	Mid-Tide	SP	0.41	1.29	0	0.05	1	42.8		7.5YR 7/2
	-3	SP	0.17	2.56	0	0.81	0.54	2.8		10YR 7/1
	-5	SP	0.17	2.56	0	0.64	0.47	1.9		10YR 7/1
	-10	SP	0.17	2.56	0.18	0.87	0.79	5.7	8.3	10YR 7/1
	-15	SP	0.18	2.47	0.14	1.1	0.97	8.9		10YR 7/1
	-20	SP	0.14	2.84	0	1.21	0.51	2		10YR 6/1
R-85	Toe of Dune	Dune not existent. No sample taken.								
	Berm	SP	0.37	1.43	0.08	0.11	0.89	31.9		7.5YR 7/2
	Mid-Tide	SP	0.27	1.89	0	0.32	0.82	22.6		7.5YR 7/1
	-3	SP	0.25	2.00	0	0.84	1.02	21.5		7.5YR 7/3
	-5	SP	0.22	2.18	0	0.81	0.88	16.1		7.5YR 7/1
	-10	SP	0.16	2.64	0.01	1.14	0.72	7.4	8	10YR 7/1
	-15	SP	0.17	2.56	0.13	1.5	0.84	8.3		10YR 7/2
	-20	SP	0.14	2.84	0.02	1.18	0.55	3.4		10YR 7/2
R-89	Toe of Dune	Dune not existent. No sample taken.								
	Berm	SP	0.4	1.32	0	0.04	1	41.9	39.2	7.5YR 7/2
	Mid-Tide	SP	0.67	0.58	0	0.16	1.14	65.9		7.5YR 7/3
	-3	SP	0.66	0.60	1.06	0.65	1.31	60.9		7.5YR 7/1
	-5	SP	0.17	2.56	0	1.43	0.58	5.9		10YR 7/1
	-10	SP	0.17	2.56	0.42	0.97	0.89	10.3	10.4	10YR 7/2
	-15	SP	0.17	2.56	0	2.41	0.92	11.8		10YR 7/2
	-20	SP	0.14	2.84	0.01	0.66	0.55	7.5		10YR 7/2
R-93	Toe of Dune	SP	0.59	0.76	0	0.03	0.84	71.8		7.5YR 7/2
	Berm	SP	0.64	0.64	0	0.14	0.95	76.5	64.5	7.5YR 7/3
	Mid-Tide	SP	0.32	1.64	0	0.95	1.09	35.3		7.5YR 7/3
	-3	SP	0.21	2.25	0	3.98	0.83	11.3		10YR 7/1
	-5	SP	0.19	2.40	0	0.18	0.7	28.2		10YR 7/1
	-10	SP	0.15	2.74	0	1.79	0.68	6.8	8.4	10YR 7/1
	-15	SP	0.17	2.56	0.13	1.22	1	12.7		10YR 6/1
	-20	SP	0.15	2.74	0.2	1.59	0.65	4.8		10YR 6/1
Flagler Beach Composite		**SP**	**0.28**	**1.85**	**0.08**	**0.93**	**0.83**	**23**	**25**	**Light to pinkish gray**

*Retained in the #4 Sieve, **Passing the #230 Sieve

3 BORROW AREAS

3.1 SAND SEARCH INVESTIGATIONS

A number of potential borrow areas were identified in the USACE Reconnaissance Report from 2004. Potential borrow areas included the ebb shoal of Matanzas Inlet, the IWW, and three off-shore shoals. The IWW and Matanzas Inlet ebb shoal were ruled out early in the process because of their limited volumes and only the three off-shore borrow areas (Area 1, Area 2, Area 3) were investigated via vibracoring. The Locations are depicted on the attached map **Plate B-1**. In addition to those offshore borrow areas, upland sand sources were also evaluated but were excluded from the study because they could not provide the quality and quantity of sand needed.

Florida Administrative Code 62B-41.007(2) requires that beach fill meets the following requirements:

- Carbonate or quartz with a particle size between 0.062 and 4.76mm
- <5% silt passing the #230 sieve
- <5% gravel sized shell retained on the #4 sieve
- Fill material must be free of foreign matter, debris, toxic material
- Fill material shall be similar in color and grainsize distribution

Halcrow Inc. investigated Area 1, which is part of the Farmton Sand Flat B geomorphologic unit, and is located approximately 2 Miles off-shore of Flagler Beach. All results are presented in the Report "Flagler Beach Shore Protection Project Feasibility Sand Search Report, March 2010 by Halcrow, Inc."

The investigation included sub bottom surveys and approximately 40 vibracores and grain size analysis on selected samples. Most vibracores show a 1 to 3-ft thick beach-compatible top sand layer. Only a few vibracores show a 3 to 5 ft thickness of beach compatible sand. However, sand thicknesses less than 5 feet are not considered dredgeable since state regulations require a 2-ft buffer above the underlying non-beach compatible layers. Therefore, Area 1 does not contain enough beach compatible material to be used as borrow area.

Area 2 and Area 3 were investigated by the USACE, Jacksonville district in 2011. Both areas are located in Federal Waters. Area 2 is part of the Korona Ridge Field geomorphologic unit and is located approximately six to seven miles off-shore of Flagler Beach. Area 3 is part of the Flagler Sand wave geomorphologic unit and is located approximately twelve to fourteen miles off-shore of Flagler Beach. Ten 20-foot vibracores were drilled in Area 2 and thirteen 20-foot vibracores were drilled in Area 3. The recovery of the vibracores is sometimes significantly less than 20 feet due to the underlying rock which could not be penetrated with the vibracore

apparatus. Laboratory testing was performed on selected sediment samples. Boring locations are shown on **Plate B-3**. Boring logs and laboratory test results are attached in the appendix.

3.2 PROPOSED BORROW AREAS 2A, 2B, AND 2C

Thicknesses of the beach compatible sand layers vary from 5 to 18 feet in Area 2. Conservative values between 5 and 7 feet below seafloor surface were used as dredging depths for the volume estimates shown in **Table 3**. However, the indicated dredging depths may change with the availability of additional testing results. The estimates indicate that Area 2 contains approximately 5.5 million cubic yards (mcy) of beach compatible sand within three subareas: Areas 2A, 2B, and 2C. Borrow areas 2A and 2B are located offshore Flagler County and are estimated to contain a combined volume of 3 mcy. Borrow area 2C is located off-shore Volusia County and is estimated to contain approximately 2.5 mcy of beach compatible sand. The borrow areas are depicted in **Plate B-3** and details are summarized in **Table 3** below. Water depths are between -50 and -60 feet North Atlantic Vertical Datum (NAVD) 88 as shown on **Plate B-4**.

Table 3: Proposed Borrow Areas 2A, 2B, 2C

Sub-area	Size (ft)	Borrow Area Size (acres)	Sand Thickness Encountered (feet)	Sand Thickness used for Volume Estimate (feet)	Volume Estimate (mcy)	Borings
2a	8,500 x 2,400	219	5 to 8	5	1.7	VC-FSP11-14, VC-FSP11-16
2b	5,000 x 1,600	117	up to 18	7	1.3	VC-FSP11-15
2c	8,700 x 2,600	332	5 to 11	5	2.5	VC-FSP11-22,

Four (4) 20-foot vibracores (VC-FSP11-14 through VC-FSP11-16, and VC-FSP11-22) were collected in February 2011 within the proposed subareas 2A, 2B, and 2C as shown on **Plate B-3** and depicted in **Figure 2**.

3.2.1 Borrow Area 2A

An arithmetic composite sample was calculated using all samples within the borrow area 2A design depth. The composite sample indicates that the sediments are poorly-graded, fine grained sands with a mean grain size that ranges from 0.19 mm (2.37 phi) to 0.37 mm (2.42 phi), with an average of 0.26 mm (1.98 phi). Visual shell values average 18%. The amount of fines passing the #230 sieve averages 1.80 %. The wet Munsell color of the sand is 10Y 5/1 (greenish gray) and the dry color is N 7/1 (light gray).

3.2.2 Borrow Area 2B

An arithmetic composite sample was calculated using all samples within the borrow area 2B design depth. The composite sample indicates that the sediments are poorly-graded, fine grained sands with a mean grain size that ranges from 0.18 mm (2.51 phi) to 0.65 mm (0.62 phi), with an average of 0.30 mm (1.73 phi). Visual shell values average 23%. The amount of fines passing the #230 sieve averages 3.8 %. The wet Munsell color of the sand is 10Y 4/1 (dark greenish gray) and the dry color is N 7/1 (light gray).

3.2.3 Borrow Area 2C

An arithmetic composite sample was calculated using all samples within the borrow area 2C design depth. The composite sample indicates that the sediments are poorly-graded, fine grained sands with a mean grain size that ranges from 0.17 mm (2.53 phi) to 0.20 mm (2.29 phi) with an average of 0.19 mm (2.39 phi). Visual shell values average 12%. The amount of fines passing the #230 sieve averages 1.9 %. The wet Munsell color of the sand is 5GY 5/1 (greenish gray) and the dry color is N 7/1 (light gray).

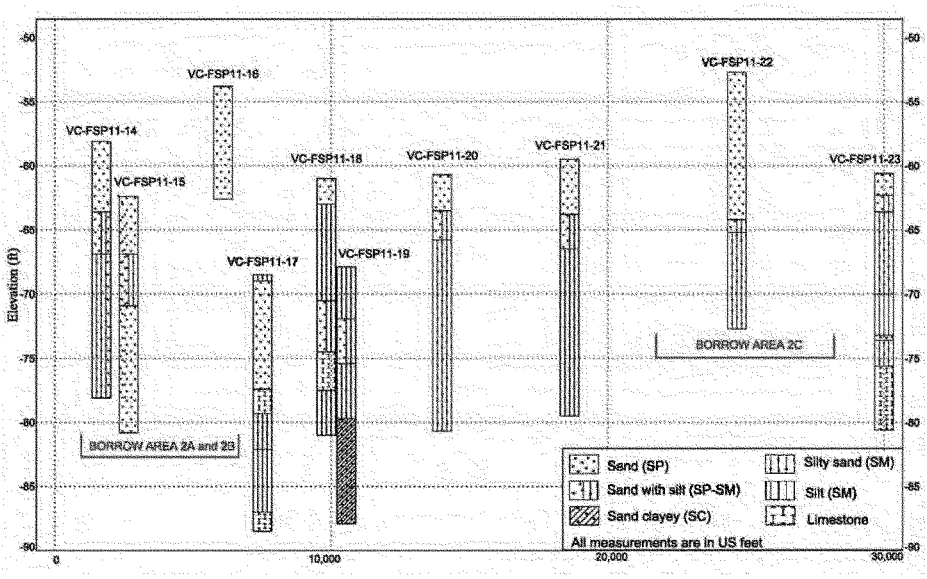


Figure 2. Borrow Area 2, 2011 Core Borings

3.2.4 Borrow Areas 2 Combined

An arithmetic composite sample for Area 2, including borrow area 2A, 2B, and 2C, was calculated using all samples within the borrow area design depths. The composite sample indicates that the sediments from borrow areas 2A, 2B, and 2C are poorly-graded, fine grained sands with a mean grain size that ranges from 0.17mm (2.53 phi) to 0.65 mm (0.62 phi), with an average of 0.26 mm (1.98 phi). Visual shell values average 19% and carbonate content averages 15 %. The amount of fines passing the #230 sieve averages 2.89 %. The wet Munsell color of the sand is 5Y 5/1 (greenish gray) and the dry color is N 7/1 (light gray).

Table 4: Sediment Characteristics of Proposed Borrow Areas 2A, 2B, 2C

PointID	Number	USCS	Mean (mm)	Mean (phi)	Gravel* (Shell)	Silt**	Std. Dev. (phi)	Visual Shell %	Carbo-nate %	Munsell Color (wet)
VC-FSP11-14	1	SP	0.26	1.92	1.29	0.96	1.04	16		10Y 5/1
VC-FSP11-14	2	SP	0.26	1.95	1.15	1.36	1.12	18		10Y 5/1
VC-FSP11-14	3	SP	0.23	2.10	1	4.52	1.22	22		5GY 5/1
VC-FSP11-16	1	SP	0.19	2.37	0.19	1	0.63	8		5GY 6/1
VC-FSP11-16	2	SP	0.20	2.32	0.31	0.91	0.72	7	12	5GY 6/1
VC-FSP11-16	3	SP	0.37	1.42	6.27	2.02	1.74	37		10Y 5/1
Borrow Area 2A Composite			**0.25**	**1.98**	**1.70**	**1.80**	**1.08**	**18**	**12**	**gray**
VC-FSP11-15	1	SP	0.29	1.80	1.17	1.46	1.15	22		10Y 4/1
VC-FSP11-15	2	SP	0.18	2.51	0	2.74	0.57	10		10Y 4/1
VC-FSP11-15	3	SP-SM	0.19	2.41	0	8.55	0.86	13		10Y 4/1
VC-FSP11-15	4	SP	0.65	0.62	13.16	3.08	2.13	49		5GY 4/1
VC-FSP11-15	5	SP	0.20	2.29	0.2	3.11	0.83	20		10Y 6/1
Borrow Area 2B Composite			**0.30**	**1.73**	**2.91**	**3.79**	**1.11**	**23**	**n/a**	**gray**
VC-FSP11-22	1	SP	0.20	2.29	0.03	1.02	0.67	18		5GY 5/1
VC-FSP11-22	4	SP	0.18	2.46	0	2.36	0.51	5		5GY 5/1
VC-FSP11-22	7	SP	0.20	2.29	0	1.95	0.66	14	17	5GY 5/1
VC-FSP11-22	10	SP	0.17	2.53	0	2.47	0.56	9		5GY 5/1
Borrow Area 2C Composite			**0.19**	**2.39**	**0.01**	**1.95**	**0.60**	**12**	**17**	**gray**
Borrow Area 2 Combined Composite			**0.26**	**1.98**	**1.65**	**2.50**	**0.96**	**18**	**15**	**gray**

* Retained in the #4 Sieve, **Passing the #230 Sieve

3.3 PROPOSED BORROW AREA 3A

Beach compatible sand was identified throughout Area 3. However, since Area 3 is approximately 12,000 acres, only a selected portion (Area 3A) of the area is proposed as a borrow area for this project (**Plate B-3).** Area 3A is approximately 2 Miles long and 1 Mile wide and has an estimated 20 mcy of beach-compatible sand. The Thickness of the encountered beach compatible sand layer varies from 7 to 14 feet. A conservative value of 5 feet below seafloor surface was used as a dredging depth for the volume estimate as shown in **Table 5.** However, the indicated dredging depth may change with the availability of additional testing results. Water depths are between -50 and -60 ft NAVD88, as shown on **Plate B-5.**

Table 5: Proposed Borrow Area 3A

Sub-area	Size (ft)	Borrow Area Size (acres)	Sand Thickness Encountered (ft)	Sand Thickness used for Volume Estimate (feet)	Volume (mcy)	Borings
3A	13,000 x 8000	2300	7ft. to 14	5	20	VC-FSP11-3, VC-FSP11-4, VC-FSP11-5 VC-FSP11-6

Four (4) 20-foot vibracores (VC-FSP11-3 through VC-FSP11-6) were collected in February 2011 within the proposed subarea 3A as shown on **Plate B-3** and depicted in **Figure 3.**

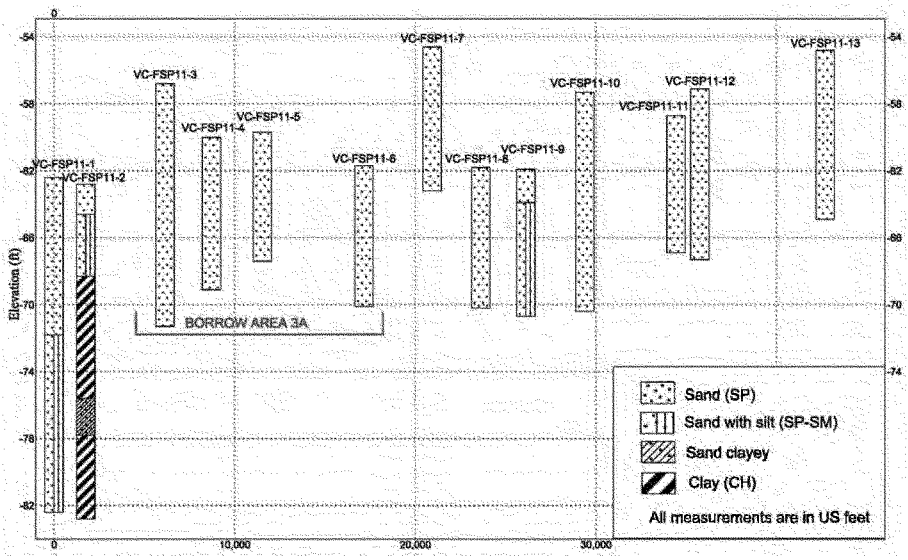


Figure 3: Borrow Area 3, 2011 Core Borings

Discrete samples were analyzed for grain-size, visual shell and carbonate content. Laboratory testing results and granulometric statistics, calculated using the method of moments, are summarized in **Table 6**.

An arithmetic composite sample was calculated using all lab samples within the borrow area design depth. The composite sample indicates that the sediments from borrow area 3A are poorly-graded, fine grained sands. The mean grain size ranges from 0.19 mm (2.40 phi) to 0.47 mm (1.09 phi), with an average of 0.29 mm (1.79 phi). Visual shell averages 16% and carbonate content averages 27%. The amount of fines passing the #230 sieve averages 1.7%. The wet Munsell color of the sand is 10Y 5/1 (greenish gray) and the dry color is N 7/1 (light gray).

Table 6: Sediment Characteristics of Proposed Borrow Area 3A

PointID	Number	USCS	Mean (mm)	Mean (phi)	Gravel* (Shell)	Silt **	Std. Dev. (phi)	Visual Shell %	Carbo -nate %	Munsell Color (wet)
VC-FSP11-3	1	SP	0.32	1.64	1.1	1.24	1.15	22		10Y 6/1
	2	SP	0.25	2.00	0	0.9	0.79	14		10Y 6/1
	3	SP	0.28	1.84	0.53	0.96	0.97	14	18	10Y 6/1
	4	SP	0.21	2.25	0.33	2.11	0.76	7		10Y 6/1
	5	SP	0.19	2.40	0	3.12	0.73	7		10Y 6/1
VC-FSP11-4	1	SP	0.38	1.40	0.45	1.08	1.08	27		10GY 5/1
	2	SP	0.47	1.09	15.67	1.82	1.44	25	40	10GY 5/1
	3	SP	0.23	2.12	1.84	1.44	1.01	7		10GY 5/1
VC-FSP11-5	1	SP	0.31	1.69	1.21	1.9	1.11	19	23	5GY 5/1
	2	SP	0.27	1.89	0.16	0.66	0.91	17		5GY 5/1
	3	SP	0.22	2.18	0	1.49	0.65	8		5GY 5/1
VC-FSP11-6	1	SP	0.31	1.69	0.43	0.54	0.92	14		5GY 5/1
	2	SP	0.29	1.79	2.19	2.22	1.29	18		5GY 5/1
	3	SP	0.3	1.74	0	1.21	1	24	26	5GY 5/1
Borrow Area3A Composite			0.29	**1.84**	**1.7**	**1.5**	**1.0**	**15.9**	**26.8**	**gray**

*Retained in the #4 Sieve, **Passing the #230 Sieve

4 COMPATIBILITY OF THE BORROW AREA WITH THE BEACHES

Grain size distribution, Overfill Factor and Renourishment Factor are used to determine if the proposed borrow areas are compatible with the Flagler beaches.

4.1 GRAIN SIZE DISTRIBUTION

Grain size analyses were performed on beach samples from Flagler County's Beaches and on discrete samples of the proposed off-shore borrow areas. Samples were analyzed for grain-size, visual shell and carbonate content. An arithmetic composite sample was calculated from the granulometric results. The composite sample results for the beach, borrow areas 2A, 2B, 2C, borrow areas 2 combined, and borrow area 3A are summarized in **Table 7** and discussed below.

The native beach sediments of Flagler Beach consist of poorly-graded, fine-grained quartz sand with a mean grain size of 0.28 mm (1.85 phi), an average carbonate content of 25%, and an average silt content of 0.9 %. The material from the borrow area 2A, 2B, 2C consists of poorly-graded, fine-grained quartz sand with a mean grain size of 0.25 mm for Area 2A, 0.30 mm for Area 2B, and 0.19 mm for Area 2C. The combined Area 2 average grainsize is 0.26mm (1.94 phi), the average carbonate content of 15%, and an average silt content of 2.89 %. The material from the borrow area 3A consists of poorly-graded, fine-grained quartz sand with a mean grain size of 0.29 mm (1.79 phi), an average carbonate content of 27%, and an average silt content of 1.48 %.

The testing results show that the material from borrow areas 2A, 2B, and 3A are very similar and compatible with the native beach and also meet the requirements of Florida state regulation. The material from borrow area 2C is very fine grained and would have to be mixed with coarser material to be compatible with Flagler County's beaches.

Table 7: Sediment Analysis Summary

Composite Designation	USCS	Mean (mm)	Mean (phi)	Gravel* (Shell)	Silt **	Std. Dev. (phi)	Visual Shell %	Carbo-nate %	Munsell Color
Borrow Area 2A	SP	0.25	1.98	1.70	1.80	1.08	18	12	gray
Borrow Area 2B	SP	0.30	1.73	2.91	3.79	1.11	23	n/a	gray
Borrow Area 2C	SP	0.19	2.39	0.01	1.95	0.60	12	17	gray
Borrow Area 2 Combined	SP	0.25	1.98	1.65	2.50	0.96	18	15	gray
Borrow Area3A	SP	0.29	1.84	1.7	1.5	1.0	15.9	26.8	gray

*Retained in the #4 Sieve, ** Passing the #230 Sieve

4.2 OVERFILL AND RENOURISHMENT FACTOR

The Overfill and Renourishment Factors were devised to estimate the predicted performance of borrow materials with respect to the native beach materials, both during initial beach stabilization and over the long term. Thus, they help in choosing the best available borrow material. The factors also are used to calculate fill construction volume and renourishment volumes.

Overfill and Renourishment Factors are calculated using the sediment grainsize and standard deviation of the native beach and the borrow area.

The analysis results for Flagler beach are summarized in **Table 8.**

4.2.1 Overfill Factor

The Overfill Factor (RA) is primarily a volume factor which may be used to calculate an intentional overfill to compensate for volume loss during the initial construction. The RA is used to determine which alternative borrow material will provide the lowest placement volume and thus is most compatible with the existing beach. An overfill factor greater than 1.3 is considered unsuitable.

The RA for Flagler Beach was calculated using the USACE software program for each of the borrow areas. The RA for borrow area 2A = 1.21, area 2B = 1.10, area 2C = 14.62, and area 3A = 1.06. Therefore borrow areas 2A, 2B, and 3A are suitable for placement on Flagler County's beaches. The RA for borrow area 2C is very high and characterizes the borrow material as unstable for Flagler County's beaches.

4.2.2 Renourishment Factor

The Renourishment Factor (RJ) estimates long term relative erosion rates of borrow materials with respect to native materials. This is done by assuming all grains have a finite residence time in the local littoral system before being transported offshore or alongshore. Larger grains remain longer. The RJ is primarily a measure of relative long-term stability. RJ values greater than one predict the borrow material will erode at a higher rate than the native beach. Conversely, values of less than one predict the borrow material is more stable. A RJ greater than 1.1 is considered unsuitable

The RJ for Flagler Beach was calculated using the USACE software program for each of the borrow areas. The RJ for borrow area 2A = 0.83, area 2B = 0.58, area 2C = 2.43, and area 3A = 0.88. Therefore borrow areas 2A, 2B, and 3A are suitable for placement on Flagler County's beaches. The RJ for borrow area 2C is very high and characterizes the borrow material as unstable for Flagler County's beaches.

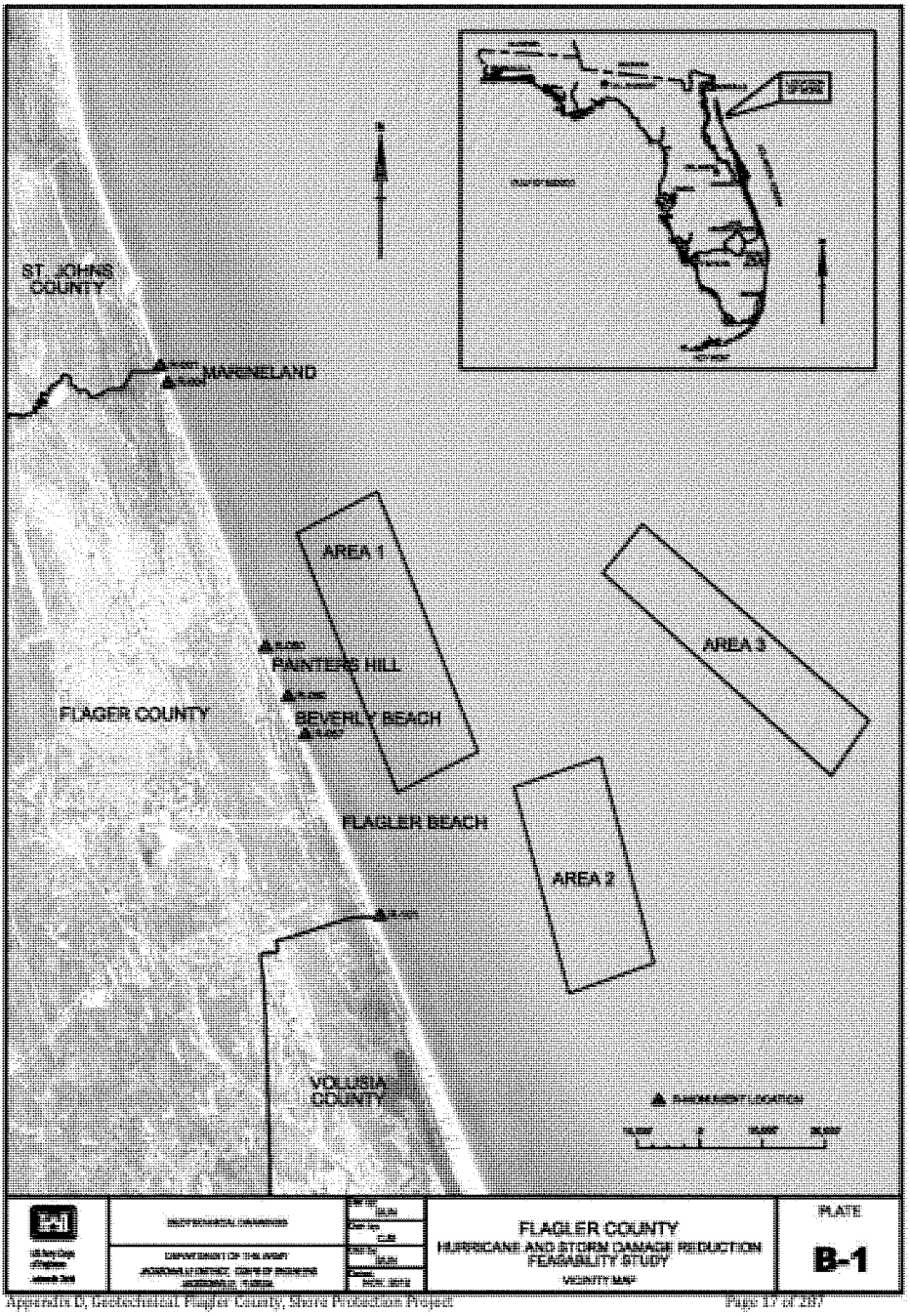
4.3 COMPATIBILITY SUMMARY

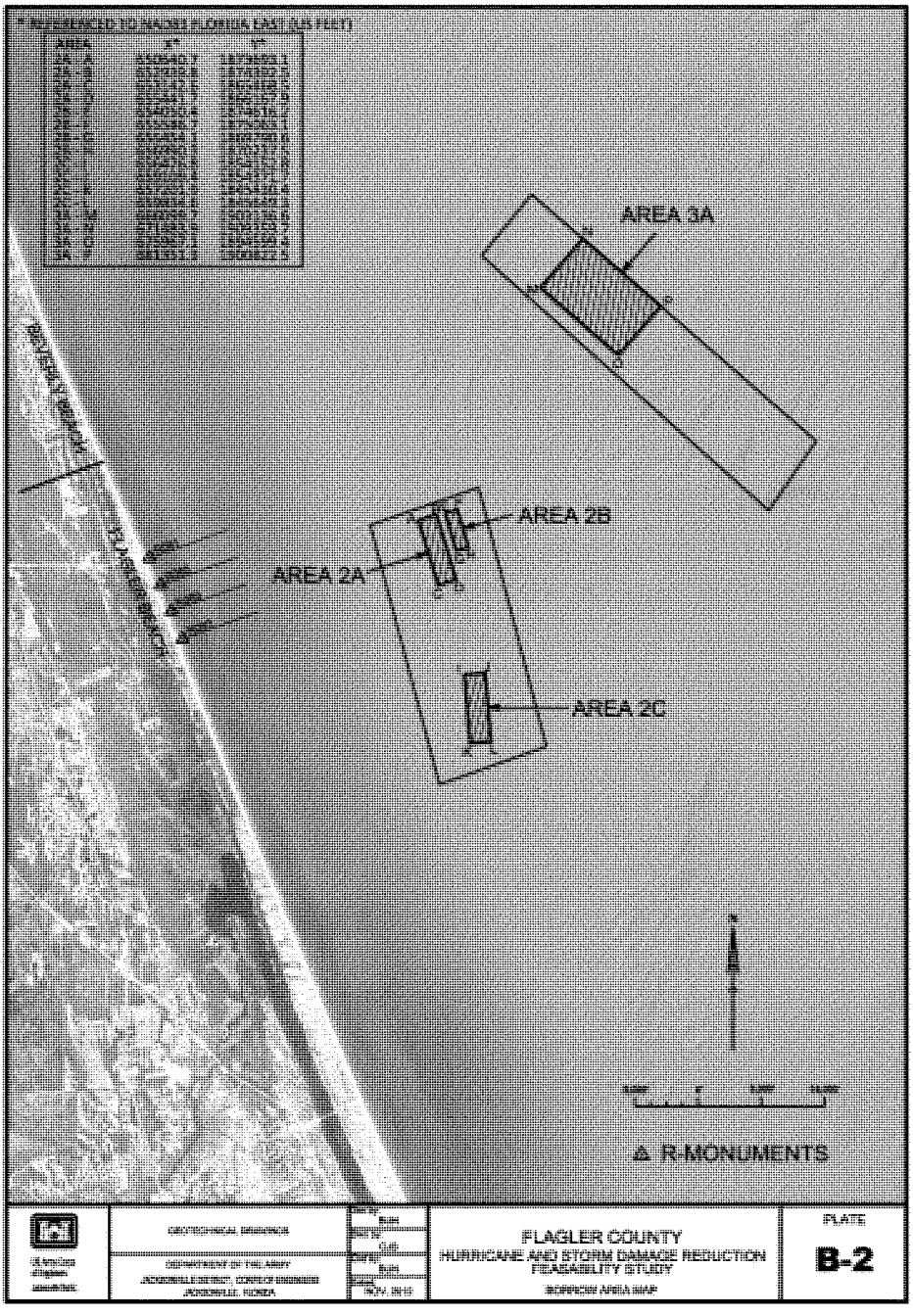
Grain size distribution, Overfill Factor and Renourishment Factor computations were used to determine if the proposed borrow areas 2A, 2B, 2C and 3A are compatible with the native beach. The compatibility analysis results for Flagler County's beaches are summarized in **Table 8.**

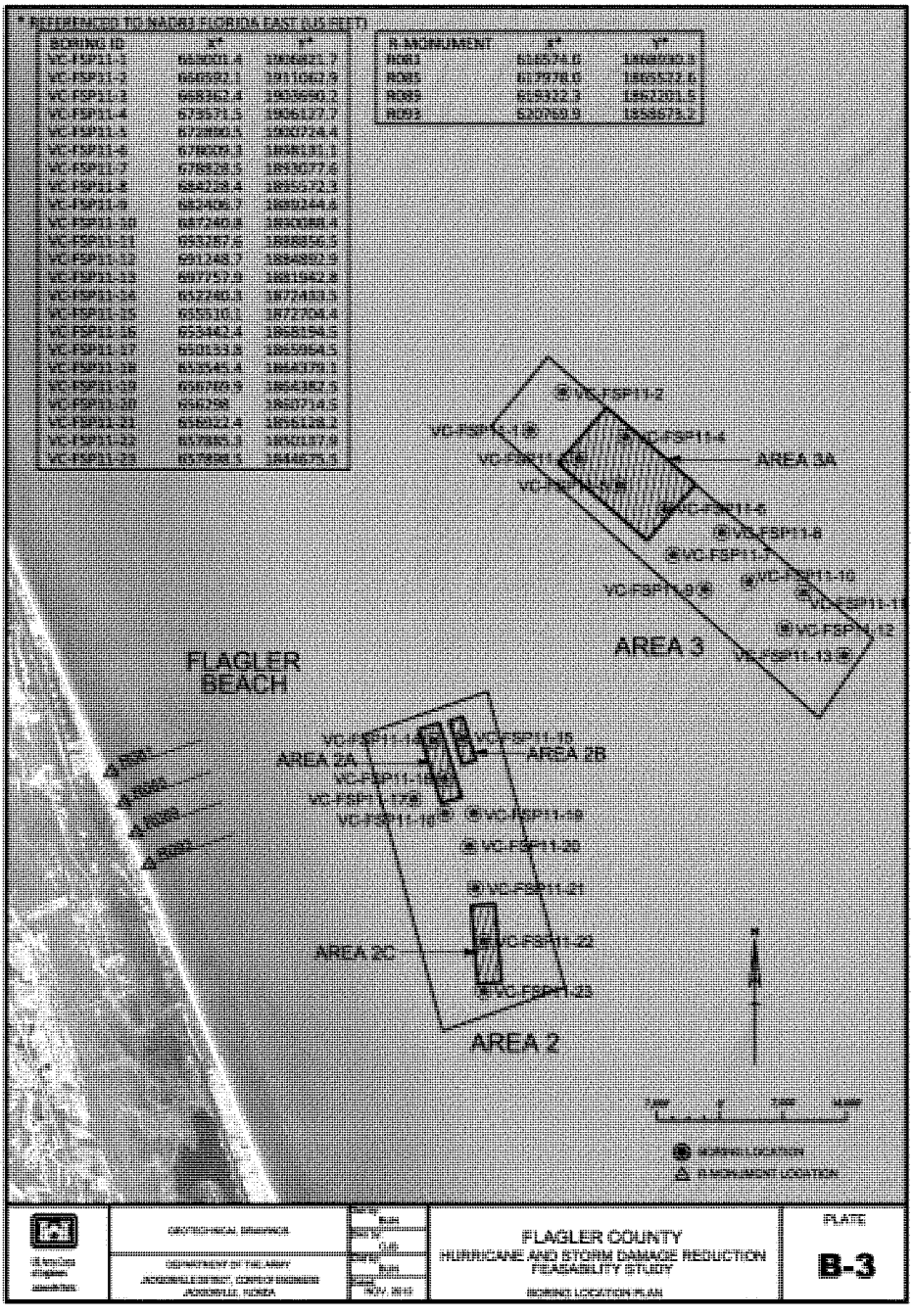
The grain size analysis revealed that the sediments of the borrow areas are composed of fine-grained quartz sand with visual shell values between 12% and 23%. The beach is also composed of fine-grained quartz sand with a visual shell value of 23%. The Overfill and Renourishment Factors for Flagler beach were calculated for each of the borrow areas using the USACE software program. Borrow areas 2A, 2B, and 3A showed Overfill Factors well below 1.3 and Renourishment Factors below 1.1 and are therefore suitable for Flagler County's beaches. The material from borrow area 2C is too fine and too poorly sorted to be compatible with Flagler County's beaches. However it could still be used if mixed with the sediments from the other proposed borrow areas. Also, additional investigation could reveal coarser material in borrow area 2C.

Table 8: Summary of Sediment Characteristics

	Borrow Area 2				Borrow Area 3A	Native Beach
	Borrow Area 2A	Borrow Area 2B	Borrow Area 2C	Borrow Area 2 Combined		
Mean (mm)	0.25	0.30	0.19	0.26	0.29	0.28
Mean (phi)	1.98	1.73	2.39	1.94	1.79	1.85
Standard Deviation (phi)	1.08	1.11	0.60	1.01	0.99	0.83
Visual Shell %	18	23	12	19	16	23
Overfill Factors, RA	1.21	1.10	14.62	1.15	1.06	n/a
Renourishment Factor RJ	0.83	0.58	2.43	0.88	0.75	n/a


ST. JOHNS COUNTY
MARINELAND
AREA 1
PAINTERS HILL
FLAGER COUNTY
BEVERLY BEACH
AREA 3
FLAGLER BEACH
AREA 2
VOLUSIA COUNTY
FLAGLER COUNTY
HURRICANE AND STORM DAMAGE REDUCTION FEASABILITY STUDY
VICINITY MAP
PLATE
B-1


AREA 3A
AREA 2B
AREA 2A
AREA 2C
BEVERLY BEACH
FLAGLER BEACH
R-MONUMENTS
GEOTECHNICAL DRAWINGS
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
FLAGLER COUNTY
HURRICANE AND STORM DAMAGE REDUCTION
FEASABILITY STUDY
BORROW AREA MAP
PLATE
B-2


* REFERENCED TO NAD83 FLORIDA EAST (US FEET)
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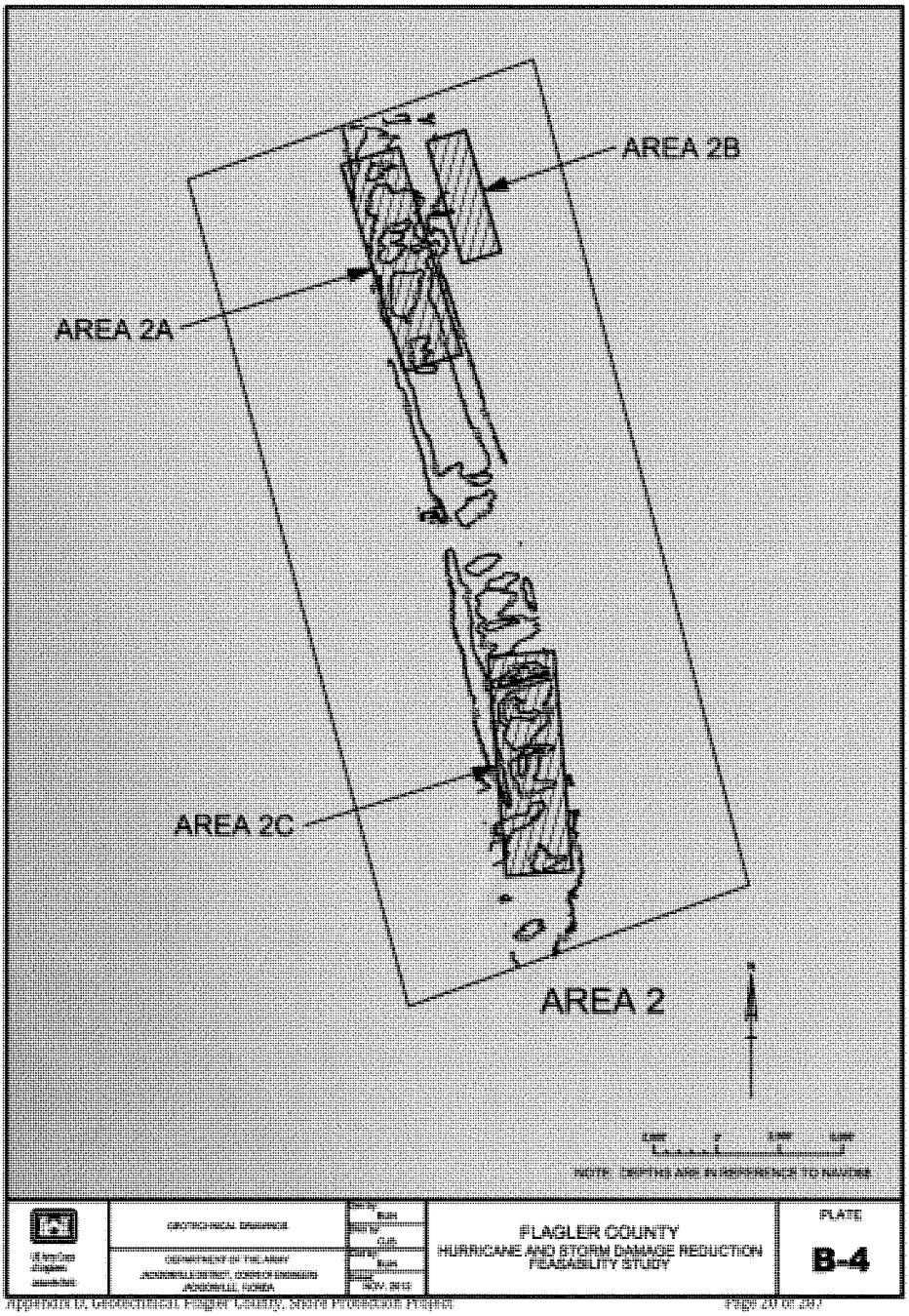
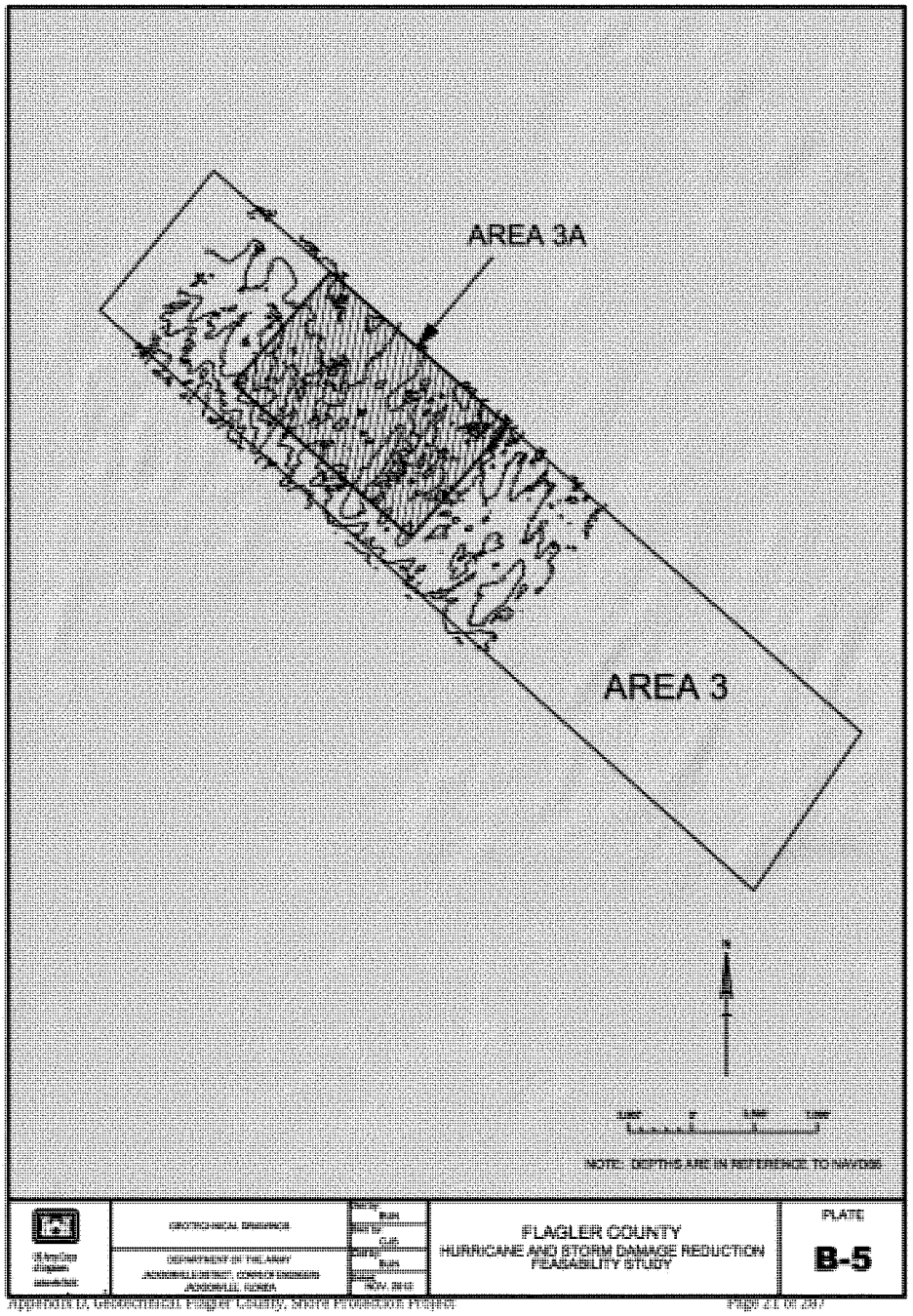
VC-FSP11-2 666592.1 1911062.9
VC-FSP11-3 668362.4 1903690.2
VC-FSP11-4 673571.5 1906127.7
VC-FSP11-5 672890.5 1900724.4
VC-FSP11-6 678009.3 1898131.1
VC-FSP11-7 678828.5 1893077.6
VC-FSP11-8 684228.4 1895572.3
VC-FSP11-9 682406.7 1889244.6
VC-FSP11-10 687240.8 1890088.4
VC-FSP11-11 693287.6 1888856.5
VC-FSP11-12 691248.7 1884892.9
VC-FSP11-13 697757.9 1881942.8
VC-FSP11-14 652240.3 1872433.5
VC-FSP11-15 655510.1 1872704.4
VC-FSP11-16 653442.4 1868194.5
VC-FSP11-17 650133.8 1865964.5
VC-FSP11-18 653545.4 1864379.1
VC-FSP11-19 656769.9 1864382.5
VC-FSP11-20 656298 1860714.5
VC-FSP11-21 656022.4 1856128.2
VC-FSP11-22 657885.3 1850137.9
VC-FSP11-23 657898.5 1844675.5
R-MONUMENT X* Y*
R081 616574.0 1868930.3
R085 617978.0 1865522.6
R089 619322.3 1862201.5
R093 620769.9 1858678.2
VC-FSP11-2
VC-FSP11-4
AREA 3A
VC-FSP11-6
VC-FSP11-7
VC-FSP11-10
VC-FSP11-9
VC-FSP11-12
VC-FSP11-13
AREA 3
FLAGLER BEACH
VC-FSP11-15
AREA 2A
AREA 2B
VC-FSP11-19
VC-FSP11-20
VC-FSP11-21
VC-FSP11-22
AREA 2C
VC-FSP11-23
AREA 2
N
MORING LOCATION
R-MONUMENT LOCATION
GEOTECHNICAL BRANCH
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
FLAGLER COUNTY
HURRICANE AND STORM DAMAGE REDUCTION
FEASIBILITY STUDY
BORING LOCATION PLAN
PLATE
B-3


AREA 2B
AREA 2A
AREA 2C
AREA 2
NOTE: DRAWING ARE IN REFERENCE TO NAVD88
GEOTECHNICAL DRAWINGS
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
FLAGLER COUNTY
HURRICANE AND STORM DAMAGE REDUCTION
FEASABILITY STUDY
PLATE
B-4


AREA 3A
AREA 3
NOTE: DEPTHS ARE IN REFERENCE TO NAVD88
GEOTECHNICAL BRANCH
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
FLAGLER COUNTY
HURRICANE AND STORM DAMAGE REDUCTION
FEASIBILITY STUDY
PLATE
B-5

APPENDIX

BORROW AREAS:

BORING LOGS AND LABORATORY TESTING RESULTS

Boring Designation VC-FSP11-1

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-1	LOCATION COORDINATES: X = 663,001 Y = 1,906,822	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 6 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -62.4 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 90 %	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	RQD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-62.4	0.0						-62.4	
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, trace fine-grained sand-sized shell, weak reaction with HCl, moist, 10Y 5/1 greenish gray (SP)	NR			Vibracore	
			From El. -64.5 to -64.9 Ft., few fine to medium-grained sand-sized shell				-64.9	
					Post 1		-64.9	
			At El. -66.8 Ft., trace fine gravel-sized shell					
			From El. -67.4 to -68.4 Ft., mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell				-67.9	
			From El. -68.4 to -70.4 Ft., trace silt		2			
							-70.4	
			From El. -70.4 to -71.8 Ft., few fine to medium-grained sand-sized shell, trace silt, strong reaction with HCl, 10Y 4/1 dark greenish gray		3			
-71.8	9.4		At El. -71.4 Ft., trace fine to coarse gravel-sized shell				-72.4	
			SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, few fine to medium-grained sand-sized shell, few silt, strong reaction with HCl, moist, 10Y 4/1 dark greenish gray (SP-SM)		4			
			From El. -76.1 to -78.9 Ft., few fine to medium-grained sand-sized shell, trace silt nodules				-77.4	

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(Continued)

Boring Designation VC-FSP11-1

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 663,001 Y = 1,906,822	-62.4 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
					5			
			From El. -78.9 to -80.1 Ft., little fine to coarse-grained sand-sized shell, occasional trace fine-grained sand-sized shell					
			From El. -80.1 to -80.4 Ft., little fine to medium-grained sand-sized shell					
-82.4	20.0						-82.4	

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. 100% recovery attained from 0.0 to 18 feet. Due to varying quantities and size of shell, recovery of sample from 18.0 to 20.0 feet was not achieved. Soil description based on material retained in the shoe.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	2.5/3.0	SP*
1-Post	2.5/3.0	SP*
2	5.5/6.0	SP*
3	8.0/8.5	SP*
4	10.0/10.5	SP-SM*
5	15.0/15.5	SP-SM*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

15
20
25
30
35

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JUN 02

Boring Designation VC-FSP11-2

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-2	LOCATION COORDINATES: X = 666,592 Y = 1,911,063	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 2 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL	BEARING	14. ELEVATION GROUND WATER
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -62.8 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 100 %	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-62.8	0.0						-62.8	
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to coarse-grained sand-sized shell, weak reaction with HCl, moist, 10Y 7/1 light greenish gray (SP)	NR			Vibracore	
-63.8							-63.8	
-64.6	1.8		At El. -64.3 Ft., trace fine gravel-sized shell		1			
			SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, few silt, few fine to medium-grained sand-sized shell, strong reaction with HCl, moist, 5GY 5/1 greenish gray (SP-SM)				-66.3	
			At El. -67.0 Ft., trace silt nodule		2			
-68.3	5.5		CLAY, fat, little fine-grained sand-sized quartz, few silt, trace fine-grained sand-sized shell, trace organic matter, weak reaction with HCl, moist, 10Y 2.5/1 greenish black (CH)					
			At El. -68.8 Ft., 1/2" thick sand seam					
			From El. -70.0 to -82.8 Ft., 10Y 4/1 dark greenish gray					
			From El. -71.8 to -73.8 Ft., occasional thin sand layers (approximately 1/16" thick)					
			From El. -72.8 to -75.6 Ft., trace fine-grained sand-sized quartz, discontinue fine-grained sand-sized shell					
-75.6	12.8		SAND, clayey, mostly fine-grained sand-sized quartz, some clay, little fine to coarse-grained sand-sized shell, few silt, weak reaction with HCl, moist, 5GY 4/1 dark greenish gray (SC)					
-77.8	15.0		From El. -77.3 to -77.8 Ft., little silt, trace					

0 5 10 15

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JUN 02

(Continued)

Boring Designation VC-FSP11-2

DRILLING LOG (Cont. Sheet)	INSTALLATION: Jacksonville District	SHEET 2 OF 2 SHEETS
PROJECT: Off-Shore Borrow Area Investigations	COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.) / HORIZONTAL: NAD83 / VERTICAL: NAVD88	
LOCATION COORDINATES: X = 666,592 Y = 1,911,063	ELEVATION TOP OF BORING: -62.8 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
			fine-grained sand-sized shell CLAY, fat, little silt, trace fine-grained sand-sized quartz, trace fine-grained sand-sized shell, weak reaction with HCl, moist, 5GY 4/1 dark greenish gray (CH) From El. -79.9 to -80.4 Ft., few fine-grained sand-sized quartz, few fine to coarse-grained sand-sized shell From El. -81.2 to -82.8 Ft., occasional sand layers (approximately 1/16" thick)						
-82.8	20.0						-82.8		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*
2	3.5/4.0	SP-SM*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

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JUN 02

Boring Designation VC-FSP11-3

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-3	LOCATION COORDINATES: X = 668,362 Y = 1,903,690	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 6 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -56.8 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 98 %	
8. TOTAL DEPTH OF BORING: 14.5 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	RQD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-56.8	0.0						-56.8	
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell, trace silt, weak reaction with HCl, moist, 10Y 6/1 greenish gray (SP)	NR			Vibracore	
							-57.8	
					1			
			From El. -59.8 to -71.3 Ft., mostly fine-grained sand-sized quartz				-60.8	
					2			
			From El. -62.5 to -66.3 Ft., little medium-grained sand-sized shell At El. -62.8 Ft., trace coarse gravel-sized shell, (up to 2.5" long and 1-3/4" wide)				-63.8	
					3-Post 3		-63.8	
			From El. -66.3 to -71.3 Ft., few fine to medium-grained sand-sized shell, trace fine gravel-sized shell				-66.8	
					4			
							-69.8	
					5			
-71.3	14.5						-71.3	
			BORING TERMINATED IN REFUSAL				Abbreviations:	

0 5 10 15

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation VC-FSP11-3

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Jacksonville District		
PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88
LOCATION COORDINATES	ELEVATION TOP OF BORING		
X = 668,362 Y = 1,903,690	-56.8 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			NOTES: 1. USACE Jacksonville is the custodian for these original files. 2. Soils are field visually classified in accordance with the Unified Soils Classification System. 3. Vibracore penetrated to 14.5 feet. Sample recovery from 13.7 to 14.5 feet was not attained. Soil description based on material retained in the shoe. 4. Laboratory Testing Results SAMPLE ID / SAMPLE DEPTH / LABORATORY CLASSIFICATION 1 — 1.0/1.5 — SP* - 2 — 4.0/4.5 — SP* - 3 — 7.0/7.5 — SP* - 3-Post — 7.0/7.5 — SP* - 4 — 10.0/10.5 — SP* - 5 — 13.0/13.5 — SP* - *Lab visual classification based on gradation curve. No Atterberg limits.				NR = Not Recorded.		

15 20 25 30 35

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JUN 02

Boring Designation VC-FSP11-4

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-4	LOCATION COORDINATES: X = 673,572 Y = 1,906,128	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL	BEARING	14. ELEVATION GROUND WATER
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -60.0 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 86 %	
8. TOTAL DEPTH OF BORING: 9.1 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD OR CORE UD	REMARKS	BLOWS/1 FT. N-VALUE
-60.0	0.0						-60.0	
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell, weak reaction with HCl, moist, 10GY 5/1 greenish gray (SP) From El. -61.5 to -62.3 Ft., trace fine to medium-grained sand-sized shell From El. -62.3 to -69.1 Ft., mostly fine-grained sand-sized quartz, little medium to coarse-grained sand-sized shell, trace silt At El. -63.6 Ft., little fine to coarse gravel-sized shell	NR			Vibracore -61.0	
					1		-64.0	
					2-Post 2		-64.0	
							-67.0	
					3			
-69.1	9.1						-69.1	
			BORING TERMINATED IN REFUSAL NOTES: 1. USACE Jacksonville is the custodian for these original files. 2. Soils are field visually classified in accordance with the Unified Soils Classification System. 3. Vibracore penetrated to 9.1 feet. Sample recovery from 7.3 to 9.1 feet was not attained. Soil description based on material retained in the shoe. 4. Laboratory Testing Results SAMPLE SAMPLE LABORATORY				Abbreviations: NR = Not Recorded.	

0 5 10 15

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation VC-FSP11-4

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 673,572 Y = 1,906,128	-60.0 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE

ID	DEPTH	CLASSIFICATION
1	1.0/1.5	SP* -
2	4.0/4.5	SP* -
2-Post	4.0/4.5	SP* -
3	7.0/7.5	SP* -

*Lab visual classification based on gradation curve. No Atterberg limits.

15 20 25 30 35

SAJ FORM 1836-A
JUN 02

Boring Designation VC-FSP11-5

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-5	LOCATION COORDINATES: X = 672,891 Y = 1,900,724	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -59.7 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 88 %	
8. TOTAL DEPTH OF BORING: 7.7 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-59.7	0.0						-59.7		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, trace silt, weak reaction with HCl, moist, 5GY 5/1 greenish gray (SP)	NR	-Post 1		Vibracore -60.7 -60.7 -63.7		
			At El. -64.2 Ft., trace fine gravel-sized coral		2				
			From El. -65.2 to -67.4 Ft., few medium-grained sand-sized shell, trace fine gravel-sized shell, strong reaction with HCl		3		-66.2		
-67.4	7.7		BORING TERMINATED IN REFUSAL				-67.4		

Abbreviations:
NR = Not Recorded.

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Vibracore penetrated to 7.7 feet. Sample recovery from 6.7 to 7.7 feet was not attained. Soil description based on material retained in the shoe.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*
1-Post	1.0/1.5	SP*
2	4.0/4.5	SP*

0 5 10 15

SAJ FORM 1836
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(Continued)

Boring Designation VC-FSP11-5

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS
PROJECT Off-Shore Borrow Area Investigations	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.) / HORIZONTAL NAD83 / VERTICAL NAVD88	
LOCATION COORDINATES X = 672,891 Y = 1,900,724	ELEVATION TOP OF BORING -59.7 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			3 6.5/6.7 SP*						
			*Lab visual classification based on gradation curve. No Atterberg limits.						

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SAJ FORM 1836-A
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Boring Designation VC-FSP11-6

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-6	LOCATION COORDINATES: X = 678,009 Y = 1,898,131	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -61.7 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 86 %	
8. TOTAL DEPTH OF BORING: 8.4 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	RQD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-61.7	0.0						-61.7	
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, little medium-grained sand-sized shell, trace silt, weak reaction with HCl, moist, 5GY 5/1 greenish gray (SP)	NR			Vibracore	
							-62.7	
					1			
			At El. -63.4 Ft., trace fine gravel-sized shell From El. -63.5 to -64.4 Ft., trace fine-grained sand-sized shell					
			From El. -65.0 to -66.6 Ft., little medium to coarse-grained sand-sized shell				-65.7	
					2			
			From El. -67.4 to -68.1 Ft., trace fine gravel-sized shell From El. -68.1 to -70.1 Ft., little medium-grained sand-sized shell				-68.5	
					3-Post		-68.5	
-70.1	8.4						-70.1	
			BORING TERMINATED IN REFUSAL NOTES: 1. USACE Jacksonville is the custodian for these original files. 2. Soils are field visually classified in accordance with the Unified Soils Classification System. 3. Vibracore penetrated to 8.4 feet. Sample recovery from 6.9 to 8.4 feet was not attained. Soil description based on material retained in the shoe. 4. Laboratory Testing Results SAMPLE ID / SAMPLE DEPTH / LABORATORY CLASSIFICATION 1 / 1.0/1.5 / SP*				Abbreviations: NR = Not Recorded.	

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(Continued)

Boring Designation VC-FSP11-6

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS
PROJECT Off-Shore Borrow Area Investigations	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.) / HORIZONTAL NAD83 / VERTICAL NAVD88	
LOCATION COORDINATES X = 678,009 Y = 1,898,131	ELEVATION TOP OF BORING -61.7 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
			2 4.0/4.5 SP* 3 6.8/6.9 SP* 3-Post 6.8/6.9 SP* *Lab visual classification based on gradation curve. No Atterberg limits.						

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Boring Designation VC-FSP11-7

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
2. BORING DESIGNATION: VC-FSP11-7	LOCATION COORDINATES: X = 678,829 Y = 1,893,078	10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
4. NAME OF DRILLER: Brian McCord		12. TOTAL SAMPLES: DISTURBED 4 / UNDISTURBED (UD) 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	13. TOTAL NUMBER CORE BOXES: 0	
		14. ELEVATION GROUND WATER	
		15. DATE BORING: STARTED 02-14-11 / COMPLETED 02-14-11	
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -54.6 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 94 %	
8. TOTAL DEPTH OF BORING: 8.6 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	RQD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-54.6	0.0						-54.6	
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, trace silt, weak reaction with HCl, moist, 10Y 5/1 greenish gray (SP)	NR			Vibracore -55.6	
					1			
			From El. -57.4 to -58.3 Ft., few fine to medium-grained sand-sized shell				-58.6	
					2-Post 2		-58.6	
			From El. -60.6 to -63.2 Ft., few medium-grained sand-sized shell				-61.6	
					3			
-63.2	8.6						-63.2	
			BORING TERMINATED IN REFUSAL				Abbreviations: NR = Not Recorded.	

NOTES:

1. USACE Jacksonville is the custodian for these original files.
2. Soils are field visually classified in accordance with the Unified Soils Classification System.
3. Vibracore penetrated to 8.6 feet. Sample recovery from 7.8 to 8.6 feet was not attained. Soil description based on material retained in the shoe.
4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation VC-FSP11-7

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Jacksonville District		
PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88
LOCATION COORDINATES	ELEVATION TOP OF BORING		
X = 678,829 Y = 1,893,078	-54.6 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			1 1.0/1.5 SP* 2 4.0/4.5 SP* 2-Post 4.0/4.5 SP* 3 7.0/7.5 SP* *Lab visual classification based on gradation curve. No Atterberg limits.						

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SAJ FORM 1836-A
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Boring Designation VC-FSP11-8

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-8	LOCATION COORDINATES: X = 684,228 Y = 1,895,572	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -61.8 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 85 %	
8. TOTAL DEPTH OF BORING: 8.4 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE #	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-61.8	0.0						-61.8		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, few fine to medium-grained sand-sized shell, weak reaction with HCl, moist, 10Y 5/1 greenish gray (SP)	NR			Vibracore		
							-62.8		
					1				
			From El. -63.8 to -64.3 Ft., little fine to coarse-grained sand-sized shell, trace fine gravel-sized shell						
			From El. -65.3 to -70.2 Ft., trace silt				-65.8		
			From El. -65.4 to -70.2 Ft., little medium to coarse-grained sand-sized shell				-65.8		
			At El. -66.1 Ft., trace fine gravel-sized shell		2-Post 2				
							-67.8		
					3				
			From El. -68.4 to -70.2 Ft., few fine to coarse-grained sand-sized shell						
-70.2	8.4						-70.2		
			BORING TERMINATED IN REFUSAL						

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Vibracore penetrated to 8.4 feet. Sample recovery from 6.6 to 8.4 feet was not attained. Soil description based on material retained in the shoe.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*

Abbreviations:
NR = Not Recorded.

(Continued)

SAJ FORM 1836
JUN 02

Boring Designation VC-FSP11-8

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS
PROJECT Off-Shore Borrow Area Investigations	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.) / HORIZONTAL NAD83 / VERTICAL NAVD88	
LOCATION COORDINATES X = 684,228 Y = 1,895,572	ELEVATION TOP OF BORING -61.8 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
			2 4.0/4.5 SP* 2-Post 4.0/4.5 SP* 3 6.0/6.6 SP* *Lab visual classification based on gradation curve. No Atterberg limits.						

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Boring Designation VC-FSP11-9

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-9	LOCATION COORDINATES: X = 682,407 Y = 1,889,245	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -61.9 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 88 %	
8. TOTAL DEPTH OF BORING: 8.8 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-61.9	0.0						-61.9	
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to coarse-grained sand-sized shell, weak reaction with HCl, moist, 10Y 5/1 greenish gray (SP)	NR			Vibracore -62.9	
					-Post 1		-62.9	
-63.9	2.0		SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, few silt, trace medium-grained sand-sized shell, weak reaction with HCl, moist, 10Y 5/1 greenish gray (SP-SM)				-65.9	
					2			
			From El. -67.7 to -70.7 Ft., mostly fine to medium-grained sand-sized quartz, little medium to coarse-grained sand-sized shell				-68.9	
			At El. -68.9 Ft., trace fine to coarse gravel-sized shell		3			
-70.7	8.8		BORING TERMINATED IN REFUSAL				-70.7	
			NOTES: 1. USACE Jacksonville is the custodian for these original files. 2. Soils are field visually classified in accordance with the Unified Soils Classification System. 3. Vibracore penetrated to 8.8 feet. Sample recovery from 7.4 to 8.8 feet was not attained. Soil description based on material retained in the shoe. 4. Laboratory Testing Results SAMPLE ID / SAMPLE DEPTH / LABORATORY CLASSIFICATION				Abbreviations: NR = Not Recorded.	

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(Continued)

Boring Designation VC-FSP11-9

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Jacksonville District		
PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88
LOCATION COORDINATES	ELEVATION TOP OF BORING		
X = 682,407 Y = 1,889,245	-61.9 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
			1 1.0/1.5 SP* 1-Post 1.0/1.5 SP* - 2 4.0/4.5 SP-SM* - 3 7.0/7.5 SP-SM* - *Lab visual classification based on gradation curve. No Atterberg limits.						

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Boring Designation VC-FSP11-10

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-10	LOCATION COORDINATES: X = 687,241 Y = 1,890,088	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 6 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -57.3 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 100 %	
8. TOTAL DEPTH OF BORING: 13.1 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-57.3	0.0						-57.3		
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, few medium-grained sand-sized shell, weak reaction with HCl, moist, 10Y 5/1 greenish gray (SP)	NR			Vibracore		
			From El. -58.6 to -70.4 Ft., trace silt		1		-58.3		
							-61.3		
					2				
							-64.3		
			From El. -64.2 to -64.6 Ft., some fine to coarse-grained sand-sized shell		3				
			From El. -66.7 to -67.9 Ft., little fine to medium-grained sand-sized shell				-67.3		
					4--Post 4		-67.3		
			From El. -68.3 to -70.4 Ft., strong reaction with HCl						
			From El. -68.6 to -69.8 Ft., little fine to coarse-grained sand-sized shell				-69.3		
			At El. -69.6 Ft., a shell fragment (1-1/2" long, 3/8" wide)		5				
-70.4	13.1		BORING TERMINATED IN REFUSAL				-70.4		
			NOTES: 1. USACE Jacksonville is the custodian for these original files.				Abbreviations: NR = Not Recorded.		

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(Continued)

Boring Designation VC-FSP11-10

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 687,241 Y = 1,890,088	-57.3 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP* -
2	4.0/4.5	SP* -
3	7.0/7.5	SP* -
4	10.0/10.5	SP* -
4-Post	10.0/10.5	SP* -
5	12.0/12.5	SP* -

*Lab visual classification based on gradation curve. No Atterberg limits.

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Boring Designation VC-FSP11-11

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-11	LOCATION COORDINATES: X = 693,288 Y = 1,888,857	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -58.7 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 100 %	
8. TOTAL DEPTH OF BORING: 8.2 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-58.7	0.0						-58.7	
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell, weak reaction with HCl, moist, 5GY 5/1 greenish gray (SP)	NR			Vibracore	
					-Post 1		-59.7	
			From El. -61.9 to -66.9 Ft., mostly fine-grained sand-sized quartz				-62.7	
			At El. -63.1 Ft., trace fine gravel-sized coral		2			
			From El. -63.7 to -64.2 Ft., little fine to coarse-grained sand-sized shell					
			From El. -65.3 to -66.9 Ft., little medium-grained sand-sized shell				-65.7	
					3			
-66.9	8.2						-66.9	
			BORING TERMINATED IN REFUSAL				Abbreviations: NR = Not Recorded.	

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*
1-Post	1.0/1.5	SP*
2	4.0/4.5	SP*
3	7.0/7.5	SP*

*Lab visual classification based on gradation

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JUN 02

(Continued)

Boring Designation VC-FSP11-11

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS
PROJECT Off-Shore Borrow Area Investigations	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.) / HORIZONTAL NAD83 / VERTICAL NAVD88	
LOCATION COORDINATES X = 693,288 Y = 1,888,857	ELEVATION TOP OF BORING -58.7 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			curve. No Atterberg limits.						

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SAJ FORM 1836-A
JUN 02

Boring Designation VC-FSP11-12

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-12	LOCATION COORDINATES: X = 691,249 Y = 1,884,893	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 5 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-14-11 / COMPLETED: 02-14-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -57.1 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 85 %	
8. TOTAL DEPTH OF BORING: 10.2 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-57.1	0.0						-57.1		
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, few fine to medium-grained sand-sized shell, no reaction with HCl, moist, 10Y 5/1 greenish gray (SP)	NR			Vibracore		
			From El. -57.6 to -62.3 Ft., little fine to medium-grained sand-sized shell		1		-58.1		
			At El. -59.3 Ft., a large shell (1" long and 3/4" wide)						
			From El. -60.5 to -67.3 Ft., trace silt				-61.1		
			From El. -61.0 to -62.6 Ft., some fine to coarse-grained sand-sized shell, weak reaction with HCl, a coral fragment (1/2" long, 3/8" wide)		2-Post 2		-61.1		
			From El. -62.6 to -67.3 Ft., little fine to medium-grained sand-sized shell						
			At El. -63.1 Ft., a large shell (1.5" long and 1/4" wide)				-64.1		
					3		-66.1		
					4				
-67.3	10.2						-67.3		
			BORING TERMINATED IN REFUSAL				Abbreviations: NR = Not Recorded.		
			NOTES: 1. USACE Jacksonville is the custodian for these original files. 2. Soils are field visually classified in accordance with the Unified Soils Classification System. 3. Vibracore penetrated to 10.2 feet. Sample recovery from 8.5 to 10.2 feet was not attained. Soil description based on material retained in the shoe.						

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(Continued)

Boring Designation VC-FSP11-12

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 691,249 Y = 1,884,893	-57.1 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP* -
2	4.0/4.5	SP* -
2-Post	4.0/4.5	SP* -
3	7.0/7.5	SP* -
4	9.0/9.5	SP* -

*Lab visual classification based on gradation curve. No Atterberg limits.

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SAJ FORM 1836-A
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Boring Designation VC-FSP11-13

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-13	LOCATION COORDINATES: X = 697,758 Y = 1,881,943	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 5 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL:	BEARING:	14. ELEVATION GROUND WATER: Not Determined
		15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -54.8 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 100 %	
8. TOTAL DEPTH OF BORING: 10.1 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE #	ROD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-54.8	0.0						-54.8		
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, few fine to medium-grained sand-sized shell, no reaction with HCl, moist, occasional gravel-sized shell, N 5/ gray (SP)	NR			Vibracore		
							-55.8		
					1				
			From El. -57.1 to -57.5 Ft., little fine to coarse-grained sand-sized shell						
							-58.8		
			From El. -58.7 to -59.8 Ft., mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell		2-Post 2		-58.8		
			From El. -60.2 to -64.9 Ft., little medium-grained sand-sized shell, weak reaction with HCl						
							-61.8		
					3				
			From El. -63.5 to -64.9 Ft., mostly fine-grained sand-sized quartz				-63.8		
					4				
-64.9	10.1						-64.9		
			BORING TERMINATED IN REFUSAL						
			NOTES:				Abbreviations: NR = Not Recorded.		
			1. USACE Jacksonville is the custodian for these original files.						
			2. Soils are field visually classified in accordance with the Unified Soils Classification System.						
			3. Laboratory Testing Results						
			SAMPLE ID / SAMPLE DEPTH / LABORATORY CLASSIFICATION						

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(Continued)

Boring Designation VC-FSP11-13

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 697,758 Y = 1,881,943	-54.8 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			1 1.0/1.5 SP* - 2 4.0/4.5 SP* - 2-Post 4.0/4.5 SP* - 3 7.0/7.5 SP* - 4 9.0/9.5 SP* - *Lab visual classification based on gradation curve. No Atterberg limits.						

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Boring Designation VC-FSP11-14

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-14	LOCATION COORDINATES: X = 652,240 Y = 1,872,434	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -58.1 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 94 %	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE #	ROD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-58.1	0.0						-58.1		
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell, trace silt, weak reaction with HCl, moist, 10Y 5/1 greenish gray (SP)	NR			Vibracore		
			From El. -59.7 to -60.4 Ft., few fine to coarse gravel-sized shell		1		-59.1		
			From El. -61.4 to -63.6 Ft., trace silt, occasional fine to coarse gravel-sized shell, 5GY 5/1 greenish gray		2		-61.1		
-63.6	5.5				3		-63.1		
			SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, little fine to coarse-grained sand-sized shell, few silt, weak reaction with HCl, moist, 5GY 4/1 dark greenish gray (SP-SM)				-66.1		
-66.9	8.8				4				
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, little fine to coarse-grained sand-sized shell, weak reaction with HCl, moist, 5GY 4/1 dark greenish gray (SM)						
			At El. -67.6 Ft., trace fine gravel-sized shell						
			From El. -68.3 to -68.9 Ft., some silt						
			From El. -68.9 to -76.9 Ft., some silt, some fine to coarse-grained sand-sized shell, trace fine gravel-sized shell						
			From El. -71.9 to -76.9 Ft., silt content decreasing with depth, shell content increasing with depth						

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(Continued)

Boring Designation VC-FSP11-14

DRILLING LOG (Cont. Sheet)	INSTALLATION: Jacksonville District	SHEET 2 OF 2 SHEETS
PROJECT: Off-Shore Borrow Area Investigations	COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.) / HORIZONTAL: NAD83 / VERTICAL: NAVD88	
LOCATION COORDINATES: X = 652,240 Y = 1,872,434	ELEVATION TOP OF BORING: -58.1 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
			At El. -76.3 Ft., trace coarse-grained sand-sized shell At El. -76.9 Ft., trace coarse-grained sand-sized limestone					
-78.1	20.0						-78.1	

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Vibracore penetrated to 20.0 feet. Sample recovery from 18.8 to 20 feet was not attained. Soil description based on material retained in the shoe.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*
2	3.0/3.5	SP*
3	5.0/5.5	SP*
4	8.0/8.5	SP-SM*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

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Boring Designation VC-FSP11-15

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-15	LOCATION COORDINATES: X = 655,510 Y = 1,872,704	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 5 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -62.4 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 88 %	
8. TOTAL DEPTH OF BORING: 18.4 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	RQD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-62.4	0.0						-62.4	
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, trace silt, weak reaction with HCl, moist, occasional traces of fine to coarse gravel-sized shell, 10Y 4/1 dark greenish gray (SP)	NR			Vibracore	
			From El. -64.4 to -66.9 Ft., strong reaction with HCl		1		-63.4	
							-66.4	
-66.9	4.5		SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, few silt, strong reaction with HCl, moist, 10Y 4/1 dark greenish gray (SP-SM)		2		-68.4	
			From El. -69.9 to -70.9 Ft., 5GY 4/1 dark greenish gray		3		-71.4	
-70.9	8.5		SAND, poorly-graded, some fine-grained sand-sized quartz, some fine to coarse-grained sand-sized shell, little fine gravel-sized shell, trace silt, weak reaction with HCl, wet, 5GY 4/1 dark greenish gray (SP)		4		-75.4	
			At El. -73.4 Ft., trace fine gravel-sized shell					
-74.2	11.8		SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, weak reaction with HCl, moist, occasional trace of silt nodules, 10Y 6/1 greenish gray (SP)		5			

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(Continued)

Boring Designation VC-FSP11-15

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS
PROJECT Off-Shore Borrow Area Investigations	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.) / HORIZONTAL NAD83 / VERTICAL NAVD88	
LOCATION COORDINATES X = 655,510 Y = 1,872,704	ELEVATION TOP OF BORING -62.4 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-80.8	18.4		BORING TERMINATED IN REFUSAL				-80.8		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Vibracore penetrated to 18.4 feet. Sample recovery from 15.6 to 18.4 feet was not attained. Soil description based on material retained in the shoe.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*
2	4.0/4.5	SP*
3	6.0/6.5	SP-SM*
4	9.0/9.5	SP*
5	13.0/13.5	SP*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

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Boring Designation VC-FSP11-16

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-16	LOCATION COORDINATES: X = 653,442 Y = 1,868,195	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -53.8 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 97 %	
8. TOTAL DEPTH OF BORING: 8.8 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-53.8	0.0						-53.8	
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, few fine to medium-grained sand-sized shell, trace silt, no reaction with HCl, moist, occasional trace of fine gravel-sized shell, 5GY 6/1 greenish gray (SP)	NR			Vibracore	
					1		-54.8	
							-57.8	
					2-Post 2		-57.8	
			From El. -59.4 to -59.6 Ft., some fine to coarse-grained sand-sized shell, trace fine gravel-sized shell					
			From El. -59.5 to -62.3 Ft., 10Y 5/1 greenish gray				-60.8	
			From El. -60.5 to -62.3 Ft., some fine to coarse-grained sand-sized shell, few fine gravel-sized shell, strong reaction with HCl		3			
-62.6	8.8						-62.6	
			BORING TERMINATED IN REFUSAL				Abbreviations: NR = Not Recorded.	

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Sanple recovery from 8.5 to 8.8 feet was not attained. Vibracore penetrated to 8.8 feet. Soil description based on material retained in the shoe.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION

(Continued)

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Boring Designation VC-FSP11-16

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 653,442 Y = 1,868,195	-53.8 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
			1 1.0/1.5 SP* - 2 4.0/4.5 SP* - 2-Post 4.0/4.5 SP* - 3 7.0/7.5 SP* - *Lab visual classification based on gradation curve. No Atterberg limits.						

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Boring Designation VC-FSP11-17

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-17	LOCATION COORDINATES: X = 650,134 Y = 1,865,965	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 3 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -68.5 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 100 %	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-68.5	0.0						-68.5		
-69.0	0.5		SAND, silty, mostly fine-grained sand-sized quartz, some sand to gravel-sized shell, little silt, strong reaction with HCl, moist, 10GY 4/1 dark greenish gray (SM)	NR	1		-69.0 Vibracore		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine to coarse-grained sand-sized shell, few fine gravel-sized shell, trace silt, weak reaction with HCl, moist, 5B 6/1 bluish gray (SP)				-72.5		
			From El. -71.5 to -75.5 Ft., little medium-grained sand-sized shell		2				
							-75.5		
			At El. -76.2 Ft., trace silt nodules		3				
			From El. -76.4 to -77.4 Ft., 10Y 5/1 greenish gray						
-77.4	8.9	Mod. Weathered	LIMESTONE, fossiliferous, moderately hard, moderately weathered, fine grained, highly fractured, solid, some silt, little sand to gravel-sized shell, few fine-grained sand-sized quartz, 5GY 5/1 greenish gray						
-79.3	10.8		At El. -79.2 Ft., some sand to gravel-sized shell, a large shell (approximately 2" long and 1-3/4" wide)						
-80.4	11.9		SAND, silty, mostly fine-grained sand-sized quartz, some silt, trace fine to coarse-grained sand-sized shell, weak reaction with HCl, moist, occasional silt seams (up to 1/4" thick), 5GY 5/1 greenish gray (SM)						
-82.1	13.6		SAND, silty, mostly fine to coarse-grained sand-sized shell, little silt, few fine-grained sand-sized quartz, few fine to coarse gravel-sized shell, a cobble-sized limestone (approximately 3.25" in diameter),						

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(Continued)

Boring Designation VC-FSP11-17

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 650,134 Y = 1,865,965	-68.5 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
			10GY 5/1 greenish gray (SM) SILT, inorganic-L, low plasticity, very soft, little clay, little fine-grained sand-sized quartz, few fine to coarse-grained sand-sized shell, weak reaction with HCl, moist, 5G 5/1 greenish gray (ML) At El. -82.5 Ft., few fine gravel-sized limestone From El. -83.5 to -83.9 Ft., few fine to coarse gravel-sized limestone At El. -84.4 Ft., trace clay nodules From El. -84.7 to -86.7 Ft., clay content increasing with depth, quartz content decreasing with depth, 10GY 3/1 very dark greenish gray					
-87.0	18.5							
-88.5	20.0	Mod. Wea.	LIMESTONE, fossiliferous, moderately hard, moderately weathered, fine grained, intensely fractured, solid, some silt, few clay, few fine-grained sand-sized quartz, 5GY 4/1 dark greenish gray				-88.5	

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.5/1.0	SP*
2	4.0/4.5	SP*
3	7.0/7.5	SP*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

SAJ FORM 1836-A
JUN 02

Boring Designation VC-FSP11-18

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS	
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida	9. SIZE AND TYPE OF BIT: See Remarks		
	10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83	VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-18	LOCATION COORDINATES: X = 653,545 Y = 1,864,379	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 2 UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL	BEARING	14. ELEVATION GROUND WATER
		15. DATE BORING	STARTED: 02-15-11 COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -61.0 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 98 %	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-61.0	0.0						-61.0		
			SAND, poorly-graded, mostly fine to coarse-grained sand-sized shell, some fine-grained sand-sized quartz, few fine-grained sand-sized shell, weak reaction with HCl, moist, 10Y 4/1 dark greenish gray (SP)	NR			Vibracore		
			At El. -61.8 Ft., occasional silt nodules, 5GY 4/1 dark greenish gray				-62.0		
-63.0	2.0				1				
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, few fine to medium-grained sand-sized shell, weak reaction with HCl, moist, 10Y 3/1 very dark greenish gray (SM)						
			From El. -65.5 to -70.5 Ft., 10Y 4/1 dark greenish gray				-66.0		
					2				
			From El. -69.1 to -70.5 Ft., little fine to coarse-grained sand-sized shell						
			From El. -69.5 to -70.5 Ft., occasional trace fine gravel-sized shell						
-70.5	9.5								
			SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, few silt, trace fine to coarse-grained sand-sized shell, weak reaction with HCl, moist, 10Y 5/1 greenish gray (SP-SM)						
			From El. -71.8 to -72.4 Ft., some fine to coarse-grained sand-sized shell, trace fine gravel-sized shell						
			From El. -72.4 to -73.3 Ft., little fine to coarse-grained sand-sized shell						
			From El. -73.5 to -74.0 Ft., few fine to medium-grained sand-sized shell, strong reaction with HCl						
-74.5	13.5	Mod. Wea.	LIMESTONE, fossiliferous, soft, moderately weathered, fine grained, intensely fractured, little sand to gravel-sized shell, few silt, few fine-grained sand-sized quartz, increasing silt content with depth, 10Y 6/1 greenish gray						

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(Continued)

Boring Designation VC-FSP11-18

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 2 OF 2 SHEETS
	Jacksonville District		
PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88
LOCATION COORDINATES	ELEVATION TOP OF BORING		
X = 653,545 Y = 1,864,379	-61.0 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-77.5	16.5	Mod. Wea.							
			SAND, silty, mostly fine-grained sand-sized quartz, some silt, no reaction with HCl, moist, trace clay nodules, 5GY 5/1 greenish gray (SM)						
			From El. -79.9 to -80.5 Ft., trace fine-grained sand-sized shell, strong reaction with HCl						
-81.0	20.0						-81.0		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Vibracore penetrated to 20 feet. Sample recovery from 19.5 to 20 feet was not attained.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*
2	5.0/5.5	SM*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

15 20 25 30 35

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Boring Designation VC-FSP11-19

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT	Off-Shore Borrow Area Investigations Flagler County, Florida
2. BORING DESIGNATION	VC-FSP11-19
LOCATION COORDINATES	X = 656,770 Y = 1,864,383
3. DRILLING AGENCY	AVS
CONTRACTOR FILE NO.	6734-11-9583
4. NAME OF DRILLER	Brian McCord
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	20.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, FLE (U.S. Ft.) / HORIZONTAL: NAD83 / VERTICAL: NAVD88
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED: 1 / UNDISTURBED (UD): 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	
15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
16. ELEVATION TOP OF BORING	-67.9 Ft.
17. TOTAL RECOVERY FOR BORING	97 %
18. SIGNATURE AND TITLE OF INSPECTOR	Karishma R. Desai, P.E., Geotechnical Engineer

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-67.9	0.0						-67.9		
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, trace fine to medium-grained sand-sized shell, strong reaction with HCl, moist, 10GY 3/1 very dark greenish gray (SM) From El. -69.2 to -70.7 Ft., few sand to gravel-sized shell						
			From El. -70.7 to -71.3 Ft., few fine to medium-grained sand-sized shell, a large shell (2" long and wide) From El. -71.3 to -73.2 Ft., little fine to coarse-grained sand-sized shell	NR			Vibracore		
-71.9	4.0		SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, some fine to coarse-grained sand-sized shell, few silt, weak reaction with HCl, moist, 10GY 3/1 very dark greenish gray (SP-SM) From El. -73.2 to -74.1 Ft., little fine to coarse-grained sand-sized shell From El. -74.1 to -75.2 Ft., trace fine to coarse-grained sand-sized shell, occasional silt nodules		1		-73.9		
-75.4	7.5		SAND, silty, mostly fine-grained sand-sized quartz, little silt, trace fine-grained sand-sized shell, strong reaction with HCl, moist, occasional trace of cemented clayey sand nodules, 5GY 6/1 greenish gray (SM) At El. -76.7 Ft., trace fine-grained sand-sized shell From El. -76.8 to -77.3 Ft., occasional clay nodules From El. -78.3 to -79.7 Ft., little clay, 10Y 5/1 greenish gray						
-79.7	11.8		SAND, clayey, mostly fine-grained sand-sized quartz, some clay, little silt, strong reaction with HCl, moist, occasional trace of fine-grained sand-sized shell, 10Y 5/1 greenish gray (SC)						

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(Continued)

Boring Designation VC-FSP11-19

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 656,770 Y = 1,864,383	-67.9 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-87.9	20.0						-87.9		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Vibracore penetrated to 20 feet. Sample recovery from 19.4 to 20 feet was not attained.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	6.0/6.5	SP-SM*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

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SAJ FORM 1836-A
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Boring Designation VC-FSP11-20

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-20	LOCATION COORDINATES: X = 656,298 Y = 1,860,715	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 3 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -60.7 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 98 %	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-60.7	0.0						-60.7		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, few fine to medium-grained sand-sized shell, strong reaction with HCl, moist, 10Y 6/1 greenish gray (SP)	NR			Vibracore		
			From El. -61.1 to -63.5 Ft., some fine to coarse-grained sand-sized shell, few fine gravel-sized shell, trace silt		1		-62.2		
-63.5	2.8		SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, few silt, weak reaction with HCl, moist, 10GY 4/1 dark greenish gray (SP-SM)				-64.7		
-65.8	5.1				2				
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, few fine to coarse-grained sand-sized shell, weak reaction with HCl, moist, 10GY 4/1 dark greenish gray (SM)						
			At El. -66.4 Ft., trace fine-grained sand-sized shell						
			From El. -66.7 to -70.3 Ft., silt content increasing with depth						
			From El. -67.7 to -69.4 Ft., some fine to coarse-grained sand-sized shell						
			From El. -69.4 to -70.8 Ft., some silt, little fine to coarse-grained sand-sized shell				-69.7		
					3				
			At El. -72.3 Ft., some silt, trace clay nodules						
			At El. -73.7 Ft., trace fine gravel-sized shell						

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(Continued)

Boring Designation VC-FSP11-20

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 656,298 Y = 1,860,715	-60.7 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR UD	REMARKS	BLOWS/ FT.	N-VALUE
			From El. -75.7 to -77.6 Ft., some fine to coarse-grained sand-sized shell, few fine to coarse gravel-sized shell						
			From El. -77.6 to -78.6 Ft., little fine to coarse-grained sand-sized shell, 10Y 7/1 light greenish gray						
			From El. -78.2 to -80.3 Ft., trace clay, occasional fine to coarse-grained sand-sized shell, 10Y 7/1 light greenish gray						
-80.7	20.0						-80.7		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Vibracore penetrated to 20 feet. Sample recovery from 19.6 to 20 feet was not attained.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.5/2.0	SP*
2	4.0/4.5	SP-SM*
3	9.0/9.5	SM*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

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Boring Designation VC-FSP11-21

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-21	LOCATION COORDINATES: X = 656,922 Y = 1,856,128	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 4 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -59.5 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 83 %	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-59.5	0.0						-59.5	
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, few fine-grained sand-sized shell, trace silt, no reaction with HCl, moist, 10Y 6/1 greenish gray (SP)	NR			Vibracore	
							-60.5	
					1			
			From El. -62.5 to -63.8 Ft., little fine to medium-grained sand-sized shell					
-63.8	4.3						-63.5	
			SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, few silt, strong reaction with HCl, moist, 10Y 4/1 dark greenish gray (SP-SM)		2			
							-65.0	
					3			
-66.5	7.0						-67.5	
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, few fine to medium-grained sand-sized shell, weak reaction with HCl, moist, 10Y 4/1 dark greenish gray (SM)		4			
			At El. -67.7 Ft., trace coarse gravel-sized shell					
			From El. -68.1 to -71.1 Ft., some silt					
			From El. -69.6 to -71.1 Ft., little fine to coarse-grained sand-sized shell, trace fine gravel-sized shell					
			At El. -70.5 Ft., some fine to coarse-grained sand-sized shell, trace fine gravel-sized shell					
			From El. -71.1 to -76.1 Ft., occasional trace fine to medium-grained sand-sized shell, occasional silt and clay nodules					

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(Continued)

Boring Designation VC-FSP11-21

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 656,922 Y = 1,856,128	-59.5 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-79.5	20.0						-79.5		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Vibracore penetrated to 20 feet. Sample recovery from 16.6 to 20 feet was not attained.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*
2	4.0/4.5	SP*
3	5.5/6.0	SP-SM*
4	8.0/8.5	SM*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

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JUN 02

Boring Designation VC-FSP11-22

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS
1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-22	LOCATION COORDINATES: X = 657,885 Y = 1,850,138	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 7 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -52.7 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 98 %	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR UD	REMARKS	BLOWS/1 FT. N-VALUE
-52.7	0.0						-52.7	
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, trace silt, weak reaction with HCl, moist, 5GY 5/1 greenish gray (SP)	NR			Vibracore	
							-53.7	
					1			
			From El. -55.2 to -57.7 Ft., few fine to medium-grained sand-sized shell				-56.7	
					2			
							-59.7	
			From El. -59.7 to -61.7 Ft., trace fine gravel-sized shell		3-Post 3		-59.7	
			From El. -61.7 to -64.2 Ft., little fine to coarse-grained sand-sized shell, few fine-grained sand-sized shell				-62.7	
			At El. -62.2 Ft., trace silt nodules		4			
-64.2	11.5		SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, few fine-grained sand-sized shell, few silt, weak reaction with HCl, moist, 5GY 4/1 dark greenish gray (SP-SM)				-64.7	
-65.2	12.5		SAND, silty, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, little silt, weak reaction with HCl, moist, occasional fine to coarse gravel-sized shell, 10GY 3/1 very dark greenish gray (SM)		5			
							-66.7	
					6			

0 5 10 15

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JUN 02

(Continued)

Boring Designation VC-FSP11-22

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 657,885 Y = 1,850,138	-52.7 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-72.7	20.0		At El. -66.4 Ft., wet At El. -67.9 Ft., occasional traces of silt nodules, silt content increasing with depth From El. -69.7 to -71.9 Ft., some fine to coarse-grained sand-sized shell From El. -69.9 to -70.5 Ft., trace gravel to cobble-sized shell, trace coarse gravel-sized oyster shell				-72.7		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. 100% recovery attained from 0.0 to 19.2 feet. Due to varying quantities and sizes of shell, recovery of sample from 19.2 to 20.0 feet was not achieved. Sample description based on material retained in the shoe.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*
2	4.0/4.5	SP*
3	7.0/7.5	SP*
3-Post	7.0/7.5	SP*
4	10.0/10.5	SP*
5	12.0/12.5	SP-SM*
6	14.0/14.5	SM*

*Lab visual classification based on gradation curve. No Atterberg limits.

Abbreviations:
NR = Not Recorded.

15 20 25 30 35

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Boring Designation VC-FSP11-23

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT: Off-Shore Borrow Area Investigations, Flagler County, Florida		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: VC-FSP11-23	LOCATION COORDINATES: X = 657,899 Y = 1,844,676	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: AVS	CONTRACTOR FILE NO.: 6734-11-9583	12. TOTAL SAMPLES	DISTURBED: 3 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Brian McCord		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER	
		15. DATE BORING	STARTED: 02-15-11 / COMPLETED: 02-15-11
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -60.6 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 87 %	
8. TOTAL DEPTH OF BORING: 20.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Karishma R. Desai, P.E., Geotechnical Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD OR CORE UD	REMARKS	BLOWS/1 FT. N-VALUE
-60.6	0.0						-60.6	
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, some fine to medium-grained sand-sized shell, trace silt, weak reaction with HCl, moist, 10Y 4/1 dark greenish gray (SP)	NR			Vibracore	0
							-61.6	
-62.3	1.7		At El. -61.9 Ft., a layer of silt (approximately 1/4" thick)		1			
			At El. -62.2 Ft., a layer of silt (approximately 1/2" thick)				-63.1	
-63.6	3.0		SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, few silt, few fine to medium-grained sand-sized shell, weak reaction with HCl, moist, 10Y 4/1 dark greenish gray (SP-SM)		2			
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, few fine to medium-grained sand-sized shell, strong reaction with HCl, moist, occasional fine to coarse gravel-sized shell, 10GY 4/1 dark greenish gray (SM)				-65.6	5
			At El. -65.1 Ft., trace clay		3			
			From El. -66.6 to -67.9 Ft., little fine to coarse-grained sand-sized shell					
			From El. -68.2 to -70.0 Ft., some silt, trace clay, silt content increasing with depth					
-70.0	9.4		At El. -69.8 Ft., few fine-grained sand-sized shell					10
			SILT, inorganic-L, low plasticity, very soft, little clay, few fine-grained sand-sized quartz, no reaction with HCl, moist, occasional trace fine to medium-grained sand-sized shell, 10GY 4/1 dark greenish gray (ML)					
-73.2	12.6		At El. -72.7 Ft., few sand to gravel-sized shell					
-73.6	13.0		LIMESTONE, fossiliferous, moderately hard, moderately weathered, fine grained, highly fractured, solid, some silt, little sand to gravel-sized shell, 10Y 5/1 greenish gray					
			SAND, silty, mostly fine to coarse-grained sand-sized shell, some silt, little fine-grained sand-sized quartz, few fine gravel-sized					
-75.6	15.0							15

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation VC-FSP11-23

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Off-Shore Borrow Area Investigations	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 657,899 Y = 1,844,676	-60.6 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/1 FT.	N-VALUE
-80.6	20.0	Moderately Weathered	shell, no reaction with HCl, moist, - 10Y 5/1 greenish gray (SM) - LIMESTONE, fossiliferous, moderately hard, - moderately weathered, fine grained, highly - fractured, solid, some silt, few clay, - occasional few sand to gravel-sized shell, - 5GY 5/1 greenish gray -				-80.6		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. 100% recovery attained from 0.0 to 17.3 feet. Due to presence of limestone, sample recovery from 17.3 to 20.0 feet was not achieved.

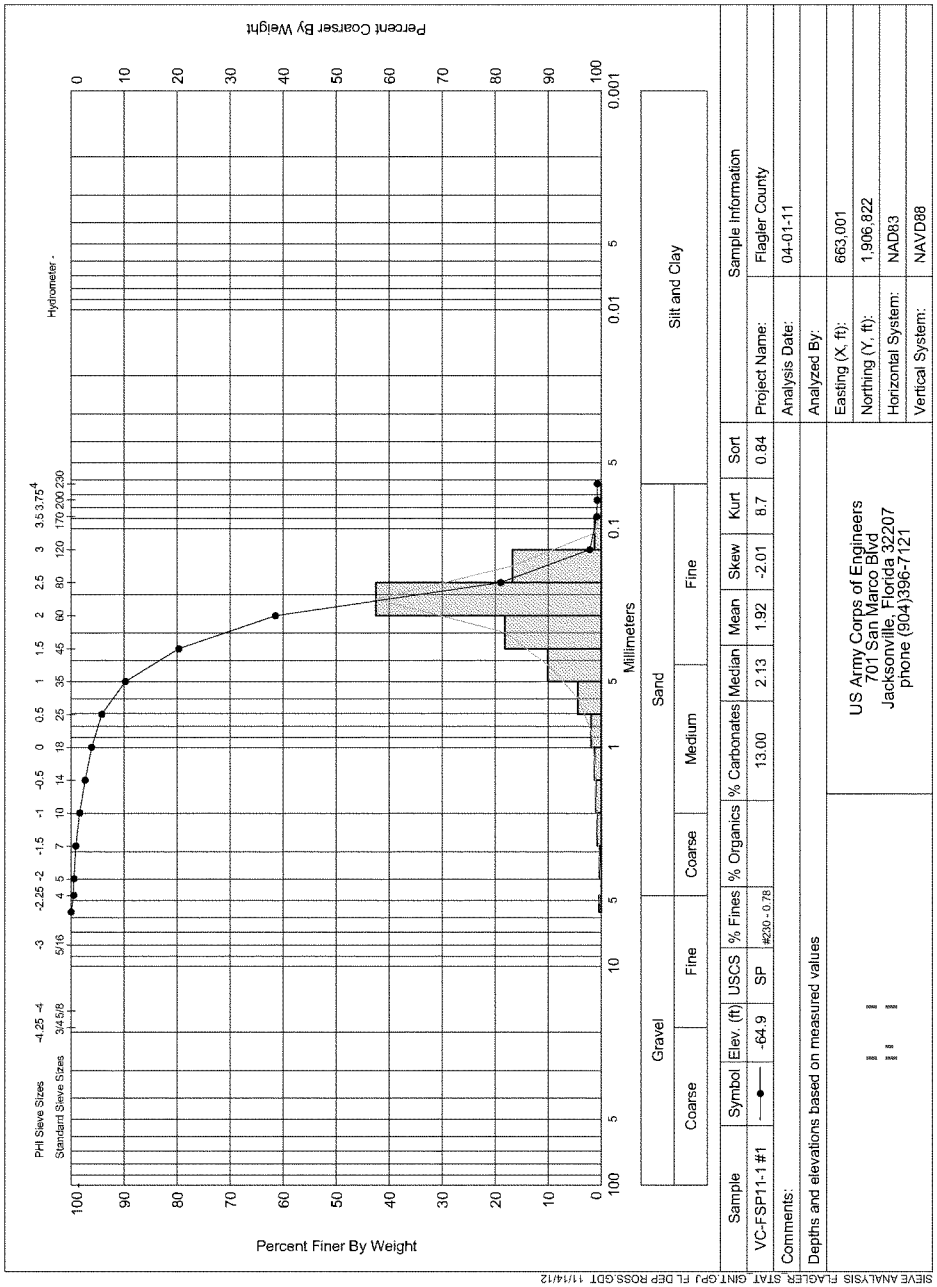
4. Laboratory Testing Results

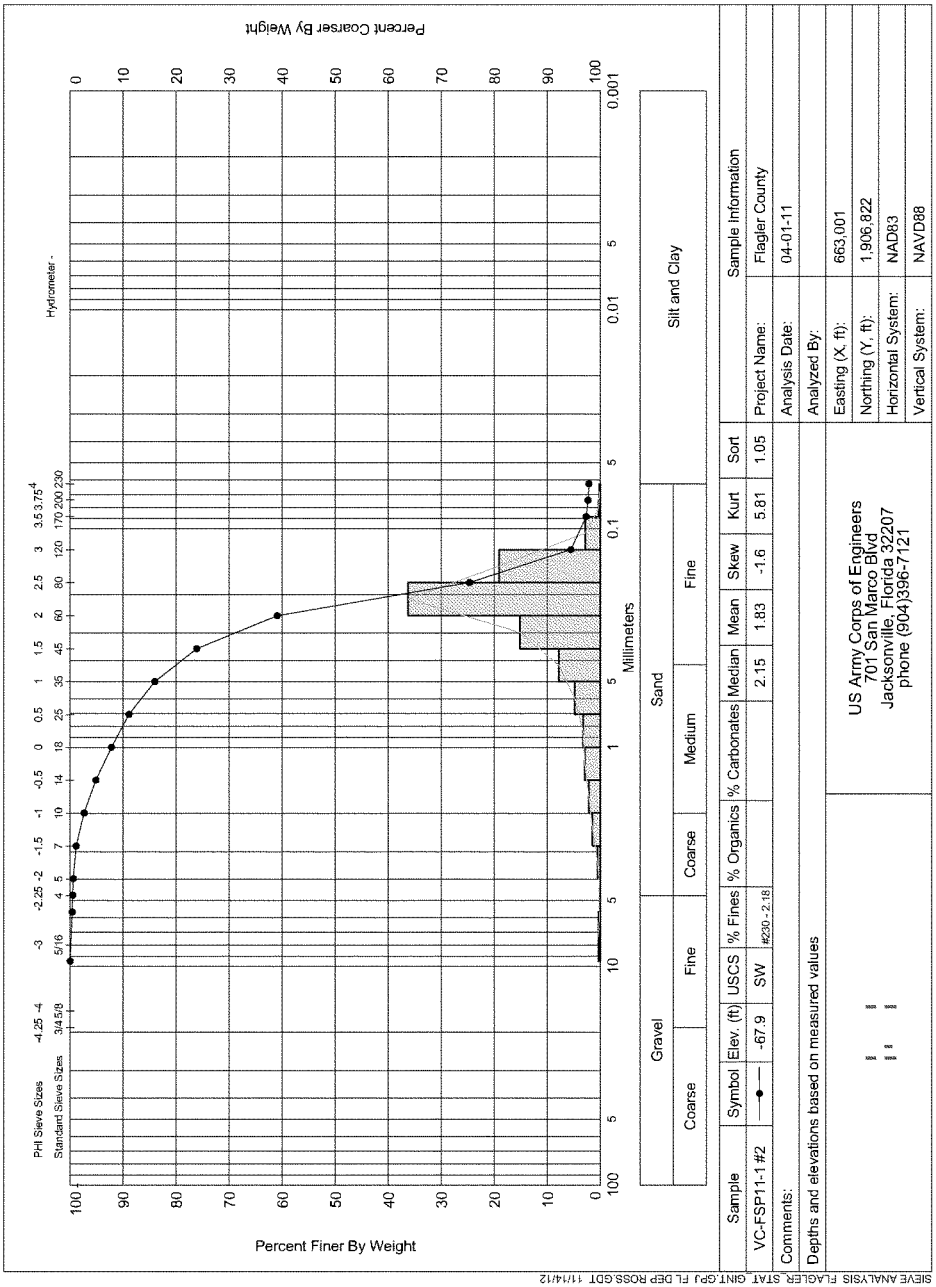
SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	1.0/1.5	SP*
2	2.5/3.0	SP-SM*
3	5.0/5.5	SM*

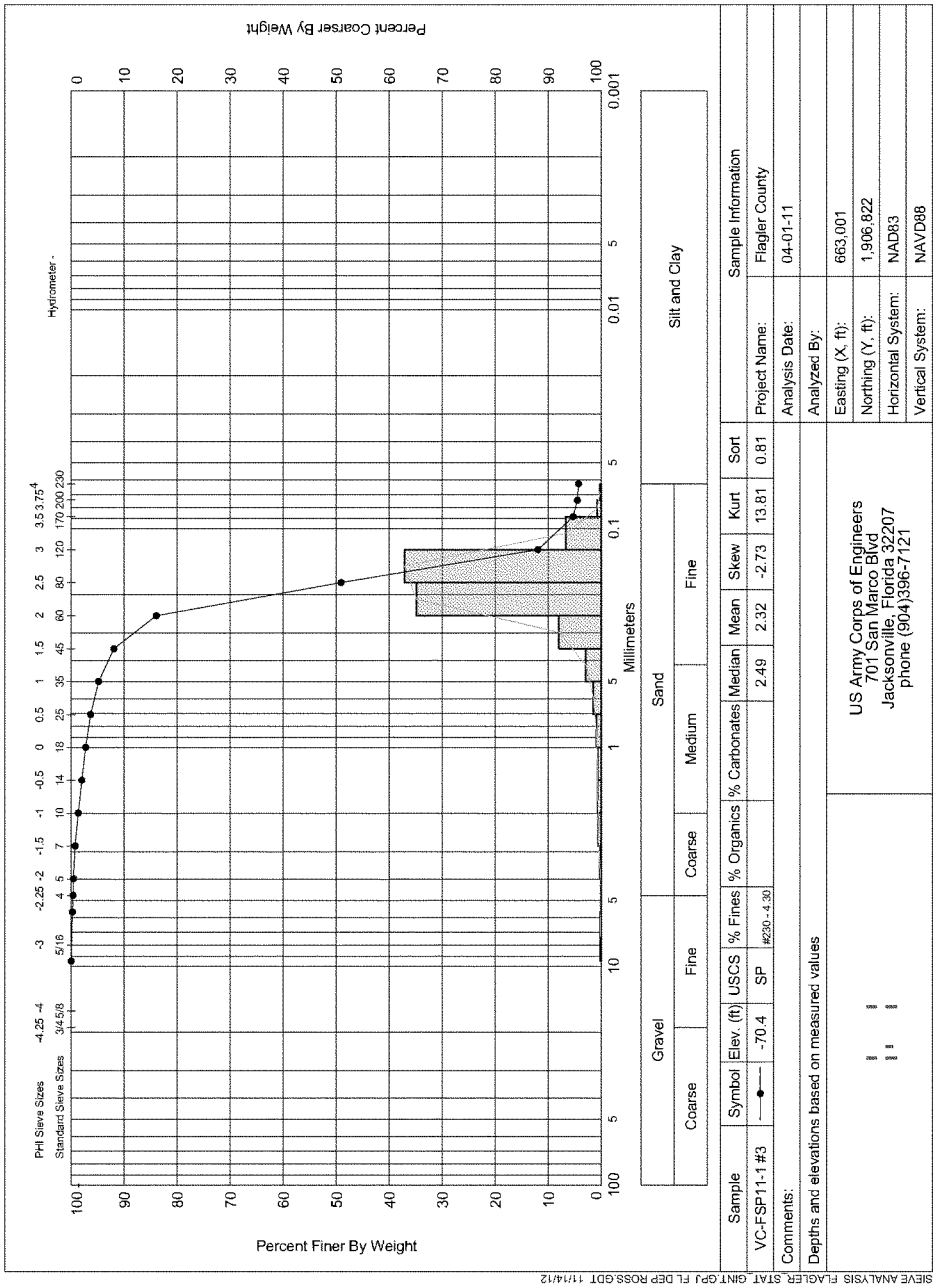
*Lab visual classification based on gradation curve. No Atterberg limits.

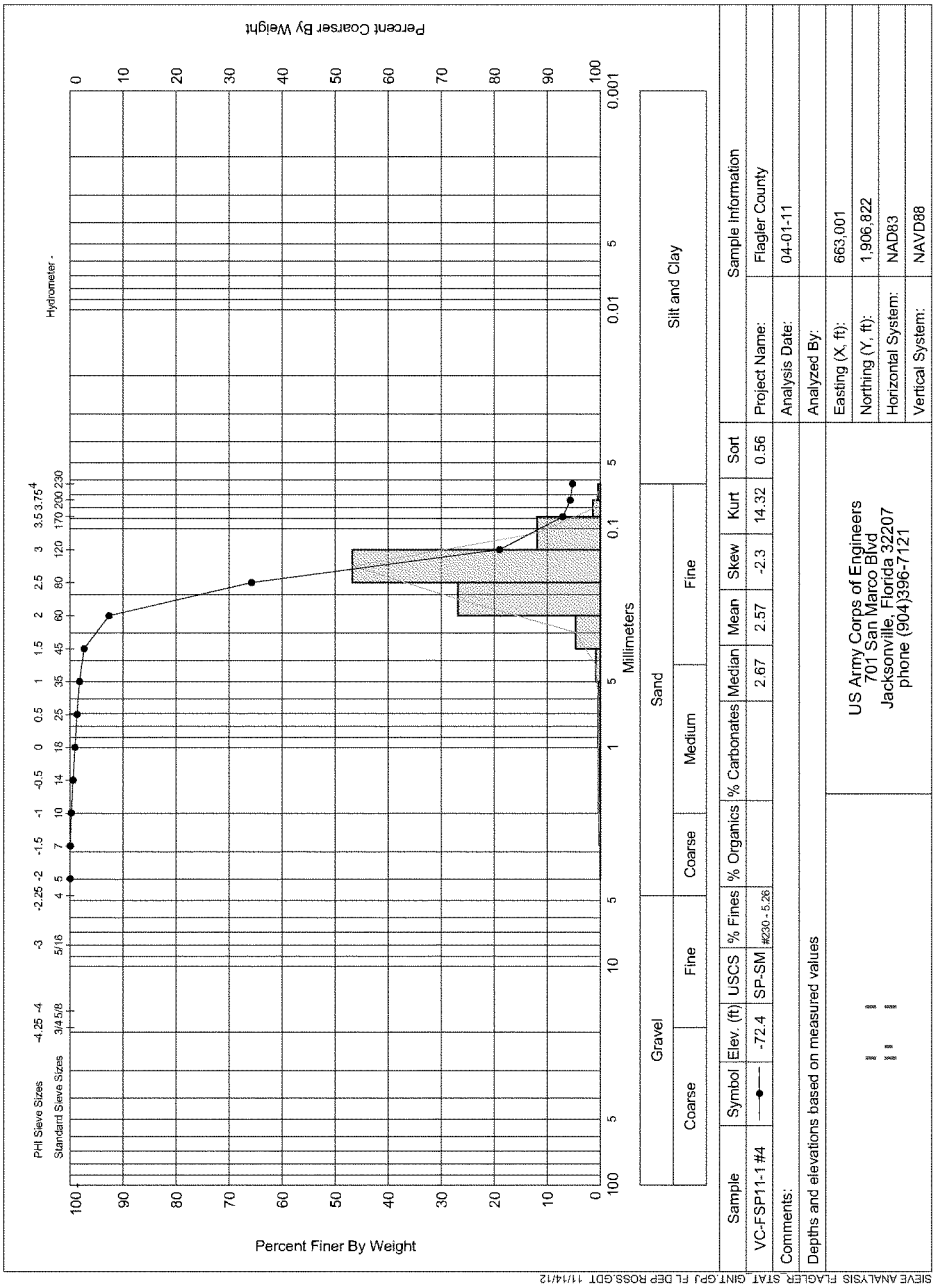
Abbreviations:
NR = Not Recorded.

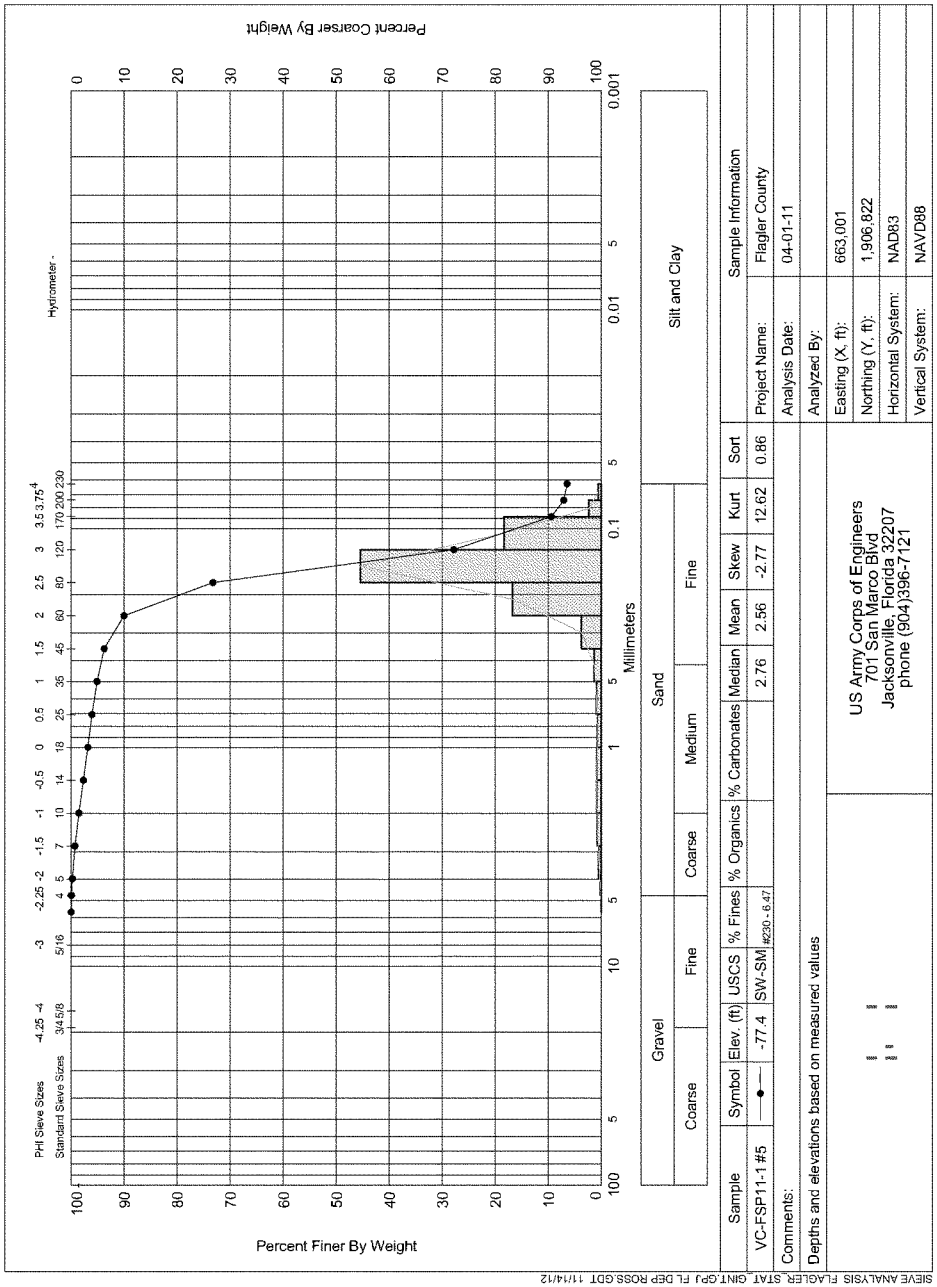
SAJ FORM 1836-A
JUN 02

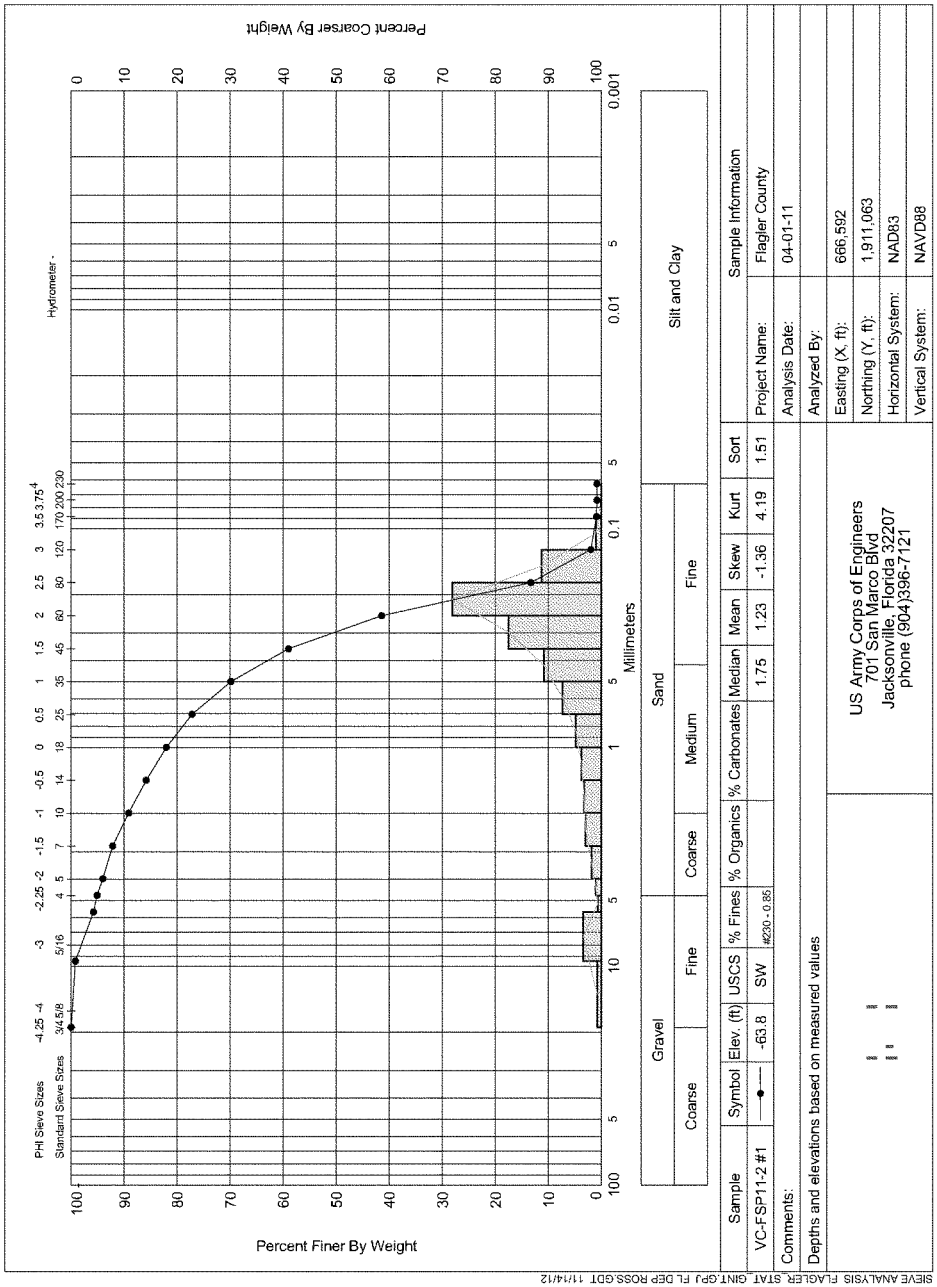

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-1 #1
-64.9
SP
#230 - 0.78
13.00
2.13
1.92
-2.01
8.7
0.84
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 663,001
Northing (Y, ft): 1,906,822
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL_DEP ROSS.GDT 11/14/12

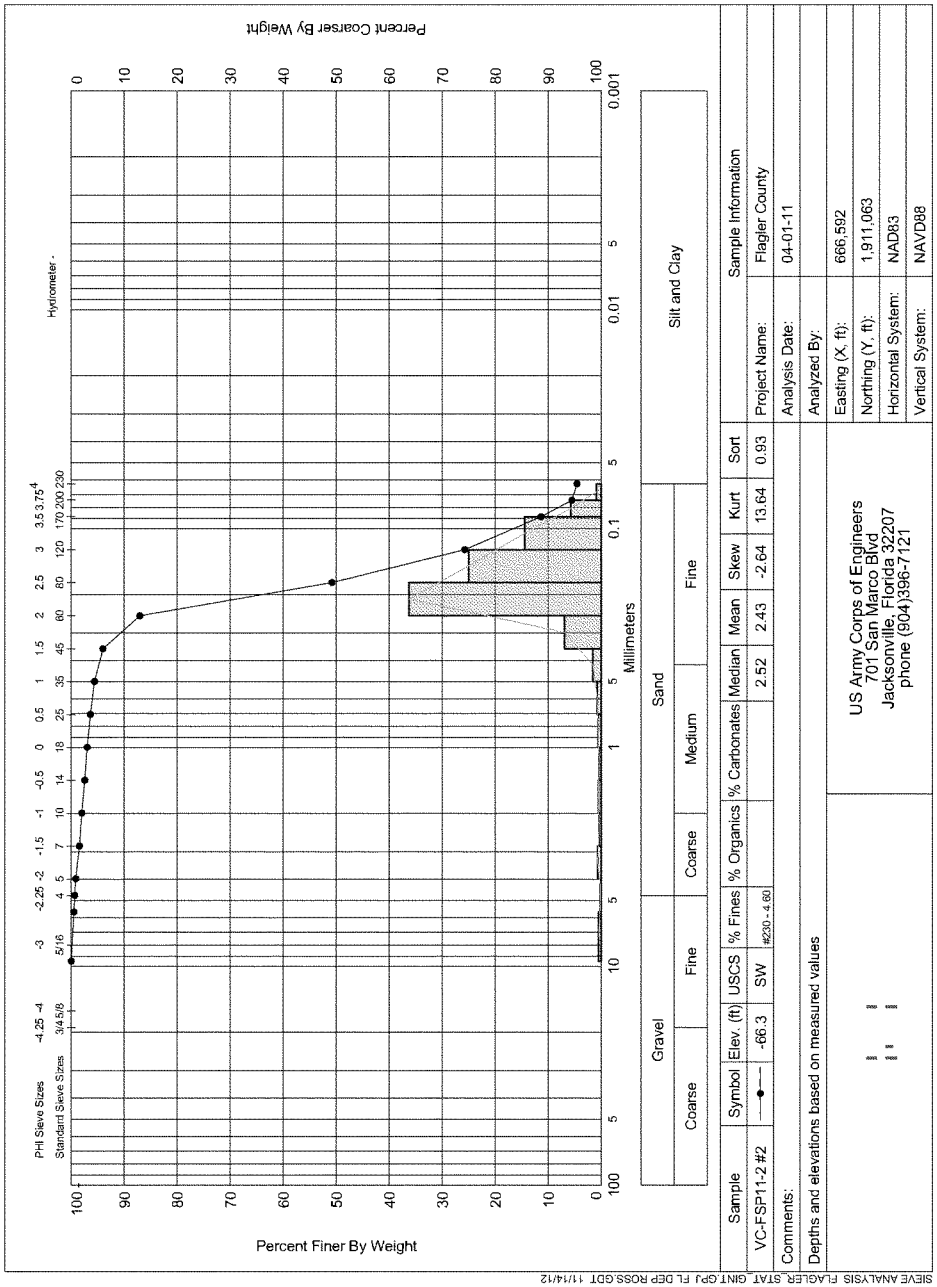

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-1 #2
-67.9
SW
#230 - 2.18
2.15
1.83
-1.6
5.81
1.05
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
663,001
Northing (Y, ft):
1,906,822
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-1 #3
-70.4
SP
#230 - 4.30
2.49
2.32
-2.73
13.81
0.81
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
663,001
Northing (Y, ft):
1,906,822
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-1 #4
-72.4
SP-SM
#230 - 5.26
2.67
2.57
-2.3
14.32
0.56
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
663,001
Northing (Y, ft):
1,906,822
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-1 #5
-77.4
SW-SM
#230 - 6.47
2.76
2.56
-2.77
12.62
0.86
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
663,001
Northing (Y, ft):
1,906,822
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-2 #1
-63.8
SW
#230 - 0.85
1.75
1.23
-1.36
4.19
1.51
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
666,592
Northing (Y, ft):
1,911,063
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-2 #2
-66.3
SW
#230 - 4.60
2.52
2.43
-2.64
13.64
0.93
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 666,592
Northing (Y, ft): 1,911,063
Horizontal System: NAD83
Vertical System: NAVD88
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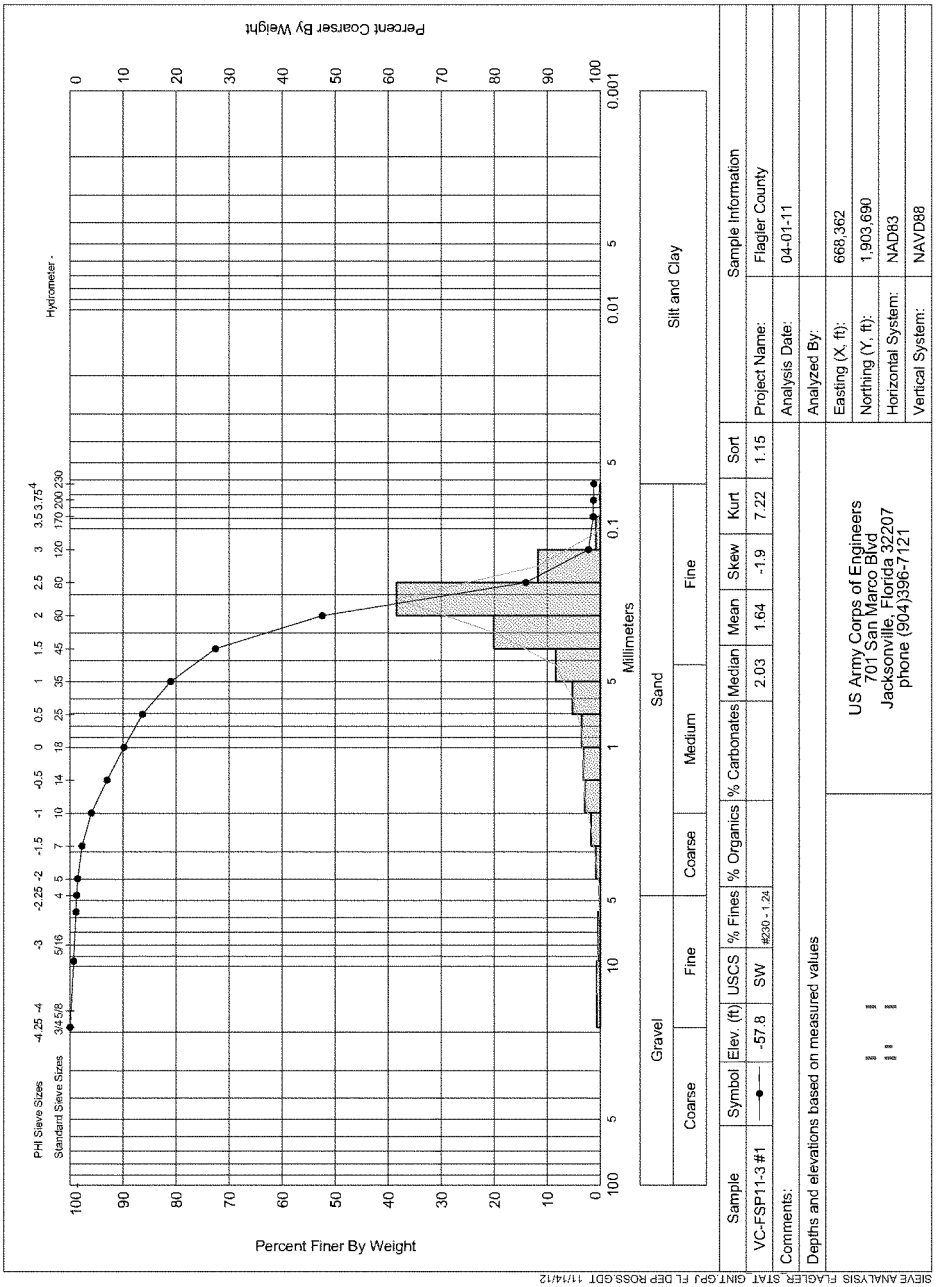
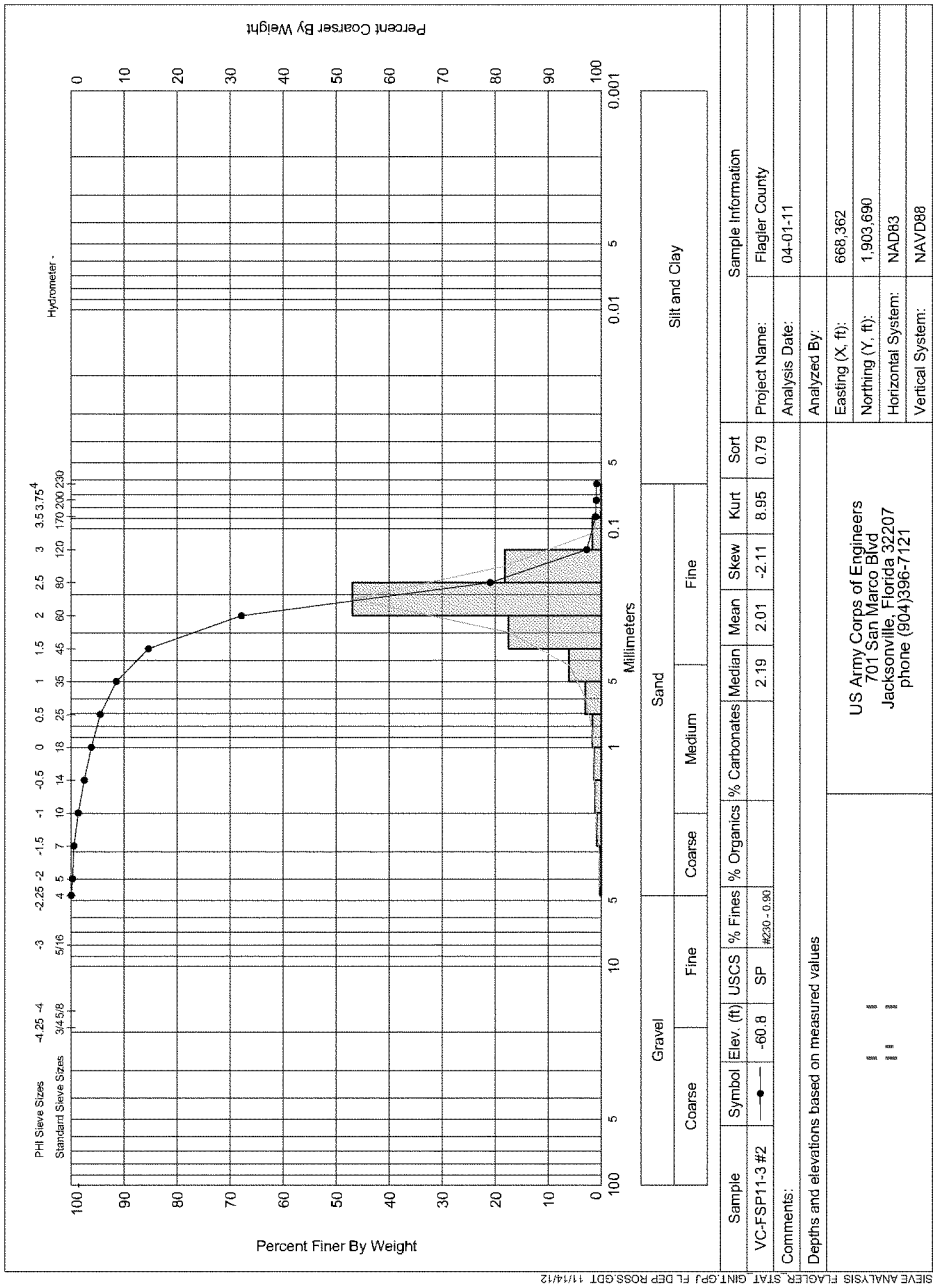
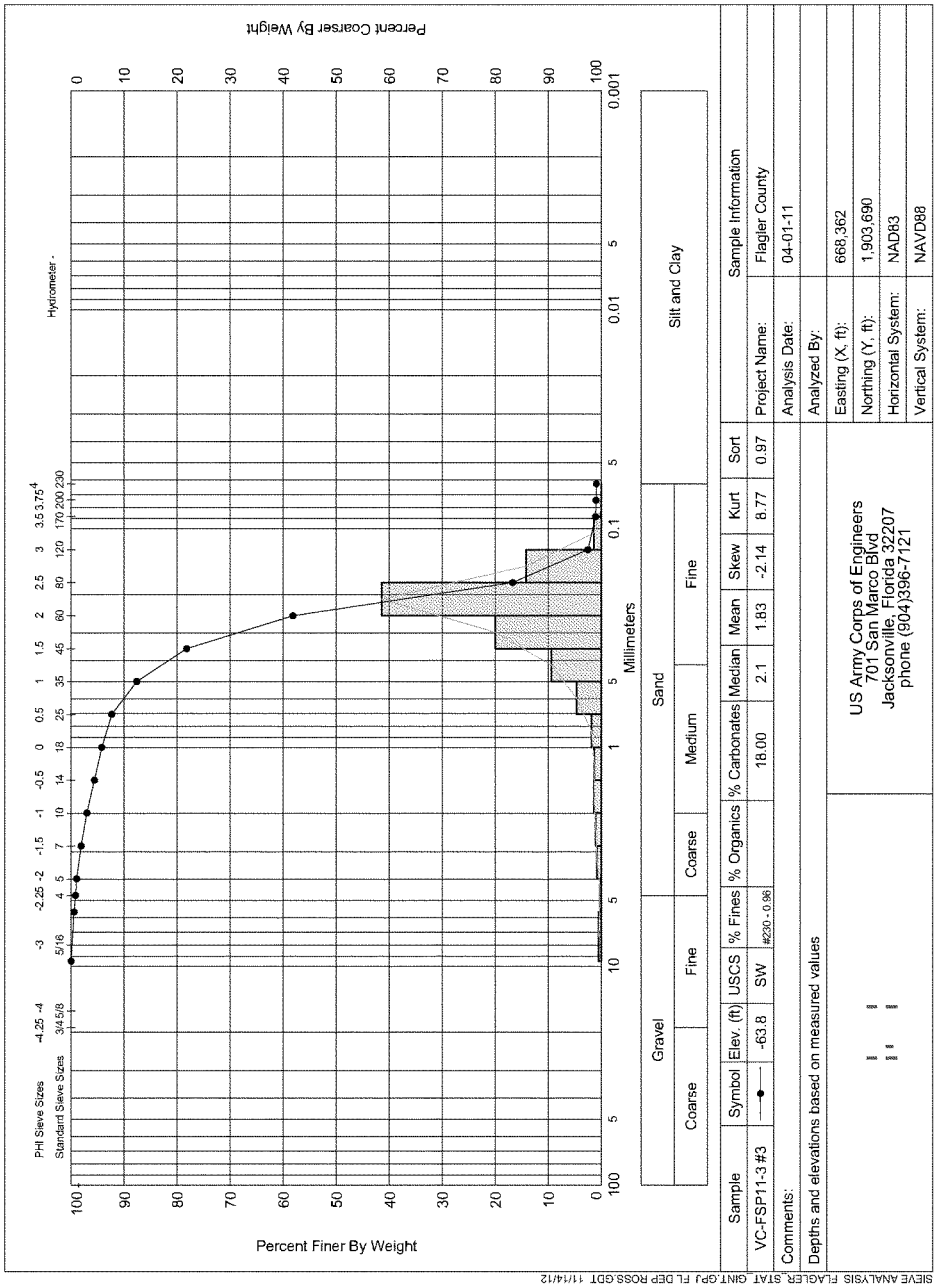
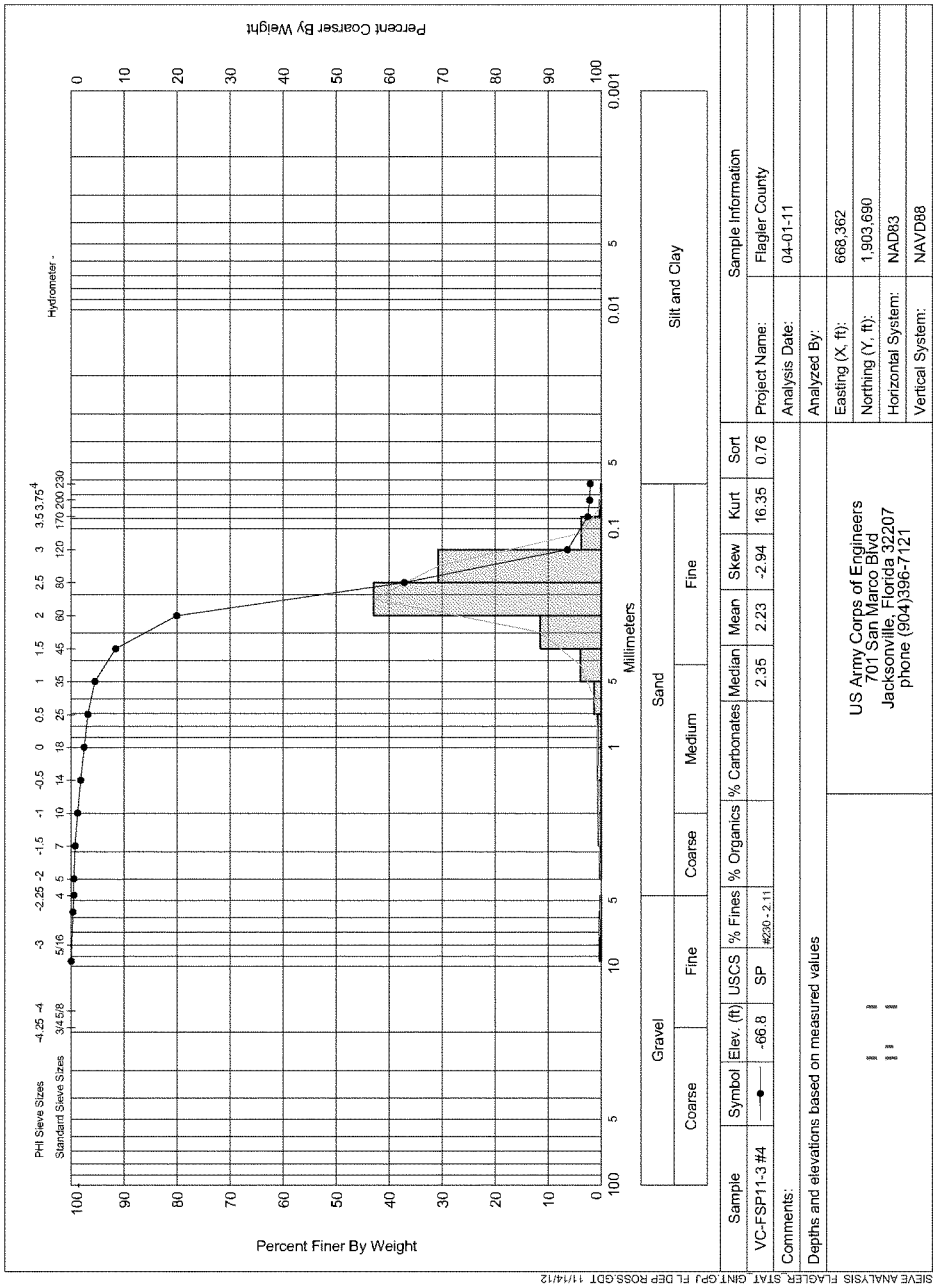
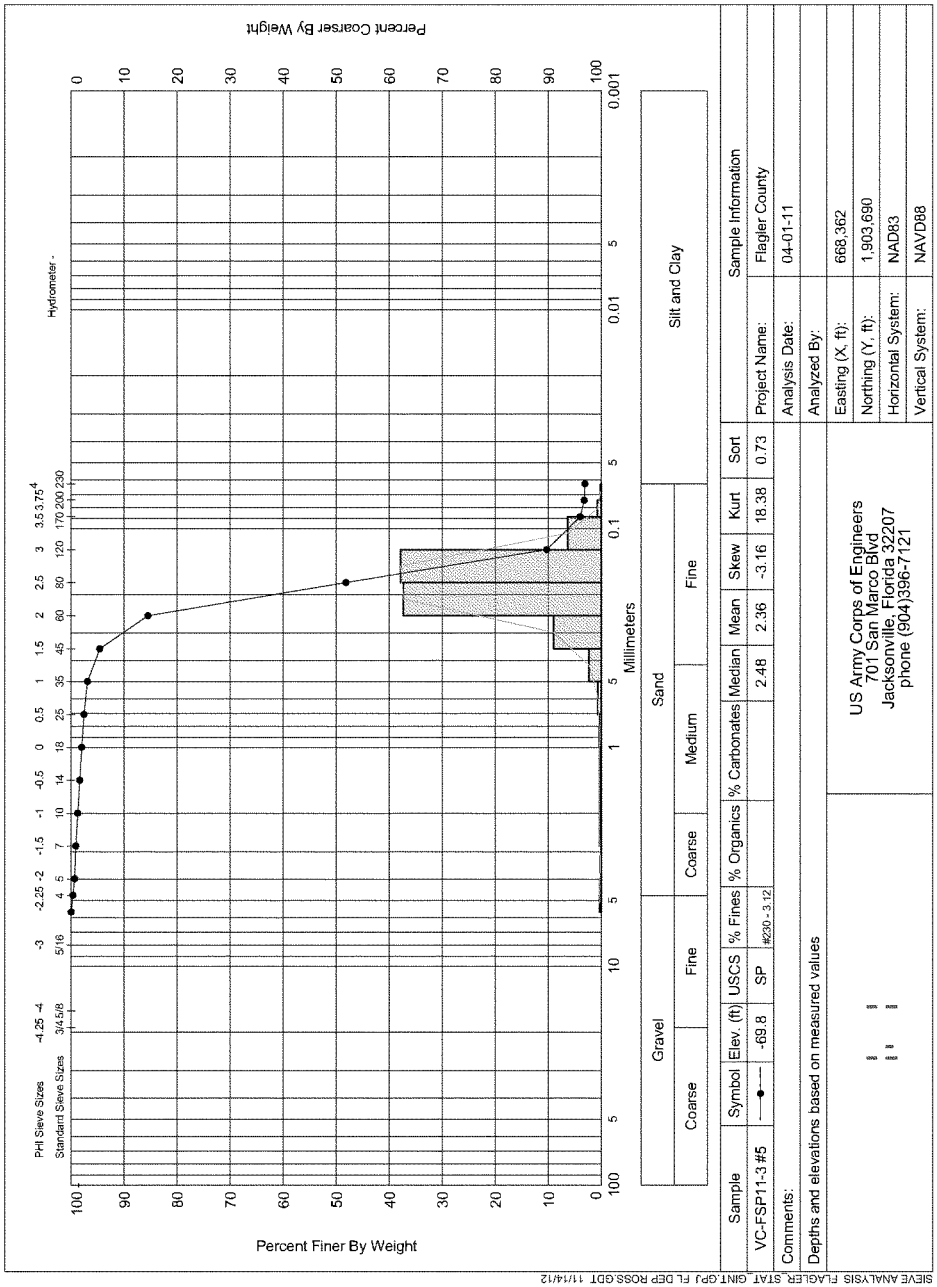
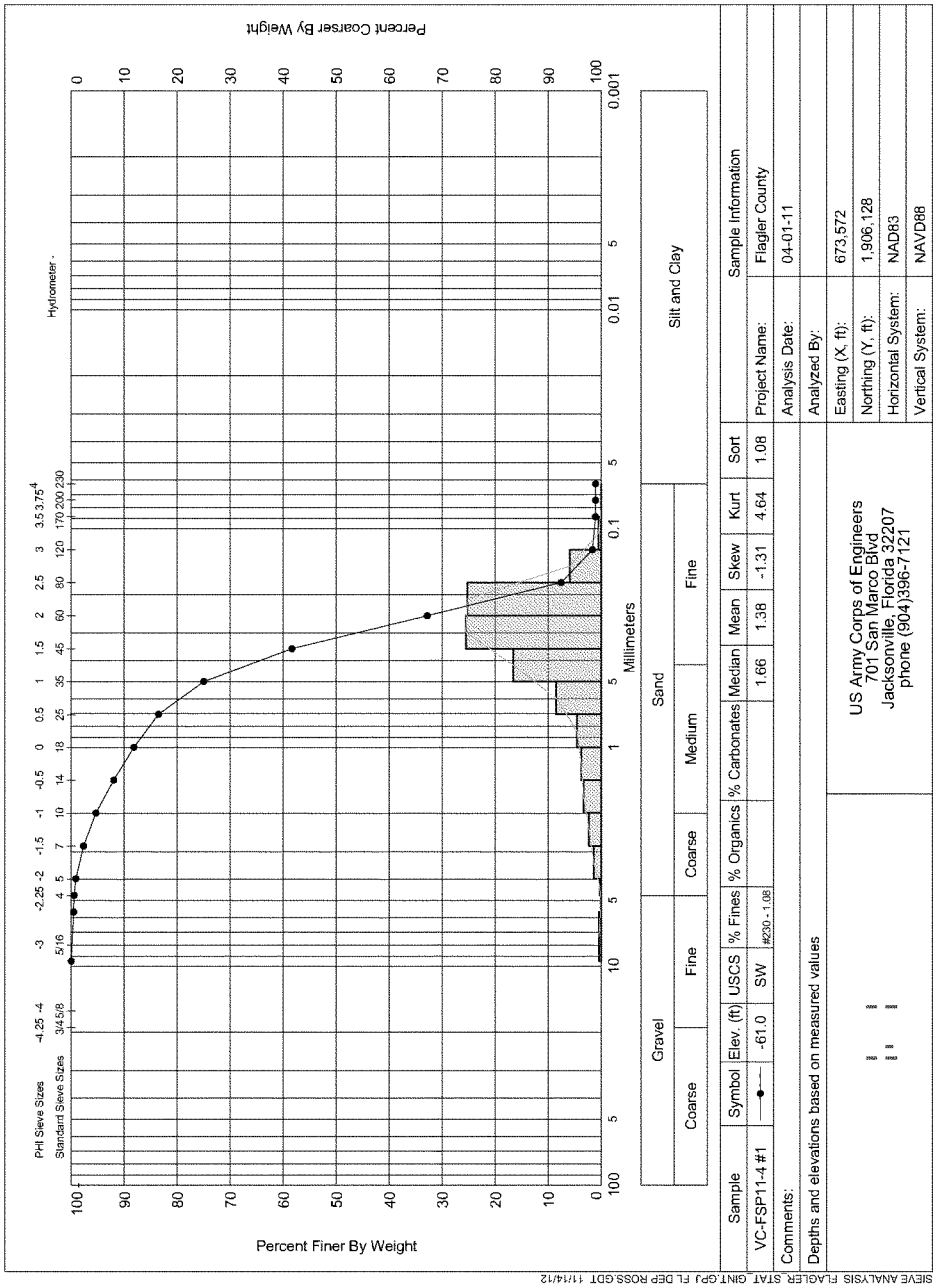

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-3 #1
-57.8
SW
#230 - 1.24
2.03
1.64
-1.9
7.22
1.15
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
668,362
Northing (Y, ft):
1,903,690
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL_DEP_ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
VC-FSP11-3 #2
Symbol
Elev. (ft)
-60.8
USCS
SP
% Fines
#230 - 0.90
% Organics
% Carbonates
Median
2.19
Mean
2.01
Skew
-2.11
Kurt
8.95
Sort
0.79
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
668,362
Northing (Y, ft):
1,903,690
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-3 #3
-63.8
SW
#230 - 0.96
18.00
2.1
1.83
-2.14
8.77
0.97
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
668,362
Northing (Y, ft):
1,903,690
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Finer By Weight
Percent Coarser By Weight
Hydrometer -
PHI Sieve Sizes -4.25 -4 -3 -2.25 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5 3.75 4
Standard Sieve Sizes 3/4 5/8 5/16 4 5 7 10 14 18 25 35 45 60 80 120 170 200 230
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample | Symbol | Elev. (ft) | USCS | % Fines | % Organics | % Carbonates | Median | Mean | Skew | Kurt | Sort
VC-FSP11-3 #4 | -66.8 | SP | #230 - 2.11 | | | 2.35 | 2.23 | -2.94 | 16.35 | 0.76
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 668,362
Northing (Y, ft): 1,903,690
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-3 #5
-69.8
SP
#230 - 3.12
2.48
2.36
-3.16
18.38
0.73
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
668,362
Northing (Y, ft):
1,903,690
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12



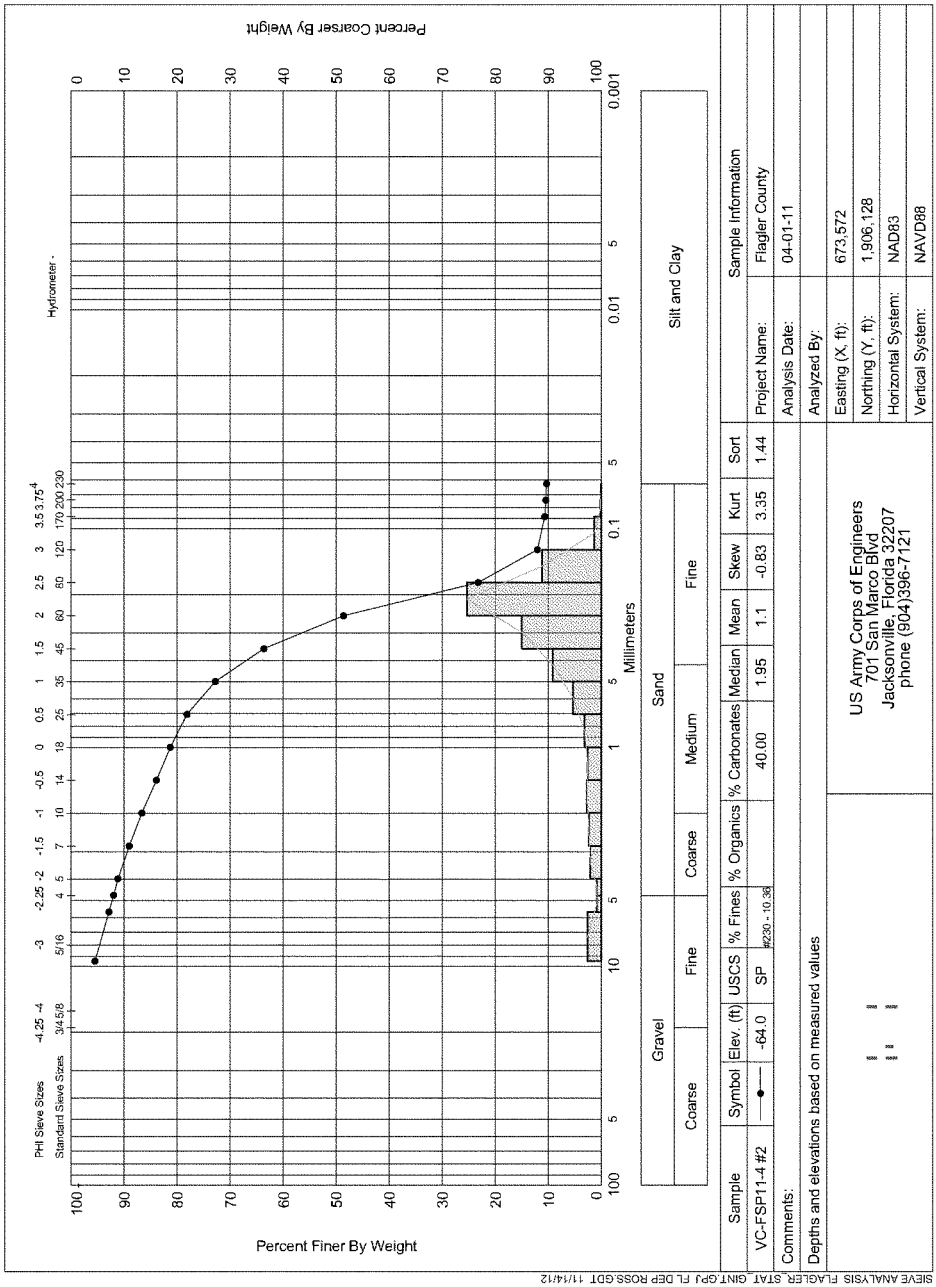
Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
VC-FSP11-4 #1		-61.0	SW	#230 - 1.08			1.66	1.38	-1.31	4.64	1.08

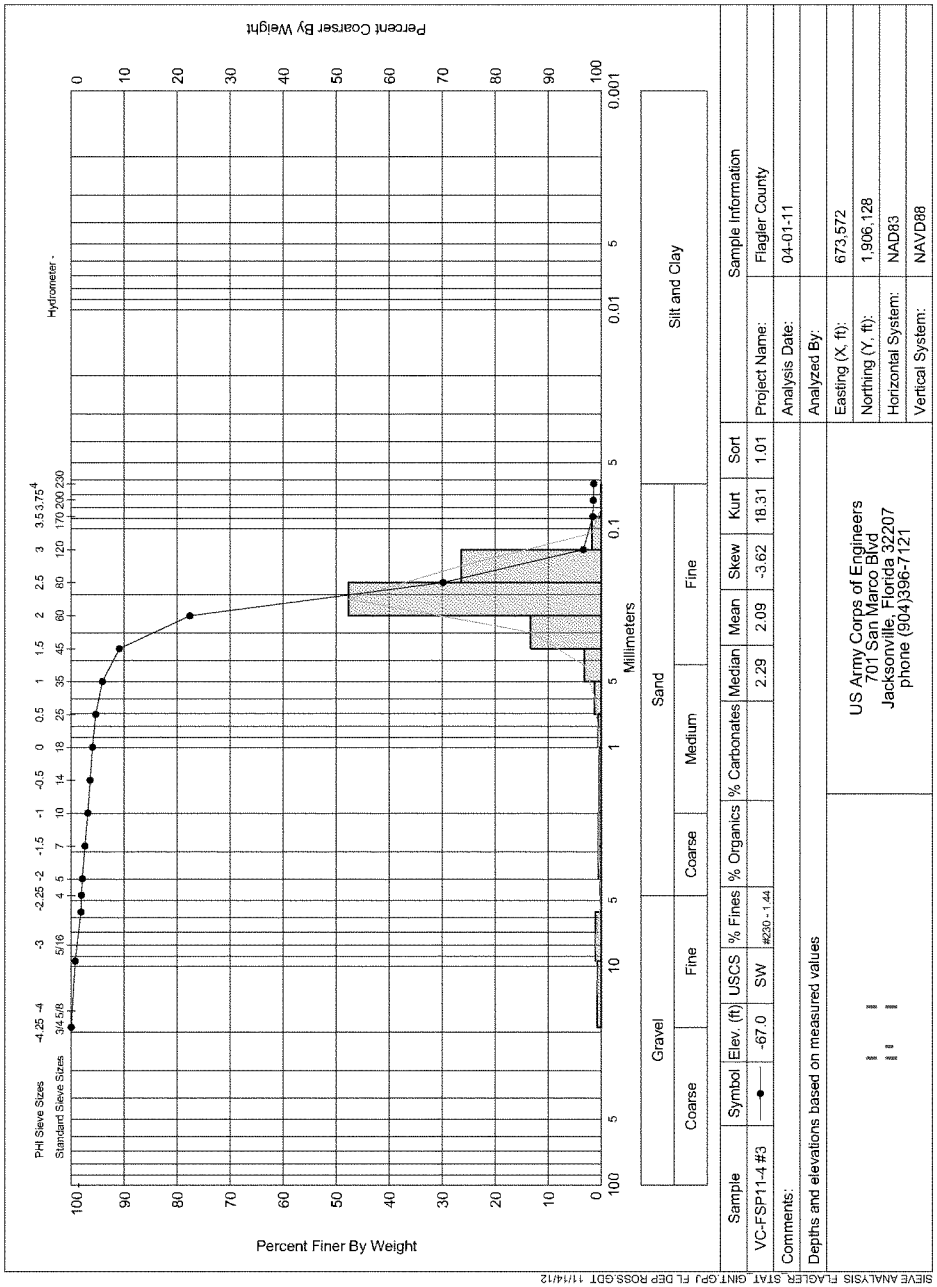
Comments:

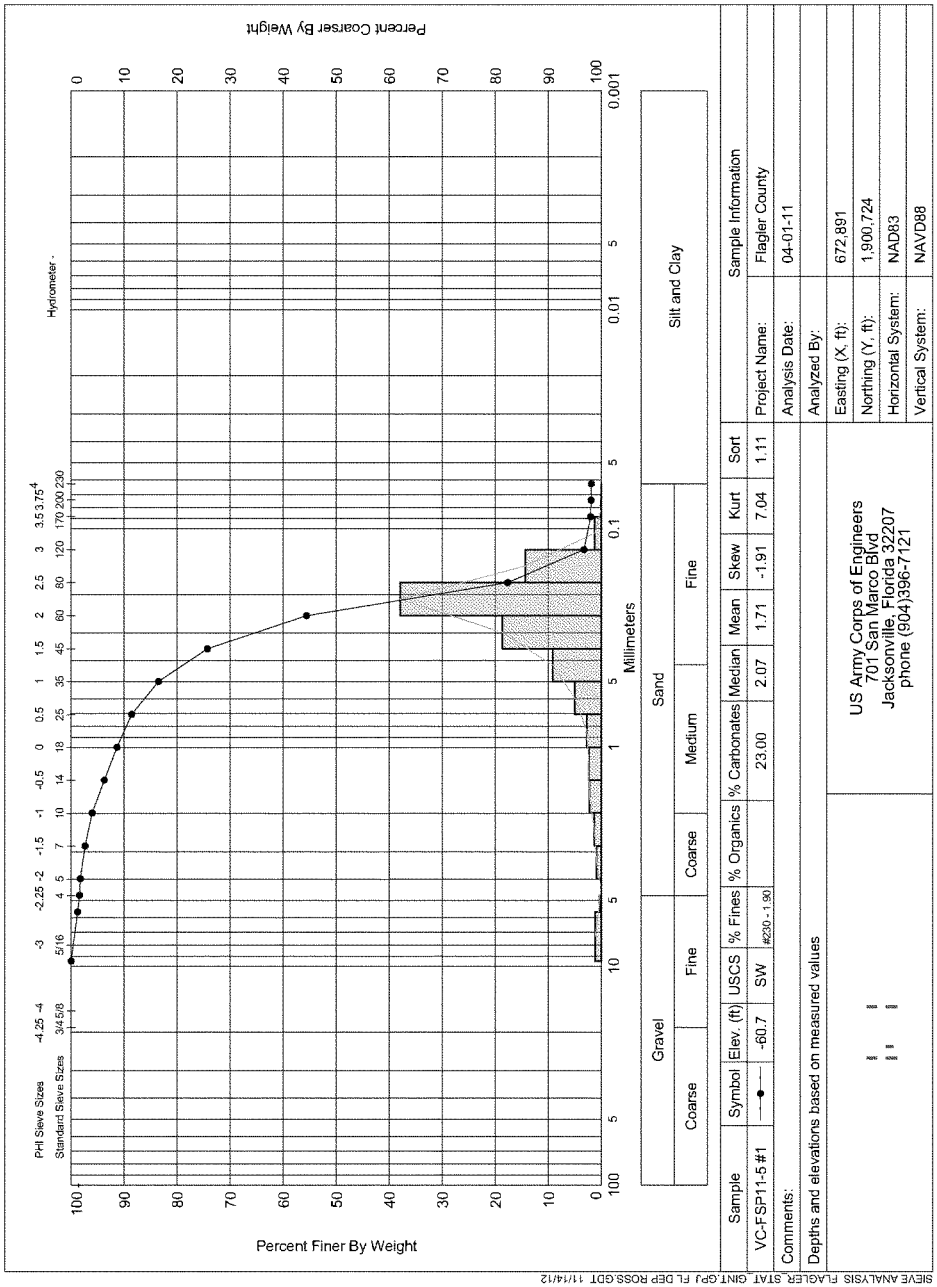
Depths and elevations based on measured values

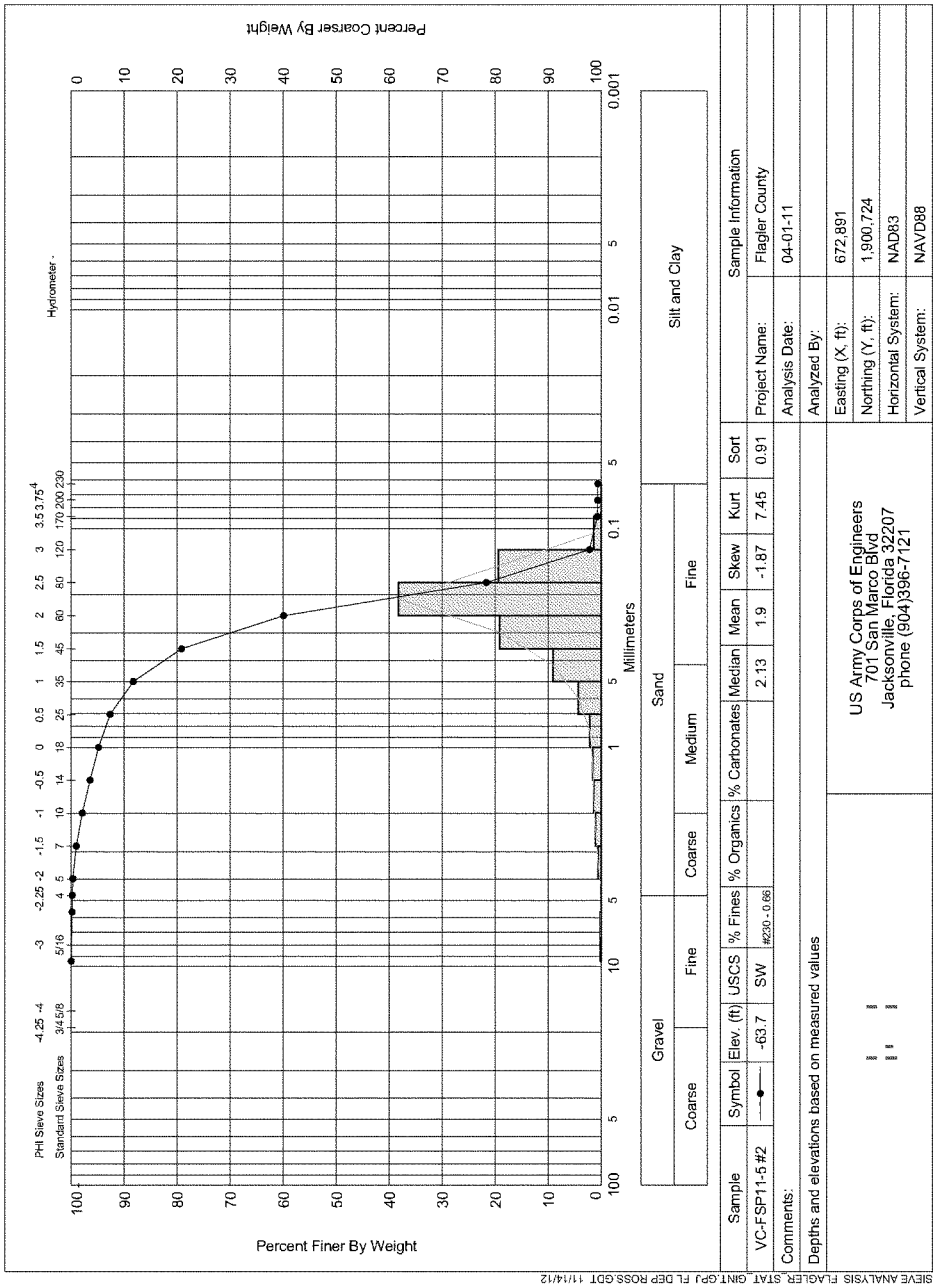
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

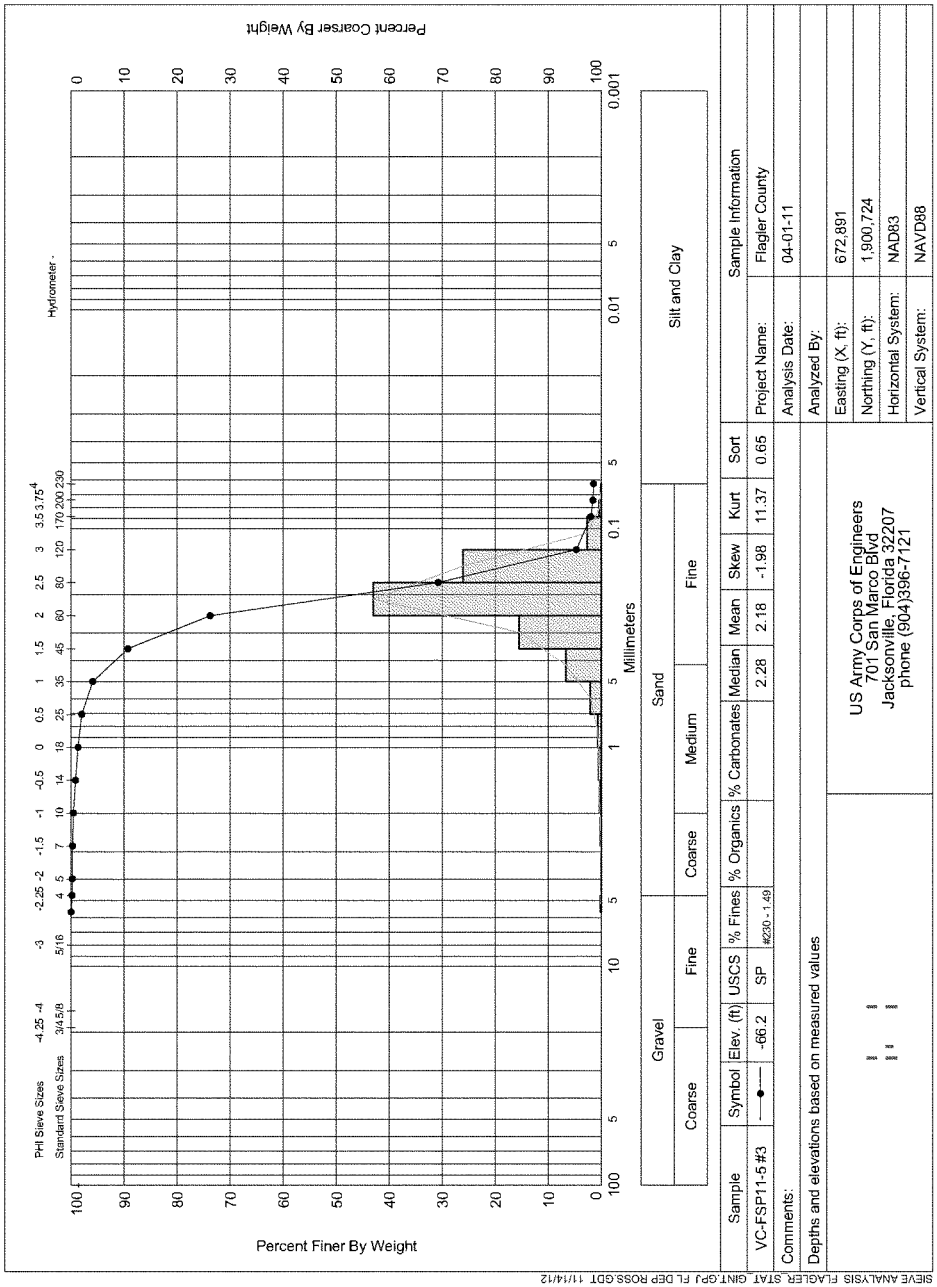
Sample Information	
Project Name:	Flagler County
Analysis Date:	04-01-11
Analyzed By:	
Easting (X, ft):	673,572
Northing (Y, ft):	1,906,128
Horizontal System:	NAD83
Vertical System:	NAVD88

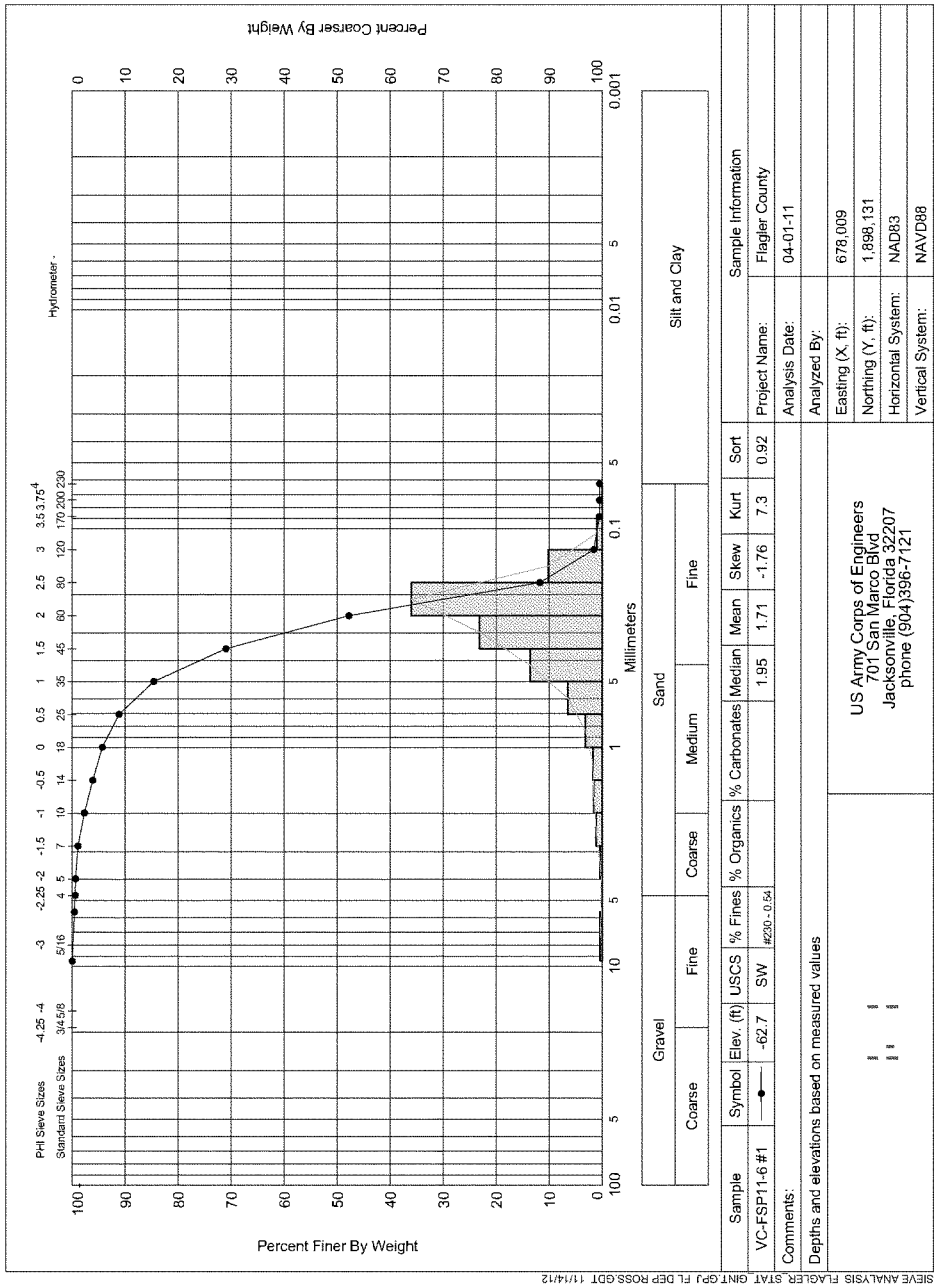

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-4 #2
-64.0
SP
#230 - 10.36
40.00
1.95
1.1
-0.83
3.35
1.44
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
673,572
Northing (Y, ft):
1,906,128
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

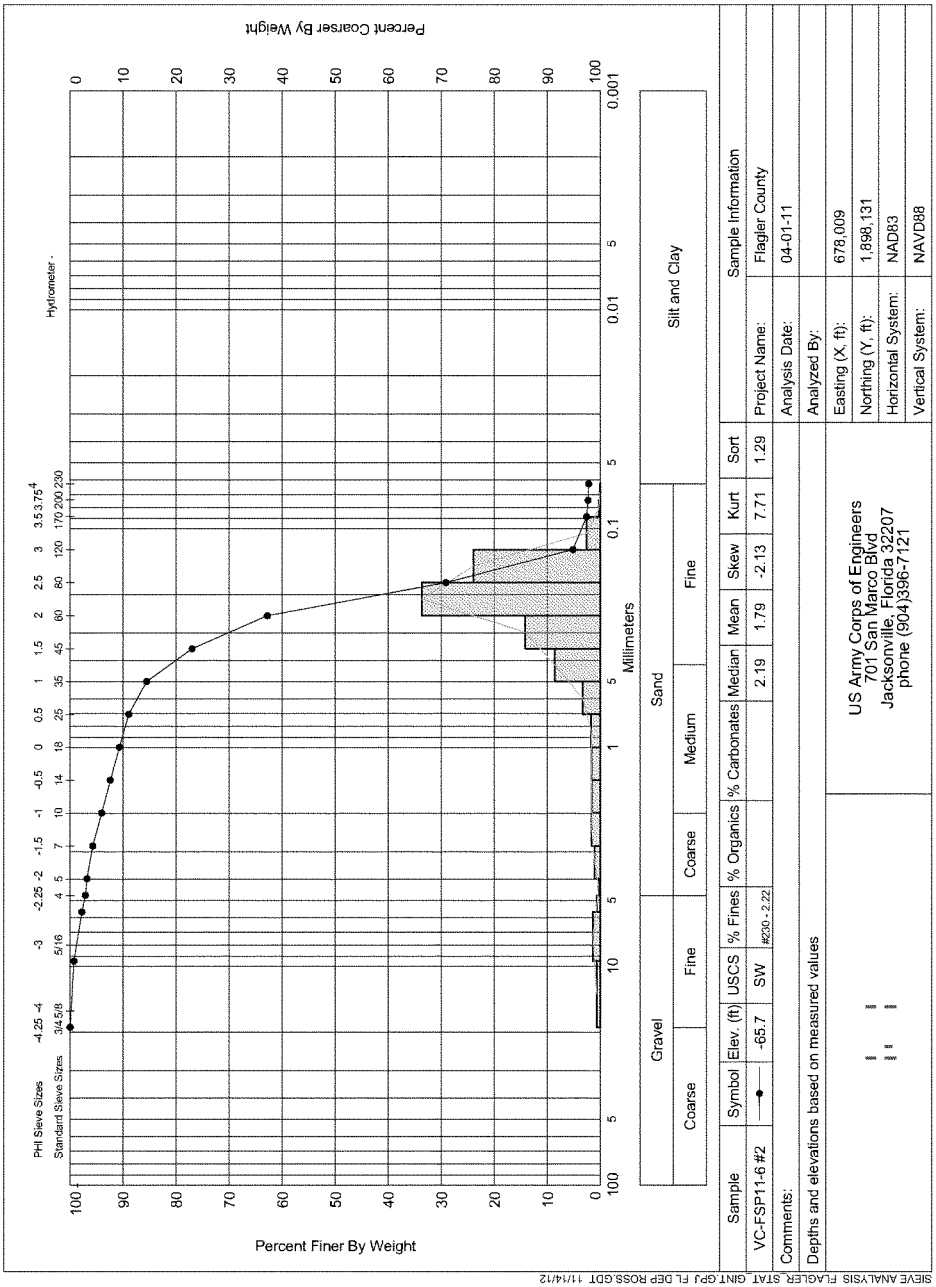

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-4 #3
-67.0
SW
#230 - 1.44
2.29
2.09
-3.62
18.31
1.01
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
673,572
Northing (Y, ft):
1,906,128
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

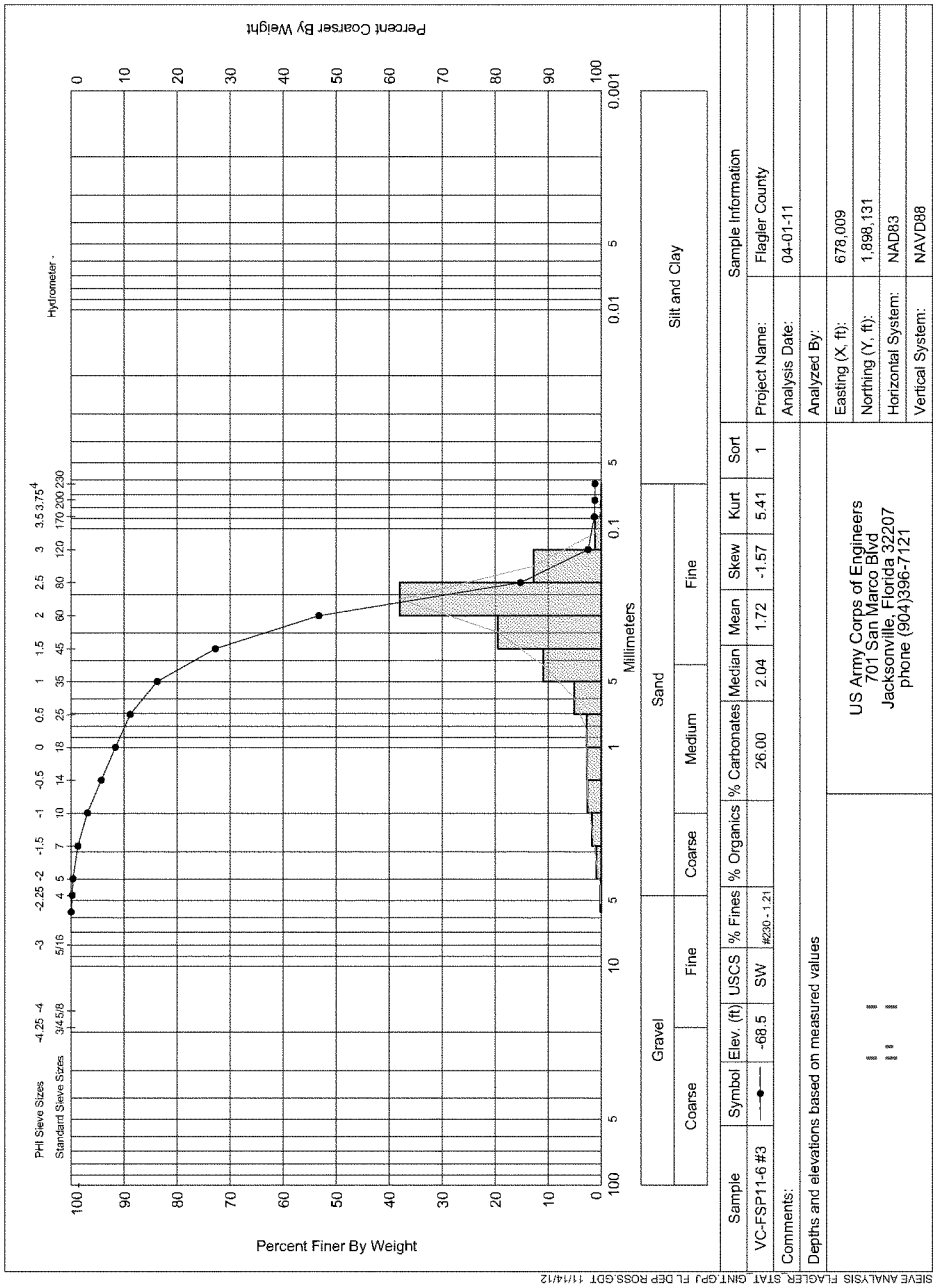

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-5 #1
-60.7
SW
#230 - 1.90
23.00
2.07
1.71
-1.91
7.04
1.11
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
672,891
Northing (Y, ft):
1,900,724
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

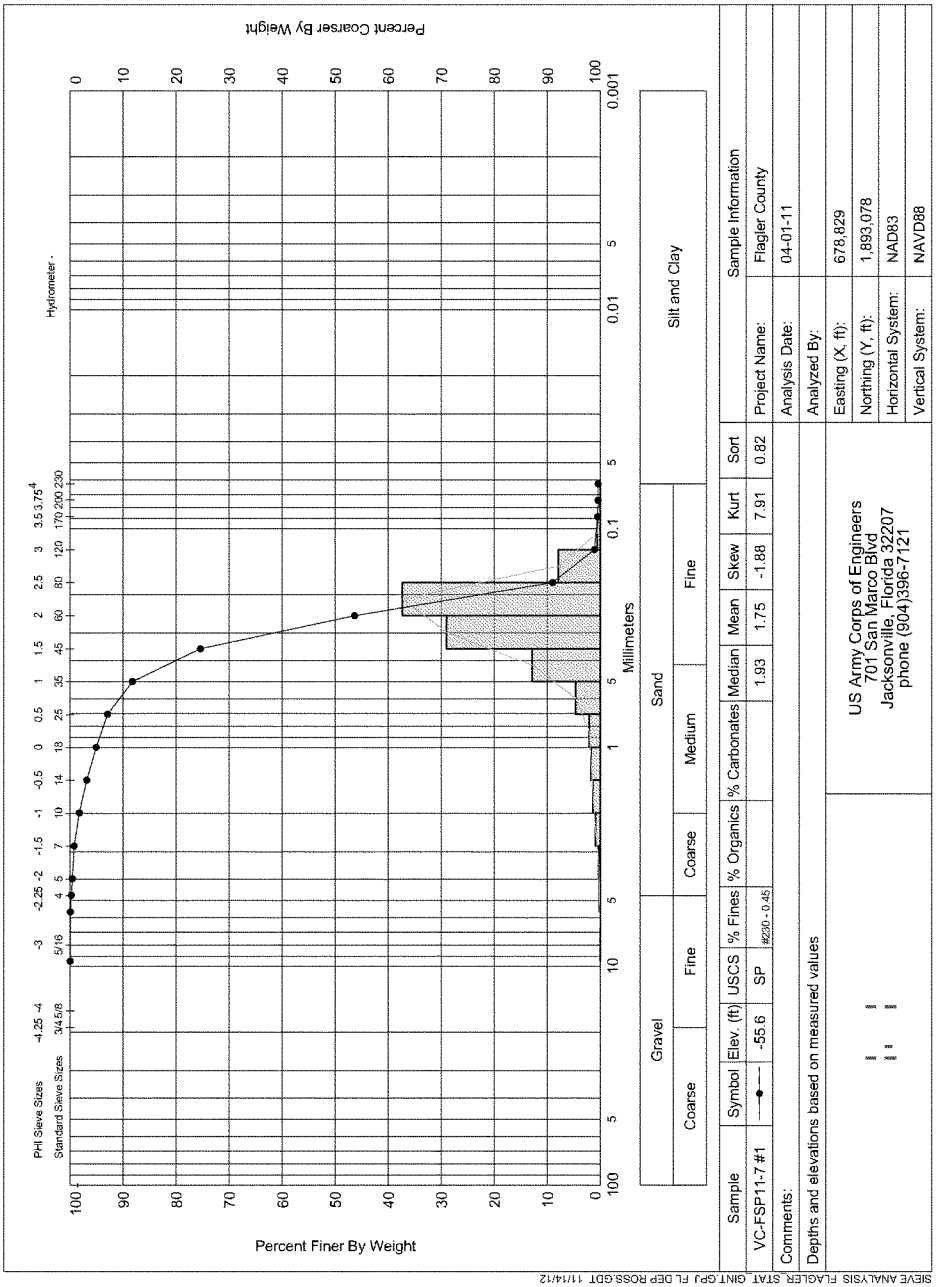

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-5 #2
-63.7
SW
#230 - 0.06
2.13
1.9
-1.87
7.45
0.91
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 672,891
Northing (Y, ft): 1,900,724
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

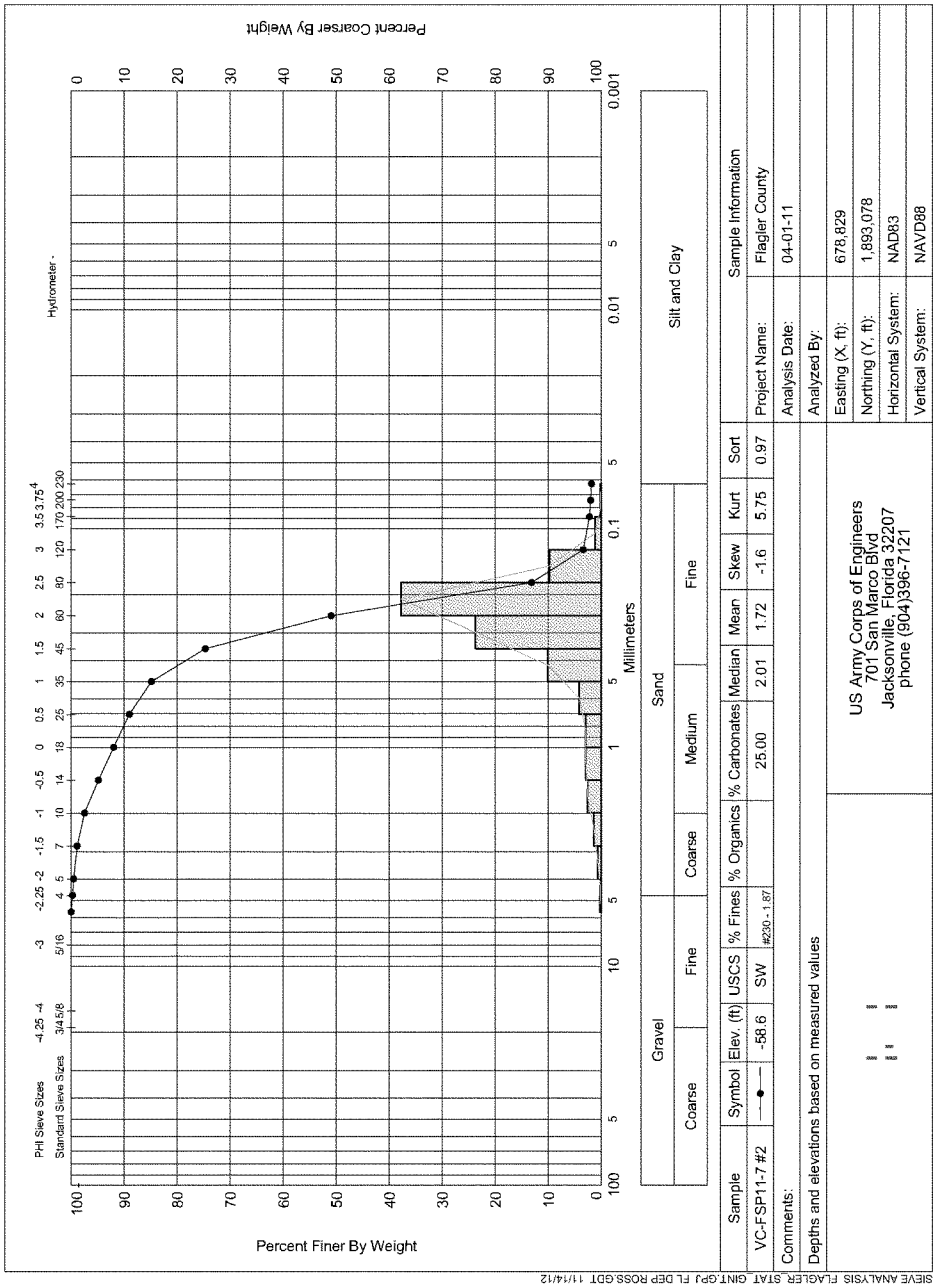

Percent Finer By Weight
Percent Coarser By Weight
Millimeters
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-5 #3
-66.2
SP
#230 - 1.49
2.28
2.18
-1.98
11.37
0.65
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
672,891
Northing (Y, ft):
1,900,724
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

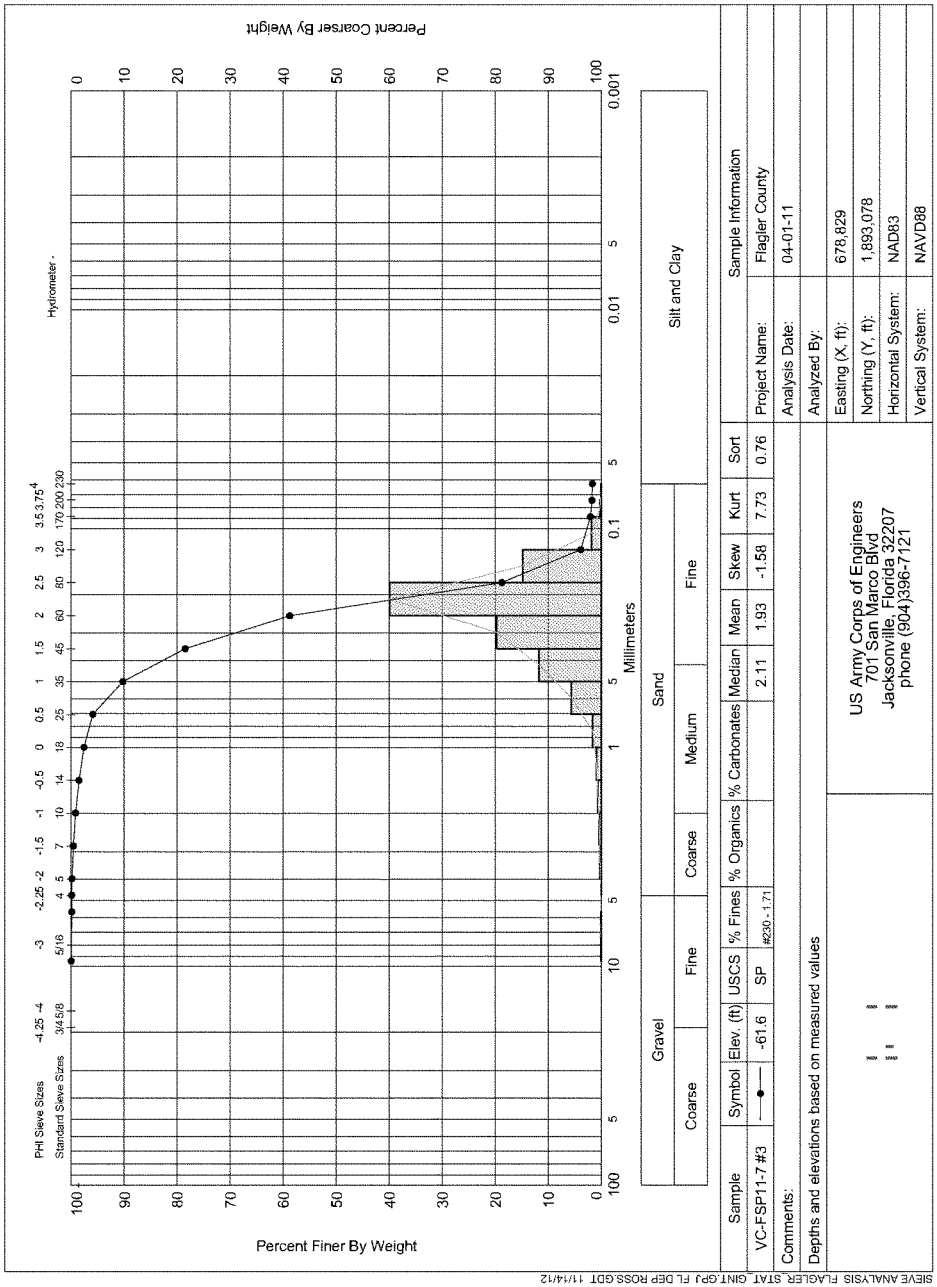

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-6 #1
-62.7
SW
#230 - 0.54
1.95
1.71
-1.76
7.3
0.92
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 678,009
Northing (Y, ft): 1,898,131
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12

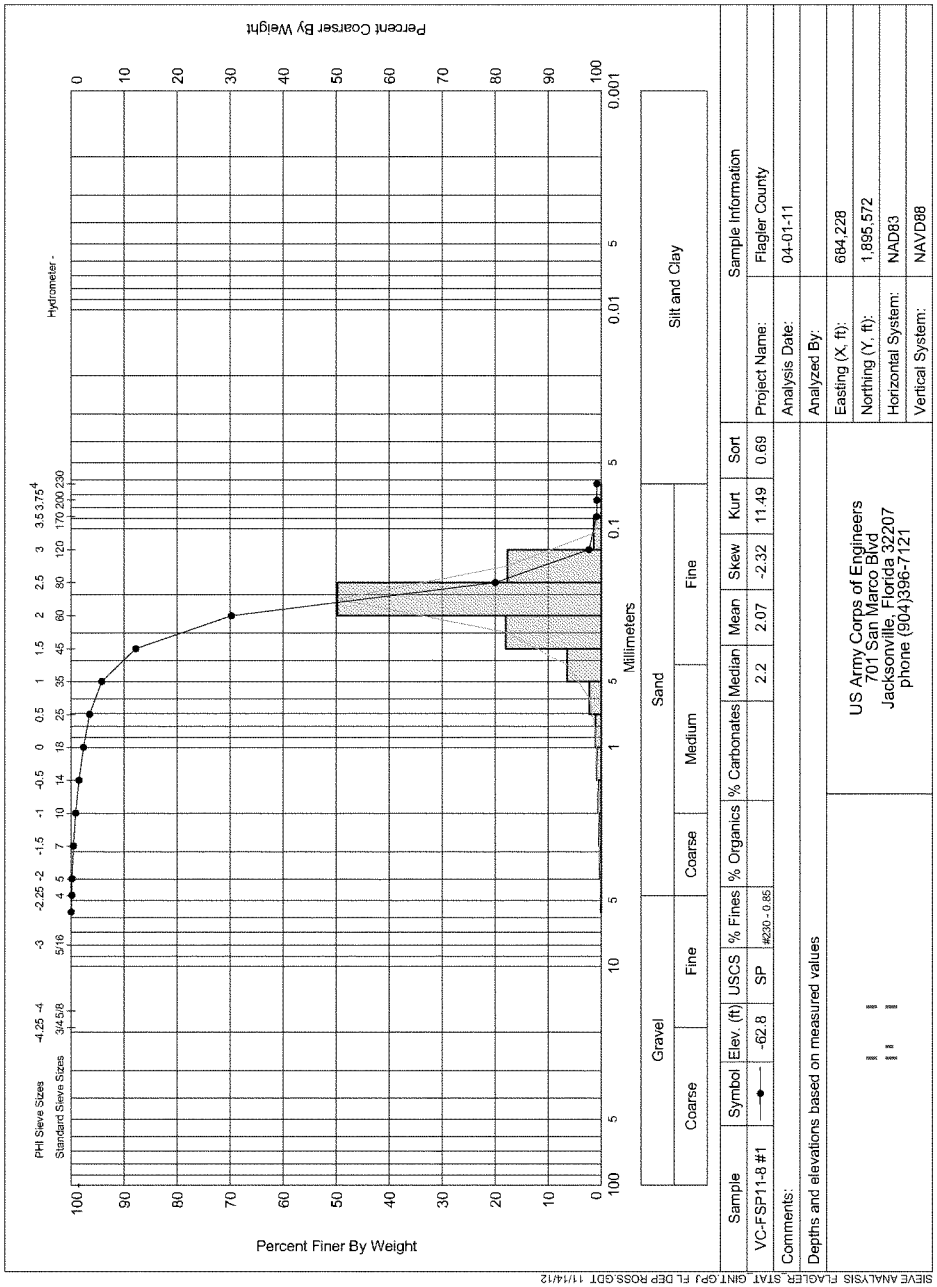

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-6 #2
-65.7
SW
#230 - 2.22
2.19
1.79
-2.13
7.71
1.29
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
678,009
Northing (Y, ft):
1,898,131
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

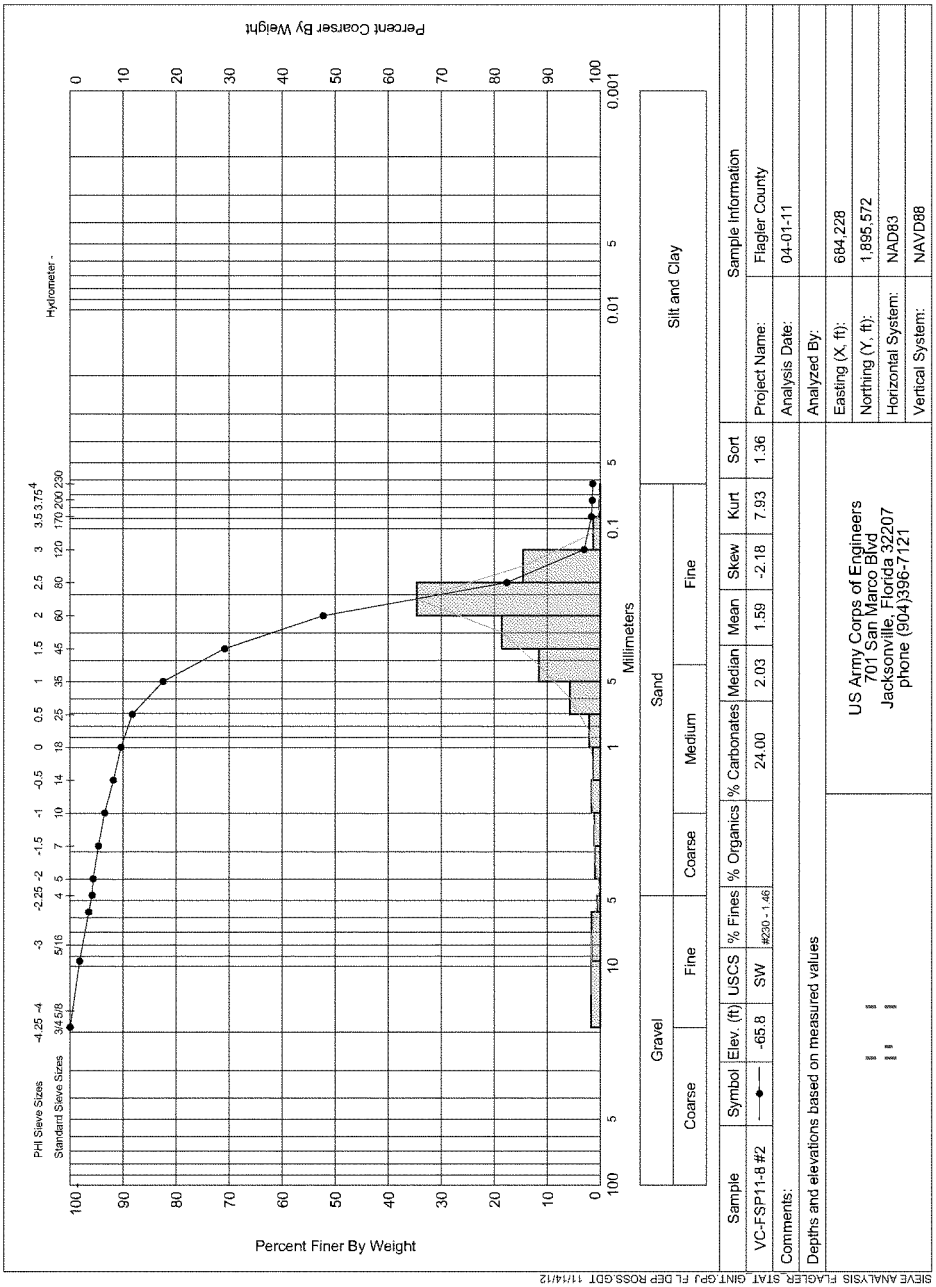

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
VC-FSP11-6 #3
Symbol
Elev. (ft)
-68.5
USCS
SW
% Fines
#230 - 1.21
% Organics
% Carbonates
26.00
Median
2.04
Mean
1.72
Skew
-1.57
Kurt
5.41
Sort
1
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
678,009
Northing (Y, ft):
1,898,131
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

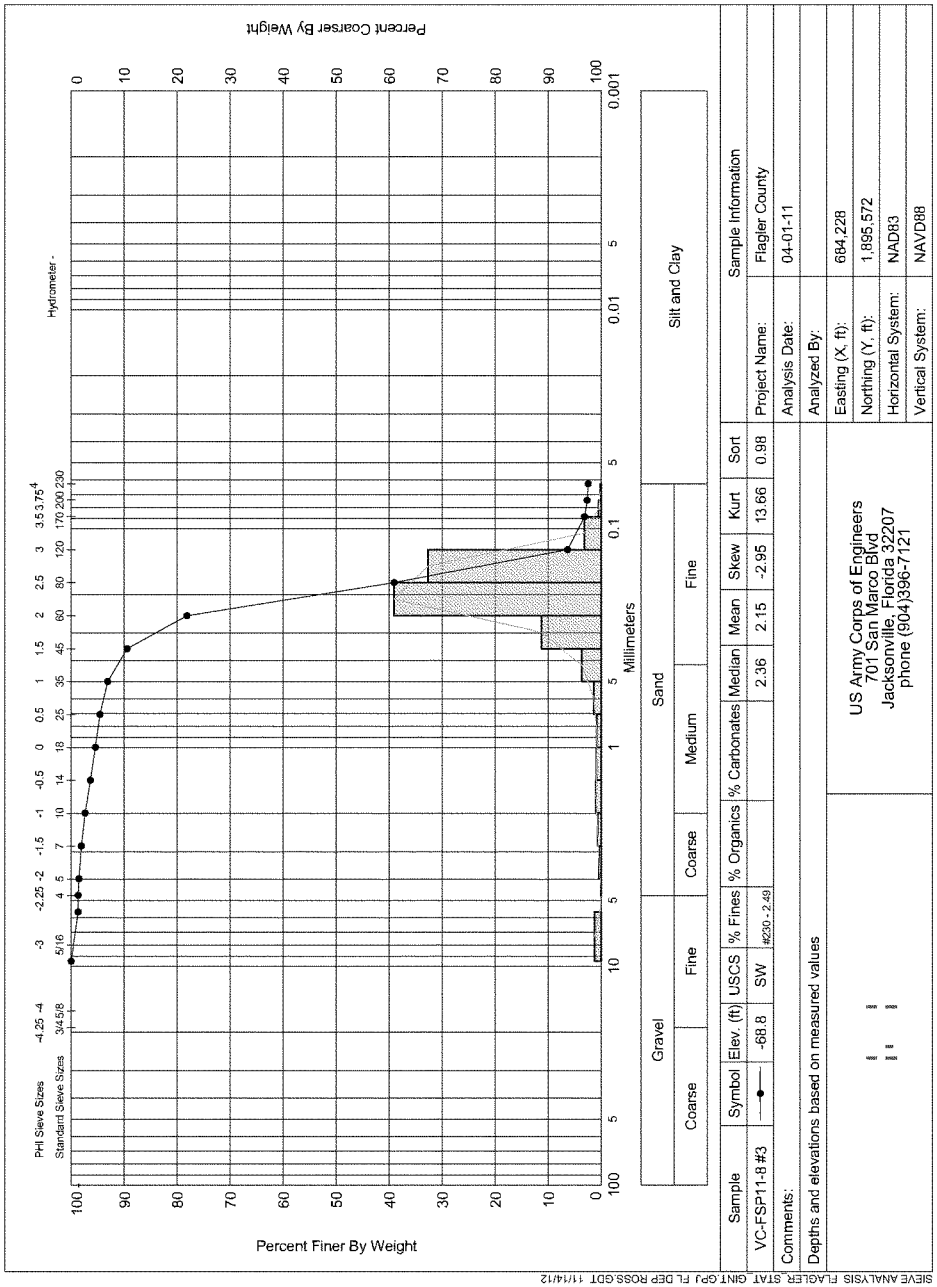

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-7 #1
-55.6
SP
#230 - 0.45
1.93
1.75
-1.88
7.91
0.82
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
678,829
Northing (Y, ft):
1,893,078
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

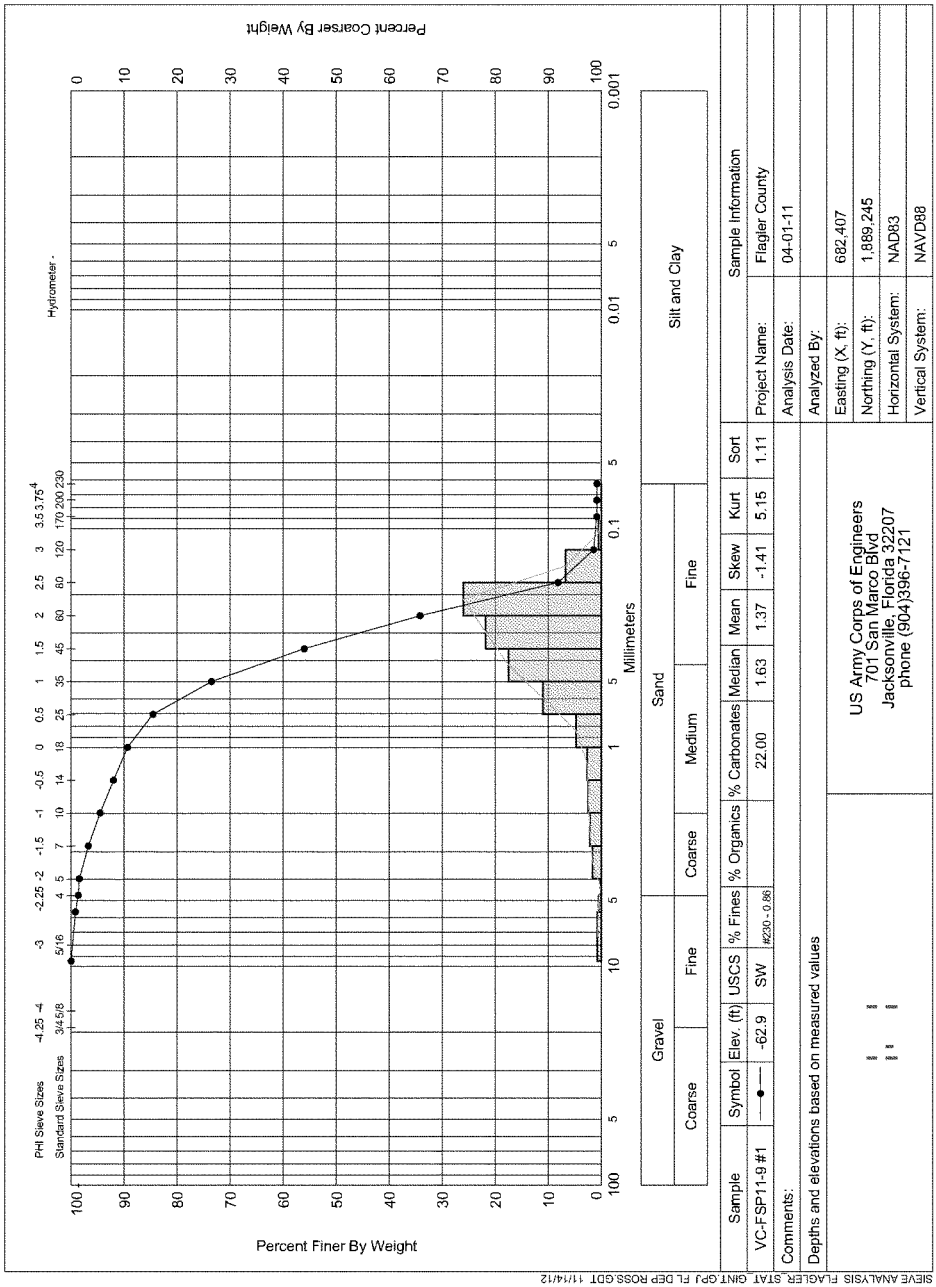

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-7 #2
-58.6
SW
#230 - 1.87
25.00
2.01
1.72
-1.6
5.75
0.97
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
678,829
Northing (Y, ft):
1,893,078
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

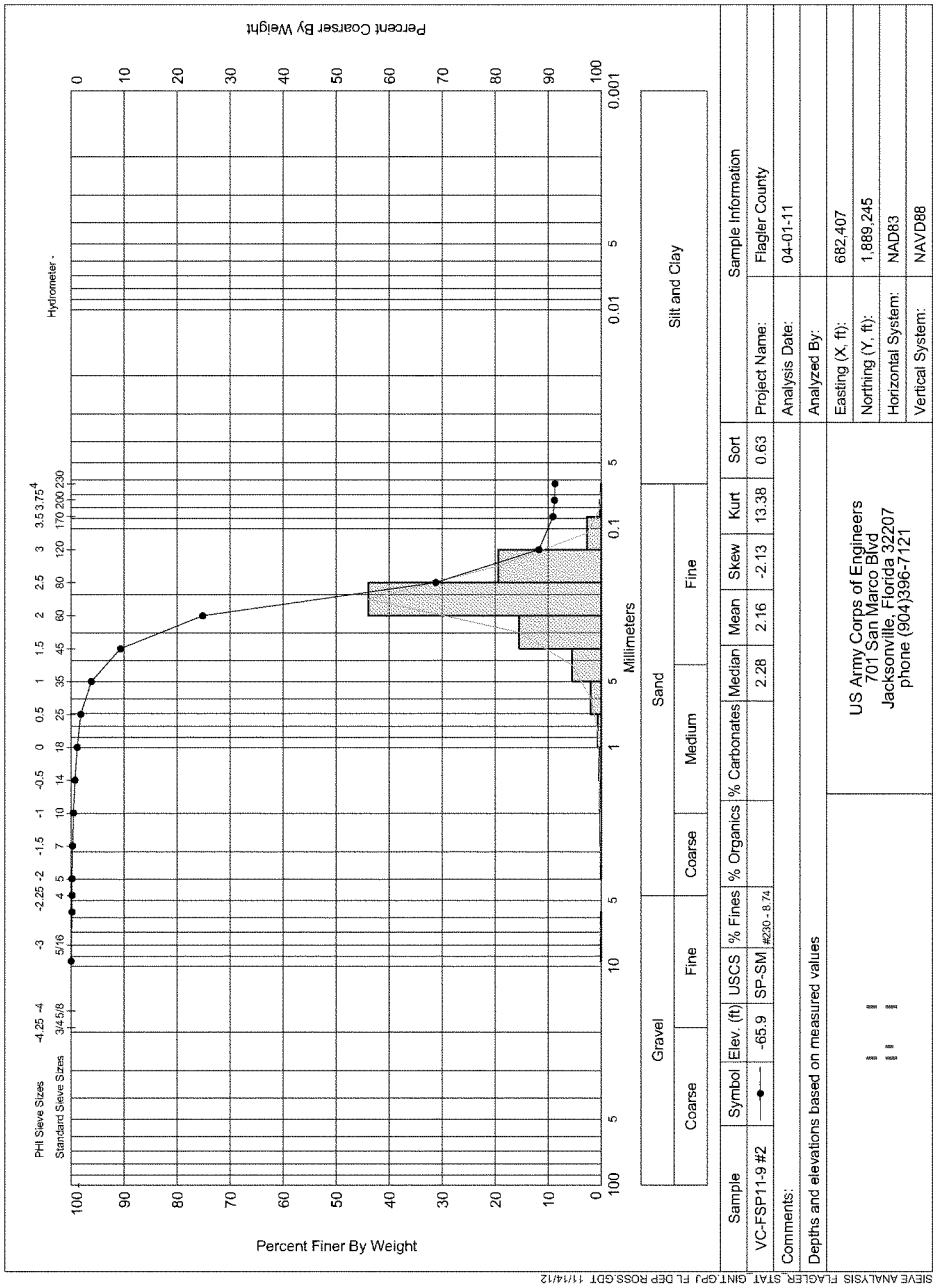

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-7 #3
-61.6
SP
#230 - 1.71
2.11
1.93
-1.58
7.73
0.76
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
678,829
Northing (Y, ft):
1,893,078
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

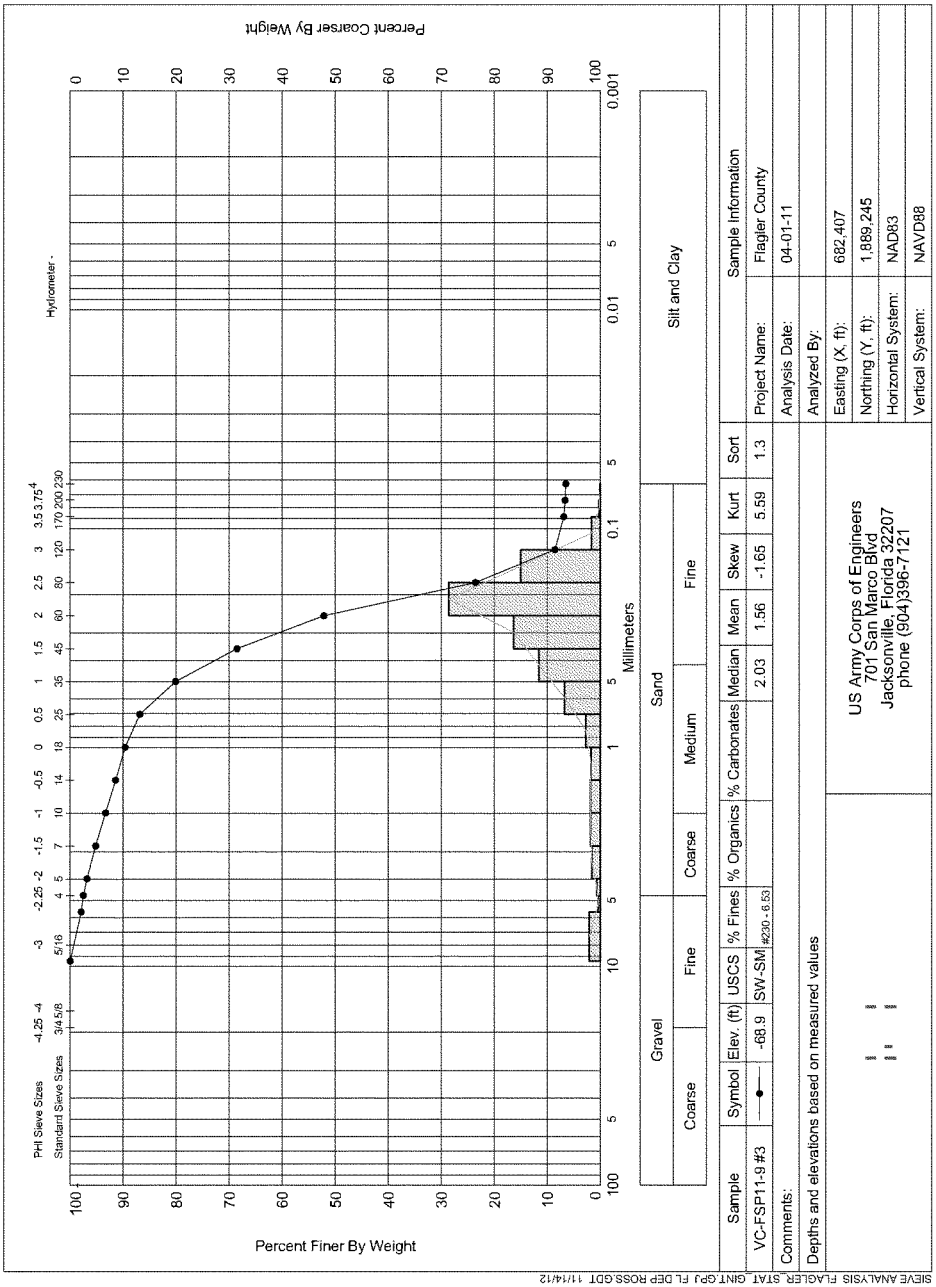

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-8 #1
-62.8
SP
#230 - 0.85
2.2
2.07
-2.32
11.49
0.69
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 684,228
Northing (Y, ft): 1,895,572
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12

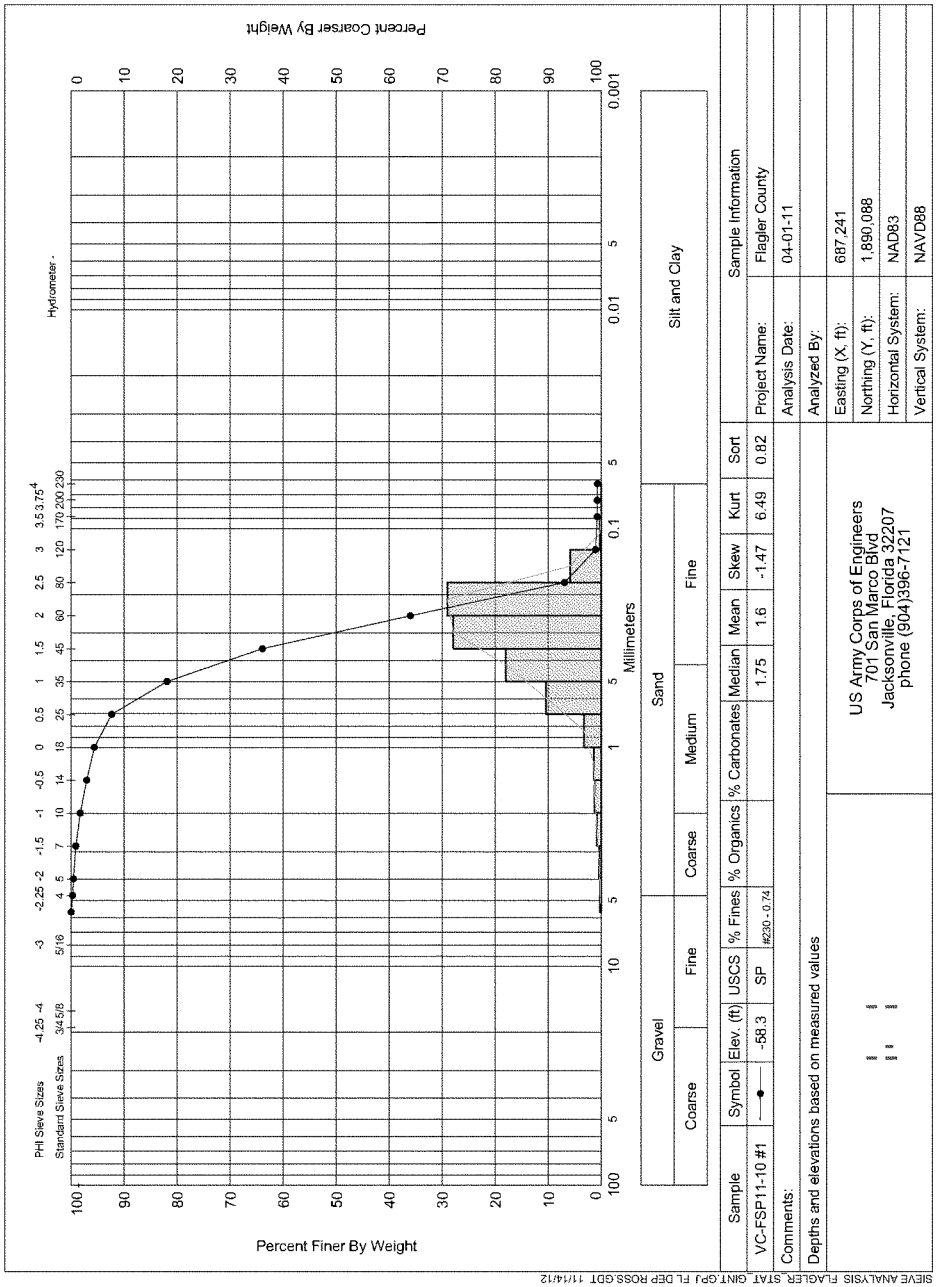

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-8 #2
-65.8
SW
#230 - 1.46
24.00
2.03
1.59
-2.18
7.93
1.36
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
684,228
Northing (Y, ft):
1,895,572
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

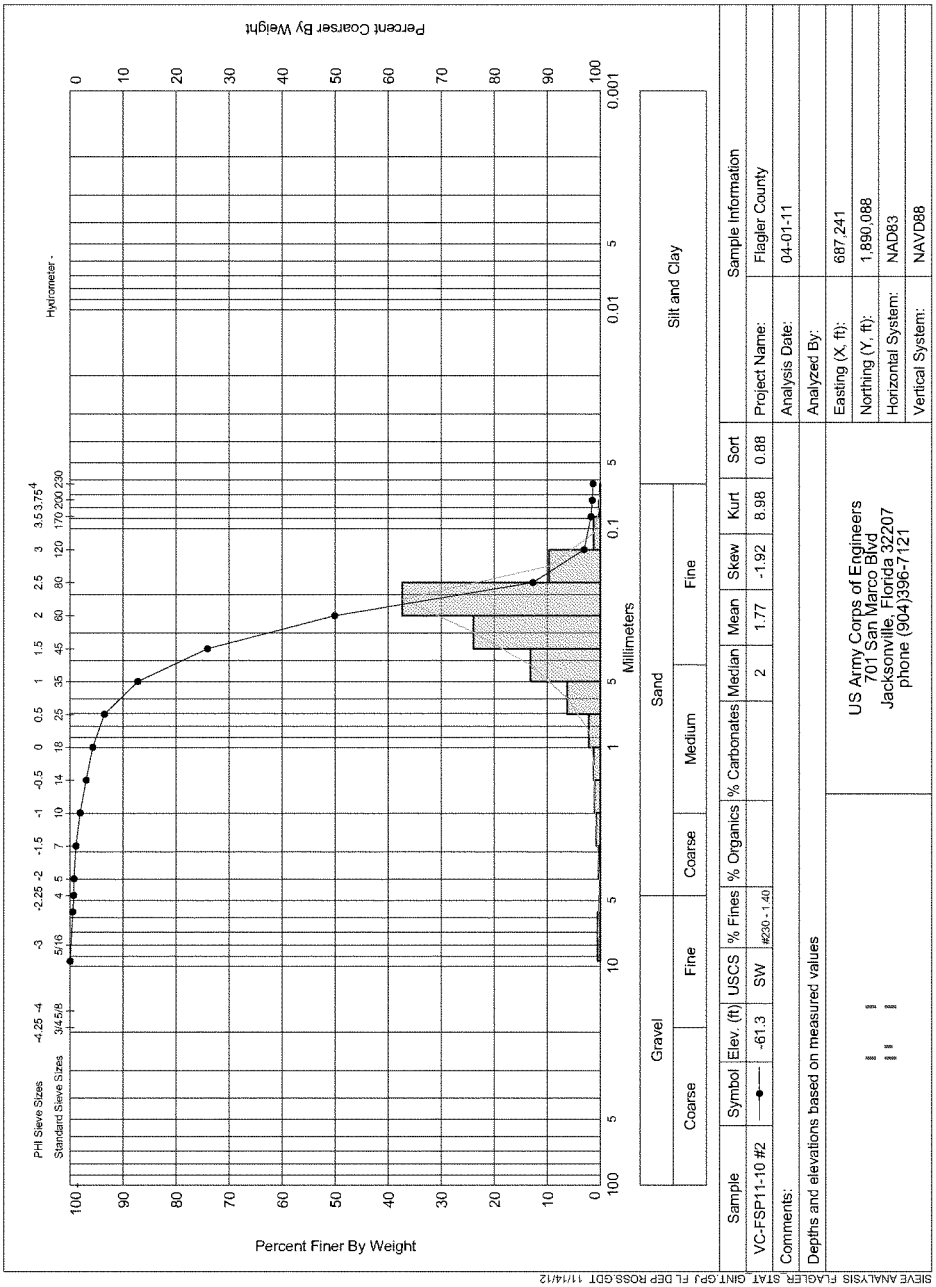

Percent Finer By Weight
Percent Coarser By Weight
Millimeters
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-8 #3
-68.8
SW
#230 - 2.49
2.36
2.15
-2.95
13.66
0.98
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
684,228
Northing (Y, ft):
1,895,572
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

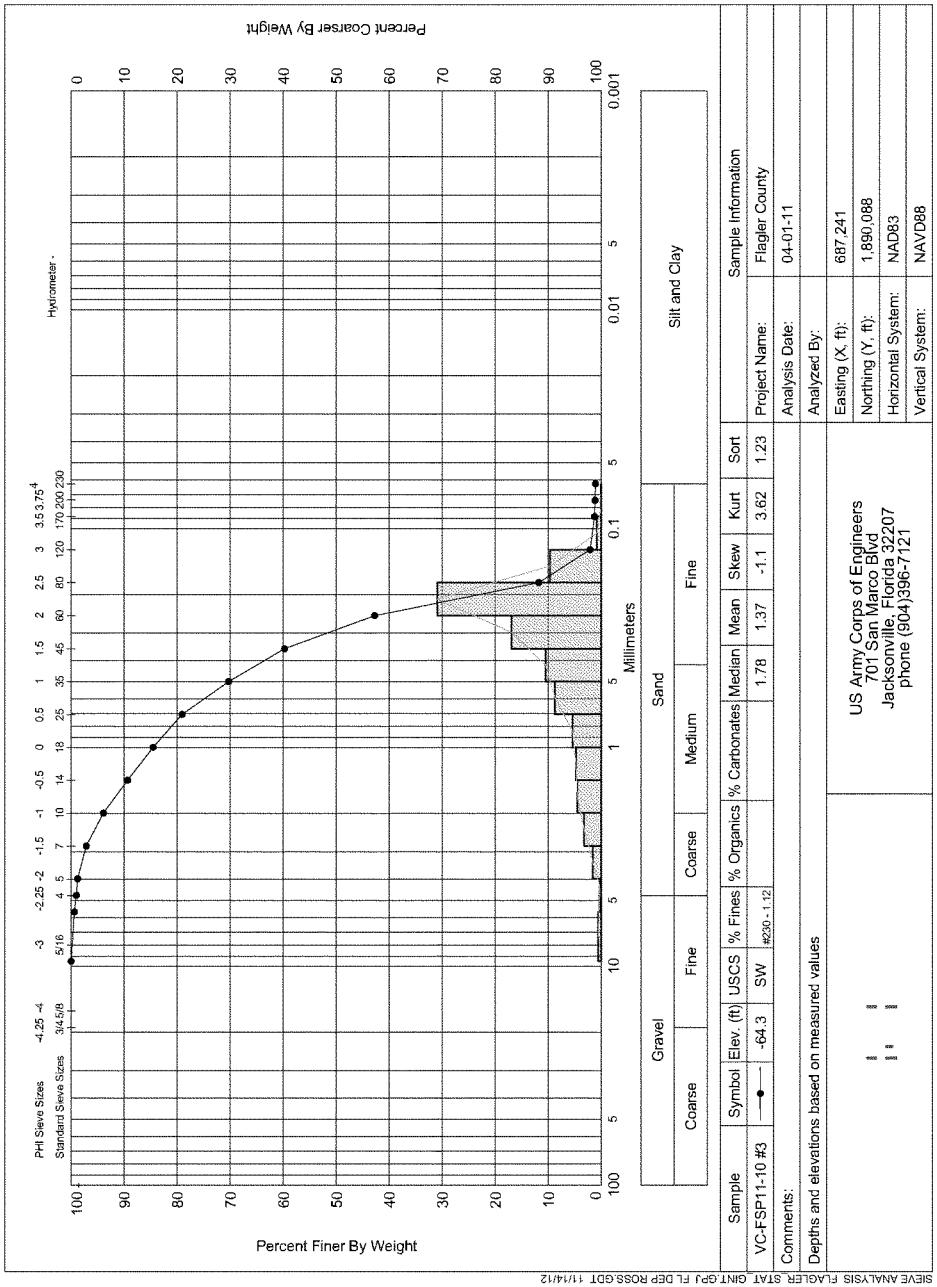

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-9 #1
-62.9
SW
#230 - 0.06
22.00
1.63
1.37
-1.41
5.15
1.11
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 682,407
Northing (Y, ft): 1,889,245
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-9 #2
-65.9
SP-SM
#230 - 8.74
2.28
2.16
-2.13
13.38
0.63
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
682,407
Northing (Y, ft):
1,889,245
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-9 #3
-68.9
SW-SM
#230 - 6.53
2.03
1.56
-1.65
5.59
1.3
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 682,407
Northing (Y, ft): 1,889,245
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-10 #1
-58.3
SP
#230 - 0.74
1.75
1.6
-1.47
6.49
0.82
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
687,241
Northing (Y, ft):
1,890,088
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-10 #2
-61.3
SW
#230 - 1.40
2
1.77
-1.92
8.98
0.88
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
687,241
Northing (Y, ft):
1,890,088
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

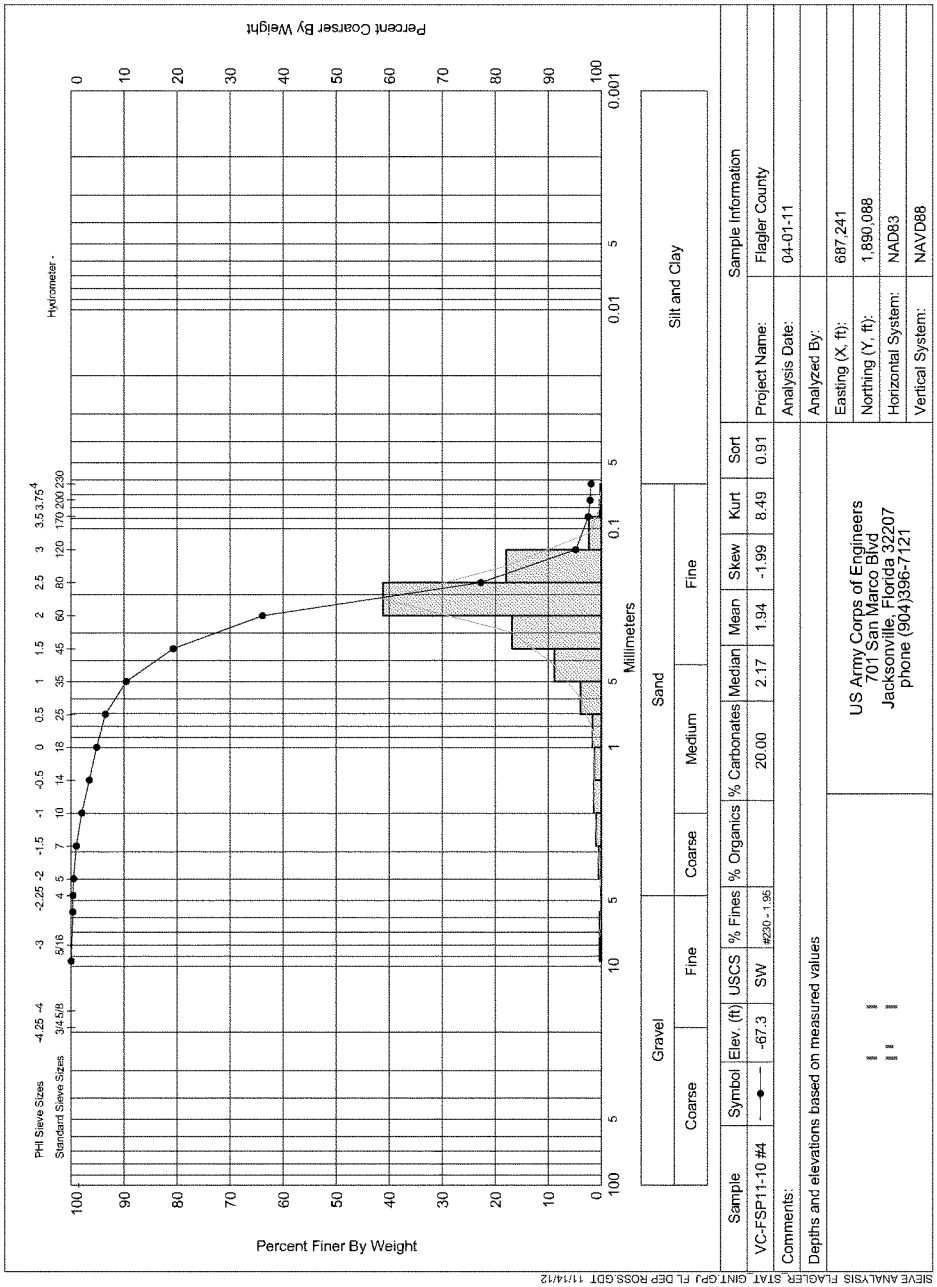


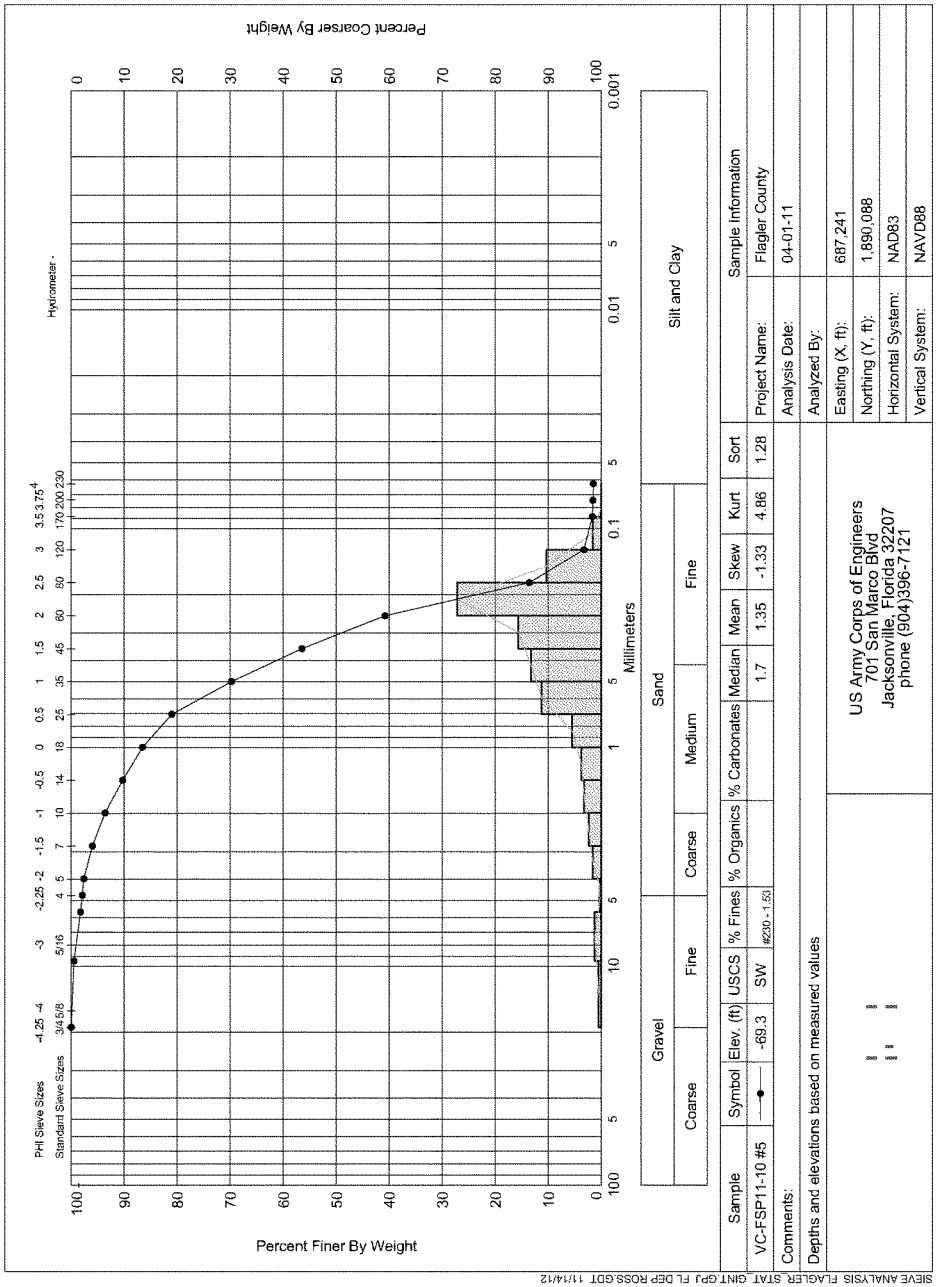
Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
VC-FSP11-10 #3		-64.3	SW	#230 - 1.12			1.78	1.37	-1.1	3.62	1.23

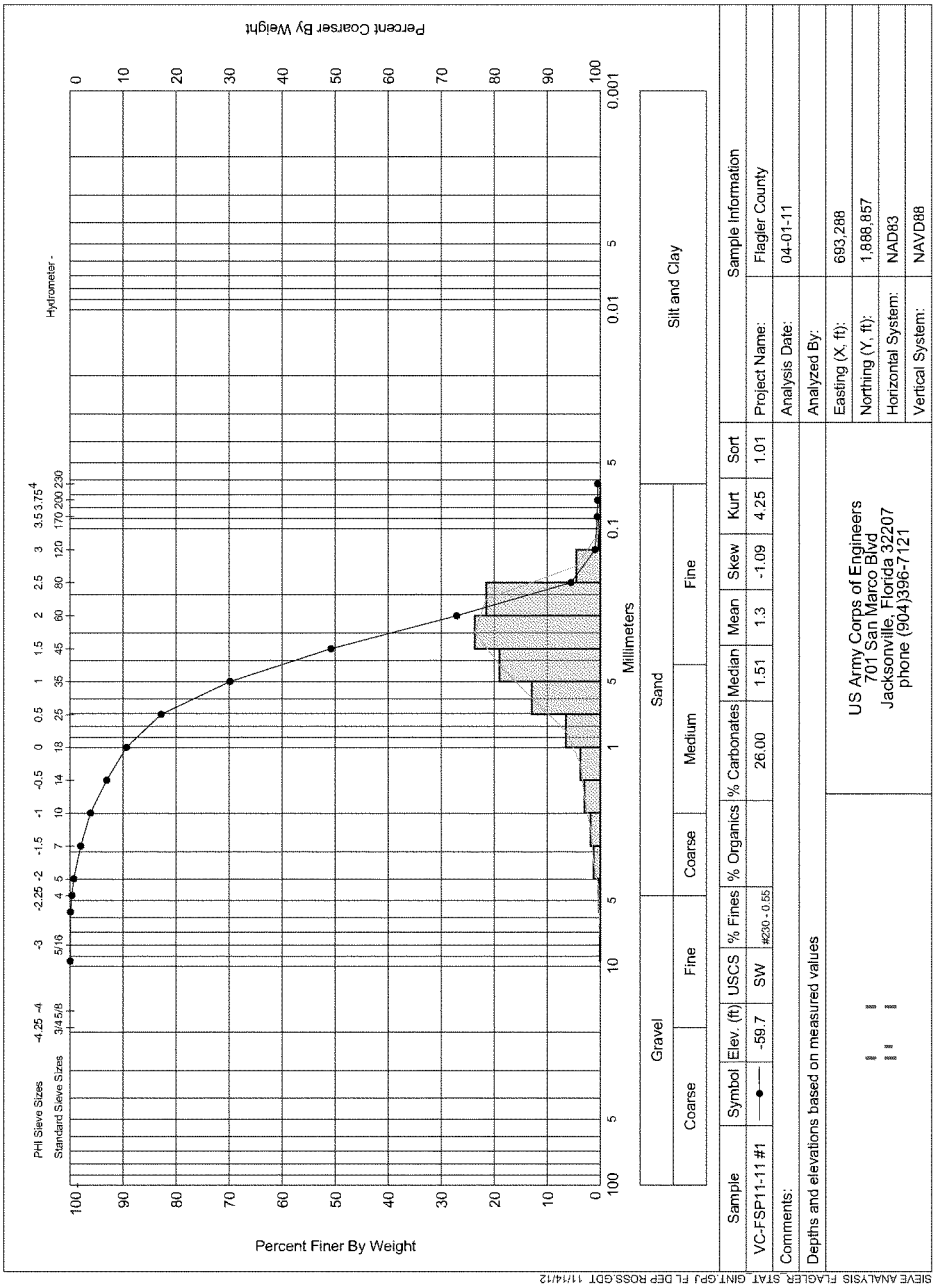
Comments:

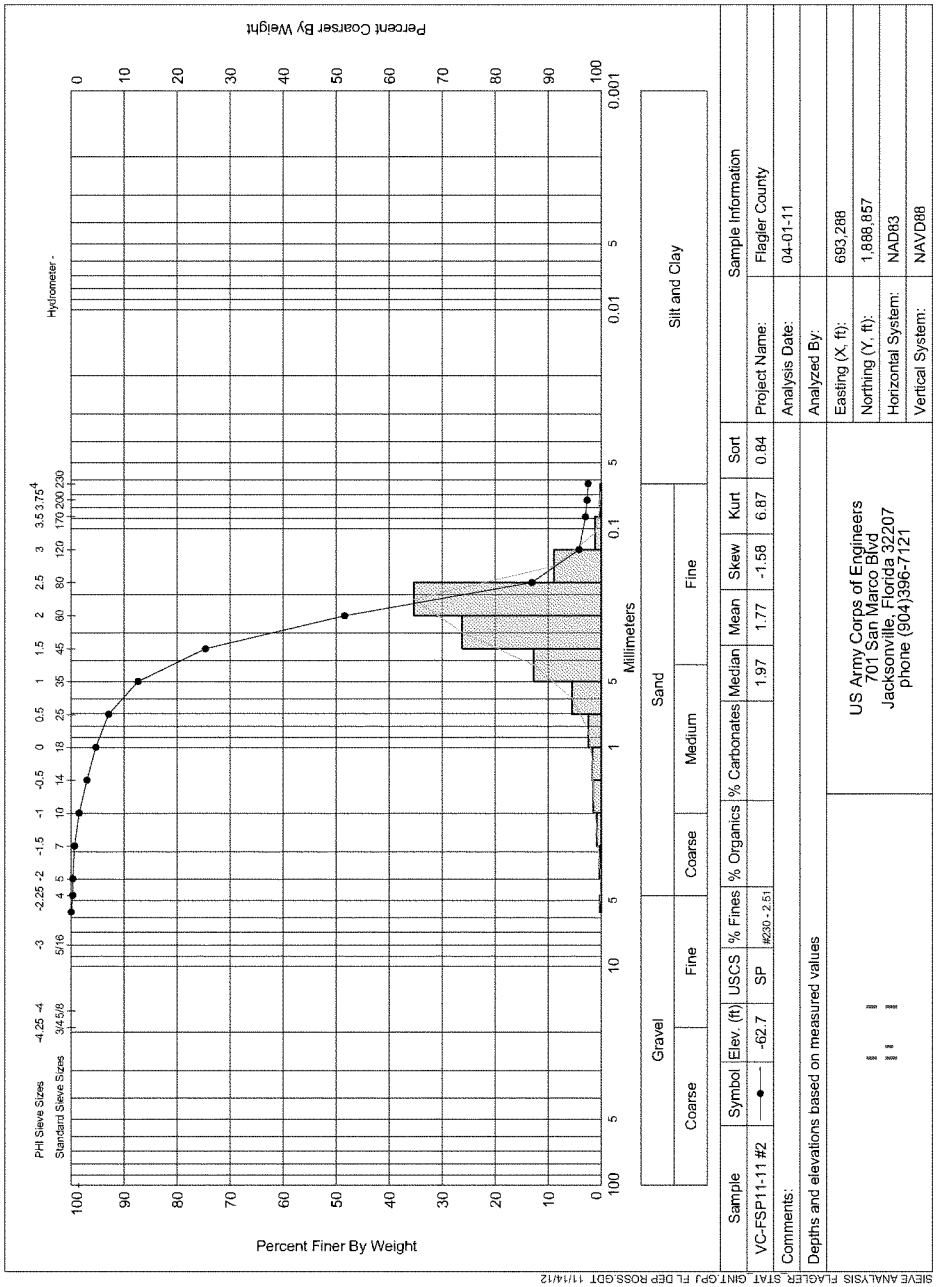
Depths and elevations based on measured values

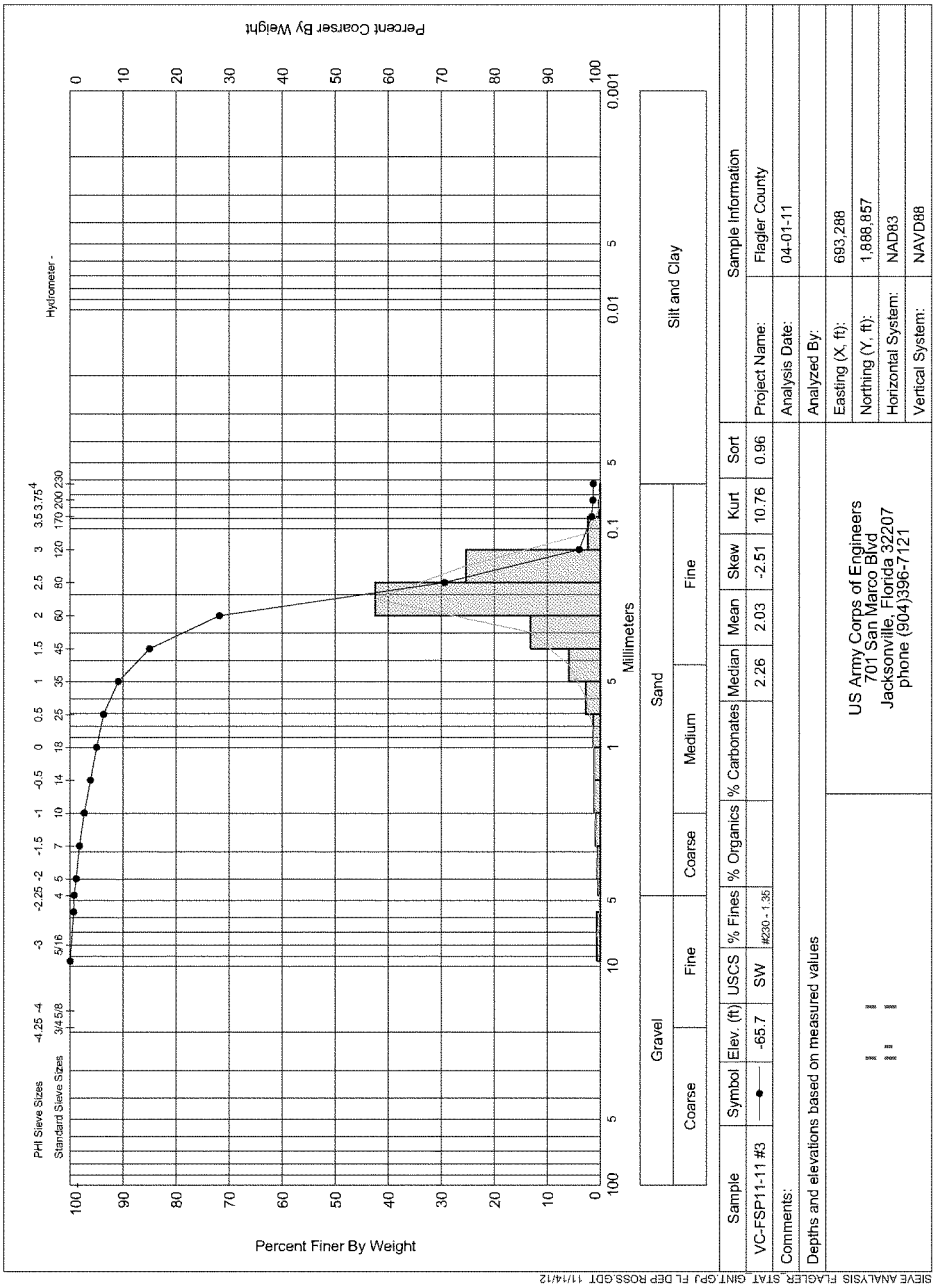
Sample Information	
Project Name:	Flagler County
Analysis Date:	04-01-11
Analyzed By:	
Easting (X, ft):	687,241
Northing (Y, ft):	1,890,088
Horizontal System:	NAD83
Vertical System:	NAVD88

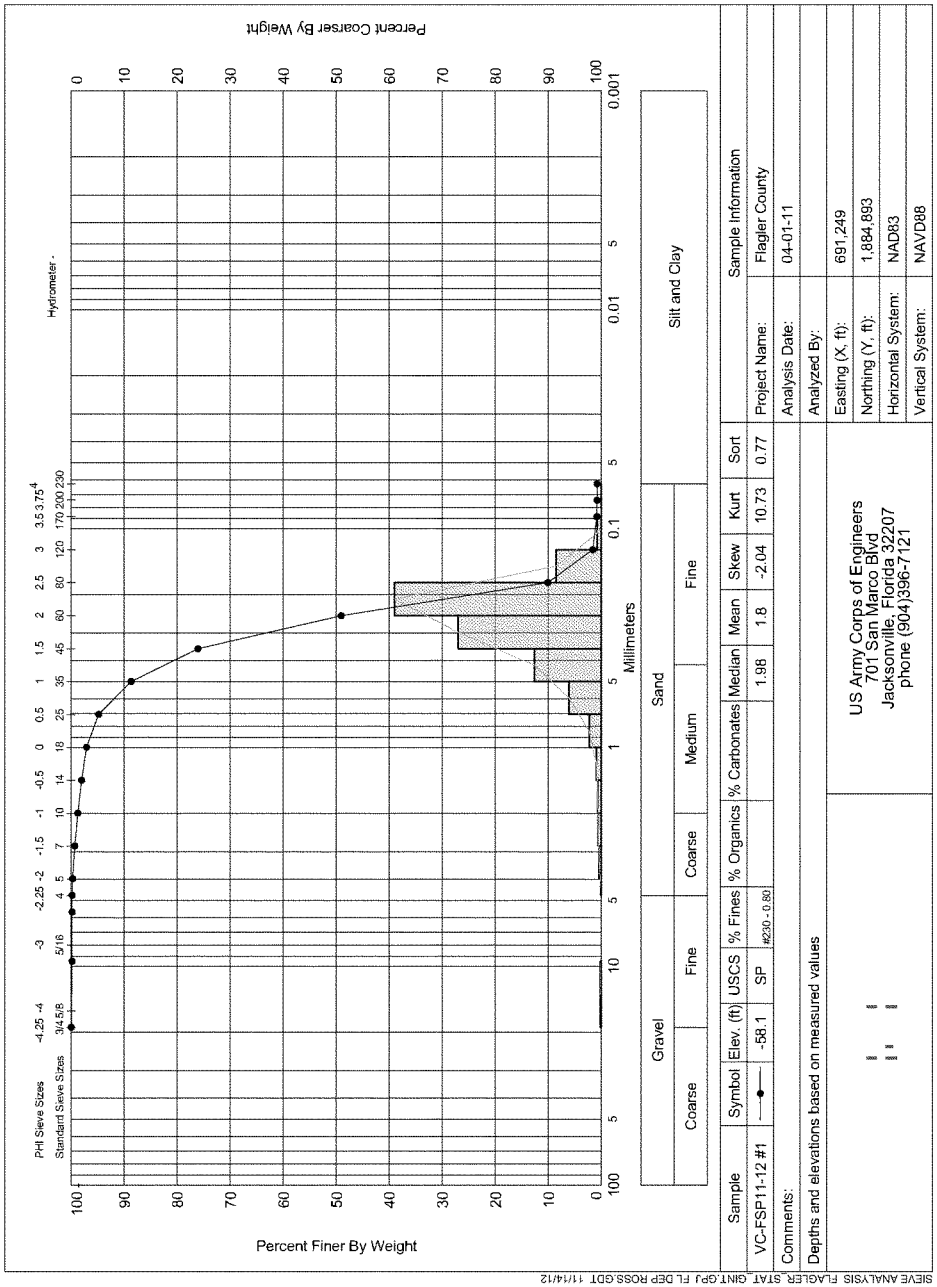

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 687,241
Northing (Y, ft): 1,890,088
Horizontal System: NAD83
Vertical System: NAVD88
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
VC-FSP11-10 #4 -67.3 SW #230 - 1.96
Comments:
Depths and elevations based on measured values
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

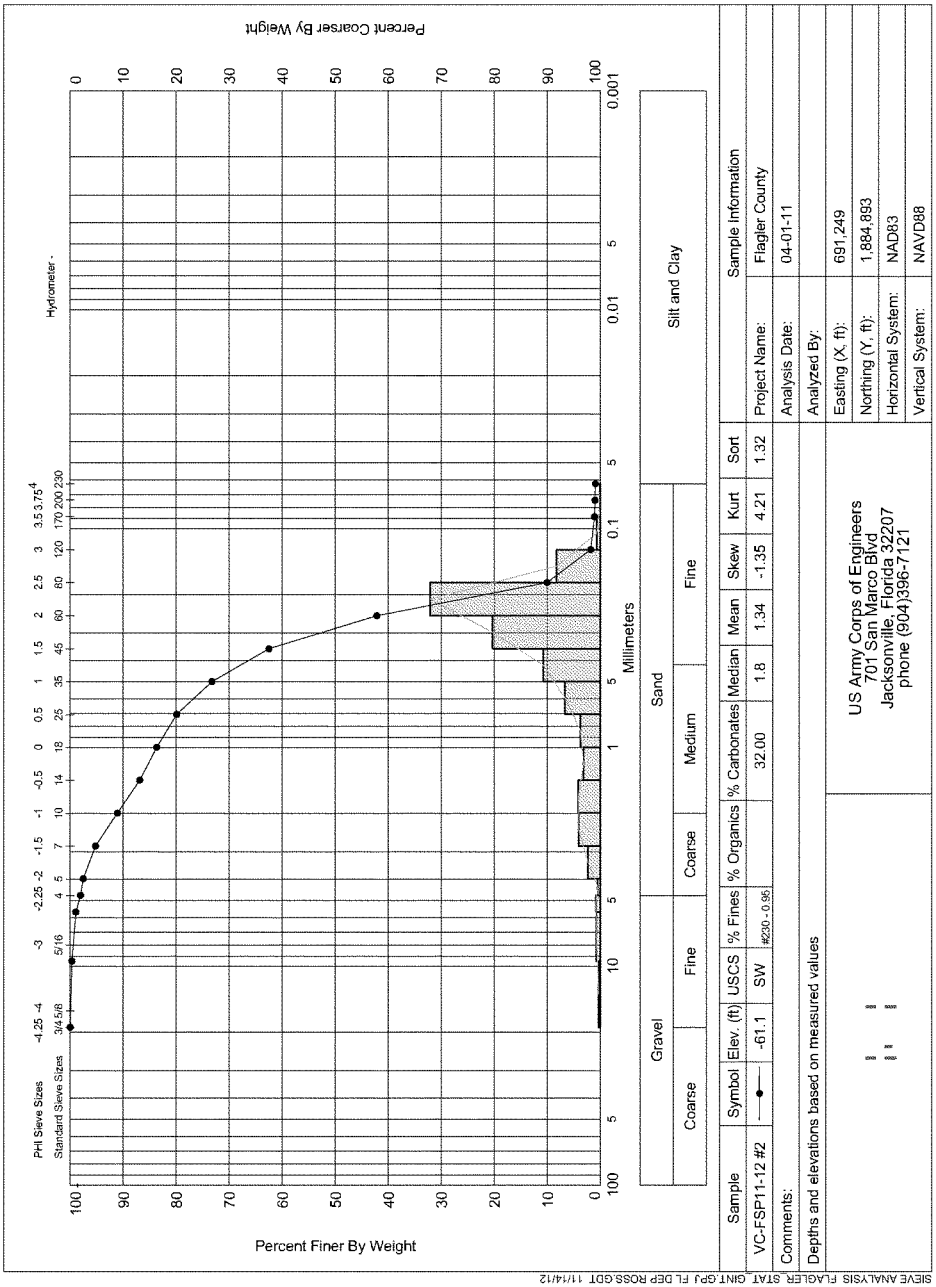

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-10 #5
-69.3
SW
#230 - 1.53
1.7
1.35
-1.33
4.86
1.28
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
687,241
Northing (Y, ft):
1,890,088
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

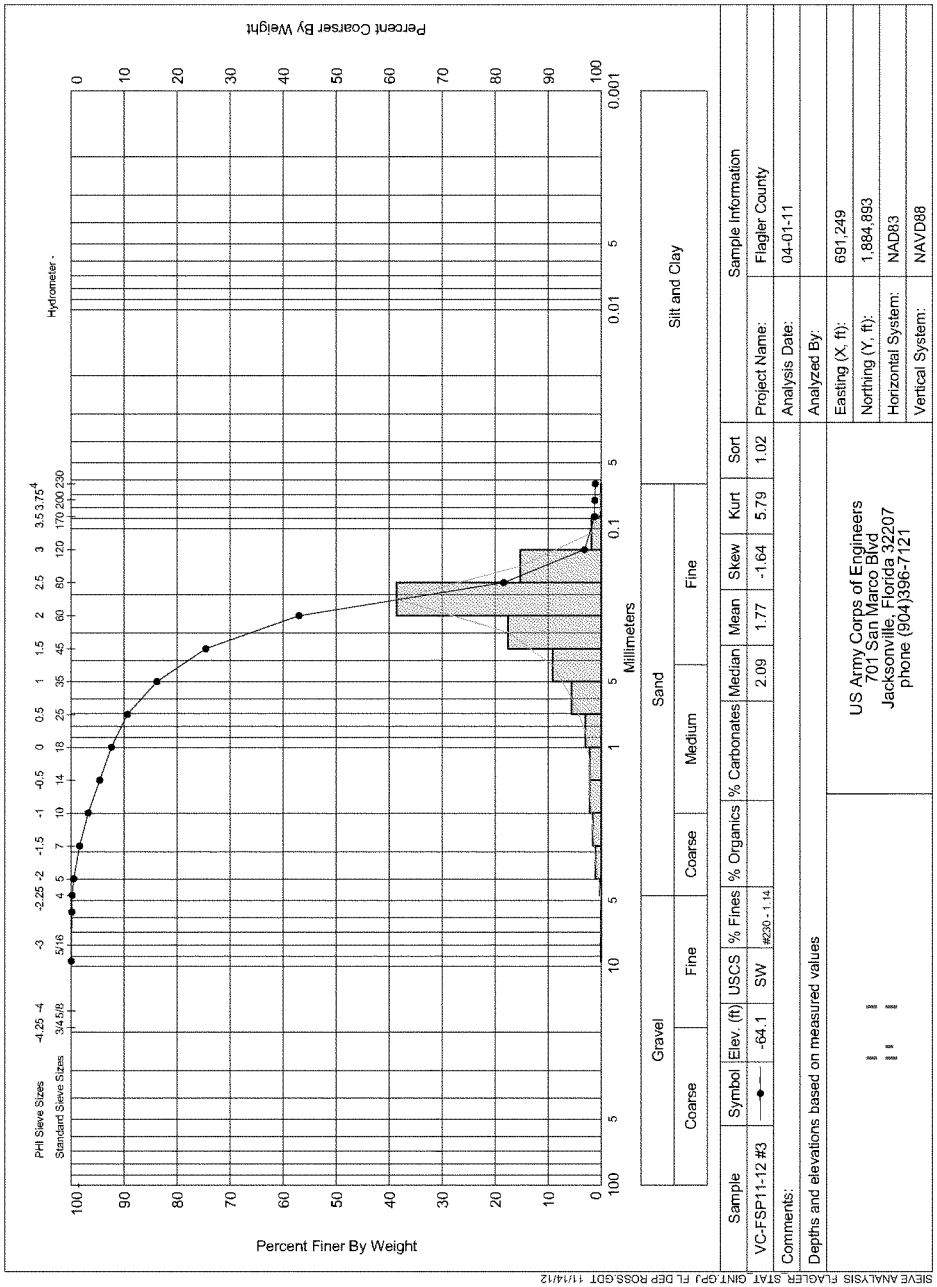

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-11 #1
-59.7
SW
#230 - 0.55
26.00
1.51
1.3
-1.09
4.25
1.01
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 693,288
Northing (Y, ft): 1,888,857
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

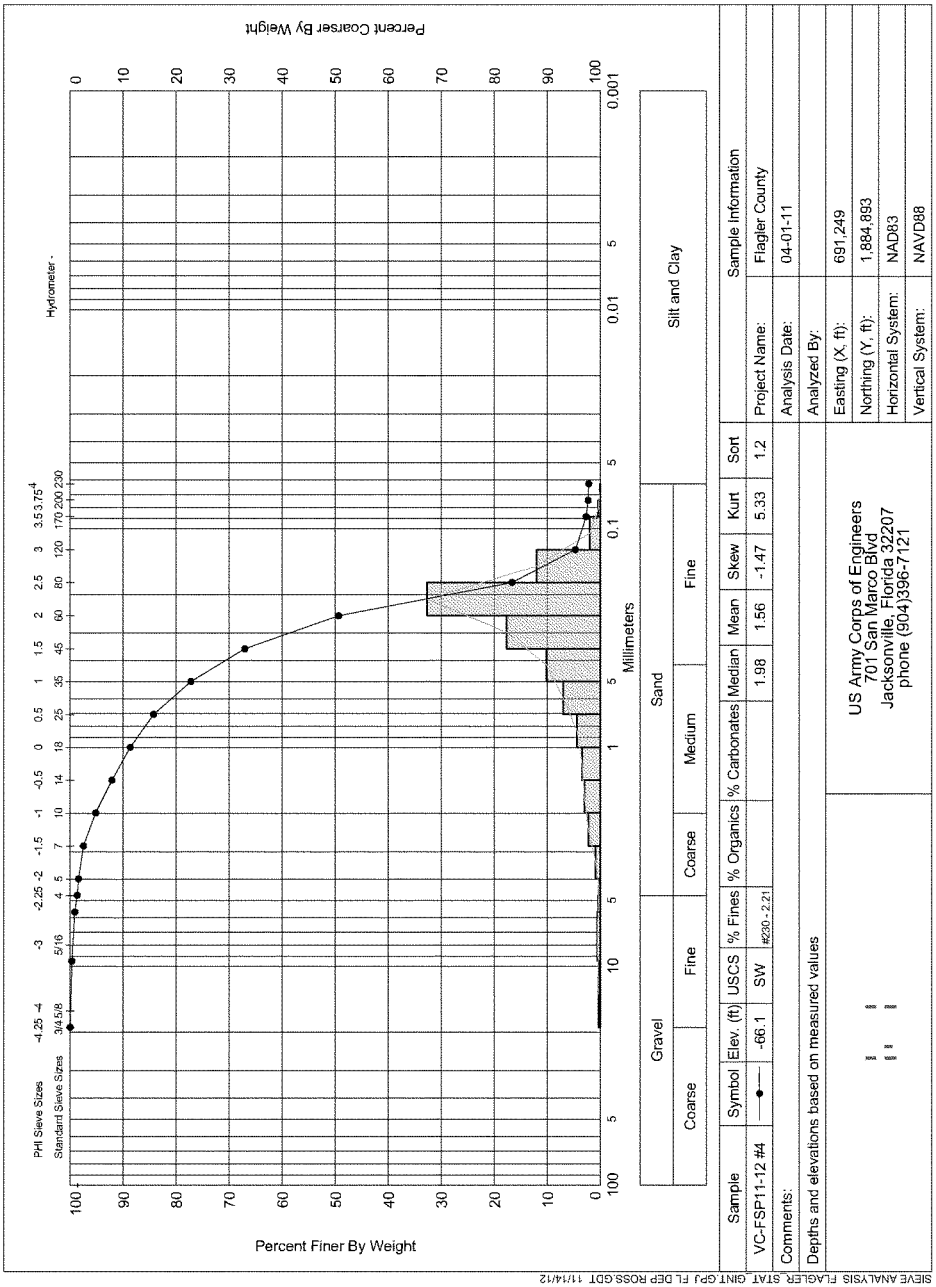

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
VC-FSP11-11 #2
Symbol
Elev. (ft)
-62.7
USCS
SP
% Fines
#230 - 2.51
% Organics
% Carbonates
Median
1.97
Mean
1.77
Skew
-1.58
Kurt
6.87
Sort
0.84
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
693,288
Northing (Y, ft):
1,888,857
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

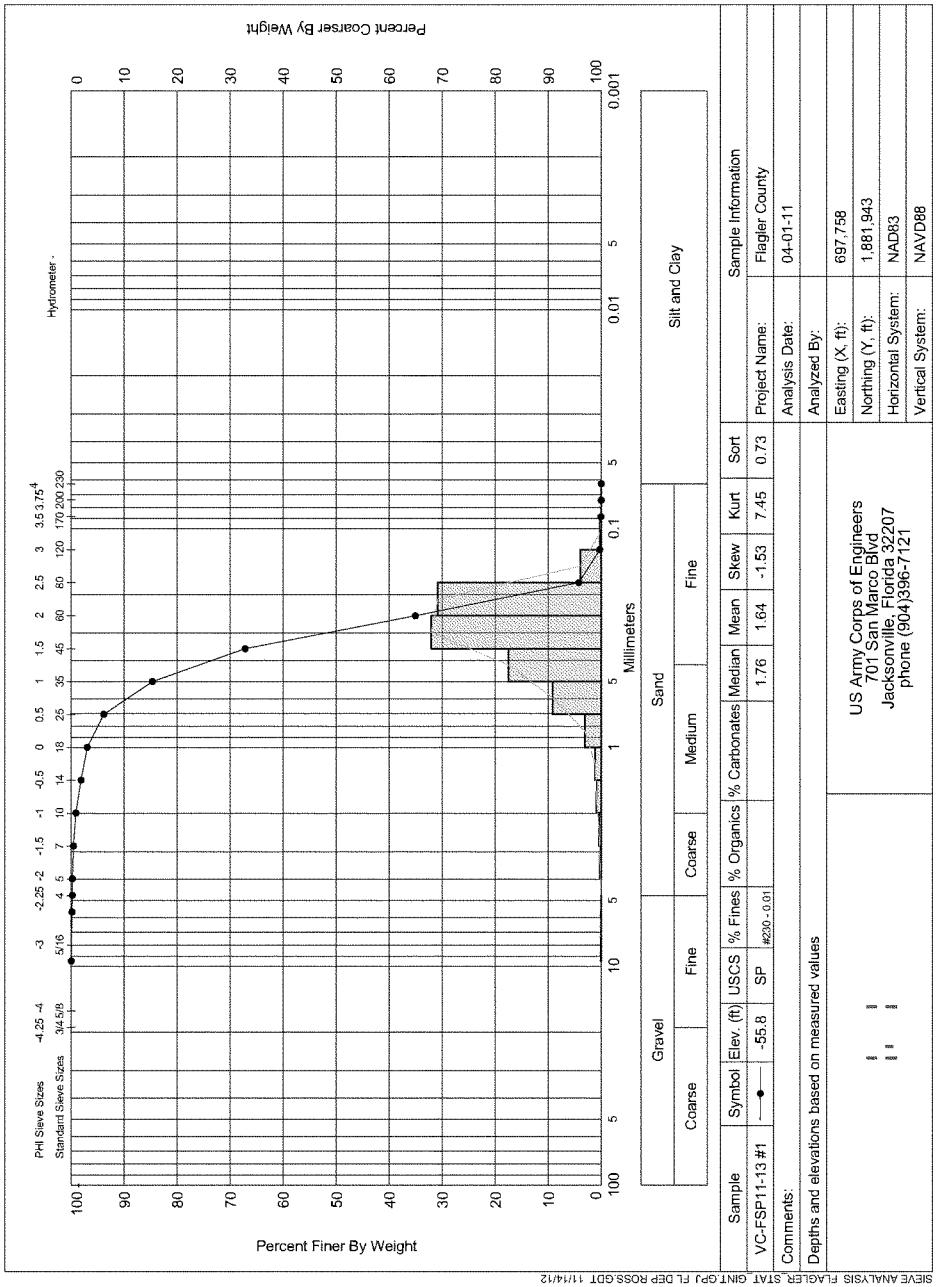

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-11 #3
-65.7
SW
#230 - 1.36
2.26
2.03
-2.51
10.76
0.96
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
693,288
Northing (Y, ft):
1,888,857
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-12 #1
-58.1
SP
#230 - 0.80
1.98
1.8
-2.04
10.73
0.77
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
691,249
Northing (Y, ft):
1,884,893
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-12 #2
-61.1
SW
#230 - 0.96
32.00
1.8
1.34
-1.35
4.21
1.32
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
691,249
Northing (Y, ft):
1,884,893
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-12 #3
-64.1
SW
#230 - 1.14
2.09
1.77
-1.64
5.79
1.02
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
691,249
Northing (Y, ft):
1,884,893
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-12 #4
-66.1
SW
#230 - 2.21
1.98
1.56
-1.47
5.33
1.2
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
691,249
Northing (Y, ft):
1,884,893
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12



Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
VC-FSP11-13 #1		-55.8	SP	#230 - 0.01			1.76	1.64	-1.53	7.45	0.73

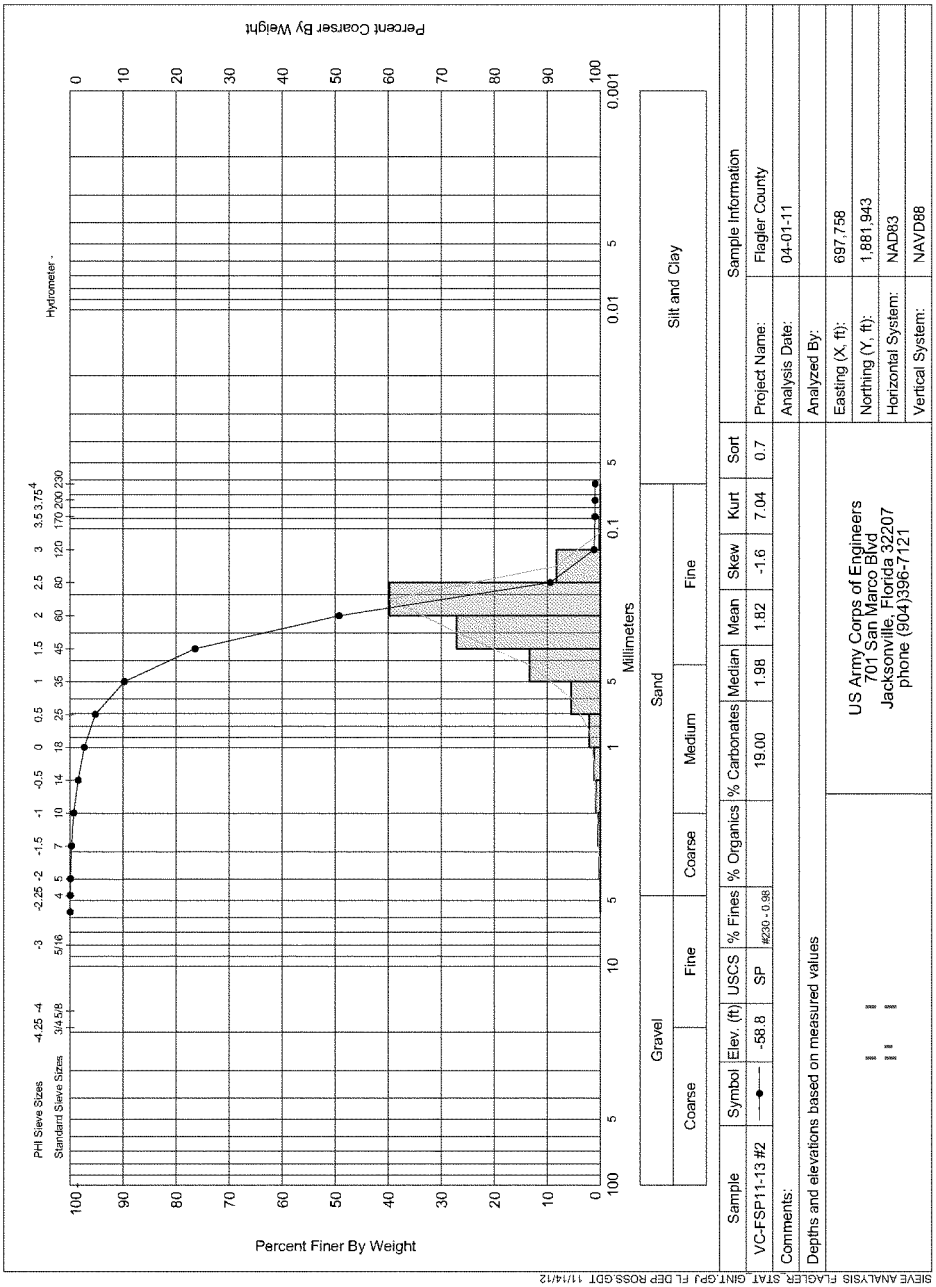
Comments:

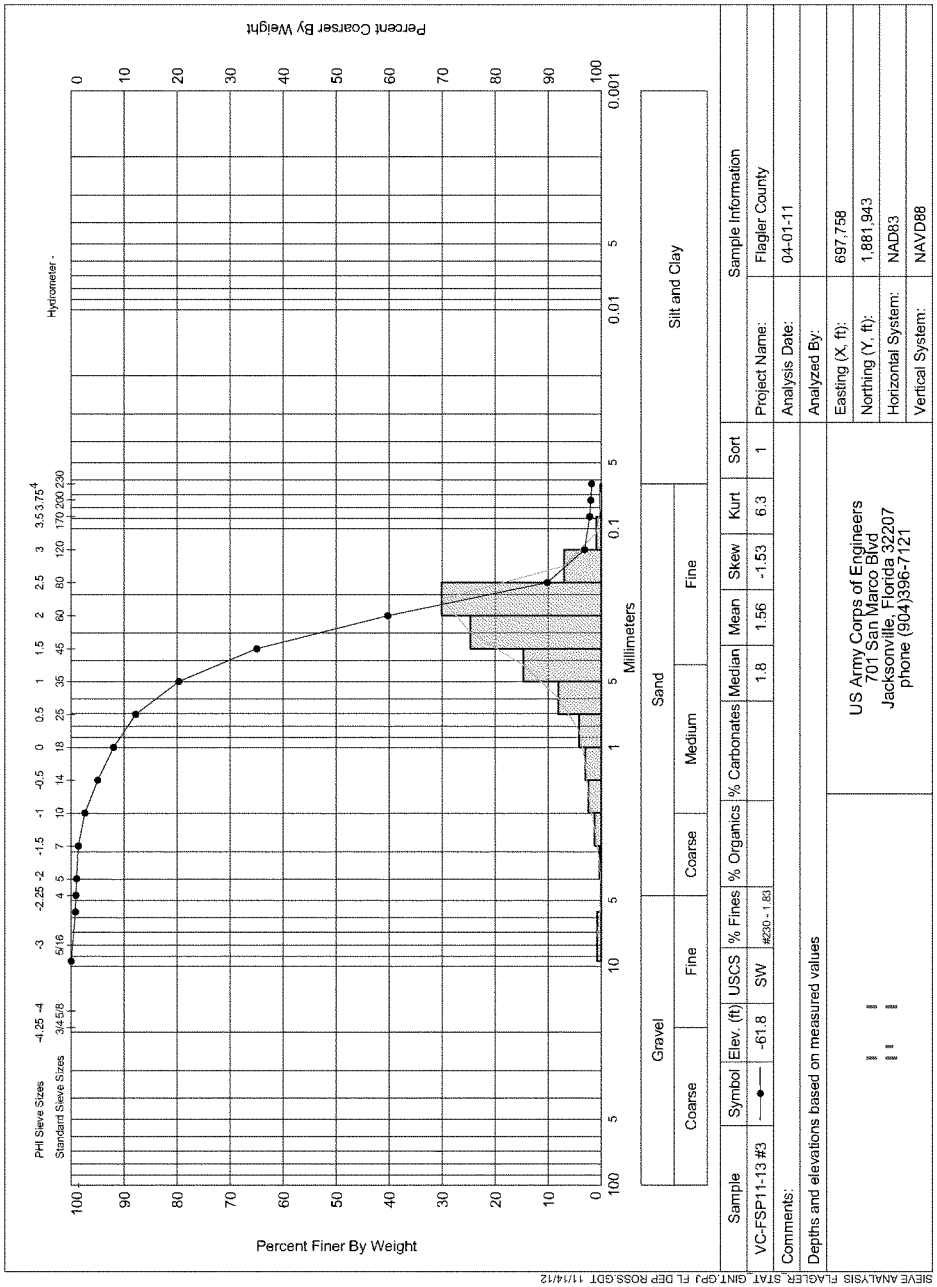
Depths and elevations based on measured values

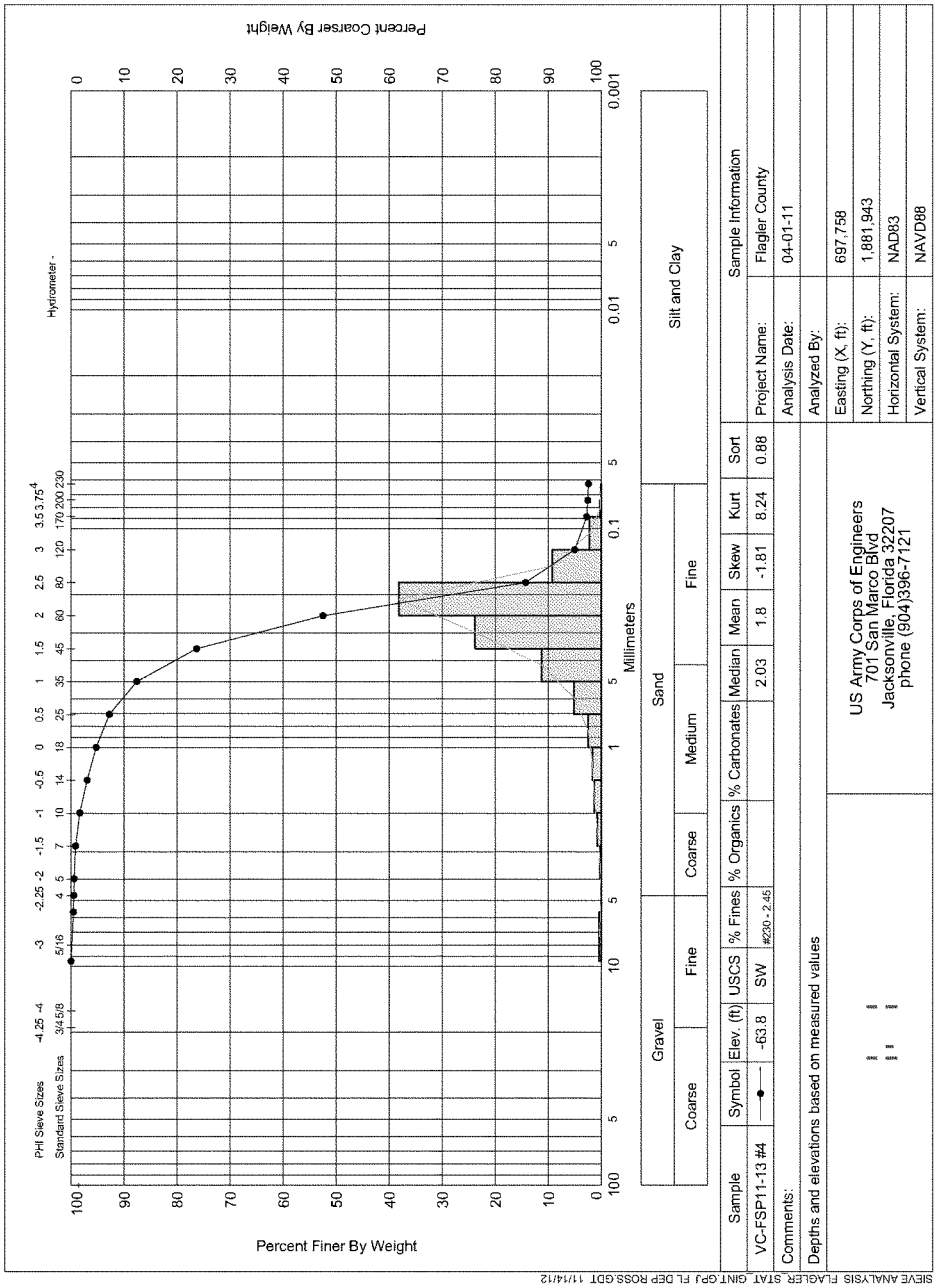
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

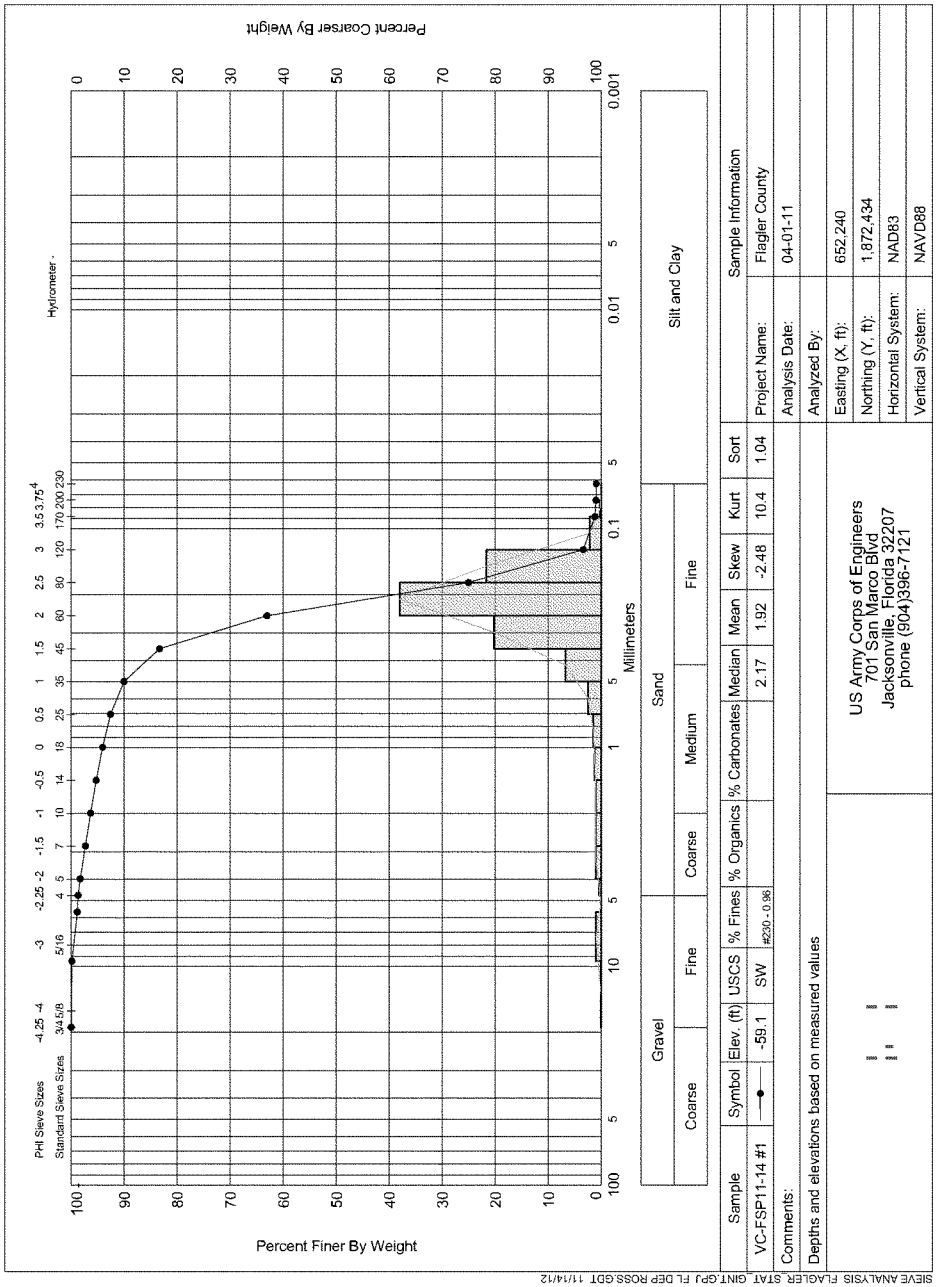
Sample Information	
Project Name:	Flagler County
Analysis Date:	04-01-11
Analyzed By:	
Easting (X, ft):	697,758
Northing (Y, ft):	1,881,943
Horizontal System:	NAD83
Vertical System:	NAVD88

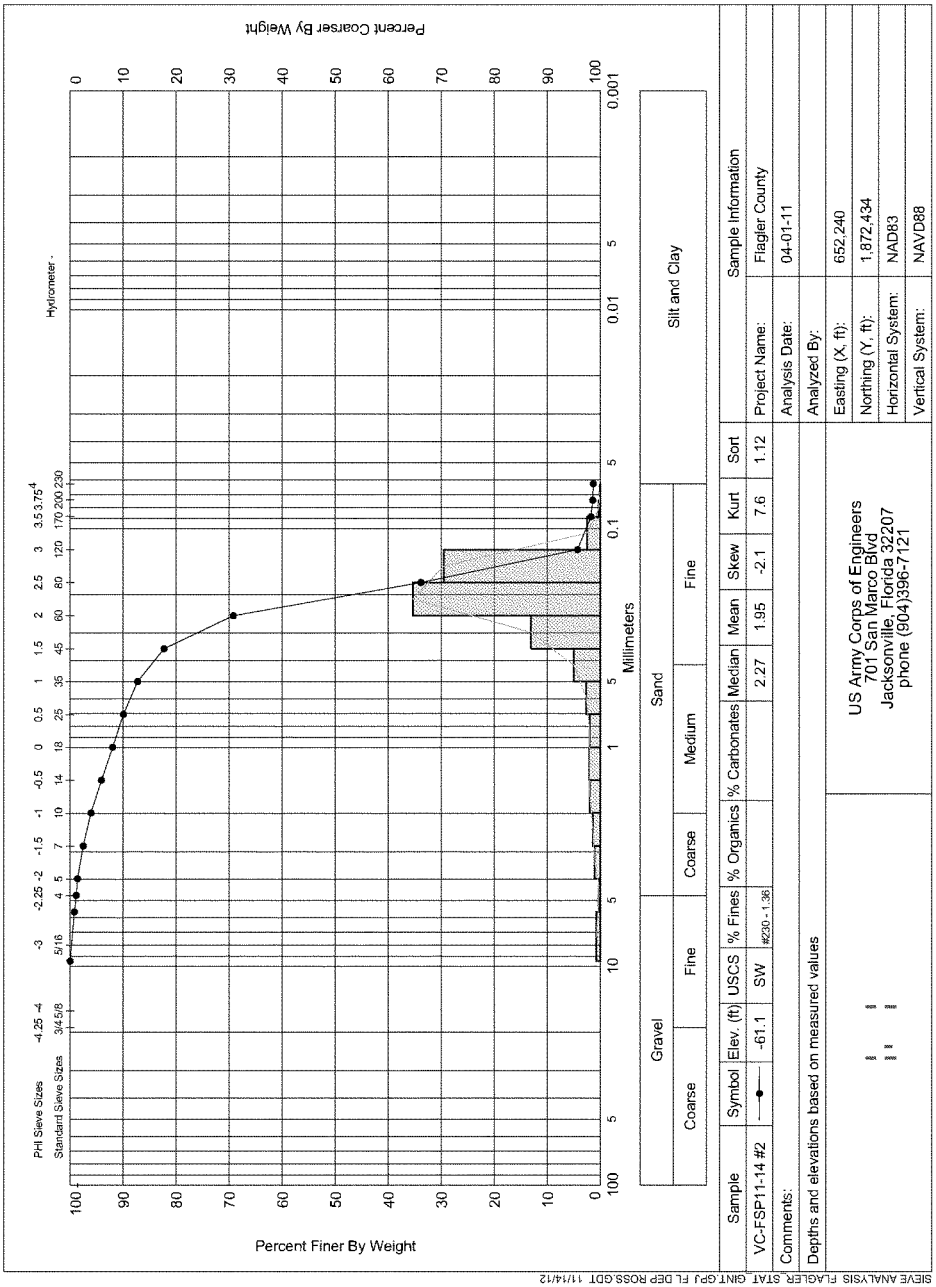
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12

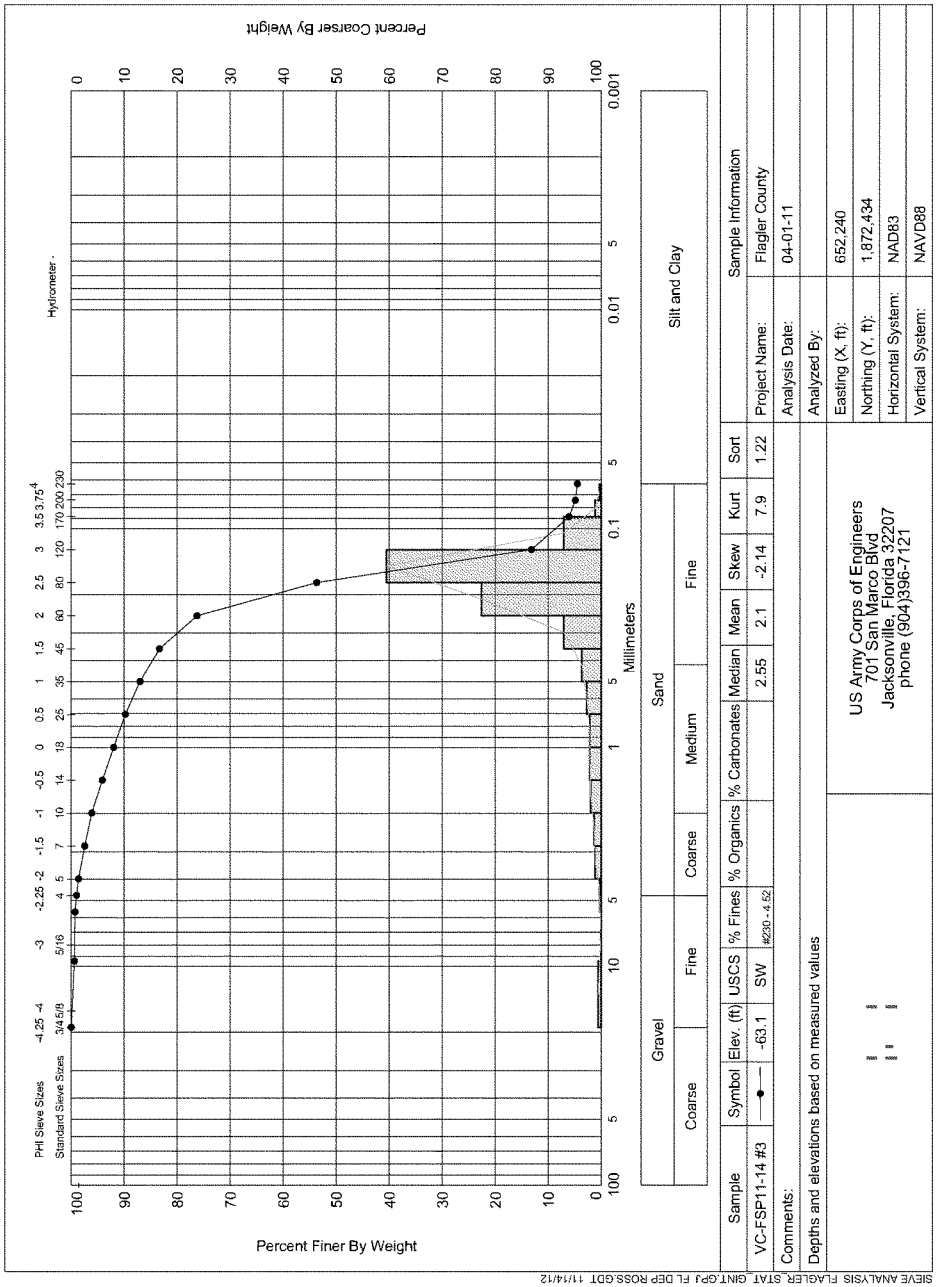

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 697,758
Northing (Y, ft): 1,881,943
Horizontal System: NAD83
Vertical System: NAVD88
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
VC-FSP11-13 #2
-58.8
SP
#230 - 0.98
19.00
1.98
1.82
-1.6
7.04
0.7
Comments:
Depths and elevations based on measured values
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

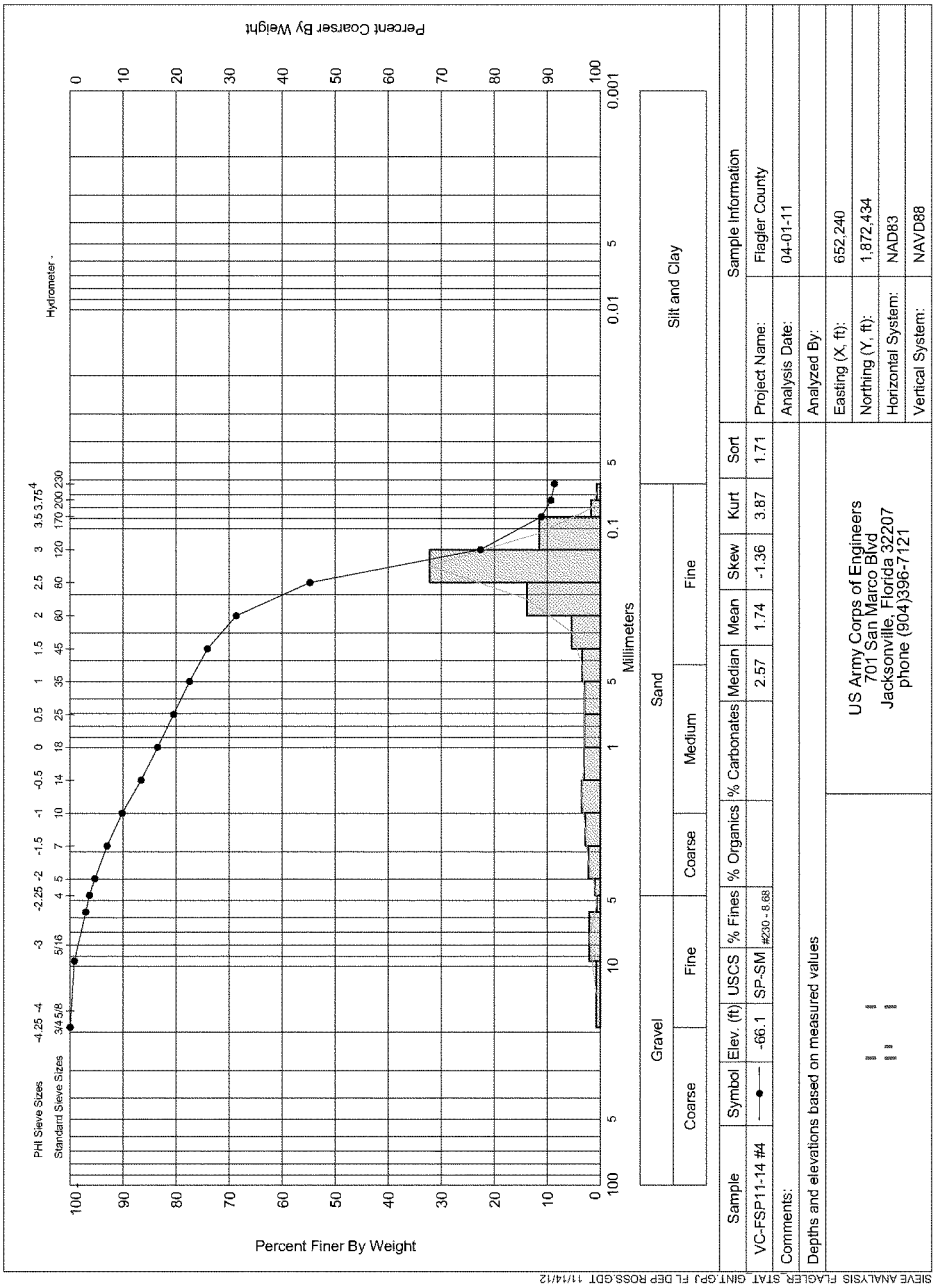

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-13 #3
-61.8
SW
#230 - 1.83
1.8
1.56
-1.53
6.3
1
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
697,758
Northing (Y, ft):
1,881,943
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

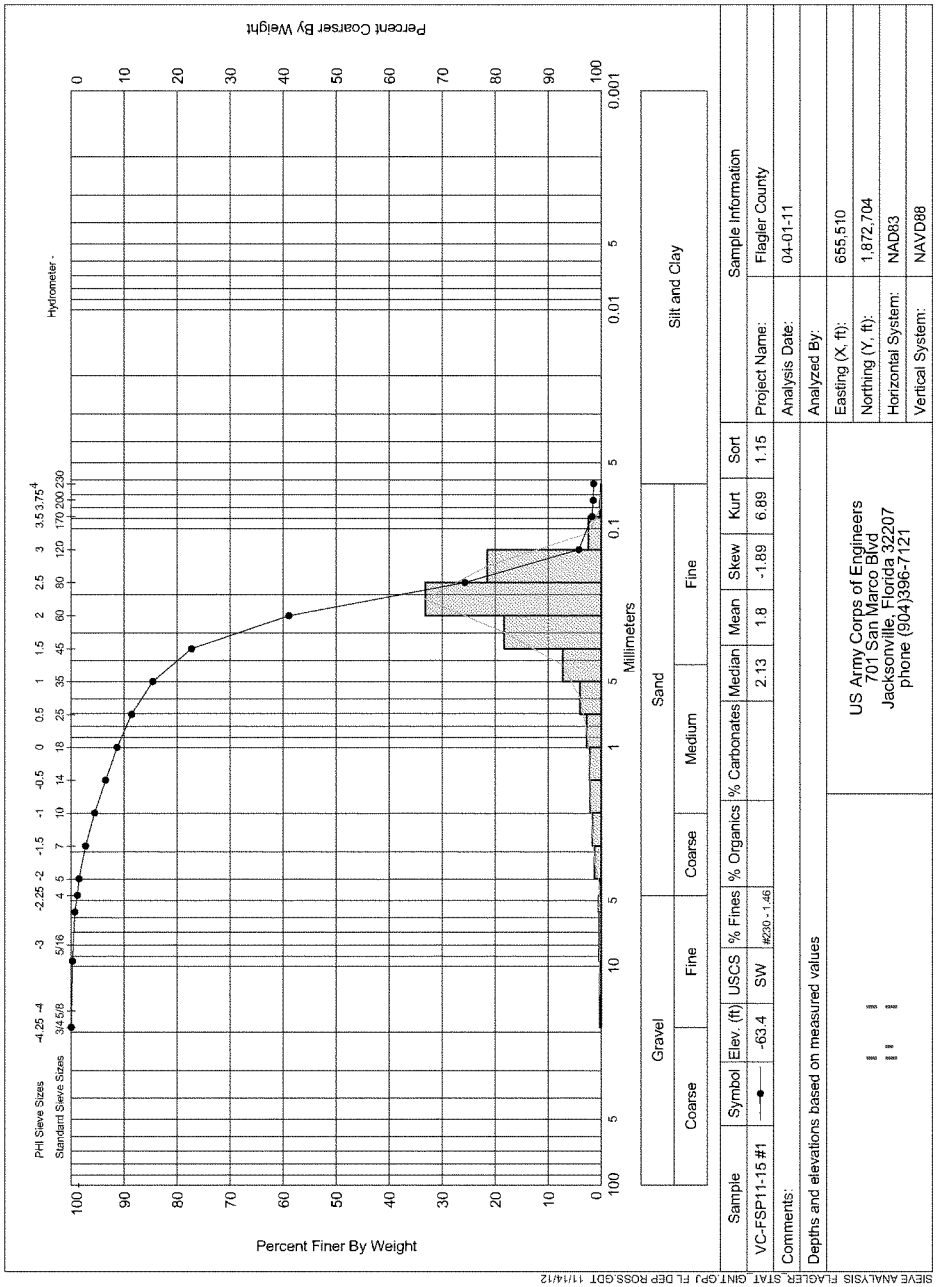

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-13 #4
-63.8
SW
#230 - 2.45
2.03
1.8
-1.81
8.24
0.88
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
697,758
Northing (Y, ft):
1,881,943
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

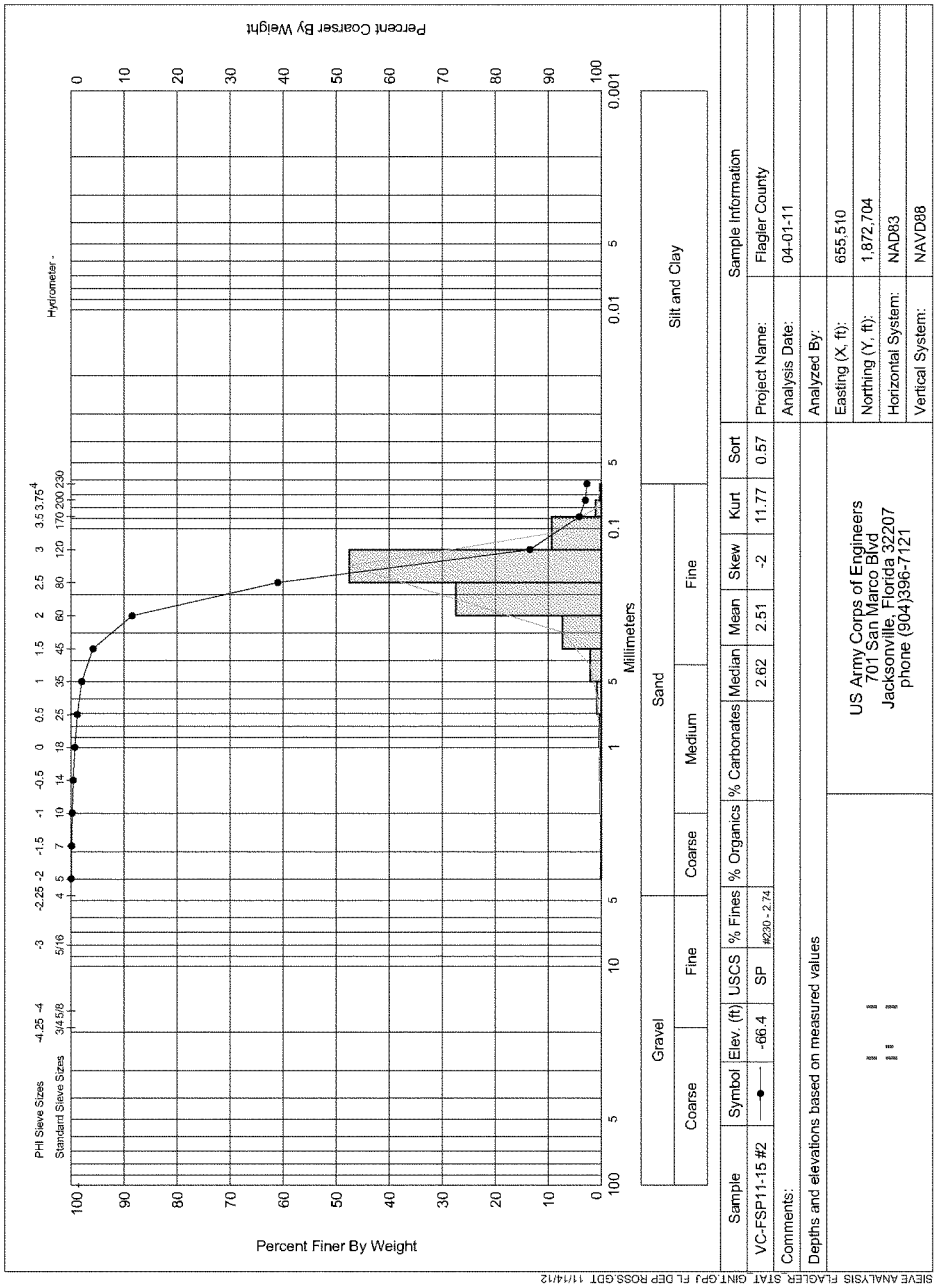

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-14 #1
-59.1
SW
#230 - 0.96
2.17
1.92
-2.48
10.4
1.04
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
652,240
Northing (Y, ft):
1,872,434
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

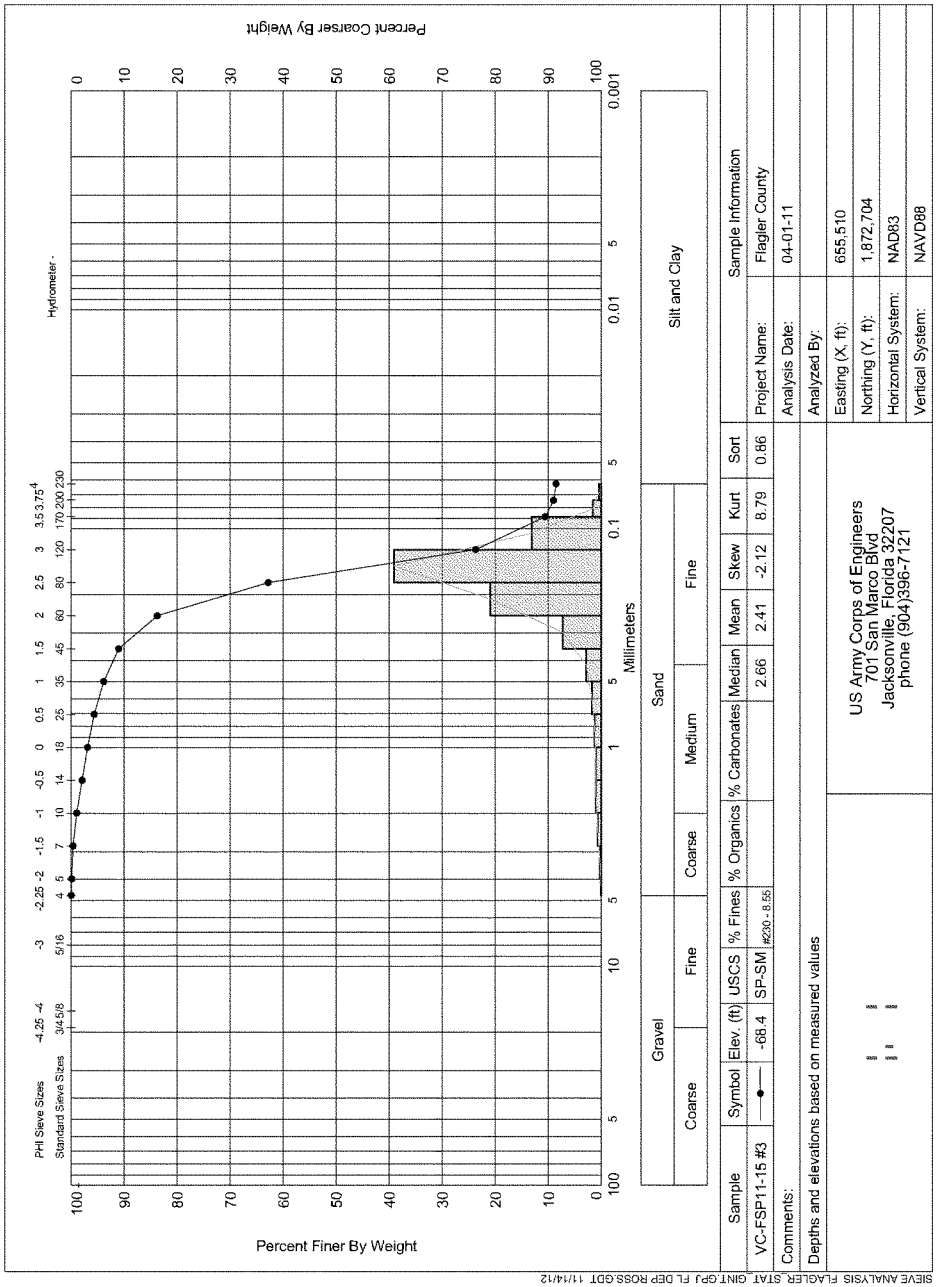

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-14 #2
-61.1
SW
#230 - 1.36
2.27
1.95
-2.1
7.6
1.12
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
652,240
Northing (Y, ft):
1,872,434
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-14 #3
-63.1
SW
#230 - 4.52
2.55
2.1
-2.14
7.9
1.22
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
652,240
Northing (Y, ft):
1,872,434
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-14 #4
-66.1
SP-SM
#230 - 8.68
2.57
1.74
-1.36
3.87
1.71
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
652,240
Northing (Y, ft):
1,872,434
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-15 #1
-63.4
SW
#230 - 1.46
2.13
1.8
-1.89
6.89
1.15
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
655,510
Northing (Y, ft):
1,872,704
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-15 #2
-66.4
SP
#230 - 2.74
2.62
2.51
-2
11.77
0.57
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
655,510
Northing (Y, ft):
1,872,704
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL_DEP_ROSS.GDT 11/14/12

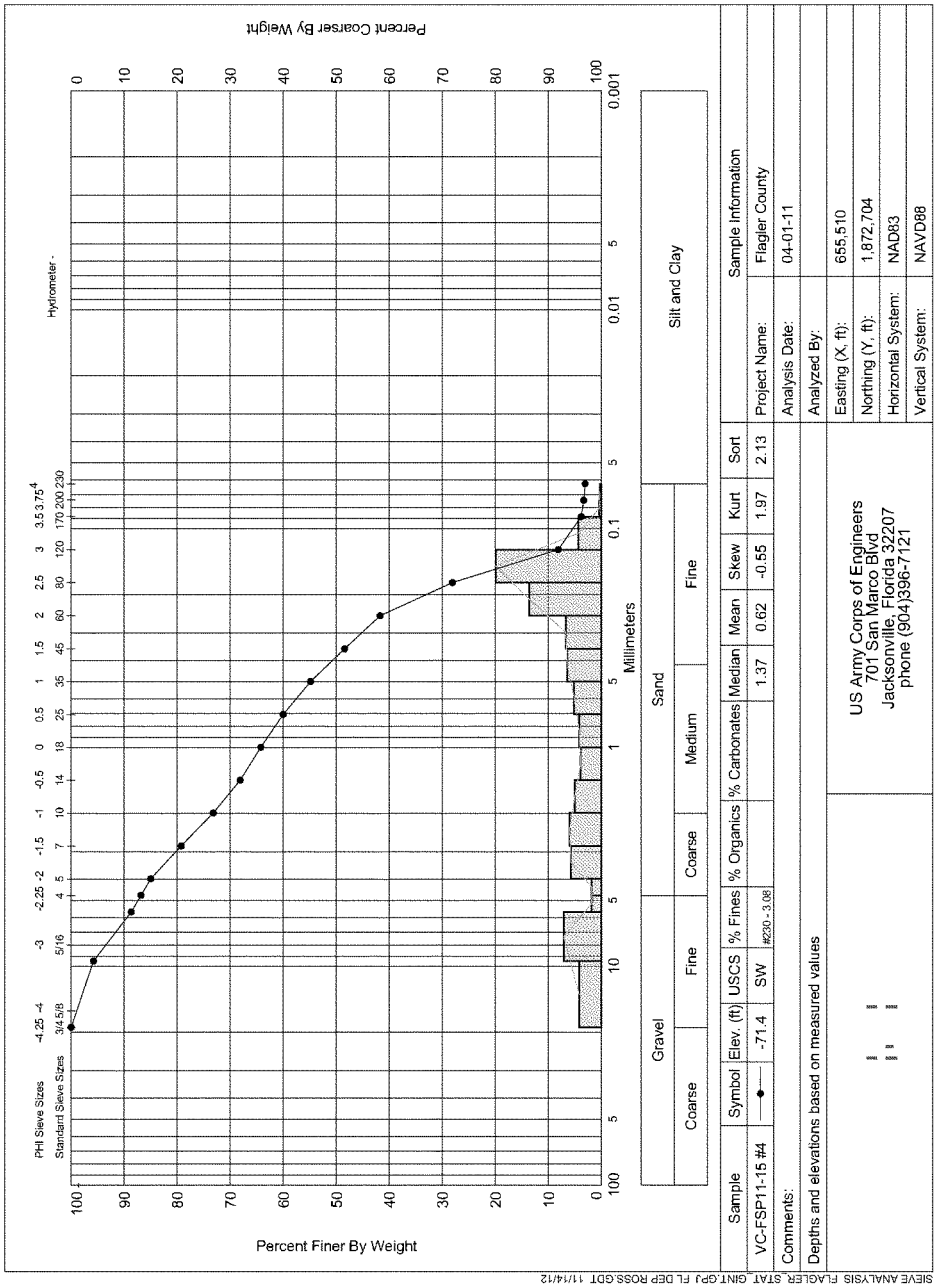


Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
VC-FSP11-15 #3		-68.4	SP-SM	#230 - 8.55			2.66	2.41	-2.12	8.79	0.86

Comments:

Depths and elevations based on measured values

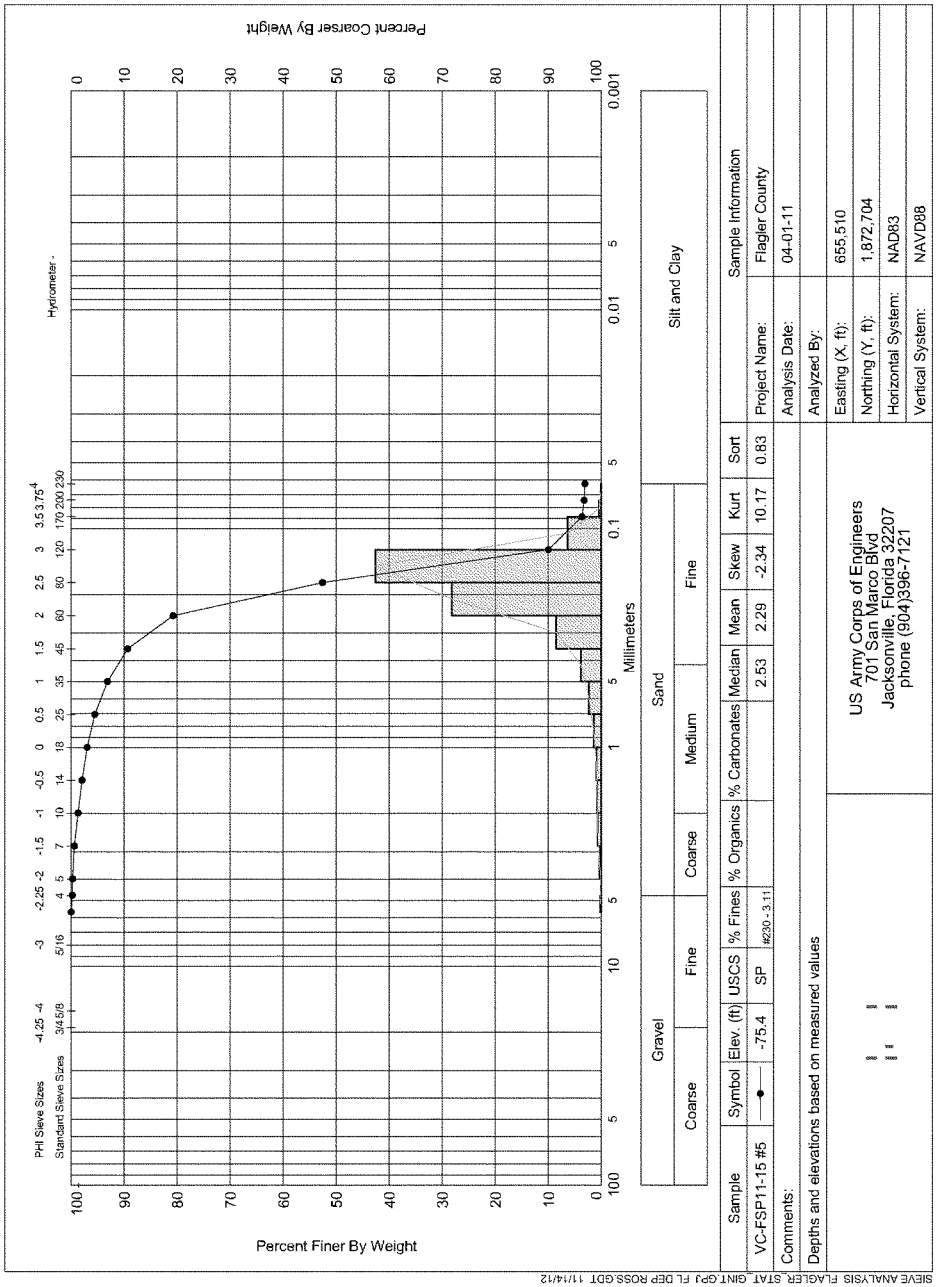
Sample Information	
Project Name:	Flagler County
Analysis Date:	04-01-11
Analyzed By:	
Easting (X, ft):	655,510
Northing (Y, ft):	1,872,704
Horizontal System:	NAD83
Vertical System:	NAVD88

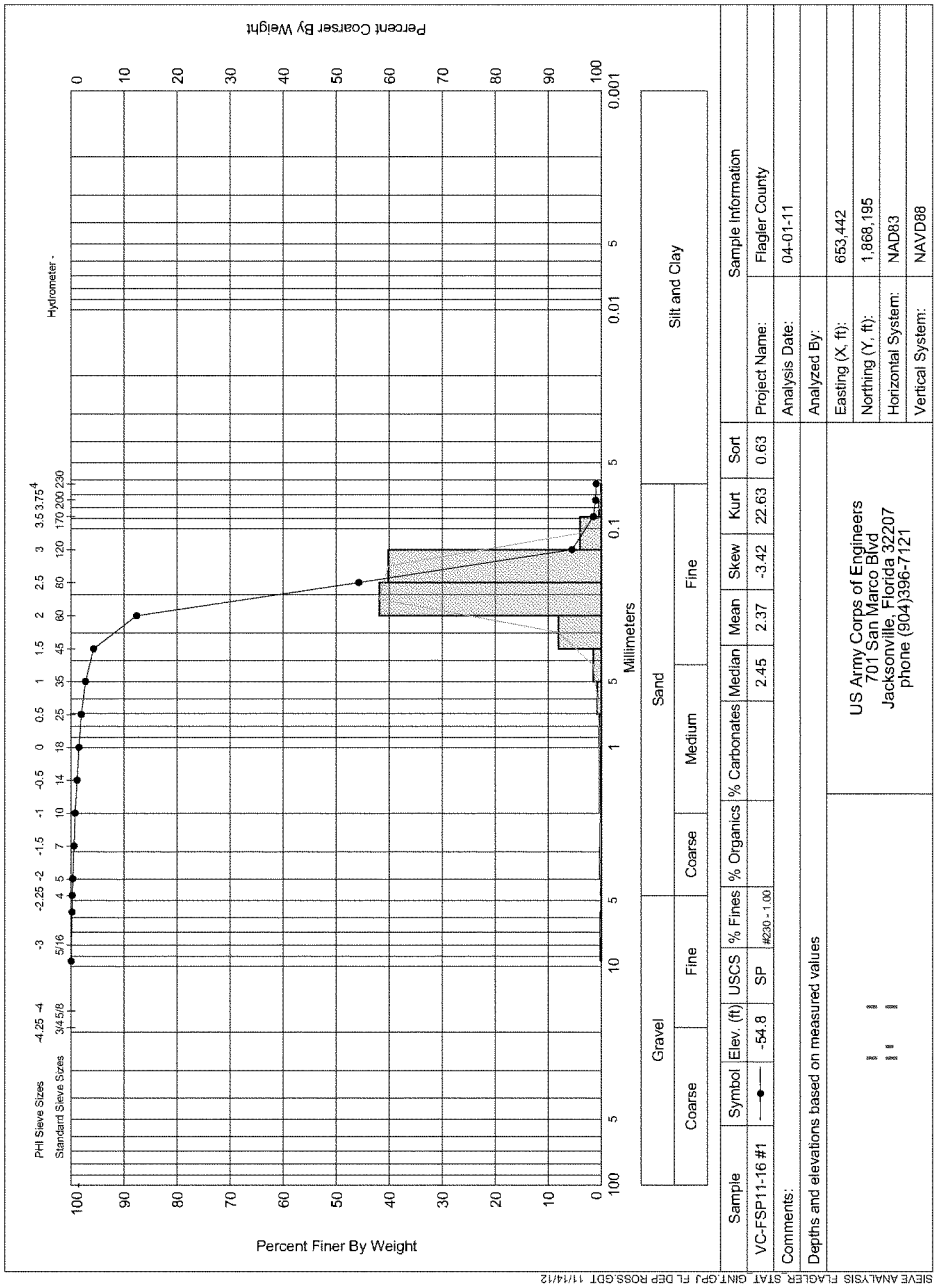


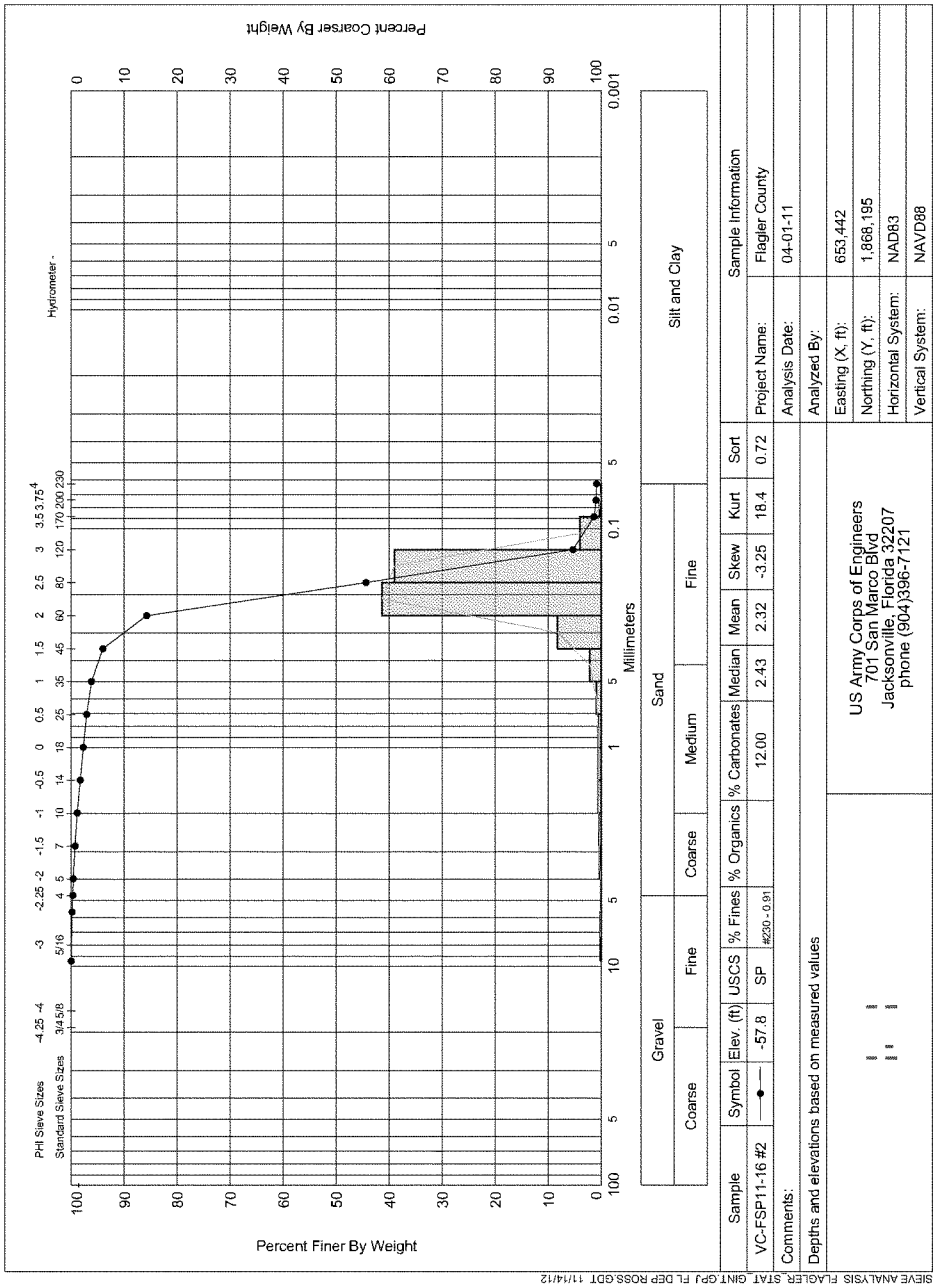
Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
VC-FSP11-15 #4		-71.4	SW	#230 - 3.08			1.37	0.62	-0.55	1.97	2.13

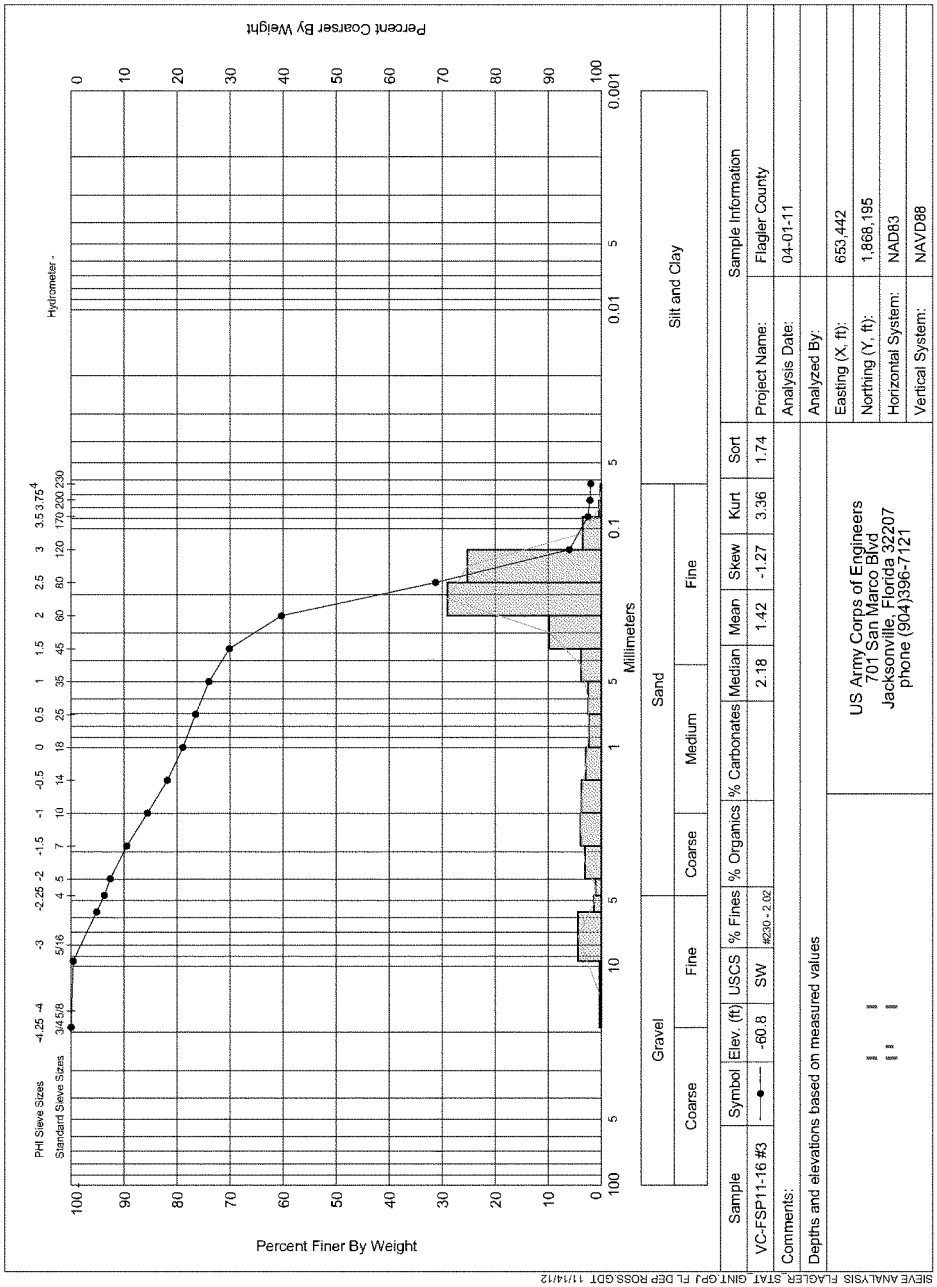
Comments:
Depths and elevations based on measured values

Sample Information	
Project Name:	Flagler County
Analysis Date:	04-01-11
Analyzed By:	
Easting (X, ft):	655,510
Northing (Y, ft):	1,872,704
Horizontal System:	NAD83
Vertical System:	NAVD88


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-15 #5
-75.4
SP
#230 - 3.11
2.53
2.29
-2.34
10.17
0.83
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
655,510
Northing (Y, ft):
1,872,704
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-16 #1
-54.8
SP
#230 - 1.00
2.45
2.37
-3.42
22.63
0.63
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
653,442
Northing (Y, ft):
1,868,195
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL_DEP_ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
VC-FSP11-16 #2
Symbol
Elev. (ft)
-57.8
USCS
SP
% Fines
#230 - 0.91
% Organics
% Carbonates
12.00
Median
2.43
Mean
2.32
Skew
-3.25
Kurt
18.4
Sort
0.72
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
653,442
Northing (Y, ft):
1,868,195
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12



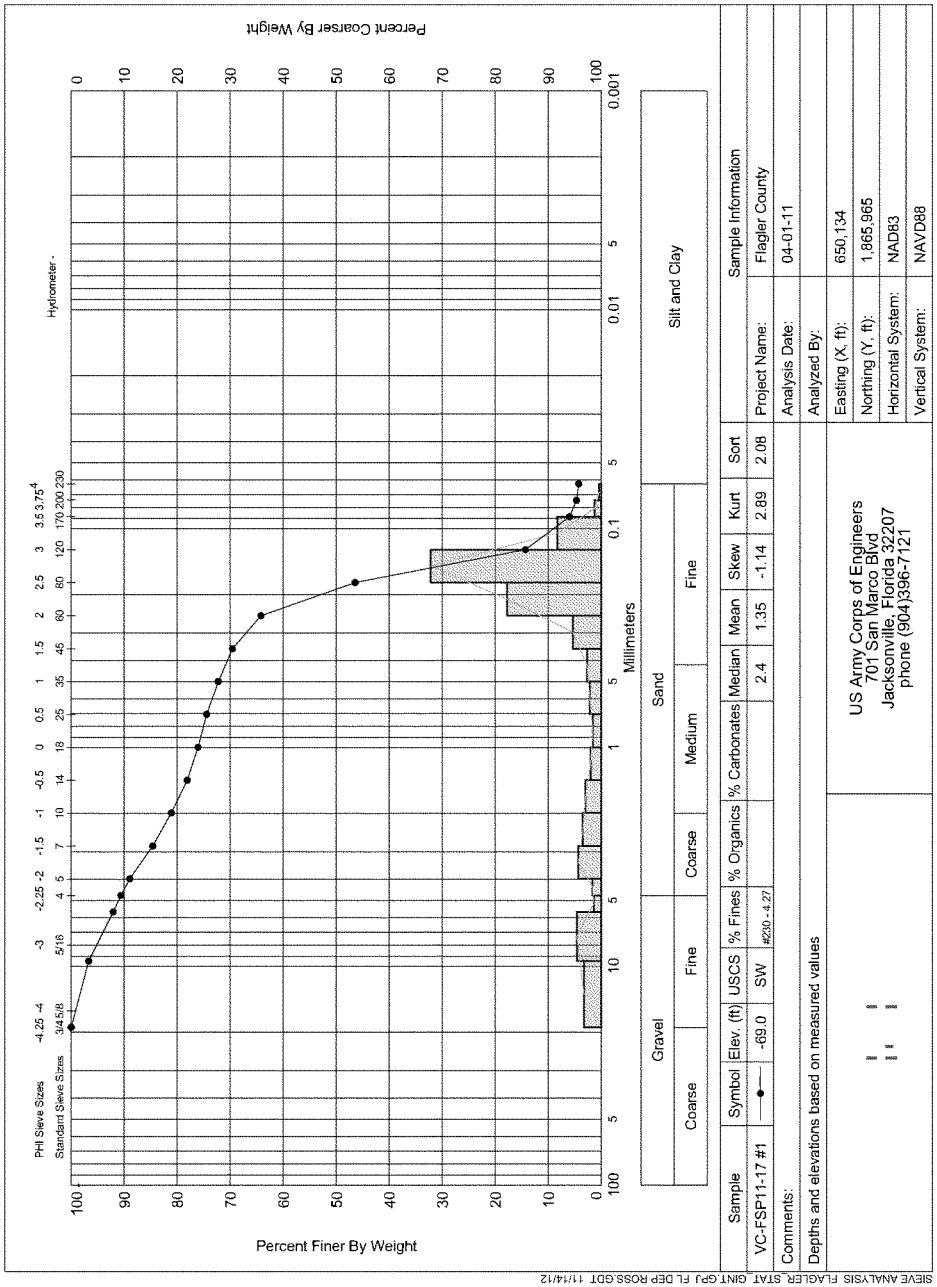
Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
VC-FSP11-16 #3		-60.8	SW	#230 - 2.02			2.18	1.42	-1.27	3.36	1.74

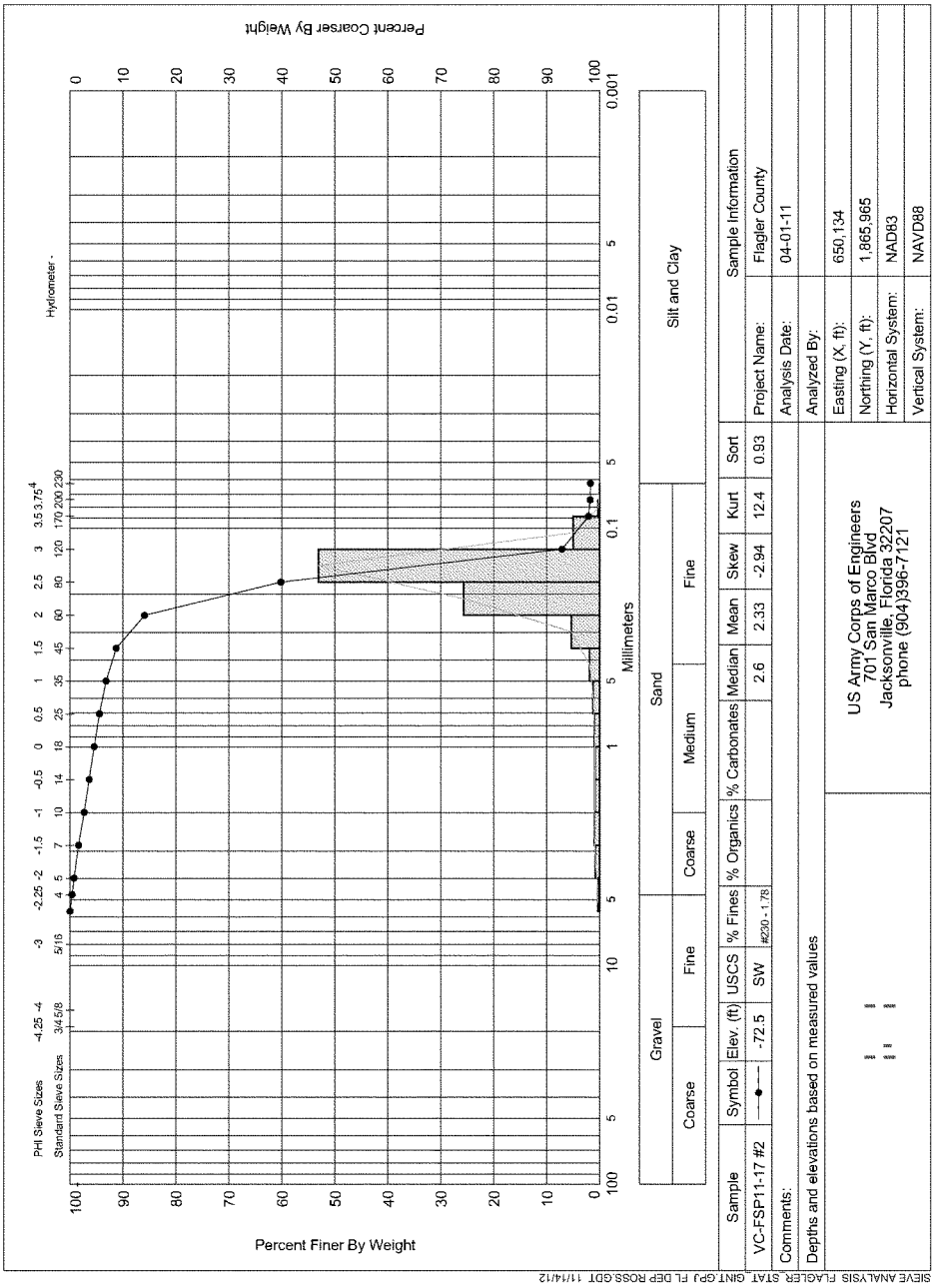
Comments:

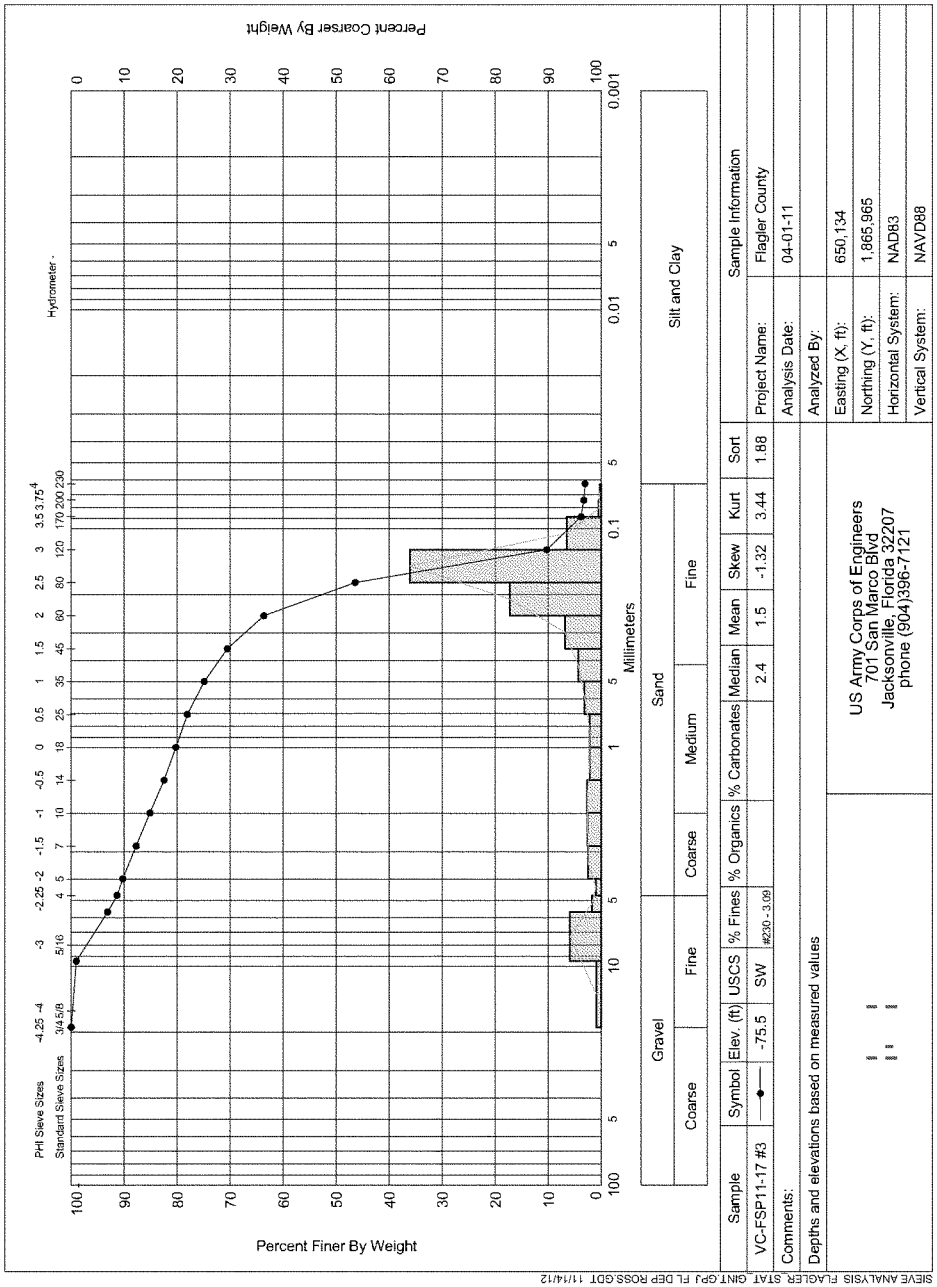
Depths and elevations based on measured values

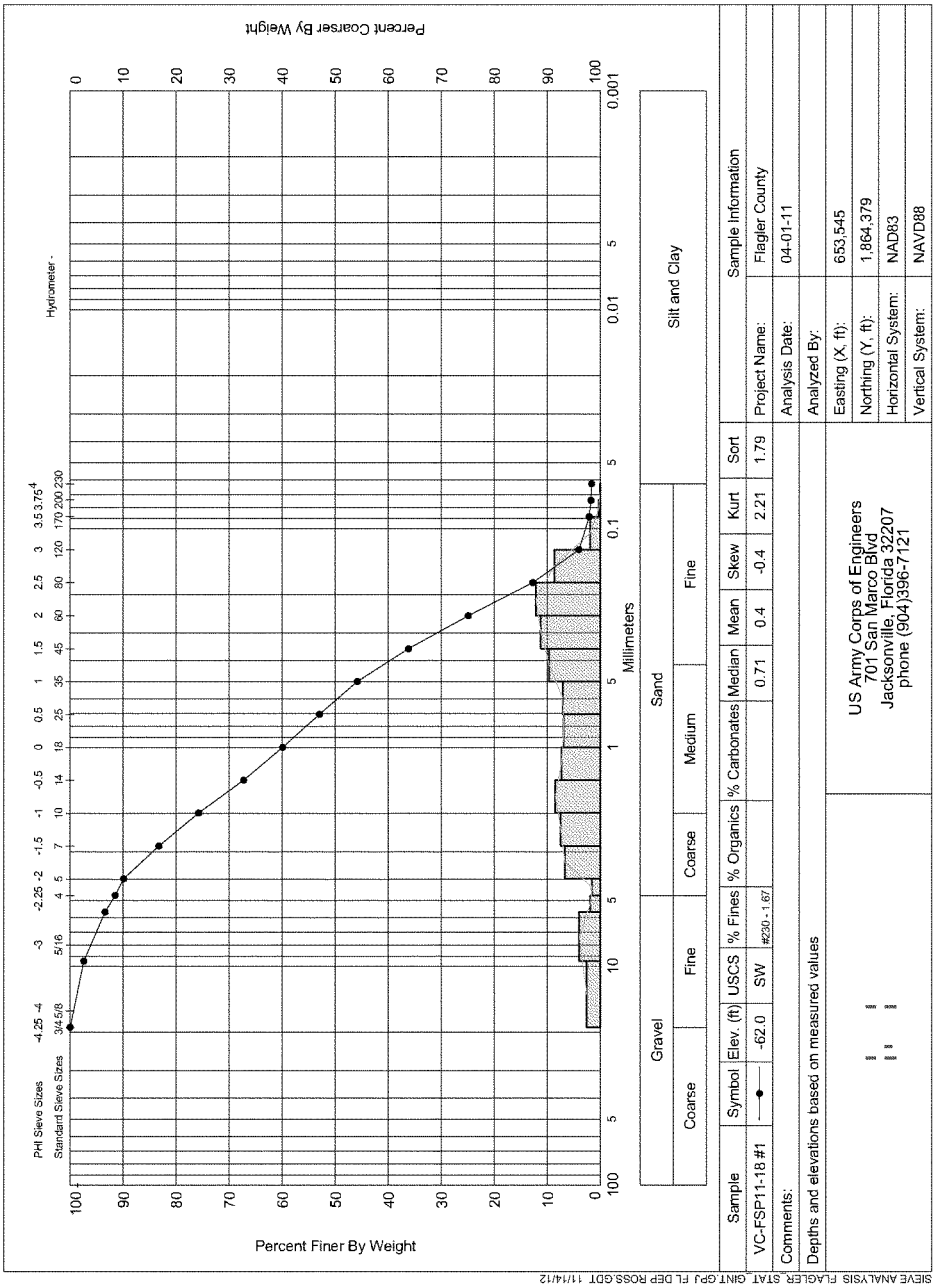
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

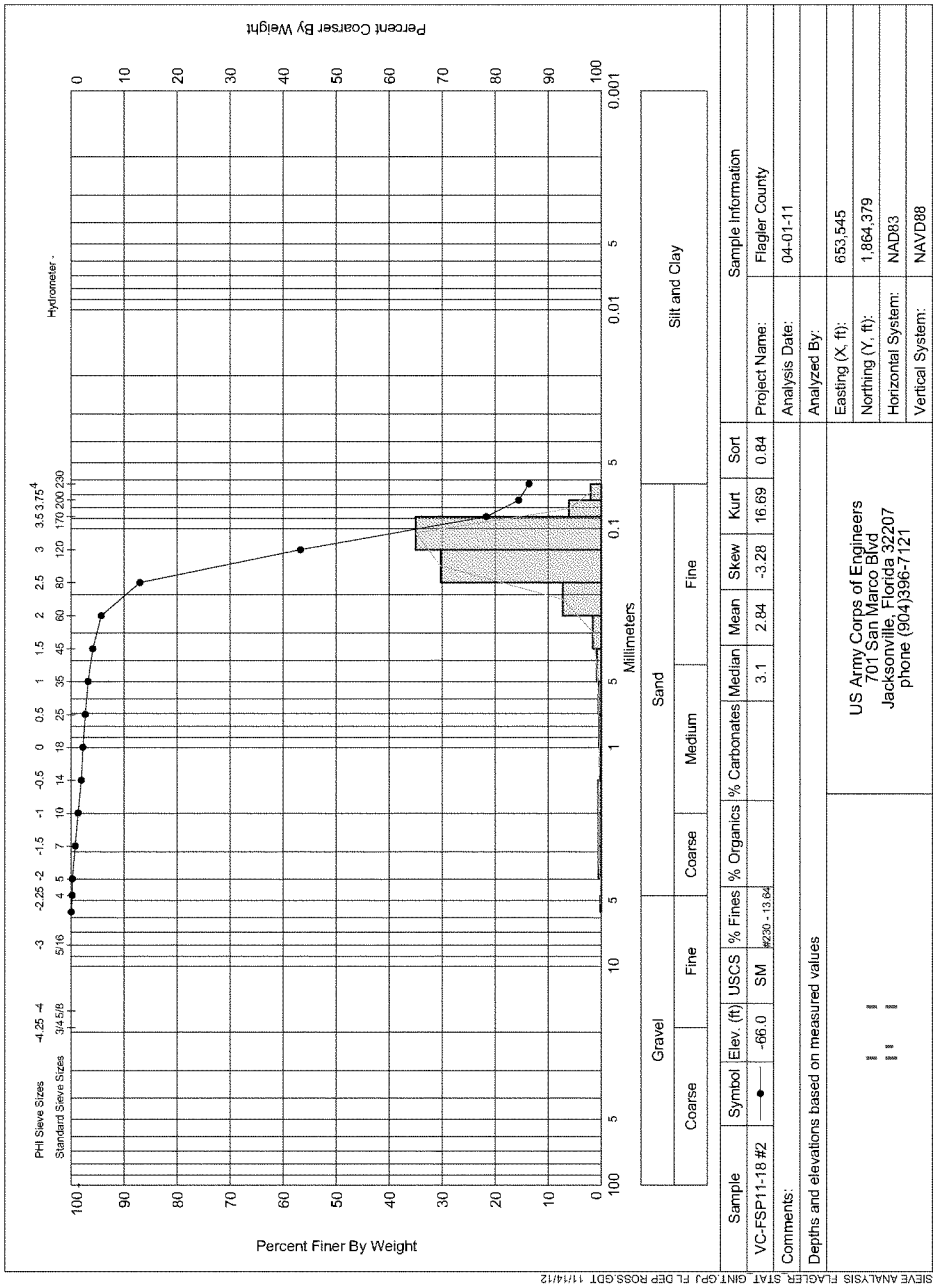
Sample Information	
Project Name:	Flagler County
Analysis Date:	04-01-11
Analyzed By:	
Easting (X, ft):	653,442
Northing (Y, ft):	1,868,195
Horizontal System:	NAD83
Vertical System:	NAVD88

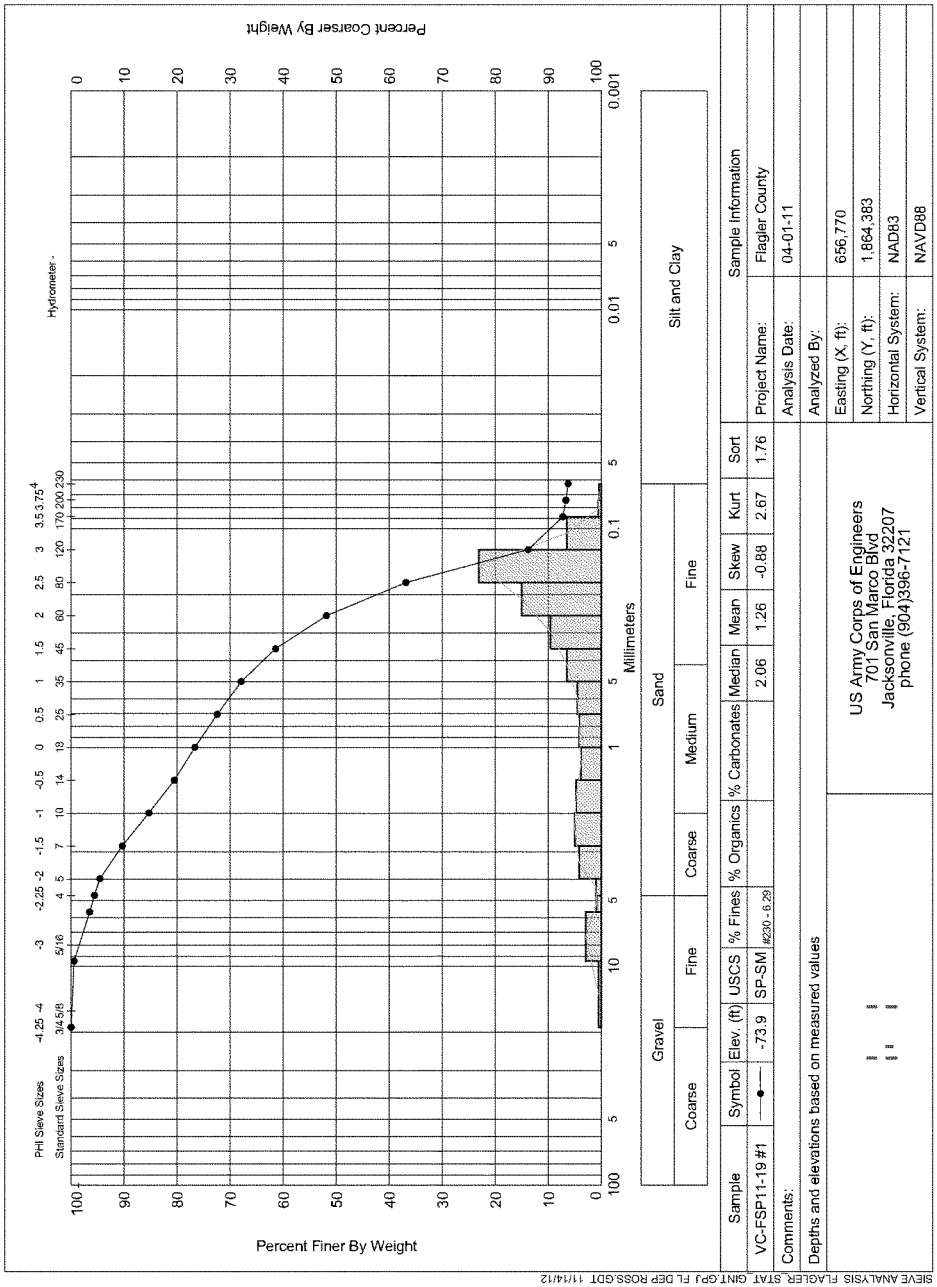

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-17 #1
-69.0
SW
#230 - 4.27
2.4
1.35
-1.14
2.89
2.08
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
650,134
Northing (Y, ft):
1,865,965
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12

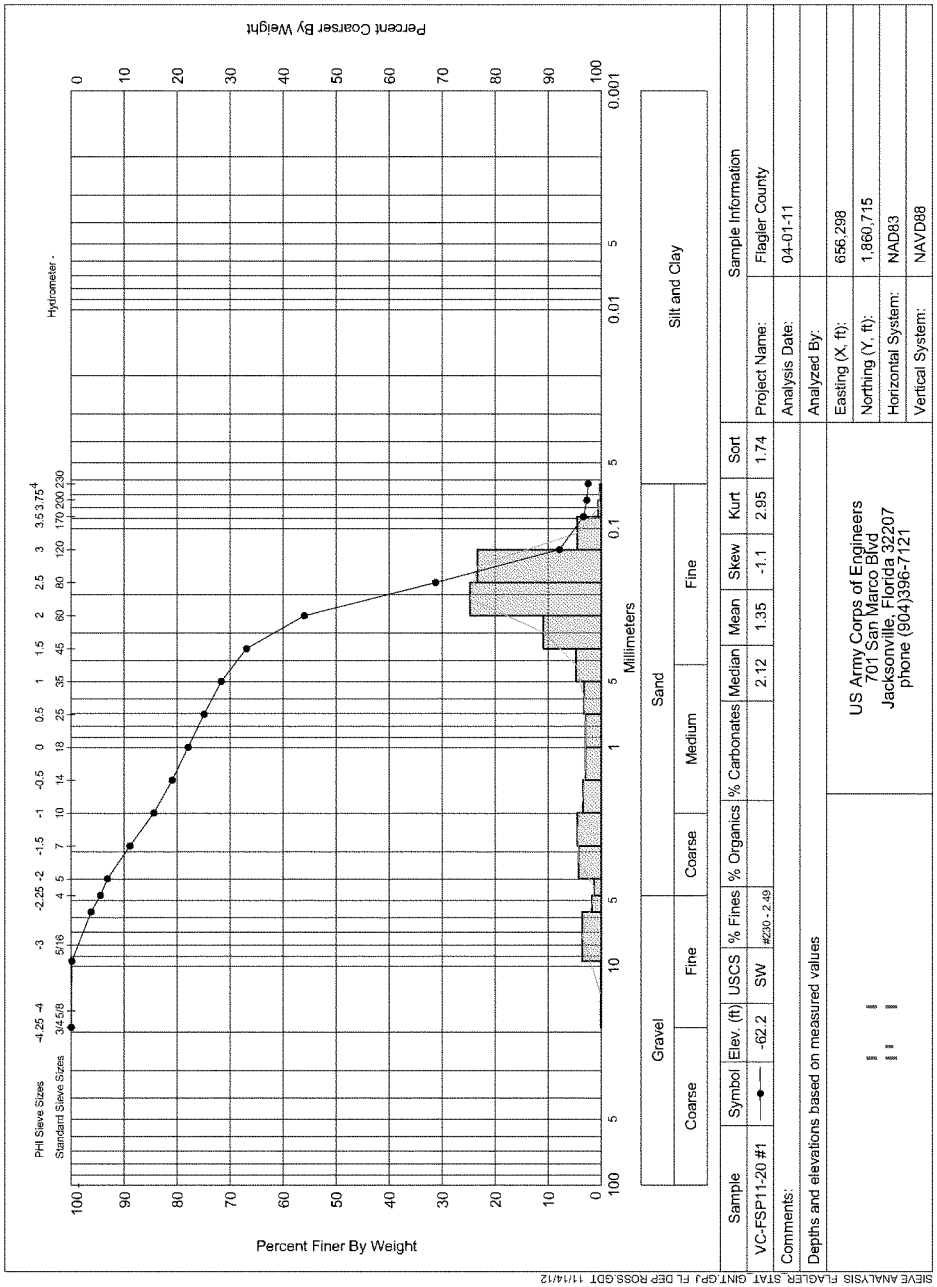

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-17 #2
-72.5
SW
#230 - 1.78
2.6
2.33
-2.94
12.4
0.93
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
650,134
Northing (Y, ft):
1,865,965
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

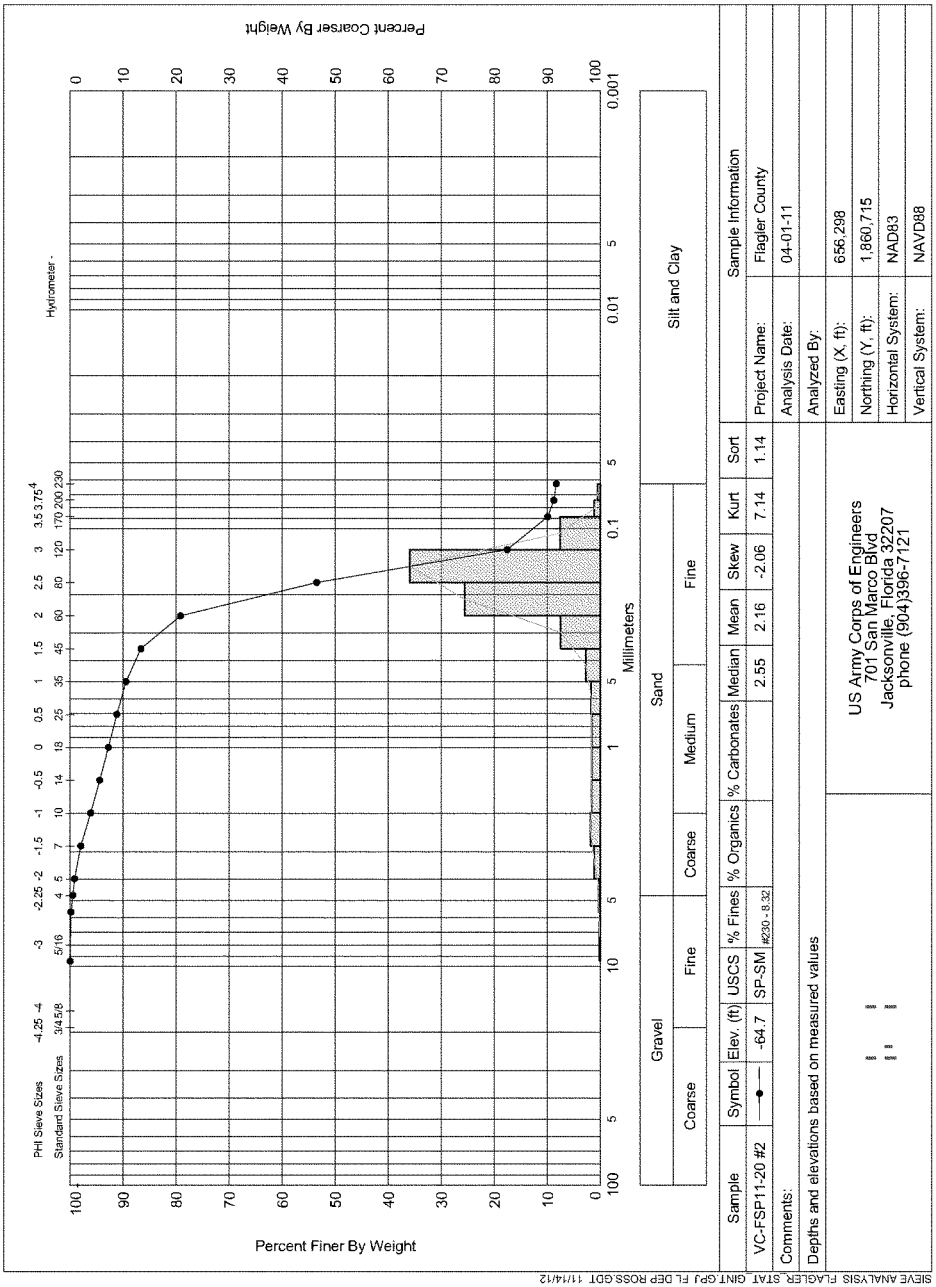

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
VC-FSP11-17 #3
Symbol
Elev. (ft)
-75.5
USCS
SW
% Fines
#230 - 3.09
% Organics
% Carbonates
Median
2.4
Mean
1.5
Skew
-1.32
Kurt
3.44
Sort
1.88
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
650,134
Northing (Y, ft):
1,865,965
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Phi Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-18 #1
-62.0
SW
#230 - 1.67
0.71
0.4
-0.4
2.21
1.79
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
653,545
Northing (Y, ft):
1,864,379
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-18 #2
-66.0
SM
#230 - 13.64
3.1
2.84
-3.28
16.69
0.84
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
653,545
Northing (Y, ft):
1,864,379
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-19 #1
-73.9
SP-SM
#230 - 6.29
2.06
1.26
-0.88
2.67
1.76
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
656,770
Northing (Y, ft):
1,864,383
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-20 #1
-62.2
SW
#230 - 2.49
2.12
1.35
-1.1
2.95
1.74
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
656,298
Northing (Y, ft):
1,860,715
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

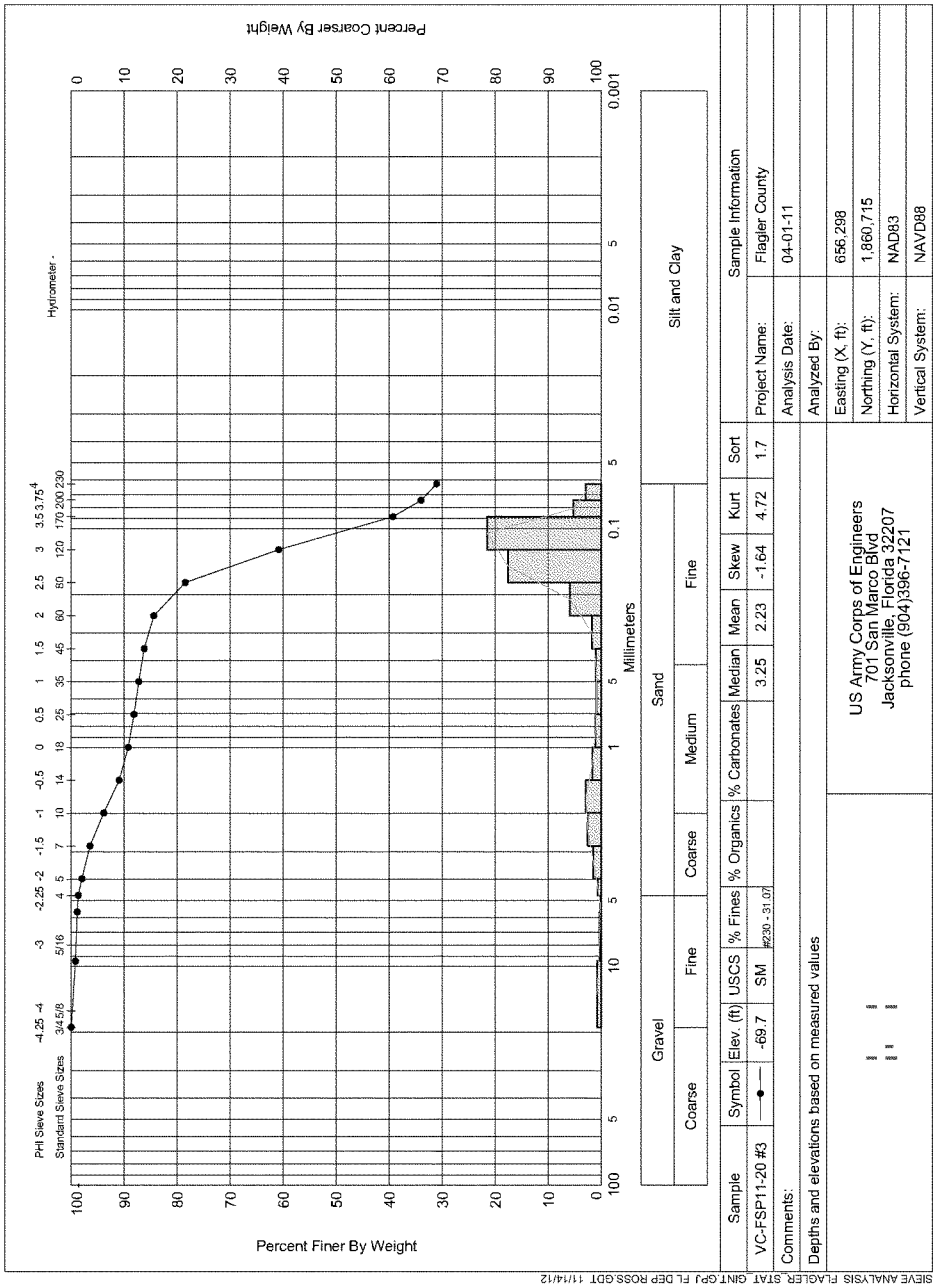


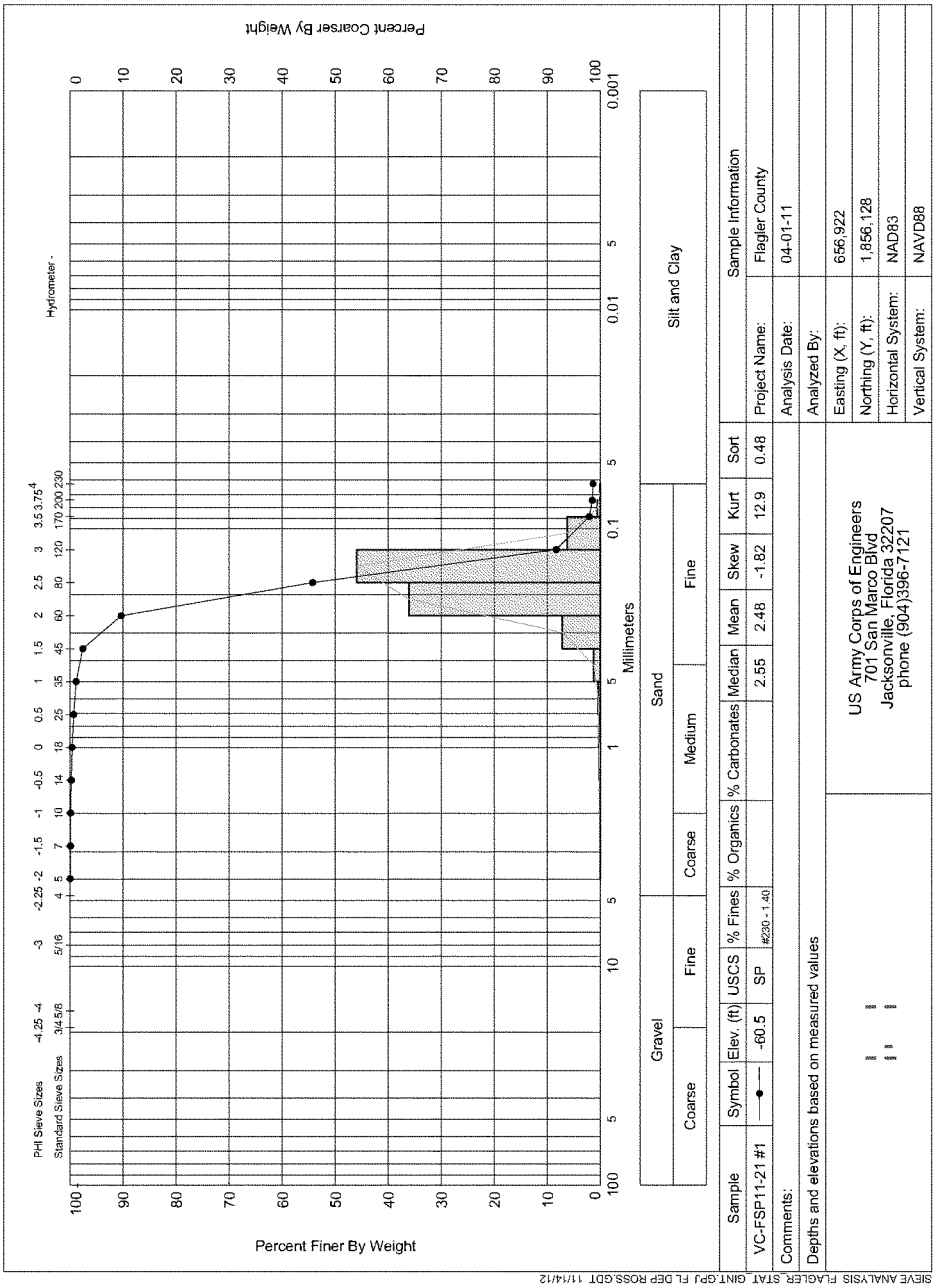
Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
VC-FSP11-20 #2	●——	-64.7	SP-SM	#230 - 8.32			2.55	2.16	-2.06	7.14	1.14

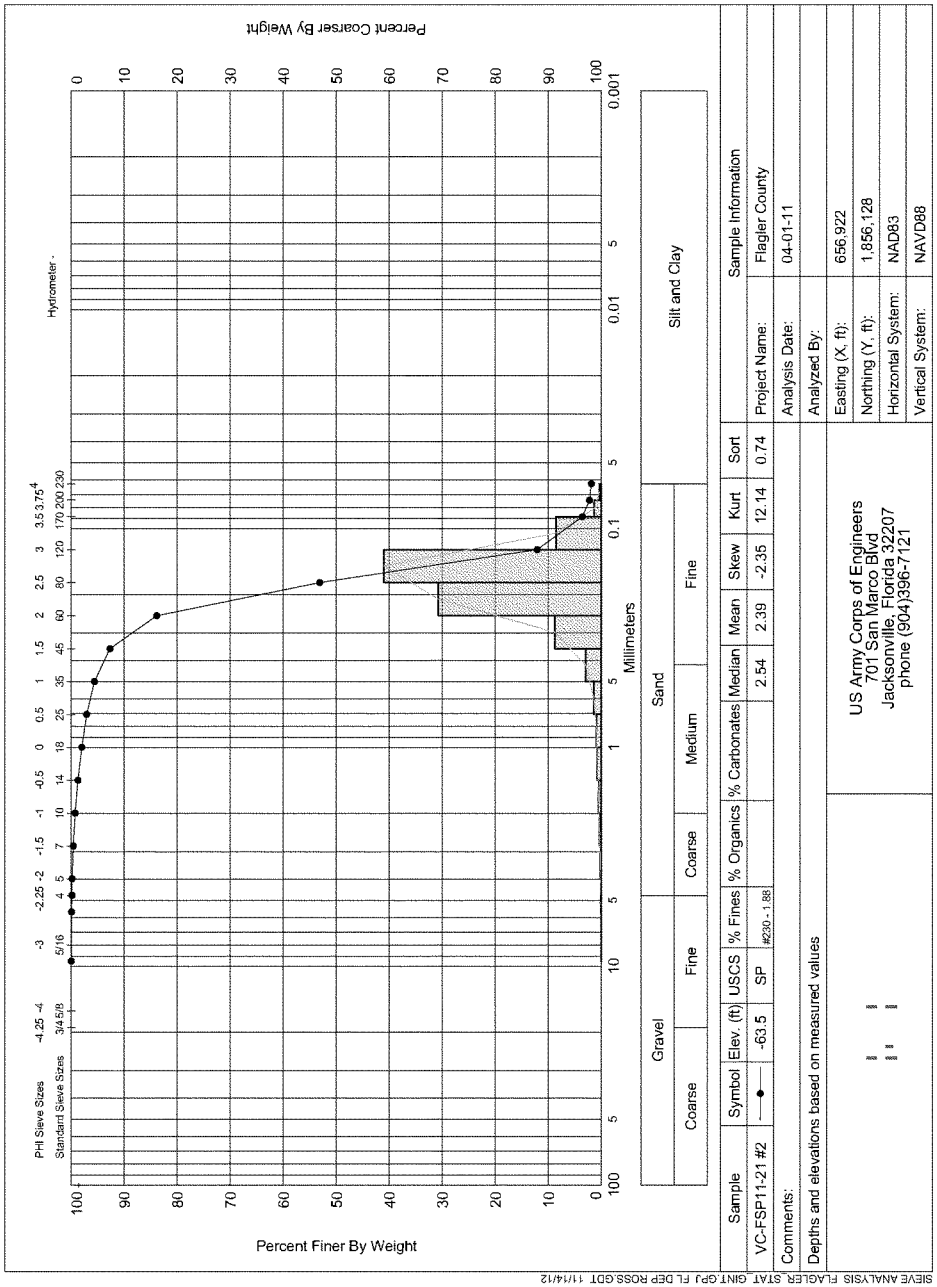
Comments:
Depths and elevations based on measured values

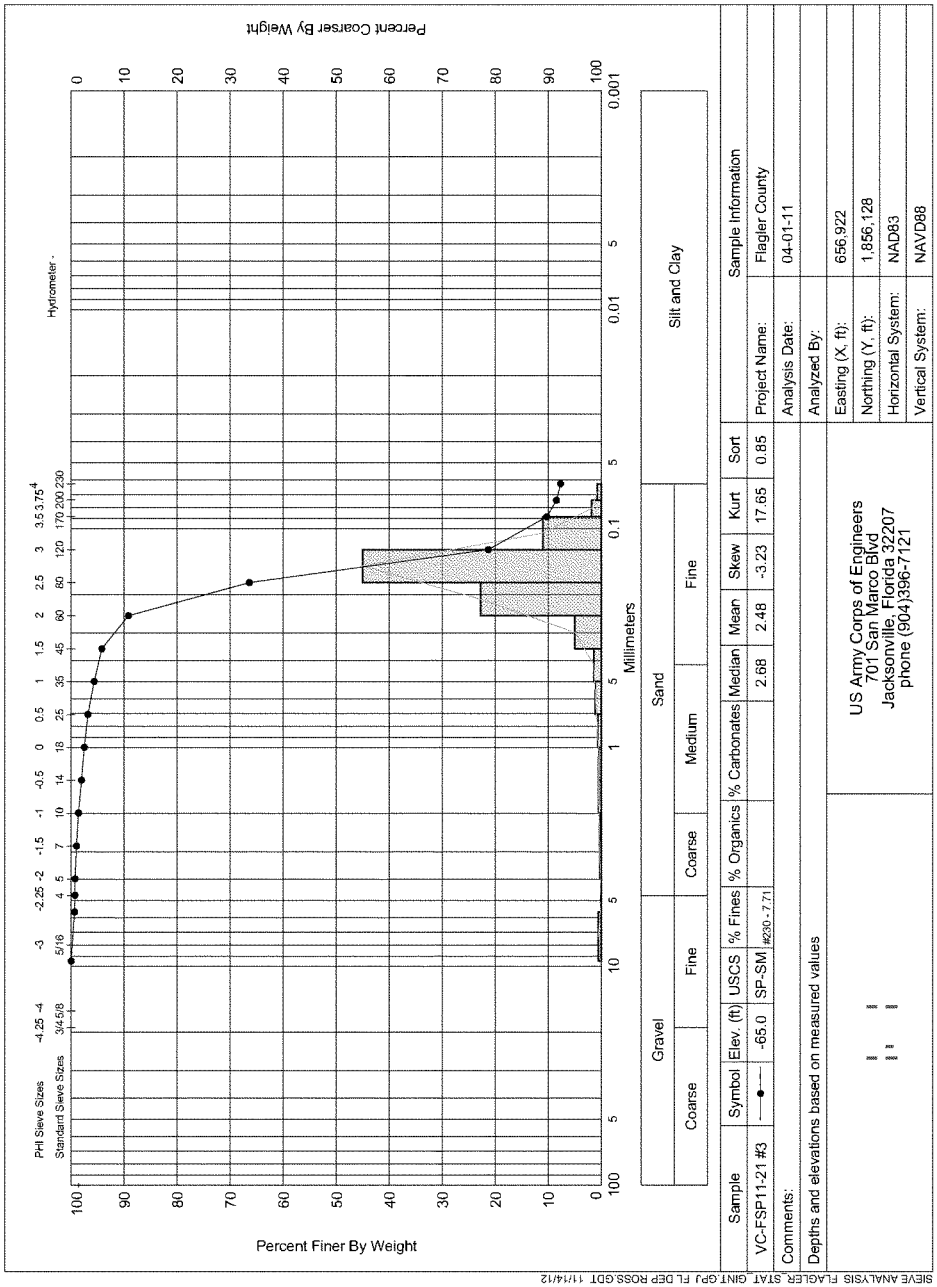
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

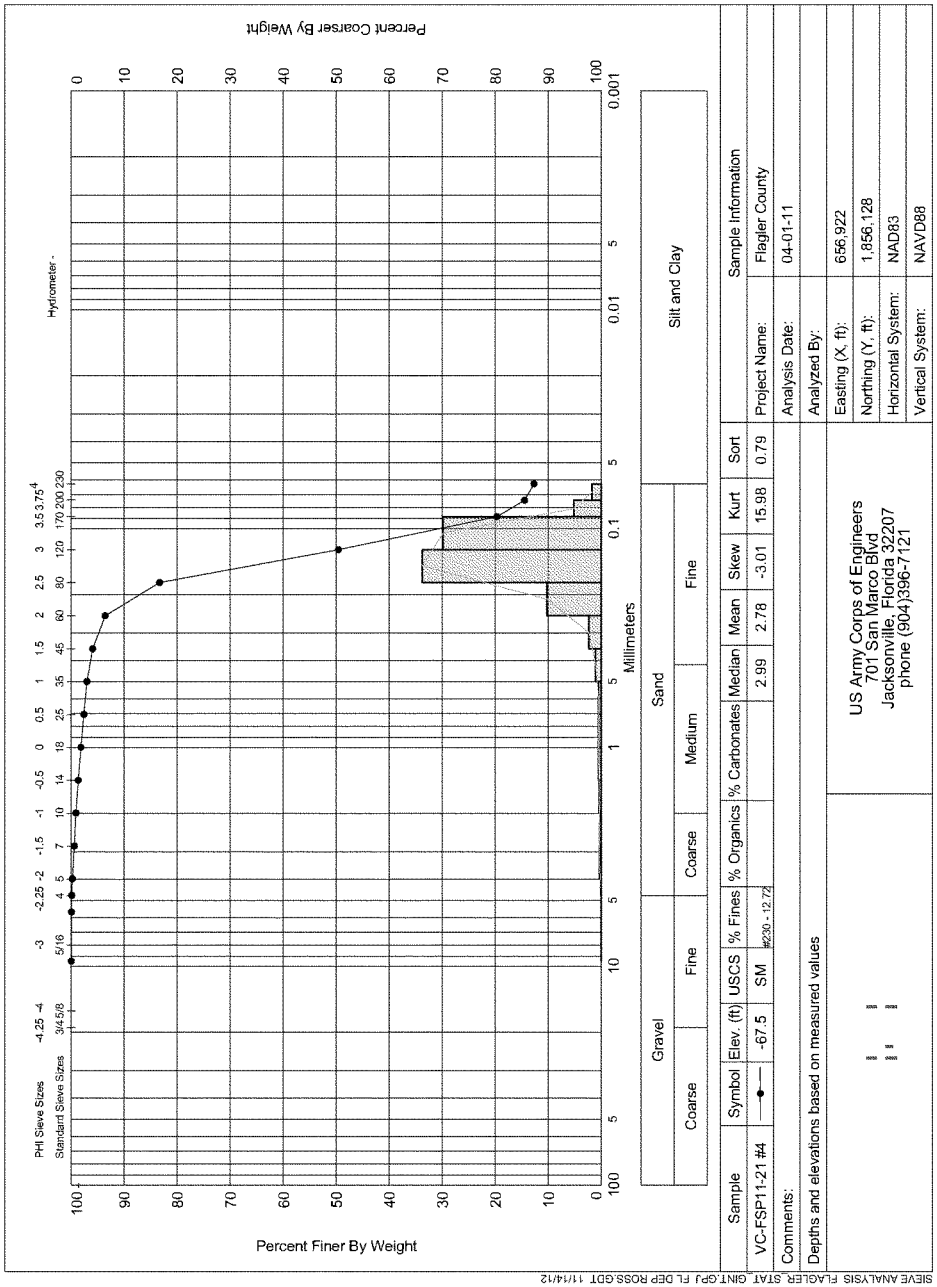
Sample Information	
Project Name:	Flagler County
Analysis Date:	04-01-11
Analyzed By:	
Easting (X, ft):	656,298
Northing (Y, ft):	1,860,715
Horizontal System:	NAD83
Vertical System:	NAVD88

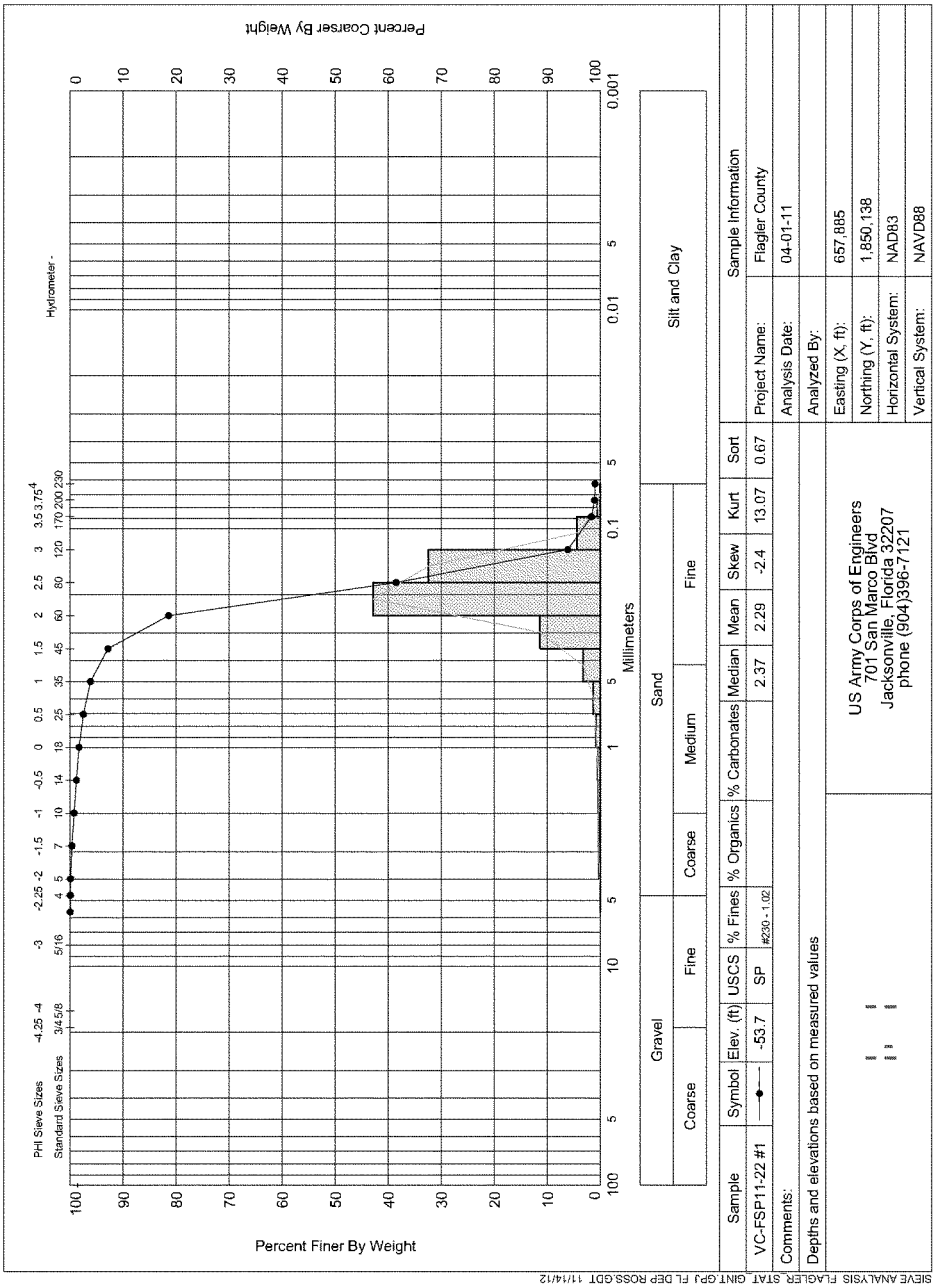

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-20 #3
-69.7
SM
#230 - 31.07
3.25
2.23
-1.64
4.72
1.7
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 656,298
Northing (Y, ft): 1,860,715
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12

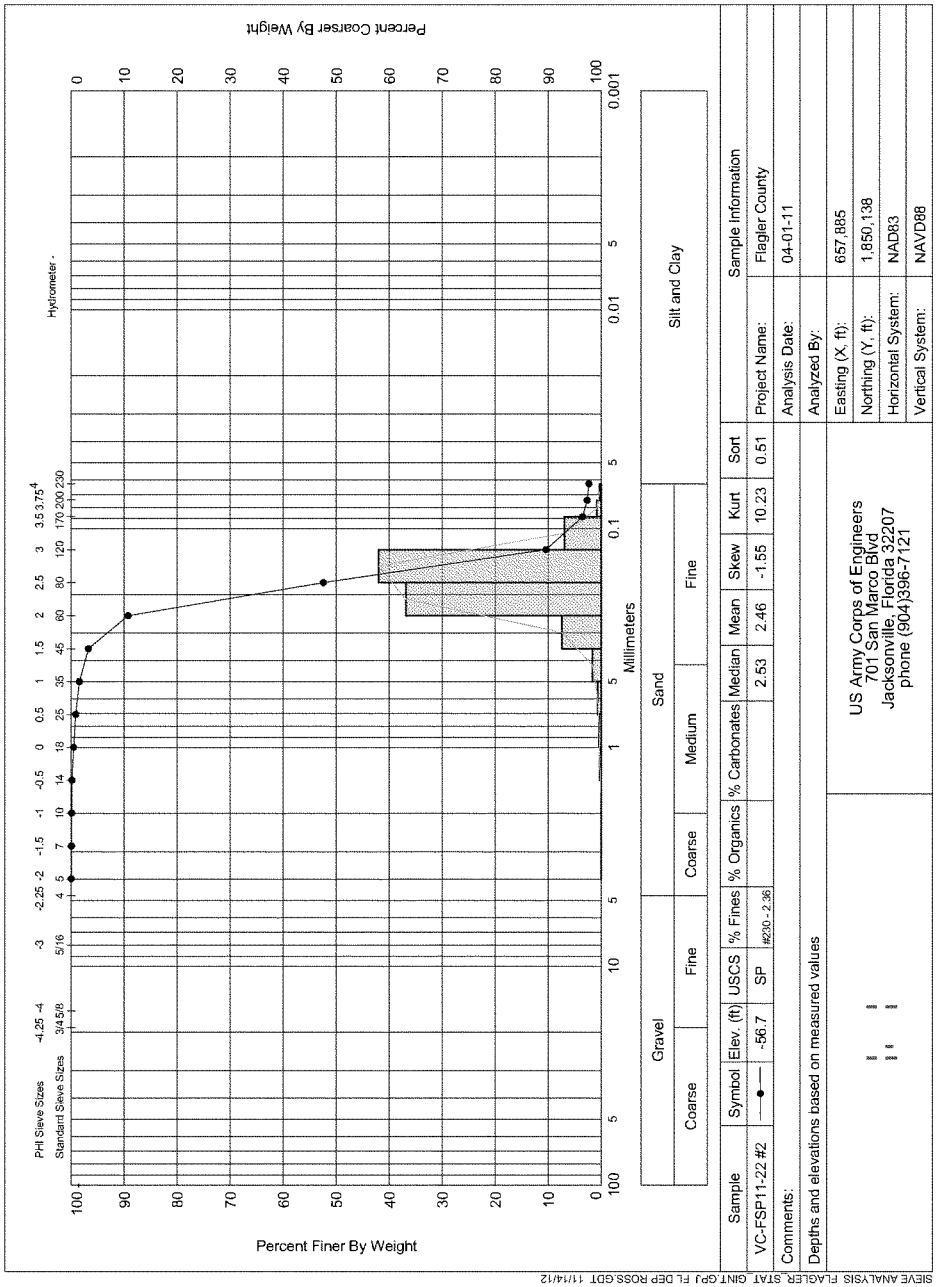

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-21 #1
-60.5
SP
#230 - 1.40
2.55
2.48
-1.82
12.9
0.48
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
656,922
Northing (Y, ft):
1,856,128
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

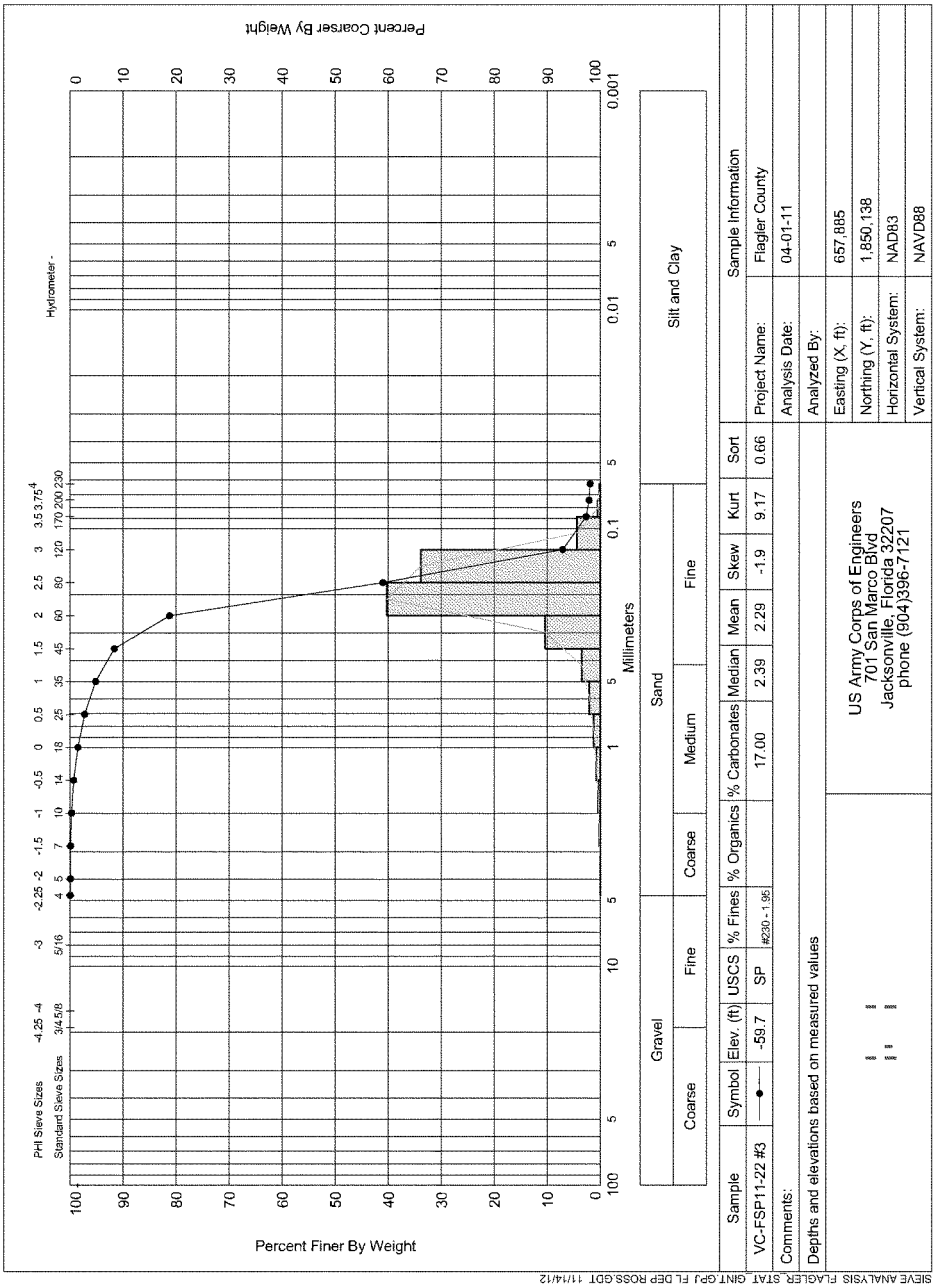

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
VC-FSP11-21 #2
Symbol
Elev. (ft)
-63.5
USCS
SP
% Fines
#230 - 1.88
% Organics
% Carbonates
Median
2.54
Mean
2.39
Skew
-2.35
Kurt
12.14
Sort
0.74
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
656,922
Northing (Y, ft):
1,856,128
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

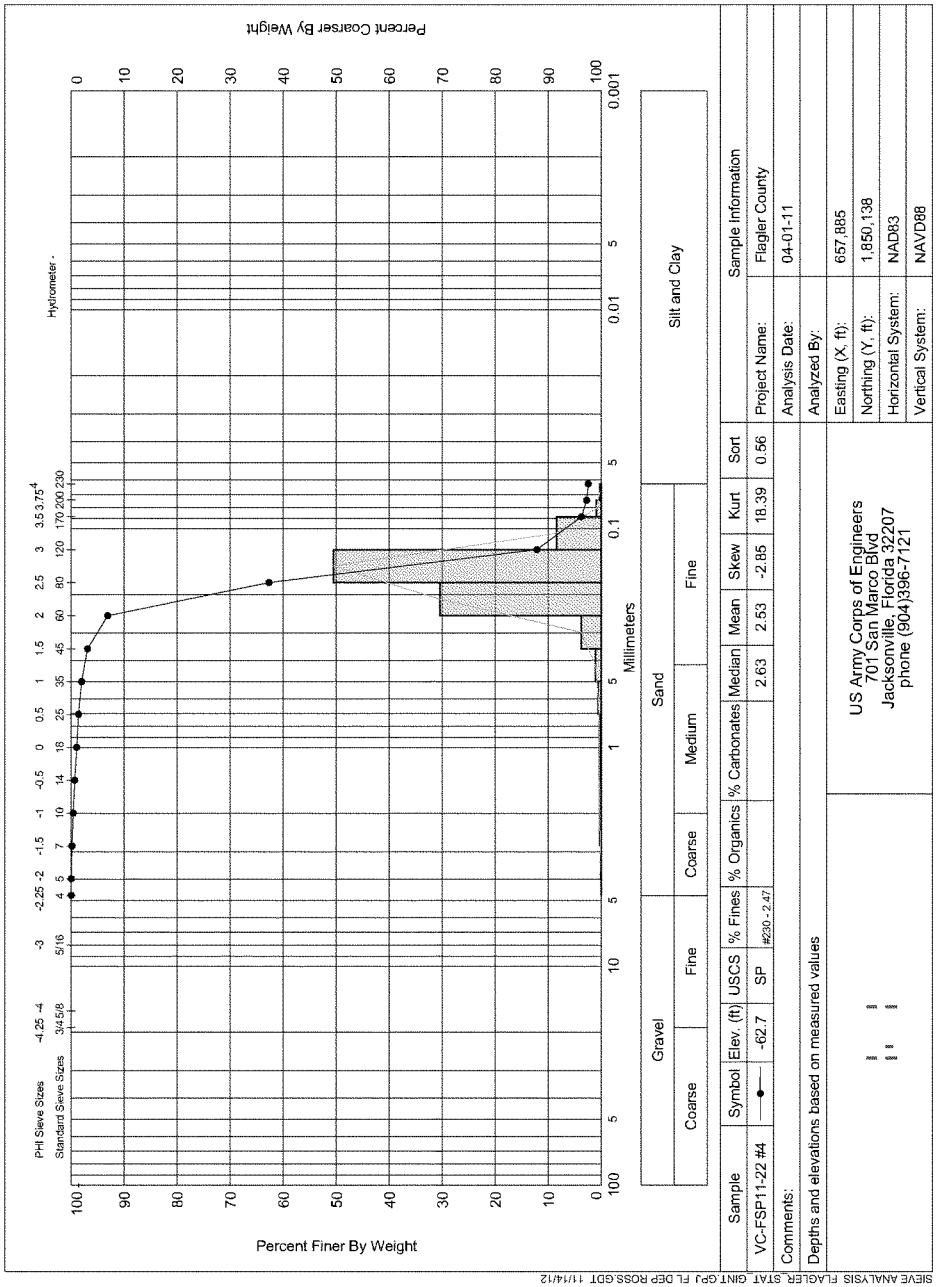

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-21 #3
-65.0
SP-SM
#230 - 7.71
2.68
2.48
-3.23
17.65
0.85
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
656,922
Northing (Y, ft):
1,856,128
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

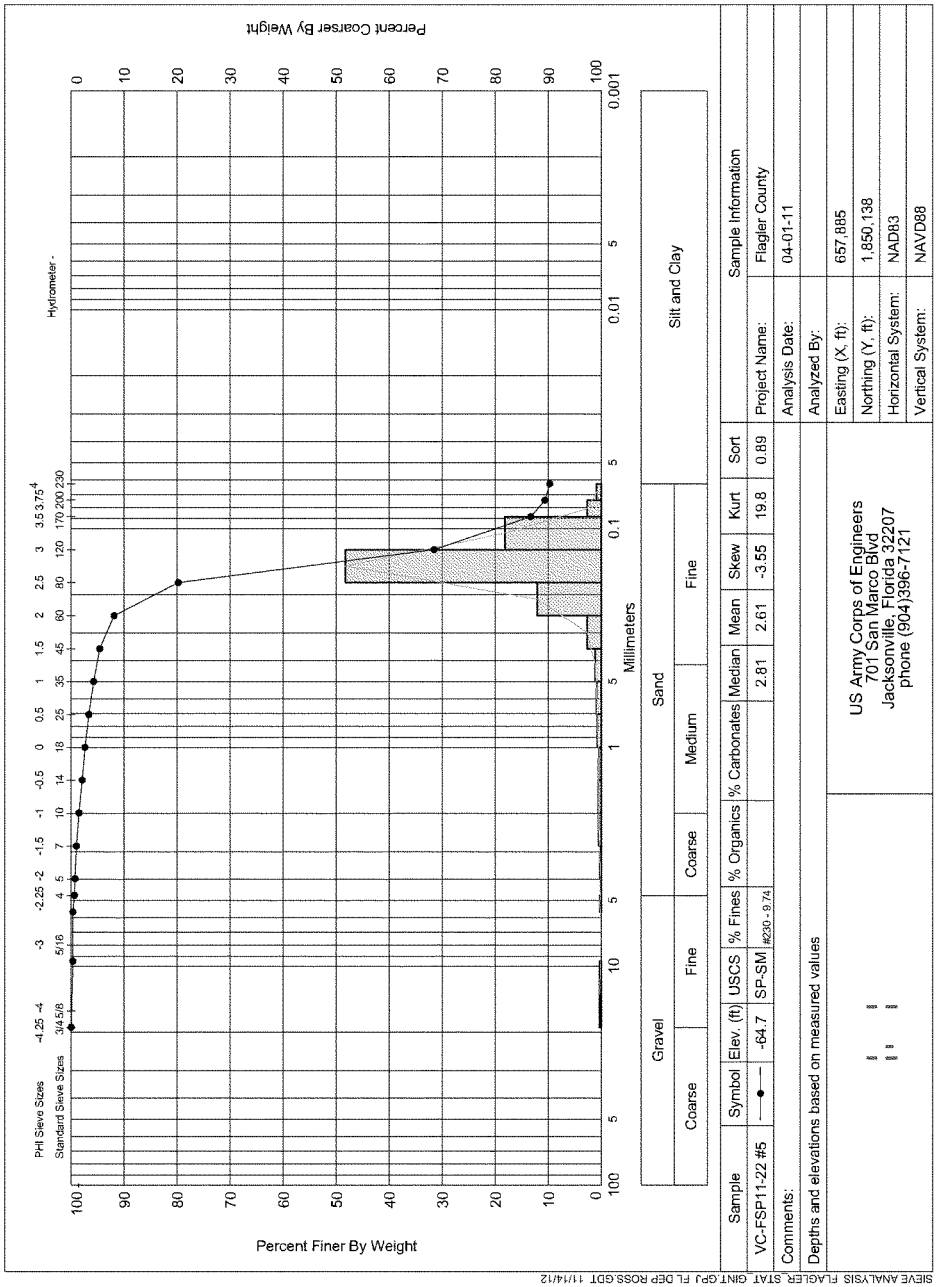

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-21 #4
-67.5
SM
#230 - 12.72
2.99
2.78
-3.01
15.98
0.79
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 04-01-11
Analyzed By:
Easting (X, ft): 656,922
Northing (Y, ft): 1,856,128
Horizontal System: NAD83
Vertical System: NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

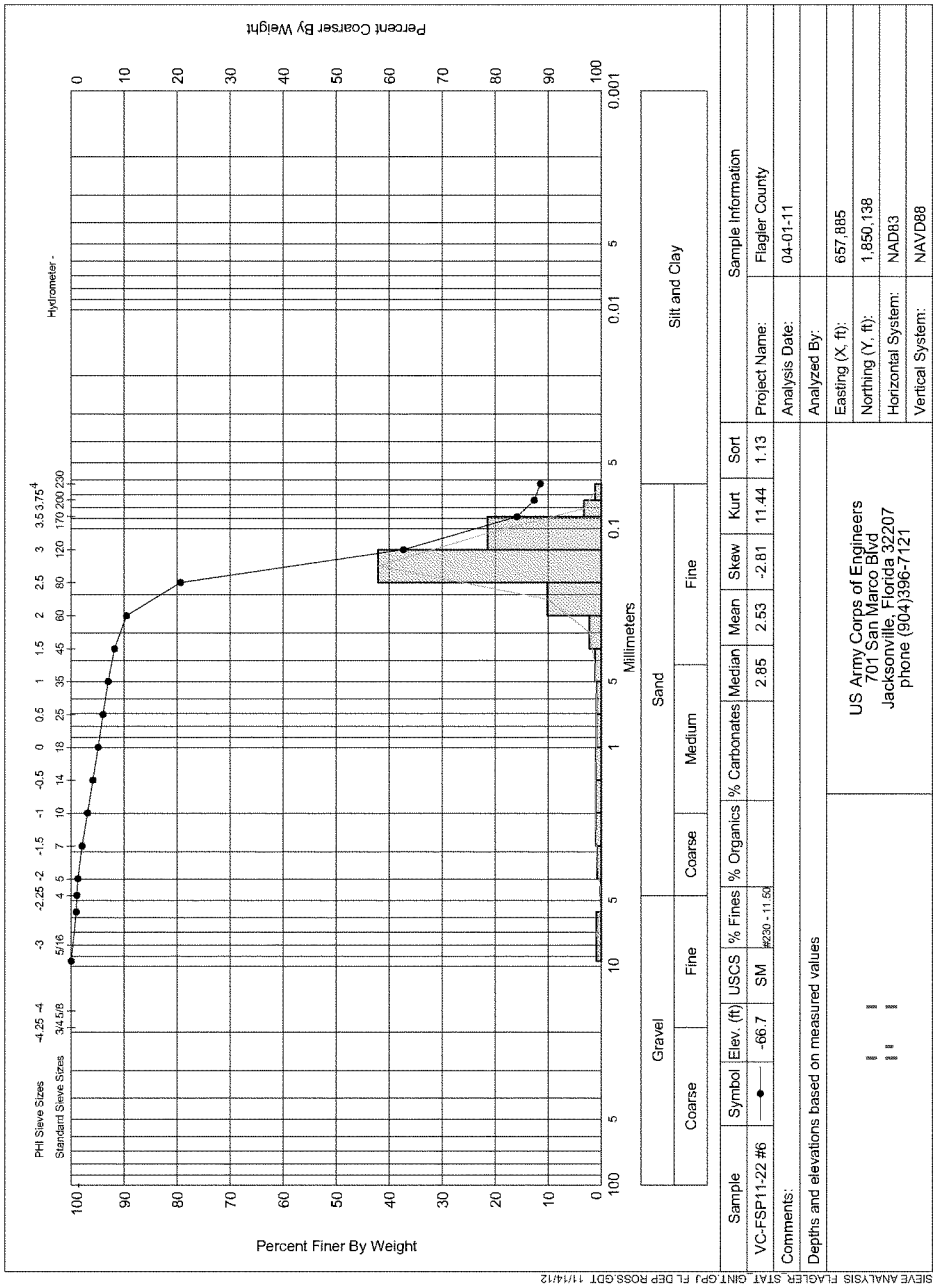

Percent Finer By Weight
Percent Coarser By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-22 #1
-53.7
SP
#230 - 1.02
2.37
2.29
-2.4
13.07
0.67
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
657,885
Northing (Y, ft):
1,850,138
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-22 #2
-56.7
SP
#230 - 2.36
2.53
2.46
-1.55
10.23
0.51
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
657,885
Northing (Y, ft):
1,850,138
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT.GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-22 #3
-59.7
SP
#230 - 1.95
17.00
2.39
2.29
-1.9
9.17
0.66
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
657,885
Northing (Y, ft):
1,850,138
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
VC-FSP11-22 #4
Symbol
Elev. (ft)
-62.7
USCS
SP
% Fines
#230 - 2.47
% Organics
% Carbonates
Median
2.63
Mean
2.53
Skew
-2.85
Kurt
18.39
Sort
0.56
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
657,885
Northing (Y, ft):
1,850,138
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

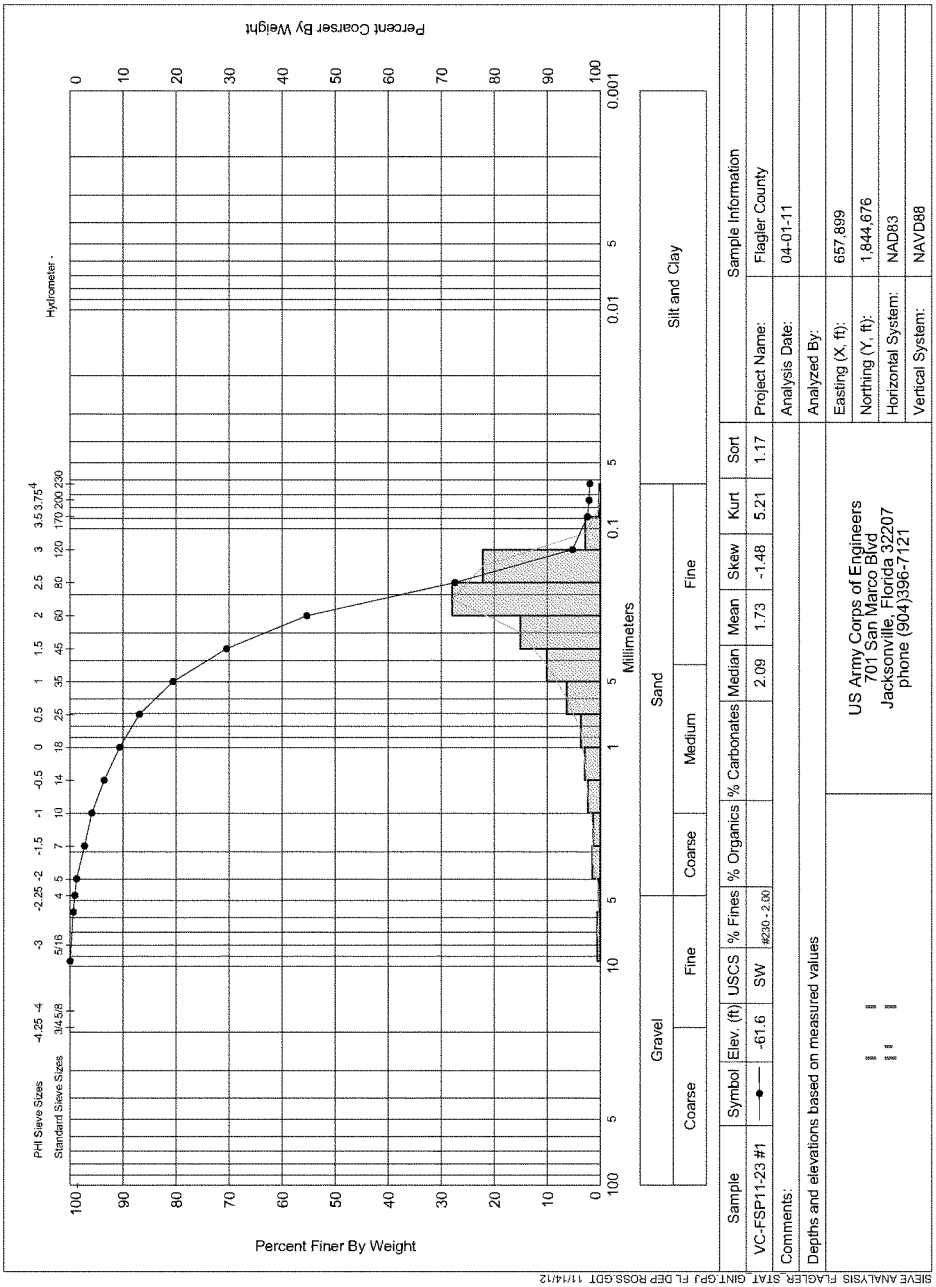

PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer
Percent Finer By Weight
Percent Coarser By Weight
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-22 #5
-64.7
SP-SM
#230 - 9.74
2.81
2.61
-3.55
19.8
0.89
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
657,885
Northing (Y, ft):
1,850,138
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

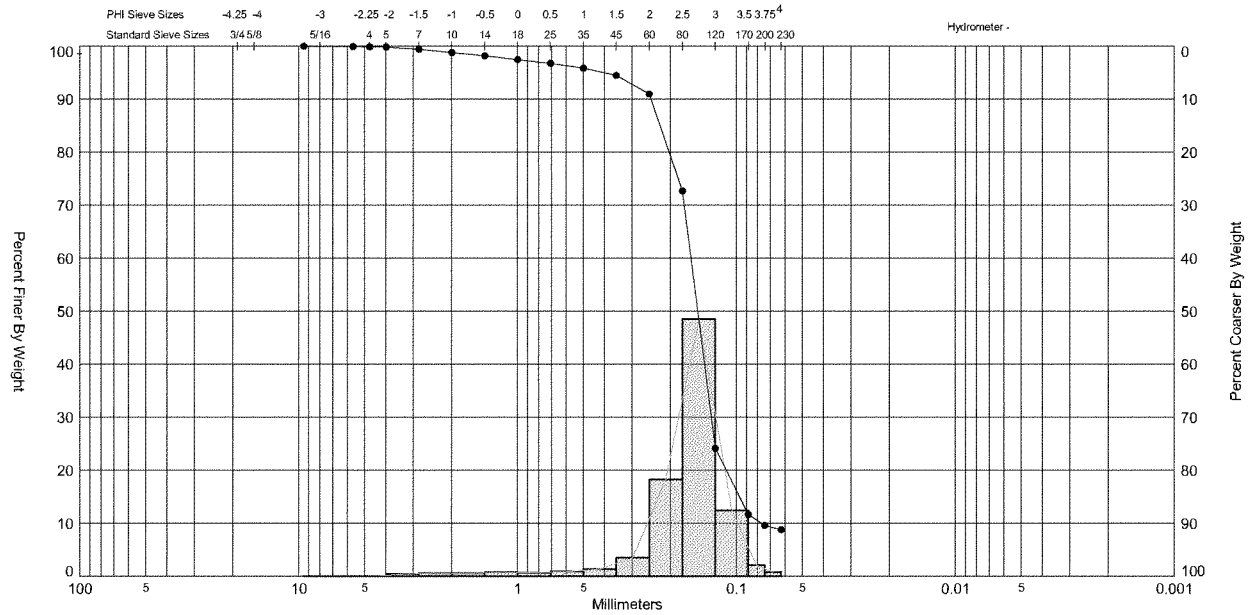


Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
VC-FSP11-22 #6		-66.7	SM	#230 - 11.50			2.85	2.53	-2.81	11.44	1.13

Comments:
Depths and elevations based on measured values

Sample Information	
Project Name:	Flagler County
Analysis Date:	04-01-11
Analyzed By:	
Easting (X, ft):	657,885
Northing (Y, ft):	1,850,138
Horizontal System:	NAD83
Vertical System:	NAVD88


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-23 #1
-61.6
SW
#230 - 2.00
2.09
1.73
-1.48
5.21
1.17
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
657,899
Northing (Y, ft):
1,844,676
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample	Symbol	Elev. (ft)	USCS	% Fines	% Organics	% Carbonates	Median	Mean	Skew	Kurt	Sort
VC-FSP11-23 #2	—●—	-63.1	SP-SM	#230 - 8.81			2.73	2.54	-2.92	14.52	0.8

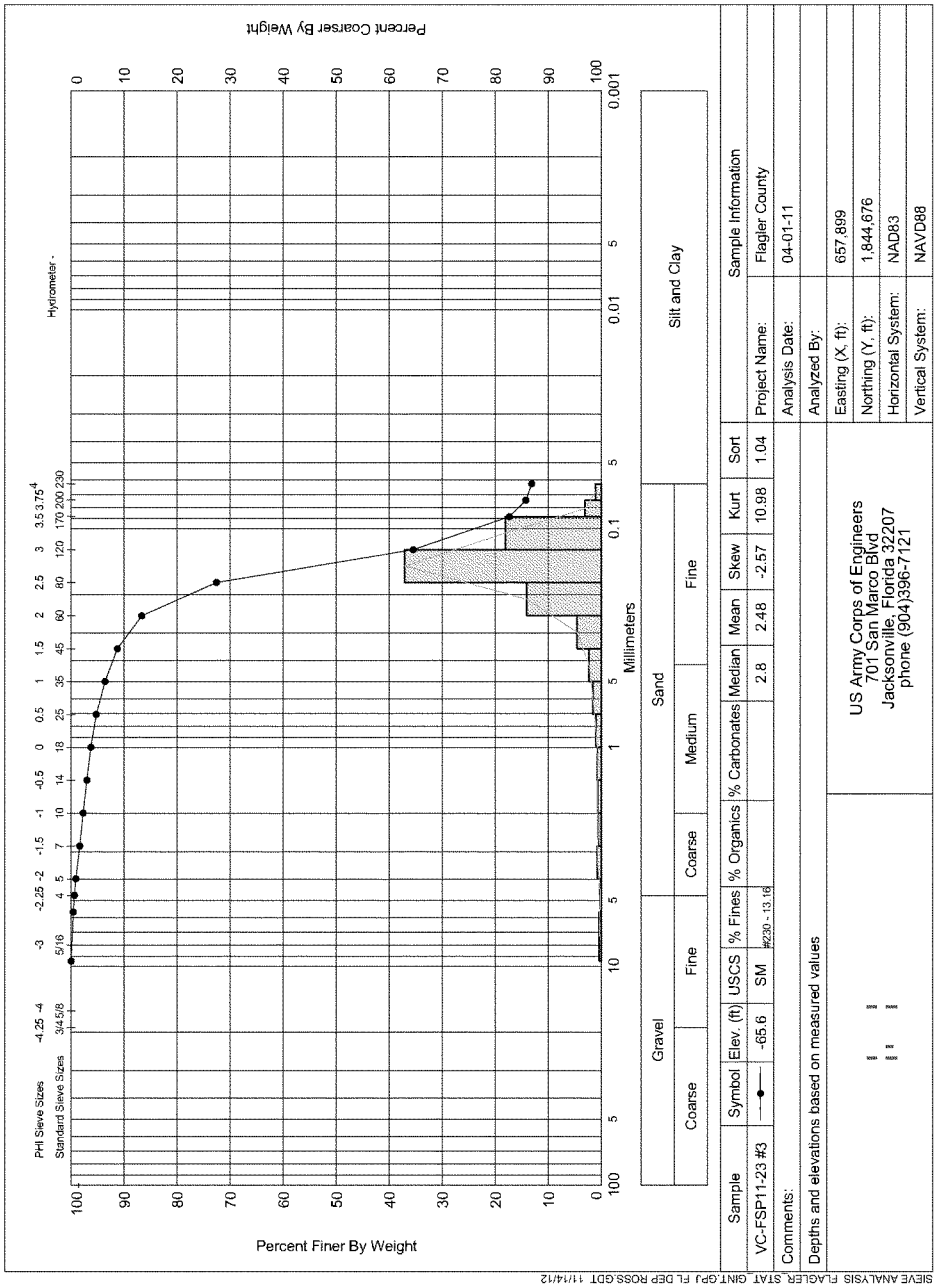
Comments:

Depths and elevations based on measured values

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Sample Information	
Project Name:	Flagler County
Analysis Date:	04-01-11
Analyzed By:	
Easting (X, ft):	657,899
Northing (Y, ft):	1,844,676
Horizontal System:	NAD83
Vertical System:	NAVD88

SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
VC-FSP11-23 #3
-65.6
SM
#230 - 13.16
2.8
2.48
-2.57
10.98
1.04
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
04-01-11
Analyzed By:
Easting (X, ft):
657,899
Northing (Y, ft):
1,844,676
Horizontal System:
NAD83
Vertical System:
NAVD88
SIEVE ANALYSIS FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-1 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
663,001	1,906,822		-64.9 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.78		13.00	11.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.47	0.47
#5	-2.00	3.99	0.05	0.52
#7	-1.50	2.82	0.34	0.86
#10	-1.00	2.00	0.74	1.60
#14	-0.50	1.41	1.02	2.62
#18	0.00	1.00	1.24	3.86
#25	0.50	0.71	1.91	5.77
#35	1.00	0.50	4.43	10.20
#45	1.50	0.35	10.10	20.30
#60	2.00	0.25	18.22	38.52
#80	2.50	0.18	42.50	81.02
#120	3.00	0.13	16.81	97.83
#170	3.50	0.09	1.30	99.13
#200	3.75	0.07	0.06	99.19
#230	4.00	0.06	0.03	99.22

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.92	2.59	2.43	2.13	1.62	1.28	0.30

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.92	0.26	0.84	-2.01	8.7

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-1 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
663,001	1,906,822		-67.9 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.18			18.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.39	0.39
#4	-2.25	4.75	0.08	0.47
#5	-2.00	3.99	0.12	0.59
#7	-1.50	2.82	0.54	1.13
#10	-1.00	2.00	1.51	2.64
#14	-0.50	1.41	2.20	4.84
#18	0.00	1.00	2.95	7.79
#25	0.50	0.71	3.30	11.09
#35	1.00	0.50	4.88	15.97
#45	1.50	0.35	7.89	23.86
#60	2.00	0.25	15.19	39.05
#80	2.50	0.18	36.26	75.31
#120	3.00	0.13	19.11	94.42
#170	3.50	0.09	2.86	97.28
#200	3.75	0.07	0.37	97.65
#230	4.00	0.06	0.17	97.82

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.10	2.73	2.50	2.15	1.53	1.00	-0.47

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.83	0.28	1.05	-1.6	5.81

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-1 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
663,001	1,906,822		-70.4 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 4/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 4.30			12.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.22	0.22
#4	-2.25	4.75	0.13	0.35
#5	-2.00	3.99	0.07	0.42
#7	-1.50	2.82	0.30	0.72
#10	-1.00	2.00	0.61	1.33
#14	-0.50	1.41	0.67	2.00
#18	0.00	1.00	0.72	2.72
#25	0.50	0.71	0.94	3.66
#35	1.00	0.50	1.49	5.15
#45	1.50	0.35	2.90	8.05
#60	2.00	0.25	7.99	16.04
#80	2.50	0.18	34.87	50.91
#120	3.00	0.13	37.12	88.03
#170	3.50	0.09	6.65	94.68
#200	3.75	0.07	0.78	95.46
#230	4.00	0.06	0.24	95.70

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.60	2.95	2.82	2.49	2.13	1.99	0.95

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.32	0.20	0.81	-2.73	13.81

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-1 #4
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
663,001	1,906,822		-72.4 NAVD88

USCS	Munsell:	Comments:
SP-SM	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 5.26			6.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.02	0.02
#10	-1.00	2.00	0.18	0.20
#14	-0.50	1.41	0.35	0.55
#18	0.00	1.00	0.36	0.91
#25	0.50	0.71	0.40	1.31
#35	1.00	0.50	0.46	1.77
#45	1.50	0.35	0.87	2.64
#60	2.00	0.25	4.70	7.34
#80	2.50	0.18	26.86	34.20
#120	3.00	0.13	46.76	80.96
#170	3.50	0.09	11.94	92.90
#200	3.75	0.07	1.40	94.30
#230	4.00	0.06	0.44	94.74

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.13	2.94	2.67	2.33	2.16	1.75

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.57	0.17	0.56	-2.3	14.32

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-1 #5
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
663,001	1,906,822		-77.4 NAVD88

USCS	Munsell:	Comments:
SW-SM	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 6.47			8.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.03	0.03
#5	-2.00	3.99	0.18	0.21
#7	-1.50	2.82	0.48	0.69
#10	-1.00	2.00	0.76	1.45
#14	-0.50	1.41	0.86	2.31
#18	0.00	1.00	0.83	3.14
#25	0.50	0.71	0.78	3.92
#35	1.00	0.50	0.94	4.86
#45	1.50	0.35	1.35	6.21
#60	2.00	0.25	3.73	9.94
#80	2.50	0.18	16.81	26.75
#120	3.00	0.13	45.41	72.16
#170	3.50	0.09	18.39	90.55
#200	3.75	0.07	2.36	92.91
#230	4.00	0.06	0.62	93.53

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.32	3.08	2.76	2.45	2.18	1.05

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.56	0.17	0.86	-2.77	12.62

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-2 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
666,592	1,911,063		-63.8 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.85			30.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.79	0.79
#3.5	-2.50	5.66	3.41	4.20
#4	-2.25	4.75	0.69	4.89
#5	-2.00	3.99	1.08	5.97
#7	-1.50	2.82	1.87	7.84
#10	-1.00	2.00	3.01	10.85
#14	-0.50	1.41	3.30	14.15
#18	0.00	1.00	3.80	17.95
#25	0.50	0.71	4.85	22.80
#35	1.00	0.50	7.32	30.12
#45	1.50	0.35	10.88	41.00
#60	2.00	0.25	17.55	58.55
#80	2.50	0.18	28.14	86.69
#120	3.00	0.13	11.31	98.00
#170	3.50	0.09	1.04	99.04
#200	3.75	0.07	0.09	99.13
#230	4.00	0.06	0.02	99.15

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.87	2.45	2.29	1.75	0.65	-0.26	-2.22

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.23	0.43	1.51	-1.36	4.19

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report
Depths and elevations based on measured values

Project Name: Flagler County	US Army Corps of Engineers 701 San Marco Blvd Jacksonville, Florida 32207 phone (904)396-7121
Sample Name: VC-FSP11-2 #2	
Analysis Date: 04-01-11	
Analyzed By:	

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
666,592	1,911,063		-66.3 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 4.60			6.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.51	0.51
#4	-2.25	4.75	0.15	0.66
#5	-2.00	3.99	0.18	0.84
#7	-1.50	2.82	0.69	1.53
#10	-1.00	2.00	0.47	2.00
#14	-0.50	1.41	0.56	2.56
#18	0.00	1.00	0.45	3.01
#25	0.50	0.71	0.60	3.61
#35	1.00	0.50	0.78	4.39
#45	1.50	0.35	1.60	5.99
#60	2.00	0.25	6.96	12.95
#80	2.50	0.18	36.23	49.18
#120	3.00	0.13	25.05	74.23
#170	3.50	0.09	14.40	88.63
#200	3.75	0.07	5.80	94.43
#230	4.00	0.06	0.97	95.40

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.90	3.34	3.03	2.52	2.16	2.04	1.19

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.43	0.19	0.93	-2.64	13.64

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-3 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
668,362	1,903,690		-57.8 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.24			22.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.67	0.67
#3.5	-2.50	5.66	0.43	1.10
#4	-2.25	4.75	0.12	1.22
#5	-2.00	3.99	0.19	1.41
#7	-1.50	2.82	0.84	2.25
#10	-1.00	2.00	1.75	4.00
#14	-0.50	1.41	2.96	6.96
#18	0.00	1.00	3.19	10.15
#25	0.50	0.71	3.49	13.64
#35	1.00	0.50	5.31	18.95
#45	1.50	0.35	8.47	27.42
#60	2.00	0.25	20.10	47.52
#80	2.50	0.18	38.40	85.92
#120	3.00	0.13	11.81	97.73
#170	3.50	0.09	0.89	98.62
#200	3.75	0.07	0.06	98.68
#230	4.00	0.06	0.08	98.76

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.88	2.47	2.36	2.03	1.35	0.72	-0.83

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.64	0.32	1.15	-1.9	7.22

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-3 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
668,362	1,903,690		-60.8 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 6/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 0.90			14.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.24	0.24
#7	-1.50	2.82	0.26	0.50
#10	-1.00	2.00	0.82	1.32
#14	-0.50	1.41	1.15	2.47
#18	0.00	1.00	1.32	3.79
#25	0.50	0.71	1.70	5.49
#35	1.00	0.50	3.01	8.50
#45	1.50	0.35	6.08	14.58
#60	2.00	0.25	17.52	32.10
#80	2.50	0.18	46.93	79.03
#120	3.00	0.13	18.21	97.24
#170	3.50	0.09	1.65	98.89
#200	3.75	0.07	0.14	99.03
#230	4.00	0.06	0.07	99.10

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.94	2.64	2.46	2.19	1.79	1.54	0.36

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.01	0.25	0.79	-2.11	8.95

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-3 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
668,362	1,903,690		-63.8 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 6/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 0.96		18.00	14.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.53	0.53
#4	-2.25	4.75	0.29	0.82
#5	-2.00	3.99	0.23	1.05
#7	-1.50	2.82	0.83	1.88
#10	-1.00	2.00	1.08	2.96
#14	-0.50	1.41	1.43	4.39
#18	0.00	1.00	1.39	5.78
#25	0.50	0.71	1.87	7.65
#35	1.00	0.50	4.71	12.36
#45	1.50	0.35	9.41	21.77
#60	2.00	0.25	20.05	41.82
#80	2.50	0.18	41.44	83.26
#120	3.00	0.13	14.19	97.45
#170	3.50	0.09	1.42	98.87
#200	3.75	0.07	0.11	98.98
#230	4.00	0.06	0.06	99.04

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.91	2.53	2.40	2.10	1.58	1.19	-0.28

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.83	0.28	0.97	-2.14	8.77

USACE GRANULARMETRIC REPORT_FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-3 #4
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
668,362	1,903,690		-66.8 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.11			7.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.33	0.33
#4	-2.25	4.75	0.16	0.49
#5	-2.00	3.99	0.00	0.49
#7	-1.50	2.82	0.23	0.72
#10	-1.00	2.00	0.48	1.20
#14	-0.50	1.41	0.58	1.78
#18	0.00	1.00	0.66	2.44
#25	0.50	0.71	0.70	3.14
#35	1.00	0.50	1.32	4.46
#45	1.50	0.35	3.93	8.39
#60	2.00	0.25	11.51	19.90
#80	2.50	0.18	42.92	62.82
#120	3.00	0.13	30.79	93.61
#170	3.50	0.09	3.81	97.42
#200	3.75	0.07	0.36	97.78
#230	4.00	0.06	0.11	97.89

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.18	2.84	2.70	2.35	2.06	1.83	1.07

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.23	0.21	0.76	-2.94	16.35

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-3 #5
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
668,362	1,903,690		-69.8 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 3.12			7.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.34	0.34
#5	-2.00	3.99	0.31	0.65
#7	-1.50	2.82	0.21	0.86
#10	-1.00	2.00	0.38	1.24
#14	-0.50	1.41	0.37	1.61
#18	0.00	1.00	0.37	1.98
#25	0.50	0.71	0.44	2.42
#35	1.00	0.50	0.66	3.08
#45	1.50	0.35	2.32	5.40
#60	2.00	0.25	9.06	14.46
#80	2.50	0.18	37.34	51.80
#120	3.00	0.13	37.86	89.66
#170	3.50	0.09	6.33	95.99
#200	3.75	0.07	0.74	96.73
#230	4.00	0.06	0.15	96.88

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.42	2.93	2.81	2.48	2.14	2.02	1.41

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.36	0.19	0.73	-3.16	18.38

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-4 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
673,572	1,906,128		-61.0 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.08			27.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.45	0.45
#4	-2.25	4.75	0.10	0.55
#5	-2.00	3.99	0.31	0.86
#7	-1.50	2.82	1.46	2.32
#10	-1.00	2.00	2.34	4.66
#14	-0.50	1.41	3.36	8.02
#18	0.00	1.00	3.80	11.82
#25	0.50	0.71	4.64	16.46
#35	1.00	0.50	8.54	25.00
#45	1.50	0.35	16.62	41.62
#60	2.00	0.25	25.54	67.16
#80	2.50	0.18	25.25	92.41
#120	3.00	0.13	5.91	98.32
#170	3.50	0.09	0.54	98.86
#200	3.75	0.07	0.05	98.91
#230	4.00	0.06	0.01	98.92

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.72	2.33	2.15	1.66	1.00	0.45	-0.95

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.38	0.38	1.08	-1.31	4.64

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-4 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
673,572	1,906,128		-64.0 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10GY 5/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 10.36		40.00	25.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	4.49	4.49
#3.5	-2.50	5.66	2.64	7.13
#4	-2.25	4.75	0.87	8.00
#5	-2.00	3.99	0.82	8.82
#7	-1.50	2.82	2.13	10.95
#10	-1.00	2.00	2.39	13.34
#14	-0.50	1.41	2.74	16.08
#18	0.00	1.00	2.61	18.69
#25	0.50	0.71	3.15	21.84
#35	1.00	0.50	5.34	27.18
#45	1.50	0.35	9.16	36.34
#60	2.00	0.25	15.02	51.36
#80	2.50	0.18	25.39	76.75
#120	3.00	0.13	11.18	87.93
#170	3.50	0.09	1.37	89.30
#200	3.75	0.07	0.21	89.51
#230	4.00	0.06	0.13	89.64

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	2.82	2.47	1.95	0.79	-0.51	-3.10

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.1	0.47	1.44	-0.83	3.35

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-4 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
673,572	1,906,128		-67.0 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.44			7.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.75	0.75
#3.5	-2.50	5.66	1.09	1.84
#4	-2.25	4.75	0.08	1.92
#5	-2.00	3.99	0.18	2.10
#7	-1.50	2.82	0.48	2.58
#10	-1.00	2.00	0.54	3.12
#14	-0.50	1.41	0.45	3.57
#18	0.00	1.00	0.45	4.02
#25	0.50	0.71	0.60	4.62
#35	1.00	0.50	1.26	5.88
#45	1.50	0.35	3.20	9.08
#60	2.00	0.25	13.32	22.40
#80	2.50	0.18	47.72	70.12
#120	3.00	0.13	26.47	96.59
#170	3.50	0.09	1.78	98.37
#200	3.75	0.07	0.11	98.48
#230	4.00	0.06	0.08	98.56

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.97	2.76	2.59	2.29	2.02	1.76	0.65

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.09	0.23	1.01	-3.62	18.31

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-5 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
672,891	1,900,724		-60.7 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.90		23.00	19.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	1.21	1.21
#4	-2.25	4.75	0.37	1.58
#5	-2.00	3.99	0.14	1.72
#7	-1.50	2.82	0.90	2.62
#10	-1.00	2.00	1.34	3.96
#14	-0.50	1.41	2.29	6.25
#18	0.00	1.00	2.38	8.63
#25	0.50	0.71	2.78	11.41
#35	1.00	0.50	5.06	16.47
#45	1.50	0.35	9.22	25.69
#60	2.00	0.25	18.69	44.38
#80	2.50	0.18	37.94	82.32
#120	3.00	0.13	14.37	96.69
#170	3.50	0.09	1.25	97.94
#200	3.75	0.07	0.10	98.04
#230	4.00	0.06	0.06	98.10

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.94	2.56	2.40	2.07	1.46	0.95	-0.77

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.71	0.31	1.11	-1.91	7.04

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-5 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
672,891	1,900,724		-63.7 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.66			17.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.16	0.16
#4	-2.25	4.75	0.03	0.19
#5	-2.00	3.99	0.12	0.31
#7	-1.50	2.82	0.64	0.95
#10	-1.00	2.00	1.14	2.09
#14	-0.50	1.41	1.46	3.55
#18	0.00	1.00	1.61	5.16
#25	0.50	0.71	2.17	7.33
#35	1.00	0.50	4.37	11.70
#45	1.50	0.35	9.13	20.83
#60	2.00	0.25	19.21	40.04
#80	2.50	0.18	38.26	78.30
#120	3.00	0.13	19.46	97.76
#170	3.50	0.09	1.43	99.19
#200	3.75	0.07	0.13	99.32
#230	4.00	0.06	0.02	99.34

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.93	2.65	2.46	2.13	1.60	1.23	-0.05

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.9	0.27	0.91	-1.87	7.45

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-5 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
672,891	1,900,724		-66.2 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.49			8.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.17	0.17
#5	-2.00	3.99	0.04	0.21
#7	-1.50	2.82	0.05	0.26
#10	-1.00	2.00	0.17	0.43
#14	-0.50	1.41	0.39	0.82
#18	0.00	1.00	0.48	1.30
#25	0.50	0.71	0.69	1.99
#35	1.00	0.50	2.08	4.07
#45	1.50	0.35	6.65	10.72
#60	2.00	0.25	15.48	26.20
#80	2.50	0.18	42.99	69.19
#120	3.00	0.13	26.07	95.26
#170	3.50	0.09	2.72	97.98
#200	3.75	0.07	0.41	98.39
#230	4.00	0.06	0.12	98.51

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.00	2.78	2.61	2.28	1.96	1.67	1.07

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.18	0.22	0.65	-1.98	11.37

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-6 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
678,009	1,898,131		-62.7 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.54			14.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.43	0.43
#4	-2.25	4.75	0.13	0.56
#5	-2.00	3.99	0.07	0.63
#7	-1.50	2.82	0.46	1.09
#10	-1.00	2.00	1.19	2.28
#14	-0.50	1.41	1.59	3.87
#18	0.00	1.00	1.81	5.68
#25	0.50	0.71	3.15	8.83
#35	1.00	0.50	6.56	15.39
#45	1.50	0.35	13.61	29.00
#60	2.00	0.25	23.18	52.18
#80	2.50	0.18	36.03	88.21
#120	3.00	0.13	10.17	98.38
#170	3.50	0.09	1.03	99.41
#200	3.75	0.07	0.04	99.45
#230	4.00	0.06	0.01	99.46

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.83	2.44	2.32	1.95	1.35	1.02	-0.19

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.71	0.31	0.92	-1.76	7.3

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-6 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
678,009	1,898,131		-65.7 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.22			18.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.72	0.72
#3.5	-2.50	5.66	1.47	2.19
#4	-2.25	4.75	0.67	2.86
#5	-2.00	3.99	0.32	3.18
#7	-1.50	2.82	1.09	4.27
#10	-1.00	2.00	1.67	5.94
#14	-0.50	1.41	1.63	7.57
#18	0.00	1.00	1.71	9.28
#25	0.50	0.71	1.75	11.03
#35	1.00	0.50	3.38	14.41
#45	1.50	0.35	8.59	23.00
#60	2.00	0.25	14.18	37.18
#80	2.50	0.18	33.68	70.86
#120	3.00	0.13	23.95	94.81
#170	3.50	0.09	2.57	97.38
#200	3.75	0.07	0.29	97.67
#230	4.00	0.06	0.11	97.78

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.04	2.77	2.59	2.19	1.57	1.09	-1.28

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.79	0.29	1.29	-2.13	7.71

USACE_GRANULARMETRIC_REPORT_FLAGLER_STAT_GINT.GPJ FL_DEP_ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-6 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
678,009	1,898,131		-68.5 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.21		26.00	24.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.18	0.18
#5	-2.00	3.99	0.15	0.33
#7	-1.50	2.82	0.94	1.27
#10	-1.00	2.00	1.79	3.06
#14	-0.50	1.41	2.61	5.67
#18	0.00	1.00	2.66	8.33
#25	0.50	0.71	2.78	11.11
#35	1.00	0.50	5.11	16.22
#45	1.50	0.35	10.97	27.19
#60	2.00	0.25	19.50	46.69
#80	2.50	0.18	38.06	84.75
#120	3.00	0.13	12.73	97.48
#170	3.50	0.09	1.19	98.67
#200	3.75	0.07	0.10	98.77
#230	4.00	0.06	0.02	98.79

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.90	2.49	2.37	2.04	1.40	0.98	-0.63

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.72	0.30	1	-1.57	5.41

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-7 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
678,829	1,893,078		-55.6 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.45			14.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.05	0.05
#4	-2.25	4.75	0.16	0.21
#5	-2.00	3.99	0.20	0.41
#7	-1.50	2.82	0.34	0.75
#10	-1.00	2.00	0.96	1.71
#14	-0.50	1.41	1.43	3.14
#18	0.00	1.00	1.77	4.91
#25	0.50	0.71	2.12	7.03
#35	1.00	0.50	4.70	11.73
#45	1.50	0.35	12.84	24.57
#60	2.00	0.25	29.06	53.63
#80	2.50	0.18	37.34	90.97
#120	3.00	0.13	7.90	98.87
#170	3.50	0.09	0.60	99.47
#200	3.75	0.07	0.07	99.54
#230	4.00	0.06	0.01	99.55

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.76	2.41	2.28	1.93	1.50	1.16	0.02

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.75	0.30	0.82	-1.88	7.91

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-7 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
678,829	1,893,078		-58.6 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.87		25.00	20.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.23	0.23
#5	-2.00	3.99	0.21	0.44
#7	-1.50	2.82	0.67	1.11
#10	-1.00	2.00	1.41	2.52
#14	-0.50	1.41	2.59	5.11
#18	0.00	1.00	2.90	8.01
#25	0.50	0.71	2.95	10.96
#35	1.00	0.50	4.18	15.14
#45	1.50	0.35	10.14	25.28
#60	2.00	0.25	23.75	49.03
#80	2.50	0.18	37.79	86.82
#120	3.00	0.13	9.75	96.57
#170	3.50	0.09	1.19	97.76
#200	3.75	0.07	0.21	97.97
#230	4.00	0.06	0.16	98.13

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.92	2.46	2.34	2.01	1.48	1.04	-0.52

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.72	0.30	0.97	-1.6	5.75

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-7 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
678,829	1,893,078		-61.6 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.71			10.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.11	0.11
#4	-2.25	4.75	0.00	0.11
#5	-2.00	3.99	0.05	0.16
#7	-1.50	2.82	0.24	0.40
#10	-1.00	2.00	0.42	0.82
#14	-0.50	1.41	0.67	1.49
#18	0.00	1.00	0.94	2.43
#25	0.50	0.71	1.65	4.08
#35	1.00	0.50	5.68	9.76
#45	1.50	0.35	11.75	21.51
#60	2.00	0.25	19.73	41.24
#80	2.50	0.18	39.97	81.21
#120	3.00	0.13	14.89	96.10
#170	3.50	0.09	1.82	97.92
#200	3.75	0.07	0.29	98.21
#230	4.00	0.06	0.08	98.29

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.96	2.59	2.42	2.11	1.58	1.26	0.58

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.93	0.26	0.76	-1.58	7.73

USACE GRANULARMETRIC REPORT_FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-8 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
684,228	1,895,572		-62.8 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.85			10.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.12	0.12
#5	-2.00	3.99	0.02	0.14
#7	-1.50	2.82	0.26	0.40
#10	-1.00	2.00	0.45	0.85
#14	-0.50	1.41	0.62	1.47
#18	0.00	1.00	0.85	2.32
#25	0.50	0.71	1.14	3.46
#35	1.00	0.50	2.30	5.76
#45	1.50	0.35	6.42	12.18
#60	2.00	0.25	18.05	30.23
#80	2.50	0.18	49.75	79.98
#120	3.00	0.13	17.68	97.66
#170	3.50	0.09	1.42	99.08
#200	3.75	0.07	0.05	99.13
#230	4.00	0.06	0.02	99.15

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.92	2.61	2.45	2.20	1.85	1.60	0.83

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.07	0.24	0.69	-2.32	11.49

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-8 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
684,228	1,895,572		-65.8 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 1.46		24.00	19.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	1.79	1.79
#3.5	-2.50	5.66	1.72	3.51
#4	-2.25	4.75	0.63	4.14
#5	-2.00	3.99	0.20	4.34
#7	-1.50	2.82	1.01	5.35
#10	-1.00	2.00	1.15	6.50
#14	-0.50	1.41	1.65	8.15
#18	0.00	1.00	1.45	9.60
#25	0.50	0.71	2.11	11.71
#35	1.00	0.50	5.81	17.52
#45	1.50	0.35	11.62	29.14
#60	2.00	0.25	18.58	47.72
#80	2.50	0.18	34.63	82.35
#120	3.00	0.13	14.57	96.92
#170	3.50	0.09	1.36	98.28
#200	3.75	0.07	0.18	98.46
#230	4.00	0.06	0.08	98.54

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.93	2.56	2.39	2.03	1.32	0.87	-1.67

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.59	0.33	1.36	-2.18	7.93

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-8 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
684,228	1,895,572		-68.8 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.49			9.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	1.30	1.30
#4	-2.25	4.75	0.00	1.30
#5	-2.00	3.99	0.14	1.44
#7	-1.50	2.82	0.46	1.90
#10	-1.00	2.00	0.71	2.61
#14	-0.50	1.41	1.02	3.63
#18	0.00	1.00	0.93	4.56
#25	0.50	0.71	0.86	5.42
#35	1.00	0.50	1.46	6.88
#45	1.50	0.35	3.66	10.54
#60	2.00	0.25	11.28	21.82
#80	2.50	0.18	39.09	60.91
#120	3.00	0.13	32.71	93.62
#170	3.50	0.09	3.20	96.82
#200	3.75	0.07	0.50	97.32
#230	4.00	0.06	0.19	97.51

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.22	2.85	2.72	2.36	2.04	1.74	0.26

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.15	0.23	0.98	-2.95	13.66

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-9 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
682,407	1,889,245		-62.9 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.86		22.00	20.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.79	0.79
#4	-2.25	4.75	0.56	1.35
#5	-2.00	3.99	0.20	1.55
#7	-1.50	2.82	1.70	3.25
#10	-1.00	2.00	2.21	5.46
#14	-0.50	1.41	2.52	7.98
#18	0.00	1.00	2.66	10.64
#25	0.50	0.71	4.79	15.43
#35	1.00	0.50	11.03	26.46
#45	1.50	0.35	17.50	43.96
#60	2.00	0.25	21.82	65.78
#80	2.50	0.18	26.03	91.81
#120	3.00	0.13	6.73	98.54
#170	3.50	0.09	0.56	99.10
#200	3.75	0.07	0.02	99.12
#230	4.00	0.06	0.02	99.14

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.74	2.35	2.17	1.63	0.93	0.53	-1.10

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.37	0.39	1.11	-1.41	5.15

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report
Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-9 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
682,407	1,889,245		-65.9 NAVD88

USCS	Munsell:	Comments:
SP-SM	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 8.74			3.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.14	0.14
#4	-2.25	4.75	0.00	0.14
#5	-2.00	3.99	0.00	0.14
#7	-1.50	2.82	0.09	0.23
#10	-1.00	2.00	0.17	0.40
#14	-0.50	1.41	0.29	0.69
#18	0.00	1.00	0.44	1.13
#25	0.50	0.71	0.67	1.80
#35	1.00	0.50	2.00	3.80
#45	1.50	0.35	5.50	9.30
#60	2.00	0.25	15.52	24.82
#80	2.50	0.18	43.93	68.75
#120	3.00	0.13	19.47	88.22
#170	3.50	0.09	2.65	90.87
#200	3.75	0.07	0.28	91.15
#230	4.00	0.06	0.11	91.26

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	2.89	2.66	2.28	2.00	1.71	1.11

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.16	0.22	0.63	-2.13	13.38

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-9 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
682,407	1,889,245		-68.9 NAVD88

USCS	Munsell:	Comments:
SW-SM	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 6.53			16.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	2.08	2.08
#4	-2.25	4.75	0.41	2.49
#5	-2.00	3.99	0.69	3.18
#7	-1.50	2.82	1.63	4.81
#10	-1.00	2.00	1.87	6.68
#14	-0.50	1.41	1.89	8.57
#18	0.00	1.00	1.80	10.37
#25	0.50	0.71	2.77	13.14
#35	1.00	0.50	6.75	19.89
#45	1.50	0.35	11.57	31.46
#60	2.00	0.25	16.38	47.84
#80	2.50	0.18	28.58	76.42
#120	3.00	0.13	14.99	91.41
#170	3.50	0.09	1.68	93.09
#200	3.75	0.07	0.24	93.33
#230	4.00	0.06	0.14	93.47

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	2.75	2.47	2.03	1.22	0.71	-1.45

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.56	0.34	1.3	-1.65	5.59

USACE_GRANULARMETRIC REPORT_FLAGLER_STAT_GINT.GPJ_FL DEP ROSS.GDT_11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-10 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
687,241	1,890,088		-58.3 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.74			8.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.27	0.27
#5	-2.00	3.99	0.15	0.42
#7	-1.50	2.82	0.44	0.86
#10	-1.00	2.00	0.83	1.69
#14	-0.50	1.41	1.23	2.92
#18	0.00	1.00	1.44	4.36
#25	0.50	0.71	3.27	7.63
#35	1.00	0.50	10.43	18.06
#45	1.50	0.35	17.99	36.05
#60	2.00	0.25	27.93	63.98
#80	2.50	0.18	29.05	93.03
#120	3.00	0.13	5.87	98.90
#170	3.50	0.09	0.31	99.21
#200	3.75	0.07	0.03	99.24
#230	4.00	0.06	0.02	99.26

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.67	2.34	2.19	1.75	1.19	0.90	0.10

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.6	0.33	0.82	-1.47	6.49

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-10 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
687,241	1,890,088		-61.3 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 1.40			8.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.48	0.48
#4	-2.25	4.75	0.17	0.65
#5	-2.00	3.99	0.07	0.72
#7	-1.50	2.82	0.38	1.10
#10	-1.00	2.00	0.78	1.88
#14	-0.50	1.41	1.14	3.02
#18	0.00	1.00	1.25	4.27
#25	0.50	0.71	2.18	6.45
#35	1.00	0.50	6.31	12.76
#45	1.50	0.35	13.15	25.91
#60	2.00	0.25	23.97	49.88
#80	2.50	0.18	37.39	87.27
#120	3.00	0.13	9.66	96.93
#170	3.50	0.09	1.28	98.21
#200	3.75	0.07	0.25	98.46
#230	4.00	0.06	0.14	98.60

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.90	2.46	2.33	2.00	1.46	1.12	0.17

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.77	0.29	0.88	-1.92	8.98

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-10 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
687,241	1,890,088		-64.3 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 1.12			29.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.59	0.59
#4	-2.25	4.75	0.36	0.95
#5	-2.00	3.99	0.26	1.21
#7	-1.50	2.82	1.64	2.85
#10	-1.00	2.00	3.23	6.08
#14	-0.50	1.41	4.56	10.64
#18	0.00	1.00	4.81	15.45
#25	0.50	0.71	5.47	20.92
#35	1.00	0.50	8.77	29.69
#45	1.50	0.35	10.56	40.25
#60	2.00	0.25	16.97	57.22
#80	2.50	0.18	30.97	88.19
#120	3.00	0.13	9.67	97.86
#170	3.50	0.09	0.84	98.70
#200	3.75	0.07	0.11	98.81
#230	4.00	0.06	0.07	98.88

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.85	2.43	2.29	1.78	0.73	0.05	-1.17

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.37	0.39	1.23	-1.1	3.62

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-10 #4
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
687,241	1,890,088		-67.3 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.95		20.00	15.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.32	0.32
#4	-2.25	4.75	0.02	0.34
#5	-2.00	3.99	0.12	0.46
#7	-1.50	2.82	0.51	0.97
#10	-1.00	2.00	1.04	2.01
#14	-0.50	1.41	1.42	3.43
#18	0.00	1.00	1.38	4.81
#25	0.50	0.71	1.65	6.46
#35	1.00	0.50	3.91	10.37
#45	1.50	0.35	8.87	19.24
#60	2.00	0.25	16.84	36.08
#80	2.50	0.18	41.17	77.25
#120	3.00	0.13	17.90	95.15
#170	3.50	0.09	2.35	97.50
#200	3.75	0.07	0.36	97.86
#230	4.00	0.06	0.19	98.05

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.00	2.69	2.47	2.17	1.67	1.31	0.06

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.94	0.26	0.91	-1.99	8.49

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-10 #5
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
687,241	1,890,088		-69.3 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.53			24.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.52	0.52
#3.5	-2.50	5.66	1.25	1.77
#4	-2.25	4.75	0.33	2.10
#5	-2.00	3.99	0.27	2.37
#7	-1.50	2.82	1.63	4.00
#10	-1.00	2.00	2.39	6.39
#14	-0.50	1.41	3.30	9.69
#18	0.00	1.00	3.76	13.45
#25	0.50	0.71	5.51	18.96
#35	1.00	0.50	11.27	30.23
#45	1.50	0.35	13.29	43.52
#60	2.00	0.25	15.67	59.19
#80	2.50	0.18	27.21	86.40
#120	3.00	0.13	10.32	96.72
#170	3.50	0.09	1.58	98.30
#200	3.75	0.07	0.12	98.42
#230	4.00	0.06	0.05	98.47

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.92	2.46	2.29	1.70	0.77	0.23	-1.29

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.35	0.39	1.28	-1.33	4.86

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-11 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
693,288	1,888,857		-59.7 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.55		26.00	29.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.07	0.07
#4	-2.25	4.75	0.28	0.35
#5	-2.00	3.99	0.33	0.68
#7	-1.50	2.82	1.31	1.99
#10	-1.00	2.00	1.85	3.84
#14	-0.50	1.41	3.05	6.89
#18	0.00	1.00	3.75	10.64
#25	0.50	0.71	6.53	17.17
#35	1.00	0.50	12.96	30.13
#45	1.50	0.35	19.06	49.19
#60	2.00	0.25	23.70	72.89
#80	2.50	0.18	21.55	94.44
#120	3.00	0.13	4.54	98.98
#170	3.50	0.09	0.39	99.37
#200	3.75	0.07	0.07	99.44
#230	4.00	0.06	0.01	99.45

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.56	2.26	2.05	1.51	0.80	0.41	-0.81

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.3	0.41	1.01	-1.09	4.25

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-11 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
693,288	1,888,857		-62.7 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 5GY 5/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 2.51			17.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.28	0.28
#5	-2.00	3.99	0.02	0.30
#7	-1.50	2.82	0.32	0.62
#10	-1.00	2.00	0.86	1.48
#14	-0.50	1.41	1.48	2.96
#18	0.00	1.00	1.67	4.63
#25	0.50	0.71	2.42	7.05
#35	1.00	0.50	5.55	12.60
#45	1.50	0.35	12.73	25.33
#60	2.00	0.25	26.24	51.57
#80	2.50	0.18	35.32	86.89
#120	3.00	0.13	8.91	95.80
#170	3.50	0.09	1.20	97.00
#200	3.75	0.07	0.30	97.30
#230	4.00	0.06	0.19	97.49

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.96	2.46	2.33	1.97	1.48	1.13	0.08

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.77	0.29	0.84	-1.58	6.87

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-11 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
693,288	1,888,857		-65.7 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.35			12.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.65	0.65
#4	-2.25	4.75	0.09	0.74
#5	-2.00	3.99	0.40	1.14
#7	-1.50	2.82	0.61	1.75
#10	-1.00	2.00	0.90	2.65
#14	-0.50	1.41	1.18	3.83
#18	0.00	1.00	1.15	4.98
#25	0.50	0.71	1.33	6.31
#35	1.00	0.50	2.77	9.08
#45	1.50	0.35	5.90	14.98
#60	2.00	0.25	13.18	28.16
#80	2.50	0.18	42.44	70.60
#120	3.00	0.13	25.38	95.98
#170	3.50	0.09	2.36	98.34
#200	3.75	0.07	0.24	98.58
#230	4.00	0.06	0.07	98.65

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.98	2.76	2.59	2.26	1.88	1.53	0.01

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.03	0.24	0.96	-2.51	10.76

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-12 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
691,249	1,884,893		-58.1 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 5/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 0.80			10.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.17	0.17
#3.5	-2.50	5.66	0.00	0.17
#4	-2.25	4.75	0.00	0.17
#5	-2.00	3.99	0.09	0.26
#7	-1.50	2.82	0.41	0.67
#10	-1.00	2.00	0.58	1.25
#14	-0.50	1.41	0.71	1.96
#18	0.00	1.00	0.92	2.88
#25	0.50	0.71	2.29	5.17
#35	1.00	0.50	6.11	11.28
#45	1.50	0.35	12.63	23.91
#60	2.00	0.25	27.01	50.92
#80	2.50	0.18	38.98	89.90
#120	3.00	0.13	8.49	98.39
#170	3.50	0.09	0.75	99.14
#200	3.75	0.07	0.04	99.18
#230	4.00	0.06	0.02	99.20

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.80	2.42	2.31	1.98	1.52	1.18	0.46

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.8	0.29	0.77	-2.04	10.73

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-12 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
691,249	1,884,893		-61.1 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 0.95		32.00	32.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.33	0.33
#3.5	-2.50	5.66	0.74	1.07
#4	-2.25	4.75	0.88	1.95
#5	-2.00	3.99	0.51	2.46
#7	-1.50	2.82	2.33	4.79
#10	-1.00	2.00	4.14	8.93
#14	-0.50	1.41	4.18	13.11
#18	0.00	1.00	3.21	16.32
#25	0.50	0.71	3.77	20.09
#35	1.00	0.50	6.67	26.76
#45	1.50	0.35	10.74	37.50
#60	2.00	0.25	20.33	57.83
#80	2.50	0.18	32.10	89.93
#120	3.00	0.13	8.23	98.16
#170	3.50	0.09	0.71	98.87
#200	3.75	0.07	0.09	98.96
#230	4.00	0.06	0.09	99.05

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.81	2.41	2.27	1.80	0.87	-0.05	-1.47

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.34	0.40	1.32	-1.35	4.21

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-12 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
691,249	1,884,893		-64.1 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.14			21.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.11	0.11
#4	-2.25	4.75	0.06	0.17
#5	-2.00	3.99	0.28	0.45
#7	-1.50	2.82	1.14	1.59
#10	-1.00	2.00	1.60	3.19
#14	-0.50	1.41	2.18	5.37
#18	0.00	1.00	2.22	7.59
#25	0.50	0.71	3.01	10.60
#35	1.00	0.50	5.58	16.18
#45	1.50	0.35	9.20	25.38
#60	2.00	0.25	17.57	42.95
#80	2.50	0.18	38.62	81.57
#120	3.00	0.13	15.26	96.83
#170	3.50	0.09	1.87	98.70
#200	3.75	0.07	0.07	98.77
#230	4.00	0.06	0.09	98.86

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.94	2.58	2.41	2.09	1.47	0.98	-0.58

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.77	0.29	1.02	-1.64	5.79

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-12 #4
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
691,249	1,884,893		-66.1 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.21			26.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.32	0.32
#3.5	-2.50	5.66	0.57	0.89
#4	-2.25	4.75	0.43	1.32
#5	-2.00	3.99	0.26	1.58
#7	-1.50	2.82	0.93	2.51
#10	-1.00	2.00	2.30	4.81
#14	-0.50	1.41	3.06	7.87
#18	0.00	1.00	3.46	11.33
#25	0.50	0.71	4.40	15.73
#35	1.00	0.50	7.04	22.77
#45	1.50	0.35	10.17	32.94
#60	2.00	0.25	17.70	50.64
#80	2.50	0.18	32.65	83.29
#120	3.00	0.13	12.00	95.29
#170	3.50	0.09	1.99	97.28
#200	3.75	0.07	0.40	97.68
#230	4.00	0.06	0.11	97.79

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.99	2.53	2.37	1.98	1.11	0.52	-0.97

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.56	0.34	1.2	-1.47	5.33

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-13 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
697,758	1,881,943		-55.8 NAVD88

USCS	Munsell:	Comments:
SP	Moist - N 5/	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.01			9.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.14	0.14
#4	-2.25	4.75	0.06	0.20
#5	-2.00	3.99	0.00	0.20
#7	-1.50	2.82	0.23	0.43
#10	-1.00	2.00	0.45	0.88
#14	-0.50	1.41	0.97	1.85
#18	0.00	1.00	1.18	3.03
#25	0.50	0.71	3.11	6.14
#35	1.00	0.50	9.18	15.32
#45	1.50	0.35	17.48	32.80
#60	2.00	0.25	32.12	64.92
#80	2.50	0.18	30.83	95.75
#120	3.00	0.13	3.94	99.69
#170	3.50	0.09	0.23	99.92
#200	3.75	0.07	0.06	99.98
#230	4.00	0.06	0.01	99.99

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.49	2.31	2.16	1.76	1.27	1.02	0.32

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.64	0.32	0.73	-1.53	7.45

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-13 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
697,758	1,881,943		-58.8 NAVD88

USCS	Munsell:	Comments:
SP	Moist - N 5/	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.98		19.00	10.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.02	0.02
#5	-2.00	3.99	0.02	0.04
#7	-1.50	2.82	0.21	0.25
#10	-1.00	2.00	0.40	0.65
#14	-0.50	1.41	0.87	1.52
#18	0.00	1.00	1.15	2.67
#25	0.50	0.71	2.08	4.75
#35	1.00	0.50	5.48	10.23
#45	1.50	0.35	13.34	23.57
#60	2.00	0.25	27.13	50.70
#80	2.50	0.18	39.81	90.51
#120	3.00	0.13	8.29	98.80
#170	3.50	0.09	0.15	98.95
#200	3.75	0.07	0.05	99.00
#230	4.00	0.06	0.02	99.02

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.77	2.42	2.30	1.98	1.52	1.21	0.52

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.82	0.28	0.7	-1.6	7.04

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-13 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
697,758	1,881,943		-61.8 NAVD88

USCS	Munsell:	Comments:
SW	Moist - N 5/	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.83			14.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.81	0.81
#4	-2.25	4.75	0.07	0.88
#5	-2.00	3.99	0.14	1.02
#7	-1.50	2.82	0.33	1.35
#10	-1.00	2.00	1.23	2.58
#14	-0.50	1.41	2.42	5.00
#18	0.00	1.00	2.98	7.98
#25	0.50	0.71	4.18	12.16
#35	1.00	0.50	8.14	20.30
#45	1.50	0.35	14.71	35.01
#60	2.00	0.25	24.69	59.70
#80	2.50	0.18	30.09	89.79
#120	3.00	0.13	7.05	96.84
#170	3.50	0.09	0.96	97.80
#200	3.75	0.07	0.21	98.01
#230	4.00	0.06	0.16	98.17

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.87	2.40	2.25	1.80	1.16	0.73	-0.50

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.56	0.34	1	-1.53	6.3

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-13 #4
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
697,758	1,881,943		-63.8 NAVD88

USCS	Munsell:	Comments:
SW	Moist - N 5/	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.45			12.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.43	0.43
#4	-2.25	4.75	0.06	0.49
#5	-2.00	3.99	0.06	0.55
#7	-1.50	2.82	0.27	0.82
#10	-1.00	2.00	0.81	1.63
#14	-0.50	1.41	1.39	3.02
#18	0.00	1.00	1.70	4.72
#25	0.50	0.71	2.50	7.22
#35	1.00	0.50	5.15	12.37
#45	1.50	0.35	11.29	23.66
#60	2.00	0.25	23.82	47.48
#80	2.50	0.18	38.20	85.68
#120	3.00	0.13	9.26	94.94
#170	3.50	0.09	2.25	97.19
#200	3.75	0.07	0.24	97.43
#230	4.00	0.06	0.12	97.55

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.01	2.48	2.36	2.03	1.52	1.16	0.06

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.8	0.29	0.88	-1.81	8.24

USACE GRANULARMETRIC REPORT_FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-14 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
652,240	1,872,434		-59.1 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.96			16.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.13	0.13
#3.5	-2.50	5.66	1.02	1.15
#4	-2.25	4.75	0.14	1.29
#5	-2.00	3.99	0.40	1.69
#7	-1.50	2.82	0.99	2.68
#10	-1.00	2.00	0.99	3.67
#14	-0.50	1.41	1.02	4.69
#18	0.00	1.00	1.23	5.92
#25	0.50	0.71	1.49	7.41
#35	1.00	0.50	2.53	9.94
#45	1.50	0.35	6.73	16.67
#60	2.00	0.25	20.25	36.92
#80	2.50	0.18	38.00	74.92
#120	3.00	0.13	21.66	96.58
#170	3.50	0.09	2.19	98.77
#200	3.75	0.07	0.23	99.00
#230	4.00	0.06	0.04	99.04

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.96	2.71	2.50	2.17	1.70	1.45	-0.37

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.92	0.26	1.04	-2.48	10.4

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-14 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
652,240	1,872,434		-61.1 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.36			18.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.79	0.79
#4	-2.25	4.75	0.36	1.15
#5	-2.00	3.99	0.23	1.38
#7	-1.50	2.82	1.09	2.47
#10	-1.00	2.00	1.46	3.93
#14	-0.50	1.41	1.98	5.91
#18	0.00	1.00	2.09	8.00
#25	0.50	0.71	2.04	10.04
#35	1.00	0.50	2.68	12.72
#45	1.50	0.35	4.98	17.70
#60	2.00	0.25	13.07	30.77
#80	2.50	0.18	35.37	66.14
#120	3.00	0.13	29.54	95.68
#170	3.50	0.09	2.52	98.20
#200	3.75	0.07	0.34	98.54
#230	4.00	0.06	0.10	98.64

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.99	2.80	2.65	2.27	1.78	1.33	-0.73

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.95	0.26	1.12	-2.1	7.6

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-14 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
652,240	1,872,434		-63.1 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 4.52			22.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.60	0.60
#3.5	-2.50	5.66	0.11	0.71
#4	-2.25	4.75	0.29	1.00
#5	-2.00	3.99	0.37	1.37
#7	-1.50	2.82	1.16	2.53
#10	-1.00	2.00	1.35	3.88
#14	-0.50	1.41	1.99	5.87
#18	0.00	1.00	2.15	8.02
#25	0.50	0.71	2.19	10.21
#35	1.00	0.50	2.76	12.97
#45	1.50	0.35	3.68	16.65
#60	2.00	0.25	7.09	23.74
#80	2.50	0.18	22.58	46.32
#120	3.00	0.13	40.48	86.80
#170	3.50	0.09	7.10	93.90
#200	3.75	0.07	1.19	95.09
#230	4.00	0.06	0.39	95.48

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.73	2.97	2.85	2.55	2.02	1.41	-0.72

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.1	0.23	1.22	-2.14	7.9

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-14 #4
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
652,240	1,872,434		-66.1 NAVD88

USCS	Munsell:	Comments:
SP-SM	Moist - 5GY 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 8.68			28.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.80	0.80
#3.5	-2.50	5.66	2.14	2.94
#4	-2.25	4.75	0.70	3.64
#5	-2.00	3.99	1.01	4.65
#7	-1.50	2.82	2.31	6.96
#10	-1.00	2.00	2.86	9.82
#14	-0.50	1.41	3.56	13.38
#18	0.00	1.00	3.11	16.49
#25	0.50	0.71	3.03	19.52
#35	1.00	0.50	2.98	22.50
#45	1.50	0.35	3.40	25.90
#60	2.00	0.25	5.43	31.33
#80	2.50	0.18	13.89	45.22
#120	3.00	0.13	32.16	77.38
#170	3.50	0.09	11.48	88.86
#200	3.75	0.07	1.81	90.67
#230	4.00	0.06	0.65	91.32

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.29	2.96	2.57	1.36	-0.08	-1.92

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.74	0.30	1.71	-1.36	3.87

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-15 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
655,510	1,872,704		-63.4 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.46			22.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.23	0.23
#3.5	-2.50	5.66	0.45	0.68
#4	-2.25	4.75	0.49	1.17
#5	-2.00	3.99	0.30	1.47
#7	-1.50	2.82	1.23	2.70
#10	-1.00	2.00	1.71	4.41
#14	-0.50	1.41	2.07	6.48
#18	0.00	1.00	2.17	8.65
#25	0.50	0.71	2.74	11.39
#35	1.00	0.50	4.00	15.39
#45	1.50	0.35	7.30	22.69
#60	2.00	0.25	18.37	41.06
#80	2.50	0.18	33.19	74.25
#120	3.00	0.13	21.50	95.75
#170	3.50	0.09	2.47	98.22
#200	3.75	0.07	0.25	98.47
#230	4.00	0.06	0.07	98.54

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.98	2.73	2.52	2.13	1.56	1.04	-0.86

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.8	0.29	1.15	-1.89	6.89

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-15 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
655,510	1,872,704		-66.4 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.74			10.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.08	0.08
#10	-1.00	2.00	0.12	0.20
#14	-0.50	1.41	0.19	0.39
#18	0.00	1.00	0.31	0.70
#25	0.50	0.71	0.46	1.16
#35	1.00	0.50	0.85	2.01
#45	1.50	0.35	2.13	4.14
#60	2.00	0.25	7.36	11.50
#80	2.50	0.18	27.46	38.96
#120	3.00	0.13	47.53	86.49
#170	3.50	0.09	9.34	95.83
#200	3.75	0.07	1.13	96.96
#230	4.00	0.06	0.30	97.26

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.46	2.97	2.88	2.62	2.24	2.08	1.55

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.51	0.18	0.57	-2	11.77

USACE.GRANULARMETRIC.REPORT_FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-15 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
655,510	1,872,704		-68.4 NAVD88

USCS	Munsell:	Comments:
SP-SM	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 8.55			13.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.09	0.09
#7	-1.50	2.82	0.25	0.34
#10	-1.00	2.00	0.70	1.04
#14	-0.50	1.41	1.02	2.06
#18	0.00	1.00	1.03	3.09
#25	0.50	0.71	1.24	4.33
#35	1.00	0.50	1.78	6.11
#45	1.50	0.35	2.84	8.95
#60	2.00	0.25	7.29	16.24
#80	2.50	0.18	20.93	37.17
#120	3.00	0.13	39.11	76.28
#170	3.50	0.09	13.13	89.41
#200	3.75	0.07	1.58	90.99
#230	4.00	0.06	0.46	91.45

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.29	2.98	2.66	2.21	1.98	0.69

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.41	0.19	0.86	-2.12	8.79

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-15 #4
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
655,510	1,872,704		-71.4 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 3.08			49.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	4.21	4.21
#3.5	-2.50	5.66	7.12	11.33
#4	-2.25	4.75	1.83	13.16
#5	-2.00	3.99	1.85	15.01
#7	-1.50	2.82	5.75	20.76
#10	-1.00	2.00	6.04	26.80
#14	-0.50	1.41	5.06	31.86
#18	0.00	1.00	3.91	35.77
#25	0.50	0.71	4.21	39.98
#35	1.00	0.50	5.15	45.13
#45	1.50	0.35	6.44	51.57
#60	2.00	0.25	6.69	58.26
#80	2.50	0.18	13.64	71.90
#120	3.00	0.13	19.94	91.84
#170	3.50	0.09	4.34	96.18
#200	3.75	0.07	0.47	96.65
#230	4.00	0.06	0.27	96.92

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.36	2.80	2.58	1.37	-1.15	-1.91	-3.16

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	0.62	0.65	2.13	-0.55	1.97

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-15 #5
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
655,510	1,872,704		-75.4 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 3.11			20.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.20	0.20
#5	-2.00	3.99	0.06	0.26
#7	-1.50	2.82	0.33	0.59
#10	-1.00	2.00	0.70	1.29
#14	-0.50	1.41	0.74	2.03
#18	0.00	1.00	0.97	3.00
#25	0.50	0.71	1.44	4.44
#35	1.00	0.50	2.39	6.83
#45	1.50	0.35	3.84	10.67
#60	2.00	0.25	8.55	19.22
#80	2.50	0.18	28.18	47.40
#120	3.00	0.13	42.60	90.00
#170	3.50	0.09	6.34	96.34
#200	3.75	0.07	0.41	96.75
#230	4.00	0.06	0.14	96.89

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.39	2.93	2.82	2.53	2.10	1.81	0.62

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.29	0.20	0.83	-2.34	10.17

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-16 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
653,442	1,868,195		-54.8 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 5GY 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.00			8.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.17	0.17
#4	-2.25	4.75	0.02	0.19
#5	-2.00	3.99	0.09	0.28
#7	-1.50	2.82	0.25	0.53
#10	-1.00	2.00	0.20	0.73
#14	-0.50	1.41	0.38	1.11
#18	0.00	1.00	0.36	1.47
#25	0.50	0.71	0.44	1.91
#35	1.00	0.50	0.78	2.69
#45	1.50	0.35	1.54	4.23
#60	2.00	0.25	8.11	12.34
#80	2.50	0.18	41.89	54.23
#120	3.00	0.13	40.22	94.45
#170	3.50	0.09	4.02	98.47
#200	3.75	0.07	0.41	98.88
#230	4.00	0.06	0.12	99.00

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.07	2.87	2.76	2.45	2.15	2.04	1.54

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.37	0.19	0.63	-3.42	22.63

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-16 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
653,442	1,868,195		-57.8 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 5GY 6/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 0.91		12.00	7.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.17	0.17
#4	-2.25	4.75	0.14	0.31
#5	-2.00	3.99	0.07	0.38
#7	-1.50	2.82	0.34	0.72
#10	-1.00	2.00	0.41	1.13
#14	-0.50	1.41	0.58	1.71
#18	0.00	1.00	0.57	2.28
#25	0.50	0.71	0.64	2.92
#35	1.00	0.50	0.90	3.82
#45	1.50	0.35	2.15	5.97
#60	2.00	0.25	8.25	14.22
#80	2.50	0.18	41.38	55.60
#120	3.00	0.13	39.03	94.63
#170	3.50	0.09	3.98	98.61
#200	3.75	0.07	0.38	98.99
#230	4.00	0.06	0.10	99.09

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.05	2.86	2.75	2.43	2.13	2.02	1.27

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.32	0.20	0.72	-3.25	18.4

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-16 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
653,442	1,868,195		-60.8 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.02			37.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.39	0.39
#3.5	-2.50	5.66	4.42	4.81
#4	-2.25	4.75	1.46	6.27
#5	-2.00	3.99	1.10	7.37
#7	-1.50	2.82	3.12	10.49
#10	-1.00	2.00	3.91	14.40
#14	-0.50	1.41	3.75	18.15
#18	0.00	1.00	2.92	21.07
#25	0.50	0.71	2.37	23.44
#35	1.00	0.50	2.54	25.98
#45	1.50	0.35	3.86	29.84
#60	2.00	0.25	9.82	39.66
#80	2.50	0.18	29.05	68.71
#120	3.00	0.13	25.24	93.95
#170	3.50	0.09	3.48	97.43
#200	3.75	0.07	0.40	97.83
#230	4.00	0.06	0.15	97.98

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.15	2.80	2.62	2.18	0.81	-0.79	-2.47

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.42	0.37	1.74	-1.27	3.36

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-17 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
650,134	1,865,965		-69.0 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10GY 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 4.27			33.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	3.29	3.29
#3.5	-2.50	5.66	4.63	7.92
#4	-2.25	4.75	1.47	9.39
#5	-2.00	3.99	1.66	11.05
#7	-1.50	2.82	4.34	15.39
#10	-1.00	2.00	3.48	18.87
#14	-0.50	1.41	3.00	21.87
#18	0.00	1.00	2.05	23.92
#25	0.50	0.71	1.61	25.53
#35	1.00	0.50	2.20	27.73
#45	1.50	0.35	2.69	30.42
#60	2.00	0.25	5.37	35.79
#80	2.50	0.18	17.74	53.53
#120	3.00	0.13	32.15	85.68
#170	3.50	0.09	8.31	93.99
#200	3.75	0.07	1.31	95.30
#230	4.00	0.06	0.43	95.73

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.69	2.97	2.83	2.40	0.33	-1.41	-2.97

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.35	0.39	2.08	-1.14	2.89

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-17 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
650,134	1,865,965		-72.5 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5B 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.78			9.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.37	0.37
#5	-2.00	3.99	0.37	0.74
#7	-1.50	2.82	0.86	1.60
#10	-1.00	2.00	1.06	2.66
#14	-0.50	1.41	0.94	3.60
#18	0.00	1.00	0.94	4.54
#25	0.50	0.71	0.99	5.53
#35	1.00	0.50	1.25	6.78
#45	1.50	0.35	1.91	8.69
#60	2.00	0.25	5.38	14.07
#80	2.50	0.18	25.71	39.78
#120	3.00	0.13	53.09	92.87
#170	3.50	0.09	4.99	97.86
#200	3.75	0.07	0.32	98.18
#230	4.00	0.06	0.04	98.22

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.21	2.92	2.83	2.60	2.21	2.03	0.23

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.33	0.20	0.93	-2.94	12.4

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-17 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
650,134	1,865,965		-75.5 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5B 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 3.09			32.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.95	0.95
#3.5	-2.50	5.66	5.91	6.86
#4	-2.25	4.75	1.79	8.65
#5	-2.00	3.99	1.06	9.71
#7	-1.50	2.82	2.55	12.26
#10	-1.00	2.00	2.59	14.85
#14	-0.50	1.41	2.67	17.52
#18	0.00	1.00	2.22	19.74
#25	0.50	0.71	2.16	21.90
#35	1.00	0.50	3.18	25.08
#45	1.50	0.35	4.37	29.45
#60	2.00	0.25	6.89	36.34
#80	2.50	0.18	17.24	53.58
#120	3.00	0.13	36.11	89.69
#170	3.50	0.09	6.48	96.17
#200	3.75	0.07	0.51	96.68
#230	4.00	0.06	0.23	96.91

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.41	2.92	2.80	2.40	0.99	-0.78	-2.73

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.5	0.35	1.88	-1.32	3.44

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-18 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
653,545	1,864,379		-62.0 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 5GY 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.67			65.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	2.58	2.58
#3.5	-2.50	5.66	4.01	6.59
#4	-2.25	4.75	1.91	8.50
#5	-2.00	3.99	1.59	10.09
#7	-1.50	2.82	6.65	16.74
#10	-1.00	2.00	7.49	24.23
#14	-0.50	1.41	8.48	32.71
#18	0.00	1.00	7.37	40.08
#25	0.50	0.71	6.93	47.01
#35	1.00	0.50	7.13	54.14
#45	1.50	0.35	9.66	63.80
#60	2.00	0.25	11.27	75.07
#80	2.50	0.18	12.17	87.24
#120	3.00	0.13	8.70	95.94
#170	3.50	0.09	1.95	97.89
#200	3.75	0.07	0.33	98.22
#230	4.00	0.06	0.11	98.33

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.95	2.37	1.99	0.71	-0.95	-1.55	-2.80

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	0.4	0.76	1.79	-0.4	2.21

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-18 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
653,545	1,864,379		-66.0 NAVD88

USCS	Munsell:	Comments:
SM	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 13.64			10.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.18	0.18
#5	-2.00	3.99	0.03	0.21
#7	-1.50	2.82	0.56	0.77
#10	-1.00	2.00	0.52	1.29
#14	-0.50	1.41	0.62	1.91
#18	0.00	1.00	0.29	2.20
#25	0.50	0.71	0.45	2.65
#35	1.00	0.50	0.53	3.18
#45	1.50	0.35	0.89	4.07
#60	2.00	0.25	1.59	5.66
#80	2.50	0.18	7.29	12.95
#120	3.00	0.13	30.30	43.25
#170	3.50	0.09	35.03	78.28
#200	3.75	0.07	6.10	84.38
#230	4.00	0.06	1.98	86.36

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.73	3.45	3.10	2.70	2.55	1.79

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.84	0.14	0.84	-3.28	16.69

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-19 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
656,770	1,864,383		-73.9 NAVD88

USCS	Munsell:	Comments:
SP-SM	Moist - 10GY 3/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 6.29			40.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.55	0.55
#3.5	-2.50	5.66	2.94	3.49
#4	-2.25	4.75	0.90	4.39
#5	-2.00	3.99	1.03	5.42
#7	-1.50	2.82	4.21	9.63
#10	-1.00	2.00	5.04	14.67
#14	-0.50	1.41	4.80	19.47
#18	0.00	1.00	3.86	23.33
#25	0.50	0.71	4.21	27.54
#35	1.00	0.50	4.53	32.07
#45	1.50	0.35	6.48	38.55
#60	2.00	0.25	9.58	48.13
#80	2.50	0.18	14.98	63.11
#120	3.00	0.13	23.07	86.18
#170	3.50	0.09	6.52	92.70
#200	3.75	0.07	0.58	93.28
#230	4.00	0.06	0.43	93.71

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	2.95	2.76	2.06	0.20	-0.86	-2.10

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.26	0.42	1.76	-0.88	2.67

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-20 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
656,298	1,860,715		-62.2 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.49			41.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.13	0.13
#3.5	-2.50	5.66	3.63	3.76
#4	-2.25	4.75	1.76	5.52
#5	-2.00	3.99	1.32	6.84
#7	-1.50	2.82	4.25	11.09
#10	-1.00	2.00	4.50	15.59
#14	-0.50	1.41	3.47	19.06
#18	0.00	1.00	3.00	22.06
#25	0.50	0.71	3.00	25.06
#35	1.00	0.50	3.23	28.29
#45	1.50	0.35	4.76	33.05
#60	2.00	0.25	10.92	43.97
#80	2.50	0.18	24.76	68.73
#120	3.00	0.13	23.36	92.09
#170	3.50	0.09	4.53	96.62
#200	3.75	0.07	0.63	97.25
#230	4.00	0.06	0.26	97.51

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.32	2.83	2.63	2.12	0.49	-0.94	-2.32

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.35	0.39	1.74	-1.1	2.95

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-20 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
656,298	1,860,715		-64.7 NAVD88

USCS	Munsell:	Comments:
SP-SM	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 8.32			20.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.15	0.15
#4	-2.25	4.75	0.34	0.49
#5	-2.00	3.99	0.33	0.82
#7	-1.50	2.82	1.18	2.00
#10	-1.00	2.00	1.86	3.86
#14	-0.50	1.41	1.72	5.58
#18	0.00	1.00	1.63	7.21
#25	0.50	0.71	1.59	8.80
#35	1.00	0.50	1.74	10.54
#45	1.50	0.35	2.81	13.35
#60	2.00	0.25	7.48	20.83
#80	2.50	0.18	25.63	46.46
#120	3.00	0.13	35.95	82.41
#170	3.50	0.09	7.63	90.04
#200	3.75	0.07	1.16	91.20
#230	4.00	0.06	0.48	91.68

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.10	2.90	2.55	2.08	1.67	-0.67

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.16	0.22	1.14	-2.06	7.14

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-20 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
656,298	1,860,715		-69.7 NAVD88

USCS	Munsell:	Comments:
SM	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 31.07			19.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.81	0.81
#3.5	-2.50	5.66	0.32	1.13
#4	-2.25	4.75	0.19	1.32
#5	-2.00	3.99	0.70	2.02
#7	-1.50	2.82	1.52	3.54
#10	-1.00	2.00	2.59	6.13
#14	-0.50	1.41	2.91	9.04
#18	0.00	1.00	1.72	10.76
#25	0.50	0.71	1.08	11.84
#35	1.00	0.50	0.91	12.75
#45	1.50	0.35	1.02	13.77
#60	2.00	0.25	1.80	15.57
#80	2.50	0.18	5.95	21.52
#120	3.00	0.13	17.63	39.15
#170	3.50	0.09	21.53	60.68
#200	3.75	0.07	5.31	65.99
#230	4.00	0.06	2.94	68.93

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
			3.25	2.60	2.03	-1.22

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.23	0.21	1.7	-1.64	4.72

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-21 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
656,922	1,856,128		-60.5 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.40			6.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.05	0.05
#10	-1.00	2.00	0.04	0.09
#14	-0.50	1.41	0.13	0.22
#18	0.00	1.00	0.15	0.37
#25	0.50	0.71	0.29	0.66
#35	1.00	0.50	0.46	1.12
#45	1.50	0.35	1.27	2.39
#60	2.00	0.25	7.22	9.61
#80	2.50	0.18	36.12	45.73
#120	3.00	0.13	45.91	91.64
#170	3.50	0.09	6.24	97.88
#200	3.75	0.07	0.59	98.47
#230	4.00	0.06	0.13	98.60

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.27	2.92	2.82	2.55	2.21	2.09	1.68

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.48	0.18	0.48	-1.82	12.9

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-21 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
656,922	1,856,128		-63.5 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 10Y 6/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 1.88			15.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.04	0.04
#4	-2.25	4.75	0.10	0.14
#5	-2.00	3.99	0.03	0.17
#7	-1.50	2.82	0.21	0.38
#10	-1.00	2.00	0.35	0.73
#14	-0.50	1.41	0.54	1.27
#18	0.00	1.00	0.73	2.00
#25	0.50	0.71	0.92	2.92
#35	1.00	0.50	1.45	4.37
#45	1.50	0.35	2.94	7.31
#60	2.00	0.25	8.81	16.12
#80	2.50	0.18	30.76	46.88
#120	3.00	0.13	41.00	87.88
#170	3.50	0.09	8.54	96.42
#200	3.75	0.07	1.34	97.76
#230	4.00	0.06	0.36	98.12

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.42	2.95	2.84	2.54	2.14	1.99	1.10

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.39	0.19	0.74	-2.35	12.14

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-21 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
656,922	1,856,128		-65.0 NAVD88

USCS	Munsell:	Comments:
SP-SM	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 7.71			13.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.62	0.62
#4	-2.25	4.75	0.08	0.70
#5	-2.00	3.99	0.04	0.74
#7	-1.50	2.82	0.27	1.01
#10	-1.00	2.00	0.37	1.38
#14	-0.50	1.41	0.56	1.94
#18	0.00	1.00	0.53	2.47
#25	0.50	0.71	0.69	3.16
#35	1.00	0.50	1.18	4.34
#45	1.50	0.35	1.45	5.79
#60	2.00	0.25	5.01	10.80
#80	2.50	0.18	22.81	33.61
#120	3.00	0.13	45.05	78.66
#170	3.50	0.09	11.03	89.69
#200	3.75	0.07	1.82	91.51
#230	4.00	0.06	0.78	92.29

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.24	2.96	2.68	2.31	2.11	1.22

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.48	0.18	0.85	-3.23	17.65

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-21 #4
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
656,922	1,856,128		-67.5 NAVD88

USCS	Munsell:	Comments:
SM	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 12.72			10.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.05	0.05
#4	-2.25	4.75	0.05	0.10
#5	-2.00	3.99	0.10	0.20
#7	-1.50	2.82	0.38	0.58
#10	-1.00	2.00	0.31	0.89
#14	-0.50	1.41	0.44	1.33
#18	0.00	1.00	0.50	1.83
#25	0.50	0.71	0.56	2.39
#35	1.00	0.50	0.56	2.95
#45	1.50	0.35	1.09	4.04
#60	2.00	0.25	2.36	6.40
#80	2.50	0.18	10.27	16.67
#120	3.00	0.13	33.75	50.42
#170	3.50	0.09	29.87	80.29
#200	3.75	0.07	5.22	85.51
#230	4.00	0.06	1.77	87.28

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.68	3.41	2.99	2.62	2.47	1.70

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.78	0.15	0.79	-3.01	15.98

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-22 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
657,885	1,850,138		-53.7 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.02			18.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.03	0.03
#5	-2.00	3.99	0.05	0.08
#7	-1.50	2.82	0.26	0.34
#10	-1.00	2.00	0.39	0.73
#14	-0.50	1.41	0.45	1.18
#18	0.00	1.00	0.48	1.66
#25	0.50	0.71	0.82	2.48
#35	1.00	0.50	1.35	3.83
#45	1.50	0.35	3.30	7.13
#60	2.00	0.25	11.42	18.55
#80	2.50	0.18	42.89	61.44
#120	3.00	0.13	32.40	93.84
#170	3.50	0.09	4.44	98.28
#200	3.75	0.07	0.59	98.87
#230	4.00	0.06	0.11	98.98

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.13	2.85	2.71	2.37	2.07	1.88	1.17

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.29	0.20	0.67	-2.4	13.07

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-22 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
657,885	1,850,138		-56.7 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.36			5.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.03	0.03
#10	-1.00	2.00	0.05	0.08
#14	-0.50	1.41	0.06	0.14
#18	0.00	1.00	0.30	0.44
#25	0.50	0.71	0.41	0.85
#35	1.00	0.50	0.69	1.54
#45	1.50	0.35	1.70	3.24
#60	2.00	0.25	7.46	10.70
#80	2.50	0.18	36.87	47.57
#120	3.00	0.13	41.99	89.56
#170	3.50	0.09	6.90	96.46
#200	3.75	0.07	0.86	97.32
#230	4.00	0.06	0.32	97.64

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.39	2.93	2.83	2.53	2.19	2.07	1.61

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.46	0.18	0.51	-1.55	10.23

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-22 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
657,885	1,850,138		-59.7 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.95		17.00	14.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.04	0.04
#7	-1.50	2.82	0.04	0.08
#10	-1.00	2.00	0.19	0.27
#14	-0.50	1.41	0.40	0.67
#18	0.00	1.00	0.79	1.46
#25	0.50	0.71	1.27	2.73
#35	1.00	0.50	2.07	4.80
#45	1.50	0.35	3.54	8.34
#60	2.00	0.25	10.41	18.75
#80	2.50	0.18	40.23	58.98
#120	3.00	0.13	33.89	92.87
#170	3.50	0.09	4.42	97.29
#200	3.75	0.07	0.56	97.85
#230	4.00	0.06	0.20	98.05

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.24	2.87	2.74	2.39	2.07	1.86	1.03

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.29	0.20	0.66	-1.9	9.17

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-22 #4
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
657,885	1,850,138		-62.7 NAVD88

USCS	Munsell:	Comments:
SP	Moist - 5GY 5/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.47			9.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.01	0.01
#7	-1.50	2.82	0.13	0.14
#10	-1.00	2.00	0.24	0.38
#14	-0.50	1.41	0.29	0.67
#18	0.00	1.00	0.36	1.03
#25	0.50	0.71	0.35	1.38
#35	1.00	0.50	0.57	1.95
#45	1.50	0.35	1.13	3.08
#60	2.00	0.25	3.80	6.88
#80	2.50	0.18	30.40	37.28
#120	3.00	0.13	50.56	87.84
#170	3.50	0.09	8.41	96.25
#200	3.75	0.07	0.97	97.22
#230	4.00	0.06	0.31	97.53

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.43	2.96	2.87	2.63	2.30	2.15	1.75

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.53	0.17	0.56	-2.85	18.39

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-22 #5
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
657,885	1,850,138		-64.7 NAVD88

USCS	Munsell:	Comments:
SP-SM	Moist - 5GY 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 9.74			9.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4	-4.25	19.03	0.00	0.00
3/8	-3.25	9.48	0.33	0.33
#3.5	-2.50	5.66	0.00	0.33
#4	-2.25	4.75	0.29	0.62
#5	-2.00	3.99	0.10	0.72
#7	-1.50	2.82	0.27	0.99
#10	-1.00	2.00	0.48	1.47
#14	-0.50	1.41	0.61	2.08
#18	0.00	1.00	0.53	2.61
#25	0.50	0.71	0.73	3.34
#35	1.00	0.50	0.90	4.24
#45	1.50	0.35	1.15	5.39
#60	2.00	0.25	2.71	8.10
#80	2.50	0.18	12.11	20.21
#120	3.00	0.13	48.24	68.45
#170	3.50	0.09	18.21	86.66
#200	3.75	0.07	2.67	89.33
#230	4.00	0.06	0.93	90.26

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.43	3.18	2.81	2.55	2.32	1.33

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.61	0.16	0.89	-3.55	19.8

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-22 #6
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
657,885	1,850,138		-66.7 NAVD88

USCS	Munsell:	Comments:
SM	Moist - 10GY 3/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 11.50			15.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.95	0.95
#4	-2.25	4.75	0.10	1.05
#5	-2.00	3.99	0.20	1.25
#7	-1.50	2.82	0.80	2.05
#10	-1.00	2.00	1.02	3.07
#14	-0.50	1.41	1.02	4.09
#18	0.00	1.00	0.99	5.08
#25	0.50	0.71	0.92	6.00
#35	1.00	0.50	0.97	6.97
#45	1.50	0.35	1.21	8.18
#60	2.00	0.25	2.25	10.43
#80	2.50	0.18	10.18	20.61
#120	3.00	0.13	42.07	62.68
#170	3.50	0.09	21.40	84.08
#200	3.75	0.07	3.26	87.34
#230	4.00	0.06	1.16	88.50

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.50	3.29	2.85	2.55	2.27	-0.04

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.53	0.17	1.13	-2.81	11.44

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-23 #1
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
657,899	1,844,676		-61.6 NAVD88

USCS	Munsell:	Comments:
SW	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.00			37.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.60	0.60
#4	-2.25	4.75	0.29	0.89
#5	-2.00	3.99	0.32	1.21
#7	-1.50	2.82	1.49	2.70
#10	-1.00	2.00	1.39	4.09
#14	-0.50	1.41	2.33	6.42
#18	0.00	1.00	2.92	9.34
#25	0.50	0.71	3.69	13.03
#35	1.00	0.50	6.37	19.40
#45	1.50	0.35	10.10	29.50
#60	2.00	0.25	15.12	44.62
#80	2.50	0.18	27.93	72.55
#120	3.00	0.13	22.17	94.72
#170	3.50	0.09	2.83	97.55
#200	3.75	0.07	0.30	97.85
#230	4.00	0.06	0.15	98.00

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.05	2.76	2.56	2.09	1.27	0.73	-0.80

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.73	0.30	1.17	-1.48	5.21

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-23 #2
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
657,899	1,844,676		-63.1 NAVD88

USCS	Munsell:	Comments:
SP-SM	Moist - 10Y 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 8.81			10.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.06	0.06
#4	-2.25	4.75	0.05	0.11
#5	-2.00	3.99	0.04	0.15
#7	-1.50	2.82	0.43	0.58
#10	-1.00	2.00	0.62	1.20
#14	-0.50	1.41	0.59	1.79
#18	0.00	1.00	0.74	2.53
#25	0.50	0.71	0.70	3.23
#35	1.00	0.50	0.91	4.14
#45	1.50	0.35	1.37	5.51
#60	2.00	0.25	3.51	9.02
#80	2.50	0.18	18.28	27.30
#120	3.00	0.13	48.54	75.84
#170	3.50	0.09	12.47	88.31
#200	3.75	0.07	2.07	90.38
#230	4.00	0.06	0.81	91.19

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.33	2.99	2.73	2.44	2.19	1.31

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.54	0.17	0.8	-2.92	14.52

USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: VC-FSP11-23 #3
Analysis Date: 04-01-11
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
657,899	1,844,676		-65.6 NAVD88

USCS	Munsell:	Comments:
SM	Moist - 10GY 4/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 13.16			11.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.40	0.40
#4	-2.25	4.75	0.22	0.62
#5	-2.00	3.99	0.26	0.88
#7	-1.50	2.82	0.74	1.62
#10	-1.00	2.00	0.64	2.26
#14	-0.50	1.41	0.71	2.97
#18	0.00	1.00	0.75	3.72
#25	0.50	0.71	1.02	4.74
#35	1.00	0.50	1.64	6.38
#45	1.50	0.35	2.34	8.72
#60	2.00	0.25	4.60	13.32
#80	2.50	0.18	14.08	27.40
#120	3.00	0.13	37.10	64.50
#170	3.50	0.09	18.13	82.63
#200	3.75	0.07	3.10	85.73
#230	4.00	0.06	1.11	86.84

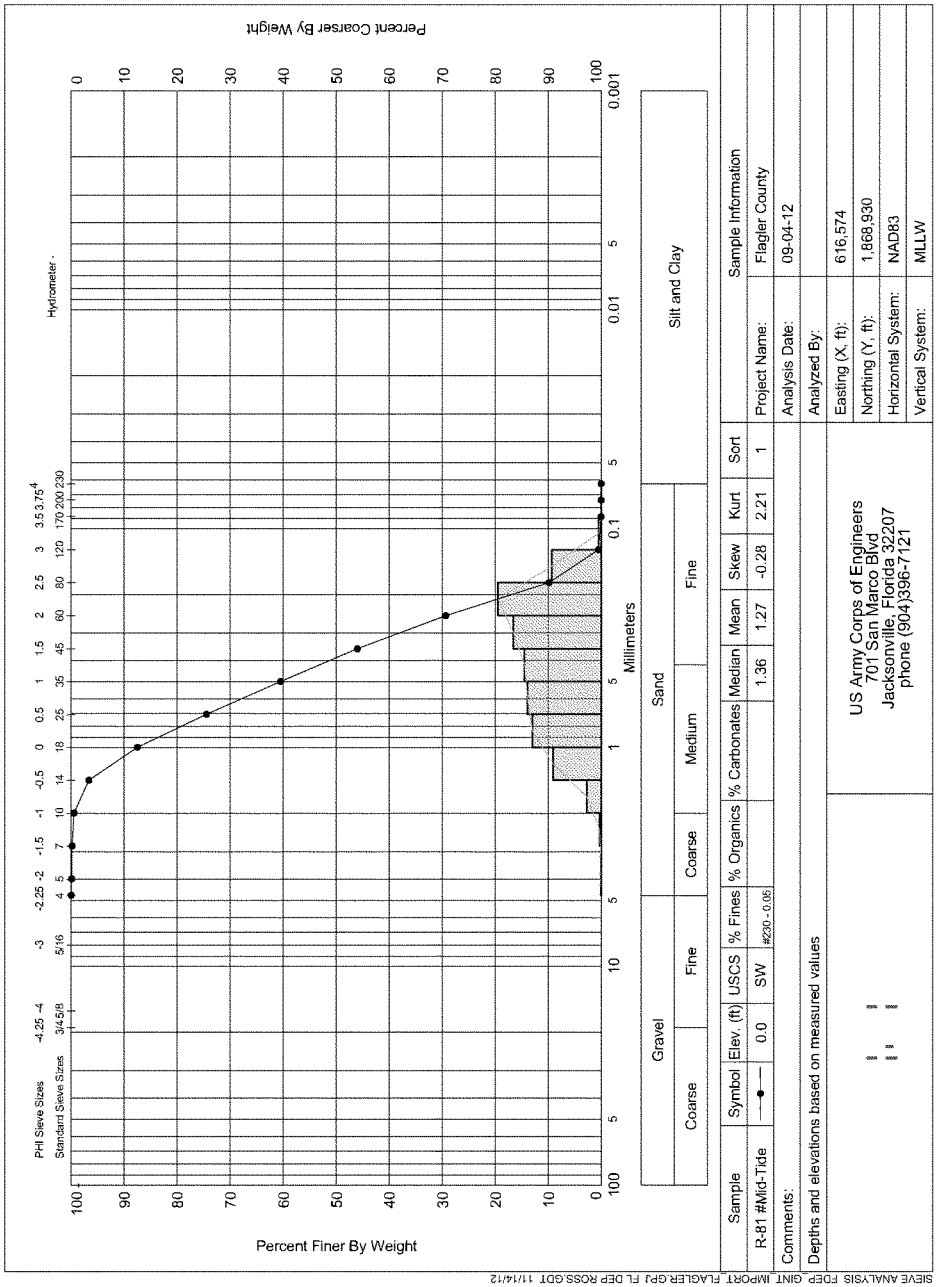
Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.61	3.29	2.80	2.41	2.09	0.58

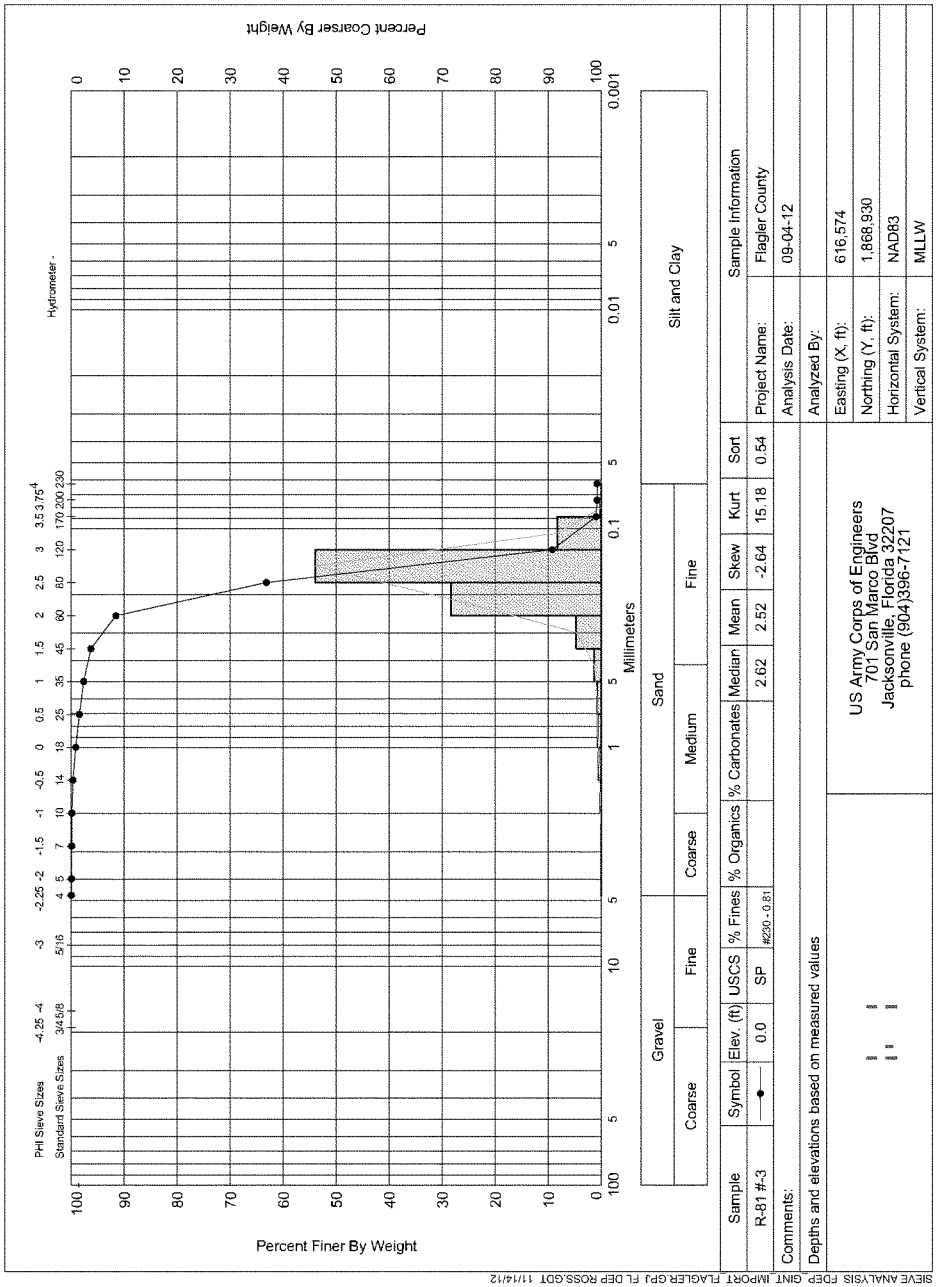
Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.48	0.18	1.04	-2.57	10.98

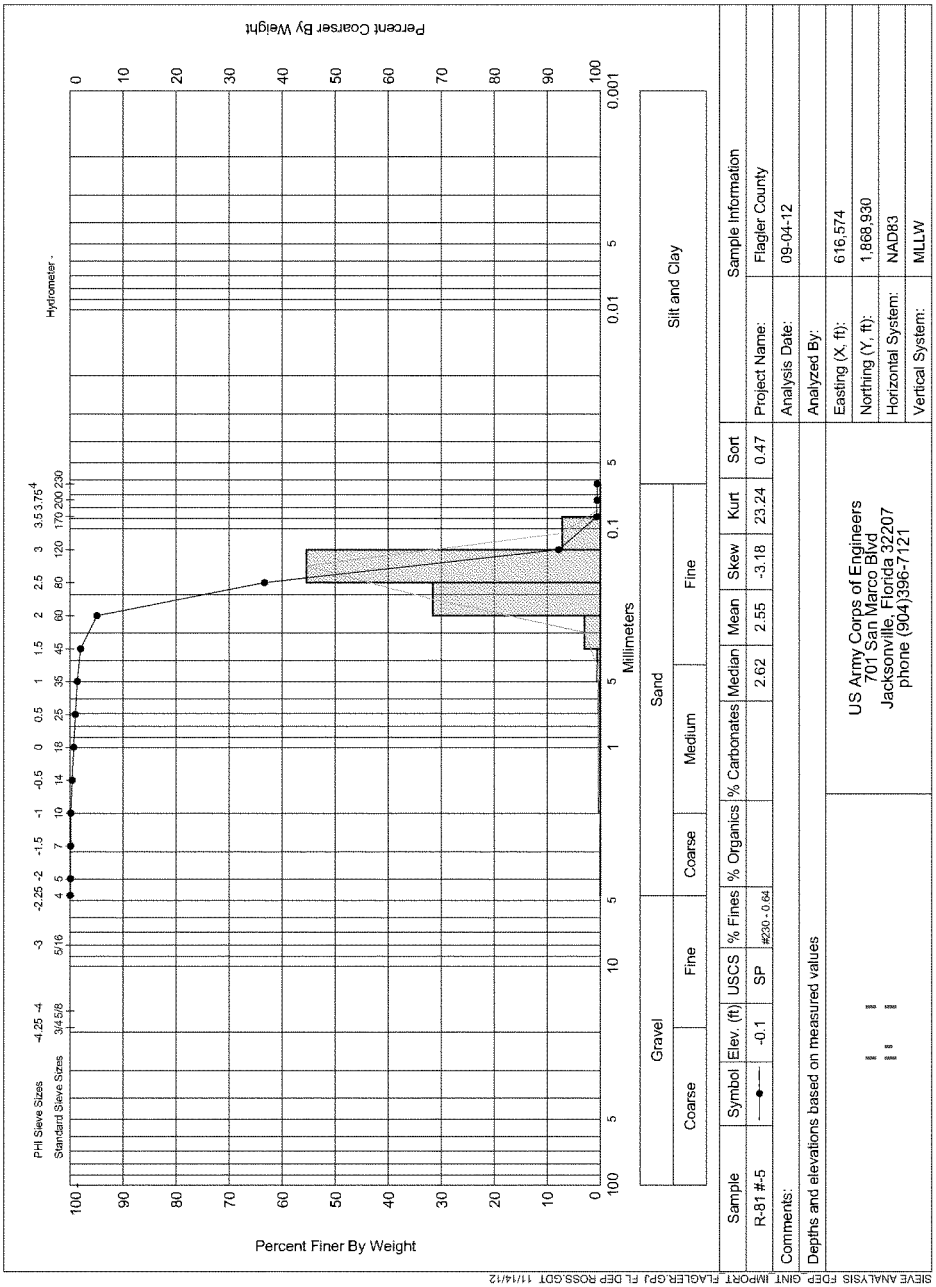
USACE GRANULARMETRIC REPORT FLAGLER_STAT_GINT.GPJ FL DEP ROSS.GDT 11/14/12

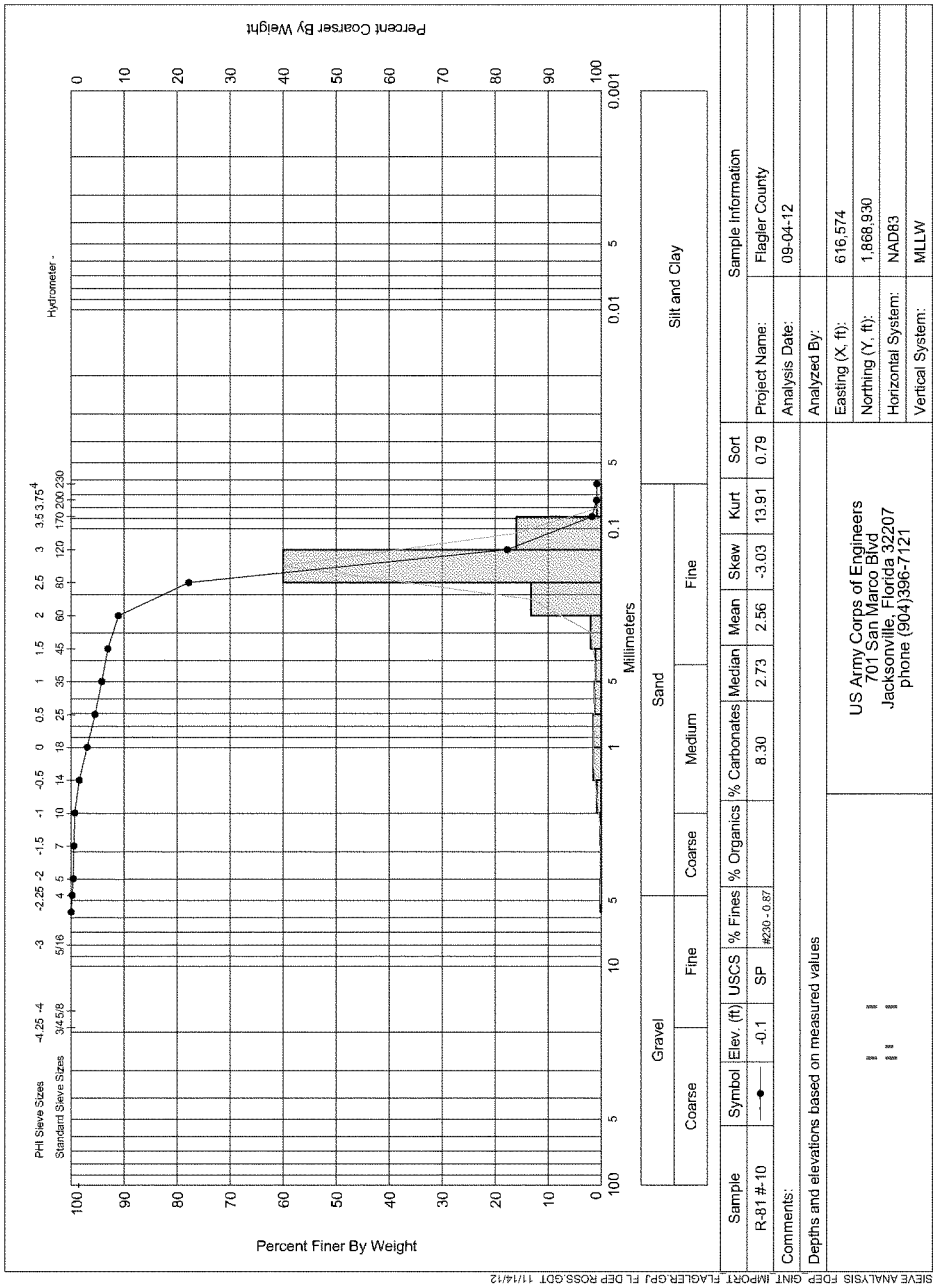
NATIVE BEACH:

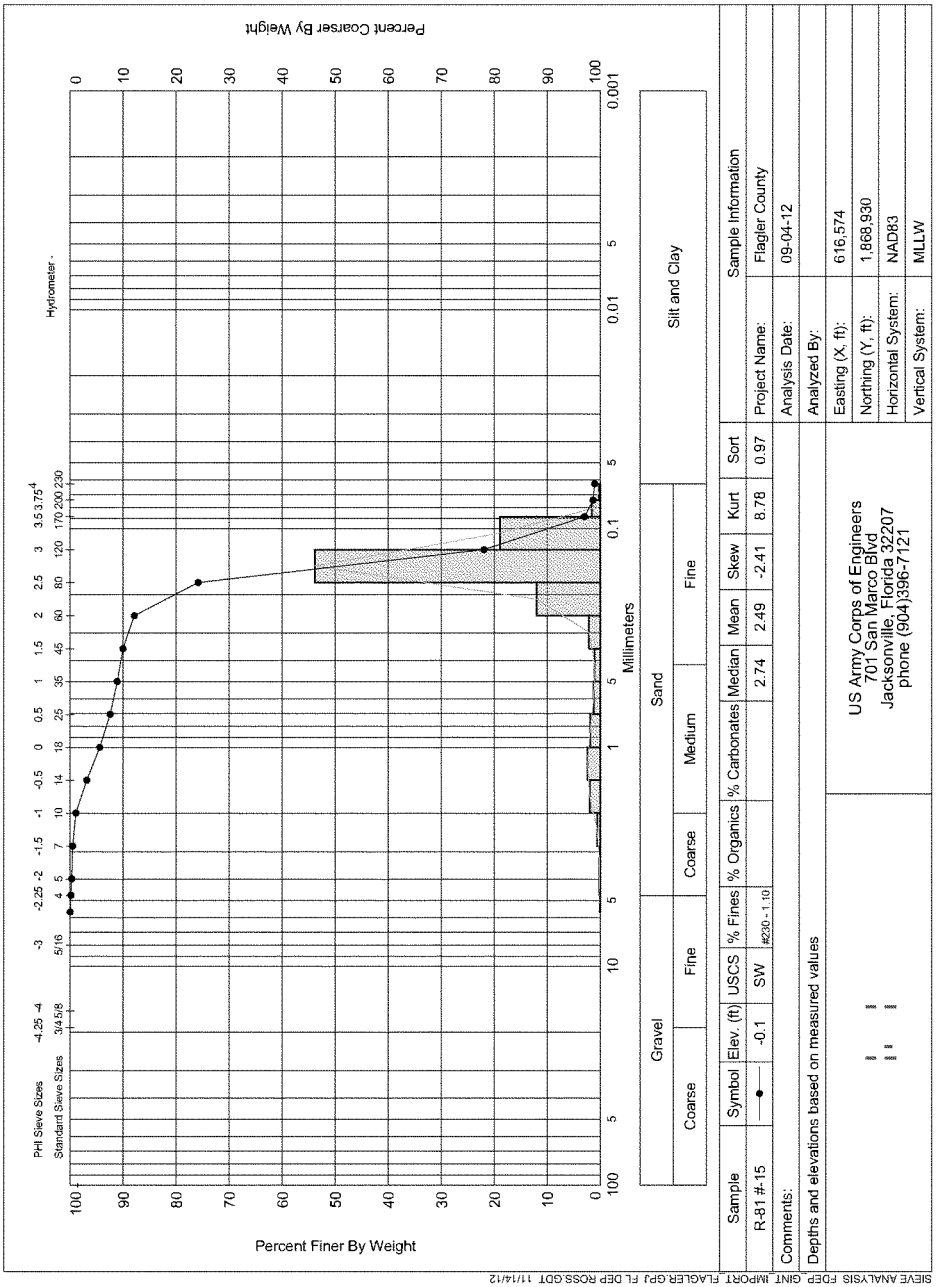
LABORATORY TESTING RESULTS

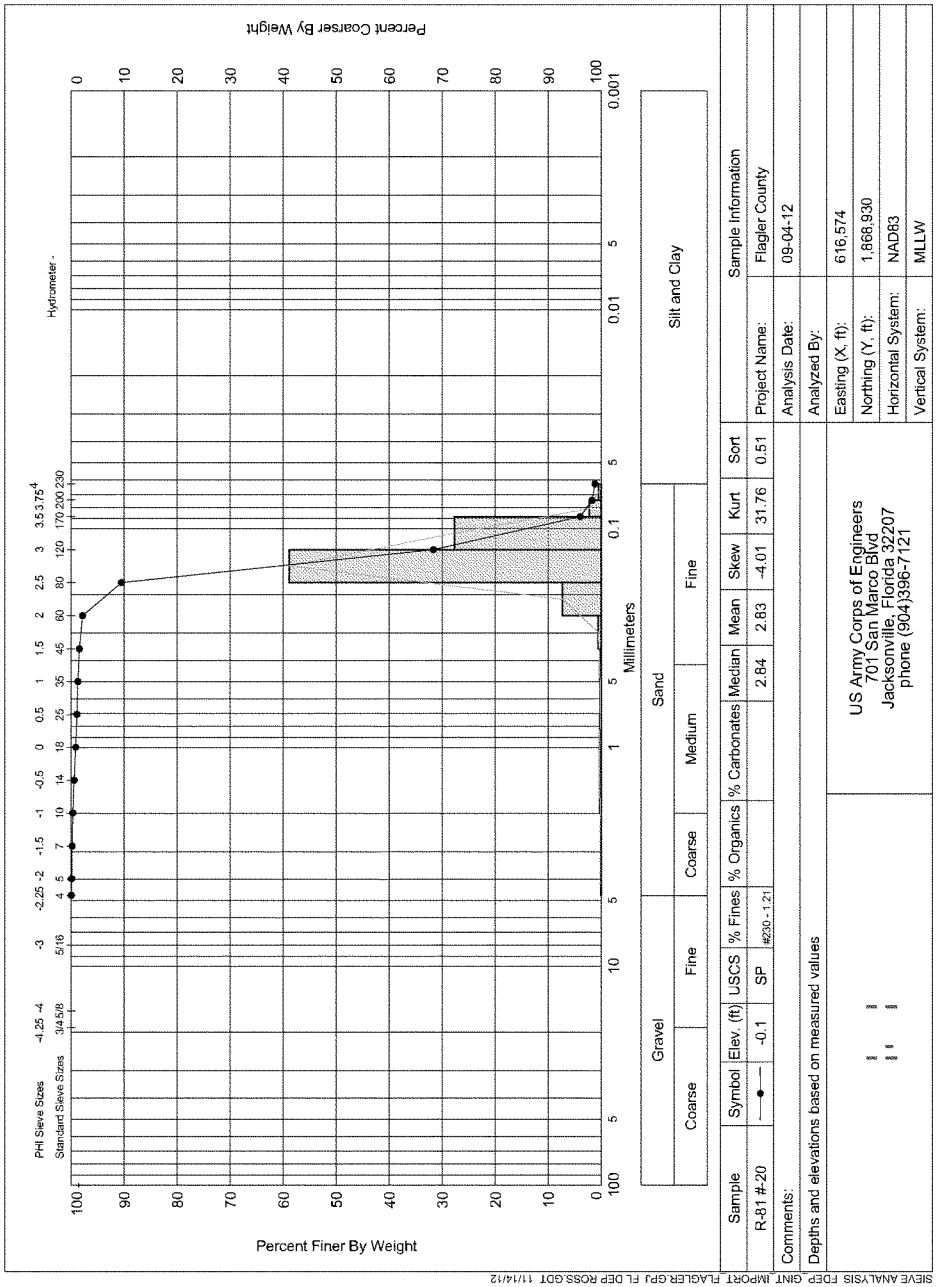

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample Information
Project Name: Flagler County
Analysis Date: 09-04-12
Analyzed By:
Easting (X, ft): 616,574
Northing (Y, ft): 1,868,930
Horizontal System: NAD83
Vertical System: MLLW
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
R-81 #Mid-Tide
Comments:
Depths and elevations based on measured values
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

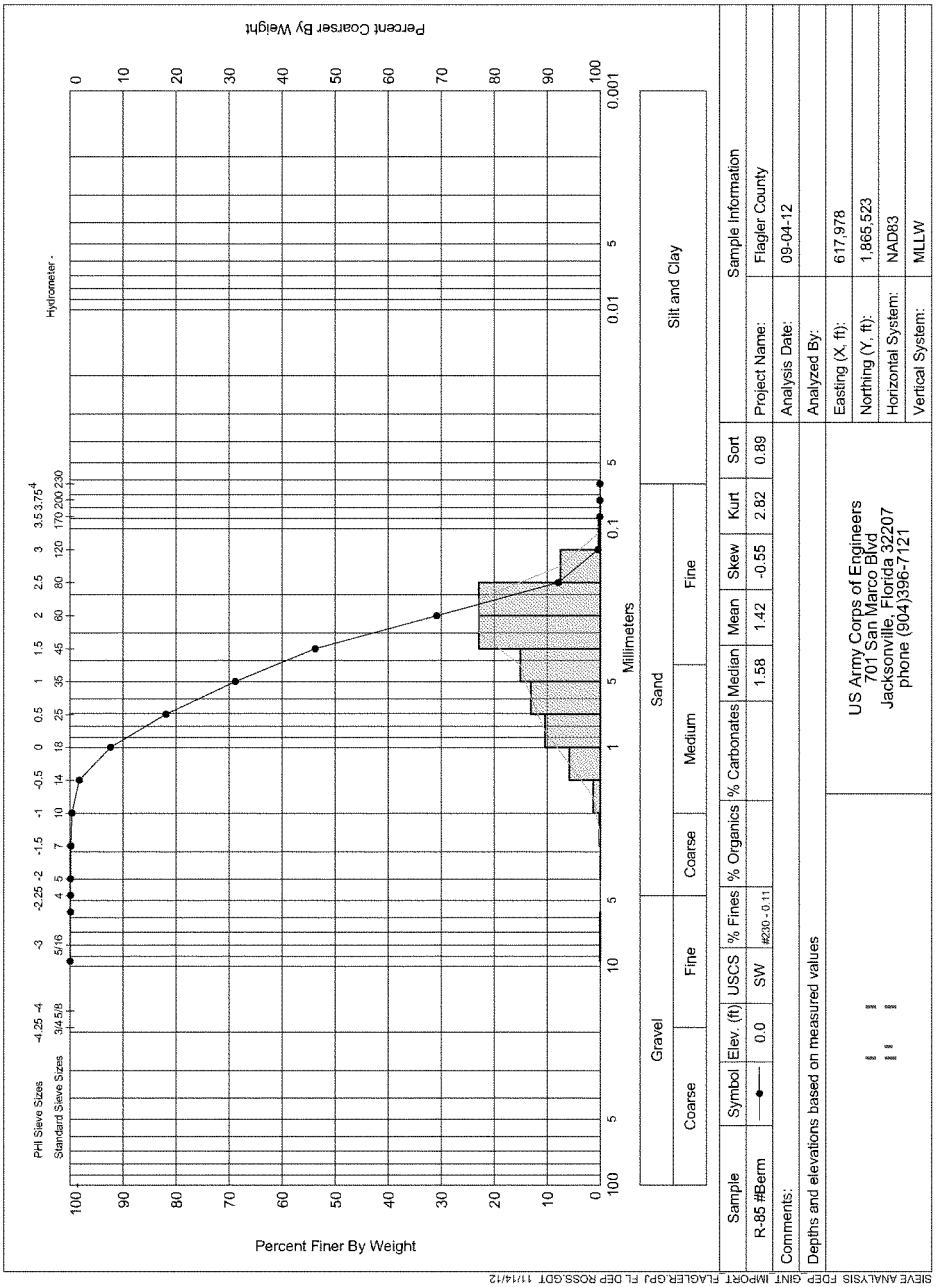

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-81 #-3
0.0
SP
#230 - 0.81
2.62
2.52
-2.64
15.18
0.54
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 09-04-12
Analyzed By:
Easting (X, ft): 616,574
Northing (Y, ft): 1,868,930
Horizontal System: NAD83
Vertical System: MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

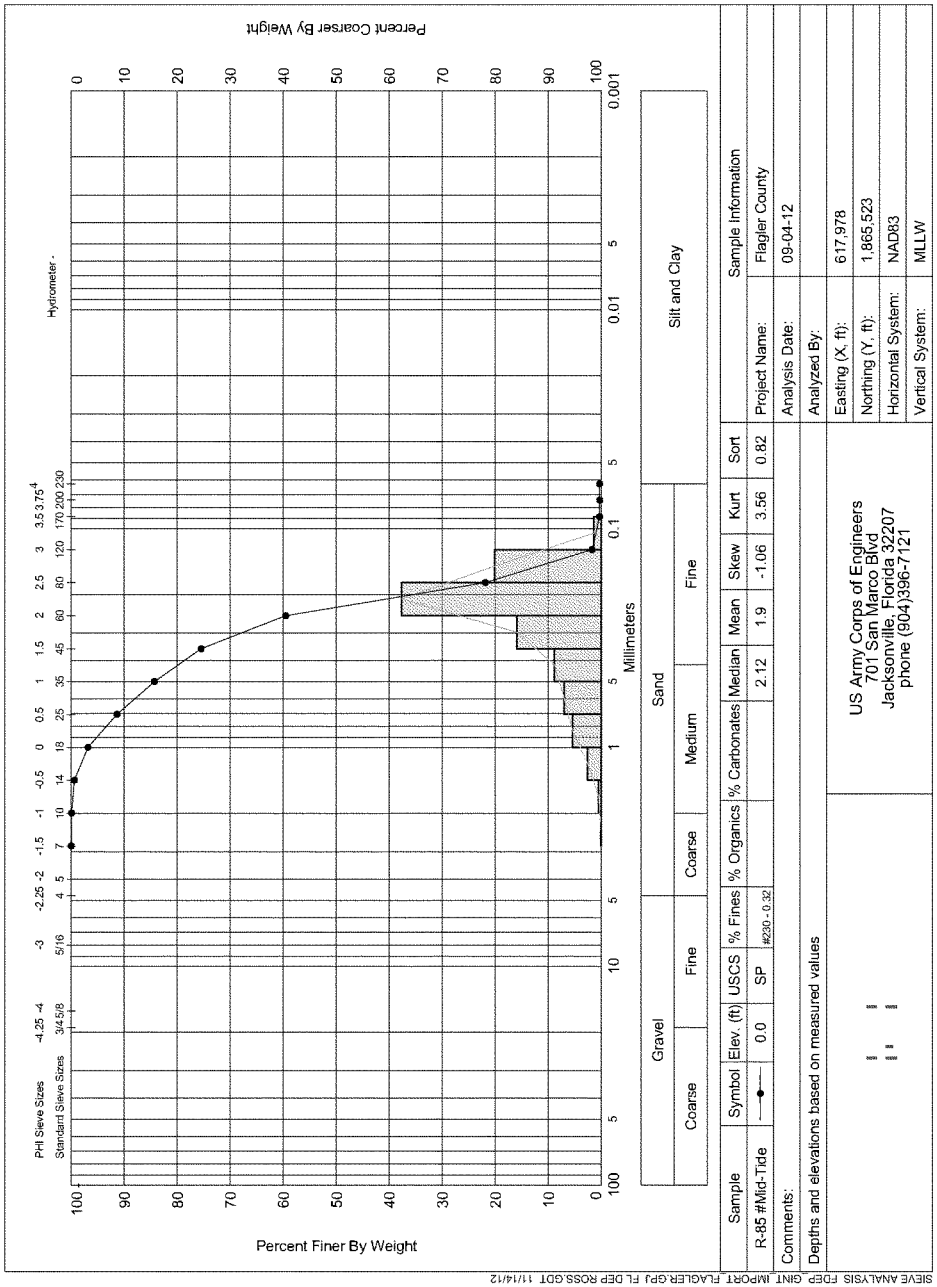

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample Information
Project Name: Flagler County
Analysis Date: 09-04-12
Analyzed By:
Easting (X, ft): 616,574
Northing (Y, ft): 1,868,930
Horizontal System: NAD83
Vertical System: MLLW
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
R-81 #-5
-0.1
SP
#230 - 0.64
2.62
2.55
-3.18
23.24
0.47
Comments:
Depths and elevations based on measured values
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

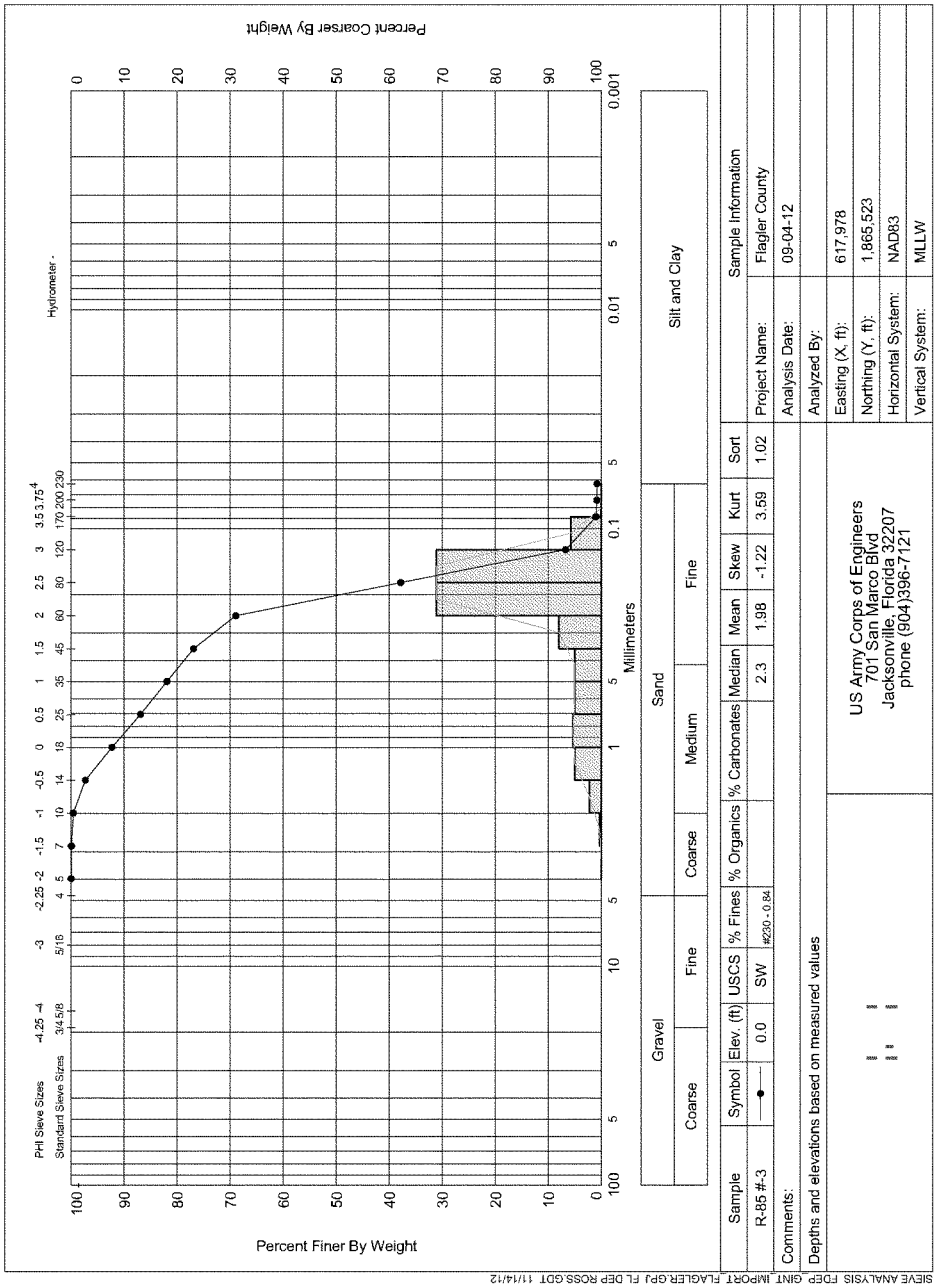

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
R-81 #10
Symbol
Elev. (ft)
-0.1
USCS
SP
% Fines
#230 - 0.87
% Organics
% Carbonates
8.30
Median
2.73
Mean
2.56
Skew
-3.03
Kurt
13.91
Sort
0.79
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-04-12
Analyzed By:
Easting (X, ft):
616,574
Northing (Y, ft):
1,868,930
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

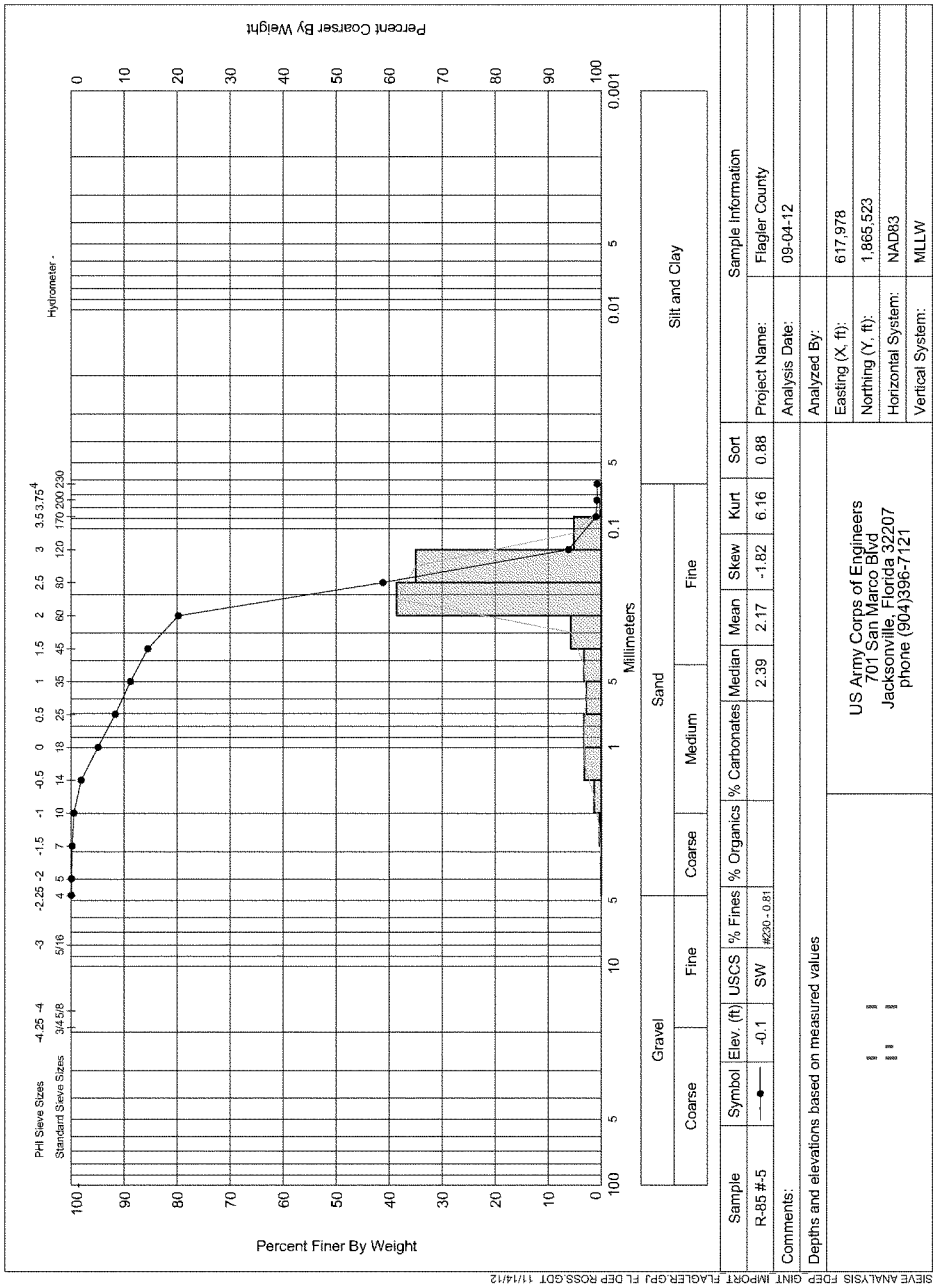

PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer
Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-81 #-15
-0.1
SW
#230 - 1.10
2.74
2.49
-2.41
8.78
0.97
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-04-12
Analyzed By:
Easting (X, ft):
616,574
Northing (Y, ft):
1,868,930
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

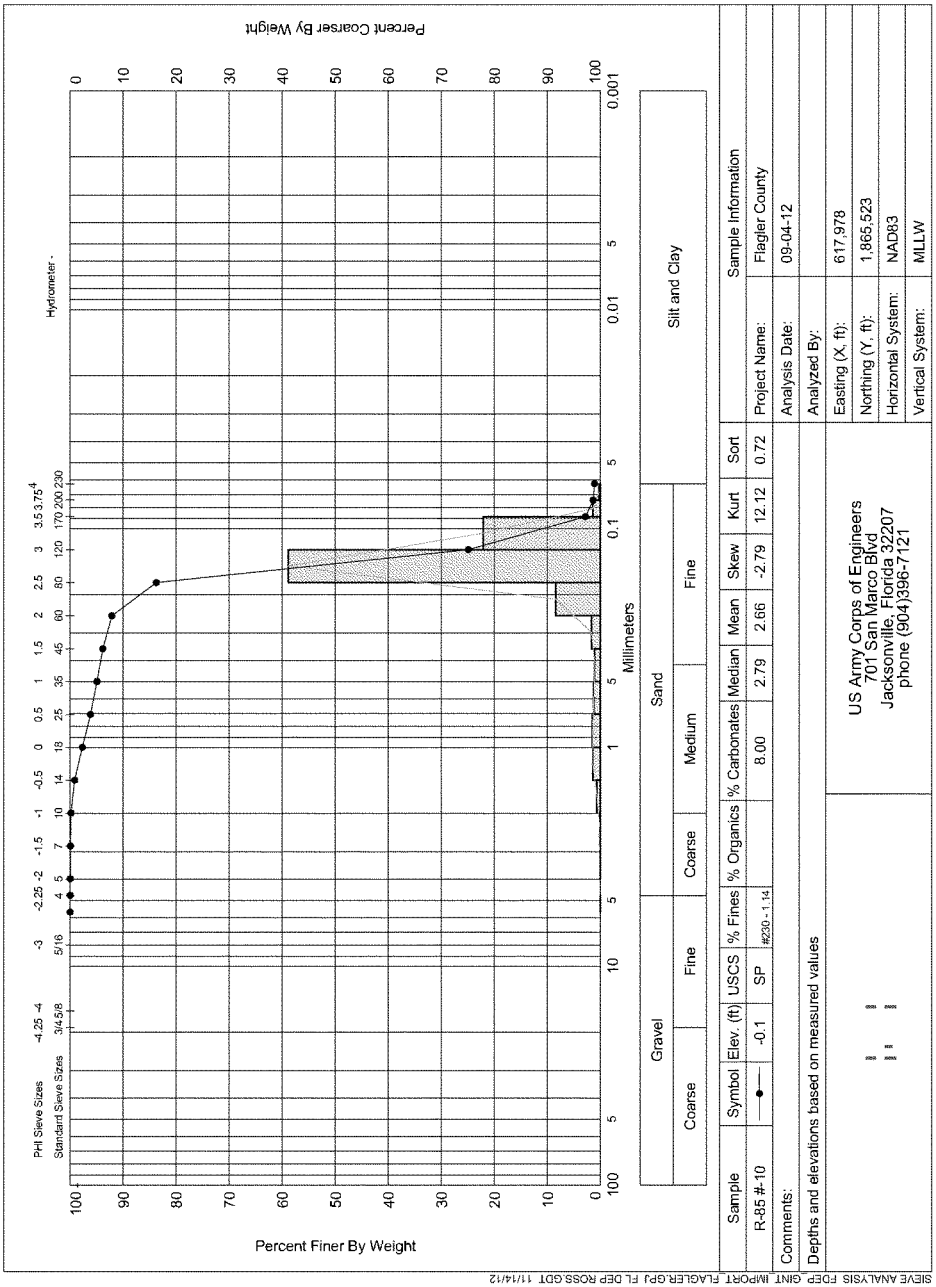

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample Information
Project Name: Flagler County
Analysis Date: 09-04-12
Analyzed By:
Easting (X, ft): 616,574
Northing (Y, ft): 1,868,930
Horizontal System: NAD83
Vertical System: MLLW
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
R-81 #-20
-0.1
SP
#230 - 1.21
2.84
2.83
-4.01
31.76
0.51
Comments:
Depths and elevations based on measured values
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

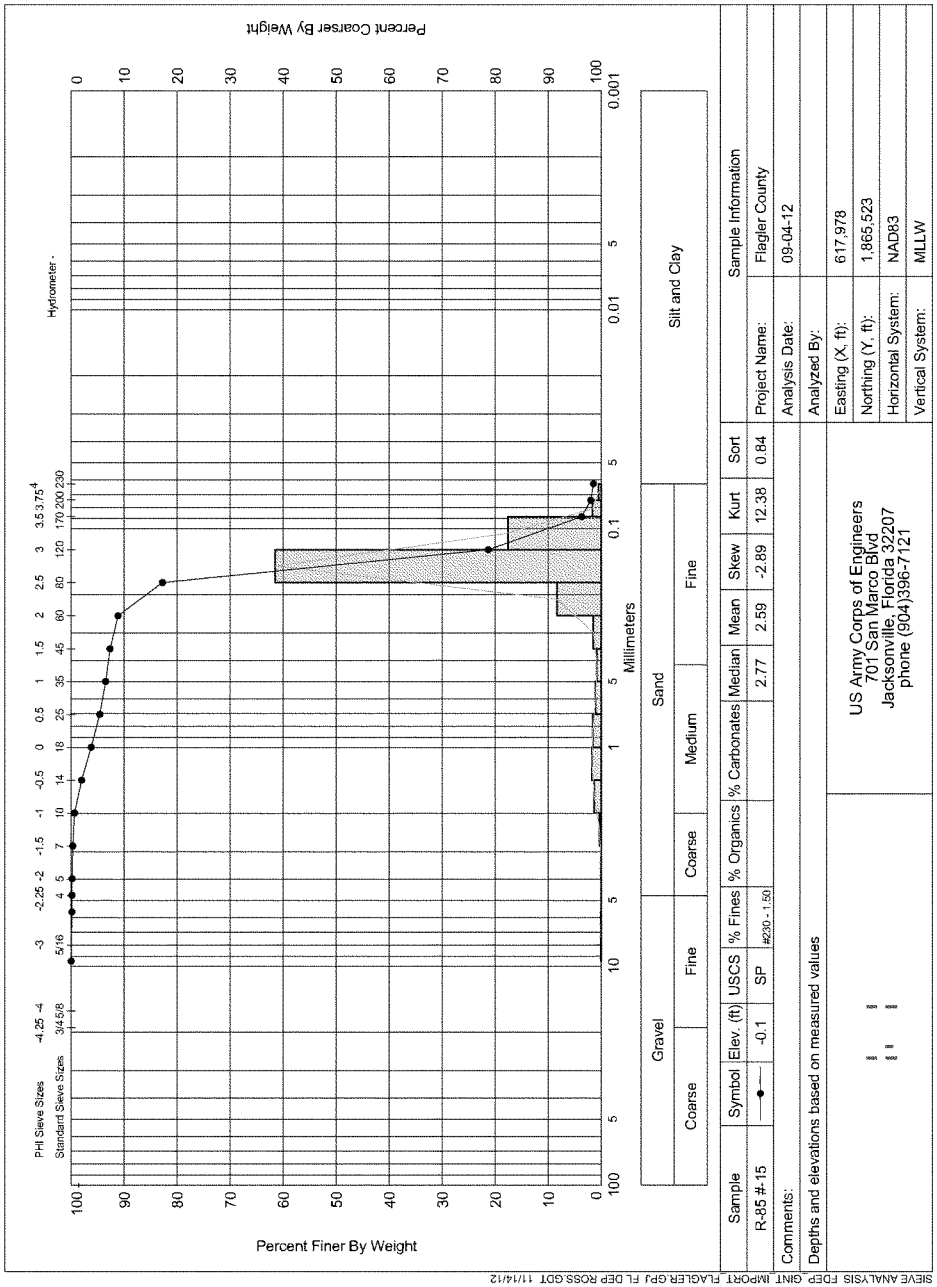

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-85 #Berm
0.0
SW
#230 - 0.11
1.58
1.42
-0.55
2.82
0.89
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-04-12
Analyzed By:
Easting (X, ft):
617,978
Northing (Y, ft):
1,865,523
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

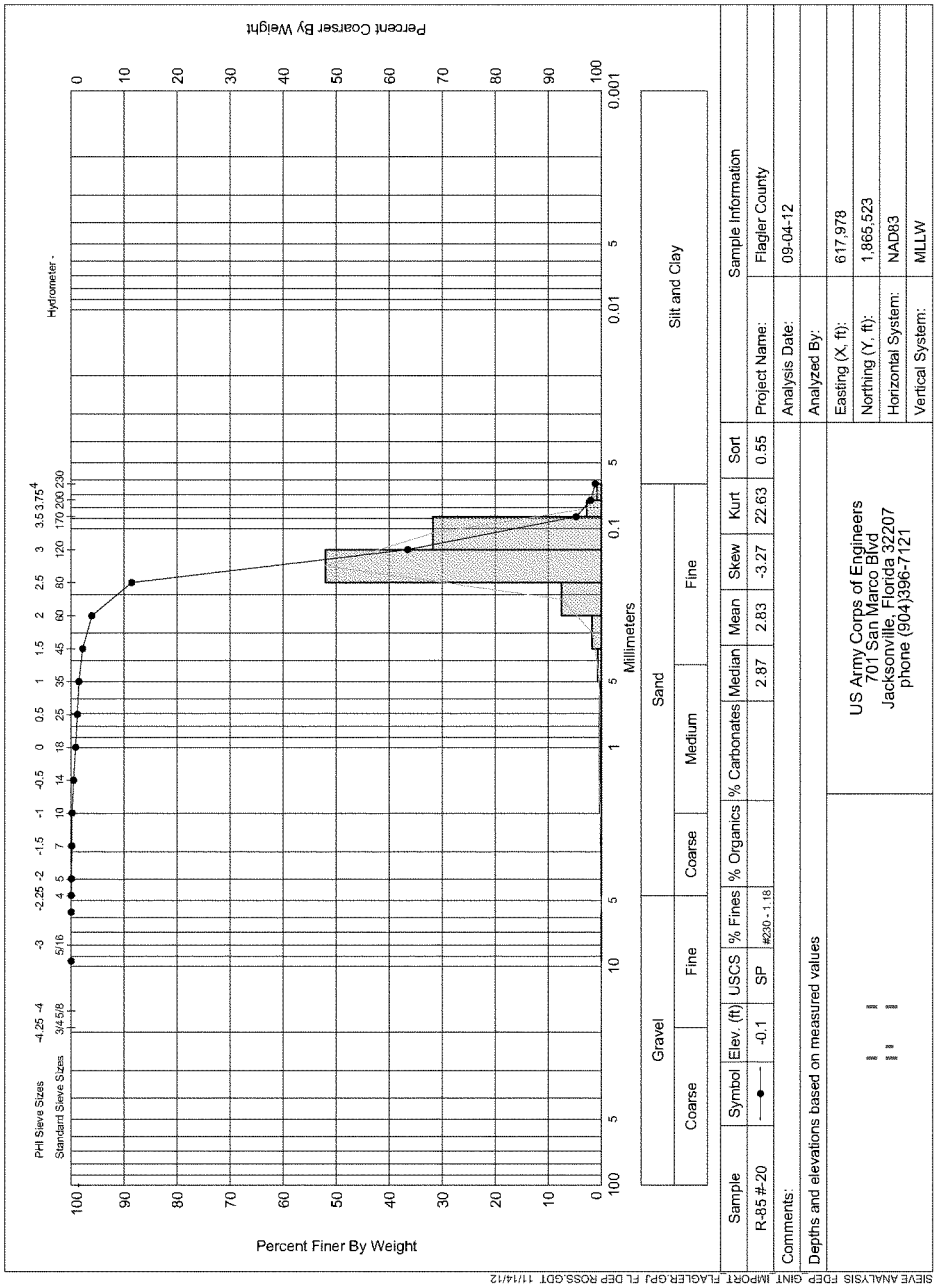

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-85 #Mid-Tide
0.0
SP
#230 - 0.32
2.12
1.9
-1.06
3.56
0.82
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-04-12
Analyzed By:
Easting (X, ft):
617,978
Northing (Y, ft):
1,865,523
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

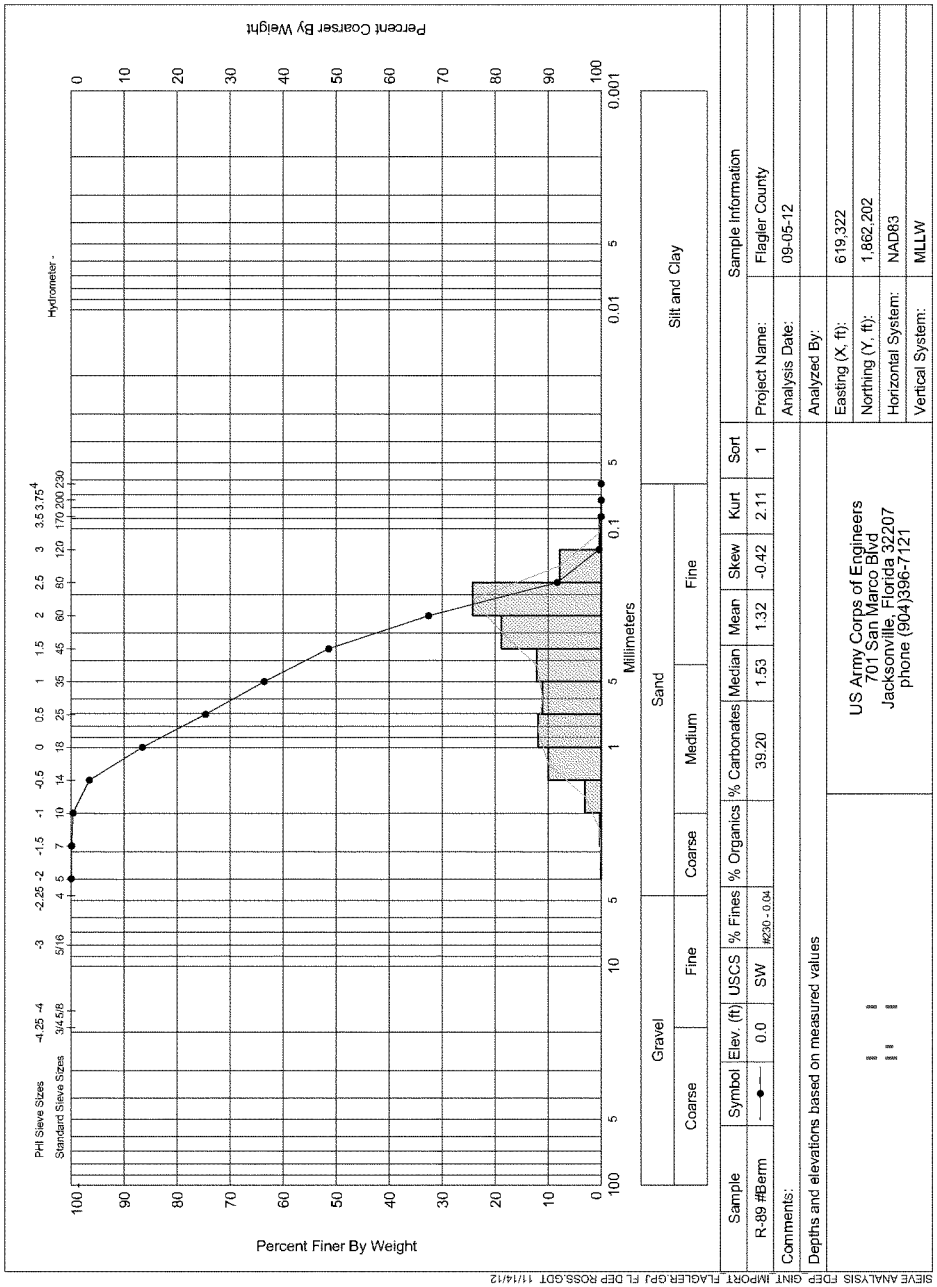

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-85 #-3
0.0
SW
#230 - 0.84
2.3
1.98
-1.22
3.59
1.02
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-04-12
Analyzed By:
Easting (X, ft):
617,978
Northing (Y, ft):
1,865,523
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

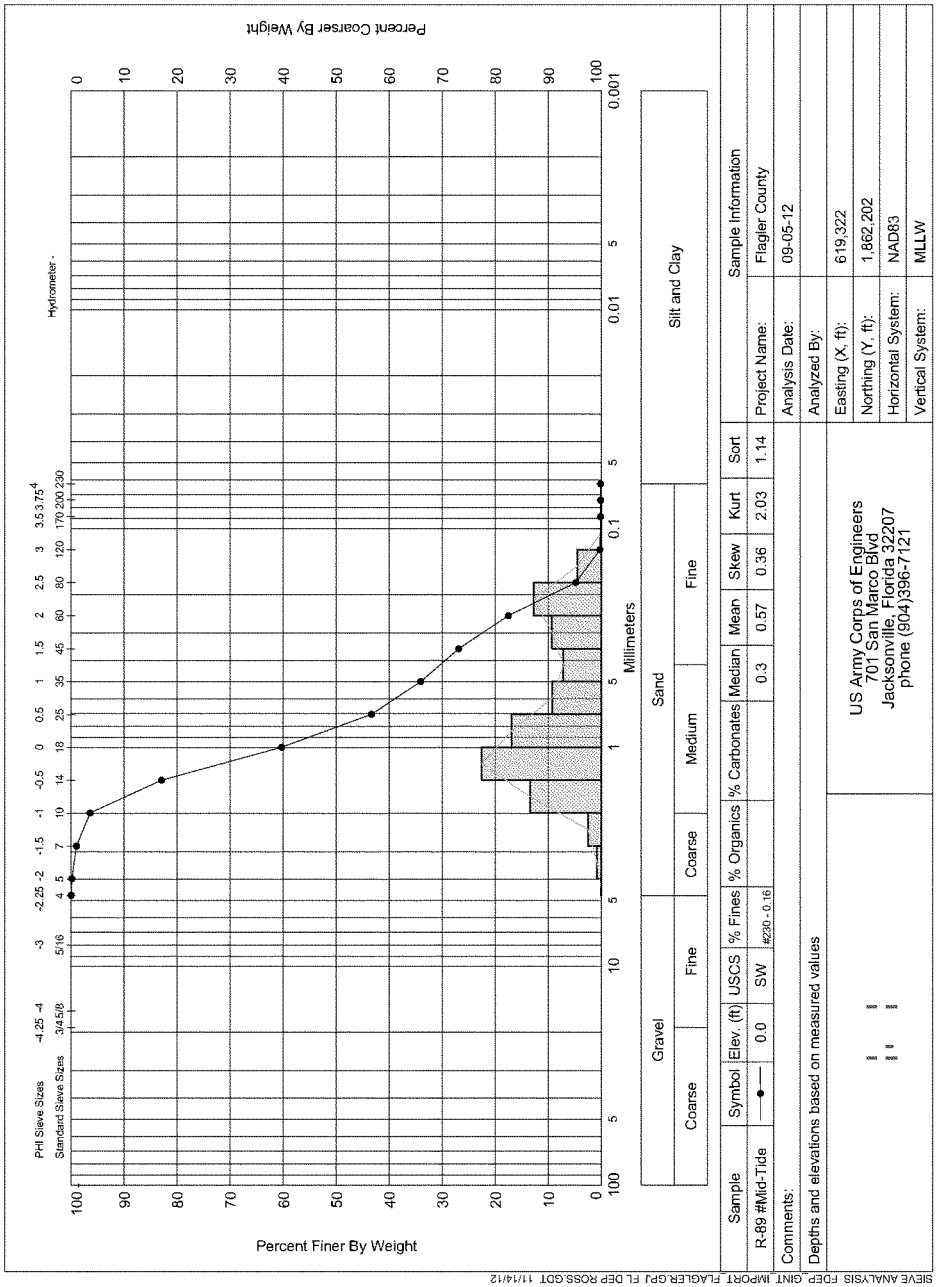

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample Information
Project Name: Flagler County
Analysis Date: 09-04-12
Analyzed By:
Easting (X, ft): 617,978
Northing (Y, ft): 1,865,523
Horizontal System: NAD83
Vertical System: MLLW
Sample | Symbol | Elev. (ft) | USCS | % Fines | % Organics | % Carbonates | Median | Mean | Skew | Kurt | Sort
R-85 #-5 | -0.1 | SW | #230 - 0.81 | | | 2.39 | 2.17 | -1.82 | 6.16 | 0.88
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

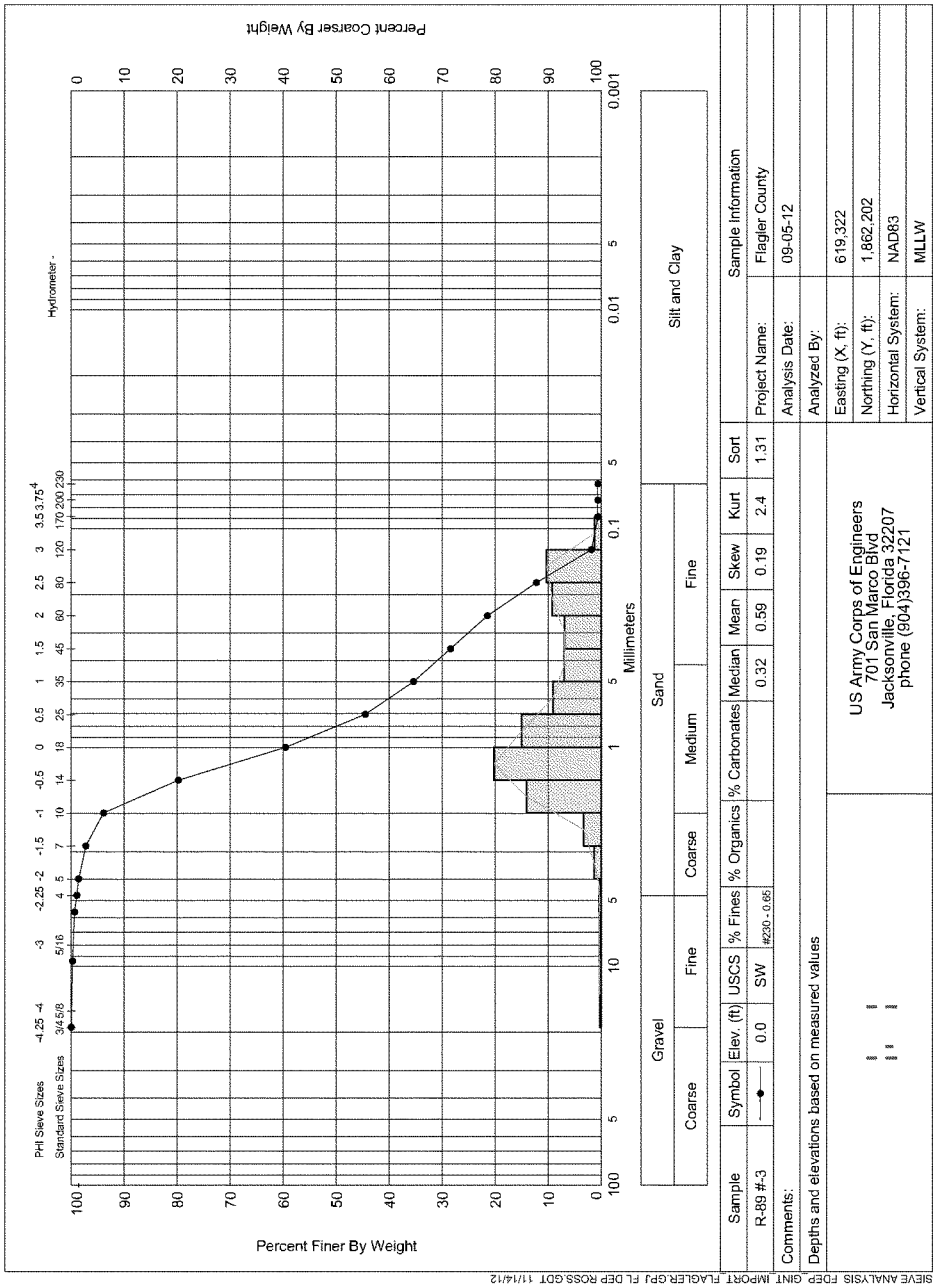

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-85 #-10
-0.1
SP
#230 - 1.14
8.00
2.79
2.66
-2.79
12.12
0.72
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name: Flagler County
Analysis Date: 09-04-12
Analyzed By:
Easting (X, ft): 617,978
Northing (Y, ft): 1,865,523
Horizontal System: NAD83
Vertical System: MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

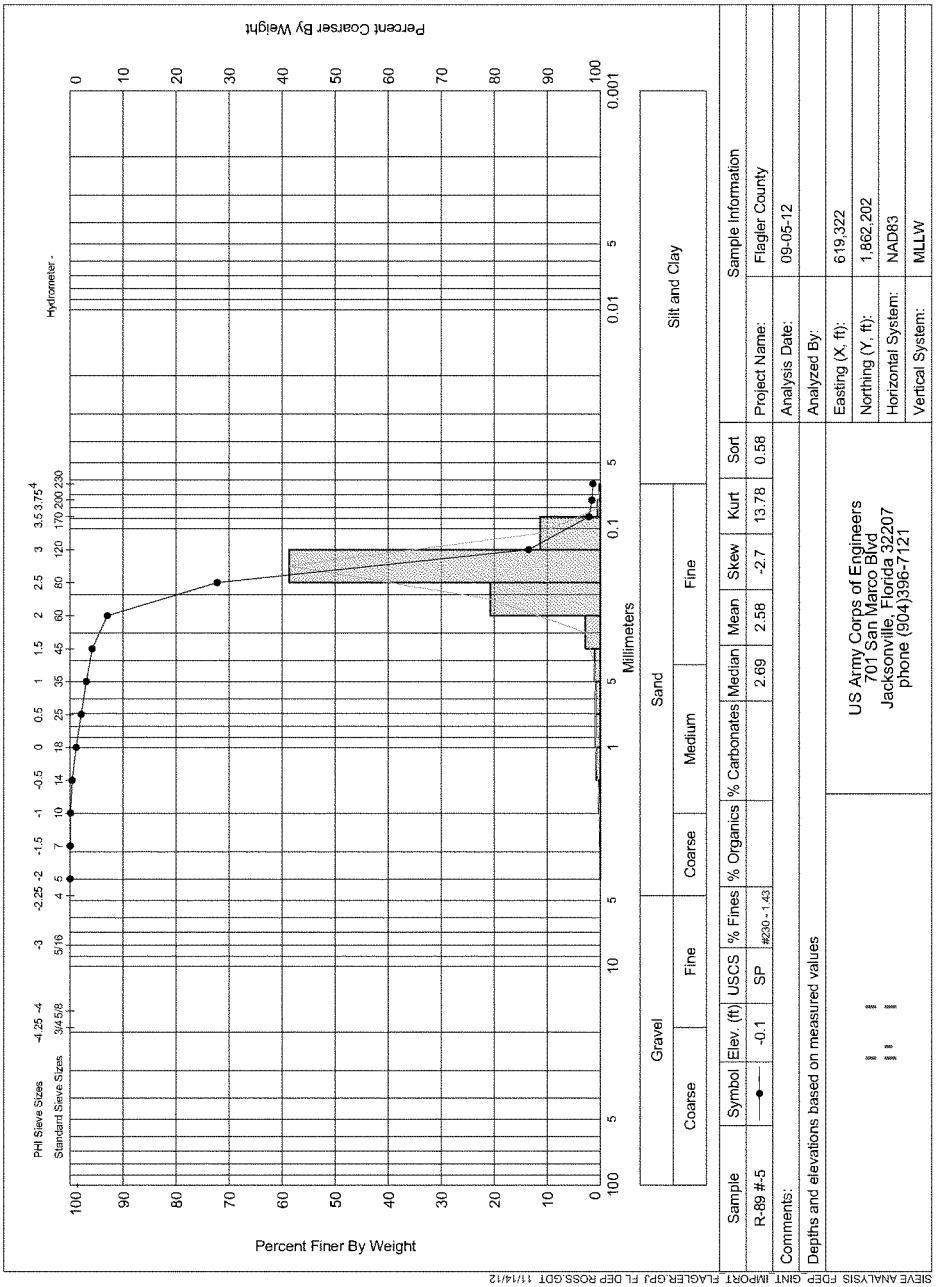

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
R-85 # 15
Symbol
Elev. (ft)
-0.1
USCS
SP
% Fines
#230 - 1.50
% Organics
% Carbonates
Median
2.77
Mean
2.59
Skew
-2.89
Kurt
12.38
Sort
0.84
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-04-12
Analyzed By:
Easting (X, ft):
617,978
Northing (Y, ft):
1,965,523
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

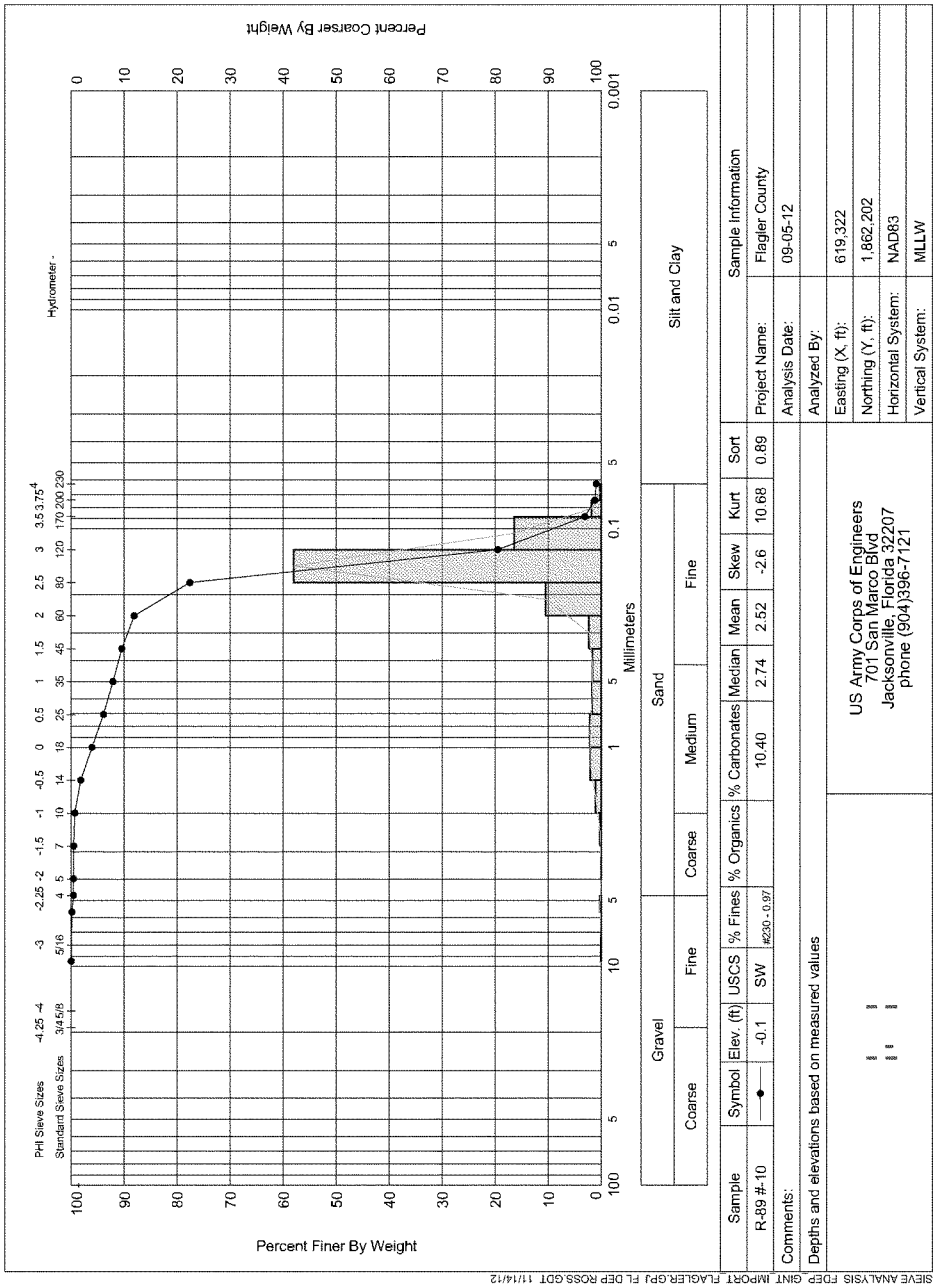

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-85 #-20
-0.1
SP
#230 - 1.18
2.87
2.83
-3.27
22.63
0.55
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-04-12
Analyzed By:
Easting (X, ft):
617,978
Northing (Y, ft):
1,865,523
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

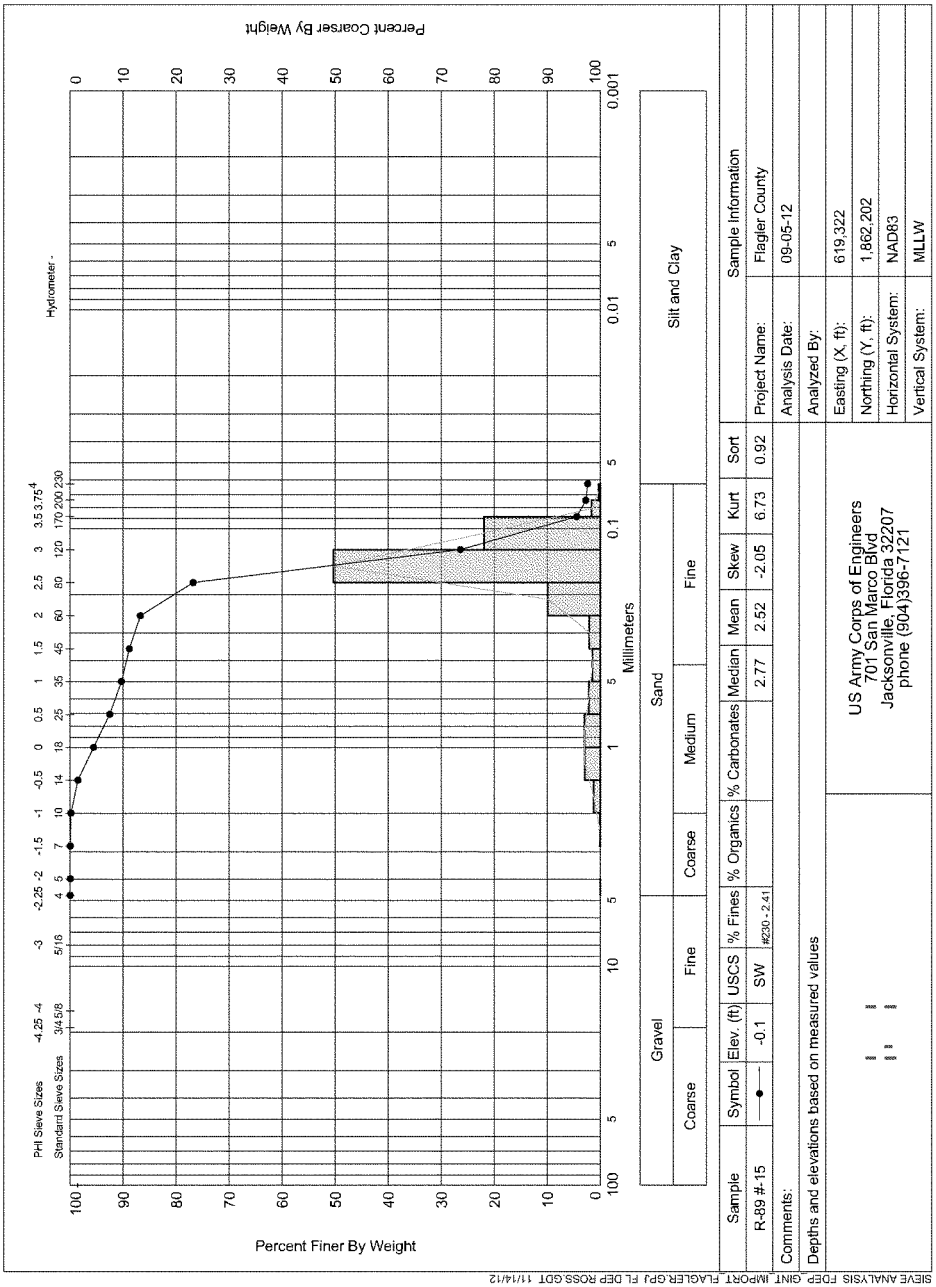

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-89 #Berm
0.0
SW
#230 - 0.04
39.20
1.53
1.32
-0.42
2.11
1
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
619,322
Northing (Y, ft):
1,862,202
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

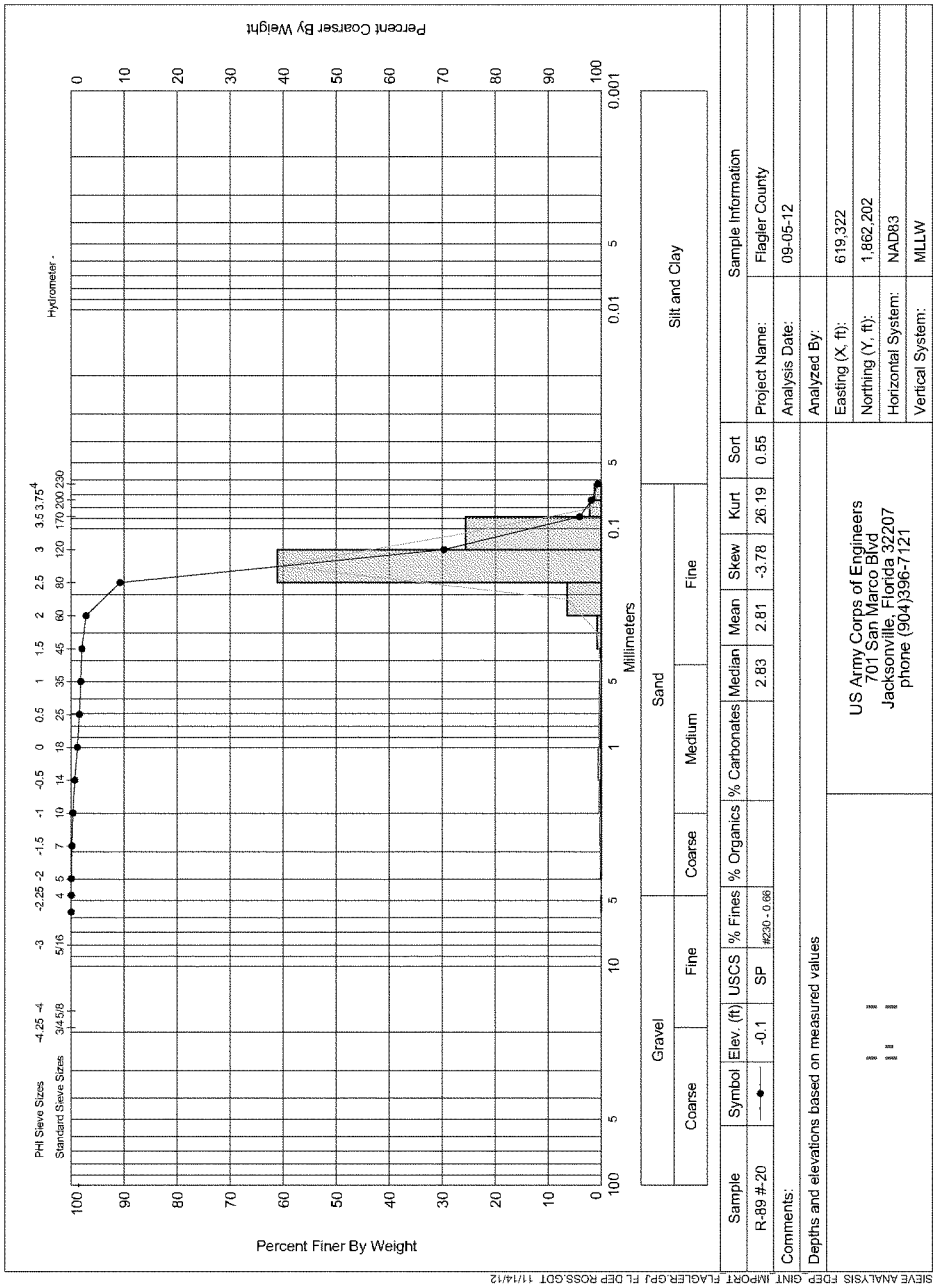

Percent Coarser By Weight
Percent Finer By Weight
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-89 ffMid-Tide
0.0
SW
#230 - 0.16
0.3
0.57
0.36
2.03
1.14
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
619,322
Northing (Y, ft):
1,862,202
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

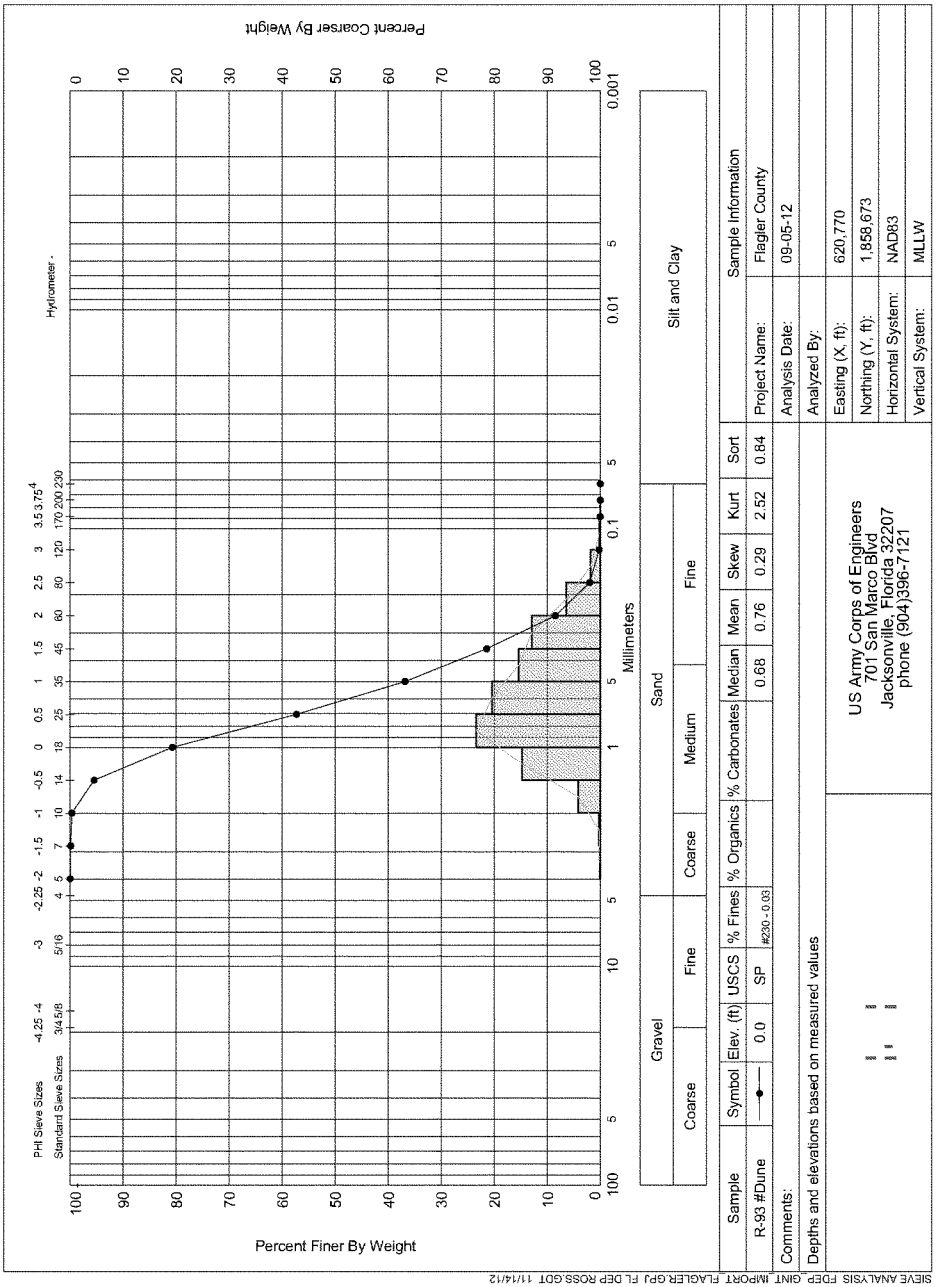

Percent Coarser By Weight
Percent Finer By Weight
Millimeters
PHI Sieve Sizes
Standard Sieve Sizes
Hydrometer -
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-89 #-3
0.0
SW
#230 - 0.65
0.32
0.59
0.19
2.4
1.31
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
619,322
Northing (Y, ft):
1,862,202
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

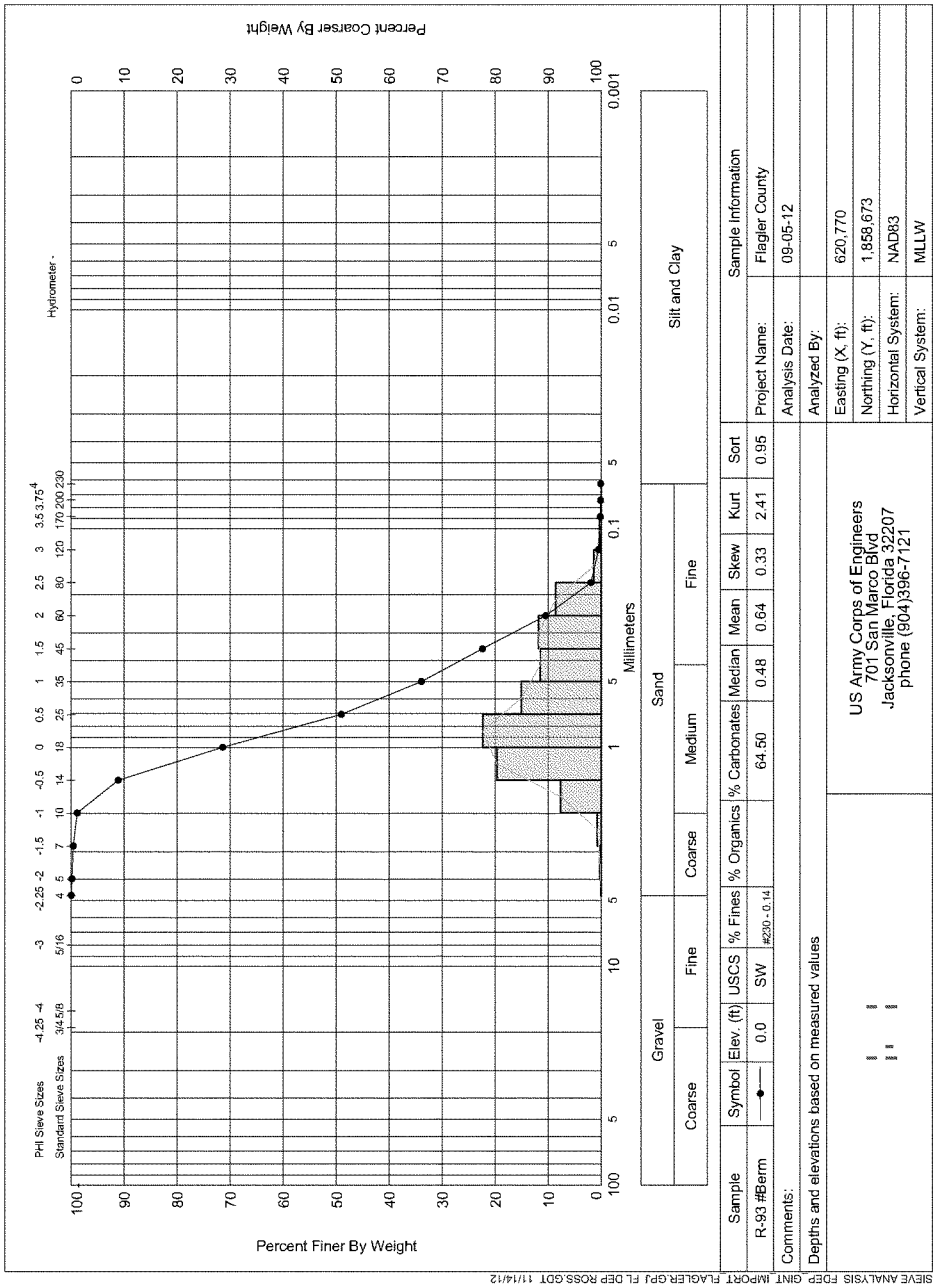

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-89 #-5
-0.1
SP
#230 - 1.43
2.69
2.58
-2.7
13.78
0.58
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
619,322
Northing (Y, ft):
1,862,202
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

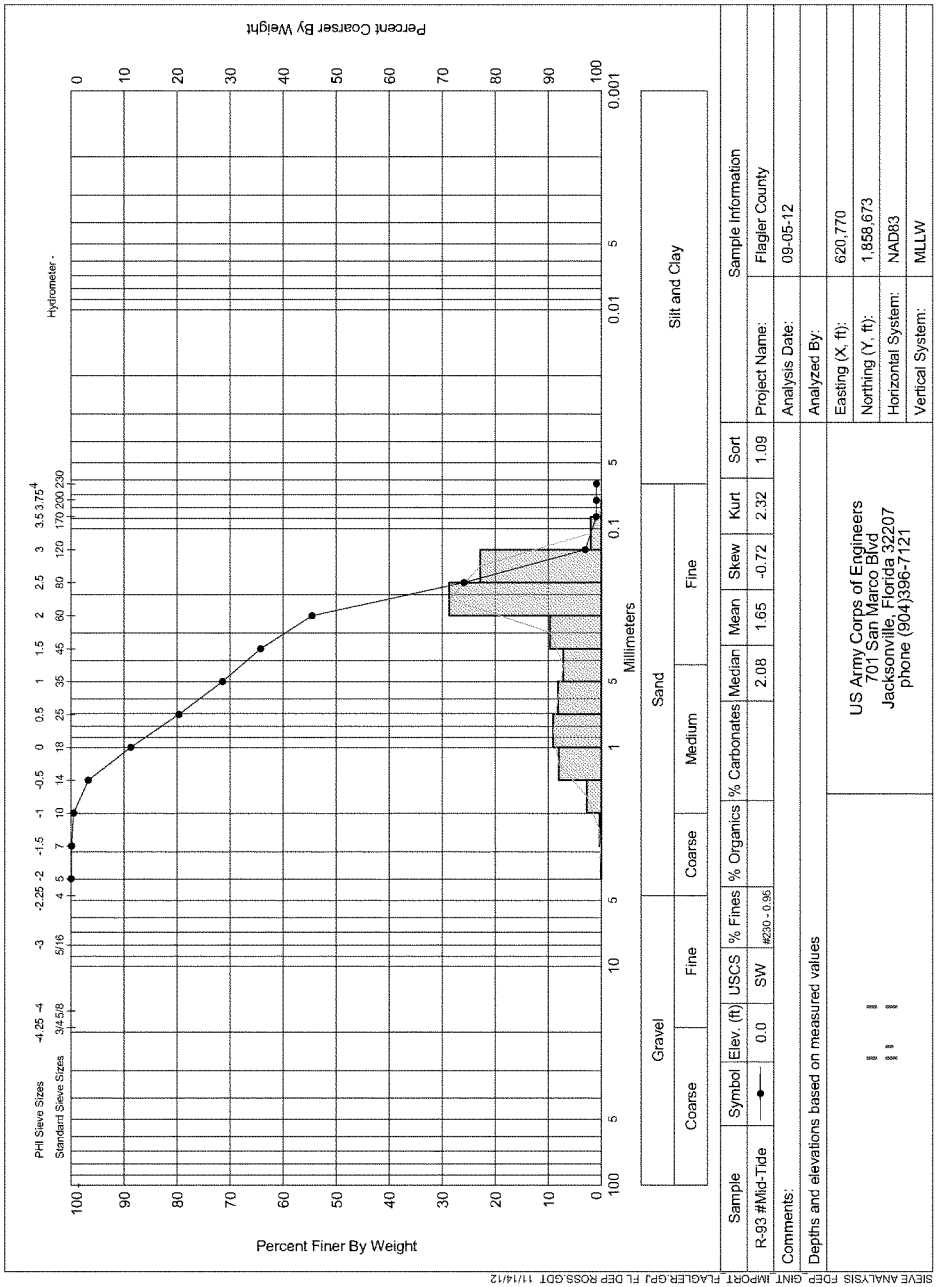

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
R-89 #-10
Symbol
Elev. (ft)
-0.1
USCS
SW
% Fines
#230 - 0.97
% Organics
% Carbonates
10.40
Median
2.74
Mean
2.52
Skew
-2.6
Kurt
10.68
Sort
0.89
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
619,322
Northing (Y, ft):
1,862,202
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

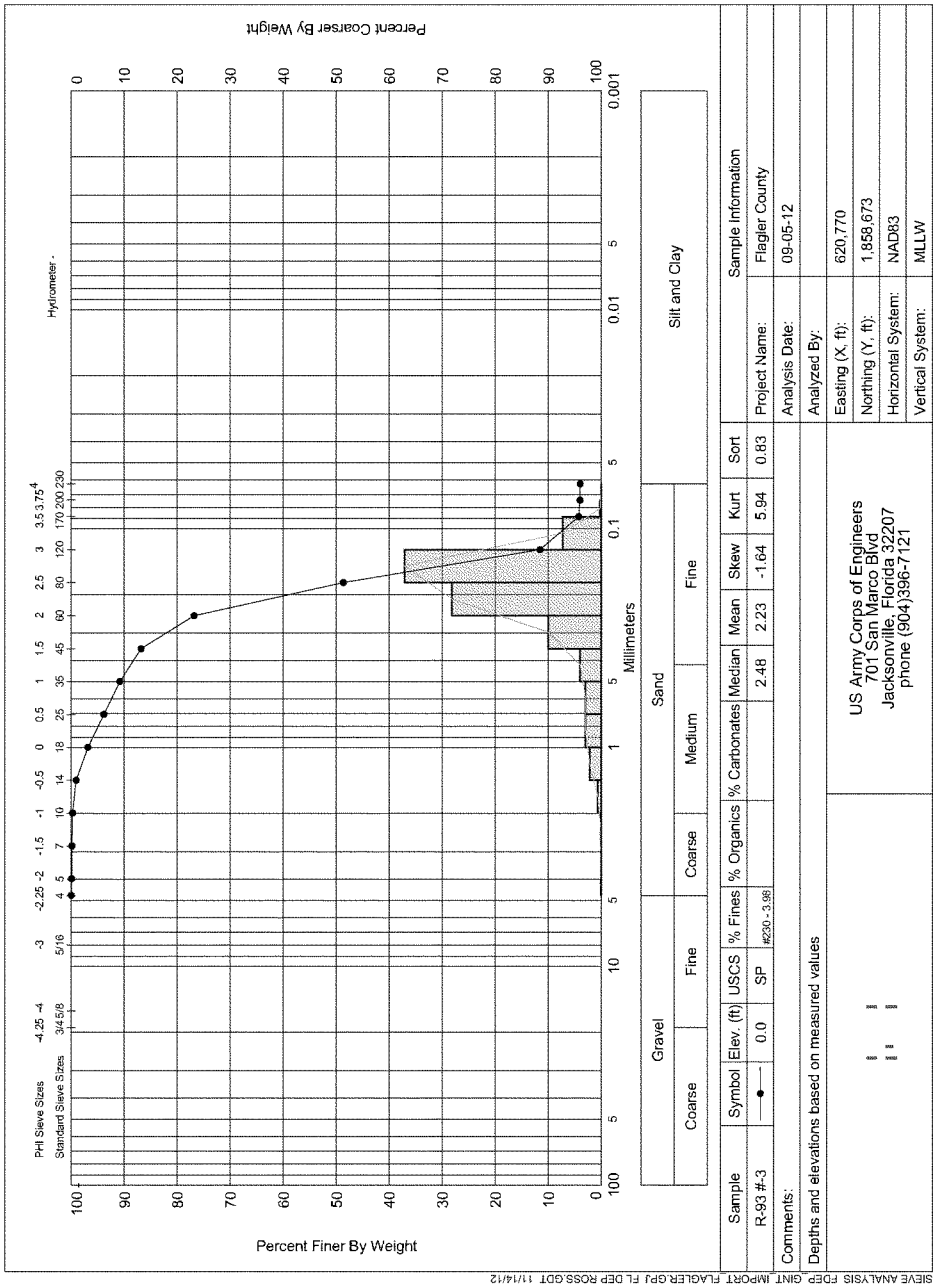

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-89 #-15
-0.1
SW
#230 - 2.41
2.77
2.52
-2.05
6.73
0.92
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
619,322
Northing (Y, ft):
1,862,202
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

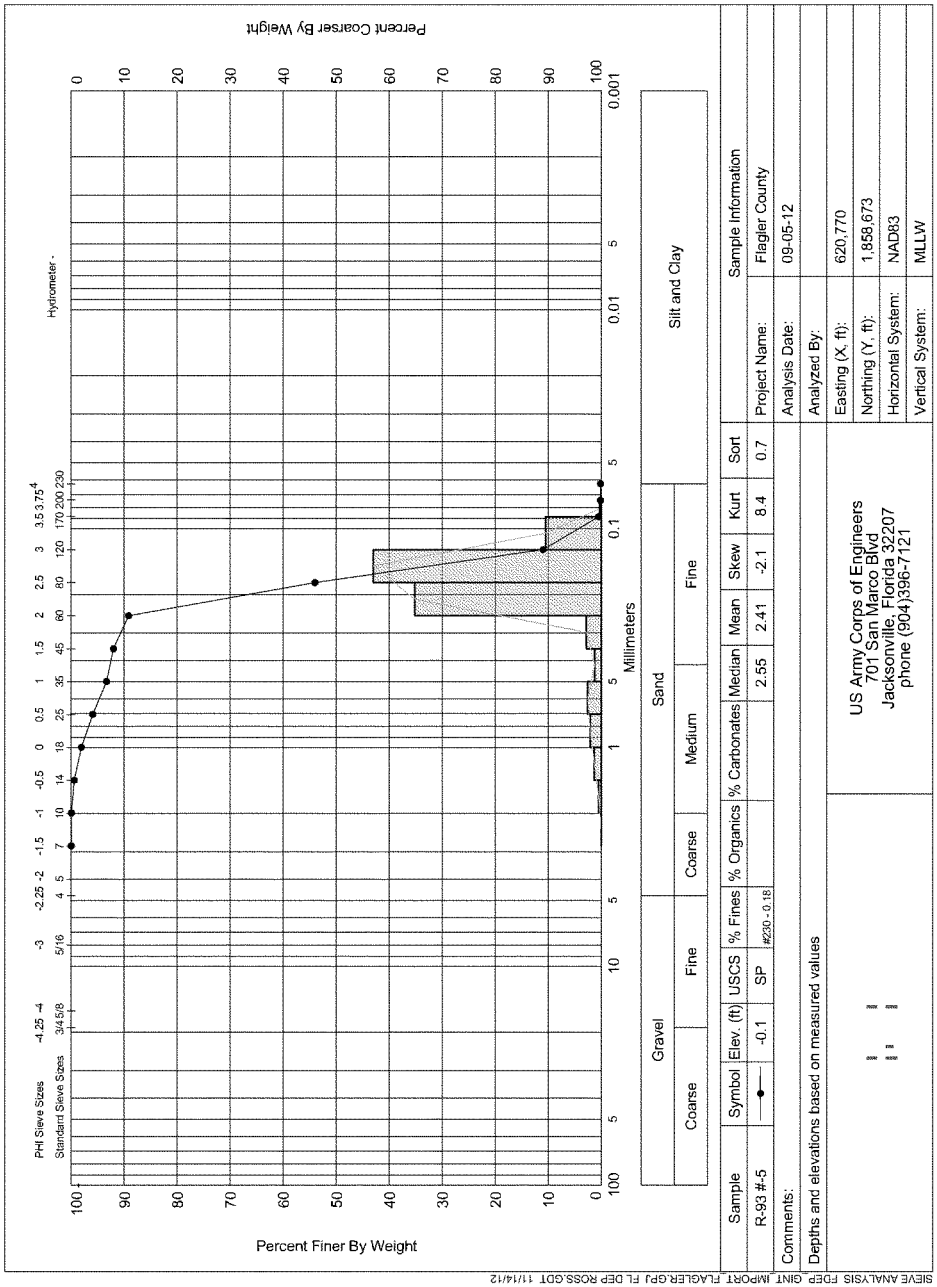

Percent Finer By Weight
Percent Coarser By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-89 #-20
-0.1
SP
#230 - 0.66
2.83
2.81
-3.78
26.19
0.55
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
619,322
Northing (Y, ft):
1,862,202
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

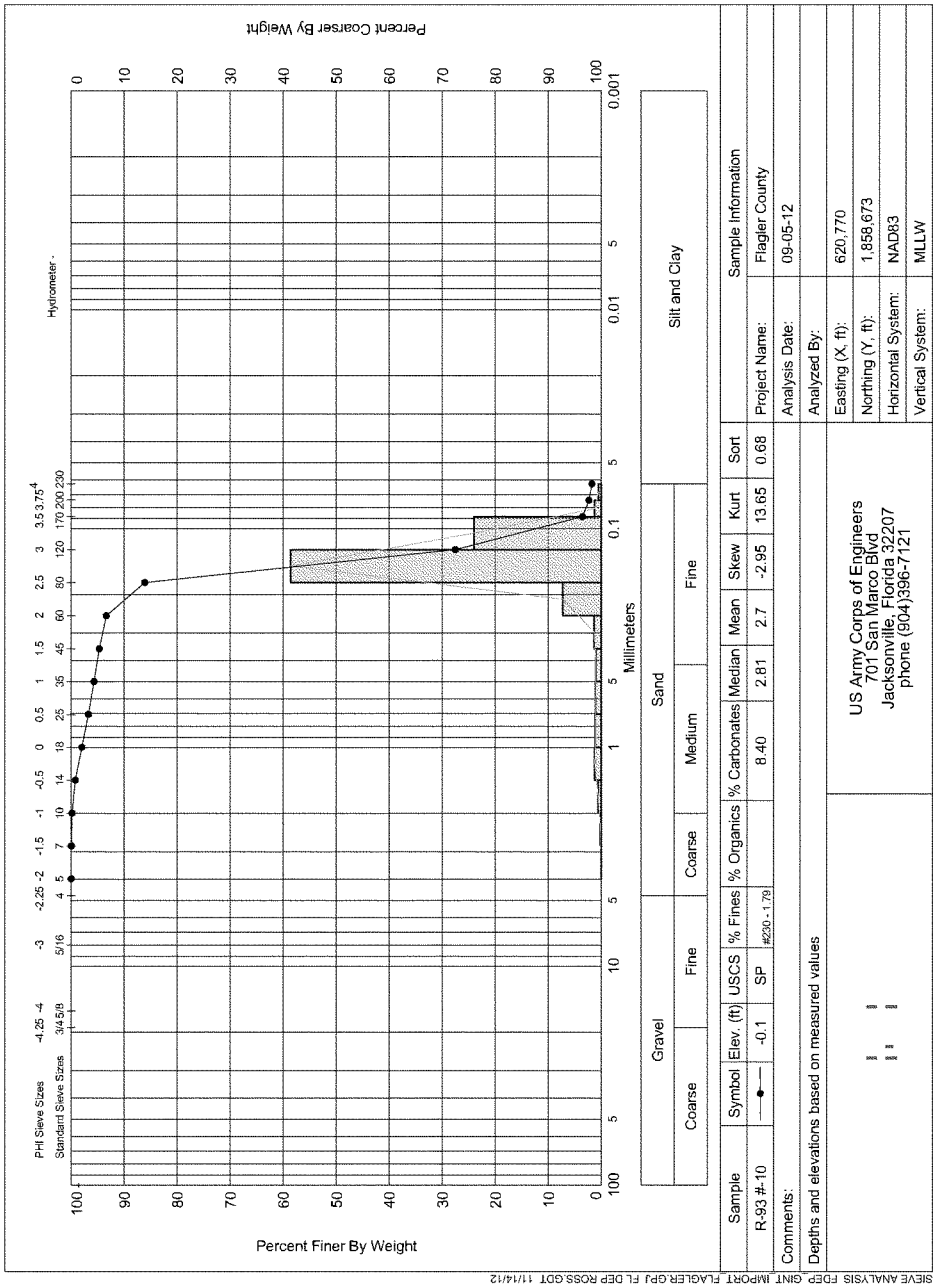

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-93 #Dune
0.0
SP
#230 - 0.03
0.68
0.76
0.29
2.52
0.84
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
620,770
Northing (Y, ft):
1,858,673
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

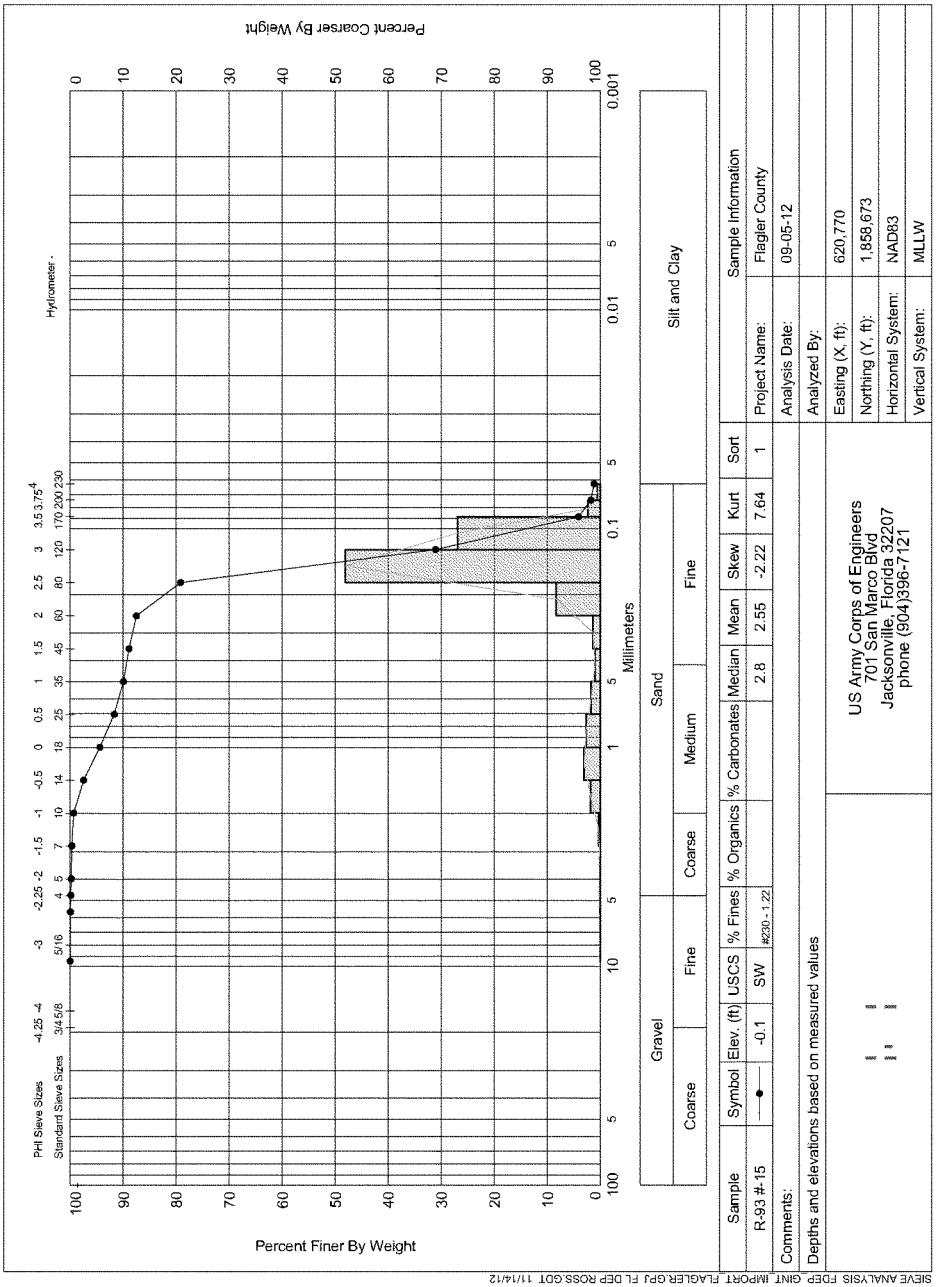

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-93 #Berm
0.0
SW
#230 - 0.14
64.50
0.48
0.64
0.33
2.41
0.95
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
620,770
Northing (Y, ft):
1,858,673
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

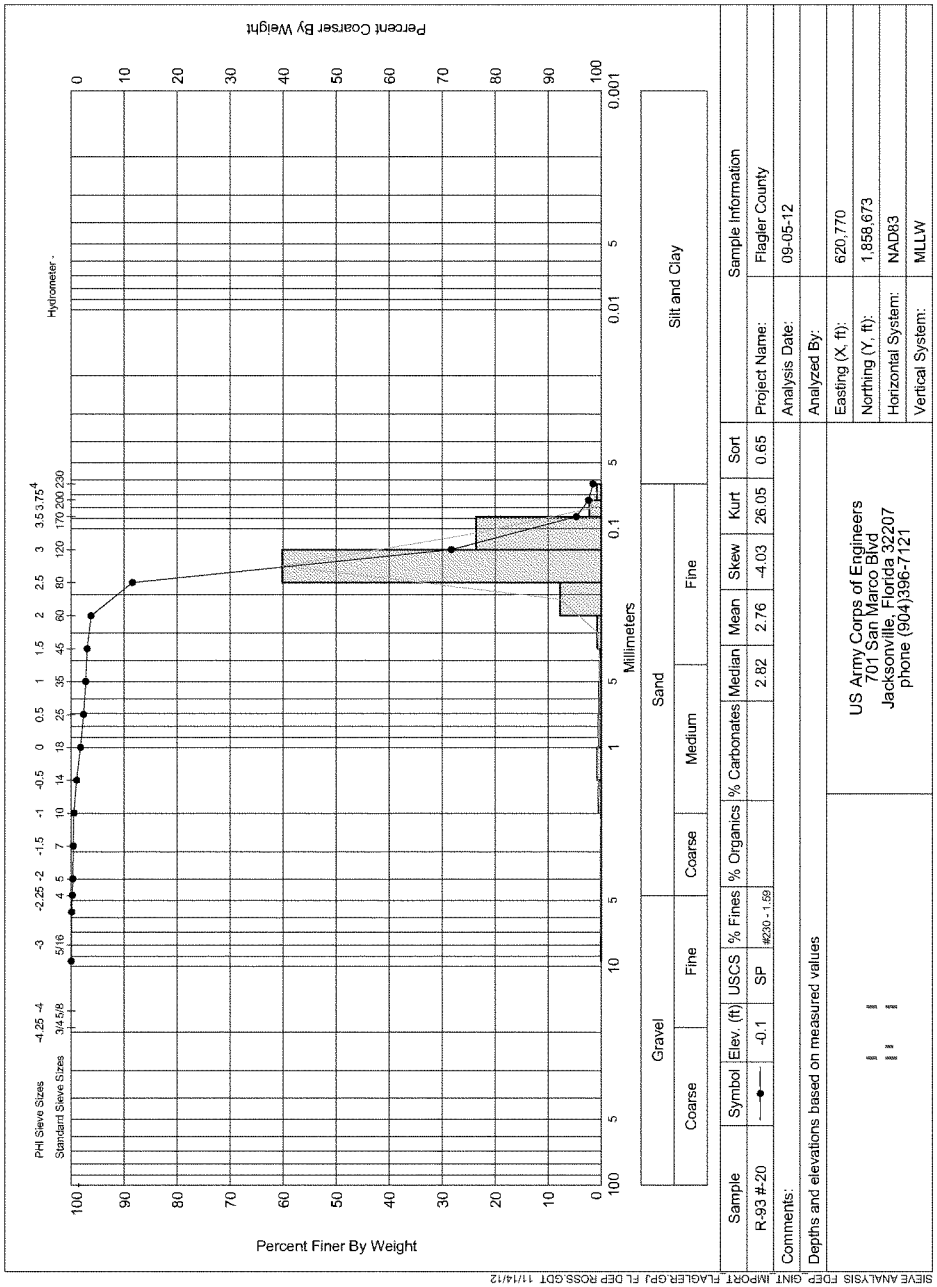

Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-93 #Mid-Tide
0.0
SW
#230 - 0.99
2.08
1.65
-0.72
2.32
1.09
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
620,770
Northing (Y, ft):
1,858,673
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-93 #-3
0.0
SP
#230 - 3.98
2.48
2.23
-1.64
5.94
0.83
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
620,770
Northing (Y, ft):
1,858,673
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Medium
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-93 #-5
-0.1
SP
#230 - 0.18
2.55
2.41
-2.1
8.4
0.7
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
620,770
Northing (Y, ft):
1,858,673
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
R-93 #-10
Symbol
Elev. (ft)
-0.1
USCS
SP
% Fines
#230 - 1.79
% Organics
% Carbonates
8.40
Median
2.81
Mean
2.7
Skew
-2.95
Kurt
13.65
Sort
0.68
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
620,770
Northing (Y, ft):
1,858,673
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Sand
Silt and Clay
Coarse
Fine
Coarse
Medium
Fine
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-93 #-15
-0.1
SW
#230 - 1.22
2.8
2.55
-2.22
7.64
1
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
620,770
Northing (Y, ft):
1,858,673
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12


Percent Coarser By Weight
Percent Finer By Weight
Hydrometer -
PHI Sieve Sizes
Standard Sieve Sizes
Millimeters
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt and Clay
Sample
Symbol
Elev. (ft)
USCS
% Fines
% Organics
% Carbonates
Median
Mean
Skew
Kurt
Sort
R-93 #-20
-0.1
SP
#230 - 1.59
2.82
2.76
-4.03
26.05
0.65
Comments:
Depths and elevations based on measured values
US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121
Sample Information
Project Name:
Flagler County
Analysis Date:
09-05-12
Analyzed By:
Easting (X, ft):
620,770
Northing (Y, ft):
1,858,673
Horizontal System:
NAD83
Vertical System:
MLLW
SIEVE ANALYSIS FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-81 #Berm
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
616,574	1,868,930		0.0 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/2	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 0.07		40.30	42.90

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.13	0.13
#7	-1.50	2.82	0.13	0.26
#10	-1.00	2.00	0.46	0.72
#14	-0.50	1.41	2.76	3.48
#18	0.00	1.00	8.34	11.82
#25	0.50	0.71	11.03	22.85
#35	1.00	0.50	13.77	36.62
#45	1.50	0.35	18.71	55.33
#60	2.00	0.25	24.03	79.36
#80	2.50	0.18	16.99	96.35
#120	3.00	0.13	3.10	99.45
#170	3.50	0.09	0.46	99.91
#200	3.75	0.07	0.01	99.92
#230	4.00	0.06	0.01	99.93

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.46	2.13	1.91	1.35	0.58	0.19	-0.41

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.21	0.43	0.9	-0.49	2.71

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-81 #Mid-Tide
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
616,574	1,868,930		0.0 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/2	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.05			42.80

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.10	0.10
#7	-1.50	2.82	0.08	0.18
#10	-1.00	2.00	0.36	0.54
#14	-0.50	1.41	2.81	3.35
#18	0.00	1.00	9.14	12.49
#25	0.50	0.71	13.03	25.52
#35	1.00	0.50	13.94	39.46
#45	1.50	0.35	14.51	53.97
#60	2.00	0.25	16.64	70.61
#80	2.50	0.18	19.50	90.11
#120	3.00	0.13	9.33	99.44
#170	3.50	0.09	0.48	99.92
#200	3.75	0.07	0.01	99.93
#230	4.00	0.06	0.02	99.95

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.76	2.34	2.11	1.36	0.48	0.13	-0.41

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.27	0.41	1	-0.28	2.21

USACE GRANULARMETRIC REPORT FDEP .GINT IMPORT FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-81 #-3
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
616,574	1,868,930		0.0 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.81			2.80

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.05	0.05
#7	-1.50	2.82	0.03	0.08
#10	-1.00	2.00	0.04	0.12
#14	-0.50	1.41	0.20	0.32
#18	0.00	1.00	0.52	0.84
#25	0.50	0.71	0.71	1.55
#35	1.00	0.50	0.80	2.35
#45	1.50	0.35	1.35	3.70
#60	2.00	0.25	4.73	8.43
#80	2.50	0.18	28.37	36.80
#120	3.00	0.13	53.95	90.75
#170	3.50	0.09	8.27	99.02
#200	3.75	0.07	0.16	99.18
#230	4.00	0.06	0.01	99.19

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.26	2.94	2.85	2.62	2.29	2.13	1.63

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.52	0.17	0.54	-2.64	15.18

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-81 #-5
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
616,574	1,868,930		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.64			1.90

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.06	0.06
#7	-1.50	2.82	0.04	0.10
#10	-1.00	2.00	0.03	0.13
#14	-0.50	1.41	0.25	0.38
#18	0.00	1.00	0.30	0.68
#25	0.50	0.71	0.31	0.99
#35	1.00	0.50	0.35	1.34
#45	1.50	0.35	0.63	1.97
#60	2.00	0.25	3.06	5.03
#80	2.50	0.18	31.63	36.66
#120	3.00	0.13	55.46	92.12
#170	3.50	0.09	7.20	99.32
#200	3.75	0.07	0.03	99.35
#230	4.00	0.06	0.01	99.36

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.20	2.93	2.85	2.62	2.31	2.17	1.99

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.55	0.17	0.47	-3.18	23.24

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-81 #-10
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
616,574	1,868,930		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.87		8.30	5.70

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.18	0.18
#5	-2.00	3.99	0.18	0.36
#7	-1.50	2.82	0.13	0.49
#10	-1.00	2.00	0.17	0.66
#14	-0.50	1.41	0.86	1.52
#18	0.00	1.00	1.49	3.01
#25	0.50	0.71	1.48	4.49
#35	1.00	0.50	1.28	5.77
#45	1.50	0.35	1.14	6.91
#60	2.00	0.25	1.99	8.90
#80	2.50	0.18	13.28	22.18
#120	3.00	0.13	60.06	82.24
#170	3.50	0.09	15.98	98.22
#200	3.75	0.07	0.87	99.09
#230	4.00	0.06	0.04	99.13

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.40	3.06	2.94	2.73	2.52	2.27	0.70

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.56	0.17	0.79	-3.03	13.91

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-81 #-15
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
616,574	1,868,930		-0.1 MLLW

USCS	Munsell:	Comments:
SW	Moist - 10YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.10			8.90

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.14	0.14
#5	-2.00	3.99	0.16	0.30
#7	-1.50	2.82	0.16	0.46
#10	-1.00	2.00	0.62	1.08
#14	-0.50	1.41	2.05	3.13
#18	0.00	1.00	2.45	5.58
#25	0.50	0.71	1.97	7.55
#35	1.00	0.50	1.31	8.86
#45	1.50	0.35	1.09	9.95
#60	2.00	0.25	2.15	12.10
#80	2.50	0.18	12.03	24.13
#120	3.00	0.13	53.89	78.02
#170	3.50	0.09	18.97	96.99
#200	3.75	0.07	1.60	98.59
#230	4.00	0.06	0.31	98.90

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.45	3.16	2.97	2.74	2.51	2.16	-0.12

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.49	0.18	0.97	-2.41	8.78

USACE GRANULARMETRIC REPORT FDEP GINT IMPORT FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-81 #-20
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
616,574	1,868,930		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.21			2.00

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.07	0.07
#7	-1.50	2.82	0.11	0.18
#10	-1.00	2.00	0.11	0.29
#14	-0.50	1.41	0.24	0.53
#18	0.00	1.00	0.30	0.83
#25	0.50	0.71	0.25	1.08
#35	1.00	0.50	0.18	1.26
#45	1.50	0.35	0.29	1.55
#60	2.00	0.25	0.59	2.14
#80	2.50	0.18	7.34	9.48
#120	3.00	0.13	58.84	68.32
#170	3.50	0.09	27.69	96.01
#200	3.75	0.07	2.25	98.26
#230	4.00	0.06	0.53	98.79

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.48	3.28	3.12	2.84	2.63	2.56	2.19

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.83	0.14	0.51	-4.01	31.76

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-85 #Berm
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
617,978	1,865,523		0.0 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/2	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.11			31.90

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.08	0.08
#4	-2.25	4.75	0.00	0.08
#5	-2.00	3.99	0.00	0.08
#7	-1.50	2.82	0.04	0.12
#10	-1.00	2.00	0.22	0.34
#14	-0.50	1.41	1.38	1.72
#18	0.00	1.00	5.89	7.61
#25	0.50	0.71	10.45	18.06
#35	1.00	0.50	13.07	31.13
#45	1.50	0.35	15.08	46.21
#60	2.00	0.25	22.92	69.13
#80	2.50	0.18	22.92	92.05
#120	3.00	0.13	7.49	99.54
#170	3.50	0.09	0.32	99.86
#200	3.75	0.07	0.03	99.89
#230	4.00	0.06	0.00	99.89

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.70	2.32	2.13	1.58	0.76	0.40	-0.22

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.42	0.37	0.89	-0.55	2.82

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-85 #Mid-Tide
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
617,978	1,865,523		0.0 MLLW

USCS	Munsell:	Comments:
SP	Moist - 7.5YR 7/1	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 0.32			22.60

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#7	-1.50	2.82	0.00	0.00
#10	-1.00	2.00	0.08	0.08
#14	-0.50	1.41	0.51	0.59
#18	0.00	1.00	2.58	3.17
#25	0.50	0.71	5.46	8.63
#35	1.00	0.50	7.06	15.69
#45	1.50	0.35	8.83	24.52
#60	2.00	0.25	15.94	40.46
#80	2.50	0.18	37.65	78.11
#120	3.00	0.13	20.13	98.24
#170	3.50	0.09	1.42	99.66
#200	3.75	0.07	0.02	99.68
#230	4.00	0.06	0.00	99.68

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.92	2.65	2.46	2.12	1.51	1.02	0.17

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.9	0.27	0.82	-1.06	3.56

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-85 #-3
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
617,978	1,865,523		0.0 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/3	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.84			21.50

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.05	0.05
#10	-1.00	2.00	0.35	0.40
#14	-0.50	1.41	2.28	2.68
#18	0.00	1.00	5.01	7.69
#25	0.50	0.71	5.39	13.08
#35	1.00	0.50	4.98	18.06
#45	1.50	0.35	5.02	23.08
#60	2.00	0.25	7.98	31.06
#80	2.50	0.18	31.09	62.15
#120	3.00	0.13	31.08	93.23
#170	3.50	0.09	5.75	98.98
#200	3.75	0.07	0.14	99.12
#230	4.00	0.06	0.04	99.16

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.15	2.85	2.71	2.30	1.62	0.79	-0.27

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.98	0.25	1.02	-1.22	3.59

USACE GRANULARMETRIC REPORT FDEP GINT IMPORT FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-85 #-5
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
617,978	1,865,523		-0.1 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.81			16.10

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.05	0.05
#7	-1.50	2.82	0.12	0.17
#10	-1.00	2.00	0.32	0.49
#14	-0.50	1.41	1.38	1.87
#18	0.00	1.00	3.19	5.06
#25	0.50	0.71	3.23	8.29
#35	1.00	0.50	2.89	11.18
#45	1.50	0.35	3.27	14.45
#60	2.00	0.25	5.76	20.21
#80	2.50	0.18	38.59	58.80
#120	3.00	0.13	35.01	93.81
#170	3.50	0.09	5.20	99.01
#200	3.75	0.07	0.15	99.16
#230	4.00	0.06	0.03	99.19

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.11	2.86	2.73	2.39	2.06	1.63	-0.01

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.17	0.22	0.88	-1.82	6.16

USACE GRANULARMETRIC REPORT_FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-85 #-10
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
617,978	1,865,523		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.14		8.00	7.40

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.01	0.01
#5	-2.00	3.99	0.00	0.01
#7	-1.50	2.82	0.03	0.04
#10	-1.00	2.00	0.13	0.17
#14	-0.50	1.41	0.67	0.84
#18	0.00	1.00	1.47	2.31
#25	0.50	0.71	1.52	3.83
#35	1.00	0.50	1.23	5.06
#45	1.50	0.35	1.10	6.16
#60	2.00	0.25	1.70	7.86
#80	2.50	0.18	8.40	16.26
#120	3.00	0.13	58.82	75.08
#170	3.50	0.09	22.07	97.15
#200	3.75	0.07	1.46	98.61
#230	4.00	0.06	0.25	98.86

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.45	3.20	3.00	2.79	2.57	2.48	0.97

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.66	0.16	0.72	-2.79	12.12

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-85 #-15
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
617,978	1,865,523		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/2	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.50			8.30

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.12	0.12
#4	-2.25	4.75	0.01	0.13
#5	-2.00	3.99	0.04	0.17
#7	-1.50	2.82	0.12	0.29
#10	-1.00	2.00	0.32	0.61
#14	-0.50	1.41	1.35	1.96
#18	0.00	1.00	1.81	3.77
#25	0.50	0.71	1.62	5.39
#35	1.00	0.50	1.10	6.49
#45	1.50	0.35	0.83	7.32
#60	2.00	0.25	1.51	8.83
#80	2.50	0.18	8.39	17.22
#120	3.00	0.13	61.48	78.70
#170	3.50	0.09	17.60	96.30
#200	3.75	0.07	1.70	98.00
#230	4.00	0.06	0.50	98.50

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.46	3.15	2.97	2.77	2.56	2.43	0.38

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.59	0.17	0.84	-2.89	12.38

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-85 #-20
Analysis Date: 09-04-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
617,978	1,865,523		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/2	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.18			3.40

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.02	0.02
#4	-2.25	4.75	0.00	0.02
#5	-2.00	3.99	0.04	0.06
#7	-1.50	2.82	0.05	0.11
#10	-1.00	2.00	0.07	0.18
#14	-0.50	1.41	0.28	0.46
#18	0.00	1.00	0.39	0.85
#25	0.50	0.71	0.32	1.17
#35	1.00	0.50	0.29	1.46
#45	1.50	0.35	0.71	2.17
#60	2.00	0.25	1.73	3.90
#80	2.50	0.18	7.53	11.43
#120	3.00	0.13	52.04	63.47
#170	3.50	0.09	31.77	95.24
#200	3.75	0.07	2.73	97.97
#230	4.00	0.06	0.85	98.82

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.50	3.32	3.18	2.87	2.63	2.54	2.07

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.83	0.14	0.55	-3.27	22.63

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-89 #Berm
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
619,322	1,862,202		0.0 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/2	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 0.04		39.20	41.90

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.07	0.07
#10	-1.00	2.00	0.28	0.35
#14	-0.50	1.41	3.08	3.43
#18	0.00	1.00	10.00	13.43
#25	0.50	0.71	11.91	25.34
#35	1.00	0.50	11.08	36.42
#45	1.50	0.35	12.16	48.58
#60	2.00	0.25	18.83	67.41
#80	2.50	0.18	24.26	91.67
#120	3.00	0.13	7.89	99.56
#170	3.50	0.09	0.39	99.95
#200	3.75	0.07	0.01	99.96
#230	4.00	0.06	0.00	99.96

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.71	2.34	2.15	1.53	0.49	0.11	-0.42

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.32	0.40	1	-0.42	2.11

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-89 #Mid-Tide
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
619,322	1,862,202		0.0 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/3	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.16			65.90

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.13	0.13
#7	-1.50	2.82	0.89	1.02
#10	-1.00	2.00	2.56	3.58
#14	-0.50	1.41	13.47	17.05
#18	0.00	1.00	22.63	39.68
#25	0.50	0.71	16.94	56.62
#35	1.00	0.50	9.29	65.91
#45	1.50	0.35	7.17	73.08
#60	2.00	0.25	9.35	82.43
#80	2.50	0.18	12.73	95.16
#120	3.00	0.13	4.53	99.69
#170	3.50	0.09	0.14	99.83
#200	3.75	0.07	0.01	99.84
#230	4.00	0.06	0.00	99.84

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.49	2.06	1.60	0.30	-0.32	-0.54	-0.95

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	0.57	0.67	1.14	0.36	2.03

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-89 #-3
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
619,322	1,862,202		0.0 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.65			60.90

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4"	-4.25	19.03	0.00	0.00
3/8"	-3.25	9.48	0.26	0.26
#3.5	-2.50	5.66	0.38	0.64
#4	-2.25	4.75	0.42	1.06
#5	-2.00	3.99	0.34	1.40
#7	-1.50	2.82	1.36	2.76
#10	-1.00	2.00	3.34	6.10
#14	-0.50	1.41	14.11	20.21
#18	0.00	1.00	20.23	40.44
#25	0.50	0.71	15.01	55.45
#35	1.00	0.50	9.13	64.58
#45	1.50	0.35	6.98	71.56
#60	2.00	0.25	6.94	78.50
#80	2.50	0.18	9.26	87.76
#120	3.00	0.13	10.35	98.11
#170	3.50	0.09	1.24	99.35
#200	3.75	0.07	0.00	99.35
#230	4.00	0.06	0.00	99.35

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.85	2.30	1.74	0.32	-0.38	-0.65	-1.16

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	0.59	0.66	1.31	0.19	2.4

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-89 #-5
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
619,322	1,862,202		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.43			5.90

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.01	0.01
#10	-1.00	2.00	0.07	0.08
#14	-0.50	1.41	0.29	0.37
#18	0.00	1.00	0.77	1.14
#25	0.50	0.71	0.95	2.09
#35	1.00	0.50	0.95	3.04
#45	1.50	0.35	1.11	4.15
#60	2.00	0.25	2.85	7.00
#80	2.50	0.18	20.74	27.74
#120	3.00	0.13	58.70	86.44
#170	3.50	0.09	11.38	97.82
#200	3.75	0.07	0.54	98.36
#230	4.00	0.06	0.21	98.57

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.38	2.98	2.90	2.69	2.43	2.21	1.64

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.58	0.17	0.58	-2.7	13.78

USACE GRANULARMETRIC REPORT FDEP_GINT IMPORT FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-89 #-10
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
619,322	1,862,202		-0.1 MLLW

USCS	Munsell:	Comments:
SW	Moist - 10YR 7/2	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.97		10.40	10.30

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.12	0.12
#4	-2.25	4.75	0.30	0.42
#5	-2.00	3.99	0.00	0.42
#7	-1.50	2.82	0.03	0.45
#10	-1.00	2.00	0.23	0.68
#14	-0.50	1.41	1.11	1.79
#18	0.00	1.00	2.14	3.93
#25	0.50	0.71	2.17	6.10
#35	1.00	0.50	1.77	7.87
#45	1.50	0.35	1.67	9.54
#60	2.00	0.25	2.33	11.87
#80	2.50	0.18	10.51	22.38
#120	3.00	0.13	58.06	80.44
#170	3.50	0.09	16.43	96.87
#200	3.75	0.07	1.89	98.76
#230	4.00	0.06	0.27	99.03

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.44	3.11	2.95	2.74	2.52	2.19	0.25

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.52	0.17	0.89	-2.6	10.68

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-89 #-15
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
619,322	1,862,202		-0.1 MLLW

USCS	Munsell:	Comments:
SW	Moist - 10YR 7/2	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 2.41			11.80

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.02	0.02
#7	-1.50	2.82	0.00	0.02
#10	-1.00	2.00	0.13	0.15
#14	-0.50	1.41	1.31	1.46
#18	0.00	1.00	2.96	4.42
#25	0.50	0.71	3.04	7.46
#35	1.00	0.50	2.20	9.66
#45	1.50	0.35	1.51	11.17
#60	2.00	0.25	2.07	13.24
#80	2.50	0.18	9.95	23.19
#120	3.00	0.13	50.39	73.58
#170	3.50	0.09	21.94	95.52
#200	3.75	0.07	1.71	97.23
#230	4.00	0.06	0.36	97.59

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.49	3.24	3.03	2.77	2.52	2.14	0.10

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.52	0.17	0.92	-2.05	6.73

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-89 #-20
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
619,322	1,862,202		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/2	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.66			7.50

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.66	0.00	0.00
#4	-2.25	4.75	0.01	0.01
#5	-2.00	3.99	0.00	0.01
#7	-1.50	2.82	0.12	0.13
#10	-1.00	2.00	0.18	0.31
#14	-0.50	1.41	0.36	0.67
#18	0.00	1.00	0.50	1.17
#25	0.50	0.71	0.38	1.55
#35	1.00	0.50	0.26	1.81
#45	1.50	0.35	0.21	2.02
#60	2.00	0.25	0.78	2.80
#80	2.50	0.18	6.42	9.22
#120	3.00	0.13	61.09	70.31
#170	3.50	0.09	25.60	95.91
#200	3.75	0.07	2.20	98.11
#230	4.00	0.06	1.23	99.34

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.48	3.27	3.09	2.83	2.63	2.56	2.17

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.81	0.14	0.55	-3.78	26.19

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-93 #Dune
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
620,770	1,858,673		0.0 MLLW

USCS	Munsell:	Comments:
SP	Moist - 7.5YR 7/2	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.03			71.80

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.09	0.09
#10	-1.00	2.00	0.24	0.33
#14	-0.50	1.41	4.19	4.52
#18	0.00	1.00	14.76	19.28
#25	0.50	0.71	23.40	42.68
#35	1.00	0.50	20.46	63.14
#45	1.50	0.35	15.41	78.55
#60	2.00	0.25	12.93	91.48
#80	2.50	0.18	6.47	97.95
#120	3.00	0.13	1.82	99.77
#170	3.50	0.09	0.18	99.95
#200	3.75	0.07	0.02	99.97
#230	4.00	0.06	0.00	99.97

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.27	1.71	1.38	0.68	0.12	-0.11	-0.48

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	0.76	0.59	0.84	0.29	2.52

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-93 #Berm
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
620,770	1,858,673		0.0 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/3	

			Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
			#230 - 0.14		64.50	76.50

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.12	0.12
#7	-1.50	2.82	0.26	0.38
#10	-1.00	2.00	0.76	1.14
#14	-0.50	1.41	7.72	8.86
#18	0.00	1.00	19.71	28.57
#25	0.50	0.71	22.38	50.95
#35	1.00	0.50	15.09	66.04
#45	1.50	0.35	11.55	77.59
#60	2.00	0.25	11.89	89.48
#80	2.50	0.18	8.57	98.05
#120	3.00	0.13	1.41	99.46
#170	3.50	0.09	0.33	99.79
#200	3.75	0.07	0.06	99.85
#230	4.00	0.06	0.01	99.86

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.32	1.77	1.38	0.48	-0.09	-0.32	-0.75

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	0.64	0.64	0.95	0.33	2.41

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-93 #Mid-Tide
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
620,770	1,858,673		0.0 MLLW

USCS	Munsell:	Comments:
SW	Moist - 7.5YR 7/3	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.95			35.30

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.07	0.07
#10	-1.00	2.00	0.39	0.46
#14	-0.50	1.41	2.77	3.23
#18	0.00	1.00	8.03	11.26
#25	0.50	0.71	9.08	20.34
#35	1.00	0.50	8.21	28.55
#45	1.50	0.35	7.18	35.73
#60	2.00	0.25	9.69	45.42
#80	2.50	0.18	28.68	74.10
#120	3.00	0.13	22.85	96.95
#170	3.50	0.09	2.05	99.00
#200	3.75	0.07	0.05	99.05
#230	4.00	0.06	0.00	99.05

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.96	2.72	2.52	2.08	0.78	0.26	-0.39

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	1.65	0.32	1.09	-0.72	2.32

USACE GRANULARMETRIC REPORT FDEP .GINT IMPORT FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-93 #-3
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
620,770	1,858,673		0.0 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 3.98			11.30

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	3.99	0.07	0.07
#7	-1.50	2.82	0.05	0.12
#10	-1.00	2.00	0.14	0.26
#14	-0.50	1.41	0.67	0.93
#18	0.00	1.00	2.22	3.15
#25	0.50	0.71	3.01	6.16
#35	1.00	0.50	3.00	9.16
#45	1.50	0.35	4.02	13.18
#60	2.00	0.25	9.99	23.17
#80	2.50	0.18	28.15	51.32
#120	3.00	0.13	37.11	88.43
#170	3.50	0.09	7.28	95.71
#200	3.75	0.07	0.25	95.96
#230	4.00	0.06	0.06	96.02

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.45	2.94	2.82	2.48	2.03	1.64	0.31

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.23	0.21	0.83	-1.64	5.94

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-93 #-5
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
620,770	1,858,673		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 0.18			28.20

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#7	-1.50	2.82	0.00	0.00
#10	-1.00	2.00	0.04	0.04
#14	-0.50	1.41	0.55	0.59
#18	0.00	1.00	1.34	1.93
#25	0.50	0.71	2.14	4.07
#35	1.00	0.50	2.60	6.67
#45	1.50	0.35	1.30	7.97
#60	2.00	0.25	2.85	10.82
#80	2.50	0.18	35.16	45.98
#120	3.00	0.13	43.02	89.00
#170	3.50	0.09	10.48	99.48
#200	3.75	0.07	0.34	99.82
#230	4.00	0.06	0.00	99.82

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.29	2.94	2.84	2.55	2.20	2.07	0.68

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.41	0.19	0.7	-2.1	8.4

USACE GRANULARMETRIC REPORT FDEP GINT IMPORT FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-93 #-10
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
620,770	1,858,673		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 7/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.79		8.40	6.80

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	3.99	0.00	0.00
#7	-1.50	2.82	0.02	0.02
#10	-1.00	2.00	0.16	0.18
#14	-0.50	1.41	0.59	0.77
#18	0.00	1.00	1.24	2.01
#25	0.50	0.71	1.22	3.23
#35	1.00	0.50	1.07	4.30
#45	1.50	0.35	0.99	5.29
#60	2.00	0.25	1.32	6.61
#80	2.50	0.18	7.25	13.86
#120	3.00	0.13	58.59	72.45
#170	3.50	0.09	23.98	96.43
#200	3.75	0.07	1.23	97.66
#230	4.00	0.06	0.55	98.21

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.47	3.24	3.05	2.81	2.60	2.52	1.35

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.7	0.15	0.68	-2.95	13.65

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-93 #-15
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
620,770	1,858,673		-0.1 MLLW

USCS	Munsell:	Comments:
SW	Moist - 10YR 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.22			12.70

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.06	0.06
#4	-2.25	4.75	0.07	0.13
#5	-2.00	3.99	0.07	0.20
#7	-1.50	2.82	0.11	0.31
#10	-1.00	2.00	0.34	0.65
#14	-0.50	1.41	1.88	2.53
#18	0.00	1.00	3.07	5.60
#25	0.50	0.71	2.71	8.31
#35	1.00	0.50	1.73	10.04
#45	1.50	0.35	1.06	11.10
#60	2.00	0.25	1.41	12.51
#80	2.50	0.18	8.32	20.83
#120	3.00	0.13	48.07	68.90
#170	3.50	0.09	26.96	95.86
#200	3.75	0.07	2.32	98.18
#230	4.00	0.06	0.60	98.78

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.48	3.28	3.11	2.80	2.54	2.21	-0.10

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.55	0.17	1	-2.22	7.64

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

Granularmetric Report

Depths and elevations based on measured values

Project Name: Flagler County
Sample Name: R-93 #-20
Analysis Date: 09-05-12
Analyzed By:

US Army Corps of Engineers
701 San Marco Blvd
Jacksonville, Florida 32207
phone (904)396-7121

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
620,770	1,858,673		-0.1 MLLW

USCS	Munsell:	Comments:
SP	Moist - 10YR 6/1	

Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
#230 - 1.59			4.80

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.48	0.00	0.00
#3.5	-2.50	5.66	0.09	0.09
#4	-2.25	4.75	0.11	0.20
#5	-2.00	3.99	0.10	0.30
#7	-1.50	2.82	0.08	0.38
#10	-1.00	2.00	0.14	0.52
#14	-0.50	1.41	0.49	1.01
#18	0.00	1.00	0.76	1.77
#25	0.50	0.71	0.55	2.32
#35	1.00	0.50	0.41	2.73
#45	1.50	0.35	0.27	3.00
#60	2.00	0.25	0.74	3.74
#80	2.50	0.18	7.80	11.54
#120	3.00	0.13	60.15	71.69
#170	3.50	0.09	23.58	95.27
#200	3.75	0.07	2.30	97.57
#230	4.00	0.06	0.84	98.41

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.49	3.26	3.07	2.82	2.61	2.54	2.08

Moment	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis
Statistics	2.76	0.15	0.65	-4.03	26.05

USACE GRANULARMETRIC REPORT FDEP_GINT_IMPORT_FLAGLER.GPJ FL_DEP ROSS.GDT 11/14/12

FLAGLER COUNTY, FLORIDA

HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FINAL INTEGRATED FEASIBILITY STUDY AND
ENVIRONMENTAL ASSESSMENT

Appendix E

Real Estate Plan



APPENDIX E

FLAGLER COUNTY, FLORIDA
FLAGLER BEACH HURRICANE AND STORM DAMAGE REDUCTION PROJECT

REAL ESTATE PLAN

Updated: June 6, 2014

FLAGLER COUNTY, FLORIDA
FLAGLER BEACH HURRICANE
AND
STORM DAMAGE REDUCTION
PROJECT

REAL ESTATE PLAN

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EXHIBIT 1: NON FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY ASSESSMENT (DRAFT)

EXHIBIT 2: RISK LETTER

REAL ESTATE PLAN

1. STATEMENT OF PURPOSE

The Real Estate Plan (REP) focuses on the Recommended Plan and is intended to support the Flagler County, Florida Hurricane and Storm Damage Reduction Project Final Integrated Feasibility Study and Environment Assessment.

This report is tentative in nature and is to be used for planning purposes only and both the final real property lines and estimates of value are subject to change even after approval of this report. There may be modifications to the plans that occur during Pre-construction, Engineering and Design (PED) phase, thus changing the final acquisition area(s) and/or administrative and land cost.

2. STUDY AND PROJECT AUTHORIZATION

The authority for conducting this Feasibility Study is contained in House Resolution 2676 adopted May 22, 2002:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, that in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing shoreline erosion protection, hurricane and storm damage reduction, and related purposes to the shores of Flagler County, Florida."*

The Reconnaissance Report, Section 905(b) Analysis, Flagler County, Florida, Shore Protection completed by U.S. Army Corps of Engineers, Jacksonville District, March 2004, recommended a strong Federal interest in initiating a feasibility phase study.

3. PROJECT LOCATION

The Flagler County Hurricane and Storm Damage Reduction Project is located on the northeast coast of Florida midway between the Florida/Georgia state line and Cape Canaveral, as shown at Figure 3-1. This County is bounded to the north by Saint John's County and to the south by Volusia County. Flagler County encompasses approximately 18 miles of sandy shoreline, located on a coastal barrier island and mainland complex that extends uninterrupted for a length of 50 miles from Matanzas Inlet in the north to Ponce de Leon Inlet in the south. Flagler County's coastal area is bound by the Matanzas River to the north, Smith Creek and the Atlantic Intracoastal Waterway to the west, and Volusia County beaches to the south.

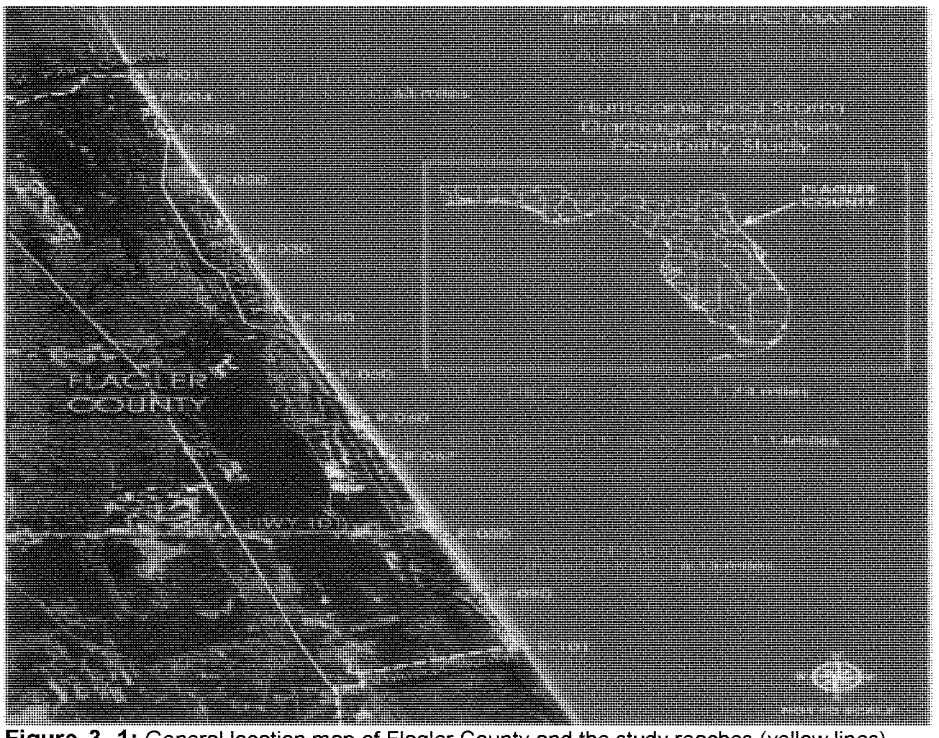


Figure 3-1: General location map of Flagler County and the study reaches (yellow lines).

4. PROJECT DESCRIPTION

The Recommended Plan (Reach C, Dune H) is the National Economic Development (NED) plan relative to cost and providing the maximum storm damage reduction benefits. The Recommended Plan is shown at Figure 4-1.

The Project area consists of a ten foot dune extension including a 10 feet sacrificial berm, located between Florida Department of Environmental Protection (FDEP) monuments R-80 and R-94. FDEP reference monuments are located approximately every 1,000 feet along the shoreline and serve as geographic reference points for survey profile lines. The project area extends along approximately 2.6 miles of shoreline and includes 100 feet north and 100 feet south of the project boundary for the taper area. SR A1A, the only north-south hurricane evacuation route for communities along the coastline, is an integral part of the county's infrastructure and is essential for public safety during evacuation events. Efforts to reduce the risk of coastal damages and improve conditions were examined in this study. The initial construction of the

project is expected to take two months.

Construction of the Recommended Plan will provide a dune and beach development by use of compatible fill material. The renourishment interval is expected to be approximately 11 years, equaling four renourishment events in addition to the initial construction over the 50 years period of Federal participation. Initial construction will require 330,000 cubic yards of sand and each renourishment will require approximately 320,000 cubic yards of sand.

The Project Scope of Work, includes the dredging material (sand) from the offshore borrow areas 2A and 2B, located approximately 7 miles offshore of the project site, placement by hydraulic dredge in the project area, then planting of vegetation on the constructed dune. Vegetation will be planted on areas of the existing dune disturbed by construction as well as newly constructed areas to stabilize the fill.

Existing within the project area is seawall and revetment constructed by Florida Department of Transportation (FDOT). There is a 420 foot precast concrete panel seawall starting 285 feet north of the pier. Starting at 7th Street South and ending at 23rd Street South, there is approximately 9,000 feet of granite revetment maintained by FDOT. This revetment was originally built in the 1960s and 1970s, with additional newer stone being placed during maintenance and repairs. Within the revetment area is a 150 foot steel sheet pile sea wall with concrete cap between 12th Street South and 13th Street South. This armor unit was constructed in December 2005 by FDOT to protect SR A1A from being undermined by erosion.

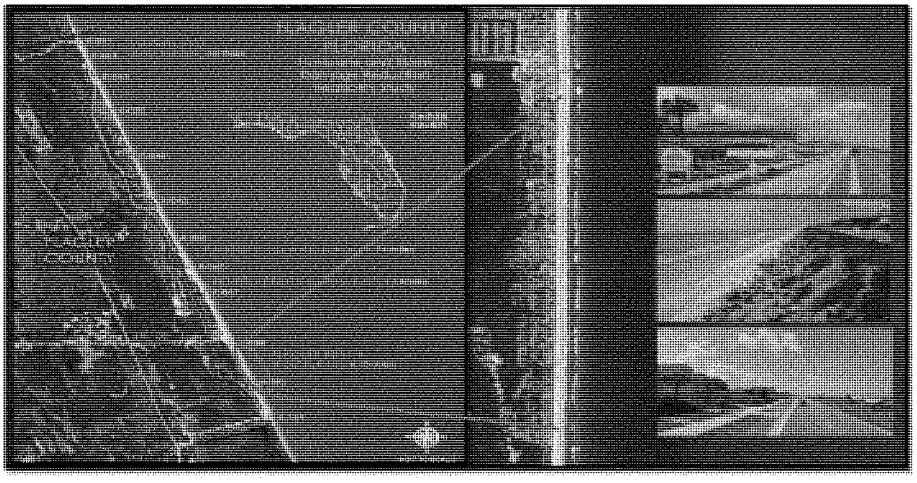


Figure 4-1: The Recommended Plan – R80 – R94

5. REAL ESTATE REQUIREMENTS

In the State of Florida beach nourishment, beach restoration, and erosion control projects are established pursuant to Florida Statute, Section 161.141, Property Rights of State and Private Upland Owners in Beach Restoration Project Areas. Florida Statute, Section 161.191, Vesting of Title of Lands, states that title to all lands seaward of the Erosion Control Line (ECL) shall be vested to the state by right of its sovereignty. The lands landward of the ECL remain vested to the upland owner.

A Survey and Legal Descriptions will be completed to establish the Florida Statute ECL between the state sovereign lands and the adjacent upland property. Upon completion of the survey, the ECL will be established and the State of Florida will issue a Sovereign Submerged Lands Authorization, contained within the Consolidated Joint Coastal Permit, for placement areas located seaward of the ECL. A final initial fill volume will be determined prior to construction of the project. The Permit would be issued in ten year increments by the State of Florida.

Based on the current project design, Perpetual Beach Storm Damage Reduction Easements will be required over 184 parcels situated within the project area. The Flagler Beach Pier located approximately 800 feet to the North of R-80 is situated outside of the project boundary and will not be impacted by the project.

The Project Area (R-80 to R-94) contains 184 parcels, and forty-two dune walkovers. Twenty-one of the walkovers are considered as public structures. Dune Walkovers on public properties only, if removed, are considered relocations. An estimated onetime relocation cost for the sponsor's twenty-one walkovers is included in the Real Estate cost estimate as part of the LERRD.

There are approximately 223 public parking spaces in the vicinity of the project area that will be available for public use. This amount of parking spaces is adequate to meet the beach use demand in the area and meets the policy requirements of ER 1165-2-130, which states, "Generally, parking for free or reasonable terms should be available within a reasonable walking distance of the beach. The amount of parking should be consistent with the attendance used in benefit evaluation". Should it be determined during PED that additional public access is required, acquisition of such access is the responsibility of the NFS.

The Borrow Area, as shown as Figure 5-1, is located offshore northeast of FDEP beach monuments R-80 to R-94. The borrow area is located approximately seven miles offshore from the project footprint. A noncompetitive negotiated agreement will be required from the Bureau of Ocean Energy Management (BOEM) in accordance with Outer Continental Shelf Lands Act for the mining of sand from the offshore site.

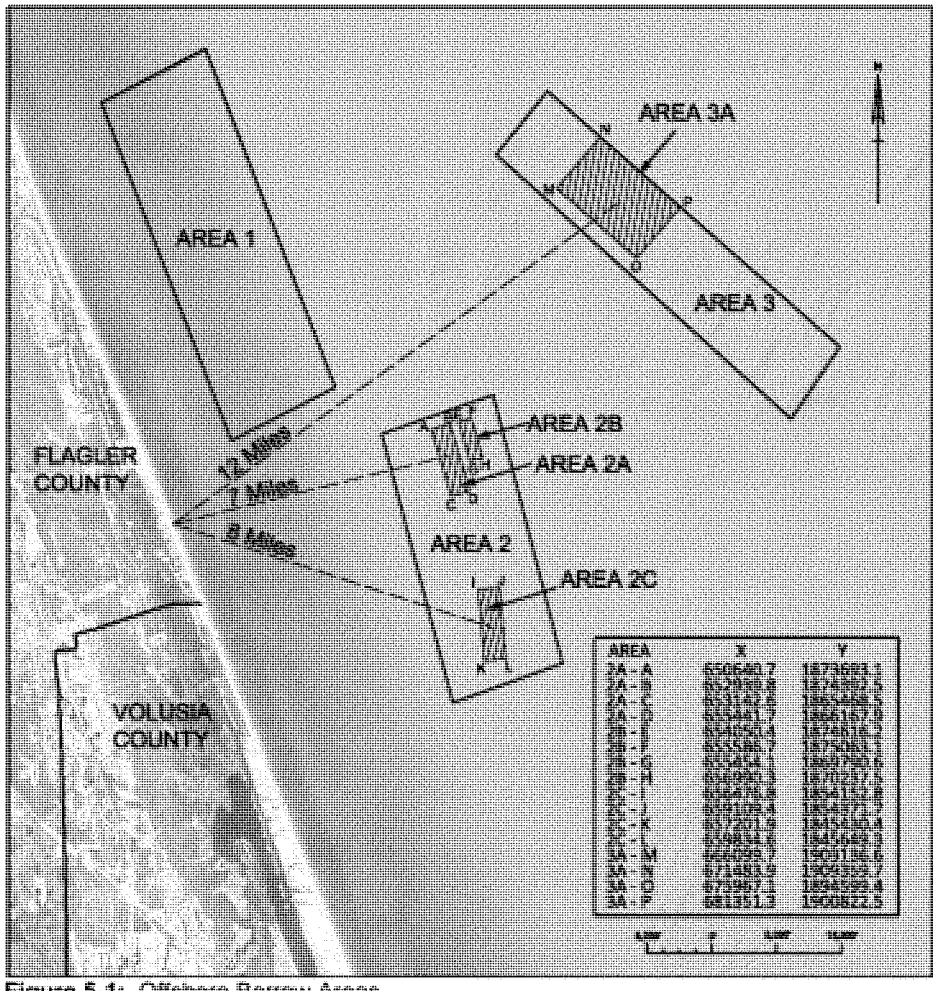


Figure 5-1: Offshore Borrow Areas

The Staging areas have not been identified at this time, but will require a Temporary Work Area Easement if not located within the perpetual storm damage reduction easement area. Access to the project along with all staging areas is planned to be located on Sponsor Owned lands situated within the project area.

Real Estate Division is currently in discussions with FDOT to determine the type of documentation which will meet the project purpose of placing fill material within the FDOT right-of-way. If the Real Estate Division determines the document is a non-

standard estate, the document will be submitted to HQ for approval. Figure 5-2 below shows one of the areas requiring placement of fill material.



Figure 5-2: FDOT ROW along State Road A1A (one of several areas)

6. FEDERALLY GOVERNMENT-OWNED LAND

There is no known land in the project area owned by the Federal Government.

7. NON FEDERALLY OWNED LAND

The non-Federal owned lands are owned by the Local Sponsor, the City of Flagler, Florida Department of Transportation and private landowners.

8. NON-FEDERAL SPONSOR'S OPERATION/MAINTAINANCE RESPONSIBILITIES

Flagler County will be the non-Federal Sponsor (NFS) for the project. The NFS has the responsibility to acquire all real estate interests required for the Project. The NFS shall accomplish all alterations and relocations of facilities, structures and improvements determined by the government to be necessary for construction of the Project. The sponsor will have operation and maintenance responsibility for the project once construction has been completed. Future periodic nourishments are considered construction and will be performed in accordance with the Project Partnership Agreement, when approved.

The Draft Assessment of the NFS Real Estate Acquisition Capability is attached as Exhibit "1" of the Real Estate Appendix. A copy will be signed and mailed to the sponsor.

The Risk Letter attached as Exhibit "2" has been signed and forwarded by mail to the NFS. The NFS should not acquire lands required for the project prior to execution of the Project Partnership Agreement (PPA). Should the NFS proceed with acquisition of lands prior to execution of the PPA; it will be at the Sponsor's risk of not receiving credit or reimbursement for any costs incurred in the connection with the acquisition process should the PPA not be signed. There is also risk in acquiring lands either not needed for the project or not acquired in compliance with requirements for crediting purposes in accordance with 49 CFR Part 24, dated March 2, 1989. Risk Letter dated May 7, 2014, advising the NFS of the risks of early acquisition is attached as Exhibit "1" of the Real Estate Appendix.

9. NON-FEDERAL SPONSOR'S AUTHORITY TO PARTICIPATE IN PROJECT

Flagler County, Florida is a political subdivision of the State of Florida as provided by Article 8, Section 1 of the Florida Constitution.

Counties of Florida are empowered by Florida Statutes 125.01(j) to "Establish and administer programs of housing, slum clearance, community redevelopment, conservation, flood and beach erosion control and beach erosion control, air pollution control, and navigation and drainage and cooperate with governmental agencies and private enterprises in the development and operation of such programs."

Flagler County as the NFS for the project has been an integral part of the Project Delivery Team (PDT) from the conception of the project. At each step of the process, Flagler County has contributed to the available information, participated in the formulation, and review of this report.

10. NAVIGATION SERVITUDE

In accordance with CECC-R Bulletin 14-05, Availability of the Navigation Servitude for Coastal Storm Damage Reduction Projects dated April 9, 2014, navigational servitude is not applicable to this project.

11. ATTITUDE OF THE LANDOWNERS

The City of Flagler Beach, Florida Department of Transportation, County of Flagler, and local communities fully support the project.

12. MINERALS

Preliminary assessment indicates no known present or anticipated mineral or sub-

surface mineral extraction activities within the vicinity of the proposed area which may affect construction, operation, or maintenance of the Project.

13. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)

There are no known HTRW in the project area.

14. INDUCED FLOODING

There will be no flooding caused by the construction of the project.

15. ZONING ORDINANCES

Zoning Ordinances are not of issue with this project. Application or enactment of zoning ordinances will not be used in lieu of acquisition.

16. RELOCATIONS ASSISTANCE (PUBLIC 91-646)

No persons or businesses will be impacted by the project. There will be no relocations under PL 91-646.

17. RELOCATIONS, ALTERATIONS, VACATIONS, AND ABANDONMENTS (UTILITIES, STRUCTURES AND FACILITIES, CEMETERIES, AND TOWNS).

There are 21 publicly owned dune walkovers that may be impacted by this project. The cost to replace the 21 public structures is approximately $1,157,000 and is considered relocation under the LERRD.

18. STANDING TIMBER AND VEGETATIVE COVER

Existing dune vegetation will be impacted during construction. The Recommended Plan includes planting of dune vegetation on newly constructed areas as well as re-vegetation of areas disturbed during construction. It is assumed that dune planting will only be necessary for initial construction and that vegetation will spread and naturally recruit to any areas that are renourished in the future.

19. RECREATION RESOURCES

There are no separable recreational lands identified for this project.

20. CULTURAL RESOURCES

In a letter dated 28 February 2012, State Historic Preservation Office concurred with the USACE finding of no historic properties within the project limits.

21. OUTSTANDING RIGHTS

There are no known outstanding rights in the project area.

22. MITIGATION

There is no mitigation for the Recommended Plan.

23. ACQUISITION SCHEDULE

The NFS is responsible for acquiring real estate interests required for the project. The Perpetual Storm Damage Reduction Easements can be acquired within 12-18 months once final plans and specs have been completed and the Project Partnership Agreement has been executed. The Project Sponsor, Project Manager and Real Estate Technical Manger will formulate the milestone schedule upon project approval to meet dates for advertisement and award of the construction contract.

24. ACQUISITION/ADMINISTRATIVE COSTS

Revision to Policy Guidance Letter No. 11, Credit for Lands, Easements, Right-of-Way (LERR) at Shore Protection Projects, dated April 21, 1989, and ER 405-1-12, Real Estate Handbook, directs lands subject to shore erosion required for project purposes be appraised considering special benefits. The intent is to preclude credit for lands needed for shore protection projects, when the increase in value of the remaining lands would offset compensation for the property as well as any severance damages. Erodible land protected by a Federal project is valued at zero as it will be enhanced post-project.

The cost estimate for all Federal and non-Federal real estate activities necessary for implementation of the project after completion of the feasibility study for land acquisition, construction, LERRD, and other items are coded as delineated in the Total Current Working Estimate utilizing the Microcomputer Aided Cost Engineering System (MCACES).

The estimate of the Federal real estate acquisition administrative cost is $1,038,000. This cost includes project real estate planning, mapping, review, oversight, monitoring, crediting review costs of approximately 184 crediting packages, certification of lands required for project purposes, legal opinions, analysis or other requirements that may be necessary during Planning, Engineering and Design (PED). The non Federal sponsor will receive credit towards its share of real estate administrative project cost incurred for certification. Non-Federal administrative costs are estimated to be $1,730,000. The non-Federal sponsor has been provided with requirements regarding acquisition policies and procedures, including compliance with Public Law 91-646, as amended, Land, Easement, Right-of-Way, Relocation and Disposal (LERRD) crediting procedures, and milestones for the land acquisition.

25. REAL ESTATE CHART OF ACCOUNTS

		Federal	Non-Federal
01B 01B--	LANDS AND DAMAGES ACQUISITION	$0.	
01B40	FEDERAL	$1,038,000.	
01B40	NON-FEDERAL		$1,730,000.
01M00	CONTINGENCIES (23%)	$ 238,740.	$ 397,900
01N00	RELOCATION (Contingency 23% incl.)		$1,157,000.
ESTIMATED REAL ESTATE SUBTOTAL COST		$1,276,740	$3,284,900
ESTIMATED REAL ESTATE TOTAL COST		**$4,561,640**	
	ROUNDED TO	**$4,562,000**	

26. ESTATES TO BE ACQUIRED

The standard and non-standard estates have been determined to represent the minimum real estate interest required from the non-Federal Sponsor to support the construction of this project.

27. STANDARD ESTATES

A perpetual beach storm damage reduction easement will be required over 184 parcels. Temporary work area easements will be required for all staging, stockpiling, permits, fill material placement, and temporary work areas for project construction.

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 Project Sponsor, for use by the United States, its representatives, agents, and contractors as a (borrow area) (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 Flagler County, Flagler Beach Hurricane and Storm Damaged Reduction Project, together with the right to trim, cut, fell and remove there from 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.

PERPETUAL BEACH STORM DAMAGE REDUCTION EASEMENT

A perpetual and assignable easement and right-of-way in, on, over, and across (the land described in Schedule A) (Tract No.___) for use by the (Project Sponsor), its representatives, agents, contractors, and assigns, to construct; preserve; patrol; operate; maintain; repair; rehabilitate; and replace; a public beach [a dune system] and other erosion control and storm damage reduction measures together with appurtenances thereto, including the right to deposit sand; to accomplish any alterations of contours on said land; to construct berms [and dunes and walkovers); to nourish and renourish periodically; to move, store and remove equipment and supplies; to erect and remove temporary structures; and to perform any other work necessary and incident to the construction, periodic renourishment and maintenance of the (Project Name), together with the right of public use and access; to plant vegetation on sand dunes and berms; to erect, maintain and remove silt screens and sand fences; to facilitate preservation of dunes and vegetation through the limitation of access to dune areas; to trim, cut, fell, and remove from said land all trees, underbrush, debris, obstructions, and any other vegetation, structures and obstacles within the limits of the easement; reserving, however, to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns, the right to construct dune over walk structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape, dimension or function, and that prior approval of the plans and specifications for such structures is obtained from the (designated representative of the Project Sponsor) and provided further that such structures are subordinate to the construction, operation, maintenance, repair, rehabilitation and replacement of the project; and further reserving to the grantor(s}, (his) (her) (its) (their) (heirs},

successors and assigns all such rights and privileges as may be used and enjoyed without interfering with or abridging the rights and easements hereby acquired; subject however to existing easements for public roads and highways, public utilities, railroads and pipelines.

TEMPORARY PIPELINE EASEMENT

A temporary and assignable easement in, on, over and across (the land described in Schedule "A") (tract Nos. , , and) for a period not to exceed beginning (date)(with the date possession is granted to the United States in this proceeding (or date of deed), and terminating with the earlier of the completion of the remediation or the filing in the local land records by the representative of the United States in charge of the Project of a notice of termination), to locate, construct, operate, maintain, repair, replace, and/or remove (a) (monitoring) (injection) (extraction) well(s), pipeline(s) and appurtenances thereto; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

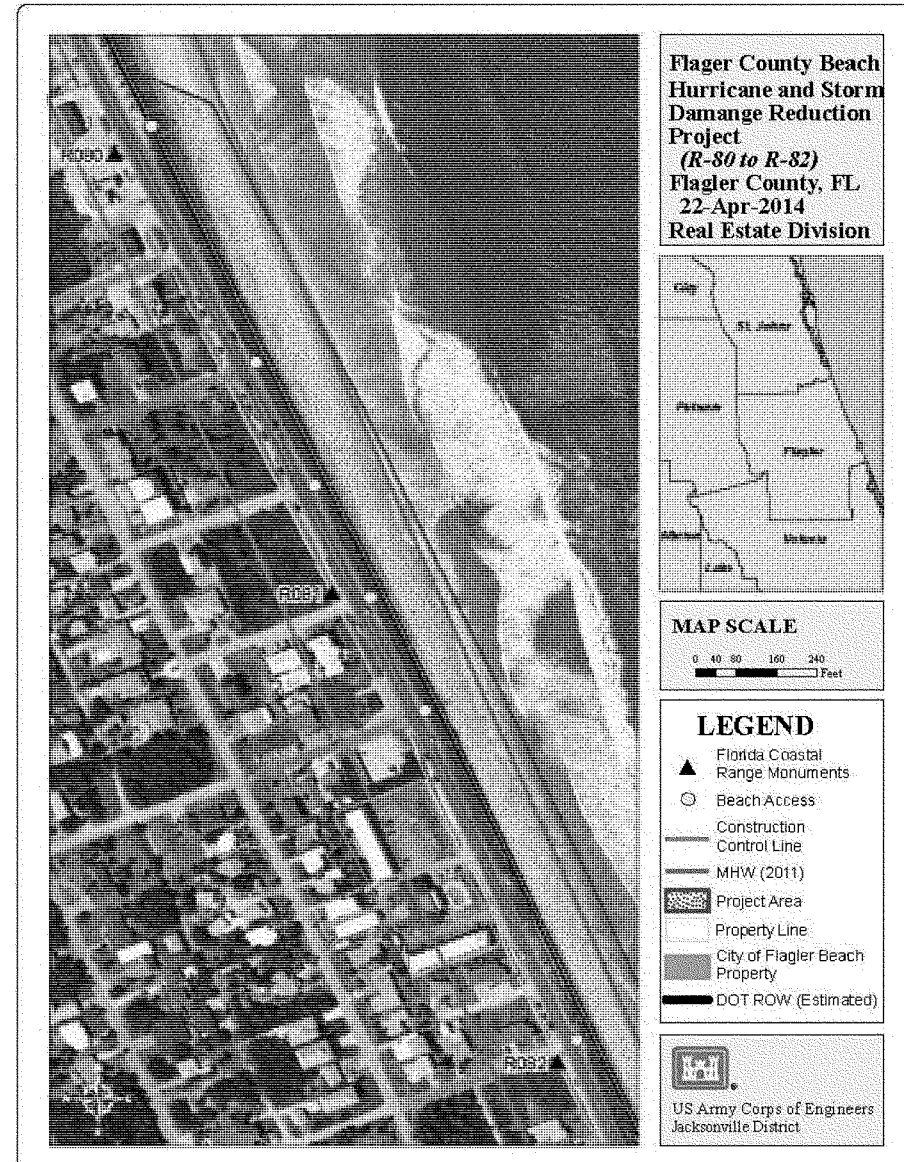
28. NON STANDARD ESTATES

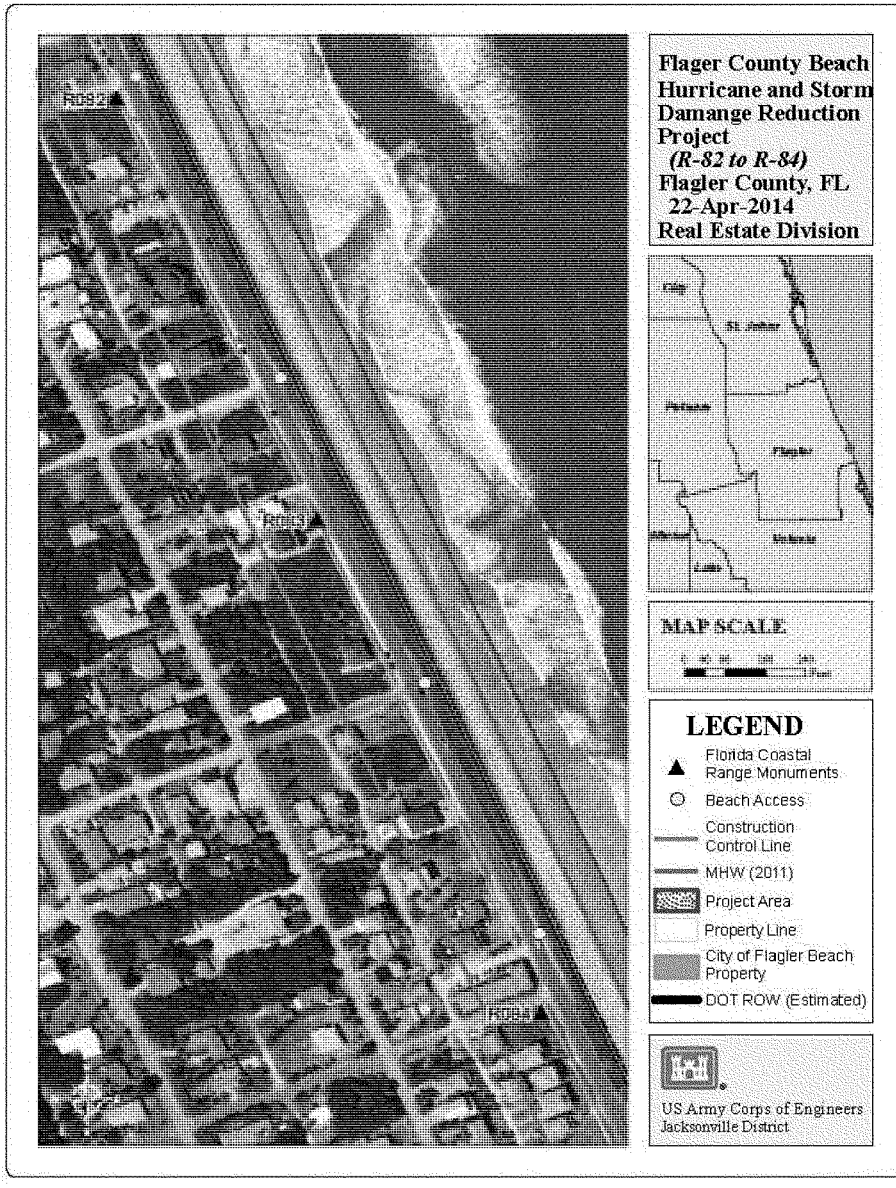
As noted in Section 5, page E-7, Real Estate Requirements; a Consolidated Joint Coastal Permit and Sovereign Submerged Lands Authorization for use of lands seaward of the ECL is required from the State of Florida. The Consolidated Joint Coastal Permit and Sovereign Submerged Lands Authorization is considered a non-standard estate and will be forwarded to HQ for approval.

Real Estate Division is currently in discussions with FDOT to determine the type of documentation which will meet the project purpose of placing fill material within the FDOT right-of-way. If Real Estate Division determines the document is a non-standard estate, the document will also be submitted to HQ for approval.

29. MAPS

Real Estate Maps for this project are located at the end of the Real Estate Plan.


R090
R091
R092
Flagler County Beach Hurricane and Storm Damange Reduction Project
(R-80 to R-82)
Flagler County, FL
22-Apr-2014
Real Estate Division
MAP SCALE
0 40 80 160 240
Feet
LEGEND
Florida Coastal Range Monuments
Beach Access
Construction Control Line
MHW (2011)
Project Area
Property Line
City of Flagler Beach Property
DOT ROW (Estimated)
US Army Corps of Engineers
Jacksonville District


R082.2
R083
R084
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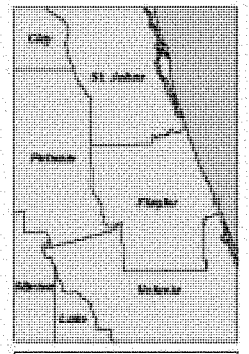
(R-82 to R-84)
Flagler County, FL
22-Apr-2014
Real Estate Division
MAP SCALE
LEGEND
Florida Coastal Range Monuments
Beach Access
Construction Control Line
MHW (2011)
Project Area
Property Line
City of Flagler Beach Property
DOT ROW (Estimated)
US Army Corps of Engineers
Jacksonville District


R094
R095
R096
Flager County Beach Hurricane and Storm Damange Reduction Project
(R-84 to R-86)
Flagler County, FL
22-Apr-2014
Real Estate Division
MAP SCALE
0 40 80 160 240
Feet
LEGEND
Florida Coastal Range Monuments
Beach Access
Construction Control Line
MHW (2011)
Project Area
Property Line
City of Flagler Beach Property
DOT ROW (Estimated)
US Army Corps of Engineers
Jacksonville District



Flagler County Beach Hurricane and Storm Damange Reduction Project
(R-86 to R-88)
Flagler County, FL
22-Apr-2014
Real Estate Division



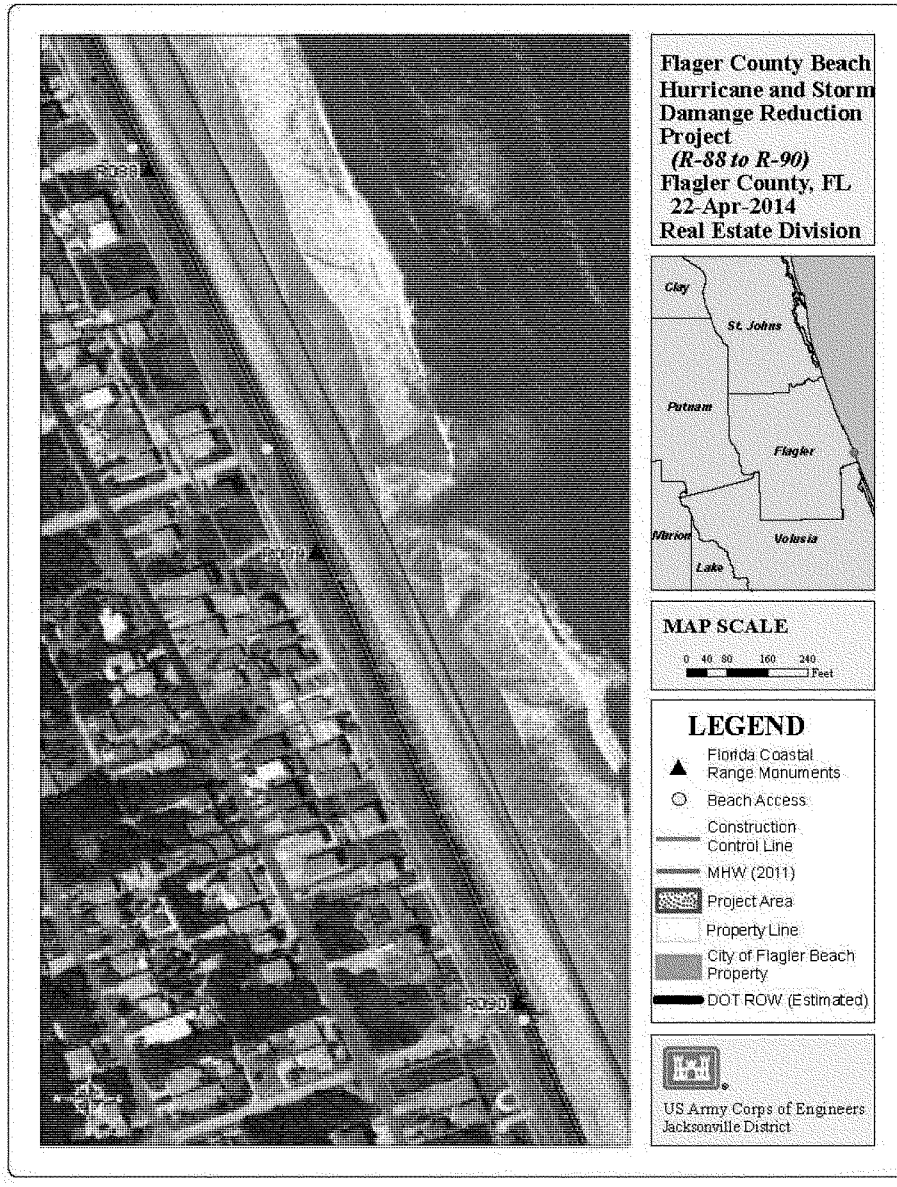
MAP SCALE

0 40 80 160 240
Feet

LEGEND

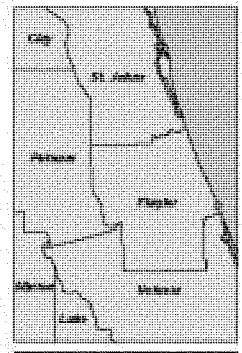
- Florida Coastal Range Monuments
- Beach Access
- Construction Control Line
- MHW (2011)
- Project Area
- Property Line
- City of Flagler Beach Property
- DOT ROW (Estimated)

US Army Corps of Engineers
Jacksonville District


R-88
R-89
R-90
Flagler County Beach Hurricane and Storm Damange Reduction Project
(R-88 to R-90)
Flagler County, FL
22-Apr-2014
Real Estate Division
Clay
St. Johns
Putnam
Flagler
Marion
Volusia
Lake
MAP SCALE
0 40 80 160 240
Feet
LEGEND
Florida Coastal Range Monuments
Beach Access
Construction Control Line
MHW (2011)
Project Area
Property Line
City of Flagler Beach Property
DOT ROW (Estimated)
US Army Corps of Engineers
Jacksonville District



Flager County Beach Hurricane and Storm Damange Reduction Project
(R-90 to R-92)
Flagler County, FL
22-Apr-2014
Real Estate Division



MAP SCALE

0 40 80 160 240
Feet

LEGEND

- Florida Coastal Range Monuments
- Beach Access
- Construction Control Line
- MHW (2011)
- Project Area
- Property Line
- City of Flagler Beach Property
- DOT ROW (Estimated)

US Army Corps of Engineers
Jacksonville District

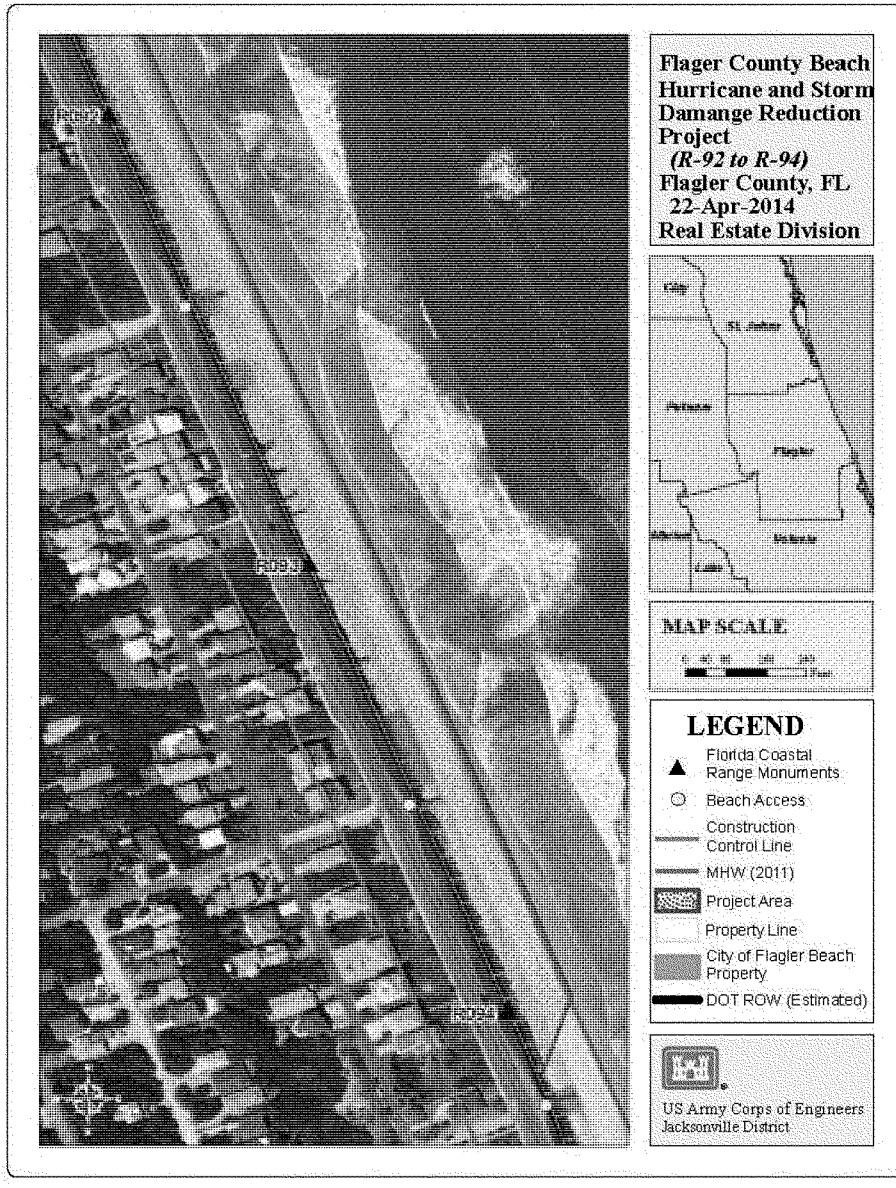

Flager County Beach
Hurricane and Storm
Damange Reduction
Project
(R-92 to R-94)
Flagler County, FL
22-Apr-2014
Real Estate Division
MAP SCALE
LEGEND
Florida Coastal Range Monuments
Beach Access
Construction Control Line
MHW (2011)
Project Area
Property Line
City of Flagler Beach Property
DOT ROW (Estimated)
US Army Corps of Engineers
Jacksonville District

EXHIBIT NO. 1

FINAL- ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY FOR FLAGLER HURRICANE AND STORM DAMAGED REDUCTION PROJECT

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? YES
b. Does the sponsor have the power of eminent domain for this project? YES
c. Does the sponsor have "quick-take" authority for this project? YES
d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? No
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? NO

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require technical training to become familiar with the real estate requirements of Federal projects including P.L. 91·646, as amended? NO
b. If the answer to IIa. is "yes," has a reasonable plan been developed to provide such training? N/A
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? YES
d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? YES
e. Can the sponsor obtain contractor support, if required in a timely fashion? YES
f. Will the sponsor likely request USACE assistance in acquiring real estate? YES – only in advisory capacity

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? YES
b. Has the sponsor approved the project/real estate schedule/milestones? No- Project Milestone will be developed during PED, will be joint effort between RE, PM and NFS

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? NA
b. With regard to this project, the sponsor is anticipated to be: highly capable

capable/moderately capable/marginally capable/insufficiently capable. HIGHLY CAPABLE

V. Coordination:

a. Has this assessment been coordinated with the sponsor? YES
b. Does the sponsor concur with this assessment? YES

Date: 10 Jun 2014

Prepared by:

Katherine C. Rivers
Realty Specialist
Real Estate Division
Jacksonville District

Reviewed by:

Hansler A. Bealyer
Chief, Acquisition Branch
Real Estate Division
Jacksonville District

Reviewed and approved by:

Karl J. Nixon
Acting Chief, Real Estate Division
Real Estate Division
Jacksonville District

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

REPLY TO
ATTENTION OF

MAY 07 2014

Real Estate Division

Subject: Flagler Beach Hurricane and Storm Damage Reduction Project – Real Estate Acquisition

ATTN: Kifah Faith Alkhatib, P.E.
County Engineer
County of Flagler
1769 East Moody Blvd, Bldg 2, Suite 309
Bunnell, Florida 32110

Dear Ms. Alkhatib;

The intent of this letter is to formally advise the County of Flagler as the potential non-Federal sponsor for the project, of the risks associated with land acquisition prior to the execution of the Project Partnership Agreement (PPA) or prior to the Government's formal notice to proceed with acquisition. If a non-Federal sponsor deems it necessary to commence acquisition prior to an executed PPA for whatever reason, the non-Federal sponsor assumes full and sole responsibility for any and all costs, responsibility, or liability arising out of the acquisition effort.

Generally, these risks include, but may not be limited to, the following:

(1) Congress may not appropriate funds to construct the proposed project;

(2) The proposed project may otherwise not be funded or approved for construction;

(3) A PPA mutually agreeable to the non-Federal sponsor and the Government may not be executed and implemented;

(4) The non-Federal sponsor may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of CERCLA, as amended;

(5) The non-Federal sponsor may acquire interests or estates that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project;

Printed on Recycled Paper

(6) The non-Federal sponsor may initially acquire insufficient or excessive real property acreage which may result in additional negotiations and/or benefit payments under P.L. 91-646 as well as the payment of additional fair market value to affected landowners which could have been avoided by delaying acquisition until after PPA execution and the Government's notice to commence acquisition and performance of LERRD; and

(7) The non-Federal sponsor may incur costs or expenses in connection with its decision to acquire or perform LERRD in advance of the executed PPA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662 or the PPA.

We appreciate the City's participation in this project. Should you have questions or concerns pertaining to this letter please feel free to contact Katherine Rivers at (904) 232-1656.

Sincerely,

Karl J. Nixon
Jacksonville District
Acting Chief, Real Estate Division

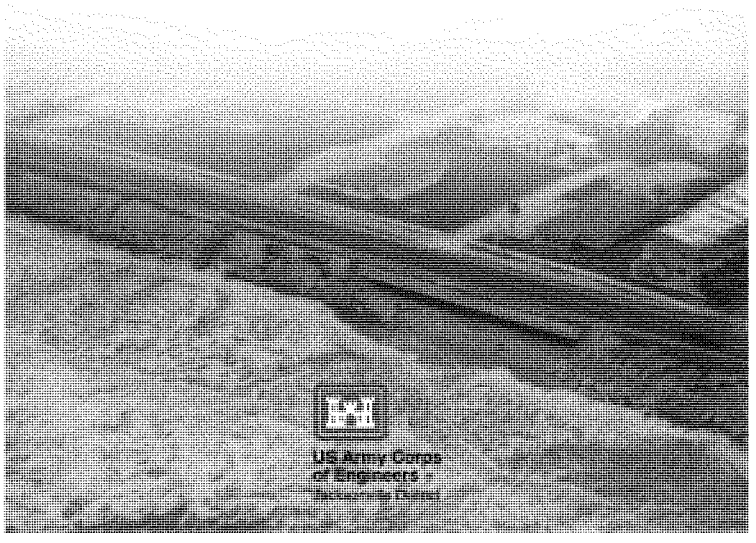
EXHIBIT NO. 2

FLAGLER COUNTY, FLORIDA

HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FINAL INTEGRATED FEASIBILITY STUDY AND
ENVIRONMENTAL ASSESSMENT

Appendix F

Environmental



Flagler County, Florida Hurricane and Storm Damage Reduction Project Integrated Feasibility Study and Environmental Assessment

Environmental Appendix F

SECTION 404(B) EVALUATION

ENVIRONMENTAL ASSESSMENT
FOR
FLAGLER COUNTY HURRICANE STORM AND DAMAGE REDUCTION
FEASIBILITY STUDY

1. Project Description

a. Location. The Flagler County Hurricane and Storm Damage Reduction (HSDR) feasibility study area encompasses approximately 18 miles of beach shoreline, bounded to the north by St. Johns County, and to the south by Volusia County. The project area is located on a coastal barrier island that varies in width from approximately 800 to 5,000 feet. The barrier island extends uninterrupted by inlets or embayment for a length of 50 miles from Matanzas Inlet at the north end to Ponce de Leon Inlet, about 27 miles to the south in Volusia County. Smith Creek and the Atlantic Intracoastal Waterway bound the island directly to the west.

b. General Description. The study area for the Feasibility Study includes the FDEP designated coastal eroded shoreline of Flagler County, per 2009 designation. The study reaches include Marineland, FDEP monument R-1 to R-4; Painters Hill, R-50 to R-59; Beverly Beach R-6- to R-66; and Flagler Beach, R-66 to R-101. Reaches between R-4 and R-50 were determined early in the screening process to not contain areas of significant erosion requiring further investigation. The purpose of the feasibility study is to assess the feasibility of providing Federal Hurricane and Storm Damage Reduction (HSDR) measures to portions of the Flagler County shoreline. The local sponsor for this project, Flagler County, has indicated strong support for feasibility phase studies for HSDR purposes along their shoreline, and has declared willingness and the capability to share applicable costs in the current study. The Recommended Plan is the National Economic Development (NED) plan which consists of a dune extension and 10-ft sacrificial berm extension in Reach C only (FDEP monuments R80 to R94). This 2.6 mile area along Flagler Beach will have an average volume of 320,000 cubic yards of material placed on the beach dune for each nourishment event of the life of the project. The average renourishment interval is 11 years, and the total volume over the life of the project is 1,610,000 cubic yards. It is assumed that dredging losses will be 26%. Therefore the estimated volume to be dredged from

the offshore borrow area over the 50-year Recommended Plan is 2,028,600 mcy.

c. Authority. The authority for conducting this Feasibility Study is contained in House Resolution 2676 adopted May 22, 2002:

> "Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, that in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing shoreline erosion protection, hurricane and storm damage reduction, and related purposes to the shores of Flagler County, Florida."

In response to this authority, the reconnaissance phase of the study was initiated upon receipt of Federal funds in 2003. The reconnaissance study for Flagler County, Florida, completed in March 2004, recommended that this study continue into the feasibility phase based on the likelihood that a Federal project may be justified and implementable given available information.

d. General Description of Dredged or Fill Material.

1) General Characteristics of Material. The sediment in the borrow area is characterized as poorly-graded, fine grained sands with an average of 16% visual shell and 27% carbonate content. The mean grain size ranges between 0.19 mm and 0.47 mm, averaging 0.29 mm. The average standard deviation is 1 phi. The amount of fine grained material passing the #230 sieve averages 1.5%. The Munsell color of the dried sand is N 7/1.

2) Source of Material. The material for use in beach nourishment will be mined from an off-shore source. This source, (Area 2), located approximately 7 miles offshore from Flagler County, encompasses over 10,000 acres and would provide more than enough material for beach renourishment along the County's beaches. Area 2 revealed beach compatible sand at three distinct locations: Sub-areas 2A, 2B, and 2C. Borrow Sub-areas 2A and 2B have a combined volume of beach compatible sand of approximately 3 million cubic yards, and borrow Sub-area 2C contains about 2.6 million cubic yards of material. Therefore, only Areas 2A and 2B are

proposed for Flagler County shoreline protection because they are closest to the placement area.

e. Description of the Proposed Discharge Site.

1) Description of Existing Beach Material. The native beach material throughout the study area consists of very fine-grained quartz sand thinly overlying coarse, medium-grained shell hash on the landward portion of the beach. The seaward portion of the beach consists of exposed, coarse shell hash. The sediment is comprised of less than 1% gravel or fine sand, less than 1% organic material, and 41.5% carbonate material. Results of the sediment analysis from collected samples indicate that the native beach sediment is bimodal consisting of a very fine-grained pinkish-gray quartz sand and medium grained reddish-yellow shell hash. The seaward portion of material consists of coarser shell hash, a likely resultant of Aeolian transport (particles transported by wind) on the sub-aerial portion of the beach along with sorting out of fine material by wave action in the intertidal (swash) zone. Some of this quartz sand appears to have been re-deposited seaward of the –0.5-ft contour.

2) Size. The project will consist of a dune extension some 10-ft seaward, as well as a 10-ft sacrificial berm with material obtained from an offshore borrow area via mechanical dredge. The length of the project along the shoreline is 2.6 miles.

3) Type of site. The type of site for placement of the sand fill material are segments of eroded, sandy, recreational beach with naturally occurring rock hardground that are variously exposed along and several hundred feet seaward of the low water shoreline. The seabed sites consist of unconsolidated fine, barren sand with no known subsurface rock within the project work zone.

4) Type of Habitat. The beach fill disposal site is a supra-tidal dry beach with a high energy intertidal environment.

5) Timing and Duration of Discharge. The exact timing of initial construction is not known at the time of submittal of the final Environmental Assessment.

f. Description of Disposal Method. Sediment form the offshore borrow area will be obtained by use of a hopper dredge with pump-out capability for subsequent hydraulic discharge to a designated staging site. Sediment will be removed from the staging site and placed and graded along the beach project areas by truck-haul and other mechanical grading equipment.

2. Factual Determinations

a. Physical Substrate Determinations.

1) Substrate elevation and slope. Details will be available with the final design.

2) Sediment Type. Material from the borrow area is fine to coarse grained quartz sand with varying amounts of small broken shell fragment; see description of 1.d(1) above.

3) Dredge/Fill Material Movement. The fill material will be subject to cross-shore erosion by waves with long-shore movement to both the north and south, and with principal new movement of fill material to the south.

4) Physical Effects on Benthos. The placement of sand on the beach face will result in the burial and loss of most of the beach infauna. Key components of these assemblages are surf clam and mole crab. With adequate recruitment, surf zone infauna, including surf clams and mole crabs should recover within one year after completion of construction if the sedimentary characteristics of the restored beach are adequate, as described above and indicated by prior analogous use of the proposed borrow area sediments.

b. Water Circulation, Fluctuation, and Salinity Determination

1) Water Column Effects. Fill placement will not have long-term or significant impacts, if any, on salinity, water chemistry, clarity, color, odor, taste, dissolved gas levels, nutrients, or eutrophication.

2) Current Patterns and Circulation. Currents in the project area are both tidal and longshore net movement of water due to the longshore current is typically from the north to the south.

3) Normal water Level Fluctuations and Salinity Gradients. Tides in the project area are semi-diurnal. Elevations of mean high water and mean low water tidal datum in Flagler County are approximately 2 feet below the NGVD 29 vertical datum.

c. Suspended Particulate/Turbidity Determinations.

1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site. There will be a temporary increase in turbidity levels in the waters adjacent to the material staging site during hydraulic discharge and a potential temporary increase in turbidity levels in the waters adjacent to the Flagler Beach shoreline within the project area during mechanical placement of the sediment to the beach face. Turbidity will be short-term and localized and no significant adverse impacts are expected. State standards for turbidity should not be exceeded during construction. Prior analogous use of the proposed borrow area sediment has not resulted in exceedance of stipulated State turbidity or water quality standards.

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

a) Light Penetration. The placement and spread of fill on the beach will increase turbidity in the nearshore area during construction. Because the immediate nearshore area is a high wave energy system and subjected to naturally occurring elevated turbidity and sediment, increases due to project construction should not be significant. A nearshore turbidity monitoring program with a plume mixing zone of 150 meters from the hydraulic dredge and discharge sites will be implemented during construction. Turbidity will be monitored during construction, and State standards for turbidity should not be exceeded. A nearshore monitoring program will be implemented to assess the potential secondary impacts of sedimentation and turbidity to nearshore communities adjacent to the equilibrium to of fill. No hardbottom resources are present in the project area.

b) Dissolved Oxygen. Dissolved oxygen levels will not be altered by this project.

c) Toxic Metals, Organics and Pathogens. No toxic metals, organics, or pathogens will be released by the project.

d) Aesthetics. Aesthetic quality will be reduced during that period when work is occurring. There will be a long term increase in aesthetic quality of the beach once the work is completed.

3) Effects of Biota

a) Primary Productivity and Photosynthesis. The level of suspended particles will temporarily increase in the surf zone during construction. Suspended material will prevent light from reaching existing algae temporarily restricting photosynthesis and primary productivity in local areas. Potential secondary impacts of chronic turbidity and sedimentation will be assessed for the nearshore communities during the post-construction monitoring.

b) Suspension/Filter Feeders. Suspension feeders will experience short-term impacts during construction, but no long-term adverse impact will occur as a result of this project.

c) Sight Feeders. Visual feeders will experience short term impacts, but no long-term adverse impacts will occur as a result of this project.

d) Contaminant Determinations. Deposited fill material will not introduce, relocate, or increase contaminants.

e) Aquatic, Ecosystem, and Organism Determinations. The grain size characteristics and composition exhibited by the proposed fill material are similar to those of the existing beach sediments. Therefore, no sediment related impacts are expected. The proposed fill material meets the exclusion criteria; consequently, no additional chemical-biological testing will be required.

4) Effects on Plankton. Although short term effects (e.g. clogging of feeder appendages) on plankton are likely, no adverse long-term impacts to planktonic organisms are anticipated.

5) Effect on Benthos. Although avoidance to non-motile or motile benthic invertebrates on nearshore hardbottom habitat and soft bottom habitat will be practiced, some long-term, adverse impacts are anticipated to occur.

6) Effects on Nekton. No adverse long-term impacts to nektonic species are anticipated.

7) Effects on the Aquatic Food Web. No adverse long-term impacts to any trophic group in the food web are anticipated.

8) Effects on Special Aquatic Sites.

   a) Coral Reefs. There are no coral reefs located with the proposed dredge and disposal areas.

   b) Sanctuaries and Refuges. There are no sanctuaries or wildlife refuges located within the proposed dredge and disposal areas.

   c) Wetlands. There are no wetlands located within the proposed dredge and disposal areas.

   d) Mud Flats. There are no mud flats located within the proposed dredge and disposal areas.

   e) Vegetated Shallows. There are no seagrass beds located within or adjacent to the dredge area, the staging sites or material placement locations.

9) Endangered and Threatened Species. There will be no significant impacts on any endangered or threatened species from the proposed project. Although designated critical habitat for the North Atlantic right whale occurs within the study area, activities proposed for the project sites will avoid impact to this habitat. Sea turtle nesting may occur in the project area during the time that the dredging and beach material placement takes place. If construction occurs during the nesting season, a nest monitoring and relocation program will be implemented as recommended by the USFWS. Although these species are unlikely to occur in the project area, protection measures for manatees, whales, shorebirds, gopher tortoise, southeastern beach mouse, and indigo snake will be followed to minimize the potential for harm to these species.

10) Other Wildlife. No significant adverse impacts to small foraging mammals, reptiles, wading birds, or wildlife in general are expected.

11) Actions to Minimize Impacts. All practical safeguards will be taken during construction to preserve and enhance environment, aesthetic, recreational, and economic values in the project area. Specific precautions that will be implemented in conjunction with the proposed project are discussed elsewhere in this Section 404(b) evaluation and

in the integrated Final Feasibility Report / Environmental Assessment for the impact.

d. Proposed Disposal Site Determinations

1) Mixing Zone Determinations. The fill material will not cause unacceptable changes in the mixing zone specified in the Water Quality Certification in relation to: depth, current velocity, direction and variability, degree of turbulence, stratification, or ambient concentrations of constituents.

2) Determination of Compliance with Applicable Water Quality Standards. Because of the inert nature of the fill material, state water quality standards will not be violated. Turbidity monitoring will be implemented as stipulated by state permits.

3) Potential Effects of Human Use Characteristics.

a) Municipal and Private Water Supplies. No municipal or private water supplies will be impacted by the implementation of the action.

b) Recreational and Commercial Fisheries. Recreational and commercial fisheries will not be permanently impacted by the disposal of dredged material on the beach. Minor or temporary adverse impacts to recreational fishing along the beach fill area may result from impacts to the nearshore hardbottom immediately along the shoreline; however, this may be evident as a seaward translocation of the fishing resource coincident with the addition of beach fill.

c) Water Related Recreation. Beach recreation will be enhanced by the nourishment of the beach. Nearshore snorkeling and fishing may be temporarily affected by increased turbidity in the vicinity of fill sites. The presence of construction-related equipment will create public safety risks at the beach sites. Adverse impacts to swimming and surfing are not anticipated because of the narrow scale of beach fill to be placed immediately along the beach face, landward of locations where swimming and surfing occur.

d) Aesthetics. The stabilization of an eroding beach will improve the aesthetics of the beach.

e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. There

are numerous non-federal beach recreation areas, including state and county parks and facilities, located along the beach fill project area. The proposed activity is anticipated to maintain or improve beach recreation opportunities associated with these parks. There are no other national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves located within the project areas.

f) Determination of Cumulative Effects on the Aquatic Ecosystem. As long as the characteristics of fill material remain consistent with previous projects (overall low proportion of fine-grained sand), there will be no significant cumulative impacts that result in a major impairment of water quality to the existing aquatic ecosystem as a result of placement of fill at the project site. Research during the feasibility phase of this project has indicated no net cumulative, adverse effect to the exposure of existing nearshore hardbottom along or adjacent to prior beach nourishment activities in the known recent past. No cumulative impacts to turtles, fish or wildlife have been documented.

g) Determination of Secondary Effects on the Aquatic Ecosystem. No adverse secondary effects of the placement of the fill material are anticipated. Long-term monitoring will document potential secondary impacts of turbidity and sedimentation upon adjacent habitats.

3. Findings of Compliance or Non-compliance 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 State of Florida and/or United States.

   c. After consideration of disposal site dilution and dispersion, the discharge of fill materials will not cause or contribute to, 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 Flagler County HSDR project 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 material 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. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur. No adverse effects to hardbottom resources are likely to occur.

f. On the basis of the guidelines, the proposed disposal site for the discharge of dredged material is specified as complying with the requirements of these guidelines.

COASTAL ZONE MANAGEMENT CONSISTENCY

FLORIDA COASTAL ZONE MANAGEMENT PROGRAM
FEDERAL CONSISTENCY EVALUATION PROCEDURES

FLAGLER COUNTY HURRICANE AND STORM DAMAGE REDUCTION
FEASIBILITY STUDY
FLAGLER COUNTY, FLORIDA

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 proposed plans and information will be submitted to the state in compliance with this chapter.

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 directions for the future and provide long-range guidance for an orderly social, economic and physical growth.
Response: The Proposed project has been coordinated with various Federal, State and local agencies during the planning process. The project meets the primary goal of the State Comprehensive Plan through preservation and protection of the shorefront and infrastructure.

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 involves the placement of beach compatible material onto an eroding beach as a protective means for residents, development, and infrastructure located along the Atlantic shoreline within Flagler County. Therefore, this project would be consistent with the efforts of the Division of Emergency Management.

Regarding natural resources, no hardbottom resources were identified to be present in the borrow or project placement areas (dune) during the subsurface resource survey; therefore, no impact would occur to this resource.

4. Chapter 253, State Lands.

This chapter governs the management of submerged state lands and resources within state lands. This includes archaeological 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 beach nourishment would create increased recreational beach and potential sea turtle nesting habitat. No seagrass beds, swamps, marshes and other wetland; mineral resources; unique natural features; spoil islands; and hardground or artificial reefs are located within or adjacent to the areas proposed for dredging, disposal, beach fill placement, or mitigation. The proposed project would comply with the intent of this chapter.

5. Chapters 253, 259, 256, and 375, Land Acquisition.

These chapters authorize the state to acquire land to protect the environmentally sensitive areas.
Response: No land acquisition is proposed in this project.

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: There is one state park, Washington Oaks State Park within the study area, but will not be included for project management measures. Therefore, no adverse impact will occur to this state park. There is one state recreational area, Gamble Rodgers Memorial State Recreation Area, which is within the project area. Protective measures to avoid or minimize impact along with mitigation measures are included in the Environmental Assessment. Regarding natural resources, no hardbottom resources were identified to be present in the borrow or project placement areas (dune) during the subsurface resource survey; therefore, no impact would occur to this resource.

7. Chapter 267, Historic Preservation.

This chapter establishes the procedures for implementing the Florida Historic Resources Act responsibilities.
Response: No significant impacts to historical properties are expected from construction of the proposed Flagler County Hurricane and Storm Damage Reduction (HSDR) project based upon the results of site investigation and this coordination.

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 beach nourishment would provide more space for recreation and the protection of recreational facilities along the receiving beach. This would be compatible with tourism for this area and therefore, is consistent with the goals of this chapter.

9. Chapters 344 and 339, Public Transportation.

This chapter authorizes the planning and development of a safe balanced and efficient transportation system.
Response: No public transportation systems would be impacted by this project.

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 fishermen 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, economic, and other studies and research.
Response: The tentatively selected plan consists of the creation of an extension of the upland dune and 10-ft sacrificial berm constructed with a hydraulic dredge. There will be no effect to fishery resources such as estuaries or other marine environments.

11. Chapter 372, Living Land and Freshwater Resources.

This chapter establishes the Fish and Wildlife Conservation 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 project will have no significant effect on freshwater aquatic life or wild animal life.

12. Chapter 373, Water Resources.

This chapter provides the authority to regulate the withdrawal, diversion, storage, and consumption of water.
Response: The project does not involve water resources as described by this chapter.

13. Chapter 373, Pollutant Spill Prevention and Control.

This chapter regulates the transfer, storage, and transportation of pollutants and the cleanup of pollutant discharges.
Response: The contract specifications will prohibit the contractor from dumping oil, fuel, or hazardous wastes in the work area and will require that the contractor adopt safe and sanitary measures for the disposal of solid wastes. A spill prevention plan will be required.

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: The proposed renourishment project will not have any regional impact on resources in the area. Therefore, the project is 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 will not further the propagation of mosquitoes 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 Florida Department of Environmental Regulation (now a part of the Florida Department of Environmental Protection).

Response: A Draft Environmental Assessment addressing project impacts has been prepared and is under review by the appropriate resource agencies including the Florida Department of Environmental Protection. Environmental protection measures will be implemented to ensure that no lasting adverse effects on water quality, air quality, or other environmental resources will occur. Water Quality Certification will be sought from the State prior to construction. The project complies with the intent of 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 not located near or on agricultural lands; therefore, this chapter does not apply.

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

REPLY TO ATTENTION OF
CESAJ-PD-EC

AUG 2 6 2008

MEMORANDUM FOR Commander, U.S. Army Records Management and Declassification Agency, ATTN: AHRC-PDD-RP Casey Building, Room 102, 7701 Telegraph Road, Alexandria, Virginia 22315-3860

SUBJECT: Notice of Intent to Prepare a Draft Environmental Impact Statement

Enclosed for publication in the Federal Register are three signed original copies of the Notice of Intent to prepare a Draft Environmental Impact Statement and compact disc for Flagler County, Florida proposal to recover critically eroded coastal shoreline. The billing code is 3710-AJ.

FOR THE COMMANDER

Encl

ERIC P. SUMMA
Acting Chief, Environmental Branch

BILLING CODE: 3710-AJ

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Intent to Prepare a Draft Environmental Impact Statement for Shoreline Protection for Flagler County, FL

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DOD.

ACTION: Notice of intent.

SUMMARY: The Jacksonville District, U.S. Army Corps (Corps) of Engineers intends to prepare a Draft Environmental Impact Statement (EIS) for protection of 18-Miles of coastal shoreline in Flagler County, FL. The project is a cooperative effort between the U.S. Army Corps of Engineers (lead Federal agency) and City of Flagler Beach (non-Federal sponsor and cooperating agency).

ADDRESSES: Ms. C. L. Brooks, U.S. Army Corps of Engineers, Jacksonville District, Planning Division, Environmental Section, P.O. Box 4970, Jacksonville, FL 32207.

FOR FURTHER INFORMATION CONTACT: C. L. Brooks at (904) 232-2130.

SUPPLEMENTARY INFORMATION: Authority for the proposed study is House Resolution 2676 adopted May 22, 2002. A Reconnaissance Report completed in March 2004 by the Corps, concluded based on preliminary findings, there was a federal interest in pursuing shoreline protection for Flagler County, FL.

1

Alternatives: Project's alternatives include no action and various levels of protection along approximately 18 miles of coastal shoreline with substantial critically eroded areas. In addition to various levels of beach nourishment and periodic renourishment, the Corps will consider other management measures such as nearshore placement of sand, breakwaters, submerged artificial reef, groins, revetments, seawalls, dunes/vegetation, change to the Coastal Construction Control Line, relocation of structures, moratorium on construction, establish a no-growth program, relocation of structures, flood proofing of structures, and condemnation of structures with land acquisition.

Issues: The EIS will consider impacts on hardbottom communities, sea grasses, protected species, shore impacts, health and safety, water quality, aesthetics and recreation, fish and wildlife resources, cultural resources, energy conservation, socio-economic resources, navigation, and other impacts identified through scoping, public involvement and interagency coordination.

Scoping: The scoping process will involve Federal, State, County and municipal agencies and other interested persons and organizations. . Any public or agency scoping meeting will be announced separately from this notice.

Public Involvement: We invite the participation of affected Federal, State and local agencies, affected Native-American Tribes, and other interested private organizations and individuals. There will be a public meeting on the Draft

Environmental Impact Statement following its preparation. The date, time, and location will be announced.

Coordination: The proposed action is being coordinated with the U.S. Fish and Wildlife Service (FWS) [under Section 7 of the Endangered Species Act and the Fish and Wildlife and Coordination Act] and with the National Marine Fisheries Service [under the Magnuson-Stevens Fishery Conservation and Management Act (on Essential Fish Habitat) and Section 7 of the Endangered Species Act. The proposed action is also being coordinated with the Florida State Historic Preservation Officer, the U.S. Coast Guard, and the U.S. Environmental Protection Agency.

Other Environmental Review and Consultation: The proposed action would involve evaluation for compliance with guidelines pursuant to Section 404(b)(1) of the Clean Water Act, water quality certification (application to the State of Florida) pursuant to Section 401 of the Clean Water Act, certification of state lands, easements, and rights-of-way, and determination of Coastal Zone Management Act Consistency.

Agency Role: As the cooperating agency, non-Federal sponsor and leading local expert, the City of Flagler Beach will provide information and assistance on the resources to be impacted, mitigation measures and alternatives. Other agencies having either regulatory authority or special expertise may also be invited to become a cooperating agency in preparation of the EIS.

3

Draft EIS Preparation: It is anticipated that the Draft EIS will be available to the public by December 2010. As the study and EIS develop, additional information will be posted under Flagler County on the Jacksonville District's Environmental Documents web page at: *http://planning.saj.usace.army.mil/envdocs/envdocsb.htm*. The status of any Florida Department of Environmental Protection application submitted for permit of this action will be posted on the internet at: *http://www.dep.state.fl.us/beaches/permitting/permits.htm*.

26 Aug 2008
DATE

ERIC P. SUMMA
ACTING CHIEF, ENVIRONMENTAL BRANCH

4

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

REPLY TO
ATTENTION OF

Planning Division
Environmental Branch

AUG 2 8 2008

To Whom It May Concern:

The Jacksonville District, U.S. Army Corps of Engineers (Corps), is gathering information to define issues and concerns that need to be addressed during a shore protection study for Flagler County, Florida. Authority for the study is contained in House Resolution 2676 adopted May 22, 2002. A reconnaissance level report has been completed and resulted in a recommendation to continue the study into the feasibility phase. The study area is the coastal shoreline that exists within the boundaries of Flagler County, approximately 18 miles.

Flagler County is located on the northeast coast of Florida midway between the Florida/Georgia state line and Cape Canaveral. The study area is part of a barrier island and mainland complex that extends from the Matanzas Inlet to the Ponce de Leon Inlet (Figures 1 and 2). Geographically, the county is bound to the north by St. Johns County, to the south by Volusia County, Putnam County to the west and the Atlantic Ocean to the east. Critically eroded areas have developed along the shoreline and pose threats to existing development, infrastructures and recreation features; shoreline stabilization structures, a major roadway (State Highway A1A); and fish and wildlife habitat.

The feasibility study will develop and evaluate shore protection alternatives with potential to reduce hurricane and storm damage along critically eroded areas; improve the quality of suitable habitats for threatened and endangered species (Table 1); provide future protective features for unique habitats; provide beneficial use of dredged material; and improve local and regional recreational opportunities. See enclosed "Notice of Intent" for additional information.

For the purposes of the Feasibility Report, the study area has been divided into six (6) reaches (Figure 3) as following:

Reach 1 – Marineland. This reach is located between the Florida Department of Environmental Protection (FDEP) monuments R-1 to R-4. Erosion is being experienced at a rate of 0.5 feet per year (ft/yr).

Reach 2 – Painters Hill. This reach is located between FDEP monuments R-50 to R-55. Erosion is ranging from 1.5 to 2.0 ft/yr.

Reach 3 – Beverly Beach. This reach is located between FDEP monuments R-64 to R-67. Critical erosion extends about 0.3 mile.

Reaches 4, 5 and 6 – Flagler County. These reaches are located between FDEP monuments R-77 to R-91. Critical erosion extends approximately 2.5 miles.

During the reconnaissance study, sand source alternatives were identified (Figures 3 and 4). It is highly probable that beach quality sand may be secured from maintenance dredging of the Matanzas Intracoastal Waterway; dredging of the material deposited into the Matanzas Inlet by tidal shoals and sediment migration patterns; or secured from offshore sand sources. During the Feasibility Study, details specific to each alternative will be evaluated to determine available volume, quality, and compatibility.

The Flagler County Shoreline Protection Project is proposed for evaluation under the Environmental Impact Statement (EIS) process. The EIS will assess impacts on the human environment, identify methods and procedures to insure that present un-quantified environmental amenities and values are sufficiently addressed, evaluate unresolved conflict that may develop over the recommended alternatives; and will initiate and use ecological/natural resources information in the planning and development of project action and alternatives. During the Feasibility Study, public meetings also will be conducted to identify and develop public concerns and obtain substantive input into the study processes.

The Corps invite you to submit comments on environmental concerns, cultural resources, study objectives, and important features within the described study area, as well as, suggested alternatives, scientific data, and possible study improvements. Within 45 days of this letter, your written communication should be directed to the letterhead address. Questions of inquiry and clarification can be directed to the Environmental Point of Contact, Ms. C.L. Brooks, at either the above letterhead, telephone number 904-232-2130, facsimile number 904-232-3442, or email address Catherine.l.brooks@usace.army.mil.

Sincerely,

Rebecca S. Griffith, Ph.D, PMP
Chief, Planning Division

Enclosure

bcc (w/ encl.):
CESAJ-PD-PC
CESAJ-DP-I

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

REPLY TO ATTENTION OF

Planning Division
Environmental Branch

AUG 2 0 2008

Dr. Roy Crabtree, Southeast Regional Administrator
NOAA Fisheries Service
263 13th Avenue South
St Petersburg, Florida 33701

Dear Dr. Crabtree:

In accordance with regulations pertaining to the National Environmental Policy Act (Title 40 of the Code of Federal Regulations, part 1501.6), I am formally inviting your agency to become a cooperating agency for an Environmental Impact Statement (EIS) on the Flagler County, Shoreline Protection Feasibility Study. A copy of the Notice of Intent to Prepare an EIS and a Plan View map of the study area are enclosed. Additional information can be obtained from the following website: http://planning.saj.usace.army.mil/envdocs/envdocsb.htm#Flagler-County.

Please note that cooperating agency status involves actions and responsibilities beyond that normally associated with a commenting or permitting agency. We request that your role include the following: (1) designate a Point of Contact representing your agency on the Project Delivery Team for this action; (2) provide early review and comment on the EIS and Feasibility Study; and (3) participate in the Feasibility Scoping Meeting (FSM), the Alternative Formulation Briefing (AFB), the public meeting on the Draft EIS, and periodic project meetings and teleconferences.

The conduct of the FSM and AFB and the formulation of the project, alternatives, and mitigation will be in accordance with Engineer Regulation ER 1105-2-100 (http://www.usace.army.mil/publications/eng-regs) and will fully consider a range of environmental, economic, and social factors. As a cooperating agency, you must fully consider the views, needs, and benefits of competing interests.

No cooperating agency will have "veto" over the selection of the project plan, alternatives, or mitigation measures. Under your status as a commenting agency, you may recommend actions not ultimately adopted or implemented by the lead agency. You may also impose requirements to the extent allowed under your legal authority as a permitting agency. Conflict with the lead agency may be resolved through mediation, placing a dissenting opinion in the EIS, withdrawing your cooperating agency status, or the Lead agency pursuing an EIS without you as a cooperating agency. For additional information see the enclosed "Rights and Responsibilities of Lead and Cooperating Agencies" (Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations, Council on Environmental Quality, 1981). Additional information on Cooperating Agencies can be found at http://ceq.eh.doe.gov/nepa/regs.

Please indicate whether you accept this invitation to become a cooperating agency (as described above) within 30 days of the date of this letter. If you have any questions, please contact Mr. Kenneth Dugger at 904-232-1686 or Ms. Catherine Brooks at 904 232-2130.

Sincerely,

Eric R. Summa
Acting Chief, Environmental Branch

Enclosures

Copies Furnished:

Ms. Lauren Milligan, Florida Department of Environmental Protection, Office of Intergovernmental Programs, 3900 Commonwealth Boulevard, MS 47, Tallahassee, Florida 32399-3000
Ms. Sally Mann, Director, Office of Intergovernmental Programs, Florida Department of Environmental Protection, 3900 Commonwealth Boulevard, MS 47, Tallahassee, Florida 32399-3000
Mr. Jack Long, Florida Department of Environmental Protection Southeast District, 400 North Congress Avenue, Suite 200, West Palm Beach, Florida 33401

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

REPLY TO ATTENTION OF

Planning Division
Environmental Branch

AUG 2 6 2008

Mr. Ken Haddad, Executive Director
Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, Florida 32399-1600

Dear Mr. Haddad:

In accordance with regulations pertaining to the National Environmental Policy Act (Title 40 of the Code of Federal Regulations, part 1501.6), I am formally inviting your agency to become a cooperating agency for an Environmental Impact Statement (EIS) on the Flagler County, Shoreline Protection Feasibility Study. A copy of the Notice of Intent to Prepare an EIS and a Plan View map of the study area are enclosed. Additional information can be obtained from the following website: http://planning.saj.usace.army.mil/envidocs/envdocsb.htm#Flagler-County.

Please note that cooperating agency status involves actions and responsibilities beyond that normally associated with a commenting or permitting agency. We request that your role include the following: (1) designate a Point of Contact representing your agency on the Project Delivery Team for this action; (2) provide early review and comment on the EIS and Feasibility Study; and (3) participate in the Feasibility Scoping Meeting (FSM), the Alternative Formulation Briefing (AFB), the public meeting on the Draft EIS, and periodic project meetings and teleconferences.

The conduct of the FSM and AFB and the formulation of the project, alternatives, and mitigation will be in accordance with Engineer Regulation ER 1105-2-100 (http://www.usace.army.mil/publications/eng-regs) and will fully consider a range of environmental, economic, and social factors. As a cooperating agency, you must fully consider the views, needs, and benefits of competing interests.

No cooperating agency will have "veto" over the selection of the project plan, alternatives, or mitigation measures. Under your status as a commenting agency, you may recommend actions not ultimately adopted or implemented by the lead agency. You may also impose requirements to the extent allowed under your legal authority as a permitting agency. Conflict with the lead agency may be resolved through mediation, placing a dissenting opinion in the EIS, withdrawing your cooperating agency status, or the Lead agency pursuing an EIS without you as a cooperating agency. For additional information see the enclosed "Rights and Responsibilities of Lead and Cooperating Agencies" (Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations, Council on Environmental Quality, 1981). Additional information on Cooperating Agencies can be found at http://ceq.eh.doe.gov/nepa/regs.

Please indicate whether you accept this invitation to become a cooperating agency (as described above) within 30 days of the date of this letter. If you have any questions, please contact Mr. Kenneth Dugger at 904-232-1686 or Ms. Catherine Brooks at 904 232-2130.

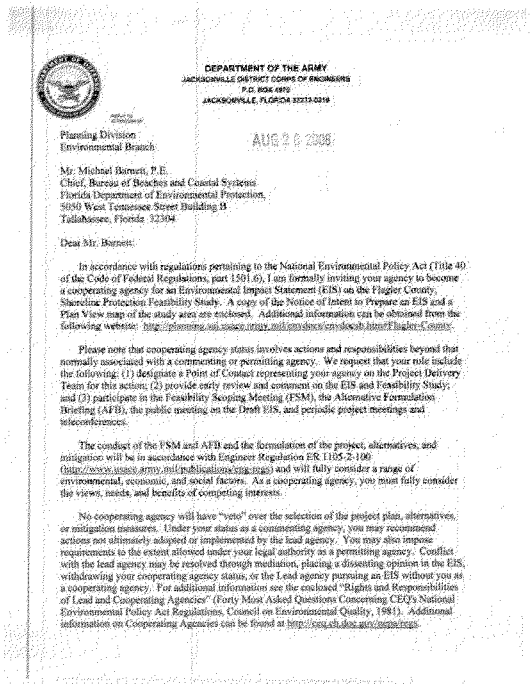
Sincerely,

Eric P. Summa
Acting Chief, Environmental Branch

Enclosures

Copies Furnished:

Mr. Tim Breault, Director, Habitat and Species Conservation, Fish and Wildlife Conservation Commission, 620 South Meridian Street, Tallahassee, Florida 32399-1600
Mr. Chuck Collins, Regional Director, Fish and Wildlife Conservation Commission, 8535 Northlake Boulevard, West Palm Beach, Florida 33412



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

Planning Division
Environmental Branch

AUG 2 8 2006

Mr. Michael Barnett, P.E.
Chief, Bureau of Beaches and Coastal Systems
Florida Department of Environmental Protection,
3900 West Tennessee Street Building B
Tallahassee, Florida 32304

Dear Mr. Barnett:

In accordance with regulations pertaining to the National Environmental Policy Act (Title 40 of the Code of Federal Regulations, part 1501.6), I am formally inviting your agency to become a cooperating agency for an Environmental Impact Statement (EIS) on the Flagler County, Shoreline Protection Feasibility Study. A copy of the Notice of Intent to Prepare an EIS and a Plan View map of the study area are enclosed. Additional information can be obtained from the following website: http://planning.sad.usace.army.mil/projects/projdesc.htm#Flagler County.

Please note that cooperating agency status involves actions and responsibilities beyond that normally associated with a commenting or permitting agency. We request that your role include the following: (1) designate a Point of Contact representing your agency on the Project Delivery Team for this action; (2) provide early review and comment on the EIS and Feasibility Study; and (3) participate in the Feasibility Scoping Meeting (FSM), the Alternative Formulation Briefing (AFB), the public meeting on the Draft EIS, and periodic project meetings and teleconferences.

The conduct of the FSM and AFB and the formulation of the project, alternatives, and mitigation will be in accordance with Engineer Regulation ER 1105-2-100 (http://www.usace.army.mil/publications/eng-regs) and will fully consider a range of environmental, economic, and social factors. As a cooperating agency, you must fully consider the views, needs, and benefits of competing interests.

No cooperating agency will have "veto" over the selection of the project plan, alternatives, or mitigation measures. Under your status as a commenting agency, you may recommend actions not ultimately adopted or implemented by the lead agency. You may also impose requirements to the extent allowed under your legal authority as a permitting agency. Conflict with the lead agency may be resolved through mediation, placing a dissenting opinion in the EIS, withdrawing your cooperating agency status, or the Lead agency pursuing an EIS without you as a cooperating agency. For additional information see the enclosed "Rights and Responsibilities of Lead and Cooperating Agencies" (Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations, Council on Environmental Quality, 1981). Additional information on Cooperating Agencies can be found at http://ceq.eh.doe.gov/nepa/regs.

Please indicate whether you accept this invitation to become a cooperating agency (as described above) within 30 days of the date of this letter. If you have any questions, please contact Mr. Kenneth Dugger at 904-232-1686 or Ms. Catherine Brooks at 904 232-2130.

Sincerely,

Eric P. Summa
Acting Chief, Environmental Branch

Enclosures

Copies Furnished:

Ms. Lauren Milligan, Florida Department of Environmental Protection, Office of Intergovernmental Programs, 3900 Commonwealth Boulevard, MS 47, Tallahassee, Florida 32399-3000
Ms. Sally Mann, Director, Office of Intergovernmental Programs, Florida Department of Environmental Protection, 3900 Commonwealth Boulevard, MS 47, Tallahassee, Florida 32399-3000
Mr. Jack Long, Florida Department of Environmental Protection Southeast District, 400 North Congress Avenue, Suite 200, West Palm Beach, Florida 33401

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

REPLY TO ATTENTION OF

Planning Division
Environmental Branch

AUG 2 6 2008

Mr. Dave Hankla, Field Supervisor
U.S. Fish and Wildlife Service
North Florida Field Office
7915 Baymeadows Way, Suite 200
Jacksonville, Florida 32256-7517

Dear Mr. Hankla:

In accordance with regulations pertaining to the National Environmental Policy Act (Title 40 of the Code of Federal Regulations, part 1501.6), I am formally inviting your agency to become a cooperating agency for an Environmental Impact Statement (EIS) on the Flagler County, Shoreline Protection Feasibility Study. A copy of the Notice of Intent to Prepare an EIS and a Plan View map of the study area are enclosed. Additional information can be obtained from the following website: http://planning.saj.usace.army.mil/envdocs/envdocsb.htm#Flagler-County.

Please note that cooperating agency status involves actions and responsibilities beyond that normally associated with a commenting or permitting agency. We request that your role include the following: (1) designate a Point of Contact representing your agency on the Project Delivery Team for this action; (2) provide early review and comment on the EIS and Feasibility Study; and (3) participate in the Feasibility Scoping Meeting (FSM), the Alternative Formulation Briefing (AFB), the public meeting on the Draft EIS, and periodic project meetings and teleconferences.

The conduct of the FSM and AFB and the formulation of the project, alternatives, and mitigation will be in accordance with Engineer Regulation ER 1105-2-100 (http://www.usace.army.mil/publications/eng-regs) and will fully consider a range of environmental, economic, and social factors. As a cooperating agency, you must fully consider the views, needs, and benefits of competing interests.

No cooperating agency will have "veto" over the selection of the project plan, alternatives, or mitigation measures. Under your status as a commenting agency, you may recommend actions not ultimately adopted or implemented by the lead agency. You may also impose requirements to the extent allowed under your legal authority as a permitting agency. Conflict with the lead agency may be resolved through mediation, placing a dissenting opinion in the EIS, withdrawing your cooperating agency status, or the Lead agency pursuing an EIS without you as a cooperating agency. For additional information see the enclosed "Rights and Responsibilities of Lead and Cooperating Agencies" (Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations, Council on Environmental Quality, 1981). Additional information on Cooperating Agencies can be found at http://ceq.eh.doe.gov/nepa/regs.

Please indicate whether you accept this invitation to become a cooperating agency (as described above) within 30 days of the date of this letter. If you have any questions, please contact Mr. Kenneth Dugger at 904-232-1688 or Ms. Catherine Brooks at 904 232-2130.

Sincerely,

Eric P. Summa
Acting Chief, Environmental Branch

Enclosures

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

Planning Division
Environmental Branch

JAN 28 2011

Mr. James F. Bennett
Bureau of Ocean Energy Management, Regulation and Enforcement Environmental Division
Branch of Environmental Assessment
381 Elden Street, MS 4042
Herndon, VA 20170

Dear Mr. Bennett:

In accordance with regulations pertaining to the National Environmental Policy Act (Title 40 of the Code of Federal Regulations, part 1501.6), I am formally responding to your request for the Bureau of Ocean Energy Management, Regulation and Enforcement Division, Branch of Environmental Assessment to become a cooperating agency for an Environmental Impact Statement (EIS) on the Flagler County Hurricane and Storm Damage Reduction (HSDR) Feasibility Study. Informal coordination with your agency is forth coming. An EIS is currently being drafted which will evaluate the Flagler County HSDR feasibility project with emphasis on identifying alternatives for the protection of natural and economic resources along Flagler County beaches and shoreline. A copy of the Notice of Intent to Prepare an EIS and a Plan View map of the study area are enclosed. Additional information can be obtained from the following website:

http://planning.saj.usace.army.mil/envdocs/envdocsb.htm#Flagler-County.

Please note that cooperating agency status involves actions and responsibilities beyond that normally associated with a commenting or permitting agency. Your agency is being specifically requested to provide special expertise on natural resources in this area.

The formulation of the project, alternatives, and mitigation will be in accordance with Engineer Regulation ER 1105-2-100 and will fully consider a range of environmental, economic, and social factors. As a cooperating agency, you must fully consider the views, needs, and benefits of competing interests.

No cooperating agency will have "veto" over the selection of the project plan, alternatives, or mitigation measures. Under your status as a cooperating agency, you may recommend actions not ultimately adopted or implemented by the lead agency. You may also impose requirements to the extent allowed under your legal authority as a permitting agency. Conflict with the lead agency may be resolved through mediation, placing a dissenting opinion in the EIS, withdrawing your cooperating agency status, or the Lead agency pursuing an EIS without you as a cooperating agency.

For additional information see the enclosed "Rights and Responsibilities of Lead and Cooperating Agencies" (Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations, Council on Environmental Quality, 1981).

Please indicate whether you accept this invitation to become a cooperating agency (as described above) within 30 days of the date of this letter. If you have any questions, please contact Ms. Kathleen McConnell at 904 232-3607.

Sincerely,

Eric P. Summa
Chief, Environmental Branch

Enclosures

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

REPLY TO ATTENTION OF

Planning Division
Environmental Branch

8 OCT 200

Ms. Teresa Calleson, Acting Director
U.S. Fish & Wildlife Service
North Florida Ecological Services Office
7915 Baymeadows Way, Suite 200
Jacksonville, FL 32256-7517

Dear Director:

This letter initiates the 30-day coordination with your office under the Statewide Programmatic Biological Opinion (SPBO) for beach placement and shore protection for the Flagler County Hurricane and Storm Damage Reduction (HSDR) project located in Flagler County, Florida. The Corps proposes to reduce damage from extreme storms and hurricanes through the shoreline protection measure of rebuilding a natural dune system that includes planting native dune-type vegetation for a section of Flagler Beach from FDEP monument R-80 to R-92. The proposed project consists of a 10-foot seaward extension of the existing dune; construction of the dune extension will extend the existing berm and entire active profile seaward. The attached figure provides a summary of the plan.

There are no identified terms and conditions, or other criteria that would not be followed. Standard Manatee protection measures would be imposed on activities in the water. With respect to sea turtles, all other terms and conditions of the SPBO would be followed. The proposed activity may affect nesting sea turtles and is not likely to adversely affect Manatees. The activity is unlikely to affect beach mice as none are known to be present within the project footprint.

This letter also notifies your office with respect to the Programmatic Piping Plover Biological Opinion (P3BO). The activity will not occur in "optimal" Piping Plover habitat and is not likely to adversely affect the Piping Plover (see enclosed information sheet). Although no optimal Piping Plover habitat is present within the project area, this species has been documented as occurring within the Gamble Rodgers State Recreational Area to the south of the project limits (R-84). It is for this reason that a P3BO informational sheet is being submitted with this document.

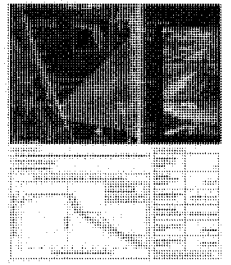
Should you determine that the proposed activity is not within the scope of the SPBO or the P3BO, please consider this letter initiation of consultation pursuant to Section 7 of the Endangered Species Act. If you have any questions, please contact me at 904 232-1665 or the technical point of contact. The technical point of contact for this action is Kathleen McConnell who can be reached at 904 232-3607.

Sincerely,

for Eric P. Summa
Chief, Environmental Branch

Enclosures

McConnell/CESAJ-PD-EC/3607/
Spinning/CESAJ-PD-EC
Harrah/CESAJ-DP-C
Dugger/CESAJ-PD-E
Summa/CESAJ-PD-E



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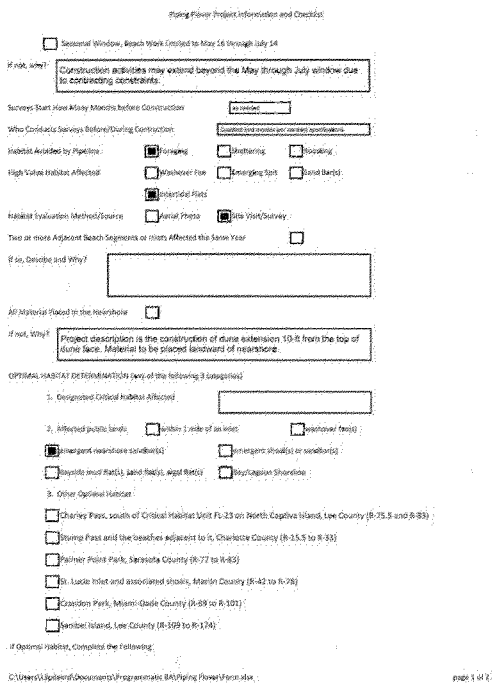

Piping Plover Project Information and Checklist

☐ Seasonal Window, Beach Work Limited to May 16 through July 14

If not, why? Construction activities may extend beyond the May through July window due to contracting constraints.

Surveys Start How Many Months before Construction [illegible]

Who Conducts Surveys Before/During Construction [illegible]

Habitat Avoided by Pipeline: ☒ Foraging ☐ Sheltering ☐ Roosting

High Value Habitat Affected: ☐ Washover Fan ☐ Emerging Spit ☐ Sand Bar(s) ☒ Intertidal Flats

Habitat Evaluation Method/Source: ☐ Aerial Photo ☒ Site Visit/Survey

Two or more Adjacent Beach Segments or Hosts Affected the Same Year ☐

If so, Describe and Why?

All Material Placed to the Nearshore ☐

If not, Why? Project description is the construction of dune extension 10-ft from the top of dune face. Material to be placed landward of nearshore.

OPTIMAL HABITAT DETERMINATION (any of the following 3 categories)

1. Designated Critical Habitat Affected

2. Affected public lands: ☐ within 1 mile of an inlet ☐ washover fan(s)

☒ Emergent nearshore sandbar(s) ☐ Emergent shoal(s) or sandbar(s)

☐ Bayside mud flat(s), sand flat(s), algal flat(s) ☐ Bay/Lagoon Shoreline

3. Other Optimal Habitat

☐ Charles Pass, south of Critical Habitat Unit FL-23 on North Captiva Island, Lee County (R-75.5 and R-83)

☐ Stump Pass and the beaches adjacent to it, Charlotte County (R-15.5 to R-33)

☐ Palmer Point Park, Sarasota County (R-77 to R-83)

☐ St. Lucie Inlet and associated shoals, Martin County (R-42 to R-78)

☐ Crandon Park, Miami-Dade County (R-89 to R-101)

☐ Sanibel Island, Lee County (R-109 to R-174)

If Optimal Habitat, Complete the Following

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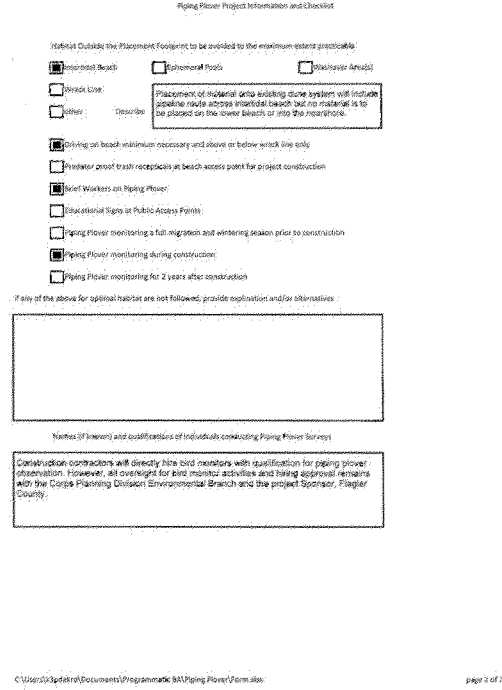

Piping Plover Project Information and Checklist

Habitat Outside the Placement Footprint to be avoided to the maximum extent practicable:

☒ Intertidal Beach ☐ Ephemeral Pools ☐ Washover Area(s)

☐ Shrub Line

☐ Other Describe: Placement of material onto existing dune system will include pipeline route across intertidal beach but no material is to be placed on the lower beach or into the nearshore.

☒ Driving on beach minimum necessary and above or below wrack line only

☐ Predator proof trash receptacles at beach access point for project construction

☒ Brief Workers on Piping Plover

☐ Educational Signs at Public Access Points

☐ Piping Plover monitoring a full migration and wintering season prior to construction

☒ Piping Plover monitoring during construction

☐ Piping Plover monitoring for 2 years after construction

If any of the above for optimal habitat are not followed, provide explanation and/or alternatives

Names (if known) and qualifications of individuals conducting Piping Plover Surveys

Construction contractors will directly hire bird monitors with qualification for piping plover observation. However, all oversight for bird monitor activities and hiring approval remains with the Corps Planning Division Environmental Branch and the project Sponsor, Flagler County.

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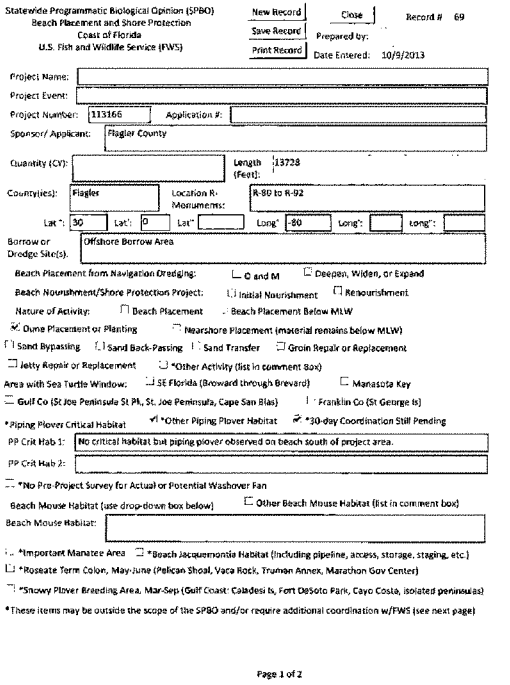


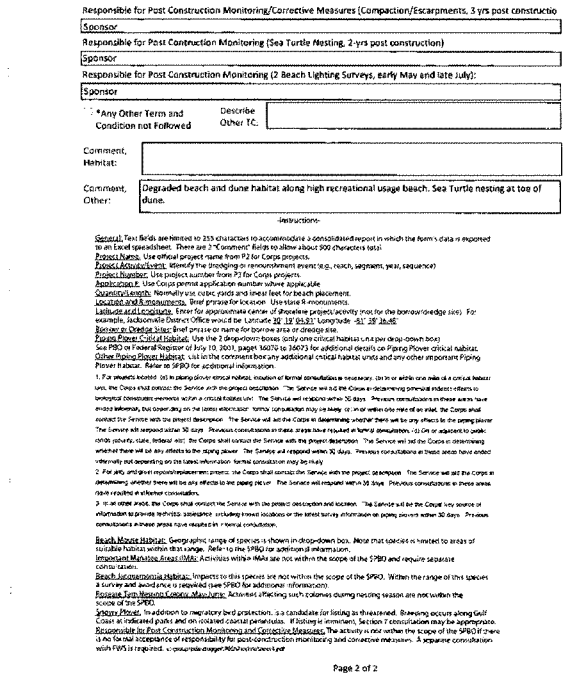
Statewide Programmatic Biological Opinion (SPBO)
Beach Placement and Shore Protection
Coast of Florida
U.S. Fish and Wildlife Service (FWS)

New Record | Close | Record # 69
Save Record | Prepared by:
Print Record | Date Entered: 10/9/2013

Project Name:
Project Event:
Project Number: 113166 Application #:
Sponsor/ Applicant: Flagler County
Quantity (CY): Length (Feet): 13728
County(ies): Flagler Location R-Monuments: R-80 to R-92
Lat °: 30 Lat': 0 Lat": Long°: -80 Long': Long":
Borrow or Dredge Site(s): Offshore Borrow Area

Beach Placement from Navigation Dredging: ☐ O and M ☐ Deepen, Widen, or Expand
Beach Nourishment/Shore Protection Project: ☐ Initial Nourishment ☐ Renourishment
Nature of Activity: ☐ Beach Placement ☐ Beach Placement Below MLW
☑ Dune Placement or Planting ☐ Nearshore Placement (material remains below MLW)
☐ Sand Bypassing ☐ Sand Back-Passing ☐ Sand Transfer ☐ Groin Repair or Replacement
☐ Jetty Repair or Replacement ☐ *Other Activity (list in comment box)
Area with Sea Turtle Window: ☐ SE Florida (Broward through Brevard) ☐ Manasota Key
☐ Gulf Co (St Joe Peninsula St Ph, St. Joe Peninsula, Cape San Blas) ☐ Franklin Co (St George Is)
*Piping Plover Critical Habitat ☑ *Other Piping Plover Habitat ☑ *30-day Coordination Still Pending
PP Crit Hab 1: No critical habitat but piping plover observed on beach south of project area.
PP Crit Hab 2:
☐ *No Pre-Project Survey for Actual or Potential Washover Fan
Beach Mouse Habitat (use drop-down box below) ☐ Other Beach Mouse Habitat (list in comment box)
Beach Mouse Habitat:
☐ *Important Manatee Area ☐ *Beach Jacquemontiie Habitat (including pipeline, access, storage, staging, etc.)
☐ *Roseate Tern Colon, May-June (Pelican Shoal, Vaca Rock, Trumon Annex, Marathon Gov Center)
☐ *Snowy Plover Breeding Area, Mar-Sep (Gulf Coast: Caladesi Is, Fort DeSoto Park, Cayo Costa, isolated peninsulas)
*These items may be outside the scope of the SPBO and/or require additional coordination w/FWS (see next page)

Page 1 of 2



Responsible for Post Construction Monitoring/Corrective Measures (Compaction/Escarpments, 3 yrs post constructio
Sponsor
Responsible for Post Contruction Monitoring (Sea Turtle Nesting, 2-yrs post construction)
Sponsor
Responsible for Post Construction Monitoring (2 Beach Lighting Surveys, early May and late July):
Sponsor
*Any Other Term and Condition not Followed Describe Other T/C:
Comment, Habitat:
Comment, Other: Degraded beach and dune habitat along high recreational usage beach. Sea Turtle nesting at toe of dune.

-Instructions-

General: Text fields are limited to 255 characters to accommodate a consolidated report in which the form's data is exported to an Excel spreadsheet. There are 2 "Comment" fields to allow about 500 characters total.
Project Name: Use official project name from PJ for Corps projects.
Project Activity/Event: Identify the dredging or renourishment event (e.g., reach, segment, year, sequence)
Project Number: Use project number from PJ for Corps projects.
Application #: Use Corps permit application number where applicable.
Quantity/Length: Normally use cubic yards and linear feet for beach placement.
Location and R-monuments: Brief phrase for location. Use state R-monuments.
Latitude and Longitude: Enter for approximate center of shoreline project/activity (not for the borrow/dredge site). For example, Jacksonville District Office would be: Latitude 30° 19' 05.21" Longitude -81° 39' 36.48"
Borrow or Dredge Site: Brief phrase or name for borrow area or dredge site.
Piping Plover Critical Habitat: Use the 3 drop-down boxes (only one critical habitat unit per drop-down box).
See PBO or Federal Register of July 10, 2001, pages 36070 to 36073 for additional details on Piping Plover critical habitat.
Other Piping Plover Habitat: List in the comment box any additional critical habitat units and any other important Piping Plover habitat. Refer to SPBO for additional information.

1. For projects located: (a) in piping plover critical habitat, initiation of formal consultation is necessary; (b) in or within one mile of a critical habitat unit, the Corps shall contact the Service with the project description. The Service will tell the Corps if it determining somewhat indirect effects to biological constituent elements within a critical habitat unit. The Service will respond within 30 days. Previous consultations in these areas have ended informally, but lower Jay on the latest information formal consultation may be likely or, in or within one mile of an inlet, the Corps shall contact the Service with the project description. The Service will tell the Corps if determining whether there will be any effects to the piping plover. The Service will respond within 30 days. Previous consultations in these areas have required a formal consultation. (c) On or adjacent to public lands (county, state, federal etc), the Corps shall contact the Service with the project description. The Service will tell the Corps in determining whether there will be any effects to the piping plover. The Service will respond within 30 days. Previous consultations in these areas have ended informally, but depending on the latest information formal consultation may be likely
2. For jetty and groin repair/replacement projects, the Corps shall contact the Service with the project description. The Service will tell the Corps in determining whether there will be any effects to the piping plover. The Service will respond within 30 days. Previous consultations in these areas have resulted in informal consultations.
3. In all other areas, the Corps shall contact the Service with the project description and location. The Service will tell the Corps key source of information to provide technical assistance including known locations of the latest survey information on piping plovers within 30 days. Previous consultations in these areas have resulted in informal consultation.

Beach Mouse Habitat: Geographic range of species is shown in drop-down box. Note that species is limited to areas of suitable habitat within that range. Refer to the SPBO for additional information.
Important Manatee Area (IMA): Activities within IMAs are not within the scope of the SPBO and require separate consultation.
Beach Jacquemontiia Habitat: Impacts to this species are not within the scope of the SPBO. Within the range of this species a survey and avoidance is required (see SPBO for additional information).
Roseate Tern Nesting County, May-June: Activities affecting such colonies during nesting season are not within the scope of the SPBO.
Snowy Plover: In addition to migratory bird protection, is a candidate for listing as threatened. Breeding occurs along Gulf Coast at indicated parks and on isolated coastal peninsulas. If listing is imminent, Section 7 consultation may be appropriate.
Responsible for Post Construction Monitoring and Corrective Measures: The activity is not within the scope of the SPBO if there is no formal acceptance of responsibility for post-construction monitoring and corrective measures. A separate consultation with FWS is required. C:\Documents and Settings\MSH\Desktop\SPBO Instructions 6.pdf

Page 2 of 2

United States Department of the Interior
U. S. FISH AND WILDLIFE SERVICE
7915 BAYMEADOWS WAY, SUITE 200
JACKSONVILLE, FLORIDA 32256-7517

IN REPLY REFER TO:
FWS Log No. 41910-2014-F-0038

May 30, 2014

Colonel Alan M. Dodd
District Commander
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019
(Attn: Kathleen McConnell)

Dear Colonel Dodd:

This document transmits the U.S. Fish and Wildlife Service's (Service) decision regarding the application of the proposed Flagler County Hurricane and Storm Reduction project located in Flagler County, Florida, to the August 22, 2011, Statewide Programmatic Biological Opinion (SPBO) (Service, 2011) and the May 22, 2013, Programmatic Piping Plover Biological Opinion (P^3BO) (Service, 2013). The U.S. Army Corps of Engineers (Corps) determined on October 8, 2013, that the proposed project "may affect" the threatened North Atlantic population of the loggerhead sea turtle (*Caretta caretta*), the endangered green sea turtle (*Chelonia mydas*), and the endangered leatherback sea turtle (*Dermochelys coriacea*). In addition, the Corps determined that the proposed project "may affect, but was not likely to adversely affect" the endangered West Indian (Florida) manatee (*Trichechus manatus latirostris*) and the piping plover (*Charadrius melodus*), because it was not located in optimal Piping Plover Habitat. This document is provided in accordance with Section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*), the Marine Mammal Protection Act of 1972, as amended (MMPA) (16 U.S.C. 1361 *et seq.*), and the provisions of the Fish and Wildlife Coordination Act of 1958, as amended (FWCA) (48 Stat. 401; 16 U.S.C. 661 *et seq.*).

PROJECT DESCRIPTION

The Corps is proposing to perform shoreline protection activities from Florida Department of Environmental Protection monuments R-80 to R-94 in Flagler Beach in order to rebuild a natural dune system by adding a10-foot seaward extension of the existing dune (Figure 1). In the event of future storms, the work should result in a significant reduction in storm damage along State Road A1A. The proposed construction will result in 330,000 cubic yards of sand placement followed by periodic nourishment events of 320,000 cubic yards. The sand will be mined from a borrow area located seven miles offshore of the placement area and delivered to the project site using a hydraulic dredge. The proposed project is expected to take 30 days for the mobilization/ demobilization activities and approximately 123 days for construction. The expected interval between renourishment events would be 11 years. Additional work associated with the project will include the planting of native shoreline vegetation on the constructed dune and on the

existing dune disturbed by the proposed construction. We consider the action area for this project to include approximately 2.6 miles of linear shoreline.

The action area is defined as all areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action. The Service identifies the action area to include the staging and discharge areas, pipeline corridor, beach access corridor, and the area of the sand placement. The project is located along the Atlantic Ocean, Flagler County, between R-80 and R-94.

THREATENED AND ENDANGERED SPECIES

Sea Turtles

The Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) share Federal jurisdiction for sea turtles under the Act. The Service has the responsibility for sea turtles on the nesting beach and the NOAA Fisheries has jurisdiction for sea turtles in the marine environment. As a result, our analysis will only address activities that may impact nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea.

Please note the provisions of this consultation do not apply to sea turtles in the marine environment, such as swimming juvenile and adult sea turtles. If applicable, you are required to consult with the NOAA Fisheries on your project. For further information on Act compliance with the NOAA Fisheries, please contact Ms. Cathy Tortorici, Chief of the Interagency Cooperation Branch, by e-mail at cathy.tortorici@noaa.gov or by phone at 727-209-5953.

The applicant has agreed to implement SPBO's Reasonable and Prudent Measures and Terms and Conditions, which apply to sand placement projects constructed during the sea turtle nesting season. The Service has determined that the proposed project is appropriate to apply to the SPBO as it concerns sand replacement activities along the coast of Florida. The minimization measures, Reasonable and Prudent Measures, and Terms and Conditions in the SPBO are applicable to the proposed project and must be followed for the loggerhead, green, and leatherback sea turtles. We have assigned log number 2014-F-0038 to this individual consultation. Please submit a report for the proposed project as described in the SPBO Term and Condition A22 following completion of the proposed work.

Piping Plover

The proposed project is located in non-optimal piping plover habitat and, therefore, consistent with the P^3BO, we conclude that a determination of "may affect, but is not likely to adversely affect" is appropriate, provided that conservation measures agreed to by the Corps for all projects that may affect the piping plover are followed. The applicant has agreed to implement the conservation measures outlined in the P^3BO that apply to projects in non-optimal habitat, including implementing the survey guidelines for non-breeding shorebirds.

Wintering shorebird surveys as described in the P^{3}BO are intended to document shorebird use of project sites before and after construction and thereby monitor project impacts to the piping plover. Reasonable and Prudent Measure 5 and Terms and Conditions 8 and 9 in the P^{3}BO describe the monitoring requirement. Term and Condition 8 stipulates that for one full piping plover migration and winter season (July 15 to May 15) prior to construction and 2 seasons following construction, bimonthly (twice-monthly) surveys for piping plovers shall be conducted in any intertidal or shoreline areas within or affected by the project. Term and Condition 9 outlines information to be collected. For projects in non-optimal habitat, such as this project, the Service has modified winter shorebird survey requirements as deemed appropriate based on specifics of the project.

If piping plovers are documented in the project area during the preconstruction surveys, the Service will be contacted for potential implementation of additional conservation measures prior to commencing construction. All shorebird survey data will be forwarded to the Service annually by July 31 of each year in which monitoring is conducted, as described in Term and Condition 9 of the P^{3}BO. The person(s) conducting the surveys must demonstrate the qualifications and ability to identify shorebird species and be able to provide the information outlined in the P^{3}BO.

West Indian (Florida) Manatee

Provided that the Florida Fish and Wildlife Conservation Commission's (FWC's) 2011 Standard Manatee Conditions for In-Water Work and minimization measures outlined in the SPBO are implemented to avoid potential impacts to manatees, the Service concurs with the determination of "may affect, but not likely to adversely affect" for the manatee.

This letter fulfills the requirements of the Act and no further action is required. If modifications are made to the project, if additional information involving potential effects to listed species becomes available, or if a new species is listed, reinitiation of consultation may be necessary.

FISH AND WILDLIFE RESOURCES

This section is provided in accordance with the FWCA of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 *et seq.*) to address other fish and wildlife resources in the project area.

In accordance with the Migratory Bird section of the SPBO, the Corps should follow the FWC standard guidelines (see attached guidelines) to protect against impacts to nesting shorebirds as a result of the proposed project. With the protection measures from the guidelines, the SPBO, and the P3BO implemented, the proposed work should not result in significant impacts to those resources.

The Corps should continue to consult with NOAA Fisheries regarding the dredge and sand placement templates as well as the downdrift areas. In addition, the Corps will assess and consult with NOAA Fisheries concerning potential impacts to foraging and swimming sea turtles, and all other marine species under their jurisdiction within the action area.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if:

1. The amount or extent of incidental take outlined in the SPBO and/or P3BO is exceeded. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation;
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion;
3. The agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or
4. A new species is listed or critical habitat designated that may be affected by the action.

Thank you for your cooperation in the effort to conserve fish and wildlife resources. Should you have additional questions or require clarification regarding this letter, please contact Terri Calleson at 904-731-3286.

Sincerely,

Jay B. Herrington
Field Supervisor

cc: Corps, Jacksonville, Florida (Kathleen McConnell)
DEP, Tallahassee, Florida (Lanie Edwards)
FWC, Tallahassee, Florida (Robbin Trindell)
NOAA Fisheries, St. Petersburg, Florida (Kathy Tortorici)

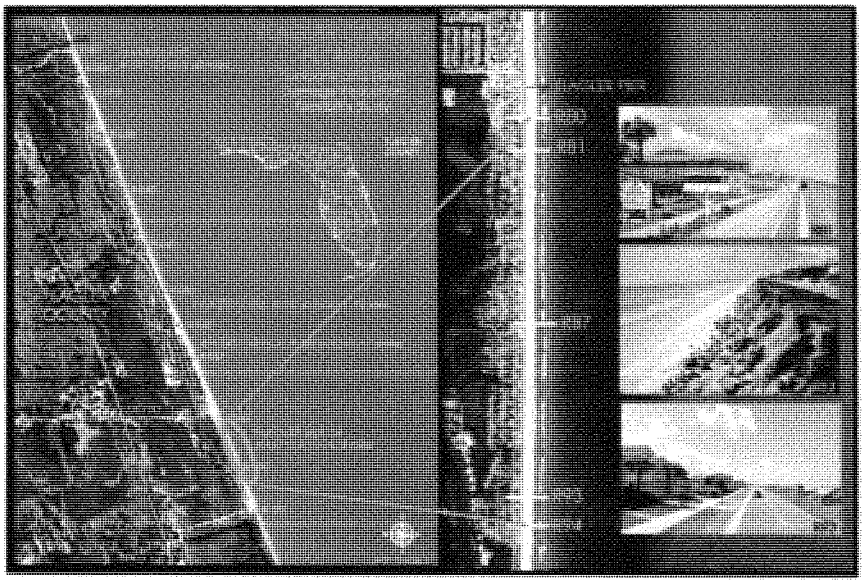


Figure 1. Specific location of proposed work

LITERATURE CITED

Florida Fish and Wildlife Conservation Commission. 2011. Standard Manatee Conditions for In-Water Work 2011. Tallahassee, Florida. Available from: http://myfwc.com/wildlifehabitats/managed/manatee/permit-review/#Main

U.S. Fish and Wildlife Service (Service). 2011. Statewide programmatic biological opinion to the U.S. Army Corps of Engineers (FWS Log No. 41910-2011-F-0170) for shore protection activities along the coast of Florida (August 22, 2011). Jacksonville, Panama City, and Vero Beach Field Offices, Florida.

U.S. Fish and Wildlife Service (Service). 2013. Programmatic piping plover biological opinion to the U.S. Army Corps of Engineers (Service Consultation Code 04EF1000-2013-F-0124) for shore protection activities in the geographical region of the north and south Florida Ecological Services Field Offices (May 22, 2013). Jacksonville and Vero Beach Field Offices, Florida.

Attachment

Standard Conditions for Placement of Dredged Material at Seabird and Shorebird Nesting Sites

1. ***Selection of Bird Monitors.*** The permittee or designated representative ("Permittee") shall hire one or more Bird Monitors, depending on the size of the area to be affected, who will monitor shorebird activity before, during, and after construction. Bird Monitors should have proven seabird and shorebird identification skills and avian survey experience. Before hiring any Bird Monitors, the Representative shall provide a list of candidate Bird Monitors with (1) their contact information and (2) a summary of their qualifications, including bird identification skills and avian survey experience, to the FWC Regional Species Conservation Biologist (contact information attached) for FWC approval before the Permittee hires the Bird Monitor(s).

2. ***Pre-Construction Meeting.*** The Permittee is responsible for arranging a meeting with the U.S. Fish and Wildlife Service (USFWS), the Florida Fish and Wildlife Conservation Commission (FWC), and the Bird Monitor(s) before any work begins. The Permittee shall notify the USFWS, the FWC Regional Species Conservation Biologist (**contact information attached**), and the Bird Monitor(s) at least 10 business days before the date of that meeting. The purpose of this meeting is to ensure that the Permittee and Bird Monitor(s) fully understand and agree with the protection measures and any additional site-specific measures that need to be taken before, during, and after construction.

3. ***Nesting Seabird and Shorebird Protection Conditions:*** Bird Monitors shall use the following survey protocols:

    a. The Bird Monitor(s) shall review and become familiar with the general information on the FWC's Florida Shorebird Database (FSD) website (www.FLShorebirdDatabase.org). They shall use the data-collection protocol and implement data-entry procedures as outlined in that website. An outline of data to be collected, including downloadable field data sheets, is available on the website.

    b. Breeding season varies by species. Most species have completed the breeding cycle by September 1, but flightless young may be present through September. The following dates are based on the best available information regarding ranges and habitat use by species around the state:

        - All Gulf Coast counties: February 15 until September 1 except:
            - Spoil islands in Hillsborough County: March 1 until September 1
            - Citrus and Levy counties: March 15 until September 1
            - Dixie and Taylor counties: April 1 until September 1

- St. Lucie, Martin, and Palm Beach counties:
  - Spoil islands and estuaries: March 15 until September 1
  - Coastal beaches: April 1until September 1
- Broward and Miami-Dade counties: April 1 until September 1
- All other Atlantic Coast counties: March 15 until September 1

Surveys during the breeding season shall begin on the first day of the breeding season or 10 days before any site work begins, whichever is later. Surveys shall be conducted through August 31 or until all breeding activity has concluded, whichever is later.

c. During the breeding season, the Bird Monitor(s) shall survey all potential beach-nesting bird habitats that may be affected by construction or pre-construction activities. The Bird Monitor(s) shall establish one or more shorebird survey routes into the FSD website to cover these areas.

d. During the pre-construction and construction phases of the project, the Bird Monitor(s) shall complete surveys on a daily basis to detecting breeding activity and the presence of flightless chicks before (1) equipment is moved to the area, (2) vehicles are operated in the area, or (3) any other activities occur that have the potential to disrupt breeding behavior or cause harm to the birds or their eggs or young.

e. The Bird Monitor(s) shall survey the project area by walking and looking for evidence of (1) shorebirds exhibiting breeding behavior, (2) shorebird chicks, or (3) shorebird juveniles, as outlined in the FSD's *Breeding Bird Protocol for Shorebirds and Seabirds*. The Bird Monitor(s) must use binoculars for these surveys.

If an ATV or other vehicle is needed to cover large project areas, operators shall adhere to the FWC's Best Management Practices for Operating Vehicles on the Beach (http://myfwc.com/conservation/you-conserve/wildlife/beach-driving/). Specifically, the vehicle must be operated at a speed under 6 mph and only on beaches at or below the high-tide line. The Bird Monitor(s) will stop at no greater than 200-meter intervals to look for breeding activity.

f. Once the Bird Monitor(s) confirms that birds are breeding, as evidenced by the presence of a scrape, eggs, or young, the Bird Monitor(s) shall notify the FWC Regional Species Conservation Biologist (**contact information attached**) within 24 hours. The Bird Monitor(s) must report all breeding activity to the FSD website within one week of data collection.

4. ***Seabird and Shorebird Buffer Zones and Travel Corridors.*** The Bird Monitor(s) shall establish a disturbance-free buffer zone around any location within the project area where

shorebirds have been engaged in breeding behavior, including territory defense. The FWC considers a 300-foot-wide buffer to be adequate based on published studies; however, a smaller, site-specific buffer may be established if approved by the FWC Regional Species Conservation Biologist (**contact information attached**). All sources of human disturbance (including pedestrians, pets, and vehicles) shall be prohibited in the buffer zone.

a. The Bird Monitor(s) shall keep breeding sites under sufficient surveillance to determine if birds appear agitated or disturbed by construction or other activities in adjacent areas. If birds do appear to be agitated or disturbed by these activities, then the Bird Monitor(s) shall widen of the buffer zone immediately to a sufficient size to protect breeding birds.

b. The Bird Monitor(s) shall ensure that reasonable and traditional pedestrian access is not blocked situations under which breeding birds will tolerate pedestrian traffic. Breeding birds may tolerate pedestrian traffic within 300 feet of an established pathway. The Bird Monitor(s) shall work with the FWC Regional Species Conservation Biologist to determine if pedestrian access can be accommodated without compromising nesting success.

c. The Bird Monitor(s) shall ensure that the perimeters of designated buffer zones are marked with posts, twine, and signs stating "Do Not Enter, Important Nesting Area" or similar language. The signs shall include the name and a phone number of the entity responsible for posting. Posts should not be higher than 3 inches once installed. "Symbolic fencing" (i.e., twine, string, or rope) shall be placed between all posts and be clearly visible to pedestrians. In areas where marine turtles nest, the ropes shall be at least 2.5 feet above the ground. If pedestrian pathways are approved by the FWC Regional Species Conservation Biologist within the 300-foot buffer zone, these should be clearly marked. The Bird Monitor(s) shall ensure that the posting is maintained in good repair until breeding is completed or terminated. Although solitary nesters may leave the buffer zone with their chicks, the posted area continues to provide a potential refuge for the family until breeding is complete. Breeding is not considered to be completed until all chicks have fledged.

d. The Bird Monitor(s) shall ensure that no construction activities, pedestrians, moving vehicles, or stockpiled equipment are allowed within the buffer area.

e. The Bird Monitor(s) shall designate and mark travel corridors outside the buffer areas so as not to cause disturbance to breeding birds. Heavy equipment, other vehicles, or pedestrians may go past breeding areas in these corridors. However, other activities such as stopping or turning heavy equipment and vehicles shall be prohibited within the designated travel corridors adjacent to the breeding site. When flightless chicks are present within or next to travel corridors, the Bird Monitor(s) shall accompany moving vehicles to ensure that no chicks are in the path of the moving vehicle and no tracks are left that could trap flightless chicks.

f. The FWC recommends that the Bird Monitor(s) ensure that some activity in the travel corridor is maintained on a daily basis in order to discourage birds from nesting within the travel corridor. These activities should not be allowed to disturb shorebirds nesting on site or interfere with marine turtle nesting, especially if the corridors are established before construction has started.

g. Flooding or flagging potential breeding sites shall be the only passive methods for modifying their suitability in upland placement areas before breeding starts unless the FWC Regional Species Conservation Biologist has approved alternative methods. The Bird Monitor(s) shall survey these areas for shorebird activity before these areas are flooded or flagged.

5. ***Seabird and Shorebird Notification.*** If the Bird Monitor(s) find that shorebirds are breeding within the project area, he or she shall ensure that an informational bulletin board is placed and maintained in the construction staging area. This bulletin board shall display the location map of the construction site, depict the location(s) of the bird breeding areas, and include a clearly visible warning stating: "NESTING BIRDS ARE PROTECTED BY LAW INCLUDING THE FLORIDA ENDANGERED AND THREATENED SPECIES ACT AND THE STATE AND FEDERAL MIGRATORY BIRD ACTS".

6. ***Equipment Storage and Placement.*** The Bird Monitor(s) shall ensure that staging areas for construction equipment are located off the shoreline whenever possible. Equipment not in use or left overnight shall be stored away from the shoreline in order to minimize disturbance to nesting shorebirds. In addition, all construction pipes that are placed on the shoreline shall be located as far landward as possible. Pipes that are stored temporarily shall be placed off the shoreline to the maximum extent possible. If it will be necessary to extend construction pipes past a known shorebird nesting site or an over-wintering area for piping plovers, then those pipes should be placed landward of the site whenever possible before birds are active in that area. No pipe or sand shall be placed seaward of a shorebird nesting site during the shorebird nesting season.

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

REPLY TO ATTENTION OF

Planning and Policy Division
Environmental Branch

OCT 0 4 2011

To Whom It May Concern:

The Jacksonville District, U.S. Army Corps of Engineers (Corps), is gathering information to define issues and concerns that need to be addressed during hurricane and storm damage reduction (HSDR) study for Flagler County, Florida. Authority for the study is contained in House Resolution 2676, adopted May 22, 2002. A Notice of Intent to prepare a Draft Environmental Impact Statement was issued on August 26, 2008. A reconnaissance level report was completed resulting in a recommendation to continue the study into the Feasibility phase. The study area is the coastal shoreline of Flagler County, approximately 18 miles.

The Flagler County HSDR Project is being evaluated under the National Environmental Policy Act (NEPA) process. The NEPA would assess impacts to the human environment, identify methods and procedures to insure that present un-qualified environmental amenities and values are sufficiently addressed, and evaluate unresolved conflict that may develop over the recommended alternatives. Additionally, the NEPA would initiate and use ecological/natural resources information in the planning and development of project action and alternatives.

The Corps invites you to attend this public scoping workshop to address environmental concerns, cultural resources, study objectives, and important features within the described study area, and to suggest alternatives, scientific data collection, and possible study improvements. The workshop would provide the opportunity for verbal and written commentary, and participation with technical specialists of various disciplines that address the Corps planning process, environmental and cultural resources, as well as engineering and economic concerns.

The workshop will be held on October 25, 2011, from 6:00 pm to 9:00 pm at the Flagler County Government Services Building, located at 1769 East Moody Blvd, Building #2, Bunnell, FL 32110. Inquiries regarding this meeting may be directed to Ms. Kathleen McConnell, at the above letterhead, by telephone at 904-232-3607, or email at Kathleen.k.mcconnell@usace.army.mil.

Sincerely,

Kenneth R. Duff
for Eric P. Summa
Chief, Environmental Branch

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

June 11, 2014 F/SER47:GG/pw

(Sent via Electronic Mail)

Colonel Alan M. Dodd, Commander
U.S. Army Corps of Engineers Jacksonville District
Jacksonville District, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Attention: Kathleen McConnell

Dear Colonel Dodd:

NOAA's National Marine Fisheries Service (NMFS) reviewed the *Flagler County, Florida Hurricane and Storm Damage Reduction Project Draft Integrated Feasibility Study and Environmental Assessment* (EA) dated January 2014. The Tentatively Selected Plan (TSP) is the National Economic Development plan and consists of a ten-foot dune extension and a ten-foot sacrificial berm over 2.6 miles of shoreline in central Flagler Beach between Florida Department of Environmental (FDEP) monuments R-80 and R-94. The sand would come from a borrow area seven miles offshore. A hydraulic dredge would likely be used to dredge sand from the borrow area and to pump sand onto the beach; heavy equipment (such as bulldozers) would be used to grade the sand into the construction template. Over the 50-year period of Federal participation, the Jacksonville District estimates four nourishment events at 11-year intervals would occur after initial construction. Initial construction and each nourishment event would require approximately 330,000 cubic yards of sand. As the nation's federal trustee for the conservation and management of marine, estuarine, and anadromous fishery resources, the following comments are provided pursuant to authorities of the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

Essential Fish Habitat
EA Section 2.4.6 identifies federally managed fishery species the Jacksonville District believes occur in the project area and discusses their distribution along with the distribution of numerous other species. These descriptions do not require augmentation to complete the EFH consultation.

Impacts to Essential Fish Habitat
NMFS examined whether the project may adversely impact live/hardbottom habitat, which EA Sections 2.4.4 and 2.4.6 note is a Habitat Area of Particulars Concern. EA Appendix F includes a report from Dial Cordy and Associates (DCA) showing "exposed or near-surface rock" between the 10-foot and 15-foot depth contours between R-80 to R-87 and notes this is generally consistent with a 1999 report from FDEP. While the DCA report does not quantify the area of

the outcrops, NMFS estimates Figures 4C and 4D show 1 to 2 acres of hardbottom habitat. The DCA report notes confirmation of these signatures may be required, and EA Appendix F and the latter part of EA Section 2.4.4 discuss a follow-up survey done about one year later in 2012. The description of the follow-up surveys is not clear. The text says multi-beam sonar and towed video were "proposed to acquire further detail of the hardbottom" but it appears only an additional sidescan sonar survey was done. The proximity of these potential outcrops to the equilibrium toe-of-fill also is not clear because the EA has few cross-sectional drawings. EA Appendix A (page A-66) suggests the equilibrium toe-of-fill extends to the 12-foot depth contour. Amending Figures 4D and 4E to include the estimated equilibrium toe-of-fill would greatly clarify the extent of the potential live/hardbottom impacts. Assuming no live/hardbottom habitat would be buried by the equilibrium toe-of-fill, NMFS has no concerns about impacts to this habitat in the fill area.

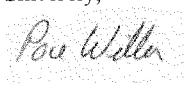
NMFS also examined whether the project may adversely impact live/hardbottom habitat at the borrow area. EA Appendix F reports no hardbottom in or near Borrow Areas 2A, 2B, and 2C. While SEAMAP[1] shows hardbottom may be present in Area 2C, the data reported in Appendix F should be substantially higher in quality and reliability than the much older SEAMAP data. Further, EA Sections 7.3.1 and 7.6.1 note a 400-foot buffer would be maintained around any hardbottom found as new information becomes available as project planning progresses (NMFS assumes the 200-foot buffer listed in Table 7-1 is a typographical error given the support the EA offers elsewhere for the 400-foot buffer). Provided a 400-foot buffer is used to protect any live/hardbottom habitat found in a borrow area, NMFS has no concerns about impacts to this habitat in the borrow areas.

Lastly, NMFS examined whether dredging of the borrow area and filling at the beach may increase the concentration of suspended sediments that can clog gills in young, less mobile fish and invertebrates and thereby increase their mortality rate. The extent of negative effects is dependent on the life history stages of the species present and duration of exposure to high concentrations of suspended sediments. In open areas, adherence to the State Water Quality Criteria for turbidity at the edge of a 150-meter mixing zone is normally sufficiently protective of fishery resources. In addition to the State Water Quality Criteria, another practicable way to minimize fishery impacts is restricting dredging to the winter months or placing restrictions on dredge operations (e.g., in the case of a cutterhead dredge, the swing speed of the ladder arm supporting the cutterhead, the rotational speed of the cutterhead blades, and the intake suction velocity at the cutterhead) can be used to minimize suspension of material. NMFS requests the Jacksonville District evaluate whether a seasonal restriction on dredging would be a practicable way to minimize impacts to larvae and juveniles migrating along the shoreline. If a seasonal restriction is not practicable, an evaluation of the duration that larvae and young juvenile fish would be exposed to high levels of suspended sediments should be beneficial.

[1] Southeast Area Monitoring and Assessment Program - South Atlantic (SEAMAP-SA). 2001. Distribution of Bottom Habitat on the Continental Shelf from North Carolina through the Florida Keys. SEAMAP-SA Bottom Mapping Project, Atlantic States Marine Fisheries Commission, Washington, DC. 166 pages

We appreciate the opportunity to provide these comments. Please direct related questions to the attention of Mr. George Getsinger at our Northeast Florida field office. He may be reached at 9741 Ocean Shore Drive, St. Augustine, Florida, 32080; by telephone at (904) 461-8674; or by email at George.Getsinger@noaa.gov.

Sincerely,



/ for

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

cc:

COE, Jason.J.Spinning@usace.army.mil, Kathleen.K.Mcconnell@usace.army.mil
EPA, Eric.H.Hughes@usace.army.mil
FWS Annie_Dziergowski@fws.gov, Terri_Calleson@fws.gov
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F/SER4, David Dale@noaa.gov, George.Getsnger@noaa.gov

Flagler County (Florida) Nearshore Hardbottom Survey

Submitted in support of the Flagler County Hurricane and Storm Damage Reduction Feasibility Study



Prepared for
Jacksonville District
U.S. Army Corps of Engineers

by
Dial Cordy and Associates Inc.
490 Osceola Avenue
Jacksonville Beach, Florida 32250

3 October 2011

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1.0 INTRODUCTION

Background. Flagler County is located on the northeast coast of Florida approximately midway between the Florida/Georgia state line and Cape Canaveral. The county is bounded to the north by St. Johns County and to the south by Volusia County (Figure 1). Flagler County has approximately 18 miles of sandy shoreline, all of which are authorized for Federal study. The coast has no inlets or embayments and the beaches are typically fronted by steep dune faces or rock revetment. Sections of coquina rock outcroppings and nearshore hardbottom are present along the coast. The Flagler County shoreline is subject to erosion caused by both storms and natural shoreline processes. The purpose of the study is to assess the feasibility of providing Federal Hurricane and Storm Damage Reduction (HSDR) measures to portions of the Flagler County shoreline (USACE 2011).

The four reaches listed in Table 1 encompass approximately 9.6 miles of coastline to be investigated in the Flagler County Feasibility Study. This includes 5.7 miles of shoreline that is designated by the Florida Department Environmental Protection (FDEP) as critically eroded. Of these four reaches, three will be included in the sidescan sonar hardbottom resource survey. These include Painters Hill, Beverly Beach, and Flagler Beach as identified in Figure 1. Marineland is excluded from the study area for this side scan sonar hardbottom resource survey (USACE 2011).

Table 1 Designated Feasibility Study Reaches for Flagler County, Florida

Section	Location (FDEP monument)	Approximate Extent (miles)
Marineland	1-4	0.63
Painters Hill*	50-60	1.74
Beverly Beach*	60-67	1.14
Flagler Beach*	67-101	6.15

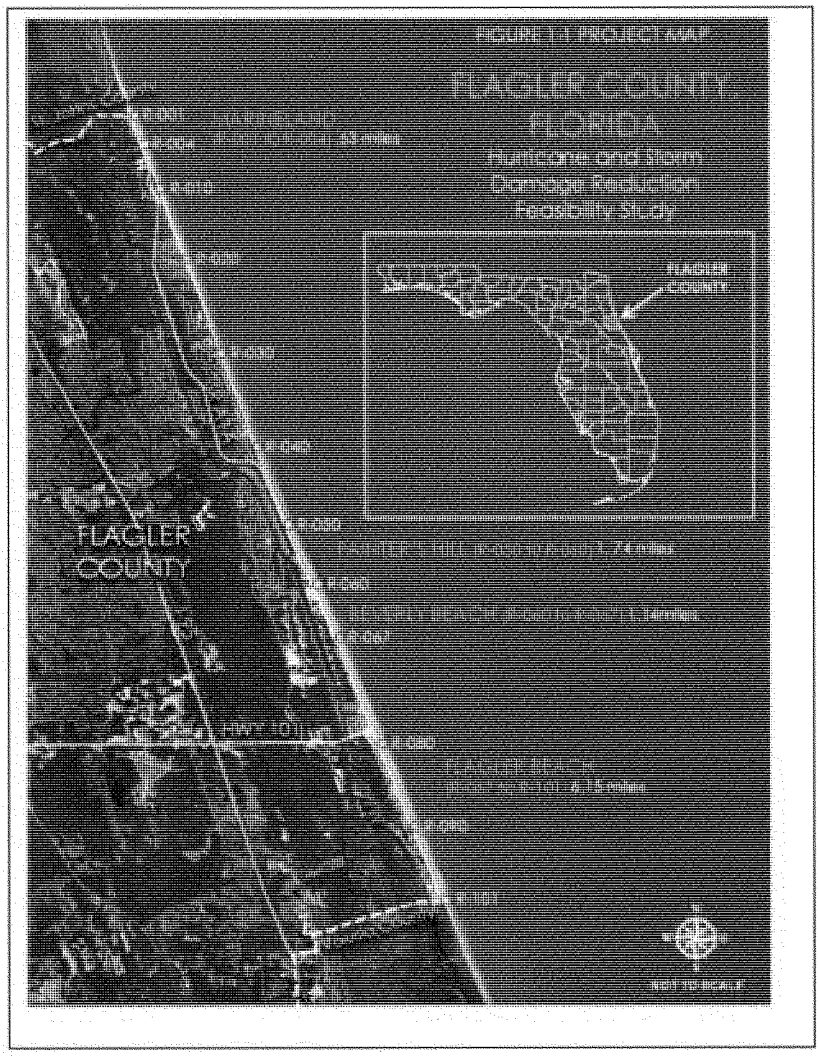
*Denotes areas to be included in the side scan sonar hardbottom resource survey.

Authorization. The authority for conducting this Feasibility Study is contained in House Resolution 2676 adopted May 22, 2002:

> "Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, that in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing shoreline erosion protection, hurricane and storm damage reduction, and related purposes to the shores of Flagler County, Florida."

In response to this authority, the reconnaissance phase of the study was initiated upon receipt of Federal funds in 2003. The reconnaissance study for Flagler County, Florida, completed in March 2004, recommended that this study continue into the feasibility phase based on the likelihood that a Federal project may be justified and implementable given available information. (USACE 2011).

Objective. The objective of this study was to detect and map potential hardbottom resources via remote sensing survey (including the use of sidescan sonar) of Flagler County beaches (from R-50 to R-101, Figure 1). Dial Cordy and Associates Inc. (DC&A) performed the work under Jacksonville District USACE under contract W912EP-11-F-0006. Identification and delineation of potential benthic habitat(s) and substrate types within the study area was conducted.



Source: Jacksonville District, USACE 2011

Figure 1 Flagler County Study Areas

2.0 METHODS

2.1 Field Activities

Sidescan sonar data of the study area was collected below the mean low water line in Flagler County on seven occasions between June 20 and August 4, 2011 (Table 2). Due to perpetual sea state issues (seas over 2 feet), all data could not be collected at the same day or week. The study area included the nearshore submerged substrates extending from 300-ft north of the FDEP marker R-50 to 300-ft south of FDEP marker 101 (at the Volusia-Flagler County line), then waterward from the mean high water line (MHW) directly 1200-ft east of these markers. The linear distance along the shoreline was approximately 9.3 miles. The spatial area encompassed approximately 2.3 square miles (Figure 2).

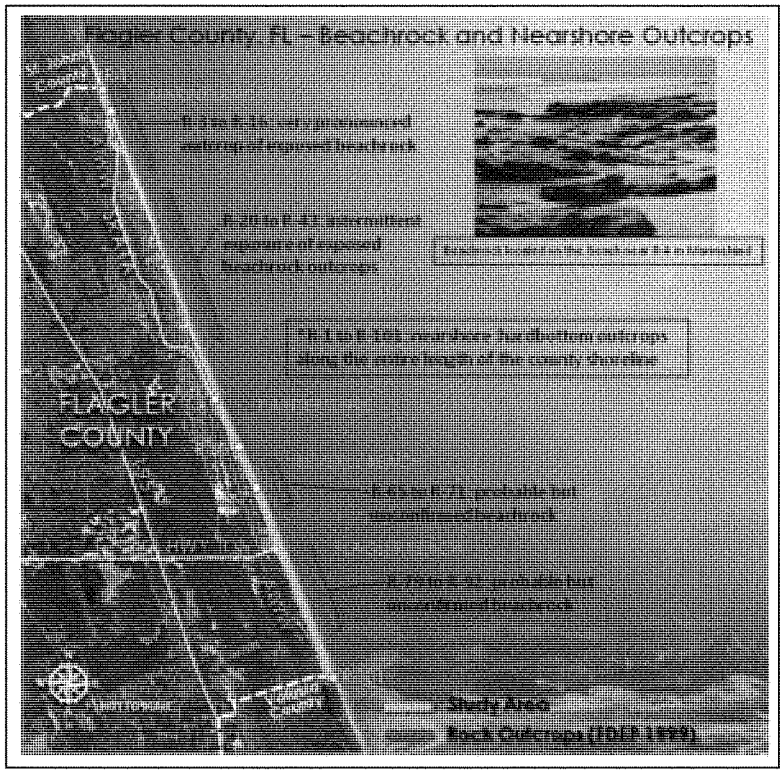
Table 2. Flagler Nearshore Side Scan Data Acquisition

			Low Tide		High Tide	
Date	Start Time	Stop Time	(Time)	(Feet)	(Time)	(Feet)
20-Jun-11	10:45	13:50	6:06	-0.07	12:12	3.50
21-Jun-11	9:20	14:30	6:50	0.06	13:02	3.43
1-Jul-11	10:10	13:35	14:24	-0.42	8:27	3.44
5-Jul-11	10:35	11:20	5:29	-0.47	11:38	3.99
11-Jul-11	11:00	14:30	11:04	-0.45	17:43	4.72
14-Jul-11	12:00	13:45	13:49	-0.55	7:48	3.64
4-Aug-11	7:05	7:55	5:52	-0.51	12:15	4.68
30-Sep-11	10:18	11:30	4:14	-0.22	10:40	5.98

Prior to mobilization, survey lines were established within the survey area using ArcMap 9.2 providing sufficient coverage to detect benthic variation of habitats and delineate their extents (Figure 2). The ArcInfo file was imported into Hypack version 2009a for navigational use.

A 25-foot Parker survey vessel was mobilized for the operation. The sidescan fish was towed off the slightly port side of the bow and submerged to a depth to not be adversely affected by surface waves. A Marine Sonic High Definition Sonar (HDS) 900 kHz high definition side-scan sonar fish in conjunction with a Trimble DSM 232 sub-meter accurate dGPS and Hypack navigation software version 2009a was used to survey each area.

Sidescan sonar coverage was 100 percent. The maximum allowable lateral range was 100 meters, but typically only data collected from within 30 meters of the fish was determined suitable for detailed analysis. With use of the 600 kHz fish, data collected out to 30 meters was determined of sufficient quality for analysis. The sidescan sonar system was operated with sufficient resolution that it was capable of detecting an object on the sea floor measuring 1m x 1m x1m from shadow length measurements. The sidescan towfish was operated at a height above the bottom of 8 to 15 percent of the range scale used. For any towfish height below 8 percent of the range scale in use the effective scanning range was defined to equal 12.5 times the towfish height. The towfish was towed at a speed such that an object 1 m on a side on the sea floor would be independently ensonified a minimum of three times per pass. At a 65 m or less range this was expected to be less than 5 knots.



Source: Jacksonville District, USACE 2011

Figure 2 Project Map for Flagler County Beach Hardbottom Survey

2.2 Data processing and analysis

Side Scan Sonar Photo Mosaic. Pixel resolution of the side scan mosaic produced from the survey was greater than 0.5 m by 0.5 m. The digital image file on the attached DVD is in a standard geo-referenced image format (GeoTiff). The mosaics were generated in one complete image file per scan transect.

Contact Images. A list of contacts with significant subsurface features was compiled and included in Appendix A. Contacts with computed target heights (based on the side scan sonar shadow lengths) of at least 1 foot were considered "significant." Other contacts without shadows

were also considered "significant" if the sonargram signature (e.g., size, shape, or pattern qualities) was notable.

Data Acquisition and Processing Abstracts. Data capture was accomplished using Seascan Survey software (Marine Sonics) and the mosaic image was created using Sonar Whiz 5.0 (Chesapeake Technology). Data processing and analysis was accomplished using QTC Swathview seabed classification software (Quester Tangent). All sonargrams and data acquisition/processing comments are available in digital form in the attached DVDs. Sonargrams are submitted in the XTF format.

3.0 RESULTS AND DISCUSSION

Figure 3 presents the mosaic of the side scan sonar data collected for the project. An electronic copy is included on the DVD for more detailed viewing. The insert included on Figure 3 provides an example of the resolution and detail that was the basis for the additional analysis. Three different features are included in the insert including washboard sand, exposed or near-surface rock, and boat wreckage debris.

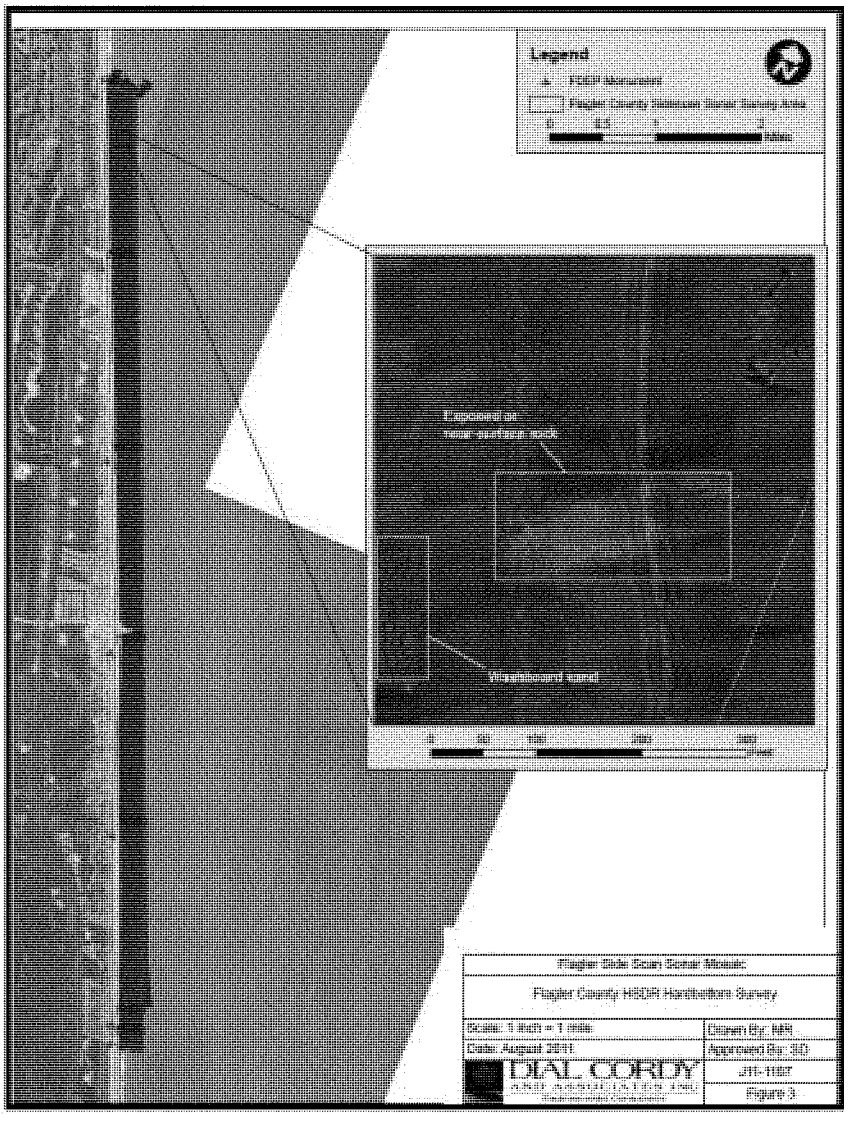
Figure 4 provides a key for the analysis of the processed side scan data that is provided in more detail in Figures 4A through 4E. While the majority of the study area was determined to consist of sandy substrates, linear bands of sand with shell hash were parallel to the shoreline, mainly around the 5-foot depth contour line. The shell hash extends throughout the full range (north to south) of the study area.

Approximately 75 isolated areas of either exposed rock or near-surface rock are scattered throughout the study area, predominately between the 10-foot and 15-foot depth contours (Appendix A). These areas tended to run perpendicular to the shoreline and were more concentrated in the central region of the study area. However, as seen in Figure 4A, a number of small, isolated areas of exposed/near-surface rock were identified west of the 5-foot contour line, but are restricted to the northern portion of the study area.

Confirmation of the substrate signatures may require additional investigation. Towed video or diver surveys or a combination of the two would determine if any of the areas designated as potential exposed rock contained biological resources that could be affected by beach fill. In addition, the boat wreckage debris site would require investigation to determine any historical or cultural significance.

4.0 LITERATURE CITED AND CONSULTED

U.S. Army Corps of Engineers (USACE). 2011. Performance Work Statement, Sidescan Sonar Survey for Hardbottom Resources for the Flagler County Hurricane and Storm Damage Reduction Feasibility Study. Jacksonville, FL. 24 pp.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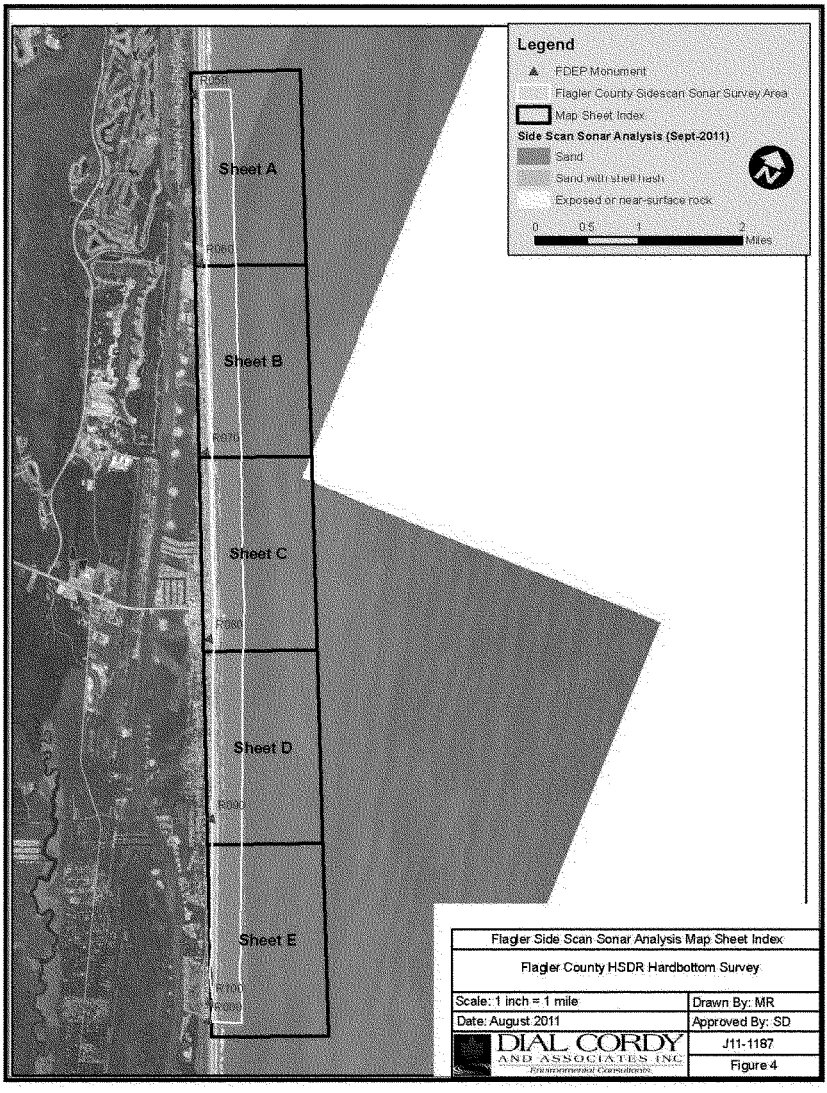
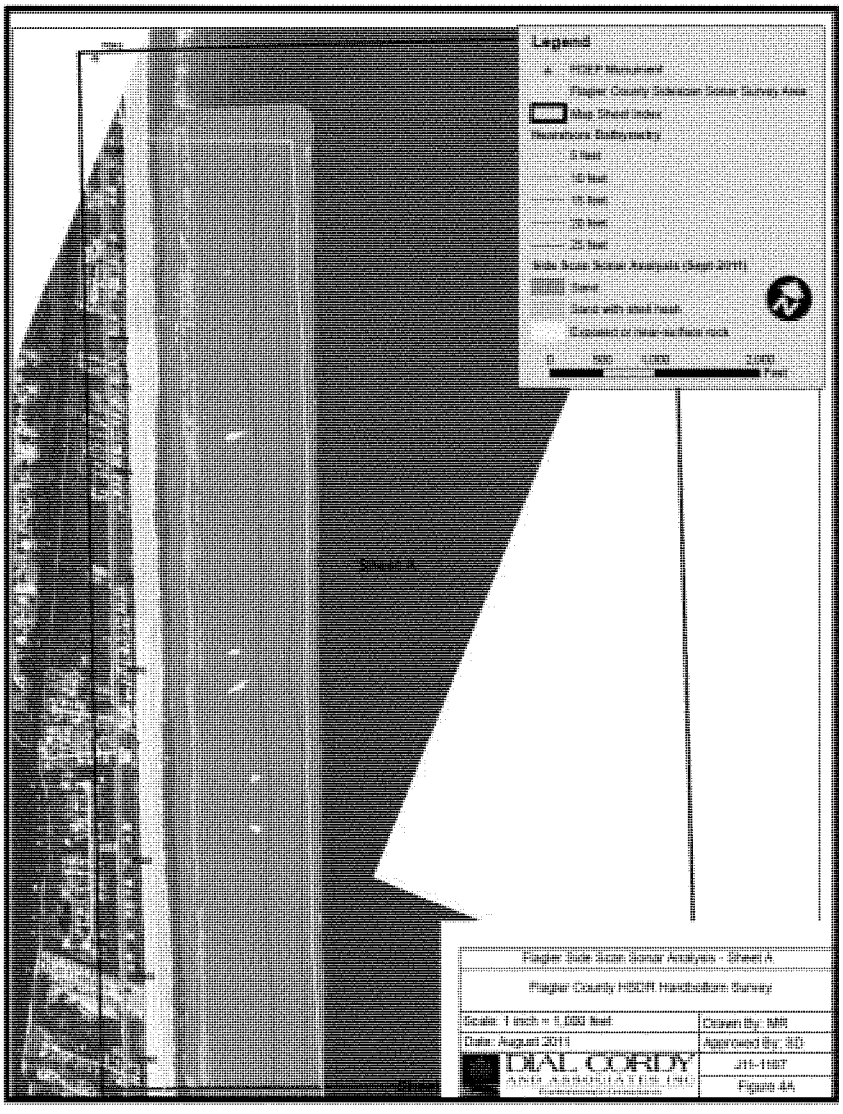
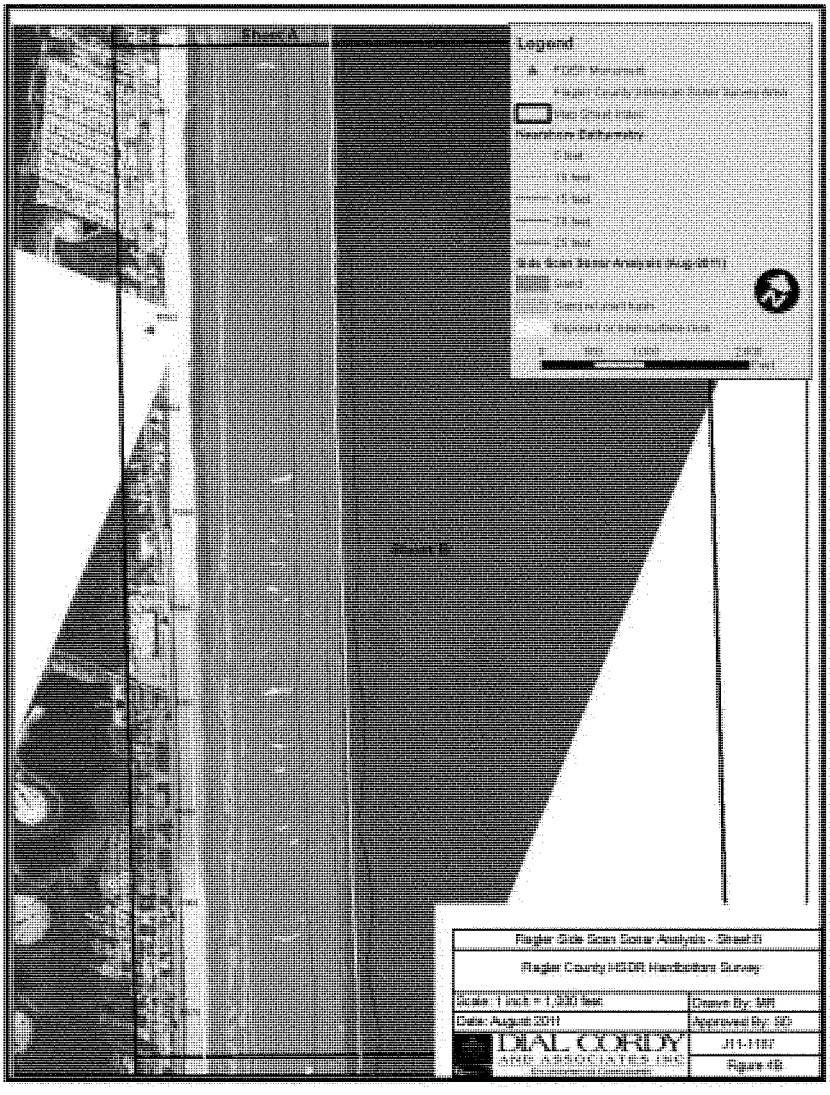
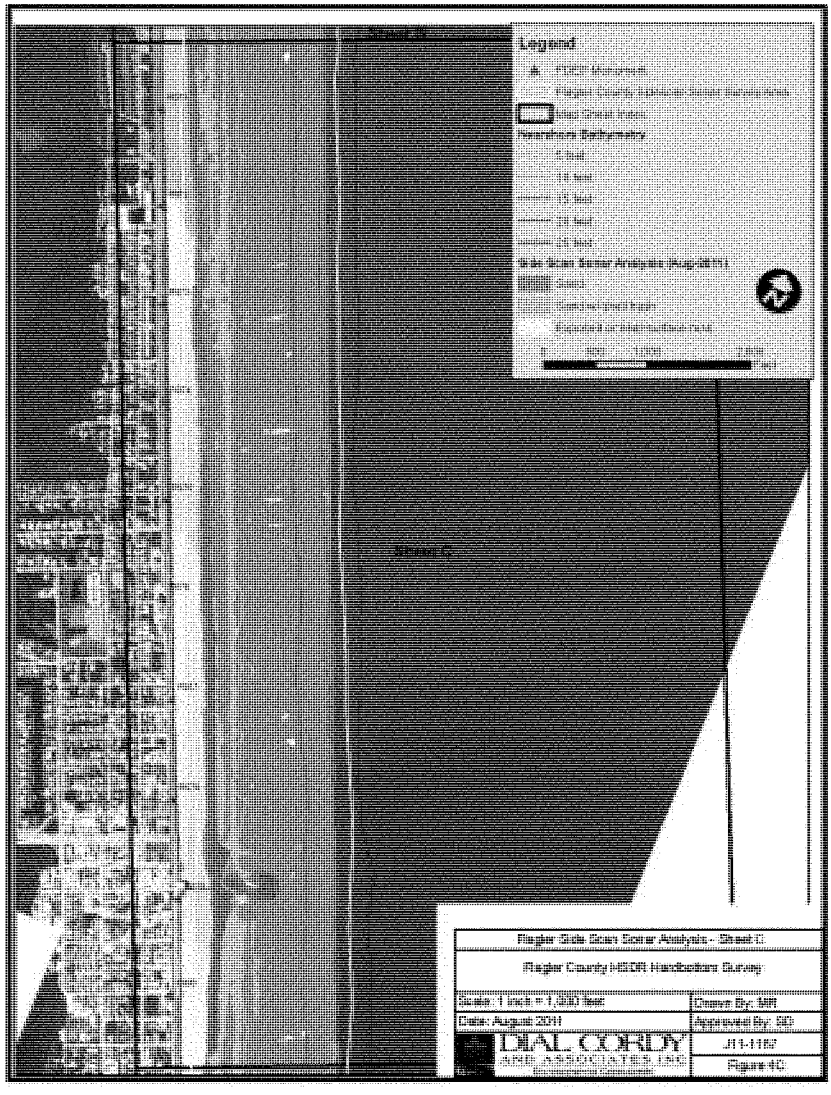
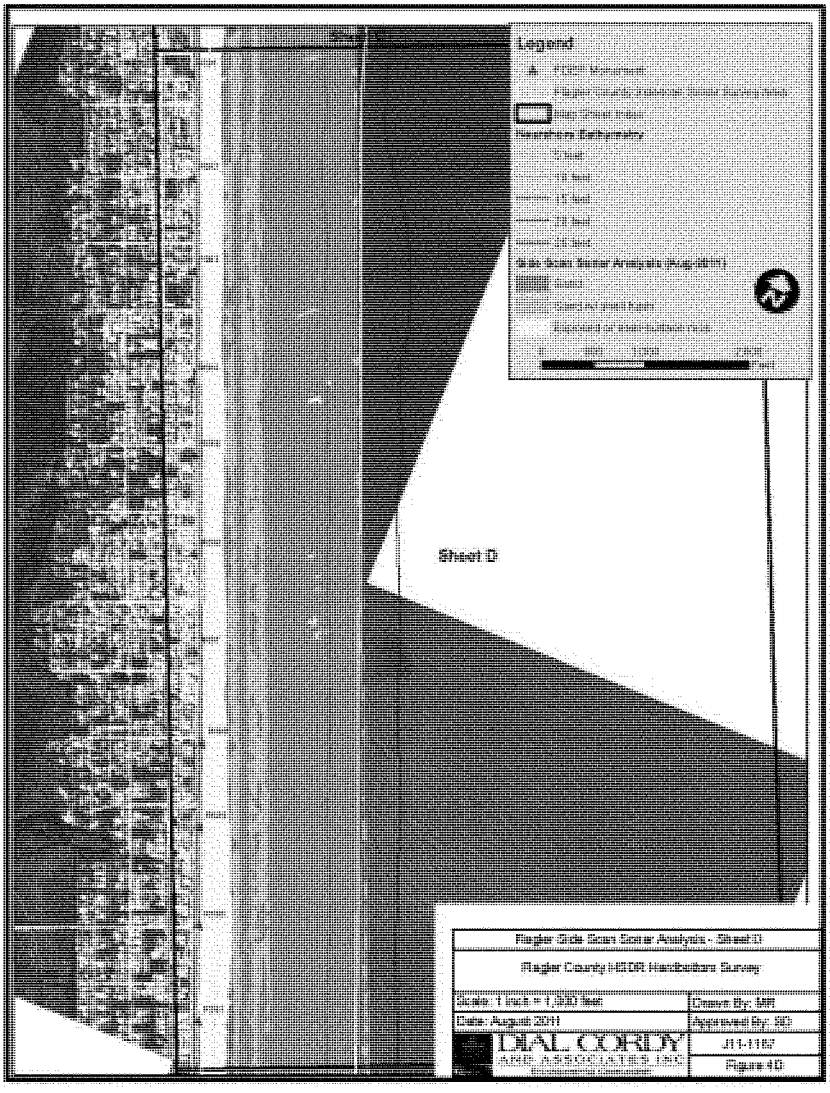
Flagler Side Scan Sonar Mosaic
Flagler County HSDR Hardbottom Survey
DIAL CORDY

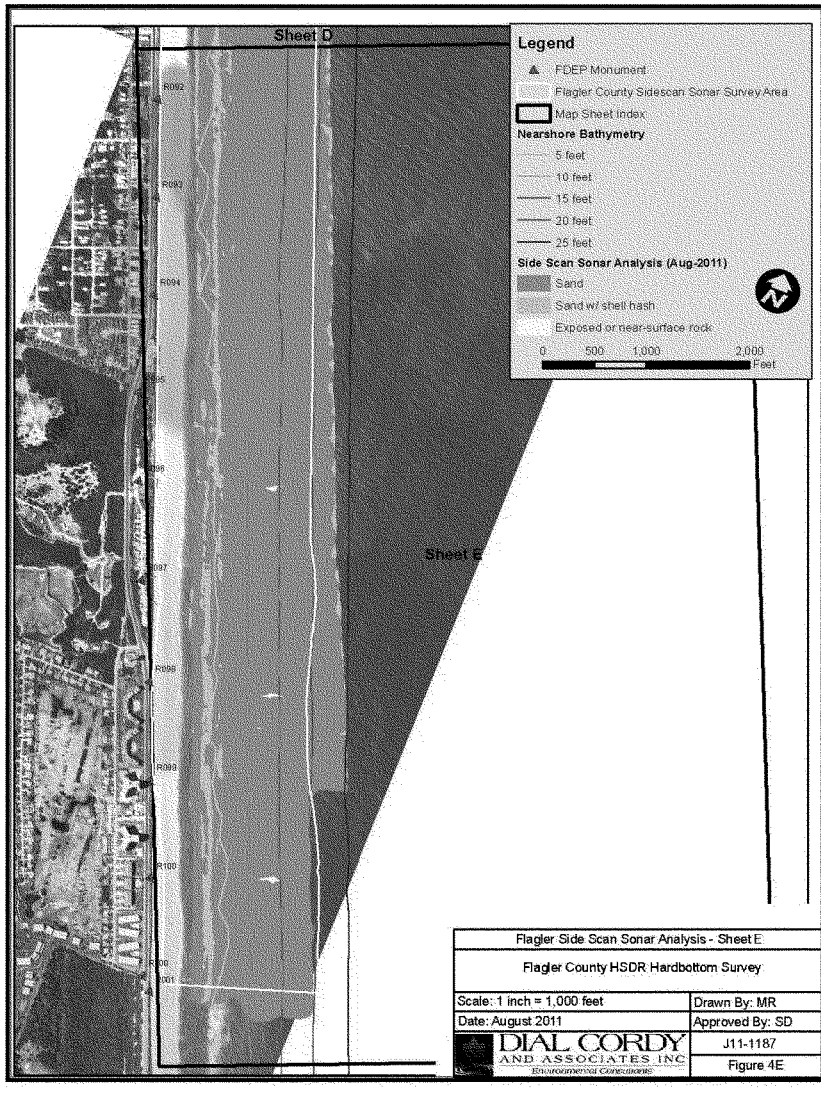

Legend
FDEP Monument
Flagler County Sidescan Sonar Survey Area
Map Sheet Index
Side Scan Sonar Analysis (Sept-2011)
Sand
Sand with shell hash
Exposed or near-surface rock
0 0.5 1 2
Miles
Sheet A
Sheet B
Sheet C
Sheet D
Sheet E
Flagler Side Scan Sonar Analysis Map Sheet Index
Flagler County HSDR Hardbottom Survey
Scale: 1 inch = 1 mile
Drawn By: MR
Date: August 2011
Approved By: SD
DIAL CORDY AND ASSOCIATES INC
Environmental Consultants
J11-1187
Figure 4


Legend
Sheet 4
Flagler Side Scan Sonar Analysis - Sheet 4
Flagler County HSDR Hardbottom Survey
Scale: 1 inch = 1,000 feet
Drawn By: MR
Date: August 2014
Approved By: BD
DIAL CORDY
Figure 4A


Sheet A
Sheet B
Legend
Nearshore Bathymetry
Side Scan Sonar Analysis (Aug 2011)
Flagler Side Scan Sonar Analysis - Sheet B
Flagler County HSDR Hardbottom Survey
Scale: 1 inch = 1,500 feet
Drawn By: MR
Date: August 2011
Approved By: SD
DIAL CORDY AND ASSOCIATES INC.
Environmental Consultants
J11-1167
Figure 4B


Legend
Flagler Side Scan Sonar Analysis - Sheet C
Flagler County HSDR Hardbottom Survey
Scale: 1 inch = 1,000 feet
Drawn By: MR
Date: August 2011
Approved By: SD
DIAL CORDY
AND ASSOCIATES INC
J11-1157
Figure 4C


Legend
Sheet D
Flagler Side Scan Sonar Analysis - Sheet D
Flagler County HSDR Hardbottom Survey
Scale: 1 inch = 1,500 feet
Drawn By: MR
Date: August 2011
Approved By: SD
DIAL CORDY AND ASSOCIATES INC.
J11-1167
Figure 4D


Sheet D
Sheet E
Legend
FDEP Monument
Flagler County Sidescan Sonar Survey Area
Map Sheet Index
Nearshore Bathymetry
5 feet
10 feet
15 feet
20 feet
25 feet
Side Scan Sonar Analysis (Aug-2011)
Sand
Sand w/ shell hash
Exposed or near-surface rock
0 500 1,000 2,000
Feet
R092
R093
R094
R096
R097
R098
R099
R100
R101
Flagler Side Scan Sonar Analysis - Sheet E
Flagler County HSDR Hardbottom Survey
Scale: 1 inch = 1,000 feet
Drawn By: MR
Date: August 2011
Approved By: SD
DIAL CORDY AND ASSOCIATES INC
Environmental Consultants
J11-1187
Figure 4E

Appendix A

Flagler County HSDR Hardbottom Survey
Contact Coordinate Table

Flagler County HSDR Harbottom Survey Anomale Coordinate Table

GRIDCODE	CLASS_ID	CLASS_DESC	X*	Y*
10	3	Exposed or near-surface rock	606036	1894963
10	3	Exposed or near-surface rock	606180	1894442
10	3	Exposed or near-surface rock	606302	1894162
10	3	Exposed or near-surface rock	606345	1894057
10	3	Exposed or near-surface rock	606493	1893941
10	3	Exposed or near-surface rock	606712	1893434
10	3	Exposed or near-surface rock	606754	1893354
10	3	Exposed or near-surface rock	611766	1882859
10	3	Exposed or near-surface rock	613838	1878655
10	3	Exposed or near-surface rock	616220	1872716
10	3	Exposed or near-surface rock	616365	1872511
10	3	Exposed or near-surface rock	618932	1866656
10	3	Exposed or near-surface rock	618876	1866451
10	3	Exposed or near-surface rock	606552	1894818
10	3	Exposed or near-surface rock	607968	1891493
10	3	Exposed or near-surface rock	608130	1891204
10	3	Exposed or near-surface rock	608607	1890456
10	3	Exposed or near-surface rock	608790	1890014
10	3	Exposed or near-surface rock	609793	1887544
10	3	Exposed or near-surface rock	609997	1887229
10	3	Exposed or near-surface rock	610356	1886523
10	3	Exposed or near-surface rock	610465	1885992
10	3	Exposed or near-surface rock	611444	1883889
10	3	Exposed or near-surface rock	611587	1883303
10	3	Exposed or near-surface rock	611639	1883588
10	3	Exposed or near-surface rock	611703	1883091
10	3	Exposed or near-surface rock	611919	1882819
10	3	Exposed or near-surface rock	612164	1882765
10	3	Exposed or near-surface rock	612096	1882495
10	3	Exposed or near-surface rock	611934	1882427
10	3	Exposed or near-surface rock	611946	1882396
10	3	Exposed or near-surface rock	612142	1882455
10	3	Exposed or near-surface rock	611914	1882283
10	3	Exposed or near-surface rock	611867	1882203
10	3	Exposed or near-surface rock	612184	1881966
10	3	Exposed or near-surface rock	612128	1881846
10	3	Exposed or near-surface rock	612500	1881922
10	3	Exposed or near-surface rock	612403	1881481
10	3	Exposed or near-surface rock	612489	1881263
10	3	Exposed or near-surface rock	612731	1881294
10	3	Exposed or near-surface rock	612299	1881669
10	3	Exposed or near-surface rock	612708	1880749
10	3	Exposed or near-surface rock	612873	1880671
10	3	Exposed or near-surface rock	613063	1880660
10	3	Exposed or near-surface rock	613190	1879983
10	3	Exposed or near-surface rock	613169	1879783
10	3	Exposed or near-surface rock	614523	1876751
10	3	Exposed or near-surface rock	614678	1876263
10	3	Exposed or near-surface rock	614942	1875994

10	3 Exposed or near-surface rock	614690	1876389
10	3 Exposed or near-surface rock	615127	1875265
10	3 Exposed or near-surface rock	615191	1875097
10	3 Exposed or near-surface rock	615337	1874780
10	3 Exposed or near-surface rock	615331	1874627
10	3 Exposed or near-surface rock	614889	1874972
10	3 Exposed or near-surface rock	615575	1874527
10	3 Exposed or near-surface rock	615445	1874411
10	3 Exposed or near-surface rock	615567	1874303
10	3 Exposed or near-surface rock	615027	1874920
10	3 Exposed or near-surface rock	616826	1871598
10	3 Exposed or near-surface rock	616861	1871316
10	3 Exposed or near-surface rock	617468	1869873
10	3 Exposed or near-surface rock	617621	1869524
10	3 Exposed or near-surface rock	618505	1867218
10	3 Exposed or near-surface rock	618481	1867353
10	3 Exposed or near-surface rock	619530	1864861
10	3 Exposed or near-surface rock	619405	1865030
10	3 Exposed or near-surface rock	619580	1864748
10	3 Exposed or near-surface rock	619664	1864450
10	3 Exposed or near-surface rock	619776	1864369
10	3 Exposed or near-surface rock	622878	1856476
10	3 Exposed or near-surface rock	623621	1854604
10	3 Exposed or near-surface rock	623624	1854266
10	3 Exposed or near-surface rock	624275	1852947
10	3 Exposed or near-surface rock	607205	1893410
0	0 Boat wreckage	[redacted]	

* Coordinates are in NAD 83 Florida State Plane System (feet)

USACE, JACKSONVILLE DISTRICT
Hydrographic Surveying

SURVEYOR'S REPORT
Hydrographic Survey
Flagler Co. Nearshore Hard Bottom
Flagler County, FL
Survey No. 12-115

Report of Survey prepared by: Matthew Staley P.S.M., U.S. Army Corps of Engineers Jacksonville District

Project: Flagler County nearshore hard bottom Side-scan, Multi-beam, and Underwater Camera Survey FY12

Location: Atlantic Ocean, 150-500 yards offshore from Flagler County, Florida.

Date: Field data was acquired 16 & 17 Aug 2012.

Right of Access: There were no access issues.

Personnel: System Operators: Kevin Smith, Chad Harralson, and Matthew Staley
Boat Captains: Dave Morrison and Rory Riker

Datum: The horizontal coordinates are referenced to the State Plane Coordinate System, Florida East, North American Datum of 1983 (NAD 83). Elevations are referenced to North American Vertical Datum of 1988 (NAVD88).

Instruments: The following instruments were used for data collection:

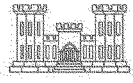
Survey Vessel:	SV-FLORIDA
Data Collection Software:	HYPACK 2011, EdgeTech DISCOVER
Side-scan:	EdgeTech 4125 Side-scan Sonar
Positioning:	DGPS / Applanix POS MV
IMU:	Applanix POS MV

Field Procedures: This survey was performed utilizing Differential GPS. Data was collected using EdgeTech Discover Software and an Edgetech 4125 Dual Frequency Side-scan operating at 400 and 900 kHz. Data was processed using SonarWiz5 software from Chesapeake Technology. GeoTIFFS and DXF files were created using SonarWiz5 as deliverables for this project.

Field Conditions: Sea conditions were on average light (1-3 feet).

Data Processing: The survey data was processed immediately upon completion of the survey. Processing, Mosaicking, and quality checks were completed in SonarWiz5.





Data Display: A total of seven GeoTIFFs were created due to the large scope of the project. These GeoTIFFS range in size from 9 MB to 30 MB. DXF polygon outlines were also created to highlight areas of interest. These polygons are color coded to show changes between current and previous survey data. Found wreckage and other man-made objects on the seafloor were used to rectify and correlate current and previous survey data sets.

Special Note: It is the Surveyors opinion, based on the available survey data, that there is no hardbottom reef in the survey area. The current survey data shows no elevated outcroppings or scoured hardbottom areas associated with hardbottom reef. The areas of supposed hardbottom reef were not found in the current survey data as compared to the previous data set. The areas of interest found in the current survey data appear to be compacted sand waves due to their shape, texture, and intensity of signal return. Similar compacted sand waves appear in the previous survey data, but are in different locations and with far less frequency and coverage.

Special Note: Upon direction from Planning Division bathymetry data was not collected due to the lack of elevated features.

Special Note: Upon direction from Planning Division underwater video was not collected due to recent storm activity and the probable obliteration of compacted sand wave areas.

USACE, JACKSONVILLE DISTRICT
Hydrographic Surveying

MAP SHEET NOTES:

REFER TO SURVEY NO. 12-115.

PLANE COORDINATES ARE BASED ON THE TRANSVERSE MERCATOR PROJECTION FOR THE EAST ZONE OF FLORIDA AND REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD 83).

THIS SURVEY WAS PERFORMED USING DIFFERENTIAL GPS POSITIONING.

SIDE-SCAN DATA MOSAICS WERE MADE USING AN EDGETECH 4125 OPERATING AT 400/900 KHZ AND PROCESSED USING SONARWIZ5.

SURVEY VESSEL	DATE OF SURVEY	AREA
SV- FLORIDA	16-17 AUG 2012	FLAGLER NEARSHORE HARDBOTTOM

THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS AT THAT TIME. THIS CHART IS SOLELY FOR THE DISTRIBUTION OF AVAILABLE DEPTHS AT THE TIME OF SURVEY.

SURVEY ACCURACY STANDARDS, QUALITY CONTROL, AND QUALITY ASSURANCE REQUIREMENTS WERE FOLLOWED DURING THIS SURVEY IN ACCORDANCE WITH USACE EM 1110-2-1003, HYDROGRAPHIC SURVEYING, 1 JAN 02.

HYDROGRAPHIC SURVEYING SECTION, CESAJ-OD-NH
http://www.saj.usace.army.mil/Divisions/Operations/Branches/HydroSurvey/index.htm

USACE, JACKSONVILLE DISTRICT
Hydrographic Surveying
OPERATIONS DIVISION

SURVEYOR'S REPORT
Hydrographic Survey
Flagler Beach Offshore Borrow Areas
FY13, Examination Survey
Flagler Beach, FL
Survey No. 13-015

Report of Survey prepared by: Kevin Smith, U.S. Army Corps of Engineers, Jacksonville District

Project: Flagler Beach Borrow Areas, FY13 Examination Survey, Flagler Beach, Florida

Location: Flagler Beach, Florida

Date: Field data was acquired 04-06 February 2013.

Right of Access: There were no issues of special access required for this project.

Personnel: SV-FLORIDA: System Operators: Tommy Thomas, Rob Jenkins, Kevin Smith

Boat Captains: Dave Morrison and Rory Riker

Datum: The horizontal coordinates are referenced to the State Plane Coordinate System, Florida East, North American Datum of 1983 (NAD 83).

Instruments: The following instruments were used for data collection:

Survey Vessel:	FLORIDA
Data Collection Software:	Hypack 2011, Discover V3.07
Side Scan:	Edgetech 4125 Side scan Sonar Operating at 400/900 kHz
Positioning:	Trimble/Applanix POS MV 320 Trimble 351 DGPS Receiver
IMU:	Trimble/Applanix POS MV 320

Field Procedures: This survey was performed utilizing Differential GPS (DGPS). An Edgetech 4125 was towed behind SV FLORIDA at a length noted daily on the log sheets. A line spacing of 200 feet was used to ensure 150% coverage of all three areas. Biologist Kat McConnell rode along during the first day of data collection.

Data Processing: The survey data was processed upon completion of the survey. The software SonarWiz5 was used to post process the raw JSF files. The bottom track filters were applied along with EGN and AGC filters to remove stripping from the data caused by seas. The data from each line was then merged together to form three different mosaics using the 900khz data, one for each area (*See Appendix A*). Theses mosaics were then exported to Google earth for viewing. No targets of interest were found in any areas. There were schools of fish encountered in areas 2A and 2C, along with sand waves and ridges apparent in all three areas. Also in area 2C there are areas of weaker intensity return (Darker Color) which appears to from different densities of bottom material. It should be noted that any hard bottom would show a higher intensity return (Bright colors) along with some type of shadow to show relief off the surrounding bottom.

USACE, JACKSONVILLE DISTRICT
Hydrographic Surveying
OPERATIONS DIVISION



Google Earth files to accompany report:

FLAGLER BORROW AREA 2A
FLAGLER BORROW AREA 2B
FLAGLER BORROW AREA 2C

Field Conditions: Sea conditions were within hydrographic survey standards.

MAP SHEET NOTES:

1. REFER TO SURVEY NO. 13-015.

2. PLANE COORDINATES ARE BASED ON THE TRANSVERSE MERCATOR PROJECTION FOR THE EAST ZONE OF FLORIDA AND REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD 83).

3. THIS SURVEY WAS PERFORMED USING DIFFERENTIAL GPS POSITIONING.

4. SIDESCAN IMAGERY WAS COLLECTED USING AN EDGETECH 4125 SYSTEM OPERATING AT 400/900 KHZ. MOSAICS SHOWN ARE IN HIGH-FREQUENCY / 900KHZ.

SURVEY VESSEL	*DATE OF SURVEY*	*AREA*
SV-FLORIDA	*04-06 FEBRUARY 2013*	*FLAGLER OFFSHORE BORROW AREA*

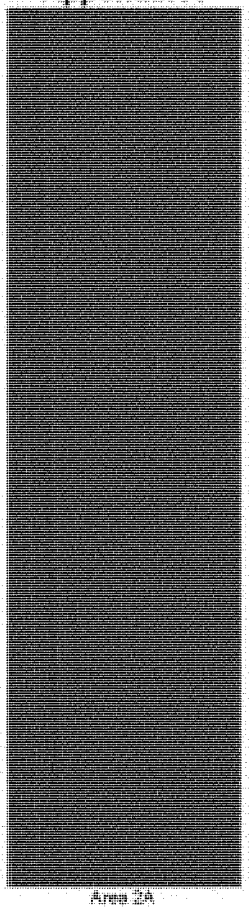
5. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS AT THAT TIME. THIS CHART IS SOLELY FOR THE DISTRIBUTION OF AVAILABLE DEPTHS AT THE TIME OF SURVEY.

6. SURVEY ACCURACY STANDARDS, QUALITY CONTROL, AND QUALITY ASSURANCE REQUIREMENTS WERE FOLLOWED DURING THIS SURVEY IN ACCORDANCE WITH USACE EM 1110-2-1003, HYDROGRAPHIC SURVEYING, 1 JAN 02.

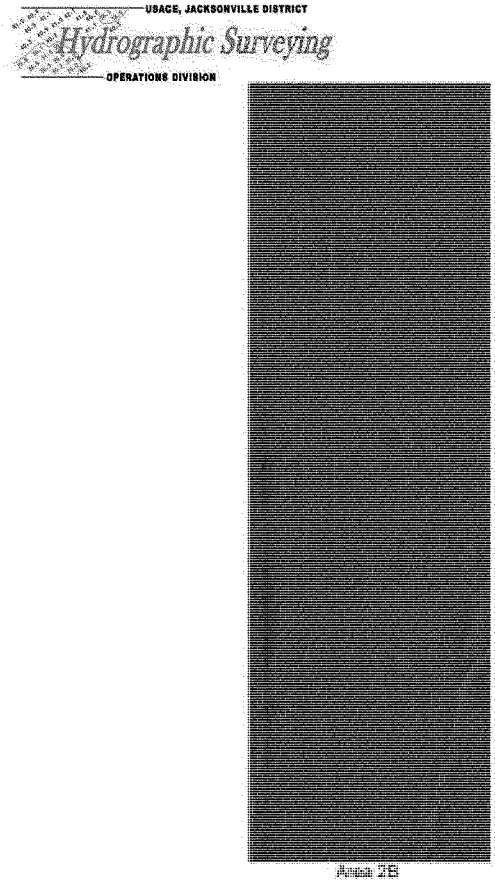
HYDROGRAPHIC SURVEYING SECTION, CESAJ-OD-N
http://www.saj.usace.army.mil/Divisions/Operations/Branches/HydroSurvey/index.htm

USACE, JACKSONVILLE DISTRICT
Hydrographic Surveying
OPERATIONS DIVISION

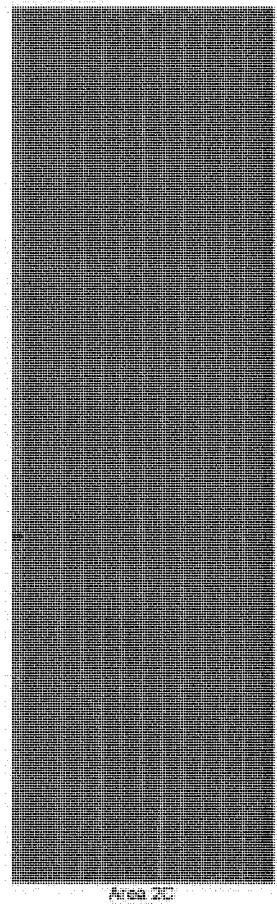
Appendix A



Area 2A

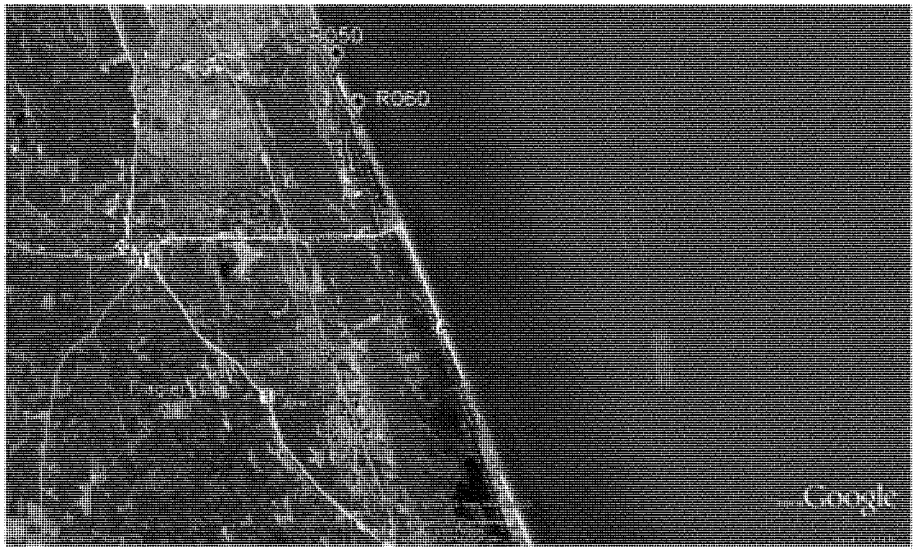

USACE, JACKSONVILLE DISTRICT
Hydrographic Surveying
OPERATIONS DIVISION
Area 28

USACE, JACKSONVILLE DISTRICT
Hydrographic Surveying
OPERATIONS DIVISION



Area 2D

-Note the Google Earth KMZ files have a 1' resolution for better examination of the data.


Google

Flagler County Hurricane Storm Damage Reduction
Sea Turtle Nesting Data Summary

Year	DR- Name (per FWRI Data)	Design Reach within Federal Interest	DEP Monument	Loggerhead		Green		Leatherback	
				Nest	False Crawls	Nest	False Crawls	Nest	False Crawls
2004	Marineland Beach	No	R-1 to R-12	4	8	3	0	0	0
	Washington Oaks State Park	No	R-12 to R-16	10	3	0	7	0	0
	North Flagler County Beaches	No	R-16 to R-35	34	10	8	4	0	0
	South Flagler County Beaches	Partially (DR- A and B)	R-35 to R-67	79	45	9	1	0	0
	Flagler Beach	Yes (DR- B, C and D)	R-67 to R-95	80	42	0	0	0	0
	Flagler Beach State Park	Yes (DR- D)	R-95 to R-101	30	7	0	0	0	0
	Total for Year			**237**	**115**	**20**	**12**	**0**	**0**
2005	Marineland Beach	No	R-1 to R-12	8	4	5	0	0	0
	Washington Oaks State Park	No	R-12 to R-16	2	2	2	1	0	0
	North Flagler County Beaches	No	R-16 to R-35	41	7	13	0	2	0
	South Flagler County Beaches	Partially (DR- A and B)	R-35 to R-67	89	31	19	0	3	0
	Flagler Beach	Yes (DR- B, C and D)	R-67 to R-95	62	58	8	4	3	0
	Flagler Beach State Park	Yes (DR- D)	R-95 to R-101	10	6	0	1	0	0
	Total for Year			**212**	**108**	**47**	**6**	**8**	**0**
2006	Marineland Beach	No	R-1 to R-12	9	4	0	0	0	0
	Washington Oaks State Park	No	R-12 to R-16	3	4	3	1	0	0
	North Flagler County Beaches	No	R-16 to R-35	45	12	11	3	0	0
	South Flagler County Beaches	Partially (DR- A and B)	R-35 to R-67	92	44	8	2	1	0
	Flagler Beach	Yes (DR- B, C and D)	R-67 to R-95	62	87	2	1	0	0
	Flagler Beach State Park	Yes (DR- D)	R-95 to R-101	92	44	8	2	1	0
	Total for Year			**303**	**195**	**32**	**9**	**2**	**0**

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2007	Marineland Beach	No	R-1 to R-12	2	4	1	0	0	0
	Washington Oaks State Park	No	R-12 to R-16	4	7	4	5	0	0
	North Flagler County Beaches	No	R-16 to R-35	55	33	20	3	0	0
	South Flagler County Beaches	Partially (DR- A and B)	R-35 to R-67	92	40	52	4	0	0
	Flagler Beach	Yes (DR- B, C and D)	R-67 to R-95	58	61	14	25	0	0
	Flagler Beach State Park	Yes (DR- D)	R-95 to R-101	8	13	1	4	1	0
	Total for Year			**219**	**158**	**92**	**41**	**1**	**0**
2008	Marineland Beach	No	R-1 to R-12	15	8	6	3	0	0
	Washington Oaks State Park	No	R-12 to R-16	3	4	6	2	0	0
	North Flagler County Beaches	No	R-16 to R-35	61	12	11	4	0	0
	South Flagler County Beaches	Partially (DR- A and B)	R-35 to R-67	142	45	9	0	0	0
	Flagler Beach	Yes (DR- B, C and D)	R-67 to R-95	90	111	1	4	0	0
	Flagler Beach State Park	Yes (DR- D)	R-95 to R-101	41	18	2	1	0	0
	Total for Year			**352**	**198**	**35**	**14**	**0**	**0**
2009	Marineland Beach	No	R-1 to R-12	8	0	1	0	0	0
	Washington Oaks State Park	No	R-12 to R-16	12	5	3	2	0	0
	North Flagler County Beaches	No	R-16 to R-35	45	10	12	4	1	0
	South Flagler County Beaches	Partially (DR- A and B)	R-35 to R-67	90	36	26	18	5	1
	Flagler Beach	Yes (DR- B, C and D)	R-67 to R-95	42	55	3	4	2	0
	Flagler Beach State Park	Yes (DR- D)	R-95 to R-101	29	7	2	0	0	0
	Total for Year			**226**	**113**	**47**	**28**	**8**	**1**
2010	Marineland Beach	No	R-1 to R-12	8	7	1	1	0	0
	Washington Oaks State Park	No	R-12 to R-16	8	5	3	3	0	0
	North Flagler County Beaches	No	R-16 to R-35	135	31	13	9	0	0
	South Flagler County Beaches	Partially (DR- A and B)	R-35 to R-67	184	62	25	13	0	0
	Flagler Beach	Yes (DR- B, C and D)	R-67 to R-95	95	89	5	6	0	0
	Flagler Beach State Park	Yes (DR- D)	R-95 to R-101	28	9	3	0	0	0
	Total for Year			**458**	**203**	**50**	**32**	**0**	**0**

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2011	Marineland Beach	No	R-1 to R-12	11	14	5	1	1	0
	Washington Oaks State Park	No	R-12 to R-16	12	5	5	3	0	0
	North Flagler County Beaches	No	R-16 to R-35	87	16	10	2	5	1
	South Flagler County Beaches	Partially (DR- A and B)	R-35 to R-67	162	34	29	4	4	0
	Flagler Beach	Yes (DR- B, C and D)	R-67 to R-95	72	57	9	2	3	0
	Flagler Beach State Park	Yes (DR- D)	R-95 to R-101	27	4	2	1	0	0
	Total for Year			**371**	**130**	**60**	**13**	**13**	**1**

North Atlantic Right Whale Sightings
Coastal Flagler County

Date	Location	Species/Class/Number	Notes	Whale ID#
2005 - 2006				
4-Dec	Washington Oaks	Mother/Calf	Photo-verified	2503
15-Jan	Flagler Beach	2 Adults	Not Photo-verified	
30-Jan	Flagler Beach	2 Adults	Not Photo-verified	
1-Mar	Flagler Beach		Stranding Report, Non-verified	
12-Mar	South Flagler Beach		Not verified	
25-Mar	South Flagler Beach		Stranding Report, entangled, possible Volusia County	
2006 - 2007				
29-Dec	Jungle Hut (Palm Coast)	Mother/Calf	Photo-verified	2430
4-Jan	Beverly Beach	Mother/Calf	Photo-verified	2430
5-Jan	South Flagler Beach	Mother/Calf	Photo-verified	2430
25-Jan	Flagler Beach	Mother/Calf	Photo-verified	2601
2-Feb	Flagler Beach	Mother/Calf	Photo-verified	2430
12-Feb	Flagler Beach	Unknown	Not Photo-verifed	
13-Feb	Flagler Beach	Mother/Calf	Photo-verified	1425
15-Feb	Flagler Beach	Mother/Calf	Photo-verified	3360
2007 - 2008	Data Unavailable			
2008 - 2009	Data Unavailable			
2009 - 2010				
14-Jan	Painters Hill	Mother/Calf	Sighted from Air Cam	3157
24-Jan	Flagler Beach	1 Adult	Sighted from Shore	
27-Jan	Marineland	Mother/Calf	Photo-verified	2430
28-Jan	Flagler Pier	Mother/Calf	Sighted from Shore	2430
28-Jan	Marineland	Mother/Calf	Photo-verified	1950
28-Jan	Off-shore Flagler Beach	8 Adults	Two separate sightings	
28-Jan	South of Flagler Pier	2 Adults, Mother/Calf	Two separate sightings	2430 (M/C)
13-Feb	North Flagler Beach	Unknown	Not Photo-verified	
15-Feb	South Flagler Beach	Mother/Calf	Not Photo-verified	
15-Feb	Flagler Pier	1 Humpback	Not Photo-verified	
15-Feb	North Flagler Beach	1 Humpback	Maybe duplicate sighting of same individual	
16-Feb	Flagler Beach	1 Humpback	Not Photo-verified	

North Atlantic Right Whale Data Summary
Coastal Flagler County

Date	Location	Species/Class/Number	Notes	Whale ID#
16-Feb	North Flagler Beach	1 Humpback	Maybe duplicate sighting of same individual	
16-Feb	Beverly Beach	1 Humpback	Maybe duplicate sighting of same individual	
19-Feb	Beverly Beach	Mother/Calf	Photo-verified	3123
20-Feb	Beverly Beach	1 Adult	Photo-verified	
20-Feb	North Flagler Beach	2 Adults	Not Photo-verified	
22-Feb	Flagler Beach	Mother/Calf	Photo-verified	3123
2-Mar	South Flagler Beach	3 Adults, Mother/Calf	Photo-verified	3123 (M/C)
15-Mar	South Flagler Beach	2 or 3 Humpback	Not Photo-verified	
24-Mar	Flagler Beach	1 Humpback	Air Cam Verified	
29-Mar	Flagler Beach	Mother/Calf, 3 Juveniles	Photo-verified	2614 (M/C)
2010 - 2011				
5-Jan	North Flagler Beach	2 Adults, 1 Juvenile	Photo-verified	calf of 2645
9-Jan	Flagler Pier	Unknown	Not Photo-verified	
18-Jan	Flagler Pier	1 Adult, 1 Juvenile	Photo-verified	
19-Jan	South of Flagler Pier	Mother/Calf	Photo-verified	1911
19-Jan	South of Flagler Pier	1 Adult, 1 Juvenile	Photo-verified, Prop Scars	2010 calf of 3123
19-Jan	South Flagler Beach	1 Adult, 1 Juvenile	Photo-verified	2010 calf of 3123
1-Feb	Flagler Beach	Mother/Calf	Photo-verified	3270
3-Feb	North Flagler Beach	2 Adult, 1 Juvenile	Photo-verified	
18-Feb	Beverly Beach	1 Humpback Juvenile	Sighted from Air Cam	
2011 - 2012	North Flagler Beach	1 Juvenile	Carcass washed up on beach 12/19/12. No other sightings	

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RE: 7107 OCEANSHORE BLVD N
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RE: 7085 OCEANSHORE BLVD N
DR JOHN ARNOLD MD
666 SEMINOLE DR
WINTER PARK FL 32789 2643

RE: 7077 OCEANSHORE BLVD N
JOHN AND MARY ELLEN COHEN-SHOHET
6565 SW 184TH TERRACE RD
OCALA FL 34474 5922

RE: 7069 OCEANSHORE BLVD N
STEPHEN SPURRIER
USC FOOTBALL OFFICE
1125 GEORGE ORGERS BLVD
COLUMBIA SC 29208

RE: 7063 OCENSHORE BLVD N
MCNAB DEVELOPMENT AND
CONSTRUCTION CORPORATION
20 RUE GRAND MER
PALM COAST FL 31237

RE: OCEANSHORE BLVD N
KUAR HUNJAN
14232 CARRS LANDING RD
WINFIELD BC

RE:7032 OCEANSHORE BLVD N
MID OHIO SECURITIES CORP TRUSTEE
C/O ERICA DORRANCE
3569 NW 89TH LN
LAKE BUTLER FL 32054

RE: 7051 OCEANSHORE BLVD N
VALERIA LYNCH TRUSTEE
7052 OCEANSHORE BLVD N
PALM COAST FL 32137

RE: 7031 OCEANSHORE BLVD N
GEORGE F AND DANA K CAUSEY
160 FORTY LOVE PT
CHAPIN SC 29036

RE: 7029 OCEANSHORE BLVD N
RAYMOND AND HELEN DEW
PO BOX 354782
PALM COAST FL 32135 4782

RE: 7023 OCEANSHORE BLVD N
DOUGLAS AND ERICA M DEW OCEANSHORE
BLVD N
PALM COAST FL 32137

RE: 7019 OCEANSHORE BLVD N
F ALLEN AND LAURA REYMOLDS
277 N BEACH ST
ORMAND BEACH FL 32174

RE: 7013 OCEANSHORE BLVD N
TIMOTHY AND REBECCA EGNON,
DONALD AND VICKY MURPHEY
7013 OCEANSHORE BLVD N
PALM COAST FL 32137

RE: 7009 OCEANSHORE BLVD N
ALAN AND ALMA FITZWATER
7009 OCEANSHORE BLVD N
PALM COAST FL 32137 2312

RE: 7001 OCEANSHORE BLVD N &
17 OCEAN SUNE CIR
WILLIAM C BRUNK
2110 CIRCLE DR
COLUMBUS OH 43220

RE: 6995 OCEANSHORE BLVD N
GERALD AND KAREN PONDER
2508 ARENDELL WAY
TALLAHASSEE FL 32308

RE:6987 OCEANSHORE BLVD N
JAMES P KURDZIEL
4631 HARBOR POINT DR
PORT RICHEY FL 34668

RE: 6979 OCEANSHORE BLVD N;
SE OF ORLANDO LLC
502 PALMER ST
ORLANDO FL 32801

RE: 6973 OCEANSIDE BLVD N
TIMOTHY D AND LYNNM HOWARD
6973 OCEANSHORE BLVD N
PALM COAST FL 32137

RE:6969 OCEANSHORE BLVD N
ELLIS WILLIAM MOORE
13030 136TH AV NE
KIRKLAND WA 98034

RE:6961 OCEANSHORE BLVD N
JOHN AND LESLIE C RANDOLPH
6201 S FLAGLER DR
WEST PALM BEACH FL 33405

RE: 6955 OCEANSHORE BLVD N
JAMES AND BONNIE MORGAN
1353 SOUTH BLUE LAKE AVE
DELAND FL 32724

RE: 68 ATLANTIC DR
FRANK J & ALTBERTA MORELLI
68 ATLANTIC DR
PALM COAST FL 32137

RE: 3397 OCEANSHORE BLVD N
LONNY BLACK
9610 NW 115TH AVE
OCALA FL 34482

RE: 3335 OCEANSHORE BLVD N
ROBERT A SOUZA
559 N 10TH STREET
FLAGLER BEACH FL 32136

RE:3431 OCEANSHORE BLVD N
DAVID & BERNADETTE WILLIAMS
3431 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2815 OCENSHORE BLVD N
BEVERLY BEACH ENTERPRISES INC
PO BOX 1048
FLAGLER BEACH FL 32136

RE:19 OCEAN DUNE CIRCLE
PAVLOS JOHN & SHARON PAVLOS
19 OCEAN DUNE CIRCLE
PALM COAST FL 32137

RE: 3385 OCEANSHORE BLVD N
CENTRAL FLORIDA DEVELOPMENT
EAST LLC
300 N MAITLAND AVE
MAITLAND FL 32751

RE:3349 OCEANSHORE BLVD N
EDDIE R FINNEY LIFE ESTATE
PO BOX 448
FLAGLER BEACH FL 32136

RE:3365 OCEANSHORE BLVD N
BOWEN ROY
P.O. BOX 350956
PALM COAST FL 32135 0956

LANE RONALD G & DIANNE R
TRUSTEES
3017 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 67 FLAGLER DR
PETER H & CYNTHIA A HOPFE
67 FLAGLER DR – HAMMOCK
PALM COAST FL 32137

RE: 3239 OCEANSHORE BLVD N
THOMAS C & JOYCE W LODGE
2391 LAKE TALMADGE DR
DELAND FL 32724

RE: 65 ATLANTIC DR
WALTER R & LINDA J BLAKE
8876 SE OAKS WAY N #402
VERO BEACH FL 32963

FLAGLER BY THE SEA INC
2982 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

PAINTERS WALK HOA
C/O CAROL OARVETZ
P O BOX 2360
FLAGLER BEACH FL 32136

RE: 6947 OCEANSHORE BLVD N
PETER SCHMIDT
7276 DELAMATER RD
DERBY NY 14047

RE: 6943 OCEANSHORE BLVD N
JESSE AND CLARK PACE
6943 OCEANSHORE BLVD N
PALM COAST FL 32137 2310

RE: 6939 OCEANSHORE BLVD N
NOB LLC
1419 OAK FOREST DR
ORMAND BEACH FL 32174

RE: 6931 OCEANSHORE BLVD N
SANDEEP AND ROHINI BAJAJ
6931 OCEANSHORE BLVD N
PALM COAST FL 32137

RE: 6925 OCEANSHORE BLVD N
DOUGLAS JENNINGS
2358 RIVERSIDE AVE APT 601
JACKSONVILLE FL 32204

RE: 6929 OCEANSHORE BLVD N
HARI MAHU FL LLC
432 OSCEOLA AVE
JACKSONVILLE BEACH FL 32250

RE: 2597 OCEANSHORE BLVD N
JOSEPH D & SARAH H JOHNSON
2597 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: OCEANSHORE BLVD N PROPERTY
MATANZAS SHORES COA
110 E COLLECTORS RD
PALM COAST FL 32137

RE:101 16TH RD
HAMMOCK BEACH OCEAN LLC
7855 B OSCEOLA POLK LINE RD
DAVENPORT FL 33896

KENT NORMAN A TRUSTEE
P O BOX 1749
FLAGLER BEACH FL 32136

RE: 2481 OCEANSHORE BLVD N
BIELEFELDT KARL & MARTHA
LEAVINES LIFE ESTATE
2481 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136-2713

RE: 2235 OCEANSHORE BLVD N
TIDWELL WILLIAM HAMPTON &
BETTY A
2235 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2571 OCEANSHORE BLVD N
SPECKHAHN HENRY D AND
INGEBORG S SPECKHAHN
2571 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

LEMNOUNI SIDI M &
DONNA E
200 MARINA BAY DRIVE #206
FLAGLER BEACH FL 32136

RE: 2585 OCEANSHORE BLVD N
STEVEN GOLDIN
27950 SW 182ND AVENUE
HOMESTEAD FL 33031

RE: 2024 S OCEANSHORE BLVD
THOMAS C & EDWARD GARRIS
WALTER GARRIES III JTWROS
PO BOX 2182
FLAGLER BEACH FL 32136

RE: 2475 & 2469 OCEANSHORE BLVD N
MOOD EMMETT A
PO BOX 2090
FLAGLER BEACH FL 32136

1937 N OCEANSHORE LLC
1583 CARTERETT AVE
CHARLESTON NC 29407

RE: 2514 OCEANSHORE BLVD N
COOK DAVID JOHNSTON SR
C/0 DENNIS BAKER
109 6TH ST
FLAGLER BEACH FL 32136

RE: 2488 OCEANSHORE BLVD N
FLAGLER OCEANFRONT
ENTERPRISES LLC
1544 S A1A
FLAGLER BEACH FL 32136

RE: 2501 N OCEANSHORE BLVD
PROPERTY
JER & ASSOCIATES
4830 BUTTERFIELD RD
HILLSIDE IL 60162

RE: 6917 OCEANSHORE BLVD N
CHRISTIAN KOCH
6917 OCEANSHORE BLVD N
PALM COAST FL 32137

RE: 6653 OCEANSHORE BLVD N
GERARD PATELLA
6653 N OCEANSHORE BLVD
PALM COAST FL 32137

RE: 6645 OCEANSHORE BLVD N
CONSOLIDATED CAPITAL
217 N WESTMONTE DR STE 1007
ALTEMONTE SPRINGS FL 32714

RE: OCEANSHORE BLVD PROPERTY
JR HANFORD AND HAL SMITH HANFORD
TRUSTEES
22 OCEAN DR
ST AUGUSTINE FL 32080

RE: 63 OCEANSIDE DR
BRIAN JAMES PAPPAS
63 OCEANSIDE DR
PALM COAST FL 32137

RE: 59 OCEANSIDE DR
RUSSELL AND MARGARET GREEN III
6917 NW 52ND LN
GAINESVILLE FL 32653

RE: 58 OCEANSIDE DR
WAYNE SIBBERT AND ESTER FORTLEY
2623 SEVILLE BLVD #203
CLEARWARER FL 33764

RE: 61 OCEAN ST
SCOTT AND FRANCINE BEAT
LIFE ESTATE
61 OCEAN ST
PALM COAST FL 32137

RE: 62 OCEAN ST
THOMAS AND SHARLAE CREWS
106 PROCTOR SR
STATESBORO GA 30458

RE: 60 SEASCAPE DR
TODD AND MONICA KINNEBREW
200 MILL POND
PLANTATION WAY
WARNER ROBBINS GA 31088

RE: 58 SEASCAPE DR
RICHARD C MCBRIDE SR TRUSTEE
58 SEASCAPE DR
PALM COAST FL 32137

RE: 63 MOODY LN
UWE AND LINDA ROSS
888 SUMNEYTOWN PIKE
LANSDALE PA 19446

RE: 66 MOODY DR
STEVE AND PAIGE CHESNUT
66 MOODY DR
PALM COAST FL 32137

RE: 30 AVENUE ROYALE
HAMMOCK DUNES OWNERS ASSO
PO BOX 353338
PALM COAST FL 32135

RE: 3527 OCEANSHORE BLVD N
COLEMAN WILLIAM L &
GWYNNETH GAIL TRUSTEE
2447 RIDGE WILL DRIVE
JACKSONVILLE FL 3 2246

RE: 3543 OCEANSHORE BLVD N
EDWARD R & DENISE A MIMS
P O BOX 2712
PALATKA FL 32178 2712

RE: 3551 OCEANSHORE BLVD N
HAMMOCK MOORINGS NORTH
HOMEOWNERS ASSO INC
5455 HIGHWAY A1A S
ST AUGUSTINE FL 32080

RE: 3569 OCEANSHORE BLVD N
SANDRA DIANA KHALILI TRUSTEE
3315 YORK ROAD
OAK BROOK IL 60521

RE: 11 OCEAN DUNE CIR
CHALRES & TEENA ELLEN WEISS
PBO BOX 353819
PALM COAST FL 32135 3819

RE: 3537 OCEANSHORE BLVD N
ROBERT J JR & JOAN E DUHAIME
1421 AUTUMN LEAF RD
TOWSON MD 21286

RE: 3523 OCEANSHORE BLVD N
CALLAVA LETICIA ASW
540 ARAGON AVE
CORAL GABLES FL 33134

RE: N OCEANSHORE BLVD PROPERTY
DE HOYOS EVELIO &
ELIN SATORY DE HOYOS
1000 OLD ENGLAND AVENUE
WINTER PARK FL 32789

RE: 3531 OCEANSHORE BLVD N
JUSTESEN EVELYN AND
NANCY M BLY CO TRUSTEES
52 MADISON ST
PEQUANNOCK NJ 07440

RE: 3539 OCEANSHORE BLVD N
AURIA KOHLER
PO BOX 938
POMPANO BEACH FL 33061

RE: 3519 OCEANSHORE BLVD N
MARKS FAMILY INC
5350 SE 18TH LANE
OCALA FL 34480

RE: 3511 OCEANSHORE BLVD N
GAMBLE NELSON R & DEBRA A
1301 N CENTRAL AVE
FLAGLER BEACH FL 32136

RE: 3505 OCEANSHORE BLVD N
CARNEIRO MANUEL AND
4 CLASSIC CT S
PALM COAST FL 32137

RE: 3489 OCEANSHORE BLVD N
POTAPOW MICHAEL G
6383 SW 21ST COURT RD
OCALA FL 34474

RE: 3481 OCEANSHORE BLVD N
LANGELLO GRACE M
3481 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 3473 OCEANSHORE BLVD N
KAREN K GOES
138 PALM COAST PKWY
BOX 171
PALM COAST FL 32137

RE: 3461 OCEANSHORE BLVD N
ALAN L & LINDA D STERLING
1624 CLEARVIEW DR
BRENTWOOD TN 37027

RE: 3453 OCEANSHORE BLVD N
LYNCH MICHAEL B &
SUSAN C PURYEAR
16612 JOHNS LAKE RD
CLERMONT FL 34711

RE: 3445 OCEANS HORE BLVD N
DARRYL AND LUCILLE MASLAK
310 CARTER RD
THOMASTON CT 06787

RE: 3429 OCEANSHORE BLVD N
CARLOS LUCERO
4640 PARK NEWPORT
NEWPORT BEACH CA 92660 6056

RE: 3423 OCEANSHORE BLVD N
GREGORY A JOHNSTON
3423 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: 3417 OCEANSHORE BLVD N
NEW HAVEN TRUST CO TRUSTEE
1 LEFEBVRE ST
ST PETER PORT
GUERNSEY GY1 4JE

RE: 3409 OCEANSHORE BLVD N
DIX JAMES D & LINDA LEE DIX
3409 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 3399 OCEANSHORE BLVD N
JAMES T CULLIS
3399 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: 3397 OCEANSHORE BLVD N
LONNYE R BLACK
9610 NW 115TH AVE
OCALA FL 34482

RE: 3395 OCEANSHORE BLVD N
CHRIS AND ANDREA PAPPOU
3209 NE 40TH ST
FT LAUDERDALE FL 33308

RE: 3393 OCEANSHORE BLVDE N
PETER C TRIOLO
1515 LAKE DANIEL DR
ORLANDO FL 32804

RE: 3391 OCEANSHORE BLVD N
JAMES E AND NANCY OLBERT
3391 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: 3381 OCEANSHORE BLVD N
BRIDGET LAPOINT
3381 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: 3373 OCEANSHORE BLVD N
CONWAY STEPHEN S & LUPITA
PO BOX 1620
FLAGLER BEACH FL 32136

RE: 3369 OCEANSHORE BLVD N
GAIL W HOLT
3369 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE; 3361 OCEANSHORE BLVD N
BRIAN A & DIANNE WALSH
585 TECHNOLOGY PARK STE 100
LAKE MARY FL 32746

RE: 3359 & 3209 OCEANSHORE BLVD N
LB CRAYTON TRUSTEE
10435 MIDTOWN PLWY UNIT 131
JACKSONVILLE FL 32246

RE: 3341 OCEANS HORE BLVD N
LEE DENNIS G AND CARIDAD E
P O BOX 357845
GAINESVILLE FL 32635

RE: 3323 OCEANSHORE BLVD N
WILLIAM J & CAROL ANN SHEAFFER
609 EAST CENTRAL BLVD
ORLANDO FL 32801

RE: 3319 OCEANSHORE BLVD N
CHARLES E JOHNSON JR TRUSTEE
436 ANCHORAGE DRIVE
NAKOMIS FL 3 4275

RE: 3311 OCEANSHORE BLVD N
TOMMY D AND BARBARA TANT
PO BOX 53
FLAGLER BEACH FL 32136

RE: 3309 OCEANSHORE BLVD N
JAMES E CORBIN JR
12470 SUNNYDALE DRIVE
WELLINGTON FL 33414

RE: 3303 OCEANSHORE BLVD N
KAHANA BEACH LLC
2 STAHL COURT
MARLTON NJ 08053

RE: 3299 OCEANSHORE BLVD N
CHARLES E II & SANDY B MULLER
7920 SW 129TH TERRACE
MIAMI FL 33156

RE: 3295 OCEANSHORE BLVD N
DAVID R SMITH TRUSTEE
3404 SHADYWOOD DR
LAMBERTVILLE MI 48144 9600

RE:3264 OCEANSHORE BLVD N
TG-EG LLC & MARTIN GILBERT JR, PAUL M
AND HARRIET H DODD, TRUSTEES
1075 MASON AVE
DAYTONA BEACH FL 32117

RE: 3249 OCEANSHORE BLVD N
PAUL & SHARON SAMARTAN
3249 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 3243 OCEANSHORE BLVD N
THOMAS J & GAIL VALLELY
P O BOX 689
3243 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 3227 OCEANSHORE BLVD N
HOWARD L & MARLENE R SKLAR
PO BOX 280
FLAGLER BEACH FL 32136

RE: 3221 OCEANSHORE BLVD N
HOWARD J MCLAUGHLIN
PO BOX 403
FLAGLER BEACH FL 32136

RE: 3215 OCEANSHORE BLVD N
RAJALAKSHMY SUNDARARAJAN
50959 WALDON PARK LN
GRANGER IN 46530

RE: 3203 OCEANSHORE BLVD N
MAGALY L MUSSER
10311 RAMBLEWOOD DR
CORAL SPRINGS FL 33071

RE: 3199 OCEANSHORE BLVD N
KEENE R BRUCE & BARBARA
2185 VIA TUSCANY
WINTER PARK FL 32789

RE: 3195 OCEANSHORE BLVD N
STEVEN R & JANICE Q DAVIS
3195 NORTH OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 3189 OCEANSHORE BLVD N
TERRY ANNE WEDDINGTON & JOHN S
REINEKE & TERESA M REINEKE
351 HAMILTON SHORE DRIVE
WINTER HAVEN FL 33881

RE: 3183 OCEANSHORE BLVD N
DAPHNE-A-;OFE ESTATE S UNIT &
INTNL SEMINARY OF TYLER CRUS
P O BOX 1208
PLYMOUTH FL 32768 1208

RE: 3179 OCEANSHORE BLVD N
GEORGE C HARPER III
PO BOX 355
PIERSON FL 32180

RE: 3171 OCEANSHORE BLVD N
OLD A1A PARTNERS LLC
PO BOX 1030
O'FALLON MO 63366

RE: 3167 OCEANSHORE BLVD N
MICHAEL & DEBRA MEURER
12534 ELM MANOR ST
SAN ANTONIO TX 78256

RE: 3165 OCEANSHORE BLVD N
DANA L FAULKNER
226 LAKE TER DR
HENDERSONVILLE TN 37075

RE: 3161 OCEANSHORE BLVD N
SUSAN W ROBERTS
PO BOX 2037
LAKELAND FL 33806

RE: 3153 N OCEANSHORE BLVD
GORDON JAMES N & RUTH H JTWROS
3153 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 3147 OCEANSHORE BLVD N
ASTON KENNETH P JR & LORI A
P.O. BOX 2150
FLAGLER BEACH FL 32136

RE: 3143 OCEANSHORE BLVD N
ELEANOR SINES
30081 ST HWY 10
WALTON NY 13856

RE: 3131 OCEANSHORE BLVD N
POKORSKY THOMAS M & MICHELE M
4436 WEILERS WAY
PORT WASHINGTON WI 53074

RE: 3129 OCEANSHORE BLVD N
COHEN WILLIAM H AS TTEE
C/0 THREE SISTERS INVESTMENT
1150 CHARMING ST
MAITLAND FL 32751

RE: 3123 OCEANSHORE BLVD N
CHARLES P & KRISTIN SHIKANY
914 N MAIN ST
WHEATON IL 60187

RE: 3121 & 3109 OCEANSHORE BLVD N
3109 N A1A LLC
1800 OLD MOODY BLVD
BUNNELL FL 32110

RE: 3105 OCEANSHORE BLVD N
TORGGLER REALTY LLC
200 OCEAN CREST DR APT 412
PALM COAST FL 32137

RE: 3101 OCEANSHORE BLVD N
MASSARO JOSEPH
3010 PAINTERS WALK
PALM COAST FL 32136

RE: 3093 OCEANSHORE BLVD N
MCMAHON PATRICK M &
DELIA MCCOY MCMAHON
18 BUCK RUN
MOHNTON PA 19540

RE: 3087 OCEANSHORE BLVD N
GALLOGLY EUGENE F
837 PITT ST
MT PLEASANT SC 29464

RE: 3079 OCEANSHORE BLVD N
ROBERT AND SHARON BARRY TRUSTEES
3738 CARDINAL BLVD
DAYTONA BEACH FL 32118

RE: 3073 N OCEANSHORE BLVD
GELSINGER CHERRY ANN
3073 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE:3065 OCEANSHORE BLVD N
MCKNIGHT JESSE H III & GENETTE PO 306 E
MOODY BLVD
BUNNELL FL 32110

RE: 3059 OCEANSHORE BLVD N
KOPCHA THOMAS S
3640 GREEN MEADOW LANE
ORION MI 48359 1492

RE: 3051 OCEANSHORE BLVD N
HOEPKER TODD & JUDY &
BUHAY JOHN & KATHLEEN T
735 EDGEWATER DRIVE
ORLANDO FL 3 2804

RE: 3043 OCEANSHORE BLVD N
GOLDEN BEACH LLC
1356 CLASSIC CT N
LONGWOOD FL 32779

RE: 3037 OCEANSHORE BLVD N
MEDLIN CHARLES H & KRISTI L
PO BOX 68
FLAGLER BEACH FL 32136

RE: 3029 OCEANSHORE BLVD N
FRANCO E EDWARD & SHARON L
7852 JAMES ISLAND WAY
JACKSONVILLE FL 32256

RE: 3023 N OCEANSHORE BLVD
LYONS THOMAS F & SUZANNE O
LIFE ESTATE
3023 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2637 OCEANSHORE BLVD N
OKELLEY SUE S &
STEPHEN BROOKS OKELLEY &
EDWARD BENSON OKELLEY
1139 ST. ANDREWS CIR
DUNWOODY GA 30338

RE: 3009 OCEANSHORE BLVD N
CHRISTOPHER A & SARAH A LEWIS
2081 CLERMONT ST
DENVER CO 80207

RE: 3001 OCEANSHORE BLVD N
GILLIARD ONETHA A & LEMA
JAMISON
18051 SW 224TH STREET
MIAMI FL 3170

RE: 2999 OCEANSHORE BLVD N
FLAGLER PARADISE LLC
800 BRICKELL AVE STE 1501
MIAMI FL 33131 3040

RE: 2995 OCEANSHORE BLVD N
EDWARD E & EILEEN F HAMBY
2995 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2991 OCEANSHORE BLVD N
WILLIAM CHARLES & JANE C SMITH
2991 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: 2989 OCEANSHORE BLVD N
WILLIAM & TIFFANY DAVIS
2691 LAKE RABUN RD
LAKE MONT GA 30552

RE: 2982 N OCEANSHORE BLVD
FLAGLER BY THE SEA INC
2982 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2975 OCEANSHORE BLVD N
MARK W KRAMP & ROBERT M BARNES TIC
2981- 82 NORTH OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2963 OCEANSHORE BLVD N
KAREN J FOLLANSBEE
48 BULOW WOODS CR
FLAGLER BEACH FL 32136

RE: OCEANSHORE BLVD N PROPERTY
IRACE STEVEN & NANCY, EUGENE &
KATHERINE
63 COMMERCIAL AVENUE
GARDEN CITY NY 11530

RE: 2949 N OCEANSHORE BLVD
DALE J & KL MATEJKA
2949 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136 2747

RE: 2949 N OCEANSHORE BLVD
NORMA & KATHRYN DURBIN, FIYAK &
KAREN DURBIN, PEACOCK & KAITLIN
DURBIN
PO BOX 1110
FLAGLER BEACH FL 32136

RE: 2945 N OCEANSHORE BLVD
MORRIS BEVERLY A
2945 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2943 OCEANSHORE BLVD N
JOHN & CAROL HOEPNER
2943 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: 2941 OCEANSHORE BLVD N
CURTIS & JOAN SHERROD
14750 SW 32 COURT
DAVIE FL 33330

RE: 2935 N OCEANSHORE BLVD
ELSMAN DONALD A & MELODY
2935 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2929 OCEANSHORE BLVD N
FLAGLER ENTERPRISES LLC
309 S CLAY ST APT A
ZELIENPOLE PA 16063

RE: 2903 OCEANSHORE BLVD N
BUDAY RONALD G & LYNDA BURBRINK
PO BOX 695
FLAGLER BEACH FL 32136

RE: 2895 OCEANSHORE BLVD N
THERESA JOINER
325 OLD MILL CT
FAYETTEVILLE GA 30214 4512

RE: 2737 OCEANSHORE BLVD N
PATEL SIDDHARTH J
P O BOX 1048
FLAGLER BEACH FL 32136

RE: 2723 OCEANSHORE BLVD N
GRESHAM ELISE H STEVEN TRUSTEE
4500 SW 80TH PLACE
GAINESVILLE FL 32608

RE: 2719 OCEANSHORE BLVD N
WINGO JAMES C JR & DEBRA L
2719 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: 2715 N & 1820 S OCEANSHORE BLVD
BARNHILL THEODORE MCCOY JR &
MARJORIE VIVIEN TRUSTEE
6615 CARDINAL LANE
ANNANDALE VA 22003

RE: 2711 OCEANSHORE BLVD N
VICTOR CORRIGAN
5461 JACQUELINE LN
N OLMSTEAD OH 44070

RE: 2703 OCEANSHORE BLVD N
MENNO FRANK & LINH B TERRIET
2656 RIVER PORT NORTH
JACKSONVILLE FL 32223

RE: 2693 OCEANSHORE BLVD N
STEPHEN FOX
8001 CASTOR AV # 137
PHILADELPHIA PA 19152 2701

RE: 2681 OCEANSHORE BLVD N
MA KWAN CHEN
5461 JACQUELINE LANE
N OLMSTEAD OH 44070

RE: 2673 OCEANSHORE BLVD N
BARRY & MARILYN LEVINE
12403 KELSO RD
THOMOTOSASSA FL 33592

RE: 2669 OCEANSHORE BLVD N
ROWGALO BERNARD TRUSTEE
9 FAIRWINDS CIR
ORMAND BEACH FL 32176

RE: 2661 OCEANSHORE BLVD N
CASTELLO MICHELE TRUSTEE
PO BOX 2531
FLAGLER BEACH FL 32136

RE: 2653 OCEANSHORE BLVD N
CAVALLARO LARRY A
PO BOX 1616
FLAGLER BEACH FL 32136

RE: 2649 OCEANSHORE BLVD N
TRIVETT DANNIE W & BARNIE L
PO BOX 181
DELAND FL 32721

RE: 2641 OCEANSHORE BLVD N
GARY & KRISTIN LEE
1068 LAUREL VALLEY ST
MARIETTA GA 30064

RE: 2629 OCEANSHORE BLVD
STEFANSSON LIVIA K TRUSTEE
9770 MOUNTAIN VIEW DRIVE
WAITE HILL OH 44094

RE: 72 FLAGLER DR
SCOTT & CLAUDIA JACKSON
240 HUNTINGTON RD
ATLANTA GA 30309

RE: 73 ROLLINS DR
STEVEN MIITCHELL
1801 NW MARKET ST #311
SEATTLE WA 98107

RE : 27 ROLLILNS DUNES DR
WILLIAM C BRUNK
2001 CIRCLE DRIVE
COLUMBUS OH 43220

RE: 29 ROLLINS DUNE DR
BERNARDO M & LORETTE F UTSET
3790 HUNT CLUB RD
JACKSONVILLE FL 32224 8412

RE: 28 ROLLINS DUNE DR
JOSEPH C & SHARON L KEHOE TRUSTEE
28 ROLLINS DUNE DR
PALM COAST FL 32137

RE: 1 SEA COLONY DR
SEA COLONY HOMEOWNERS ASSOC
C/O SOUTHEAST MANAGEMENT
PO BOX 354734
PALM COAST FL 32135 4734

RE: 25 OCEAN DUNE CIRCLE
HAL & LINDA IRWIN
420 LAKE ESTATE DR
CHAPIN SC 29063

RE: 23 OCEAN DUNE CIRCLE
JOSEPH & LAURA DEFOREST
411 S OAKDALE DR
STILLWATER OK 74074 6704

RE: 21 OCEAN DUNE CIRCLE
MICHAEL J & MARGARET MAHONEY
20 VILLAGE WOODS RD
HAVERHILL MA 01822

RE: 15 OCEAN DUNE CIR
TODD & VALERIE ELLIOTT
13610 DORNOCH DR
ORLANDO FL 32828

RE: 9 OCEAN DUNE CIR
JEFFERY R KISSINGER TRUSTEE
9 OCEAN DUNE CIR
PALM COAST FL 32137

RE: 7 OCEAN DUNE CIR
WHITMAN LORD R AND LURUE L
PO BOX 1009
STATESBORO GA 30459

RE: OCEAN DUNE CIR PROPERTY
PETER & DEBBIE HEALEY
16 OCEAN DUNE CIR
PALM COAST FL 32137

RE:3439 & 2424 OCEANSHORE BLVD N
GEOFFREY BODDEN & CARRIE SMITH
6337 JACK WRIGHT ISLAND RD
ST AUGUSTINE FL 32092

RE: 2621 OCEANSHORE BLVD N
GROMLING FRANK C & BRENDA P
P O BOX 1080
FLAGLER BEACH FL 32136

RE: 2601 OCEANSHORE BLVD N
JOSEPH & MARY LICATA
2804 RIVERSIDE DR
WANTAGH NY 11793

RE: 3349 OCEANSHORE BLVD N
EDDIE FINNEY LIFE ESTATE
PO BOX 446
FLAGLER BEACH FL 32136

RE: 3335 OCEANSHORE BLVD N
LAKE AND RESORT PORPERTIES LLC
669 EMORY VALLEY ROAD
OAK RIDGE TN 37830

RE:2140 OCEANSHORE BLVD S
DEL SIGNORE RONALD & ROSALIA
2126 BELLCREST COURT
ROYAL PALM BEACH FL 33411

AMMEX INVESTMENTS INC
PO BOX 65417
ORANGE PARK FL 32065

RE:1935 OCEANSHORE BLVD N
MCKENZIE W H & MARGARET
1935 N OCEANSHORE DRIVE
FLAGLER BEACH FL 32136

RE: 2450 OCEANSHORE BLVD N
OCEANSIDE @ BEVERLY BEACH CONDOS
2450OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: 2136 OCEANSHORE BLVD S
DAVID & SUZANNE DEFERIE
PO BOX 15388
ASHEVILLE NC 28805

RE: 2024 S OCEANSHORE BLVD
GARRIS THOMAS C & EDWARD
2024 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: OCEANSHORE BLVD PROPERTY
TOWNSEND J L
821 EAST INT SPEEDWAY BLVD
DAYTONA BEACH FL 32118

RE:OCEANSHORE BLVD PROPERTY
PAPE ROBERT J & BARBARA J
1203 SALT CREEK ISLAND DR
PONTE VEDRA BEACH FL 32082

RE:28 OCEAN PALM VILLA S
DEVINE-BEATY JOSEPHINE F
28 OCEAN PALM VILLAS SOUTH
FLAGLER BEACH FL 32136

RE: HWY A1A PROPERTY
KIM RICHARD H
798 NE 71ST STREET
BOCA RATON FL 33487

RE : 1943 OCEANSHORE BLVD N
DAMRON CHARLES E & DINA MARIE
1943 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: N OCEANSHORE BLVD PROPERTY
GLADSTONE A MYLES & MATTY J
315 KING FARM BLVD APT 402
ROCKVILLE MD 20850 6675

RE: N HWY A1A PROPERTY
JEFFREY MORRISON
9560 BAY HILL DR
WARREN OH 44484

RE: OCEANSHORE BLVD N PROPERTY
KETHA REAL ESTATE ENTERPRISE LLC
2925 SKYWAY CIRCLE N
IRVING TX 75038

RE: OCEANSHORE BLVD N PROPERTY
CAIN RUTH CLARK TRUSTEE
C/O LEE CAIN
3812 VIRGINIA DR
ORLANDO FL 32803

RE: OCEANSHORE BLVD N PROPERTY
DAVID B & JUDY SHROVER
2274 ANDERSON DRIVE
ORMOND BEACH FL 32174

RE: OCEANSHORE BLVD N PROPERTY
LONGVIEW PROPERTIES LLC
3920 WESTBROOK ROAD
SUWANEE GA 30024

RE: OCEANSHORE BLVD N PROPERTY
REISS ELAINE
573 N VALLEY FORGE RD
NEPTUNE BEACH FL 32266

RE: OCEANSHORE BLVD N
MANUAL LEVINE D & ANNETTE D LEVINE
10739 SANTA ROSA DR
BOCA RATON FL 33498

RE: 1597 OCEANSHORE BLVD N
SEASCAPE PROPERTIES LLC
1597 MASTERPIECE WAY
DELAND FL 32724

RE: OCEANSHORE BLVD N PROPERTY
OLRICH BILLIE SHAFFER
C/O JACKIE HARDIN
P.O. BOX 731
POMONA PARK FL 32181

RE: HWY A1A PROPERTY
RYCRAFT HELEN A
13555 LAKES WAY
ORLANDO FL 32828

RE: OCEANSHORE BLVD N PROPERTY
WHITTAKER ALICIA GREENE
1815 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136 2901

RE: 1802 CENTRAL AV
GREGORY L & MARSHA SAUER
1802 N CENTRAL AVE
FLAGLER BEACH FL 32136

RE: HWY A1A PROPERTY
JAMES A NELSON &
JOANNE ECKHARDT
P.O. BOX 2098
FLAGLER BEACH FL 32136

RE: HWY A1A PROPERTY
FRANK J & BARBARA H NAVRAN
23 WHITE DEER LANE
PALM COAST FL 32164

RE: HWY A1A PROPERTY
FRANK A AND PAMELA J BOTELHO
35 ST ANDREWS CT
PALM COAST FL 32137

RE: HWY A1A PROPERTY
CHAS E AND CAROLYN E SALYER
1744 N CENTRAL AVE
FLAGLER BEACH FL 32136

RE: HWY A1A PROPERTY
HVIZDAK WILLIAM G
3154 HILLSIDE RD
EDINBURG PA 1 6116

RE: 1728 N CENTRAL AVE
JOHN WADE THOMPSON
1728 N CENTRAL AVE
FLAGLER BEACH FL 32136

RE: 1815 N OCEANSHORE BLVD
WHITTAKER RICHARD & MARGINE E
1815 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136 2901

RE: HWY A1A PROPERTY
GARY & MARTHA SPRINGER
1246 LAKESIDE DRIVE
COROLLA NC 27927

RE: N HWY A1A PROPERTY
CAREY &DOROTHY KLEE STRICKLAND
8107 SW 72 AVE 305 E
MIAMI FL 33143

RE: HWY A1A PROPERTY
RHUDY MARTHA
P.O. BOX 1525
FLAGLER BEACH FL 32136

RE: HWY A1A PROPERTY
SIMON R SANFORD & R MARGIER
6591 CARINLOUGH PLACE
DUBLIN OH 43016

RE: 1703 OCEANSHORE BLVD N
MARVIN A SHEETS
PO BOX 1487
BUNNELL FL 32110

RE: HWY A1A PROPERTY
MICHAEL J & MARIANNE KEHOE
PO BOX 591
FLAGLER BEACH FL 32136

RE: 1647 OCEANSHORE BLVD N
CAROLYN B HUNSAKER
1647 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE : 1641 OCEANSHORE BLVD N
ANTHONY L & GEORGIA CARUSO
1641 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 1635 OCEANSHORE BLVD N
JAMES HARTKOP & STACY WITFILL
3079 W BLOSSOM DR
BEVERLY HOLLS FL 34465

RE: 1633 N OCEANSHORE BLVD
SAUNDERS JEANNE FULGHUM &
JAMES ANTHONY
1633 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 1505 NORTH OCEAN SHORE BLVD
JANIE T BARROWS E TAYLOR LAWHORN
1505 N CENTRAL AVE
FLAGLER BEACH FL 32136

RE: OCEANSHORE BLVD N PROPERTY
MARGARET O'NEIL
37 MEETINGHOUSE LANE
WEYMOUTH MA 02189 1044

RE: N HWY A1A PROPERTY
THE ALIKI TOWNHOUSE ASSOC INC
PO BOX 2496
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
JOHN C & VICKIE E WETSEL
15620 ARABIAN WAY
MOUNT VERDE FL 34756

RE: 1347 N OCEANSHORE BLVD
DEEN CLAUDE SISCO
PO BOX 637
FLAGLER BEACH FL 32136 0637

RE: N HWY A1A PROPERTY
WELLS FARGO BANK
MAC Z3057 010
PO BOX 2248
JACKSONVILLE FL 32203 2248

RE: N HWY A1A PROPERTY
RICHARD A NORTHRIP &
1900 ALASKAN WAY #306
SEATTLE WA 98101

RE: N HWY A1A PROPERTY
1309 FLAGLER LLC
11621 KEW GARDEN AVE STE 109
PALM BEACH GARDENS FL 33410

RE: 1305 N OCEANSHORE BLVD N
THOMAS M SCARISBRICK
P.O. BOX 1267
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
PETER A & LUCILLE M CANALE
112 CHRISTOPHERS MILL RD
MEDFORD NJ 08055

RE: N HWY A1A PROPERTY
DUENSING CLYDE JR &WINNIE R
PO BOX 121
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
T C A INC C/O STEPHEN LAWRENCE
3145 GEARY BLVDSUITE 707
SAN FRANCISCO CA 94118

RE: N HWY A1A PROPERTY
LHP SCALES INC
P O BOX 1207
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
DARREN Q & JANICE M CHAMBERS
1517 GOLF CLUB EXT
DOUGLAS GA 31533

RE: 1201 N OCEANSHORE BLVD N
PARKER RAYMOND A & CLAUDIA J
1201 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 1119 OCEANSHORE BLVD N
IRWIN MARCI E
1119 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 1112 N CENTRAL AVE
RICHARD O & JOAN R MORGAN
1112 N CENTRAL AVENUE
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
LONG LARRY W & JEANNE R
PO BOX 1445
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
RAVAL PRADEEP A & MARTA C
3554 NW 63RD PLACE
GAINESVILLE FL 32653

RE: N HWY A1A PROPERTY
WOLCOTT INC REALTORS
PO BOX 1407
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
JAMES F AND BETTY L COX
341 PALM DRIVE
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
KASTURY UMA R
5 CATHERINE CT
BOONTON NJ 07005

RE: 2579 OCEANSHORE BLVD N
CHARLES R & RHODA TURNBLACER
2579 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
DOUGLAS E ERNST
150 POND TRACE
FAYETTEVILLE GA 30215 5351

RE: 909 OCEANSHORE BLVD N
FLAGLER BEACH HOLDINGS LLC
8851 HWY A1A SOUTH
ST AUGUSTINE FL 32080

RE: N HWY A1A PROPERTY
FLAGLER BEACH PROPERTIES LLC
17375 W HWY 40
OCALA FL 34481 8797

RE: N HWY A1A PROPERTY
LOWE PALM COAST INC
PO BOX 354489
PALM COAST FL 32135 4489

RE: N HWY A1A PROPERTY
KENNETH R TARSITANO
29 BEDFORD DRIVE
PALM CITY FL 32137

RE: 2080 OCEANSHORE BLVD N
DENNIS L LOTT & KELLY A LEWELLEN
2080 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
WALKER DEAN
6156 S WILLIAMSON BLVD
PORT ORANGE FL 32128

RE: N HWY A1A PROPERTY
DAVID ALLEN AND AFAF K WENSKY
2628 CORTE VIDA
PLEASANTON CA 94566

RE: N HWY A1A PROPERTY
WILLIAM M & ZOEE B FOREHAND
P O BOX 2029
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
VRE FLAGLER BEACH LLC
502 N CARROLL AVE STE 120
SOUTHLAKE TX 76092 6449

RE: N HWY A1A PROPERTY
FLAGLER BEACH HOLDINGS LLC
1481 LAMBERT AVE
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
BETTY H ANNIS
2826 MONDAUI DR
ROCKLEDGE FL 32955

RE: S HWY A1A PROPERTY
BR & FAMIL LTD PARTNERSHIP
C/O BILLY TIMMS
1203 CAVE SPRING RD
ROME GA 30161

RE: 1224 S OCEANSHORE BLVD
JAI HANUMAAN LLC
1224 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 1544 S HWY A1A
OLDE TOWNE ENCHANTMENT INC
1544 S A1A
FLAGLER BEACH FL 32136

RE: 1600 S HWY A1A
DIANE DOMPE LARSON
1600 SOUTH A1A
FLAGLER BEACH FL 32136

RE: 1604 S OCEANSHORE BLVD
TIMOTHY GOULD
1604 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
DETRICK FRED G
P O BOX 964
FLAGLER BEACH FL 32136

RE: S HWY A1A PORPERTY
JERE SCOLA
4615 NW 53RD AVE
GAINESVILLE FL 32653

RE: S HWY A1A PROPERTY
JEFFREY A FISHER
2015 N CENTRAL AVENUE
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
AMIN BHAVESH R & DIVYA
224 GREGG PKWY
COLUMBIA SC 29206

RE: 1816 OCEANSHORE BLVD S
RODGER & SUZANNE CLEMENT
1816 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
MOIDOM LLC
140-25 MULBERRY AV
FLUSHING NY 11355

RE: S HWY A1A PROPERTY
JULES S II & THERESE ABBOSH
100 BRISTOL PL
PONTE VEDRA BEACH FL 32082

RE: S HWY A1A PROPERTY
DEMUS & CARRIE DEERING
4401 OLD SPARTA RD
COOKEVILLE TN 38506

RE: S HWY A1A PROPERTY
FIRST LAND NORTH LLC
PO BOX 566601
PINECREST FL 33256

RE: S HWY A1A PROPERTY
VASYL N & MILKA G
C/0 NINA RAM
208 CLUBSIDE DR
TANEYTOWN MD 21787

RE: S HWY A1A PROPERTY
LEO A JR & KAREN SCHOTT
4530 38TH WAY SOUTH
ST PETERSBURG FL 33711

RE: S HWY A1A PROPERTY
JUDY MISBACH
2130 E 56TH AVE APT J106
ANCHORAGE AK 99507 5438

RE: 2264 OCEANSHORE BLVD S
TAMMY JANE SULLIVAN
400 E BAY ST STE 302
JACKSONVILLE FL 32202

RE: S HWY A1A
YANKOWSKI JUDITH A & JOSEPH R
PO BOX 1192
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
ROBERT J & CAROLE A ELLIOTT
PO BOX 445
FLAGLER BEACH FL 32136

RE: SHWY A1A PROPERTY
THE EIGHTEEN EIGHT GROUP LLC
193 BLACK MEADOW RD
CHESTER NY 10918

RE: S HWY A1A PROPERTY
PHILLIP & MARGO BACSICK
2568 S CENTRAL AVE
FLAGLER BEACH FL 32136

RE: 2300 OCEANSHORE BLVD S
KALBERER RICHARD N TRUSTEE
PO BOX 2194
MYRTLE BEACH SC 29578 2194

RE: OCEANSHORE BVD S PROPERTY
NICKLER MICHAEL TRUSTEE
8246 MAN O WAR ROAD
PALM BEACH GARDENS FL 33418 7719

RE: OCEANSHORE BLVD S PROPERTY
MELTON MARIE A
2316 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
CYNTHIA A DANGIOLINI
P O BOX 1889
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
BUFFARDI INVESTMENT CORP
% PALM WEST REALTY INC
2 FLORIDA PK DR N SUITE 107
PALM COAST FL 32137

RE: S HWY A1A PROPERTY
WILLIAM STEPNICKA
9521 MEECH AVE
CLEVELAND OH 44105

RE: S HWY A1A
SAMORISKI PAUL J
5331 SW 98TH COURT
MIAMI FL 33165

RE: OCEANSHORE BLVD S PROPERTY
HALL LINDA B & RICHARD D
628 YORKSHIRE DR
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
RUDOLPH & MARGARET P BARLAN
9 BLACKBERRY PL
PALM COAST FL 32137

RE: S HWY A1A PROPERTY
JOSEF & VALENDON WALLY
908 HARDSTONE WAY
SANTA ROSA CA 95405

RE: S HWY A1A PROPERTY
SREEKANTH R & VANDANA R
CHANDRUPATLA
1700 N JIMMIE FOX PATH
HERNANDO FL 34442

RE: 2400 S HWY A1A
LORETTA HILLIER
2340 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
ROBERT S LUTZ
2400 S A1A
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
LEE C & LOIS A FOSHAY
151 CENTER RD
DUDLEY MA 01571

RE: S HWY A1A PROPERTY
BARRY GRIFFIN
2448 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
MOULTRIE L & JANE L HITT
2544 S CENTRAL AVE
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
PAL PARKER & SONS INC
PO BOX 218
FLAGLER BEACH FL 32136

RE: S HWY A1A
STEPHEN D FANN
119 BETH COURT
GALLATIN TN 37066

RE: S HWY A1A PROPERTY
MONTGOMERY ANDREW WILLIAMSON
MARY ELIZABETH SLOOF
576 HAROLD AVE NE
ATLANTA GA 30371 1790

RE: HWY A1A PROPERTY
FRANK & ISABEL CARRANO
5951 NW FOURTH AVE
BOCA RATON FL 33487

RE: S HWY A1A PROPERTY
MARK J CHICKERING
45 WHITCOCK LANE
PALM COAST FL 32164

RE: S HWY A1A
FRANK JOSEPH & MARGARETA
PO BOX 295
REDDING CT 06896

RE: S HWY A1A PROPERTY
BROOKS A TRUSTEE
PO BOX 571
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
SLLAN G & DELORIS C HALLER
PO BOX 1838
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
MARIO R AND MARYLOU BAIATA
1411 S DAYTONA AVE
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
JOHN J & JAMI L VERDEROSA
1399 CURRAHEE CLUB DRIVE
TOCCOA GA 20577

RE: S HWY A1A PROPERTY
JAMES JOSEPH ANDERSON
623 CUMBERLAND DR
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
NEAL R & AMORETTE J NORDIN
2820 DOWNING ST
JACKSONVILLE FL 32205

RE: S HWY A1A PROPERTY
GLENN P MACARTHUR
7432 SUNSHINE SKYWAY LN S
ST PETERSBURG FL 33711 5110

RE: S HWY A1A PROPERTY
CAROL A MICKEN
2614 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2616 OCEANSHORE BLVD N
ROBERT L SLATTERY
2616 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2620 OCEANSHORE BLVD S
JOHN R ATHEY & DENISE MANZOLILLO
2620 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2624 OCEANSHORE BLVD S
JOHN J & JANICE M JENKINS
2624 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2628 SOUTH A1A
JOSEPH M & BEVERLY A BACHMAN
2628 SOUTH A1A
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
JAMES & DOROTHEA BENINTENDE
PO BOX 1802
FLAGLER BEACH FL 32136 1802

RE: S HWY A1A PROPERTY
WOLFGANG BAER TRUSTEES
380 W CARMEL VALLEY RD
CARMEL VALLEY CA 93924

RE: 1001 OCEANSHORE BLVD N
MAURO ALISON
1001 N OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2644 S OCEANSHORE BLVD
JOHN T & GLORIA W RIDENOUR TRUSTEES
2644 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
CHARLES L & MARY E JETT
7469 APRELLE DR
SANFORD FL 32771

RE: S HWY A1A PROPERTY
JOHN P BERNARDI
2652 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE:2656 OCEANSHORE BLVD S
WILLIAM T & ERIKA T EVERETT
2656 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
TONY STIVERS ET AL
10400 INNISBROOK DRIVE
JACKSONVILLE FL 32222

RE: S HWY A1A PROPERTY
CHARLES W JR & SUSAN HEATH
JEAN GEORGE& DAVID ROBBINS
614 CODDINGTON ROAD
ITHACA NY 14850

RE: S HWY A1A PROPERTY
HALBERT C & LIVIA M CAPUY
625 HIGH HAMPTON DRIVE
AUGUSTA GA 30907

RE: S HWY A1A PROPERTY
ELINOR F PHELAN
PO BOX 2837
BUNNELL FL 32110

RE: S HWY A1A PROPERTY
EGENETO INVESTMENTS
3148 DEEPWATER LN
MAUMEE OH 43537 9588

RE: S HWY A1A PROPERTY
JAY R & MARTIA S MCNEILL
PO BOX 1292
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
DEBORAH GAINES
4410 NE 25TH AVE
LIGHTHOUSE POINT FL 33604

RE: S HWY A1A PROPERTY
JOHN W & PATRICIA D GIBBS
13445 BONICA WAY
WINDMERE FL 34786

RE: S HWY A1A PROPERTY
THOMAS W III & CAROLE HARWOOD
2724 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: S HWY A1A PROPERTY
LAWRENCE P & ROSALIND A SERVINSKY
4097 PORTAGE STREET
PORTAGE PA 15946

RE: 2732 HWY A1A S
ELKE VOGEL
2732 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: OCEANSHORE BLVD S PROPERTY
MICHELE HERBOLDT
2744 A OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: OCEANSHORE BLVD S PROPERTY
WALTER CZERWONKA & PAUL S ALLEN
6453 CROSSWINDS DR
CLOVER SC 29701 7528

RE: OCEANSHORE BLVD S PROPERTY
LAKIC MIRO & KEVIN REEVES
61 SOUTH TURN CIRCLE
PONCE INLET FL 32127

RE: OCEANSHORE BLVD S PROPERTY
SZCZEBAK EDWARD & JULIA
215 STONE SCHOOL RD
SUTTON MA 01590

RE: OCEANSHORE BLVD S PROPERTY
ELOISE CANTORE
3603 CARAMBOLA CIR
VIERA FL 32940

RE: OCEANSHORE BLVD S PROPERTY
WILLIAM H & ANNA LYNN SHAW
2706 S CENTRAL AVE
FLAGLER BEACH FL 32136

RE: OCEANSHORE BLVD PROPERTY
TYPE E CORPORATION INC THE
2805 SOUTH OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2811 OCEANSHORE BLVD S 6
CHARLOTTE F SANDERS TRUSTEE
2144 PENN DR
DELAND FL 32724

2815 OCEANSHORE BLVD S
PATRICK J O'BRIEN
2815 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: OCEANSHORE BLVD PROPERTY
PEBBLE BEACH VILLAGE HOA INC
PO BOX 1221
FLAGLER BEACH FL 32136

RE: 3510 & 3500 OCEANSHORE BLVD S
OCEAN BEACH CLUB II CONDO
3510 ONCEANSHORE BLVD S
FLAGLER BEACH FL 32136

RE: 3580 OCEANSHORE BLVD S
NAUTILUS CONDO
3580 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 3590 HWY A1A S
C/O DAVID ROTENBERG
555 SKOKIE BLVD STE 555
NORTHBROOK IL 60062

RE: 3600 OCEANSHORE BLVD S
OCEANVIEW MANOR CONDO
3600 OCEANSHORE BLVD S
FLAGLER BEACH FL 32136

RE: OCEAN HAMMOCK PROPERTY
OWNERS ASSOC INC MGNT SERV
5455 HWY A1A SOUTH
ST AUGUSTINE FL 32080

RE: 3551 OCEANSHORE BLVD N
HAMMOCK MOORINGS N HOA INC
5455 HIGHWAY A1A S
ST AUGUSTINE FL 32080

RE: 50 OCEAN RIDGE BLVD N
DENISE E BIRK TRUSTEE
3909 LITHIA RIDGE BLVD
VALRICO FL 33594

RE: 48 OCEAN RIDGE BLVD N
SUSAN C MACFARLAN TRUSTEE
66 ISLAND ESTATES PKWY
PALM COAST FL 32137

RE: 58 OCEAN RIDGE BLVD
CHARLES LAMB
1344 HONAN DR
SOUTH BEND IN 46614

RE: 56 & 28 OCEAN RIDGE BLVD N
HOFFMAN FAMILY LIMITED
1225 E WARNER ROAD STE 17
TEMPE AZ 85284

RE: 54 OCEAN RDIGE BLVD N
ANDREW E & MARY F BILINSKI TRUSTEE
1291 TWEED COURT
VIENNA VA 22182

RE: 52 OCEAN RIDGE BLVD N
PATRICK G & ANNA M VASTANO TRUSTEE
316 MARGUERITA AV
SANTA MONICA CA 90402

RE: 44 OCEAN RIDGE BLVD N
RBS INVESTMENTS OF PALM COAST LLC
5409 HUNT CAMP RD
ROANOKE VA 24018

RE : 42 OCEAN RIDGE BLVD N
YVONNE E TIMMES
5525 VILLA LAKE CT
SUWANEE GA 30024

RE: 40 OCEAN RIDGE BLVD N
DENNIS & CATERINE FITZGERALD ESTATE
40 OCEAN RIDGE BLVD
PALM COAST FL 32137

RE: 38 OCEAN RIDGE BLVD N
MICHAEL D & KRISTI A CHIUMENTO
84 ISLAND ESTATES PKWY
PALM COAST FL 32137

RE; 36 OCEAN RIDGE BLVD N
STAYING IN THE GREEN LLLP
10863 KOI RD
ORLANDO FL 32817

RE: 34 OCEAN RIDGE BLVD N
FEHNEL RICHARD & LAURA G
34 OCEAN RIDGE BLVD N
PALM COAST FL 32137

RE: 32 OCEAN RIDGE BLVD N
LEE A G JR
PO BOX 413
ALMA GA 31510

RE: 26 OCEAN RIDGE BLVD N
MUNDAY WILLIAM F JR & RITA M
436 EAGLES POINT
CHAGRIN FALLS OH 44023

RE: 24 OCEAN RIDGE BLVD N
BRUSSARD DAVID & ANN TTEE
118 HUNTINGTON AVE APT1605
BOSTON MA 02116

RE: 22 OCEAN RIDGE BLVD N
ALBERT LAWRENCE R &
KIM M CAMERON
3303 WATER ST NW UNIT 8H
WASHINGTON DC 20007

RE: 20 OCEAN RIDGE BLVD N
ROBERT & MARY ANNE BOWLES
4757 S ATLANTIC AVE #502
PONCE INLET FL 32137

RE: 18 OCEAN RIDGE BLVD N
SOLOMON TEDDY
P O BOX 467
ALMA GA 31510

RE: 15 OCEAN RIDGE BLVD N
EVANS FRANCIS C & SUSAN D
16 OCEAN RIDGE BLVD N
PALM COAST FL 32137

RE: 14 OCEAN RIDGE BLVD N
BELGRADE HOLDINGS LLC
14 OCEAN RIDGE BLVD N
PALM COAST FL 32137

RE: 12 OCEAN RIDGE BLVD N
RICHARD C & CINDY R ROBERTSON
119 PENINSULA DRIVE
PEACHTREE CITY GA 30269

RE: 10 OCEAN RIDGE BLVD N
JAMES & DEBORAH EZELL
853 CHESTNUT LAKE DR
MARIETTA GA 30068

RE: 8 OCEAN RIDGE BLVD N
JOHN J & ANNE M BEYSTEHNER
8 OCEAN RIDGE BLVD N
PALM COAST FL 32137

RE: 6 OCEAN RIDGE BLVD N
LAI FAMILY LIMITED PARTNERSHIP
18209 TOWN HARBOUR ROAD
CORNELIUS NC 28031 7775

RE: 4 OCEAN RIDGE BLVD N
RONALD J & ELIZABETH B KELLY
4 OCEAN RIDGE BLVD N
PALM COAST FL 32137

RE: 2 OCEAN RIDGE BLVD N
KEVIN P & EILEEN P VAN FLEET
145 WEAVERS RD
GREENSBURG PA 15601

RE:1 OCEAN RIDGE BLVD N
RICHARD F & LORI L RADER
PO BOX 353279
PALM COAST FL 32135 3279

RE: 3 OCEAN RIDGE BLVD S
LAWRENCE & BARBARA A MENTZ
140 W 86TH STREET APT #2B
NEW YORK NY 10024

RE: 7 OCEAN RIDGE BLVD S
BEVERLY E WEBSTER
8709 E LYNCHBURG-SALEM TNPK
GOODE VA 24556

RE: 9 OCEAN RIDGE BLVD S
E C N PROP OF ST JOHNS CO LLC
8301 WEST MCNABB ROAD
TAMARAC FL 33321

RE: 11 OCEAN RIDGE BLVD S
CHARLES S & CHRISTINE M HARDIGREE
11 OCEAN RIDGE BLVD S
PALM COAST FL 32137

RE: 13 OCEAN RIDGE BLVD S
TROYA EDUARDO
102 YACHT HARBOR DR UNIT 377
PALM COAST FL 32137 3432

RE: 15 OCEAN RIDGE BLVD S
JERRY C SPRINGER
2587 MUIR CIRCLE
WEST PALM BEACH FL 33414

RE: 19 OCEAN RIDGE BLVD S
DAPILA ARVIND & SNEH &
SONEET KAPILA & PRABODH
2420 DEL LAGO DRIVE
FORT LAUDERDALE FL 33316

RE: 21 OCEAN RIDGE BLVD N
WILLIAM JOHN ROGERS II
21 OCEAN RIDGE BLVD SOUTH
PALM COAST FL 32137 3378

RE: 23 OCEAN RIDGE BLVD S
CHARLES C MULLINS III
10267 HART BRANCH CIRCLE
ORLANDO FL 32832

RE: 25 & 27 OCEAN RIDGE BLVD S
RICHARD M & GRACE BENNINGTON
9612 ENCLAVE PLACE
PORT ST LUCIE FL 34986

RE: 29 OCEAN RIDGE BLVD S
ROBERT M & STACEY TROLLINGER
2916 MILTON
DALLAS TX 75205

RE: 31 OCEAN RIDGE BLVD S
MICHAEL & MOLLY H GENNARO
6 MEADOW ROAD
HARRISON NY 10528

RE: 35 OCEAN RIDGE BLVD S
ALSH INVESTMENTS LLC
2207 S CLEAR CREEK RD
KILLEEN TX 76549

RE: 37 & 39 OCEAN RIDGE BLVD S
ARCEO CONSTANTINO MD
39 OCEAN RIDGE BLVD
PALM COAST FL 32137

OCEAN HAMMOCK PROPERTY
HOA INC MNGT SERVICES
5455 HWY A1A SOUTH
ST AUGUSTINE FL 32080

RE: 31 CALLE DEL SUR
JAMES & EVETTE MENI
13120 RIVER ROAD
POTOMAC MD 208541123

RE: 33 CALLE DEL SUR
FELDMAN HOWARD J & CLARICE R
& ALAN MINTZ & PAMELA
4455 29TH STREET NW
WASHINGTON DC 20008

RE: 69 CALLE DEL SUR
MORRIS & GREENE LLC
6004 BROWNSBORO PARK BLVD
SUITE E
LOUISVILLE KY 40207

RE: 47 CALLE DEL SUR
HUNT HARVEY & MELISSA
19 AVENUE DE LA MER APT 102
PALM COAST FL 32137

RE: 57 CALLE DEL SUR
KAZA ERIKS & KRISTINA
5030 DOWN POINT LANE
WINNDERMERE FL 34786

RE: 61 CALLE DEL SUR
WHANG & KYOUNG JA MOON
1085 DEARBORN ROAD
FORTLEE NJ 07024

RE: 61 CALLE DEL SUR
RICHARD A & SANDRA J MECKLER
21 LAKE ROAD
SHORT HILLS NJ 07078

RE: 63 CALLE DEL SUR
THOMAS R ANDERSON
8 CARLOS COURT
PALM COAST FL 32137

RE: 69 CALLE DEL SUR
WILLIAM H & KIELE NEAS WOLF
1545 BELLEVUE AV
HILLSBOROUGH CA 94010

RE : 71 CALLE DEL SUR
MICHAEL T & MARIE RUSSO
71 CALLE DEL SUR
PALM COAST FL 32137

RE: 73 & 75 CALLE DEL SUR
PRIVATE IDAHO
632 11TH ST
SANTA MONICA CA 90401 2904

RE: 77 CALLE DEL SUR
FLAGLER DEL SUR LLC
2758 DAWN RD
JACKSONVILLE FL 32207

RE: 81 CALLE DEL SUR
WATERFRONT LLC
19416 PRESIDENTIAL WAY
N MIAMI BEACH FL 33179

RE: 83 CALLE DEL SUR
DONALD & GLORIA GARDNER
83 CALLE DEL SUR
PALM COAST FL 32137

RE: 85 CALLE DEL SUR
KAREN B & CRAIG W MOORE
717 KENNINGTON TERRACE
LAKE FOREST IL 60045

RE: 87 CALLE DEL SUR
CHARLES H E & JUANITA VOGEL
26 ISLAND ESTATES PKWY
PALM COAST FL 32137

RE: 89 CALLE DEL SUR
JEFFREY J VORHOLT
13 VIA ROMA
PALM COAST FL 32137

RE: 91 CALLE DEL SUR
LAZZARA GASPER JR TRUSTEE
5000 SAWGRASS VILLAGE STE 28
PONTE VEDRA BEACH FL 32082

RE: 95 CALLE DEL SUR
MICHAEL & LISA HELLER
128 DOCKSIDE CIRCLE
WESTON FL 33327

RE: 97 CALLE DEL SUR
RICHARD PRESTON & L GROLL
4820 NW 128TH ST
MIAMI FL 33054

RE: 99 CALLE DEL SUR
GARY N & JESSICA M ACKERMAN
RONALD T & BARBARA ACKERMAN
55 ST JAMES DRIVE
PALM BEACH GARDENS FL 33418

RE: 101 CALLE DEL SUR
CRUZ EVARISTO G & ELAINE
28 WINCHESTER LN
HOLMDEL NJ 07733

RE : 103 CALLE DEL SUR
FRANK A TAYLOR TRUSTEE
44 N LAKEVIEW DR
PALM COAST FL 32137

RE: 105 CALLE DEL SUR
FISERV ISS & CO TRUSTEE
FBO ALAN MESSER & GRASMERE LLC
PO BOX 173859
DENVER CO 80217

RE: 107 CALLE DEL SUR
RICHASON THOMAS F & MARY ANN
107 CALLE SUR DEL S
PALM COAST FL 32137 1218

RE: 109 CALLE DEL SUR
PATEL ATUL & RESHMA PATEL
12949 HUNTLEY MANOR DRIVE
JACKSONVILLE FL 32224

RE: 111 CALLE DEL SUR
RICHARD W & CHARLOTTE A COLLIER
5500 GRASMERE DR
PLANO TX 75093

RE: 113 CALLE DEL SUR
RICHARD F & MICHAEL R DIETZ
185 AVENUE DE LA MER # 203
PALM COAST FL 32137

RE: 35 CALLE DEL SUR
GIBBS JUDITH L TRUSTEE
35 CALLE DEL SUR
PALM COAST FL 32137

RE: 3931 OCEANSHORE BLVD N
CALICO AMALGAMATED PROP LLC
284 SOUTH ISLAND
GOLDEN BEACH FL 33160

RE: 3919 OCEANSHORE BLVD N
WILSTA INVESTMENTS FLAGLER LLC
ATTN: KRISTY KING
1172 S. DIXIE HWY., #481
CORAL GABLES, FL 33146

RE: 3913 OCEANSHORE BLVD N
HARRIS D & SHARON P HOBBY
8070 INNSBRUCK DRIVE
ATLANTA GA 30350

RE : 3907 OCEANSHORE BLVD N
PCF 27 LLC C/O NATALIE MIRANDA
8428 PASEO VISTA DRIVE
LAS VEGAS NV 89128

RE: 3861 OCEANSHORE BLVD N
BROTHEN BRIAN R & JILL M
404 AVONDALE COURT
WINTER SPRINGS FL 32708

RE: 3855 OCEANSHORE BLVD N
PUVVADA VENKATAPATHI & MADHAVI KANTAMNENI
1163 MEADOWLOOK CT
RESTON VA 20194

RE: 3849 OCEANSHORE BLVD N
THOMPSON BLAKE
PO BOX 52
NASSAU DE 19969

RE: 3843 OCEANSHORE BLVD N
STEVEN R & DENISE E PARSON
6054 WINDING LAKE DR
JUPITER FL 33458

RE: 3837 OCEANSHORE BLVD N
PJR REALTY LLC
340 N 12TH STREET STE 203
PHILADELPHIA PA 19107

RE: 3835 OCEANSHORE BLVD N
ALPINE LLC
11390 TWELVE OAKS WAY STE 520
NORTH PALM BEACH FL 33408

RE: 3825 OCEANSHORE BLVD N
DAMODAR LLC
13830 SAXON LAKE DR
JACKSONVILLE FL 32225

RE: 3813 OCEANSHORE BLVD N
DUYCK CARL W & DENNIS J FLOOD
PO BOX 215
LEWES DE 11958

RE: 3765 OCEANSHORE BLVD N
LEVERTON ROGER F & MARILYN F
3765 NORTH OCEANSHORE
PALM COAST FL 32137

RE: 3759 OCEANSHORE BLVD N
CAROLYN BREWER &
GUILLERMO H DAVILA
2580 SE 8TH STREET
POMPANO BEACH FL 33062

RE: 3753 OCEANSHORE BLVD N
WILLIAM B SCHER JR &
C ELLEN MACNEIL
5201 PORTSMOUTH ROAD
BETHESDA MD 20816

RE: 3741 OCEANSHORE BLVD N
ROBERT & BARBARA J PAPE
1203 SALT CREEK ISLAND DRIVE
PONTE VEDRA BEACH FL 32082

RE: 3735 OCEANSHORE BLVD N
ALAN & RENE M CARDINALE
10095 MAIN ROAD
PO BOX 77
MATTITUCK NY 11952

RE: 3729 OCEANSHORE BLVD N
ROESEL PAUL F
2570 JONES MILL ROAD
STATESBORO GA 30461

RE: 3709 OCEANSHORE BLVD N
ERIC J BOHRER
7980 MAYTEN AVE APT 4004
RANCHO CA 91730

RE: 2617 OCEANSHORE BLVD N
CLASSIC 59 INVESTMENTS
7888 CATHERDDRAL DRIVE
NIAGRA FALLS, ON CANADA

RE: 2597 OCEANSHORE BLVD N
JOSEPH D & SARAH H JOHNSON
2597 OCEANSHORE BLVD N

SEA COLONY HOA INC
C/O SOUTHEAST MANAGEMENT
P.O. BOX 354734
PALM COAST FL 32135 4734

RE: N OCEANSHORE BLVD PROPERTY
MORRISON JEFFREY H
9560 BAY HILL DR
WARREN OH 44484

OCEANSIDE @ BEVERLY BEACH
CONDOMINIUM BLDG B
2455 OCEANSHORE BLVD N
FLAGLER BEACH FL 32136

RE: N HWY A1A PROPERTY
GLADSTONE A MYLES & MATTY J
315 KING FARM BLVD APT 402
ROCKVILLE MD 20854 2556

RE: 2811 OCEANSHORE BLVD S 5
CASS LARMORE CAROLYN
PO BOX 1289
FLAGLER BEACH FL 32136

RE: 2400S A1A
HILLIER LORETTA
2340 S OCEANSHORE BLVD
FLAGLER BEACH FL 32136

RE: 2408 S OCEANSHORE BLVD
LEE & LOIS FOSHAY
151 CENTER RD
DUDLEY MA 01571

RE: 41 CALLE DEL SUR
LINDEGREN LENNART S AND
ROBERTA T LINDEGREN H/W
41 CALLE DEL SUR
PALM COAST FL 32137

RE: 115 CALLE DEL SUR
ECKERT DAVID D
115 CALLE DEL SUR
PALM COAST FL 32137

RE: 7 AVE DE LA MER
PORTO MAR NEIGHBORHOODASSOC INC
C/O SOUTHERN STATES MGMT
7 FLORIDA PARK DR N STE C
PALM COAST FL 32137

RE: 3600 OCEANSHORE BLVD S
OCEAN PALM GOLF CLUB
PARTNERSHIP
3600 S CENTRAL AVE
FLAGLER BEACH FL 32136

RE: 28111 OCEANSHORE BLVD S 7
CLARK JOSEPH R
12 LAKE AVENUE
DELAND FL 32724

FLAGLER COUNTY HURRICANE AND STORM DAMAGE REDUCTION INTEGRATED DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT

FLAGLER COUNTY, FLORIDA

FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the Detailed Project Report (DPR) and Environmental Assessment (EA) of the Selected Plan and the Future Without Project (No Action Alternative) for the Flagler County Hurricane and Storm Damage Reduction Study, Flagler County. The Selected Plan includes reduction of damage from extreme storms and hurricanes through the shoreline protection measure of rebuilding a natural dune system that includes planting native dune-type vegetation. This Finding incorporates by reference all discussions and conclusions contained in the integrated EA enclosed hereto. Based on information analyzed in the EA, reflecting pertinent information obtained from other agencies and special interest groups having jurisdiction by law and/or special expertise, I conclude that the proposed action will have no significant impact on the quality of the human environment. Reasons for this conclusion are in summary:

a. The U.S. Army Corps of Engineers, Jacksonville District, (Corps) will take measures to minimize the effects to the threatened and endangered species including sea turtles. There will be no unauthorized impacts to other threatened and endangered species. The project will not jeopardize the continued existence of any federally listed species or adversely modify designated critical habitat.

b. I have determined that Selected Plan, as proposed, will have no adverse affect on significant historic properties. Coordination with the Florida State Historic Preservation Officer and appropriate federally recognized tribes has been initiated. As stated in the EA, use of the shoreline will have no effect on historic properties as none are located within the immediate footprint of the project area, and that the preferred alternative (Selected Plan) will have beneficial effects to those historic properties located immediately west of the project area. Furthermore, no historic properties would be affected by any of the project alternatives in the nearshore.

c. State water quality standards will be met. A Water Quality Certification (WQC) permit application will be submitted for issuance by the Florida Department of Environmental Protection (FDEP).

d. The Corps has determined that the proposed project is consistent with the Coastal Zone Management Act (CZMA). The final concurrence from the State will be issued with the FDEP permit.

e. Measures to eliminate, reduce below the level of significance, or avoid potential impacts to fish and wildlife resources will be implemented during project construction.

f. The proposed project has been evaluated pursuant to the Migratory Bird Treaty Act. The Jacksonville District's Migratory Bird Protection procedures will be implemented for this project and for future projects. These procedures have been coordinated with the U.S. Fish and Wildlife Service and the State of Florida.

g. Benefits to the public will include restored and improved natural habitat for protected species, fish and wildlife, restored aquatic ecosystem, and engagement by the local community.

h. Measures will be in place during construction to eliminate, reduce, or avoid adverse impacts below the threshold of significance to fish and wildlife resources include the following:

1. All dredge and placement activities will occur within the template of authorized and permitted areas;
2. All water based activities would follow standard sea turtle protections measures and the conditions of the NMFS SARBO, and
3. Dredged material placement would comply with the shoreline protection measures conditions of the USFWS SPBO.

In consideration of the information summarized, I find that the proposed action will not significantly affect the human environment and does not require an Environmental Impact Statement. This document will be available to the public on the U.S. Army Corps of Engineers Jacksonville District website at:

http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx#Flagler

_____
Date

_____
Alan M. Dodd
Colonel, U.S. Army
District Commander

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

Planning Division
Environmental Branch

To Whom It May Concern:

Pursuant to the National Environmental Policy Act and U.S. Army Corps of Engineers Regulation (33 CFR 230.11), this letter constitutes the Notice of Availability for the Flagler County, Florida Hurricane and Storm Damage Reduction Project Draft Integrated Feasibility Study and Environmental Assessment.

The draft document is available on the U.S. Army Corps of Engineers, Jacksonville District website for your review and comment at:

http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx#Flagler

For comments to be considered, they must be received within 30 days from the date of this letter unless additional review time is authorized by federal law. Letters should be addressed to the letterhead address, to the attention of the Planning Division, Environmental Branch, Coastal Section. If you have any questions or comments, please contact Ms. Kathleen McConnell by telephone at 904-232-3607, or by email at kathleen.k.mcconnell@usace.army.mil.

Sincerely,

Eric P. Summa
Chief, Environmental Branch

FLAGLER COUNTY, FLORIDA

HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FINAL INTEGRATED FEASIBILITY STUDY AND
ENVIRONMENTAL ASSESSMENT

Appendix G

Pertinent Correspondence



Appendix G
Pertinent Correspondence

FLAGLER COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FINAL INTEGRATED FEASIBILITY STUDY AND
ENVIRONMENTAL ASSESSMENT

Agency Review Comments

FLAGLER COUNTY, FLORIDA HURRICANE AND STORM DAMAGE REDUCTION PROJECT DRAFT INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT JANUARY 2014			
	Comments Provided by Department of Interior, Bureau of Ocean Energy Management (5 March 2014)		
#	**Page**	**Section**	**Specific Comment**
1	ES-2, Last Paragraph	Executive Summary	The first sentence of the last paragraph states that the sand borrow source is located 7 miles offshore, within Outer Continental Shelf (OCS) waters. Realizing that Under Section 8(k) of the Outer Continental Shelf Lands Act (OCSLA), BOEM has sole jurisdiction over these identified sand resources, recommend stating BOEM's role as a cooperating agency on this project as established via letter dated 23 February 2011. Stating BOEM's OCS resource management responsibility and cooperating status on this project up front in the Executive Summary will help establish the context of BOEM's role throughout the document.
SAJ Response:			The sentence "The Bureau of Ocean Energy Management (BOEM) has sole jurisdiction over the identified sand resources for this project under the Outer Continental Shelf Lands Act, and is a cooperating agency on this project." Has been added to the last paragraph on page ES-2.
2	ES-2, General	Executive Summary; General	Clarify whether the Cubic Yardage requirement identified in the Executive Summary and throughout the report is placed quantity or dredged quantity. In the context of BOEM's connected action through the issuance of the MOA, identifying the estimated dredged volume, including losses, is an important component of the NEPA analysis. Recommend distinguishing between dredged volume and placed volume in the Executive Summary and throughout the report.
SAJ Response:			Our cost estimate assumed 26% dredging losses from the borrow area. For the initial placement volume of 330,000 cy, the associated dredge volume is 415,800 cy. For the periodic nourishment placement volume of 320,000 cy, the associated dredge volume is 403,000 cy. Revisions will be made to distinguish between these volumes in the executive summary and throughout the report as appropriate (See new section 6.5).
3	ES-3, General	Executive Summary; General	The discussion of "coquina outcroppings" in the Executive Summary and throughout the report lacks context in some areas to help the reader understand why impacts will not occur. Recommend clarifying that, based on beach and nearshore hard bottom surveys,

			no "direct" burial of supratidal/onshore coquina outcroppings will occur as well as "indirect" burial to nearshore hard bottom features through transport processes both along shore and cross shore. This clarification helps to better classify the relative location of these features to the project area and is necessary to inform the EFH assessment as a component of MSFMCA compliance.
SAJ Response:			In the discussion of coquina outcroppings, the sentence, "Based on the beach and nearshore hardbottom surveys, neither direct burial of coquina outcroppings nor indirect burial to nearshore hard bottom features, through along shore and cross shore transport processes, will occur." Has been added to the on page ES-3.
4	ES-3, General	Executive Summary; General	The executive summary states that there are no known cultural resource issues in the placement or borrow area. However, on page F-38 there is clear indication of shipwreck debris in the side-scan sonar image within the nearshore, and on page F-37 the appendix suggests additional research and survey to assess the historical nature of the wreck. Clearly mapping and avoiding this area with respect to interrelated components of the dredging and placement action, such as potential pipeline corridors, pump out anchor points, etc., is necessary to assure that known sites are avoided. Additionally, appropriate surveys of the potential borrow area(s) have yet to be completed. Recommend that the executive summary more clearly state that additional surveys are still needing to be conducted to clear the borrow areas of potentially significant resources and that appropriate mitigative buffers would be included at the time to effectively avoid impacts.
SAJ Response:			The sentence that states "there are no known cultural resource issues…" has been revised to read, "There are currently no previously recorded cultural resources in the placement or borrow area. Additional cultural resource surveys still need to be conducted to clear the borrow areas and near shore of potentially significant resources and that appropriate buffers would be used at the time of construction to effectively avoid impacts."
5	1-5	1.3	Recommend stating the full scope of the study area including the offshore OCS sand resource. The full scope of the study area is necessary to effectively capture BOEM's purpose and need, to provide an MOA for use of sand resources within the OCS.
SAJ Response:			The following paragraph has been added to section 1.4 to clarify that the areas investigated for sand sourced, including OCS are part of the study area. "The study area includes the areas investigated for potential sand sources that could be used to implement storm damage reduction measures. These include upland sand mines and offshore borrow

			areas. Several of the offshore borrow areas investigated are partially or fully located in Outer Continental Shelf (OCS) waters, which is under the sole jurisdiction of The Bureau of Ocean Energy Management (BOEM)."
6	2-1	2.2	See previous comment. Recommend clarifying the location of these coquina outcroppings with respect to supratidal, intertidal, and subtidal environments (i.e. beach, swash, nearshore) to better inform the EFH analysis and the relative location of these resources to the proposed action.
SAJ Response:			Revised in report (Sect 2-2, pg 2-1): "The coquina rock is exposed in the supratidal area and in the intertidal zone at low tide along sections of the northern beaches between Florida Department of Environmental Protection (FDEP) Monuments R-3 and R-16. Another section of exposed outcrop is located between R-20 and R- 43. Other sections of rock are suspected to exist in the subtidal zone along the shoreline but are likely covered with sand (DEP, 1999)."
7	2-14	Figure 2-12	Clarify that a portion of borrow area 1 and all of borrow areas 2 and 3 are within the OCS and sole jurisdiction of BOEM relative to the state water line defined in the legend.
SAJ Response:			The text in section 2.2.5 has been revised to clarify that a portion of borrow area 1 and all of borrow areas 2 and 3 are within the OCS and sole jurisdiction of BOEM relative to the state water line defined in the legend.
8	2-28	2.4.1 and Appendix D (Section 1.2)	The document discussing the geology of the onshore "study area" well. However, realizing that the offshore borrow source is part of the study area, it is also important to characterize its geology and geomorphology to better inform the potential impact analysis and EFH assessment. Dredging of a relict sand shoal system with varying relief forms will have different impact characteristics compared to that of a sand sheet. Recommend including a discussion of the geomorphologic setting of the borrow source within Appendix D and incorporating relevant sections into the main report where appropriate.
SAJ Response:			The sentence "The investigated borrow areas include part of the Korona Ridge Field geomorphologic unit (Area 2) and part of the Flagler Sand Wave geomorphologic unit (Area 3)." has been added to section 2.4.1 of the main report. Appendix D also has been revised to include the description of the geomorphologic characteristics of the investigated sand sources.
9	2-29	2.4.3	NMFS requested that smalltooth sawfish be evaluated as a component of recent consultation for the recent Brevard County, FL project. Based on recent abundance and distribution studies, their presence in the borrow area is unlikely; however, recommend evaluating smalltooth sawfish distribution for this project to confirm whether additional

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			consultation is necessary. The current 1997 SARBO does not include smalltooth sawfish.
SAJ Response:			Text revised in Sect 2.4.3, pg 2-32: "Smalltooth sawfish are unlikely to be present in the nearshore along Flagler County shoreline based on recent abundance and distribution data, although historically, they have been known to occur in the Atlantic in the Everglades region of south Florida and the Gulf of Mexico (NMFS website August, 2013)." Text inserted pg 2-43: "The smalltooth sawfish (*Pristis pectinata*) is currently listed as endangered under the ESA by NMFS (50 CFR 224). In 2003, it was the first marine fish species in U.S. waters added to the ESA listing. Although smalltooth sawfish once ranged throughout U.S. coastal waters along the southeastern Atlantic and northern Gulf of Mexico, its known primary range is now reduced to the coastal waters near Everglades National Park and the Charlotte Harbor Estuary in extreme southern Florida (NMFS website August, 2013). Sightings are very rare. No designated critical habitat occurs along the Flagler County shoreline within the study area. Smalltooth sawfish typically inhabit shallow waters (depths up to 20 feet) near the mouths of rivers in estuarine lagoons over sandy or muddy substrates; likewise, they may also be found in deeper waters (greater than 50 feet) along continental shelf (NMFS Website August 2013). The current 1997 South Atlantic Regional Biological Opinion (SARBO) does not include smalltooth sawfish. Sawtooth sawfish are unlikely to be present in the nearshore along Flagler County shoreline."
10	2-30	2.4.3	Recommend this section be updated to include the NMFS proposed critical habitat designation published on 18 July 2013: https://www.federalregister.gov/articles/2013/07/18/2013-17204/endangered-and-threatened-species-designation-of-critical-habitat-for-the-northwest-atlantic-ocean.
SAJ Response:			Inserted text Sect 2.4.3 pg 2-32 (sea Turtle Nesting Habitat): "Currently, the NMFS has proposed designation of critical habitat for loggerhead turtles along the Florida coastline. The outcome of this designation is pending."
11	2-30	2.4.3	The second paragraph on page 2-30 notes that only the North Atlantic right whale and the Humpback whale have been sighted along coastal Flagler County. The North Atlantic Right whale is discussed on page 2-36; however, there is no discussion on the Humpback whale. Recommend including a discussion of humpback whales in the project vicinity to better analyze potential effects in section 7. Additionally, in section 2.4.3 manatees are excluded from discussion based on their habitat range being outside of the project area; however, Table7-1 notes that potential encounters can occur associated with dredge and support vessels. Recommend consistency throughout the report regarding the potential

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			risk of impacts to manatees based on all interrelated components of the proposed action.
SAJ Response:			Revised text to insert discussion of humpback whale starting on pg 2-40, (too long to include entire text here).
12	2-35	2.4.3	The discussion of nesting sea turtle distribution is good; however, recommend including a paragraph discussing known habitat use within the proposed offshore borrow areas. This discussion is necessary with respect to the dredging component of the action and the potential overlap with proposed critical habitat designation.
SAJ Response:			Revised text Sec 2.4.3 pg 2-33: "Sea turtles may also utilize the proposed borrow area offshore, although no survey data has been collected to assess this usage. The proposed loggerhead turtle critical habitat includes offshore Florida as potential breeding habitat, which could include the borrow area located 7 miles offshore (NMFS Website press release, July, 2013)."
13	2-40	2.4.3	This section needs to be updated to reflect the revised proposed listing as threatened (30 September 2013; http://www.fws.gov/northeast/redknot/pdf/ProposedRule_2013_22700.pdf). Additionally, proposed critical habitat is pending.
SAJ Response:			Revised text with insert on pg 2-43 "Red knot (*Caladris canutus* spp *rufus)* is proposed under the ESA as a candidate bird species by the northeast FWS Region 5 (FWS 2011). The current FWS species assessment and listing priority assignment (May 2011) states that the species wintering habitat range includes the eastern coastline of Florida where wintering red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks, as well as mangrove and brackish lagoons. Of these habitat types, only sandy beaches are found in Flagler County, which are moderately degraded. Although the most recent report of a red knot sighting was in 2007 at Gamble Rodgers Memorial State Recreation Area (eBirds database website 2013), the likelihood of red knot occurring on the beaches throughout Flagler County is very low."
14	2-40	2.4.4	This section only discusses hard bottom survey data conducted in the nearshore environment. Recommend including survey data from proposed offshore borrow areas and subsequent borrow area refinement based on documented hard bottom communities and associated avoidance buffers. This data is important to effectively evaluate EFH impacts associated with dredging of the borrow area and to communicate any avoidance measures integrated into the planning process.

SAJ Response:			A paragraph has been added to section 2.4.4 stating "A side scan survey was also performed the USACE Jacksonville District Hydrographic Survey Section for Borrow Areas 2A, 2B, and 2C. No targets of interest or hardbottom were found in any of the areas. There were sand waves and sand ridges apparent in all three areas. The report from this survey can be found in Appendix F."
15	2-46	2.4.4	Section 3.0 of the nearshore hard bottom survey conducted by DCA suggested that towed video and or diver groundtruth would be necessary to ground truth presumed HB and cultural resources. As described on page 2-46, SAJ subsequently completed an additional survey which did not include the recommended ground truth methodologies and documented no hard bottom present. Though the paragraph states that multibeam and towed video were proposed, the actual survey only included side scan. Recommend providing some clarifying details regarding the actual survey methodology and what the different DCA and Corps survey techniques were to better explain why one survey suggested hard bottom and another suggested no hard bottom. If the Corps sides scan was run with tighter spacing and different frequency, this should be clarified.
SAJ Response:			Revised text with insert 2.4.4, pg 2-49, paragraph 1: [The USACE survey originally was to include towed video] "However, due to weather conditions at time of survey, towed video data was unable to be collected." "The USACE 2012 survey data collection method included use of EdgeTech 4125 Side-scan sonar operating at 400 and 900 kHz. Comparatively, the Dial Cordy and Associates 2011 data was operated at 600 kHz."
16	2-60	2.4.8	The referenced Cultural resources survey suggests that surveys of the offshore borrow areas have been completed; however, statements later in the report suggest that surveys still need to be conducted of the borrow areas. Confirm whether surveys were conducted and correct the report accordingly.
SAJ Response:			Updated to state "No cultural resource surveys have yet to be conducted within the borrow areas and along the nearshore"…
17	2-61	2.4.8	As stated on page 2-61, cultural resources surveys of the proposed borrow areas are still pending. This is a significant data set that is lacking with respect to SHPO compliance and the associated borrow area refinement and selection process. If resources are identified as a result of this survey, proposed borrow areas and associated volumes could be reduced due to incorporation of avoidance buffers. Based on the documented volume of material needed to complete the project relative to the volume available within the recommended borrow area, there is limited contingency to accommodate buffer requirements. These data are necessary to clearly define the borrow area and associated

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			volume for incorporation into the BOEM/Corps MOA for use of OCS sand.
SAJ Response:			Section indicates that 2A, 2B, and 2C are to be surveyed. 1.7cy is just from 2A. See comment 25 for updated language to section 7-5 to clarify.
18	2-62	2.4.8	Recommend that the nearshore wreck identified on NOAA charts and subsequently documented by DCA and the Corps be accurately mapped based on recent survey data and incorporated into project plans as an avoidance area to minimize risk of anchoring and/or pipeline conveyance impacts associated with the dredge pump out activities.
SAJ Response:			Resource is not currently within area of proposed placement for selected plan. While the planned Cultural resource surveys will officially record the wreck it will not be placed on plans unless work is identified to occur near the resource. Appropriate buffering and language will be added to Plans and Specs as needed.
19	2-67	2.4.13	Recommend documenting that the borrow area has been cleared of any UXO risk.
SAJ Response:			We will coordinate with our FUDS group to see if there would be any reason to expect UXOs in the borrow area.
20	6-12	6.7	Understanding that more refined vibracore and survey data will occur during PED, recommend incorporating an additional discussion on the proposed borrow area use plan based on the available data. For example, the geotechnical appendix documents ranges of dredging depths based on the compatibility analyses conducted to date. Incorporating the ranges of potential dredging depths, the post dredging sediment types, etc. will help specifically inform the EFH analysis as well as other physical and biological effects.
SAJ Response:			A new section, now 6.5, has been added to more fully describe the borrow area based on available data and the proposed use plan. The map of the borrow areas and table showing quantities has been moved into this section along with a written description of the borrow areas to be used for the TSP, how they will be used, and the difference between placement volume and dredged volume.
21	7-3	Table 7.1	Hard bottom resources: This discussion is not consistent with the survey results presented in Appendix F. Confirm that all of the proposed borrow area 2A has been sufficiently surveyed and all hard bottom resources avoided. Recommend consistently documenting throughout the report what has or has not been completed.
SAJ Response:			Revised HB Resources of Table 7-1: Alternatives "No hardbottom resources are known to be present within or adjacent to the project limits or borrow area based on project-specific surveys. Resources that may exist outside of the project or borrow area will be

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			avoided. No effects are expected to occur." No Action: "No impacts would occur. Known hardbottom resources occur within the study area but do not occur within the borrow area or project limits."
22	7-4	Table 7.1	Essential Fish Habitat: See previous comment. Also, a discussion of the geomorphology of the identified sediment resource is recommended. Understanding the geomorphology of the sand resource is important to inform the EFH assessment relative to physical and biological recovery.
SAJ Response:			Revised EFH of Table 7-1: Short-term turbidity would be present at the borrow area. No hardbottom resources were identified to be present in the borrow area during the subsurface resource survey. No placement of material will occur in the nearshore. No impact would occur to this resource.
23	7-5	Table 7.1	Historic and Cultural Resources: No survey for submerged cultural resources has been conducted in the proposed borrow area. These data could reduce the total volume available within 2A. Realizing that the total available within 2A is 1.7 MCY and the project calls for 1.6 MCY, there is little contingency.
SAJ Response:			Table now has added text:"May require use of borrow area 2 B to meet sand volume needs". 7.15.13 added text "While currently borrow area 2A is the main source, if is volume removed because of the identification of resources within the proposed borrow area then additional borrow sources can be looked at with 2B."
24	7-7	7.1.2	As discussed in previous comments, recommend discussing the details of the DCA and USACE hard bottom survey methodologies to support the difference in findings (i.e. line spacing, KHZ used, etc.).
SAJ Response:			Revised text Sect 7.1.2, pg 7-7 with insert:"Methods employed for the DCA survey differed from those employed by USACE Hydrographic survey as described in Section 2.4.4, and may account for the contrasting results." Last sentence: "Details of the two surveys, including details of methods and findings, are included in the **Environmental Appendix F**."

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25	7-7	7.1.2	Recommend clarifying that additional surveys will be completed of the pipeline corridor and any associated pump out locations prior to construction to assure avoidance of hard bottom and cultural resources.
SAJ Response:			Text added "Prior to construction additional surveys may be required to assess the most current conditions to assure avoidance of hardbottom and culture resources. Such surveys will be performed as needed to address any changes in conditions or to complete any work as previous identified in the study."
26	7-8	7.3.1	Recommend including a discussion on the red knot as appropriate (see comment 13)
SAJ Response:			Revised text with insertion of Section 7.3.1.4: "The Preferred Alternative may affect, but is not likely to adversely affect the wintering piping plover population in Flagler County. The most recent sighting of a Red Knot on a Flagler County Beach was in 2007 at the Gamble Rodgers Memorial State Recreation Area. The degraded beach habitat quality within the project limits would prohibit use by Red Knot."
27	7-11	7.6	As discussed in previous comments, a discussion of the geomorphologic setting of the proposed borrow area would help better inform the physical and biological impact analysis associated with dredging of the habitat features.
SAJ Response:			Revised text in Section 7.6.1, pg 7-12, with insert: "Borrow areas that include part of the Korona Ridge Field geomorphologic unit (Area 2) and part of the Flagler Sand Wave geomorphologic unit (Area 3) would be affected by material excavation. These areas rely on currents to form mounds which are gradually deposited over time. Removal or the upper portion of the ridge would have minimal impact as the removal of material is conservatively estimated over the expanse of the shoal's upper portion that is approximately 7,500 ft long by 2,500 ft wide."
28	7-12	7.6.1	As discussed in previous comments, a discussion of the proposed borrow area use plan based on the current geotechnical data set would better inform the analysis of benthic recovery.
SAJ Response:			See comment above regarding discussion of the borrow area use. Revised text to include the text (on same page): "Benthic organisms are expected to recover and inhabit the substrate within the borrow areas over time."
29	7-13	7.10	Recommend including more recent references in the noise discussion. BOEM has contributed to recent studies on dredging noise in collaboration with ERDC and can provide recent relevant literature and recommend additional language upon request.

SAJ Response:			Unless there is some important aspect of information regarding noise that was overlooked, there is little justification to rewrite this section although newer references are available. If BOEM has a particular item that needs clarification, please provide it.
30	7-16	7.15.1.1	References to Appendix C need to be changed as Appendix C does not exist as a part of the report package. Recommend including Cultural resource survey as a separate attachment.
SAJ Response:			Cultural Resource Surveys will not be added as large portions of the survey would be not be available due to issues concerning the reporting of known resources. Appendix C is part of the report package and is the Economics Appendix.
31	7-16	7.15.1.3	Completion of cultural resource surveys will be required prior to initiating construction as will be outlined in the MOA. Currently, the total volume available vs. needed does not allow much room to incorporate any buffers.
SAJ Response:			See response to comment 24. Also it is acknowledged that surveys will be needed to be completed prior to completion of the MOA. Also note the 1.7 MCY is for the 50 Year period. It is unlikely that all 1.7 will be needed for first placement. This will allow for buffering as needed.
32	8-2	8.3	Recommend including a discussion of the Outer Continental Shelf Lands Act (OCSLA) and associated coordination requirements with BOEM.
SAJ Response:			A new section has been added, now 8.3.1, to discuss the OCSLA and associated coordination requirements using the provided text from comment # 43.
33	8-2	8.3.1	As previously discussed, recommend including a statement in the reference to the SARBO that clarifies BOEM's proposed action being covered under.
SAJ Response:			A sentence has been added to the end of section 8.3.2 (formerly 8.3.1) to clarify that the SARBO covers BOEM's proposed action.
34	8-3	8.3.2	As established in the cooperating agency letters, recommend clarifying BOEM's role in the EFH consultation.
SAJ Response:			A sentence has been added to section 8.3.4 (formerly 8.3.3) to clarify that as a cooperating agency, BOEM will have a participating role in the EFH consultation.
35	4	Appendix D; 1.2	Recommend including a discussion of offshore geology and geomorphology and incorporate relevant text into appropriate sections of the main report.

SAJ Response:			Appendix D and section 2.4.1 of the main report have been revised to include the description of the geomorphologic characteristics of the investigated sand sources.
36	9	Appendix D; Section 3.2, Table 3	Recommend incorporating references to the maximum depth of cuts into appropriate sections of the main report.
SAJ Response:			Appendix D and new section 6.5 of the main report have been revised to clarify the cut depths associated with the proposed borrow areas.
37	15	4.2.1	Clearly defining the dredged volume relative to the placement volume is important as the actual dredged volume is what will be included in the MOA. Recommend clarifying whether overfill and renourishment factors were considered in the total volume estimate and confirming that the dredged volume and placed volume are consistently reported throughout the report and appendices.
SAJ Response:			Revisions will be made to distinguish between these volumes in the executive summary and throughout the report as appropriate (See new section 6.5).
38	General		As a consequence of the integrated structure of the document, there are inconsistencies regarding which borrow areas are going to be utilized for this project. It seems to indicate that primarily Borrow Areas 2A, 2B, and 2C are going to be utilized, but in certain locations it mentions Borrow Area 3 and 3A will be utilized. In Appendix F (p. F-2) under Source of Material, Area 3 is discussed, but survey data is for Area 2, and no survey has been conducted of Area 3. Recommend clearly discussing the borrow areas that were considered from a formulation standpoint relative to those that were identified for use to meet the needs of the project. Clearly defining the borrow areas to be dredged is the basis of the NEPA analysis, the supporting surveys to define the level of potential impacts, and the quantity of OCS material defined in the pending MOA.
SAJ Response:			A new section, now 6.5, has been added to more fully describe the borrow area based on available data and the proposed use plan. The map of the borrow areas and table showing quantities has been moved into this section along with a written description of the borrow areas to be used for the TSP and how they will be used. This should help clarify between the areas studied and those planned to be used for the recommended plan.
39	App F		The identified Boat Wreckage coordinates should be redacted from the table until the wreck can be assessed and evaluated as being eligible for listing on the National Register of Historic Places. Recommend that the Florida SHPO should be notified of the discovery and NHPA Section 106 consultation should be initiated.

SAJ Response:			Coordinates have been blackout. Consultation and coordination will occur prior to PED phase. As stated in previous comment #24, the resource will be recorded with the state after the appropriate survey has been conducted. Currently the resource is outside the project area and thus no longer part of this undertaking at this time. Consultation is ongoing though and once surveyed, consultation will occur.
40	App F		The remote-sensing surveys that have been performed only consist of side-scan sonar in the borrow areas. BOEM usually requires that side-scan sonar, magnetometer and sub-bottom profiler data be collected according to our specifications and then reviewed by a qualified marine archaeologist meeting the Secretary of the Interior's Professional Qualifications. Compliance with these requirements is especially important within the proposed borrow area(s) prior to construction and for the near-shore area where the ship wreckage is found. Information on the existing ship wreckage (and potential sites identified in future surveys) from the more robust data set could provide additional information as to the type and age of the vessel, as well as the extent of the vessel remains. This will be critical for decisions related to buffer areas around the site to avoid affecting the potential historic property during beach renourishment.
SAJ Response:			Survey will be performed prior to PED. Corps standards for underwater survey will meet or exceed BOEM's requirements.
41	General		The cultural resource assessment of the near-shore environment and the offshore borrow areas should also discuss the potential for the presence of buried and submerged paleolandforms utilizing the data collected from the integrated remote-sensing survey (sss, mag, and sub-bottom profiler) as well as any relevant data from cores.
SAJ Response:			Concur. Survey performed prior to PED will address these issues. District requirement also include use of three types of equipment.
42	General		As discussed in previous comments, the discussion of the differences between the SSS surveys conducted by the contractor and the ACOE (pp. 2-46 through 2-48) lacks clarity both in the methodology utilized for both projects, as well as in the imagery used as examples in the report. The length of time between the two surveys and the amount of noise exhibited in the SSS imagery is problematic in reaching definitive conclusions about hard-bottom presence or absence, especially since the contractor and the ACOE reached very different conclusions from the survey data.

SAJ Response:			Revisions were made in Chapters 2 and 7 of the report to clarify the discrepancy. The revisions focus on the methods used to gain the data.
43	General		On 28 January 2010 the USACE Jacksonville District sent a letter requesting that BOEM (previously BOEMRE) participate as a cooperating agency in the preparation of the NEPA document for this project. Having jurisdiction over mineral leasing in the OCS, BOEM agreed to serve as a cooperating agency on the study via letter dated 23 February 2011. As stated in the letter, BOEM agreed to participate in required consultations (i.e. ESA, MSFCMA, NHPA, and CZMA). BOEM requested that the Corps state BOEM's cooperating role where the Corps is serving as the lead Federal agency to assure coverage for BOEM's action. Additionally, where existing biological opinions are being applied for this project (i.e. SARBO), BOEM requested that the Corps, as lead agency, ensure applicability to BOEM's action. The current Draft integrated document only discusses BOEM's involvement in Sections 6.8 (LERRD Considerations) and 9.1 (Draft Items of Local Cooperation). Recommend that additional text be included to clarify BOEM's Cooperating Agency status as established in the 23 February 2011 letter. Additionally, recommend adding additional language in the proposed action section that clarifies BOEM's proposed action to issue a negotiated agreement pursuant to its authority under the Outer Continental Shelf Lands Act. Request that if BOEM's cooperating role and connected action was not established in the consultation letters (i.e. ESA, EFH, NHPA, etc.), that follow-up coordination occurs with each agency to clarify. Recommended language may include the following: **Under Section 8(k) of the Outer Continental Shelf Lands Act (OCSLA), dredging of sediment resources within the OCS requires authorization by the Bureau of Ocean Energy Management (BOEM) for use during initial or maintenance construction or both. The BOEM Leasing Division is charged with environmentally responsible management of federal OCS sand and gravel resources. P.L. 102-426 [43 United States Code (U.S.C.) 1337(k)(2)], enacted October 31, 1994, gave BOEM the authority to negotiate, on a noncompetitive basis, the rights to OCS sand, gravel, and shell resources for CSDR projects; beach or wetlands restoration projects; or for use in construction projects funded in whole or part by or authorized by the federal government. Recognizing that identified borrow areas are within the OCS, BOEM has agreed to serve as a cooperating federal agency on this study and may**

			undertake a connected action (i.e. authorize use of the OCS borrow area) that is related to, but unique from the Corps' proposed action. BOEM's proposed action is to issue a negotiated agreement pursuant to its authority under the OCSLA.
SAJ Response:			The recommended language has been added to the new section 6.5.
44	General		Recommend including a summary table that documents all areas of concern relative to each resource category and the associated mitigation measures that will be implemented to avoid and/or minimize impacts.
EDITORIAL COMMENTS			
1	2-29	2.4.3	Recommend clarifying Federally listed species to distinguish from state-listed species.
SAJ Response:			All listed species are referenced as Federal listed under ESA. There are no state listed species included.
2	2-30	2.4.3, second paragraph	Cetacean common names should be lower case with the exception of proper nouns in the name (i.e., North Atlantic). Change to "sei whale, fin whale, humpback whale, sperm whale" and elsewhere in the document
SAJ Response:			Edits made
3	2-30	2.4.3, second paragraph	Once Balaenoptera has been spelled out, it is appropriate to shorten it to B. in subsequent uses. Also, the appropriate scientific name for the sperm whale is Physeter macrocephauls. Species name catadon is outdated.
SAJ Response:			Edits made
4	2-30	2.4.3	Sea Turtle Nesting Habitat paragraph: The scientific names for these sea turtle species were given previously (pg 2-29). They do not need to be listed again here. Suggest removing.
SAJ Response:			Leaving scientific names in both sections for clarity.
5	2-32	2.4.3	Last paragraph on this page, first two sentences of that paragraph: References to the South Atlantic Ocean DPS are incorrect. The relevant DPS for this area is the Northwest Atlantic DPS. The South Atlantic Ocean DPS occurs south of the equator; it does not include the southern portion of the North Atlantic Ocean.

SAJ Response:			Edit made
6	2-36	2.4.3	North Atlantic right whale section, second sentence: Recommend replacing "Wikipedia" citation with the primary literature.
SAJ Response:			Reference replaced
7	2-37	2.4.3	Second paragraph on this page: Recommend clarifying that critical habitat is designated pursuant to the ESA.
SAJ Response:			Edit made so that the sentence now reads "This usage is based upon key habitat criteria for wintering and calving, which lead to a "Critical Habitat" designation by NMFS, designated pursuant to the ESA."
8	2-37	2.4.3	Third paragraph on this page: This paragraph appears to be outdated. Recommend updating with latest recovery plan.
SAJ Response:			Latest recovery plan published in June 2013. Revision made accordingly.
9	2-51	Demersal Soft Bottom	Check the plural form for mentioned fish species.
SAJ Response:			Will Check
10	2-52	Coastal Pelagic	See comment above.
SAJ Response:			Will Check
11	2-53	Demersal Hard bottom	See comment above.
SAJ Response:			Will Check
12	2-68	Native Americans	Recommend including a summary of which tribes inhabited the area.
SAJ Response:			No portion of the TSP area is near the midden in question. The Corps has also consulted with appropriate federally recognized tribes regarding its shoreline survey work. If work is conducted in this are the consultation will be updated to address any concerns

			regarding this archaeological site.
13	3-1	3.1 and Global	New IPCC report may be available by publication of this EA – consider referring to it (or specifying that, as of time of preparation, 2007 IPCC report was most current).
SAJ Response:			Edit will be made if a new version of the report comes out prior to publication of this EA.
14	3-23	3.6	Where "no impacts will occur", substitute, "no *reasonably foreseen* impacts will occur." Recommend global application.
SAJ Response:			Edits made
15	4-2	4.1	BOEMRE to BOEM - remove **R**egulation and **E**nforcement for all BOEM references
SAJ Response:			Edit made

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

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HERSCHEL T. VINYARD JR.
SECRETARY

March 24, 2014

Ms. Kathleen K. McConnell
Jacksonville District, Environmental Branch
U.S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, FL 32232-0019

RE: Department of the Army, Jacksonville District Corps of Engineers – Draft Integrated Feasibility Study and Environmental Assessment (IFS/EA), Flagler County Hurricane and Storm Damage Reduction Project – Flagler County, Florida.
SAI # FL201401236812C

Dear Ms. McConnell:

The Florida State Clearinghouse has coordinated the state's review of the Draft IFS/EA under the following authorities: Presidential Executive Order 12372; Section 403.061(42), *Florida Statutes*; the Coastal Zone Management Act (16 U.S.C. §§ 1451 *et seq.*, as amended); and the National Environmental Policy Act (42 U.S.C. §§ 4321-4347, as amended).

The Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission and Florida Department of Transportation submitted comments, concerns and recommendations regarding the Draft IFS/EA in the attached memorandum, letter and Clearinghouse database report, which are incorporated herein by this reference and made an integral part of this letter.

Based on the information contained in the Draft IFS/EA and the enclosed state agency comments, the state has determined that, at this stage, the proposed federal activities are consistent with the Florida Coastal Management Program (FCMP). To ensure the project's continued consistency with the FCMP, the concerns identified by our reviewing agencies must be addressed prior to project implementation. The state's continued concurrence will be based on the activities' compliance with FCMP authorities, including federal and state monitoring of the activities to ensure their continued conformance, and the adequate resolution of issues identified during this and subsequent regulatory reviews. The state's final concurrence of the project's consistency with the FCMP will be determined during the environmental permitting process, in accordance with Section 373.428, *Florida Statutes*.

Ms. Kathleen K. McConnell
SAI # FL201401236812C
Page 2 of 2
March 24, 2014

Thank you for the opportunity to review the draft document. Should you have any questions regarding this letter, please don't hesitate to contact me at Lauren.Milligan@dep.state.fl.us or (850) 245-2170.

Yours sincerely,

Lauren P. Milligan

Lauren P. Milligan, Coordinator
Florida State Clearinghouse
Office of Intergovernmental Programs

Enclosures

ec: Roxane Dow, DEP BMESP
Scott Sanders, FWC
Martin Markovich, FDOT



Florida
Department of Environmental Protection
"More Protection, Less Process"



Project Information	
Project:	FL201401236812C
Comments Due:	03/04/2014
Letter Due:	03/24/2014
Description:	DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT CORPS OF ENGINEERS - DRAFT INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT, FLAGLER COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT - FLAGLER COUNTY, FLORIDA.
Keywords:	ACOE - DIFS/EA, FLAGLER COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT
CFDA #:	12.101

Agency Comments:

FISH and WILDLIFE COMMISSION - FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

The FWC advises that a number of state and federally listed species - Florida manatee, North Atlantic right whale, marine turtles and least tern - may occur within or adjacent to the proposed project site. Because the project could adversely affect these species, FWC requests that the following information be included in the final IFS/EA or applications for state permits: construction access points and equipment travel corridors; and type of dredge equipment, actions taken to avoid or minimize take of marine turtles and any potential use of chase/relocation trawling. As additional information is developed or becomes available, the FWC may have additional comments regarding appropriate conservation measures. Please contact Ms. Kristen Nelson Sella at (850) 922-4330 or Kristen.Sella@MyFWC.com for further information and assistance.

ST. JOHNS RIVER WMD - ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

SJRWMD does not have any comments.

ENVIRONMENTAL PROTECTION - FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Staff of the DEP's Division of Water Resource Management has reviewed the Draft IFS/EA for the Flagler County project. The preferred alternative is consistent with the Strategic Beach Management Plan and staff generally agrees with the decisions currently documented. We concur that the Draft IFS/EA is consistent with our statutory authorities at this stage. There is a question on the assumption that there will be a 90% recovery of the berm after every storm. Is this reasonable to assume for high frequency events as well as extreme events? The state's final coastal zone consistency finding will occur at the completion of the engineering and design phase when the items needed to complete the state's permitting of the project are available. These items include: 1. Design level geotechnical data and analysis to confirm that the proposed sediments are beach-compatible within the final borrow area configuration. 2. A detailed review of the model setup and calibration used to determine the exact design of the construction profile. 3. Physical monitoring of the project needed to assess project performance. We appreciate the efforts of the U.S. Army Corps of Engineers to address this erosion problem, and look forward to working with them to construct the project.

STATE - FLORIDA DEPARTMENT OF STATE

No Comments Received

NE FLORIDA RPC - NORTHEAST FLORIDA REGIONAL PLANNING COUNCIL

The Northeast Florida Regional Council has no comments at this time.

FLAGLER -

No Comments

TRANSPORTATION - FLORIDA DEPARTMENT OF TRANSPORTATION

FDOT District Five staff reports that the agency supports the recommendations included in the Draft IFS/EA. Mr. Alan Hyman, Director of Transportation Operations, has been working with the USACE and Flagler County represetative, Faith Alkhatib, on the project and the FDOT will be contributing funding towards the study. For further information or comments concerning the FDOT's involvement, please contact Mr. Hyman at alan.hyman@dot.state.fl.us or (386) 943-5477.

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

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RICK SCOTT
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HERSCHEL T. VINYARD JR.
SECRETARY

MEMORANDUM

TO: Lauren Milligan, Florida State Clearinghouse
Office of Intergovernmental Programs

FROM: Roxane Dow, Beaches, Mines and ERP Support Section
Division of Water Resource Management

SUBJECT: Flagler County Hurricane and Storm Damage Reduction Project
SAI # FL201401236812C

DATE: March 19, 2014

Staff of the Division of Water Resource Management has reviewed the Draft Integrated Feasibility Study and Environmental Assessment (IFS/EA) for the Flagler County project. The preferred alternative is consistent with the Strategic Beach Management Plan and staff generally agrees with the decisions currently documented. We concur that the Draft IFS/EA is consistent with our statutory authorities at this stage.

There is a question on the assumption that there will be a 90% recovery of the berm after every storm. Is this reasonable to assume for high frequency events as well as extreme events?

The state's final coastal zone consistency finding will occur at the completion of the engineering and design phase when the items needed to complete the state's permitting of the project are available. These items include:

1. Design level geotechnical data and analysis to confirm that the proposed sediments are beach-compatible within the final borrow area configuration.
2. A detailed review of the model setup and calibration used to determine the exact design of the construction profile.
3. Physical monitoring of the project needed to assess project performance.

We appreciate the efforts of the U.S. Army Corps of Engineers to address this erosion problem, and look forward to working with them to construct the project.

Thank you for the opportunity to comment.

cc: Danielle Irwin, Marty Seeling, Tom Jacobs, Lainie Edwards

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March 12, 2014

Ms. Lauren P. Milligan
Department of Environmental Protection
Florida State Clearinghouse
3900 Commonwealth Boulevard, M.S. 47
Tallahassee, FL 32399-3000
Lauren.Milligan@dep.state.fl.us

RE: SAI # FL201401236812C, Jacksonville District Corps of Engineers, Draft Integrated Feasibility Study and Environmental Assessment (DIFS/EA), for Flagler County, Florida, Hurricane and Storm Damage Reduction Project, Flagler County, Florida.

Dear Ms. Milligan:

The Florida Fish and Wildlife Conservation Commission (FWC), Imperiled Species Management Section, has coordinated our agency's review of the Draft Integrated Feasibility Study and Environmental Assessment (IFS/EA) for hurricane and storm damage reduction along the Atlantic Ocean shoreline of Flagler County, Florida. We are providing the following input under the National Environmental Policy Act, the Fish and Wildlife Coordination Act, and the Coastal Zone Management Act/Florida Coastal Management Program (CZMA/FCMP).

Project Description and Location

The selected plan consists of a ten foot dune extension including a 10 ft sacrificial berm in Reach C between FDEP monuments R80 and R94 in central Flagler Beach. The selected plan covers 2.6 linear miles of shoreline and mainly prevents damage to SR-A1A.

Construction of the selected plan will use a sand borrow source located seven miles offshore of the project site in Federal waters. The project will most likely be constructed with a hydraulic dredge typically used for beach nourishment projects (bulldozers, dump trucks, etc.) Each nourishment event, including initial construction, will require approximately 330,000 cubic yards of sand. The renourishment interval is expected to be approximately 11 years, equaling 4 renourishment events in addition to initial construction over the 50 year period of Federal participation.

Potentially Affected Resources

The following state and federally listed species may occur within or adjacent to the proposed project location (see Table 1 below). These species are protected under federal law, as the State of Florida has adopted the federal status of these species, or are listed under state law in accordance with Chapter 67A-27, Florida Administrative Code.

Table 1. Potentially Affected Resources

Scientific Name	Common Name	Status*
Trichechus manatus latirostris	Florida manatee	FE
Eubalaena glacialis	North Atlantic Right Whale	FE
Caretta caretta	Loggerhead sea turtle	FT
Chelonia mydas	Green sea turtle	FE
Dermochelys coriacea	Leatherback sea turtle	FE
Lepidochelys kempii	Kemp's ridley sea turtle	FE
Eretmochelys imbricata	Hawksbill sea turtle	FE
Sternula antillarum	Least tern	ST

*FE - Federally Endangered; FT - Federally Threatened; ST – State Threatened.

Potential Effects and Recommendations

The proposed project could adversely affect the species listed above; however, the potential adverse impacts associated with this work should be adequately offset with appropriate conservation measures. Fish and wildlife protective measures that would likely be applicable for this project are described in **Attachment 1**: *FWC Recommended Fish and Wildlife Species Protective Measures Flagler County, Florida, Hurricane and Storm Damage Reduction Project (March 12, 2014).* We recommend that these measures be incorporated into these documents as conservation measures and followed for all in-water and beach activity. Brief descriptions of potential effects are provided below.

Florida manatee: The Florida manatee (*Trichechus manatus latirostris*) may inhabit the waters of Flagler County, including coastal areas. Several manatee carcasses have been recovered along the ocean shoreline. In-water work in manatee habitat poses potential risk to manatees, including injuries from dredging equipment as well as vessels used during the project.

Sea turtles: The coastal waters of Flagler County provide important foraging and migratory habitat for the loggerhead (*Caretta caretta*), green (*Chelonia mydas*), Kemp's ridley (*Lepidochelys kempii*) and leatherback (*Dermochelys coriacea*) sea turtles and occasionally the hawksbill sea turtle (*Eretmochelys imbricata*). During the period of May 1 through October 31, Flagler County beaches support vital nesting habitat essential for the recovery of the loggerhead sea turtle and less frequently green and leatherback sea turtles.

Beach construction activities can disturb nesting females if the project occurs during the nesting season, and the placement of sand may physically alter nesting habitat. In addition, increases in artificial lighting due to construction activities and the creation of

an elevated beach berm can expose hatchlings and nesting females to lights that were not visible prior to the project and can increase the occurrence of disorientations which are often fatal.

Incidental take of sea turtles including the relocation of nests due to the proposed project must be authorized via the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions and Incidental Take Authorization as appropriate. In accordance with Florida Statute 379.2431 (1), the FWC provides recommendations regarding the nature, timing, and sequence of the project to ensure the protection of sea turtles.

North Atlantic Right Whale: The proposed vessel operations for offshore dredging activities may affect the North Atlantic right whale (*Eubalaena glacialis)* as vessels travel through right whale critical habitat. The National Marine Fisheries Service (NMFS) has implemented both regulatory and non-regulatory conservation efforts, including the establishment of a Seasonal Management Area (SMA) with mandatory vessel speed restrictions as well as other conservation measures. Some of the activity associated with this project is proposed within the southeast SMA along the coast of Flagler County.

Seabird, shorebird and migratory birds: A variety of birds consistently use the intertidal zones along the Atlantic Coast waters and connecting waterways and adjacent mid-beach habitat within the project area.

Least terns (*Sternula antillarum*) as well as many other migratory species occur within the project area. Beach nourishment and associated construction activity in proximity to shorebird nests or nesting areas can interfere with ongoing or potential breeding activity, including mortality of eggs, chicks, and fledglings due to disturbance from heavy equipment and construction; therefore, measures are needed to protect them during sand placement. Continued nesting by shorebirds on the wider nourished berm could create a sink for reproductive effort unless all nesting areas are identified and protected. Migratory birds using the area are also protected by state and federal laws.

Additional Information Needed

Inclusion of the information requested below in the final Environmental Assessment (EA) or applications for state permits will facilitate our review of the project and result in a more efficient permitting process. Therefore, we recommend that the following information be included in the EA or applications for state permits:

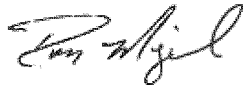
a) Identify any potential construction access points, equipment travel corridors and pipeline corridors (including upland areas) that may be used during the project. These corridors may impact resources not previously identified that will need to be included in the final EA.

b) Indicate what type of dredge equipment may be used and actions that will be taken to avoid or minimize take of sea turtles (e.g., construction windows), and if the applicant proposes to conduct chase/relocation trawling.

Summary

We find this proposal consistent with our authorities under Florida's Coastal Zone Management Program. As additional project information is developed or becomes available, the FWC may have additional comments regarding appropriate conservation measures. Because details and adequate offsetting measures are still forthcoming, FWC's final recommendations and CZMA consistency determination will be provided during the environmental permitting process. However, if the applicant incorporates the above recommendations, it would facilitate our review of the project and accelerate future permitting process. If your staff has any specific questions regarding our comments in this letter, I encourage them to contact Kristen Nelson Sella at (850) 922-4330 or Kristen.Sella@myfwc.com.

Sincerely,



for

Carol Knox, Section Leader
Imperiled Species Management Section

ck/kns

Flagler County Hurricane and Storm Damage Reduction_18627

Attachments: Attachment 1: March 12, 2013 *FWC Recommended Fish and Wildlife Species Protective Measures Walton County, Florida, Hurricane and Storm Damage Reduction Project*

Attachment 1:
FWC Recommended Fish and Wildlife Species Protective Measures
Flagler County, Florida, Hurricane and Storm Damage Reduction Project
(March 12, 2014).

The following recommendations are made by the Florida Fish and Wildlife Conservation Commission (FWC) for the protection of manatees, whales, seabirds, shorebirds and sea turtles and to ensure consistency with the Florida Coastal Zone Management Act and specifically with Florida Statute 379.2431 (1) and (2) and Florida Administrative Code 68A- 1.002, - 4.001, - 16.001 and 68A-27 (rules relating to endangered or threatened species).

1. The National Marine Fisheries Service's 2006 Sea Turtle and Smalltooth Sawfish Construction Conditions shall be followed for all in-water activity. In addition to guidelines outlined by NMFS, any collision with and/or injury to a sea turtle should also be reported immediately to the Sea Turtle Stranding and Salvage Network (STSSN) at 1-888-404-FWCC (3922).

2. To avoid impacts to manatees during nearshore placement, the 2011 Standard Manatee Construction Conditions for In-water Work shall be followed.

3. ***Hopper Dredging.*** In the event a hopper dredge is utilized, the following requirements shall be met in addition to the Terms and Conditions of the applicable NMFS SARBO (25 August, 1995; Revision 29 October, 1997).

a. Handling of captured sea turtles shall be conducted only by persons with prior experience and training in these activities and who is duly authorized to conduct such activities through a valid Marine Turtle Permit issued by the Florida Fish and Wildlife Conservation Commission (FWC), pursuant to Florida Administrative Code (FAC) 68E-1.

b. Standard operating procedure shall be that dredging pumps shall be disengaged by the operator, or the draghead bypass value shall be open and in use when the dragheads are not firmly on the bottom, to minimize impingement or entrainment of sea turtles within the water column. This precaution is especially important during the cleanup phase of dredging operations.

c. A state-of-the-art rigid deflector draghead must be used on all hopper dredges at all times of the year.

d. The Sea Turtle Stranding and Salvage Network (STSSN) Coordinator shall be notified at 1-904-573-3930 or via e-mail at Allen.Foley@myfwc.com of the start-up and completion of hopper dredging operations. In the event of capturing or recovering sea turtles or sea turtle parts, the STSSN should be contacted at seaturtlestranding@myfwc.com.

e. Relocation trawling or non-capture trawling shall be implemented in accordance with the applicable NMFS Biological Opinion and Incidental Take authorization. Any

activity involving the use of nets to harass and/or to capture and handle sea turtles in Florida waters requires a Marine Turtle Permit from FWC.

i. The permittee or their contractor shall e-mail (MTP@MyFWC.com) weekly reports to the Imperiled Species Management section on Friday each week that trawling is conducted in Florida waters. These weekly reports shall include: the species and number of turtles captured in Florida waters, general health, and release information. A summary (FWC provided Excel spreadsheet) of all trawling activity, including non-capture trawling, and all turtles captured in Florida waters, including all measurements, the latitude and longitude (in decimal degrees) of captures and tow start-stop points, and times for the start-stop points of the tows, including those tows on which no turtles are captured, shall be submitted to MTP@myfwc.com by January 15 of the following year or at the end of the project.

4. In order to protect right whales, the following protection precautions for North Atlantic Right Whales shall be followed from December 1 to March 31 while in the southeastern critical habitat area. This area encompasses the waters between 31 deg.15'N (approximately located at the mouth of the Altamaha River, GA) and 30 deg.15'N (approximately Jacksonville, FL) from the shoreline out to 15 nautical miles offshore; and the waters between 30 deg.15'N and 28 deg.00'N (approximately Sebastian Inlet, FL) from the shoreline out to 5 nautical miles:

a. The National Marine Fisheries Service (NMFS) shall be contacted prior to project commencement at se.rw.sightings@NOAA.gov in order to request daily updates of whale sightings during this portion of the year. The request for sighting updates should include at least one valid email address to receive these alerts within the text of the email.

b. To avoid collisions with whales, a dedicated observer shall be posted to spot right whales. The observer (s) shall use the daily updates of whale sighting from NMFS for assistance when looking for whales.

c. All personnel on all support vessels shall observe for right whales while operating within critical habitat.If whales have been spotted within 15 nautical miles (nm) of the vessel's path within the previous 24 hours, the dredge and support vessels shall slow to 10 knots or less when transiting between areas during evening hours or when there is limited visibility due to fog or sea states of greater than Beaufort 3 (unless weather and sea conditions dictate greater speeds for safe navigation).

d. All dredge and support vessel operators shall be familiar with, and adhere to, the federal right whale minimum approach regulation, as defined in 50 CFR 224.103(c).

5. ***Beach Driving.*** All vehicles shall be operated in accordance with the FWC's Best Management Practices for Operating Vehicles on the Beach (http://myfwc.com/conservation/you-conserve/wildlife/beach-driving/). Specifically, the vehicle must be operated at a speed <6 mph and run at or below the high-tide line. All personnel associated with the project shall be instructed about the potential presence of nesting seabirds, shorebirds and sea turtles and the need to avoid take of (including

disturbance to) these protected species.

6. ***Beach Maintenance.*** All derelict concrete, metal, and coastal armoring material and other debris shall be removed from the beach prior to any material placement to the maximum extent practicable. If debris removal activities will take place during shorebird breeding or sea turtle nesting seasons, the work shall be conducted during daylight hours only and shall not commence until completion of daily seabird, shorebird or sea turtle surveys each day. All excavations and temporary alterations of the beach topography shall be filled or leveled to the natural beach profile prior to 9 p.m. each day.

7. ***Pre-Construction Meeting.*** A meeting between representatives of the contractor, the US Fish and Wildlife Service (FWS), the FWC, the permitted sea turtle surveyor and Bird Monitors as appropriate, shall be held prior to commencement of work on projects. At least 10-business days advance notice must be provided prior to conducting this meeting. The meeting will provide an opportunity for explanation and/or clarification of the protection measures as well as additional guidelines when construction occurs during nesting season, such as staging equipment and reporting within the work area as well as follow up meetings during construction.

8. ***Nesting Seabird and Shorebird Protection Conditions:*** Nesting seabird and shorebird (i.e. shorebird) surveys should be conducted by trained, dedicated individuals (Bird Monitor) with proven shorebird identification skills and avian survey experience. A list of candidate Bird Monitors with their contact information, summary of qualifications including bird identification skills, and avian survey experience shall be provided to the DEP and FWC. This information will be submitted to the FWC regional biologist (Figure 3) prior to any construction or hiring for shorebird surveys for revision and consultation. Bird Monitors shall use the following survey protocols:

a. Bird Monitors shall review and become familiar with the general information, employ the data collection protocol, and implement data entry procedures outlined on the FWC's Florida Shorebird Database (FSD) website (www.FLShorebirdDatabase.org). An outline of data to be collected, including downloadable field data sheets, is available on the website.

b. Breeding season varies by species. Most species have completed the breeding cycle by September 1, but flightless young may be present through September. The following dates are based on the best available information regarding ranges and habitat use by species around the state:

All Gulf Coast counties: February 15 – September 1 except:
Citrus and Levy: March 15- September 1
Dixie and Taylor: April 1 – September 1
St. Lucie, Martin, and Palm Beach Counties spoil islands & estuaries: March 15 – September 1
St. Lucie, Martin, and Palm Beach Counties coastal beaches: April 1- September 1
Broward and Miami-Dade Counties: April 1 – September 1
All other Atlantic Coast Counties: March 15 – September 1

c. Breeding season surveys shall begin on the first day of the breeding season or 10 days prior to project commencement (including surveying activities and other pre-construction presence on the beach), whichever is later. Surveys shall be conducted through August 31st or until all breeding activity has concluded, whichever is later.

d. Breeding season surveys shall be conducted in all potential beach-nesting bird habitats within the project boundaries that may be impacted by construction or pre-construction activities. Portions of the project in which there is no potential for project-related activity during the nesting season may be excluded. One or more shorebird survey routes shall be established in the FSD website to cover these areas.

e. During the pre-construction and construction phases of the project, surveys for detecting breeding activity and the presence of flightless chicks will be completed on a daily basis prior to movement of equipment, operation of vehicles, or other activities that could potentially disrupt breeding behavior or cause harm to the birds or their eggs or young.

f. Surveys shall be conducted by walking the length of the project area and visually surveying for the presence of shorebirds exhibiting breeding behavior, shorebird/seabird chicks, or shorebird/seabird juveniles as outlined in the FSD *Breeding Bird Protocol for Shorebirds and Seabirds*. Use of binoculars is required.

g.If an ATV or other vehicle is needed to cover large project areas, operators will adhere to the FWC's Best Management Practices for Operating Vehicles on the Beach (http://myfwc.com/conservation/you-conserve/wildlife/beach-driving/). Specifically, the vehicle must be operated at a speed <6 mph and run at or below the high-tide line. The Bird Monitor will stop at no greater than 200 meter intervals to visually inspect for breeding activity.

h. Once breeding is confirmed by the presence of a scrape, eggs, or young, the Bird Monitor will notify the FWC Regional Species Conservation Biologist (**Figure 3**) within 24 hours. All breeding activity will be reported to the FSD website within one week of data collection.

9. ***Seabird and Shorebird Buffer Zones and Travel Corridors.*** Within the project area, the permittee shall establish a disturbance-free buffer zone around any location where shorebirds have been engaged in breeding behavior, including territory defense. A 300 ft-wide buffer is considered adequate based on published studies. However, a smaller, site-specific buffer may be implemented upon approval by the FWC Regional Species Conservation Biologist (Figure 3) as needed. All sources of human disturbance (including pedestrians, pets, and vehicles) shall be prohibited in the buffer zone.

a. The Bird Monitor shall keep breeding sites under sufficient surveillance to determine if birds appear agitated or disturbed by construction or other activities in adjacent areas. If birds do appear to be agitated or disturbed by these activities, then the width of the buffer zone shall be increased immediately to a sufficient size to protect breeding birds.

b. Reasonable and traditional pedestrian access should not be blocked where breeding birds will tolerate pedestrian traffic. This is generally the case with lateral movement of beach-goers walking parallel to the beach at or below the highest tide line.

c. Pedestrian traffic may also be tolerated when breeding was initiated within 300 feet of an established beach access pathway. The permittee shall work with the FWC Regional Species Biologist to determine if pedestrian access can be accommodated without compromising nesting success.

d. Designated buffer zones must be marked with posts, twine, and signs stating "Do Not Enter, Important Nesting Area" or similar language around the perimeter which includes the name and a phone number of the entity responsible for posting. Posts should not exceed 3'in height once installed. Symbolic fencing (twine, string, or rope) should be placed between all posts at least 2.5' above the ground and rendered clearly visible to pedestrians. If pedestrian pathways are approved by the FWC Regional Species Conservation Biologist within the 300-foot buffer zone, these should be clearly marked. The posting shall be maintained in good repair until breeding is completed or terminated. Although solitary nesters may leave the buffer zone with their chicks, the posted area continues to provide a potential refuge for the family until breeding is complete. Breeding is not considered to be completed until all chicks have fledged.

e. No construction activities, pedestrians, movement of vehicles, or stockpiling of equipment shall be allowed within the buffer area.

f. Travel corridors shall be designated and marked outside the buffer areas so as not to cause disturbance to breeding birds. Heavy equipment, other vehicles, or pedestrians may transit past breeding areas in these corridors. However, other activities such as stopping or turning shall be prohibited within the designated travel corridors adjacent to the breeding site. When flightless chicks are present within or adjacent to travel corridors, movement of vehicles shall be accompanied by the Bird Monitor who will ensure no chicks are in the path of the moving vehicle and no tracks capable of trapping flightless chicks result.

g. To discourage nesting within the travel corridor, it is recommended that the Permittee should maintain some activity within these corridors on a daily basis, without disturbing any nesting shorebirds documented on site or interfering with sea turtle nesting, especially when those corridors are established prior to commencement of construction.

10. ***Notification.*** If shorebird breeding occurs within the project area, a bulletin board will be placed and maintained in the construction staging area with the location map of the construction site showing the bird breeding areas and a warning, clearly visible, stating that "NESTING BIRDS ARE PROTECTED BY LAW INCLUDING THE FLORIDA ENDANGERED AND THREATENED SPECIES ACT AND THE STATE and FEDERAL MIGRATORY BIRD ACTS".

11. ***Sea Turtle Nest Surveys and Relocation.*** For sand placement projects that occur during the period from May 1 through October 31, daily early morning (before 9 a.m.) surveys shall be conducted, and eggs shall be relocated per the requirements below (a to c) until completion of the project . (Note: sea turtle monitors shall not enter posted

shorebird buffer areas to conduct monitoring or to relocate nests.) Monitoring and reporting should continue throughout the nesting season and should be conducted according to Post-construction Monitoring and Reporting Sea Turtle Protection Conditions included in this document.

a. Nesting surveys shall be initiated 65 days prior to sand placement activities or by May 1 whichever is later. Nesting surveys and egg relocations shall continue through the end of the project or August 31 whichever is earlier. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in a through c below. Monitoring should resume the following nesting season and should be conducted according to *Post-construction Monitoring and Reporting Sea Turtle Protection Conditions* included in this document.

b. Nesting surveys and egg relocations shall only be conducted by persons with prior experience and training in these activities and who are duly authorized to conduct such activities through a valid permit issued by FWC, pursuant to F.A.C 68E-1. Please contact FWC's Sea Turtle Management Program in Tequesta at MTP@myfwc.com for information on the permit holder in the project area. It is the responsibility of the permittee to ensure that nesting surveys are completed. Nesting surveys shall be conducted daily between sunrise and 9 a.m. (in all time zones).

c. Only those nests in the area where sand placement shall occur shall be relocated. Nest relocation shall not occur upon completion of sand placement. Nests requiring relocation shall be moved no later than 9 a.m. the morning following deposition to a nearby self-release beach site in a secure setting where artificial lighting will not interfere with hatchling orientation. Relocated nests shall not be placed in organized groupings. Relocated nests shall be randomly staggered along the length and width of the beach in settings that are not expected to experience daily inundation by high tides or known to routinely experience severe erosion and egg loss, or that are subject to artificial lighting. Nest relocations in association with construction activities shall cease when sand placement activities no longer threaten nests.

d. Nests deposited within areas where construction activities have ceased or will not occur for 65 days or nests laid in the nourished berm prior to tilling shall be marked and left in place unless other factors threaten the success of the nest. The turtle permit holder shall install an on-beach marker at the nest site and/or a secondary marker at a point as far landward as possible to assure that future location of the nest will be possible should the on-beach marker be lost. No activity will occur within this area nor will any activities occur which could result in impacts to the nest. Nest sites shall be inspected daily to assure nest markers remain in place and the nest has not been disturbed by the project activity.

12. ***Sea Turtle or Nest Encounters.*** Upon locating a dead or injured sea turtle adult, hatchling or egg that may have been harmed or destroyed as a direct or indirect result of the project, the Corps, applicant, and/or local sponsor shall be responsible for notifying FWC Wildlife Alert at 1-888-404-FWCC (3922). Care shall be taken in handling injured sea turtles or eggs to ensure effective treatment or disposition, and in handling dead specimens to preserve biological materials in the best possible state for later analysis. In the event a sea turtle nest is excavated during construction activities, the

permitted person responsible for egg relocation for the project shall be notified immediately so the eggs can be moved to a suitable relocation site.

13. ***Equipment Storage and Placement.*** Staging areas for construction equipment shall be located off the beach, if off-beach staging areas are available. Nighttime storage of construction equipment not in use shall be off the beach to minimize disturbance to shorebird and sea turtle nesting and hatching activities. In addition, all construction pipes that are placed on the beach shall be located as far landward as possible without compromising the integrity of the existing or reconstructed dune system. Pipes placed parallel to the dune shall be 5 to 10 feet away from the toe of the dune. Temporary storage of pipes shall be off the beach to the maximum extent possible. If it will be necessary to extend construction pipes past a known shorebird nesting site or over-wintering area for piping plovers, then whenever possible those pipes should be placed landward of the site before birds are active in that area. No pipe or sand shall be placed seaward of a shorebird nesting site during the shorebird nesting season.

14. ***Project Lighting.*** Direct lighting of the beach and nearshore waters shall be limited to the immediate construction area during the sea turtle nesting season and shall comply with safety requirements. Lighting on offshore or onshore equipment shall be minimized through reduction, shielding, lowering, and appropriate placement to avoid excessive illumination of the water's surface and nesting beach while meeting all Coast Guard, EM 385-1-1, and OSHA requirements. Light intensity of lighting equipment shall be reduced to the minimum standard required by OSHA for General Construction areas, in order not to misdirect sea turtles. Shields shall be affixed to the light housing and be large enough to block light from all lamps from being transmitted outside the construction area (Figure 2 below).

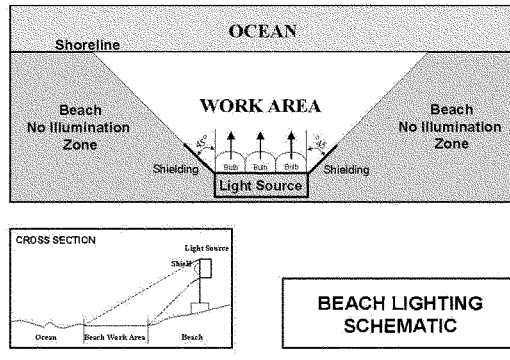


Figure 2.

15. ***Fill Restrictions.*** During the sea turtle nesting season, the contractor shall not extend the beach fill more than 500 feet along the shoreline between dusk and the following day

until the daily nesting survey has been completed and the beach cleared for fill advancement. An exception to this may occur if there is permitted sea turtle surveyor present on-site to ensure no nesting and hatching sea turtles are present within the extended work area. If the 500 feet is not feasible for the project, an agreed upon distance will be decided on during the preconstruction meeting. Once the beach has been cleared and the necessary nest relocations have been completed, the contractor will be allowed to proceed with the placement of fill during daylight hours until dusk at which time the 500-foot length limitation shall apply.

16. ***Compaction Sampling.*** Sand compaction shall be monitored in the area of sand placement immediately after completion of the project and prior to April 15th for three (3) subsequent years and shall be monitored in accordance with a protocol agreed to by the FWS, FWC, and the applicant or local sponsor. The requirement for compaction monitoring can be eliminated if the decision is made to till regardless of post-construction compaction levels. Out-year compaction monitoring and remediation are not required if placed material no longer remains on the beach. At a minimum, the protocol provided under a and b below shall be followed. If the average value for any depth exceeds 500 pounds per square inch (psi) for any two or more adjacent stations, then that area shall be tilled immediately prior to the following date listed above. If values exceeding 500 psi are distributed throughout the project area but in no case do those values exist at two adjacent stations at the same depth, then consultation with the FWC or FWS will be required to determine if tilling is required. If a few values exceeding 500 psi are present randomly within the project area, tilling will not be required.

a. Compaction sampling stations shall be located at 500-foot intervals along the project area. One station shall be at the seaward edge of the dune/bulkhead line (when material is placed in this area), and one station shall be midway between the dune line and the high water line (normal wrack line).

b. At each station, the cone penetrometer shall be pushed to a depth of 6, 12, and 18 inches three times (three replicates). Material may be removed from the hole if necessary to ensure accurate readings of successive levels of sediment. The penetrometer may need to be reset between pushes, especially if sediment layering exists. Layers of highly compact material may lie over less compact layers. Replicates shall be located as close to each other as possible, without interacting with the previous hole and/or disturbed sediments. The three replicate compaction values for each depth shall be averaged to produce final values for each depth at each station. Reports will include all 18 values for each transect line, and the final 6 averaged compaction values.

c. No compaction sampling shall occur within 300 feet of any shorebird nest.

d. Any vehicles operated on the beach in association with compaction surveys shall operate in accordance with the FWC's Best Management Practices for Operating Vehicles on the Beach (http://myfwc.com/conservation/you-conserve/wildlife/beach-driving/).

17. ***Tilling Requirements.*** If tilling is required as specified above, the area shall be tilled to a depth of 36 inches. All tilling activity shall be completed prior to the sea turtle nesting season. If tilling occurs during shorebird nesting season (See 3b above), shorebird surveys prior to tilling shall be required per the Shorebird Conditions included within this document. It is the responsibility of the contractors to avoid tilling, scarp removal, or dune vegetation planting in areas where nesting birds are present. Each pass of the tilling equipment shall be overlapped to allow thorough and even tilling. If the project is completed during the sea turtle nesting season, tilling will not be performed in areas where nests have been left in place or relocated. If compaction measurements are taken, a report on the results of the compaction monitoring shall be submitted electronically to FWC at marineturtle@myfwc.com prior to any tilling actions being taken.

a. No tilling shall occur within 300 feet of any shorebird nest.

b. If flightless shorebird young are observed within the work zone or equipment travel corridor, a Shorebird Monitor shall be present during the operation to ensure that equipment does not operate within 300 feet of the flightless young.

c. A relatively even surface, with no deep ruts or furrows, shall be created during tilling. To do this, chain-linked fencing or other material shall be dragged over those areas as necessary after tilling.

d. Tilling shall occur landward of the wrack line and avoid all vegetated areas 3 square feet or greater with a 3 square foot buffer around the vegetated areas. The slope between the mean high water line and the mean low water line must be maintained in such a manner as to approximate natural slopes.

e. Any vehicles operated on the beach in association with tilling shall operate in accordance with the FWC's Best Management Practices for Operating Vehicles on the Beach (http://myfwc.com/conservation/you-conserve/wildlife/beach-driving/).

18. ***Escarpment Surveys.*** Visual surveys for escarpments along the project area shall be made immediately after completion of the sand placement project and during March 15 to April 15 for three (3) subsequent years if sand from the project area still remains on the beach.

Escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of at least 100 feet shall be leveled and the beach profile shall be reconfigured to minimize scarp formation by April 15. Any escarpment removal shall be reported by location. If the project is completed during the sea turtle nesting and hatching season, escarpments may be required to be leveled immediately, while protecting nests that have been relocated or left in place. FWC shall be contacted immediately if subsequent reformation of escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet occurs during the nesting and hatching season to determine the appropriate action to be taken. If it is determined that escarpment leveling is required during the nesting or hatching season, the FWS or FWC will provide a brief written authorization that describes methods to be used to reduce the likelihood of

impacting existing nests. An annual summary of escarpment surveys and actions taken shall be submitted electronically to marineturtle@myfwc.com along with the annual summary as described below. If escarpment removal occurs during shorebird breeding season (See 3B), shorebirds surveys shall be required per the *Shorebird Conditions* included within this document prior to removal. (NOTE: Out-year escarpment monitoring and remediation are not required if placed material no longer remains on the dry beach).

a. No heavy equipment shall operate within 300 feet of any shorebird nest.

b. If flightless shorebird young are observed within the work zone or equipment travel corridor, a Shorebird Monitor shall be present during the operation to ensure that equipment does not operate within 300 feet of the flightless young.

c. Any vehicles operated on the beach in association with escarpment surveys or removal shall operate in accordance with the FWC's Best Management Practices for Operating Vehicles on the Beach (http://myfwc.com/conservation/you-conserve/wildlife/beach-driving/).

19. ***Post-construction Shorebird Protection Conditions:*** If beach cleaning will occur on the nourished beach, a minimum of 30% of the biotic material within the wrack line will be left on the beach post-cleaning at the strand line in a natural configuration to ensure that the nourished beach re-establishes its function as foraging habitat for shorebirds. This shall occur for as long as the placed sand remains on the beach.

20. ***Post-construction Monitoring and Reporting Sea Turtle Protection Conditions:*** Reports on all sea turtle nesting activity shall be provided for the initial sea turtle nesting season (May 1 through August 31) and for up to three additional nesting seasons as follows:

a. For the initial nesting season and the following year, the number and type of emergences (nests or false crawls) shall be reported per species in accordance with **Table 1 below**.

b. An additional year of nesting surveys may be required if nesting success for any species on the nourished beach is less than 40%.

c. For the initial nesting season, reproductive success shall be reported per species in accordance with **Table 1 below**. Reproductive success shall be reported for all loggerhead, Kemp's ridley, green and leatherback nests.

d. In the event that the reproductive success documented by species meets or exceeds required criteria (outlined in **Table 1 below**) for each species, monitoring for reproductive success shall be recommended, but not required for the second year post-construction.

e. Monitoring of nesting activity in the seasons following construction shall include daily surveys and any additional measures authorized by the FWC. Summaries shall include all crawl activity, nesting success rates, hatching success of all relocated

nests, hatching success of a representative sampling of nests left in place (if any) by species, project name and applicable project permit numbers and dates of construction.

f. Data should be reported for the nourished areas in accordance with the **Table 1 below** and should include number of nests lost to erosion or washed out. Summaries of nesting activity shall be submitted in electronic format (Excel spreadsheets) to the FWC Imperiled Species Management section at MTP@myfwc.com. All summaries should be submitted by January 15 of the following year. The FWC Excel spreadsheet is available upon request from MTP@myfwc.com.

21. Two lighting surveys shall be conducted of all artificial lighting visible from the renourished berm. The first survey shall be conducted between May 1 and May 15 the first nesting season following construction or immediately after placement if construction is not completed until after May 15, and a second survey between July 15 and August 1. The survey shall be conducted by the permittee or local sponsor and should be conducted to include a landward view from the seaward most extent of the new beach profile. The survey should follow standard techniques for such a survey and include number and type of visible lights, location of lights and photo documentation. For each light source visible, it must be documented that the property owner(s) have been notified of the problem light with recommendations for correcting the light. Recommendations must be in accordance with the Florida Model Lighting Ordinance for Marine Turtle Protection (Chapter 62B-55, F.A.C.) and local lighting restrictions. In addition to local code enforcement, actions must be taken by the permittee to ensure that no lights or light sources are visible from the newly elevated beach within their respective areas. A report summarizing all lights visible shall be submitted to FWC Imperiled Species Management Section at marineturtle@myfwc.com by the 1st of the month following survey. A summary report documenting what corrective actions have been taken provided and all compliance and enforcement actions shall also be submitted by December 15 of that year. After the annual report is completed, a meeting shall be set up with the permittee or local sponsor, county or municipality, FWC and the FWS to discuss the survey report as well as any documented sea turtle disorientations in or adjacent to the project area.

Table 1. Sea Turtle Monitoring for Beach Placement of Material

Metric	Duration	Variable	Criterion
Nesting Success	Year of construction, one year to two or three years post construction if placed sand remains on beach and variable does not meet criterion based on previous year	Number of nests and non-nesting emergences by day by species	40% or greater

Hatching Success	Year of construction and one to three years post construction if placed sand remains on beach and variable does not meet criterion based on previous year	Number of hatchlings by species to completely escape egg	Average of 60% or greater (data must include washed out nests)
Emergence Success	Year of construction and one to three years post construction if placed sand remains on beach and variable does not meet success criterion based on previous year	Number of hatchlings by species to emerge from nest onto beach	Average must not be significantly different than the average hatching success
Disorientation	Year of construction and one to three years post construction if placed sand remains on beach	Number of nests and individuals that disorient	
Lighting Surveys	Two surveys the year following construction , one survey between May 1 and May 15 and second survey between July 15 and August 1	Number, location and photographs of lights visible from nourished berm, corrective actions and notifications made	100% reduction in lights visible from nourished berm within one to two month period
Compaction	Not required if the beach is tilled prior to nesting season each year placed sand remains on beach	Shear resistance	Less than 500 psi
Escarpment Surveys	Weekly during nesting season for up to three years each year placed sand remains on the beach	Number of scarps 18 inches or greater extending for more than 100 feet that persist for more than 2 weeks	Successful remediation of all persistent scarps as needed

Figure 3.


Shorebird Breeding Seasons
and Regional Shorebird Contacts
N
Gulf of Mexico
Atlantic Ocean
Regional Contacts
for Shorebird Issues
John Himes
John.Himes@MyFWC.com
850-265-3676
3911 Hwy 2321 Panama City, FL 32409-1658
Terry Doonan
Terry.Doonan@MyFWC.com
386-758-0525
3377 East U.S. Hwy. 90, Lake City, FL 32055
Alex Kropp
Alex.Kropp@MyFWC.com
352-732-1225
1239 SW 10th St Ocala, FL 34471
Nancy Douglass
Nancy.Douglass@MyFWC.com
863-648-3205
3900 Drane Field Rd Lakeland, Fl 33811-1299
Ricardo Zambrano
Ricardo.Zambrano@MyFWC.com
561-625-5122
8535 Northlake Blvd West Palm Beach, FL 33412
Florida Fish and Wildlife
Conservation Commission
MyFWC.com
620 South Meridian Street
Tallahassee, Florida 32399-1600
Shorebird Breeding Season
February 15 - September 1
Spoil Islands Hillsborough Bay March 1 - September 1
March 15 - September 1
April 1 - September 1
Spoil Islands & Estuaries March 15 - September 1
Coastal Beaches April 1 - September 1

Northeast Florida Regional Council

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DEP Office of Intergovt'l Programs

February 26, 2014

Lauren P. Milligan
Florida State Clearinghouse
Florida Department of Environmental Protection
3900 Commonwealth Boulevard, MS 47
Tallahassee, Florida 32399-3000

SAI # FL201401236812C
NEFRC # FSC-14-F001

Project Description: Department of the Army, Jacksonville District Corps of Engineers – Draft Integrated Feasibility Study and Environmental Assessment, Flagler County Hurricane and Storm Damage Reduction Project - Flagler County, Florida.

Attn: Florida State Clearinghouse

Pursuant to the provisions of Presidential Executive Order 12372, Governor's Executive Order 95-359 and Chapter 29E-6 Florida Administrative Code, the staff of the Northeast Florida Regional Council (NEFRC) has reviewed the draft study & environmental assessment for storm damage reduction in Flagler County, Florida. After review, staff at the Northeast Florida Regional Council has no comments at this time.

All the best,

Eric B. Anderson

Eric B. Anderson, AICP
Regional Planner
Intergovernmental Coordination & Review
Northeast Florida Regional Council
(904) 279-0885 x178
eanderson@nefrc.org

Public Review Comments

Residents and Private Individuals

Name of Commenter	Contact Information	Date Comment Received	How Comment Received	Comment Key Point(s) Summary	USACE/Sponsor Response Summary
Carey Strickland	1708 N Central Ave Flagler Beach, FL 32137 dscissorhappy@aol.com	23-Jan-14	email	Wants to know if property her is within the TSP; has a dune walkover; inquiry of how the dune walkover would be affected.	This property is located north of the pier, and is not located with the TSP reach. Flagler County will need to get easements from the property owners will be needed prior to construction. These easements will cover what happens to the walkovers. (Response by MTD)
Dale Clegg	flaglerlpn@yahoo.com	23-Jan-14	email	Opposes sand placement on beach-- thinks it is an ineffective measure, not a solution but a waste of money	The return on investment for the TSP is estimated to be $1.83 for every dollar spent. (Response by MTD)
Frank Meeker	fmmeker@flaglercounty.org	25-Jan-14	email	Discusses other option of concrete filled tubes along shoreline as not appropriate. Coastline engineering modification would be required due to current steepness. Use of this technology would be more destructive to shoreline structures.	Groins and other similar structures were considered in this study, however, the beach along Flagler County is relatively straight. Structures in this case would likely cause the erosion to worsen on down drift shorelines unless additional sand was placed down drift of the structure. For this reason the study found structures to be cost prohibitive and not meet the study objectives. (Response by MTD)
Scott and Judy Adie	57 Barkley Lane, Palm Coast, FL 32137 scott@osgfx.com	28-Jan-14	email	Believe that adding sand to beach is a temporary fix; prefers concrete barriers and large stone placement perpendicular to the shoreline; believe it will retain sand. Requests breakwater structures in the plan.	Groins and other similar structures were considered in this study, however, the beach along Flagler County is relatively straight. Structures in this case would likely cause the erosion to worsen on down drift shorelines unless additional sand was placed down drift of the structure. For this reason the study found structures to be cost prohibitive and not meet the study objectives. (Response by MTD)
Dr. B. Nagendra Kumar SAB Innovations Pvt Ltd, Chennai, India	sabinnovationspvtltd@gmail.com	28-Jan-14	email and attachment	Proposes proprietary hard structure technology placement along shoreline that will trap sediment and become buried. Requests its use as a test project for Flagler Beach.	Specific to the conditions in Flagler County, Florida we do not feel like the use of hard structures either by themselves or in combination with other measures will be able to meet the objectives of the study. As far as using Flagler County as a test site for the SAB technology, that is something we cannot recommend through this study. The technology would first need to be vetted through the Corps Engineering Research and Development Center (ERDC). (Response by MTD)
Mary Ann Clark	1923 S Flagler Ave Flagler Beach FL 32136 mafsclark@bellsouth.net	3-Feb-14	email	Feels the plan is a waste of public funds and time; should let nature take its course.	The return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD)
Frederick and Suze Peace	1571 Alanson Dr Deland, FL 32724 4sfpeace@bellsouth.net	3-Feb-14	email an USPS	Recommends use of eminent domain for re-routing of SR A1A to move it inland. Does not feel that TSP is a fix, but is detrimental to the environment, i.e. turtles, a waste of time, and will fail.	Regarding detriment to the environment: The shoreline within the TSP has been damaged from armoring by revetment and sea wall construction. The construction of a natural dune will replace lost functions of wildlife habitat and biodiversity. (Response by KKM)
Mike Flank	1732 S oceanshore Blvd Flagler Beach, FL mlfclf@aol.com	1-Feb-14	email	Proponent of preserving beaches, feel there are no guaranteed solutions to problem; and report accurately illustrates positive action to sustain beach, but is better than no action. Supports the project as presented by USACE and sponsor.	Noted
Jane L. Hitt	2544 S Central Ave Flagler Beach FL 32136	6-Feb-14	email	Feels the public meeting was informative, but disappointed at the turnout. Hopes the communication between the Flagler Beach Officials, County Commissioners and residents can be improved. Inquired if all property owners fronting SR A1A were included in the NOA mailing; if the 30-day comment period is flexible.	Regarding NOA mailing: All properties abutting the project site were included in the NOA mailing. The list was compiled from the Flagler Co Tax Appraiser website to get the most recent (2013) data; however, there were around 40 NOA's returned as non-deliverable. The 30 day period was extended to +/- 45 days. (Response by KKM)
Mark and Toni Treworgy	2316 & 2320 S Oceanshore Blvd Flagler Beach FL 32136 Tyacht@cfl.rr.com	13-Feb-14	email	Concerned about impact to businesses (boutique and B & B) during project construction; have 2 dune walkovers, concerned about access to beach and walkovers destruction; worried about potential loss of revenue and cost of walkover replacement.	Prior to construction Flagler County will need to obtain a 50 year perpetual easement from the property owner. This construction easement will allow for dune nourishment on the property as needed over 50 years. This easement will also cover what happens if the walkovers are damaged or need to be removed in order to construct the dune nourishment project. So, the responsibility for any repair or rebuild of the walkovers on the property will be between the property owner and Flagler County as agreed to in the easement. (Response by MTD)
Patti Powell	719 N Central Ave Flagler Beach FL 32136 44 powell@cfl.rr.com	14-Feb-14	email	Critical of $3.3M spent on feasibility report, along with time and conclusions. Feels TSP is wasteful, and not proven effective in event of storm or hurricane damage to structures. Critical of borrow area location 7 miles from shore, quality of material. Recognizes socio-economic significance of SR A1A, critical of FDOT's revetment and seawall. Critical of model (Beach-fx) determination of project to Reach C only, and lack of scientific documentation supporting model findings. Objects to terms "robust" and "highly effective" regarding model output and potential reduction of erosion damage. Suggest FDOT and FDEP come together and determine solution to SR A1A of revetment maintenance and on-going drainage problems; feels TSP is not a solution, and will not have positive effect to tourism (socio-economics). Objects to Flagler County residents participation in saving SR A1A via a dune restoration. Views entire project as wasteful spending for both Federal and non-Federal partners.	The feasibility report and study process having been undergoing several rounds of review required by the Corps policy, so it does take some time to ensure that all requirements are met. It is true that the TSP will primarily protect 2.6 miles of A1A. Flagler County supports this plan as the non-Federal sponsor for the project. This is the only stretch of the study area where a project was found to be both economically justified and to have adequate public access for Federal participation. The term "robust" is used to describe how the plan is economically justified across the three possible future sea level rise scenarios used by the Corps for planning purposes, and the term "highly effective" is used in describing how the TSP prevents almost all of the damages anticipated to occur in the future without project condition. The return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD)

Residents and Private Individuals

Name of Commenter	Contact Information	Date Comment Received	How Comment Received	Comment Key Point(s) Summary	USACE/Sponsor Response Summary
Rick Morgan	15 Riviere Ln Palm Coast FL 32164 rim3231@gmail.com	14-Feb-14	email	Request consideration of other alternatives than simply dredging sand and placement on the beach; include structures to hold sand and build up the beach. Proponent of Holmberg design; suggests using a small portion of the beach to test its integrity. Feels sand dredge and placement on beach is wasteful.	Groins and other similar structures were considered in this study, however, the beach along Flagler County is relatively straight. Structures in this case would likely cause the erosion to worsen on down drift shorelines unless additional sand was placed down drift of the structure. For this reason the study found structures to be cost prohibitive and not meet the study objectives. (Response by MTD)
Jane L. Hitt	2544 S Central Ave Flagler Beach FL 32136	15-Feb-14	email	Second comment follow up to reiterate opposition to the project. Feels without a defined evidence of success at other beaches, plan is a commitment to an open-ended drain on limited funds. Feels the plan will irreparably damage shoreline environment.	Regarding the irreparable damage to the shoreline environment: The shoreline within the TSP has been damaged from armoring by revetment and sea wall construction. The construction of a natural dune will replace lost functions of wildlife habitat and biodiversity. (Response by KKM)
JoAnne Ricardi	1423 N Central Ave Flagler Beach FL 32136 jodickric@aol.com	15-Feb-14	email	Disappointed with results of study, time and funds spent to conclude with dredge and renourishment; feels it is not a solution nor innovative. Objects to use of gray borrow area material covering coquina sand, impacting sea organisms at borrow site, sea turtles and benthic organisms on the shoreline. Objects to cost responsibility of project to local communities to support an FDOT roadway. Vehemently opposed to this project.	Short-term impact to dune and beach habitat due to burial/disturbance, but long term benefit through increase of these habitats for nesting sea turtles, shorebirds and benthic fauna. Temporary impact to fish in the water column and benthic resources during dredging activities. Short-term turbidity would be present at the borrow area and placement site. No hardbottom resources were identified to be present in the borrow area during the subsurface resource survey; therefore, no impact would occur to this resource. (Response by KKM)
Coralee Leon	PO Box 160 Flagler Beach FL 32136 1coralee@earthlink. net	16-Feb-14	USPS, email attachment	Objects to the time and cost of study to propose dredge and placement plan. Feels the solution is the problem with eroding onshore dunes and beaches. Sees the plan as a fix to FDOT problem of SR A1A, does not prevent damage that had occurred in the past or areas outside the 2.6 mile project limit. Dune is a temporary fix, citing New Smyrna Beach example. Feels the Federal and State governments should bear the cost of the project as the local residents don't have a say in the plan but must live with what is decided by State and Federal officials.	It is true that the TSP will primarily protect 2.6 miles of A1A. Flagler County supports this plan as the non-Federal sponsor for the project. This is the only stretch of the study area where a project was found to be both economically justified and to have adequate public access for Federal participation. Similar projects have worked around the state of Florida. The return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD)
Rita Bloom Gombar	1517 N Oceanshore Blvd Flagler Beach FL 32136 ritabgombar@gmail.com	15-Feb-14	email and attachment	Finds current plan distasteful. Objects to 10-year and $3.3M study with TSP recommendation. Feels plan is temporary, costly and likely to fail. Feels that local opinion was overlooked by USACE and motive is to fix SR A1A; feels the State and Federal government are responsible for all costs.	Flagler County supports this plan as the non-Federal sponsor for the project. It is understood the project will need periodic renourishment over the 50 years of the TSP. Over this 50 years. The return on investment for the TSP is estimated to be $1.83 for every dollar spent. (Response by MTD)
JoAnne and Dick Ricardi (separate comments of same content received from each)	1423 N Central Ave Flagler Beach FL 32136 jodickric@aol.com	16-Feb-14	email	Second comment follow up to reiterate opposition to the project. Feels helpless by the prospect of being dominated by the USACE into a massive environmental disaster of dredging and beach renourishment. Shocked by conclusion after 10 years of study same old failed operation should be used again. Feels study lacks attention to environmental effects-- using borrow area 7 miles offshore could introduce a foreign substance; effect on sea turtles nesting; and gopher tortoises in the dune.	Regarding sea turtles and gopher tortoise: Sea turtle nesting on Flagler Beach is less often found within the TSP area as little or no dune exists; sea turtles do not typically nest along an armored shoreline. Dune construction with a fore beach of sand and native vegetation will encourage nesting. Gopher tortoise typically do not burrow along the base of beach or within armored shoreline, but prefer upland dune habitat in a higher elevation, i.e. south of Marineland outside of the TSP. Survey of the TSP by USACE biologists have not recorded any gopher tortoises or burrows along the beach face. (Response by KKM)
Kim Carney	604 Springdale Dr Flagler Beach FL 32136 kcarney123@gmail.com	17-Feb-14	email	Critical of $3.3M spent on feasibility report, along with time and conclusions. Feels TSP is wasteful, and not proven effective in event of storm or hurricane damage to structures. Critical of borrow area location 7 miles from shore and quality of material. Recognizes socio-economic significance of SR A1A, critical of FDOT's revetment and seawall. Critical of model (Beach-fx) determination of project to Reach C only, and lack of scientific documentation supporting model findings. Objects to terms "robust" and "highly effective" regarding model output and potential reduction of erosion damage. Suggest FDOT and FDEP come together and determine solution to SR A1A of revetment maintenance and on-going drainage problems; feels TSP is not a solution, and will not have positive effect to tourism (socio-economics). Objects to Flagler County residents participation in saving SR A1A via a dune restoration. Views entire project as wasteful spending for both Federal and non-Federal partners. Feels the project could be damaging to the environment (sea turtle nesting).	The feasibility report and study process having been undergoing several rounds of review required by the Corps policy, so it does take some time to ensure that all requirements are met. It is true that the TSP will primarily protect 2.6 miles of A1A. Flagler County supports this plan as the non-Federal sponsor for the project. This is the only stretch of the study area where a project was found to be both economically justified and to have adequate public access for Federal participation. The term "robust" is used to describe how the plan is economically justified across the three possible future sea level rise scenarios used by the Corps for planning purposes, and the term "highly effective" is used in describing how the TSP prevents almost all of the damages anticipated to occur in the future without project condition. The return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD) Regarding environmental damage and sea turtles: Sea turtle nesting on Flagler Beach is less often found within the TSP area as little or no dune exists; sea turtles do not typically nest along an armored shoreline. Dune construction with a fore beach of sand and native vegetation will encourage nesting. (Response by KKM)

Residents and Private Individuals

Name of Commenter	Contact Information	Date Comment Received	How Comment Received	Comment Key Point(s) Summary	USACE/Sponsor Response Summary
Randall Cody	rcody1@gmail.com	20-Feb-14	email	Observed rocks holding up SR A1A are eroding away. Wants to know the status of the north side, was it considered in the study?	The northern portion of Flagler Beach was considered. The stretch of shoreline extending about 3.5 miles north from the Flagler Beach Pier is referred to as "Design Reach B" in the draft feasibility study. Based on surveys going back to the 70s the northern portion of Flagler Beach has been more stable than the stretch of shoreline south of the pier where the tentatively selected plan (TSP) calls for dune nourishment. Although there are a few locations in northern Flagler Beach where the department of transportation has placed rocks to protect A1A, it is anticipated that over the next 50 years, the cost to implement a dune nourishment or any other measure would cost more than the value of what would be protected. (Response by MTD)
Walter Mahler	walter.mahler@gmail.com	19-Feb-14	email	Feels the plan has merit if dunes are planted with stabilizing vegetation such as sea oats that can stand up better to storms and prevent erosion.	Native species included for planting in the newly created dune will include sea oats, recognized as fundamental for holding soil in place. Also, other appropriate native species for upland dune will be planted, such as beach morning glory and seashore paspalum grass. (Response by KKM)
Carol Propper	csprop60@gmail.com	28-Feb-14	email	Suggests using rip-rap revetment to retain sand on the shore and encourage sand to accumulate along the beach; would cost less and stay in place instead of washing out to sea like a dredge and fill operation. Refers to this project as a funding waste similar to the Cross Florida Barge Canal.	Structures were considered in this study, however, the beach along Flagler County is relatively straight. Structures in this case would likely cause the erosion to worsen on down drift shorelines unless additional sand was placed down drift of the structure. For this reason the study found structures to be cost prohibitive and not meet the study objectives. (Response by MTD)
James and Sharon Gallagher	51 Wedgewood Lane Palm Coast FL 32164	3-Mar-14	email	Critical of $3.3M spent on feasibility report, along with time and conclusions. Feels TSP is wasteful, and not proven effective in event of storm or hurricane damage to structures. Critical of borrow area location 7 miles from shore and quality of material. Recognizes socio-economic significance of SR A1A, critical of FDOT's revetment and seawall. Critical of model (Beach-fx) determination of project to Reach C only, and lack of scientific documentation supporting model findings. Objects to terms "robust" and "highly effective" regarding model output and potential reduction of erosion damage. Suggest FDOT and FDEP come together and determine solution to SR A1A of revetment maintenance and on-going drainage problems; feels TSP is not a solution, and will not have positive effect to tourism (socio-economics). Objects to Flagler County residents participation in saving SR A1A via a dune restoration. Views entire project as wasteful spending for both Federal and non-Federal partners. Feels the project could be damaging to the environment (sea turtle nesting).	The feasibility report and study process having been undergoing several rounds of review required by the Corps policy, so it does take some time to ensure that all requirements are met. It is true that the TSP will primarily protect 2.6 miles of A1A. Flagler County supports this plan as the non-Federal sponsor for the project. This is the only stretch of the study area where a project was found to be both economically justified and to have adequate public access for Federal participation. The term "robust" is used to describe how the plan is economically justified across the three possible future sea level rise scenarios used by the Corps for planning purposes, and the term "highly effective" is used in describing how the TSP prevents almost all of the damages anticipated to occur in the future without project condition. The return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD) Regarding environmental damage and sea turtles: Sea turtle nesting on Flagler Beach is less often found within the TSP area as little or no dune exists; sea turtles do not typically nest along an armored shoreline. Dune construction with a fore beach of sand and native vegetation will encourage nesting. (Response by KKM)
Patricia Brown	whoknows11us@gmail.com	13-Mar-14	email and attachment	Feels the USACE completed the study with arrogance. Would like to see USACE and FDOT make an exception to the "Right of Way" issue faced by FDOT by allowing them to provide the solution. Dismayed by the delay of the study report issuance. Series of comments/question. 1) Why are federal monies spent on beach projects; feels that USACE beach projects in past have led to more damages. 2) Why did FDOT Dist 5 provide $250K to Flagler County for repayment to USACE for the feasibility study? Concerns that Flagler County is funding FDOT roadway project. 3) USACE is using both Federal and Flagler Co tax dollars for the project. USACE is essential a contractor and others are paid to do specific work; is there a bid process for selection? What was done by USACE and what was done by contractors? 4) Use of subjective words "robust, not aesthetically pleasing" as part of a scientific study. Challenge the use of these words and discounting Underwater Stabilizers as viable technology. 5) What was result of the "peer review plan" as updated in August 2010? 6) Why were the economic conditions not properly assessed during the USACE Reconnaissance Study; why was sand search and other items done before the economic value?	1) Federal money is used for beach nourishment projects that benefit the national economy and have a positive return on investment from reducing damages to public and private infrastructure. 2) FDOT provided funding to Flagler County in support of the feasibility study as agreed to between the County and FDOT. 3) Bids are solicited for work done by contractors in support of the study. Work contracted out for the feasibility study included physical and environmental surveys of the study area to determine first floor structure elevations, the presence and location of hardbottoms, and the characteristics of material in the offshore borrow areas. The generation of the report and reviews was done by the Corps. 4) Subjective words were used to describe alternatives, however they were not used to biasly screen out certain alternatives. 5) The peer review plan describes the required reviews for the study. 6) The economic conditions described in the 2004 Reconnaissance Study were based on existing data available at that time. (Response by MTD)

Residents and Private Individuals

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				7) Why are misleading terms used in the report that can be mis-interpreted by average person? 8) Where is updated itemized Flagler County Feasibility Cost Estimate that was in August 2004 plan? Would like to compare original costs to current. 9) Beach walkovers are now part of the economic cost but not previously; why were they left out before? looking for proof of replacement costs.10) What is reasoning for 400-ft damage zone inland; clarification of FDOT ROW needed. 11) Dune walkover estimated costs for replacement are apart from project; can private owners afford replacing walkover on their property? 12) If project requires Federal easement along beach face, will County have to acquire the easements? 13) Contingency funding for the initial project can be manipulated for cost/benefit ratio; will Flagler County residents carry cost of revetment maintenance, a FDOT cost?	7) The references to renourishment interval and dune/beach nourishment are not meant to be misleading. The executive summary states that renourishment will be needed over the 50 year project life. 8) The latest study cost estimate was the one included in the in the PMP updated in 2010. 9) The cost to replace the public walkovers is included in the cost estimate incase the contractor is not able to build the project around the walkovers without damaging them. 10) The FDOT is included in the 400 foot inland extent of the study area. The inland extent does include Central Avenue and several structures west of it. The BCR only accounts for benefits to structures damaged in the future without project condition, so the inland extent of the study area and does not have an impact on the BCR. 11&12) Prior to construction Flagler County will need to obtain a 50 year perpetual easement from the property owner. This construction easement will allow for dune nourishment on the property as needed over 50 years. This easement will also cover what happens if the walkovers are damaged or need to be removed in order to construct the dune nourishment project. So, the responsibility for any repair or rebuild of the walkovers on the property will be between the property owner and Flagler County as agreed to in the easement. 13) The contingency is based on the risks identified on in the cost and schedule risk analysis (CSRA) which is included in the Cost Engineering Appendix. (Response by MTD)
				14) Why was Mayport tidal gauge used instead of St. Augustine or Bing's Landing for Appendix C, A-13? 15) Why was FDOT data beyond 2010 not used for updated report. 16) Project to last 11 years; if FDOT has already spent $6M why not use their own budget? 17) Clarify cost sharing scheme; does not follow as originally presented. 18) Requests scientific proof regarding the nearshore currents in the project area not influenced by the Gulf Stream but by interaction with incidental waves (Appendix C-A28).19) What is actual cost of sand, discrepancy of cost throughout report sections. 20) Requests justification of maintaining current slope as described in Appendix B-5. Critical of report length and funds expended; feels the information has been "massaged" to provide a basis of USACE employment and SR A1A costs on Flagler County taxpayers rather than FDOT.	14) The Mayport tide gauge is used because it has a long period of record and gives the best representation of the ocean tides in Flagler County compared to other gauges in the vicinity of the project area which are located in inland water ways away from inlets. 15) At the time of analysis and model set-up the FDOT was only able to provide data through 2010. 16) Flagler County is aware that most of the TSP benefits are associated with A1A and is still in support of the project as the non-Federal sponsor. 17) The cost sharing for the study is 50% Federal and 50% non-Federal. The cost sharing for the initial construction of the project is 65% Federal and 35% non-Federal. The cost sharing periodic renourishments is 50% Federal and 50% non-Federal. 18) The Gulf Stream, also known as the Florida Current when it travels between the Florida Straits and Cape Hatteras, reaches its closest proximity to the Florida coast near Fort Lauderdale. By the time the Gulf Stream reaches the latitude of Flagler Beach, it is approximately 50 nautical miles from shore. Although the current does meander both east and west over time, those meanders do not bring the current close enough to the shoreline for even the outermost layers to enter the coastal nearshore region (directly effecting nearshore current patterns). There are many sources of data available on the internet that discuss and define the basic characteristics and behavior of the Gulf Stream/Florida Current. There are also numerous sites which explain the basic concepts of how nearshore currents result from local wave climate. Two excellent sources are: http://oceancurrents.rsmas.miami.edu/atlantic/florida_3.html and http://www.seagrant.wisc.edu/Home/Topics/CoastalEngineering/Details.aspx?PostID=690 19) The cost of the sand from the offshore borrow area is estimated to cost approximately $21.54 per cubic yard without the 23% contingency factored in. 20) The slope of the constructed dune will not have the same slope as the existing revetment. The constructed dune will be designed to be similar to natural dunes in parts Flagler County that are currently unarmored. (Response by MTD & LH)

Residents and Private Individuals

Name of Commenter	Contact Information	Date Comment Received	How Comment Received	Comment Key Point(s) Summary	USACE/Sponsor Response Summary
JT Carney	jtcarney@cfl.rr.com	13-Mar-14	email and attachment	Concerned that study is a shift of maintenance cost of SRA1A from State and FDOT to Flagler Co taxpayers. Several Questions by Chapter. Ch 1: Please define which of 4 interests are at risk-- upland development, recreation, wildlife habitat, and cultural resources. Ch 2: Revetment areas have negative impact to sea turtle nesting prompted questions 1) is there a better way to define nest locations (GPS, by Block); 2) Location of picture in Figure 2-18; 3) How does this nesting area compare to other locations in Florida; 4) No details provided about sand along face of revetment areas (dry, wet); was Turtle Patrol contacted as data source, and have nests been moved? 5) Where was Figure 2-28 photo taken, leads viewers to think entire beach is this way; 6) objects to term "viewshed" as one word, commonly used word; 7) where are the bird nesting locations?	Ch 1: The four interests at risk referenced in the question are used by the state to deterring if erosion in an area is classified as "critical". Upland development at risk includes several single family houses located east of A1A in Painters Hill and Beverly Beach and SR A1A in Flagler Beach. Recreation at risk includes the areas where revetments and sea walls have been built as well as where dune walkovers have been damaged, limiting access too use the beach. Wildlife habitat at risk includes areas where revetments and sea walls have been or will be built to prevent erosion, resulting in the loss of beach/dune nesting habitat. A cultural resource at risk includes SR A1A which is a historic scenic byway. (Response by MTD) Ch 2: The data was acquired from the Florida Fish and Wildlife Conservation Commission (FWC) who manage all sea turtle volunteer data throughout the state. As discussed on page 2-33, the FWC data does not include GPS location coordinates because of inconsistency of reporting but has the nesting data organized by reaches, the basis of the Tables 2-10 to 2-12. The area found to have the least nesting was south Flagler Beach where revetment and SR A1A seawall have replaced habitat. 2.) Location of the photo in Figure 2-18 was north of Flagler Beach in the Painters Hill area. 3.) The Gulf region of the Florida has higher population density for sea turtle nesting. On the Atlantic coast, FWC data from 2010 shows that in Flagler Co. 463 nests were reported, whereas Brevard Co reported 31,758 nests. 4.) The sand material in front of the revetment is similar to the sand face of the native dunes. Turtle Patrol was not contacted; their data is submitted to the FWC, who provided that data used in Sec 2.4.3. To date, no nests have been relocated related to this project. 5.) The photo was taken on Flagler Beach north of the Pier, and was used as a representative view. 6.) "View shed" is a term that is used to describe an area of visible landscape. 7.) Survey of specific shorebird nests are not required as part of field activities for the study. (Response by KKM)
				Ch 3: Addresses cumulative impacts in Beverly Beach from seawalls. Several questions: 1) Has Beach-*fx* been calibrated to model US real life performance? 2) What predictive computer program does Beach-*fx* replace? 3) Where else has Beach-*fx* been used? 4) Does Beach-*fx* always recommend nourishment or have other technology been recommended? 5) Why is it assumed that 90% of the berm recovers post-storm (Table 3-6, pg 3-16); what scientific evidence exists that this happens? 6) Who is the SAJ contracted surveyor who estimated the first floor elevations of all structures in the sturdy area and what was the cost of this work? 7) Is it correct that the overall analysis uses the low level costs estimated in Table 3-7; what is the reasoning, and did it increase the benefit to cost ratio (BCR)?	Ch 3: 1) Yes, Beach-fx has been calibrated to model real life erosion and performance. 2) Beach-fx replaces the Storm Damage Model (SDM) which was developed and used by the Jacksonville District. Beach-fx is now the only certified model to be used Corps wide for this type of study. 3) Beach -fx has been used for projects that have been approved in Panama City Beach, FL and Edisto Beach, SC. There are other ongoing studies currently using it around the country. 4) Beach-fx does not always recommend beach nourishment. For example the Edisto Beach, SC study recommended groins in combination with beach nourishment. 5) Only one recovery factor can be used by the model, not different ones for different frequency storms. There is no post storm beach recovery data available for Flagler County. 90% represents an approximate average between recovery from frequent/small storms that is likely close to 100% and recovery from less frequent/larger storms that is likely less than 90%. It is also relevant that since we calibrate long term modeled erosion to measured rates, that the overall long-term volume loss of the beach is not controlled by the recovery factor, but it is controlled by the calibration to measured data. 6) Degrove Surveyors, Inc. was contracted to survey the first floor elevations of structures within the study area for approximately $60,000. 7) Table 3-7 shows without project damages for three different sea level rise scenarios. The low sea level rise scenarios which reflects the measured historic sea level rise is used for the BCR presented, however the analysis was done for the intermediate and high sea level rise rate also. The BCR remains about the same for the increased sea level rise scenarios as shown at the end of chapter 5. (Response by MTD)

Residents and Private Individuals

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				Ch 4: Addresses FDOT maintenance costs to beach revetment area, and Flagler Co taxpayers will be paying 50% of the costs for this area. Assumes FDOT costs would be reduced. Seawall along the beach is producing hazardous conditions from corrosion. Ch 5: Questions of the screening process (plan formulation). 1) Are there other ratios >1 that may yield longer term benefits, such as reef and renourishment with initial greater cost but lower maintenance longterm? 2) What is the balance between economic development vs storm damage and insurance; environmental quality vs aesthetics and natural resources; other social effects vs life, safety, and property values; regulate economic development vs employment, sales, and business development? Suggests more detail is needed in plan analysis with positive BCR, more detail for the elimination process. Is there a positive alternative to the proposed plan?	Ch 4: no specific questions. Ch 5: 1) all of the benefit to cost ratios presented consider costs that include all anticipated maintenance/repair costs over a 50 year period. The 50 year planning period is based on Corps policy. 2) The BCR is based on the economic benefits of reducing damages to existing infrastructure and a small amount is from incidental recreation benefits. Benefits for other social effects and environmental quality are considered qualitatively, but are not reflected in the BCR. The final alternatives with positive BCRs are shown in Table 5-9. (Response by MTD)
				Ch 6: No explanation regarding how sand will fit and stay on the dune at existing angle. Questions: 1) If known past successful projects using this plan, please provide the study results or citation. 2) Who (peer groups) has examined the Beach-*fx* data to provide assurance that renourishments is feasible every 11 years? 3) Sparse data of longterm impacts of dredging sand from borrow area; discussion should be improved. 4) Have FDOT or FDEP given approval of this plan? 5) Is Flagler County the first time experiment for this type of project; critical of other counties that have had similar concerns (erosion, loss of offshore sand source); Flagler County should not join them. Ch 7: Feels threatened by statement if borrow area is not used for this project, demand of sand for other shoreline protection would be used in the future by other stakeholders. Does not feel the TSP will improve or help solve the erosion longterm. Thinks data was skewed to create a project fitting within the BCR guidelines; are Flagler County officials just seeking federal funding? Believes the plan is to cover up past mistakes at great cost to county taxpayers and that dredging projects create more costly problems that they fix.	Ch 6: 1) The TSP design is specific to Flagler County, however similar projects have been successfully implemented along the east coast of Florida in Nassau, Duval, St. Johns, Brevard, Martin, Palm Beach, Broward, and Dade Counties. 2) The use of Beach-fx specific to this study has been reviewed the Engineering Research and Development Center (ERDC) by the model developers and by the Coastal Planning Center of Expertise. 3) The borrow area falls under the jurisdiction of the Bureau or Ocean Energy Management, and the discussion of dredging in the borrow area has been revised based on their comments. 4) FDOT and FDEP have reviewed the draft report and are currently in support of the project. 5) The TSP design is specific to Flagler County, however similar projects have been successfully implemented along the east coast of Florida in Nassau, Duval, St. Johns, Brevard, Martin, Palm Beach, Broward, and Dade Counties. (Response by MTD) Ch 7: The statement about the borrow areas potentially being used by other stake holders is not a threat, but a reflection of the current climate within Florida, where there are several active beach nourishment projects looking for new sources of sand. (Response by MTD)
SaveFlaglersBeach.com Officers	SaveFlaglersBeach.com whoknows11us@gmail.com	6-Mar-14	email	Gives background on citizen organization- non-profit, volunteers, education-focused on shoreline systems. Feels mining sand for placing on dune strewn rock revetment won't solve serious situation. Felt posters and information was difficult to understand, "young" engineers were ill prepared to answer questions, and have been educated with "out of date" text books. The 10-year, $3M study left them feeling cheated, and project will put a lot of money towards dredging industry. The group feels it is at "war" with USACE; the military is not held accountable for actions, cites Hurricane Katrina as example. Accusation of using money for backing Congressional politicians and lobbyists with no intention to solve the beach and shoreline avulsion on Flagler's coastline. Finds the work to date as unacceptable and would prefer to put two feet of annual vertical height of sand on the beach, protect the natural sand dune system, and preserve SR A1A. Feels that the group's dedicated work has been disregarded and deserves more respect than have received in the past.	The feasibility report and study process has been conducted in accordance with Corps policy. Flagler County is in support of the project as the non-Federal sponsor. The return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD)
Lourdes Quintero-Knapp	2544 S Oceanshore Blvd Flagler Beach FL lourdes.knapp@gmail.com	14-Mar-14	email	Opposed to the project. Feels it is an open-ended commitment due to lack of knowledge about similar projects; not a permanent fix for erosion problem which could damage the shoreline and ecology.	Similar projects have worked around the state of Florida. The return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD)

Residents and Private Individuals

Name of Commenter	Contact Information	Date Comment Received	How Comment Received	Comment Key Point(s) Summary	USACE/Sponsor Response Summary
Mary Louk	mlouklb@gmail.com	17-Mar-14	e mail and attachment	Feels it is fiscally irresponsible to recommend commitment of $43.5 funding for a plan that is known to fail by needing periodic renourishments. Questions: 1) How close of a match is the sand from 7 miles out? 2) What is the sand harvesting doing to the ocean floor? 3) What is the impact to the areas around it? 4) How long will the sand supply last? 5) What is the impact to the marine and sea life during this whole process from collection through redistribution of the sand? Concerned grows due to recent articles regarding Miami-Dade and Broward Counties sand search problem. Per study: wants more detail of analysis of other options with positive points (3 pts or less); short term and long term costs, and why they were eliminated. Believe a cross-agency review (USACE, FDOT, FDEP, others) review options for longterm cost and viability of options. Would like to see something different than what has been done before.	Regarding 5): Short-term impact to dune and beach habitat due to burial/disturbance, but long term benefit through increase of these habitats for nesting sea turtles, shorebirds and benthic fauna. Temporary impact to fish in the water column and benthic resources during dredging activities. Short-term turbidity would be present at the borrow area and placement site. No hardbottom resources were identified to be present in the borrow area during the subsurface resource survey; therefore, no impact would occur to this resource. (Response by KKM)
Robert Welz	88 Cochise Ct Palm Coast, FL 32137	5-Feb-14	USPS	Agrees that damage to beaches is from storms. Feels some areas need re-sanding. Thinks that the sand needs to come from Matanzas Inlet first due to its damage from sand build up which has hurt local fishing, bait shops, and impaired Coast Guard rescue response. Intracoastal has sand build-up problem; this project could help with that. Feels it would be cheaper to dredge from Matanzas Inlet and truck-transport to Flagler Beach.	Beach quality sand that is dredged from the intracoastal waterway in the vicinity of Matanzas Inlet has historically been placed on the beaches to the south of the inlet. The shoals around the Matanzas Inlet were considered as a potential sand source early on in the study, however it did not show to have enough sand available for the project. (Response by MTD)
Donald White, Conservation chair for Flagler Audubon Society	13 Wilderness Run Flagler Beach FL 32136 djwhite077@gmail.com	5-Feb-14	Comment Card	Requests listing Flagler Audubon Society, Inc as party of record, and gave contact information: Attn: Conservation Chair, P.O.Box 350695 Palm Coast, FL 32135-0695; e mail: flalgeraudubon@gmail.com. Phone 386-259-0366	Noted and added to mailing list
Donald White, Board Member Environmental Council of Volusia and Flagler Counties	P.O Box 929 Daytona Beach FL 32115 djwhite077@gmail.com	5-Feb-14	Comment Card	Requests listing Environmental Council of Volusia and Flagler Counties as party of record, and gave contact information. Phone 386-259-0366	Noted and added to mailing list
RM (Pete) Hull	19 Ibis Ct North Palm Coast, Fl 32137	5-Feb-14	Comment Card	Olsen Engineering in Jacksonville. No other comment given on card, see recorded comments below.	Noted
Barbara Revels, Flagler BOCC	P.O.Box 434 Flagler Beach Fl 32136 brevels@flaglercounty.org	5-Feb-14	Comment Card	Should major storm event occur before project is done, will the Corps react to FDOT's action to hold the highway? Will you stop them from hard vertical armoring? Will you assist them in emergency soil placement instead of armoring? What other options will they/we have and will local government have approval or denial ability of those actions?	Until the project becomes authorized and appropriated, it would be business as usual, so any type of storm incident that may occur before 2017 construction would be business as usual (FDOT or what ever the process would be). Once construction is completed, in the event of a major storm and erosion, the project would be eligible for Flood Control Coastal Emergency (FCCE) funds at 100% Federal responsibility; the local sponsor is not on for one dime. But to get into that program, the initial construction must be completed. USACE would not assist in emergency soil placemen; that would be a State function until such time as the project is authorized. Any technical assistance [pre-authorized] would be up to the State and FDOT. (Response by JH). The FDOT has a process in place with the City and County and all applicable agencies before we do anything, we have to activate biological assistance, and have to consult with all the applicable stakeholders, lessons learned from what was done previously. (Response by Aland Hyman FDOT).
Heidi McNeely	318 North 11th Street Flagler Beach FL 32136	5-Feb-14	Comment Card	If after initial event or up to third replenishment, and it's not working, can the County pull the plug?	If the project is not performing after initial construction, Flagler County could decide to pull the plug on the project. A project partnership agreement (PPA) will need to be executed prior to initial construction that will outline the Federal and non-federal responsibilities agreed to for the project. (Response by MTD)
Alan Hyman, Director of Transportation Operations, FDOT	719 South Woodland Deland FL 32720 386-943-5477 alan.hyman@dot.state.fl.us	5-Feb-14	Comment Card	Wanted to thank USACE, FDEP, City and County on working on this important project. The FDOT will continue to work with and actively support all efforts in stabilizing the beach while also protecting SR A1A. Thanks to all stakeholder to come up with a workable solution.	Noted
Allan Hailer	P.O. Box 1838 Flagler Beach FL 32136	5-Feb-14	Comment Card	Requested to be included on the mailing list. No other comment	Noted and added to mailing list
Sandra Mason	1601 North Central Avenue Unit #801 Flagler Beach, FL 32136 beachsandra@mac.com	27-Mar-14	email and attachment	As discussed at the presentation meeting, the time allotted to read and understand and formulate questions and/or comments was extremely brief in relation to the nearly 10 years it took to create the plan. I appreciate your willingness to extend the 30 day comment period.	The comment period was extended to March 15, 2015.

Residents and Private Individuals

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				Has this type of "sacrificial berm" been done in the SE US on the Atlantic coast? Please provide location(s) and renourishment intervals.	There are several beach nourishment projects on the Atlantic Coast of Florida that have beach nourishment projects that have sacrificial berm features. These projects and their respective planned nourishment intervals are as follows: Nassau County has a 4 mile project with a planned nourishment interval of 5 years, Duval County has a 10 mile project with a planned nourishment interval of 4 years, St. Johns County has a 3 mile project with a planned nourishment interval of 5 years, Brevard County has a 6 mile project and 3 mile project with a planned nourishment intervals of 6 years, Ft. Pierce has a 1 mile project with a planned nourishment interval of 2 years, and Martin County has a 4 mile project with a planned nourishment interval of 13 years. The planned nourishment interval does not always match exactly with when the actual nourishments take place depending on the timing of storms and erosion. (Response by MTD)
				How is it possible to project a cost if the type of equipment is not known? What other type(s) of equipment are being considered and what are their associated costs and environmental risks?	We can not say for sure what type of equipment will be used because the construction of the project will be bid out to a contractor, and we cannot dictate the exact type of equipment they must use. However, the cost is based on the most likely equipment expected to be used based on similar completed projects. There is a low risk that a different type of equipment would be used that would increase the cost or have negative environmental impacts. (Response by MTD)
				How does the TSP benefit the critically eroded area in North Flagler Beach? How does the non-critical beach benefit?	The Florida Department of Environmental Protection (FDEP) has designated 4.8 miles of shoreline in Flagler County as "Critically Eroded". The TSP will directly benefit 2.6 miles of the critically eroded shoreline. Non-critical areas will not be benefited by the TSP. (Response by MTD)
				This report does not meet the purpose and objectives. See Table 5-5 and 5-6.	Table 5-5 and 5-6 present a preliminary evaluation of the possible management measures considered in the first step of project formulation compared to the Federal objectives. The study has determined that there is a feasible HSDR project for Flagler County, which is described by the TSP. (Response by MTD)
				Does economic justification mean the cost of implementation or are potential benefits over time factored in? Some projects may have a higher initial installation cost but a relatively low repeat maintenance cost, making them a more cost effective alternative long term. Renourishment projects have a 4- time repeat over 50 years. Was 50 years the repeat maintenance interval used in determining cost/benefit for all alternatives?	The economic justification includes a comparison of the costs including initial construction and all periodic nourishments over 50 years to the benefits realized over the same 50 year period. 50 year maintenance costs in addition to initial construction costs were used in determining the costs for all of the alternatives. The 50 year maintenance costs for the different alternatives are described in figure 5-3. (Response by MTD)
				"The inland extent of the Flagler County study is based on detailed engineering analysis recently completed for St. John's County..." Why is this valid for Flagler County?	This inland extent was used for setting up the Beach-fx model based on the extent of shoreline recession in the study area being expected to be similar to that immediately to the north since geographic characteristics and wave climate closely resemble those of St. Johns County. An additional 100 feet was added to the probable 100-year storm recession to ensure adequate data collection for probable areas of impact. The model results showed that the erosion and damages did not go beyond this inland extent, so the inland model extent is valid. (Response by MTD)
				Referring to referenced erosion rates from 1999 FDEP report: Where is the verification? Since a range is given was the mid range number of -0.5 ft./yr. used for the model? If not, and no verification has been reported, would not the -1 foot per year stated in your report be inaccurate?	The context of the reference to the FDEP report made in section 1.6.2 is a short summary of the FDEP report along with summaries of other non-Federal studies. This erosion rate was not used for the model. The latest erosion rates based on the surveys at each profile in the study area were used in the model. These erosion rates are described in Table 3-1 of the main report and in even more detail in Table A-9 and Figure A-10 of the Engineering Appendix. (Response by MTD)
				"FDOT does not currently have any dune stabilization plans for SR A1A in their 5 year work program." The 5-year rolling budget published in 2012 had a total of $4,289,751 projected for SR A1A Stabilization between 2011-2015 with $3,957,486 budgeted for 2014-2015.	The context of the reference to FDOT not currently having any dune stabilization plans in section 1.6.2 is a short summary of the FDOT 2010 PD&E study along with summaries of other non-Federal studies. (Response by MTD)
				What role does the pier play in the critical erosion in south Flagler Beach?	The pier tends to trap sand from longshore transport causing downdrift erosion about 2,000 feet south of the pier due to the interruption of longshore transported sand. (Response by MTD)

Residents and Private Individuals

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				"Due primarily to the stabilizing presence of a concrete and steel seawall over a significant portion of the reach, Beverly Beach experiences a lower shoreline rate of change, approximately -0.11 ft./yr." This seems to indicate that a similar seawall constructed along the length of Flagler Beach would solve the erosion problems. Where are the cost/benefit numbers over a 50-year period for comparison to the TSP? Does the Beverly Beach seawall cause the same downdrift erosion as the pier and what role does it play in the critical erosion of reach R065.2-070 in north Flagler Beach?	The rough order of magnitude cost for a seawall, including maintenance over 50 years is estimated at $5,191/linear foot where as the rough order magnitude cost for vegetated dunes over 50 years is estimated at $3,166/linear foot. These costs used for screening purposes is shown in figure 5.3. The seawall in Beverly Beach doesn't cause downdrift erosion to the same extent as the pier. This seawall is located about 3,000 feet north of the critically eroded area from R-65.2 to R-70. The critical designation for this area is primarily due to the proximity of erosion to A1A. (Response by MTD)
				Why then was Alternative S-8 Nearshore Placement dismissed?	Nearshore placement was screened out because it is not likely to work as well as beach placement as there is a possibility that the sand may never migrate onto the beach. (Response by MTD)
				"...any tropical disturbance passing within this distance even a weak tropical storm, would be likely to produce some damage along the shoreline." This statement is conjecture. Where is the data to substantiate this statement? As a Flagler Beach resident I can tell you from experience that frequently tropical systems produce less damage than non-named systems or nor'easters.	The first paragraph in section 2.2.11 notes that although hurricanes typically generate larger waves and storm surge, northeasters often have a greater impact on the shoreline because of longer duration and greater frequency. More importantly nor'easters are included in the historic storm database which is used my the model to estimate future erosion and damages. The context of the discussion referenced by this comment is in reference to Figure 2-15 which shows only tropical storm paths. (Response by MTD)
				Nesting data with specific locations is available. Locations are referenced by cross street numbers and walkovers.	The data was acquired from the Florida Fish and Wildlife Conservation Commission (FWC) who manage all sea turtle volunteer data throughout the state. As discussed on page 2-33, the FWC data does not include GPS location coordinates because of inconsistency of reporting but has the nesting data organized by reaches, the basis of the Tables 2-10 to 2-12. The area found to have the least nesting was south Flagler Beach where revetment and SR A1A seawall have replaced habitat. (Response by KKM)
				The Flagler Turtle Patrol relocates nests that are in danger of overwash, especially those areas in R-79. Relocation information is also available.	Through consultation between the Corps, USFWS and NMFS, the Federal Biological Opinion for the project covers all activities related to sea turtle protection, including nest monitoring, relocation and data collection submission. Furthermore, prior to any construction activities, the project will require permit issuance by FDEP which also includes mandatory actions for the continued protection of sea turtles and their nests. Sea turtle nest relocation will be conducted by qualified permit holders which could include the Flagler Turtle Patrol or other parties determined by project-specific requirements at time of construction in compliance with the Biological Opinion and FDEP permit. (Response by KKM)
				Why was there only one site visit in a 9-year period for a $3m plus project?	There have been several site visits by USACE Biologists, Archaeologists, Geologists, hydrographic surveyors, and other team members throughout the feasibility planning phase of this study, most recently occurring from 2010 to present. Additionally, data collection by contracted services have been conducted on behalf of the USACE and Flagler County including cultural resource, nearshore resources, borrow area, and sand search surveys. (Response by KKM)
				"Florida pompano, flounder and tarpon are considered to be Aquatic Resources of National Importance (ARNI) by the U.S Environmental Protection Agency (EPA)" How will these species be affected by dredging, loss of habitat, and turbidity?	Dredging may temporarily affect feeding success of species due to turbidity and loss of benthic organisms; however, adjacent similar habitat is available for feeding. Benthic organisms are expected to recover and inhabit the substrate within the borrow areas over time. The temporary adverse effect of turbidity from dredging is expected to diminish upon completion of dredging activities. No permanent loss of fish habitat is expected. (Response by KKM)
				Table 2-16 Bird Sightings. "All observations occurred during one-day event (August 2, 2011) by USACE Biologist. Is a sample of one valid considering the length of the project? Same single site visit in a 9-year $3mil project?	Several site visits have occurred by USACE biologists for the purpose of the Environmental Assessment (EA) component of the feasibility study, although observations from the August 2, 2011 date were included in the EA. These site visits were incidental in nature which is sufficient for NEPA compliance during a planning phase. The site visits are not intended to be considered comprehensive bird surveys, which are not required for a planning phase EA under NEPA. In addition, data resources from FWC, Florida Audubon Society, and Cornell Ornithology Lab (birds) database website were researched for statistical data used in the study during the planning phase of the project. (Response by KKM)

Residents and Private Individuals

Name of Commenter	Contact Information	Date Comment Received	How Comment Received	Comment Key Point(s) Summary	USACE/Sponsor Response Summary
				Table 2-18 Existing Coastal Inventory by Damage Element Category & Type. Is this table for the entire length of Flagler County or just the length of the TSP? There are not 1,286 structures in the 2.6 miles of project area. What is the real number for the project area? What is the cost/benefit ratio in the actual project area? Are you suggesting that the TSP will benefit all structures along the Flagler County coast? If so, how?	Table 2-18 is for the entire 9.6 mile study area described in Table 1-3 and in more detail section 2.2.1. Table 2-5 of the Economic Appendix shows that there are 472 structures in the 2.6 mile TSP area, also known as reach C. The TSP will not benefit all structures along the entire Flagler County coast or even all of the structures in reach C. The project only benefits the structures that would otherwise be damaged in the without project condition. Most of the benefits are associated with reductions to armor damage along the A1A revetment. The benefit to cost ratio of 1.83 presented in the report only applies to the 2.6 mile TSP. (Response by MTD)
				What is the dollar value placed on beach armor in "disrepair" in the project area?	Existing coastal armor was inventoried, categorized, and valued based on its composition and level of protection afforded. The existing value of the road and armor in the 2.6 mile TSP (reach C) area is estimated at approximately $7.5 million. More details on the existing coastal armor value is in section 2.3 of the economic appendix. (Response by MTD)
				"According to FDOT contractors, this revetment is maintained at an annual cost of approximately $1.5million." Please cite the source of this information. It is in conflict with the published FDOT budget.	This should be $1.25 million annually based on the FDOT PD&E study. This sentence will be revised for consistency. (Response by MTD)
				This study notes only 40 years of shoreline data. Why were earlier sources such as the aerial photographs in the UF digital collections not used?	Earlier sources of shoreline data were not used because the accuracy of that data can not be. Also aerial photographs and some of the older data can not be used to determining volume changes when compared to the data used for the study. (Response by MTD).
				Table 3.3 Qualitative Matrix describing vulnerability of resources from potential accelerations in SLC. This table appears to show "low vulnerability" for infrastructure over the next 50 years. Why then is there a need to spend $40mil of taxpayer money?	Table 3-3 does show that the infrastructure in the study area has a low vulnerability specific to future sea level change (SLC). However, the infrastructure is still vulnerable to erosion damages and the return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD)
				"…it can be reasonably assumed that efforts will be made to maintain the dune at its current elevation to protect Highway A1A." That being said, why is spending $40m needed or justified?	Over the 50 year project life the cost to implement the TSP is estimated to cost less than what it would cost FDOT to repair the armor and roadway on an as needed basis. The return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD)
				Does beach-fx take into account the natural recovery processes during those intervals? It appears to be a snapshot of the worst-case scenario. Beaches have the ability to recover naturally as evidenced by the fluctuation in the location and length of "critically eroded" segments within the study area.	Beach-fx does account for the natural recovery process following erosion events. A 90% recovery factor is used. Only one recovery factor can be used by the model, not different ones for different frequency storms. There is no post storm beach recovery data available for Flagler County. 90% represents an approximate average between recovery from frequent/small storms that is likely close to 100% and recovery from less frequent/larger storms that is likely less than 90%. It is also relevant that since we calibrate long term modeled erosion to measured rates, that the overall long-term volume loss of the beach is not controlled by the recovery factor, but it is controlled by the calibration to measured data. (Response by MTD, LH, &JE)
				What criterion is used to determine aesthetics?	The impacts on aesthetics in the future without project condition is described as long-term decline in appearance of the beach as it continues to erode based on the comments at past public workshops and meetings that the existing revetment and seawall are considered visually unattractive. (Response by MTD)
				...why was Alternative S-8 Nearshore Placement eliminated? It is the only alternative that addresses "the natural process to replace sediment."	Nearshore placement was screened out because it is not likely to work as well as beach placement as there is a possibility that the sand may never migrate onto the beach. (Response by MTD)
				"The report will serve as a decision document for Federal participation related to hurricane and storm damage reduction over a 50-year period." Does this mean that regardless of advances in technology our community has no other option or alternative FOR THE NEXT 50 YEARS?	Monitoring of the project performance, changes to the project area, or advances in technology may warrant changes to the project over the 50 years of the project life. Any potential future change to the project would need to get certain approvals, including congressional authorization, before the change could be implemented. (Response by MTD)
				Referring to NED benefits: Does this benefit have a time frame? For example, cheapest to construct has very little value if it doesn't last. How were the cost savings over time factored in to each alternative? Also, how were negative environmental impacts factored in?	The time frame for NED benefits is 50 years. The costs used for each of the alternatives reflects the total costs over 50 years. The project was formulated to avoid negative environmental impacts. If an alternative was selected that required mitigation for negative environmental impacts, then the cost of the mitigation would be included in the total project cost. No mitigation for environmental impacts is anticipated for this project. (Response by MTD)

Residents and Private Individuals

Name of Commenter	Contact Information	Date Comment Received	How Comment Received	Comment Key Point(s) Summary	USACE/Sponsor Response Summary
				Please quantify how each alternative met or did not meet the NED criteria above. Charts 5-9 to 5-19 subjectively rule out alternatives without providing any data.	Table 5-1 to 5-6 on pages 5-9 to 5-19 include a subjective rating based on the potential to meet the planning objective of reducing storm damages, as well as decreased costs of emergency services, lowered flood insurance premiums, and project costs. Costs and benefits used to fully evaluate the NED objective were not computed at this stage; however, engineering judgment was used for the value of a measure for this initial screening. (Response by MTD)
				"It was assumed that it would not be feasible or practical to implement any alternatives along a stretch of shoreline less than 1 mile." Why? Critical erosion is critical erosion. If Federal protection is deemed necessary in one area how can it not be in another? This implies that the cost/benefit ratio is used solely for the critical area and not the county as a whole.	In order to compare costs for different alternatives, the costs would need to have a similar scope in terms of shoreline length protected and time period. One mile was assumed because projects smaller than this would not likely provide enough protection to infrastructure to justify Federal project. This one mile length was used for developing the rough order of magnitude cost estimates. Project formulation and screening was not based on the "critical erosion designation". (Response by MTD)
				"ROM Estimate (One Time Build) $/LF" Is this the basis for selecting a method? Cost of construction over the life span of each alternative needs to be factored in for an accurate cost/benefit analysis. Where are these numbers?	The rough order of magnitude (ROM) cost estimates presented in Figure 5-3 include construction and maintenance costs applicable over 50 years for each alternative. The screening is based on this 50 year cost. (Response by MTD)
				Was not the criteria to be 5-1 above, demonstrating economic benefit consistent with protecting the environment? How exactly does dredging protect the environment? How can dredging and creating an artificial berm be cheaper per 5-26 (One Time Build) than alternative S-8, Nearshore placement?	The national economic development (NED) account does displays the plan with the greatest net economic benefit consistent with protecting the nation's environment. Dredging to construct the TSP would establish a protective vegetative dune that will incidentally provide nesting habitat for birds and turtle. Without a project this area it is likely that rock revetment will continue to be placed over the next 50 ears leading to additional loss of this habitat. Nearshore placement would likely be cheaper that dune and berm construction, however nearshore placement was screened out because it is not likely to work as well as beach placement as there is a possibility that the sand may never migrate onto the beach. (Response by MTD)
Attendance at Public meeting- recorded comments					
Jane Mealy				Not commenting on meeting, heard most of this before at previous meetings. Wants on record that Flagler Beach Commission brought up at last workshop and other discussion, want County and Corps to answer any final concerns that we might have.	Noted
Doyle Lewis				Lives in Flagler Beach. Observed the beach present over last 10+ years, and appreciates the plan. Wants to inspect whatever equipment that will be used, when it arrives in port. Plans to build a house on the beach.	The earliest the construction could be expected to begin is 2017. The project will be bided out, and the exact equipment to be used will be determined by the contractor awarded the project. (Response by MTD)
Sandra Mason				Already addressed some questions. Wonder when the Corps submits budgets to the Federal government where we see this project in your budget for the next phase? Also requested additional time for the public review period, to be included in the record.	The main people that are responsible to provide budgets is the Office of Management Budget (OMB). Based on the guidelines they have set forth, we did not receive the preconstruction, engineering design fund for 2015. (Response by JH, PM)
Linda Provencher, Mayor City of Flagler Beach				Has this project been done anywhere else in the state of Florida or anywhere else that we could possibly look at or monitor?	Numerous beach and dune nourishments around, gave Martin County as example; has small beach and dune nourishment project at north end of county. Brevard County at Patrick's AF Base,: built dune nourishment project along the road. They are very similar to this project. Difference is that the others built a dune as part of the project, but also included beach widening. Specifically, Flagler Beach has a small beach with a steep berm, which we are trying to emulate to establish natural function. (Response by MTD)

Residents and Private Individuals

Name of Commenter	Contact Information	Date Comment Received	How Comment Received	Comment Key Point(s) Summary	USACE/Sponsor Response Summary
Heidi McNeely			Comment card above	Question on other studies, cite St. John's project, where >1M cyds of sand placed in St Augustine in 2003, 2005 and 2012. Report did not provide funding spent; cycle is >11 years. Referred to Virginia Beach projects in 1960's and 70's where millions of dollars were spent; feels this data should have been included in the report. Questions relevance of facts provided in Ch.1, example: cited structural and content value-- why should USACE/ Sponsor be concerned about the contents of very expensive homes on the beach. Looking at the proposed $43M, feels that it is only 1/6th of the total investment, but that the $43M won't be spent for any of those homes in that area, instead just a small portion of Flagler Beach. Questions the $43M over 50 years for a natural process of losing sand every 11 years as stated (by USACE), along with statement of sand accretion; questions the renourishment cycle. Felt that a lot of the non-structural measures were dismissed. Mentions the Hammock and the coastal construction line westward; is the Hammock "hurting" that bad because of this? What is the effect to Flagler Beach if SR A1A has to be moved a little bit, i.e. onto an alternative street; has this cost been looked at? Feels USACE/Sponsor are playing the hurricane card a bit regarding the SR A1A evacuation route; there are alternative streets and more concerned about the IWW bridge.	The costs associated with this project are detailed in the Cost Engineering Appendix and summarized in the main report. While similar to other projects, this project requires less volume to be placed than most other projects, so the over all costs are not comparable to projects in other locations. The content value of structures is included in the analysis according to Corps policy. The content of structures has an economic value associated with it, and reducing damages to it yields an economic benefit in the same way that benefits are realized by preventing damages to the structures themselves. The structure inventory and future without project information presented in the first 3 chapter cover the 9.6 mile study area described in Table 1-3. The TSP will not benefit all structures along the entire Flagler County coast or even all of the structures in reach C. The project only benefits the structures that would otherwise be damaged in the without project condition. Most of the benefits are associated with reductions to armor damage along the A1A revetment. This is described in chapters 5 and 6. The benefit to cost ratio of 1.83 presented in the report only applies to the 2.6 mile TSP. Non-structural measures were considered and costs were developed with input from FDOT for relocating A1A in Flagler Beach which is described in chapter 5. The CCCL setback in the Hammocks area has worked because most of the development was built after this policy was in place. A1A and other structures were built in according to the development policy at the time, and non-structural measures are more costly and have more legal challenges when development is already in place. (Response by MTD)
John Herpielding				Not a genius but can read. Other sites where USACE has done beach erosion projects, will hear it is wonderful, but when you ask the people what they think of the job a couple years later, they will say it doesn't work. Asking local people to foot the bill for >$10M is a lot of money for something that doesn't work. Discusses God and Mother Nature's role in ocean currents. Key Point: Unless you can justify what you are doing, thinks it is wrong by the simple fact that you've been running a study for 12 years and can't find the right answer.	The return on investment for the TSP is estimated to be $1.83 for every dollar spent over 50 years. (Response by MTD)
Rick Belhumer				Resident of Flagler Beach. Points out that parts of the Reach are close to the road [SR A1A].Are you starting out with that average and then adding 10 more feet so it will be pretty my a straight dune going down through there? If there is a wall, you are only going 10 feet from it?	Initial construction it will start where the existing dune ends if existing armor is there now at the top of the dune. It will extend seaward 10 feet from there. It will slope downward 3-on-1 to the level of the existing beach berm, then continue out for the rest of the volume. The first 10 feet is straight out from the wall, and then with 3-on-1 slope, about another 30 feet from there. (Response by MD). The dune will be 10-ft off what we are referring to as the existing edge. However, the shoreline is not straight, it waivers. We plan to essentially extend the existing dune edge by bringing it out about 20 feet from SR A1A, then 10 feet from there for an average of 30 feet from the road edge with the slope to the berm, and straighten the dune as well. (Response by LH)
John Herpielding (repeat)				Second question regarding eminent domain: do you guys have any answers to what might be involved with that? Who pays for that part? (Referring to walkovers and the property that will be dumped upon.)	There are 42 walkovers in the project footprint. Of these, 21 are public and 21 are private. The study proposes they would be removed, the extension put in, and then replaced, but this is not definite. During the 2015 construction and design phase, will look at every opportunity to keep them in place and possibly work around them. The non-federal sponsor, Flagler County, is responsible for obtaining those perpetual storm damage easements for all creditable structures or items-- whatever money they spend for the public walkovers, USACE will credit back to their share on the construction. USACE will also cost-share in the replacement of the public walkovers. For the private walkovers, that is between the county and private citizen. (Response by JH)

Residents and Private Individuals

Name of Commenter	Contact Information	Date Comment Received	How Comment Received	Comment Key Point(s) Summary	USACE/Sponsor Response Summary
Pete Hall				Resident of Palm Coast. Refers to his son's house in Baldhead Island [NC] where the USACE dredged the Cape Fear channel and eroded the beach. USACE help refurbish the beach with similar technology of groin construction which was found to be effective. The engineering firm that did the work is based in Jacksonville (Olsen Engineering), who is well-versed in Atlantic coastline and has done local private and public funded projects; Olsen Engineering are interested in helping with this project as well. Mr. Hall is interested in anything that might be useful to the people of Flagler County or the Federal government in solving the erosion problem.	Groins and other similar structures were considered in this study, however, the beach along Flagler County is relatively straight. Structures in this case would likely cause the erosion to worsen on down drift shorelines unless additional sand was placed down drift of the structure. For this reason the study found structures to be cost prohibitive and not meet the study objectives. (Response by MTD)
Alan Hyman, Director of Transportation Operations, FDOT			Comment card above	Thanks the Corps [USACE] FDEP, City and county on working this very important project, long time coming as indicated by the timeline. The FDOT will continue to work with and actively support all efforts in stabilizing the beach while also protecting SR A1A. We realize that it is very important economically. Thanks again to all the state coffers to come up with a workable solution.	Noted
Joanne Ricardi			E mail also	Long time Flagler Beach resident. Disappointed that the only solution is same thing that has been done elsewhere and doesn't work. Concerned about statement that there will be no harm to creatures. States there are gopher tortoises on the dunes, assume they will be addressed prior to sand placement. Sea turtle beach nesting concern for 6 months of the year, commitment from USACE/Sponsor to do the project outside of the sea turtle nesting season.	Regarding gopher tortoises- USACE has surveyed the entire study area and have not found any gopher tortoises along the dune face or top. They may be further back in the dune outside of the work or study area. Typically they like to burrow in upland soft sand, but along the beach, they are out of their element. Regarding sea turtle nesting season, a requirement that USACE has with our resource agencies, USFWS, NMFS, and FWC, is to work together and get biological opinions, which are memorandums of agreement that the project will meet specific terms and conditions to address the habitat and usage of these areas by listed protected species as well as general wildlife. Working outside the windows of nesting season is preferred but not always the reality. We have measures in place that we can use to address the nesting season, such as pre-construction surveys and nest relocation if construction is during these windows. All work is done in the best feasible manner possible to protect these species and in compliance with our biological opinions and permits to the satisfaction of the resource agencies. (Response by KKM)
Doyle Lewis, return				Repeated that the younger people that want to build here need somebody to support them; they are the ones that is doing the work. If you want them to have a job, you would give them a job.	Noted

From: Carey Strickland Strickland
To: kathleen.k.mcconnell@usace.army.mil.
Subject: [EXTERNAL] dunewalkover
Date: Thursday, January 23, 2014 9:13:10 PM

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i live in Flagler Beach and am concerned about my property on a1a which I have Littoral rights too and have a dune walkover on, in which i have permitted and built a dune walkover on. The talk about possibly damaging it or taking it by eminent domain is alarming . my name is Carey Strickland and my address is 1708 N. Central Flagler Beach , Fl. 32137 . Is this property in the path of restoration of the beach ? If so why would they need to remove it or take my land ?

PLease email me something about my situation as to my concern. I will be looking forward to hearing back from you , Carey.

if you would rather call me my phone # is (305)299-9955

From: Durkin, Martin T SAJ on behalf of HSDR Comments, Flagler
To: McConnell, Kathleen K. SAJ
Subject: FW: [EXTERNAL] Flagler Beach restoration by sand dredging (UNCLASSIFIED)
Date: Monday, January 27, 2014 10:58:59 AM

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Dale Clegg [mailto:flaglerlpn@yahoo.com]
Sent: Thursday, January 23, 2014 4:37 PM
To: HSDR Comments, Flagler
Subject: [EXTERNAL] Flagler Beach restoration by sand dredging

Hello -
I'll start by saying that I've been spending year-round time at Flagler Beach for the 50+ years I've lived in Flagler County. I've spent hours hiking, surfing and fishing that beach, and I know it well. I've also frequently spent time at beaches as far north as St. Augustine and as far south as Ponce Inlet.

I don't claim to know what the solution is to the erosion, but I know what it isn't. The solution is not to pump sand onto the beach and just hope it doesn't wash away during the first n'easter or hurricane that goes by. I've seen what happened to the beach at St. Augustine after millions of tax dollars were spent dredging and pumping from the inlet to the beach some years back. The first time, one storm wiped away all the efforts that money could buy. Some of that white sand ended up down here on our red beaches for awhile, then most of it washed away to somewhere else. I'm expecting that to happen at St.Augustine beach again before long after the second foolhardy effort was just recently completed. Flagler Beach has always been a narrow beach since I was a kid and long before that. That's the way it is, and that's the way it will always be, no matter what Man tries to do with it. The problem isn't the beach - it's the fact that we've foolishly built stuff (including a state road) right on top of an ever-changing piece of real estate. I don't know any good solution for that, but please don't waste millions of our tax dollars on a non-solution. Thanks for your time - Dale Clegg

Classification: UNCLASSIFIED
Caveats: NONE

From: Durkin, Martin T SAJ on behalf of HSDR Comments, Flagler
To: McConnell, Kathleen K. SAJ
Subject: FW: Comments on the ACOE study (UNCLASSIFIED)
Date: Monday, January 27, 2014 10:59:45 AM

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Frank Meeker [mailto:fmeeker@flaglercounty.org]
Sent: Saturday, January 25, 2014 6:43 PM
To: HSDR Comments, Flagler
Subject: [EXTERNAL] Comments on the ACOE study

In reference to the reasons why some options are not appropriate. I suspect that undercurrent stabilizers have difficulty in high wave energy environments. Attempts have been made in the past on the west coast. I believe at least two efforts ended in failure as the concrete filled tubes bucked as waves eroded under the bases. That coast is considerable flatter than ours so I suspect that without engineered modifications in a current design, (and so far, such engineering has not been presented to the Flagler Beach Commission, the Tourist Development Council or the Flagler County Commission) our steep slopes will allow a transfer of a greater amount of destructive wave energy closer inshore rendering anything of permanent nature susceptible to failure.

Frank J. Meeker, C.E.P.
Flagler BOCC, District 2

PLEASE NOTE: Florida has a very broad public records law. Most written communications to or from the Flagler County Board of County Commissioners and employees regarding public business are public records available to the public and media upon request. Your e-mail communications may be subject to public disclosure.

Classification: UNCLASSIFIED
Caveats: NONE

Robert Welz
88 Cochise Ct
Palm Coast, Florida 32137

Kathleen McConnell
(CESAJ-PD-EC)
Us Corps of Engineers
701 San Marco Boulevard
Jacksonville, Fl 32207

Dear Kathleen McConnell:

Flager beach resand project

1. I agree that their was damage done to the beaches and a lot was from NE storms

2. That some areas need resanding

3. But I think the sand needs to come from Matanzas inlet first this inlet all some has been damaged with added sand

    * This has hurt the local fishing

* hurt local bait shops and the area as we are losing a inlet that was hard to get out is now very hard now but people will still try and the bar is a bad place to get stuck and could cause lost of life as there is no rescue eg Coast Guard coming for a long time.

* The intercoastal has a major problem with sand building up but if the extra sand was removed from the inlet and just inside of the bridge this would greatly improve the intercoastal area also where do you think the sand for shoring up intercoastal comes from ever few year you all have to spend many millions on dreging the intercoastal area at matanza do to shoring. Would not it be better to now take the sand you need for flager beach form this inlet. and as for cost it would be cheaper also as from dredged to dump truck to area needed.Thank you!

Sincerely,

Robert Welz

From: Nagendra Kumar B
To: HSDR Comments, Flagler
Cc: McConnell, Kathleen K. SAJ
Subject: Re: [EXTERNAL] SAB Technology for Beach Development at Flagler? (UNCLASSIFIED)
Date: Wednesday, January 29, 2014 7:49:39 AM

Dear Martin Durkin,

Thank you very much for your reply.

In my opinion, SAB technology is unique and it is not a totally hard structure though it virtually appears to be a hard structure. Humans can not replace the nature fully using the artificial nourishment for eroding areas as in case of Flagler. So Green Technology like SAB technology is essential to save human resources while fighting against the nature. I appreciate views and existing players of business if the net result is environment friendly. So, there is a scope for your recommendation for a test project on SAB Technology as it is like a digestible pill in human body for diseases without negative impacts. I am sure ERDC will look into this new, innovative and environment friendly technology for coastal protection. I request that you kindly recommend this technology for a test site, if possible and I assure you the huge economic benefits for all stake holders of coastal protection at Flagler.

I will not be able to attend the public workshop to be held on Feb 5. If possible, pl. convey message to convince that this new concept may be investigated with a test site.

Thanking in advance for kind review and consideration of my views.

Dr. B.Nagendra Kumar
Executive Director
SAB Innovations Pvt Ltd.
Chennai, India
Phone No. :+91-94442-38590

On Tue, Jan 28, 2014 at 11:18 PM, HSDR Comments, Flagler <Flagler.HSDRComments@usace.army.mil> wrote:

> Classification: UNCLASSIFIED
> Caveats: NONE
>
> Dr. B.Nagendra Kumar,
> Thank you for your e-mail and interest in this study. We have considered several measures similar to the SAB technology which you have provided information on. Specific to the conditions in Flagler County, Florida we do not feel like the use of hard structures either by themselves or in combination with other measures will be able to meet the objectives of the study. As far as using Flagler County as a test site for the SAB technology, that is something we cannot recommend through this study. The technology would first need to be vetted through the Corps Engineering Research and Development Center (ERDC). The ERDC website is http://www.erdc.usace.army.mil/.
> A public workshop for this study will be held on Wednesday, Feb 5 at 6 pm, at the Government Center in Bunnell, FL.
> Thank you,
> Marty
>
> Martin Durkin
> Coastal-Navigation Section
> Planning Division
> Jacksonville District
> US Army Corps of Engineers

Phone- (904)-232-2190

-----Original Message-----
From: Nagendra Kumar B [mailto:sabinnovationspvtltd@gmail.com]
Sent: Tuesday, January 28, 2014 10:18 AM
To: HSDR Comments, Flagler
Subject: [EXTERNAL] SAB Technology for Beach Development at Flagler?

Dear Sir,

I am sending this mail with a request to review the application of SAB Technology along the coast of Flagler for beach development and for a possible consideration of test project at this coastal site using this technology.

This SAB technology has many applications in the fields of coastal protection, coastal inlet stability, near shore pipeline installations, Scour protection along the marine and hydraulic structures and river and estuarine bank protection. You may find further description on this new, innovative, effective and economic technology at the web site given below:

https://plus.google.com/u/0/b/101194826952224271949/101194826952224271949/about/p/pub

The latest information brochure on this technology is attached for your information, perusal and further discussion if possible.

Dr. B.Nagendra Kumar

Executive Director

SAB Innovations Pvt Ltd.

Chennai, India

Phone No. :+91-94442-38590

Classification: UNCLASSIFIED
Caveats: NONE

From: Durkin, Martin T SAJ on behalf of HSDR Comments, Flagler
To: McConnell, Kathleen K. SAJ
Subject: FW: [EXTERNAL] Breakwaters for Flagler Beach. (UNCLASSIFIED)
Date: Tuesday, January 28, 2014 12:21:34 PM
Attachments: Scott Adie.vcf

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Scott Adie [mailto:scotta@osgfx.com]
Sent: Tuesday, January 28, 2014 9:45 AM
To: HSDR Comments, Flagler
Subject: [EXTERNAL] Breakwaters for Flagler Beach.

Dear Army Corps of Engineers,

I just finished reading an article in the 'Palm Coast Observer' titled 'Flagler County Beaches About To Get Sandier'. I am excited about the possibilities. However, I agree with County Commissioner Kim Carney, that just adding sand to the beaches is a temporary fix. My reasons come not from and engineering background, though I have studied this subject in the past, but mostly from observation and experience. This is what I believe will offer a more permanent solution.
Breakwaters of concrete and large stone running perpendicular to the coastline and AIA Highway will retain the sand better than anything else. Experience shows that just the simple construction of a pier extends the beaches by reducing erosion due to storm and wave action. The most damaging wave action comes from either northern or southern sea swells that tend to scrape sand away from the shoreline and displace it to deeper waters offshore. Waves that come straight into the coastline do displace some soil but not at nearly the level that northern or southern swells do. Breakwaters and piers tend to greatly diminish the effects of this wave action. I believe if you do not include the addition of breakwaters to the soil replacement plan, that most of the effort will be wasted in a few years. Breakwaters also improve the habitat for sea life and improve the safety for swimmers by reducing rip tides. Please try to incorporate breakwaters into the plan to ensure that this is not a wasted effort. Examples of the success of breakwaters are available for study and Newport Beach California is one of the beaches that has been enhanced by the addition of breakwaters many years ago. Check it out, you'll be glad you did and so will we. Thanks.

Scott & Judy Adie
Hospitality Ministry
Calvary Chapel Flagler Beach
57 Barkley Lane
Palm Coast, FL 32137
scotta@osgfx.com
www.osgfx.com
386-627-8210

Classification: UNCLASSIFIED
Caveats: NONE

From: Durkin, Martin T SAJ on behalf of HSDR Comments, Flagler
To: McConnell, Kathleen K. SAJ
Subject: FW: [EXTERNAL] Storm Damage Reduction STudy (UNCLASSIFIED)
Date: Monday, February 03, 2014 4:36:23 PM

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Mary Ann clark [mailto:mafsclark@bellsouth.net]
Sent: Monday, February 03, 2014 11:53 AM
To: HSDR Comments, Flagler
Subject: [EXTERNAL] Storm Damage Reduction STudy

In my opinion this plan is a complete waste of the public's money and your time. The ocean takes the sand away and returns it at its own pace over many years. We humans should not interfere with Mother Nature! Use the money for the education of our children.

Mary Ann Clark, 1923 South Flagler Avenue, Flagler Beach FL 32136

Classification: UNCLASSIFIED
Caveats: NONE

From: Durkin, Martin T SAJ on behalf of HSDR Comments, Flagler
To: McConnell, Kathleen K. SAJ
Subject: FW: [EXTERNAL] Public Comment on Flagler Beach Problem (UNCLASSIFIED)
Date: Tuesday, February 04, 2014 7:39:13 AM

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: FREDERICK & SUZE PEACE [mailto:4sfpeace@bellsouth.net]
Sent: Monday, February 03, 2014 6:02 PM
To: HSDR Comments, Flagler
Subject: [EXTERNAL] Public Comment on Flagler Beach Problem

This is a time for eminent domain use. There is NO way to fix the Flagler Beach problems except to remove state road A1A. Move it inland. What a nice natural beach it would be. Adding 10 feet of sand and shore is NOT a fix. It is costly, detrimental to the environment, ie. turtles, and it simply is a waste of time and won't work.

Suze Peace
1571 Alanson Dr.
DeLand, Fl 32724
Volusia County
386-738-0924
4sfpeace@bellsouth.net

Classification: UNCLASSIFIED
Caveats: NONE

From: Durkin, Martin T SAJ on behalf of HSDR Comments, Flagler
To: McConnell, Kathleen K. SAJ
Subject: FW: [EXTERNAL] Comments regarding Flagler County Beach Project (UNCLASSIFIED)
Date: Wednesday, February 05, 2014 11:31:39 AM

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Mike Flank [mailto:mlfclf@aol.com]
Sent: Wednesday, February 05, 2014 11:07 AM
To: HSDR Comments, Flagler
Cc: ssettle@cityofflaglerbeach.com; lprovencher@cityofflaglerbeach.com
Subject: [EXTERNAL] Comments regarding Flagler County Beach Project

I am a resident of Flagler Beach and have just built a house on South Oceanshore Blvd.

I have read through the 300 page Army Corp report on the issues and recommendations involving the repair and protection of the beach as we know it. Reading through the data on research predictions of possible present and future storm damage is of course of great interest to anyone living in the immediate area.

I am a strong proponent of preserving and protecting the beaches as one of Florida's most vital resources. I do realize that many opponents feel that any measures proposed by the Army Corp's Report are only temporary measures with no sustainable permanence. However, I realistically feel that there are no guaranteed solutions with regards to nature and its fury. As the report accurately illustrates positive action to sustain is certainly far better than no action. Likewise, to consider experimental solutions that are unproven as was considered earlier in 2013 by the City of Flagler Beach have proven to be completely unverifiable and bad choices.

In conclusion, I completely support the project as presented by the Army Corp. to re nourish the beach and repair the revetments and maintain the same appearance and quality of the beaches that we love.

Mike Flank
1732 South Oceanshore Blvd.
Flagler Beach, Florida
mlfclf@aol.com

Classification: UNCLASSIFIED
Caveats: NONE

From: Jane
To: McConnell, Kathleen K. SAJ
Subject: [EXTERNAL] I attended the meeting in Flagler
Date: Thursday, February 06, 2014 1:01:19 PM

Hi Ms. McConnell,

The meeting was very informative. However, I was surprised and disappointed in the turnout from Flagler Beach. If, as was mentioned last night, Flagler Beach officials had not been actively included/ involved in the County meetings up to now, that may explain the relatively small turnout..

I hope as a result of the forum you provided last night, that the communication between Flagler County Commissioners and the Flagler Beach officials and residents can be improved. As a result, you should receive many more comments from those who would be directly affected by your Project.

As an owner of one a private beach walkway parcel, I received notification of the 30 day comment period in your letter of Jan. 17. I am interested to know if all property owners fronting A1A were included in that mailing , or approximately how many Flagler Beach residents received them. Also, did I understand correctly that the 30 day period for comments is flexible?

Thank you for your response,

Jane L. Hitt
2544 .S. Central Avenue
Flagler Beach, FL 32136
(386)439-1465

From: Jane
To: McConnell, Kathleen K. SAJ
Subject: [EXTERNAL] Comment on Flagler County Project
Date: Saturday, February 15, 2014 9:58:16 AM

To: Kathleen McConnell, USACOE

From: Jane L. Hitt, 2544 S. Central Ave., Flagler Beach, FL 32136

This is a follow-up of my letter to you of Feb. 6, 2014, in response to the Feb. 5 presentation of the Corps of Engineers proposed beach re-nourishment project for a section of Flagler Beach.

I hereby wish to place on record my opposition to the proposed Flagler County Hurricane and Storm Damage Reduction Project.

Without any definitive evidence of successful outcomes at other beaches, this plan becomes a commitment to an open-ended drain on the limited funds of our City and County. As your report demonstrates, there is no permanent fix for the erosion problem. And of greatest importance, this plan will irreparably damage the shoreline, animals and plants.

We will not support unending destruction of our beach habitat, as well as our future quality of life here.

Sincerely,

Jane Hitt

.

From: Patti Powell
To: McConnell, Kathleen K. SAJ
Subject: [EXTERNAL] Flagler Beach
Date: Friday, February 14, 2014 5:53:23 AM

Colonel Alan M. Dodd

District Engineer

Dear Colonel Dodd,

I have been involved for the past several years in the FLAGLER COUNTY, FLORIDA, HURRICANE AND STORM DAMAGE REDUCTION STUDY Project No.: 113166. Needless to say the amount of funding required to bring this project to this point, over $3,300,000 of taxpayer's dollars, is obscene. The time required, just a few months shy of 10 years since the September 2004 signed agreement with the non-federal sponsor, to bring this project to this point is obscene and the end result of this study is obscene.

The document presented is very neatly titled with all appropriate pages and sections, as the law requires, however, the content is skewed 100% toward a wasteful sacrificial dune with no studies showing this project will "save" in the event of a storm or hurricane, structural and content value of approximately $340 million as stated in the study. The structure this project beautifies is SR A1A, which by its name alone will tell you it is a State Road and belongs to the State of Florida. Our community has been built around this road. And it is because of this road being built on the primary dune system many years ago that many people believe we have the areas of critically eroded dunes and beach that we have today.

The reader often gets confused because the entire beach in Flagler County is used throughout the report however, the only area that is being used to justify the study is the very small and focused area of the tentatively selected plan as Reach C in Flagler Beach. As stated in the Executive Summary page ES-2 "The TSP covers 2.6 miles of shoreline length and mainly prevents damage to SR A1A."

I cannot believe the sand being used for the dune extension is being taken 7 miles directly offshore. Where is our sand? For years the USACOE has been telling us that sand only travels via long shore transport. NOW after years of fighting the fight, the report admits on page 2.23 "Once caught in the waves, this sediment is carried along the shore and redeposited farther down the beach, or is carried offshore and stored temporarily in submerged sand bars." It goes on to describe the fierce wave's effect on the beach width and height. Look at the changes in Flagler Beach's profile from photos in 1920s and now. The slope of the beach has grown from 2-3 feet to 11-14 feet. Our sand is gone! It is unique and colorful sand that will not return from dredged sand offshore.

The City of Flagler Beach has lived with an unsightly, eroding seawall since December 2006. The FDOT

built the seawall in a defensive move to hold up A1A and it has. The revetment is a complete eyesore. Both the City of Flagler Beach and Flagler County have written resolutions against seawalls. The revetment is in effect a seawall. It was designed by a civil engineer not a coastal engineer. We all know a healthy beach system contains a vegetated dune with a slope of 1:1. Over the years the waves have encroached on our dune system and the storm water runoff from SRA1A has led to many vulnerable areas of erosion for the road and the dune. Since the decision to put SRA1A where it is, followed by widening the road several years ago the City of Flagler Beach and our beach did not have a chance. We are blessed not to have had a direct hit from a hurricane. We have lost homes on South Flagler Avenue due to storms. Refer to page 3-7, "However, it should be noted that elevations within the project area (Atlantic Ocean-side of the island) are some of the highest on the barrier island, about 15-20 feet above Mean Sea Level. The profile of the island slopes downward from these elevations to the landward side , marsh side, of the island where the lowest elevations of infrastructure are around 2 -10 feet above current MSL." It goes on to state, "Marsh side areas of the island will likely be impacted by inundation more frequently than the ocean side as sea level rises, especially during extreme high tide events."

Storms and hurricanes bring wind and rain. Nothing in this TSP prevents or protects homes from storms or hurricanes. It does not even protect SRA1A. The mitigation of damages can only be to SRA1A. The report leaves the reader thinking the TSP will protect houses and infrastructure. The sea wall used to calculate the total damages does have a useful life. There are projected dates when the sea wall will need to be rebuilt. How does that happen with this project? The last sentence on page 6-2 states, "Most of the benefits are associated with reductions to armor damage along the A1A revetment. In the with-project condition, the cost of maintaining and repairing the revetment is significantly less than it would be in the without project condition. This reduction is the primary source of economic benefits." There is a figure used of $49,000,000 to $2,200,000. That savings is recognized by the State of Florida NOT the City of Flagler Beach nor Flagler County. The State maintains this infrastructure. They should be the entity that enters into a relationship with the USACOE.

What exactly is meant by "highly effective"? There are no highly effective beach/dune nourishment projects. One hundred percent of these projects must have repeated nourishments. On page 6-3 the TSP is described as "not only highly effective, it is also efficient." Moving sand from offshore to the dune and back again, and again, and again is not efficient. There is no data that supports the fact the TSP is effective. Over time this one very small section of A1A will continue to experience erosion because nothing is being done to prevent it. Our sea turtle nests will still need to be relocated to wider sections of the beach. By extending the dune 10 feet seaward the actual width of the beach, mostly at high tide will decrease the width of the beach. The most critical area in front of the dune that needs to have dry sand to feed the dune will be decreased.

Your study uses modeling to determine "the NED plan is highly effective at reducing erosion damages. In the with-project condition the vast majority of damages in Reach C are prevented". The model does not state how or why. There is no science to back this statement. It is a computer model. The last sentence on page 6-3 states "the plan can be considered robust". Robust is a word used in creative writing. If you asked 50 people what they think when they hear the word robust you would probably get 50 different definitions. That is not a word I would use when I see what this report has to offer. So many decisions are made based on the contents of the draft report. Why would the writer use such a word? Robust in relation to what?

Lack of citizen involvement should not be interpreted as citizen support. Many citizens have not been involved with this project because it has taken so long to get to this point. Many people are not affected by this project. Tourism is going to continue to be a major source of revenue for Flagler County with or without this project. This project has so many long term effects on our environment, on our infrastructure and on our community as a whole. The TSP does not solve any problem. I suggest you pull FDEP and FDOT together to discuss this project as they are the stakeholders. They may be willing to fund it, however, I am not. Flagler County does not have a tourist base like Miami and Ft. Lauderdale. Our eroded dunes are NOT stopping visitors. In fact our Tourism Development Council has done an outstanding job marketing our county and we have surveys to prove it. The revetment and

seawall is just outside of the "busy" section of our beach. In a 2011 meeting with the FDOT and their proposed project to extend the current seawall and add sand and vegetation to the project led to a resolution in the City of Flagler Beach against seawalls. They will not continue to cover the wall year after year. This project is nothing more than moving the money responsibility from the state to the citizens of Flagler County.

As far as Beachfx, it is nothing more than a computer program. A program that does not have any history as this project is the first project on the Beachfx program. It appears the USACOE is trying to forecast the future of our beach. Why not look back instead of trying to look forward? The only structures damaged during a storm event include a hotel, the pier and a few west of A1A buildings. THIS PROJECT WOULD NOT HAVE SAVED THEM!

The City of Flagler Beach has a Historical Museum that gives data on what our City has evolved into over the past 90 years. The City is working on and has a draft of our Beach Management Plan, all giving you much history about our shoreline and the rebuilding of our structures. The structure damages included in this study does not take into effect the Municipal Pier. This single structure brings more people to Flagler Beach than any other destination in Flagler County. FEMA has assisted with rebuild of this structure as well as our City insuring the structure. THIS PROJECT WILL NOT PROTECT THIS STRUCTURE. The ONLY structure this project attempts to protect is SRA1A. The revetment was not built correctly, it is NOT maintained by the FDOT and the problem with the runoff on A1A has not been dealt with. Start with resolving the problem not adding to it.

Our community is not financially positioned to buy into this dune beautification project. Many of us do not believe dredging is a sound, proven technique to save our beaches. There is so much harm done to the environment as a result of dredging that is not discussed in your report. Dredgers are made rich by all of the work the USACOE provides them with year in and year out. Our community does not want to be part of this repeated, ineffective, costly solution to saving SRA1A. The infrastructure is important for those of us on the island but more importantly it is more important for tourism. That is why the County is behind this. This scenario is nothing more than saving a road that brings money into our community.

I cannot wrap my mind around the fact it cost the citizens of Flagler County $3,300,000 for this study. Local tourism dollars have been drained at the expense of this draft report. The Federal government will be given numbers that are exploited and manipulated to "calculate" a magical ratio. This project will be thrown into a pool of projects and we will call on lobbyists to move us to the top of the list. You know the politics behind the future funding of this wasteful spending, however, you should probably look at the financial health of the non-federal sponsor. Can you enter into a relationship with them not knowing how they are going to fund their portion? Levying taxes on a community that is riddled with high unemployment and marked decreases in home values is not a secure method of funding.

Thank you for your consideration in this matter.

Patti Powell

719 North Central Ave

Flagler Beach, FL 32136

-----Original Message-----
From: M Treworgy [mailto:Tyacht@cfl.rr.com]
Sent: Thursday, February 13, 2014 12:21 AM
To: McConnell, Kathleen K. SAJ
Subject: [EXTERNAL] Flagler Beach renourishment

Hello,
We live and have our boutique bed and breakfast inn at 2316 & 2320 S Oceanshore Blvd in Flagler Beach. According the the Feasibility Study and Environmental Assessment, this project while underway, it will greatly impact our ability to rent our rooms. We own two lots east of SR A1A each with dune walkovers which provide our guest with direct access to the beach. When this project begins and if the dune walkovers are damaged or destroyed, will we have an Executive Order, or the similar, allowing us to immediately rebuild or repair without having to apply for State, County or City building permits? This is of utmost concern to us because everyday that goes by will be lost revenue, which is our sole source of income.
Please respond as soon as possible. Thank you.
Mark and Toni Treworgy
386-439-0092

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

From: Rick Morgan
To: McConnell, Kathleen K. SAJ
Subject: [EXTERNAL] flagler beach
Date: Friday, February 14, 2014 1:49:20 PM

Please consider alternatives to simply dredging sand and dumping it on Flagler Beach for it to wash away in a short time. You should consider the opportunity to restore sand but also install devices to hold the sand and build up the beach. The town considered a process by Mr Holmburg which made sense.Give it a try on a short section of beach to either prove or dis-prove that it works. Just dumping sand is dumping our money!

Rick Morgan

15 Riviere Ln

Palm Coast, FL 32164

From: jodickric@aol.com
To: McConnell, Kathleen K, SAJ
Subject: [EXTERNAL] Flagler County, Hurricane and Storm damage Reduction Study
Date: Saturday, February 15, 2014 8:16:37 PM

Attention of Colonel Alan M Dodd, District Manager, USACOE, Jacksonville FL Project No.: 113166

Dear Sir,

I am a tax payer and resident of Flagler Beach where much of this project is to take place. I have attended the many meetings that have taken place in the last 10 years and I am bitterly disappointed with the results. You have had available to you time, money, supposed expects in the fields of science, engineering, coastal biology, FWC, and who knows how many others, and the only solution you can come up with is the same one that you always do that doesn't work,: Dredging and renourishment . THIS IS THE EQUIVALENT OF NO SOLUTION and is so sad. Where are your innovators, problem solvers, inventors, people who will try new things, and just might find a permanent solution?

The cost is already high and it is all taxpayer money for no real solution.

Now you want to go forward with a costly plan to dredge 7 miles off our shore, and destroy our existing dune with the sand that looks like cement, totally foreign to our coquina sand which is unique to only our beach. It will look terrible until it is washed away, and that will surely happen, probably in less than 5 years as was suggested in your plan. Did any of your people spend any real time in Flagler Beach, or was this all done by computer and previous studies?

Now to the creatures that we care about, the sea turtles, the ghost crabs who clean up the beach, and others who live there. They will be killed by your sand placement, as will the sucking up of the ocean creatures 7 miles out. As to your.idea of relocating the nests, we have a very capable Turtle Patrol that has been doing it and doesn't need your help.

Lastly, with the amount of money all of this will take to accomplish, you should be discussing this project with the state of Florida and the DOT as they are responsible for securing A1A which is the reason for the project. We, in Flagler Beach have already told them we do not want any more seawalls to ruin more of our beach, which is essential to the tourists who come here.

Flagler County has many small cities who do not have the deep pockets needed to fund the millions of dollars for this destruction. As a citizen and tax payer, I am vehemently opposed to this project.

Respectfully submitted,
JoAnne Ricardi
1423 N Central Ave
Flagler Beach FL 32136
386-439-4261

From: Coralee Leon
To: McConnell, Kathleen K, SAJ
Subject: [EXTERNAL] Flagler Beach project
Date: Sunday, February 16, 2014 10:55:03 AM
Attachments: ACE Feb 14 2014.docx

The attached are my comments regarding the project planned for Flagler Beach

Thanks for your attention,

Coralee Leon

Coralee Leon
PO Box 160 Flagler Beach FL 32136 Phone: (386) 517 1617 E-mail 1coralee@earthlink.net

February 14, 2014

Planning Division Environmental Brand, Coastal Section
Department of the Army, Jacksonville District Corps of Engineers
PO Box 4970
Jacksonville FL 32232-0019

It has taken nearly 10 years and cost the citizens of Flagler County more than $3.3 million for the Army Corps of Engineers to come to the same conclusion it reaches in nearly 100 percent of its studies—that dredging is the best way to fix our dunes.

This is the very "solution" that has proved itself over the years to have the dual advantages of playing havoc with the onshore and offshore environments while creating even more quickly eroding beaches and dunes. And you think the citizens of Flagler County should pay many more millions to bring this project to fruition.

It hardly matters that the study concerns just a 2.6 mile portion of dune. After all, the only thing your project purports to protect is State Road A1A, which the Florida Department of Transportation has told us repeatedly is not even under the jurisdiction of Flagler County.

Over the years our area has weathered many storms and sustained storm damage. But what you propose would not prevent any of the damage that has occurred in the past. And judging by your similar artificial dune in New Smyrna Beach a few years back, I'd venture a guess that the project itself will disappear beneath the waves within a short period of time. All at a magnificent cost of many, many millions of dollars.

We, the citizens of Flagler Beach and Flagler County, can no longer propose a more sustainable alternative to dredging and seawalls to save our beaches, so we are pretty much stuck with whatever those in charge decide. But it should be clear to all that "those in charge"—meaning the state and federal officials—should bear the costs of those decisions.

The people of Flagler County have already paid our fair share. Please be kind enough to take up the rest of the matter with the appropriate state departments.

Cordially,

Coralee Leon

From: Rita Bloom Gombar
To: McConnell, Kathleen K. SAJ
Subject: [EXTERNAL] Flagler Beach
Date: Sunday, February 16, 2014 12:56:07 PM
Attachments: army corps of engineers.docx

This letter is my comment on the feasibility study done for portions of A1A in Flagler Beach.

Thank you for your consideration.

rita b gombar

Rita Bloom Gombar (Mrs. Stephen E. Gombar Jr.)
PO Box 1839
1517 North Oceanshore Boulevard
Flagler Beach, Florida 32136

February 15, 2014

Planning Division Environmental Brand, Coastal Section
Department of the Army, Jacksonville District Corps of Engineers
PO Box 4970
Jacksonville FL 32232-0019

Hello.

As a 40-year former resident of Hollywood, Florida and now a 13-year resident of Flagler Beach, I cannot express my complete and utter distaste for your current plan for our beach. I will let others more knowledgeable speak to all the problems that dredging has caused in other areas along our coast; my frustration comes from personal experience.

It is almost impossible to believe that the result of a more than ten year long and more than $3 million dollar study ended with this solution: "I know, let's dredge"! I have seen first hand over the last fifty years what a silly (and am I purposely understating here) idea this is.

Aside from the prohibitive expense, we all know that dredging is a band aid --- and one that does not prevent damage to occur to the underlying problem. This method has been tried up and down the east coast over ad over and has failed miserably.

It is my understanding that this project is for a $2\frac{1}{2}$ mile stretch of Flagler Beach and its purpose is to make sure A1A remains viable, as it is an emergency route. Okay. Fine. You're going to do what you're going to do. I have been to enough meetings in this city to know that Flagler Beach really has no say in what the Army Corps of Engineers does. Our opinions do not matter; we know. We get it.

But given that fact – and it has been hammered into us over the years – don't make us pay for it. We have already spent over $3 million dollars which could have been put to better use elsewhere, and which accomplished nothing.

So please send the bills somewhere north of us: to Tallahassee or Washington, DC. I think we have been more than fair and I think our responsibility should be over.

Thank for your consideration.

Rita Bloom Gombar
1517 North Oceanshore Boulevard

Flagler Beach, Florida 32136

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

June 11, 2014 F/SER47:GG/pw

(Sent via Electronic Mail)

Colonel Alan M. Dodd, Commander
U.S. Army Corps of Engineers Jacksonville District
Jacksonville District, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Attention: Kathleen McConnell

Dear Colonel Dodd:

NOAA's National Marine Fisheries Service (NMFS) reviewed the *Flagler County, Florida Hurricane and Storm Damage Reduction Project Draft Integrated Feasibility Study and Environmental Assessment* (EA) dated January 2014. The Tentatively Selected Plan (TSP) is the National Economic Development plan and consists of a ten-foot dune extension and a ten-foot sacrificial berm over 2.6 miles of shoreline in central Flagler Beach between Florida Department of Environmental (FDEP) monuments R-80 and R-94. The sand would come from a borrow area seven miles offshore. A hydraulic dredge would likely be used to dredge sand from the borrow area and to pump sand onto the beach; heavy equipment (such as bulldozers) would be used to grade the sand into the construction template. Over the 50-year period of Federal participation, the Jacksonville District estimates four nourishment events at 11-year intervals would occur after initial construction. Initial construction and each nourishment event would require approximately 330,000 cubic yards of sand. As the nation's federal trustee for the conservation and management of marine, estuarine, and anadromous fishery resources, the following comments are provided pursuant to authorities of the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

Essential Fish Habitat
EA Section 2.4.6 identifies federally managed fishery species the Jacksonville District believes occur in the project area and discusses their distribution along with the distribution of numerous other species. These descriptions do not require augmentation to complete the EFH consultation.

Impacts to Essential Fish Habitat
NMFS examined whether the project may adversely impact live/hardbottom habitat, which EA Sections 2.4.4 and 2.4.6 note is a Habitat Area of Particulars Concern. EA Appendix F includes a report from Dial Cordy and Associates (DCA) showing "exposed or near-surface rock" between the 10-foot and 15-foot depth contours between R-80 to R-87 and notes this is generally consistent with a 1999 report from FDEP. While the DCA report does not quantify the area of

the outcrops, NMFS estimates Figures 4C and 4D show 1 to 2 acres of hardbottom habitat. The DCA report notes confirmation of these signatures may be required, and EA Appendix F and the latter part of EA Section 2.4.4 discuss a follow-up survey done about one year later in 2012. The description of the follow-up surveys is not clear. The text says multi-beam sonar and towed video were "proposed to acquire further detail of the hardbottom" but it appears only an additional sidescan sonar survey was done. The proximity of these potential outcrops to the equilibrium toe-of-fill also is not clear because the EA has few cross-sectional drawings. EA Appendix A (page A-66) suggests the equilibrium toe-of-fill extends to the 12-foot depth contour. Amending Figures 4D and 4E to include the estimated equilibrium toe-of-fill would greatly clarify the extent of the potential live/hardbottom impacts. Assuming no live/hardbottom habitat would be buried by the equilibrium toe-of-fill, NMFS has no concerns about impacts to this habitat in the fill area.

NMFS also examined whether the project may adversely impact live/hardbottom habitat at the borrow area. EA Appendix F reports no hardbottom in or near Borrow Areas 2A, 2B, and 2C. While SEAMAP[1] shows hardbottom may be present in Area 2C, the data reported in Appendix F should be substantially higher in quality and reliability than the much older SEAMAP data. Further, EA Sections 7.3.1 and 7.6.1 note a 400-foot buffer would be maintained around any hardbottom found as new information becomes available as project planning progresses (NMFS assumes the 200-foot buffer listed in Table 7-1 is a typographical error given the support the EA offers elsewhere for the 400-foot buffer). Provided a 400-foot buffer is used to protect any live/hardbottom habitat found in a borrow area, NMFS has no concerns about impacts to this habitat in the borrow areas.

Lastly, NMFS examined whether dredging of the borrow area and filling at the beach may increase the concentration of suspended sediments that can clog gills in young, less mobile fish and invertebrates and thereby increase their mortality rate. The extent of negative effects is dependent on the life history stages of the species present and duration of exposure to high concentrations of suspended sediments. In open areas, adherence to the State Water Quality Criteria for turbidity at the edge of a 150-meter mixing zone is normally sufficiently protective of fishery resources. In addition to the State Water Quality Criteria, another practicable way to minimize fishery impacts is restricting dredging to the winter months or placing restrictions on dredge operations (e.g., in the case of a cutterhead dredge, the swing speed of the ladder arm supporting the cutterhead, the rotational speed of the cutterhead blades, and the intake suction velocity at the cutterhead) can be used to minimize suspension of material. NMFS requests the Jacksonville District evaluate whether a seasonal restriction on dredging would be a practicable way to minimize impacts to larvae and juveniles migrating along the shoreline. If a seasonal restriction is not practicable, an evaluation of the duration that larvae and young juvenile fish would be exposed to high levels of suspended sediments should be beneficial.

[1] Southeast Area Monitoring and Assessment Program - South Atlantic (SEAMAP-SA). 2001. Distribution of Bottom Habitat on the Continental Shelf from North Carolina through the Florida Keys. SEAMAP-SA Bottom Mapping Project, Atlantic States Marine Fisheries Commission, Washington, DC. 166 pages

We appreciate the opportunity to provide these comments. Please direct related questions to the attention of Mr. George Getsinger at our Northeast Florida field office. He may be reached at 9741 Ocean Shore Drive, St. Augustine, Florida, 32080; by telephone at (904) 461-8674; or by email at George.Getsinger@noaa.gov.

Sincerely,

/ for

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

cc:

COE, Jason.J.Spinning@usace.army.mil, Kathleen.K.Mcconnell@usace.army.mil
EPA, Eric.H.Hughes@usace.army.mil
FWS Annie_Dziergowski@fws.gov, Terri_Calleson@fws.gov
SAFMC, Roger.Pugliese@safmc.net
FDEP, Martin.Seeling@dep.state.fl.us, Jeff.Raley@dep.state.fl.us
F/SER4, David Dale@noaa.gov, George.Getsnger@noaa.gov

From: jodickric@aol.com
To: McConnell, Kathleen K. SAJ; HSDR Comments, Flagler
Subject: [EXTERNAL] Fwd: Planned Environmental Disaster
Date: Sunday, February 16, 2014 5:02:17 PM

To Whom it Should Concern:
Project no.: 113116

Residents of Flagler County and particularly Flagler Beach feel helpless by the prospect of being dominated by The Corps of Engineers into a massive environmental disaster called dredging and beach renourishment. We are shocked by their conclusions after a ten year, 3.3 million dollar study, that the same old failed operations that has burdened tax payers in the past should be used again for the next ten years.

Incredibly, the study by Federal, State and local agency officials together could only offer on the same old fallacies we have been brainwashed with in the past . Most alarming is the study's lack of attention to the environmental affect.
++ There is no mention of the far reaching detrimental effect of introducing a foreign substance from seven miles at sea onto a beach of unique crushed coquina shells.
++ What will be the effect on sea turtles who have imprinted themselves to the beach of their birth? By nature they return to the same beach to reproduce but are spooked away by any threatening changes.
What is the affect on the ecological balance of nature at the sea bed where dredging occurs? That disruption will harm all forms of sea life.
++ Gopher Tortoises? When asked about safety precautions for the tortoise population on the dunes we were told by a team member that they had checked and there are no tortoises because they don't like to be near the water. This tells me they never looked or never considered the problem. I plan to photograph gopher tortoise burrows on the dunes and will send them to you in the near future.

In closing, it is unbelievable to think our government would spend this amount of taxpayer money while exposing the harmful affects on nature its creatures and only to enable the beach problem to continue for years to come.
With regard to your plan, Personally, I would rather do nothing. That would save the money , save the beach, save our sea life and let mother nature do what she has been doing for hundreds of years. It would also give us time to consider new and better ideas.

Dick Ricardi
1423 No Central Ave, Flagler Beach, Fl
Tel 386 439 4261

From: Kim Carney
To: McConnell, Kathleen K, SAJ
Subject: [EXTERNAL] Public Comment for Flagler County Draft Feasibility Study
Date: Monday, February 17, 2014 9:35:23 AM
Attachments: Letter re USACOE Study.docx

Please make my response part of the study. I have also mailed via USPS.

February 14, 2014

Colonel Alan M. Dodd
District Engineer
USACOE
Jacksonville, FL

Dear Colonel,

I have been involved for the past several years in what appears to be a strained Project Management Plan: Project Title: FLAGLER COUNTY, FLORIDA, HURRICANE AND STORM DAMAGE REDUCTION STUDY
Project No.: 113166. Needless to say the amount of funding required to bring this project to this point, over $3,300,000 of taxpayer's dollars, is obscene. The time required, just a few months shy of 10 years since the September 2004 signed agreement with the non-federal sponsor, to bring this project to this point is obscene and the end result of this study is obscene.

The document presented is very neatly titled with all appropriate pages and sections, as the law requires, however, the content is skewed 100% toward a wasteful sacrificial dune with no studies showing this project will "save" in the event of a storm or hurricane, structural and content value of approximately $340 million as stated in the study. The structure this project beautifies is SR A1A, which by its name alone will tell you it is a State Road and belongs to the State of Florida. Our community has been built around this road. And it is because of this road being built on the primary dune system many years ago that many people believe we have the areas of critically eroded dunes and beach that we have today.

The reader often gets confused because the entire beach in Flagler County is used throughout the report however, the only area that is being used to justify the study is the very small and focused area of the tentatively selected plan as Reach C in Flagler Beach. As stated in the Executive Summary page ES-2 "The TSP covers 2.6 miles of shoreline length and mainly prevents damage to SR A1A."

I cannot believe the sand being used for the dune extension is being taken 7 miles directly offshore. Where is our sand? For years the USACOE has been telling us that sand only travels via longshore transport. NOW after years of fighting the fight, the report admits on page 2.23 "Once caught in the waves, this sediment is carried along the shore and redeposited farther down the beach, or is carried offshore and stored temporarily in submerged sand bars." It goes on to describe the fierce wave's effect on the beach width and height. Look at the changes in Flagler Beach's profile from photos in 1920s and now. The slope of the beach has grown from 2-3 feet to 11-14 feet. Our sand is gone! It is unique and colorful sand that will not return from dredged sand offshore.

The City of Flagler Beach has lived with an unsightly, eroding seawall since December 2006. The FDOT built the seawall in a defensive move to hold up A1A and it has. The revetment is a complete eyesore. Both the City of Flagler Beach and Flagler County have written resolutions against seawalls. The revetment is in effect a seawall. It was designed by a civil engineer not a coastal engineer. We all know a healthy beach system contains a vegetated dune with a slope of 1:1. Over the years the waves have encroached on our dune system and the storm water runoff from SRA1A has led to many vulnerable areas of erosion for the road and the dune. Since the decision to put SRA1A where it is, followed by widening the road several years ago the City of Flagler Beach

and our beach did not have a chance. We are blessed not to have had a direct hit from a hurricane. We have lost homes on South Flagler Avenue due to storms. Refer to page 3-7, "However, it should be noted that elevations within the project area (Atlantic Ocean-side of the island) are some of the highest on the barrier island, about 15-20 feet above Mean Sea Level. The profile of the island slopes downward from these elevations to the landward side , marsh side, of the island where the lowest elevations of infrastructure are around 2 -10 feet above current MSL." It goes on to state, "Marsh side areas of the island will likely be impacted by inundation more frequently than the ocean side as sea level rises, especially during extreme high tide events." Storms and hurricanes bring wind and rain. Nothing in this TSP prevents or protects homes from storms or hurricanes. It does not even protect SRA1A. The mitigation of damages can only be to SRA1A. The report leaves the reader thinking the TSP will protect houses and infrastructure. The sea wall used to calculate the total damages does have a useful life. There are projected dates when the sea wall will need to be rebuilt. How does that happen with this project? The last sentence on page 6-2 states, "Most of the benefits are associated with reductions to armor damage along the A1A revetment. In the with-project condition, the cost of maintaining and repairing the revetment is significantly less than it would be in the without project condition. This reduction is the primary source of economic benefits." There is a figure used of $49,000,000 to $2,200,000. That savings is recognized by the State of Florida NOT the City of Flagler Beach nor Flagler County. The State maintains this infrastructure. They should be the entity that enters into a relationship with the USACOE.

What exactly is meant by "highly effective"? There are no highly effective beach/dune nourishment projects. One hundred percent of these projects must have repeated nourishments. On page 6-3 the TSP is described as "not only highly effective, it is also efficient." Moving sand from offshore to the dune and back again, and again, and again is not efficient. There is no data that supports the fact the TSP is effective. Over time this one very small section of A1A will continue to experience erosion because nothing is being done to prevent it. Our sea turtle nests will still need to be relocated to wider sections of the beach. By extending the dune 10 feet seaward the actual width of the beach, mostly at high tide will decrease the width of the beach. The most critical area in front of the dune that needs to have dry sand to feed the dune will be decreased.

Your study uses modeling to determine "the NED plan is highly effective at reducing erosion damages. In the with-project condition the vast majority of damages in Reach C are prevented". The model does not state how or why. There is no science to back this statement. It is a computer model. The last sentence on page 6-3 states "the plan can be considered robust". Robust is a word used in creative writing. If you asked 50 people what they think when they hear the word robust you would probably get 50 different definitions. That is not a word I would use when I see what this report has to offer. So many decisions are made based on the contents of the draft report. Why would the writer use such a word? Robust in relation to what?

Lack of citizen involvement should not be interpreted as citizen support. Many citizens have not been involved with this project because it has taken so long to get to this point. Many people are not affected by this project. Tourism is going to continue to be a major source of revenue for Flagler County with or without this project. This project has so many long term effects on our environment, on our infrastructure and on our community as a whole. The TSP does not solve any problem. I suggest you pull FDEP and FDOT together to discuss this project as they are the stakeholders. They may be willing to fund it, however, I am not. Flagler County does not have a tourist base like Miami and Ft. Lauderdale. Our eroded dunes are NOT stopping visitors. In fact our Tourism Development Council has done an outstanding job marketing our county and we have surveys to prove it. The revetment and seawall is just outside of the "busy" section of our beach. In a 2011 meeting with the FDOT and their proposed project to extend the current seawall and add sand and vegetation to the project led to a

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The City of Flagler Beach has a Historical Museum that gives data on what our City has evolved into over the past 90 years. The City is working on and has a draft of our Beach Management Plan, all giving you much history about our shoreline and the rebuilding of our structures. The structure damages included in this study does not take into effect the Municipal Pier. This single structure brings more people to Flagler Beach than any other destination in Flagler County. FEMA has assisted with rebuild of this structure as well as our City insuring the structure. THIS PROJECT WILL NOT PROTECT THIS STRUCTURE. The ONLY structure this project attempts to protect is SRA1A. The revetment was not built correctly, it is NOT maintained by the FDOT and the problem with the runoff on A1A has not been dealt with. Start with resolving the problem not adding to it.

Our community is not financially positioned to buy into this dune beautification project. Many of us do not believe dredging is a sound, proven technique to save our beaches. There is so much harm done to the environment as a result of dredging that is not discussed in your report. Dredgers are made rich by all of the work the USACOE provides them with year in and year out. Our community does not want to be part of this repeated, ineffective, costly solution to saving SRA1A. The infrastructure is important for those of us on the island but more importantly it is more important for tourism. That is why the County is behind this. This scenario is nothing more than saving a road that brings money into our community.

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Kim Carney
Citizen, City of Flagler Beach
604 Springdale Drive
386-439-0899

From: McConnell, Kathleen K. SAJ
To: Durkin, Martin T SAJ
Subject: FW: [EXTERNAL] Flagler Beach (UNCLASSIFIED)
Date: Thursday, April 17, 2014 7:28:19 AM
Attachments: Letter re USACOE Study rev2.doc

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Jim Gallagher [mailto:jimgallagher@cfl.rr.com]
Sent: Monday, March 03, 2014 5:59 PM
To: McConnell, Kathleen K. SAJ
Subject: [EXTERNAL] Flagler Beach

Here you go. Best Wishes.

Jim Gallagher
Home - 386-446-7511
Cell - 386-793-4377

Classification: UNCLASSIFIED
Caveats: NONE

February 14, 2014

Colonel Alan M. Dodd
District Engineer
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Jacksonville, FL

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Sincerely,

James J and Sharon K Gallagher

51 Wedgewood Lane'

Palm Coast,Fl 32164

From: Randy Cody
To: HSDR Comments, Flagler
Subject: [EXTERNAL] Flagler Beach Shoreline Re-nourishment
Date: Wednesday, February 19, 2014 10:49:15 AM

I have a home on the north side of Flagler Beach. Rocks have been added to hold up A1A, this fix is eroding away. What about the north side? Is this area not being considered?

Randall Cody
Florida Seaside Rentals
Cody Real Estate/ERA
Owner/Broker
513/871-0640(O)
513/407-2639(C)
floridaseasiderentals.com <http://floridaseasiderentals.com/>

From: Walter Mahler
To: HSDR Comments, Flagler
Subject: [EXTERNAL] Sand dune build-up
Date: Wednesday, February 19, 2014 8:32:14 PM

I think the plan has merit as long as the built-up dunes are properly planted with stabilizing vegetation such as sea oats. Areas with healthy vegetation stand up much better to storms that tend to erode the dunes.

Sent from my iPad

From: carol propper
To: HSDR Comments, Flagler
Cc: editor@palmcoastobserver.com
Subject: [EXTERNAL] NOT RE-NOURISHING OUR BEACHES BY DREDGING
Date: Friday, February 28, 2014 10:35:31 AM

Dear Sirs: Do you remember when all up and down the EASTERN SEABOARD , people put out fingers along the coast, called "rip-rap" made of ROCKS and other hard objects. These managed to retain the sand on the shore and encourage sand to accumulate along the beaches.

This MUST cost less than dredging sand out of the ocean. The BEST part is that it is inclined to stay where you put the material, instead of washing out to sea again like always happens when a dredge-and-fill job is done.

Look at the times when the different beaches are "re-nourished" and sure enough, a few days later, a big storm comes in washes all that 'new' sand out to sea.

What a waste of money by the Corps of Engineers; similar to the CROSS FLORIDA BARGE CANAL bondoggal.

Here's to common sense(which I realize is not so common, anymore) and a solution that will last YEARS AND YEARS instead of the inevitable WASH-OUTS of our FLORIDA BEACHES.

Sincerely, Carol Propper

March 13, 2014

To: Colonel Alan M. Dodd, USACE Commander

Jacksonville District

OFFICIAL COMMENT: Via: Flagler.HSDRCComments
Flagler.HSDRCComments@usace.army

OFFICIAL COMMENT: Via: kathleen.k.mcconnell@usace.army.mil.

From: Patricia W. Brown, Flagler Beach, FL

Re: Flagler County, Florida Hurricane and Storm Damage Reduction Report Draft Integrated Feasibility Study and Environmental Assessment Project 11316 dated January 2014

As a Flagler County and Flagler Beach citizen for over 40 years, I have been very involved since 2004 with the erosion problems of our beautiful beach. Early on, my research even earned $40,000 for the county when I found the FDEP sharing agreement which no one seemed to know about or had used. I have been aghast at the arrogance displayed by the USACE representatives over the years, even though several did show common sense and were helpful. My feeling was that the USACE were bought and paid for by us, the citizens and taxpayers, **but learned through experience that was not the case.**

It can only be a display of arrogance that the feasibility study would be allowed to extend over the years once it was learned that there was not enough economic value to do the typical solution of mining sand and dumping and spreading it on the beach. **It is evident that the USACE has had to work their "magic" with the numbers in order to provide their continued employment – partly through fees, percentages and contingency costs.**

Basically, I would like to see the USACE, FDOT, state and any other people who would need to be involved cooperate and make an EXCEPTION to the "right-of-way" issues faced by FDOT and allow them to provide the solution. If they had the right and ability to choose a plan which would widen the beach and rebuild the dune, there would be much more protection for both A1A and businesses/residences than what is being proposed by the Feasibility Study or seawalls. FDOT, according to this report, has been spending $600,000 per year on maintenance of the revetment.

After all, we are one of the few places in the state where FDOT right-of-way lies so close to the beach and ocean. As is pointed out in C-22 of the Feasibility Study, "the road and road armor is not a protective feature that provides benefits for protecting landward structures."

Most of the comments below demand an answer, but since answers from USACE have NOT been time-sensitive or forth-coming in the past, we will see what happens at this point. At meetings I well remember the promise in February 2013 that the Feasibility report would be forth-coming, and then every month or so, it was moved later and later, until it was announced in January 2014. I had a lot of confidence in Major General Michael Walsh in his changes in the process, but see that he has now retired. Hopefully his practical ideas were not what precipitated his retirement.

1. Why are federal monies spent on beach projects?

Supporting legislation acknowledges damage done to beaches and coastlines by planning, execution and projects for inlets controlled by the Army Corp of Engineers – many studies conducted by the USACE have proven that the engineering work done by the USACE has resulted in damage. The federal monies appropriated by Congress is a legislated attempt to compensate for such damage. Please acknowledge what is stated from many sources.

2. Why did the District 5, Florida Department of Transportation, provide $250,000 to Flagler County as part of the funds for "pre-payment" to the USACE for the Feasibility Project?

The USACE acknowledges throughout the report their cooperative effort with Florida Department of Environment, Florida Department of Transportation, etc. and I have been to many meetings where the FDOT, in particular, was involved in teleconferencing. I, for one, would like the question answered honestly – if the FDOT understands that the proposed project would shift partial maintenance costs away from the state and onto Flagler taxpayers, it would be logical they would provide a small amount of money to help this happen.

Were the county commissioners involved in the decision or what others were involved and is there any reason they did not understand the consequences to Flagler taxpayers? Of what benefit is it to Flagler taxpayers to shift expenses to them rather than the state? What examples are there that Flagler County has paid maintenance costs for state roads in Flagler County?

I understand that USACE realized they would not receive any funding FY2013 and they may have pressed the point so that the county would prepay. It has just been announced that there would be funding from the FY2014 budget.

I have never heard Flagler County acknowledge that the expenditures for Marlowe and Company as lobbyist for Flagler Beach for a number of years has had an effect in the county getting the USACE funding. Marlowe and Company certainly states that this is the case.

3. The USACE is spending both federal dollars and Flagler county tax payer dollars for the project. It appears the USACE is essentially a contractor and that others are paid to do different sections of the work. Is there a bid process for selection? Where is the documentation for bids for the Flagler project?

I notice that In the Cape Canaveral Authority *Integrated Section 203 Navigation Study Report and Draft Environmental Assessment* (June 2012) (this "project involves deepening and widening existing Federal navigation channels" which was expected to cost $43.3 million.)

CH2MHILL engineering was involved and Dial, Cordy & Associates, Inc. was used for the environmental analysis. This is the same company used in the Flagler Project. I know that FDOT uses CH2Mhill for many projects as well. TetraTech, Irvine CA was used by Peoples First Community Bank for an environmental study on "Sunset Cove, Flagler Beach". What USACE personnel was used and what contractors were used?

4. When did it become appropriate to use "subjective" words such as *robust, not aesthetically pleasing*, etc. as part of a 3 million plus dollar "scientific" study?

In my opinion, these words were used specifically to appeal emotionally and judgmentally to people unacquainted to the process and what was being proposed. For instance, in Table 5-6 Flagler Beach Structural Measures, S-1 Seawalls and S-2 Revetments (rocks presently in place) which we know are unsightly are not discussed, but S-12 Undercurrent Stabilizers are listed as "Not aesthetically appealing". Undercurrent stabilizer projects can be viewed via Google Earth and as they successfully increase shorelines in a number of locations and are not visible as their success proceeds, why would the comment be made? I personally have talked with owners of successful installations, and they certainly would not characterize a process which, in one case, has saved their home and property from falling into Lake Michigan as anything but positive. I challenged this statement early in the process of the Feasibility Study with the Team Leader when he contacted me, and it is noted that it is still included. Why would the USACE, with their access to sophisticated satellite imagery, historical permit information, etc. as well as pretty much unlimited staff and time (the project is in it's 10th year) have the audacity to make such a prejudiced statement? As expected, this procedure was eliminated immediately.

5. Where are the results of the Peer Review Plan as updated in August 2010? A Recent Final Independent External Peer Review for Brevard County (December 9, 2009) done by Battelle, Columbus, OH found inaccuracies in environmental species, misspelling, under- and over- estimates of various elements of sand requirements, indication that "the decision of mitigate for 3.0 acres of rock burial was negotiated and not based on scientific data" (pA-20), lack of justification for certain conclusions, etc.

Will there be inaccuracies highlighted in the Flagler study as well? I have a copy of the August 2010 "Feasibility Scoping Meeting Read Ahead Package" and there have been suggestions made in that paper.

Daniel Haubner, Project Manger, was responsible for both the St. Johns County Peer Review Plan (Draft updated May 2010 – wasn't able to locate a copy without "draft" designation) and the Flagler County Peer Review Plan (updated August 2010). Both plans are essentially word for word except for specific county details.

The preliminary cost estimates for the 4 ITR were itemized:

- FSM Briefing Materials - $20 K
- AFB Materials - $30 K
- Draft Report - $40 K-ITR plus $10K for EPR
- Final Report - $30K – ITR
- PCX management - $20 K ($5 K peer each review)
- PCX CWRB (USACE National Planning Center of Expertise – Coastal Storm Damage Reduction) preparation and participation - $5 K

for a total of approximately $155,000 added to the Feasibility Plan cost. Jason Harrah is listed as project manager now.

The reviews were determined to be required because the total anticipated cost would be over $45 million, although that figure has been reduced.

6. Why were the economic conditions not properly assessed during the Reconnaisance Study provided by USACE (federal funds) which cost $200,000 – or as I have found new figures when doing research for this letter, it now shows as $98,000? Why was the sand search study and other items done before the economic value. If the economic value had been done first, we might not be discussing the Feasibility Study.

This study was done in order to assess whether the cost-benefit ratio for Flagler County was conducive to mining (dredging) sand and putting it on the beach, and if so, where. The USACE Reconnaisance Study determined that a Feasibility Study – first at $1.2 million in 2004, now up to $3.3+ million – was justified. In the past few years there was a "mea culpa" from USACE stating that the economic value was insufficient to warrant "dredged sand on the beach" BUT it was sufficient to apply dredged sand to the rock revetment to cover it and provide sacrificial sand to wash away over the years, in a supposed effort to protect state A1A. To quote page ES-2, "The TSP is the National Economic Development (NED) plan, consisting of a ten foot dune extension including a 10' sacrificial berm in Reach C, between FDEP monuments R80 and R94 in central Flagler Beach.

7. Why are misleading references made to "renourishment interval," "dune/beach renourishment," throughout the report? The average lay person interprets that to mean mining (dredging) sand and placing it on the beach – where they walk, swim, play, etc. and turtles lay their nests.

The report clearly states, page ES-2, "The TSP is the National Economic Development (NED) plan, consisting of a ten foot dune extension including a 10' sacrificial berm in Reach C, between FDEP monuments R80 and R94 in central Flagler Beach." Media coverage followed the information in the Executive Summary which was misleading in most respects. One newspaper did print a second story which clarified the impression somewhat.

8. Where is the updated <u>itemized</u> Flagler County Feasibility Cost Estimate which was a part of the August 2004 Feasibility Plan, the authorization and beginning of this study? The Project Management Plan in August 2010 (FY 2010) contained estimated costs as well as current progress; cost estimate to complete, remaining duration, predecessors along with Appendix C, Feasibility Phase Cost Estimates and showed expended as well as remaining, in-kind, etc. costs. All this information was left out of the January 2014 report.

I'm sure this has been done – after all, the USACE is accountable to so many different offices, including Congress and the non-federal sponsor. It will be interesting to compare original estimates against actual expenditures, since the cost of the project went from approximately $1.5 million to $3.3+ million where it is now. Dates for these totals should be given as well as who did the work – is there any reason to expect less from the USACE than from a private contractor?

9. Beach walkovers are now considered as part of the economic cost, but were not considered at the time of one of the public meetings. A citizen's comment brought up the cost. Why would something this obvious be left off since they have been there the whole 10+ years of the study? Where is the proof for the replacement/repair cost for the public walkovers – who was consulted since these belong to the City of Flagler Beach and are either on city owned land or land with city easements.

They are easily seen in aerial mapping, etc. and I understand USACE representatives visited the city on more than one occasion.

10. What was the reasoning for 400' inland as the damage zone during a hurricane (section 2-p73)? According to FDOT documents, approximately 70-100' of that 400' would be FDOT right-a-way, leaving approximately 300' inland. Please indicate whether this is one block – from A1A to Central Avenue or whether it includes part of the next street.

Without this information and the ability to verify it, the cost to benefit ratio can be skewed very easily.

11. The report indicates there are 21 public dune walkovers with anticipated demotion and reconstruction from 40' to 50'. The cost given in Appendix C-3p28, at lowest cost, is $2,356,115. This equates to a cost of $112,195.95 per walkover. There is an anticipation of contracted construction apart from the rest of the project – with perhaps several contractors.

Presently, the city has done reconstruction and repairs of the present walk-overs after storm damage. This cost is another one which is easy to skew . As well, how many private owners are going to be able to spend this kind of money for a walkover from their property?

12. If the project requires federal easements for all the lots which face the beach before they can do this project, does that mean that the county would have to buy or acquire the easements? The city of Flagler Beach already has these easements and owns many of the lots. Does that essentially mean that the Flagler County would be in control of the beach through the easements?

The city of Flagler Beach has paid many years of lobbyist costs which resulted in the funds being "found" for the USACE portion of the project. As well they spent a FDEP grant for half a million dollars for the Halcrow Sand Search – for which Flagler County only received less than $300,000 as in-kind credit.

13. Contingency funding for the initial project of between 22% and 25% can easily be manipulated to generate an acceptable cost-benefit ratio. Is this really what the citizens of Flagler County want – a project which saddles them with the cost of revetment maintenance which should be an FDOT and state cost?

14. Appendix C, A-13 uses the Mayport (Jacksonville) gage for various tidal information. Why wasn't the St. Augustine or the Bing's Landing gage used?

15. Data indicates that FDOT has spent approximately $600,000 per year from Fy2001-2010. The report was presented in January 2014. Why wasn't the information updated

past 2010? In addition, revetment mid-cost was given in the study. 2.6 miles for the project = 13,728 lineal feet x $423.87 per lineal foot = $5,818,887 total cost. Somewhat a different picture, without even the inclusion of the walkovers.

16. The project is projected to last for 11 years -- if FDOT has spent $6 million in 10 years on maintenance of the right-of-way revetment, as reported, why don't they use their budget for this project – disregard the federal and non-federal shares, and spend about the same amount of money. Is it the same old story that FDOT is hampered by the antiquated, but possibly purposeful, splitting up of responsibility mentioned at the first of this official comment.

17. In original materials, the federal/non-federal cost split was going to be higher for the federal share. According to USACE FY 2014 the federal cost sharing has been 50/50, not as originally anticipated. This does not include the complete cost for Halcrow Sand Search study paid by Flagler Beach (using FDEP funds) nor Marlowe and Company lobbyist cost paid solely by Flagler Beach.

18. Please show scientific proof for the statement in Appendix C-A28:
The near-shore currents in the project vicinity are not directly influenced by the Gulf Stream, but may be influenced indirectly via interaction with incident waves.

Influence of Matanzas Inlet (2.4 miles to the north) and Ponce de Leon Inlet (27 miles to the south) ebb and flood currents on local currents is negligible. In both cases the distance between the inlet and the project area places the project outside the influence of inlet tidal fluctuations.

19. Page 5-48 indicates 320,000 cubic yards average volume for each nourishment event, with 5 events at an average annual cost of $810,000. Other numbers are given in other areas of reports, appendices. What are the actual costs for sand which agree from section to section of the report? As quoted on page 9-1, "The TSP covers 2.6 miles of shoreline length and mainly prevents damage to SR-A1A."

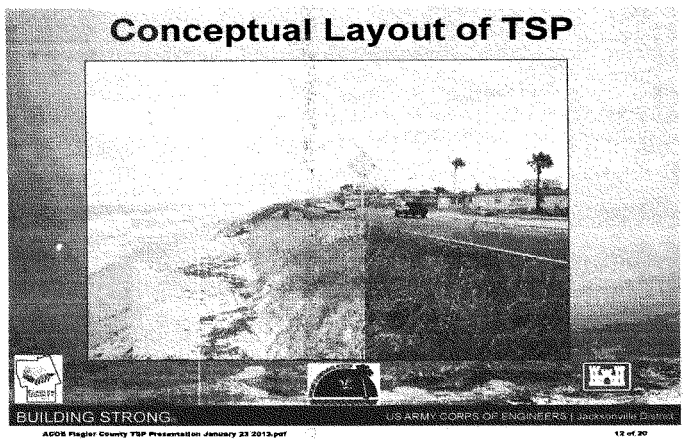
20. Numerous studies point out that most of the problem for Flagler County beaches is the slope of the dune. Appendix B-p5, indicates a 1 on 3 slope, a 35.0 berm with a 1 on 100 slope, and foreshore fill of approximately –2 feet – NAVD88 with a slope of 1 on 5. Please justify maintaining the current slope based on the following information.

The 1st picture is the photoshopped example of how the project will look given by the USACE.

The 2nd illustration used by the USACE is drawn in such a way to ignore A1A and the distances of the road. It is very misleading in my estimation and I hunted through all the report and the appendices to find something different, but I never found it.

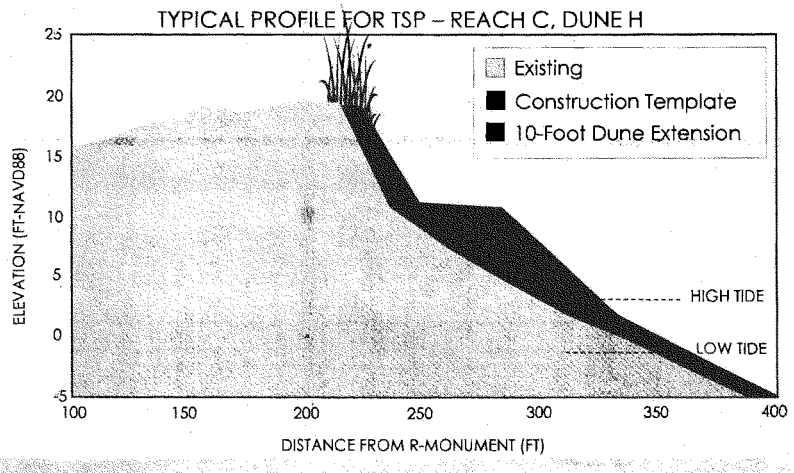
The 3rd picture was presented in a powerpoint given by John Herrin of ASR. It agrees with many other engineering reports which I am not taking the time to enumerate now.

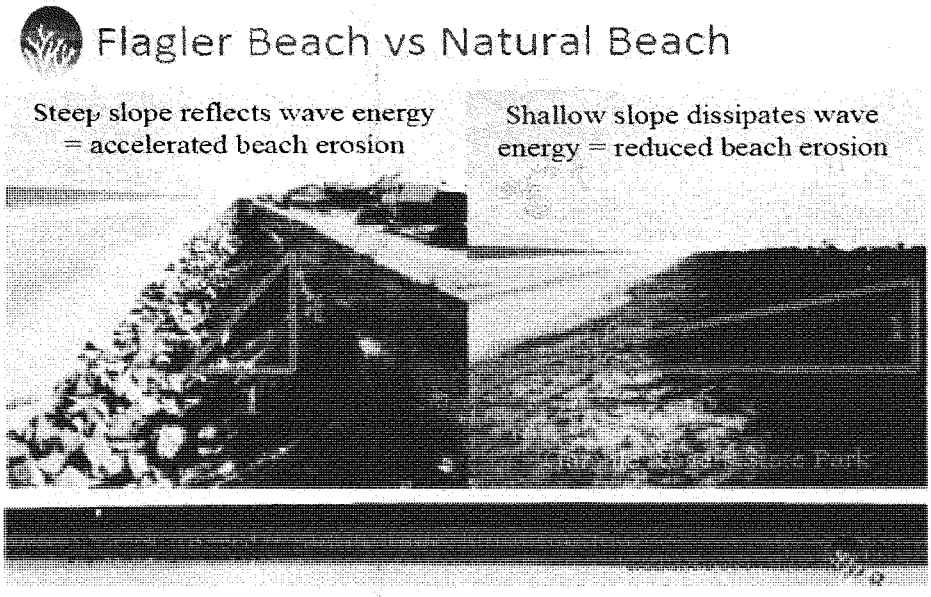
The 4th illustration was used in a powerpoint by FDOT, explaining the jurisdictional boundaries and why they couldn't do anything on the beach, even if it was the best approach.



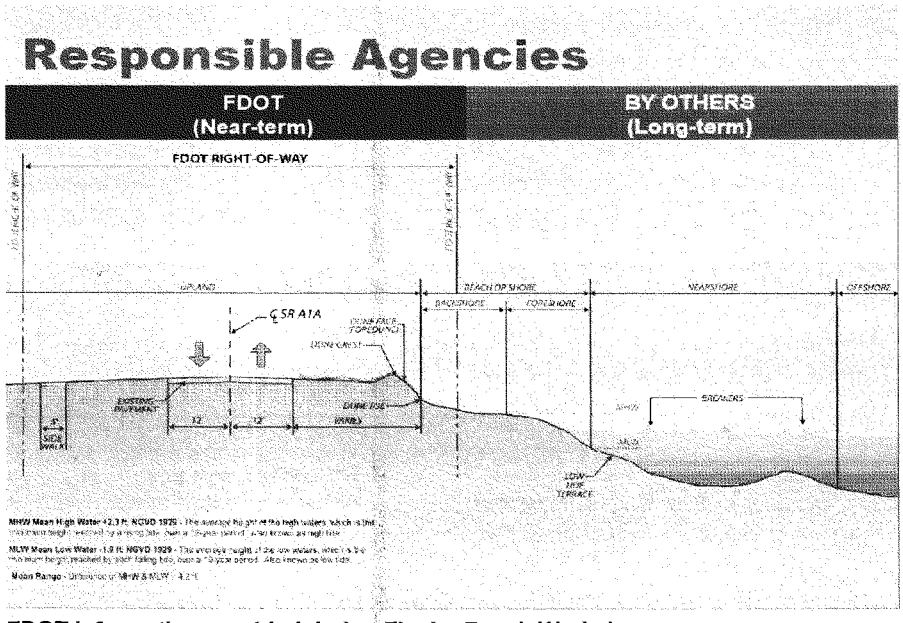
ENGINEERING ASPECTS

10-foot seaward extension of the dune and beach profile in Reach C





Slope presented during Flagler Beach Workshop 2011 by John Herrin of ASR:



FDOT information provided during Flagler Beach Workshop

As you can see, I have taken the time and effort to study the nearly 1000 pages of USACE information for this project as well as many other references. I am vehemently opposed to using our taxes to continue this charade of a project – I feel the information has been "massaged" in many ways to allow it to provide a basis for obtaining continued employment opportunities for USACE and shift the maintenance expense of A1A to the shoulders of Flagler taxpayers. Why anyone, including our county and city government, would be held hostage by this project is unbelievable to me. We deserve better.

CC by mail:

Major General John Peabody, US Army

(reference letter to Major General Walsh 4/29/13)

Deputy Commanding General for Civil and Emergency Operations

US Army Corps of Engineers

441 G Street, NW

Washington, DC 20314-1000

James C. Dalton, P.E., Chief, South Atlantic Division

(reference letter to Major General Walsh 4/29/13 w/cc to you)

Regional Integration Team, Chief of Engineering and Construction

Headquarters, US Army Corps of Engineers

441 G Street, NW

Washington, DC 20314-1000

March 13, 2014

To: Colonel Alan M. Dodd, USACE Commander, Jacksonville District

OFFICIAL COMMENT: Flagler.HSDRComments: mailto:Flagler.HSDRComments@usace.army.mil
OFFICIAL COMMENT: via: Kathleen.k.mcconnell@usace.army.mil

From: James T Carney, Citizen of Flagler Beach, FL

Re: Flagler County, Florida Hurricane and Storm Damage Reduction Report Draft Integrated Feasibility Study and Environmental Assessment Project 11316 dated January 2014

I have to thank my friend, a civil engineer, for the help in understanding this very large study which has been produced. Our beach is very valuable to me, and obviously a project which is going to benefit our city and county is of importance to me.

That the project is being done to protect the rock revetments along A1A, with shifting the cost of maintenance of the revetment being transferred from the state and FDOT to the taxpayers of Flagler County makes me WAKE UP and wonder what is going on.

My questions and comments are organized by chapter.

Chapter 1: Information has been shown in table form (Table 1-1 and 1-2). Please define which of these 4 specific interests are at risk (or more at risk) in each area:

- Upland Development
- Recreation
- Wildlife Habitat
- Important Cultural Resources

Chapter 2: The study acknowledges the poor performance of existing revetments. They do not meet the needs of turtle nesting and there is a negative impact on turtle nesting. I do not understand why the Fish and Wildlife Division would approve the study, unless everyone's philosophy is "we expect the volunteer Turtle Patrol to move the nests when there are problems, so let the local people deal with the problems which are created by the project."

- Is there a better way to define turtle nesting locations? GPS locations? By block?
- Where was the picture taken shown in Figure 2-18?
- How does the amount of nesting compare to other areas in Florida?
- Turtles require dry sand for nesting. Interestingly p2-35 indicates "no nests were observed along the section soft shoreline containing armoring or revetment." But no indication was given about the sand conditions there. Did the USACE biologist contact the Turtle Patrol which does a day-to-day observation, tagging, etc.? Had nests been moved?

- Where was the picture taken for figure 2-28? I would recognize it as the northern portion of Flagler Beach, at low tide. People looking at this figure would think the entire beach is this way.
- The dictionary shows "viewshed" as one word, while two words are used in the report. Which is correct? In addition, would this be a commonly used word? I had to look it up.
- Where are bird nesting locations?

The report on p2-63 indicates "these (aesthetic) values are subjective, and as such, the erosional features of the beach and its adverse impact to the area's aesthetic quality cannot be effectively quantified." However subject words such as "robust, aesthetically unpleasing" etc. were used in the study – I think most people would say that the revetments, etc. can certainly be effectively quantified as unpleasant to look at as well as unsafe as the rocks work their way down to the beach.

Chapter 3: Page 3-2 indicates that Beverly Beach experiences a lower rate of shoreline rate of change due primarily to the stabilizing presence of a concrete and steel seawall over a significant portion of the beach. However, what is not said is that the first seawall created so much erosion on the south end that much land was eroded and another seawall had to be put up. The result of the second seawall is the erosion of the adjacent lot. This is typical of the disadvantages of a seawall.

- Has Beach-*fx* been calibrated to model US real life performance?
- What predictive computer program does Beach-*fx* replace?
- Where else has Beach-*fx* been used?
- Does Beach-*fx* always recommend nourishment or have other technologies been recommended?
- In Table 3-6 (p3-16) why is it assumed that 90% of the berm recovers post storm? What scientific evidence exists that this happens?
- Who is the SAJ contracted surveyor who estimated the first floor elevations of all structures in the study area? What was the cost of this survey work?
- Is it correct that the overall analysis uses the low level costs estimated in Table 3-7? What was the reasoning for this? Did this help to increase the cost/benefit ratio?

Chapter 4: It is reported that FDOT spends approximately $600,000 annually to maintain the Flagler Beach revetment areas. In contrast, if the study recommendation is implemented, Flagler County taxpayers will be paying 50% of the cost for essentially the same areas. It would have to be assumed that FDOT (state) costs would be substantially reduced. The current seawall is producing shards of steel that fall to the base of the seawall and end up due to waves in the area where people walk. So far luckily no one has been injured by one. Although several have been picked up and thrown back to A1A.

Chapter 5: This chapter indicates the screening process followed by the USACE study.

- Are there other ratios above 1 that may yield longer term benefits? One example might be: reef and renourishment may cost more initially but have lower long term maintenance cost and less renourishment.
- What is the balance between (or are all equal?):
  Economic Development vs storm damage, insurance
  Environmental Quality vs aesthetics, natural resources
  Other Social Effects vs life, safety, property values
  Regulate Economic Development vs employment, sales, business development

Greater detail should be given in the analysis of plans with a positive benefit/cost ratio as well as more detail for the elimination process. There is very little detail in pros and cons of each section. Is there a positive alternative to the proposed plan?

Chapter 6: Costs are based on Beach-*fx* average calculations for dredged sand required. No explanations are given for how the sand is actually going to fit and stay on the same dune angle as exists now. So many efforts have been made over the years to hold the sand on the dune – plantings of native grasses, etc.; discarded Christmas trees, etc. FDOT has paid for some of the actions, while volunteers and city sponsorship have provided others.

- If there have been successful past projects using this same plan (sacrificial dredged sand placed in front of a rock revetment), please provide the study, evaluation, etc. in the references or provide specific inserts.
- Who or what groups have examined the Beach-*fx* data to provide reassurance that renourishment of the revetment area is feasible every 11 years (4 times after initial plan)?
- There is sparse data on the long term impacts of removing dredged sand from the proposed borrow area approximately 7 miles offshore. This should be improved.
- Has FDEP given approval of this plan? What about FDOT?
- Is Flagler County the "experimental" first time for such a project as this? Remember, Flagler and Volusia Counties are the only two coastal counties which have not been involved in an offshore dredging (mining) project. Other counties in the state are paying the piper for their past dredging projects with lack of off-shore sand, increased erosion, etc. I would not want Flagler County to join their ranks.

Chapter 7: Section 7-18.1 is almost like a veiled threat: "If the borrow areas identified in this EA are not used for this project, the growing demand for sand to use in protecting Florida shorelines suggests that they would be utilized in the future by other stakeholders." Who is going to approve/encourage such use – the USACE?

All in all, after spending the time and effort to review the study, I am disappointed that the USACE did not come up with a project which was really going to improve/help beach erosion on a long term basis. It really appears that the information has been skewed in order to create a project that will fit the federal cost/benefit guidelines – in reality, are Flagler County administrators just in the mix in order to obtain federal funding?

Will this be another situation like the rock revetment – it is acknowledged that it was a poor choice of materials, poor design, etc. from the beginning – and we are living with the results now. Now we are being asked by the USACE to cover up the past mistakes, and to do it for the next 50 years – at a great cost to Flagler taxpayers. There appears to be no other solutions to any beach erosion problem than dredging. My research shows more money being spent on problems produced by these projects than the projects themselves.

From: Durkin, Martin T SAJ on behalf of HSDR Comments, Flagler
To: Harrah, Jason S SAJ; Bronson, Candida K SAJ; McConnell, Kathleen K. SAJ
Subject: FW: [EXTERNAL] Official Comment (UNCLASSIFIED)
Date: Thursday, March 06, 2014 6:55:24 AM

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: whoknows11us@gmail.com [mailto:whoknows11us@gmail.com] On Behalf Of PB
Sent: Wednesday, March 05, 2014 9:05 PM
To: HSDR Comments, Flagler
Subject: [EXTERNAL] Official Comment

March 4, 2014

To: Colonel Alan M. Dodd, USACE Commander

Jacksonville District

OFFICIAL COMMENT: Via: Flagler.HSDRComments Flagler.HSDRComments@usace.army <mailto:Flagler.HSDRCComments@usace.army>

OFFICIAL COMMENT: Via: kathleen.k.mcconnell@usace.army.mil <mailto:kathleen.k.mcconnell@usace.army.mil> .

Re: USACE presentation on Wednesday, February 5, 2014 - Flagler County, Florida Hurricane and Storm Damage Reduction Report Draft Integrated Feasibility Study and Environmental Assessment Project 11316 dated January 2014

From: SaveFlaglersBeach.com officers

We appreciate the opportunity to respond to what was presented to the citizens of our seaside town by the USACE on February 5, 2014. First, here's a little about us.

A group of citizens organized the movement in 2004. Most of our members attended the commission meetings, town hall meetings, workshops and training sessions held over the years. We are a Florida non-profit corporation and have a website. For ten years we have done extensive research on beach and shoreline avulsion, which we know is man-made. We know how to solve the problems and resolve all issues. We made a PowerPoint and met and shared our findings with many members of professional groups and residents. We stood and spoke with many people and at Flagler Beach "First Friday in the Park" gatherings. We also had business cards and handouts to help people understand the seriousness of our situation here. We traveled to other coastal communities to discuss their problems and concerns.

The movie, "The Big Uneasy" was mandatory viewing for our members. It does indeed tell the "true story" when Katrina came calling to New Orleans and 1,800 human beings shouldn't have died in the parishes along the Gulf Coast. We met with many local, county and state politicians with no real ROI on our investments of time and money. Most politicians stick together but never become the leaders we vote for. Very sad!

We have worked and educated ourselves just like your Corps employees but received no pay. At the meeting February 5, the crowd was much smaller than earlier years. Many of our citizens have become tired of hearing the same old, same old. Although there was a suggestion about doing something about the erosion, there was no scientific information shared about what actually causes the avulsion and how to stop it. Mining sand and pushing it against our dune strewn rock revetment doesn't solve or resolve our serious situation. Your pictures and information set up around the room took some effort but the audience didn't understand the posters and pictures. The young engineers trying to answer questions were ill-prepared to do that. It is a difficult subject to understand, and your engineers have been educated with text books that are very much out of date. So sad!

Your 10 year study has cost us over 3 million dollars and we feel cheated. We also understand that it puts a great deal of money in the pockets of the huge dredging (mining) industry as well as engineering firms and lobbyists – it becomes a matter of power and heaps of greed. We feel that we are in a "war" with you – as part of the military, you are not held responsible nor accountable for anything you do. The 1,800 people killed on the gulf coast of New Orleans is an example.

You have the money....which is really our tax money. You have the political backing of the lobbyists and a very political process in Congress. You all stick together and have absolutely no intention of actually learning how to solve beach and shoreline avulsion on our coastlines. We could teach you many things and we didn't learn about wave action in a classroom aquarium the size of a swimming pool. Your work is unacceptable to us when we could be putting two feet of annual vertical height of sand on our beach, protecting our natural sand dune system, and preserving A1A, our designated historic, scenic A1A Byway.

To quote retiring Major General Michael J Walsh, November 28, 2013, "'Essayons' is an American Army term. It means 'Let us try.' When others have failed, let us try. When others don't know what to do, let us try. When the mission must be accomplished, 'Essayons!'

A good statement, but we want more than trying – and this report doesn't even meet that standard. We feel that we are being held captive by you and congress for getting the truth out. Does this make you feel proud of your contributions? Is this your mission and your desired legacy? How pitiful and pathetic.

Let's get real and work together for real and truthful solutions and endless solid contributions. We welcome you to join us in not trying, but making some real progress in the state of Florida. We deserve to be respected and treated much better than you have treated us in the past. Actually, you have appeared to disregard us and our dedicated work.

CC by mail:

Major General John Peabody, US Army

(reference letter to Major General Walsh 4/29/13)

Deputy Commanding General for Civil and Emergency Operations

US Army Corps of Engineers

441 G Street, NW

Washington, DC 20314-1000

James C. Dalton, P.E., Chief, South Atlantic Division

(reference letter to Major General Walsh 4/29/13 w/cc to you)

Regional Integration Team, Chief of Engineering and Construction

Headquarters, US Army Corps of Engineers

441 G Street, NW

Washington, DC 20314-1000

Classification: UNCLASSIFIED
Caveats: NONE

From: Lourdes Quintero-Knapp
To: McConnell, Kathleen K, SAJ
Subject: [EXTERNAL] Flagler Beach, Fl
Date: Friday, March 14, 2014 6:46:49 PM

To: Kathleen McConnell, USACOE

From: Lourdes Knapp 2544 S OceanShore blvd Flagler Beach, FL

This a follow-up in response to the presentation of the Corp of Engineers proposed beach re-nourishment project for a section of Flagler Beach.

I hereby wish to place my opposition to the proposed Flagler County Hurricane and Storm Damage Reduction Project.

With out any definitive evidence of successful outcomes at other beaches, this plan becomes a commitment to an open-ended drain on the limited funds
of our City and County. As your report demonstrates, there is no permanent fix
for the erosion problem. And of greatest importance, this plan will irreparably damage the shoreline, animals and plants.

We will not support unending destruction of our beach habitat, as well as our future quality of life here in our beautiful town.

Sincerely,

Lourdes Knapp

March 15, 2014

Colonel Alan M. Dodd
District Engineer
USACOE
Jacksonville, FL

Dear Colonel Dodd,

I have serious reservations about using beach renourishment in the Flagler County Hurricane and Storm Damage Reduction Project. First off, I feel it is fiscally irresponsible to recommend to the taxpayers that we commit to a spend of $43,466,000 when the plan is one that is known to fail and has built into the plan "periodic renourishment", which is nice way of saying do it over and over again. The estimated cost of the initial renourishment is $14,127,000 that leaves $29,339,000 to fix the failed renourishment.

I also wonder what the impact is of renourishment:

- How close of a match is the sand from 7 miles out?
- What is this sand harvesting doing to the ocean floor?
- What is the impact to the areas around it?
- How long will the sand supply last?
- What is the impact to the marine and sea life during this whole process from collection through redistribution of the sand?

My concern for renourishment being the solution is further complicated when you have articles such as the one that ran in AP.org dated August 14, 2013 states "Miami-Dade and Broward counties are the first in the state to deplete their offshore sources of sand that can be used for beach renourishment projects, said Tom Martin, a senior coastal engineer with the U.S. Army Corps of Engineers." (http://bigstory.ap.org/article/corps-runs-out-sand-miami-dade-beaches) I do not want to see us build a dependency on something that has a limited supply.

As for the study:
I would like to see more detail of the analysis on the other options with positive points (3 points or less), what their short term and long term costs are and why they were eliminated.

Section 4.2.1 on page 4-5 states "It is estimated that the annual expense to FDOT of maintaining the revetment in Flagler Beach is approximately $600,000/year." I would like to see the detailed breakdown by year of what work FDOT has done and the associated expense.

In summary, I strongly believe that we need a cross agency review including USACE, FDOT, FDEP and other impacted agencies to review the options including consideration of the long term cost and viability of the various options and/or combination of options. I think now is the time to look hard at the options and try something different than what has been done before.

Sincerely,
Mary Louk,
Flagler Beach, FL

Sandra Mason
1601 North Central Avenue
Unit #801
Flagler Beach, FL 32136
beachsandra@mac.com
March 24, 2014

Jason Harrah, Project Manager
Jacksonville District
US Army Corp of Engineers
701 San Marco Blvd.
Jacksonville, FL 32201
Jason.s.harrah@usace.army.mil

Dear Mr. Harrah:

Please find attached my questions regarding the Flagler County Hurricane & Storm Damage Reduction Project Tentatively Selected Plan (TSP). As we discussed at the presentation meeting, the time allotted to read and understand and formulate questions and/or comments was extremely brief in relation to the nearly 10 years it took to create the plan. I appreciate your willingness to extend the 30 day comment period.

It was a pleasure meeting you at the presentation. Thank you for your help.

Sincerely,

Sandra Mason

Bcc:

ACOE 1 2014 Feasibility Study for Flagler County, Florida
Questions:

ES-2 "The TSP is the National Economic Development (NED) plan, consisting of a ten foot dune extension including a 10' sacrificial berm in Reach C..."
Has this type of "sacrificial berm" been done in the SE US on the Atlantic coast? Please provide location(s) and renourishment intervals.

ES-2 "The plan will most likely be constructed with a hydraulic dredge..."
How is it possible to project a cost if the type of equipment is not known? What other type(s) of equipment are being considered and what are their associated costs and environmental risks?

1-2 "By including the entire southern half of the county, economic and real estate data will be available to determine the benefits of reducing the risk of storm damage in the critical areas along with the non-critical areas..."
How does the TSP benefit the critically eroded area in North Flagler Beach? How does the non-critical beach benefit?

1-5 1.3 Purpose and Objectives "This study will determine the feasibility of providing hurricane and storm damage reduction within...reaches of Flagler County coastline. Alternatives considered will include: no action, non-structural measures, shore protection with hard structures, shore protection with shot structures combinations of the above, and others."
This report does not meet the purpose and objectives. See Table 5-5 and 5-6.

"This report will recommend a plan that is technically sound, environmentally acceptable, and economically justified."
Does economic justification mean the cost of implementation or are potential benefits over time factored in? Some projects may have a higher initial installation cost but a relatively low repeat maintenance cost, making them a more cost effective alternative long term. Renourishment projects have a 4-time repeat over 50 years. Was 50 years the repeat maintenance interval used in determining cost/benefit for all alternatives?

1-5 "The inland extent of the Flagler County study is based on detailed engineering analysis recently completed for St. John's County..."
Why is this valid for Flagler County?

1-9 "Shoreline Change Rate Estimates Flagler County July 1999. "The report estimated a shoreline change rate of approximately -1 foot per year for the county."
The statement actually reads, "The shoreline orientation is not straight but rather has a concave curvature in the north, transitioning toward a headland at Flagler Beach. The primary coastal process appears to be a smoothing of irregularities along the overall curvature, with net transport to the south.

Erosion is generally between 0.0 and -1.0 ft./yr. Caution in future planning is recommended, as is the verification of these results via future surveys." Where is the verification? Since a range is given was the mid range number of -0.5 ft./yr. used for the model? If not, and no verification has been reported, would not the -1 foot per year stated in your report be inaccurate?

1-10 "FDOT does not currently have any dune stabilization plans for SR A1A in their 5 year work program."
The 5-year rolling budget published in 2012 had a total of $4,289,751 projected for SR A1A Stabilization between 2011-2015 with $3,957,486 budgeted for 2014-2015.

2-17 "...the Flagler Pier at R-79. The pier tends to trap sand from long shore transport causing accretion north of the pier, as well as down drift erosion about 2.000 feet south of the pier due to the interruption of long shore transported sand."
What role does the pier play in the critical erosion in south Flagler Beach?

2-18 "Due primarily to the stabilizing presence of a concrete and steel seawall over a significant portion of the reach, Beverly Beach experiences a lower shoreline rate of change, approximately -0.11 ft./yr."
This seems to indicate that a similar seawall constructed along the length of Flagler Beach would solve the erosion problems. Where are the cost/benefit numbers over a 50-year period for comparison to the TSP? Does the Beverly Beach seawall cause the same downdrift erosion as the pier and what role does it play in the critical erosion of reach R065.2-070 in north Flagler Beach?

2-24 "After storms pass, gentle waves usually return sediment from the sand bars to the beach, which is restored gradually to its natural shape."
Why then was Alternative S-8 Nearshore Placement dismissed?

"...any tropical disturbance passing within this distance even a weak tropical storm, would be likely to produce some damage along the shoreline."
This statement is conjecture. Where is the data to substantiate this statement? As a Flagler Beach resident I can tell you from experience that frequently tropical systems produce less damage than non-named systems or nor'easters.

2-32 "Nesting data provided by FWC could not be correlated with exact spatial locations as GPS data are not collected during the next monitoring. Therefore we were not able to determine any established trends..."
This is simply not true. Nesting data with specific locations is available. Locations are referenced by cross street numbers and walkovers.

2-35 "However no nests were observed near the Flagler Beach Pier, R-79 where dune erosion, revetment, and armor structure are present."

The Flagler Turtle Patrol relocates nests that are in danger of overwash, especially those areas in R-79. Relocation information is also available.

Anecdotal observation of sea turtle nests along various reaches of the study area were recorded during a site visit by USACE Biologist on 2 August, 2011."
Why was there only one site visit in a 9-year period for a $3m plus project?

2-54 "Florida pompano, flounder and tarpon are considered to be Aquatic Resources of National Importance (ARNI) by the U.S Environmental Protection Agency (EPA)"
How will these species be affected by dredging, loss of habitat, and turbidity?

2-60 Table 2-16 Bird Sightings. "All observations occurred during one-day event (August 2, 2011) by USACE Biologist.
Is a sample of one valid considering the length of the project? Same single site visit in a 9-year $3mil project?

2-73 Table 2-18 Existing Coastal Inventory by Damage Element Category & Type.
Is this table for the entire length of Flagler County or just the length of the TSP? There are not 1,286 structures in the 2.6 miles of project area. What is the real number for the project area? What is the cost/benefit ratio in the actual project area? Are you suggesting that the TSP will benefit all structures along the Flagler County coast? If so, how?

2-75 "Flagler Beach has the most armor in the study area, much of which is in varying stages of disrepair."
What is the dollar value placed on beach armor in "disrepair" in the project area?

"According to FDOT contractors, this revetment is maintained at an annual cost of approximately $1.5million."
Please cite the source of this information. It is in conflict with the published FDOT budget.

3.1 "Historical rates of shoreline erosion were projected to future years to locate the shoreline position 50 years from now."
This study notes only 40 years of shoreline data. Why were earlier sources such as the aerial photographs in the UF digital collections not used?

3.6 Table 3.3 Qualitative Matrix describing vulnerability of resources from potential accelerations in SLC.
This table appears to show "low vulnerability" for infrastructure over the next 50 years. Why then is there a need to spend $40mil of taxpayer money?

3.10 "...it can be reasonably assumed that efforts will be made to maintain the dune at its current elevation to protect Highway A1A."

That being said, why is spending $40m needed or justified?

3-13 "Beach-fx fully incorporates risk and uncertainty, and is used to simulate future hurricane and storm damages...Storm damage is defined as the damage incurred by the temporary loss of a given amount of shoreline as a direct result of waves, erosion, and inundation."
Does beach-fx take into account the natural recovery processes during those intervals? It appears to be a snapshot of the worst-case scenario. Beaches have the ability to recover naturally as evidenced by the fluctuation in the location and length of "critically eroded" segments within the study area.

3-24 "Aesthetic Resources"
What criterion is used to determine aesthetics?

4-4 "Throughout the study area, infrastructure has been developed directly on top of the primary dune system, often depriving the beach from sediment gained from natural dune erosion...Therefore, periodic severe storm events are removing sediment from the dune and beach face and the natural processes to replace the sediment are being restricted."
This being the case, why was Alternative S-8 Nearshore Placement eliminated? It is the only alternative that addresses "the natural process to replace sediment."

4-14 "The report will serve as a decision document for Federal participation related to hurricane and storm damage reduction over a 50-year period."
Does this mean that regardless of advances in technology our community has no other option or alternative FOR THE NEXT 50 YEARS?

5-1 "The national economic development (NED) account displays the plan with the greatest net economic benefit consistent with protecting the nation's environment,,,"
Does this benefit have a time frame? For example, cheapest to construct has very little value if it doesn't last. How were the cost savings over time factored in to each alternative? Also, how were negative environmental impacts factored in?

5-7 "The NED criteria includes consideration a measure's potential to meet the planning objectives of reducing storm damages, as well as decreased costs of emergency services, lowered flood insurance premiums and project costs."
Please quantify how each alternative met or did not meet the NED criteria above. Charts 5-9 to 5-19 subjectively rule out alternatives without providing any data.

5-25 "It was assumed that it would not be feasible or practical to implement any alternatives along a stretch of shoreline less than 1 mile."
Why? Critical erosion is critical erosion. If Federal protection is deemed necessary in one area how can it not be in another? This implies that the cost/benefit ratio is used solely for the critical area and not the county as a whole.

5-26 "ROM Estimate (One Time Build) $/LF"
Is this the basis for selecting a method? Cost of construction over the life span of each alternative needs to be factored in for an accurate cost/benefit analysis. Where are these numbers?

5-31 "The five measures carried forward into the intermediate screening phase showed the greatest potential to feasibly achieve planning objective #1 to reduce damages to structures and infrastructure in the study area based on ROM estimates."
Was not the criteria to be 5-1 above, demonstrating economic benefit consistent with protecting the environment? How exactly does dredging protect the environment? How can dredging and creating an artificial berm be cheaper per 5-26 (One Time Build) than alternative S-8, Nearshore placement?



MARLOWE & COMPANY

GOVERNMENT AFFAIRS CONSULTANTS

Memo

To: Bruce Campbell
From: Howard Marlowe and Rich Ring
Re: Comments on the Corps' Feasibility Study Report
Date: February 15, 2014

The comments below were written by our consultant Rich Ring, formerly of the Corps' North Atlantic Division and of the Corps' Coastal Center of Planning Expertise. The City does not need to submit these as formal comments. Rather, with your permission and after explaining Rich's comments and concern, we will communicate directly with the District's study manager.

Background:

1. The Flagler County study covers 18 miles of shoreline subject to erosion caused by storms and natural processes. The study investigated 9.7 miles as the remaining 8.3 miles were found not to experience erosion that threatens infrastructure or produce economic benefits that would exceed costs, therefore resulting in a negative benefit-cost ratio (BCR) precluding further study.

2. The 9.7 miles under study were divided into four reaches with Flagler Beach (6.2 miles) accounting for two-thirds of the area.

Findings:

1. The Tentatively Selected Plan (TSP) for the study is also the National Economic Development Plan (NED) and covers 2.6 miles of shoreline in central Flagler Beach. The majority of economic benefits (93%) are based in the reduction/prevention of damage to State Route A1A. These benefits are based in the components of the TSP providing protection to the existing revetment and coastal armoring which protect A1A.

1667 K STREET, NW ■ SUITE 480 ■ WASHINGTON, DC 20006 ■ (202) 775-1796 ■ FAX (202) 775-0214
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A Limited Liability Company

2. The TSP consists of a 10 foot wide dune extension and a 10 foot wide sacrificial berm over the 2.6 mile length of the project. Initial construction and renourishments will each consist of 330,000 cubic yards of sand which will come from a borrow source, in Federal waters, 7 miles offshore from the project site. The renourishment interval is estimated to be 11 years which will result in four renourishments over the 50 year period of federal participation.

3. The total project cost including initial construction and all renourishments in Oct 2014 prices is $43,465,000. Annual benefits and annual costs, both estimated at the current FY '14 discount rate of 3.5% are $2,000,000 and $1,100,000 respectively. The benefit cost ratio is 1.83 to 1. Total benefits include recreation benefits, however they only account for 3.5% of total benefits.

4. The report states that no mitigation is required. There are also no known cultural resource issues in the placement or borrow area. Existing dune vegetation will be impacted during construction. However, the TSP includes planting of dune vegetation on newly constructed areas as well as revegetation of areas disturbed during construction.

Observations:

1. Jacksonville District (SAJ) did a good job on this report. There is an extensive amount of information and analysis in all pertinent areas. All of the steps in the Corps Planning process were covered in detail.

2. It is admirable that SAJ used the Beach Fx model, which incorporates Risk and Uncertainty, in performing the economic analysis. This should be a plus in the HQ review and the CWRB.

3. SAJ also incorporated all 3 scenarios of Sea Level Rise in all of the without-project and with-project conditions as well as the plan formulation process.

4. SAJ also relied on much information provided by the Florida DEP and other Federal sources for the environmental analysis.

5. It is a strength of the project that its outputs protect SR A1A which is an evacuation route and a heavily used local route. This will preclude the recreation benefits criticism.

Items of Concern:

1. The report did not contain letters from the Federal agencies (US fish and Wildlife Service, National Marine Fisheries Services, EPA) nor the state agencies such as FLDEP agreeing with the finding that no mitigation is required. I am sure that SAJ will not forward this report for review without obtaining and including these letters.

2. There is no evidence of District Quality Control (DQC) performed by SAJ or Agency Technical Review (ATR) conducted by the Coastal PCX. Again, I trust that these will and must be done and documented prior to forwarding the report.

3. The greatest concern that I have is shown in Table ES-3 on page ES-4. The benefit-cost ratio is displayed at the current Federal discount rate of 3.5% without recreation (1.76 to 1), with recreation (1.83 to 1) and at the arbitrary OMB rate of 7% which results in a BCR of 1.1 to 1. Just the difference in rates (3.5% vs. 7%) causes a decrease in annual benefits of 18.5% due to present worth

discounting and an increase in annual cost of 31% due to a higher annual payment. These changes are all artificial and math related and very detrimental to the project. I know of no requirement to include the 7% budgetary exercise rate in a Feasibility Report and it is my recommendation not to include any 7% based information in this Feasibility Report. **The place for 7% information is the annual FY budget drill after this project is authorized. This is (again) a Feasibility vs. Budgetary issue; each of which should be addressed independently. Including 7% information in this Feasibility report could provide a basis for bias in a reviewer who tends to blend feasibility and budgetary considerations**.

US Army Corps of Engineers.
Jacksonville District

Comments/ Questions

See Privacy Act Statement on reverse side

SUBJECT/EVENT: Flagler County Shoreline Study Mtg

DATE: Feb 5, 2014

CHECK ONE:

☒ OFFICIAL COMMENT (Comment WILL be included in the final report)

☐ GENERAL QUESTION (Informational only. Comment WILL NOT be included in the final report)

COMMENTS/QUESTIONS Please also List Flagler Audubon Society, Inc as a party of record and send written correspondence to:
Flagler Audubon Society, Inc
Attn: Conservation Chair
P.O. Box 350695
Palm Coast, FL 32135-0695 and

electronic correspondence to
flagleraudubon@gmail.com

Donald White Conservation Chair Flagler Audubon Society Inc
NAME AND TITLE (PLEASE PRINT)

13 Wilderness Run
MAILING ADDRESS

Flagler Beach FL 32136
CITY STATE ZIP CODE

386-259-0366
PHONE NUMBER

djwhite077@gmail.com
EMAIL ADDRESS

US Army Corps of Engineers.
Jacksonville District

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DATE: Feb 5, 2014

CHECK ONE:

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☐ GENERAL QUESTION (Informational only. Comment WILL NOT be included in the final report)

COMMENTS/QUESTIONS Please list Environmental Council of Volusia + Flagler as a party of record. Send written correspondence to:
Environmental Council of Volusia and Flagler
P.O. Box 929
Daytona Beach, FL 32115

Donald White Board Member
NAME AND TITLE (PLEASE PRINT)

See above
MAILING ADDRESS

CITY STATE ZIP CODE

386-259-0366
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dwhite077@gmail.com
EMAIL ADDRESS

US Army Corps of Engineers.
Jacksonville District

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CHECK ONE:

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☐ GENERAL QUESTION (Informational only. Comment WILL NOT be included in the final report)

COMMENTS/QUESTIONS

Olsen Engineering understands

RM (Pete) Hull
NAME AND TITLE (PLEASE PRINT)

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US Army Corps of Engineers.
Jacksonville District

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COMMENTS/QUESTIONS

Should there be a major storm event occur before the Project is done with major erosion, How will the Corps react to FDOT's actions to hold the highway?

① Will you stop them from hard Vertical armoring?

② will you assist them in Emergency soil placement instead of armoring?

③ WHAT other options will they have and will Local government have approval or denial ability of those actions?

BARBARA REVELS
NAME AND TITLE (PLEASE PRINT)

P.O. Box 434
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US Army Corps of Engineers.
Jacksonville District

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☐ GENERAL QUESTION (Informational only. Comment WILL NOT be included in the final report)

COMMENTS/QUESTIONS

If after Initial Event or 1 or 2, or even 3rd re-plenishment event, it's not working, can County pull the plug?

Heidi McNeely
NAME AND TITLE (PLEASE PRINT)

318 N. 11th St.
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CITY STATE ZIP CODE

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Jacksonville District

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☐ GENERAL QUESTION (Informational only. Comment WILL NOT be included in the final report)

COMMENTS/QUESTIONS

I would like to thank the Corps of Engineers, FDEP City & County in working on this very important project.

The DOT will continue to work with & actively support all efforts in stabilizing the beach while protecting SRA1A.

Thanks again to all stakeholders to come up with a solution. Workable

Alan Hyman, Director of Transportation Operations - Florida D.O.T.
NAME AND TITLE (PLEASE PRINT)

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Page 1

FLAGLER COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION STUDY
PUBLIC WORKSHOP

DATE TAKEN: Wednesday, February 5, 2014
TIME: 6:20 p.m. - 7:15 p.m.
PLACE: Flagler County
Emergency Operations Center
1769 East Moody Boulevard
Building 3
Bunnell, Florida

This cause came on to be heard at the time and place aforesaid, when and where the following proceedings were reported by:

Delina M. Valentik,
Registered Professional Reporter,
Florida Professional Reporter

Page 2

THEREUPON

MR. HARRAH: Okay. We'll go ahead and get started. If everyone will take your seats.

First of all, I'd like to say good evening. I want to do some introductions first, if I can. I'll start with the County folks first. We have Chairman of the County, Mr. Hanns. Stand up.

We have Commissioner Meeker.

MR. MEEKER: By the way, he's wrong, do not take your chairs. Leave your chairs right here.

MR. HARRAH: That's right. Commissioner Revels.

MS. REVELS: Right here. Thanks.

MR. HARRAH: And Commissioner Ericksen.

We also have County Administrator, Mr. Coffey. And we have County Engineer Faith Alkhatib. And that's it for the County.

For the City we have Vice Chair Mealy. We have the Mayor, Ms. Provencher. We have Commissioner Shupe, Commissioner Carney. And we have City Manager, Mr. Bruce Campbell.

And we also have Alan Hyman from the FDOT as well.

And now I'd like to introduce some of the Corps folks you'll see in the room. These folks

Page 3

will be in the back of the room here at the posters when we conclude the presentation to answer additional questions or comments you may have.

My name is Jason Harrah. I'm the project manager for the Flagler County Shore Protection Project from the US Army Corps of Engineers. I have Marty Durkin, he's the planning technical lead for the project. Candida Bronson out of our planning group. Kat McConnell, she's the head biologist for the project. Jim Lagrone, he's our engineering technical lead for the project. Laurie Hadley. Laurie's our modeler, who's preparing models for the project. And we also have Idris Dobbs. Idris is our economist for the project. And Susan Jackson standing up is in our corporate communications office, public relations.

Who did I forget? I just met her today, so I'm having a hard time remembering her name. She's from our headquarter's office in Washington DC on an assignment.

Lauren. Is that right?

MS. VICINIE: Laura.

MR. HARRAH: Laura. So she's in from Washington DC visiting the district for a few weeks.

Page 4

Good evening everyone, we're here tonight to present to you the recommended plan for the Flagler County Shore Protection Project. Since 2008 the Jacksonville district's been fully engaged to develop a recommended plan that everyone in the City and the surrounding community can live with. We've been working diligently with the local echelon of Flagler County to find a working solution.

The recommended plan you're about to see calls for the seaward extension of dunes in certain portions of the county. These dunes are an important natural resource for the county and will help provide protection from storms. They're going to provide habitat for wildlife and they're also going to provide a recreational attraction for tourists. They will provide protection from strong winds and waves during storms. And they will also protect State Road A1A which is a major hurricane evacuation route as most of you know. And is also a culturally significant resource as well to the County.

These dunes are going to minimize the impacts to erosion and finally these dunes are going to enhance the tourism for the beautiful beaches of

Flagler County. And I will tell you that it is a beautiful place. Most of my relatives from West Virginia, believe it or not, they drive from West Virginia eight hours to Flagler County to vacation. So it is a beautiful place.

So now what I will to do is turn it over to Candida Bronson for a quick update on the planning and the Marty Durkin will do the presentation.

MS. BRONSON: Thanks, Jason. Good evening everyone. My name is Candida Bronson and I am from the Corps Coastal Navigation Planning Section. And I just wanted to share a few thoughts on the importance of this meeting tonight and where we're going through this planning process. The draft report has been compiled. The team's been working hand in hand, the Army Corps of Engineers with Flagler County and -- over the last several years they've completed data collection, engineering and economic modeling efforts and have evaluated alternatives. And tonight we'll be presenting the plan to you.

This plan will aid in the stabilization of the shoreline here providing storm damage reduction and shore protection along this coastline. We feel this is the best plan out of the alternatives that

we have evaluated.

The plan is described in the draft report which is out for public review right now. The State of Florida and environmental resource agencies are also reviewing the plan right now.

Your comments are very important to us. As you came in you got a fact sheet and a comment card. On there you can mark if you'd like to speak and there will be an opportunity after the presentation for you to say your comments and get those on the record. If you want to think about your comments, you can also send it in. There's an e-mail address and a mailing address on the comment card. Your comments will be incorporated into the final report. As it goes through the next steps of review and approval over the next several months, then it will accompany the final report, your comments are included in that submittal, as it goes up to Washington for review.

The assistant secretary of the Army is the one that would approve this project. And after that it would be transmitted over to Congress. Congress needs to authorize the project and appropriate the funds, provide us the money, before we could go to construction. So there's several

more steps along the way.

I think that's all the major points, so at this point I will turn it over to Mr. Marty Durkin who will be presenting the plan.

MR. DURKIN: Hi, everyone. My name's Marty Durkin. Thanks for coming out tonight. Getting to the presentation. These are some of the things I'm going to talk about. We'll go over the background of the study. How we came up with our selected plan for identifying problems and opportunities, our study objectives. Our future without project conditions, I'll talk about. And then I'll talk about the plan formulation and how we came up with our Tentatively Selected Plan. And some of the engineering costs and environmental aspects of that plan. And then I'll also talk about the schedule and where the study goes from here at the end.

So quick back ground this study was authorized in 2002 through a House resolution where Congress directed the Army Corps of Engineers to study the Flagler County shoreline for hurricane and storm damages and ways to resolve those problems. A reconnaissance report was completed in 2004. And that's a quick one-year study without going out and doing any new analysis, just

gathering existing data to determine if there's federal interest in continuing into the feasibility stage that we're at now.

So there's a positive reconnaissance report that was completed. The Army Corps and our partners, Flagler County, executed a feasibility cost-sharing agreement to begin the feasibility study. Then due to lack of federal funding the feasibility study was not initiated until 2008.

In 2011 we got to the feasibility scoping milestone where we got approval from our headquarters on, you know, the -- what we were looking at in this study and the path it was going on. And here today we're at the draft feasibility study and environmental assessment. So that draft report just went out for public review and that's what we're going to be talking about here tonight.

So the first thing we do when we begin our study is identify our problems and opportunities. Well, along the coastline in Flagler County the problem is that erosion is causing damages and threatening infrastructure, both public and private that includes single family-houses, the road, A1A, anything out there along the shoreline that could

Page 9

be damaged by erosion is what we're looking at in our study. And in addition to that, there's also, you know, threat to tourism opportunities and habitat and environmental conditions with eroding shoreline.

So opportunities focus on positive outcomes if those problems are addressed. So there's opportunities to reduce damages to coastal infrastructure caused by erosion. There's opportunities to maintain the environmental habitat and the evacuation route that's out there now and -- as well as the tourism opportunities that exist. And from those problems and opportunities we develop our study objectives which is the, you know, what's the purpose of the study what do we want to do. The main thing we want to do is reduce damages to infrastructure. You know, roads, buildings, like I said, anything out there that's been built and is threatened by erosion, our main objective is to reduce damages to that through any project we implement. So that's our main goal that we're formulating to meet that objective. At the same time we want to make sure that we maintain the environmental quality and, you know, the evacuation route and the recreational and tourism

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opportunities that exist out there.

So we started out the study and we started out with four study reaches, Marineland at the north end of the county, then in the southern half of the county, Painter's Hill, Beverly Beach, and Flagler Beach. That was our study area. And those were areas identified in the reconnaissance report that I mentioned earlier. Also the DEP -- or sorry. I'll try to avoid acronyms -- acronyms as much as I can. TSP is Tentatively Selected Plan. So that's one you're going to see a lot tonight. But the State of Florida designates shoreline as critically eroded, based on surveys they've been conducting along the shoreline, and the DEP designated critical areas when we began the study -- were also included in these study reaches up in Marineland and Painter's Hill which begins just south of Varn Park, if you know where that is, and then down to the Volusia County line.

So once we started looking into the study, we started to focus in on the southern half. Up in Marineland the main pieces of infrastructure or stuff that could be damaged up there is the Marineland Oceanarium and the parking lot just to the south of it. Which is already, you know,

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currently protected by large robust revetment, so what we saw with our preliminary analysis that, you know, there's no storms that have happened in the past in Flagler County that would significantly cause damages, so any project wouldn't be cost efficient, meaning that, you know, any project we could build, the benefits wouldn't outweigh that. So we started looking at the southern half of the county. And we split it up into these design reaches. So reach A is Painter's Hill and Beverly Beach. And these are kind of based on the -- the physical shoreline differences. So in Reach A -- and also the development that exists there. So in Reach A it's mostly unarmored single-family residences. There's a few houses that have put up vinyl sheet pile walls, but mostly unarmored single family residences is your infrastructure closest to the shoreline.

In Reach B, A1A became -- becomes your most shore front infrastructure all the way down past the pier. And then as you get into reach C from about 7th Street South down to 28th Street, you have where the existing DOT revetment seawall currently exists. And then reach D is Gamble Rogers Recreation Area at the southern end of the

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county. So that's how we split up our design reaches for analysis purposes because they're so similar with the existing infrastructure that's there.

And on the next slide what we'll talk about is our future without project conditions. The study reaches I just showed you along the bottom, Reach A, Painter's Hill and Beverly Beach. Reach B, north part of Flagler Beach. Reach C, south of the pier. And Reach D at the southern end of the county. And what our without -- before I explain what these -- this graphic is showing. Our without project conditions is what we forecast to happen over the next 50 years without a federal project being implemented. So 50 years is our study horizon or planning period of analysis. So over 50 years we want to forecast what's going to happen along the shoreline in Flagler Beach if we don't do a federal summit. So we want to look at what's going to be damaged over the next 50 years. So to do that we gather existing physical data that's out there.

The Department of Environmental Protection with the State of Florida has been surveying these beaches since the '70s. So we have surveys going

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back to the '70s that we can look at to see what areas of shoreline are eroding faster than others. That's what you see this red line here showing the historic erosion rates. We got to consider that the sea level's rising. So the sea level is going to the continue to rise at least at the rate it's been rising over the next 50 years. So we consider that.

We have a database of all the storms that have ever impacted Flagler -- Flagler County shoreline. So we have a database that has all the, you know, wave heights and durations of those storms and water elevations during those storms. On top of that we have all the data for the houses and the road and what it costs to replace them when they're damaged. So we model our future without project conditions, you know, based on that information we have along with what the pictures show and what DOT is going to do to continue to keep the road open by putting armor out there. And if -- you know, houses built after 1988, they can get a permit from the State to build a vinyl sheet pile wall.

So those are all costs and damages that you're seeing in this these gray bars that'll

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happen over the next 50 years without a federal project. So you see some costs up here in to reach A to single-family homes as erosions continues over the next 50 years. These are, you know, damages and what it's going to cost to replace anything that gets damaged as well as costs for individuals to armor their property.

In Reach B you see there's a lower historical erosion rate. And, you know, it's mostly unarmored there currently. And A1A -- and, so you don't have high damages in that area which kind of makes sense. There hasn't been -- you know, DOT hasn't gone out there and started armoring yet. So we don't forecast a whole lot of damages in reach B.

In Reach C, south of the pier, you have some of your historical erosion rates are the highest. And you also have the highest damages where most of these damages here are DOT protecting the roadway, roadway and, you know, replacing the armor in order to keep it open. So those are those damages out in the 50-year future. So based on those future without -- and then in reach D, the road kind of comes more inland, so there's not as many damages there. It's in Gamble Rogers so there's not as much infrastructure.

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So we formulate, based on this without project conditions, and in Reach A, federal participation is not warranted because there's not adequate public parking and access. Which means a project could be there, though, it would be justified economically. However, our Corps policy states that every half mile there needs to be public access to the beach which doesn't exist. So we cannot cost share in a federal project in that area.

In Reach B and Reach D where you saw the low future without project damages, project is not economically justified meaning that the benefits do not exceed the costs to build a project.

And Reach C is where our Tentatively Selected Plan is. The alternative for a dune, extension of the dune and beach profile meets all of our study objectives and it's consistent with Corps policy. There's adequate parking in Flagler Beach for the public to use every half mile. So that -- what that Tentatively Selected Plan entails it's 2.6 miles from 7th Street South down to South 28th Street, it's a 10-foot extension of the dune and beach profile which I'll talk a little bit more about what that is on the following slides.

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The sand will be from a borrow area seven miles off shore. It will be brought in by a dredge and placed on the beach. Vegetation'll be planted on the dunes to match the native vegetation that's out there now. And so over a 50-year period, you'd have your initial construction at the beginning of that 50 years, and then you'd have four more constructions over that 50 years at about every 11 years. That's an estimate, average estimate, 'cause the timing of when you have storms and how the beaches erode, it's not consistent over time. So that could vary some. And each time it would be about 320,000 cubic yards brought in.

So the 10-foot seaward extension of the dune and beach profile, what you have here -- I'll go back -- just explain something. These are monuments that are out here. The State of Florida has put those out there. They're all around the state, you'll see those in our report and other reports, so all these are monuments. They're survey markers, surveying the marks for where they run beach profile surveys. And these exist all around the state of Florida. And the State's been surveying on them to try to get each -- each area at least once every four years or more often, if

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they can.

So they survey out from these survey markers, and they survey a line straight out, so for a typical one of those survey lines in reach C, this is the cross sectional profile that you'll see. So you have, you know, the high -- the high dunes that you have here in Flagler Beach where A1A is right here at the top of the dune. Then this area now in most areas is armor, DOT armor, and various conditions or the seawall protecting the road. Then you have your beach area here which slopes down and your about four to five-foot idle range depending on the time of the year.

And then underwater the beach keeps going. And, you know, you have your sandbars and offshore area. And how beaches naturally function if there's no development or armoring on top of them, beaches can naturally take care of themselves. You all know this. You live at the beach. But when you get a storm a lot of the sand will erode out of the dune and move out onto the berm. And the sand from the berm will move out into the underwater area into the sandbars and then when you have calmer conditions in the summertime a lot of that sand moves back up onto the beach. And if you have

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no development here, you know, the wind can blow the sand back into the dune and the dune has a chance to naturally recover.

Once there's armor put up here, you know, that -- when a storm happens that sand from the dune can't move out onto the beach and so the sand from the beach still moves offshore, but your -- your beach profile continually gets lower once armor goes up. So what the project proposes to do is shift this whole -- the whole shoreline profile, including the underwater part, 10 feet seaward so that way you have some dune here to allow the beach to function naturally when you do get a storm. But we can't place sand efficiently in the underwater part, so what our construction template will look like when we build is like this, so you have the top of the dune -- we'll come out from the existing top of the dune 10 feet. This'll come out -- and these slopes look really steep right now, you can't, you know, build something that steep. I'll get to that in a second. But keep in mind the scale on the bottom here is a lot longer. That's like 300 feet there, then 30 feet along the side here. So it's not drawn proportionally to -- to fit it on this screen here.

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So we have to place all the material -- in order to extend the whole profile out, including the underwater part, we have to place it all above water when we build the beach. So at initial construction, you know, it'll look like we've made the beach a whole lot wider. But the main thing is just to extend this dune and the whole profile 'cause that's where you're getting your protection from storms.

During the normal wave climate and environment, the water's not making it up to the dune or impacting it. So this'll insure that there's sand there when the storm does hit to allow the beach to function naturally and take care of itself. So we'll vegetate the dune and probably shortly within a year after construction you're going to see all this -- this stuff that was placed on the dry beach kind of naturally, due to the wave action, you know, move out into the offshore sandbars. So it's -- it's eroding, but it's not disappearing from the beach system. It's still out there. So now your whole beach go -- even the underwater part is there for when storms come, you know, sand can move from this dune that we built out onto the -- the beach to maintain its profile.

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In the summertime you know that sand can move back on shore under the calmer wave environments. So that's -- that's what is entailed in this Tentatively Selected Plan and how it's supposed to work.

And then over time, you know, eventually it will erode away and we'll have to come back out approximately every 11 years and rebuild it to get back to its natural function. And, like I was saying, the steep slopes that's not what it's really going to look like. So here's what it looks like now. And what you'd expect it to look like from a ground level after we've built it is more like this. Something that you would see toward the northern part of the county or in Gamble Rogers where there is no armor currently built.

The beach -- we're not going to make a beach any wider like a huge Miami Beach or Daytona Beach or anything like that. Flagler County's historically always had a relatively narrow beach. But those dunes over time have gotten to the point where armors needed to be put up. So we're putting those dunes back to allow the beach to function naturally. So this is a visual rendering of what you'd expect the beach there to look like from the

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before to after, after it all equil- -- equilibrates or equilibrated just meaning, you know, once it's been constructed and the waves have had time to work it all out to its natural shape.

So the cost for the project, the initial construction would be about $14,000,000 which would be 65 percent on the federal government and then the nonfederal costs would be 35 percent of that. Following nourishments would be about $7,000,000 with that cost being cost shared 50/50 between the Army Corps and Flagler County and -- well, I guess, it would be a combination of Flagler County and the State. But those would be nonfederal costs. And so the total cost over 50 years would be about a little over $40,000,000.

The environmental aspects of this, though, even though we weren't -- you know, the Tentatively Selected Plan was the best plan for reducing damages to infrastructures, coincidentally it's also very good for the environment and it's preferable over our without project condition where now you have habitat for birds and turtles to nest. There's some hard bottom resources in northern Flagler County coquina rock outcroppings on the beach. This fill would not cover up any rock

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outcroppings. And there would be no impacts to any cultural resources. And actually, you know, protect A1A which is a historic scenic byway, so it's positive for cultural resources as well.

So in summary the Tentatively Selected Plan meets all of our objectives to reduce damages to infrastructure. The benefit cost ratio is 1.83. So over the 50-year period for the plan, for every dollar you spend, you're getting a return on your investment of $1.83 due to, you know, damages being prevented or armor not having to be placed after every storm. And in addition to that you're also maintaining your environmental quality and recreational and tourism opportunities that exist now.

So here's where we're at, this is kind of our whole civil works process, planning process right here. We're currently at the feasibility study phase. It's a draft report. It still has to go up and eventually become finalized and approved by the Assistant Secretary of the Army for Civil Works as Candida mentioned earlier. After that it'll move into our preengineering -- or preconstruction, engineering and design phase. Then it would have to go up to Congress. And Congress would have to

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authorize the construction of the project through a Water Resources Development Act. And once that happens Congress then also has to fund it for construction to happen. So the earliest that construction could happen would be 2017.

Again -- so, as Candida mentioned earlier, again, the report is out for public review right now. You can e-mail Kat these -- or send mail to Kat McConnell. You can send e-mails to this address here. And there's comment cards here tonight for you to write down your comments and we'll take them. We have some poster stations set up around the room. And, hopefully, you got to go around and ask any questions you had and, you know, we'll be here for after the question session if you have any more questions or anything else you would like to discuss with us.

And now I will pass it over to Susan for the question answers.

Thank you for your time.

MS. JACKSON: Can you hear me? Okay.

UNIDENTIFIED SPEAKER: No.

UNIDENTIFIED SPEAKER: No.

MS. JACKSON: Turn this up?

MR. HARRAH: You got to get it real close.

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MS. JACKSON: Testing. Testing. Okay. I'm glad everybody could make it here tonight. We really appreciate the community's interest in our project and we hope to hear some great comments and questions from you. We'll also be here, though, like Marty said after the meeting, to answer more one-on-one questions. The way we operate this is we would like to give everybody a few minutes of time to comment and/or ask questions and we'll respond to them. And what we're going to do is invite you one by one up to the podium, please give your first name and last name clearly. I've got a list of people who already have told us that they would like to speak, so I'll announce the name.

MR. HARRAH: Let me just say one thing.

MS. JACKSON: All right.

MR. HARRAH: We will -- we will try to answer your question if we can. If it's something that we can answer right now, we do have a court reporter we're taking all the questions back with us. We have to when we get the report finalized every single question that we receive in writing, e-mail or here tonight will be provided in the final report. So you'll get an answer to every single question you have. If it's something quick and

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simple we can answer here, we will. If you have a more complex issue or question, we'll take a that back with us and we will address those.

Do you want to do it there or here?

MS. JACKSON: Well, they're going to be moving up here, then this is for us.

MR. HARRAH: I didn't know if you'd have backfeed, if you didn't turn it off.

Okay.

MS. JACKSON: Okay. Our first speaker, and I apologize guys in advance if I mispronounce some of these names. But this is Jane Mealy.

MS. MEALY: Hi, I'm not going to comment so much on the plan, we've sat through the meetings before and have heard most of this, those of us that have been to those meetings. I just want to have on the record that the Flagler Beach Commission did vote to -- well, we brought it up at the last workshop and then we've discussed it several times since that we want to either the County, and maybe with some representatives from the Corps, to answer any concerns that -- final concerns that we might have, so I just want to have that on the record.

MS. JACKSON: Thank you very much.

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Doyle Levy.

MR. LEWIS: Lewis:

MS. JACKSON: Oh, Doyle Lewis.

MR. LEWIS: I live in Flagler Beach. My name is Doyle Lewis. I've been watching the ocean, the beach there for 10 years for sure, longer than that, but a lot of people didn't know that. So I appreciate your plan very much. This is going to be very short. Whenever you figure out what kind of equipment you're going to be using, I'd like to see it. If it comes in port up here in Jacksonville or wherever it is, I would like to know immediately, so I can tell the people here. I've got to do some traveling now. And I would just like to be informed because I'm very interested in building a house right there where I can keep watching the beach and I'm planning on it. Thank you.

MS. JACKSON: Thank you very much, sir.

Sandra Mason.

MS. MASON: Hi. You all have answered a couple of the questions already. But I wonder if you had any idea since you do have to submit budgets from the Corps to the federal government where you see this project in your budget for the

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next phase? I mean, 2015's already been submitted; right? So, I mean, there aren't --

MR. HARRAH: Based on the guidelines, the main people that are responsible to provide budgets is the Office of Management Budget, or OMB, based on the guidelines they've set forth, we did not receive the preconstruction, engineering design funds for 2015.

MS. MASON: Uh-huh.

MR. HARRAH: We're in the process right now of preparing 2016 packages. And we will submit those.

Now, does that mean the project stops once this report is done? No. The County has the opportunity, if they should choose so, to provide what we call contributed funds for the preconstruction phase. So they can advance us the funds to keep the design moving and not miss that one-year window and have to wait until 2016. So the County can up front those funds, if they would like to do so.

MS. MASON: Okay. Thank you for answering that.

And then my husband sent you an e-mail and he asked if I would read it into the record.

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MR. HARRAH: Yes.

MS. MASON: He's a re- -- we're both residents of Flagler Beach. And reviewing the draft report on hurricane and storm reduction, it has been in work for numerous years, and it's quite lengthy with the pendencies even longer, we have a 30-day response period, given the length of time it took to you write it, would it not be fair to have a little bit more of a time to read it and respond to it? And that was his question to you which you answered.

MR. HARRAH: Yes, ma'am.

MS. MASON: And I just wanted to read it into the record. Thank you.

MR. HARRAH: Yes, ma'am.

MS. JACKSON: Linda Provencher.

Linda, I hope I pronounced that correctly.

MR. HARRAH: Mayor Provencher.

MS. JACKSON: Mayor.

MS. PROVENCHER: Thank you very much.

My question is has this project been done anywhere else in the state of Florida or anywhere else that we could possibly look at or monitor?

MR. HARRAH: Marty.

MR. DURKIN: Dune nourishment pro- --

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MR. HARRAH: Microphone.
MR. DURKIN: There's been numerous beach nourishments and dune nourishments around -- around the state of Florida. And the closest ones to here would be in Martin County to the south of here where they've done one project that's a federal project that is a dune and a small beach nourishment project at the north end of the county. And then they've done private dune only nourishment projects down there into the southern half of the county.
Also in Brevard County in Patrick's Air Force Base they've built dune nourishment projects along the road there. And so those are the two that are closest along the east coast that I can think of.
MS. PROVENCHER: So not exactly like this, but close to it?
MR. DURKIN: Yes, very similar.
MS. PROVENCHER: Okay. But this is really the first time that this particular project has been done?
MR. DURKIN: The only difference is that on most of the other projects they build a dune part of it and then they -- based on what the existing beach was like in that specific area, if it was

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naturally a lot wider beach, they'll build out a wider beach, traditionally. So in a lot of our projects, it's more of just building out the flat part of the beach. Where in this the project, you know, the shorelines are -- or naturally been a small beach with a steep berm, so we're trying to emulate that. So it -- it functions naturally. We're not trying to build out a beach like we do in other places. We're trying to build something specific to Flagler.
MS. PROVENCHER: Thank you.
MR. HARRAH: And they -- we've done these projects also, another planning, Superstorm Sandy came up the east coast, New Jersey, some of the districts up there, they're looking at the dune extension projects as well. You can go on Google. I did a couple of weeks ago. There are some of those dune projects they're already proposing up in New Jersey everywhere.
MS. JACKSON: Heidi -- Heidi McNeely.
MS. McNEELY: I'm Heidi McNeely. I'm a resident of Flagler Beach. To follow up on Mayor Provencher's question about other studies, you in your actual -- in this study you cite a study that was done for the St. Johns project. And in there

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you talk about over a million cubic yards of sand being deposited in St. Augustine that had to be done in 2003, again in 2005, in 2012. You did not provide information on the number of dollars that were spent for that. Obviously, that's a lot more than every 11 years. I think that's information that you could have provided in that study.
I know that Virginia Beach has had beach replenishment projects for decades. I used to live up there. Back in the '60s and '70s they were doing it. They've spent millions of dollars. I imagine you have the information on that. I think those sorts of numbers should have been included in a report like this.
I also feel that in that first chapter you gave us facts that now that I've seen your presentation, I'm wondering why are they even there. For example, you mention that in your study almost 1,500 structures could be affected by dune erosion. You cite a structural and content value of $340,000,000. Why you should be concerned about the contents of very expensive homes on the beach front, I don't know. But there's that number of $340,000,000.
And so when I look at the 43,000,000, I

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think, well, gee, that's only a sixth of the total investment here. Well, maybe it's worth it. But now I'm learning tonight that that 43,000,000 won't even be spent for any of those homes or that area, instead just a very small portion of Flagler Beach. So you see where you throw in numbers, like, ooh, maybe it's really worth it. And then maybe it really isn't.
I also really questioned this idea of the $43,000,000 over 50 years, it's a natural process we're just going to keep losing sand. You know it yourself. You say it's every 11 years. Maybe it'll be much more sooner than that. And then you even said in your study that parts of Flagler Beach are experiencing accretion right now. And devoted maybe one sentence to that. Maybe we're in accretion mode right now. Maybe there will be more accretion. Maybe we don't really need to spread this out as much as we do. I don't know.
Gosh, I had -- well, I had a few other points, but I'm forgetting one that was right on the tip of my tongue.
Oh, yes, I felt that you dismissed a lot of the nonstructural measures, just sort of out of hand. A1A, you've mentioned yourself how well it

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works in the Hammock, that you move the co- -- you moved the coastal construction line westward. A1A goes to the west. Is the Hammock really hurting that bad because of that? How much is that really going to affect Flagler Beach if we did have to reroute A1A a little bit, maybe just a small part of it. There are alternate streets. Did you even look at what the cost of that would be? There are no numbers on it.

And I also feel that you're sort of playing the hurricane card a little bit where it doesn't need to be played when you talk about, oh, A1A is our hurricane evacuation route. Well, it is and it's really important. But we do have alternate streets. And I think most of us are more concerned about getting over the Intracoastal bridge than whether we have to take Daytona or Flagler, instead of A1A to get out of here. Plus it's not going to disappear overnight. There's going to be time to make adjustments for A1A if we have to.

MR. HARRAH: Thank you.

MS. JACKSON: Thank you very much.

John Herpielding.

MR. HERPIEDLING: Hi there. My name is John Herpielding. I'm no genius and -- but I do -- I

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can read. And every place that I've looked at to where they've gone ahead and done this for this beach erosion, if you listen to the Army Corps of Engineers, they'll tell you what a wonderful job it's done. But if you go in there and look to see what the people think of the job that's been done, a couple of years later almost to a fault people will tell you it doesn't work. It doesn't work. Well, if it doesn't work then these people here that you're asking to foot the bill for over $10,000,000. That's a lot of money for something that just doesn't work. And you can't prove it.

God brings that -- the ocean in. The ocean is coming on. It's a natural thing that is moving around. The sand comes out. The sand comes in. You're just not improving it. You can't stop it. You cannot stop Mother Nature. God might be able to and he ain't asking for $10,000,000. So unless you can really justify what you're doing, I think it's wrong. And the simple fact that you've been running a study for 12 years already tells you you're wrong, you can't find the right -- right answer. So I got my say.

MS. JACKSON: Thank you, sir.

Barbara Revels.

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MS. REVELS: I just submitted my questions.

MS. JACKSON: Oh, okay.

MS. REVELS: I mean, I don't know if you're going to answer them or not tonight.

MR. HARRAH: Well --

MS. JACKSON: You want to --

MR. HARRAH: I think the easiest -- we could look at them, keep going, I'll look at them and see if we can. If not, we'll -- you know we'll answer them definitely in the report, let me see what you got. Just keep on going with the other folks.

MS. JACKSON: Rick Belhumer.

MR. BELHUMER: Yeah, Rick Belhumer, Flagler Beach. There's parts of that area, that reach area that are very, very close to the road right now. And you're talking about adding 10 feet. Are you starting out with that average and then adding 10 more feet so it will be pretty much a straight dune going down through there? Is that what you're --

MR. DURKIN: For the -- for the initial construction, it'll -- it'll start at wherever the existing dune ends or if there's existing armor there now at the top of there, it'll extend out 10 feet from there. Then it'll slope out, about three-on-one slope out to about the level of the

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existing beach berm. And then continue out from there for the rest of the volume.

MR. BELHUMER: So in other words --

MR. DURKIN: To that --

MR. BELHUMER: -- so where there's a wall, you're only going out 10 feet from it?

MR. DURKIN: Ten feet straight out and then it's -- with the three-on-one slope probably about another 30 feet out from there, the slope. So the whole footprint -- do you want to talk?

MS. HADLEY: See, if I can talk loud enough for this. Actually, what we're going to do is it's 10 foot off what we're referring to as the existing. However, we know the shoreline's not straight. It waivers. So what we're planning to do is to essentially -- I hate to say extend the existing, but to bring it out about 20 feet from A1A and then 10 feet from there so --

MR. HERPIELDING: So it's going to average 30 feet from the edge of the road?

MR. HARRAH: Correct.

MR. HERPIELDING: So it's going to straighten it out.

MS. HADLEY: Yes, sir.

MR. HERPIELDING: Now, I have another

question about this eminent domain, do you guys answer or have any answers to what might be involved with that? And who -- who pays for that part of this?

MR. HARRAH: Are you talking about for the walkovers? Is what you -- what are you referring to?

MR. HERPIELDING: Walkovers and the property that you're going to be dumping --

MR. HARRAH: Right.

MR. HERPIELDING: -- sand on.

MR. HARRAH: Right. Typically, the way these projects work, there's about 42 walkovers in the project footprint. There's about 21 public and 21 private. Right now on the study we have proposed that those walkovers would have to be removed, the dune extension put in and those walkovers replaced. Now, is that a definite? Absolutely not.

Once we get into the preconstruction and design phase in 2015 we're going to look at every opportunity to keep those in place and possibly work around 'em. And so the question is how does that work. The nonfederal sponsor, in this case, Flagler County, is responsible for obtaining those perpetual storm damage easements and for all of

those structures that is creditable -- creditable item that whatever money they spend for the public walkovers, we will credit back to their share on the construction. So they will receive credit for that. We will also cost share with them in the replacement cost of the public walkovers.

For the private walkovers that is between the County and the private citizen.

MR. HERPIELDING: Okay. All right. Thank you.

MS. JACKSON: Is there anybody else from the audience that would like to come up to speak?

Sir.

MR. HALL: Give you my slip.

MR. HARRAH: Yes, sir.

MS. JACKSON: Can you please state your name once you get up there.

MR. HALL: My name is Pete Hall. And I live in Palm Coast. And I've been here about seven years. I grew up in Jacksonville. The reason I wanted to come up and talk to y'all is that my son has a house on the beach in Baldhead Island where the Corps of Engineers dredged Cape Fear to keep the channel open. And they had a lot of erosion on the beach. And as a result of that, they helped

the people on Cape Fear to refurbish that beach and they've done it through a technology that was very similar to the technology that you purchased -- Flagler purchased the study on it, which has to do with putting groins (phonetic) out perpendicular to the beach. And it's been very effective. So because of the news I've seen about the Flagler Beach problem, I got in touch with Baldhead and asked them who they were working with to help them to do this and it's a company in Jacksonville called Erik Engineering -- Olsen Engineering. And they're very well-versed in the coastline of the Atlantic Coast. They have projects, one in Amelia Island. They have projects in Ponte Vedra. They have projects all down the coast. Many of them are private. Many of them are through the government. And so they're very interested in what they can do to help. I'm very interested in anything that might be useful to the people of Flagler or to the federal government in -- in trying to solve the problem of erosion.

MS. JACKSON: We appreciate that. Thank you, sir.

MR. HYMAN: Good evening, Alan Hyman, Florida Department of Transportation. I just have a

comment. I would just like to thank the Corps, Florida DEP, City and County on working on this very important project. It's been a long time coming as we've seen from the timeline. The D- -- the DOT will continue to work with and actively support all efforts in stabilizing the beach while also protecting State Road A1A. We realize that it is very important economically. And thanks again to all state coffers to come up with a workable solution, so I just like to thank everyone that's working on this.

MS. JACKSON: Thank you very much.

Anybody else from the audience?

MS. RICARDI: My name is Joanne Ricardi. I live in Flagler Beach. I know this has been a long -- long session for everybody. And I've attended most everything. I'm very, I have to say, acutely disappointed that the only solution has come out of this, and it was an expensive one, is the same thing that has been being done and doesn't work. Having said that, I wanted to bring up one other thing that I have never mentioned here. I think it was in section six -- might have been six two -- 6.2, it mentioned that there would be no problem with creatures. I don't know how that

Page 41

could possibly happen. We have gopher tortoises all the way up and down our dunes. I'm assuming you will do something about those before you -- before you dump any sand on the dune structure.

The other thing is the sea turtles, they come and they do their nesting six months of our year. And I would also hope that you would make a commitment, if you get to this project, 2'17, we may not even -- we may not need to be talking about this anymore, but also commit to not do this when it is turtle nesting time.

MR. HARRAH: Absolutely.

MS. RICARDI: And I'd like to see that.

MR. HARRAH: Absolutely.

MS. RICARDI: They are very precious to us and a lot of people in this community are very concerned about how this will affect them. Thank you.

MS. McCONNELL: Hi, I'm Kat McConnell, I'm the lead ecologist and environmental specialist for this project and I appreciate your comment. I would like to address the two things that you mentioned. First off with gopher tortoises, we have done surveys all along up and down the -- the entire study area which went from county line to

Page 42

county line, and we have not found any gopher tortoises that would be along the dune or the dune face. They may be further back in on the dune, but that is not in our work area or our study area.

So gopher tortoises, typically, don't like beaches because they like to burrow in and if they burrow too far, then they get water and then they're very -- they're out of their element and they're not very happy.

As far as working within -- with -- with sea turtle nesting season, part of the requirements that the Army Corps has with our resource agencies, especially, the US Fish and Wildlife Service as well as the Fish and Wildlife Conservation with the State of Florida is to work together and get biological opinions from these agencies which are basically memorandums of agreement that we will meet specific terms and conditions to address the habitat and the usage of these areas by a list of protected species as well as general wildlife.

We will be working with the Fish and Wildlife Service in doing any kind of sea turtle relocation nests -- of nests if we are working in those windows. But if we are working outside of those windows, which would be our preference, then we

Page 43

won't need to do that.

So let me recap. To do a work of this nature using federal funds, we have to coordinate with these agencies. In this coordination process we work with them to do it in the best feasible manner possible so that we are protecting these species. Working outside the windows of nesting season is our preferred, but that isn't always the reality. But we do have measures in place that we can use to address those -- those windows -- or, excuse me, to address those sea turtles when they are nesting. And one of the things is to do surveys before and during the -- the work to relocate nests if necessary. That's what we've been doing now with our emergency beach renourishment projects down in the southern part of the state as -- as well.

As these contracts were awarded and we needed to build these beaches back after Hurricane Sandy, we just didn't have the luxury of working outside the window so we ended up having to work within them. But it was done in a manner that was compatible with our biological opinions and that was to the satisfaction of our resource agencies.

MS. JACKSON: We only have Jason that's going to answer a few questions that we received from the

Page 44

audience.

MR. HARRAH: Questions from the commissioner, should there be a major storm that may occur before the project is done with major erosion, how will the Corps react to FDOT's actions to hold the highway? Will you stop them from harboring armor?

Yeah, I mean, until the project becomes authorized and appropriated, it would basically be business as usual. So any type of storm incident that may occur before thet 2017 construction event, would be business as usual. Mr. Hyman and FDOT or whatever the process would be, would be what would occur until we get the construction complete.

Now, once the construction is complete, the initial construction is complete, the project's authorized, et cetera, in the event there be a major storm come up the coast, and we receive significant erosion, we have another program called FCCE, I don't know the acronym, Flood Control Coastal Emergency that we would come in, assess the beach, do renourishment and a portion of that is 100 percent federal. So the local sponsor is not on for a dime. That's 100 percent federal. But in order to get in that program, we have to complete the initial construction.

Page 45

The next question, will you assist them in emergency soil placement instead of armoring? No, I don't think we would at that time till the project was authorized. That would be strictly a State function.

MS. REVELS: I meant, technical assistance.

MR. HARRAH: We have technical assistance costs in the Army through our support for others group that we could do, but I don't know if Mr. Hyman would want to venture into that program or not. That's up to the FDOT.

Number three, what other options will they -- will we have and will local government have approval or deniability of those actions?

What are you referring to exactly in actions?

MS. REVELS: Again, emergency. Before the project's built if there is an emergency storm event and FDOT does what they need to do to protect the road, how is local government considered in that?

MR. HARRAH: Alan, you want to speak to that?

MR. HYMAN: I think the --

MR. HARRAH: You want that way. Okay.

MR. HYMAN: I can face the crowd. We do have a process in place with the City and County and all

Page 46

applicable agencies before we do anything, we do have call numbers for biological assistance, so we're not just going to go out and dump rock. We will consult with all the applicable stakeholders. And that was one of the lessons learned from what we've done previously. Thank you.

MS. JACKSON: Anybody else with any questions?

MR. LEWIS: (Raises hand.)

MS. JACKSON: Sir, you want to come back up?

MR. LEWIS: Doyle Lewis. I just want to repeat that the younger people that want to build here, they need somebody to support them. And they're going to be the ones that's doing the work. If you want them to have a job, you would let them have a job, very serious out there. Give 'em a job.

MS. JACKSON: Thank you, sir.

Ladies and gentlemen, this concludes our meeting portion tonight. You are more than welcome to stay and talk to the members of our team. We have these poster boards up here. If there is one in particular or is there a question you want answered one on one, please make yourself at home, we'll be here for a while now.

Page 47

(The public workshop concluded at 7:15 p.m.)

Page 48

CERTIFICATE OF REPORTER

STATE OF FLORIDA
COUNTY OF VOLUSIA

I, Delina M. Valentik, Registered Professional Reporter, Florida Professional Reporter, CERTIFY that I was authorized to and did stenographically report the foregoing proceedings; and that the transcript is a true and complete record of my stenographic notes.

I FURTHER CERTIFY that I am not a relative, employee, attorney, or counsel of any of the parties, nor am I a relative or employee of any of the attorneys or counsel connected with the action, nor am I financially interested in the action.

DATED this 20th day of February, 2014.

Delina M. Valentik

Delina M. Valentik,
Registered Professional Reporter
Florida Professional Reporter

Digital Certificate Authenticated
By VeriSign

Administration
1769 E. Moody Blvd Bldg 2
Bunnell, FL 32110

FLAGLER COUNTY
FLORIDA

www.flaglercounty.org
Phone: (386)313-4001
Fax: (386)313-4101

June 2, 2014

Colonel Alan M. Dodd, District Commander
U.S. Army Corps of Engineers
Jacksonville District
701 San Marco Blvd.
Jacksonville, FL 32207

Dear Colonel Dodd,

Flagler County as the non-federal sponsor for the Flagler County SPP fully supports the recommended plan as proposed in the final report. The success of this project is essential to the protection of critical resources and infrastructure along our coast as well as our local economy. We stand committed to working with the Army Corps of Engineers to complete the feasibility report process. We also understand our financial obligations as stated throughout the feasibility report.

Sincerely,

Craig M. Coffey
County Administrator

cc: Faith Alkhatib, P.E. Flagler County
Jason Harrah, ACOE
Candida Bronson, ACOE

Charles Ericksen, Jr.	Frank Meeker	Barbara Revels	Nate McLaughlin	George Hanns
District 1	District 2	District 3	District 4	District 5

NON-FEDERAL SPONSOR'S
SELF-CERTIFICATION OF FINANCIAL CAPABILITY
FOR DECISION DOCUMENTS

I, Kristi Moss, do hereby certify that I am the Financial Services Director of Flagler County (the "Non-Federal Sponsor"); that I am aware of the financial obligations of the Non-Federal Sponsor for the Flagler County Shore Protection Project; and that the Non-Federal Sponsor will have the financial capability to satisfy the Non-Federal Sponsor's obligations for that project. I understand that the Government's acceptance of this self-certification shall not be construed as obligating either the Government or the Non-Federal Sponsor to implement a project.

IN WITNESS WHEREOF, I have made and executed this certification this 5th day of June, 2014

BY: _____
Kristi Moss

TITLE: Financial Services Director

DATE: June 5, 2014

FDOT

Florida Department of Transportation

RICK SCOTT
GOVERNOR

719 South Woodland Boulevard
DeLand, Florida 32720

ANANTH PRASAD, P.E.
SECRETARY

August 12, 2014

Mr. Jason Harrah
Project Manager
Water Resources Branch Jacksonville District
US Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, FL 32207

Subject: Flagler County, Florida
Hurricane and Storm Damage Reduction Project
Integrated Feasibility Study and Environmental Assessment

Dear Mr. Harrah:

The Florida Department of Transportation would like to thank the Corps of Engineers for working on this very important project in Flagler County, Florida. The constant erosion of Flagler Beach will continue to threaten and erode sections of SRA1A resulting in the possibility of significant damage to not only the roadway but also upland areas, recreational interests, evacuation routes, local business and residential interests that will result in significant impacts to the local and regional economy. Prior remedial work performed by the Department primarily consisted of protecting the roadway only without consideration of permanent dune restoration or other strategies to protect the adjacent beach or upland areas.

The Department believes that the comprehensive solution proposed by the Corps is necessary for future protection of not only the roadway but the local community as well. We are in full support of the recommended plan and look forward to seeing this project authorized and constructed in the near future.

Sincerely,

Noranne Downs

Noranne Downs, P.E.
District Secretary

ND:AH:n

Cc: Alan E. Hyman, P.E., FDOT
Faith Alkhatib, Flagler County

CATHERINE D. ROBINSON
MAYOR

JOHN ROGERS
VICE-MAYOR

LAWRENCE WILLIAMS
CITY MANAGER



Crossroads of Flagler County

COMMISSIONERS:

ELBERT TUCKER

BILL BAXLEY

BONITA ROBINSON

RECEIVED

AUG 13 REC'D

COUNTY ADMINISTRATOR
FLAGLER COUNTY, FLORIDA

August 11, 2014

Honorable George Hanns, Chairman
Flagler County Board of County Commissioners
1769 E. Moody Boulevard, Building 2
Bunnell, Florida 32110

Honorable Linda Provencher, Mayor
City of Flagler Beach
105 S. Second Street
Flagler Beach, Florida 32136

RE: Flagler County and City of Flagler Beach Stabilization Project

Dear Honorable Hanns and Provencher:

The City of Bunnell strongly supports Flagler County Hurricane and Storm Damage Reduction Study and the Environmental Assessment Project. As members of Flagler County and neighbors to the City of Flagler Beach we all understand how important this project is to the stability of the coastal infrastructures.

Not only is SR-A1A a major hurricane evacuation route, it is also an integral part of Flagler County's coastal infrastructure as the beaches are vital to sustaining the tourism in our County.

Every opportunity to reduce the risk of coastal erosion and damage to the infrastructure caused by the onslaught of hurricanes and storms should be considered priority number one.

Sincerely,

Catherine D. Robinson,
Mayor

TOWN OF BEVERLY BEACH, FLORIDA

2735 NORTH OCEANSHORE BLVD.
BEVERLY BEACH, FL 32136
(386) 439-6888
FAX: (386) 439-3202

August 12, 2014

RECEIVED
AUG 15 REC'D
COUNTY ADMINISTRATOR
FLAGLER COUNTY, FLORIDA

Flagler County Administration
1769 E. Moody Blvd., Bldg. 2
Bunnell, FL 32110

Re: Letter of Support for the Flagler County Hurricane and Storm Damage Reduction Study and Environmental Assessment Project

Dear Commissioner Hanns and Mayor Provencher,

Few are the opportunities to act before a disaster actually occurs. We in government often work from a reactive framework: a problem arises and we address it in a slow and methodical manner, channeling it through the proper authorities before trying to resolve it. By that time, however, other variables enter the scenario and the problem changes altogether.

In the case of the Flagler County Hurricane and Storm Reduction Study and Environmental Assessment Project, we have the chance to act before it is too late. Erosion is a slow, insidious process that robs municipalities of tourist dollars, and undermines every residence and business in its path. While mathematical models are not always totally accurate predictive mechanisms, a consensus of these models tells us that we still have time to forestall a disaster that would negatively impact Flagler County forever.

On behalf of the Town of Beverly Beach, I want to thank you and your respective administrations for having the courage and leadership to bring this issue to the forefront. With a spirit of determination and cooperation, your efforts can induce the realization that the time to act is now.

Sincerely,

James D. Ardell

James Ardell
Mayor

RECEIVED
AUG 15 REC'D
COUNTY ADMINISTRATOR
FLAGLER COUNTY, FLORIDA

OFFICE OF THE MAYOR

August 13, 2014

The Honorable George Hanns
County Commission Chairman, Flagler County
1769 E. Moody Blvd, Bldg 2
Bunnell, FL 32110

The Honorable Linda Provencher
Mayor, City of Flagler Beach
PO Box 70
Flagler Beach, FL 32136

Re: Flagler Beach Stabilization Project

County Commission Chairman George Hanns and Mayor Linda Provencher:

The Palm Coast City Council would like to express support for a beach stabilization project in Flagler Beach. It is our understanding that you and your staffs have been working diligently with the U.S. Army Corps of Engineers (USACE) to identify potential steps to protect A1A, a critical north-south roadway corridor for Flagler County. Palm Coast recognizes the importance of the natural resources of such a special place. The Atlantic Coast shoreline supports a rich diversity of native habitat and beauty of regional, state, and national importance. These resources enrich the quality of life for our citizens and are vital to attracting visitors to our beautiful community.

Through extensive due diligence inclusive of numerous studies and assessments, the collaboration with the USACE has generated potential action that addresses the sensitivity of the area. Please accept this letter in support of this due diligence and overall approach to protecting this precious area.

Sincerely,

Jon Netts
Mayor

CC: City Council
Executive Team
Craig Coffey, County Administrator

THE TOWN OF
MARINELAND
FLORIDA
ESTABLISHED 1940
FLORIDA'S FIRST REMARKABLE COASTAL PLACE

9507 N. Oceanshore Blvd.,
St. Augustine, FL 32080

Phone: (904)461-4005
mayor.marineland@gmail.com

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AUG 22 REC'D
COUNTY ADMINISTRATOR
FLAGLER COUNTY, FLORIDA

Mr. George Hanns
Chairman, Board of County Commissioners
1769 E. Moody Blvd., Bldg. 2, Suite 301
Bunnell, FL 32110-0787

The Honorable Linda Provencher
Mayor, City of Flagler Beach
105 S. Second St.
Flagler Beach, FL 32136

22 August 2014

Dear Colleagues,

On behalf of the Town of Marineland, please accept this letter in support of your recent efforts in beach stabilization in Flagler County, subject to appropriate environmental safeguards ensuring the long-term health of the beach. As your neighbors in Flagler County, we are well aware of the positive effect this project will have on our tourism industry. As such, we feel this this project is essential for the continuing vivacity of our county. Should you need further information or support from us, please do not hesitate to contact us.

Sincerely,

Leslie S. Babonis, Ph.D.
Mayor, Town of Marineland

Final State and Agency Review Letters

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Lauren Milligan
Clearinghouse Officer
Florida Department of Environmental Protection
3900 Commonwealth Boulevard
Mail Station 47
Tallahassee, Florida 32399-3000

Dear Ms. Milligan:

Enclosed are thirteen copies of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

In accordance with Executive Order 12372, Intergovernmental Review of Federal Programs, and the State process instituted by Florida, we request your comments and recommendations, as the State single point of contact, on the proposed report. As set forth in Public Law 78-534 (as amended by Public Law 104-303) pertaining to coordination procedures on water resources reports and Public Law 85-624 pertaining to fish and wildlife, please submit your comments and recommendations (including the views of the agency responsible for fish and wildlife) within 30 days. Send your reply to me at the following address:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

I appreciate your assistance with this review. Any questions on the proposed project or this request can be addressed to Scott Nicholson, (202) 761-1765.

The position of the State of Florida will be considered in determining whether the proposed report of the Chief of Engineers should be changed prior to its transmittal to the Secretary of the Army. If all State process recommendations cannot be accommodated in the

final report of the Chief of Engineers, you will be so informed. Your comments will be included with the report when it is transmitted to Congress. A copy of the transmittal letter will be provided when the Secretary of the Army transmits the report to Congress.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Honorable Rick Scott
Governor of Florida
The Capitol
400 S. Monroe Street
Tallahassee, Florida 32399

Dear Governor Scott:

The purpose of this letter is to notify you of the distribution of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project. In accordance with Executive Order 12372, Intergovernmental Review of Federal Programs, and the State process instituted by Florida; Public Law 78-534 (as amended by Public Law 104-303) pertaining to coordination procedures on water resources reports; and Public Law 85-624 pertaining to fish and wildlife, we have requested comments on the proposed report from single point of contact, Ms. Lauren P. Milligan, Florida State Clearinghouse. We will consider State process comments provided by the single point of contact to be the position of the State of Florida regarding the recommendation of the Chief of Engineers.

Comments of the State of Florida will be considered in determining whether the proposed report of the Chief of Engineers should be changed prior to its transmittal to the Secretary of the Army. These comments will be included with the report when it is transmitted to Congress.

Receipt of State views and recommendations within 30 days will facilitate expeditious processing of the final report of the Chief of Engineers.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Honorable Bill Shuster
Chairman, Committee on Transportation
and Infrastructure
House of Representatives
2165 Rayburn House Office Building
Washington, DC 20515

Dear Mr. Chairman:

Enclosed for your information are copies of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

The district engineer's report is currently under review by the Office of Water Project Review. Upon completion of that review and receipt of comments on the proposed report from federal agencies and the State, the Chief of Engineers will forward his final report to the Secretary of the Army.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

SEP 0 9 2014

Planning and Policy Division

Office of Environmental Policy
and Compliance
Attn: Loretta Sutton
Department of the Interior
Main Interior Building, Room 2342
1849 C Street NW
Washington, DC 20240

Dear Ms. Sutton:

Enclosed for your review and comment are six copies of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on any aspect of the report for which your agency has jurisdiction by law or has special expertise. In order to facilitate processing of this document in a timely manner, you are requested to provide any comments or recommendations within 30 days. Send your reply to me at the following address:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

I appreciate your assistance with this review. Any questions on the proposed project or this request can be addressed to Scott Nicholson, (202) 761-1765.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, DC 20240

OCT - 9 2014

TAKE PRIDE IN AMERICA

9043.1
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Mr. Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works
U.S. Army Corps of Engineers
CECW-P(SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

RE: Proposed Chief of Engineers and the Report of the District Engineer on the Flagler County Hurricane and Storm Damage Reduction Project, FL

Dear Mr. Brown:

The U.S. Department of the Interior (Department) has reviewed the U.S. Army Corps of Engineers (Corps), Chief of Engineers Report and District Engineers Report to include the Final Integrated Feasibility Study and Environmental Assessment for the Flagler County Hurricane and Storm Damage Reduction Project, Florida. As a cooperating agency, our Bureau of Ocean Energy Management (BOEM) was integrally involved in the development phases of the draft document to include the submission of comments. We wish to offer the following additional comments based upon BOEM's review of the final report.

General Comments

Our BOEM comments on the draft document included the suggestion that a summary table be included in the report that documents all areas of concern relative to each resource category and the associated mitigation measures that will be implemented to avoid and/or minimize impacts. Appendix G does not contain a response to this comment and it does not appear that any summary table was incorporated into the report. The inclusion of a summary table that consolidates all commitments would serve as a valuable reference during subsequent project planning steps leading up to construction (e.g. lease agreement, plans and specifications, etc.).

Specific Comments

Page F-38; F-40; and F-47, Appendix F

The Corps response to BOEM Comment 39 regarding the redaction of the boat wreckage coordinates states that the coordinates for the boat wreckage have been blacked out. However,

the coordinates for the boat wreckage identified in Appendix F (Contact Coordinates Table, Page F-47) were not blacked out. Furthermore, the location of the boat wreckage could be estimated from figures F-38 (Figure 3) and F-40 (Figure 4A) based on the given depth contour and the shoreline markers. It is recommended that the location of the boat wreckage in these figures be removed.

Page 2-35, Section 2.4.3

The following language was inserted into section 2.4.3 to address comments provided by BOEM during the review of the draft report regarding loggerhead sea turtle critical habitat, which was pending at the time the report was written:

"Currently, the NMFS has proposed designation of critical habitat for loggerhead turtles along the Florida coastline. The outcome of this designation is pending."

The final rule was published on July 10, 2014, and became effective on August 11, 2014. We recommend that the report be updated to reflect the final ruling.

The Department appreciates the opportunity to provide comments. If you have any questions regarding our comments, please contact Mr. Douglas Piatkowski, Physical Scientist, BOEM, at 703-787-1833, or email douglas.piatkowski@boem.gov.

Sincerely,

Willie R. Taylor
Director, Office of Environmental Policy
and Compliance

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

NOV 17 2014

Mr. Willie R. Taylor
Office of Environmental Policy and Compliance
Department of the Interior
Main Interior Building, Room 2342
1849 C Street NW
Washington, D.C. 20240

Dear Mr. Taylor:

This letter is in response to your comments on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project and Final Environmental Assessment, which were provided in a letter dated October 9, 2014. We appreciate the support that the Bureau of Ocean Energy Management (BOEM) has provided as a cooperating agency for this study effort.

BOEM recommended that a summary table be included in the report that documents all areas of concern relative to each resource category and the associated mitigation measures that will be implemented to avoid and/or minimize impacts. A summary of the direct and indirect impacts to environmental resources were included in Table 7-1 of the main report. However, since there are not mitigation requirements associated with this project, mitigation measures could not be portrayed in a table.

The final report will be modified via replacement pages to address BOEM's other final report comments. Specifically, the coordinates and location of the boat wreckage shown in Appendix F will be redacted from the final report, and the reference to the designation of critical habitat for loggerhead turtles along the Florida coastline in section 2.4.3 will be updated to reflect the final ruling from NMFS that became effective on August 11, 2014.

We trust that the information provided in this letter sufficiently addresses any of your unresolved concerns. If you would like to discuss these issues further, please contact Mr. Jason Harrah at (904) 232-1381.

Sincerely,

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Environmental Protection Agency
Attn: Heinz Mueller
Environmental Officer, Region 4
61 Forsyth Street
Atlanta, Georgia 30303

Dear Mr. Mueller:

Enclosed for your review and comment are two copies of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on any aspect of the report for which your agency has jurisdiction by law or has special expertise. In order to facilitate processing of this document in a timely manner, you are requested to provide any comments or recommendations within 30 days. Send your reply to me at the following address:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

I appreciate your assistance with this review. Any questions on the proposed project or this request can be addressed to Scott Nicholson, (202) 761-1765.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

September 23, 2014

Mr. Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works
U.S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

Subject: EPA NEPA Review Comments on Proposed Chief of Engineers Report and Final EA for the Flagler County, Florida, Hurricane and Storm Damage Reduction Project

Dear Mr. Brown:

The U.S. Environmental Protection Agency (EPA) has reviewed the subject U.S. Army Corps of Engineers' (Corps) Environmental Assessment (EA) and Draft Chief of Engineers Report (Chief's Report) in accordance with our responsibilities under Section 102(2)(C) of the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act. It is our understanding that the Corps initiated this study and subsequent EA to evaluate coastal storm damage reduction for the shores of Flagler County Florida.

The Corps identifies a National Economic Development (NED) plan, which is the plan that maximizes net benefits to the nation through reduction of future storm damages. The NED plan consists of a 10-foot dune and beach profile extension along 2.6 miles of shoreline in Flagler Beach and mainly prevents damage to State Road A1A (SR A1A).

Based on our analysis of the above referenced proposed action, EPA has the following comments related to commitments outlined in the Chief's Report:

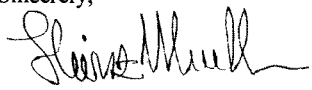
- EPA notes that a Section 401 Water Quality Certification (WQC) will be required prior to construction and will be obtained from the State of Florida. EPA recommends that any anticipated mitigation and monitoring required for the 401 WQC be outlined in detail in the Chief's Report.

- EPA understands that the Corps is coordinating with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) on this project. We support efforts by the Corps to minimize impacts to listed species and recommend any commitments required by the NMFS and USFWS relating to environmental surveys or monitoring for impacts to listed species be outlined in detail in the Chief's Report.

- EPA also recommends that the responsible party for financial commitments relating to ecological monitoring and/or water quality monitoring be clearly defined in the Chief's Report.

EPA appreciates the opportunity to review the Final EA and Draft Chief's Report for the Flagler County Hurricane Storm Damage Reduction Project. Should the Corps have questions regarding our comments, please feel free to contact Dan Holliman of my staff at 404/562-9531 or holliman.daniel@epa.gov.

Sincerely,



Heinz J. Mueller
Chief, NEPA Program Office
Office of Environmental Accountability

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

Planning and Policy Division

NOV 17 2014

Mr. Heinz J. Mueller
U.S. Environmental Protection Agency, Region IV
Atlanta Federal Center
61 Forsyth Street
Atlanta, Georgia 30303

Dear Mr. Mueller:

This letter is in response to your comments on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project and Final Environmental Assessment, which were provided in a letter dated September 23, 2014.

In your letter, you recommend that any anticipated mitigation and monitoring required for the 401 Water Quality Certification (WQC) or monitoring for impacts to listed species, as well as the responsible financial parties for these actions be outlined in detail in the Chief's Report. Water quality monitoring requirements during construction will be outlined in the WQC. The WQC will be obtained after the Chief's Report is signed and prior to execution of the Project Partnership Agreement and the start of construction. The project does not include any additional monitoring during construction for listed species, beyond the standard requirements that are contained in the National Marine Fisheries Service South Atlantic Regional Biological Opinion and the US Fish and Wildlife State Programmatic Biological Opinion for the US Fish and Wildlife. This project is not anticipated to require any post construction mitigation or monitoring.

We trust that the information provided in this letter sufficiently addresses any of your unresolved concerns. If you would like to discuss these issues further, please contact Mr. Jason Harrah at (904) 232-1381.

Sincerely,

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

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U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Federal Emergency Management Agency
Environmental Officer, Region 4
Attn: Stephanie Madson
3003 Chamblee Tucker Road
Atlanta, Georgia 30341

Dear Ms. Madson:

Enclosed for your review and comment are two copies of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on any aspect of the report for which your agency has jurisdiction by law or has special expertise. In order to facilitate processing of this document in a timely manner, you are requested to provide any comments or recommendations within 30 days. Send your reply to me at the following address:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

I appreciate your assistance with this review. Any questions on the proposed project or this request can be addressed to Scott Nicholson, (202) 761-1765.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Office of Strategic Planning
National Oceanic and Atmospheric
Administration
Attn: Steve Kokkinakis
1315 East West Highway
Silver Spring, Maryland 20910

Dear Mr. Kokkinakis:

Enclosed for your review and comment is a copy of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project. We are also forwarding copies of the report to Mr. David Bernhart, Southeast Region, National Marine Fisheries Service.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on any aspect of the report for which your agency has jurisdiction by law or has special expertise. In order to facilitate processing of this document in a timely manner, you are requested to provide any comments or recommendations within 30 days. Send your reply to me at the following address:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

I appreciate your assistance with this review. Any questions on the proposed project or this request can be addressed to Scott Nicholson, (202) 761-1765.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

National Marine Fisheries Service
Attn: David M. Bernhart
Southeast Regional Office
263 13th Avenue, South
St. Petersburg, Florida 33701-5511

Dear Mr. Bernhart:

Enclosed for your review and comment is a copy the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on any aspect of the report for which your agency has jurisdiction by law or has special expertise. In order to facilitate processing of this document in a timely manner, you are requested to provide any comments or recommendations within 30 days. Send your reply to me at the following address:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

I appreciate your assistance with this review. Any questions on the proposed project or this request can be addressed to Scott Nicholson, (202) 761-1765.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

SEP 0 9 2014

CECW-P (1105-2-10a)

MEMORANDUM FOR DEPUTY ASSISTANT SECRETARY FOR PROJECT PLANNING AND REVIEW, OFFICE OF THE ASSISTANT SECRETARY OF THE ARMY FOR CIVIL WORKS

SUBJECT: Proposed Report of the Chief of Engineers on Flagler County, Florida, Hurricane and Storm Damage Reduction Project -- INFORMATION MEMORANDUM

1. Purpose. To provide you with a copy of the subject proposed report.

2. Discussion.

a. I enclose for your information a copy of the proposed report of the Chief of Engineers.

b. We have transmitted the proposed report, together with the report of the district engineer, to the State of Florida; Departments of the Interior, Transportation and Commerce; Regional Administrator, Region 4, Environmental Protection Agency; Environmental Officer, Region 4, Federal Emergency Management Agency, for review and comment.

c. We have provided information copies to the Committee on Environment and Public Works of the United States Senate and the Committee on Transportation and Infrastructure of the United States House of Representatives.

FOR THE COMMANDER:

Theodore A. Brown

Encl

THEODORE A. BROWN, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

BOEM Regulation and Enforcement
Leasing Division
Attn: Colleen Finnegan
381 Elden Street, MS 4010
Herndon, Virginia 20148

Dear Ms. Finnegan:

Enclosed for your review and comment is a copy of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on any aspect of the report for which your agency has jurisdiction by law or has special expertise. In order to facilitate processing of this document in a timely manner, you are requested to provide any comments or recommendations within 30 days. Send your reply to me at the following address:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

I appreciate your assistance with this review. Any questions on the proposed project or this request can be addressed to Scott Nicholson, (202) 761-1765.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Faith Alkhatib, P.E.
Flagler County Engineer
1769 Moody Boulevard,
Building 2, Suite 309
Bunnell, Florida 32110

Dear Ms. Alkhatib:

Enclosed for your review and comment is a copy of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on any aspect of the report for which your agency has jurisdiction by law or has special expertise. In order to facilitate processing of this document in a timely manner, you are requested to provide any comments or recommendations within 30 days. Send your reply to me at the following address:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

I appreciate your assistance with this review. Any questions on the proposed project or this request can be addressed to Scott Nicholson, (202) 761-1765.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Honorable Barbara Boxer
Chairman, Committee on Environment
and Public Works
United States Senate
410 Dirksen Senate Office Building
Washington, DC 20510

Dear Ms. Chairman:

Enclosed for your information are copies of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

The district engineer's report is currently under review by the Office of Water Project Review. Upon completion of that review and receipt of comments on the proposed report from federal agencies and the State, the Chief of Engineers will forward his final report to the Secretary of the Army.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Federal Highway Administration
Attn: James Christian
Florida Division Administrator
545 John Knox Road, Suite 200
Tallahassee, Florida 32303

Dear Mr. Christian:

Enclosed for your review and comments are two copies of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on any aspect of the report for which your agency has jurisdiction by law or has special expertise. In order to facilitate processing of this document in a timely manner, you are requested to provide any comments or recommendations within 30 days. Send your reply to me at the following address:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

I appreciate your assistance with this review. Any questions on the proposed project or this request can be addressed to Scott Nicholson, (202) 761-1765.

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 09 2014

Federal Highway Administration
Attn: Kreig Larson
Office of Project Development
and Environmental Review
1200 New Jersey Avenue, S.E.
Washington, DC 20590

Dear Mr. Larson:

Enclosed for your review and comment is a copy of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on the report within 30 days. The point of contact is Scott Nicholson, (202) 761-1765. Send your reply to:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

Planning and Policy Division

SEP 0 9 2014

Federal Highway Administration
Attn: Ms. Gloria Shepherd
Associate Administrator for Planning,
Environment and Realty
1200 New Jersey Avenue, S.E.
Washington, DC 20590-9898

Dear Ms. Shepherd:

Enclosed for your review and comments is a copy of the proposed report of the Chief of Engineers and the report of the district engineer on the Flagler County, Florida, Hurricane and Storm Damage Reduction Project.

Also, we have provided copies of the proposed report of the Chief of Engineers, and the report of the district engineer, to Mr. Kreig Larson, Office of Project Development and Environmental Review, and Mr. James Christian, State of Florida, Division Administrator.

In accordance with established coordination procedures on water resources reports, please furnish your comments and recommendations on the report within 30 days. The point of contact is Scott Nicholson, (202) 761-1765. Send your reply to:

Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

Sincerely,

Theodore A. Brown

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Enclosures

DEPARTMENT OF THE ARMY
CHIEF OF ENGINEERS
2600 ARMY PENTAGON
WASHINGTON, DC 20310-2600

REPLY TO
ATTENTION OF

DAEN

2 3 DEC 2014

THE SECRETARY OF THE ARMY

SUBJECT: Flagler County, Florida, Hurricane and Storm Damage Reduction Project

1. I submit for transmission to Congress my report on hurricane and storm damage reduction at Flagler County, Florida. It is accompanied by the report of the district and division engineers. This report is in partial response to Resolution 2676 adopted 22 May 2002 by the Committee on Transportation and Infrastructure of the United States House of Representatives. The resolution requested the Secretary of the Army to review the feasibility of providing shoreline erosion protection, hurricane and storm damage reduction, and related purposes to the shores of Flagler County, Florida. Pre-construction engineering and design activities for the project will continue under the authority cited above.

2. The reporting officers recommend a project for coastal storm damage reduction. Based on an evaluation of alternative plan costs and economic benefits, the national economic development (NED) plan consists of a 10-foot dune and beach profile extension along 2.6 miles of shoreline in Flagler Beach and mainly prevents damage to State Road A1A (SR A1A). SR A1A is considered critical infrastructure and serves as the only viable hurricane evacuation route for over 2,300 residents of Flagler Beach, as well as a necessary component of post storm emergency response and recovery. This segment of SR A1A in the project area is located on the highest elevation in the Flagler Beach barrier island and is a vital link within a 14 mile segment that connects two bridges that are the primary routes off and onto the island during evacuation and recovery efforts. The non-federal sponsor, Flagler County, supports the NED plan. The recommended plan is the NED plan and consists of the following improvements:

a. The project would extend the dune and beach profile 10 feet seaward from a construction baseline 20 feet east of, and parallel to, SR A1A along 2.6 miles of shoreline from survey monuments R80 to R94, with subsequent periodic nourishments;

b. The plan would include construction of the dune to an elevation 19 feet North American Vertical Datum 88 (NAVD88) to match the elevation of the existing dune. From the seaward end of the dune extension, a 1 vertical on 3 horizontal dune slope would extend to the design berm elevation of 11 feet NAVD88 to match the existing berm elevation. The constructed berm would extend 35 feet seaward from the toe of the dune with a 1 vertical on 100 horizontal berm slope. The foreshore fill would extend from the seaward edge of the berm to approximately -2 feet NAVD88 with a slope of 1 vertical on 5

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horizontal. This template, dimensioned for constructability, will then equilibrate into the project (10-foot dune and profile extension) template;

c. The berm taper, or transition from the constructed berm to the existing adjacent berm, would extend 200 feet at the north and south ends of the project;

d. Initial construction will require approximately 330,000 cubic yards of sand, and each periodic nourishment event will require approximately 320,000 cubic yards. The renourishment interval is expected to be approximately 11 years, equaling 4 renourishment events in addition to initial construction over the 50-year period of federal participation;

e. The borrow areas identified for the project, areas 2A and 2B, are located approximately 7 miles offshore from the placement area. There is approximately 3 million cubic yards (mcy) of beach quality sand in these two areas. The estimated volume to be dredged from areas 2A and 2B over the 50-year recommended plan is 2,028,600 mcy, assuming 26% dredging losses; and

f. Native vegetation will be planted on areas of the existing dune disturbed by construction, as well as the newly constructed dune and dune slope to stabilize the fill. It is assumed that dune planting will only be necessary for initial construction and that vegetation will spread and naturally grow and spread to any areas that are renourished in the future.

3. Flagler County is the non-federal cost sharing sponsor for all features. Based on Fiscal Year 2015 price levels, the estimated total project cost of the NED Plan is $44,962,000, which includes the project first cost of initial construction of $14,182,000 and a total of four periodic renourishments at a total cost of $30,780,000. Periodic renourishments are planned at 11-year intervals. Cost sharing is applied in accordance with the provisions of Section 103 of the Water Resources Development Act (WRDA) of 1986, as amended (33 U.S.C. 2213), as follows:

a. The federal share of the total first cost would be about $9,218,300 and the non-federal share would be about $4,963,700, which equates to 65 percent federal and 35 percent non-federal. The non-federal costs include the value of lands, easements, rights-of-way, relocations and dredged or excavated material disposal areas (LERRD) estimated to be $3,336,000.

b. The federal share of future periodic renourishment is estimated to be $15,390,000 and the non-federal share is estimated to be $15,390,000 which equates to 50 percent federal and 50 percent non-federal.

4. Based on a 3.375 percent discount rate and a 50-year period of analysis, the total equivalent average annual costs of the project are estimated to be $1,235,000. All project costs are allocated to the authorized purpose of hurricane and storm damage reduction.

DAEN
SUBJECT: Flagler County, Florida, Hurricane and Storm Damage Reduction Project

The selected plan would reduce average annual coastal storm damages by about $2,172,000. The equivalent average annual benefits, which include recreation and traffic re-routing benefits, are estimated to be $2,372,000 with net average annual benefits of $1,137,000. The benefit to cost ratio is approximately 1.9 to 1. The project would reduce damages to a hurricane evacuation route. The project would also establish at least 3.15 acres of beach habitat that could provide suitable nesting habitat for threatened and endangered species such as loggerhead, green, and leatherback sea turtles and piping plover and rufa red knot shorebirds along 2.6 miles of shoreline.

5. Risk and uncertainty has been explicitly factored into the economic analysis of this project. Chapter 6 of Corps Engineering Regulation 1105-2-100, entitled "Risk-Based Analysis for Evaluation of Hydrology/Hydraulics and Economics in Shore Protection Studies" specifies the analysis requirements for shore protection projects, the fundamental requirement being that all shore protection analyses adopt a life cycle approach. A statistical risk based model, Beach-fx, was used in this study to formulate and evaluate the project in a life-cycle approach. Beach-fx integrates the engineering and economic analyses and incorporates uncertainty in both physical parameters and environmental forcing, which enables quantification of risk with respect to project evolution and economic costs and benefits of project implementation. The application of Beach-fx in this study is to estimate future without project damages and quantify the damages prevented by various storm damage reduction alternatives for Flagler County over the 50 year project life.

6. The project is intended to address erosion and prevent damages to structures and infrastructure; it is not intended to, nor will it, reduce the risk to loss of life during major storm events. Loss of life can only be prevented by residents and visitors following the local evacuation plans that are already in place. The proposed project would greatly reduce, but not completely eliminate future storm damages. Coastal storm damages are reduced by approximately 96% in the location of the recommended plan, and by approximately 65% across the entire study area. These residual risks have been communicated to the residents of Flagler County.

7. In accordance with the ER 1100-2-8162 on sea level change, the study performed a sensitivity analysis to evaluate the effects that different rates of sea level change could have on the recommended plan. The NED plan was formulated using the historical or low rate of sea level change. Beach-fx was used to model the performance of the NED plan for what the ER defines as intermediate and high rates of sea level rise. The benefits of the project increase significantly in the intermediate and high sea level rise scenarios, but the costs also increase. Thus, the project performance (in terms of the benefit-cost ratio) is relatively constant throughout the three scenarios. As both costs and benefits are increasing, the net benefits actually increase with increasing rates of sea-level rise. Overall, these results suggest that the NED plan is both effective and robust in all three simulated sea level rise scenarios. Adaptive management will be used including adjusting the timing of periodic renourishments and project volume requirements based on monitoring reports to

compensate for any significant accelerated sea level rise beyond the historical or low rate should it become necessary.

8. In accordance with the Corps Engineering Circular (EC 1165-2-214) on review of decision documents, all technical, engineering and scientific work underwent an open, dynamic and rigorous review process to ensure technical quality. This included District Quality Control review, Agency Technical Review (ATR), Major Subordinate Command (MSC) review and a Corps Headquarters (HQUSACE) policy and legal review. All concerns of the ATR have been addressed and incorporated into the final report. The requirement to perform Independent External Peer Review (IEPR) was waived by HQUSACE since there was no Environmental Impact Statement (EIS) for the study, it had negligible adverse impacts to the environment and is not controversial. All comments from the above referenced reviews have been addressed and incorporated into the final documents. Overall, the reviews resulted in improvements to the technical quality of the report.

9. Washington level review indicates that the project recommended by the reporting officers is technically sound, environmentally and socially acceptable, and economically justified. The plan complies with all essential elements of the 1983 U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Land Related Resources Implementation studies and complies with other administrative and legislative policies and guidelines. Also the views of interested parties, including federal, state and local agencies have been considered.

10. I concur in the findings, conclusions and recommendations of the reporting officers. Accordingly, I recommend that the plan to reduce hurricane and storm damages for Flagler County, Florida is authorized in accordance with the reporting officers' recommended plan at an estimated total project cost of $44,962,000, which includes the project first cost of initial construction of $14,182,000 and a total of four periodic renourishments at a total cost of $30,780,000, with such modifications as in the discretion of the Chief of Engineers may be advisable. My recommendation is subject to cost sharing, financing and other applicable requirements of federal and state laws and policies, including Section 103 of the WRDA of 1986, as amended (33 U.S.C. 2213). The non-federal sponsor would provide the non-federal cost share and all LERRD. Further, the non-federal sponsor would be responsible for all operations, maintenance, repair, rehabilitation, and replacement (OMRR&R) costs. This recommendation is subject to the non-federal sponsor agreeing to comply with all applicable federal laws and policies including that the non-federal sponsor must agree with the following requirements prior to project implementation.

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits and as further specified below:

DAEN
SUBJECT: Flagler County, Florida, Hurricane and Storm Damage Reduction Project

(1) Enter into an agreement that provides, prior to construction, 35 percent of design costs;

(2) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of any relocations determined by the federal government to be necessary for the initial construction, periodic nourishment, and operation and maintenance of the project; in particular, the federal government and the project sponsor shall coordinate with the Bureau of Ocean Energy Management for use of offshore borrow areas and provide a copy of the lease agreement to the federal government; and

(3) Provide, during construction, any additional amounts as are necessary to make their total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits; and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits.

b. For so long as the project remains authorized, operate, maintain, and repair the completed project, or functional portion of the project, at no cost to the federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable federal and state laws and regulations, and any specific directions prescribed by the federal government;

c. Give the federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the federal government shall relieve the non-federal sponsor of responsibility to meet the non-federal sponsor's obligations, or to preclude the federal government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, mitigation, operation, maintenance, repair, replacement, and rehabilitation of the project and any project related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended (42 U.S.C. 9601 9675), that may exist in, on, or under lands, easements, or rights-of-way that the federal government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the federal government determines to be subject to the navigation servitude, only the federal government shall perform such investigations unless the federal government provides the non-federal sponsor with prior specific written direction, in which case the non-federal sponsor shall perform such investigations in accordance with such written direction;

g. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the federal government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

h. Agree that the non-federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. If applicable, 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 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, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable federal and state laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; the Age Discrimination Act of 1975 (42 U.S.C. 6102); the Rehabilitation Act of 1973, as amended (29 U.S.C. 794) and Army Regulation 600 7 issued pursuant thereto; and 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (labor standards originally enacted as the Davis-Bacon Act, the Contract Work Hours and Safety Standards Act, and the Copeland Anti-Kickback Act);

k. Provide the non-federal share of that portion of the costs of data recovery activities associated with historic preservation, that are in excess of 1% of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

DAEN
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l. Participate in and comply with applicable federal floodplain management and flood insurance programs;

m. Do not use federal funds to meet the non-federal sponsor's share of total project costs unless the federal granting agency verifies in writing that the expenditure of such funds is authorized;

n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the project;

o. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

q. For so long as the project remains authorized, the non-federal sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of federal participation is based;

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

s. Comply with Section 221 of the Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the WRDA of 1986, as amended (33 U.S.C. 2213(j)), which provide that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the federal government; and

u. Comply with Section 402 of the WRDA of 1986, as amended (33 U.S.C. 701b-12), which requires the non-federal sponsor to participate in and comply with applicable federal floodplain management and flood insurance programs, prepare a floodplain management plan within one year after the date of signing the project partnership agreement (PPA), and implement the plan no later than one year after project construction is complete.

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11. The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. These recommendations do not reflect program and budgeting priorities inherent in the formulation of 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 the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the non-federal sponsor, the state, interested federal agencies and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

THOMAS P. BOSTICK
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Chief of Engineers